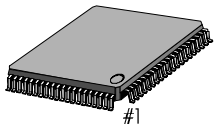
PRODUCT SUMMARY AND CHARACTERISTICS

80-QFP



KS1452 is a 1 chip IC of the digital servo signal processor/wide capture range PLL, used in a DVDP.

FEATURES, CHARACTERISTICS

- CD/CDROM 1, 2, 4, 8x, DVD 1x compatible digital servo IC
- Complete automatic adjusting feature (focus/tracking loop's input gain, offset, balance, loop gain)
- Each servo loop has a digital filter, reducing the number of external parts.
- Built-in AGC feature that responds optimally to various disc types.
- High speed moving control (built-in sled fg encoder) and built-in speed controlling search algorithm.
- Built-in 8-bit A/D converter and 9-bit D/A converter.
- Various filter characteristics and internal constants can be set from syscon.
- The interface with syscon is compatible with both 1-bit serial and 8-bit parallel transmission.
- Built-in defect and shock response
- Built-in 16-bit track counter
- Chooses the best method from multiple search algorithms.
- Servo operation improved by widening the range through high speed sampling of 151.2kHz.
- Built-in wide capture range (±50%) PLL
- Built-in EFM slice
- Built-in F/V converter for RF EQ adjustment of DAC method
- FD/PD gain adjustment
- Built-in wide range VCO (20 ~ 280MHz)
- 5V single power supply

BLOCK DIAGRAM

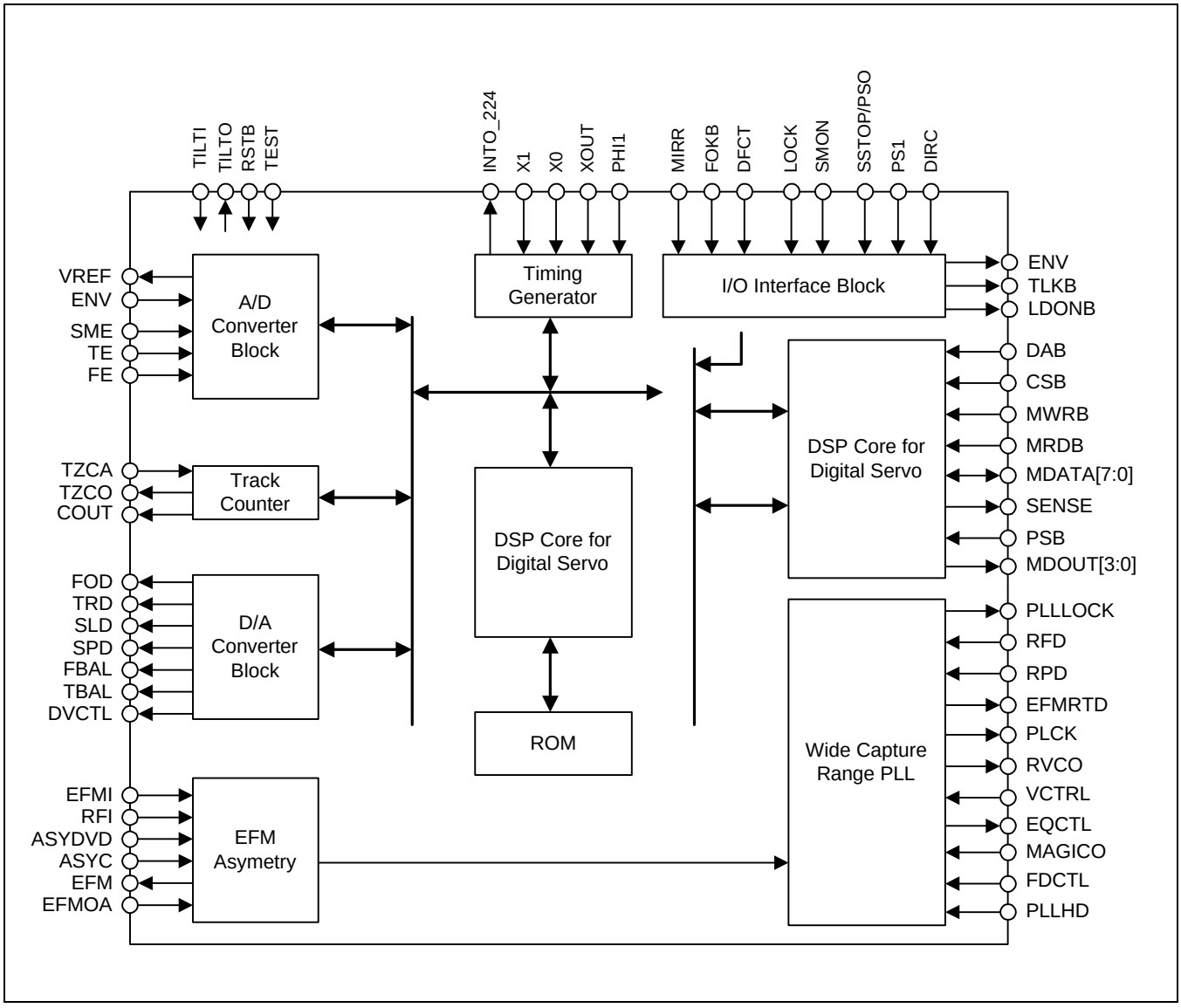


Figure 1. Block Diagram

PIN CONFIGURATION

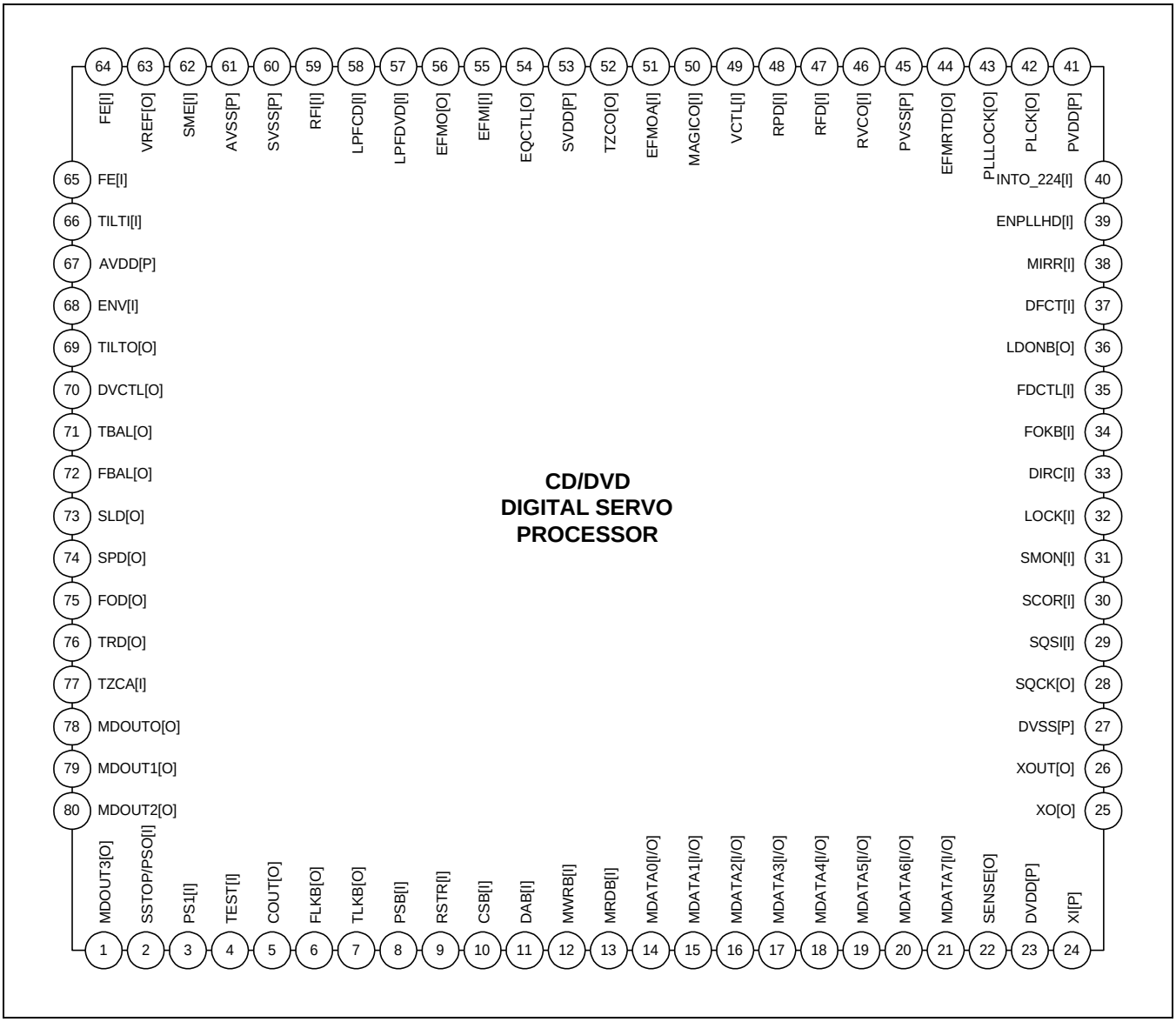


Figure 2. Pin Configuration

PIN DESCRIPTION

Table 1. Pin Description

NO	Pin Name	I/O	Description
1	MDOUT3	O	Mode data3 out controlled by micom
2	SSTOP/PS0	I	Limit switch/sled position sensor input pin0
3	PS1	I	Sled motor position sensor input pin1
4	TEST	I	Test pin (L: normal H: test)
5	COUT	O	Counter clock
6	FLKB	O	Focus servo lock signal output pin
7	TLKB	O	Tracking servo lock signal output pin
8	PSB	I	0: 1bit 1: 8bit
9	RSTB	I	System reset signal input pin
10	CSB	I	MICOM chip select pin
11	DAB	I	MICOM data/address select pin
12	MWRB	I	MICOM write clock signal input pin
13	MRDB	I	MICOM read clock signal input pin
14	MDATA0	I/O	MICOM data pin0
15	MDATA1	I/O	MICOM data pin1
16	MDATA2	I/O	MICOM data pin2
17	MDATA3	I/O	MICOM data pin3
18	MDATA4	I/O	MICOM data pin4
19	MDATA5	I/O	MICOM data pin5
20	MDATA6	I/O	MICOM data pin6
21	MDATA7	I/O	MICOM data pin7
22	SENSE	O	Internal status monitor pin
23	DVDD	P	Servo logic & ROM V_{DD} power supply pin
24	XI	I	System clock signal input pin
25	XO	O	System clock signal output pin
26	XOUT	O	Clock out (33.8688MHz) to DSP
27	DVSS	P	Servo logic & ROM VSS power supply pin
28	SQCK	O	Clock output pin for subcode data read
29	SQSI	I	Subcode data input pin
30	SCOR	I	Timing detection input pin for subcode data read
31	SMON	I	Spindle motor on signal input pin
32	LOCK	I	CLV lock signal input pin
33	DIRC	I	Direct jump control (for 1 track jump)
34	FOKB	I	Focus ok signal input pin
35	FDCTL	I	PLL frequency detect control input pin
36	LDONB	O	Laser diode on signal output pin

Table 1. Pin Description (Continued)

NO	Pin Name	I/O	Description
37	DFCT	I	Defect detection signal input pin
38	MIRR	I	Mirror signal input pin
39	PLLHD	I	PLL hold signal from Micom
40	INT0_224	0	Servo interrupt monitor pin
41	PVDD	P	PLL logic block V_{DD} power supply pin
42	PLCK	O	EFM data recovery clock
43	PLLLOCK	0	Frequency lock detect output (H: lock L: unlock)
44	EFMRTD	O	Latched EFM output signal
45	PVSS	P	PLL logic block VSS power supply pin
46	RVCO	I	Resistor pin for VCO gain
47	RFD	I	Gain adjust resister for frequence detector
48	RPD	I	Gain adjust resister for phase detector
49	VCTL	I	control voltage for VCO
50	MAGIC0	I	FD output's input for hysteresis control (testing)
51	EFMOA	I	EFM offset adjustment pin
52	TZCO	O	Tracking zero cross output pin
53	SVDD	P	Servo CPU V_{DD} power supply pin
54	EQCTL	O	EQ control signal
55	EFMI	I	EFM input signal for test
56	EFMO	O	EFM output signal
57	LPFDVD	I	Asymmetric input signal for DVD
58	LPFCD	I	Asymmetric input signal for CD
59	RFI	I	RF input signal
60	SVSS	P	Servo CPU V_{SS} power supply pin
61	AVSS	P	Analog block V_{SS} power supply pin
62	SME	I	Spindle error input pin
63	VREF	O	Reference voltage output pin
64	TE	I	Tracking error signal input pin
65	FE	I	Focus error signal input pin
66	ENV	I	RF envelope input pin
67	TILTI	I	Tilt in (reserved)
68	AVDD	P	Analog block V_{DD} power supply pin
69	TILTO	O	Tilt out (reserved)
70	DVCTL	O	Depth variation contol signal output pin
71	TBAL	O	Tracking balance signal output pin
72	FBAL	O	Focus balance signal output pin
73	SLD	O	Sled motor drive signal output pin

Table 1. Pin Description (Continued)

NO	Pin Name	I/O	Description
74	SPD	O	Spindle motor drive signal output pin
75	FOD	O	Focus actuator drive signal output pin
76	TRD	O	Tracking actuator drive signal output pin
77	TZCA	I	TE signal for tracking zero cross input pin
78	MDOUT0	O	Mode data0 out controlled by MICOM
79	MDOUT1	O	Mode data1 out controlled by MICOM
80	MDOUT2	O	Mode data2 out controlled by MICOM

ELECTRICAL CHARACTERISTICS

DC CHARACTERISTICS

Input Pin (V_{DD} = 5.0V ±5%, V_{SS} = 0V, Ta = -20 ~ +70 °C)

Table 2. DC Characteristics Input Pin

No	Item	Symbol	Conditions	Value			Unit
				Min.	Typ.	Max.	
Input pin (1): Digital input pin							
1	Input voltage high level1	Vih1		$0.7V_{DD}$	-	-	V
2	Input voltage low level1	Vil1		-	-	$0.3V_{DD}$	V
3	Input leakage current1	Ilkg1	Vin = 0 ~ 5V	-	-	±10	µA
4	Input leakage current3	Ilkg2	Vin = 5V			±20	µA
Input pin (2): Analog input pin (FE,TE)							
5	Input voltage high level2	Vih2	(MData 7 ~ 0)	-	-	Vdd	V
6	Input voltage low level2	Vil2		0	-	-	V
7	Consumption current	Idd		-	-	150	mA

Output Pin (V_{DD} = 5.0V ±5%, V_{SS} = 0V, Ta = -20 ~ +70 °C)

Table 3. DC Characteristics Output Pin

NO	Item	Symbol	Conditions	Value			Unit
				Min.	Typ.	Max.	
Output pin (1): Analog output pin (FOD, TRD, SLD, SPD, FBAL, TBAL)							
1	Output voltage high level1	Voh1	Ioh1 = -1mA	V_{DD}-0.5V	-	-	V
2	Output voltage low level1	Vol1	Iol1 = 1mA	-	-	V_{SS}+0.5V	V
Output pin (2): Normal digital output pin							
3	Output voltage high level2	Voh2	Ioh2 = -1mA	V_{DD}-0.5V	-	-	V
4	Output voltage low level2	Vol2	Iol2 = 1mA	-	-	V_{SS}+0.5V	V
Output pin (3): Sense pin							
5	Output voltage high level3	Voh3	Ioh3 = -1mA	V_{DD}-0.5V	-	-	V
6	Output voltage low level3	Vol3	Iol3 =1mA	-	-	Vss+0.5V	V

AC CHARACTERISTICS

ADC & DAC (V_{DD} = 5.0V ±5%, V_{SS} = 0V, Ta = -20 ~ +70°C)

Table 4. AC Characteristics ADC & DAC

NO	Item	Symbol	Conditions	Value			Unit
				Min.	Typ.	Max.	
D/A conveter (FOD, TRD)							
1	Resolution	RES				9	BIT
2	Linearity	Lin				±2	LSB
D/A conveter (SPD, SLD, FBAL, TBAL, Tiltd, DVCTL)							
3	Resolution	RES				7	BIT
4	Linearity	Lin				±2	LSB
A/D conveter							
5	Resolution	RES				8	BIT
6	Linearity	Lin				±2	LSB

PLL (V_{DD} = 5.0V ±5%, V_{SS} = 0V, Ta = -20 ~ +70°C)

Table 5. AC Characteristics PLL

NO	Item	Symbol	Conditions	Value			Unit
				Min.	Typ.	Max.	
1	VCO max frequency	F_{VCO}, H	V_{ctl} = 3.8V	208	260	312	MHz
2	VCO max frequency	F_{VCO}, L	V_{ctl} = 1.0V	45	56	67	MHz
3	VCO gain	G_{VCO}		58.2	72.9	87.5	MHz/V
4	PD up/dn current matching	$R_{Iup/dn}$	R_{pp} = 10.7 V_L, H = 3.8 V_L, H = 1.0	-3.8	-0	3	%
5	Bandgap voltage	V_{bg}		1.30	1.32	1.34	V

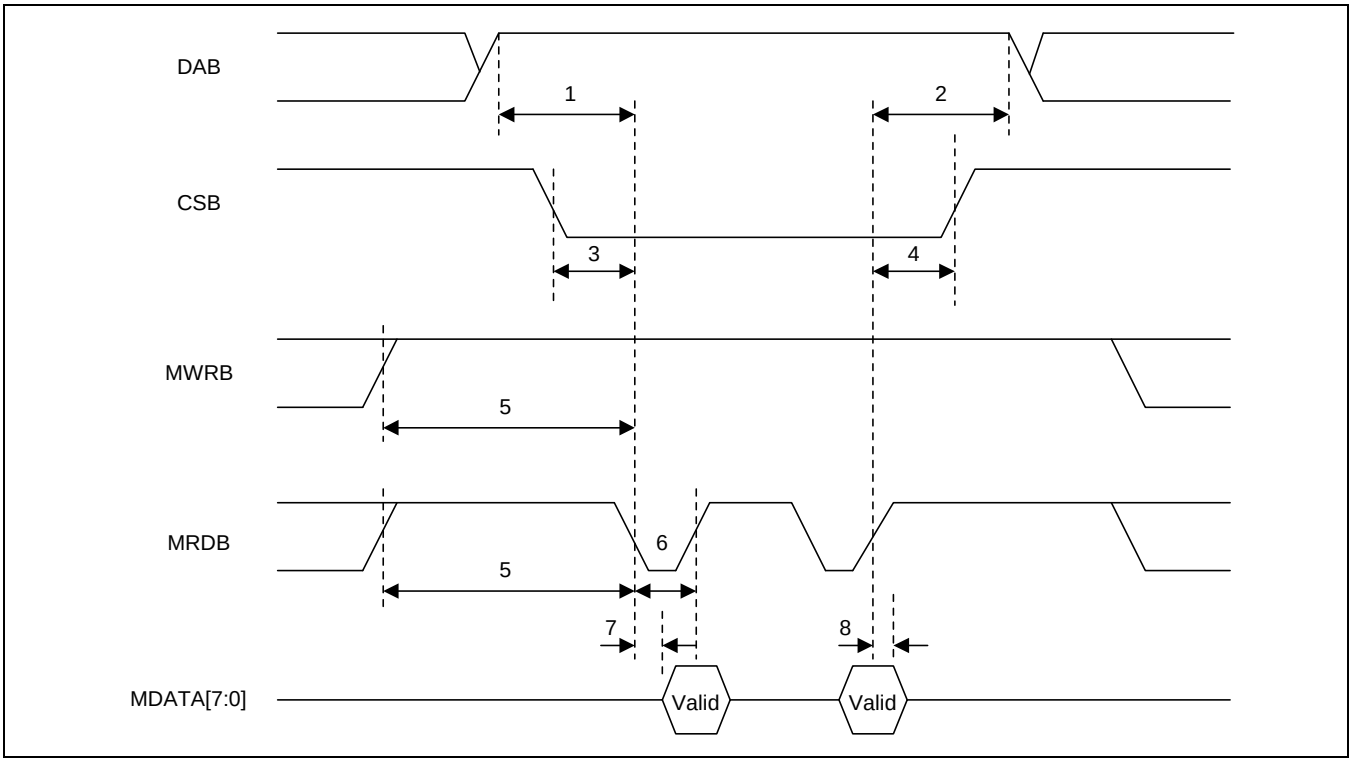
MICOM Interface

Table 6. AC Characteristics MICOM Interface

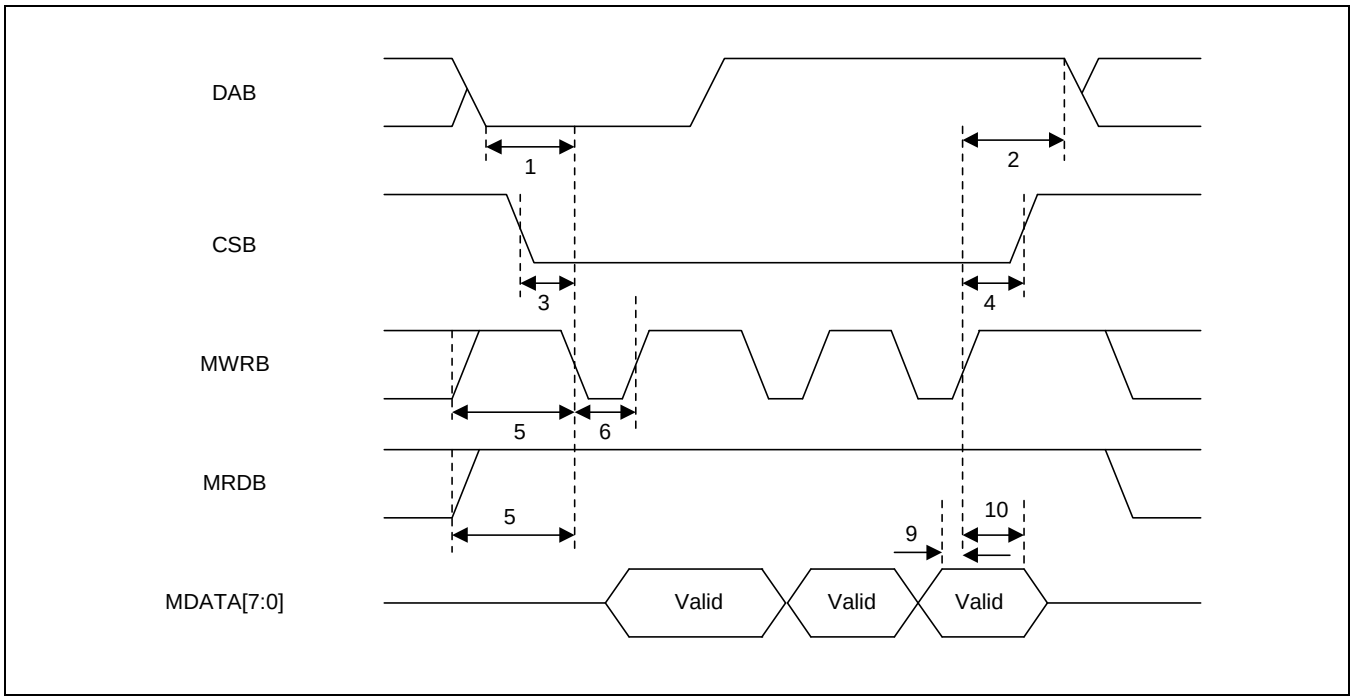
NO	Description	Value			Unit
		Min.	Typ.	Max.	
1	DAB setup	40	-	-	ns
2	DAB hold	10	-	-	ns
3	CSB setup	30	-	-	ns
4	CSB hold	5	-	-	ns
5	MWRB or MRDB inactive	50	-	-	ns
6	MWRB or MRDB active pulse width	50	-	-	ns
7	MRDB active to MDATA[7:0] low-impedence	5	-	-	ns
8	Read data hold after MRDB inactive	10	-	-	ns
9	Write data setup	30	-	-	ns
10	Write data hold	20	-	-	ns

MICOM Interface Timming

Read Cycle (Servo to Syston)



Write Cycle (Syscon to Servo)



ABSOLUTE MAXIMUM RATINGS

Table 7. Absolute Maximum Ratings

No	Item	Symbol	Value	Unit
1	Power voltage	V_{DD}	-0.3 ~ 7.0	V
2	Input voltage	VI	V_{SS}-0.3 ~ V_{DD}+0.3	V
3	Operating temperature	Topr	-20 ~ +70	°C
4	Storage temperature	Tstg	-55 ~ +125	°C

OPERATING PRINCIPLES

NORMAL PLAY

Home In

Summary

If you move the P/U from the initial location to the innermost circumference using reverse sled move, and the PS signal isn't generated for a set amount of time, home in is presumed. Then forward move is carried out long enough to escape the lead In area to finish the task.

- Input signal: PS0, PS1
- Output signal: SLD
- Operation mode select: (LIM = HDWcmd's factor)

LIM = L	LIM = H
Sled stop determined by LIMIT S/W	Sled stop determined by position sensor

Command

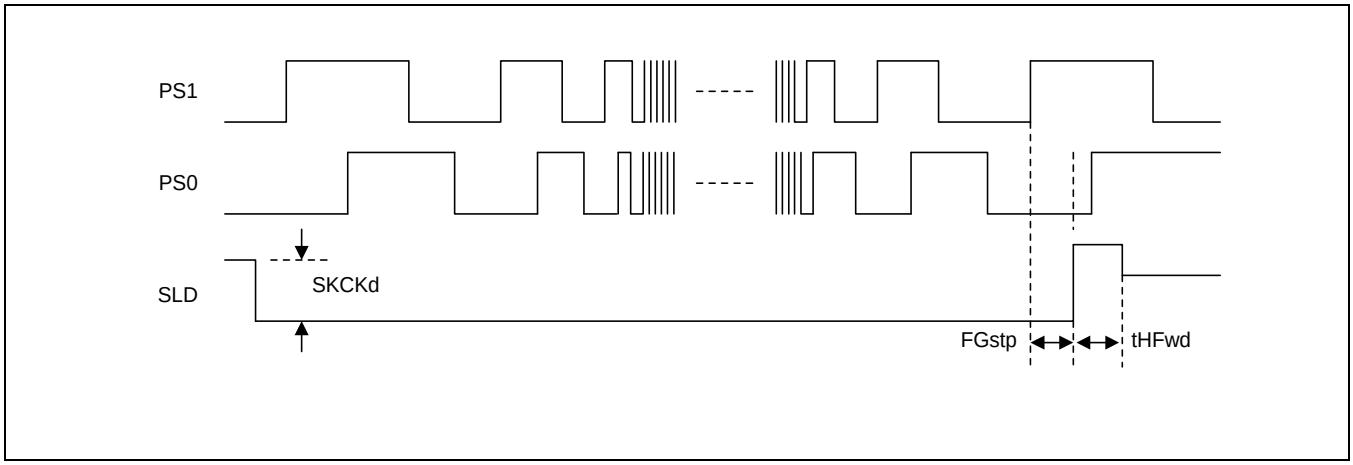
Transmit SLDcmd (04xxxx cmd).

Related Registers

Register	Address	Function	Command
SKCKd	10C1	Sled kick level (vref reference)	0CFFF1
FGstp	0049	PS period that determines sled stop	0CFFF8
tHFwd	004A	FWD move time after home_in	0CFFF9

Operation Description

Sled is moved in the reverse direction. If PS1 or PS0 shows no signal change for a set length of time (FGstp), forward KICK the sled output for tHFwd, then return to Vref.



Home In detection by limit S/W (when there is no sled position sensor):

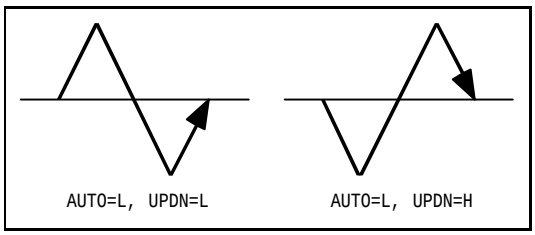
If there is a limit S/W, it is set to HDWcmd's LIM = L (sled stop determined by limit S/W), DSSP's PS0 pin is changed to SSTOP, and the limit S/W is connected to that block.
SLDcmd's home = L (normal), SMOV, SPLY's bit is controlled, and MICOM is manual.

Focus Search (Disc Detection)

Summary

The FOD outputs delta waves and moves the actuator up and down to determine disc presence and disc type using the FE (S_CURVE) signal. The results are sent to MICOM using a data bus.

- Input signal: FE
- Ouptut signal: FOD, MDATA[7:0]



Command

DDTcmd (01xxxx cmd) → focus search & disc detect

Register	Address	Function	Command
FSpk	0055	Output-adjusting coefficient during F_srch pull_in (full swing's %)	0AFFF0
unBal	00BD	S_curve unbalance % reference	1E00BD
POS_J	10C7	Determined by FODbias level	0FFFF7
DDT_J	10C8	Disc presence detection level	0FFFF8
Fpk_J	10C9	S_curve size detection level	0FFFF9
LYdt	10CE	Detection level for distance between layers	0FFFFE
NZlvl	10CC	Noise level	0FFFFC

Related Registers

Operation Description

When the focus search command is received, output signal FOD starts at the Vref voltage and outputs delta waveforms. At this time, search speed or slope is decided by the FSP value from the disc detect command coefficients.

Disc presence and type are detected by the disc detect command, and its references include the following:

- FEpk: FE input signal's peak to peak value
- DBL: number of S-curves
- POS: S-curve detection location
- DIN: S-curve presence

The location for carrying out disc detection is in the middle of moving from the lower value to the upper value when AUTO = L and UPDN = H. The results are stored in [FEpk] and [DDTdt]. After completing the disc detect command, the OR values of the two memories are output to MICOM (refer to command set's DDTcmd).

15 [DH] 8 7 [DL] 0

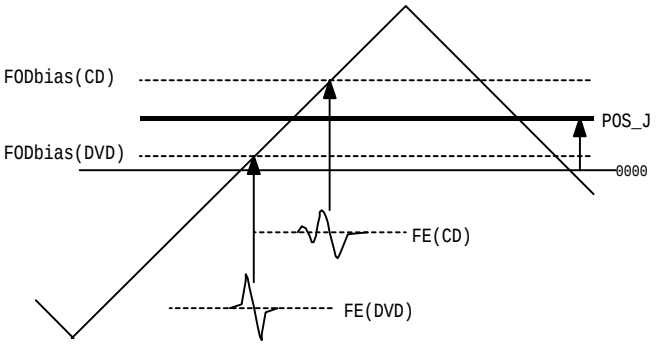
FE Peak Level	DBL	FEpk	POS	0	0	0	DIN	0

FPS2-0	Search Speed
000	3.46Hz
001	1.73Hz
011	0.87Hz
111	0.43Hz

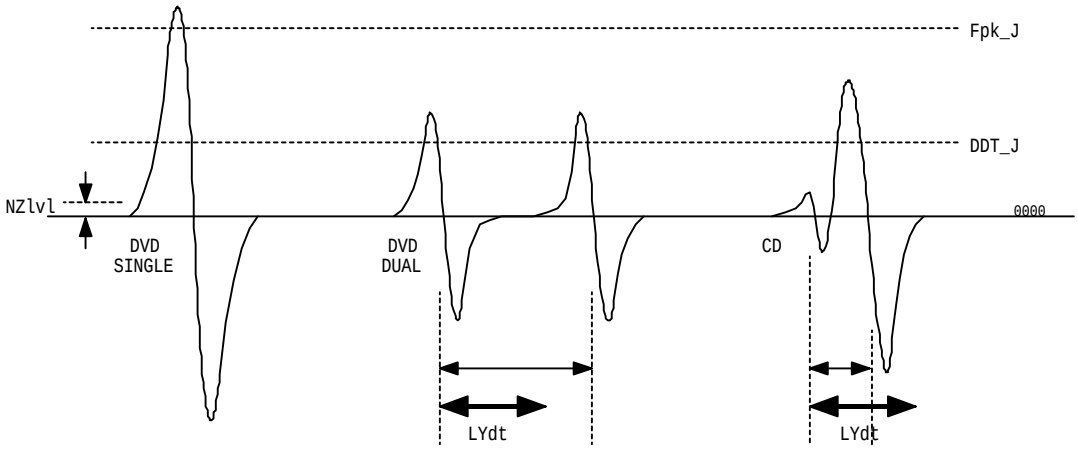
Bit	Content	0	1
DBL	No of S_CURVE	Single (1)	DUAL (2)
Fpk	S_CURVE size	CD, DVDD (small)	DVDS (large)
POS	S_CURVE detection iocation	DVD (low)	CD (high)
DIN	S_CURVE presence	Empty	Present

You can also set an S-curve detecting and search method using the command set CDScmd (06xxxx)'s constants, FSOS and FSHF. When FSOS = L', S-curve is detected in both directions without regard to DDTcmd's UPDN bit. When it is "H", S-curve is detected when UPDN = L'(actuator up) and actuator is down. When UPDN = H' (actuator down), S-curve is detected when actuator is up. This is because the actuator and the system can be initially unstable, and the S-curve must be detected when they are stable. Also, you can decide on a full search or half search during DDT using FSHF, to choose the search time.

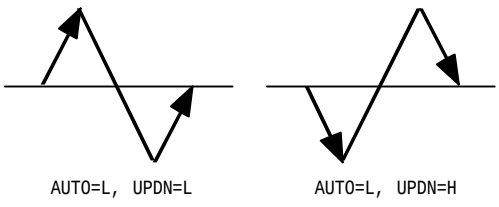
DDT Detect Waveform



FODbias = FSpk * FSval



When AUTO = 0 and UPDN = 1, the focus search direction is reversed.



Focus Pull-In

Summary

The FOD outputs delta waves to move the actuator up and down, and carries out focus pull-in near the FE (S_CURVE) signal's zero cross.

- Input signal: FE, FOKB
- Output signal: FOD, FLKB

Command

FONcmd (02xxxx cmd) is transmitted.

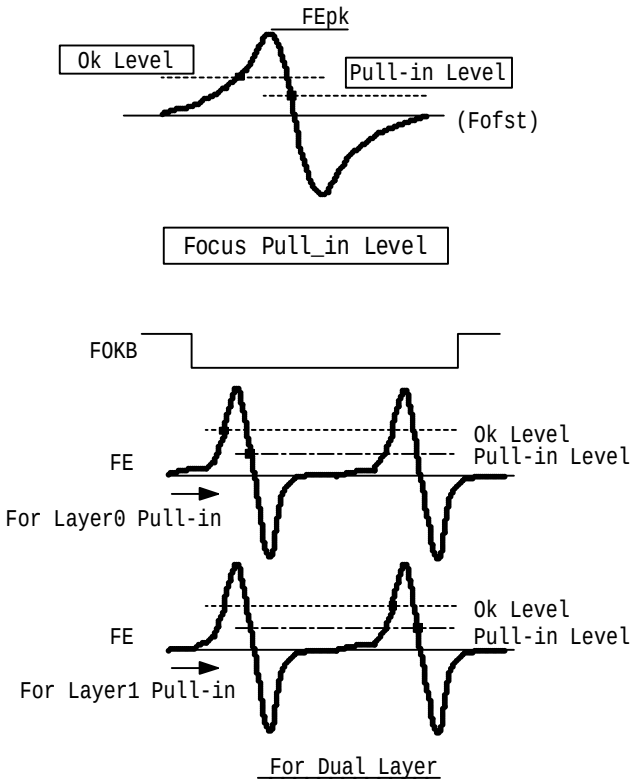
Related Registers

Register	Address	Function	Command
FSpk	0055	Output-adjusting coefficient during F_srch pull_in	
FZCofs	10CF	FZC offset level (in manual mode)	
FLoff	004D	FLKB (focus lock) off time	
FLon	004E	FLKB (focus lock) on time	
FSspd	0038	Focus search speed register	

Operation Description

Pull-in standby status is maintained starting when the FE signal becomes larger than the S curve ok level (S_OK_L), and focus pull-in is carried out when the FE signal becomes smaller than the S curve pull-in level (S_PI_L).

PIL[3:0]	S_curve ok Level	Pull-In Level
xx11	xx01	x110
x010	1x00	0x00
FEpk/2	FEpk/2	FEpk/4
FEpk/4	FEpk/8	FEpk/8
FEpk/4	FEpk/8	FEpk/8
FEpk/16	FEpk/16	FEpk/32


FEpk
Ok Level
Pull-in Level
(Fofst)
Focus Pull_in Level
FOKB
FE
Ok Level
Pull-in Level
For Layer0 Pull-in
FE
Ok Level
Pull-in Level
For Layer1 Pull-in
For Dual Layer
FE
FLon
FLoff
FOKB
FLKB

Tracking Pull-In

Summary

When a TRK pull-in command is received in off track status, the tracking loop is turned on. If SLSV = L, sled is turned on simultaneously.

- Input signal: TE, MIRR
- Output signal: TRD, TLKB

Command

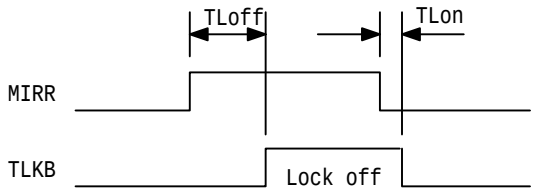
TONcmd (03xxxx) is transmitted.

Related Registers

Register	Address	Function	Command
GuT	0046	TRK gain up time after TRK_pull_in	0CFFF5
dlyTG	1096	TGup delay time after GuT is completed	1E1096
TLoff	004F	TLKB (tracking lock) off time	0CFFFE
TLon	0050	TLKB (tracking lock) on time	0CFFFF

Operation Description

- GuT (+dlyTG) must be set so that right after tracking on, gain is up to the tracking servo's settling period (period where the remaining difference exceeds the allowed range) to raise the stability of track pull-in.
- If a beam spot exists between tracks during play (deviation from the track), the RF IC outputs to MIRR = H. tracking lock status is determined using the MIRROR signal.



Focus/tracking manual gain up/down command: MICOM can select gain.

Gain	Command	Fchg	DWN (Fcs)	Tchg	Up (Trk)
Manual FCS down/trk up	5BF000	H	H	H	H
Manual FCS down/trk NORM	5BE000	H	H	H	L
Manual fcs/trk gain normal	5BA000	H	L	H	L
Manual fcs norm/trk up	5BB000	H	L	H	H
Manual fcs/trk gain change off	5B0000	L	Don't care	L	Don't care

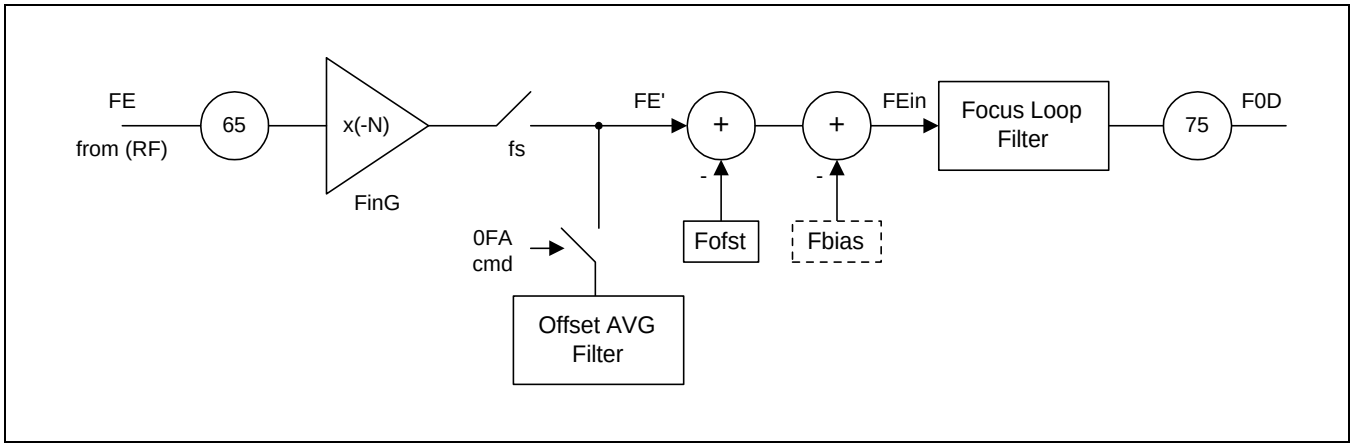
AUTOMATIC ADJUSTING FEATURE

Focus/Tracking Offset Adjustment

Summary

Before turning the servo loop filter on, the focus and tracking error offset are measured/averaged and stored in the register. This is to use the values during later filter operations in order to eliminate remaining error offset.

- Input signal: FE, TE
- Adjusting register (32-bit): Fofst (#1083 ~ 2), Tofst (#1085 ~ 4)
- Output signal: Sense
- Filter operations:
  FEin = FE - Fofst - (Fbias) TEin = TE - Tofst
  (FE/TE: ADC data, FEin/TEin: loop filter input data)



Command

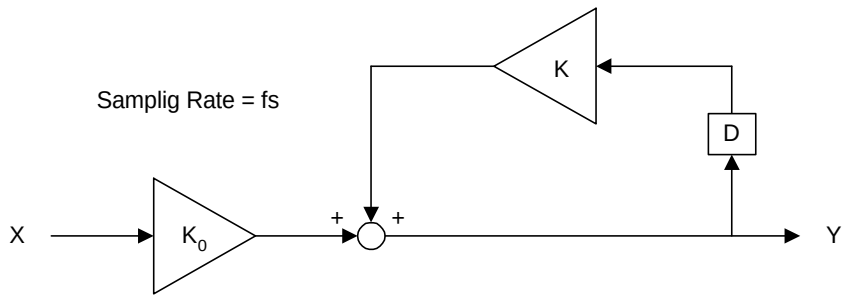
- OFAcmd (11xxxx cmd)
- Laser on/off selection is possible during offset measurement. If FOK is already on, the lens is automatically moved up/down until free of FOK.

Related Registers

Register	Address	Function
Fofst	1082	Focus offset data save
Tofst	1084	Tracking offset data save
Toffset K_0	003C	Offset average value filter's new data gain (K_0 = 1 -K)
Toffset K	003D	Offset average value filter's old data gain
tOFa	0058	Offset measurement time

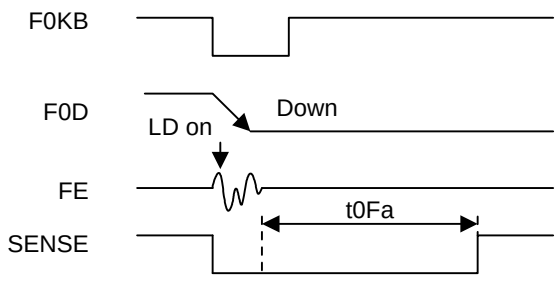
Average Value Filter

The average value filter has basically the same configuration as the integrating filter, except K_0 must always have the value of 1-K. For example, if K_0 = 0040, a new average value is found by adding the new input's 1/512 and the previous average 511/512. (If the input is DC, it is maintained for the output without any changes in the gain.)



Average Value Filter Configuration

Timing Diagram (Example: When LD is on & LENS is down)

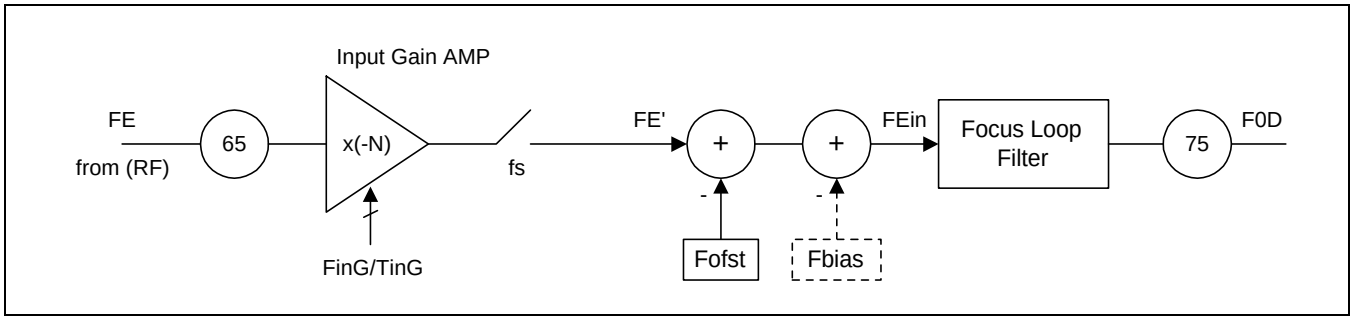


Focus/Tracking Input Gain Adjustment

Summary

The object of the focus/tracking input gain adjustment is to select the appropriate input gain using H/W before sampling, according to the size of the FE and TE signals input into the servo IC. This allows you to use the ADC's full input range and raises the quantized data's ability for decomposition.

- Input signal: FE, TE
- Output signal FEin, TEin (internal signal) or FOD, TRD (external signal)



Command

- manual setting: DPRW(1C)cmd
- Automatic adjustment focus → DDT(01)cmd
  tracking → TBA(13)cmd

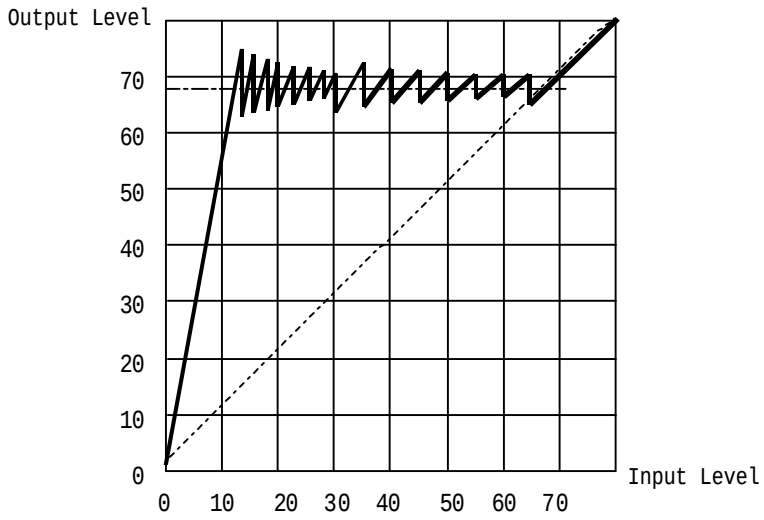
Look-up Table

FinG/TinG	[dB]	Input level	Output level
00 ~ 07	0	7F ~ 70	7F ~ 70
00 ~ 07	0	6F ~ 68	6F ~ 68
08 ~ 0F	0.67	67 ~ 60	70 ~ 68
10 ~ 17	1.39	5F ~ 58	70 ~ 67
18 ~ 1F	2.18	57 ~ 50	70 ~ 67
20 ~ 27	3.05	4F ~ 48	71 ~ 66
28 ~ 2F	4.02	47 ~ 40	71 ~ 66
30 ~ 37	5.10	3F ~ 38	72 ~ 65
38 ~ 3F	6.35	37 ~ 30	6E ~ 64
40 ~ 43	7.41	2F ~ 2C	6F ~ 76
44 ~ 47	8.20	2B ~ 28	6F ~ 67
48 ~ 4B	9.07	27 ~ 24	6F ~ 66
4C ~ 4F	10.04	23 ~ 20	6F ~ 66
50 ~ 53	11.13	1F ~ 1C	70 ~ 65
54 ~ 57	12.37	1B ~ 18	70 ~ 64
58 ~ 5B	13.82	17 ~ 14	71 ~ 62
5C ~ 5F	15.56	13 ~ 10	72 ~ 60
5C ~ 5F	15.56	0F ~ 00	5A ~ 00

Operation Description

The input gain's automatic adjustment has the ability to absorb the deviation of the focus and tracking error's signal level from the RF IC for each set. Also, when there is no gain ¿"»Ø feature for different disc types within the RF IC, it corrects the focus and tracking error's signal level difference. For focus, the s_curve size measured during focus search is used as the input gain amp's input. For tracking, the TE's track zero cross size when the disc is spinning in off track status is used as the input gain amp's input. Automatic adjustment is carried out so that it is near 4.2V (6ch) no matter what the input gain amp's output level is. The look-up table given above shows the input gain amp's gain characteristics. This has the advantage of using the ADC's input range to its fullest, and improving the decomposition ability in quantization. If you have a gain feature in the RF IC according to disc type and the automatic adjustment feature is used for the total loop gain, the input gain can be set to a fixed value at an appropriate level by manual setting.

Input Gain Adjustment AMP'S Gain Characteristics (for automatic adjustment)

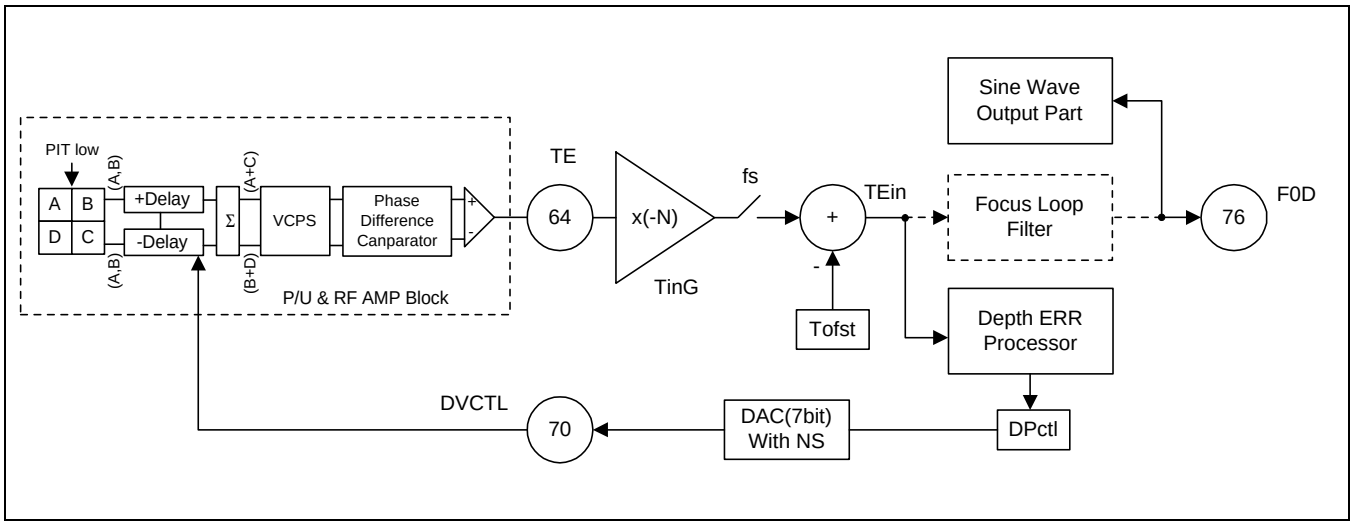


PIT Depth Adjustment

Summary

When finding tracking error in the DVD using the DPD (Differential Phase Detect) method, the TE signal's size and offset can differ according to the various pit depths for each disc. To compensate for this characteristic, a delay of the opposite polarity to the RF Amp's (A, B) and (C, D) is given, and the amount of delay in the servo is adjusted to have a TE of a regular size regardless of the lens location.

- Input signal: TE
- Output signal: TRD, DPCTL



Command

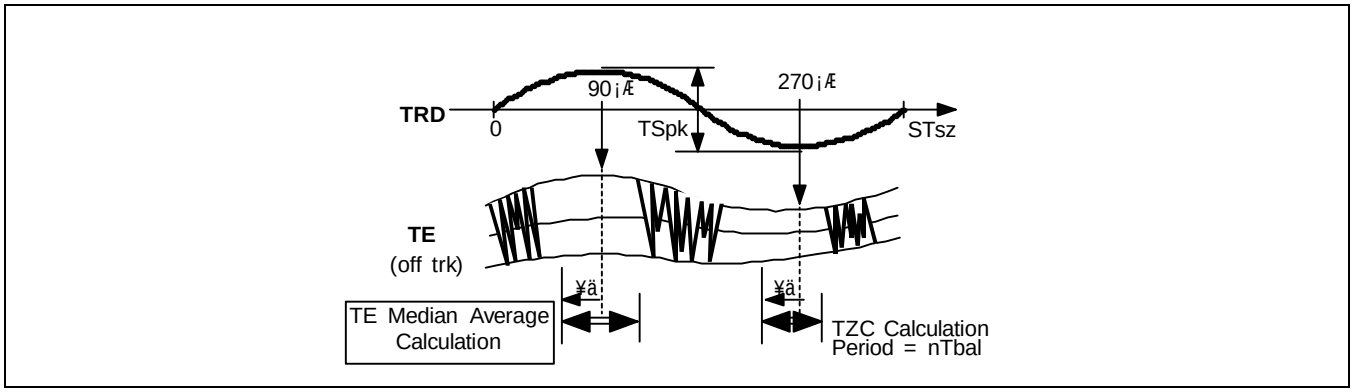
DPAcmd (16xxxx cmd) is transmitted.

Related Registers

Register	Address	Function	Command
nTbal	0061	Number of tzc cycles for one depth adjustment error detection	0AFFFC
nDP	10BE	TRD (sine) output frequency	0DFFFE
TSpk	0056	TRD (sine) output amplitude	0AFFF1
DPok	10B4	Depth variance ok level (allowed deviance)	0DFFF4
DPk	002E	PIT depth adjustment sensitivity coefficient	0EFFFA
Tengh	00BE	Minimum limit of tzc size	1E00BE
fmin	00DA	TZC detect minimum frequency	1E00DA
fmax	00EA	TZC detect maximum frequency	1E00EA

Operation Description

The TE signal's amplitude and median changes according to the lens shift amount, due to the influence of the disc pit depth. The deviation is the most severe when the inner/outer shift amount is at its peak. Therefore, if you vary the RF IC's depth delay and carry out automatic adjustment, the TE signal's amplitude and median will be regular regardless of shift amount. This algorithm uses a method where the inner and outer circumferences' medians are the same at the maximum shift

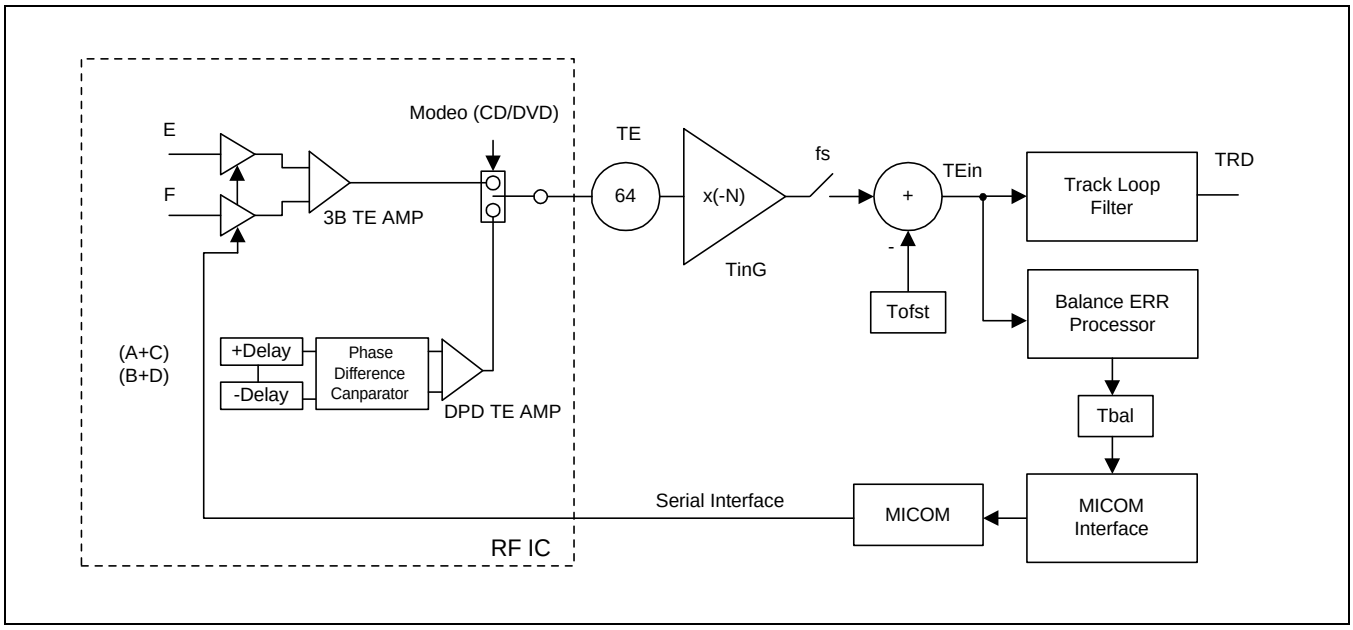


Tracking Balance Adjustment

Summary

TE's zero cross component cycle's maximum and minimum value, generated by the eccentricity in the off track state, is found and averaged. TBAL signal is output so that the average value is the same as Tofst. For CDs, the balance is repeat adjusted by varying the E, F amp's gain within the RF Amp. For DVDs, the balance is repeat adjusted by varying each channel's delay amount.

- Input signal: TE
- Output signal: TBAL



Command

TBAcmd (13xxxx cmd) is transmitted

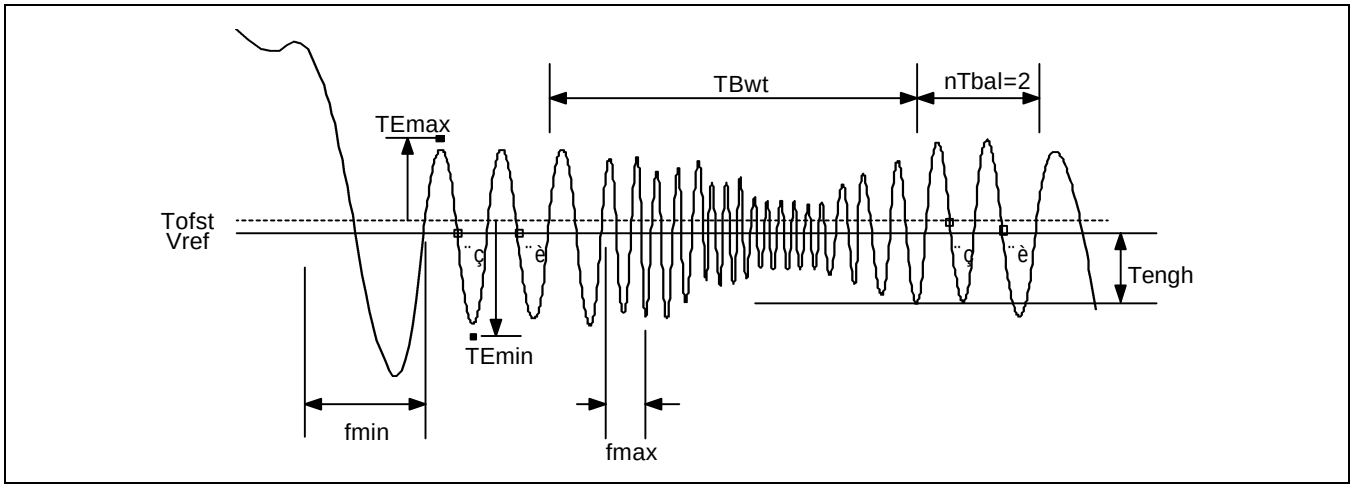
Related Registers

Register	Address	Function	Command
nTbal	0061	Number of tzc cycles for one balance err detection	0AFFFC
TBwt	005A	Wait time after Tbal change to the next measurement	0AFFF5
TBok	10B1	t_bal ok level (allowed deviance)	0DFFF1
TBk	0031	TRK balance adjustment sensitivity coefficient	0EFFFD
Tengh	00BE	Minimum limit of tzc size	1E00BE
fmin	00DA	TZC minimum frequency	1E00DA
fmax	00EA	TZC maximum frequency	1E00EA

Operation Description

Out of the TE(tzc) signals, the TEmin and TEmax are measured in the periods that pass through Vref and satisfy all the conditions of fmin and fmax. The median of these two values is calculated, and if these periods are continued for the number of nTbals, the difference between the average value of the medians and the adjustment reference level (= Tofst) is said to be the balance error. If the error is smaller than TBok, the adjustment is ended, but if it is larger, the product of Tbal's previous value and TBk is output.

When you renew the Tbal output value, the gain or delay within the RF's TE AMP varies, making the TE signal's balance error change as well. A wait time (TBwt) longer than the settling time according to such analog characteristics is set. When the system is stabilized after the wait time, the operations for balance error detection are repeated.



nTbal is 2N and can be set to a maximum of 0080h.

fmin, fmax's frequency → select data conversion method

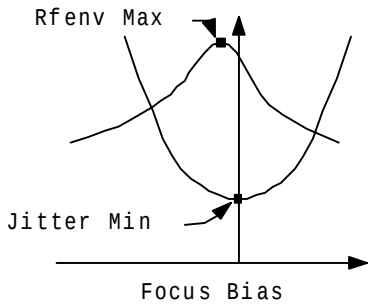
$$\frac{fs}{fmin} = \frac{151.2kHz}{615Hz} = 246(00F6h)$$

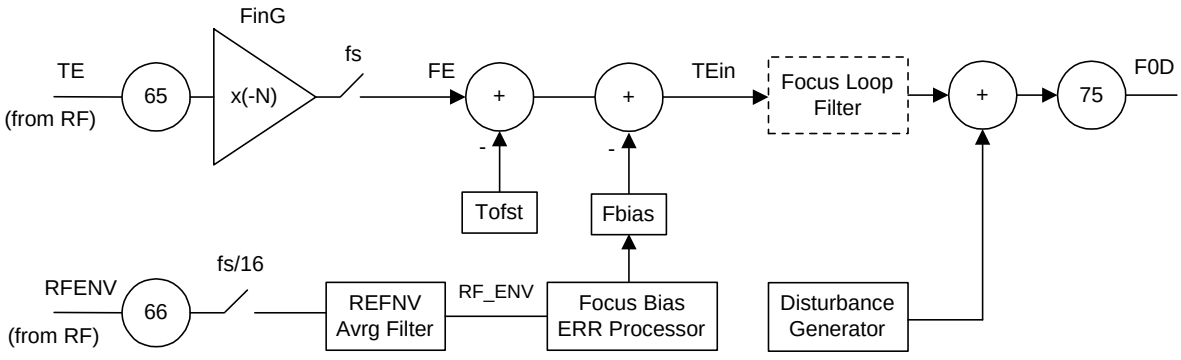
Focus Bias Adjustment

Summary

Focus bias adjustment is carried out so that playback is executed when the RF signal quality is at its best. The quality of the RF signal is shown by the jitter amount, but it is difficult to have an algorithm that can measure jitter on the IC and find the minimum point. Therefore, you use the characteristic where the jitter is always at its minimum near the focus bias point with the largest RF envelope size. The focus bias is adjusted so that the envelope is at its maximum size.

- Input signal: FE, RFENV
- Output signal: FOD





Command

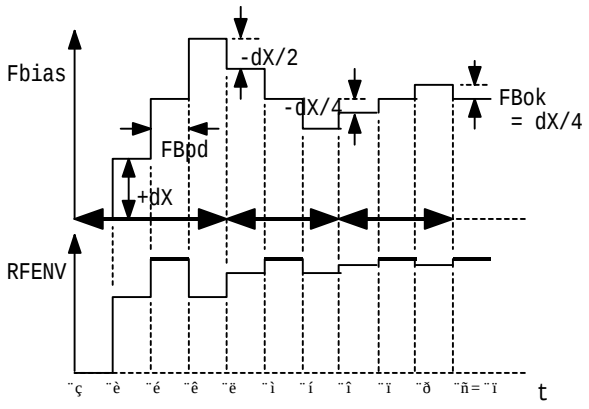
FBAcmd (12xxxx cmd) is transmitted.

Related Registers

Register	Address	Function	Command
FBpd	0059	RFENV measurement period for focus bias adjustment	0AFFF4
FBok	10B0	Focus bias ok level	0DFFF0
dXbuf	002F	Initial DX select level	0EFFFB

Operation Description

RFENV's signal difference is minimized by the FE signal carrying the disturbance. The disturbance uses the FE as reference and is used after selecting +, - dX. The disturbance level value is given to the first + direction, the RFenv value is stored, and ±is repeated so that the dxbuf amount of the largest RFENV level is added/subtracted from the Fbias amount to find the final Fbias.

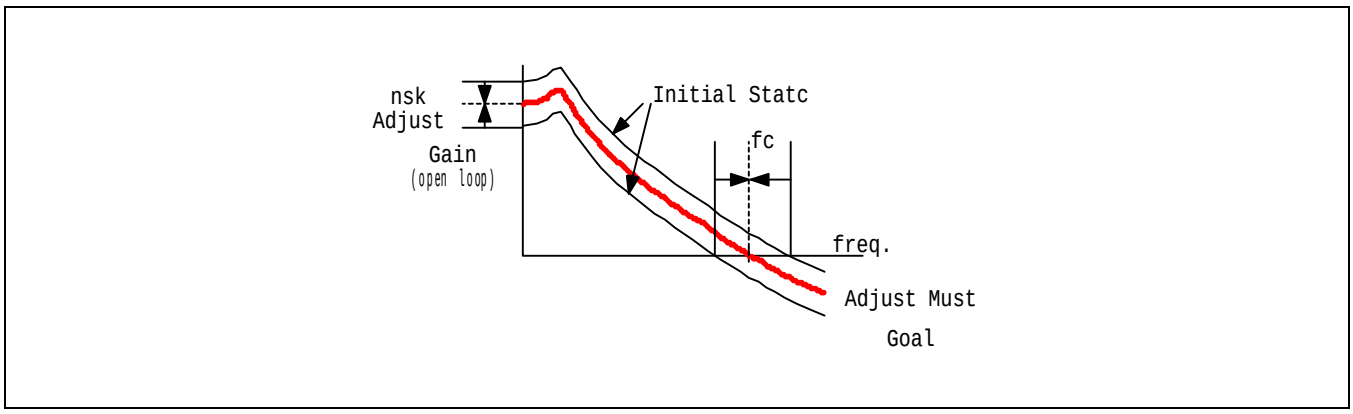


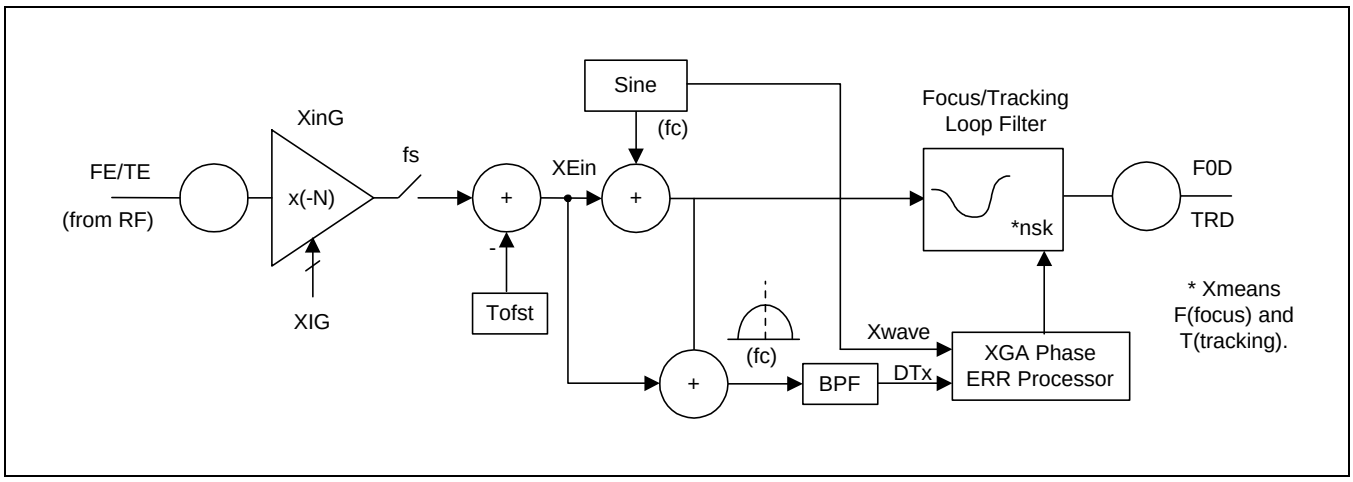
Focus/Tracking Loop Gain Adjustment

Summary

The loop filter's output gain is automatically adjusted so that the focus/tracking open loop bandwidth is at the specific frequency needed by the system.

- Input signal: FE, TE
- Output signal: FOD, TRD





Command

- Focus gain: FGAcmd (14xxxx cmd) is transmitted.
- Tracking gain: TGAcmd (15xxxx cmd) is transmitted.

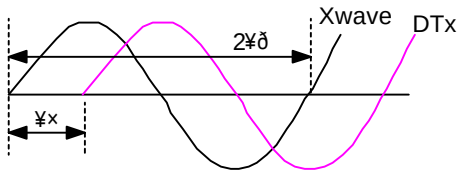
Related Registers

Register	Address	Function	Command
xGcnt	10C5	measurement period	0FFFF5
xGwt	10C4	wait time	0FFFF4
Ffrq	0074	Focus loop bandwidth (sine freq.)	0AFFFE
Kf	0076	F_gain (sine) disturbance level	1E0076
Kcf	0032	F_gain adjustment sensitivity coefficient	0EFFFE
FGok	10B2	F_gain adjustment ok level	0DFFF2
FGmax	005C	F_gain adjustment maximum value	0AFFF7
FGmin	005D	F_gain adjustment minimum value	0AFFF8
Tfrq	0078	Tracking loop bandwidth (sine freq.)	0AFFFF
Kt	007A	T_gain (sine) disturbance level	1E007A
Kct	0033	T_gain adjustment sensitivity coefficient	0EFFFF
TGok	10B3	T_gain adjustment ok level	0DFFF3
TGmax	005E	T_gain adjustment maximum value	0AFFF9
TGmin	005F	T_gain minimum value	0AFFFA

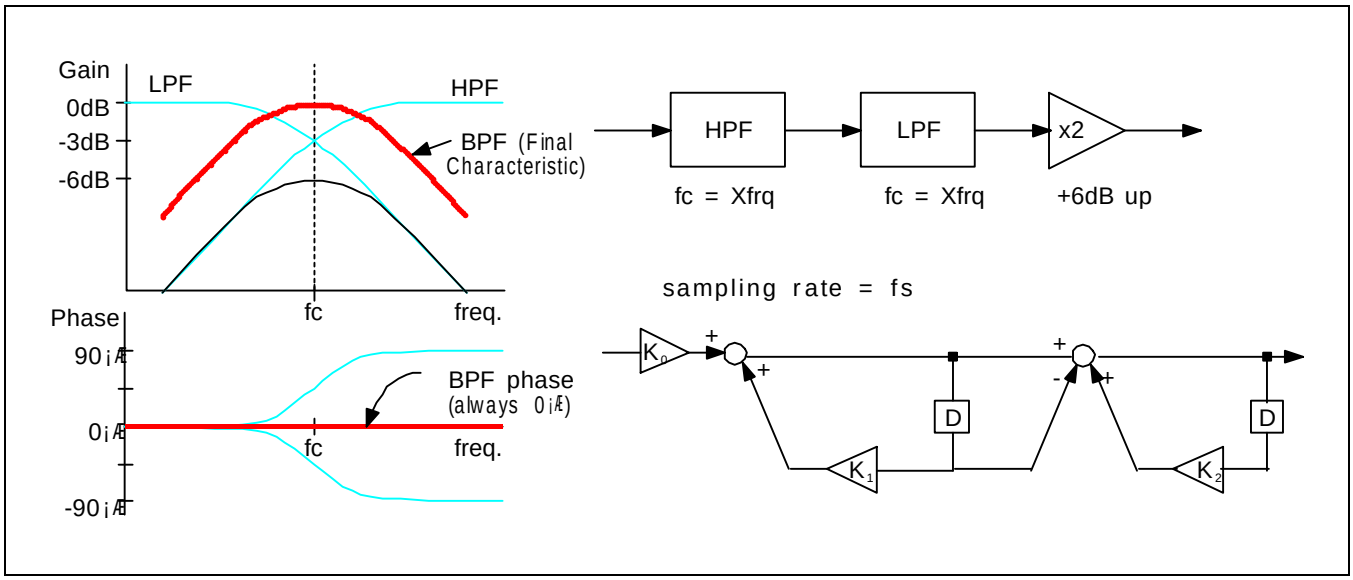
Operation Description

A sine wave is output to the FOD output, and the phase difference (ψ) of the signals that have passed through mech such as P/U, and the original sine wave are compared. The loop EQ filter's final output gain is automatically adjusted so that the phase difference is 90°.

The adjustment is repeated many times to find the optimum state, and BPF is carried out to eliminate the noise components in the input signal.



Detecting Signal BPF



Register	Address	Function	Command
xGa K0	00FA	xGA BPF's K0 (attenuator gain) = (1-K1)*2	5Dxxxx
xGa K1	00FB	xGA BPF's K1 (LPF pole coefficient)	5Exxxx
xGa K2	00FD	xGA BPF's K2 (LPF pole coefficient)	5Fxxxx

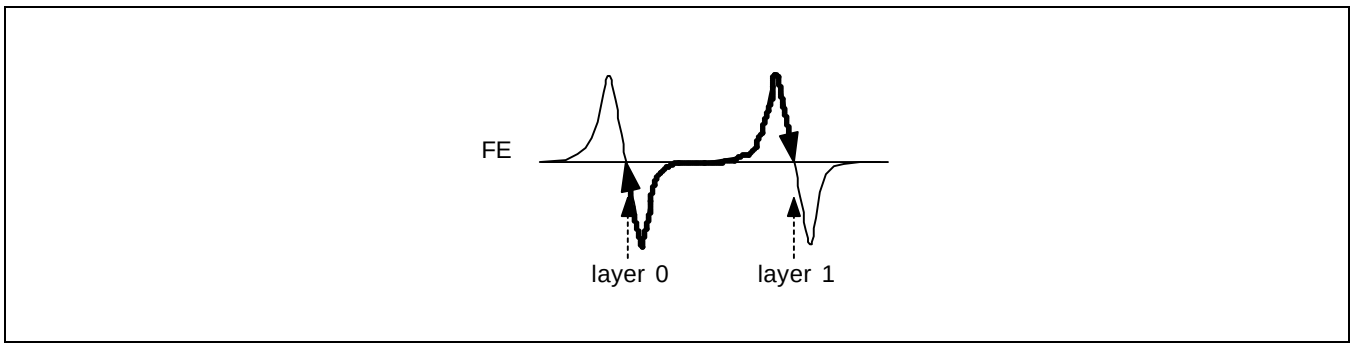
LAYER JUMP, TRACK JUMP & SLED MOVE FEATURES

Focus (Layer) Jump

Summary

Layer jump is for when you want to go from the current layer to another layer and continue playback, while in DVD dual layer disc playback, or in off track state. Layer jump is carried out by outputting a kick/brake pulse to the focus output block.

- Input signal: FE
- Output signal: FOD



Command

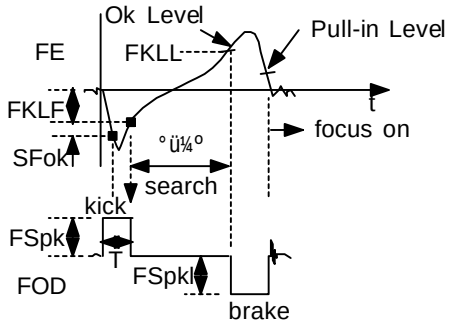
FONcmd's LYRX. selects the target layer by TONcmd's TLRX.

Related Registers

Register	Address	Function	Command
FSpk	0055	f_srch output adjustment coefficient (kick level)	0AFFF0
Fkll	0024	FE level coefficient for deciding kick time	0EFFF0
Fklf	108D	FE level coefficient for deciding brake time	1E108D
FSpkl	002C	f_srch output adjustment coefficient (brk level)	0EFFF8
SFok	10CD	FE hysteresis level	0FFFFD
tFpi	0042	Time to tracking pull-in after focus pull-in	0CFFF1

Operation Description

When the FON/TON command is input, the kick/brake level is selected according to the layer you are jumping to, and the sum of the FOD output average value and the kick value is output. This value determines the FE value, checks the FE signal level, and completes the layer jump by selecting a kick area and brake area according to the absolute values FKLF or FKLL.

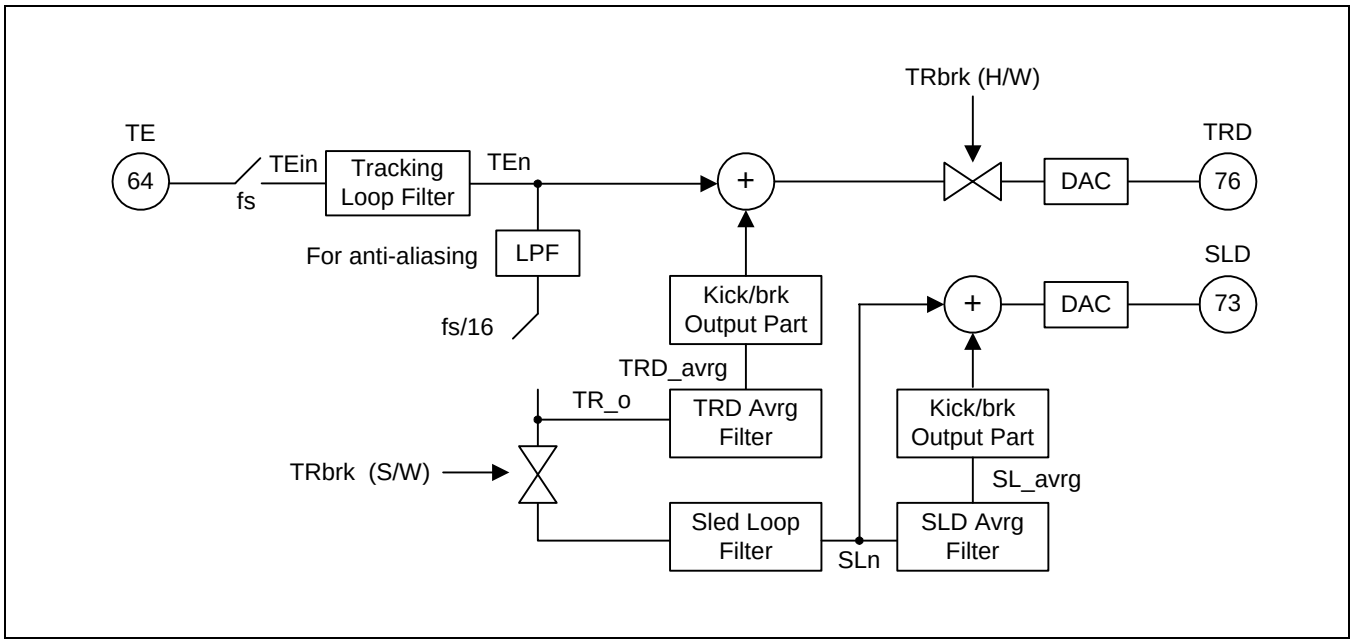


Track Jump Using Kick/Brake

Summary

This method jumps tracks by outputting an acceleration/deceleration pulse to the TRD output (bang-bang jump) to carry out kick/brake. The algorithm consists of 3 steps (kick + brake + stabilizing area), and the track count is executed using mirror or C.OUT (TZC without noise). Speed control is not part of the basic operations. Sled move (kick/brake method) can be carried out together depending on the number of tracks to be jumped.

- Input signal: TE (TZC), mirr
- Output signal: TRD, SLD, C.OUT, TrS (TILTO), sense



Initialize

(is the default setting)

Cmd	Bit	Mode Content	L	H	Default
Ton	TOLB	Lens brake when trk pull-in after jump	off	on	033600
	SFOG	Focus gain in kick+brk+Gut area	normal	down	
	STRG	Tracking gain in kick + brk + GuT + dlyTG area	normal	up	
INI	JPCK	Track counter clock select when jumping more than Cchg	TZC	MIRR	090100
	TKJM	Track jump method	kick/brk	speed control	
	BTS	Brake ending condition	ivbuf	Jstp	
FLG	enTJn	Trk pull-in when goal trk number is reached during jump	don't execute	execute	1A0011
HDW	enTT	Tilto (pin #69) output signal	TrS	Tilt	085900

Command

JMPcmd (05xxxx cmd) is transmitted.

JPM[1:0]	*00	01	10	11
Jump mode	Auto (decided by bound)	Track jump	Sled move	Repeat TRK jump

Register	Address	Function	Command
TKCKd	10C0	Initial kick level	0FFFF0
SMlvl	10C3	Sled move level during trk jump	0FFFF3
TKj_k	0025	Kick/brake duty select coefficient Trk kick time T = TKj_k * N	0EFFF1
TKl_k	002A	TRK brake level adjusting coefficient Trk brake level = TKCKd * 2 * TKl_k	0EFFF6
SMl_k	002B	Sled brake level adjusting coefficient Sled brake level = SMlvl * 2 * SMl_k	0EFFF7
Kwdt	0077	Max kick delay time	1E0077
Bmin_k	10CA	Min BRK time (/5 if kick time)	0FFFFA
sTMk	00FF	TRK brake area observation window time Max trk brk time = T * 2 * sTMk	1E00FF
Tstbl	0043	Stabilization time after trk jump	0CFFF2
Twin	0044	Mirr/TZC blind time	0CFFF3
Mstp	0045	Stop time compensation time during jump (stop = ivbuf - Mstp)	0CFFF4
GuT	0046	TGup/FGdw time after jump	0CFFF5
dlyTG	1096	TGup delay time after GuT end	1E1096
Cchg	10B8	C.out (up/dw) and TZC/mirr (up) select trk #	0DFFF8
Bound	10B9	Trk jump and fine search's boundary trk #	0DFFF9
SMcnt	10BB	Trk # from after trk kick to sled move start	0DFFFB
ivTimg	00AA	TZC/mirr select trk # with K/B reversal location as reference	1E00AA
fsTjN	009A	Brk forced stop trk #	1E009A

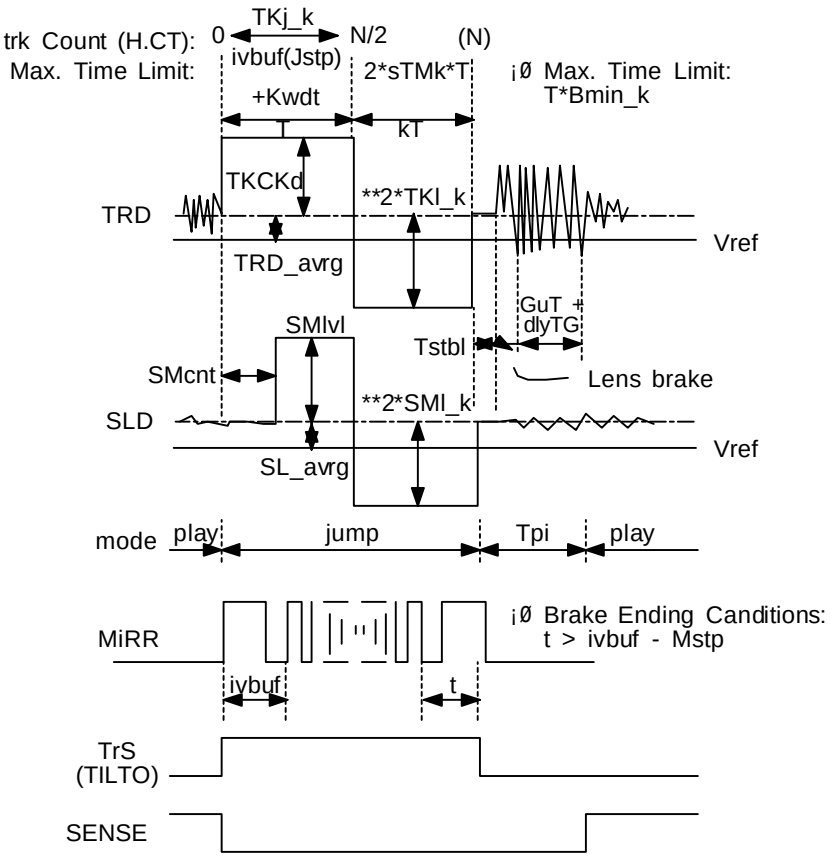
Operation Description

- Tracking Kick/Brk Output:
  - The track kick pulse is the TRD output average value (TRD_avrg) before jump, overlapped with the kick level (TKCKd). The track kick pulse reverts to brake when the track counter (H.CT) becomes larger than the jump trk # (N)*TKj_k, and the level is TKCKd*2*TKl_k.

  - Maximum Kick Time Limit
    If the MIRR period within the kick area becomes larger than ivbuf (Jstp) + Kwdt (according to BTS select conditions), it is a long-term error of the MIRR, and there is a change to brake for safety.

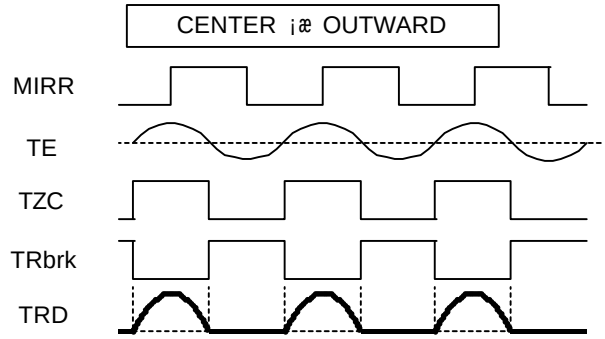
- Sled Kick/Brake Output:
  - When the jump trk # generated by the track kick reaches the sled movement count (SMcnt), the sled output average value before the jump (SL_avrg) and the sled move level (SMlvl) kick are overlapped. Sled reverts to brake along with the trk kick's reversion to brake, and the level is SMlvl*2*SMl_k.

- Tracking Kick/Brk Timing Diagram



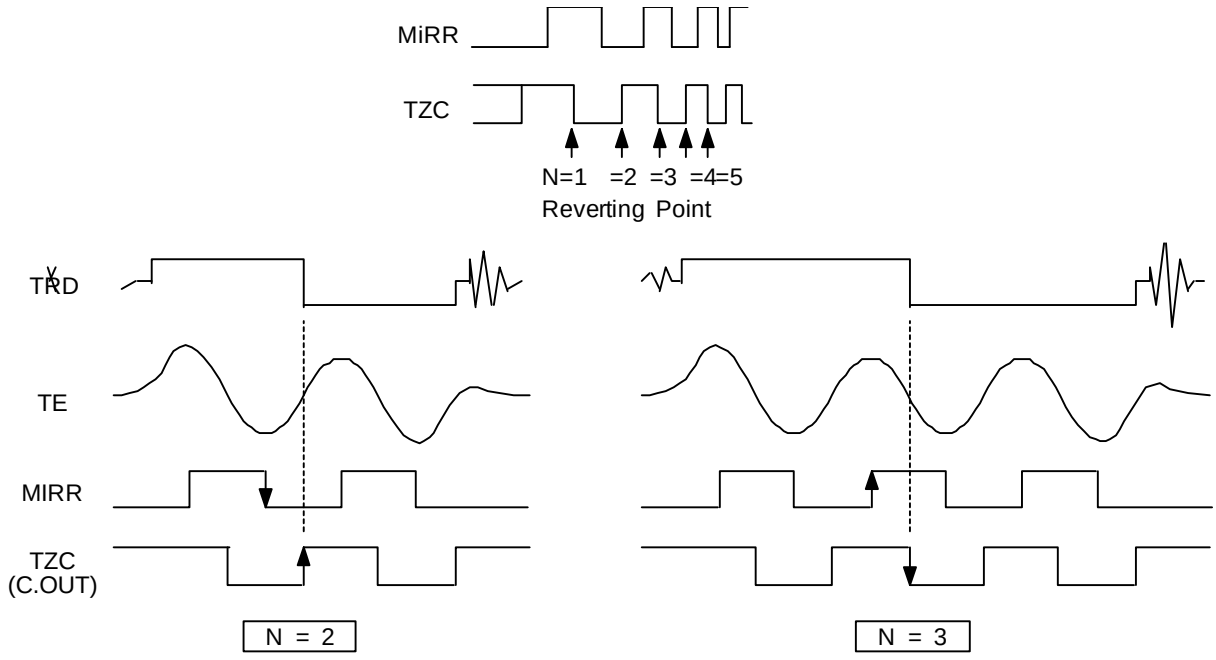
- Jump End and Stabilization Area
  - Brake End:
    : When a deceleration is 1.5 times the acceration time (T).
    : When the number of tracks you want to jump is less than [fsTJN], or when the initial value eTJN is 1 bit and the track counter hardware counter value is larger than the track number.
    : When the timer value [TM1] selected in the deceleration area's Mirr negative edge is reduced at each interrupt so the value is less than [MSTP], and the different between 1.5T and the reduced value is less than [BRKmin].
  - Stabilization Time (Tstbl): The brake end point is like when you step input to the actuator, so you wait at the output average level until the vibrations are settled.

- Lens Brake: When track cross is generated after the Tstbl period due to remaining speed, the TRD output is interrupted to the Vref level using the MIRR and TZC's phase difference.



- Tracking Gain Up: After the stabilization time, the track on (Ton_int) routine is started. When Tstbl is over, GuT is set and tracking gain up (when STRG = H) and focus gain down (when SFOG = H) are carried out. When GUT period is past, focus gain goes back to normal, and the sled filter is turned on. Also, when dlyTG passes, the tracking gain is turned to normal as well, and goes basck to normal play mode.

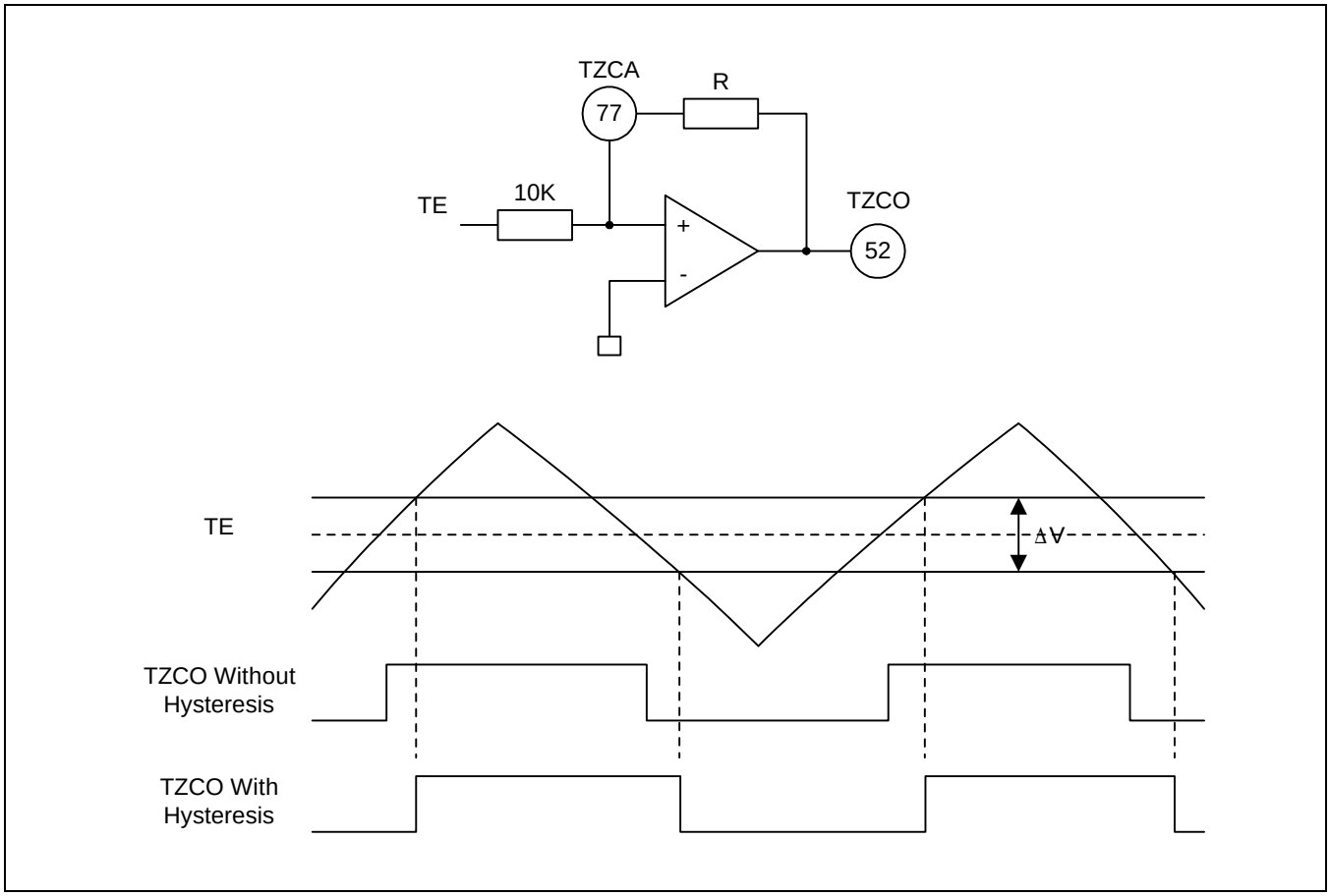
• Kick/Brake Reverting Point (calculated at mirr edge)



Output Average Value Filter

Register	Address	Function	Command
To_avrg K_0	003E	TRD average value filter's new data gain (K_0 = 1-K)	-
To_avrg K	003F	TRD average value filter's old data gain	5C7FC1
SLavrg K_0	007E	SLD average value filter's new data gain (K_0 = 1-K)	-
SLavrg K	007F	SLD average value filter's old data gain	5C7FC4

TZC Comparator's Hysteresis Characteristics



Repeat Track Jump (refer to MICOM command set)

XTAL JIT[2:0]	0	1
000	Manual Jump Mode	
001	2.3Hz	4.6Hz
010	2.3Hz	4.6Hz
011	3.5Hz	7Hz
100	5.7Hz	11.5Hz
101	9.2Hz	18.5Hz
110	12.7Hz	25.5Hz
111	17Hz	34Hz

Sled Move using FG Pulse

Summary

This is a long distance track search using the sled kick/brake method when using the FG pulse as a way for measuring the number of tracks being moved. The FG pulse is composed of 2 pulses of 90° called PS1 and PS0, and the direction as well as distance can be found. the exclusive-or signal of PS0 and PS1 is called FG, and the move operation is carried out while counting the number of FG.

- Input signal: PS0, PS1
- Output signal: SLD, TRD, sense
- Initialize:

(is the default setting)

Cmd	Bit	Mode Content	L	H	Default
HDW	enTT	Tilto (pin #69) output signal	TrS	Tilt	085900
	SNS	Track count input signal during sled move	TZC/mirr	FG (PS0, 1)	
INI	SMM	Sled move method	kick/brk	speed control	090100
	JPEC	Automatic err correction when having jumped past the trk # goal	don't execute	execute	
	BJJM	Track jump correction for remaining trk# after sled move	don't execute	execute	
FLAG	enTJn	Trk pull-in when you reach the trk# goal during jump	don't execute	execute	1A0011
	enSPi	After sled move, pull in to the sled pull in routine	don't execute	execute	
Ton	TOLB	Lens brake during trk pull-in after jump	off	on	033600
	SFOG	Focus gain during kick+brk+Gut area	normal	down	
	STRG	Tracking gain during kick+brk+GuT+dlyTG area	normal	up	

Related Registers

Register	Address	Function	Command
SKCKd	10C1	Kick/brk level	0FFFF1
SMlvl	10C3	(JPEC = H)'s kick level during sled move repeat kick	0FFFF3
SL_k	0029	Kick period selecting coefficient, selected separately for each move istance	0EFFF5
Jstbl	0041	Stabilizing time after sled move	0CFFF0
FGjsp	0044	PS period for trk pull_in	0CFFF7
PSstp	10F0	PS period for sled kick emergency detection reference	1E10F0
Twin	0044	Mirr/TZC blind time	0CFFF3
ENTc	10BD	Sled encoder decomposition ability	1E10BD
GuT	0046	TGup/FGdw time after move	0CFFF5
dlyTG	1096	TGup delay time after GuT end	1E1096
Bound2	10BA	Fine srch and sled move boundary	0DFFFA

Operation Description

- Position Sensor and Track Count Method:
  When the multiple N-S magnetic poles attached along the sled deceleration gear's cylinder starts to rotate by sled motor operation, the 2 hall sensors with the 90° phase angle detects the magnetic change and outputs a voltage in sine wave form. Also, this signal is changed into a logic signal in the comparator, and is input to the DSSP's status input as PS0 and PS1. The tolerance for the phase angle 90° is decided by the mechanical location, and if it is accurate, 4 FG edges are made in the PS0 and PS1's 1cycle.

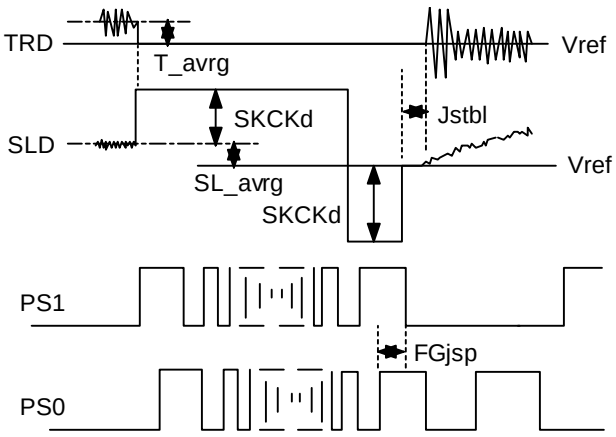
  The number of trks per FG pulse can be calculated by deck mechanisms such as the number of magnetic poles, etc. The value can be stored in the ENTc register by MICOM. When the FG edge is detected acoording to sled move, the S/W counter (STcnt) increases by ENTc, and you can measure the number of trks moved even without H.CT operation.

- Sled Kick/Brake Output:
  1. Waveform: The sled kick pulse is the SLD output average value before the move (SL_avrg), overlapped with the sled kick level (SKCKd) and output to SLD. The sled kick pulse reverts to brake when the STcnt becomes the reverse count value found by move trk #(N)*SL_k. At this time, the brake level is the same as the kick level (SKCKd), but while the kick's point of reference is SL_avrg, that of brake is Vref. This is because the average output level before and after a move is different for long-distance moves. There isn't that much change in the lens shift in short movements in the level of track jump, so the kick/brake and stabilization area's output reference level are both SL_avrg (TRD_avrg). But in long-distance moves, the lens is at the midpoint, so there is no more meaning for the output average after kick. Therefore, the TRD output during sled kick/brake and stabilization area are held at Vref instead of TRD_avg, and off status is maintained.

2. Limit Feature for Emergency During Kick/Brake: Unlike track jump using MIRR/TZC, PS0 and PS1 have almost no chance of an output error due to circuitry reasons, apart from the damage of the hall sensor or comparator. However, there is a chance of kick time becoming very long, or getting trapped in an endless kick when the load on the sled becomes abnormally large. To prevent this, there is an emergency detection timer (PSstp) that stops the move and changes to pull-in mode when the PS edge doesn't come out within a specific length of time.

- Move End and Stabilization Area
  1. Brake End: In the deceleration area, if the interval between the FG pulse period is longer than the time set by MICOM (FGjsp), or the movement direction is incorrect, the SLD output is set back to Vref and the brake is stopped.

  2. Stabilization Area: The SLD output is held to Vref for the stabilization area set by MICOM. TRD also maintains Vref status. When the stabilization area comes to an end, it diverges into the TrSV routine within the Fon_int, and attempts normal tracking/sled pull-in.



Speed Control Track Jump & Sled Move

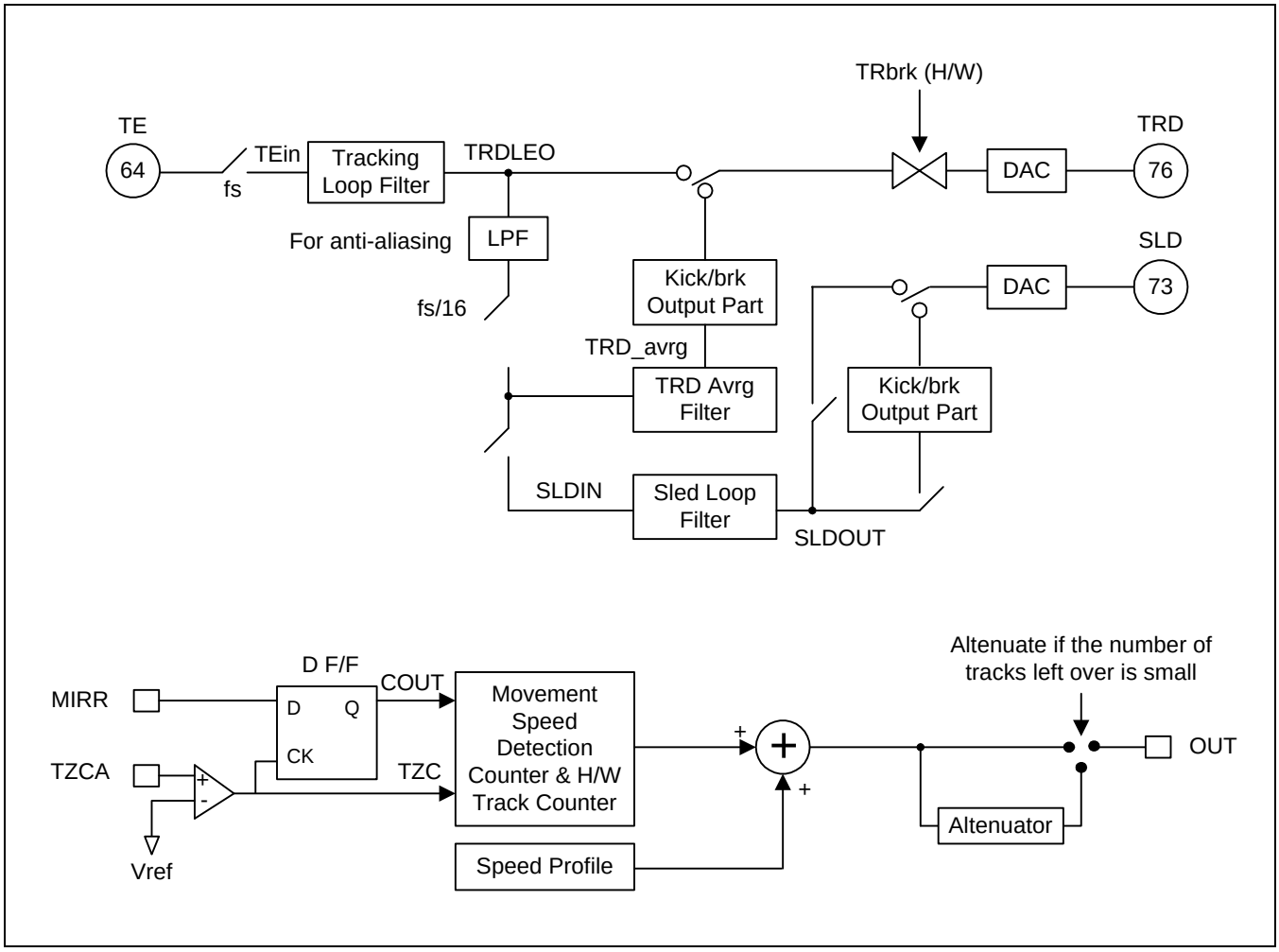
Speed Control Track Jump

Summary

Speed control track jump is a track jump method that moves the P/U's lens. The number of tracks to be jumped can be set between 1 and 255. The speed control kick detects the P/U lens'speed in relation to the disc using the track error and MIRR signals from the disc, and controls the TRD kick signal so that it matches the DSP speed profile. You can select the TM_win to reduce TZC errors such as glitches generated by initial kicks. When tracking is on, lens brake and loop gain up periods can be selected.

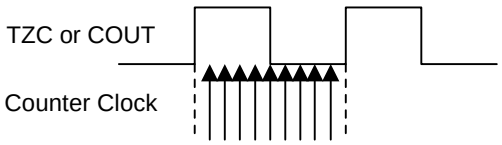
- Initialize:
  When INIcmd's TKJM is set to H and JPMcmd is received, speed control track jump is carried out for the number of tracks set by command. Other initial conditions are the same as those described in track jump using kick/brake.

Speed Control Related Block Diagram



Operation Description

Tracking drive carried out by measuring the difference between the speed profile and the MIRR distance:
Speed is controlled by feedback to the TRD level.
TZC, MIRR or COUT input into DSSP can be counted by the internal counter clock, so that you can move the tracks at the speed you want (max 151.2/4kHz).



Speed Control Sled Move 1 using MIRR/TZC

Summary

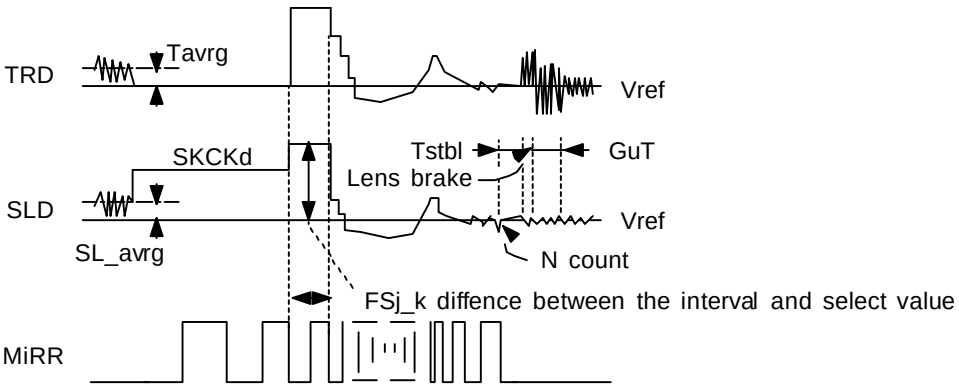
This method is a speed control sled move, but it uses the TZC/MIRR in the detection signal, consequently using the tracking drive (TRD) as well as the sled drive (SLD) as control output. It also has the track kick correct for eccentricity. However, it needs enough tuning because the combination of the mixing is very complicated. This method is appropriate for jumps that are too long for track kick, but too short for FG sled move. The principle behind speed control is almost the same as speed control track jump. The only difference is that the control output is not only track drive (TRD), but includes the sled drive (SLD). The maximum speed of this method is 151.2/4kHz .

- Initialize:
  When HDWcmd's SNS = L, INIcmd's SMM = H and JPMcmd is received, a speed control track jump is carried out for the number given by command. Other initial conditions are same as those in track jump using kick/ brake.

Command

JMPcmd (06xxxx cmd) is transmitted.

Timing Diagram



Speed Control Sled Move 2 using MIRR/TZC

Summary

Like speed control sled move 1, this method also uses TZC/MiRR in the detection signal. However, this method only uses sled drive (SLD) as the control output, so it is appropriate for jumps where a high speed sled speed is required. The principle for speed control is almost the same as that of sled move 1, only excepting that the control output controls only sled drive (SLD) and that actual MIRRs are counted instead of between the edges of MIRRs. This method is usually used for long distance move, and the maximum speed is the same as MIRR or TZC's maximum speed from the RF IC. Therefore, when using this method, you need a high quality MIRR at high speeds.

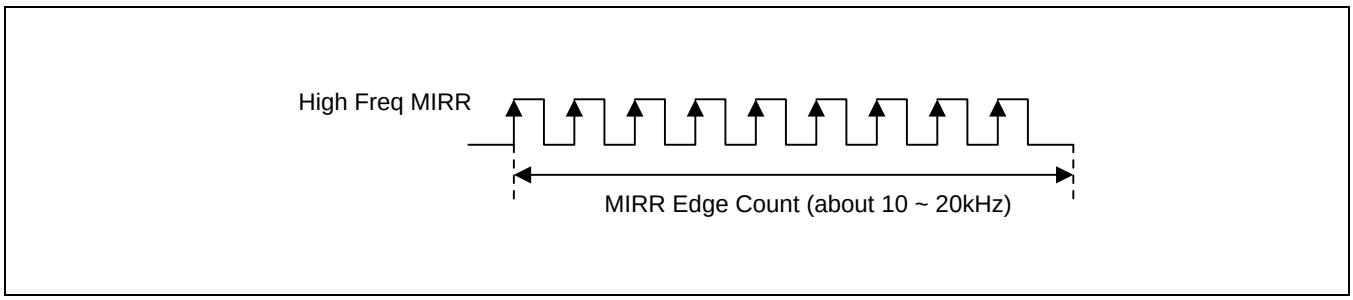
- Initialize:
  When HDWcmd's SNS = L, INIcmd's SMM = H and JPMcmd is received, speed control track jump is carried out for the number of tracks given by command. Other initial conditions are the same as those in track jump using kick/brake.

Command

JMPcmd (06xxxx cmd) is transmitted.

Operation Description

The speed can be controlled by selecting beforehand the speed you want (number of MIRR) and counting the number of MIRR for measuring the deviance and sending feedback to the sled drive (SLD) level. You can move the tracks at the speed you want using the internal counter clock to count the TZC or MIRR input into DSSP.



Speed Control Sled Move using FG Pulse

Summary

This method is an FG speed control (iNicmd's SMM = 1) sled move when you can use the FG pulse as a way to measure the number of tracks being moved. The principle of speed control is almost the same as that of speed control track jump. The difference is that the speed detection signal is not MiRR but FG (PS1×Ž PS0), and the control output is not TRD, but SLD. This method is also used for long distance moves.

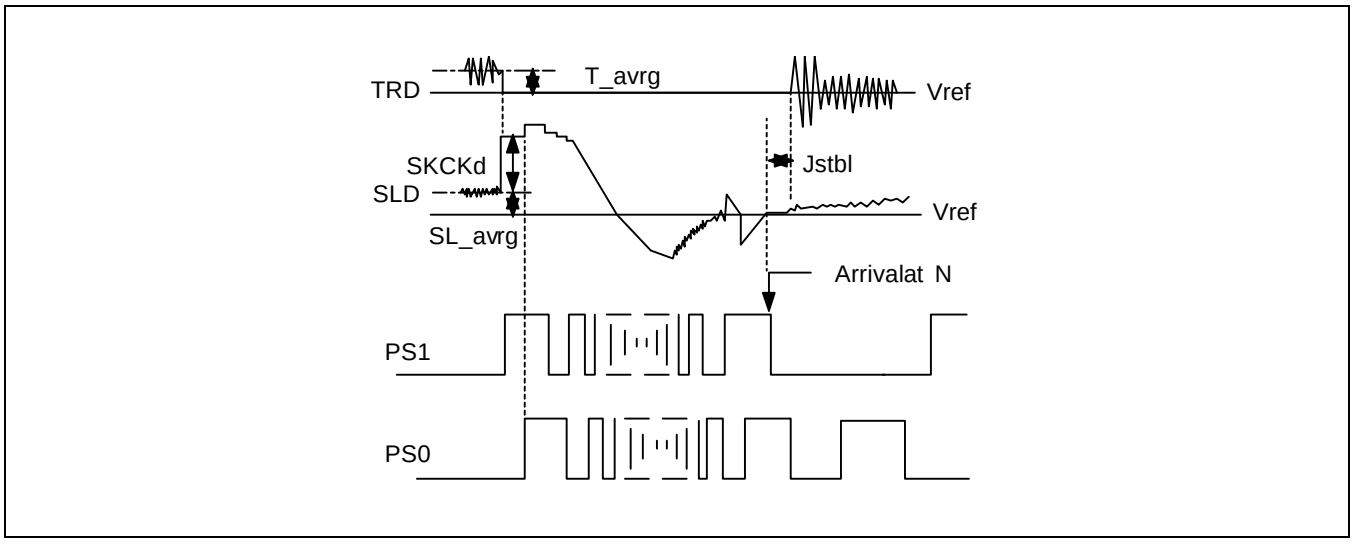
- Initialize:
  When HDWcmd's SNS = H, INIcmd's SMM = H and JPMcmd is received, track jump is carried out for the number of tracks given by command. Other initial conditions are the same as those in track jump using kick/brake.

Command

JMPcmd (06xxxx cmd) is transmitted.

Operation Description

The sled kick pulse is the SL_avrg before kick overlapped with SKCKd, which is output to SLD. The sled kick pulse reacts with the difference between the FG pulse's second edge and the speed profile's interval, so that the drive voltage is output to SLD. Speed control is carried out so that it matches the profile. Also, FG pulse is ENTc track, so if you have a short track search, the number of tracks moved becomes N immediately after speed control, making speed control useless.



Emergency Handling Process

Focus Drop Handling Process

Summary

If during focus pull-in, playback or jump, the focus servo is dropped due to any reason, the system stability is increased by having an operation mode that automatically carries out pull-in without MICOM. You only need to set the initial conditions. No separate commands are needed.

- Input signal: FE, FOKB
- Output signal: FOD, FLKB
- Initialize:

(is the default setting)

Cmd	Bit	Mode Content	L	H	Default
FON	FOPI	Automatic pull-in at focus drop	yes	no	026200
EME	FDOL	Layer selection for automatic pull-in at ocus drop	previous ayer	don't care	074F00
	upFv	FSval (P/U location info) update after focus ull-in	yes	no	
FLG	Fptmg	Focus drop decision flag	FLK	FOK	1A0011
HDW	PCUP	P/U type (vibrations)	strong	weak	085900

Related Registers

Register	Address	Function	Command
FONc	1004	FON (02cmd)'s parameter copy	1E1004
FSspd	0038	Repeat pull_in f_srch speed	1E0038
FSpk	0055	Output adjust coeff. during F_srch pull_in	0AFFF0
FSrng	10C6	F_srch limit level	0FFFF6
tFpi	0042	T_pull_in time after F_pull_in	0CFFF1
FLoff	004D	Focus lock off time	0CFFFC
FLon	004E	Focus lock on time	0CFFFD

Anti Shock Handling Process

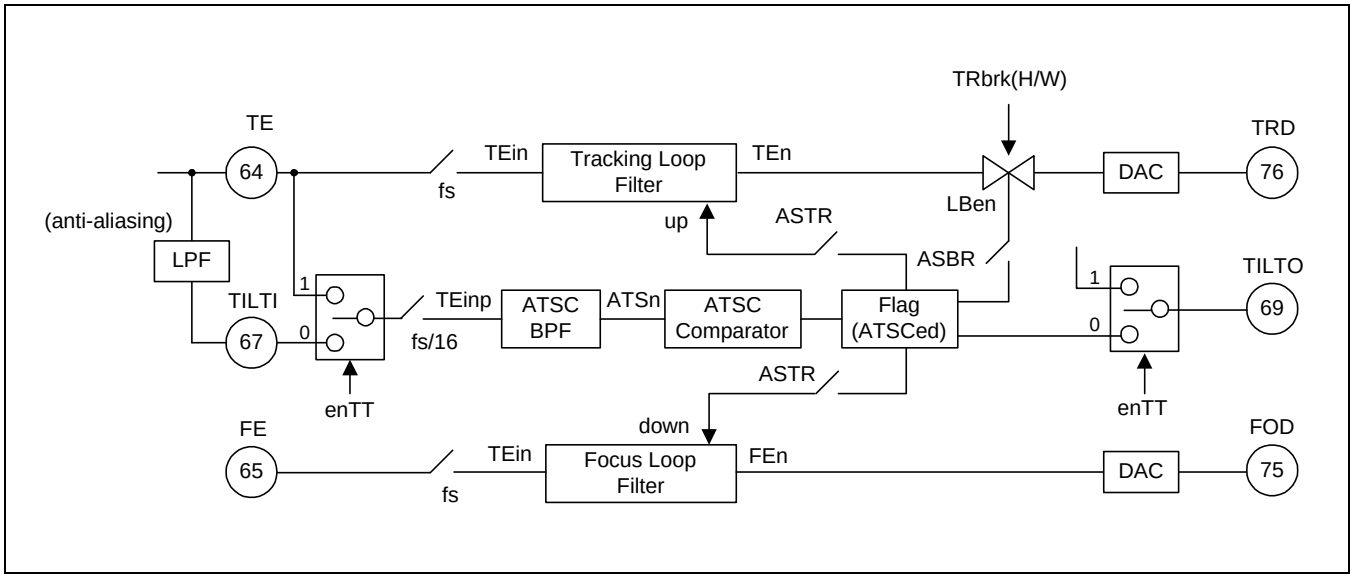
Summary

If an external shock is applied to the system while in playback, the lens shakes, causing tracking errors that lower the stability of the servo system. To reduce the influence of such errors, abnormal signals above a certain level of frequency is detected as shock components for generating ATSC signals. Appropriate steps are taken by the tracking and focus servo loop.

- Input signal: TILTI (TE input for ATSC use)
- Output signal: FOD, TRD, TILTO (monitor)
- Initialize:

(is the default setting)

Cmd	Bit	Mode Content	L	H	Default
HDW	enTT	ATSC BPF input block select	TILTI	TE	085900
	enASin	BPF for ATSC (for shock detection)	internal PF	external PF	
TON	TRPI	Kick pulse used during tracking pull_in	yes	no	033600
EME	DSAS	Anti shock handling	enable	disable	074F00
	ASFO	Focus gain during ATSC period	normal	down	
	ASTR	Tracking gain ATSC period	normal	up	
	ASBR	Lens brake ATSC period	off	on	



- Operation description changes according to the combination of TRPI and DSAS.

TRPI	DSAS	Operation Description
0	0	Track pull-in using kick pulse if off track during ATSC ICK pull-in if mirr occurs in off track during play hoose out of 3 (ASBR, ASFO, ASTR) (leave it to servo)
0	1	
1	0	
1	1	

- Feature combination when TRPI = H and DSAS = L

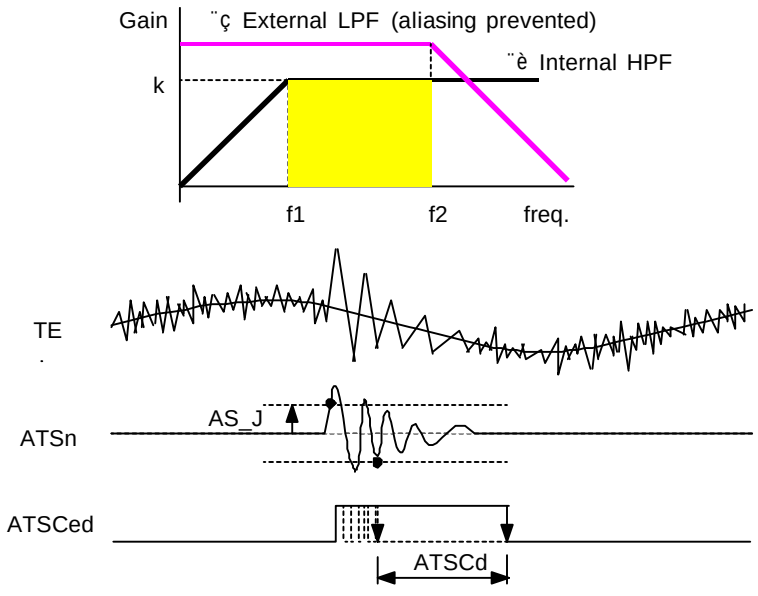
cmd	0741	0742	0743	0744	0745	0746	0747
ASFO	0	0	0	1	1	1	1
ASTR	0	1	1	0	0	1	1
ASBR	1	0	1	0	1	0	1

Related Register

Register	Address	Function	Command
AS_J	10CB	ATSC comparator threshold level	0FFFFB
ATSCd	004C	Continuing handling time after ATSC	0CFFFB
ATSCk1	00CB	ATSC BPF low frequency pole (f1)	55FFFF
ATSCk	00CC	ATSC BPF gain	56FFFF

Operation Description

Make ATSn after filtering TE, then add delay time to ATSn to make the ATSC signal.



CLV Lock Off Handling Process

Summary

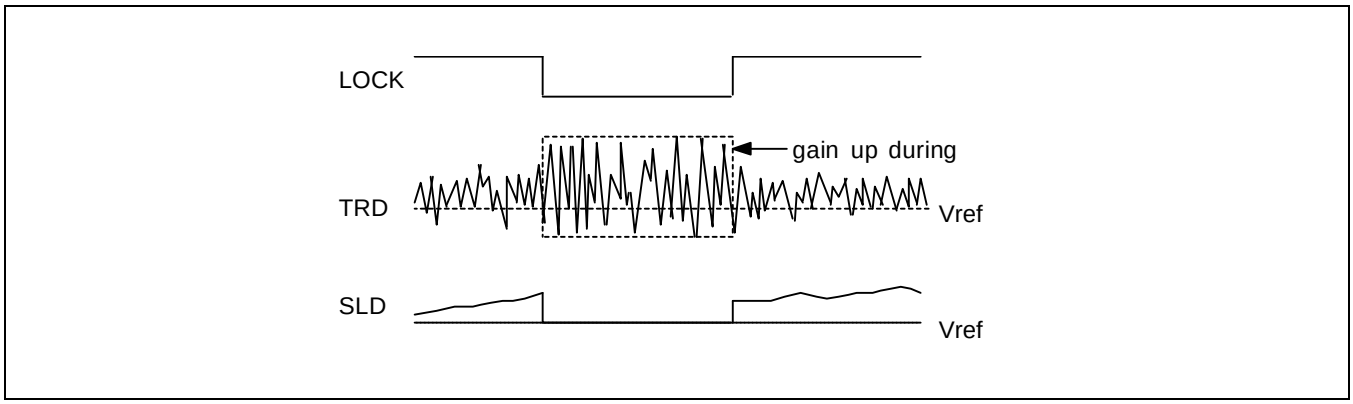
If CLV lock is turned off during playback for any reason, the spindle servo becomes unstable, and it can affect the tracking servo, causing an emergency. To prevent such an occurence, you can receive the lock from the data processor to take the appropriate steps to the tracking and sled servo when lock is off.

- Input signal: LOCK
- Output signal: TRD, SLD
- Initialize:

(is the default setting)

Cmd	Bit	Mode Content	L	H	Default
FLG	enLOCK	Tracking gain when lock is off	normal	up	1A0011
EME	SLST	Sled stop when lock is off	no	yes	074F00

Timing Diagram

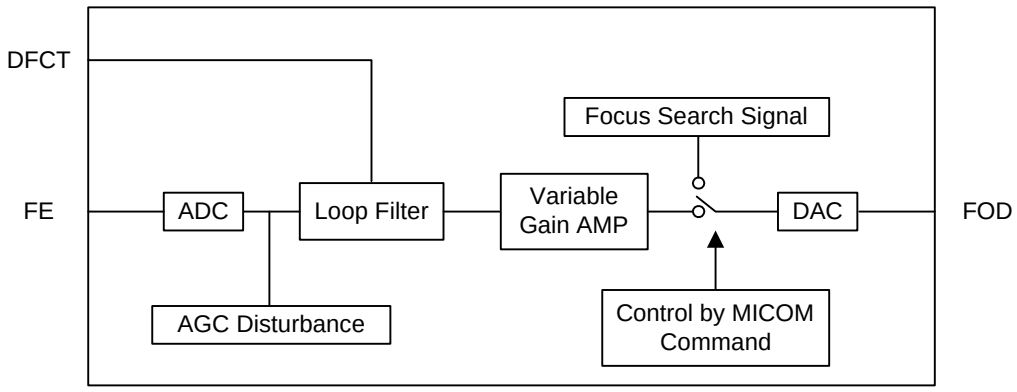


Servo Loop Filter

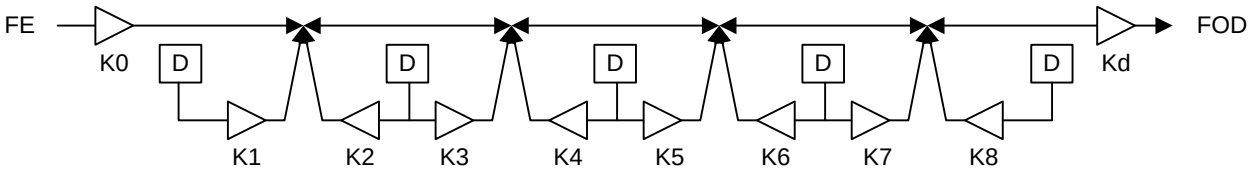
Focus Servo

Summary

As shown in the focus servo block diagram, the focus error signal from the FE block goes through the compensation filter and variable gain AMP after A/D, then goes through D/A conversion to be output to the FOD/ TRD block. The variable gain AMP is automatically selected during auto gain adjustment.



Focus Servo Block Diagram

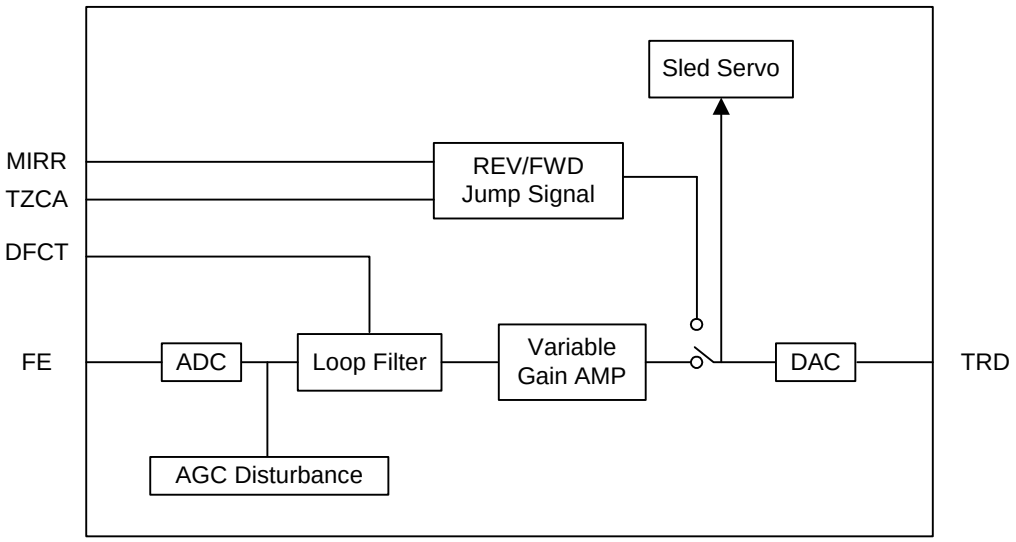


Focus Loop Filter

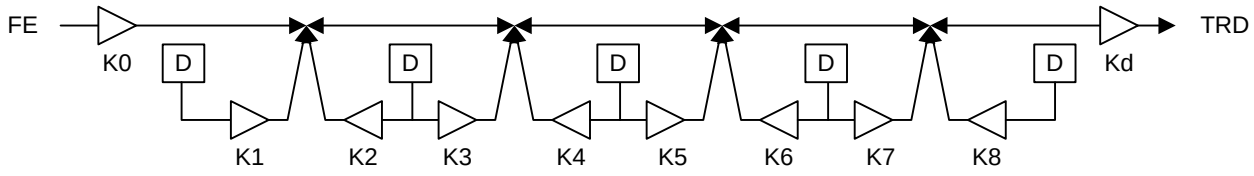
Tracking Servo

Summary

As shown in the focus servo block diagram, the focus error signal from the FE block goes through the compensation filter and variable gain AMP after A/D, then goes through D/A conversion to be output to the TRD block. The variable gain AMP is automatically selected during auto gain adjustment.



Tracking Servo Block Diagram

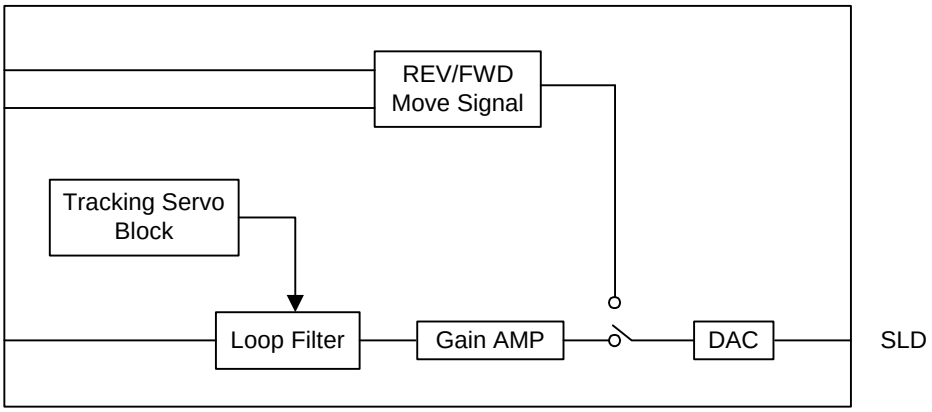


Tracking Loop Filter

SLED Servo

Summary

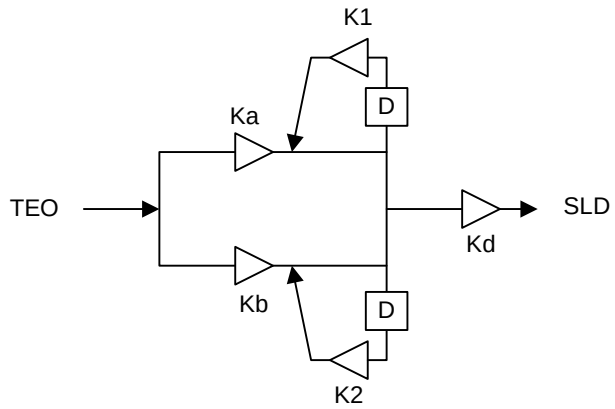
As shown in the sled servo block diagram, the TRD signal input from the tracking servo block goes through the compensation filter and gain AMP, then is D/A converted for outputting into the SLD block.



Tracking Servo Block Diagram

FWD/REV

During sled move, you can carry out fast sled move using the sled motor's FG signal input from PS0, 1. (sled stop when lock is off.)



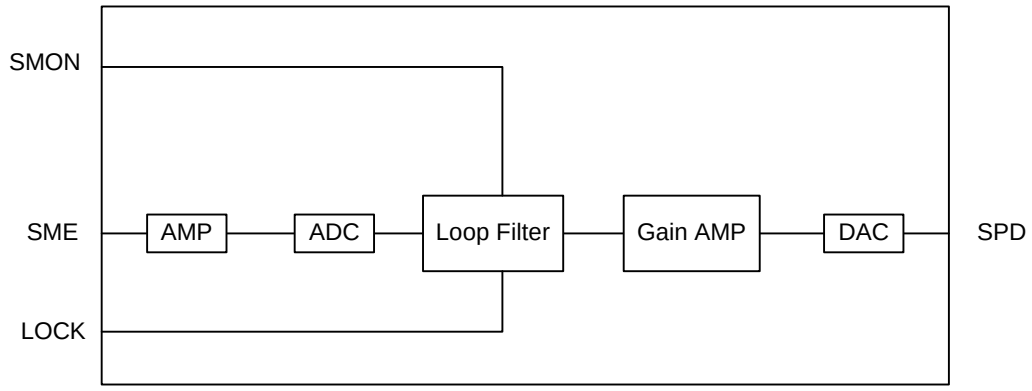
Sled Filter

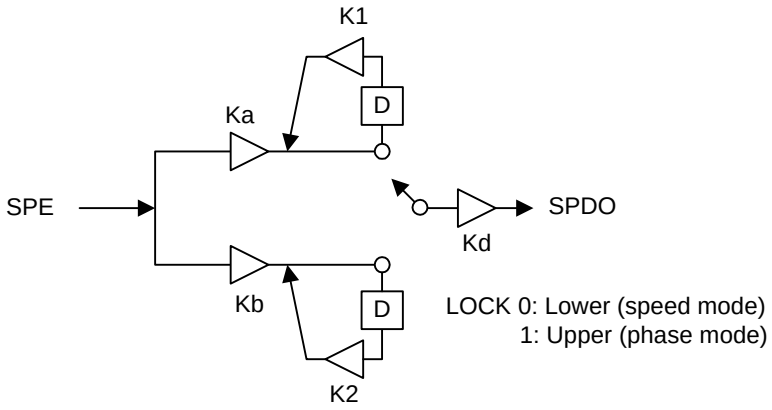
Spindle Servo

Summary

In the spindle servo block diagram, the spindle error signal input from DSP goes through the compensation Filter and the gain AMP, then is D/A converted to be output into the SPD block.

(LOCK = L: CLV s-mode, reduces loop filter bandwidth
LOCK = H: CLV p-mode, enlarges loop filter bandwidth)



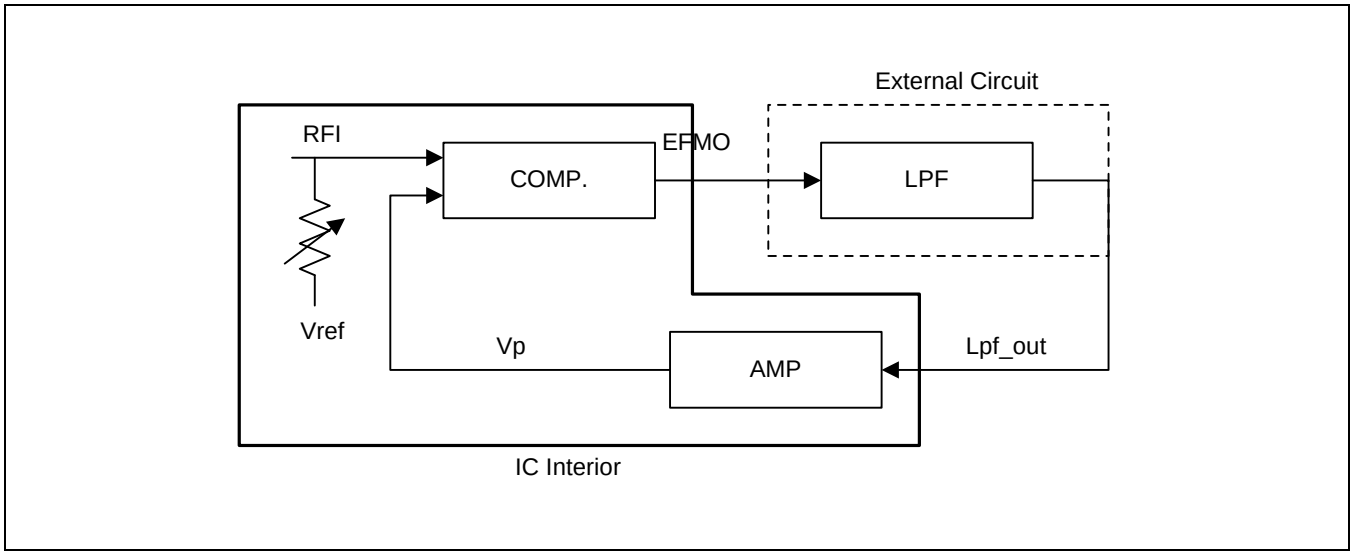


Spindle Filter

Data_slicer Circuit

Summary

The input signal from RF (3T ~ 14T) is converted into a pulse waveform of duty 50% and output without regard to ΔVoffset generation.



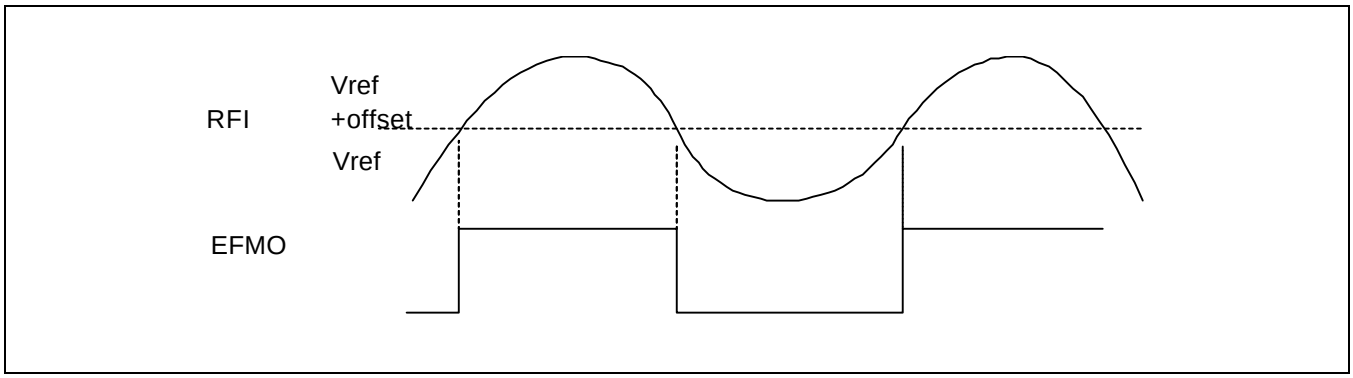
Pins Used

Pin Name	I/O	Description
RFI	I	Analog RF input signal
LPF_DVD	I	Slicing level error voltage limited by LPF_DVD
LPF_CD	I	Slicing level error voltage limited by LPF_CD
EFMO	O	EFM output signal waveform adjusted by comp.

Frequency Input Content Per Mode (3T reference)

mode	frequency
CD *1	720kHz
CD *4	2.88MHZ
CD *8	5.76MHZ
CD *16	11.52MHZ
CD *24	17.28MHZ
DVD *1	4.36MHZ
DVD *2	8.72MHZ
DVD *3	13.08MHZ

Operation Waveform Diagram



RFI Input Impedence

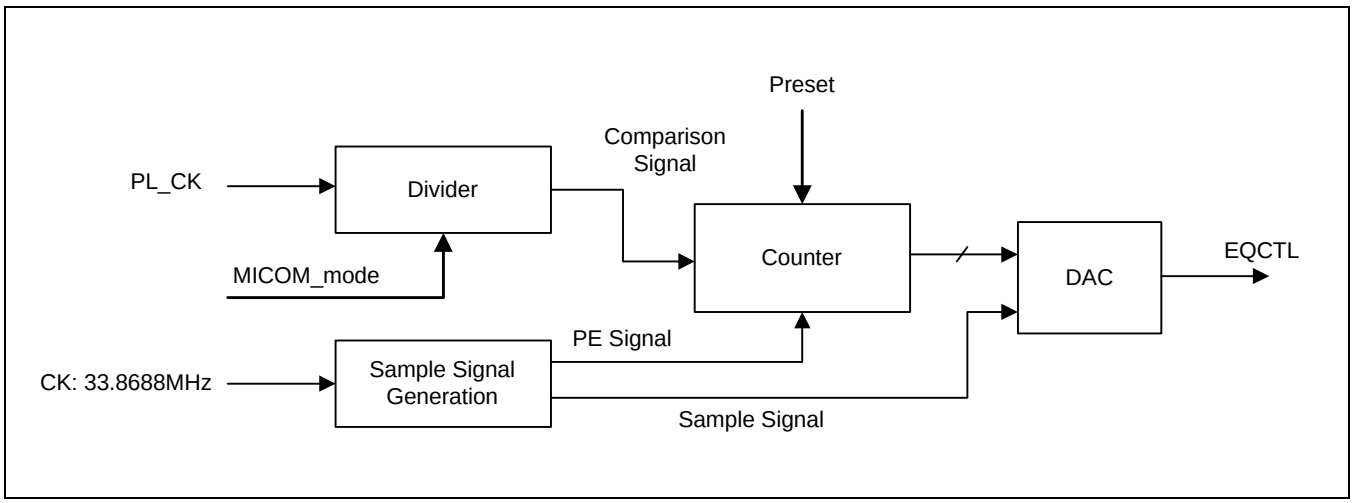
- Input impedence set in 6 steps

MICOM Mode	000	001	010	011	100	101
Resistance KΩ	40	20	10	5	15	7.5

EQ_CONTROL

Summary

F/V convert that converts frequency into voltage by inputting the the CK generated in PLL.

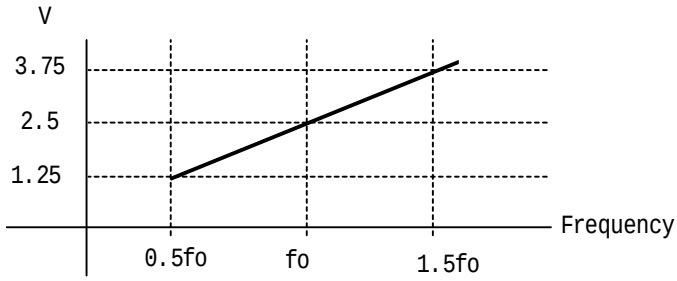


Pins Used

Pin Name	I/O	Description
PL_CK	Internal signal	Bit CK generated in PLL ccording to each speed
Micom_mode	I	MICOM interface
CK	I	Main CK (33.8688MHz)
EQCTL	O	Bit CK F/V output

Spec

- 6step F/V frequency select (CLV reference)
- Input frequency range median frequency ±50%
- 0.25V/±10%
- Linearity: < ±7%



Speed and Comparison Signal

- Comparison signals are made to be regular by receiving speed information from MICOM and PL_CK from the PLL block.

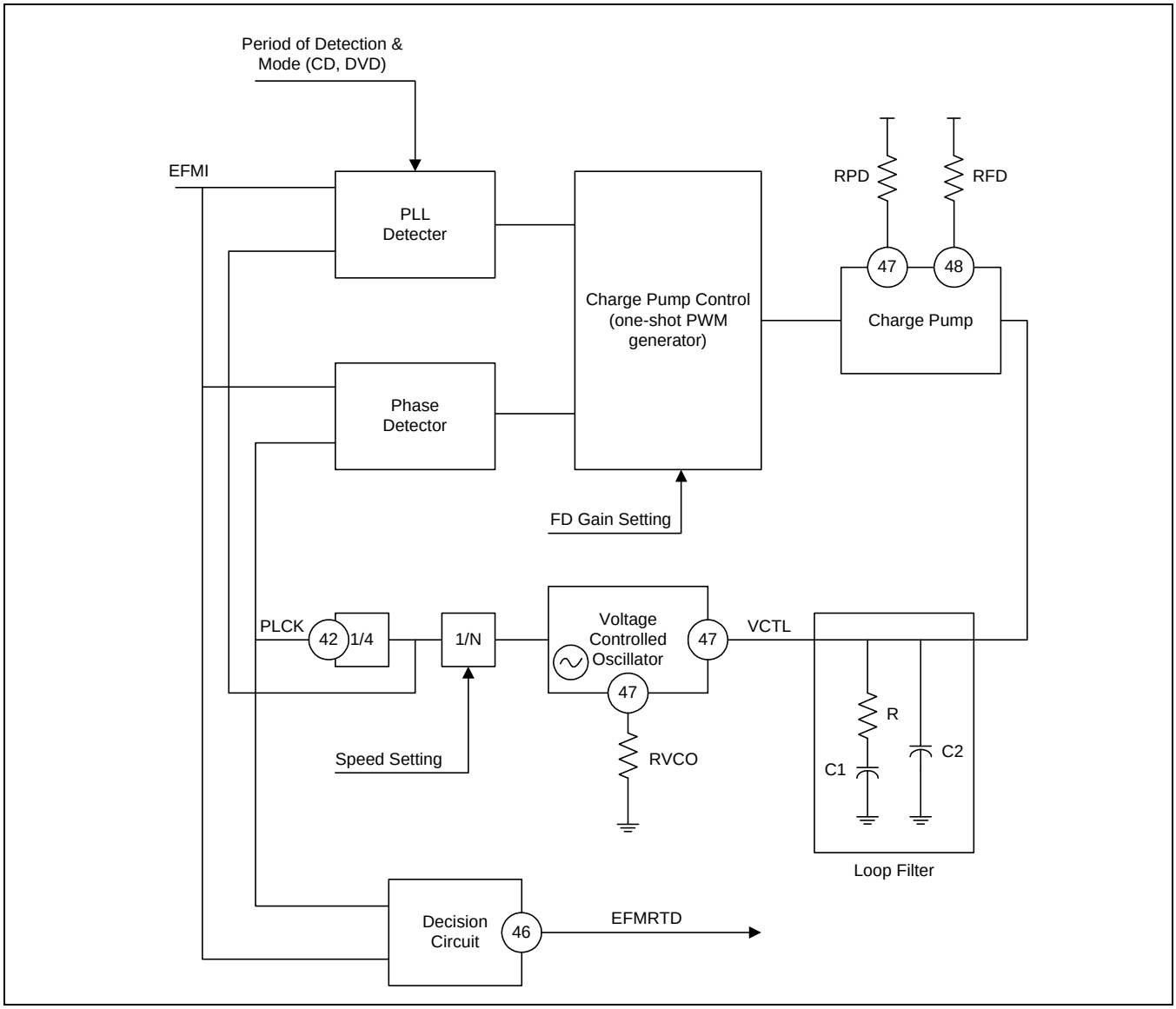
Speed Information		Pl_CK[MHz]	N	Comparison Ignal [MHz]
000	CD*1	4.3218	1	4.3218
001	CD*2	8.6432	2	4.3218
010	CD*4	17.2872	4	4.3218
011	CD*8	34.5744	8	4.3218
100	DVD*1	26.16	6	4.36
101	DVD*2	52.32	12	4.36

Wide Capture Range PLL

Summary

The channel clock restoration PLL supplies the system clock for restoring the EFM data in the DSP into its original signal components. The EFMI signal from the data silcer has the form of RLL (3T ~ 11T, 14T) code. Restoring the clock in a signal means that you are extracting clocks with a period of T. The PLL being supplied follows the frequency change of the clock existing within ±50% of the center frequency, allowing for playback speed improvement at track jump or other points when the data is incontinuous. It can also be used with the CAV control method. The built-in features include the following:

- CD 1/2/4/8x and DVD 1x compatible
- Track jump and disc DFCT through phold pin possible
- Uniform LPF regardless of speed
- Fast tracking through PWM generation during jump control
- PD, FD gain separation control using RPD and RFD (improves safety and speed)



Operation Description per Block

- Frequency detector
  Detects the frequency difference between the reference signal (EFM) and the VCO divided by N.
- Phase detector
  Detects the phase difference between the reference signal (EFM) and the VCO divided by N.
- Charge pump control
  Controls the detected deviance with the 10 PWM (Pulse Width Modulation) outputs.
- Charge pump
  Generates a current according to the detected deviance.
- External LPF
  Changes the current generated in the charge pump to analog form.
- Voltage Control Oscillator (VCO)
  Outputs proportional frequency according to the analog input.
- Programmable frequency divider
  Divides the VCO clock output according to the mode set by MICOM.

MICOM COMMAND SET

Table 8. MICOM Command Set

Command		DHH				DHL				DL	Note
Name	code	DH7	DH6	DH5	DH4	DH3	DH2	DH1	DH0	DL7 ~ DL0	
STPcmd	00	STOP	ABRT	IDLE	LDX	0	0	0	0		
DDTcmd	01	$\overline{\text{AUTO}}$	$\overline{\text{UPDN}}$	$\overline{\text{FIGA}}$	$\overline{\text{FBAL}}$	$\overline{\text{FoFa}}$	FSP2	FSP1	FSP0		FSspd
FONcmd	02	LYRX	FMthd	$\overline{\text{FOPI}}$	FSPC	0	0	0	0		FONc
TONcmd	03	TLRX	$\overline{\text{SLSV}}$	$\overline{\text{TRPI}}$	TOLB	MTLB	SFOG	STRG	DGs		TONc
SLDcmd	04	HOME	SMOV	SPLY	0	0	0	0	0		
JMPcmd	05	DIR	JPM1	JPM0	JIT2	JIT1	JIT0	JPD9	JPD8	JPD7~JPD0	JMPc
CDScmd	06	WHIN	STSP	FSOS	DPSI	PLLS	JPCC	JPFC	FSHF		INIc (15-9)
EMEcmd	07	FDOL	SLST	RPT	upFv	DSAS	ASFO	ASTR	ASBR		EMEc
HDWcmd	08	enTT	LIM	enASin	SNS	PCUP	DOFO	DOTR	XTAL		HDWc
INIcmd	09	SLDO	JPCK	TKJM	JPEC	BJJM	BTS	SMM	SLB		iNic
MSCcmd	0A	MD11	MD10	MD9	MD8	MD7	MD6	MD5	MD4	MD3~MD0 MSS3~MSS0	BANK0 55
SPDcmd	0B	DKS1	DKS0	0	$\overline{\text{VCT}}$	0	0	SPD1	SPD0		SPDc
TMScmd	0C	TD11	TD10	TD9	TD8	TD7	TD6	TD5	TD4	TD3~TD0 TMS3~TMS0	BANK0 41
OKScmd	0D	OD11	OD10	OD9	OD8	OD7	OD6	OD5	OD4	OD3~OD0	BANK1 B0
AJKcmd	OE	AD11	AD10	AD9	AD8	AD7	AD6	AD5	AD4	AD3~AD0 AJS3~AJS0	BANK0 24
LEScmd	0F	LD11	LD10	LD9	LD8	LD7	LD6	LD5	LD4	LD3~LD0 LES3~LES0	BANK1 C0
AARWcmd	10	AA11	AA10	AA9	AA8	AA7	AA6	AA5	AA4	AA3~AA0 AS3~AAS0	
OFAcmd	11	FTS	LDOF	U/B	0	0	0	0	0		
FBAcmd	12										
TBAcmd	13	$\overline{\text{TIGA}}$	$\overline{\text{RPTB}}$	0	0	0	0	0	0		
FGAcmd	14										
TGAcmd	15										
DVAcmd	16										
EFMCcmd	17	LPFS	EGA2	EGA1	EGA0	RES2	RES1	RES0	0	ODA5~ODA0	
FcScmd	18				HWO4	HWO3	HWO2	HWO1	HWO0		
SQJcmd	19	JPLY	0	0	0	0	0	0	0		
FLAGcmd	1A	stp	Fptmg	enMH	HOME	itvJ	TSV	SSV	enTJn		
		DL7	DL6	DL5	DL4	DL3	DL2	DL1	DL0		

Table 8. MICOM Command Set (Continued)

Command		DHH				DHL				DL	Note
Name	**code**	**DH7**	**DH6**	**DH5**	**DH4**	**DH3**	**DH2**	**DH1**	**DH0**	**DL7 ~ DL0**	
		DFCTed	ATSCed	tbmthd	fbmthd	dsaSQ	FSend	enSPi	enLOCK		
SNSCcmd	1B	RWB	0	NORM	FTCK	0	0	0	BANK	MOD7~ MOD0	
DPRWcmd	1C	DD11	DD10	DD9	DD8	DD7	DD6	DD5	DD4	DD3~DD0t6, DPS2~0	
FTSTcmd	1D				WTF				WFF		
RamRcmd	1E	NEXT	0	0	BANK	0	0	0	PAGE	RAM7~ RAM0	
RamWcmd	1F	RD15	RD14	RD13	RD12	RD11	RD10	RD9	RD8	RD7~RD0	

ACTION COMMAND

Commands 00 ~ 05 are all directly related to the actual servo operation, so they are called action commands. If you send one of these commands during repeat jump, it stops the repeat jump.

STPcmd (Address 00H)

This command stops MPcmd (05H) or Auto adjustment related servo operation, or changes it to stop mode. It also slows the frequency of ssp1605 to reduce current consumption during stop, and turns the laser diode on or off (check priority is STOP>ABRT, and IDLE and LDX are the same).

.STOP reserves the mode to stop. If you make a stop reservation, repeat PULL_in is prohibited, MON signal becomes low, and it enters stop mode. If you send the stop cmd (0080) during a stop reservation, it immediately goes to stop mode.

Command		DHH				DHL				DL	Note
Name	**Code**	**DH7**	**DH6**	**DH5**	**DH4**	**DH3**	**DH2**	**DH1**	**DH0**	**DL7 ~ DL0**	
STPcmd	00	STOP	ABRT	IDLE	LDX	0	0	0	0		
Reset value											

STOP : Go to stop mode. This bit can be used in any mode.
"L" : Don't do anything but check the bits.
"H" : Stop mode reservation.

ABRT : Stop JMPcmd (05H) or adjustment related servo operation.
"L" : Don't do anything but check the bits.
"H" : Stop.

IDLE : Go to IDLE (power save) mode. RAM data remains. However, it only operates in stop mode.
"L" : Go from IDLE mode to normal mode.
"H" : Go to IDLE mode. (DSP core operation speed becomes 1/256)

LDX : Laser diode on/off bit. Only operates in stop mode.
"L" : Laser diode off
"H" : Laser diode on

DH3 ~ 0 : Reserved. Set to "L".

Initialize when STOP = 1 and ABRT = 0, but the automatically adjusted values don't change.

Initialize when STOP = 1 and ABRT = 1, but used mainly for Tray off since it changes the automatically adjusted values.

DDTcmd (Address 01H)

Laser diode is automatically turned on.

To detect disc presence, the focus actuator searches at a speed set by focus FS2-0. After this command, the information is stored in the buffer so that syscon can read the disc presence and disc type information (cd, dvd, dvd single, dvd double).

Command		DHH				DHL				DL	Note
Name	Code	DH7	DH6	DH5	DH4	DH3	DH2	DH1	DH0	DL7 ~ DL0	
DDTcmd	01	AUTO	UPDN	FIGA	FBAL	FoFa	FSP2	FSP1	FSP0		
Reset value											

AUTO : Focus search mode select
"L" : Auto mode (sense: ready/busy)
"H" : Manual mode (sense: FZC)

UPDN : Valid when auto bit "1"
"L" : Up ; actuator up
"H" : Down; actuator down

Focus search direction is reversed when AUTO = 0 and UPDN = 1.

FIGA : Change focus input gain by FE level.
"L" : Change.
"H" : Fix to 0dB.

FBAL : Adjust F-BAL so that the min. and max. values of focus s-curve are the same during DDTcmd.
"L" : Adjust
"H" : Don't adjust

FoFa : Focus offset adjustment during DDTcmd
"L" : Adjust
"H" : Don't adjust

FSP2 ~ 0 : Actuator speed controlling bit during DDTcmd and focus pull-in (only when k = 3).

FPS2	FPS1	FPS0	Speed
0	0	0	3.46Hz
0	0	1	1.73Hz
0	1	1	0.87Hz
1	1	1	0.43Hz

- Data that Syscon can use after DDTcmd.

S curve's peak data (Ram0 Bank0 1B)

D15 D8	D7							D0
FE PEAK DATA	X	X	X	X	X	X	X	X

Various data Flags (Ram0 Bank1 0A)

D15 D8	D7							D0
X	DBL	FEpk	POS	0	0	0	DIN	X

DBL : Layer judgement
"0" : Single layer
"1" : Dual layer

FEpk : Level is
"0" : Smaller than decided value
"1" : Larger than decided value

POS : Distance from VREF to S CURV is
"0" : Small. (DVD same.)
"1" : Large. (CD same.)

DIN : DISC pesence
"0" : Present
"1" : Absent

X : Don't Care

FONcmd (Address 02H)

This command carries out focus pull-in. The laser diode is automatically turned on. If focus is already on when this command is received, nothing happens. If FONcmd is received after TONcmd (03H), only the tracking servo is turned off.

Command		DHH				DHL				DL	Note
Name	Code	DH7	DH6	DH5	DH4	DH3	DH2	DH1	DH0	DL7 ~ DL0	
FONcmd	02	LYRX	FMTHD	FOPI	FSPC	0	0	0	0		
Reset value											

LYRX : Bit that selects the layer for pull-in at DVDP (set to L for CDP, CDROM).
"L" : Pull-in to layer 0 when focus pull-in hasn't occurred.
Jump to layer 0 when focus pull-in has occurred.
When FMTHD = H, attempt pull-in from bottom to top.
"H" : Pull-in to layer 1 when focus pull-in hasn't occurred.
Jump to layer 1 when focus pull-in has occurred.
When FMTHD = H, attempt pull-in from top to bottom.

FMTHD : Focus pull-in method
"L" : Attempt pull-in from both S CURV's top and bottom
"H" : Attempt pull-in from either S CURV's top or bottom

FOPI : Bit that selects whether or not to carry out focus pull-in automatically within the given range after Drop out.
"L" : Carry out automatic pull-in.
"H" : Don't carry out automatic pull-in.

FSPC : Automatic speed control selecting bit during focus pull-in (This feature lowers the search speed the closer you get to the pull-in point).
"L" : Don't carry out automatic speed control.
"H" : Carry out automatic speed control.

Direct Access Command: S curve ok level: Fil (Ram0 Bank0 01)
S curve pull in level: Fpl (Ram0 Bank0 02)

Example

S curve ok level		Focus pull in level			
4000H	:	4000H	FEpk/2	:	FEpk/2
2000H	:	2000H	FEpk/4	:	FEpk/4

TONcmd (Address 03H)

Tracking pull-in command.

If tracking is already on when this command is received, nothing happens.

Command		DHH				DHL				DL	Note
Name	**Code**	**DH7**	**DH6**	**DH5**	**DH4**	**DH3**	**DH2**	**DH1**	**DH0**	**DL7 ~ DL0**	
TONcmd	03	TLRX	SLSV	TRPI	TOLB	MTLB	SFOG	STRG	DGs		
Reset value											

TLRX :Tracking on after layer jump (set to "L" for CDP, CDROM).
"L" : Jump to layer 0 for tracking pull-in.
"H" : Jump to layer 1 for tracking pull-in.

SLSV : Sled servo on.
"L" : Turn sled servo on automatically during tracking pull-in.
"H" : Don't turn sled servo on during tracking pull-in.

TRPI : Tracking pull-in method select
"L" : Use tracking kick pulse during pull-in.
"H" : Don't use tracking kick pulse during pull-in.

TOLB : Lens brake during tracking on.
"L" : Don't enable lens brake.
"H" : Enable lens brake.

MTLB : Manual tracking's lens brake
"L" : Don't enable lens brake.
"H" : Enable lens brake.

SFOG : Focus gain select during search.
"L" : Gain normal.
"H" : Gain down.

STRG : Tracking gain select at search end.
"L" : Gain noraml.
"H" : Gain up.

DGs : Tracking gain select during tDFCT period when defect is detected.
"L" : STRG valid. (gain decision by STRG)
"H" : STRG invalid.(tracking gain always normal)

SLDcmd (Address 04H)

Sled motor controlling command. Bit check starts at the home bit.

Command		DHH				DHL				DL	Note
Name	**Code**	**DH7**	**DH6**	**DH5**	**DH4**	**DH3**	**DH2**	**DH1**	**DH0**	**DL7 ~ DL0**	
SLDcmd	04	HOME	SMOV	SPLY	0	0	0	0	0		SENSE
Reset value											

HOME : Sled home_in mode select

"L" : Normal sled control mode

"H" : Auto sled home_in control mode

When this bit is set, the sled motor continues backward move until the limit S/W is detected. From then on, forward move is carried out for the time set by TMScmd (0CH)'s tHFwd.

SMOV,SPLY : Sled on/off and sled move controlling bit.

"00" : Sled off

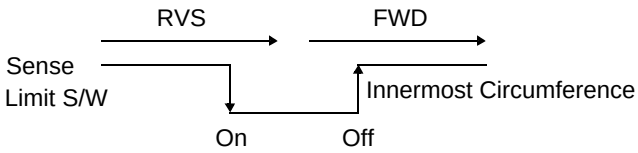
"01" : Sled on

"10" : Sled foward move (kick level is set by LEScmd's SKCKd).

"11" : Sled backward move (kick level is set by LEScmd's SKCKd).

DH4 ~ 0 : Reserved. Set to "L".

When home = H (auto sled control mode), sense is as shown below.



Sense outputs excepting the auto mode, output limit senser information in focus off status during sled movement. The limit senser is chosen by HDWcmd's constant (LIM), and is "L" at command's initial point, and "H" when it reaches either the innermost or the outermost circumference. When focus is on, it is in manual sled move. If the FG signal (= 1) is chosen by the HDWcmd's constant (SNS) the FG signal is output to sense, and if not (= 0) the TZC signal is output instead. Therefore, sled move is carried out by MICOM counting this signal.

JMPcmd (Address 05H)

Sled and tracking jump command. Returns to normal play mode after jump.

Command		DHH				DHL				DL	Note
Name	**Code**	**DH7**	**DH6**	**DH5**	**DH4**	**DH3**	**DH2**	**DH1**	**DH0**	**DL7 ~ DL0**	
JMPcmd	05	DIR	JPM1	JPM0	JIT2	JIT1	JIT0	JPD9	JPD8	JPD7 ~ JPD0	
Reset value											

DIR : Selects jump direction.

"L" : Forward jump

"H" : Reverse jump

JPM1 ~ 0 : Jump type selecting bit.

"00" : Tracking jump or sled jump according to jump track number. Jump type is determined by OKScmd (0DH)'s boundary.

"01" : Tracking jump.

"10" : Sled move.

"11" : Repeat tracking jump at intervals chosen by JIT2 ~ 0.

JIT2 ~ 0 : Repeat track jump's time interval select bit. Its period is from beginning of one jump to the beginning of the next jump.

"000" : Manual jump mode.

XTAL JIT2 ~ 0	0	1	Note
000	Manual Jump Mode If JPD9 ~ 0 are all 0, DIRC pin from syscon used)		
001	2.3Hz	4.6Hz	
010	4.6Hz	9.2Hz	
011	6.9Hz	13.8Hz	
100	11.5Hz	23.1Hz	
101	18.5Hz	36.9Hz	
110	25.4Hz	50.8Hz	
111	34.6Hz	69.2Hz	

JPD9 ~ 8 : If the following conditions are fulfilled in manual jump mode, stop and set sense output to "H".

"00" : X (don't use)

"01" : Count (assigned track number)

"10" : Tstp (mirr area)

"11" : Count or Tstp

JPD12 ~ 0 : Unless JPM1 ~ 0 bit is 11, the JIT2 ~ 0 bit is JPD12 ~ JPD10 bit. The number of tracks being jumped is data*8 when JPM1 ~ 0 bit is 10. In other cases, it stays the same. When JMP1, 0 = 10 (sled move), data*8 is the number of tracks actually being jumped.

SYSTEM SELECT COMMAND

CDScmd (Address 06H)

Condition Command.

Can set wanted feature for each system.

Command		DHH				DHL				DL	Note
Name	**Code**	**DH7**	**DH6**	**DH5**	**DH4**	**DH3**	**DH2**	**DH1**	**DH0**	**DL7 ~ DL0**	
CDScmd	06	WHIN	STSP	FSOS	DPSI	PLLS	JPCC	JPFC	FSHF		
Reset value											

WHIN : Tilt input pin use.
"0" : Tilt input
"1" : Tracking error for eliminating tracking average and anti shock aliasing.

STSP : Spindle filer on/off in standby (stop mode)
"0" : Spindle filter off.
"1" : Spindle filter on.

FSOS : S curve detect in only one direction during focus search (DDT)
"0" : detect in both directions
"1" : detect in one direction

DPSI : How will the depth control output be transmitted to the RF chip during depth control
"0" : Transmission by servo
"1" : Transmission by I/F with MICOM

PLLS : PLL hold signal select
"0" : Hold only the parts with lense brake
"1" : Hold all parts of the track with lense brake

JPCC : Hardware counter clock change during speed control sled move using mirr or TZC.
"0" : No change
"1" : Change

JPFC : Change from high speec search to fine search during speed control sled move using mirr or TZC.
"0" : No change
"1" : Change

FSHF : Half search during DDT
"0" : Full search
"1" : Half search

EMEcmd (Address 07H)

Handling processes for emergencies such as defect/shock.

Command		DHH				DHL				DL	
Name	**Code**	**DH7**	**DH6**	**DH5**	**DH4**	**DH3**	**DH2**	**DH1**	**DH0**	**DL7 ~ DL0**	
EMEcmd	07	FDOL	SLST	RPT	upFv	DSAS	ASFO	ASTR	ASBR		
Reset value											

FDOL : Pull-in layer select bit during focus drop out.
"L" : Automatically finds Drop outlayer for pull in.
"H" : Pull-in without layer check.

SLST : Selects whether or not to stop the sled when lock signal is off.
"L" : Don't stop
"H" : Stop

RPT : Adjusts the actuator's up/down search frequency.
"L" : Search once.
"H" : Repeat search (continue until next command is received.)

upFv : FSval after focus pull in (pick up's location data) update
"L" : Don't update
"H" : Update

DSAS : Disable anti-shock
"L" : Enable
"H" : Disable

TRPI	DSAS	Operation Description
0	0	Track pull-in using kick pulse during ATSC off track ick pull-in if mirr occurs in play during off track hoose out of 3 (ASBR, ASFO, ASTR) (leave it to servo)
0	1	
1	0	
1	1	

ASFO : Focus gain down selecting bit when there is a shock.
"L" : Focus gain maintained normally
"H" : Focus gain down

ASTR : Focus gain up selecting bit when there is a shock.
"L" : Tracking gain maintained normally
"H" : Tracking gain up

ASBR : Lens brake enabled during anti-shock.
"L" : Disable
"H" : Enable

HDWcmd (Address 08H)

Changes DSSP's H/W. This command is the first one used after the reset is cancelled. You can use this command only in standby mode.

Command		DHH				DHL				DL	Note
Name	**Code**	**DH7**	**DH6**	**DH5**	**DH4**	**DH3**	**DH2**	**DH1**	**DH0**	**DL7 ~ DL0**	
HDWcmd	08	enTT	LIM	enASin	SNS	PCUP	DOFO	DOTR	XTAL		
Reset value											

enTT : Tilt output control
"0" : "H" during tracking jump or move.
"1" : Normal tilt output.

LIM : Signal used for stopping at the innermost circumference.
"0" : Use the limit S/W connected to the SSTOP pin. Stop when "H".
"1" : Stop the sled if there is no FG pulse in TMScmd (0CH)'s FG stop time.

enASin : Anti shock filter select
"0" : Use internal filter
"1" : Use external filter

SNS : Signal used during sled move
"0" : TZC and mirr
"1" : FG pulse

PCUP : Pick up type
"L" : Pick up resistant to vibration
"H" : Pick up weak against vibration

DOFO : Focus hold after defect
"L" : Hold
"H" : Don't hold

DOTR : Tracking hold after defect
"L" : Hold.
"H" : Don't hold

Xtal : External X-tal frequency selecting bit
"L" : X-tal = 16.9MHz, sampling frequency = 75.6kHz
"H" : X-tal = 33.9MHz, sampling frequency = 151.2kHz

INIcmd (Address 09H)

Initial state selecting command.

Command		DHH				DHL				DL	Note
Name	**Code**	**DH7**	**DH6**	**DH5**	**DH4**	**DH3**	**DH2**	**DH1**	**DH0**	**DL7 ~ DL0**	
INIcmd	09	SLDO	JPCK	TKJM	JPEC	BJJM	BTS	SMM	SLB		
Reset value											

SLDO : Sled output method during speed control track jump.
"L" : The same
"H" : Through the sled filter

JPCK : Signal used when moving the sled with a sled motor without a sensor. (track counter clock)
"L" : TZC
"H" : Mirr

TKJM : Tracking jump method
"L" : No speed control
"H" : Speed control

JPEC : Error correction when the sled jump past the jump number during sled move or track jump
"L" : Don't correct
"H" : Correct

BJJM : Remaining track number correction after sled move using JMPcmd (05H)'s boundary
"L" : Don't correct
"H" : Track jump the remaining tracks after kick break sled move using MIRR or PS.

BTS : During tracking jump, stop if the mirr period deciding the stop point (falling to falling) becomes
"L" : the same as the mirr period (rising to rising) at the beginning of the jump.
"H" : larger than TMScmd (0CH)'s JSTP data.

SMM : SLED move method (used in combination with SNS)
"0" : No speed control
"1" : Speed control move

SLB : Lense brake after jump.
"L" : Enable at each Mirror
"H" : Enable once at each mirror for the gain up time.

MSCcmd (Address 0AH)

Initial value select command0.

Command		DHH				DHL				DL	Note
Name	**Code**	**DH7**	**DH6**	**DH5**	**DH4**	**DH3**	**DH2**	**DH1**	**DH0**	**DL7 ~ DL0**	
MSCcmd	0A	MD11	MD10	MD9	MD8	MD7	MD6	MD5	MD4	MD3 ~ MD0 SS3 ~ MSS0	
Reset value											

When reading data, CMD FFF MSS3 ~ 0

MSS3 ~ 0 : RAM select bit to be selected

MD11 ~ 0 : Data during write (MSS0 ~ 7: RAM D15 ~ D4 MSS8 ~ f: D11 ~ D0)

MSS3~0	Parameter Name	Contents	Default	Data Area	RAM Addres
0h	FSpk	Output adjust. coeff. during focus search pull in	4000	upper	0055
1h	TSpk	Sine wave amplitude output to TRD during depth ontrol	0800	upper	0056
2h	tDFCT	No gain change for this time after DFCT	1000	upper	0057
3h	tOFa	Focus tracking offset measuring time	1B90	upper	0058
4h	FBpd	Focus balance measuring time	3000	upper	0059
5h	TBwt	Wait time for tracking balance adjustment	2274	upper	005a
6h	Sbrk	Brake time for MIRR or TZC using sled move	14AC	upper	005b
7h	FGmax	Upper gain value during focus gain adjustment	0060	upper	005c
8h	FGmin	Lower gain value during focus gain adjustment	0018	upper	005d
9h	TGmax	Upper gain value during tracking gain adjustment	0018	upper	005e
ah	TGmin	Lower gain value during tracking gain adjustment	0018	upper	005f
bh	tTpi	Pull-in ok time during kick-using track pull in	0018	lower	0060
ch	nTbal	Track # to be measured during tracking balance djustment	0010	lower	0061
dh	LTrN	Brake constant during mirr or TZC using high speed ontrol	0014	lower	0062
eh	Ffrq	Servo bandwidth select during focus gain adjust	000A	lower	0071
fh	Tfrq	Servo bandwidth select during tracking gain adjust	000B	lower	0075

Set time = Interrupt frequency*set value = 6.6usec*set value (33.9MHz)
= 12.2usec*set value (16.9MHz)
Except tDFCT, which is 16x = 105usec*set value (33.9MHz)
= 210usec*set value (16.9MHz)

SPDcmd (Address 0BH)

DVD/CD-ROM and speed-related command.

Command		DHH				DHL				DL	Note
Name	**Code**	**DH7**	**DH6**	**DH5**	**DH4**	**DH3**	**DH2**	**DH1**	**DH0**	**DL7 ~ DL0**	
SPDcmd	0B	DKS1	DKS0	0	VCT	0	0	SPD1	SPD0		
Reset value											

DSK1 : CD-ROM/DVD/LD select bit
"0" : CD-ROM/CD/LD
"1" : DVD

DSK0 : Filter coefficient setting select

SPD1~0 : Speed-related select bit

DH5, 3, 2 : Reserved. Set to "L".

VCT : Select vector for reading S!/ID for DSK1.
"0" : Select.
"1" : Don't select.

Xtal	DSK1	DSK0	SPD1	SPD0	Feature
0	0	0			CD-ROM 1X/2X
0	0	1			CD-ROM 4X
0	1	0			DVD
0	1	1			DVD
1	0	0	0	0	CD-ROM 1X
1	0	0	0	1	CD-ROM 2X
1	0	0	1	0	CD-ROM 4X
1	0	0	1	1	CD-ROM 8X
1	0	1			LD
1	1	0			DVD
1	1	1	0	0	DVD 1x
1	1	1	0	1	DVD 2x
1	1	1	1	0	DVD
1	1	1	1	1	DVD

TMScmd (Address 0CH)

Initial value select command1.

Command		DHH				DHL				DL	Note
Name	**Code**	**DH7**	**DH6**	**DH5**	**DH4**	**DH3**	**DH2**	**DH1**	**DH0**	**DL7 ~ DL0**	
TMScmd	0C	TD11	TD10	TD9	TD8	TD7	TD6	TD5	TD4	TD3 ~ TD0 MS3 ~ TMS0	
Reset value											

When reading data, CMD FFF TMS3 ~ 0

TMS3 ~ 0 : Time select bit to be selected

TD11 ~ 0 : Data (RAM: D11 ~ D0)

TMS3~0	Parameter Name	Contents	Default	Data Area	RAM Addres
0h	Jstbl	Stabilization time select after jump	0300	lower	0041
1h	tFpi	Tracking pull in time after focus pull-in	0014	lower	0042
2h	Tstbl	Stabilization time at track jump	0001	lower	0043
3h	Twin	TZC blind time select at tracking jump	0014	lower	0044
4h	MSTP	Use as stop condition the difference between the irst mirr duty (rising to rising) during search nd the MSTP time	0003	lower	0045
5h	GuT	Track gain up time after jump	0300	lower	0046
6h	Jstp	If the Mirr period exceeds Jstp during tracking UMP, stop tracking jump.	0060	lower	0047
7h	FGjsp	Track pull in if PS doesn't occur for more than his time during PS jump.	0300	lower	0048
8h	FGstp	Track pull in if the position sensor doesn't ccur for more than this time during home in.	0800	lower	0049
9h	tHFwd	Set forward move time after home-in.	0300	lower	004a
ah	DFCTpd	Set DFCT continued processing time after DFCT.	0040	lower	004b
bh	ATSCd	Set ATSC continued processing time after ATSC.	0800	lower	004c
ch	FLoff	FLKB off time select	0300	lower	004d
dh	FLon	FLKB on time select	0014	lower	004e
eh	TLoff	TLKB off time select	0001	lower	004f
fh	TLon	TLKB on time select	0200	lower	0050

Select time = Interrupt freq. *select value = 6.6usec*select value (33.9MHz)

= 13.2usec*select value (16.9MHz)

OKScmd (Address 0DH)

Initial value select command2.

Command		DHH				DHL				DL	Note
Name	**Code**	**DH7**	**DH6**	**DH5**	**DH4**	**DH3**	**DH2**	**DH1**	**DH0**	**DL7 ~ DL0**	
OKScmd	0D	OD11	OD10	OD9	OD8	OD7	OD6	OD5	OD4	OD3 ~ OD0 KS3 ~ OKS0	
Reset value											

When reading data, CMD FFF OKS3 ~ 0

OKS3 ~ 0 : Time selct bit to be selected

OD11 ~ 0 : Data (RAM: D11 ~ D0)

OKS3~0	Parameter Name	Contents	Default	Data Area	RAM Address
0h	FBok	Focus balance ok level	0800	lower	10b0
1h	TBok	Tracking balance ok level	0800	lower	10b1
2h	FGok	Focus gain ok level	0200	lower	10b2
3h	TGok	Tracking gain ok level	0080	lower	10b3
4h	DPok	Depth variance ok level	0080	lower	10b4
5h	FSjspd	Stop speed control during fine search speed ontrol	0003	lower	10b5
6h	TSjspd	Stop speed control during track jump speed ontrol	0003	lower	10b6
7h	PSjspd	Stop speed control during sled move speed ontrol	0003	lower	10b7
8h	Cchg	(C.out) and (TZC/MIRR) select during track ump to ck	0100	lower	10b8
9h	bound	Track jump and sled move boundary	0100	lower	10b9
ah	bound2	Fine search and PS jump boundary	0281	lower	10ba
bh	SMcnt	Time to sled move after track kick	0008	lower	10bb
ch	SScnt	Brake time during sled move	0080	lower	10bc
dh	ENTc	Track number per PS pulse	0069	lower	10bd
eh	nDP	Frequency with actuator during depth control	0028	lower	10be
fh	Dialw	Reserved (distance allowance during HST)	0100	lower	10bf

Detailed description of FSjspd, TSjspd, and PSvjspd (Table size: 32).

- FSjspd (default: 0803: upper 13bit: 080 lower 3bit: 3)
  Upper 13bit: 080: 0000 1000 0000 0:number of 0s above 1 4-1 = 3 → 2x2x2 = 8
  8: → Start to brake when the there are 256 remaining tracks
  Lower 3bit: 3: pull in speed after jump (1.92kHz in the table below)

  Example) FSjspd (0402:upper 13bit: 040 lower 3bit: 2)
  Upper 13bit: 040: 0000 0100 0000 0: number of 0s above 1 5-1 = 4 → 2x2x2x2 = 16
  16: → Start to brake when there are 256x2 remaining tracks
  Lower 3bit: 2: pull in speed after jump (2.26kHz in the table below)

- TSjspd (default: 1003 :upper 13bit:100 lower 3bit:3)
  Upper 13bit: 100: 0001 0000 0000 0: number of 0s above 1 3-1 = 2 → 2x2 = 4
  8: → Start to brake when there are 256 remaining tracks
  Lower 3bit: 3: pull in speed after jump (1.92kHz in the table below)

- PSvjspd (default: 0103: upper 13bit: 010 lower 3bit: 3)
  Upper 13bit: 010: 0000 0001 0000 0: number of 0s above 1 7-1 = 6 → 2x2x2x2x2x2 = 64
  128: → Start to brake when there are 68 (mirr: 4352) remaining ps
  Lower 3bit: 3: pull in speed after jump (PS freq. 169Hz in the table below)

Mirr Frequency if the System Clock is 34MHz (same with 17MHz)					
FSjspd		**TSjspd**		**PSvjspd (PS freq.)**	
0h	3.04kHz	0h	3.04kHz	0h	263Hz
1h	2.67kHz	1h	2.67kHz	1h	232Hz
2h	2.26kHz	2h	2.26kHz	2h	200Hz
3h	1.92kHz	3h	1.92kHz	3h	169kHz
4h	1.55kHz	4h	1.55kHz	4h	137Hz
5h	1.18kHz	5h	1.18kHz	5h	105Hz
6h	0.81kHz	6h	0.81kHz	6h	73.5Hz
7h	0.5kHz	7h	0.5kHz	7h	41.8Hz

AJKcmd (Address 0EH)

Initial value select command3.

Command		DHH				DHL				DL	Note
Name	**Code**	**DH7**	**DH6**	**DH5**	**DH4**	**DH3**	**DH2**	**DH1**	**DH0**	**DL7 ~ DL0**	
AJKcmd	OE	AD11	AD10	AD9	AD8	AD7	AD6	AD5	AD4	AD3~AD0 JS3~AJS0	
Reset value											

When reading data, CMD FFF AJS3 ~ 0

AJS3 ~ 0 : RAM select bit to be selected

AD11 ~ 0 : Data during write (RAM D15 ~ D4)

AJS3~0	Parameter Name	Contents	Default	data Area	RAM Address
0h	FKLL	Brake point deciding level during layer jump	3000	upper	0024
1h	TKj_k	Kick break duty deciding coefficient during rack jump	3D00	upper	0025
2h	FSj_k	Fine search gain adjusting coefficient	1800	upper	0026
3h	TSj_k	Gain adjusting coefficient in tracking speed ontrol Jump	1800	upper	0027
4h	PSj_k	Sled move speed control gain adjusting oefficient using PS	1000	upper	0028
5h	SL_k	Kick brake duty deciding coefficient in osition sensor using sled move	5A00	upper	0029
6h	TKl_k	Track brake level coefficient during track ump (data)*2	4000	upper	002a
7h	SMl_k	Sled brake level coefficient during track jump data)*2. During speed control track jump, data)*32 to SLD0	4000	upper	002b
8h	FSPKL	Brake levelduring layer jump	4000	upper	002c
9h	Jbuf	Mirr or cout storing buffer	-	-	002d
ah	DPk	Adjustment sensitivity coefficient during epth control	1000	upper	002e
bh	dXbuf	First kick level during focus balance	3000	upper	002f
ch	FBk	Focus balance adjustment sensitivity coeff.	7FFF	upper	0030
dh	TBk	Tracking balance adjustment sensitivity coeff.	0A00	upper	0031
eh	Kcf	Focus gain adjustment sensitivity coeff.	0800	upper	0032
fh	Kct	Tracking gain adjustment sensitivity coeff.	0800	upper	0033

LEScmd (Address 0FH)

Initial value select command4.

Command		DHH				DHL				DL	Note
Name	**Code**	**DH7**	**DH6**	**DH5**	**DH4**	**DH3**	**DH2**	**DH1**	**DH0**	**DL7 ~ DL0**	
LEScmd	0F	LD11	LD10	LD9	LD8	LD7	LD6	LD5	LD4	LD3 ~ LD0 ES3 ~ LES0	
Reset value											

When reading data, CMD FFF LES3 ~ 0

LES3 ~ 0 : RAM select bit to be selected

LD11 ~ 0 : Data during write (RAM D15 ~ D4)

LES3~0	Parameter Name	Contents	Default	data Area	RAM Addres
0h	TKCKd	Track kick level during tracking jump	1000	upper	10c0
1h	SKCKd	Sled move level during sled move	4000	upper	10c1
2h	TKlvl	Track kick level during sled move	7000	upper	10c2
3h	SMlvl	Sled move level during tracking jump	4000	upper	10c3
4h	xGwt	Stabilization time during loop gain adjustment	7F00	upper	10c4
5h	xGcnt	Measurement time during loop gain adjustment	1000	upper	10c5
6h	FSrng	Limit level select during focus search	1000	upper	10c6
7h	POS_J	CD DVD deciding level by distance from Vref to ayer	1B90	upper	10c7
8h	DDT_J	Disc presence deciding level	1000	upper	10c8
9h	Fpk_J	CD DVD deciding level by scurve size	3000	upper	10c9
ah	Bmin_k	Min. brk time (kick time %)	1000	upper	10ca
bh	AS_J	Anti shock level	1800	upper	10cb
ch	NZlvl	Noise level during focus search	0800	upper	10cc
dh	SFok	Hysteresis level during DDT or layer jump	1000	upper	10cd
eh	LYdt	CD DVD deciding level by distance between layers	0800	upper	10ce
fh	FZCofs	Focus zero crossing offset level	0A00	upper	10cf

AARWcmd (Address 10H)

Reads/writes auto adjusted data.

command		DHH				DHL				DL	Note
Name	**Code**	**DH7**	**DH6**	**DH5**	**DH4**	**DH3**	**DH2**	**DH1**	**DH0**	**DL7 ~ DL0**	
AARWcmd	10	AA11	AA10	AA9	AA8	AA7	AA6	AA5	AA4	AA3 ~ AA0 AS3 ~ AAS0	
Reset value											

When reading data, CMD FFF MSS3 ~ 0

AAS3 ~ 0 : RAM select bit to be selected

AA11 ~ 0 : Data during write (AAS0 ~ e: RAM D15 ~ D4 MSSf: D11 ~ D0)

AAS3~0	Parameter Name	Contents	Default	data Area	RAM Address
0h	FinG	Focus input gain	0000	upper	10a6
1h	TinG	Tracking input gain	0000	upper	10a7
2h	Fofst	Focus offset	0000	upper	1082~3
3h	Tofst	Tracking offset	0000	upper	1084~5
4h	Fbal	Focus balance	0000	upper	1086
5h	Tbal	Tracking balance	0000	upper	1087
6h	Fbias	Focus bias	0000	upper	1088
7h	Tbias	Tracking bias	0000	upper	1089
8h	FODbias	Focus output bias	0000	upper	1090
9h	Travrg	Tracking output average	0000	upper	10f3
ah	SLavrg	Sled output average	0000	upper	1095
bh	DPctl	Depth control result	0000	upper	10af
ch	GND	Vref average	0000	upper	1080~1
dh	RF_env	RF envelope average result	0000	upper	1092~3
eh	DDTdt	Data after disc detect	0000	lower	100a

AUTO ADJUST COMMAND

OFAcmd (Address 11H)

Auto foucs/tracking offset adjust command measures and adjusts the tracking error when the laser diode is on.

Command		DHH				DHL				DL	Note
Name	code	DH7	DH6	DH5	DH4	DH3	DH2	DH1	DH0	DL7 ~ DL0	
OFAcmd	11	FTS	LDOF	U/B							
Reset value											

FTS : Focus or tracking offset adjust select.
"L" : Focus offset adjustment.
"H" : Tracking offset adjustment.

LDOF : Laser diode on/off during offset adjustment.
"L" : Laser diode on.
"H" : Laser diode off.

U/B : Focus actuator location movement direction during offset adjustment, if FOK is High.
"L" : Raise actuator until FOK becomes low to adjust offset.
"H" : Lower actuator until FOK becomes low to adjust offset.

DH6 ~ 0 : Reserved. Select "L".

FBAcmd (Address 12H)

Ends focus balance adjust when the RF signal is at its maximum, using the RF envelop signal. Must use after focus pull-in.

Command		**DHH**				**DHL**				**DL**	**Note**
Name	**Code**	**DH7**	**DH6**	**DH5**	**DH4**	**DH3**	**DH2**	**DH1**	**DH0**	**DL7 ~ DL0**	
FBAcmd	12										SENSE
Reset value											

TBAcmd (Address 13H)

Averages and measures the TE's maximum and minimum values using eccentricity when focus is on and tracking is off. Always use before starting play (tracking on).

Command		DHH				DHL				DL	Note
Name	Code	DH7	DH6	DH5	DH4	DH3	DH2	DH1	DH0	DL7 ~ DL0	
TBAcmd	13	TIGA	RPTB	0	0	0	0	0	0		SENSE
Reset value											

TIGA : Change tracking input gain according to TE level.
"L" : Change.
"H" : Don't change.

RPTB : Decide whether to repeat tracking balance adjustment.
"L" : Repeat until adjustment error error falls below TBok.
"H" : Don't repeat.

DH5 ~ 0 : Reserved. Select "L".

FGAcmd (Address 14H)

Auto focus gain adjustment command.

Use when focus servo and tracking servo are on.

Command		DHH				DHL				DL	Note
Name	Code	DH7	DH6	DH5	DH4	DH3	DH2	DH1	DH0	DL7 ~ DL0	
FGAcmd	14										SENSE
Reset value											

TGAcmd (Address 15H)

Auto tracking gain adjustment command.

Use when focus servo and tracking servo are on.

Command		DHH				DHL				DL	Note
Name	Code	DH7	DH6	DH5	DH4	DH3	DH2	DH1	DH0	DL7 ~ DL0	
TGAcmd	15										SENSE
Reset value											

DPAcmd (Address 16H)

Depth control command.

Adjust when focus servo is on and tracking servo is off.

Command		DHH				DHL				DL	Note
Name	Code	DH7	DH6	DH5	DH4	DH3	DH2	DH1	DH0	DL7 ~ DL0	
DPAcmd	16										
Reset value											

EFMCcmd (Address 17H)

EFM asymmetry circuit control command.

Command		DHH				DHL				DL	Note
Name	Code	DH7	DH6	DH5	DH4	DH3	DH2	DH1	DH0	DL7 ~ DL0	
EFMCcmd	17	LPFS	EGA2	EGA1	EGA0	RES2	RES1	RES0	0		
Reset value											

LFPS : CD/DVD select EFM's LPF input.
"L" : CD
"H" : DVD

EGA2 ~ 0 : EFM loop gain select
"000" : 0.5x "010" : 2.5x "100" : 5x "110" : 10x
"001" : 1x "011" : 3.75x "101" : 7.5x "111" : 10x

RES2 ~ 0 : RFI block Input impedence
"000" : 40KΩ (X1 CD) "010" : 10KΩ (X4 CD) "100" : 15KΩ (X1 DVD)
"001" : 20KΩ (X2 CD) "011" : 5KΩ (X8 CD) "101" : 7.5KΩ (X2 DVD)

SYSTEM COMMAND

HWOcmd (Address 18H)

Common-use pin output control.

Command		DHH				DHL				DL	Note
Name	**Code**	**DH7**	**DH6**	**DH5**	**DH4**	**DH3**	**DH2**	**DH1**	**DH0**	**DL7 ~ DL0**	
FcScmd	18	0	0	0	HWO4	HWO3	HWO2	HWO1	HWO0		
Reset value		0	0	0	0	0	0	0	0		

HWO4 ~ 0 : Respectively responds to pin MDOUT[3:0].

SQJcmd (Address 19H)

Current layer information input at layer Jump failure.

Command		DHH				DHL				DL	Note
Name	**Code**	**DH7**	**DH6**	**DH5**	**DH4**	**DH3**	**DH2**	**DH1**	**DH0**	**DL7 ~ DL0**	
SQJDcmd	19	JPLY	JD22	JD21	JD20	JD19	JD18	JD17	JD16	JD15 ~ JD8	
		JD7	JD6	JD5	JD4	JD3	JD2	JD1	JD0		
Reset value											

JPLY : Current layer status input if dual layer.
"0" : Layer 0
"1" : Layer 1

JD22~16 : (Reserved). BCD code of the arrival point's absolute time minute data for a CDROM.
D22 ~ D16 out of ID address 3bytes for DVDP.

JD15~8 : (Reserved). BCD code of the arrival point's absolute time second data for a CDROM.
D15 ~ D8 out of ID address 3bytes for DVDP.

JD7~0 : (Reserved). BCD code of the arrival point's abosolute time frame data for a CDROM.
D7 ~ D0 out of ID address 3bytes for DVDP.

(Reserved). If you execute a layer jump together in case of a dual layer, carry out the track jump first, then the layer jump. Also, if you have a dual layer in oposit track path form, and are jumping from layer0 to layer1, you can correct it to data of layer0 form for the jump.

If you have a dual layer and SQen = 0, and the layer has changed during playback due to shock, you can send the layer infor to the servo using this CMD. If you carry out layer jump using TONcmd, you can go back to the layer from playback.

FLGcmd (Address 1AH)

Current servo control status.

Command		DHH				DHL				Note
Name	**Code**	**DH7**	**DH6**	**DH5**	**DH4**	**DH3**	**DH2**	**DH1**	**DH0**	
FLGcmd	1A	stp	Fptmg	enMH	HOME	itvJ	TSV	SSV	enTJn	
		DL7	DL6	DL5	DL4	DL3	DL2	DL1	DL0	
		DFCTed	ATSCed	tbmthd	fbmthd	dsaSQ	FSend	enSPi	enLOCK	
Reset value										

Stp : Stop flag
"L" : Don't stop.
"H" : Stop.(stop if mon = L, and maintain standby.)

Fptmg : Focus servo DROP decision flag
"L" : FLK
"H" : FOK

enMH : Mirr detection processing method during play if tracking gain is normal.
"L" : Maintain current status.
"H" : Output tracking input hold value to the mirr section tracking output.

enTJn : Track pull in when wanted track number is reached during track jump.
"L" : Don't pull in.
"H" : Pull in.

HOME : Home location flag
"L" : Don't Home in.
"H" : Home in. (don't set directly using this cmd.)

itvJ : Interval jump flag
"L" : Don't interval jump.
"H" : Interval jump. (don't set directly using this cmd.)

tbmthd : Tracking balance correction method (L: balance H: bias)

fbmthd : Focus balance correction method (L: balance H: bias)

dsaSQ : SQJump/iDJump related flag
"L" : Repeat jump until achieving track number set by dialw.
"H" : Jump once.

FSend : Pick up standby at this level after focus search (L: Vref H: FSrng)

enSPi : Sled pull in routine use (L: don't use H: use)

enLOCK : Tracking gain when lock is dropped (L: normal H: up)

All other flags are automatically selected within the program.

SNSCcmd (Address 1BH)

Sense pin output control.

You can monitor the RAM data within the DSSP. The output at this time is transmitted to the tilt output through the tilt dac. (monitoring possible for page 0)

Command		DHH				DHL				DL	Note
Name	**Code**	**DH7**	**DH6**	**DH5**	**DH4**	**DH3**	**DH2**	**DH1**	**DH0**	**DL7 ~ DL0**	
SNSCcmd	1B	RWB	0	NORM	FTCK	0	0	0	BANK	MOD7 - MOD0	
Reset value											

RWB : Monitor signal read/write
"0" : Write
"1" : Read

NORM, FTLK: Sense pin output control bit
"00" : Normal sense output (ready/busy)
"10" : FLKB output
"11" : TLKB output

BANK : RAM bank you want to monitor

MOD7~MOD0: RAM adress you want to monitor

DPRWcmd (Address 1CH)

Direct port read/write command.

Command		DHH				DHL				DL	Note
Name	**Code**	**DH7**	**DH6**	**DH5**	**DH4**	**DH3**	**DH2**	**DH1**	**DH0**	**DL7 ~ DL0**	
DPRWcmd	1C	DD11	DD10	DD9	DD8	DD7	DD6	DD5	DD4	DD3 ~ DD0t6, DPS2 ~ 0	
Reset value											

ST6, DPS2 ~ 0: Output port select.

Data Input Method: Set DD11 ~ 0 data 12bit to 1. ST6 is irrelevant.

Example: If you read after sending "1CFFF3, you will read status data.

ST6, DPS2 ~ 0

"X000" : Read analog input's ADC digital data.

"X001" : Read free running counter's interrupt vector.

"X010" : Read SubQ/ID.

"X011" : Read status.

"X100" : Read hardware track counter's HCT value.

"X101" : Read data from MICOM.

"X110" : Read command from MICOM.

"X111" : Do nothing.

Data Output Method: Selected by combination of ST6 and DPS2 ~ 0.

Example: If you send "1C100B, 0100 is written to DSSP's CNTbuf.

ST6, DPS2 ~ 0

"0000" : Output upper DD11 ~ 2 bit to focus drive FOD.

"0001" : Output upper DD11 ~ 2 bit to tracking drive TRD.

"0010" : Output upper DD11 ~ 4 bit to sled drive SLD.

"0011" : Output upper DD11 ~ 4 bit to spindle drive SPD.

"0100" : Output upper DD11 ~ 2 bit to focus gain select register FIG.

"0101" : Output upper DD11 ~ 2 bit to tracking gain select register TIG.

"0110" : Output upper DD11 ~ 4 bit to focus balance output FBAL.

"X111" : Do nothing.

"1000" : Output DD8 ~ 0 to analog select resistor asel.

"1001" : Output DD7 ~ 0 bit to interrupt vector resistor VCT.

"1010" : Output DD11 ~ 4 bit to tilt drive output TLTD.

"1011" : Output "0000" to upper 4 bits of DSSP control resistor CNTbuf 16bit, and DD11 ~ 0 bit to the lower 12 bits.

"1100" : Clear hard ware counter HCT to ‘0000H".

"1101" : Of the 16-bit data sent to MICOM, output DD11 ~ 0 to upper 12 bits, and "1101”to lower 4 bits.

"1110" : Output DD11 ~ 4 to tracking balance output TBAL, and DD3 ~ 0 * 16 + "1110" to depth compensation output DPCTL.

FTSTcmd (Address 1DH)

Testing command for measuring digital servo's filter characteristics.

Command		DHH				DHL				DL	Note
Name	**Code**	**DH7**	**DH6**	**DH5**	**DH4**	**DH3**	**DH2**	**DH1**	**DH0**	**DL7 ~ DL0**	
FTSTcmd	1D				WTF				WFF		
Reset value											

WTF tracking filter test

0 :Tracking filter normal test

1 :Tracking filter up test

WFF focus filter test

0 :Focus filter normal test

1 :Focus filter down test

However, sled filter test input is tilt input.

RamRcmd (Address 1EH)

This command directly accesses and reads SRAM, the digital servo's internal data.

Command		DHH				DHL				DL	Note
Name	**Code**	**DH7**	**DH6**	**DH5**	**DH4**	**DH3**	**DH2**	**DH1**	**DH0**	**DL7 ~ DL0**	
RamRcmd	1E	NEXT	0	0	BANK	0	0	0	PAGE	RMD7 ~ RMD0	SENSE
Reset value											

NEXT : SRAM address becomes +1.

"L" : SRAM address is selected in RMD7 ~ RMD0 bit.

"H" : SRAM address becomes RMD7 ~ RMD0+1.

DH6~5, 3~1 : Reserved. Select "L".

RAM7~RAM0: Internal sram address select. According to page 0,1, sram is composed of a total of 1024 words, which can be divided into bank0 512words, and bank1 512words.

BANK : Bank 0, 1 select

PAGE : Page 0, 1 select

RAM7 ~ 0 : SRAM address select

RamWcmd (Address 1FH)

This command directly accesses and writes on SRAM, digital servo's internal data.

You must first select the SRAM address according to the RamRcmd(1eH).

If you continue to write after data is selected, the address increases by +1.

Command		DHH				DHL				DL	Note
Name	**Code**	**DH7**	**DH6**	**DH5**	**DH4**	**DH3**	**DH2**	**DH1**	**DH0**	**DL7 ~ DL0**	
RamWcmd	1F	RD15	RD14	RD13	RD12	RD11	RD10	RD9	RD8	RD7 ~ RD0	SENSE
Reset value											

RD15 ~ RD0 : Data
Bit direct access command

- (EMEc) 15: Tracking lense brake delivery towards the sled.
  Address: Ram0 bank1 02
  "0" : No
  "1" : Yes
- (HDWc) 14: Whether to use the mirr or mirr TZC latch signal during tracking speed control.
  Address: Ram0 bank1 01
  "0" : Mirr
  "1" : Mirr, TZC latch signal
- (HDWc) 13: Hold method during defect
  Address: Ram0 bank1 01
  "0" : Hold signal in defect area
  "1" : Hold to the hold value before the defect

FILTER COEFFICIENT SELECTING COMMAND

Command		DHH				DHL				DL	Note
Name	**Code**	**DH7**	**DH6**	**DH5**	**DH4**	**DH3**	**DH2**	**DH1**	**DH0**	**DL7 ~ DL0**	
Fcoef	2X	RWB	Fk14	Fk13	Fk12	Fk11	Fk10	Fk9	Fk8	Fk7 ~ Fk0	
Sceof	3X	RWB	Sk14	Sk13	Sk12	Sk11	Sk10	Sk9	Sk8	Sk7 ~ Sk0	
Tceof	4X	RWB	Tk14	Tk13	Tk12	Tk11	Tk10	Tk9	Tk8	Tk7 ~ Tk0	
Lceof	5X	RWB	LK14	Lk13	Lk12	Lk11	Lk10	Lk9	Lk8	Lk7 ~ Lk0	
FTGcmd	5B	Fchg	DWN	Tchg	UP						
AVkcmd	5C	AD12	AD11	AD10	AD9	AD8	AD7	AD6	AD5	AD4 ~ AD0 VS2 ~ AVS0	

You must first select this filter's coefficient using the SPDcmd (0BH) command before selecting other speed-related components.

Fxkcmd (Address 20 ~ 33H)

Selects compensation filter coefficient for focusing.

2xFFFF : Read (x+1) coefficient.
2x<× ê ü > : Write coefficient to (x+1) address.

20 ~ 27 : Focus normal coefficient select command. (K1 ~ K8)
28 ~ 2F : Focus down coefficient select command. (K1 ~ K8)
30 ~ 31 : Focus normal coefficient select command. (K0, Kd)
32 ~ 33 : Focus down coefficient select command. (K0, Kd)

SPKcmd (Address 34 ~ 38H)

Selects spindle compensation filter coefficient.

34 ~ 37 : Spindle coefficient select command. (Ka, K1, Kb, K2)
38 : Spindle output gain select command. (Kd)

SLKcmd (Address 3A ~ 3EH)

3A ~ 3D : Sled coefficient select command. (Ka, K1, Kb, K2)
3E : Sled output gain select command. (Kd)

Txkcmd (Address 40 ~ 53H)

Selects compensation filter coefficient for tracking.

40 ~ 47 : Tracking normal coefficient select command. (K1 ~ K8)
48 ~ 4F : Tracking down coefficient select command. (K1 ~ K8)
50 ~ 51 : Tracking normal coefficient select command. (K0, Kd)
52 ~ 53 : Tracking down coefficient select command. (K0, Kd)

ASKcmd (Address 55 ~ 56H)

55 : Anti shock coefficient select command. (K1)
56 : Anti shock otuput gain select command. (K)

TTKcmd (Address 58 ~ 5AH)

58 ~ 59 : Tilt filter coefficient select command. (K0, K1)
5A : Tilt filter output gain select command. (Kd)

FTGcmd (Address 5BH)

Manual focus tracking gain adjustment command.

Command		DHH				DHL				DL	Note
Name	**Code**	**DH7**	**DH6**	**DH5**	**DH4**	**DH3**	**DH2**	**DH1**	**DH0**	**DL7 ~ DL0**	
FTGcmd	5B	Fchg	DWN	Tchg	Up						
Reset value											

Fchg : Focus gain change.
"L" : Don't change
"H" : Change

DWN : Focus gain
"L" : Normal
"H" : Down

Tchg : Tracking gain change.
"L" : Don't change
"H" : Change

UP : Focus gain
"L" : Normal
"H" : Up

AVkcmd (Address 5CH)

Average Filter Coefficient.

This command is not automatically selected by SPDcmd (0BH), so if you want to change the average filter coefficient, select the coefficient together with the SPDcmd.

Command		DHH				DHL				DL	Note
Name	Code	DH7	DH6	DH5	DH4	DH3	DH2	DH1	DH0	DL7 ~ DL0	
AVkcmd	5C	AD12	AD11	AD10	AD9	AD8	AD7	AD6	AD5	AD4 ~ AD0 VS2 ~ AVS0	
Reset value											

When reading data, CMD FFF AVS2 ~ 0 (AD0 = high)

AVS2 ~ 0 : RAM select bit to be selected

AD12 ~ 0 : Data during write

AVS2~0	Parameter Name	Contents	RAM Address (K, K0)
0h	offset	Focus, tracking offset average coefficient	03d
1h	To_avrg	Tracking output average coefficient	03f
2h	Favrg	Focus input average coefficient	06d
3h	Tavrg	Tracking input average coefficient	06f
4h	SLavrg	Sled output average coefficient	07f
5h	ENVavrg	RF envelope average coefficient	01d
6h	VREFavrg	Reference voltage average coefficient	01f
7h	K1, K2	Band pass filter's K1, K2 (same) K0 = 1-K1 during gain adjust	

xGkcmd (Address 5D ~ 5FH)

5D ~ 5F : Band pass filter coefficient select command during loop gain adjust. (K0, K1, K2)

5D : Input attenuater. (K0)

5E : Pole point (K1)

5F : Zero point (K2)

PLLcmd (Address 78H)

This command controls the SRAM of the PLL inside the digital servo interior

Command		DHH				DHL				DL	Note
Name	**Code**	**DH32**	**DH31**	**DH30**	**DH29**	**DH28**	**DH27**	**DH26**	**DH25**	**DH24 ~ DH16**	
PLLcmd	78	DVCD	SPD1	SPD0	FDHD	FDHT	TMX1	TMX0	SLRG	PWM[7:0]	
		DL15	DL14	DL13	DL12	DL11	DL10	DL9	DL8	DL7 ~ DL0	
		SP1	SP0	SLID1	SLID0	VUFEN	SLUD	DFEN	ATEN	Unused	

DVCD : DVD or CD mode select
"0" : CD
"1" : DVD

SPD1	SPD0	Feature
1	1	CD8X
1	0	CD4X
0	1	CD2X
0	0	CD1X

SPD0 ~ 1 : Speed setting

SLRG : RPD, RFD select (according to CD, DVD mode)
“0” : CD mode
"1” : DVD mode

FDHD : Pseudo TMAX eliminating feature
“0” : Use
“1” : Don't use

FDHT : FD error hold time select when FDHD is “0”.
“0” : 5
“1” : 10

TMX1 TMX0 : TMAX detection period select
0 0 : ±128 EFM edges
0 1 : ±256 EFM edges
1 0 : ±512 EFM edges
1 1 : Don't use

PWM<7:0> : PWM generation for FD control

f(PWM) = f(SYSTEM) ÷ 2(n+1), where n is an integer selected by PWM<7:0>.

A current is sent to the charge pump according to the FD error signal when the f(PWM) clock is high. (here, f(PWM) is PWM's LSB, and the max value is 10f(PWM).)

SP1	SP0	Feature
1	0	Normal PD
0	1	PD reacting to EFMI/2
0	0	PD reacting to EFMI/4

SP1 SP0 : PD operation mode select

SLID1	SLID0	Feature
1	1	Normal
1	0	3.2% increase
0	1	6.4% increase
0	0	12.8% increase

SLID1, SLID0 : DN current variable register

VUFEN : VCO underflow auto protection use.
"0" : Don't use
"1" : Use

SLUD : PD up/dn priority.
"0" : Fixed up and dn
"1" : Autosequence (The output order of PD's "UP" and "DN" is decided by FD error direction. You can prevent control voltage increase due to PD if you use this mode.)

DFEN : DFCT use
"0" : Don't use
"1: : Use

ATEN : ATSC use
"0" : Don't use
"1" : Use

APPLICATION CIRCUIT

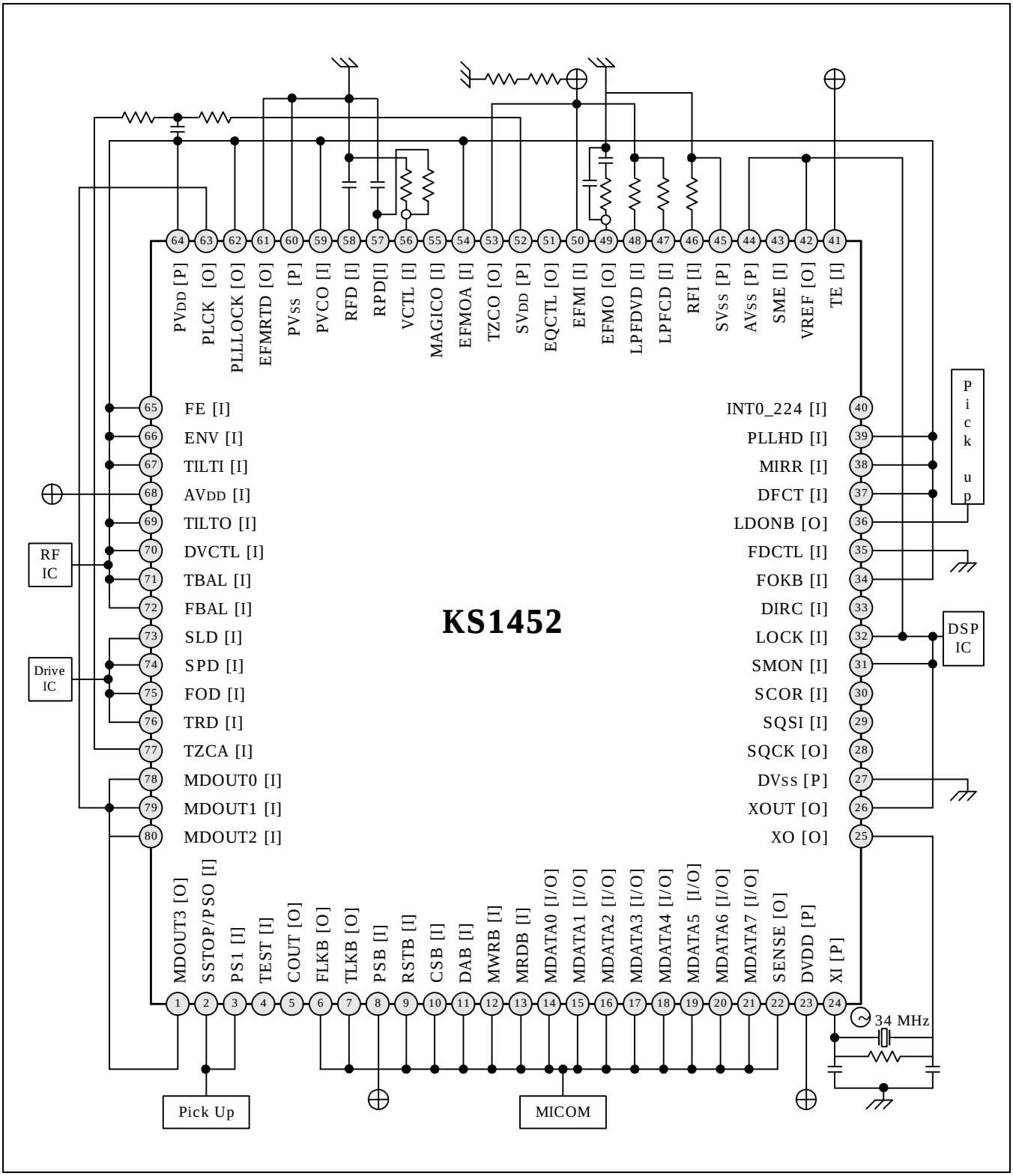


Figure 3. Application Circuit

PACKAGE DIMENSIONS

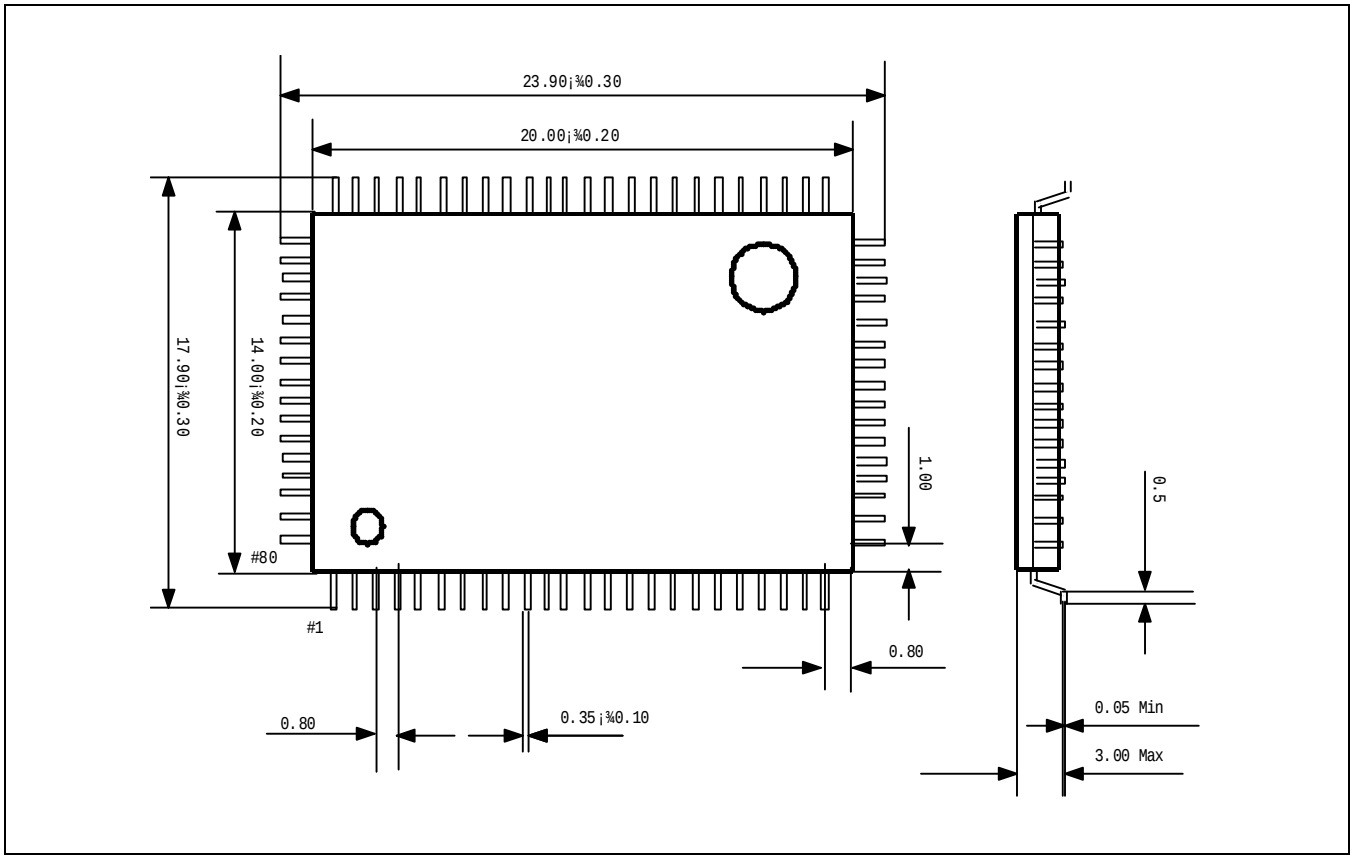


Figure 4. Package Dimensions