

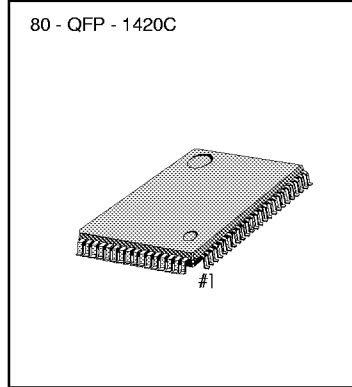
**INTRODUCTION**

The KA9220C is an 1-Chip BICMOS integrated circuit to perform the function of RF AMP and SSP (Servo Signal Processor) for Compact disc player applications. It consists of RF signal processing, focus servo, tracking servo, sled servo control, EFM detecting and automatic power control circuits.

**FEATURES**

- RF Amplifier
- Focus Error Amplifier
- Tracking Error Amplifier
- Mirror Detector
- Focus OK detector
- EFM Comparator and Auto-Asymmetry control Amplifier
- Defect Detector for improvement to playability
- Built-in APC (Automatic power control) Amplifier (Focus, Tracking, sled, spindle servo control)
- Built-in Autosequencer
- Anti-shock function
- The function of preventing sled run away
- Double speed operation available
- Operating supply Voltage range: 3.4 ~ 5.5V

80 - QFP - 1420C

**ORDERING INFORMATION**

| Device  | Package      | Operating Temperature |
|---------|--------------|-----------------------|
| KA9220C | 80-QFP-1420C | -20°C~ +75°C          |

BLOCK DIAGRAM

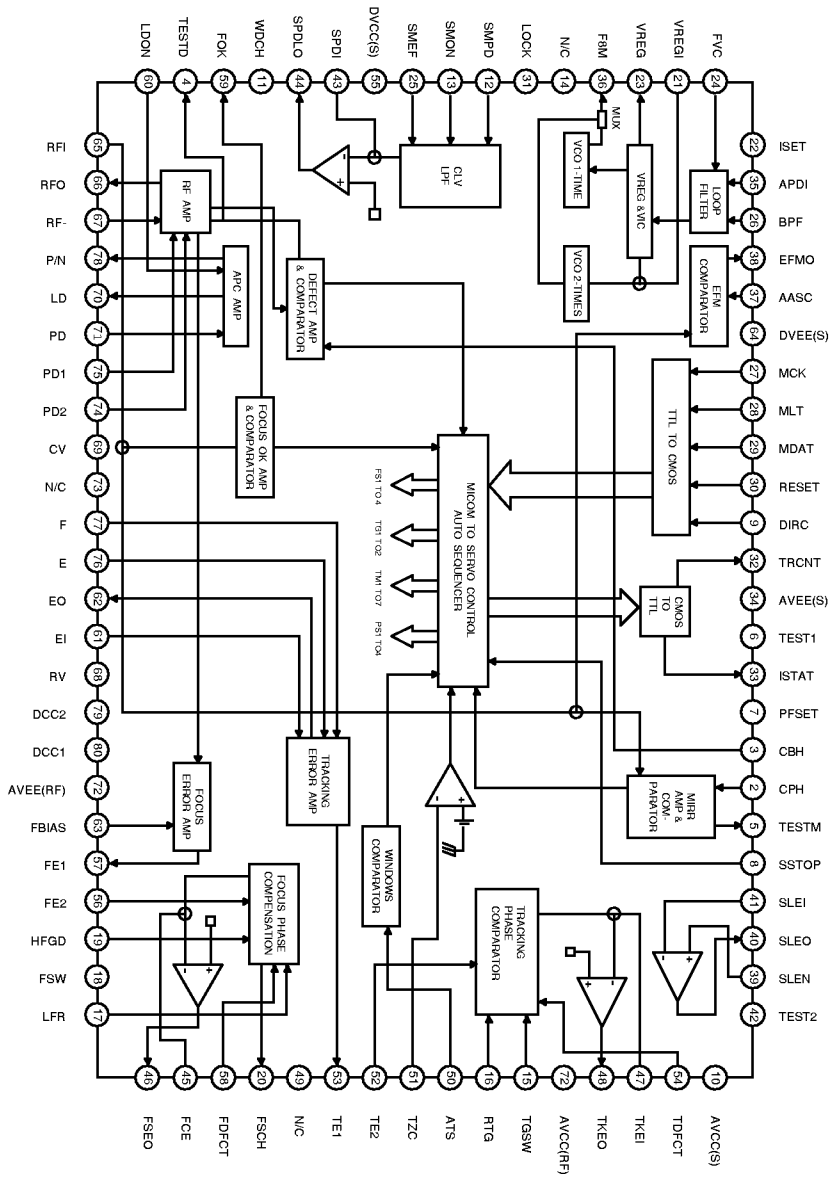


Fig. 1

## PIN DESCRIPTION

| Pin No | Symbol   | Description  |
|--------|----------|--|
| 1      | AVEE (R) | Analog negative power supply input pin for RF part   |
| 2      | CPH      | Capacitor connection pin of mirror hold.   |
| 3      | CBH      | Capacitor connection pin of defect bottom-hold   |
| 4      | TESTD    | Defect test pin  |
| 5      | TESTM    | Mirror test pin  |
| 6      | Test1    | Input pin for test   |
| 7      | PPSET    | Peak frequency setting pin for focus, tracking compensation and fc (cut off frequency) of CLV LPF. |
| 8      | SSTOP    | Check the position pin of pick-up whether inside or not.   |
| 9      | DIRC     | Direct 1 Track Jump Control Pin  |
| 10     | AVCC (S) | Analog positive power supply input pin for SERVO part.   |
| 11     | WDCH     | Auto-sequencer clock-input pin<br>(Normal speed = 88.2KHz, Double speed = 176.4KHz)                |
| 12     | SMPD     | Connection pin of DSP SMPD   |
| 13     | SMON     | Connection pin of DSP SMON, spindle servo ON at "H"  |
| 14     | N/C      | No connection pin  |
| 15     | TGSW     | Providing time constant to change the high frequency tracking gain                                 |
| 16     | RTG      | Capacitor connection pin to switch the tracking gain of high frequency                             |
| 17     | LFR      | Capacitor connection pin to perform rising low bandwidth of focus servo loop                       |
| 18     | FSW      | High frequency gain of focus servo loop can be changed by FS3 switch ON or OFF                     |
| 19     | HFGD     | Reducing high frequency gain with capacitor connected between pini18 and pin19                     |
| 20     | FSCH     | Time constant external pin to generate focus search waveform                                       |
| 21     | VREGI    | External regulator voltage input pin for VCO   |
| 22     | ISET     | Determining the peak value of focus search, track jump and SLED kick                               |

## PIN DESCRIPTION (CONTINUED)

| Pin No | System   | Description   |
|--------|----------|---|
| 23     | VREG     | 3.5V Regulator output pin   |
| 24     | N/C      | No connection pin   |
| 25     | SMEF     | Providing an external LPF time constant of CLV SERVO Loop                     |
| 26     | N/C      | No connection Pin   |
| 27     | MCK      | Clock input pin from micom  |
| 28     | MLT      | Latch input pin from micom  |
| 29     | MDAT     | Data input pin from micom   |
| 30     | RESET    | Reset input pin from micom, reset at "L"                                      |
| 31     | LOCK     | Pin for operation of the sled runaway prevention function at "L"              |
| 32     | TRCNT    | Track count output pin  |
| 33     | ISTAT    | Internal status output pin  |
| 34     | AVEE (S) | Analog negative power supply input pin for SERVO part                         |
| 35     | N/C      | No connection   |
| 36     | N/C      | No connection   |
| 37     | AASC     | Auto-Asymmetry control input pin  |
| 38     | EFMO     | EFM comparator output pin   |
| 39     | SLEN     | Non-inverting input pin of SLED SERVO amplifier                               |
| 40     | SLEO     | Output pin of SLED SERVO amplifier  |
| 41     | SLEI     | Inverting input pin of SLED SERVO amplifier                                   |
| 42     | TEST2    | Test input pin to change speed mode<br>Normal speed = "H", Double speed = "L" |
| 43     | SPDI     | Inverting input pin of spindle servo amplifier                                |
| 44     | SPDLO    | Spindle servo amplifier output pin  |
| 45     | FCE      | Inverting input pin of focus servo amplifier.                                 |

## PIN DESCRIPTION (Continued)

| Pin No | System   | Description   |
|--------|----------|---|
| 46     | FSEO     | Output pin of focus servo amplifier                                 |
| 47     | TKEI     | Non-inverting input pin of tracking servo amplifier                 |
| 48     | TKEO     | Output pin of tracking servo amplifier                              |
| 49     | N/C      | No connection   |
| 50     | ATS      | Anti-shock input pin  |
| 51     | TZC      | Tracking Zero Crossing input pin                                    |
| 52     | TE2      | Tracking Error Servo input pin                                      |
| 53     | TE1      | Output pin of tracking Error Amplifier                              |
| 54     | TDFCT    | Capacitor Connection pin for Defect Compensation of tracking servo  |
| 55     | DVCC (S) | Digital positive power supply input pin for servo part              |
| 56     | FE2      | Focus error servo input pin   |
| 57     | FE1      | Output pin of focus error Amplifier                                 |
| 58     | FDFCT    | Capacitor connection pin for defect compensation of focus servo     |
| 59     | FOK      | Output pin of Focus OK comparator.                                  |
| 60     | LDON     | Laser diode ON/OFF control pin                                      |
| 61     | EI       | Feedback input pin of E I-V amplifier                               |
| 62     | EO       | Output pin of E I-V Amplifier                                       |
| 63     | FBIAS    | Bias pin of non-inverting input of focus error amplifier            |
| 64     | DVEE (S) | Digital negative power supply input pin for servo part              |
| 65     | RFI      | Output Signal of RF summing amplifier is inputted through capacitor |
| 66     | RFO      | Output pin of RF summing amplifier                                  |
| 67     | RF-      | Inverting input pin of RF summing amplifier                         |
| 68     | RV       | Output pin of $(AVCC + AVEE)/2$ Voltage                             |
| 69     | CV       | Bias input pin of Center Voltage buffer                             |

## PIN DESCRIPTION (CONTINUED)

| Pin No | System   | Description   |
|--------|----------|---|
| 70     | LD       | Output pin of APC amplifier                               |
| 71     | PD       | Input pin of APC amplifier                                |
| 72     | AVEE (R) | Analog positive power supply input pin for RF part        |
| 73     | N/C      | No connection   |
| 74     | PD2      | Inverting input pin of RF I-V AMP2                        |
| 75     | PD1      | Inverting input pin of RF I-V AMP1                        |
| 76     | F        | Inverting input pin of F I-V AMP                          |
| 77     | E        | Inverting input pin of E I-V AMP                          |
| 78     | P/N      | Selecting P - sub/N - sub of Laser diode                  |
| 79     | DCC2     | Defect bottom - hold output is inputted through capacitor |
| 80     | DCC1     | Output pin of defect bottom - hold                        |

**ABSOLUTE MAXIMUM RATINGS** ( $T_a = 25^\circ\text{C}$ )

| Characteristic        | Symbol           | Value      | Unit             |
|-----------------------|------------------|------------|------------------|
| Supply Voltage        | $V_{\text{MAX}}$ | 6          | V                |
| Power Dissipation     | $P_D$            | 900        | mW               |
| Operating Temperature | $T_{\text{OPR}}$ | -20 ~ +75  | $^\circ\text{C}$ |
| Storage Temperature   | $T_{\text{STG}}$ | -55 ~ +150 | $^\circ\text{C}$ |

**ELECTRICAL CHARACTERISTICS**

( $T_a = 25^\circ\text{C}$ ,  $AV_{\text{CC}} = DV_{\text{CC}} = +2.5\text{V}$ ,  $AV_{\text{EE}} = DV_{\text{EE}} = -2.5\text{V}$ ,  $\text{GND} = 0\text{V}$ , Unless Otherwise Specified)

| Characteristic  | No | Symbol                       | Test Conditions                                       | Input pin | Output Pin | Min   | Typ  | Max  | Unit |
|-----------------|----|------------------------------|---|-----------|------------|-------|------|------|------|
| Supply Current  | 1  | $I_{\text{CC}}$              |   |           |            | 36    | 49   | 62   | mA   |
| RF AMP          | 2  | $V_{001}$                    |   |           | Pin66      | - 80  | 0    | 80   | mA   |
|                 | 3  | $G_{V1}$                     | $V_i = 1\text{KHz}$ , 40mV <sub>P-P</sub><br>Sinewave | Pin74     | Pin66      | 25.1  | 28.1 | 31.1 | dB   |
|                 | 4  | $V_{\text{OH}(\text{MAX})1}$ | $V_i = 0.2V_{\text{DC}}$<br>Output: + Peak Voltage    | Pin74     | Pin66      | 1.3   |      |      | V    |
|                 | 5  | $V_{\text{OL}(\text{MAX})1}$ | $V_i = -0.2V_{\text{DC}}$<br>Output: - Peak Voltage   | Pin74     | Pin66      |       |      | -0.3 | V    |
| FOCUS ERROR AMP | 6  | $V_{002}$                    |   |           | Pin57      | - 120 |      | 120  | mV   |
|                 | 7  | $G_{V2}$                     | $V_i = 1\text{KHz}$ , 40mV <sub>P-P</sub><br>Sinewave | Pin 75    | Pin57      | 27.0  | 30.0 | 33.0 | dB   |
|                 | 8  | $G_{V3}$                     |   | Pin74     | Pin57      | 27.0  | 30.0 | 33.0 | dB   |
|                 | 9  | $\Delta G_{V1}$              | $G_{V2} - G_{V3}$                                     |           |            | -3    | 0    | 3    | dB   |
|                 | 10 | $V_{\text{OH}(\text{MAX})2}$ | $V_i = 0.2V_{\text{DC}}$<br>Output: + Peak Voltage    | Pin74     | Pin57      | 1.9   |      |      | V    |
|                 | 11 | $V_{\text{OL}(\text{MAX})2}$ | $V_i = -0.2V_{\text{DC}}$<br>Output: - Peak Voltage   | Pin74     | Pin57      |       |      | -1.9 | V    |

## ELECTRICAL CHARACTERISTICS (CONTINUED)

| Characteristic |                            | No | Symbol                | Test Conditions   | Input pin | Output Pin | Min  | Typ  | Max  | Unit |
|----------------|----------------------------|----|-----------------------|---|-----------|------------|------|------|------|------|
| TRACK-ING      | Output Offset Voltage      | 12 | $V_{O03}$             |   |           | Pin53      | - 50 | 0    | 50   | mV   |
|                | Voltage Gain F             | 13 | $G_{V4}$              | $V_I = 1\text{KHz}, 0.3\text{V}_{\text{P-P}}$<br>Sinewave   | Pin76     | Pin53      | 7.0  | 10.0 | 13.0 | dB   |
|                | Voltage Gain E             | 14 | $G_{V5}$              | GV4 - GV5   | Pin77     | Pin53      | 7.0  | 10.0 | 13.0 | dB   |
|                | Gain difference            | 15 | $\Delta G_{V2}$       |   |           |            | -3   | 0    | 3    | dB   |
| ERROR AMP      | Maximum Output Amplitude H | 16 | $V_{OH(\text{MAX})3}$ | $V_I = 0.2V_{\text{DC}}$<br>Output: + Peak Voltage          | Pin76     | Pin53      | 1.9  |      |      | V    |
|                | Maximum Output Amplitude L | 17 | $V_{OL(\text{MAX})3}$ | $V_I = -0.2V_{\text{DC}}$<br>Output: - Peak Voltage         | Pin76     | Pin53      |      |      | -1.9 | V    |
| APC AMP        | Output Voltage 1           | 18 | $V_{01}$              | $V_I = 190\text{mV} + V_{\text{EE}}$                        | Pin71     | Pin70      | 1.4  |      |      | V    |
|                | Output Voltage 2           | 19 | $V_{02}$              | $V_I = 90\text{mV} + V_{\text{EE}}$                         | Pin71     | Pin70      |      |      | -1.0 | V    |
|                | Output Voltage 3           | 20 | $V_{03}$              | $V_I = 100\text{mV} + V_{\text{EE}}$                        | Pin71     | Pin70      | 1.4  |      |      | V    |
|                | Output Voltage 4           | 21 | $V_{04}$              | $V_I = 170\text{mV} + V_{\text{EE}}$                        | Pin71     | Pin70      |      |      | -1.0 | V    |
|                | Output Voltage 5           | 22 | $V_{05}$              | $V_I = 0\text{mV} + V_{\text{EE}}$                          | Pin71     | Pin70      | 1.4  |      |      | V    |
|                | Output Voltage 6           | 23 | $V_{06}$              | $V_I = 0\text{mV} + V_{\text{EE}}$<br>$170 = 0.8\text{mA}$  | Pin71     | Pin70      |      |      | -1.0 | V    |
|                | Maximum Output Amplitude H | 24 | $V_{OH(\text{MAX})4}$ |   | Pin70     | Pin70      | 0    |      |      | V    |
|                | Maximum Output Amplitude L | 25 | $V_{OL(\text{MAX})4}$ | $V_I = 0\text{mV} + V_{\text{EE}}$<br>$170 = -0.8\text{mA}$ | Pin70     | Pin70      |      |      | 0    | V    |



## ELECTRICAL CHARACTERISTICS (CONTINUED)

| Characteristic |                                   | No | Symbol         | Test Conditions   | Input pin | Output Pin | Min  | Typ  | Max   | Unit |
|----------------|-----------------------------------|----|----------------|---|-----------|------------|------|------|-------|------|
| FOK            | Threshold Voltage                 | 26 | $V_{THI}$      |   | Pin65     | Pin59      | -430 | -380 | -330  | mV   |
|                | High Output Voltage               | 27 | $V_{OH(FOK)1}$ | $V_I = 45\text{KHz}, -375\text{mV}_{DC}$<br>$1\text{V}_{P-P}$ Sinewave    | Pin65     | Pin59      | 2.2  |      |       | V    |
|                | Low Output Voltage                | 28 | $V_{OL(FOK)1}$ |   | Pin65     | Pin59      |      |      | -1.8  | V    |
| MIRROR AMP     | High Output Voltage               | 29 | $V_{OH(MIR)1}$ | $V_I = 10\text{KHz}, -0.4\text{mV}_{DC}$<br>$0.8\text{V}_{P-P}$ Sinewave  | Pin65     | Pin5       | 1.8  |      |       | V    |
|                | Low Output Voltage                | 30 | $V_{OL(MIR)1}$ |   | Pin65     | Pin5       |      |      | -2.2  | V    |
|                | Bottom hold frequency             | 31 | $f_{RES(B)}$   | $V_I = 900\text{KHz}, -0.4\text{mV}_{DC}$<br>$0.8\text{V}_{P-P}$ Sinewave | Pin65     | Pin5       |      | 550  | 900   | Hz   |
|                | Max operation frequency           | 32 | $f_{1(MAX)1}$  | $V_I = 30\text{KHz}, -0.4\text{mV}_{DC}$<br>$0.8\text{V}_{P-P}$ Sinewave  | Pin65     | Pin5       | 30   | 75   |       | KHz  |
| DEFECT AMP     | High Output Voltage               | 33 | $V_{OH(DEF)1}$ | $V_I = 1\text{KHz}, 15\text{mV}_{DC}$<br>$32\text{mV}_{P-P}$ Sinewave     | Pin74     | Pin4       | 1.8  |      |       | V    |
|                | Low Output Voltage                | 34 | $V_{OL(DEF)1}$ |   | Pin74     | Pin4       |      |      | -2.2  | V    |
|                | Minimum input Operating Frequency | 35 | $f_{1(MIN)}$   | $V_I = 1\text{KHz}, 15\text{mV}_{DC}$<br>$32\text{V}_{P-P}$ Sinewave      | Pin74     | Pin4       |      | 670  | 1000  | Hz   |
|                | Maximum input Operating Frequency | 36 | $f_{1(MAX)2}$  | $V_I = 1\text{KHz}, 15\text{mV}_{DC}$<br>$32\text{V}_{P-P}$ Sinewave      | Pin74     | Pin4       | 2.0  | 4.7  |       | KHz  |
| EFM            | Duty Cycle 1                      | 37 | $D_1$          | $V_I = 750\text{KHz}, 0\text{V}_{DC}$<br>$0.7\text{V}_{P-P}$ Sinewave     | Pin56     | Pin37      | -50  | -    | 50    | mV   |
|                | Duty Cycle 2                      | 38 | $D_2$          | $V_I = 750\text{KHz}, 0.25\text{V}_{DC}$<br>Sinewave                      | Pin56     | Pin37      | 0    | 50   | 100   | mV   |
| FOCUS SERVO    | DC Voltage Gain                   | 39 | $V_{O(DC)1}$   | $V_I = 0.1\text{V}_{DC}$  | Pin56     | Pin46      | 19.0 | 21.5 | 24.0  | dB   |
|                | Output Voltage 1                  | 40 | $V_{O(FCS)1}$  | $V_I = 0.5\text{V}_{DC}$  | Pin56     | Pin46      | 1.98 |      |       | V    |
|                | Output Voltage 2                  | 41 | $V_{O(FCS)2}$  | $V_I = -0.5\text{V}_{DC}$   | Pin56     | Pin46      |      |      | -1.98 | V    |
|                | Output Voltage 3                  | 42 | $V_{O(FCS)3}$  | $V_I = 0.5\text{V}_{DC}$  | Pin56     | Pin46      | 1.18 |      |       | V    |

## ELECTRICAL CHARACTERISTICS (CONTINUED)

| Characteristic         |                         | No | Symbol           | Test Conditions                                    | Input pin | Output Pin | Min   | Typ   | Max   | Unit |
|------------------------|-------------------------|----|------------------|--|-----------|------------|-------|-------|-------|------|
| FOCUS<br>SERVO         | Output Voltage 4        | 43 | $V_{O(FCS)4}$    | $V_I = -0.5V_{DC}$                                 | Pin56     | Pin46      |       |       | -1.18 | V    |
|                        | Search Output Voltage 1 | 44 | $V_{O(SEARCH)1}$ | Data = \$30 + \$02                                 | Pin56     | Pin46      | -0.63 | -0.50 | -0.38 | V    |
|                        | Search Output Voltage 2 | 45 | $V_{O(SEARCH)2}$ | Data = \$30 + \$03                                 | Pin56     | Pin46      | 0.38  | 0.50  | 0.63  | V    |
|                        | AC Gain 1               | 46 | $G_{V(AC)1}$     | $V_I = 1.2KHz, 100mV_{P.P}$<br>Sinewave, SD = \$08 | Pin56     | Pin46      | 19.0  | 23.0  | 27.0  | dB   |
|                        | AC Gain 2               | 47 | $G_{V(AC)2}$     | $V_I = 1.2KHz, 100mV_{P.P}$<br>Sinewave, SD = \$0C | Pin56     | Pin46      | 14.0  | 18.5  | 23.0  | dB   |
| TRACK<br>-ING<br>SERVO | DC Voltage Gain         | 48 | $G_{V(DC)2}$     | $V_I = -0.2V_{DC}$                                 | Pin65     | Pin48      | 13.5  | 15.5  | 17.5  | dB   |
|                        | Output Voltage 1        | 49 | $V_{O(TCK)1}$    | $V_I = -1.5V_{DC}$                                 | Pin52     | Pin48      | 1.98  |       |       | V    |
|                        | Output Voltage 2        | 50 | $V_{O(TCK)2}$    | $V_I = 1.5V_{DC}$                                  | Pin52     | Pin48      |       |       | -1.98 | V    |
|                        | Output Voltage 3        | 51 | $V_{O(TCK)3}$    | $V_I = -1.5V_{DC}$                                 | Pin74     | Pin48      | 1.18  |       |       | V    |
|                        | Output Voltage 4        | 52 | $V_{O(TCK)4}$    | $V_I = 1.5V_{DC}$                                  | Pin74     | Pin48      |       |       | -1.18 | V    |
|                        | Jump Output Voltage 1   | 53 | $V_{O(JUMP)1}$   |  |           | Pin48      | -0.63 | -0.50 | -0.38 | V    |
|                        | Jump Output Voltage 2   | 54 | $V_{O(JUMP)2}$   |  |           | Pin48      | 0.38  | 0.50  | 0.63  | V    |
|                        | AC Gain 1               | 55 | $G_{V(AC)3}$     | $V_I = 1.2KHz, 100mV_{P.P}$<br>Sinewave            | Pin52     | Pin48      | 9.0   | 12.5  | 16.0  | dB   |
|                        | AC Gain                 | 56 | $G_{V(AC)4}$     | $V_I = 2.7KHz, 100mV$<br>Sinewave                  | Pin52     | Pin48      | 17.5  | 21.5  | 25.5  | dB   |
| SLED<br>SERVO          | DC Voltage Gain         | 57 | $G_{V(DC)3}$     | $V_I = 0.1V_{DC}$                                  | Pin39     | Pin40      | 21.0  | 23.0  | 25.0  | dB   |
|                        | Output Voltage 1        | 58 | $V_{O(SLD)1}$    | $V_I = 0.4V_{DC}$                                  | Pin39     | Pin40      | 1.98  |       |       | V    |
|                        | Output Voltage 2        | 59 | $V_{O(SLD)2}$    | $V_I = -0.4V_{DC}$                                 | Pin39     | Pin40      |       |       | -1.98 | V    |
|                        | Output Voltage 3        | 60 | $V_{O(SLD)3}$    | $V_I = 0.4V_{DC}$                                  | Pin39     | Pin40      | 1.18  |       |       | V    |

## ELECTRICAL CHARACTERISTICS (CONTINUED)

| Characteristic                |                                | No | Symbol         | Test Conditions                              | Input pin | Output Pin | Min   | Typ   | Max   | Unit |
|-------------------------------|--------------------------------|----|----------------|--|-----------|------------|-------|-------|-------|------|
| SLED<br>SERVO                 | Output Voltage 4               | 61 | $V_{O(SLD)4}$  | $V_I = -0.4V_{DC}$                           | Pin39     | Pin40      |       |       | -1.18 | V    |
|                               | Kick Output Voltage 1          | 62 | $V_{O(KICK)1}$ |  |           | Pin40      | 0.45  | 0.59  | 0.73  | V    |
|                               | Kick Output Voltage 2          | 63 | $V_{O(KICK)2}$ |  |           | Pin40      | -0.73 | -0.59 | -0.45 | V    |
| SPINDLE<br>SERVO              | DC Voltage Gain                | 64 | $G_{V(DC)4}$   | $V_I = 0.2V_{DC}$                            | Pin12     | Pin44      | 14.0  | 16.0  | 18.0  | dB   |
|                               | Output Voltage 1               | 65 | $V_{O(SPD)1}$  | $V_I = 1.0V_{DC}$                            | Pin12     | Pin44      | 1.78  |       |       | V    |
|                               | Output Voltage 2               | 66 | $V_{O(SPD)2}$  | $V_I = -1.0V_{DC}$                           | Pin12     | Pin44      |       |       | -1.78 | V    |
|                               | Output Voltage 3               | 67 | $V_{O(SPD)3}$  | $V_I = 1.0V_{DC}$                            | Pin12     | Pin44      | 1.13  |       |       | V    |
|                               | Output Voltage 4               | 68 | $V_{O(SPD)4}$  | $V_I = -1.0V_{DC}$                           | Pin12     | Pin44      |       |       | -1.13 | V    |
| PLL                           | Regulator Output Voltage       | 69 | $V_{REG}$      |  | Pin74     |            | 3.30  | 3.47  | 3.65  | V    |
| RF<br>AMP                     | Maximum Output Amplitude H (L) | 70 | $V_{OH(MAX)5}$ | $V_I = 0.2V_{DC}$<br>Output: + Peak Voltage  | Pin74     | Pin66      | 0.5   |       |       | V    |
|                               | Maximum Output Amplitude L (L) | 71 | $V_{OL(MAX)5}$ | $V_I = -0.2V_{DC}$<br>Output: - Peak Voltage | Pin74     | Pin66      |       |       | -0.3  | V    |
| FOCUS<br>ERROR<br>AMP         | Maximum Output Amplitude H (L) | 72 | $V_{OH(MAX)6}$ | $V_I = 0.2V_{DC}$<br>Output: + Peak Voltage  | Pin74     | Pin57      | 1.1   |       |       | V    |
|                               | Maximum Output Amplitude L (L) | 73 | $V_{OL(MAX)6}$ | $V_I = -0.2V_{DC}$<br>Output: - Peak Voltage | Pin74     | Pin57      |       |       | -1.1  | V    |
| TRACK<br>-ING<br>ERROR<br>AMP | Maximum Output Amplitude H (L) | 74 | $V_{OH(MAX)7}$ | $V_I = 0.2V_{DC}$<br>Output: + Peak Voltage  | Pin74     | Pin53      | 1.1   |       |       | V    |
|                               | Maximum Output Amplitude L (L) | 75 | $V_{OL(MAX)7}$ | $V_I = -0.2V_{DC}$<br>Output: - Peak Voltage | Pin76     | Pin53      |       |       | -1.1  | V    |
| APC<br>AMP                    | Output Voltage 7               | 76 | $V_{O7}$       | $V_I = 190mV + V_{EE}$                       | Pin71     | Pin70      | 0.1   |       |       | V    |

## ELECTRICAL CHARACTERISTICS (CONTINUED)

| Characteristic |                         | No | Symbol          | Test Conditions   | Input pin | Output Pin | Min   | Typ   | Max   | Unit |
|----------------|-------------------------|----|-----------------|---|-----------|------------|-------|-------|-------|------|
| APC AMP        | Output Voltage 8        | 77 | $V_{O8}$        | $V_I = 90\text{mV} + V_{EE}$  | Pin71     | Pin70      |       |       | -0.2  | V    |
|                | Output Voltage 9        | 78 | $V_{O9}$        | $V_I = 100\text{mV} + V_{EE}$   | Pin71     | Pin70      | 0.6   |       |       | V    |
|                | Output Voltage 10       | 79 | $V_{I0}$        | $V_I = 170\text{mV} + V_{EE}$   | Pin71     | Pin70      |       |       | 0     | V    |
|                | Output Voltage 11       | 80 | $V_{I1}$        | $V_I = 0\text{V} + V_{EE}$  | Pin71     | Pin70      | 0.6   |       |       | V    |
|                | Output Voltage 12       | 81 | $V_{I2}$        | $V_I = 0\text{V} + V_{EE}$  | Pin71     | Pin70      |       |       | -0.2  | V    |
| FOK            | Threshold Voltage 2     | 82 | $V_{TH2}$       |   | Pin65     | Pin59      | -430  | -380  | -330  | mV   |
|                | Low Output Voltage      | 83 | $V_{OH(FOK)2}$  | $V_I = 45\text{KHz}, -375\text{mV}_{DC}$<br>$1\text{V}_{P-P}$ Sinewave  | Pin65     | Pin59      | 1.2   |       |       | V    |
|                | High Output Voltage     | 84 | $V_{OL(FOK)2}$  |   | Pin65     | Pin59      |       |       | -1.0  | V    |
| MIRROR AMP     | Low Output Voltage      | 85 | $V_{OH(MIR)2}$  | $V_I = 10\text{KHz}, -0.4\text{V}_{DC}$<br>$0.8\text{V}_{P-P}$ Sinewave | Pin65     | Pin5       | 1.0   |       |       | V    |
|                | High Output Voltage     | 86 | $V_{OL(MIR)2}$  |   | Pin65     | Pin5       |       |       | -1.2  | V    |
| DEFECT AMP     | High Output Voltage     | 87 | $V_{OH(DEF)2}$  | $V_I = 1\text{KHz}, 15\text{mV}_{DC}$<br>$32\text{V}_{P-P}$ Sinewave    | Pin74     | Pin4       | 1.0   |       |       | V    |
|                | Low Output Voltage      | 88 | $V_{OL(DEF)2}$  |   | Pin74     | Pin4       |       |       | -1.2  | V    |
| EFM            | Duty Cycle 3            | 89 | $D_3$           | $V_I = 750\text{KHz}, 0\text{V}_{DC}$<br>$0.7\text{V}_{P-P}$ Sinewave   | Pin65     | Pin37      | -50   | 0     | 50    | mV   |
|                | Duty Cycle 4            | 90 | $D_4$           | $V_I = 750\text{KHz}, 0.25\text{V}_{DC}$<br>Sinewave                    | Pin65     | Pin37      | 0     | 50    | 100   | mV   |
| FOCUS SERVO    | Output Voltage 5        | 91 | $V_{O(fcS)5}$   | $V_I = 0.5\text{V}_{DC}$  | Pin56     | Pin46      | 1.18  |       |       | V    |
|                | Output Voltage 6        | 92 | $V_{O(fcS)6}$   | $V_I = -0.5\text{V}_{DC}$   | Pin56     | Pin46      |       |       | -1.18 | V    |
|                | Search Output Voltage 3 | 93 | $V_{O(SEARC)3}$ |   |           | Pin46      | -0.63 | -0.50 | -0.38 | V    |
|                | Search Output Voltage 4 | 94 | $V_{O(SEARC)4}$ |   |           | Pin46      | 0.38  | 0.50  | 0.63  | V    |

## ELECTRICAL CHARACTERISTICS (CONTINUED)

| Characteristic  |                       | No  | Symbol         | Test Conditions    | Input pin | Output Pin | Min   | Typ   | Max   | Unit |
|-----------------|-----------------------|-----|----------------|--------------------|-----------|------------|-------|-------|-------|------|
| TRACK-ING SERVO | Output Voltage 5      | 95  | $V_{O(Tck)5}$  | $V_I = -1.5V_{DC}$ | Pin52     | Pin48      | 1.18  |       |       | V    |
|                 | Output Voltage 6      | 96  | $V_{O(Tck)6}$  |                    | Pin52     | Pin48      |       |       | -1.18 | V    |
|                 | Jump Output Voltage 3 | 97  | $V_{O(JUMP)3}$ |                    |           | Pin48      | -0.63 | -0.50 | -0.38 | V    |
|                 | Jump Output Voltage 4 | 98  | $V_{O(JUMP)4}$ |                    |           | Pin48      | 0.38  | 0.50  | 0.63  | V    |
| SLED SERVO      | Output Voltage 5      | 99  | $V_{O(SLD)}$   | $V_I = 0.4V_{DC}$  | Pin39     | Pin40      | 1.18  |       |       | V    |
|                 | Output Voltage 6      | 100 | $V_{O(SLD)}$   | $V_I = -0.4V_{DC}$ | Pin39     | Pin40      |       |       | -1.18 | V    |
|                 | Kick Output Voltage 3 | 101 | $V_{O(KICK)3}$ |                    |           | Pin40      | 0.40  | 0.54  | 0.68  | V    |
|                 | Kick Output Voltage 4 | 102 | $V_{O(KICK)4}$ |                    |           | Pin40      | -0.68 | -0.64 | -0.40 | V    |
| SPINDLE SERVO   | Output Voltage 5      | 103 | $V_{OH(SPD)5}$ | $V_I = 1.0V_{DC}$  | Pin12     | Pin44      | 0.98  |       |       | V    |
|                 | Output Voltage 6      | 104 | $V_{OL(SPD)6}$ | $V_I = -1.0V_{DC}$ | Pin12     | Pin44      |       |       | -0.98 | V    |



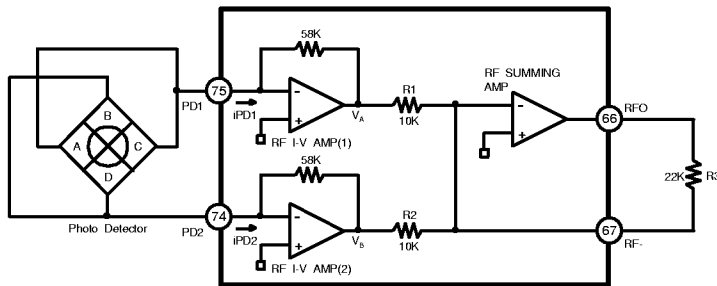
**DESCRIPTION OF FUNCTION**

1. RF AMP BLOCK

1) Description

The KA9220C is designed for 3-spot type optical pick-up assembly. The photo detector is composed of 6 light sensor (A through F). The photo detector A, B, C and D detect audio modulation signal on the disc and generate focus error signal. The E and F photo detectors generate tracking error signal.

2) RF AMPLIFIER



RF I - V AMP (1) and RF I - V AMP (2) are converted current of PD1 (A + C) and PD2 (B + D) through the 58 Kohm Internal resistor into Voltage.

Furthermore, they are added to RF Summing amplifier.

This signal (A + B + C + D) is outputted from RFO (Pin66).

The output Voltage is as follow.

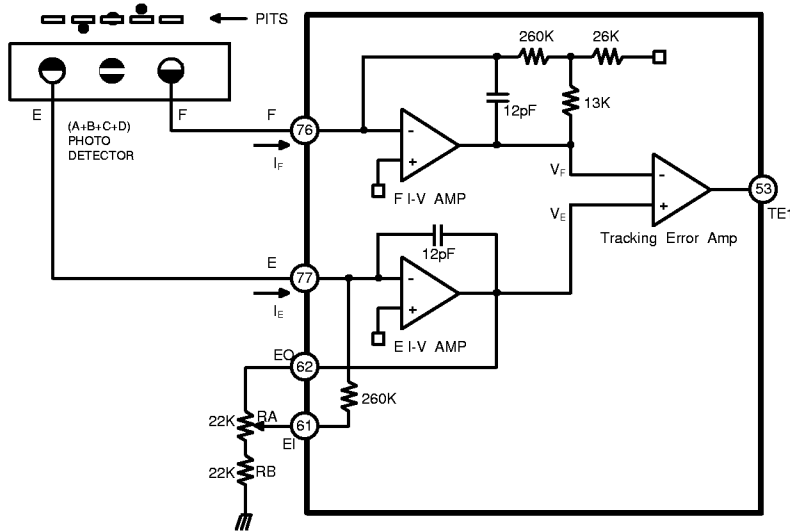
$$V_{RFO} = - R3 \times (iPD1 + iPD2)$$

$$= - R3 \times \left( \frac{V_A}{R_1} + \frac{V_B}{R_2} \right)$$

$$= - 22K \times \left( \frac{V_A}{10K} + \frac{V_B}{10K} \right)$$

$$= - 2.2 \times (V_A + V_B)$$

3) TRACKING ERROR AMPLIFIER



The output of photo detector F is directed to the (-) Input of F I - V AMP and out of photo detector E is directed to the (-) input of E I - V AMP. These input signals are current. E I-V AMP and F I-V AMP are converted into voltage from the current signal. When correct tracking, two input ( $V_F$ ,  $V_E$ ) signals are equal. The occurrence of tracking error is due to difference between F I-V AMP output and E I-V AMP output.

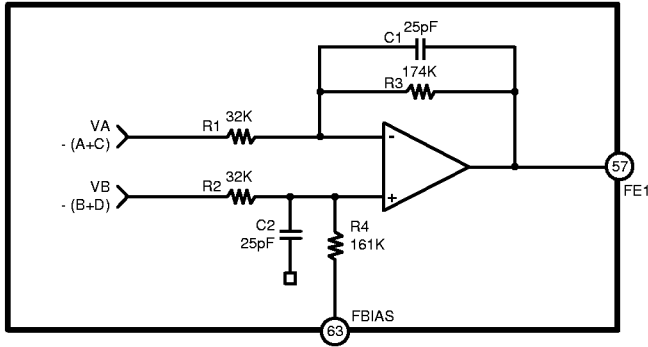
$$V_F = I_F \times \left[ \left( \frac{260K \times 13K}{26K} \right) + 273K \right] = I_F \times 403K$$

$$V_E = I_E \times \left[ \left( \frac{R_A}{R_B + 22K} \right) + 260K + R_A + 260K \right]$$

accordingly,  $V_{TE1} = (I_E - I_F) \times 1290K$

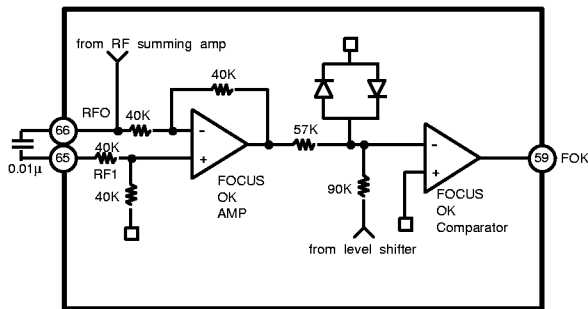


4) FOCUS ERROR AMPLIFIER



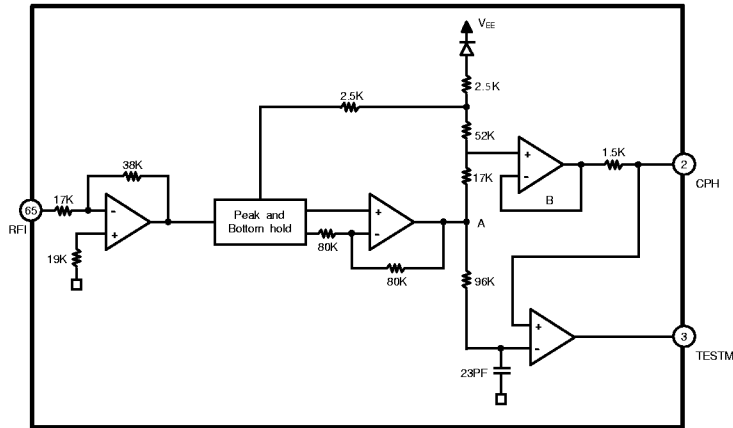
The focus error amp is the difference between RF I-V AMP (1) output  $V_A$  and RF I-V AMP (2) output  $V_B$ . This two ( $V_A$ ,  $V_B$ ) signals are each applied to the (-) and (+) input of focus error amp. As the result of differential voltage, Focus error signal is appeared at FE1 Pin (Pin57). This FE1 Output Voltage (low frequency) becomes  $(A + C) - (B + D)$ , as follow  $V_{FE1} = R_1/R_3 (V_B - V_A)$ . The focus error voltage is directed to the focus servo Block, to maintain optimum focusing at all times.

5) FOCUS OK GENERATION CIRCUIT



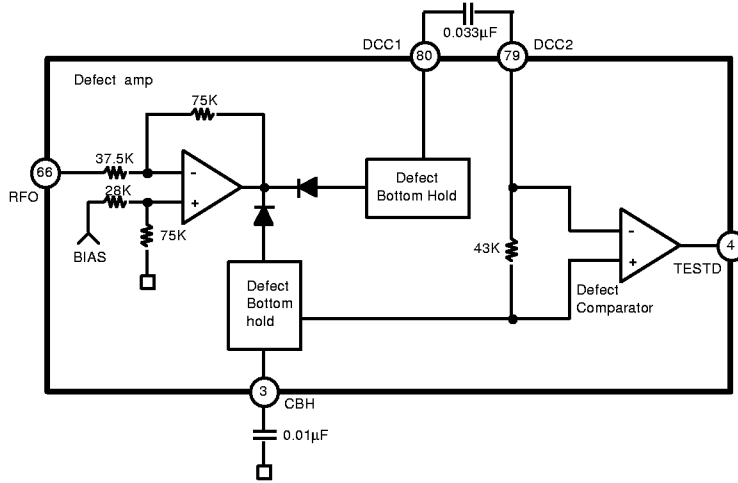
The focus Ok circuit generates a timing window to monitor focus search status of focus servo. When RFO (Pin 66) Voltage is more than - 0.37V, the focus OK circuit is inverted. Time constant of HPF in EFM comparator and in mirror circuit and that of LPF in focus ok circuit are determined by Capacitor (0.01μF) between RFI and RFO.

6) MIRROR CIRCUIT



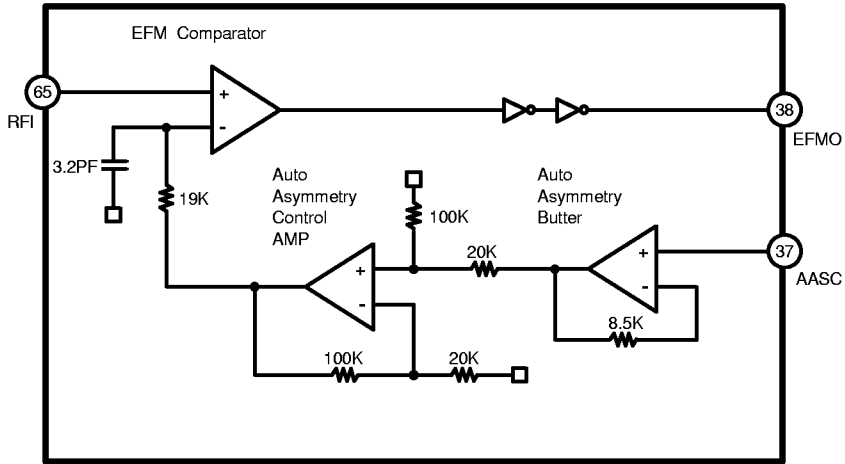
After RF input signal is amplified by Mirror amp, it is held in Bottom and Peak hold circuit. Such a hold is determined by the time constant. Envelope signal A (demodulated to DC) is two-thirds of the peak value of this signal. The time constant of A signal is held when it is larger than that of B signal. Therefore, mirror output is ; Low at track on disc, High at between tracks on disc, High when detect is detected.

7) DEFECT CIRCUIT



The bottom hold has had two time constant of long and short, after than the RFI signal inverted.  
 The short time constant of bottom hold is generated shorter than 0.1m sec of disc mirror defect, and long time constant is generated by previous mirror level. Mirror defect detection signals are generated by differentiation on Capacitor Coupling, and then transfer level.

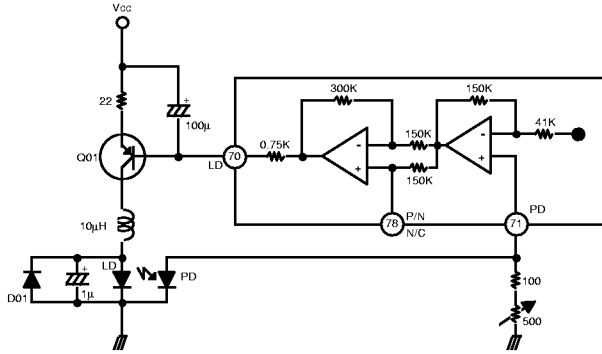
8) EFM COMPARATOR



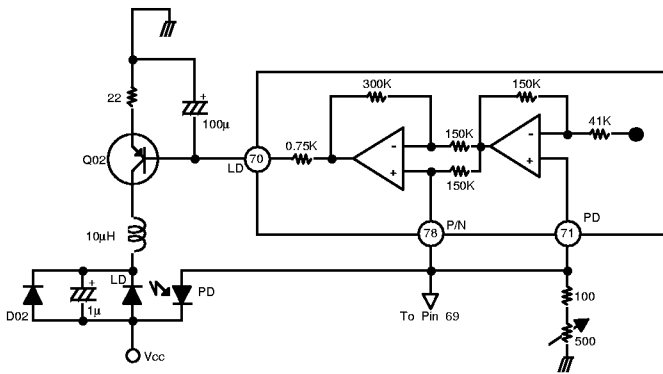
The EFM Comparator converts a RF Signal into a binary signal. A processing of disc production is occurred disproportion because of modification of disc. That is not reduced by only AC coupling. The reference voltage of EFM comparator is controlled utilizing the fact that the generation-probability 1, 0 is 50% (duty) in the binary EFM signal.

9) APC (AUTOMATIC POWER CONTROL) CIRCUIT

A. + 5V Single Power Supply P-sub Laser



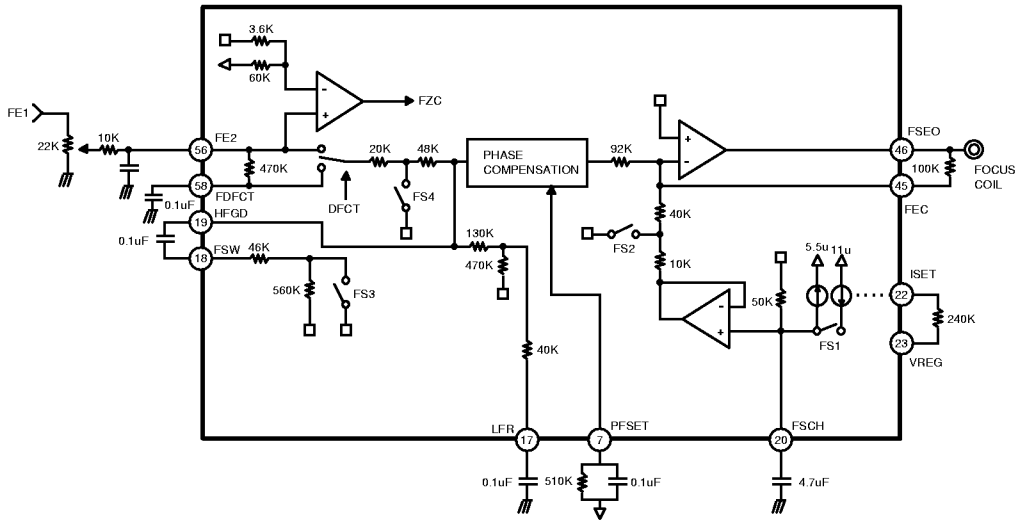
B. + 5V Single Power Supply N-sub Laser



As the Laser diode has had large negative temperature characteristic when it does something for regularly supply current on laser diode. Therefore, the output on processing monitor photo diode must be controlled current for getting regularly output power. This APC circuit is composed by single powersupply operation. This circuit can use p-sub and N-sub of laser diode according to application circuit.

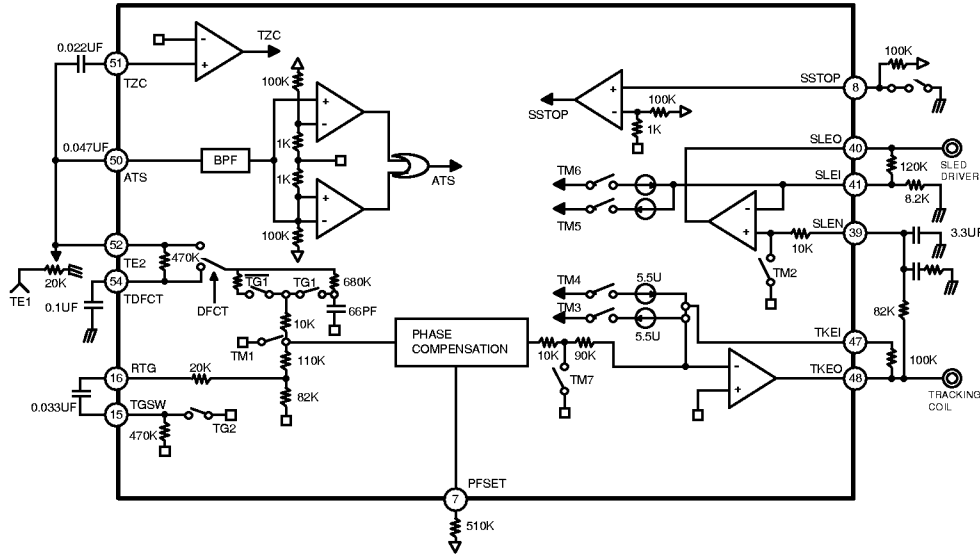
2. SERVO BLOCK

1) FOCUS SERVO BLOCK



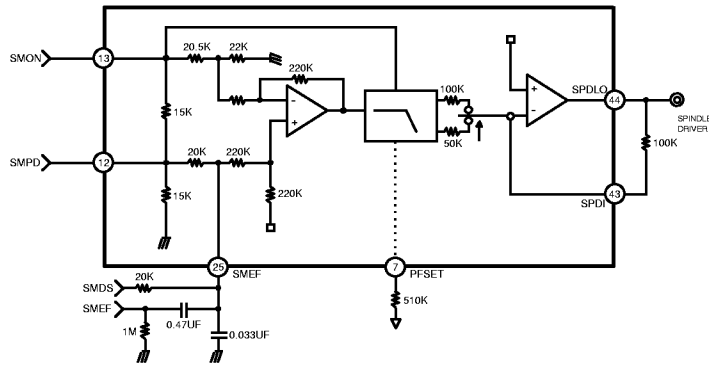
When the defect signal is detected, the focus servo Loop is isolated.  
 At this time, the focus servo error output is outputted through low pass filter formed by connecting a capacitor (0.1 $\mu$ F) between the built-in 470K $\Omega$  resistor and FDFCT Pin (Pin58). Accordingly, the focus error output is held as just before error value during the defect.  
 The peak frequency of the focus phase compensation is at about 1.2KHz when the resistor connected to PFSET (Pin7) is 510K $\Omega$ . It is inversely proportional to the resistor connected to the Pin 7.  
 While the focus search is operating, the FS4 switch is ON and then Focus error signal is isolated, accordingly it is outputted by FSE0 Pin (Pin48).  
 When the FS2 switch is ON, the focus servo Loop is on and then focus error is outputted through the focus servo Loop.

2) TRACKING AND SLED SERVO LOOP



The capacitor across RTG (Pin16) and TGSW (Pin15) reduces high frequency gain when the TG2 switch is OFF. The Peak frequency of the tracking phase compensation is at about 1.2KHz when the resistor connected to PFSET (Pin7) is 510KΩ. It is inversely proportional to the resistor connected to the Pin 7. The tracking error signal is switched into low pass filter route formed by connecting a capacitor between the built - in resistor at DFCT (470KΩ) and Pin54 (TDFCT) as for tracking error signal.

## 3) SPINDLE SERVO AND LOW PASS FILTER

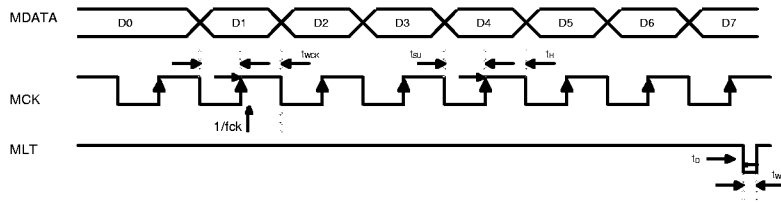


The 0.033nF and the 20K $\Omega$  connected to Pin25 (SMEF) form the 200Hz low Pass filter.  
And the carrier component of spindle servo error signals is eliminated.  
In the CLV - S mode, SMEF becomes L and Pin25 LPF fc lowers, strengthening the filter further.



3. COMMANDS

1) CPU Serial interface timing chart



| Item              | Symbol    | Min. | Typ. | Max. | Unit |
|-------------------|-----------|------|------|------|------|
| Clock frequency   | $f_{ck}$  |      |      | 1    | MHz  |
| Clock pulse width | $f_{wck}$ | 500  |      |      | ns   |
| Hold time         | $t_{su}$  | 500  |      |      | ns   |
| Setup time        | $t_h$     | 500  |      |      | ns   |
| Delay time        | $t_D$     | 500  |      |      | ns   |
| Latch pulse width | $t_{wl}$  | 1000 |      |      | ns   |

2) HEXA COMMANDS

1. \$0X

- This command controls focus servo Loop.

| D7 | D6 | D5 | D4 | D3  | D2  | D1  | D1  |
|----|----|----|----|-----|-----|-----|-----|
| 0  | 0  | 0  | 0  | FS4 | FS3 | FS2 | FS1 |

- \$00

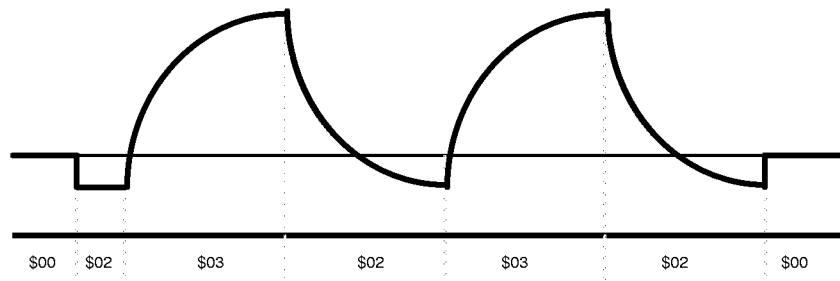
If FS1 =0, Pin20 is charged to  $(11\mu\text{A} - 5.5\mu\text{A}) \times 50\text{K}\Omega = 0.275\text{V}$ .

- \$02

The Pin46 Voltage level is as follow,

$(11\mu\text{A} - 5.5\mu\text{A}) \times 50\text{K}\Omega \times \text{feed back resistor } 50\text{K}\Omega$

The focus search voltage is produced by \$02 and \$03



- FS4 SWITCH

\$00- Focus servo off

\$08- Focus servo on

2. \$1X.

This command controls tracking servo Loop Gain and Break circuit

|    |    |    |    |                   |                      |     |     |
|----|----|----|----|-------------------|----------------------|-----|-----|
| D7 | D6 | D5 | D4 | D3                | D2                   | D1  | D1  |
| 0  | 0  | 0  | 1  | Anti Shock ON/OFF | Break Circuit ON/OFF | TG2 | TG1 |

3. \$2X.

|    |    |    |    |  |    |  |    |
|----|----|----|----|--|----|--|----|
| D7 | D6 | D5 | D4 | D3   | D2 | D1   | D1 |
| 0  | 0  | 1  | 0  | Tracking control<br>0 0 OFF<br>0 1 SERVO ON<br>1 0 F - Jump<br>1 1 R - Jump<br>TM1, TM3, TM4 |    | SLED Control<br>0 0 OFF<br>0 1 SERVO ON<br>1 0 F - Kick<br>1 1 R - Kick<br>TM2, TM5, TM6 |    |

4.S3X.

- D0, D1 : SLED Normal Kick
- D2, D3 : Focus Search Peak

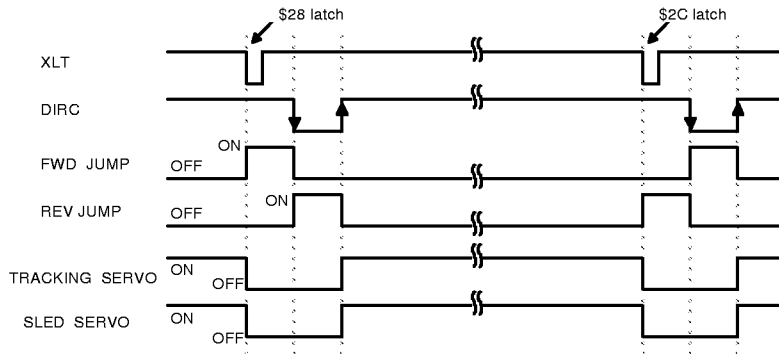
| D7 | D6 | D5 | D4 | Focus Search |          | SLED Kick Peak |          | Relative value |
|----|----|----|----|--------------|----------|----------------|----------|----------------|
|    |    |    |    | D3 (PS3)     | D2 (PS2) | D1 (PS1)       | D0 (PS0) |                |
| 0  | 0  | 0  | 1  | 0            | 0        | 0              | 0        | ± 1            |
|    |    |    |    | 0            | 1        | 0              | 1        | ± 2            |
|    |    |    |    | 1            | 0        | 1              | 0        | ± 3            |
|    |    |    |    | 1            | 1        | 1              | 1        | ± 4            |

5. \$4X to \$7X

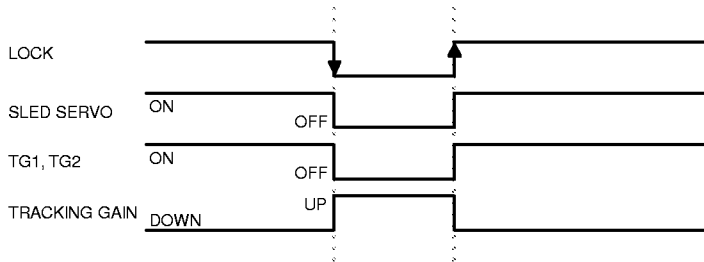
\$4X to \$7X are for the auto sequencer commands.

3) Other

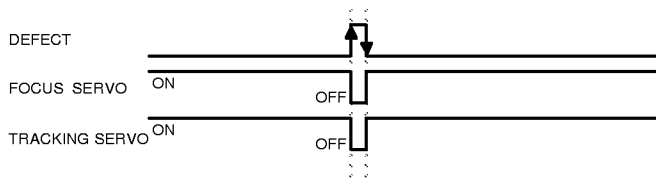
1. DIRC



2. LOCK (Sled runaway prevention circuit)



3. DEFECT (Disc defect countermeasure circuit)



4) System Control

| ITEM             | HEXA                       | ADDRESS |    |    |    | DATA                       |                            |                         |                         | ISTAT   |        |
|------------------|----------------------------|---------|----|----|----|----------------------------|----------------------------|-------------------------|-------------------------|---------|--------|
|                  |                            | D7      | D6 | D5 | D4 | D3                         | D2                         | D1                      | D0                      |         | OUT    |
| FOCUS CONTROL    | \$0X                       | 0       | 0  | 0  | 0  | FS4<br>FOCUS ON            | FS3<br>GAIN DOWN           | FS2<br>SEARCH ON        | FS1<br>SEARCH UP        | FZC     |        |
| TRACKING CONTROL | \$1X                       | 0       | 0  | 0  | 1  | ANTI<br>SHOCK              | BREAK ON                   | TG2<br>GAIN SET         | TG1<br>GAIN SET         | A . S   |        |
| TRACKING MODE    | \$2X                       | 0       | 0  | 1  | 0  | TRACKING MODE              |                            | SLED MODE               |                         | TZC     |        |
| SELECT           | \$3X                       | 0       | 0  | 1  | 1  | PS4<br>FOCUS<br>SEARCH + 2 | PS3<br>FOCUS<br>SEARCH + 1 | PS2<br>SLED<br>KICK + 2 | PS1<br>SLED<br>KICK + 1 | STOP    |        |
| AUTO SEQUENCE    | \$4X                       | 0       | 1  | 0  | 0  | AS3                        | AS2                        | AS1                     | AS0                     |         |        |
| RAM<br>SET       | BLIND (A< E)/<br>OVER FLOW | \$5X    | 0  | 1  | 0  | 1                          | 0.18ms                     | 0.09ms                  | 0.045ms                 | 0.022ms | Hi - Z |
|                  | BREAK (B)                  |         | 0  | 1  | 0  | 1                          | 0.36ms                     | 0.18ms                  | 0.09ms                  | 0.045ms |        |
|                  | KICK (D)                   | \$6X    | 0  | 1  | 1  | 0                          | 11.6ms                     | 5.8ms                   | 2.90ms                  | 1.455ms |        |
|                  | TRACK<br>JUMP (N)          | \$7X    | 0  | 1  | 1  | 1                          | 64                         | 32                      | 16                      | 8       |        |
|                  | TRACK<br>JUMP (M)          |         |    |    |    |                            | 128                        | 64                      | 32                      | 16      |        |
| NORMAL SPEED     | \$F0                       |         |    |    |    |                            |                            |                         |                         |         |        |
| DOUBLE SPEED     | \$F3                       |         |    |    |    |                            |                            |                         |                         |         |        |

## 5) Serial data truth table

## 1. Focus control

| SERIAL DATA     | HEXA | SWITH |     |     |     |
|-----------------|------|-------|-----|-----|-----|
| FOCUS CONTROL   |      | FS4   | FS3 | FS2 | FS1 |
| 0 0 0 0 0 0 0 0 | \$00 | 0     | 0   | 0   | 0   |
| 0 0 0 0 0 0 0 1 | \$01 | 0     | 0   | 0   | 1   |
| 0 0 0 0 0 0 1 0 | \$02 | 0     | 0   | 1   | 0   |
| 0 0 0 0 0 0 1 1 | \$03 | 0     | 0   | 1   | 1   |
| 0 0 0 0 0 1 0 0 | \$04 | 0     | 1   | 0   | 0   |
| 0 0 0 0 0 1 0 1 | \$05 | 0     | 1   | 0   | 1   |
| 0 0 0 0 0 1 1 0 | \$06 | 0     | 1   | 1   | 0   |
| 0 0 0 0 0 1 1 1 | \$07 | 0     | 1   | 1   | 1   |
| 0 0 0 0 1 0 0 0 | \$08 | 1     | 0   | 0   | 0   |
| 0 0 0 0 1 0 0 1 | \$09 | 1     | 0   | 0   | 1   |
| 0 0 0 0 1 0 1 0 | \$0A | 1     | 0   | 1   | 0   |
| 0 0 0 0 1 0 1 1 | \$0B | 1     | 0   | 1   | 1   |
| 0 0 0 0 1 1 0 0 | \$0C | 1     | 1   | 0   | 0   |
| 0 0 0 0 1 1 0 1 | \$0D | 1     | 1   | 0   | 1   |
| 0 0 0 0 1 1 1 0 | \$0E | 1     | 1   | 1   | 0   |
| 0 0 0 0 1 1 1 1 | \$0F | 1     | 1   | 1   | 1   |

## 2. Tracking Gain control

| SERIAL DATA      | HEXA | SWITH  |     |        |     |
|------------------|------|--------|-----|--------|-----|
| TRACKING CONTROL |      | AS = 0 |     | AS = 1 |     |
|                  |      | TG2    | TG1 | TG2    | TG1 |
| 0 0 0 1 0 0 0 0  | \$10 | 0      | 0   | 0      | 0   |
| 0 0 0 1 0 0 0 1  | \$11 | 0      | 1   | 0      | 1   |
| 0 0 0 1 0 0 1 0  | \$12 | 1      | 0   | 1      | 0   |
| 0 0 0 1 0 0 1 1  | \$13 | 1      | 1   | 1      | 1   |
| 0 0 0 1 0 1 0 0  | \$14 | 0      | 0   | 0      | 0   |
| 0 0 0 1 0 1 0 1  | \$15 | 0      | 1   | 0      | 1   |
| 0 0 0 1 0 1 1 0  | \$16 | 1      | 0   | 1      | 0   |
| 0 0 0 1 0 1 1 1  | \$17 | 1      | 1   | 1      | 1   |
| 0 0 0 1 1 0 0 0  | \$18 | 0      | 0   | 1      | 1   |
| 0 0 0 1 1 0 0 1  | \$19 | 0      | 1   | 1      | 0   |
| 0 0 0 1 1 0 1 0  | \$1A | 1      | 0   | 0      | 1   |
| 0 0 0 1 1 0 1 1  | \$1B | 1      | 1   | 0      | 0   |
| 0 0 0 1 1 1 0 0  | \$1C | 0      | 0   | 1      | 1   |
| 0 0 0 1 1 1 0 1  | \$1D | 0      | 1   | 1      | 0   |
| 0 0 0 1 1 1 1 0  | \$1E | 1      | 0   | 0      | 1   |
| 0 0 0 1 1 1 1 1  | \$1F | 1      | 1   | 0      | 0   |

3. Tracking mode control

| SERIAL DATA     | HEXA | Function            |                     |                   |
|-----------------|------|---------------------|---------------------|-------------------|
|                 |      | DIRC = 1            | DIRC = 0            | DIRC = 1          |
|                 |      | TM =<br>6 5 4 3 2 1 | TM =<br>6 5 4 3 2 1 | TM<br>6 5 4 3 2 1 |
| 0 0 1 0 0 0 0 0 | \$20 | 0 0 0 0 0 0         | 0 0 1 0 0 0         | 0 0 0 0 1 1       |
| 0 0 1 0 0 0 0 1 | \$21 | 0 0 0 0 1 0         | 0 0 1 0 1 0         | 0 0 0 0 1 1       |
| 0 0 1 0 0 0 1 0 | \$22 | 1 0 0 0 0 0         | 1 0 1 0 0 0         | 0 1 0 0 0 1       |
| 0 0 1 0 0 0 1 1 | \$23 | 0 1 0 0 0 0         | 0 1 1 0 0 0         | 0 1 0 0 0 1       |
| 0 0 1 0 0 1 0 0 | \$24 | 0 0 0 0 0 1         | 0 0 0 1 0 0         | 0 0 0 0 1 1       |
| 0 0 1 0 0 1 0 1 | \$25 | 0 0 0 0 1 1         | 0 0 0 1 1 0         | 0 0 0 0 1 1       |
| 0 0 1 0 0 1 1 0 | \$26 | 1 0 0 0 0 1         | 1 0 0 1 0 0         | 0 1 0 0 0 1       |
| 0 0 1 0 0 1 1 1 | \$27 | 0 1 0 0 0 1         | 0 1 0 1 0 0         | 0 1 0 0 0 1       |
| 0 0 1 0 1 0 0 0 | \$28 | 0 0 0 1 0 0         | 0 0 1 0 0 0         | 0 0 0 0 1 1       |
| 0 0 1 0 1 0 0 1 | \$29 | 0 0 0 1 1 0         | 0 0 1 0 1 0         | 0 0 0 0 1 1       |
| 0 0 1 0 1 0 1 0 | \$2A | 1 0 0 1 0 0         | 1 0 1 0 0 0         | 0 1 0 0 0 1       |
| 0 0 1 0 1 0 1 1 | \$2B | 0 1 0 1 0 0         | 0 1 1 0 0 0         | 0 1 0 0 0 1       |
| 0 0 1 0 1 1 0 0 | \$2C | 0 0 1 0 0 0         | 0 0 0 1 0 0         | 0 0 0 0 1 1       |
| 0 0 1 0 1 1 0 1 | \$2D | 0 0 1 0 1 0         | 0 0 0 1 1 0         | 0 0 0 0 1 1       |
| 0 0 1 0 1 1 1 0 | \$2E | 0 0 1 0 0 0         | 1 0 0 1 0 0         | 0 1 0 0 0 1       |
| 0 0 1 0 1 1 1 1 | \$2F | 0 1 1 0 0 0         | 0 1 0 1 0 0         | 0 1 0 0 0 1       |

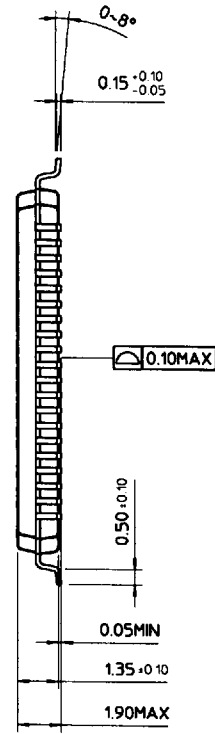
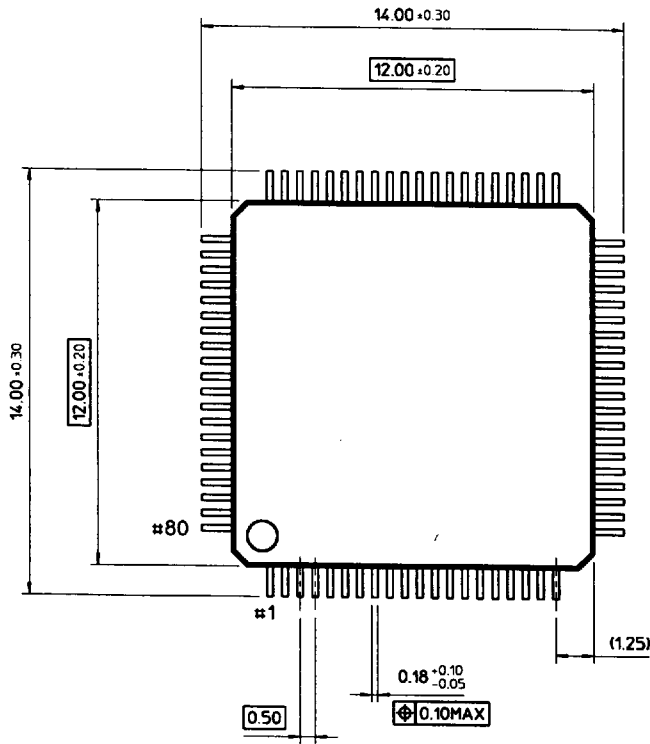


## 4. Auto Sequence

|               | <b>AS3</b> | <b>AS2</b> | <b>AS1</b> | <b>AS0</b> |
|---------------|------------|------------|------------|------------|
| CANCEL        | 0          | 0          | 0          | 0          |
| FOCUS ON      | 0          | 1          | 1          | 1          |
| 1 TRACK JUMP  | 1          | 0          | 0          | X          |
| 10 TRACK JUMP | 1          | 0          | 1          | X          |
| 2N TRACK JUMP | 1          | 1          | 0          | X          |
| M TRACK MOVE  | 1          | 1          | 1          | X          |

X = 0 forward X = 1 reverse

80-QFP-1212



80-QFP-1420C

