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AN8801SC

## Three-Beam Method Head Amplifier IC for CD Player

■ Overview

The AN8801SC is a head amplifier IC supporting a digital servo.

Combination of this IC and the MN6650 (digital servo processor) allows the rational servo system to be constructed with small number of external parts.

■ Features

- 5V single supply operation
- Low consumption power
- I-V amplifier, tracking error amplifier, focus error amplifier, RF amplifier and APC built-in
- Detection of DO, CROSS, OFTR and vibration
- Combination with the MN6650 enabling automatic adjustment for tracking balance, tracking offset, tracking gain, focus offset and focus gain

Umit : mm

42-lead SSOP package (SSOP042-P-0450)

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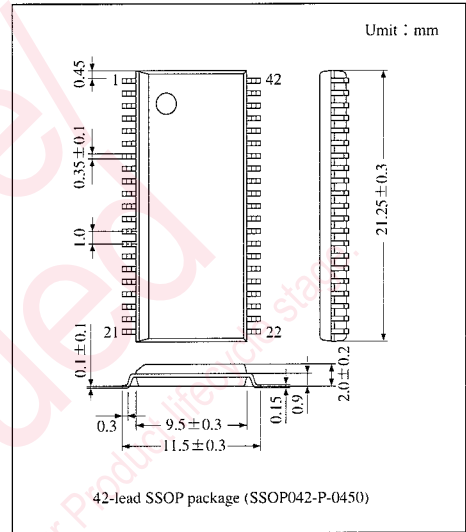
■ Block Diagram
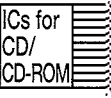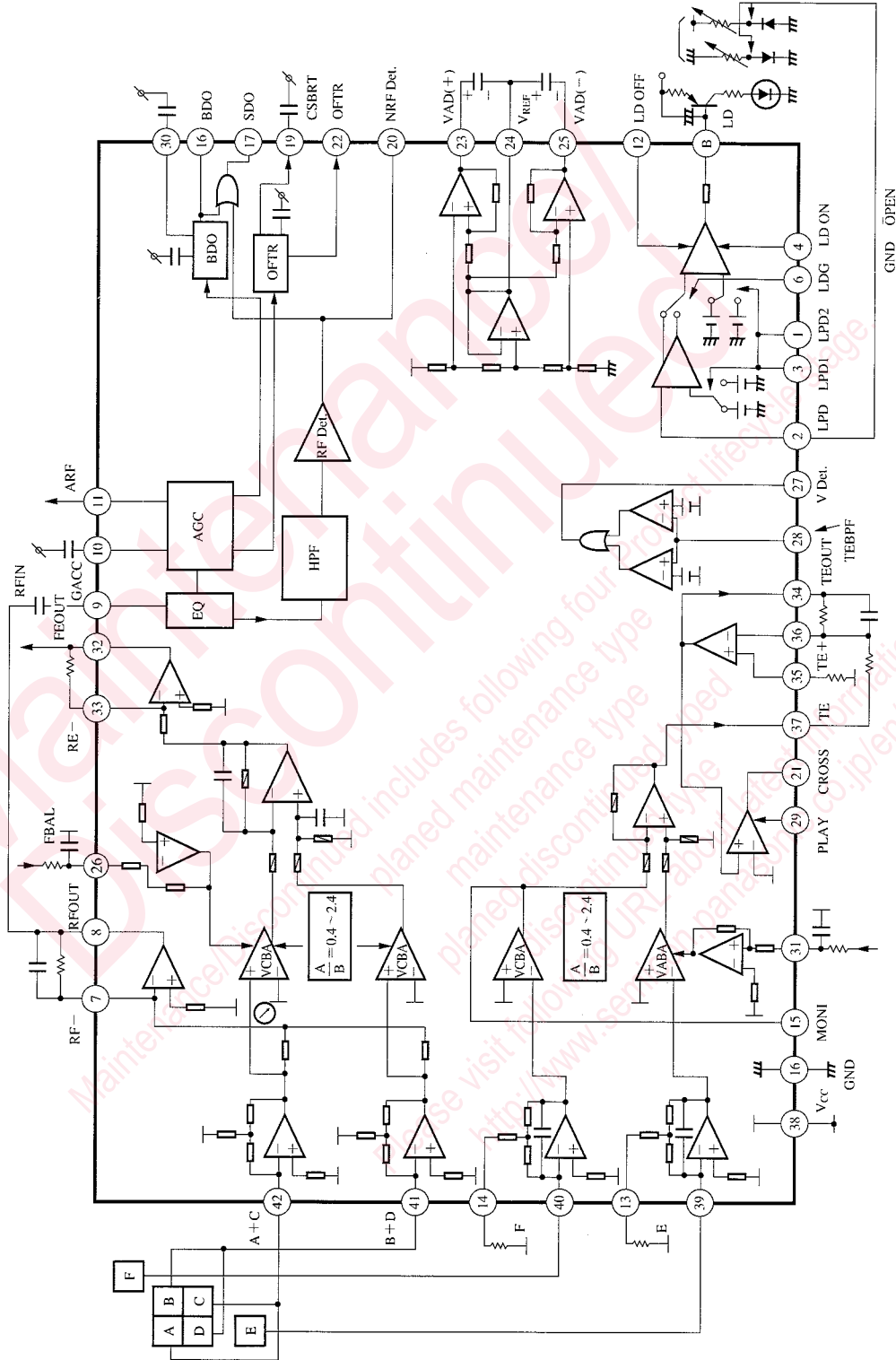
■ Pin Description

Pin No.	Pin Name	I/O	Function Description
1	LDP1	I	Polarity switching of APC monitor P_D (1)
2	LPD	I	Signal input of P_D for LD output monitor
3	LDP2	I	Polarity switching of APC monitor P_D (2)
4	LDON	I	ON/OFF switching of LD APC
5	LD	O	Connected to base of external Tr for LD drive
6	LDG	I	APC loop gain switching
7	RF—	I	Reverse rotation input pin of RF Amp. for connecting a resistance
8	RFOUT	O	Output pin of RF Amp. (reverse rotation amp.)
9	RFIN	I	RF AGC input pin
10	C. AGC	——	C connecting pin for RF AGC loop filter
11	ARF	O	RF output pin after AGC
12	LDOFF	I	Input pin for forced stop of LD APC
13	PDER	——	Connecting pin for resistance setting IV conversion resistance value of PIN diode E
14	PDFR	——	Connecting pin for resistance setting IV conversion resistance value of PIN diode F
15	MONI	——	Output monitor pin of TE balance amp. (F)
16	GND	——	Ground pin
17	SDO	O	SDO detection output pin ; positive logic ; SDO=BDO+NRFDET
18	BDO	O	BDO detection output pin ; positive logic
19	C. SBRT	——	Connecting pin C for OFTR low speed detection
20	NRFDET	O	Amplitude detection information of RF signal; negative logic
21	CROSS	O	Output of TE CROSS detection signal
22	OFTR	O	OFF TRACK detection output
23	VAD (+)	O	$V_{CC} \times 0.8$ (V) output pin
24	V_{REF}	O	$V_{CC} \times 0.5$ (V) output pin
25	VAD (−)	O	$V_{CC} \times 0.2$ (V) output pin
26	FBAL	I	Control signal input pin for FO balance adjustment
27	VDET	O	Output of vibration detection
28	TEBPF	I	Input of vibration detection
29	PLAY	I	PLAY signal pin ; positive logic
30	C. SBDO	——	Connecting pin C for low speed detection of dark level DO
31	TBAL	I	Control signal input pin for TE balance adjustment
32	FEOUT	O	Output pin of focus error signal
33	FE−	I	Reverse rotation input pin of FE Amp.
34	TEOUT	O	Output pin of TE Amp.
35	TE+	I	Normal rotation input pin of TE Amp.
36	TE−	I	Reverse rotation input pin of TE Amp.
37	TE	O	Output pin of TE signal
38	V_{CC}	——	Supply connecting pin
39	PDE	I	Connected to PIN diode E
40	PDF	I	Connected to PIN diode F
41	PDAC	I	Connected to B/D of astigmatic 4-division P_D
42	PDBD	I	Connected to A/C of astigmatic 4-division P_D

■ Absolute Maximum Ratings (Ta＝25℃)

Parameter	Symbol	Rating	Unit
Supply Voltage	V_{CC}	6	V
Supply Current	I_{CC}	50	mA
Power Dissipation	P_D	300	mW
Operating Ambient Temperature	T_{opr}	$-30 \sim +85$	℃
Storage Temperature	T_{stg}	$-55 \sim +125$	℃

■ Recommended Operating Range (Ta＝25℃)

Parameter	Symbol	Range
Operating Supply Voltage Range	V_{CC}	4.5V ～ 5.5V

■ Electrical Characteristics (Ta＝25℃±2℃)

Parameter	Symbol	Condition	min.	typ.	max.	Unit
Total Circuit Current	I_{tot}	$V_{CC}=5V$	10	14.5	19	mA
V_{REF} Output Voltage	V_{REF}	$V_{CC}=5V$	2.25	2.53	2.81	V
VAD (+) Output Voltage	$\Delta V_{AD(+)}$	$V_{CC}=5V$	1.28	1.43	1.58	V
VAD (−) Output Voltage	$\Delta V_{AD(-)}$	$V_{CC}=5V$	1.30	1.45	1.60	V
Focus Error Amp.						
Output Offset Voltage of Focus Error Amp.	V_{OF-FO}	$V_{CC}=5V$	-300	0	300	mV
Crosstalk Quantity of Focus Error Offset Balance	V_{OF-FOB}	$V_{CC}=5V$, $V_{FB}=0.5V$ Applied	-250	——	250	mV
I−V Conversion Gain of Focus Error Amp.	R_{FO}	$V_{CC}=5V$, $V_{FB}=V_{REF}$	80	115	150	kΩ
I−V Conversion Relative Gain of Focus Error Amp.	ΔR_{FO}	$V_{CC}=5V$, $V_{FB}=V_{REF}$	-10	0	10	%
Focus Balance Variable Range 1−1	B_{F01-1}	$V_{CC}=5V$, $V_{FB}=5V$	0.35	0.5	0.65	——
Focus Balance Variable Range 1−2	B_{F01-2}	$V_{CC}=5V$, $V_{FB}=0V$	1.05	1.5	1.95	——
Focus Balance Variable Range 2−1	B_{F02-1}	$V_{CC}=5V$, $V_{FB}=5V$	1.05	1.5	1.95	——
Focus Balance Variable Range 2−2	B_{F02-2}	$V_{CC}=5V$, $V_{FB}=0V$	0.35	0.5	0.65	——
Frequency Characteristics of Focus Error Amp.	G_{FO}	$V_{CC}=5V$, $f=1kHz$, 30kHz Input	-4.5	-3	-1.5	dB
Tracking Error Amp.						
Output Offset Voltage of Tracking Error Amp.	V_{OF-T}	$V_{CC}=5V$	-300	0	300	mV
Crosstalk Quantity of Tracking Error Offset Balance	V_{OF-TB}	$V_{CC}=5V$, $V_{TB}=0.5V$ Applied	-250	——	250	mV
I−V Conversion Gain of Tracking Error Amp.	R_T	$V_{CC}=5V$, $V_{TB}=V_{REF}$	540	720	900	kΩ
I−V Conversion Relative Gain of Tracking Error Amp.	ΔR_T	$V_{CC}=5V$, $V_{TB}=V_{REF}$	-10	0	10	%
Tracking Balance Variable Range 1−1	B_{T1-1}	$V_{CC}=5V$, $V_{TB}=5V$	0.35	0.5	0.65	——
Tracking Balance Variable Range 1−2	B_{T1-2}	$V_{CC}=5V$, $V_{TB}=0V$	1.05	1.5	1.95	——
Tracking Balance Variable Range 2−1	B_{T2-1}	$V_{CC}=5V$, $V_{TB}=5V$	1.05	1.5	1.95	——
Tracking Balance Variable Range 2−2	B_{T2-2}	$V_{CC}=5V$, $V_{TB}=0V$	0.35	0.5	0.65	——
Frequency Characteristics of Tracking Error Amp.	G_{TO}	$V_{CC}=5V$, $f=3kHz$, 46kHz Input	-4.5	-3	-1.5	dB

ICs for
CD/
CD-ROM

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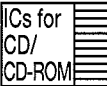
■ Electrical Characteristics (Cont.) $(Ta=25°C\pm2°C)$

Parameter	Symbol	Condition	min.	typ.	max.	Unit
CROSS Detection						
CROSS Output H Level	V_{CR-H}	$V_{CC}=5V$, $V_{TB}=V_{REF}$ Input : f=3kHz	4.2	—	—	V
CROSS Output L Level	V_{CR-L}	$V_{CC}=5V$, $V_{TB}=V_{REF}$ Input : f=3kHz	—	—	0.8	V
PLAY mode CROSS Operation	V_{CR-P}	$V_{CC}=5V$, $V_{TB}=V_{REF}$ Input : f=3kHz	4.2	—	—	V
RF-Amp.						
RF-Amp. Offset Voltage	V_{OF-RF}	$V_{CC}=5V$	−75	0	75	mV
RF-Amp. I−V Conversion Gain	R_{RF}	$V_{CC}=5V$	44.5	56	67.5	kΩ
RF-Amp. I−V Conversion Relative Gain	ΔR_{RFI}	$V_{CC}=5V$	−10	0	10	%
RF-Amp. Frequency Characteristics Note)	G_{RF}	$V_{CC}=5V$ Input : f=500kHz, 3MHz	−4.5	−3	−1.5	dB
AGC						
AGC Max. Gain	G_{AGC}	$V_{CC}=5V$ Input : f=500kHz, Sine Wave	15	18.5	21	dB
EQ Characteristics	ΔG_{EQ}	$V_{CC}=5V$ Input : f=500kHz, Sine Wave	0	1.0	2.0	dB
AGC Operation Gain	G_{OP-AGC}	$V_{CC}=5V$ Input : f=500kHz, Sine Wave	4	6	9	dB
AGC Compressibility	G_{cm-AGC}	$V_{CC}=5V$ Input : f=500kHz, Sine Wave	0	2	3.5	dB
AGC Frequency Characteristics	G_{f-AGC}	$V_{CC}=5V$ Input : f=3MHz, Sine Wave	−1.5	0	2.5	dB
RFDET						
$\overline{RFDET}$ Detection Operation	V_{NRF}	$V_{CC}=5V$ Input : f=500kHz, Sine Wave	75	115	155	mV_{P-P}
$\overline{RFDET}$ H Level	V_{NRF-H}	$V_{CC}=5V$ Input : f=500kHz, Sine Wave	4.2	—	—	V
$\overline{RFDET}$ L Level	V_{NRF-L}	$V_{CC}=5V$ Input : f=500kHz, Sine Wave	—	—	0.8	V
BDO						
BDO Detection Current	I_{BDO}	$V_{CC}=5V$	1.0	1.4	1.8	μA
BDO H Level	V_{BDO-H}	$V_{CC}=5V$ Input : f=1kHz, Rectangle Wave	4.2	—	—	V
BDO L Level	V_{BDO-L}	$V_{CC}=5V$ Input : f=1kHz, Rectangle Wave	—	—	0.8	V
OFTR						
$\overline{OFTR}$ Detection Current	I_{OFTR}	$V_{CC}=5V$	1.0	1.4	1.8	μA
OFTR H Level	V_{OFTR-H}	$V_{CC}=5V$ Input : f=1kHz, Rectangle Wave	4.2	—	—	V
OFTR L Level	V_{OFTR-L}	$V_{CC}=5V$ Input : f=1kHz, Rectangle Wave	—	—	0.8	V
SDO						
SDO H Level	V_{SDO-H}	$V_{CC}=5V$ Input : f=1kHz, Rectangle Wave	4.2	—	—	V
SDO L Level	V_{SDO-L}	$V_{CC}=5V$ Input : f=1kHz, Rectangle Wave	—	—	0.8	V

Note) The value may fluctuate by the influence of printed board, socket and etc.

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■ Electrical Characteristics (Cont.) (Ta=25℃±2℃)

Parameter	Symbol	Condition	min.	typ.	max.	Unit
LD−APC						
LD ON H Input Level	V_{LDON-H}	$V_{CC}=5V$	3.5	—	—	V
LD OFF H Input Level	$V_{LDOFF-H}$	$V_{CC}=5V$	3.5	—	—	V
LD ON Operation Voltage (1)	$V_{LD(1)}$	$V_{CC}=5V$, V_2 : DC Sweep	1.9	2.2	2.5	V
LD ON Operation Voltage (2)	$V_{LD(2)}$	$V_{CC}=5V$, V_2 : DC Sweep	0.135	0.17	0.205	V
LD ON Operation Voltage (3)	$V_{LD(3)}$	$V_{CC}=5V$, V_2 : DC Sweep	0.115	0.135	0.155	V
V. Det. Detection						
V. Det. Level (1)	$V_{Det.(1)}$	$V_{CC}=5V$, V_{28} : DC Sweep	52	74	96	mV
V. Det. Level (2)	$V_{Det.(2)}$	$V_{CC}=5V$, V_{28} : DC Sweep	−95	−73	−51	mV
V. Det. H Level	$V_{Det.-H}$	$V_{CC}=5V$, V_{28} : DC Sweep	4.2	—	—	V
V. Det. L Level	$V_{Det.-L}$	$V_{CC}=5V$, V_{28} : DC Sweep	—	—	0.8	V

■ Operational Description
• RFAmplifier

As shown in Figure 1, RF signals are generated by three-beam method pick-up.

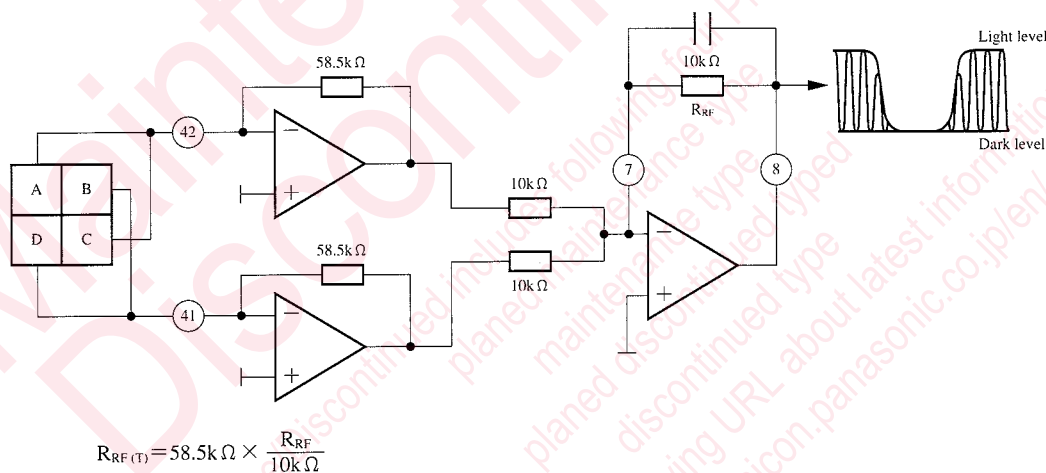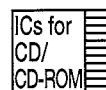Equivalent resistance to RFOUT (Pin⑧) is 58.5kΩ, when resistance between RF-and RFOUT is 10kΩ.

$$R_{RF(T)}=58.5k\Omega \times \frac{R_{RF}}{10k\Omega}$$

Figure 1 : RF Amplifier

• Focus Error Amplifier

As shown in Figure 2, the operation result of $(A+C)(B+D)$ is outputted to FEOUT (Pin㉜). Equivalent resistance to FEOUT is 234kΩ, when resistance between FE and FEOUT is 40kΩ.
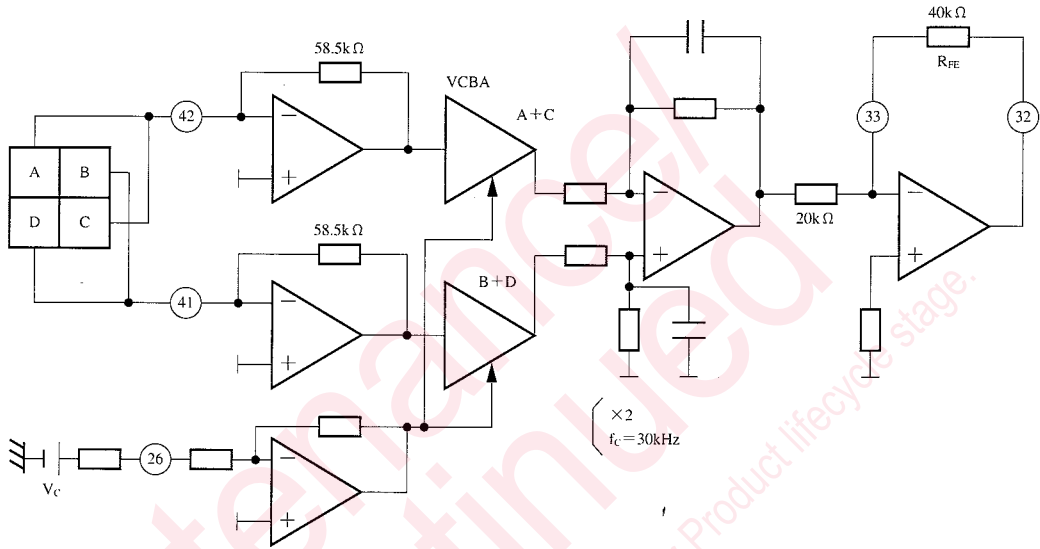
Figure 2 : Focus Error Amplifier

The VCBA is for focus balance adjustment. Connecting 100kΩ of external resistance to Pin㉖, signal ratio between $A+C$ and $B+D$ can be controlled as shown in Table 1.

Table 1

V_C	$\dfrac{A+C}{B+D}$	$\dfrac{B+D}{A+C}$
0V	0.4	2.5
2.5V	1.0	1.0
5.0V	2.5	0.4

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• Tracking Error Amplifier

As shown in Figure 3, it receives the output currents E and F of three-beam method pin photo diode for sub-beam detection, and outputs the operation result of $E - F$ to TEOUT (Pin㉞).
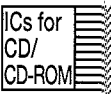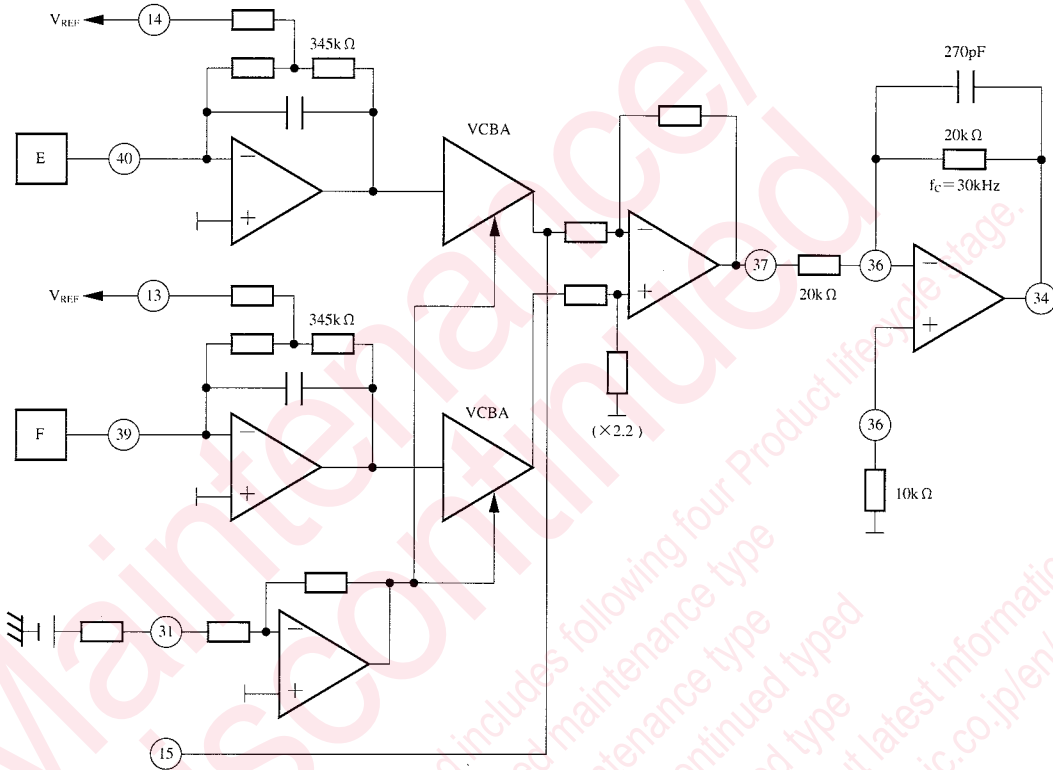

Figure 3 : Tracking Error Amplifier

Pins⑬ and ⑭ are used to make the resistance converting the current to voltage variable. When these pins are directly connected to V_{REF} and $20k\Omega$ of resistance is connected between TE and TE-, and between TE and TEOUT respectively, equivalent resistance to TEOUT is $757k\Omega$.

Table 2

V_C	E/F	F/E
0V	0.4	2.5
2.5V	1.0	1.0
5.0V	2.5	0.4

The VCBA is for tracking balance adjustment in the same way of for focus. Table 2 shows the tracking balance ratio under the same conditions as shown in Table 1. The capacitor connected between TE - and TEOUT must be set so that fc can be 30 kHz.

• AGC

In order to absorb the attenuation of RF signal by disk, pick-up dispersion, finger print and other factors, AGC circuit for RF is incorporated.

The input impedance of Pin⑨ is approx. $27.9k\Omega$. By Pin⑪ (ARF), gain-controlled RF-signal is outputted. Input allowable level is approx. $1V_{P-P} \sim 500mV_{P-P} \sim 250mV_{P-P}$, and output is $1 V_{P-P}$. Pin⑩ is a connecting pin with capacity for constructing the AGC loop filter. It is recommended that the external capacitor of $1\mu F$ around should be connected for V_{CC}.
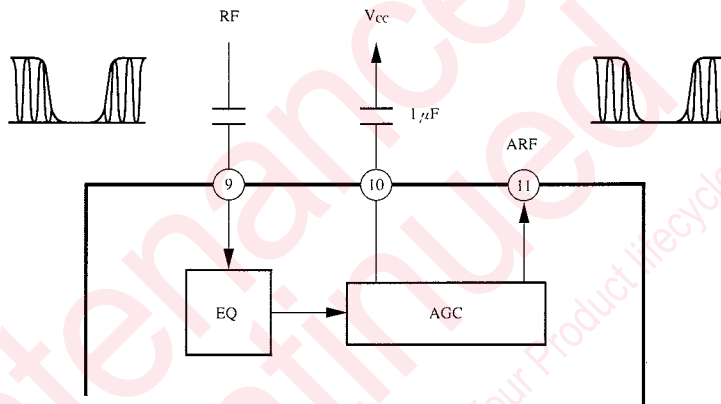

Figure 4 : AGC

• RFDET

The RFDET detects amplitude of RF signal inputted to Pin⑨. Threshold value is approx. 100mV (f=500kHz), and RFPresent =L, RF Absent=H are outputted.

• BDO Detection

It detects BDO by the low speed detection circuit and high speed detection circuit. The high speed detection circuit is incorporated. On the other hand, the capacitor of the low speed detection circuit must be connected to Pin㉚. The capacity value is 680pF and it is recommended that it should be connected for V_{CC}. When this capacity value of Pin㉚ is increased, BDO is detected with large RF missing rate. When it is decreased, BDO can be detected with small RF missing rate.

BDO present=H
BDO absent=L

• OFTR Detection

OFTR detection reversely corresponds with BDO detection. However, its detection method is the same as for BDO. Capacitor for the low speed detection must be connected to Pin⑲. It is recommended that it should be connected to V_{CC} at 3000 pF in the same way as for Pin㉚. The relation between the capacity value and OFTR detection timing is as the same for BDO.
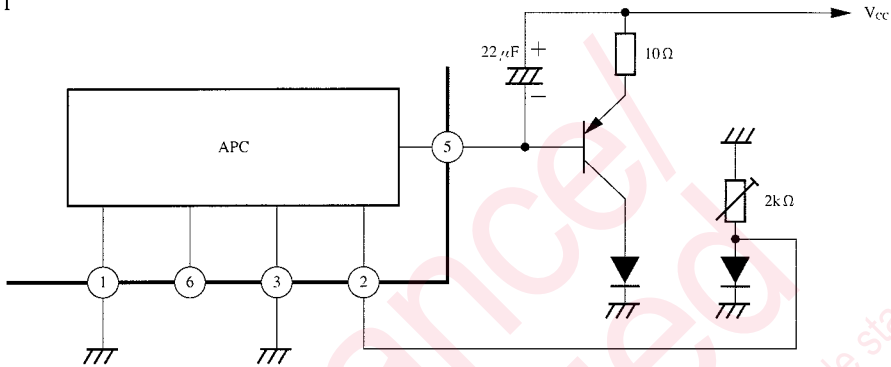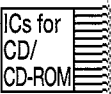
OFTR=H
Off from OFTR=L

•APC

The APC is constructed to support the P—sub and N—sub of laser PD either.
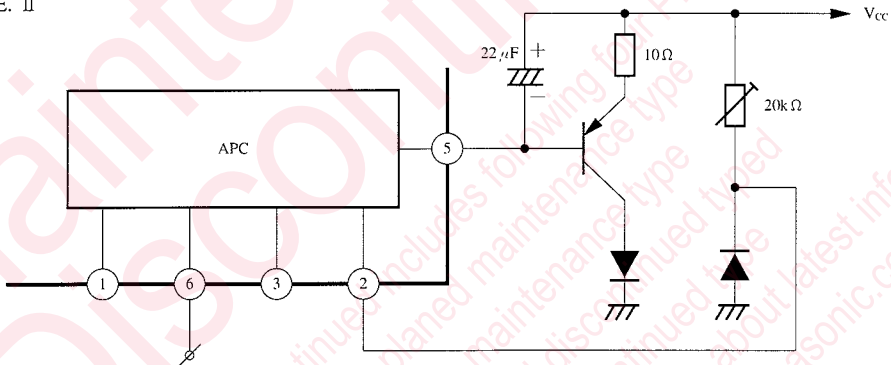
(1) Type I

By connecting Pin① or ③ to GND, the reference voltage of LD can be switched. When Pin① is connected to GND, the reference voltage becomes 170 mV. When Pin③ is connected to GND, it becomes 140 mV.

(2) TYPE. II

•Supply for AD, Reference Supply

Three supplies are incorporated : two supplies for AD ($V_{CC} \times 0.8$, $V_{CC} \times 0.2$ output) and a servo reference supply ($V_{CC}/2$). Pin㉓ outputs $V_{CC} \times 0.8$ and Pin㉕ outputs $V_{CC} \times 0.2$, respectively. Pin㉓ has approx. 2mA of capacity only for source, and Pin㉕ has approx. 2mA of capacity only for sink. A capacitor for oscillation prevention is required for VREF. It is recommended that the capacitor value should be 1 μF to 100 μF. Also, Pin㉔ outputs $V_{CC}/2$, and has approx. 3mA of current capacity for sink/source. It is recommended that it should be given 1 μF to 10 μF of capacity in addition.

•Vibration Detection

The AN8801SC has a wind comparator of approx. ±70mV. Abnormal vibration components of tracking error are detected and the data for whether vibration is present or not is outputted to Pin㉗.

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