SONY

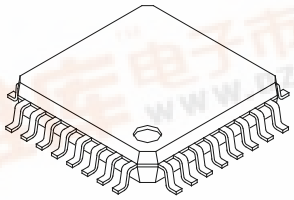
CXA2555Q

RF Amplifier for CD Player/CD-ROM

Description

The CXA2555Q is an IC for RF signal processing of CD player and CD-ROM.

32 pin QFP (Plastic)



Features

- Wide-band RF AC amplifier
  (RF AC signal fc ≥ 20MHz)
- 4-mode RF equalizer (active filter type)
- RF equalizer boost amount and cut-off frequency adjustable
- EFM time constant adjustable (switching function provided)
- Peak hold time constant of mirror circuit adjustable
- Tracking error amplifier cut-off frequency adjustable
- Tracking error amplifier voltage gain adjustable
- Center error amplifier
- APC (Automatic Power Control) function
- APC ON/OFF control
- Supports laser coupler

Absolute Maximum Ratings

• Supply voltage	V_{CC}	7	V
• Storage temperature	Tstg	–65 to +150	°C
• Power consumption	P_D	800	mW

Operating Conditions

• Supply voltage	V_{CC} – GND	3.0 to 5.5	V
• Operating temperature	Topr	–20 to +75	°C

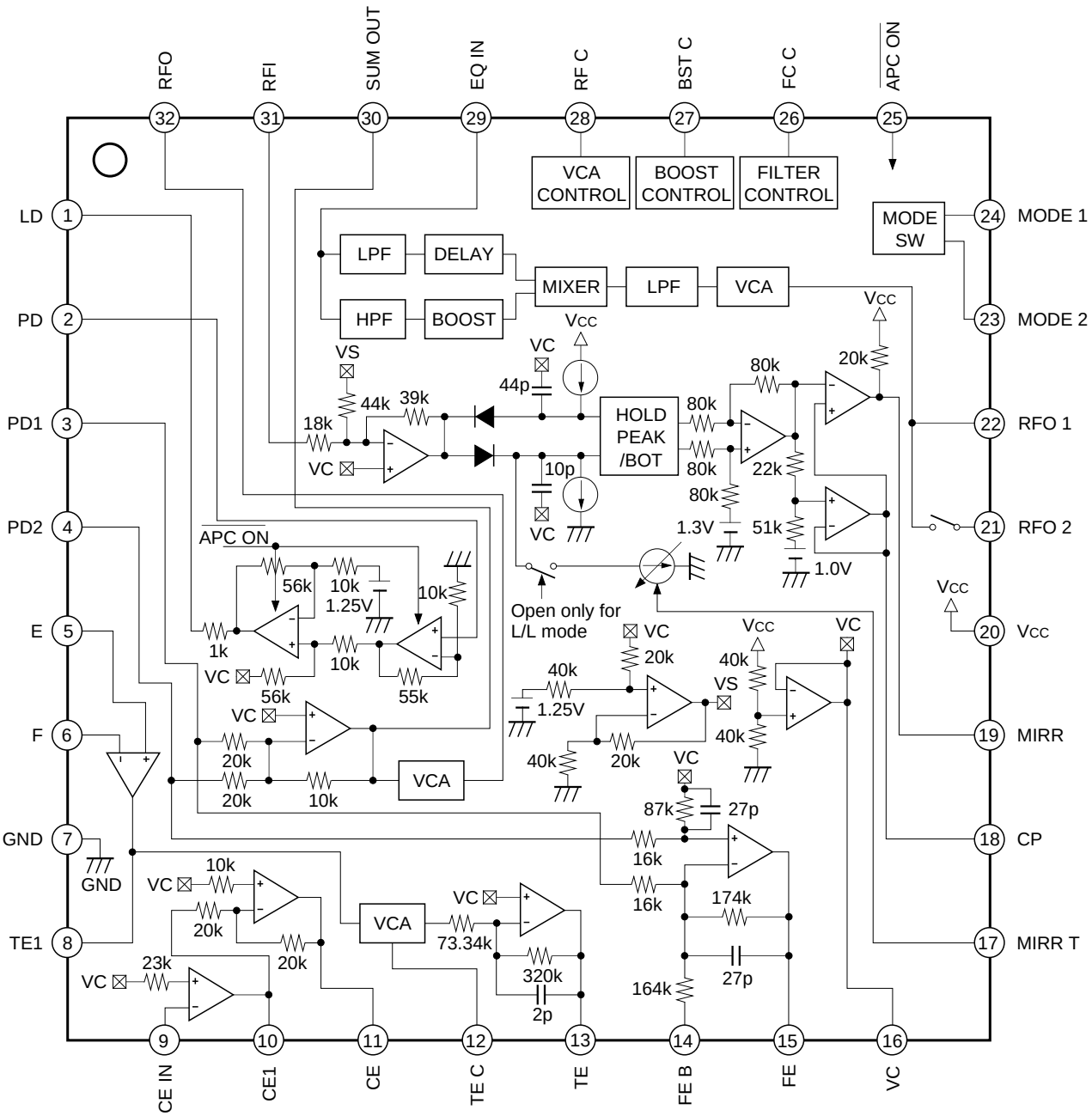
Applications

- CD players
- CD-ROM drives

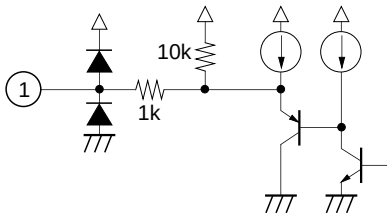
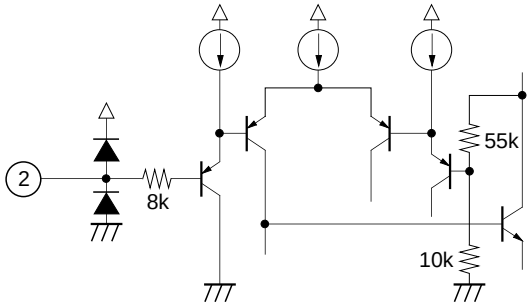
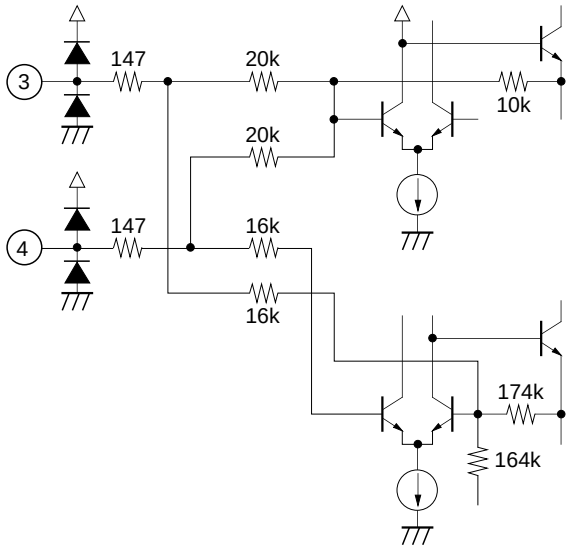
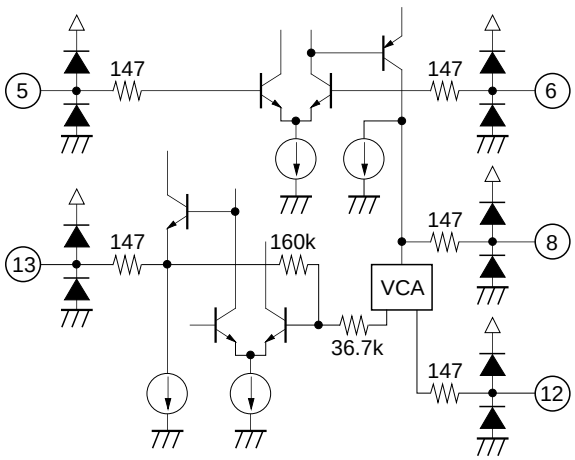
Functions

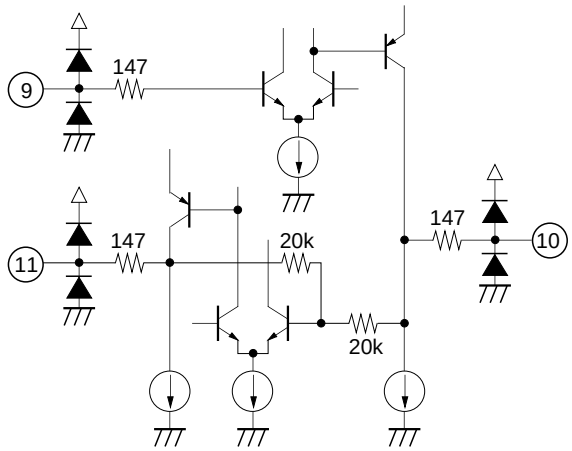
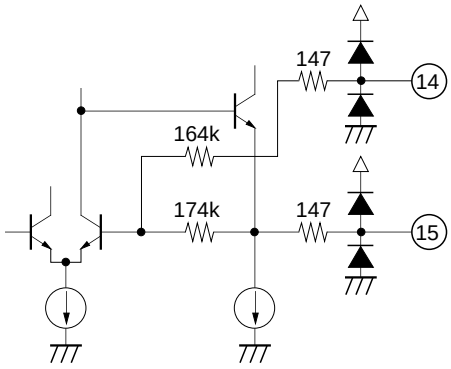
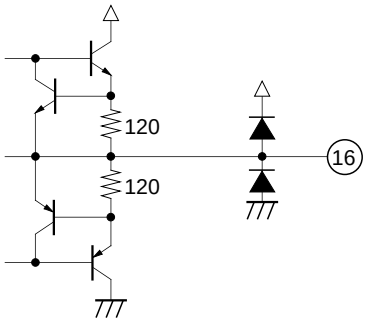
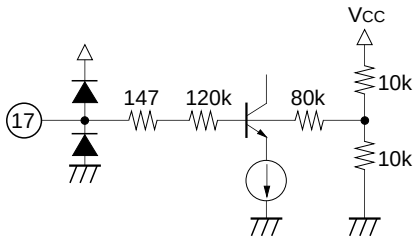
- RF summing amplifier
- RF equalizer
- Focus error amplifier
- Tracking error amplifier
- Center error amplifier
- Mirror detection function
- APC circuit

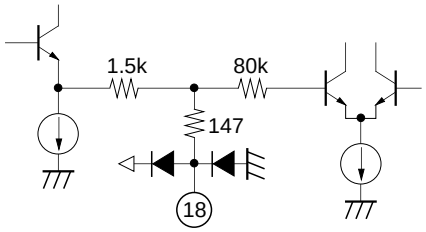
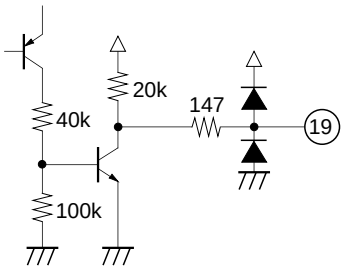
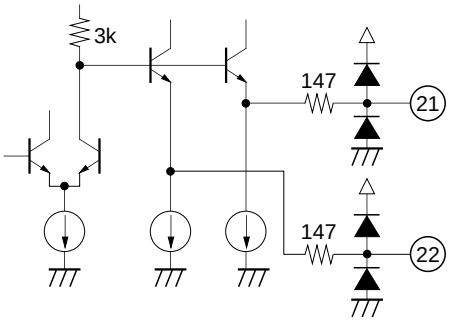
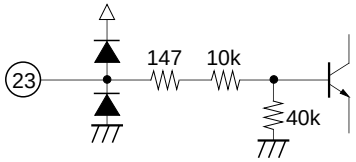
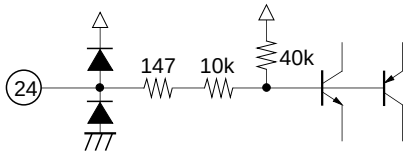
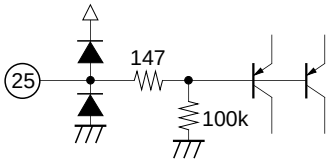
Block Diagram

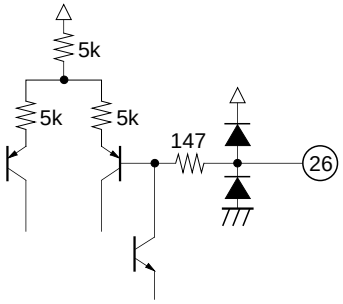
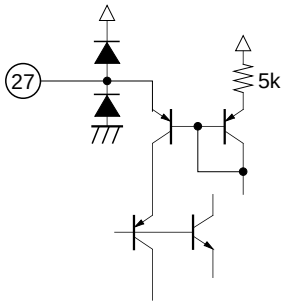
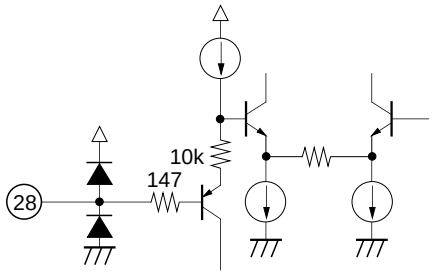
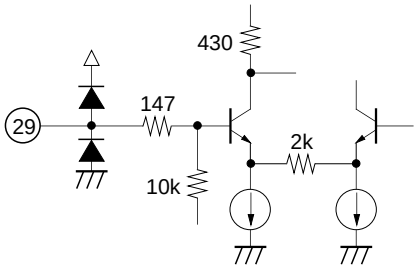
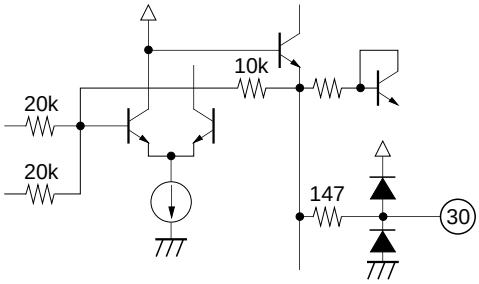


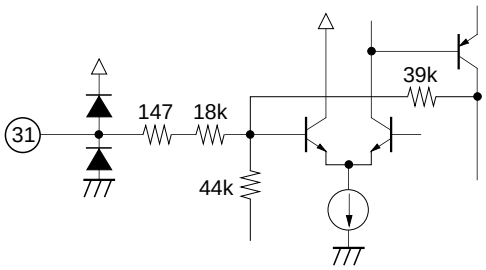
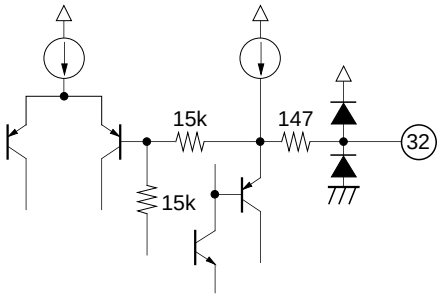
Pin Description

Pin No.	Symbol	I/O	Equivalent circuit	Description
1	LD	O		APC amplifier output.
2	PD	I		APC amplifier input.
3 4	PD1 PD2	I I		Input of RF summing amplifier and focus error amplifier.
7	GND			Ground.
5 6 8 12 13	E F TE1 TE C TE	I I O I O		Tracking error amplifier input for Pins 5 and 6; tracking error amplifier output for Pin 8; tracking error amplifier low-frequency gain setting for Pin 12; tracking error amplifier output for Pin 13.

Pin No.	Symbol	I/O	Equivalent circuit	Description
9 10 11	CE IN CE1 CE	I O O		Center error amplifier input for pin 9; inverting amplifier output for pin 10; non-inverting amplifier output for pin 11.
14 15	FE B FE	O O		Focus bias adjustment for Pin 14; focus error amplifier output for Pin 15.
16	VC	O		(Vcc + GND)/2 DC voltage output.
17	MIRR T	I		Peak hold time constant adjustment.

<table>
<tr><th>Pin No.</th><th>Symbol</th><th>I/O</th><th>Equivalent circuit</th><th>Description</th></tr>
<tr><td>18</td><td>CP</td><td>I</td><td> 
</td><td>Connects a mirror hold capacitor.
Non-inverted input of mirror comparator.</td></tr>
<tr><td>19</td><td>MIRR</td><td>O</td><td> 
</td><td>Mirror comparator output.</td></tr>
<tr><td>20</td><td>Vcc</td><td></td><td></td><td>Power supply.</td></tr>
<tr><td>21
22</td><td>RFO 2
RFO 1</td><td>O
O</td><td> 
</td><td>Buffer switch output for the RF time constant setting for Pin 21.
ON when Pins 23 and 24 are connected to GND.
EQ signal output for Pin 22.</td></tr>
<tr><td>23</td><td>MODE 2</td><td>I</td><td> 
</td><td rowspan="2">Double-speed mode switching input.
<table><tr><th></th><th>Mode 1</th><th>Mode 2</th></tr><tr><td>× 1</td><td>GND</td><td>GND</td></tr><tr><td>× N</td><td>Vcc</td><td>GND</td></tr><tr><td>× 1.5N</td><td>GND</td><td>Vcc</td></tr><tr><td>× 2.0N</td><td>Vcc</td><td>Vcc</td></tr></table>N is varied according to the external resistor connected to Pin 26.</td></tr>
<tr><td>24</td><td>MODE 1</td><td>I</td><td> 
</td></tr>
<tr><td>25</td><td>$\overline{\text{APC ON}}$</td><td>I</td><td> 
</td><td>Switching pin for APC amplifier ON/OFF.
OFF when connected to Vcc;
ON when connected to GND.</td></tr>
</table>

Pin No.	Symbol	I/O	Equivalent circuit	Description
26	FC C	I		Input to set the RF equalizer LPF cut-off frequency.
27	BST C	I		Sets the high-frequency boost amount of RF equalizer.
28	RF C	I		Sets the low-frequency gain of RF amplifier and RF equalizer.
29	EQ IN	I		RF equalizer input.
30	SUM OUT	O		RF summing amplifier output inversion.

Pin No.	Symbol	I/O	Equivalent circuit	Description
31	RFI	I		Mirror circuit input. The RF summing amplifier output is input.
32	RFO	O		RF signal output. Eye pattern check point.

Electrical Characteristics

(Ta = 25°C, V_{CC} = 2.5V, GND = Vc, V_{EE} = –2.5V)

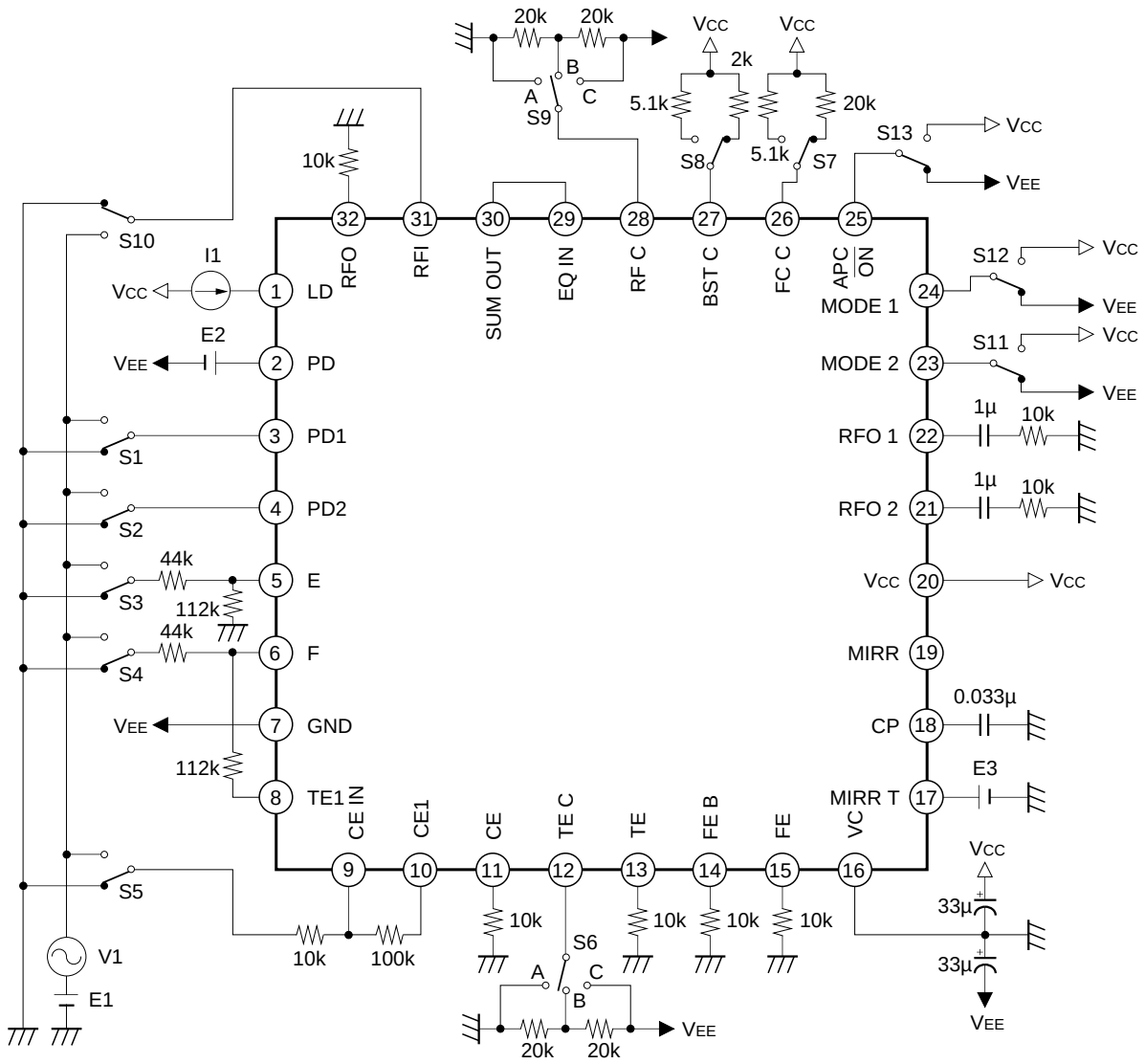
No.		Measurement item	Symbol	SW conditions													Bias conditions			Measure-ment point	Description of output waveform and measurement method	Min.	Typ.	Max.	Unit
				S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	E1	E2	E3						
1		Current consumption	ICC						B			B					0V	0.3V	0V	20	DC current measurement	18.5	30	43.5	mA
2		Current consumption	IEE						↓			↓					↓	↓	↓	7	DC current measurement	–43.5	–30	–18.5	mA
5	RF DC amplifier	Offset voltage	V1-1						↓			↓					↓	↓	↓	32	DC current measurement	–65	140	275	mV
6	RF DC amplifier	Voltage gain	G1-1	O	O				↓			↓					↓	↓	↓	32	V1 = 100mVp-p f = 100kHz	16	19	22	dB
7	RF DC amplifier	VCA gain 1	G1-2	O	O				↓			C					↓	↓	↓	32	V1 = 100mVp-p, f = 100kHz Difference for G1-1	–11.5	–8	–4.5	dB
8	RF DC amplifier	VCA gain 2	G1-3	O	O				↓			A					↓	↓	↓	32	V1 = 100mVp-p, f = 100kHz Difference for G1-1	4.5	8	11.5	dB
9	RF DC amplifier	Frequency response	F1-1	O	O				↓			B					↓	↓	↓	32	V1 = 100mVp-p, f = 10MHz Difference for G1-1	–3	—	—	dB
10	RF DC amplifier	Maximum output amplitude H	V1-2	O	O				↓			↓					300mV	↓	↓	32	DC voltage measurement	1.75	2.25	—	V
11	RF DC amplifier	Maximum output amplitude L	V1-3	O	O				↓			↓					–300mV	↓	↓	32	DC voltage measurement	—	–1.6	–0.95	V
12	FE amplifier	Offset voltage	V2-1						↓			↓					0V	↓	↓	15	DC voltage measurement	–60	0	60	mV
13	FE amplifier	Voltage gain 1	G2-1	O					↓			↓					↓	↓	↓	15	V1 = 100mVp-p f = 1kHz	17.5	20.5	23.5	dB
14	FE amplifier	Voltage gain 2	G2-2		O				↓			↓					↓	↓	↓	15	V1 = 100mVp-p f = 1kHz	17.5	20.5	23.5	dB
15	FE amplifier	Voltage gain difference	G2-3						↓			↓					↓	↓	↓	15	G2-1 – G2-2	–2.5	0	2.5	dB
16	FE amplifier	Frequency response 1	F2-1	O					↓			↓					↓	↓	↓	15	V1 = 100mVp-p, f = 20kHz Difference for G2-1	–3	—	—	dB
17	FE amplifier	Frequency response 2	F2-2		O				↓			↓					↓	↓	↓	15	V1 = 100mVp-p, f = 20kHz Difference for G2-2	–3	—	—	dB
18	FE amplifier	Maximum output amplitude H	V2-2		O				↓			↓					300mV	↓	↓	15	DC voltage measurement	1.9	2.4	—	V
19	FE amplifier	Maximum output amplitude L	V2-3	O					↓			↓					300mV	↓	↓	15	DC voltage measurement	—	–2.3	–1.7	V

No.		Measurement item	Symbol	SW conditions													Bias conditions			Measure-ment point	Description of output waveform and measurement method	Min.	Typ.	Max.	Unit
				S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	E1	E2	E3						
20	TE amplifier	Offset voltage	V3-1						B			B					0V	0.3V	0V	13	DC voltage measurement	–60	30	150	mV
21		Voltage gain 1	G3-1			O														13	V1 = 100mVp-p f = 1kHz	17.9	20.9	23.9	dB
22		Voltage gain 2	G3-2				O													13	V1 = 100mVp-p f = 1kHz	17.9	20.9	23.9	dB
23		Voltage gain difference	G3-3						↓											13	G3-1 – G3-2	–2.0	0	2.0	dB
24		VCA gain 1	G3-4			O			C											13	V1 = 100mVp-p, f = 1kHz	11.9	14.9	17.9	dB
25		VCA gain 2	G3-5			O			A											13	V1 = 100mVp-p, f = 1kHz	23.9	26.9	29.9	dB
26		Frequency response 1	F3-1			O			B											13	V1 = 100mVp-p, f = 20kHz Difference for G3-1	–3	—	—	dB
27		Frequency response 2	F3-2				O													13	V1 = 100mVp-p, f = 20kHz Difference for G3-2	–3	—	—	dB
28		Frequency response 3	F3-3			O								O	O					13	V1 = 100mVp-p, f = 180kHz Difference for G3-1	–3	—	—	dB
29		Frequency response 4	F3-4				O							O	O		↓			13	V1 = 100mVp-p, f = 180kHz Difference for G3-2	–3	—	—	dB
30		Maximum output amplitude H	V3-2				O										300mV			13	DC voltage measurement	1.9	2.4	—	V
31		Maximum output amplitude L	V3-3			O											300mV			13	DC voltage measurement	—	–2.2	–1.7	V
32	CE amplifier	Offset voltage	V4-1														0V			11	DC voltage measurement	–90	65	200	mV
33		Voltage gain 1	G4-1					O												11	V1 = 100mVp-p, f = 1kHz Difference for G2-1	17	20	23	dB
34		Frequency response 1	F4-1					O									↓			11	V1 = 100mVp-p, f = 20kHz Difference for G3-1	–3	—	—	dB
35		Maximum output amplitude H	V4-2					O									300mV			11	DC voltage measurement	0.85	1.7	—	V
36		Maximum output amplitude L	V4-3					O	↓			↓					300mV	↓	↓	11	DC voltage measurement	—	–2.1	–0.85	V

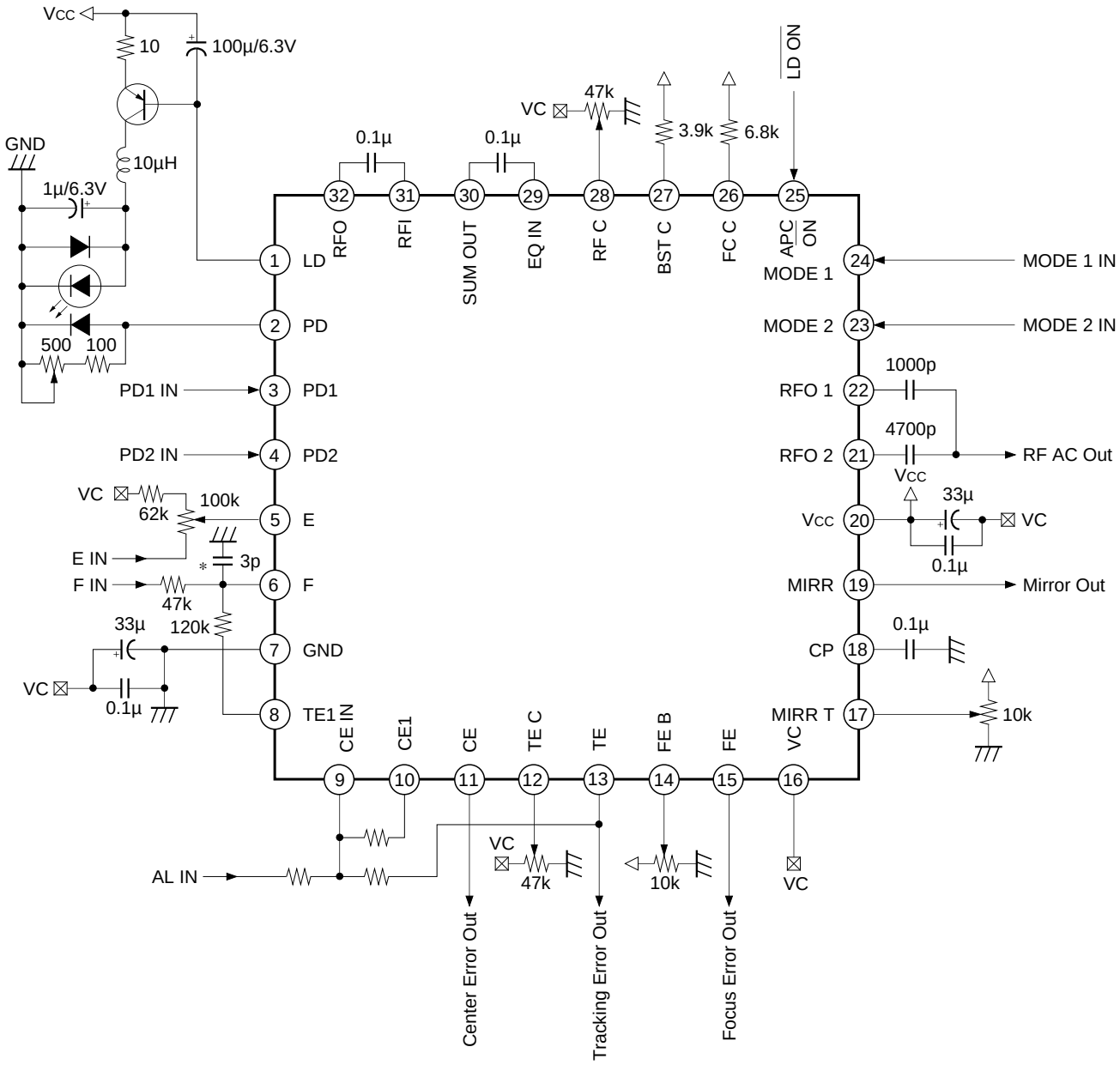
No.		Measurement item	Symbol	SW conditions													Bias conditions			Measure-ment point	Description of output waveform and measurement method	Min.	Typ.	Max.	Unit
				S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	E1	E2	E3						
37	RFAC Amplifier (RF Equalizer + Sum Amplifier)	Offset voltage	V5-1						B			B					0V	0.3V	0V	22		0.25	0.75	1.15	V
38		Offset voltage	V5-2						↓			↓					↓	↓	↓	21		0.25	0.8	1.15	V
39		Voltage gain 1	G5-1	O	O				↓			↓					↓	↓	↓	22	V1 = 25mVp-p, f = 100kHz	17	22.5	26.5	dB
40		VCA gain 1	G5-2	O	O				↓			A					↓	↓	↓	22	V1 = 25mVp-p, f = 100kHz Difference for G5-1	4.5	8	10.5	dB
41		Boost gain	G5-3	O	O				↓		O	B					↓	↓	↓	22	V1 = 100mVp-p, f = 2MHz Difference for G5-1	1.5	4	6.5	dB
42		Frequency response 1	F5-1	O	O				↓			↓					↓	↓	↓	22	V1 = 25mVp-p, f = 1MHz Difference for G1-1	–3	—	—	dB
43		Frequency response 2	F5-2	O	O				↓	O		↓			O		↓	↓	↓	22	V1 = 25mVp-p, f = 10MHz Difference for G1-1	–3	—	—	dB
44		Frequency response 3	F5-3	O	O				↓	O		↓		O			↓	↓	↓	22	V1 = 25mVp-p, f = 15MHz Difference for G1-1	–3	—	—	dB
45		Frequency response 4	F5-4	O	O				↓	O		↓		O	O		↓	↓	↓	22	V1 = 25mVp-p, f = 20MHz Difference for G1-1	–3	—	—	dB
46		Maximum output amplitude H	V5-3	O	O				↓	↓	↓	↓	↓	↓	↓	↓	300mV	↓	↓	22	V5-3 – V5-1	0.45	0.85	—	V
47		Maximum output amplitude L	V5-4	O	O				↓	↓	↓	↓	↓	↓	↓	↓	–300mV	↓	↓	22	V5-1 – V5-4	0.45	0.9	—	V
48		Output noise	VN						↓	↓	↓	↓	↓	↓	↓	↓	0V	↓	↓	22	HPF = 400Hz, LPF = 3MHz	—	—	6	mV
50	MIRR	High level output voltage	V6-1						↓	↓	↓	↓	O	↓	↓	↓	–400mV	↓	↓	19	V1 = 0.8Vp-p, f = 10kHz	1.8	—	—	V
51		Low level output voltage	V6-2						↓	↓	↓	↓	O	↓	↓	↓	–400mV	↓	↓	19	V1 = 0.8Vp-p, f = 10kHz	—	—	–2.2	V
52		Mirror hold frequency response	F6-1						↓	↓	↓	↓	O	↓	↓	↓	–200mV	↓	↓	19	V1 = 0.8Vp-p, 55% AM Mod.	—	400	600	Hz
53		Bottom hold frequency response	F6-2						↓	↓	↓	↓	O	↓	↓	↓	–400mV	↓	↓	19	V1 = 800mVp-p	—	550	900	Hz
54		Maximum operating frequency 1	F6-3						↓	↓	↓	↓	O	↓	↓	↓	–400mV	↓	↓	19	V1 = 800mVp-p	40	—	—	kHz
55		Maximum operating frequency 2	F6-4						↓	↓	↓	↓	O	O	O	↓	–400mV	↓	1.0V	19	V1 = 800mVp-p	250	—	—	kHz
56		Minimum input voltage	V6-3						↓	↓	↓	↓	O	↓	↓	↓	–400mV	↓	0V	19	f (V1) = 10kHz	0.35	—	—	Vp-p
57		Maximum input voltage	V6-4						↓	↓	↓	↓	O	↓	↓	↓	–400mV	↓	↓	19	f (V1) = 10kHz	—	—	1.8	Vp-p

No.	Measurement item		Symbol	SW conditions													Bias conditions			Measure-ment point	Description of output waveform and measurement method	Min.	Typ.	Max.	Unit
				S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	E1	E2	E3						
58	APC	Output voltage 1	V7-1						B			B					0V	69mV	0V	1	DC voltage measurement	—	–1.6	–0.9	V
59		Output voltage 2	V7-2															123mV		1	DC voltage measurement	–1.2	–0.35	1.4	V
60		Output voltage 3	V7-3															177mV		1	DC voltage measurement	0.3	1.6	—	V
61		Output voltage 4	V7-4													O		0V		1	DC voltage measurement	1.8	2.4	—	V
62		Output voltage 5	V7-5															0V		1	I1 = 0.8mADC DC voltage measurement	—	–0.9	0	V
63	VC	Output voltage	VC						▼			▼					▼	0.3V	▼	16	DC voltage measurement	–0.1	0	0.1	V

Electrical Characteristics Measurement Circuit



Application Circuit



Application circuits shown are typical examples illustrating the operation of the devices. Sony cannot assume responsibility for any problems arising out of the use of these circuits or for any infringement of third party patent and other right due to same.

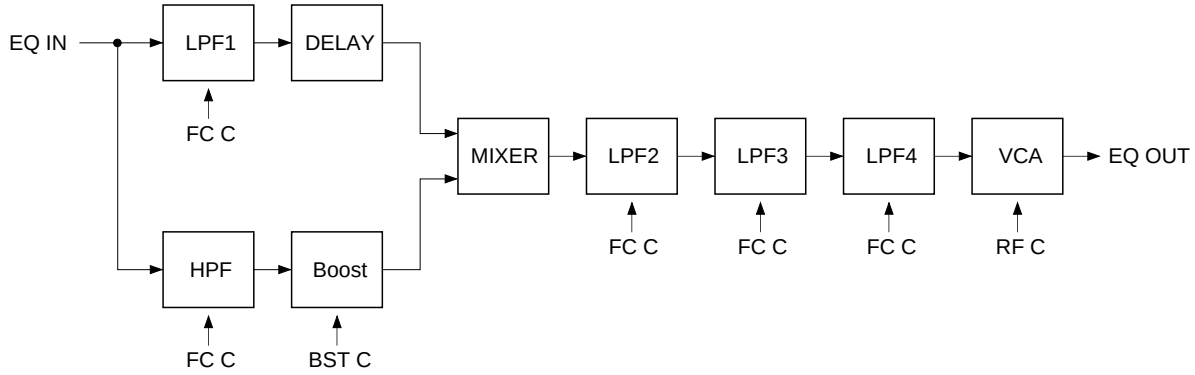
Description of Functions

RF Block

The RF signal processing is performed by this circuit.
The output is separated to AC and DC. The AC is the capacitance-coupled input via the equalizer circuit and used for the EFM demodulation signal processing. The DC contains the DC component and is used for the mirror, defect and FOK signal processings.

The VCA function is provided for both the AC and DC signal processing systems. Pin 28 is the control voltage input pin. (See the characteristics graphs on page 19 and page 20 for the gain and control voltage.)

RF Equalizer Block Diagram is as shown below:



The equalizer function is provided for the AC signal processing system for the EFM signal demodulation.
The each filter is constructed in the Bessel type which has the little group delay difference.
The boost frequency and boost amount can be set by the external resistors connected to Pins 26 and 27.
(See the characteristics graphs on page 19 for the boost frequency and boost amount.)

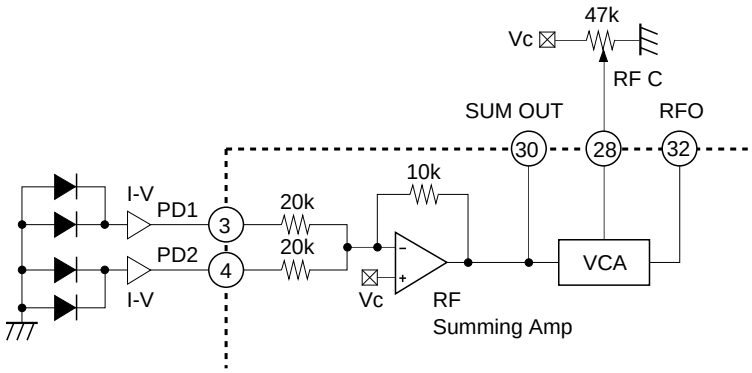
The transmittance for each filter is as follows:

HPF: $(KS^2) / (S^2 + 3.22597S + 2.94933)$
LPF1: $(2.94933) / (S^2 + 3.22597S + 2.94933)$
LPF2: $(3.32507) / (S^2 + 2.75939S + 3.32507)$
LPF3: $(4.20534) / (S^2 + 1.82061S + 4.20534)$
LPF4: $(1.68536) / (S + 1.68536)$

RF DC Amplifier

The signal currents from the photodiodes A, B, C and D are I-V converted and input to Pins 3 and 4 as PD1 = A + C, PD2 = B + D.

These signals are added by the RF summing amplifier, inverted by the RF drive amplifier and output to Pin 32. The VCA control voltage on Pin 28 is used for the gain adjustment.

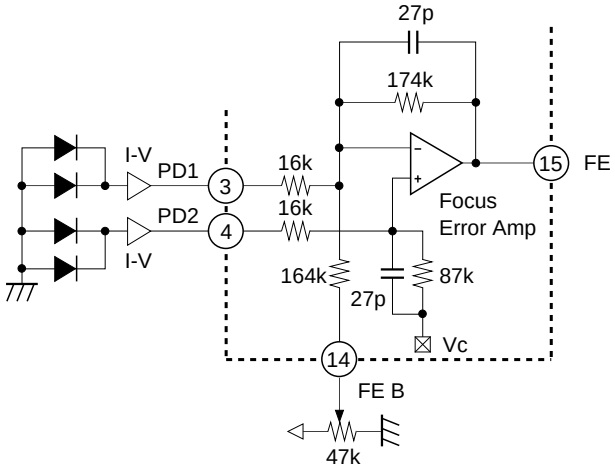


The low frequency component of the RFO output voltage is as follows:

$V_{RFO} = 4.9 \times (PD1 + PD2)$ (RFC voltage = 1/2 VC)

Focus Error Amplifier

The operation of PD2-PD1 is performed and the resulting signal is output to Pin 15.



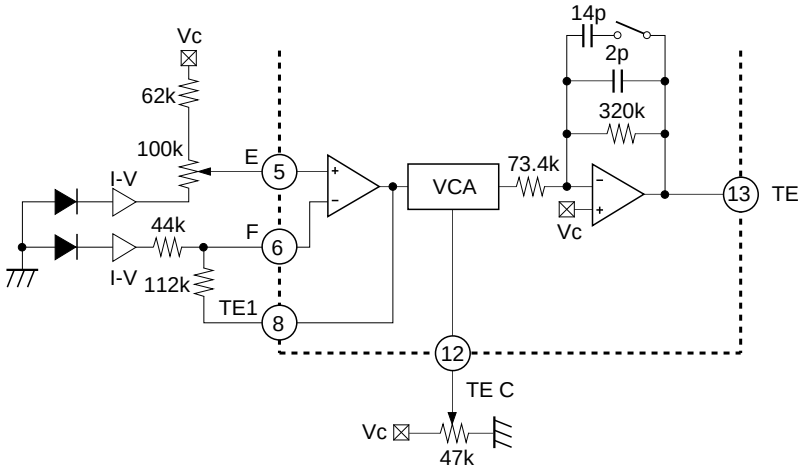
The low frequency component of the FE output voltage is as follows:

$$V_{FE} = \frac{174k}{16k} \times (PD2 - PD1)$$

$$= 10.9 \times (PD2 - PD1)$$

Tracking Error Amplifier

The signal current from the photodiode F is I-V converted and input to Pin 6 via the input resistor. The signal current from the photodiode E is I-V converted and input to Pin 5 after its gain is adjusted by the volume. These signals undergo operational amplification at the tracking error amplifier, VCA and tracking drive amplifier and they are output to Pin 13.



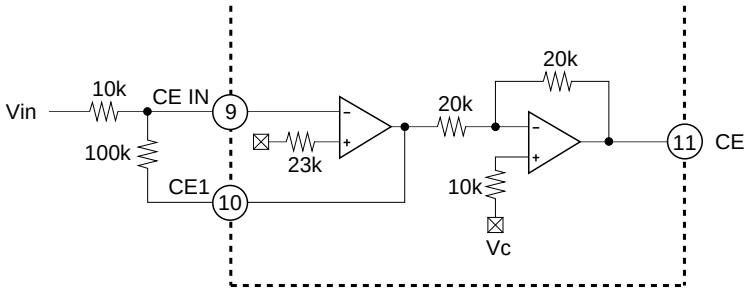
The low frequency component of the TE output voltage is as follows:

$$V_{TE} = \frac{112k}{44k} \times \frac{320k}{73.4k} \times (F - E)$$

$$= 11.1 \times (F - E) \qquad \text{(TEC voltage = 1/2 VC)}$$

Center Error Amplifier

The input signal is operational amplified by the center error amplifier and center drive amplifier after passing via the input resistor and then it is output to Pin 11.



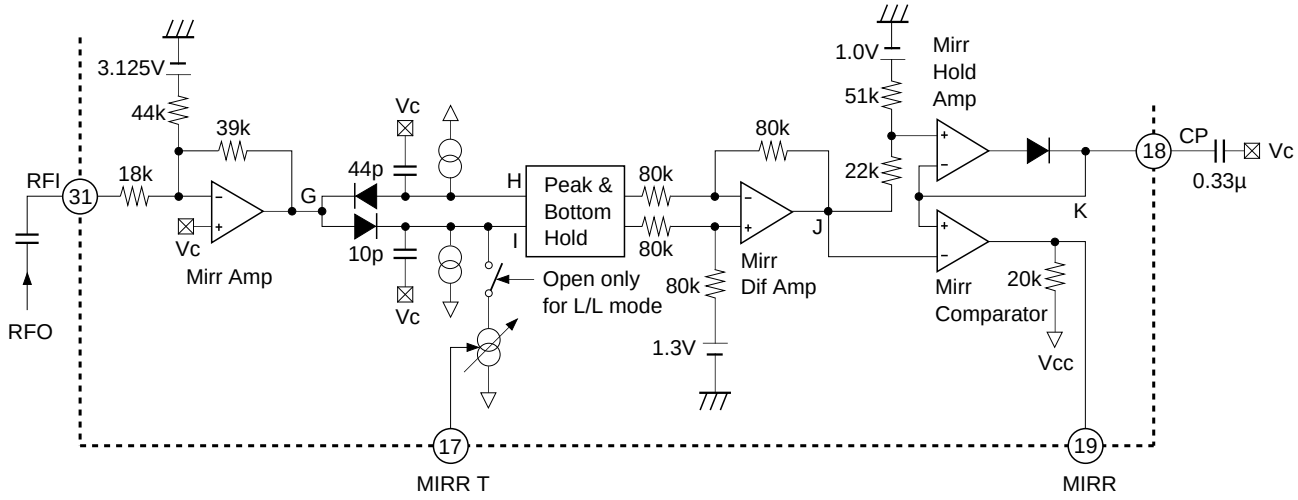
The low frequency component of the CE output voltage is as follows:

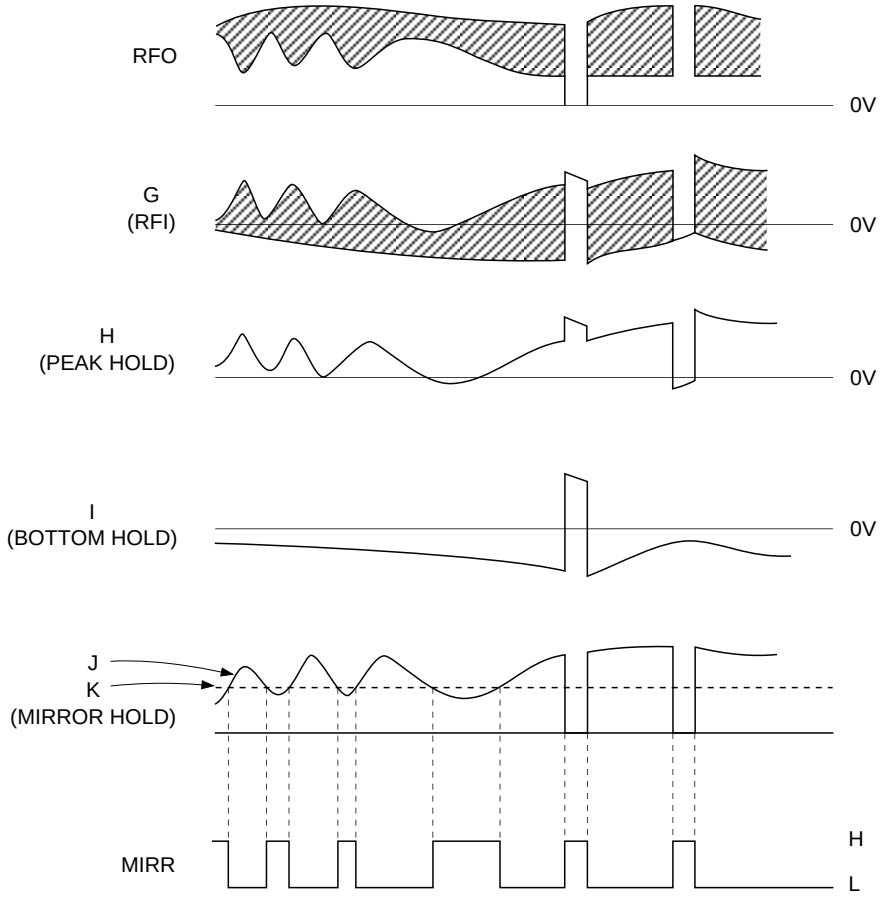
$$V_{CE} = \frac{100k}{10k} \times \frac{20k}{20k} \times Vin$$

$$= 10 \times Vin$$

Mirror Circuit

The mirror circuit performs peak and bottom hold after RFI signal has been amplified. The peak hold is executed with the time constant which follows the traverse signal of 100kHz for L/L mode (both of Pins 23 and 24 are connected to GND) and maximum 600kHz (adjustable with the DC voltage on Pin 17) for L/H, H/L, H/H modes. The bottom hold is executed with the time constant which follows the rotation cycle envelope fluctuation.

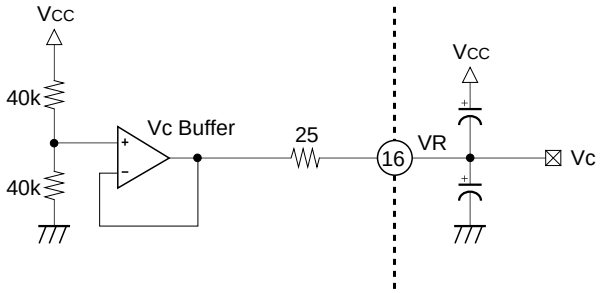




The mirror signal is output by comparing to the signal K (2/3 level of the J peak value which is peak-held with a large time constant) where the difference of hold signals H and I is obtained. The mirror output is low for tracks on the disc and high for the area between tracks (the mirror areas). In addition, a high signal is output when a defect is detected. The mirror hold time constant must be sufficiently large in comparison with the traverse signal.

Center Voltage Generation Circuit

The center voltage of VR = (Vcc + GND)/2 is supplied. The maximum current is approximately ±3mA

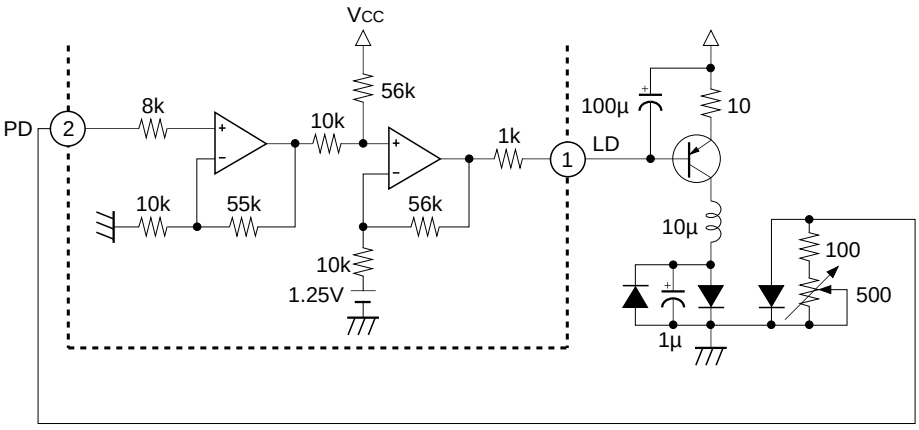


APC Circuit

When the laser diode is driven by a constant current, the optical power output has extremely large negative temperature characteristics.

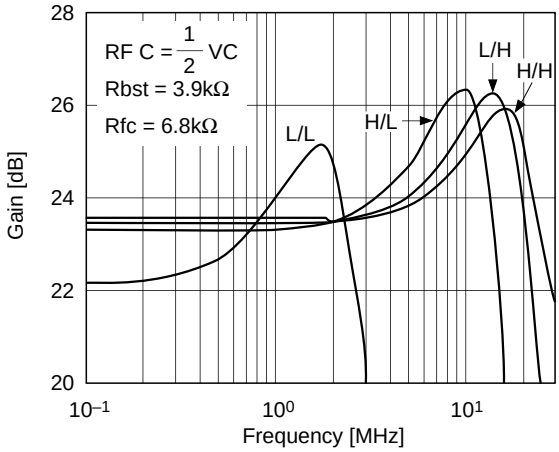
The APC circuit is used to maintain the optical power output at a constant level. The laser diode current is controlled according to the monitor photodiode output.

APC is ON by connecting $\overline{\text{APC\_ON}}$ pin to GND; it is OFF by connecting the pin to Vcc.

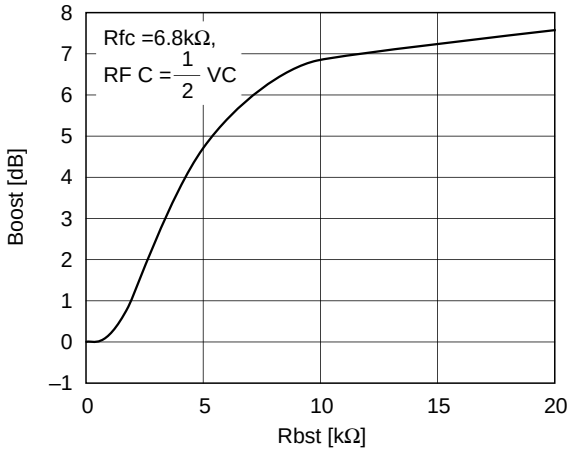


RF AC Characteristics Graphs (Pin 22)

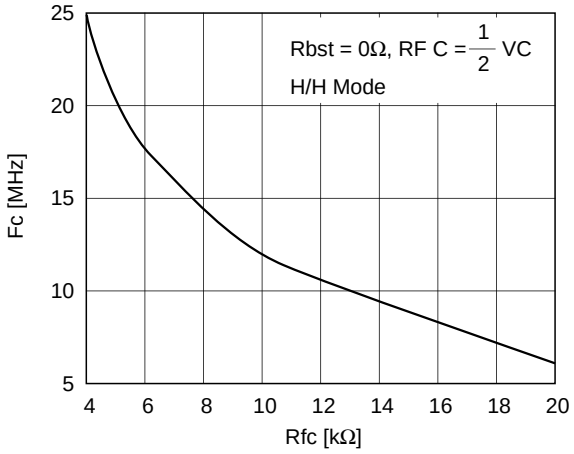
Frequency response



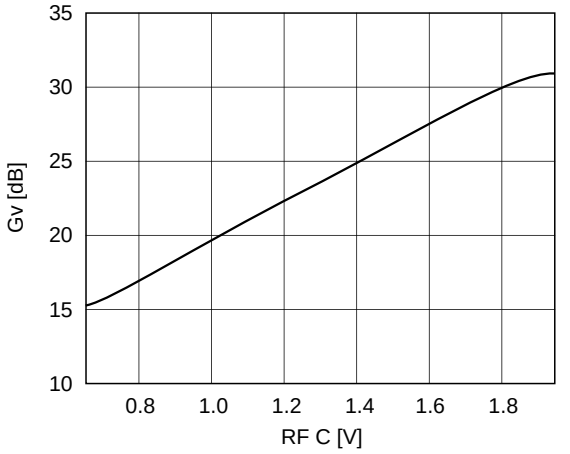
Boost gain characteristics



Cut-off frequency



VCA characteristics



Notes) In the graphs above,

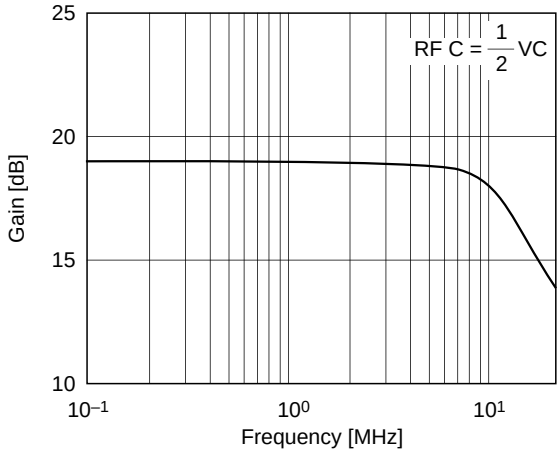
Rfc: FC C (pin 26) external resistor value

Rbst: BST C (pin 27) external resistor value

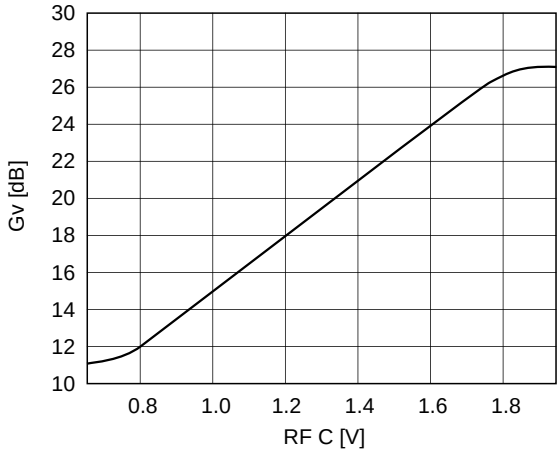
* To ensure stable operation, it is recommended to select Rfc value of 6.2kΩ and above, and Rbst of 10kΩ and below in all cases.

RF DC Characteristics Graphs (Pin 32)

Frequency response

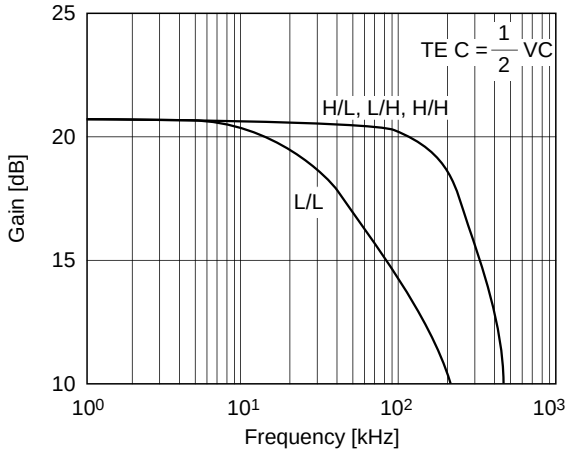


VCA characteristics

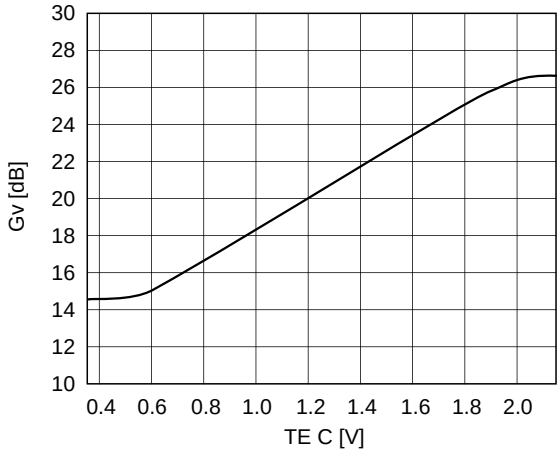


TE Characteristics Graphs (Pin 13)

Frequency response

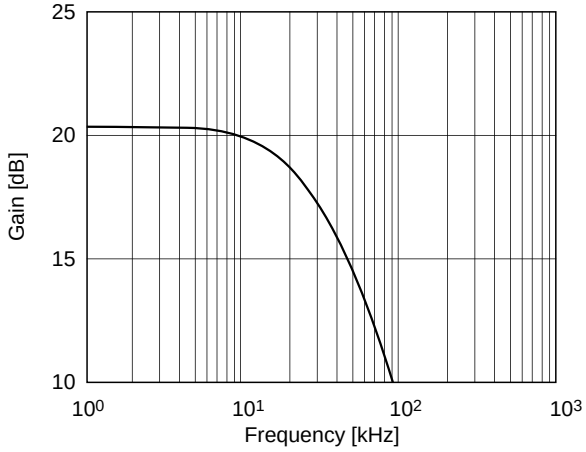


VCA characteristics



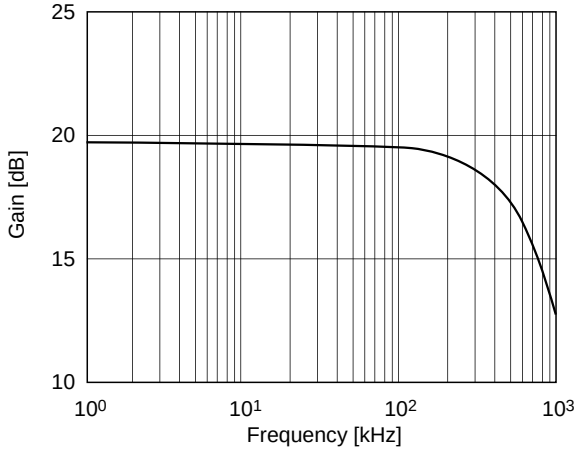
FE frequency response (Pin 15)

Frequency response



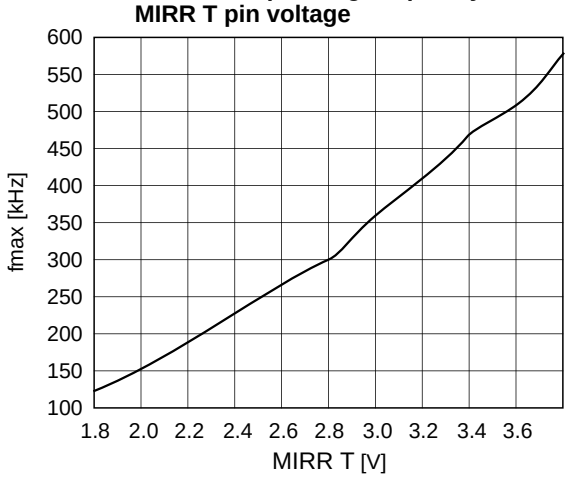
CE frequency response (Pin 11)

Frequency response



MIRROR Characteristics Graph (Pin 19)

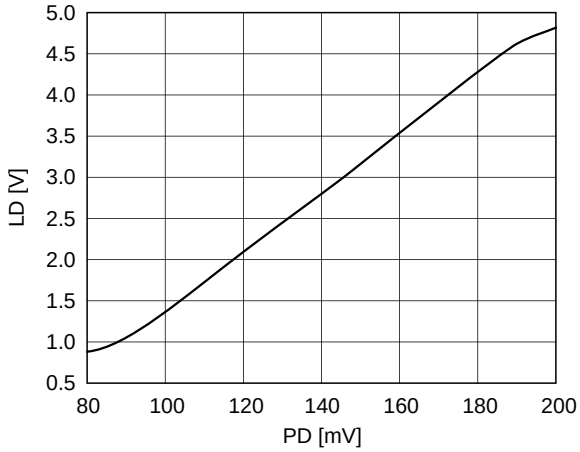
Maximum operating frequency vs. MIRR T pin voltage



Vin = –0.4V_{DC}, 800mVp-p
H/L, L/H, or H/H Mode

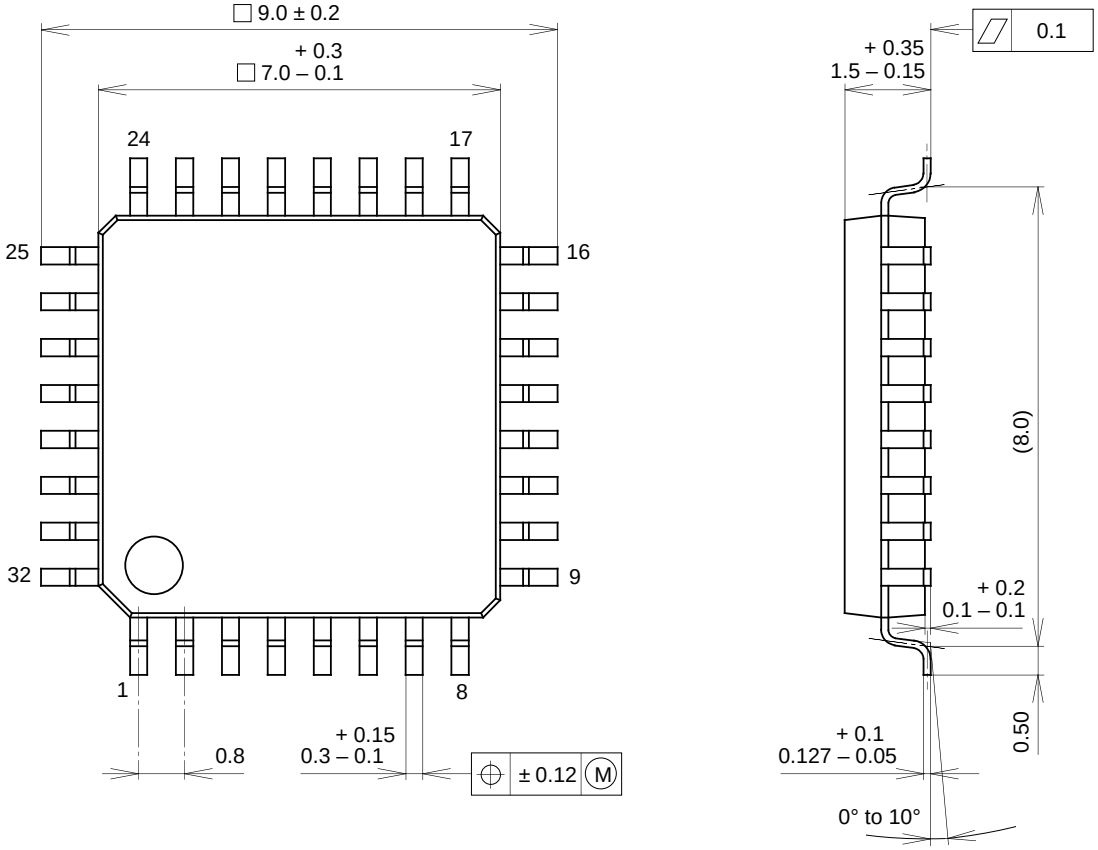
APC Characteristics Graph (Pin 1)

LD voltage vs. PD voltage



Package Outline Unit: mm

32PIN QFP (PLASTIC)



SONY CODE	QFP-32P-L01
EIAJ CODE	∗QFP032-P-0707-A
JEDEC CODE	————

PACKAGE MATERIAL	EPOXY RESIN
LEAD TREATMENT	SOLDER PLATING
LEAD MATERIAL	42 ALLOY
PACKAGE WEIGHT	0.2g