STRUCTURE	:	Silicon Monolithic Integrated Circuit
PRODUCT SERIES	:	Power driver for CD/DVD player
TYPE	:	BA5956FM
PACKAGE OUTLINES	:	Figure 1
POWER DISSIPATION	:	Figure 2
BLOCK DIAGRAM	:	Figure 3
APPLICATION	:	Figure 4
TEST CIRCUIT	:	Figure 5

◎ Features

○ 2 channel current feedback type driver, 3 channel BTL driver.
○ Employs the HSOP-M36 power package for compaction.
○ Has a wide dynamic range.
○ The thermal shutdown circuit is built.
○ Mute circuit is built in. (except for loading driver)
○ A power supply is divided into 4 systems.
【PreVcc, PowVcc1=actuator, PowVcc2=loading motor, PowVcc3=sled motor, spindle motor】

◎Absolute Maximum Rating (Ta=25℃)

Item	Symbol	Rating	Unit
Supply voltage	PreVcc,PowVcc	18	V
Power dissipation	Pd	2.2*1	W
Maximum output current	Iomax	1*2	A
Operating temperature range	Topr	-35～85	℃
Storage temperature range	Tstg	-55～150	℃

*1 Rating for 70 ㎜×70 ㎜(size), 1.6 ㎜(thickness), copper foil occupation ratio less than 3%, And use of glass-epoxy substrate.
When this IC is used above Ta=25℃, note that this rating decreases 17.6mW each time the temperature increases 1℃.

*2 This rating of permissible dissipation must not exceed ASO.

◎Operating Supply Range

PreVcc	4.5 ～ 14 （V）
PowVcc	4.5 ～ PreVcc （V）

● ELECTRICAL CHARACTERISTICS

(Unless otherwise noted, Ta=25℃, PreVcc=PowVcc3=12V, PowVcc1=PowVcc2=5V, BIAS=1.65V, RL=8Ω, Rd=0.5Ω,C=100pF)

Parameter	symbol	MIN	TYP	MAX	Unit	Condition	Test circuit
Quiescent current	IQ	—	34	44	mA		Figure.5
Voltage for mute ON	VMON	0	—	0.5	V		Figure.5
Voltage for mute OFF	VMOFF	2.0	—	—	V		Figure.5
<Actuator driver>							
Output offset current	IOOF	-6	0	6	mA		Figure.5
Maximum output voltage	VOM	3.6	4.0	—	V	VIN=±1.65V	Figure.5
Trans conductance	Gvc	1.5	1.8	2.1	A/V	VIN=BIAS±0.2V	Figure.5
<Sled motor driver pre OPAMP & OPAMP>							
Common mode input range	VICM	0.4	—	10.5	V		Figure.5
Input offset voltage	VIOFOP	-6	0	6	mV		Figure.5
Input bias current	IBOP	—	—	300	nA		Figure.5
Low level output voltage	VOLOP	—	0.2	0.5	V		Figure.5
Output source current	ISO	0.5	—	—	mA		Figure.5
Output sink current	ISI	0.5	—	—	mA		Figure.5
<Sled motor driver>							
Output offset voltage	VOOFSL	-50	0	50	mV		Figure.5
Maximum output voltage	VOMSL	8.0	9.5	—	V	VIN=±1.65V	Figure.5
Closed loop voltage gain	GVSL	17.6	19.6	21.6	dB	VIN=±0.2V	Figure.5
<Loading motor driver>							
Output offset voltage	VOOFLD	-50	0	50	mV		Figure.5
Maximum output voltage	VOMLD	3.5	4.0	—	V	VIN=±1.65V	Figure.5
Gain error by polarity	GVLD	15.7	17.7	19.7	dB	VIN=BIAS±0.2V	Figure.5
<Spindle motor driver>							
Output offset voltage	VOOFSP	-50	0	50	mV		Figure.5
Maximum output voltage	VOMS	8.0	9.5	—	V	VIN=±1.65V	Figure.5
Gain error by polarity	GVSP	15.7	17.7	19.7	dB	VIN=BIAS±0.2V	Figure.5

○ This product is not designed for protection against radioactive rays.

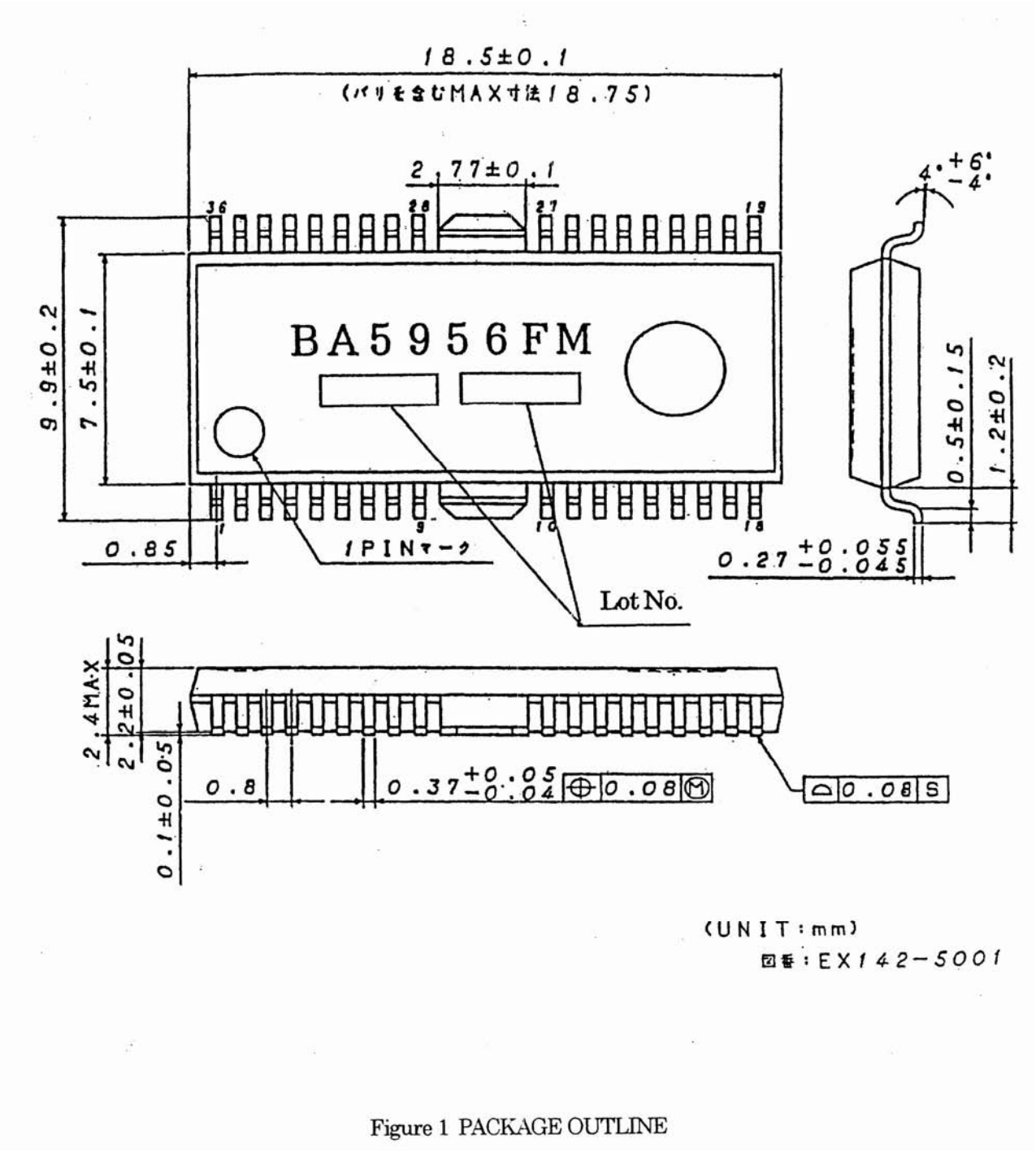
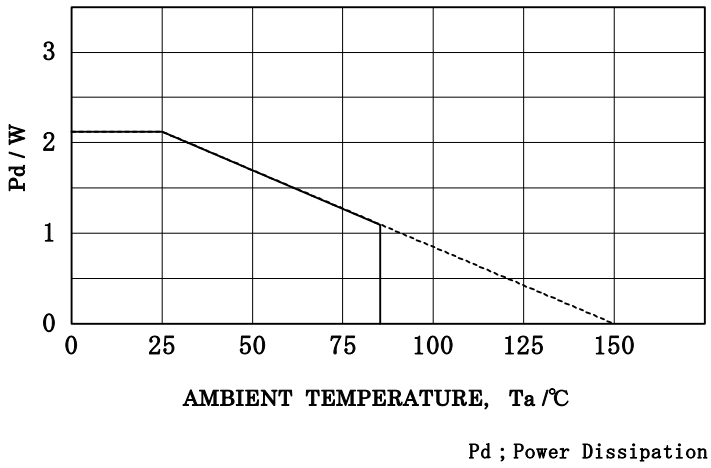


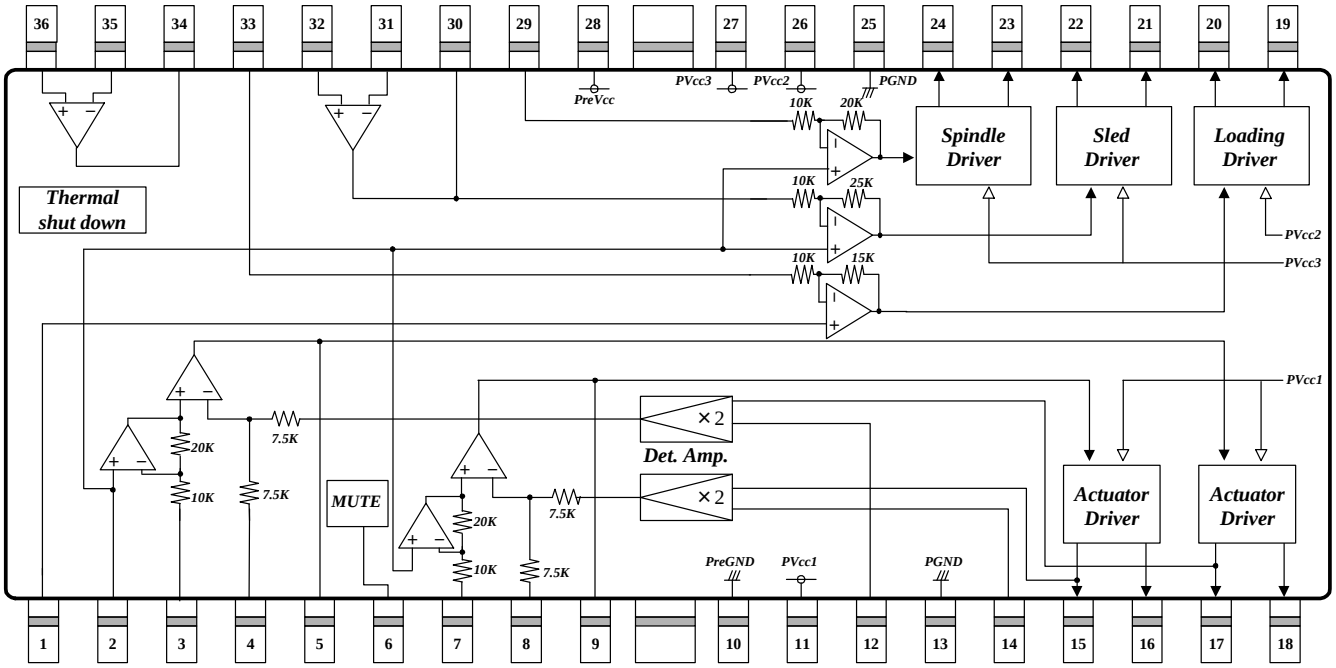
Figure 1 PACKAGE OUTLINE

Electrical characteristic curves



Rating for 70mm × 70mm(size), 1.6mm(thickness), copper foil occupation ratio less than 3%, and use of glass-epoxy substrate.

Figure 2 POWER DISSIPATION



Unit of resistance: Ω

Figure 3 BLOCK DIAGRAM

● Pin description

No	Pin name	Pin description	No	Pin name	Pin descrition
1	LDBIAS	Input for bias voltage (Loading driver)	19	VOLD (−)	Inverted output of loading
2	BIAS	Input for bias: voltage	20	VOLD (+)	Non inverted output of loading
3	FCIN	Input for focus driver	21	VOSL (−)	Inverted output of sled
4	CFCerr1	Connection with capacitor for error amplifier 1	22	VOSL (+)	Non inverted output of sled
5	CFCerr2	Connection with capacitor for error amplifier 2	23	VOSP (−)	Inverted output of spindle
6	MUTE	Input for mute control	24	VOSP (+)	Non inverted output of spindle
7	TKIN	Input for tacking driver	25	PGND2	GND for power block of loading, sled and spindle driver
8	CTKerr1	Connection with capacitor for error amplifier 1	26	PVcc2	Vcc for power block of loading driver
9	CTKerr2	Connection with capacitor for error amplifier 2	27	PVcc3	Vcc for power block of sled and spindle driver
10	PreGND	GND for pre-drive block	28	PreVcc	Vcc for pre-drive block
11	PVcc1	Vcc for power block of actuator	29	SPIN	Input for spindle driver
12	VNFFC	Feedback for focus driver	30	OPOUTSL	Sled Pre OP amplifier output
13	PGND1	GND for power block of actuator	31	OPINSL(−)	Sled Pre OP amplifier invert input
14	VNFTK	Feedback for tracking driver	32	OPINSL (+)	Sled Pre OP amplifier non invert input
15	VOTK(−)	Inverted output of tracking	33	LDIN	Input for loading driver
16	VOTK (+)	Non inverted output of tracking	34	OPOUT	OP amplifier output
17	VOFC(−)	Inverted output of focus	35	OPIN(−)	OP amplifier invert input
18	VOFC (+)	Non inverted output of focus	36	OPIN (+)	OP amplifier non invert input

notes) Symbol of + and - (output of drivers) means polarity to input pin.
(For example if voltage of pin3 is high , pin18 is high.)

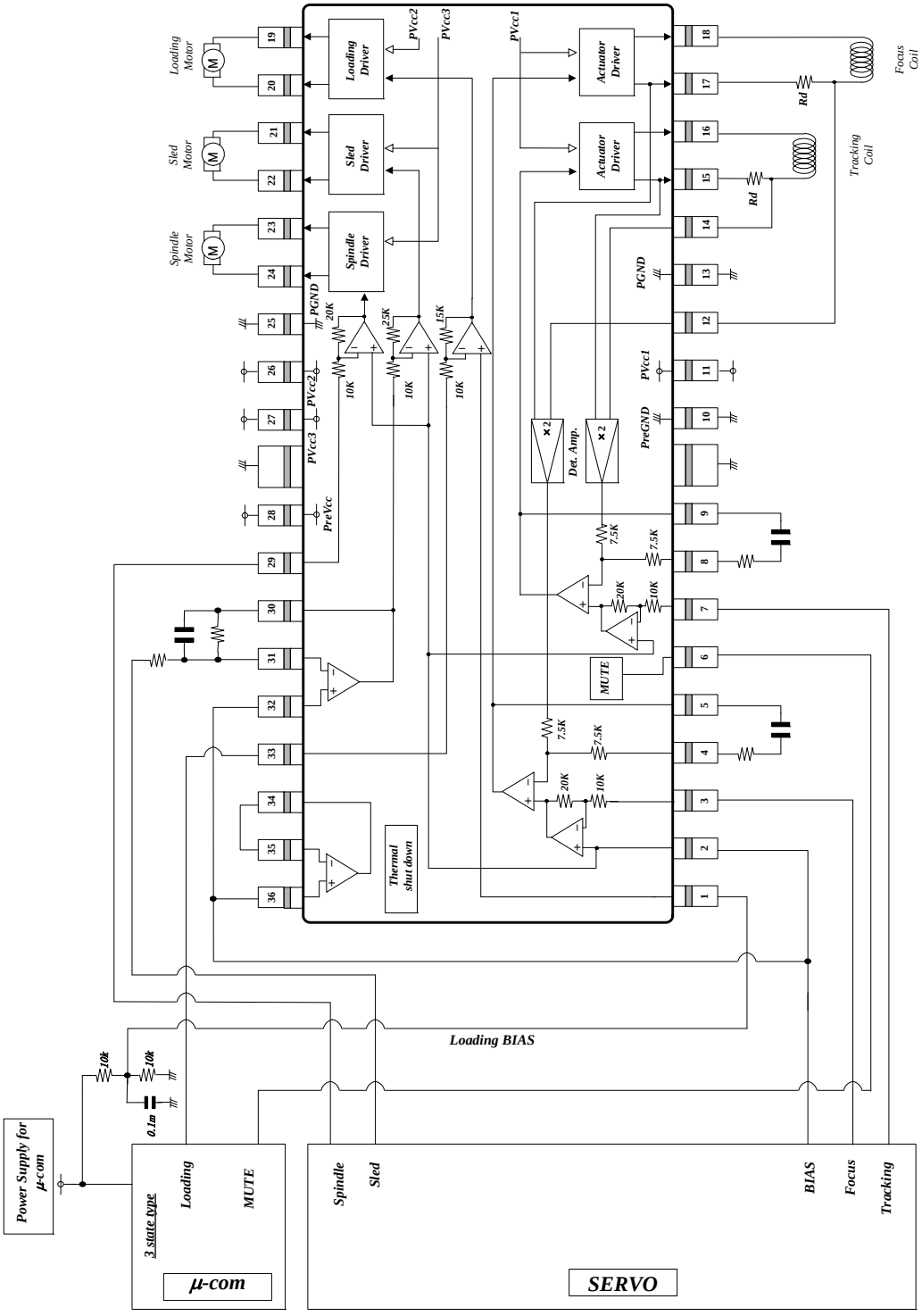
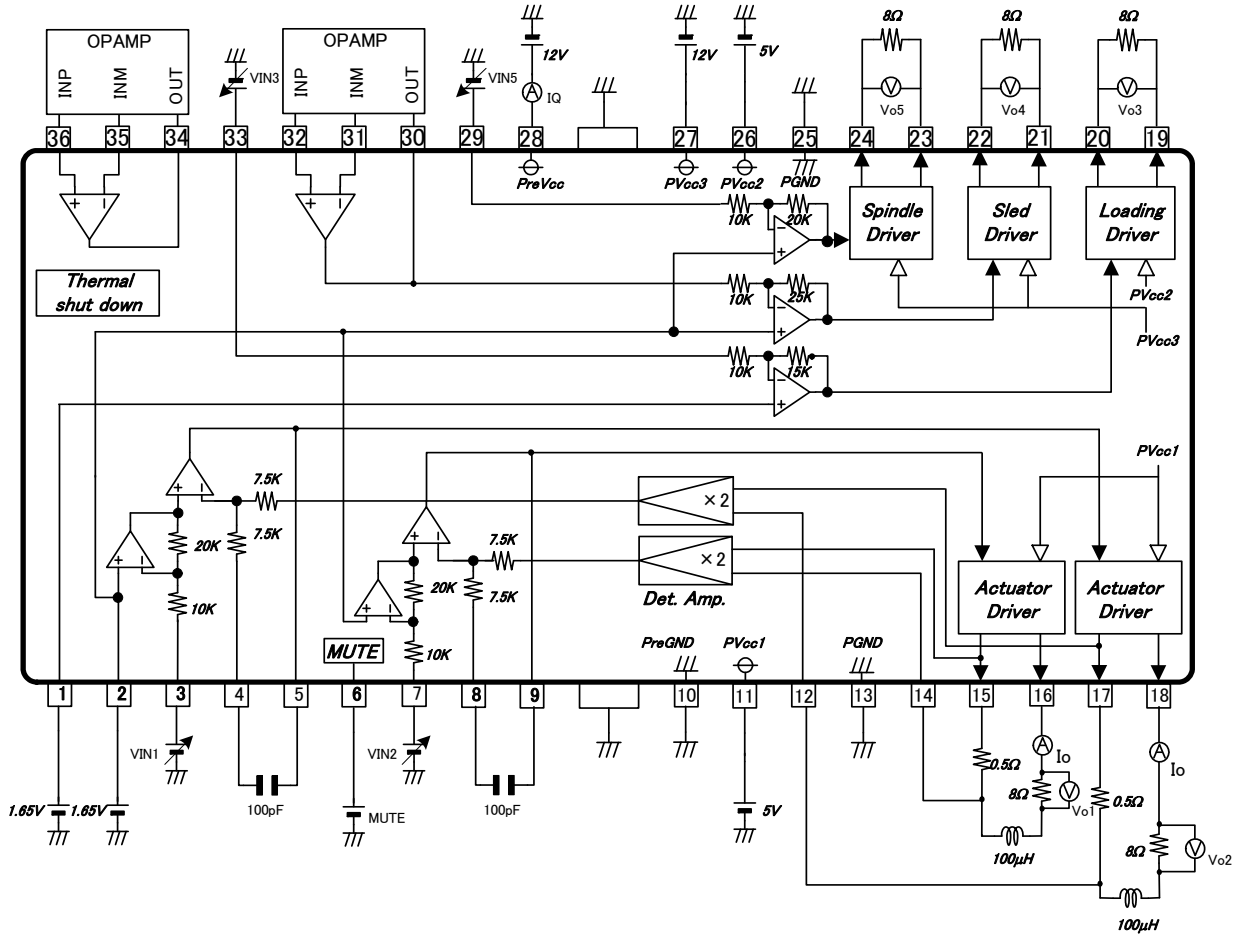
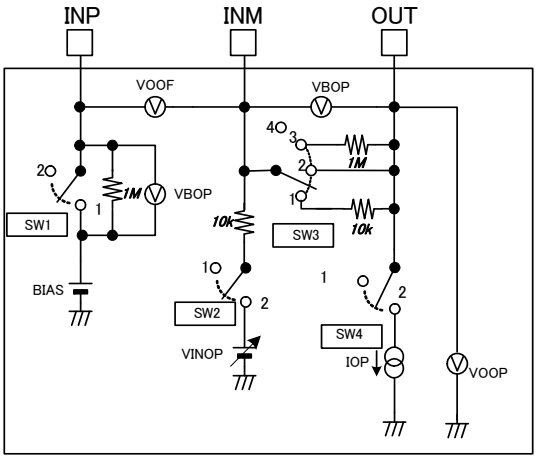


Figure 4 APPLICATION





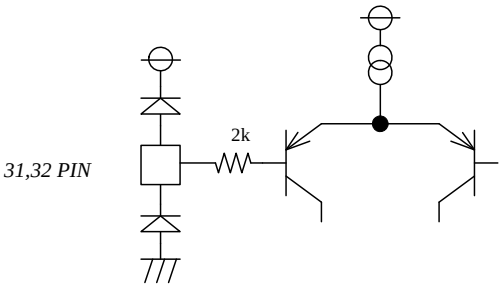
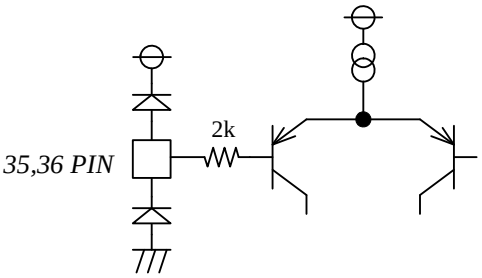
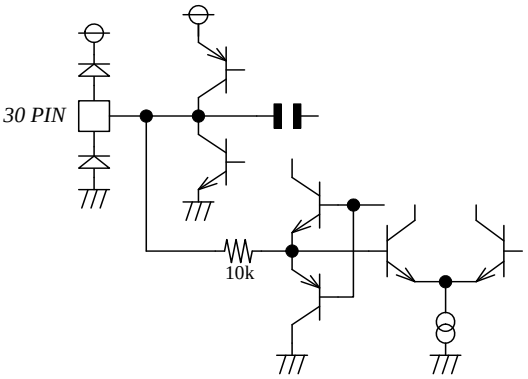
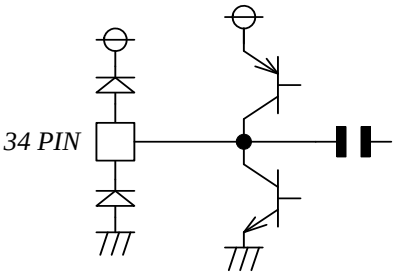
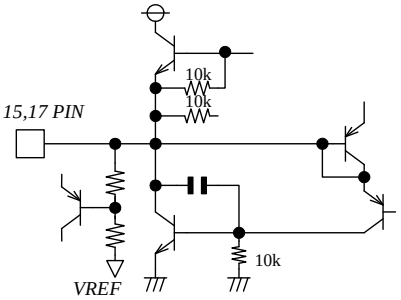
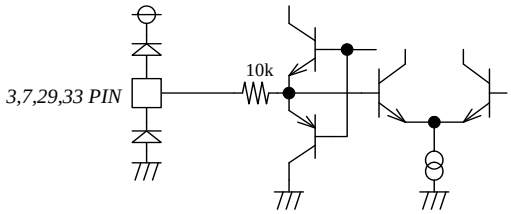
OPAMP

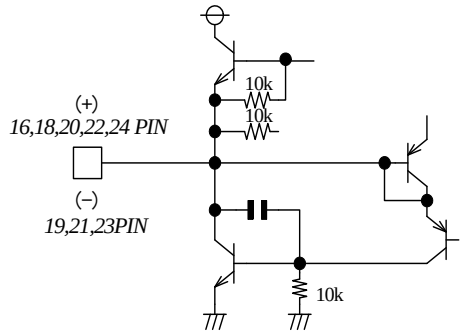
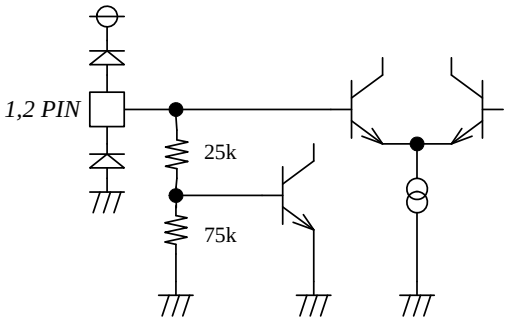
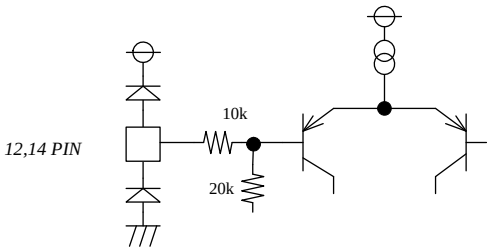
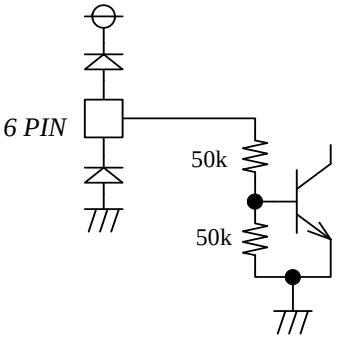
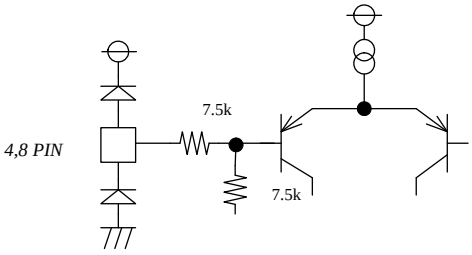
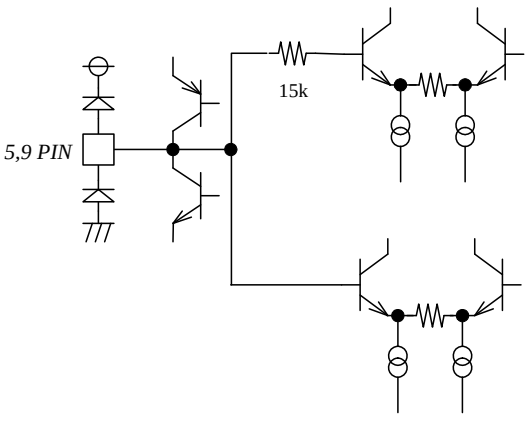
Figure5 TEST CIRCUIT

● Measurement circuit switch table

Symbol	Switch				Input						Condition	Measurement point
	SW1	SW2	SW3	SW4	VIN1	VIN2	VIN3	VIN5	VINOP	MUTE		
IQ	1	1	2	1	1.65V	1.65V	1.65V	1.65V	−	2.0V		IQ
VMON	1	1	2	1	1.65V	1.65V	1.65V	1.65V	−	2.0V		IQ
VMOFF	1	1	2	1	1.65V	1.65V	1.65V	1.65V	−	0.5V		IQ
<Actuator driver>												
IOOF	1	1	2	1	1.65V	1.65V	1.65V	1.65V	−	2.0V		IO
VOM	1	1	2	1	±1.65V	±1.65V	1.65V	1.65V	−	2.0V	VIN1,2=0, 3.3V	VO1,2
Gvc	1	1	2	1	±0.2V	±0.2V	1.65V	1.65V	−	2.0V	VIN=1.45, 1.85V	IO
<Sled motor driver pre OPAMP & OPAMP>												
IBOP	2	1	3	1	1.65V	1.65V	1.65V	1.65V	−	2.0V		VBOP
VIOFOP	1	1	2	1	1.65V	1.65V	1.65V	1.65V	−	2.0V		VOOF
VOLOP	1	2	1	1	1.65V	1.65V	1.65V	1.65V	12V	2.0V		VOOP
ISO	1	1	2	2	1.65V	1.65V	1.65V	1.65V	−	2.0V		VOOP
ISI	1	1	2	2	1.65V	1.65V	1.65V	1.65V	−	2.0V		VOOP
<Sled motor driver>												
VOOFSL	1	1	2	1	1.65V	1.65V	1.65V	1.65V	−	2.0V		VO4
VOMSL	1	2	1	1	1.65V	1.65V	1.65V	1.65V	±1.65V	2.0V	VINOP=0, 3.3V	VO4
GVSL	1	2	1	1	1.65V	1.65V	1.65V	1.65V	±0.2V	2.0V	VINOP=1.45, 1.85V	VO4
<Loading driver>												
VOOFLD	1	1	2	1	1.65V	1.65V	1.65V	1.65V	−	2.0V		VO3
VOMLD	1	1	2	1	1.65V	1.65V	±1.65V	1.65V	−	2.0V	VIN3=0, 3.3V	VO3
GVLD	1	1	2	1	1.65V	1.65V	±0.2V	1.65V	−	2.0V	VIN3=1.45, 1.85V	VO3
<Spindle driver>												
VOOFSP	1	1	2	1	1.65V	1.65V	1.65V	1.65V	−	2.0V		VO5
VOMS	1	1	2	1	1.65V	1.65V	1.65V	±1.65V	−	2.0V	VIN5=0, 3.3V	VO5
GVSP	1	1	2	1	1.65V	1.65V	1.65V	±0.2V	−	2.0V	VIN5=1.45, 1.85V	VO5

● EQUIVALENT CIRCUIT OF TERMINALS

Pre OP amplifier input for sled driver		OP amplifier input	
OP amplifier output for sled driver (& driver input)		OP amplifier output	
inverted output for focus and tracking driver		Driver input	

Output for driver		Bias input	
Feedback for focus and tracking driver		Mute	
Connection with capacitor for error amplifier 1		Connection with capacitor for error amplifier 2	

●Notes on use

1. Thermal-shut- down circuit built-in. In case IC chip temperature rise to 175℃ (typ.) thermal-shut-down circuit operates and output current is muted. Next time IC chip temperature falls below 150℃ (typ.)

2. In case mute-pin voltage under 0.5V or opened, quiescent current is muted. Mute-pin voltage should be over 2.0V for normal application.

3. In case supply voltage falls below 3.5V (typ.), output current is muted. Next time supply voltage rises to 3.7V(typ.), the driver blocks start.

4. Bias-pin (pin1 and pin2) should be pulled up more than 1.2V. In case bias-pin voltage is pulled down under 1.0V (typ.), output current is muted.

5. In case a capacitance load is connected to the OP amplifier output, the amplifier phase margin decreases, which causes the peak or oscillator.
   When connecting such load, insert a resistance in series between the output and the capacitance load and take a full consideration for frequency characteristics, to prevent problems during practical use.

6. Insert the by-pass capacitor between Vcc-pin and GND-pin of IC as possible as near (approximately 0.1μF).

7. Heat dissipation fins are attached to the GND on the inside of the package. Make sure to connect these to the external GND

8. Avoid the short-circuits between:
   Output pin and Vcc
   Output pin and GND
   Output pins
   If this caution is ignored, IC damage may cause smokes.

9. Examine in consideration of operating margin, when each driver output falls below sub-voltage of IC (GND) due to counter-electromotive-force of load.

< Supplement >

Current feedback driver

Trans conductance (output current/input voltage) is shown as follws.

$$gm = \frac{1}{R_d + R_{WIRE}} \quad (\mathrm{A}/\mathrm{V})$$

R_{WIRE}: ≒0.075Ω（±0.05Ω）（Typ.）:Au wire

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