

## 2-channel driver for CD changers

### BA6780 / BA6780FP-Y

The BA6780 and BA6780FP-Y are 2-channel driver IC for CD changers that includes a reversible, variable speed electronic governor and a reversible driver. On sets that have dual-rail power supplies, the BA6780 and BA6780FP-Y can be operated from just the negative supply to reduce influence on the positive power supply.

The input uses PWM control, and it is possible to directly input from a microprocessor running off the positive power supply.

#### ●Applications

Changers for CD players and MD players.

#### ●Features

- 1) Output voltage can be freely set using the output voltage setting pin.
- 2) Internal mute function if the power supply voltage drops.
- 3) Thermal shutdown function. (Contains hysteresis)
- 4) PWM input.
- 5) Settable reference voltage output pin.
- 6) Wide operating supply voltage.

#### ●Absolute maximum ratings (Ta = 25°C)

Parameter	Symbol	Limits	Unit
Power supply voltage	V <sub>CC</sub>	18	V
Logic input voltage	V <sub>FIN</sub> , V <sub>RIN</sub>	22	V
Power dissipation	BA6780	1.31 *1	W
	BA6780FP-Y	1.45 *2	
Maximum current consumption	I <sub>max</sub>	1.4 *3	A
Operating temperature	T <sub>opr</sub>	-25~+75	°C
Storage temperature	T <sub>stg</sub>	-55~+150	°C

\*1 When a DIP18 package is used. Reduced by 10.48mW for each increase in Ta of 1°C over 25°C.

\*2 When mounted on a PCB board (70mm×70mm, t=1.6mm glass epoxy board).

Reduced by 11.6mW for each increase in Ta of 1°C over 25°C.

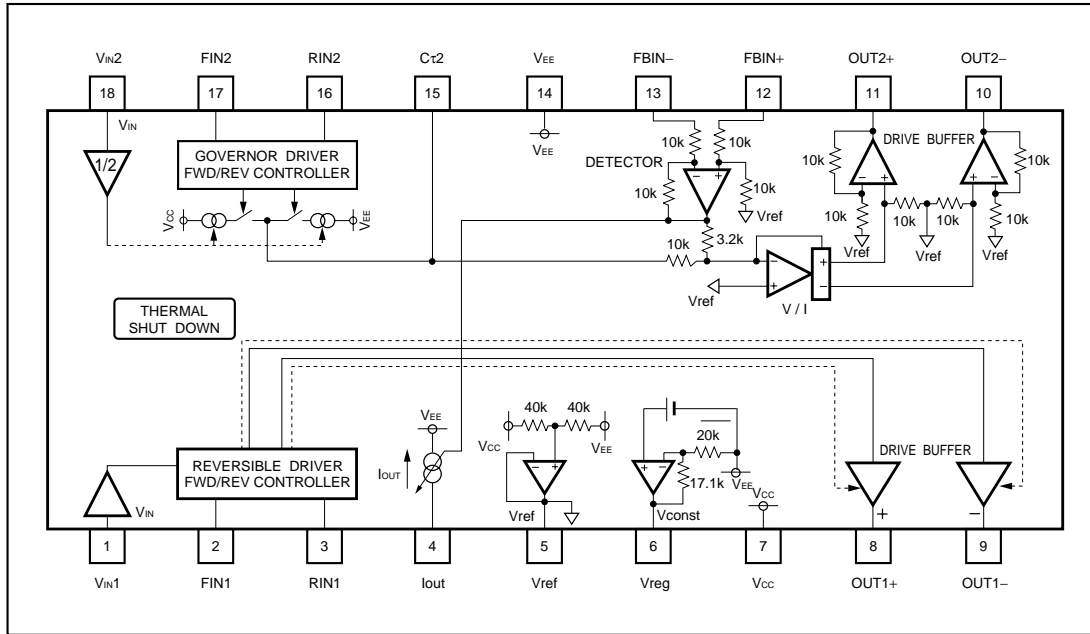
\*3 Should not exceed Pd or ASO values.

#### ●Recommended operating conditions (Ta = 25°C)

Parameter	Symbol	Limits	Unit
Power supply voltage	V <sub>CC</sub>	7~16	V
Input voltage for Vin	V <sub>IN</sub>	0~V <sub>CC</sub> /2~1.0	V

Optical disc ICs

●Block diagram and pin descriptions  
BA6780

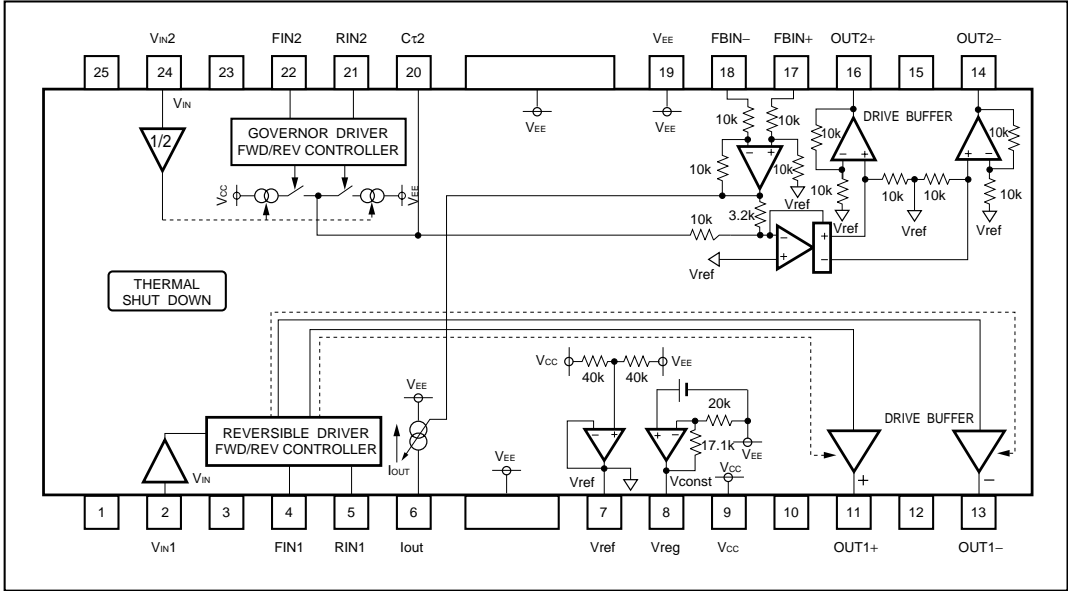


Pin No.	Pin name	I/O	Function
1	V <sub>IN1</sub>	I	Input pin for setting high output voltage for the reversible driver
2	FIN1	I	Input pin for forward control signal for the reversible driver
3	RIN1	I	Input pin for reverse control signal for the reversible driver
4	I <sub>out</sub>	O	Governor load current detector output (open collector*1 )
5	V <sub>ref</sub>	O	Internal reference voltage pin
6	V <sub>reg</sub>	O	4.6V constant voltage output
7	V <sub>cc</sub>	I	Power supply (+)
8	OUT1+	O	Reversible driver output (+)
9	OUT1-	O	Reversible driver output (-)
10	OUT2-	O	Governor output (-)
11	OUT2+	O	Governor output (+)
12	FBIN+	I	Governor load current detector amplifier input (+)
13	FBIN-	I	Governor load current detector amplifier input (-)
14	V <sub>EE</sub>	I	Power supply (-) (connection within substrate)
15	C <sub>τ2</sub>	I	For connection of capacitor for the governor PWM filter
16	RIN2	I	Governor reverse control signal input
17	FIN2	I	Governor forward control signal input
18	V <sub>IN2</sub>	I	Input pin for setting high output voltage for the governor

\*1 Refer to operating notes.

Optical disc ICs

BA6780FP-Y



Pin No.	Pin name	I/O	Function
1	N.C.	-	
2	V <sub>IN1</sub>	I	Input pin for setting high output voltage for the reversible driver
3	N.C.	-	
4	FIN1	I	Input pin for forward control signal for the reversible driver
5	RIN1	I	Input pin for reverse control signal for the reversible driver
6	I <sub>out</sub>	O	Governor load current detector output (open collector*1 )
7	V <sub>ref</sub>	O	Internal reference voltage pin
8	V <sub>reg</sub>	O	4.6V constant voltage output
9	V <sub>CC</sub>	I	Power supply (+)
10	N.C.	-	
11	OUT1+	O	Reversible driver output (+)
12	N.C.	-	
13	OUT1-	O	Reversible driver output (-)
14	OUT2-	O	Governor output (-)
15	N.C.	-	
16	OUT2+	O	Governor output (+)
17	FB IN +	I	Governor load current detector amplifier input (+)
18	FB IN -	I	Governor load current detector amplifier input (-)
19	V <sub>EE</sub>	I	Power supply (-) (connection within substrate)
20	C <sub>τ</sub> 2	I	For connection of capacitor for the governor PWM filter
21	R IN 2	I	Governor reverse control signal input
22	F IN 2	I	Governor forward control signal input
23	N.C.	-	
24	V <sub>IN2</sub>	I	Input pin for setting high output voltage for the governor
25	N.C.	-	

\*1 Refer to operating notes.

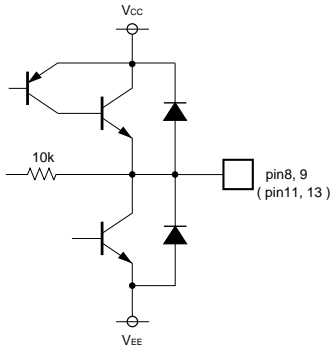
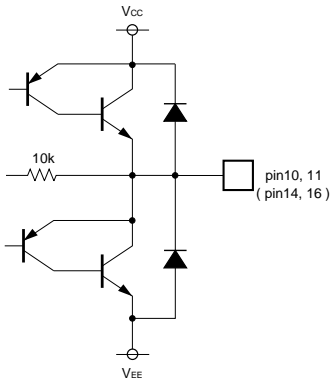
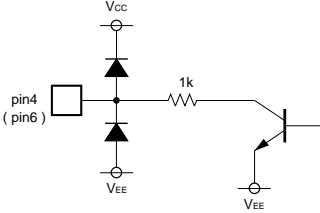


Optical disc ICs

● Input / output circuits ( ( ) :pins for BA6780FP-Y)

Pin function	Equivalent circuit
Logic input	
Voltage setting input	
For connection of capacitor for PWM filter	
Load current detector	

Optical disc ICs

Pin function	Equivalent circuit
<p>Output (reversible driver)</p>	
<p>Output (governor)</p>	
<p>Load current detector signal output (governor)</p>	



## Optical disc ICs

● Electrical characteristics (unless otherwise noted, Ta = 25°C, V<sub>CC</sub> = 10V) (\*1 BA6780FP-Y)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Quiescent current	I <sub>Q</sub>	–	8.0	16.0	mA	Open mode with no load
Mute on voltage	V <sub>CC1</sub>	–	–	3.5	V	Mute on voltage when V <sub>CC</sub> falls
Mute off voltage	V <sub>CC2</sub>	5.5	–	–	V	Mute off voltage when V <sub>CC</sub> rises
V <sub>ref</sub> input voltage range	V <sub>IN</sub>	0	–	4	V	–
V <sub>ref</sub> pin current	I <sub>IN</sub>	–	0.02	1.0	μA	–
PWM input high level voltage	V <sub>IH</sub>	4.0	–	–	V	With V <sub>CC</sub> as the reference potential
PWM input low level voltage	V <sub>IL</sub>	–	–	1.0	V	With V <sub>CC</sub> as the reference potential
PWM input high level current	I <sub>IH</sub>	–	–	100	μA	–
PWM input low level current	I <sub>IL</sub>	–1.0	–	1.0	μA	–
<b>&lt;Electronic governor&gt;</b>						
Output offset voltage	V <sub>OF</sub>	–100	0	100	mV	R <sub>L</sub> (load)=9Ω, R <sub>O</sub> (current detector)=0.6Ω
Max. pin-to-pin output voltage	V <sub>OM</sub>	6.0	6.5	–	V	R <sub>L</sub> (load)=9Ω, R <sub>O</sub> (current detector)=0.6Ω
Pin-to-pin output voltage 1-1	V <sub>OUT11</sub>	4.2	4.7	5.2	V	Forward mode
Pin-to-pin output voltage 1-2	V <sub>OUR12</sub>	–5.2	–4.7	–4.2	V	Reverse mode
Pin-to-pin output voltage 1-3	V <sub>OUT13</sub>	–100	0	100	mV	Brake mode
Pin-to-pin output voltage 1-4	V <sub>OUT14</sub>	–50	0	50	mV	Stop mode
Voltage gain of positive feedback amplifier	G <sub>VNF</sub>	20.5	22.0	23.5	dB	V <sub>ref</sub> =0V, V <sub>IN</sub> =–20dBV, f=1kHz
<b>&lt;Reversible driver&gt;</b>						
Output saturation voltage	V <sub>CESAT</sub>	–	1.0	2.1	V	I <sub>O</sub> =100mA, V <sub>IN2</sub> =5V, Total of upper side and lower side ineffective voltage of output Tr
Pin-to-pin output voltage 2-1	V <sub>OUT21</sub>	4.5	5.0	5.5	V	Forward mode
Pin-to-pin output voltage 2-2	V <sub>OUT22</sub>	–5.5	–5.0	–4.5	V	Reverse mode
Pin-to-pin output voltage 2-3	V <sub>OUT23</sub>	–50	0	50	mV	Brake mode
Pin-to-pin output voltage 2-4	V <sub>OUT24</sub>	–50	0	50	mV	Stop mode
Output load fluctuation	V <sub>OUT</sub>	–	200	400	mV	Difference in output voltage for I <sub>O</sub> =400mA and I <sub>O</sub> =100mA
<b>&lt;4.6V constant-voltage output&gt;</b>						
Output voltage	V <sub>reg</sub>	4.35	4.60	4.85	V	–
Output load fluctuation (source)	V <sub>OSO</sub>	–20	–5	–	mV	1mA source
Output load fluctuation (sink)	V <sub>OSI</sub>	–	5	20	mV	1mA sink

© Not designed for radiation resistance.

Optical disc ICs

● Measurement circuit  
BA6780

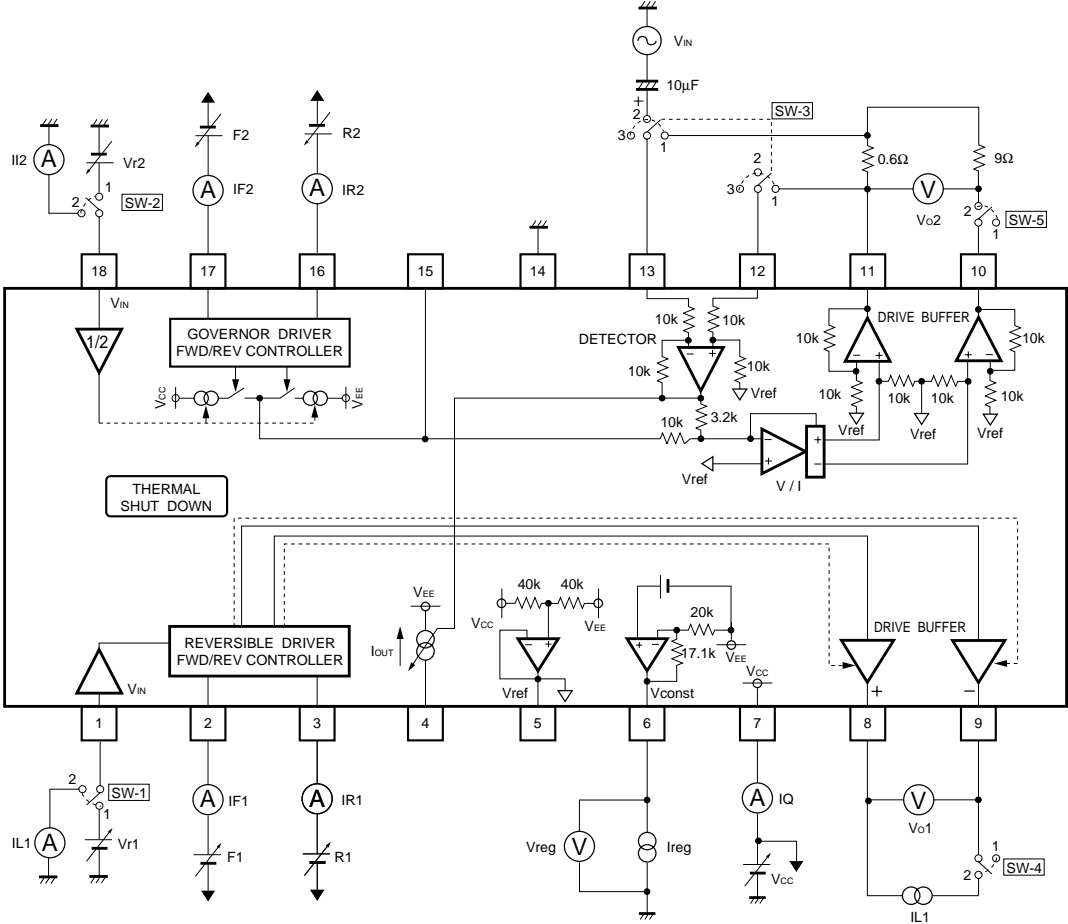


Fig.1



Optical disc ICs

BA6780FP-Y

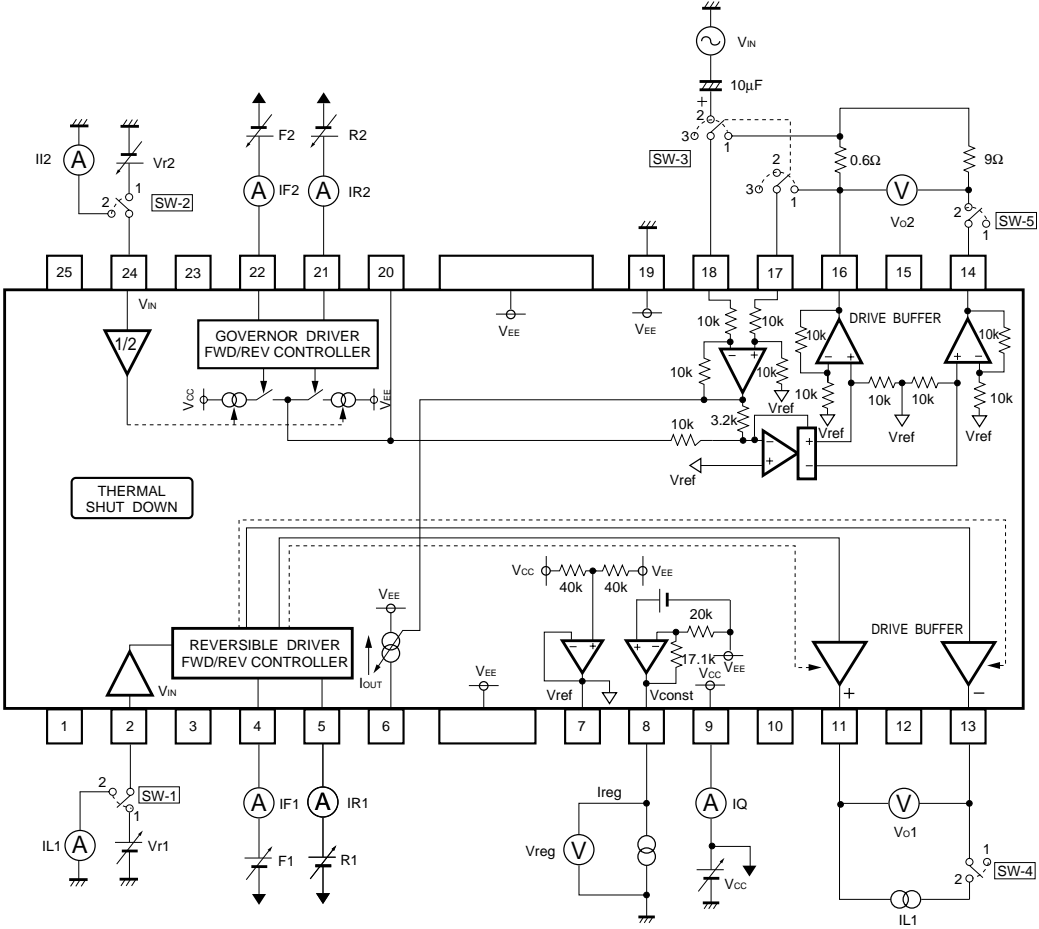


Fig.2





## Optical disc ICs

## ● Measurement circuit switch table

BA6780 / BA6780FP-Y

Parameter	SW					Input								Conditions	Measurement
	SW1	SW2	SW3	SW4	SW5	Vr1	Vr2	F1	R1	F2	R2	V <sub>IN</sub>	IL1		
Quiescent current	1	1	3	1	1	0	0	0	0	0	0	–	–	–	IQ
Mute on voltage	1	1	3	1	1	2	0	0	5	0	0	–	–	V <sub>CC</sub> swept down from 10V	Vo1
Mute off voltage	1	1	3	1	1	2	0	0	5	0	0	–	–	V <sub>CC</sub> swept up from 0V	Vo1
V <sub>ref</sub> input voltage range	1	1	3	1	2	*1	*1	0	5	0	5	–	–	*1 Check for abnormality in output in Vr1 and Vr2 input range	Vo1 Vo2
V <sub>ref</sub> pin current	2	2	3	1	1	0	0	0	0	0	0	–	–	–	II1 II2
PWM input high level voltage	1	1	3	1	2	2	2	*2	*2	*2	*2	–	–	*2 Sweep the F/R input, and check that the mode switching is occurring in a range that satisfies the rated values	Vo1
PWM input low level voltage	1	1	3	1	2	2	2	*2	*2	*2	*2	–	–		Vo2
PWM input high level current	1	1	3	1	1	0	0	5	5	5	5	–	–	–	IF1 IF2
PWM input low level current	1	1	3	1	1	0	0	5	5	5	5	–	–	–	IR1 IR2
<Electronic governor>															
Output offset voltage	1	1	1	1	2	0	0	0	0	5	5	–	–	–	Vo2
Max. pin-to-pin output voltage	1	1	3	1	2	0	4	0	0	0	5	0	–	–	Vo2
Pin-to-pin output voltage 1-1	1	1	1	1	2	0	2.5	0	0	0	5	–	–	–	Vo2
Pin-to-pin output voltage 1-2	1	1	1	1	2	0	2.5	0	0	5	0	–	–	–	Vo2
Pin-to-pin output voltage 1-3	1	1	1	1	2	0	2.5	0	0	5	5	–	–	–	Vo2
Pin-to-pin output voltage 1-4	1	1	1	1	2	0	2.5	0	0	0	0	–	–	–	Vo2
Voltage gain of positive feedback amplifier	1	1	2	1	1	0	0	0	0	5	5	*3	–	*3 –20dBV, 1kHz	Vo2
<Reversible driver>															
Output saturation voltage	1	1	1	2	1	5	0	0	5	0	0	–	*4	*4 100mA (take care with polarity)	V <sub>CC</sub> –Vo1
Pin-to-pin output voltage 2-1	1	1	3	2	1	2.5	0	0	5	0	0	–	*5	*5 100mA (take care with polarity)	Vo1
Pin-to-pin output voltage 2-2	1	1	3	2	1	2.5	0	5	0	0	0	–			
Pin-to-pin output voltage 2-3	1	1	3	1	1	2.5	0	5	5	0	0	–			
Pin-to-pin output voltage 2-4	1	1	3	1	1	2.5	0	0	0	0	0	–			
Output load fluctuation	1	1	3	2	1	2.5	0	0	5	0	0	–	*6	*6 Difference in output voltage for I=400mA and I=100mA	Vo1
<4.6V constant-voltage output>															
Output voltage	1	1	3	1	1	0	0	0	0	0	0	–	–	–	V <sub>reg</sub>
Output load fluctuation (source)	1	1	3	1	1	0	0	0	0	0	0	–	–	Source I <sub>reg</sub> =1mA	V <sub>reg</sub>
Output load fluctuation (sink)	1	1	3	1	1	0	0	0	0	0	0	–	–	Sink I <sub>reg</sub> =1mA	V <sub>reg</sub>

Optical disc ICs

● Application example  
BA6780

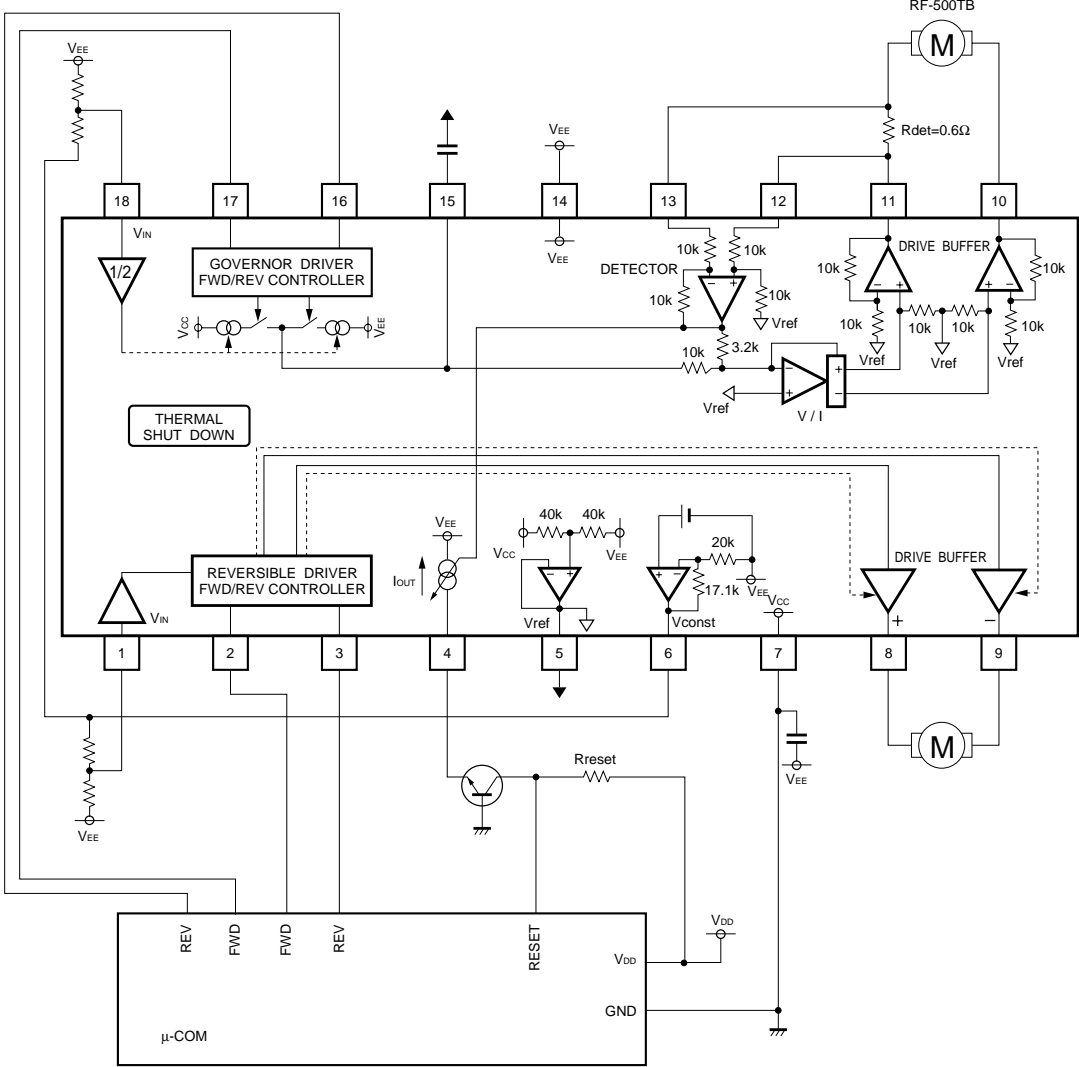


Fig.3



Optical disc ICs

BA6780FP-Y

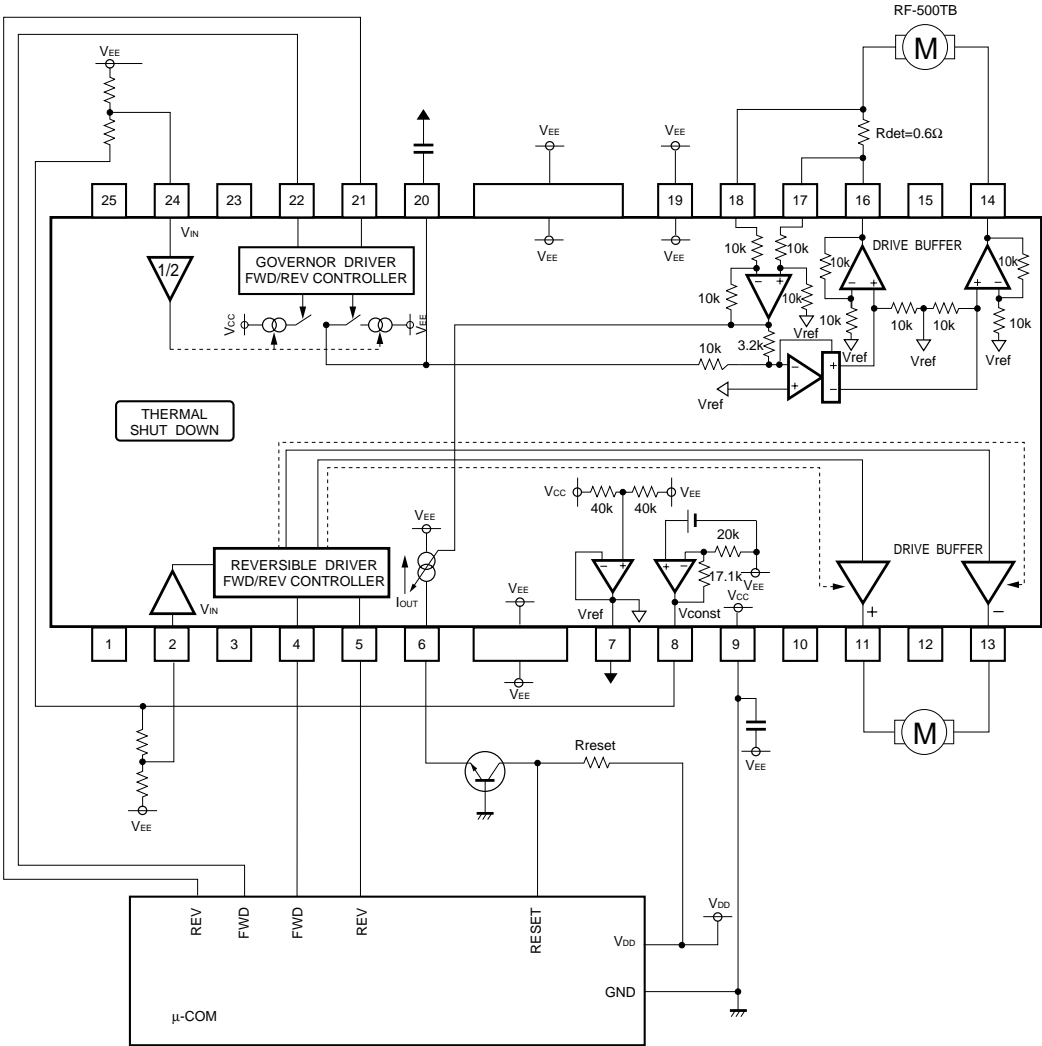


Fig.4



## Optical disc ICs

## ● Input / output truth table

&lt;Reversible drive&gt;

FIN	RIN	OUT (+)	OUT (-)	Mode
L	H	H	L	Forward mode
H	L	L	H	Reverse mode
H	H	L	L	Brake mode
L	L	OPEN	OPEN	Open mode

&lt;Governor drive&gt;

FIN	RIN	OUT (+)	OUT (-)	Mode
L	H	H	L	Forward mode
H	L	L	H	Reverse mode
H	H	$V_{CC} / 2$	$V_{CC} / 2$	Brake mode
L	L	OPEN	OPEN	Open mode

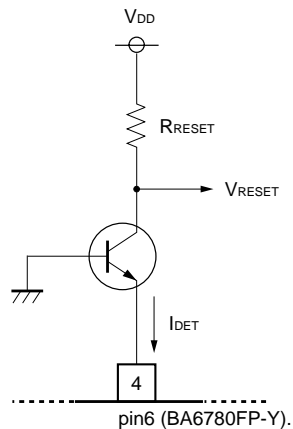
## ● Using the load current detector output pin (pin 4)

Refer to the example circuit on the right for the connection method. The  $V_{RESET}$  value is determined as follows :

$$I_{DET} = \frac{I_O \times R_{DET}}{3.2k\Omega} \quad V_{RESET} = V_{DD} - I_{DET} \times R_{RESET}$$

$$\therefore V_{RESET} = V_{DD} - \frac{I_O \times R_{DET} \times R_{RESET}}{3.2k\Omega}$$

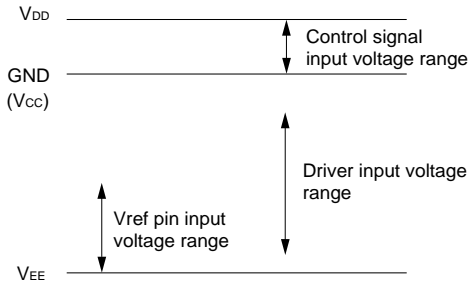
( $R_{DET}$  is the load current detector resistance, refer to the application circuit)



Optical disc ICs

● Operation notes

- (1) The BA6780 and BA6780FP-Y have built in shutdown circuit that mute the output current when the chip temperature reaches 175°C (Typ.). The hysteresis is set to 25°C (Typ.), so the mute will be released when the chip temperature falls to 150°C (Typ.).
- (2) The output current is muted when the supply (V<sub>CC</sub>) falls to 3V or less. When the mute is applied, the reverse driver is set to the V<sub>EE</sub> level, and governor driver is set to the V<sub>EE</sub> / 2 level.
- (3) The V<sub>CC</sub> voltage level is the reference for the logic input pin input voltage, so when it is converted from the V<sub>EE</sub> potential, the high level becomes (V<sub>CC</sub>+5) V, and the low level becomes (V<sub>CC</sub>) V. The voltage potential levels for the pins are shown in the diagram below.
- (4) Connect a bypass capacitor at the base of this IC for the power supply.



● Electrical characteristic curves

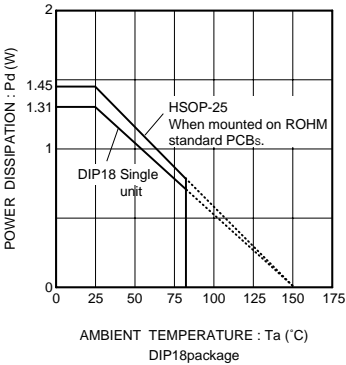


Fig.5 Thermal dissipation curve

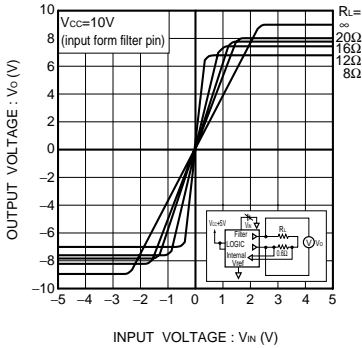


Fig.6 I / O characteristics with governor connected

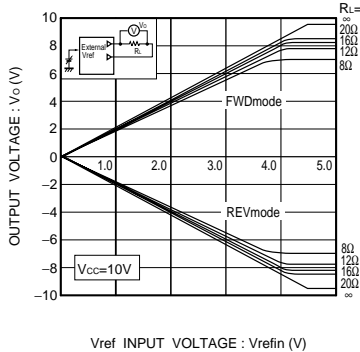


Fig.7 Reversible driver I / O characteristics

Optical disc ICs

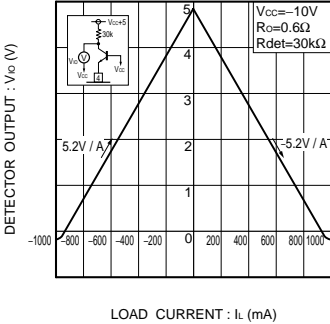


Fig.8 Load current detector output characteristics

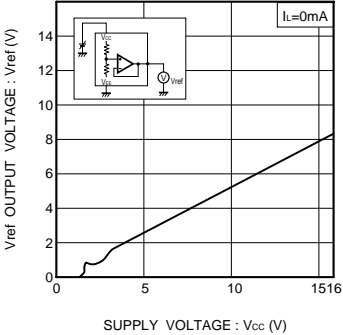


Fig.9 Internal Vref output characteristics

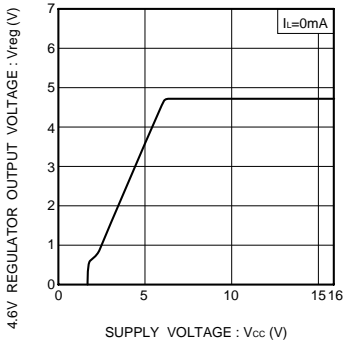


Fig.10 4.6V constant-voltage source output voltage characteristics

●External dimensions (Units : mm)

