

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 _{CC}	18	V
Logic input voltage	V _{FIN} , V _{RIN}	22	V
Power dissipation	BA6780	1.31 *1	W
	BA6780FP-Y	1.45 *2	
Maximum current consumption	I _{max}	1.4 *3	A
Operating temperature	T _{opr}	-25~+75	°C
Storage temperature	T _{stg}	-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.

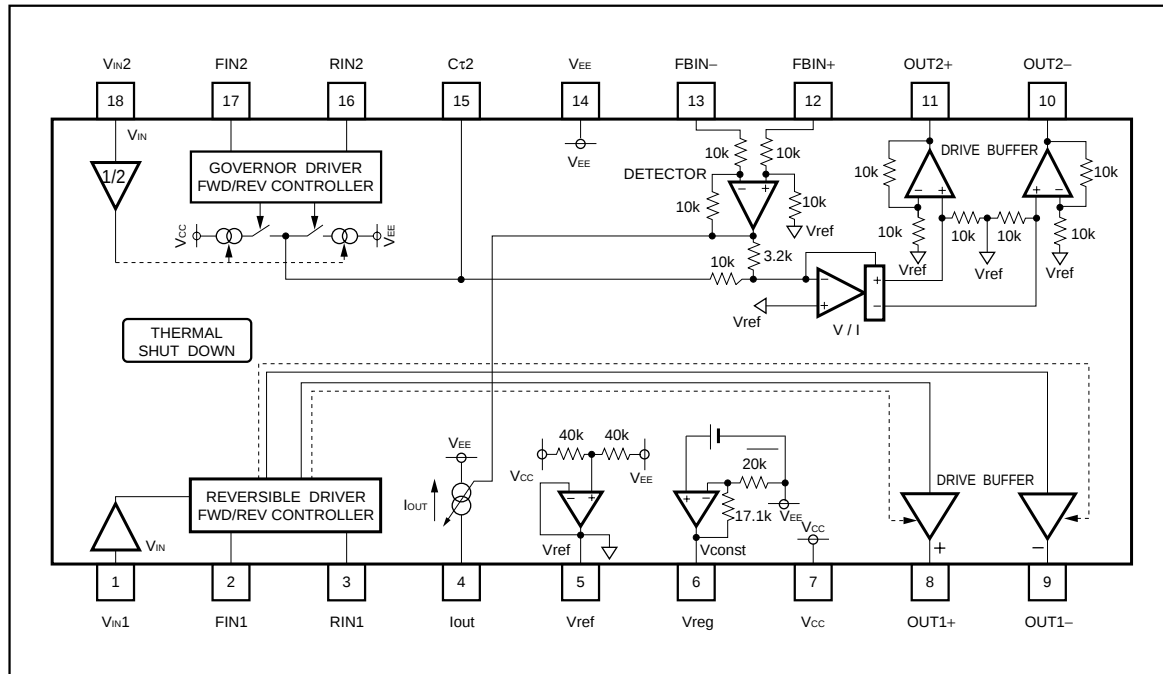
●Recommended operating conditions (Ta = 25°C)

Parameter	Symbol	Limits	Unit
Power supply voltage	V _{CC}	7~16	V
Input voltage for Vin	V _{IN}	0~V _{CC} / 2~1.0	V

Optical disc ICs

●Block diagram and pin descriptions

BA6780

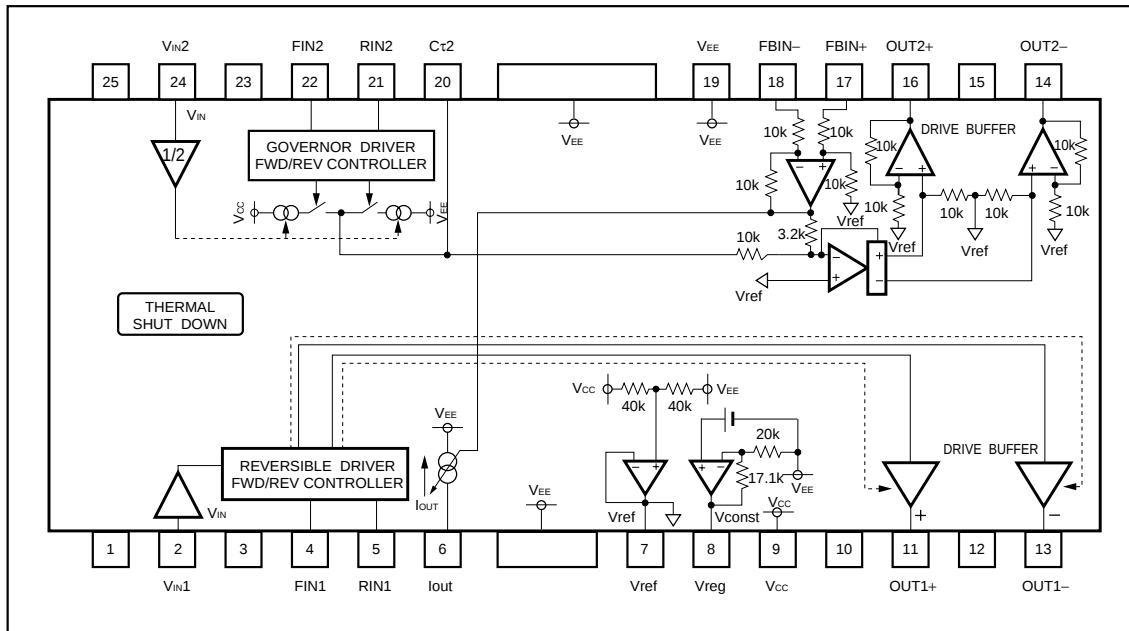


Pin No.	Pin name	I/O	Function
1	V _{IN1}	I	Input pin for setting high output voltage for the reversible driver
2	FIN1	I	Input pin for forward control signal for the reversible driver
3	RIN1	I	Input pin for reverse control signal for the reversible driver
4	I _{OUT}	O	Governor load current detector output (open collector*1)
5	V _{ref}	O	Internal reference voltage pin
6	V _{reg}	O	4.6V constant voltage output
7	V _{CC}	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 _{EE}	I	Power supply (-) (connection within substrate)
15	C _{t2}	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 _{IN2}	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 _{in1}	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	Iout	O	Governor load current detector output (open collector*1)
7	Vref	O	Internal reference voltage pin
8	Vreg	O	4.6V constant voltage output
9	V _{CC}	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 _{EE}	I	Power supply (-) (connection within substrate)
20	C _{t2}	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 _{in2}	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
Output (reversible driver)	The circuit shows a full-bridge output stage. It consists of four transistors: two NPN transistors at the top and two PNP transistors at the bottom. The top NPN transistors have their emitters connected to V_{CC}. The bottom PNP transistors have their emitters connected to V_{EE}. The collectors of the top NPN transistors are connected to the collectors of the bottom PNP transistors. A 10k resistor is connected between the two central nodes (the junctions of the transistors). This central node is connected to a square symbol representing the output pin, labeled 'pin8, 9 (pin11, 13)'.
Output (governor)	The circuit is similar to the first one, showing a full-bridge output stage with four transistors (two NPN at the top, two PNP at the bottom) connected between V_{CC} and V_{EE}. A 10k resistor is connected between the two central nodes. This central node is connected to a square symbol representing the output pin, labeled 'pin10, 11 (pin14, 16)'.
Load current detector signal output (governor)	The circuit shows a load current detector. It features a square symbol representing the input pin, labeled 'pin4 (pin6)'. This pin is connected to a node between two diodes. One diode is connected to V_{CC} and the other to V_{EE}. This node is connected to the base of an NPN transistor. The emitter of this transistor is connected to V_{EE}, and its collector is connected to a 1k resistor, which is then connected to an output terminal.

Optical disc ICs

●Electrical characteristics (unless otherwise noted, Ta = 25°C, V_{CC} = 10V) (*1 BA6780FP-Y)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Quiescent current	I _Q	—	8.0	16.0	mA	Open mode with no load
Mute on voltage	V _{CC1}	—	—	3.5	V	Mute on voltage when V _{CC} falls
Mute off voltage	V _{CC2}	5.5	—	—	V	Mute off voltage when V _{CC} rises
Vref input voltage range	V _{IN}	0	—	4	V	—
Vref pin current	I _{IN}	—	0.02	1.0	μA	—
PWM input high level voltage	V _{IH}	4.0	—	—	V	With V _{CC} as the reference potential
PWM input low level voltage	V _{IL}	—	—	1.0	V	With V _{CC} as the reference potential
PWM input high level current	I _{IH}	—	—	100	μA	—
PWM input low level current	I _{IL}	−1.0	—	1.0	μA	—

<Electronic governor>

Output offset voltage	V _{OF}	−100	0	100	mV	R _L (load)=9Ω, R _O (current detector)=0.6Ω	
Max. pin-to-pin output voltage	V _{OM}	6.0	6.5	–	V	R _L (load)=9Ω, R _O (current detector)=0.6Ω	
Pin-to-pin output voltage 1-1	V _{OUT11}	4.2	4.7	5.2	V	Forward mode	12, 13 open 17, 18pin open *1 R _L (load)=9Ω R _O (current detector)=0.6Ω V _{IN2} =2.5V
Pin-to-pin output voltage 1-2	V _{OUT12}	−5.2	−4.7	−4.2	V	Reverse mode	
Pin-to-pin output voltage 1-3	V _{OUT13}	−100	0	100	mV	Brake mode	
Pin-to-pin output voltage 1-4	V _{OUT14}	−50	0	50	mV	Stop mode	
Voltage gain of positive feedback amplifier	G _{VNF}	20.5	22.0	23.5	dB	V _{ref} =0V, V _{IN} =−20dBV, f=1kHz	

<Reversible driver>

Output saturation voltage	V _{CESAT}	—	1.0	2.1	V	I _O =100mA, V _{IN2} =5V, Total of upper side and lower side ineffective voltage of output Tr		
Pin-to-pin output voltage 2-1	V _{OUT21}	4.5	5.0	5.5	V	Forward mode	I _O =100mA	V _{IN1} =2.5V
Pin-to-pin output voltage 2-2	V _{OUT22}	−5.5	−5.0	−4.5	V	Reverse mode		
Pin-to-pin output voltage 2-3	V _{OUT23}	−50	0	50	mV	Brake mode		
Pin-to-pin output voltage 2-4	V _{OUT24}	−50	0	50	mV	Stop mode		
Output load fluctuation	V _{OUT}	—	200	400	mV	Difference in output voltage for I _O =400mA and I _O =100mA		

<4.6V constant-voltage output>

Output voltage	V _{reg}	4.35	4.60	4.85	V	—
Output load fluctuation (source)	V _{OSO}	−20	−5	—	mV	1mA source
Output load fluctuation (sink)	V _{OSI}	—	5	20	mV	1mA sink

© Not designed for radiation resistance.

●Measurement circuit

BA6780

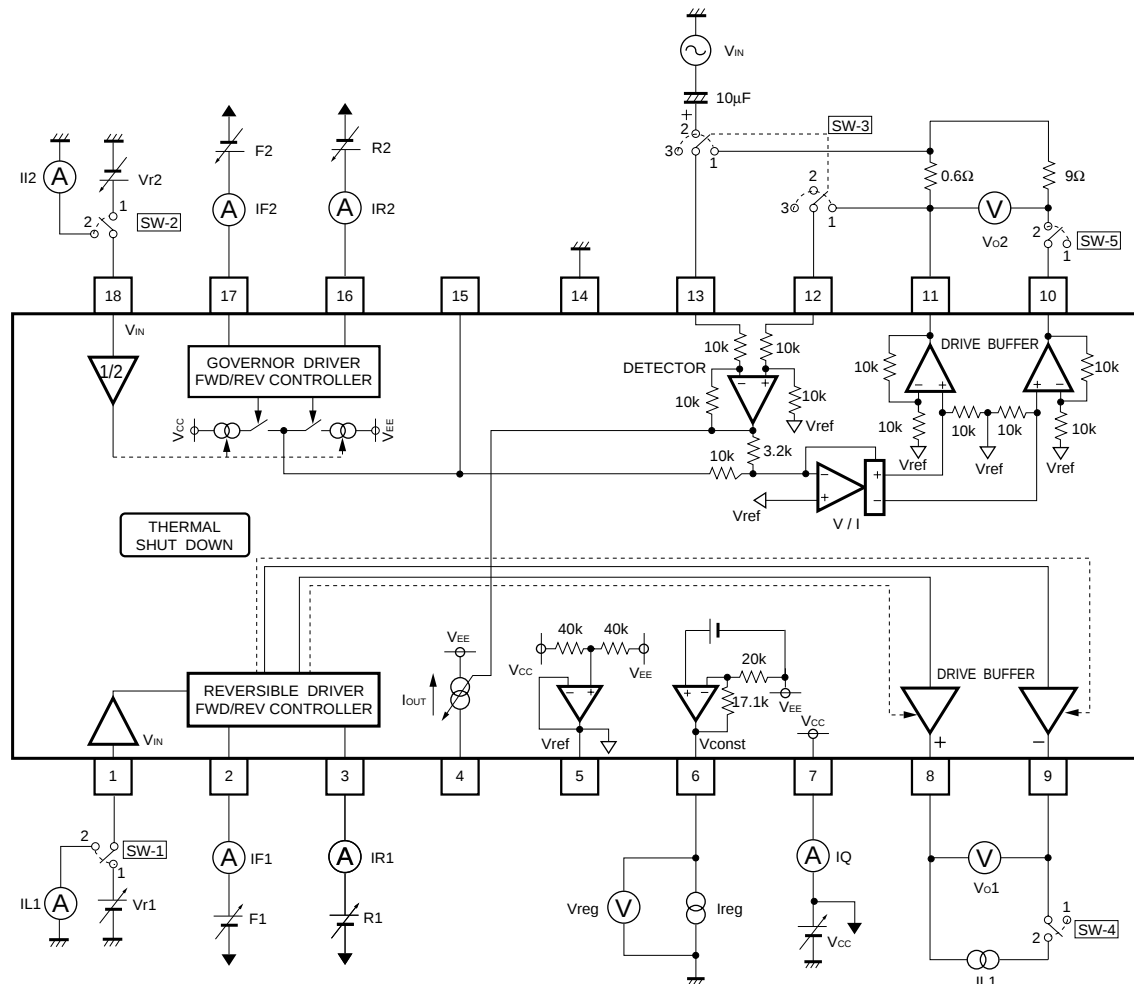


Fig.1

BA6780FP-Y

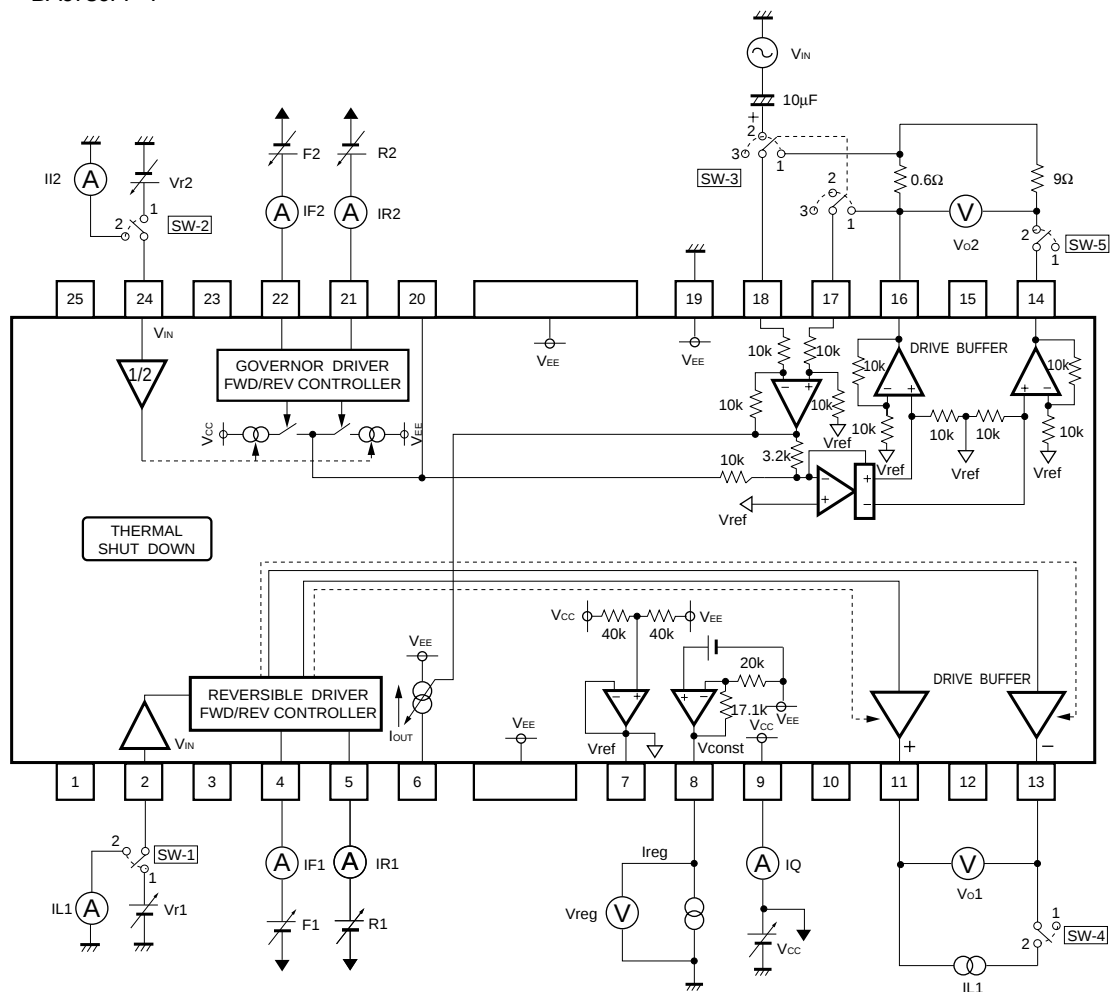


Fig.2

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 _{IN}	IL1		
Quiescent current	1	1	3	1	1	0	0	0	0	0	0	–	–	–	I _Q
Mute on voltage	1	1	3	1	1	2	0	0	5	0	0	–	–	V _{CC} swept down from 10V	V _{O1}
Mute off voltage	1	1	3	1	1	2	0	0	5	0	0	–	–	V _{CC} swept up from 0V	V _{O1}
V _{ref} 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	V _{O1} V _{O2}
V _{ref} 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	V _{O1}
PWM input low level voltage	1	1	3	1	2	2	2	*2	*2	*2	*2	–	–		V _{O2}
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	–	–	–	V _{O2}
Max. pin-to-pin output voltage	1	1	3	1	2	0	4	0	0	0	5	5	–	–	V _{O2}
Pin-to-pin output voltage 1-1	1	1	1	1	2	0	2.5	0	0	0	5	–	–	–	V _{O2}
Pin-to-pin output voltage 1-2	1	1	1	1	2	0	2.5	0	0	5	0	–	–	–	V _{O2}
Pin-to-pin output voltage 1-3	1	1	1	1	2	0	2.5	0	0	5	5	–	–	–	V _{O2}
Pin-to-pin output voltage 1-4	1	1	1	1	2	0	2.5	0	0	0	0	–	–	–	V _{O2}
Voltage gain of positive feedback amplifier	1	1	2	1	1	0	0	0	0	5	5	*3	–	*3 –20dBV, 1kHz	V _{O2}
<Reversible driver>															
Output saturation voltage	1	1	1	2	1	5	0	0	5	0	0	–	*4	*4 100mA (take care with polarity)	V _{CC} –V _{O1}
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)	V _{O1}
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	V _{O1}
<4.6V constant-voltage output>															
Output voltage	1	1	3	1	1	0	0	0	0	0	0	–	–	–	V _{reg}
Output load fluctuation (source)	1	1	3	1	1	0	0	0	0	0	0	–	–	Source I _{reg} =1mA	V _{reg}
Output load fluctuation (sink)	1	1	3	1	1	0	0	0	0	0	0	–	–	Sink I _{reg} =1mA	V _{reg}

Optical disc ICs

●Application example

BA6780

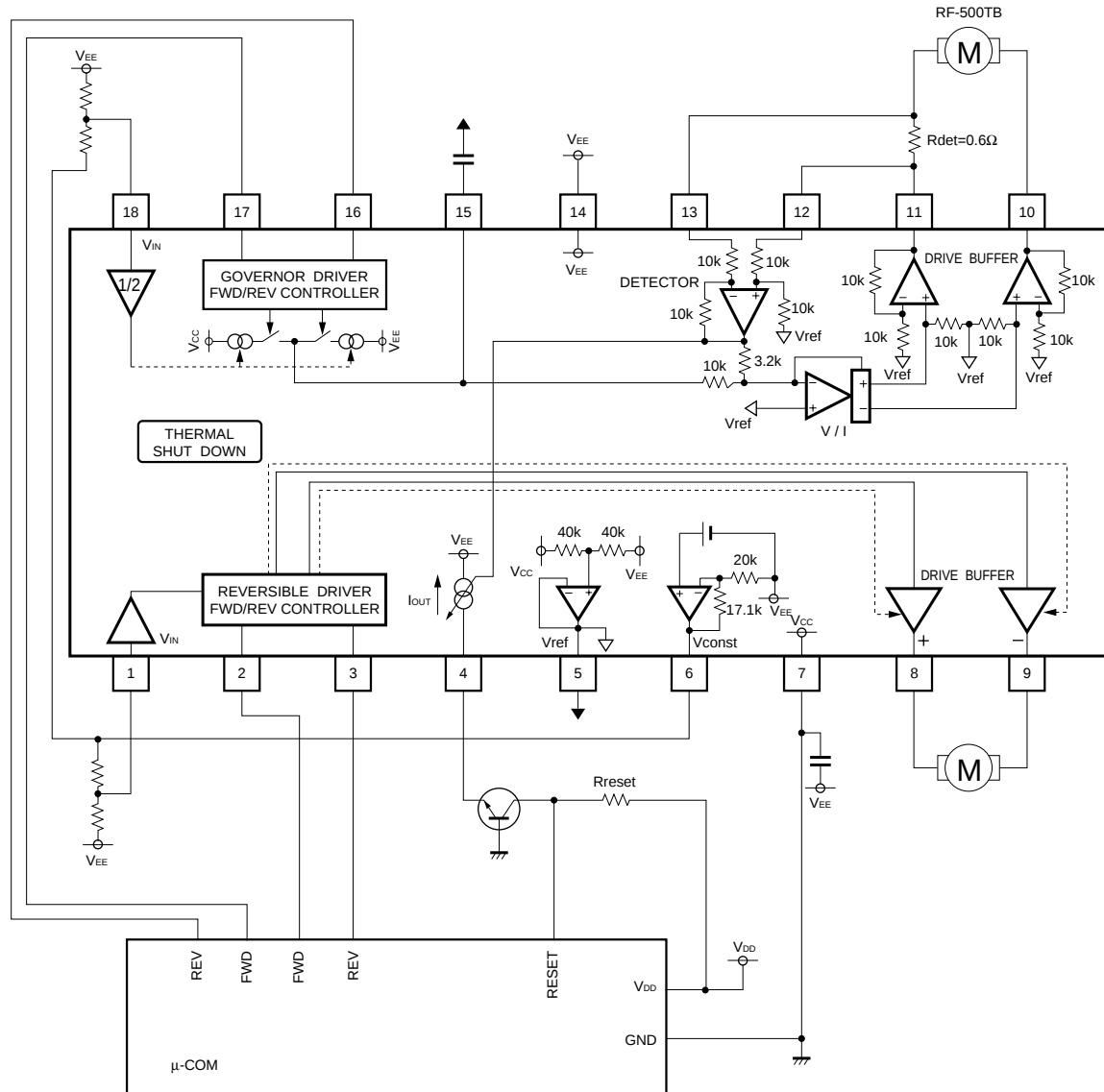


Fig.3

BA6780FP-Y

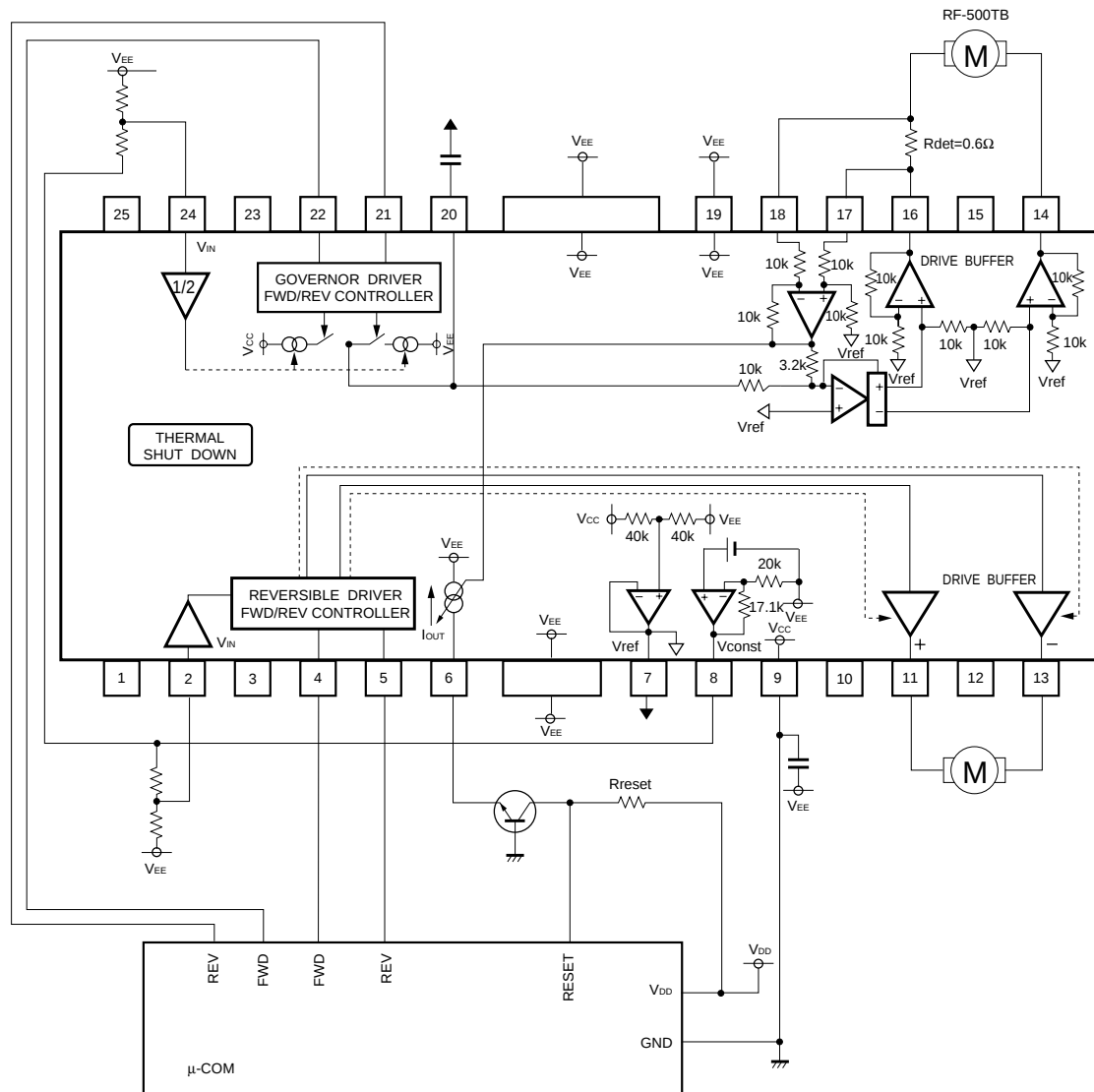


Fig.4

Optical disc ICs

●Input / output truth table

<Reversible drive>

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

<Governor drive>

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

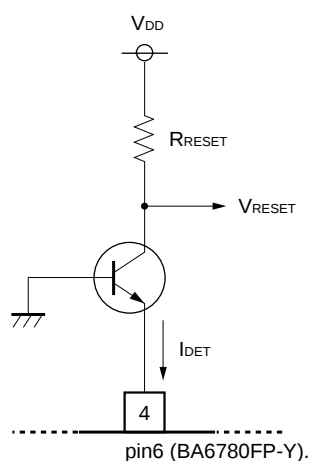
●Using the load current detector output pin (pin 4)

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

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

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

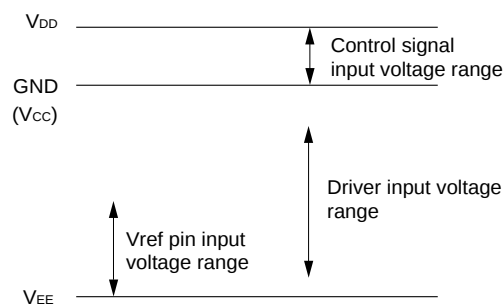
(R_{DET} is the load current detector resistance, refer to the application circuit)



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_{CC}) falls to 3V or less. When the mute is applied, the reverse driver is set to the V_{EE} level, and governor driver is set to the $V_{EE} / 2$ level.
- (3) The V_{CC} voltage level is the reference for the logic input pin input voltage, so when it is converted from the V_{EE} potential, the high level becomes $(V_{CC}+5)$ V, and the low level becomes (V_{CC}) 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

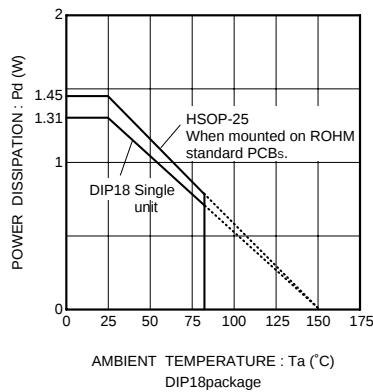


Fig.5 Thermal dissipation curve

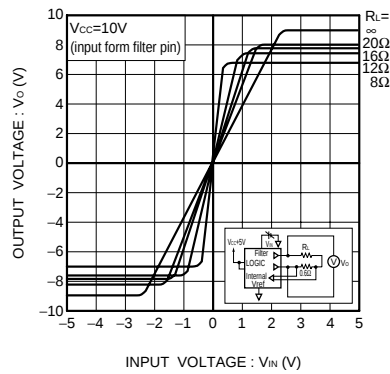


Fig.6 I / O characteristics with governor connected

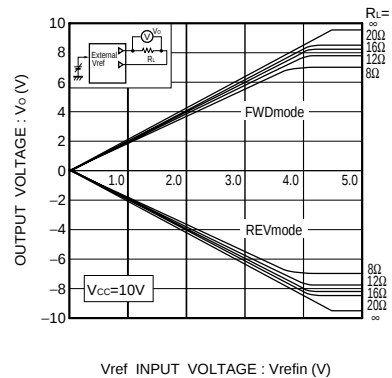
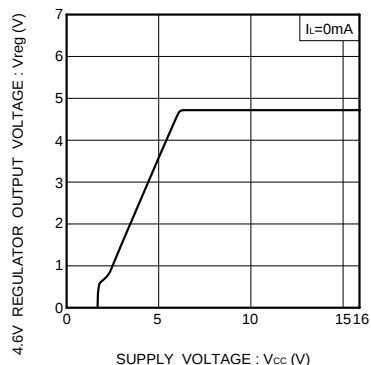
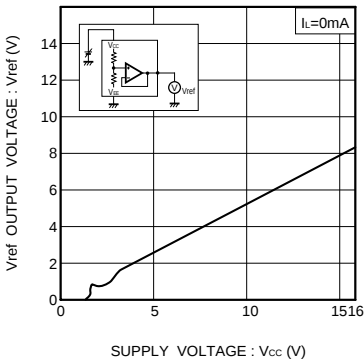
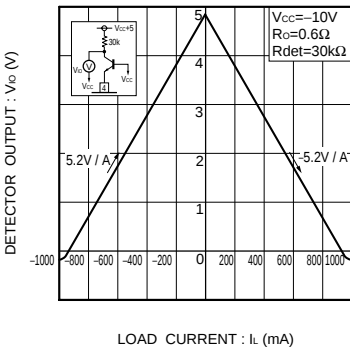


Fig.7 Reversible driver I / O characteristics

Optical disc ICs



●External dimensions (Units : mm)

