BA6399FP

4-channel H-bridge-type BTL driver

The BA6399FP is a 4-channel H-bridge-type, BTL driver for the motors or actuators on a CD player.

Features

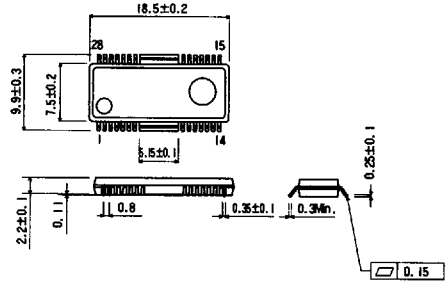
- available in a HSOP28 package
- supply voltage range (6 ~ 11V)
- wide dynamic range (6.0 V typically at V_{CC} = 8 V, RL = 8 Ω)
- gain of driver output can be changed by changing a single external resistor
- includes general purpose operational amplifier
- built-in 5-V regulator
- internal mute circuit provided
- built-in thermal shutdown circuit

Applications

- CD player
- CD -ROM

Dimensions (Units : mm)

BA6399FP (HSOP28)



Block diagram

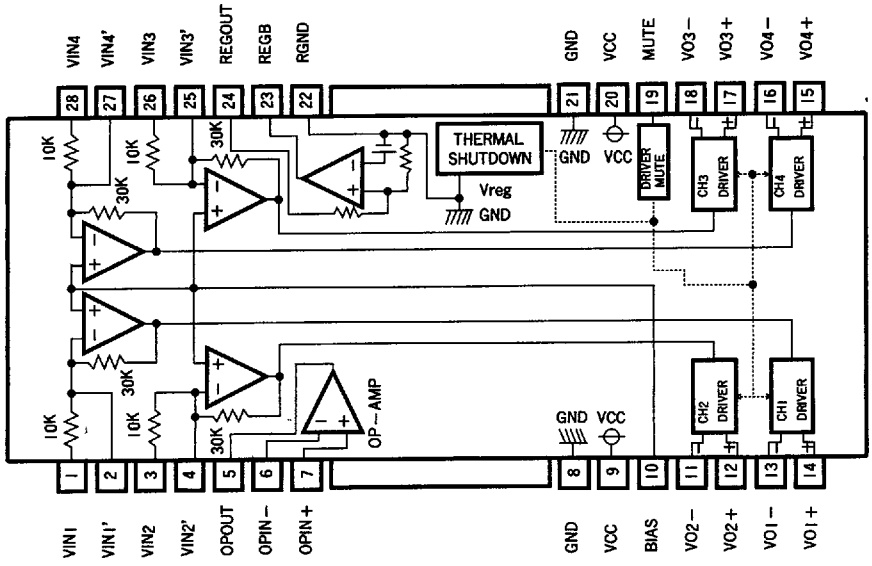


Table 1 Pin description (Sheet 1 of 2)

Pin no.	Symbol	Description
1	VIN1	Driver CH1 input
2	VIN1'	Driver CH1 input, gain adjustment pin
3	VIN 2	Driver CH2 input
4	VIN 2'	Driver CH2 input, gain adjustment pin
5	OP OUT	Operational amplifier output
6	OP IN-	Operational amplifier input, negative
7	OP IN+	Operational amplifier input, positive
8	GND	Substrate ground
9	V_{CC}	
10	BIAS	Bias input
11	VO2-	Driver CH2 negative output
12	VO2+	Driver CH2 positive output
13	VO1-	Driver CH1 negative output
14	VO1+	Driver CH1 positive output
15	VO4+	Driver CH4 positive output
16	VO4-	Driver CH4 negative output
17	VO3+	Driver CH3 positive output

Table 1 Pin description (Sheet 2 of 2)

Pin no.	Symbol	Description
18	VO3-	Driver CH3 negative output
19	MUTE	Driver mute control input
20	V_{CC}	
21	GND	Substrate ground
22	RGND	Regulator ground
23	REGB	External transistor base connection pin
24	REG OUT	5 V output, connects to external transistor collector
25	VIN3'	Driver CH3 gain adjustment pin
26	VIN3	Driver CH3 input
27	VIN4'	Driver CH4 gain adjustment pin
28	VIN4	Driver CH4 input

Absolute maximum ratings (T_a = 25°C)

Parameter	Symbol	Limits	Unit	Conditions
Power supply voltage	V_{CC}	18	V	
Power dissipation	P_d	1.7	W	Reduce power by 13.6 mW for each degree above 25°C. Mounted on 50 × 50 × 1.0 mm phenol paper PCB.
Operating temperature	T_{opr}	−30~+85	°C	
Storage temperature	T_{stg}	−55~+150	°C	

Recommended operating conditions (T_a = 25°C)

Parameter	Symbol	Min	Typical	Max	Unit	Conditions
Power supply voltage	V_{CC}	6	8	11	V	Operates at 4~11 V when regulator not used

Electrical characteristics (unless otherwise noted, T_a = 25°C, V_{CC} = 8 V, R_L = 8 Ω, f = 1 kHz)

Parameter	Symbol	Min	Typical	Max	Unit	Conditions
Quiescent current	I_Q	2.5	5.0	7.5	mA	No load
Driver						
Input voltage, offset	V_{OI}	−5	0	5	mV	
Output voltage, offset	V_{OO}	−5	0	5	mV	
Dead zone width	V_{DB}	10	20	30	mV	Total for positive and negative sides
Output amplitude	V_{OM}	5.6	6.0		V	Differential output
Gain (close circuit)	G_{VC}	7.0	9.5	11.5	dB	V_{IN} = 500 mV dc, differential output
Gain, positive and negative voltage differential	ΔG_{VC}	−0.9	0	0.9	dB	V_{IN} = 500 mV dc, differential output
Ripple rejection	RR		80		dB	V_{IN} = 0.1 mV_{rms}, f = 100 Hz
Mute-off voltage	V_{MOFF}	0.5			V	Mute only affects CH4 (pins 15 and 16 output)
Mute-on voltage	V_{MON}			2.0	V	
5 V regulator						
Output voltage	V_{REG}	4.75	5.00	5.25	V	I_L = 100 mA
Output load variation	ΔV_{RL}	−50	0	10	mV	I_L = 0 ~ 200 mA
Power supply voltage variation	ΔV_{VCC}	−10	0	40	mV	I_L = 100 mA (V_{CC} = 6 ~ 11V)
Drop voltage	V_{DIF}		0.3	0.6	V	V_{CC} = 4.7 V, I_L = 200 mA, Power transistor must meet conditions: V_{SAT} < 0.2 V when I_C = 200 mA.
V_{REG} amplifier output current	I_{REG}	8	20		mA	V_{CC} = 4.7 V, when adding 3 V, pin 24 open
Operational amplifier						
Offset voltage	V_{OFOP}	−5	0	5	mV	
Input bias current	I_{BOP}			300	nA	
High-level output voltage	V_{OHOP}	6.5	7.2		V	
Low-level output voltage	V_{OLOP}			1.8	V	
Output drive current (sink)	I_{SINK}	10	40		mA	50 Ω, at V_{CC}
Output drive current (source)	I_{SOURCE}	10	40		mA	50 Ω, at ground
Voltage gain (open circuit)	G_{VO}		72		dB	V_{IN} = −75 dBV
Slew rate	SR		1		V/μs	

Figure 1 Application example

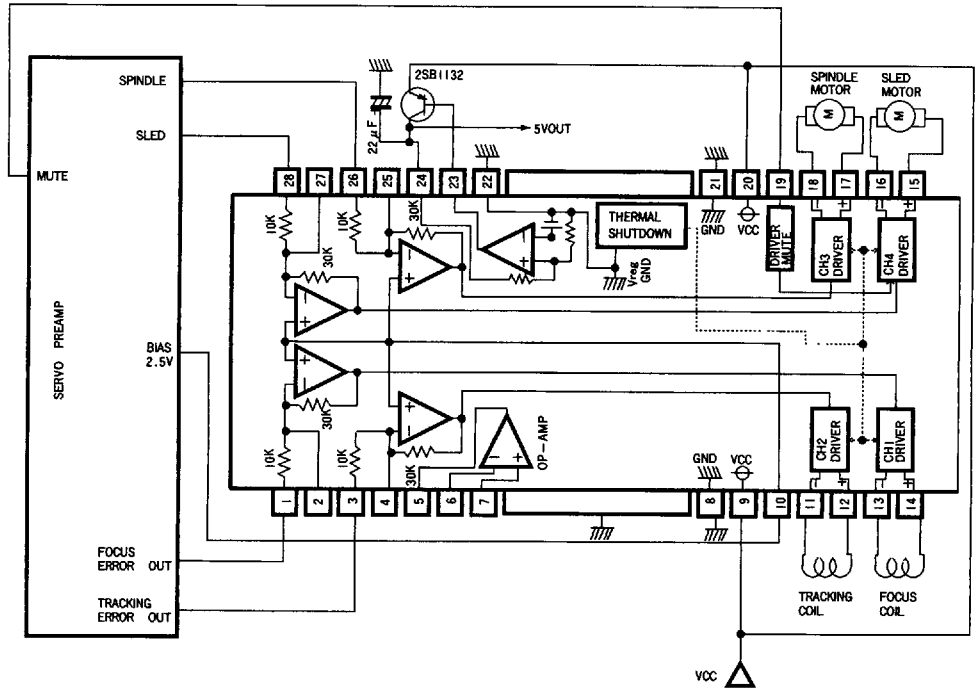
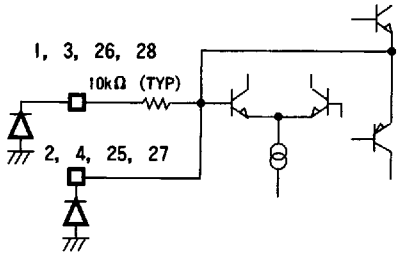
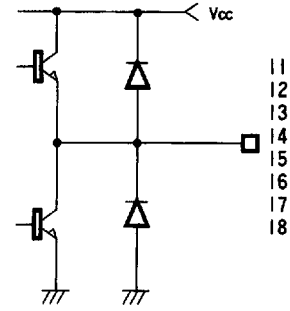
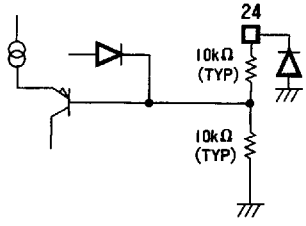
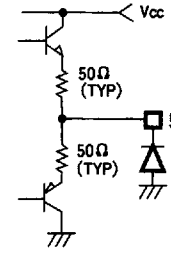


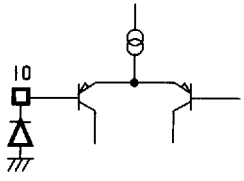
Figure 2 Input and output equivalent circuits

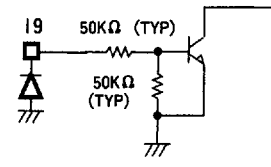


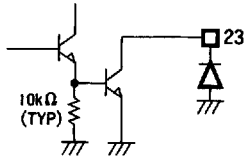


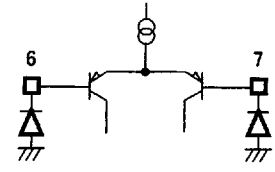












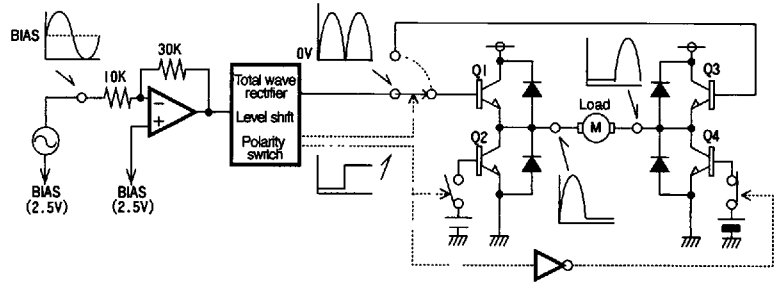
Operation

Driver

The error signal of the focus tracking from the servo preamplifier and the control signal from the motor are the inputs to the IC. The input signal is normally a signal centered around 2.5 V.

The polarity is switched when the signal is greater or less than the bias voltage. The power transistors Q1 and Q4 or Q2 and Q3 are turned ON (see Figure 3), depending on the polarity switch. The power transistor (Q1 or Q3), whichever is ON, is driven by the full wave rectified signal as well as the level shifted signal. It supplies current to the load. Note that when there is no input, both output pins are at the GND level.

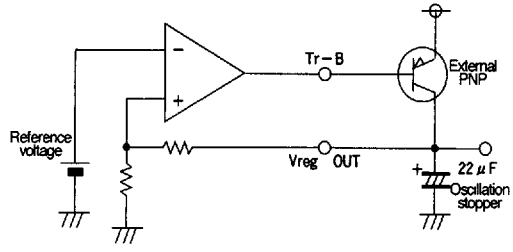
Figure 3 Driver equivalent circuit



Regulator

The regulator is a typical series regulator which creates a reference voltage internally. A PNP low saturation-type transistor must be connected to the IC.

Figure 4 Regulator equivalent circuit



Operational amplifier

This is a standard 4558 type.

Precautions for use

- A thermal shut down circuit is built into the BA6399FP. When the temperature of the chip reaches 175°C (typically), the output current is muted. The thermal shutdown switch resets when the temperature falls below 150°C.
- If the mute pin (pin 19) voltage is greater than 2.0 V, channel 4 (pins 15 and 16) is muted. Under normal operating conditions, make sure to pull pin 19 below 0.5 V.
- If the bias pin (pin 10) drops below 1.4 V, the output is muted. Make sure that under normal operating conditions, this pin is at 1.6 V or above.
- The channel 4 output is muted in the event of a thermal shut down, a mute application, or a bias pin voltage drop.
- The dead zone width is determined as follows:
  Dead zone width = input resistance ×1 μA

  When using the built-in input resistance (10 kΩ), the dead zone width is typically 10 mV (one side). Because the input resistance and the 1 μA temperature characteristics are canceled, there are virtually no variations with temperature provided the internal resistance is used.

  However, if an external resistor is added to change the gain, the dead zone width should be recalculated with the above formula. The temperature change is about –4000 ppm/°C and the gain changes by approximately of 4000 ppm/°C.
- Make sure to connect a 0.1 μF capacitor to the dc supplied power main input to filter out voltage ripples.
- Because the gain is high, if a long wire is connected to the pin that adjusts the gain, the output may oscillate due to free capacitance. Consequently, keep these wires as short as possible in your design.
- Heat dissipation fins are attached to the GND on the inside of the package. Make sure to connect these to the external GND.
- The capacitor connected between the regulator output (pin 24) and the GND also serves to stop oscillation of the IC circuit. Consequently, make sure to use one with good temperature characteristics.

Electrical characteristic curves

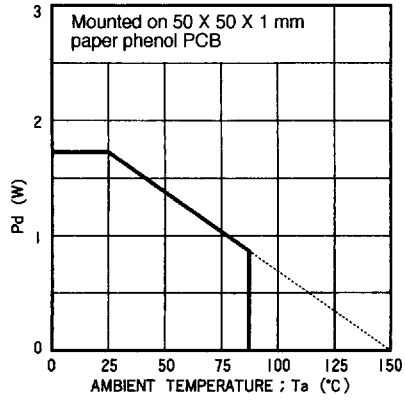


Figure 5

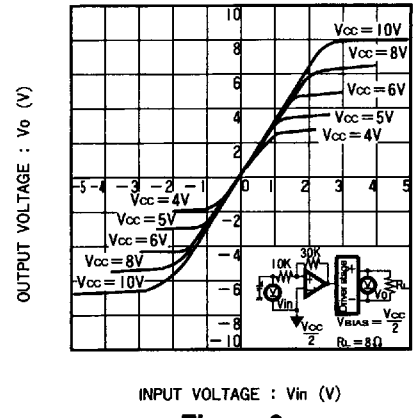


Figure 6

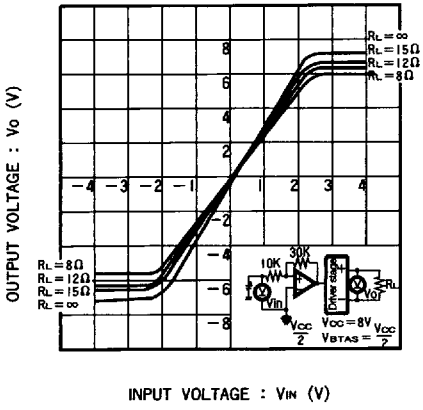


Figure 7

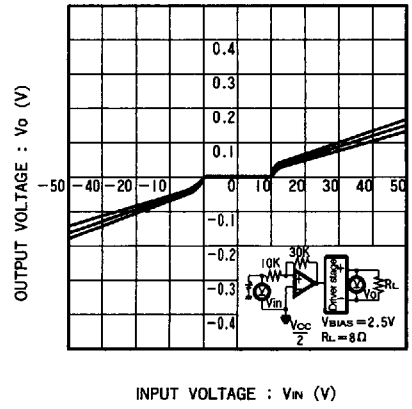


Figure 8

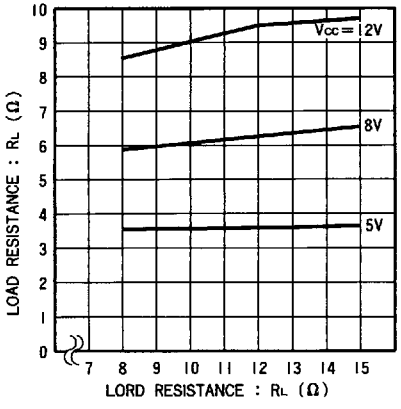


Figure 9

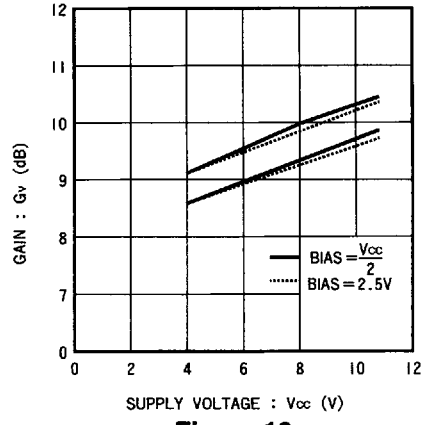


Figure 10

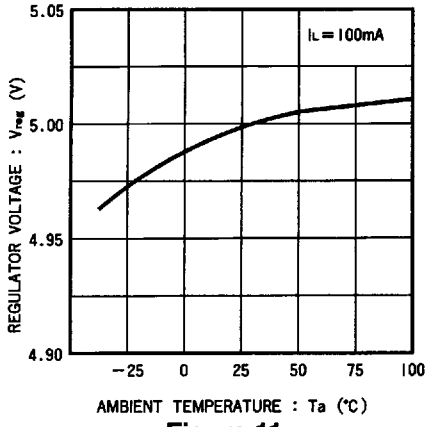


Figure 11

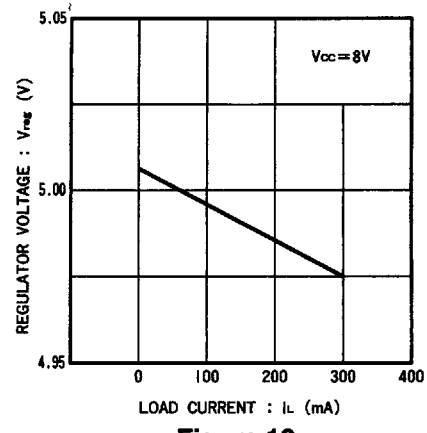


Figure 12

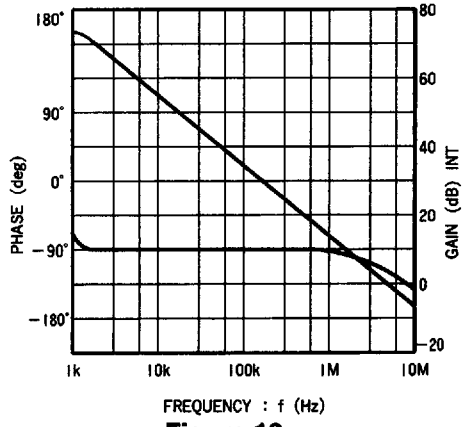


Figure 13