

# AN8387S

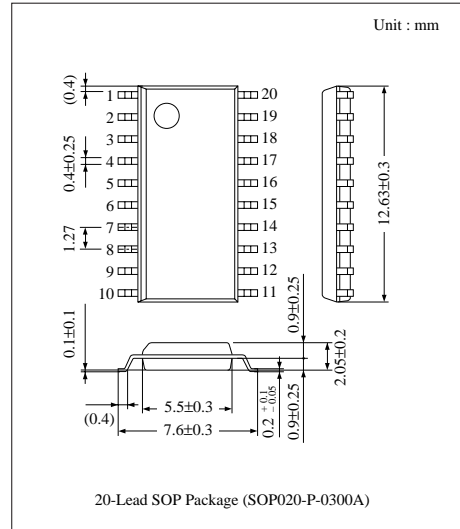
## 2-channel Linear Driver

### ■ Overview

The AN8387S is an IC which incorporates 2 circuits of BTL drivers for driving various DC motors such as actuators (focus, tracking traverse), spindles, and loading of the CD players.

### ■ Features

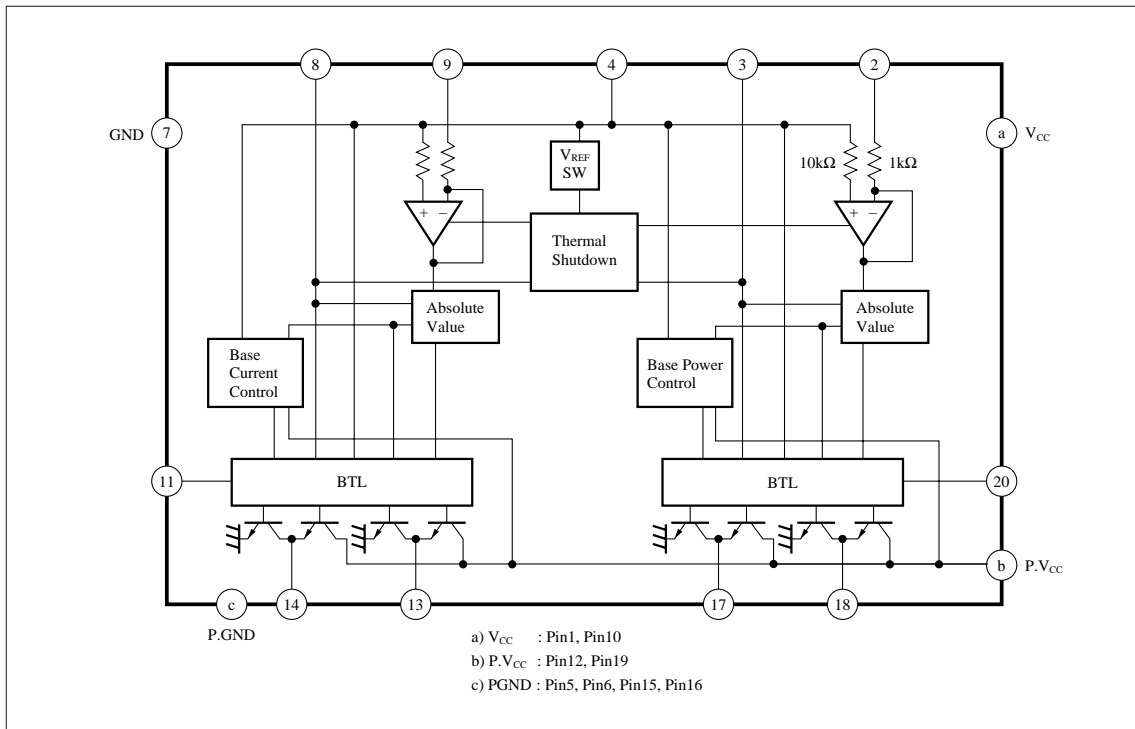
- Operating supply voltage range ;  $V_{CC}=3.5V$  to  $9V$   
 $PV_{CC}=1.5V$  to  $9V$
- Built-in 2 circuits of voltage driven BTL drivers  
(maximum drive current :  $500mA$ )
- Quiescent current (current consumption at no input) ;  $3.2mA$
- Provided with power control pin
- Provided with driver output voltage limiting pin
- Built-in thermal protective circuit  
(operating temperature :  $160^{\circ}C$  typ.)



### ■ Applications

Linear driving of the DC motors and actuators of the CD players. CD radio cassette tape recorders, and so on.

### ■ Block Diagram



### ■ Absolute Maximum Ratings (Ta=25°C)

Parameter	Symbol	Rating	Unit
Supply Voltage	V <sub>CC</sub>	10	V
Power Dissipation	P <sub>D</sub>	1,200 <sup>Note)</sup>	mW
Operating Ambient Temperature	T <sub>opr</sub>	-30 ~ +85	°C
Storage Temperature	T <sub>stg</sub>	-55 ~ +125	°C

Note) When mounted onto the glass epoxy PCB (50mm × 50mm × 0.8mm)

### ■ Recommended Operating Range (Ta=25°C)

Parameter	Symbol	Range
Operating Supply Voltage Range	V <sub>CC</sub>	3.5V ~ 9V
	P.V <sub>CC</sub>	1.5V ~ 9V

### ■ Electrical Characteristics (Ta=25°C)

Parameter	Symbol	Condition	min.	typ.	max.	Unit
Current Consumption at No Input (V <sub>CC</sub> )	I <sub>VCCQ</sub>	V <sub>CC</sub> =9V, V <sub>ref</sub> =4.5V, PV <sub>CC</sub> =9V	1	2	3.5	mA
Current Consumption at No Input (PV <sub>CC</sub> )	I <sub>PVCCQ</sub>	V <sub>CC</sub> =9V, V <sub>ref</sub> =4.5V, PV <sub>CC</sub> =9V	0.7	1.2	3.5	mA
PV <sub>CC</sub> Leak Current	I <sub>PVCCL</sub>	V <sub>CC</sub> =0V, V <sub>ref</sub> =OPEN, PV <sub>CC</sub> =10V	—	—	1	μA
V <sub>ref</sub> Threshold (H) <sup>Note 1)</sup>	V <sub>refH</sub>	V <sub>CC</sub> =3V, PV <sub>CC</sub> =10V, V <sub>IN</sub> =0V	1.45	—	—	V
V <sub>ref</sub> Threshold (L) <sup>Note 2)</sup>	V <sub>refL</sub>	V <sub>CC</sub> =3V, PV <sub>CC</sub> =10V, V <sub>IN</sub> =0V	—	—	1	V
Input Amp. Input Impedance	RA <sub>IN</sub>	V <sub>CC</sub> =5V, V <sub>ref</sub> =2.5V, V <sub>IN</sub> =2.4→2.6V	0.75	1	1.25	kΩ
Driver Input Offset Voltage <sup>Note 3)</sup>	V <sub>I offset</sub>	V <sub>CC</sub> =9V, V <sub>ref</sub> =4.5V, PV <sub>CC</sub> =9V	-10	0	10	mV
Driver Output Offset Voltage <sup>Note 3)</sup>	V <sub>O offset</sub>	V <sub>CC</sub> =9V, V <sub>ref</sub> =4.5V, PV <sub>CC</sub> =9V	-55	0	55	mV
Driver Dead Zone Width <sup>Note 3)</sup>	V <sub>DZ</sub>	V <sub>CC</sub> =9V, V <sub>ref</sub> =4.5V, PV <sub>CC</sub> =9V	-10	—	19	mV
Driver Transfer Gain (+) <sup>Note 3)</sup>	G <sup>+</sup>	V <sub>CC</sub> =9V, V <sub>ref</sub> =4.5V, PV <sub>CC</sub> =9V	13	15.1	17	dB
Driver (+), (-) Transfer Gain Ratio <sup>Note 3)</sup>	RG	V <sub>CC</sub> =9V, V <sub>ref</sub> =4.5V, PV <sub>CC</sub> =9V	-1.9	-0.9	0.5	dB
Driver Output Voltage	V <sub>OLG</sub>	V <sub>CC</sub> =9V, V <sub>ref</sub> =4.5V, PV <sub>CC</sub> =9V, V <sub>LIM</sub> =0V	-130	—	130	mV
Driver Output Voltage Absolute Value	V <sub>OL</sub>	V <sub>CC</sub> =9V, V <sub>ref</sub> =4.5V, PV <sub>CC</sub> =9V, V <sub>LIM</sub> =3V	2.25	—	3	V
Driver Power Transistor Saturation Voltage	V <sub>sat</sub>	V <sub>CC</sub> =9V, V <sub>ref</sub> =4.5V, PV <sub>CC</sub> =9V, I <sub>O</sub> =300mA	—	0.29	0.38	V
PC Input Pin Threshold Voltage (H) <sup>Note 4)</sup>	V <sub>PC THH</sub>	V <sub>CC</sub> =9V, V <sub>ref</sub> =2.5V, PV <sub>CC</sub> =5V, V <sub>IN</sub> =2.3V	2.8	—	—	V
PC Input Pin Threshold Voltage (L) <sup>Note 5)</sup>	V <sub>PC THL</sub>	V <sub>CC</sub> =9V, V <sub>ref</sub> =2.5V, PV <sub>CC</sub> =5V, V <sub>IN</sub> =2.3V	—	—	0.8	V
Protective Diode Forward Voltage	V <sub>PD</sub>	I <sub>O</sub> =300mA	0.9	1.5	1.8	V
Thermal Protective Circuit Operating Temperature	T <sub>THD</sub>		—	160	—	°C

Note1) V<sub>ref</sub> voltage required to operate the driver.

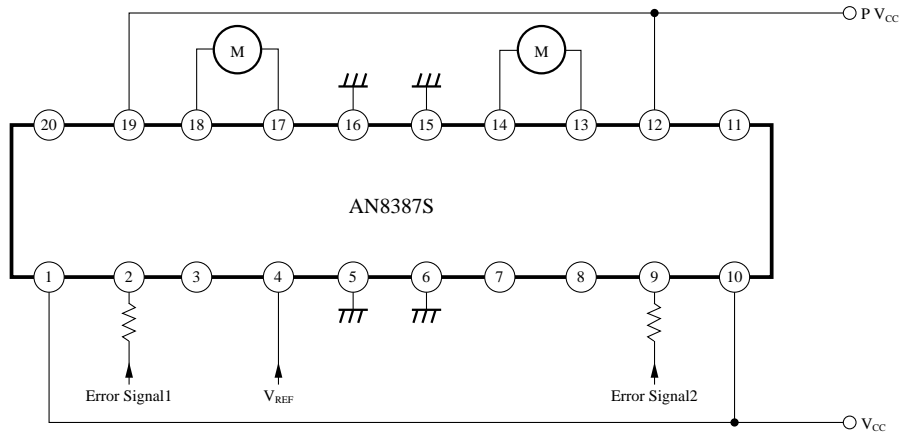
Note2) If V<sub>ref</sub> is made lower than this voltage, the driver does not operate.

Note3) Refer to the driver input/output characteristics chart.

Note4) If the PC pin voltage is made higher than this voltage, there will be no output voltage from the driver. Both (+) and (-) outputs are pulling in the current.

Note5) If the PC pin voltage is made lower than this voltage, the driver operates normally.

■ Application Circuit



■ Pin Descriptions

Pin No.	Symbol	I/O	DC Voltage	Equivalent Circuit	Description
1 10	V <sub>CC</sub>	I	4.8V		V <sub>CC</sub> pin. Not connected to the PV <sub>CC</sub> pin.
2	IN1	I	2.5V	<p>Operational amplifier is of PNP differential input</p>	Error signal input pin for the channel-1 driver
9	IN2	I	2.5V		Error signal input pin for the channel-2 driver
3	PC1	I	0V		Input pin for the PC (inter-output voltage of the channel-1 driver OFF)
8	PC2	I	0V		Input pin for the PC (inter-output voltage of the channel-2 driver OFF)

■ Pin Descriptions (Cont.)

Pin No.	Symbol	I/O	DC Voltage	Equivalent Circuit	Description
4	V <sub>ref</sub>	I	2.5V		V <sub>ref</sub> input pin
5 6 15 16	P.GND	O	0V		P.GND pin
7	GND	O	0V		GND pin
11	VLIM2	I	V <sub>CC</sub>		VLIM pin for the channel-2 driver. Used when limiting the output voltage of the pins 13 and 14
20	VLIM1	I	V <sub>CC</sub>		VLIM pin for the channel-1 driver. Used when limiting the output voltage of the pins 17 and 18
12 19	PV <sub>CC</sub>	I	3V		Power V <sub>CC</sub> pin. Supplies the driver current.

■ Pin Descriptions (Cont.)

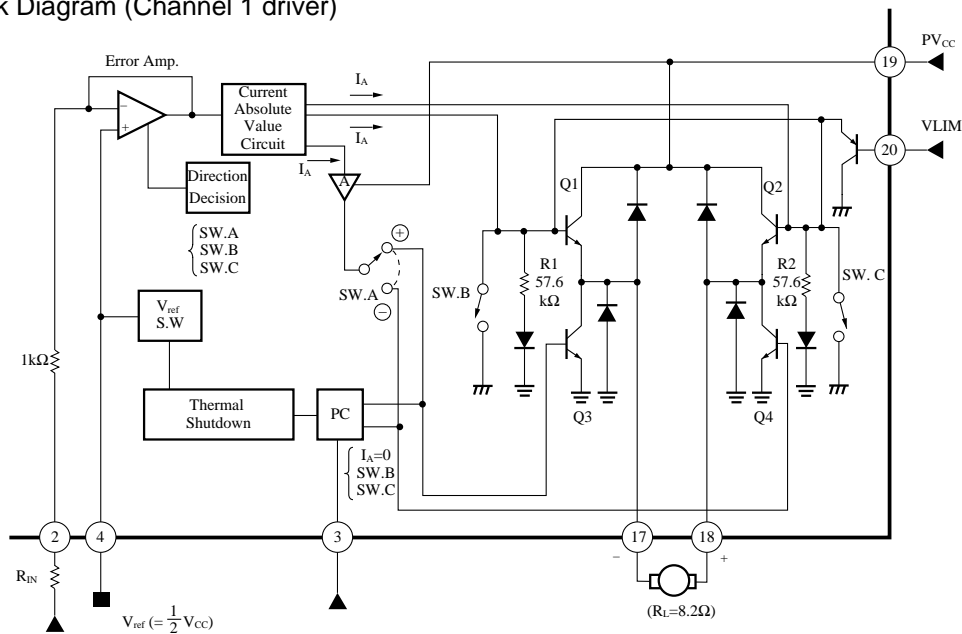
Pin No.	Symbol	I/O	DC Voltage	Equivalent Circuit	Description
13	D2+	O	(2.7V)		Non-inverting output pin for the channel-2 driver
14	D2-	O	(0.3V)		Inverting output pin for the channel-2 driver
17	D1-	O	(0.3V)		Inverting output pin for the channel-1 driver
18	D1+	O	(2.7V)		Non-inverting output pin for the channel-1 driver

■ Supplementary Explanation

• Operational Description

The AN8387S incorporates the two channels of drivers. Since both channels have the identical functions, the following describes the channel-1 driver.

• Block Diagram (Channel 1 driver)



An error signal ( $V_{IN}$ ) input to the pin2 is converted into the absolute value input current  $I_A$  through the error amplifier and current absolute value circuit. The value of  $I_A$  is as follows.

$$I_A = \frac{|V_{IN} - V_{ref}|}{R_{IN} + 1k\Omega}$$

1) When  $V_{IN} > V_{ref}$ , the direction determining circuit operates so that the following conditions are met.

- SW.A : ⊕
- SW.B : ON
- SW.C : OFF

2) When  $V_{IN} < V_{ref}$ , the direction determining circuit operates so that the following conditions are met.

- SW.A : ⊖
- SW.B : OFF
- SW.C : ON

The output ( $V_+ - V_-$ ) between the pins18 and 17 has the following relation with the input ( $V_{IN} - V_{ref}$ ) between the pins 2 and 4.

$$(V_+ - V_-) = \frac{57.6k\Omega}{R_{IN} + 1k\Omega} (V_{IN} - V_{ref})$$

Therefore, the driver's gain G will be as follows. (when the motor load  $R_L$  is  $8.2\Omega$ )

$$G = \frac{(V_+ - V_-)}{(V_{IN} - V_{ref})} = \frac{57.6k\Omega}{1k\Omega + R_{IN}}$$

The output voltage  $V_-$  of the pin17 and  $V_+$  of the pin18 can be limited by applying a voltage to the VLIM pin20.

For example, if a voltage of 3V is applied to the pin20 when  $V_{CC} = 9V$  and  $R_L = 8.2\Omega$ , the maximum value of  $|V_+$

$-V_-|$  is limited within the following range.

$$2.25V \leq |V_+ - V_-| \leq 3V$$

When the pin20 is short-circuited to GND,

$|V_+ - V_-| \leq 130mV$  results regardless of an input error signal ( $V_{IN}$ ).

If the pin20 is prepared to short-circuit to GND at power-on of the set, it can be used to prevent operation error at power-on of the motor or actuator.

When the pin20 is not used, short-circuit it to the pins1 and 10.

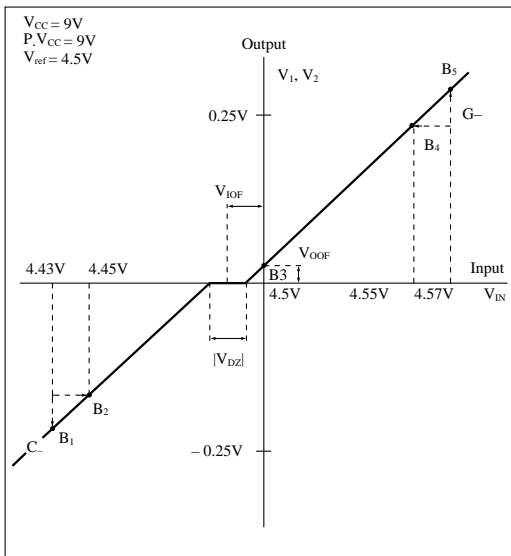
The pin3 is a PC pin. If a voltage of 2.8V or more is applied to this pin, SW.B and SW.C are turned on,  $I_A$  becomes 0mA, and the base current flows to the bases of Q3 and Q4 simultaneously to turn on Q3 and Q4. As a result, the pins17 and 18 are almost short-circuited to P.GND.

This IC incorporates the thermal shutdown circuit. If the chip temperature of the IC comes to about 160°C, both drivers of the two channels are turned off. (the output pins17, 18, 14, and 13 are short-circuited to P.GND)

Similarly, if the applied voltage ( $V_{ref}$ ) of the  $V_{ref}$  pin4 comes to 1V or less, both drivers of the two channels are turned off.

• Driver Input/Output Characteristics

- Input Offset ( $V_{IOF}$ )
- Output Offset ( $V_{OOF}$ )
- Dead Zone ( $|V_{DZ}|$ )
- Transfer Gain (+) ( $G_+$ )
- (+), (-) Transfer Gain Ratio ( $R_G$ )



$$G_+ = \frac{B_5 - B_4}{20mV}, G_- = \frac{B_2 - B_1}{20mV}, R_G = \frac{G_+}{G_-}$$

• Characteristics Curve

P<sub>D</sub>-T<sub>a</sub>

