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.

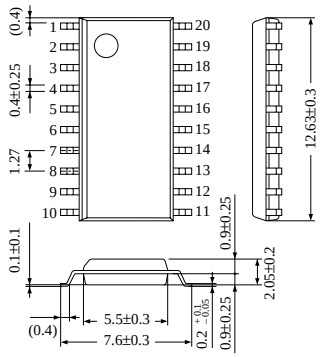
■ Features

- 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
  (maximun 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°C typ.)

■ Applications

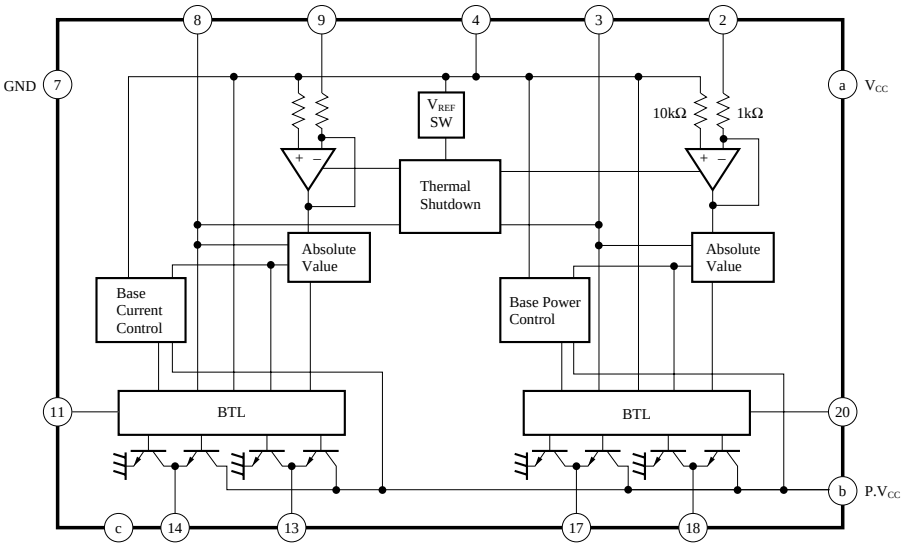
Linear driving of the DC motors and actuators of the CD players. CD radio cassette tape recorders, and so on.

Unit : mm



20-Lead SOP Package (SOP020-P-0300A)

■ Block Diagram



a) V_{CC} : Pin1, Pin10
b) $P.V_{CC}$: Pin12, Pin19
c) PGND : Pin5, Pin6, Pin15, Pin16

■ Absolute Maximum Ratings (Ta=25˚C)

Parameter	Symbol	Rating	Unit
Supply Voltage	V_{CC}	10	V
Power Dissipation	P_D	1,200 Note)	mW
Operating Ambient Temperature	T_{opr}	–30 ~ +85	˚C
Storage Temperature	T_{stg}	–55 ~ +125	˚C

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

■ Recommended Operating Range (Ta=25˚C)

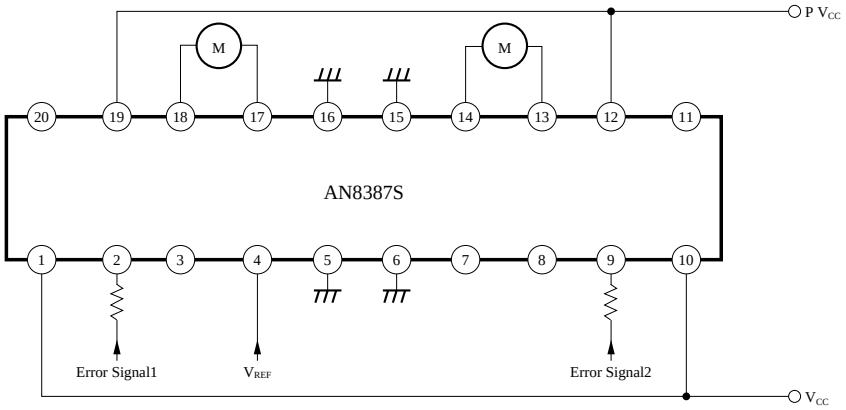
Parameter	Symbol	Range
Operating Supply Voltage Range	V_{CC}	3.5V ~ 9V
	$P.V_{CC}$	1.5V ~ 9V

■ Electrical Characteristics (Ta=25˚C)

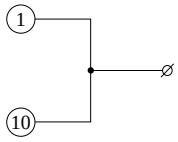
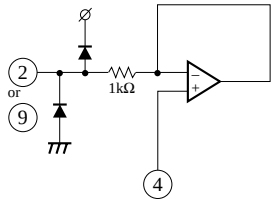
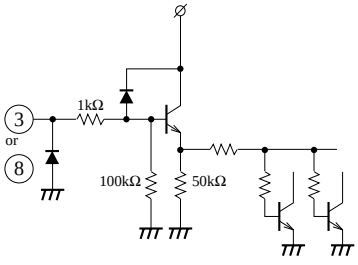
Parameter	Symbol	Condition	min.	typ.	max.	Unit
Current Consumption at No Input (V_{CC})	I_{VCCQ}	V_{CC}=9V, V_{ref}=4.5V, PV_{CC}=9V	1	2	3.5	mA
Current Consumption at No Input (PV_{CC})	I_{PVCCQ}	V_{CC}=9V, V_{ref}=4.5V, PV_{CC}=9V	0.7	1.2	3.5	mA
PV_{CC} Leak Current	I_{PVCCL}	V_{CC}=0V, V_{ref}=OPEN, PV_{CC}=10V	—	—	1	µA
V_{ref} Threshold (H) Note 1)	V_{refH}	V_{CC}=3V, PV_{CC}=10V, V_{IN}=0V	1.45	—	—	V
V_{ref} Threshold (L) Note 2)	V_{refL}	V_{CC}=3V, PV_{CC}=10V, V_{IN}=0V	—	—	1	V
Input Amp. Input Impedance	RA_{IN}	V_{CC}=5V, V_{ref}=2.5V, V_{IN}=2.4→2.6V	0.75	1	1.25	kΩ
Driver Input Offset Voltage Note 3)	$V_{I\ offset}$	V_{CC}=9V, V_{ref}=4.5V, PV_{CC}=9V	–10	0	10	mV
Driver Output Offset Voltage Note 3)	$V_{O\ offset}$	V_{CC}=9V, V_{ref}=4.5V, PV_{CC}=9V	–55	0	55	mV
Driver Dead Zone Width Note3)	$\|V_{DZ}\|$	V_{CC}=9V, V_{ref}=4.5V, PV_{CC}=9V	–10	—	19	mV
Driver Transfer Gain (+) Note3)	G^+	V_{CC}=9V, V_{ref}=4.5V, PV_{CC}=9V	13	15.1	17	dB
Driver (+), (–) Transfer Gain Ratio Note 3)	RG	V_{CC}=9V, V_{ref}=4.5V, PV_{CC}=9V	–1.9	– 0.9	0.5	dB
Driver Output Voltage	V_{OLG}	V_{CC}=9V, V_{ref}=4.5V, PV_{CC}=9V, V_{LIM}=0V	–130	—	130	mV
Driver Output Voltage Absolute Value	$\|V_{OL}\|$	V_{CC}=9V, V_{ref}=4.5V, PV_{CC}=9V, V_{LIM}=3V	2.25	—	3	V
Driver Power Transistor Saturation Voltage	V_{sat}	V_{CC}=9V, V_{ref}=4.5V, PV_{CC}=9V, I_O=300mA	—	0.29	0.38	V
PC Input Pin Threshold Voltage (H) Note 4)	$V_{PC\ THH}$	V_{CC}=9V, V_{ref}=2.5V, PV_{CC}=5V, V_{IN}=2.3V	2.8	—	—	V
PC Input Pin Threshold Voltage (L) Note 5)	$V_{PC\ THL}$	V_{CC}=9V, V_{ref}=2.5V, PV_{CC}=5V, V_{IN}=2.3V	—	—	0.8	V
Protective Diode Forward Voltage	V_{PD}	I_O=300mA	0.9	1.5	1.8	V
Thermal Protective Circuit Operating Temperature	T_{THD}		—	160	—	˚C

Note1) V_{ref} voltage required to operate the driver.
Note2) If V_{ref} is made lower than this voltage, the driver dose 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.

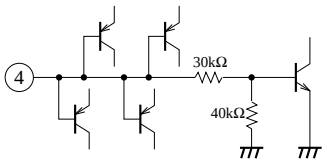
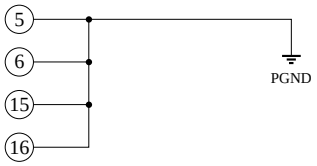
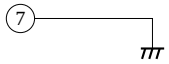
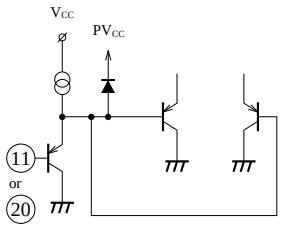
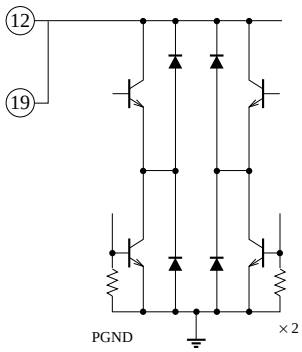
■ Application Circuit



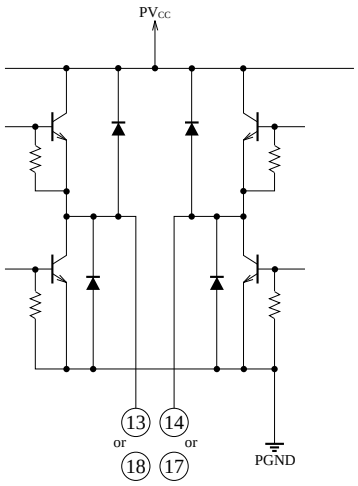
■ Pin Descriptions

Pin No.	Symbol	I/O	DC Voltage	Equivalent Circuit	Description
1 10	V_{CC}	I	4.8V		V_{CC} pin. Not connected to the PV_{CC} pin.
2	IN1	I	2.5V	 Operational amplifier is of PNP differential input	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_{ref}	I	2.5V		V_{ref} input pin
5 6 15 16	P.GND	O	0V		P.GND pin
7	GND	O	0V		GND pin
11	VLIM2	I	V_{CC}		VLIM pin for the channel-2 driver. Used when limiting the output voltage of the pins 13 and 14
20	VLIM1	I	V_{CC}		VLIM pin for the channel-1 driver. Used when limiting the output voltage of the pins 17 and 18
12 19	PV_{CC}	I	3V		Power V_{CC} pin. Supplies the driver current.

■ Pin Descriptions (Cont.)

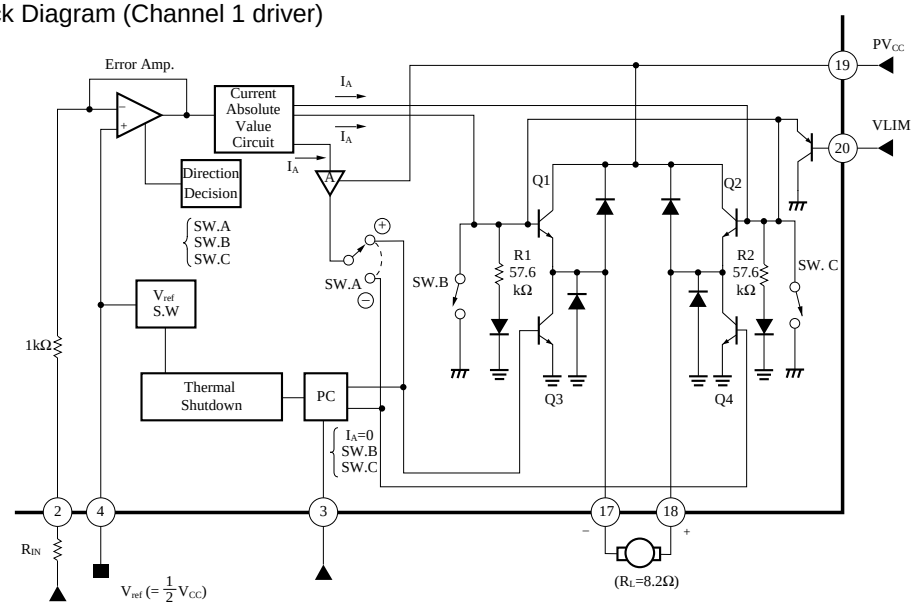
Pin No.	Symbol	I/O	DC Voltage	Equivalent Circuit	Description
13	D2+	O	(2.7V)		Non-inverting output pin for the channel-2 driver
14	D2–	O	(0.3V)		Inverting output pin for the channel-2 driver
17	D1–	O	(0.3V)		Inverting output pin for the channel-1 driver
18	D1+	O	(2.7V)		Non-inverting output pin for the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

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

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

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

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 = 8.2Ω, 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.

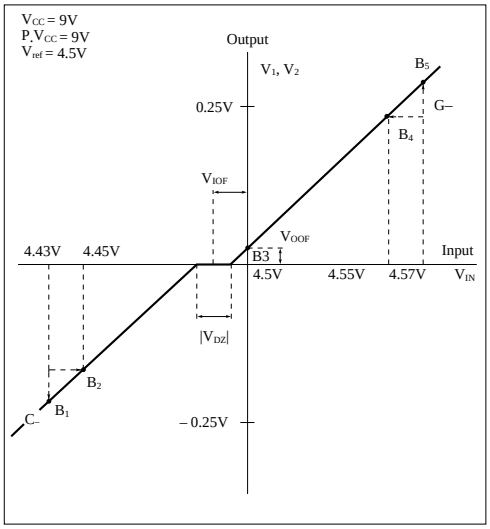
The pin3 is a PC pin. If a voltage of 2.8V or more is applied to this pin, SW.B and SW.C are turned on, I_A becomes 0mA, and the base current flows to the bases of Q3 and Q4 simultaneously to turn on Q3 and Q4. As a result, the pins17 and 18 are almost short-circuited to P.GND.

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.

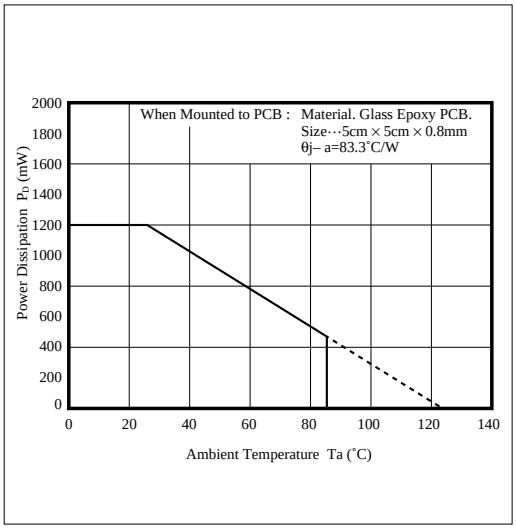
• Driver Input/Output Characteristics

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



• Characteristics Curve

P_D – Ta



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