

# AN8787NSB

## 4-channel linear driver IC for CD/CD-ROM drive

### ■ Overview

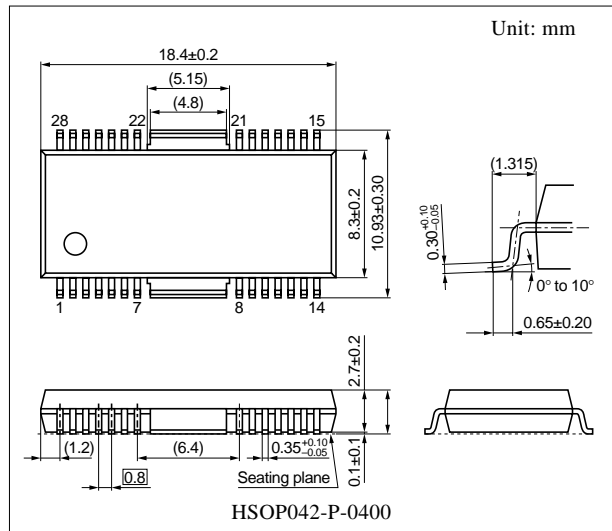
The AN8787NSB is a 4-channel driver IC that has 2-channel of H-bridge method actuator driver with current feedback, one channel of BTL type traverse driver and one channel of tri-state output type loading driver. It is optimum for actuator or motor driver of CD/CD-ROM player. It comes with a surface mount package that excels in heat radiating characteristic.

### ■ Features

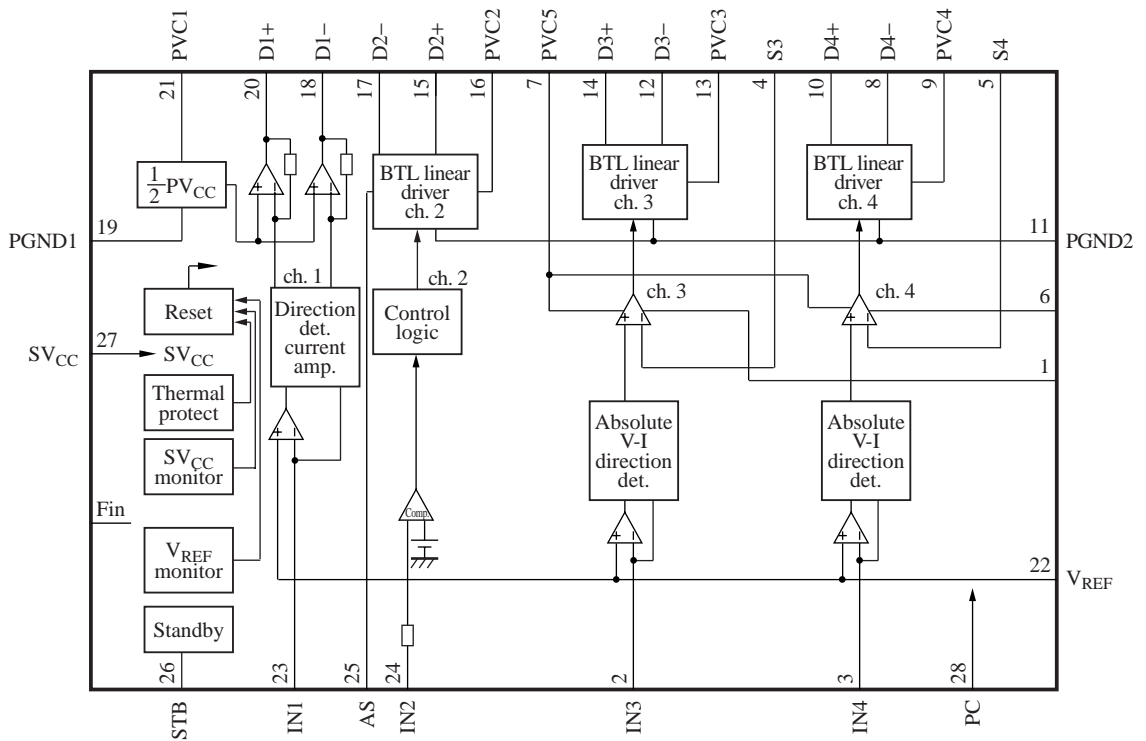
- Little phase delay due to current feedback method (2-channel for actuator)
- Channels for loading motor (H-bridge system) are available for three modes of forward rotation, reverse rotation and braking
- Muting SW with 2 modes: A loading channel is in operation, and the other 3 channels are in muting; Loading is in muting and the other 3 channels are in operation.
- Standby switch to stop all functions
- Wide output dynamic range is available regardless of a reference power source on the system.
- I/O gain setting by an external resistor
- Thermal shut-down circuit built-in (with hysteresis)

### ■ Applications

- CD/CD-ROM drive
- DVD/DVD-ROM drive



■ Block Diagram



■ Pin Descriptions

Pin No.	Description	Pin No.	Description
1	Driver-3 phase compensation pin	16	Driver-2 power supply pin
2	Driver-3 input pin	17	Driver-2 reverse rotation output pin
3	Driver-4 input pin	18	Driver-1 reverse rotation output pin
4	Driver-3 feedback pin	19	Driver-1 GND pin
5	Driver-4 feedback pin	20	Driver-1 forward rotation output pin
6	Driver-4 phase compensation pin	21	Driver-1 power supply pin
7	Driver-3, driver-4 power supply pin	22	V <sub>REF</sub> input pin
8	Driver-4 reverse rotation output pin	23	Driver-1 input pin
9	Driver-4 current feedback power supply pin	24	Driver-2 input pin
10	Driver-4 forward rotation output pin	25	Driver-2 output voltage adjustment pin
11	Driver-2, driver-4 GND pin	26	Standby input pin
12	Driver-3 reverse rotation output pin	27	System power supply pin
13	Driver-3 current feedback power supply pin	28	PC (power cut) input pin
14	Driver-3 forward rotation output pin	Fin	GND pin
15	Driver-2 forward rotation output pin		

### ■ Absolute Maximum Ratings

Parameter	Symbol	Rating	Unit
Supply voltage	$SV_{CC}$	14.4	V
Supply current	$I_{CC}$	—	mA
Power dissipation *2	$P_D$	582	mW
Operating ambient temperature *1	$T_{opr}$	-30 to +85	°C
Storage temperature *1	$T_{stg}$	-55 to +150	°C

Note) \*1: Except for the power dissipation, operating ambient temperature and storage temperature, all ratings are for  $T_a = 25^\circ\text{C}$ .

\*2: Referring to "■ Application Circuit Example", use within the range of  $P_D = 582$  mW or less at  $T_a = 85^\circ\text{C}$ , following the allowable power dissipation characteristic curve of "■ Application Notes".

### ■ Recommended Operating Range

Parameter	Symbol	Range	Unit
Supply voltage *	$SV_{CC}$	6.4 to 14	V
	$PV_{C1}, PV_{C2}, PV_{C5}$	4.5 to 14	

Note) \*: Refer to "■ Application Circuit Example".

### ■ Electrical Characteristics at $SV_{CC} = V_{CC1} = V_{CC2} = 12$ V, $V_{CC3} = 5$ V, $R_L = 8$ $\Omega$ , $V_{PC} = 5$ V, $V_{STB} = 5$ V, $T_a = 25^\circ\text{C}$

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Current consumption 1 with no signal	$I_{SVCC}$	$V_{PC} = 5$ V, $V_{STB} = 5$ V	—	13	30	mA
Current consumption 2 with no signal	$I_{VCC1}$	$V_{PC} = 5$ V, $V_{STB} = 5$ V	—	4	6	mA
Current consumption 3 with no signal	$I_{VCC2}$	$V_{PC} = 0$ V, $V_{STB} = 5$ V	—	1	4	mA
Current consumption 4 with no signal	$I_{VCC3}$	$V_{PC} = 5$ V, $V_{STB} = 5$ V	—	1	4	mA
Current consumption with no signal at standby 1	$I_{SVCC-S}$	$V_{PC} = 5$ V, $V_{STB} = 0$ V	—	3	6	mA
Current consumption with no signal at standby 2	$I_{VCC1-S}$	$V_{PC} = 5$ V, $V_{STB} = 0$ V	—	1	3	mA

#### Driver 1

Output offset voltage	$V_{OOF-1}$		-30	0	30	mV
Gain (+)	$G_{I+}$		18.5	21.0	23.5	dB
Relative gain (+/-)	$\Delta G_{I-}$		-2.8	0	2.8	dB
Limit voltage (+)	$V_{LI+}$		6.5	8.0	—	V
Limit voltage (-)	$V_{LI-}$		—	-8.0	-6.5	V

■ Electrical Characteristics at  $V_{CC} = V_{CC1} = V_{CC2} = 12\text{ V}$ ,  $V_{CC3} = 5\text{ V}$ ,  $R_L = 8\ \Omega$ ,  $V_{PC} = 5\text{ V}$ ,  $V_{STB} = 5\text{ V}$ ,  $T_a = 25^\circ\text{C}$  (continued)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
<b>Driver 2</b>						
Output voltage 1 (+)	$V_{21+}$	$V_{CC2} = 5\text{ V}$ , $V_{PC} = 0\text{ V}$ $V_{IN2} = 4\text{ V}$ , $R_{AS} = 10\text{ k}\Omega$	2.5	2.8	3.1	V
Output voltage 1 (-)	$V_{21-}$	$V_{CC2} = 5\text{ V}$ , $V_{PC} = 0\text{ V}$ $V_{IN2} = 1\text{ V}$ , $R_{AS} = 10\text{ k}\Omega$	-3.1	-2.8	-2.5	V
Output voltage 2 (+)	$V_{22+}$	$V_{CC2} = 5\text{ V}$ , $V_{PC} = 0\text{ V}$ $V_{IN2} = 4\text{ V}$ , $R_{AS} = 0\text{ k}\Omega$	3.4	4.0	4.6	V
Output voltage 2 (-)	$V_{22-}$	$V_{CC2} = 5\text{ V}$ , $V_{PC} = 0\text{ V}$ $V_{IN2} = 1\text{ V}$ , $R_{AS} = 0\text{ k}\Omega$	-4.6	-4.0	-3.4	V
Braking ability	$V_{BRK}$	$V_{CC2} = 5\text{ V}$ , $V_{PC} = 0\text{ V}$ $I_{IN2} = 0\ \mu\text{A}$ , $I_O = 200\text{ mA}$	—	0.3	1.0	V
Input pin bias current	$I_{IN2}$	$V_{CC2} = 5\text{ V}$ , $V_{PC} = 0\text{ V}$ , $V_{IN2} = 5\text{ V}$	—	40	100	$\mu\text{A}$
Driver-2 power transistor current at power cut	$I_{drv2}$	$V_{PC} = 5\text{ V}$ , $I_{IN2} = 0\ \mu\text{A}$	—	—	1.0	$\mu\text{A}$
<b>Driver 3</b>						
Output offset voltage	$V_{OOF-3}$	$R_{S3} = 0.5\ \Omega$	-60	—	60	mV
Gain (+)	$G_{3+}$	$R_{S3} = 0.5\ \Omega$	8.5	10.5	12.5	dB
Relative gain (+/-)	$\Delta G_3$	$R_{S3} = 0.5\ \Omega$	-1.3	0	1.3	dB
Limit voltage (+)	$V_{L3+}$	$R_{S3} = 0.5\ \Omega$	3.4	3.9	—	V
Limit voltage (-)	$V_{L3-}$	$R_{S3} = 0.5\ \Omega$	—	-3.9	-3.4	V
Dead zone width	$V_{DZ3}$	$R_{S3} = 0.5\ \Omega$	-5	15	45	mV
<b>Driver 4</b>						
Output offset voltage	$V_{OOF-4}$	$R_{S4} = 0.5\ \Omega$	-60	—	60	mV
Gain (+)	$G_{4+}$	$R_{S4} = 0.5\ \Omega$	8.5	10.5	12.5	dB
Relative gain (+/-)	$\Delta G_4$	$R_{S4} = 0.5\ \Omega$	-1.3	0	1.3	dB
Limit voltage (+)	$V_{L4+}$	$R_{S4} = 0.5\ \Omega$	3.4	3.9	—	V
Limit voltage (-)	$V_{L4-}$	$R_{S4} = 0.5\ \Omega$	—	-3.9	-3.4	V
Dead zone width	$V_{DZ4}$	$R_{S4} = 0.5\ \Omega$	-5	15	45	mV
<b>Power cut operation</b>						
PC threshold high-level voltage	$V_{PCH}$		3.5	—	—	V
PC threshold low-level voltage	$V_{PCL}$		—	—	1.0	V
PC input current	$I_{PC}$		—	70	120	$\mu\text{A}$
<b>Standby operation</b>						
STB threshold high-level voltage	$V_{STBH}$		3.5	—	—	V
STB threshold low-level voltage	$V_{STBL}$		—	—	1.0	V
STB pin source current	$I_{STB}$		—	—	3	$\mu\text{A}$

- Electrical Characteristics at  $SV_{CC} = V_{CC1} = V_{CC2} = 12\text{ V}$ ,  $V_{CC3} = 5\text{ V}$ ,  $R_L = 8\ \Omega$ ,  $V_{PC} = 5\text{ V}$ ,  $V_{STB} = 5\text{ V}$ ,  $T_a = 25^\circ\text{C}$  (continued)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Reset circuit						
Reset operation release supply voltage	$V_{RST}$		—	—	5	V
$V_{REF}$ detection voltage	$V_R$		1.35	—	—	V

• Design reference data

Note) The characteristics listed below are theoretical values based on the IC design and are not guaranteed.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Thermal protection circuit						
Thermal protection operating temperature	$T_{THD}$		—	160	—	$^\circ\text{C}$
Thermal protection hysteresis width	$\Delta T_{THD}$		—	45	—	$^\circ\text{C}$
Reset circuit						
Voltage detection reset hysteresis width	$V_{HYS}$		—	0.2	—	V

■ Usage Notes

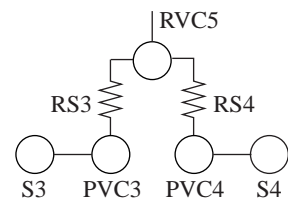
- $SV_{CC}$  must be used in the highest potential. Otherwise it possibly causes an operation error.
- Ch. 3 and ch. 4 are current feedback type drivers. Do not apply voltage directly to PVC3 and PVC4, but apply from PVC5 through the current feedback detection resistors RS3 and RS4, respectively. And commonly connect S3 pin to PVC3 pin and S4 pin to PVC4 pin.

At this time, as an output current flows on the detection resistors RS3 and RS4, use a resistor which has a sufficient allowable power dissipation.

To set gain for ch. 3 and ch. 4, use the following formula:

$$\frac{|V_{IN3(4)} - V_{REF}|}{R_{3(4)} + 500\ \Omega} \times 2.2\ \text{k}\Omega = R_{S3(4)} \times I_{OUT3(4)}$$

( $I_{OUT3}$  and  $I_{OUT4}$  are the load current for ch. 3 and ch. 4, respectively.)



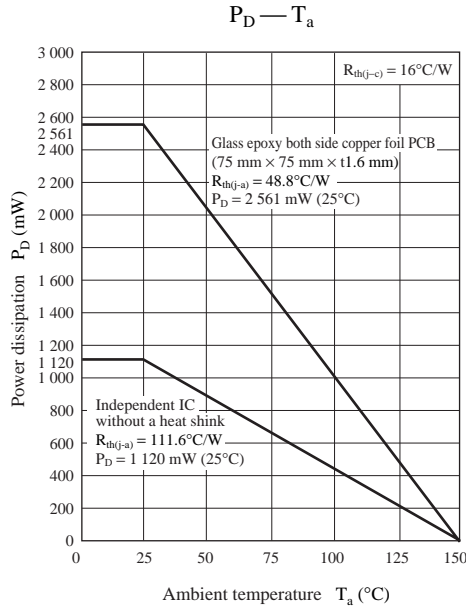
- Power cut operation

	PC		Standby	
	Low (open)	High	Low	High (open)
Ch. 1, Ch. 3, Ch. 4	Mute	Active	Standby	Active
Ch. 2 (exclusive for L0)	Active	Mute		or Mute

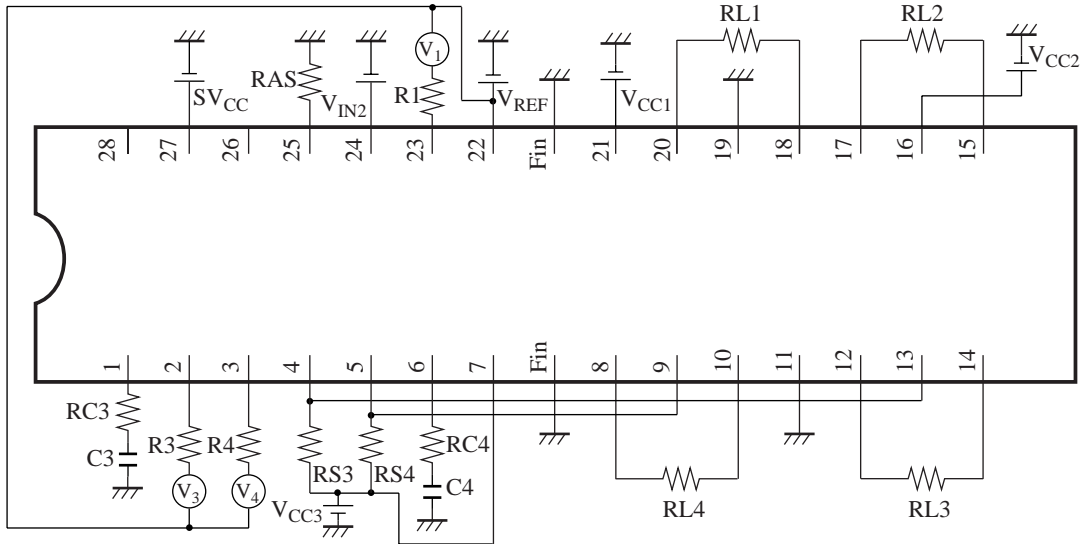
- Do not use ch. 2 (exclusive for loading) at more than 6 V of  $V_{CC2}$  when ch. 2 load is  $20\ \Omega$  and less.
- Appropriate care should be taken on the characteristics. When changing an external circuit constant on actual use, secure an appropriate margin in consideration of characteristic fluctuation of external parts and our ICs including transient characteristics as well as static ones.
- Avoid the short-circuits between output pin and  $V_{CC}$ , output pin and GND (line-to-supply and line-to-ground), and between output pins (short-circuit due to load). Otherwise, the IC is likely to emit smoke and break down.
- An appropriate prior study should be done for use of dip soldering.

■ Application Notes

- $P_D - T_a$  curves of HSOP042-P-0400



■ Application Circuit Example



When the AN8787NSB is use, take into account the following cautions and follow the power dissipation characteristic curve.

1. Load current  $I_{P1}$  flowing into load RL1 is supplied through pin 21.

$$I_{P1} = \frac{|V_{20} - V_{18}|}{R_{L1}}$$

2. Load current  $I_{P2}$  flowing into load RL2 is supplied through pin 16.

$$I_{P2} = \frac{|V_{17} - V_{15}|}{R_{L2}}$$

### ■ Application Circuit Example (continued)

3. Load current  $I_{P3}$  flowing into load  $RL3$  is supplied through pin 13 via the resistor  $RS3$ .

$$I_{P3} = \frac{|V_{14} - V_{12}|}{R_{L3}}$$

4. Load current  $I_{P4}$  flowing into load  $RL4$  is supplied through pin 9 via the resistor  $RS4$ .

$$I_{P4} = \frac{|V_{10} - V_8|}{R_{L4}}$$

5. Dissipation increase ( $\Delta P_D$ ) inside the IC (power output stage) caused by loads  $RL1$ ,  $RL2$ ,  $RL3$  and  $RL4$  is as follows:

$$\begin{aligned} \Delta P_D = & (V_{CC1} - |V_{20} - V_{18}|) \times \frac{|V_{20} - V_{18}|}{R_{L1}} + \{V_{CC3} - (R_{S3} + R_{L3}) \times \frac{|V_{14} - V_{12}|}{R_{L3}}\} \times \frac{|V_{14} - V_{12}|}{R_{L3}} \\ & + (V_{CC2} - |V_{17} - V_{15}|) \times \frac{|V_{17} - V_{15}|}{R_{L2}} + \{V_{CC3} - (R_{S4} + R_{L4}) \times \frac{|V_{10} - V_8|}{R_{L4}}\} \times \frac{|V_{10} - V_8|}{R_{L4}} \end{aligned}$$

6. Dissipation increase ( $\Delta P_S$ ) inside the IC (signal block supplied from pin 27) caused by loads  $RL1$ ,  $RL2$ ,  $RL3$  and  $RL4$  comes roughly as follows:

$$\begin{aligned} \Delta P_S = & 3 \times \frac{V_1}{R_1} \times (2 \times SV_{CC} + |V_{20} - V_{18}|) + \frac{I_{P2}}{K} \times (SV_{CC} - |V_{17} - V_{15}|) \\ & + \frac{I_{P3}}{K} \times (SV_{CC} - |V_{14} - V_{12}|) + \frac{I_{P4}}{K} \times (SV_{CC} - |V_{10} - V_8|), \text{ where } K \approx 100 \end{aligned}$$

7. Dissipation increase in a driver operating mode is  $\Delta P_D + \Delta P_S$ .

8. Allowable power dissipation without load ( $P_{D1}$ ) can be found as follows:

$$P_{D1} = SV_{CC} \times I_{(SVCC)} + V_{CC1} \times I_{(VCC1)} + V_{CC2} \times I_{(VCC2)} + V_{CC3} \times I_{(VCC3)}$$

9. Allowable power dissipation in a load operating mode ( $P_D$ ) comes roughly as follows:

$$P_D = P_{D1} + \Delta P_D + \Delta P_S$$



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