Three-Phase Motor Driver

Description

The HA13457NT three-phase brushless DC motor driver has an output current of up to 1.5 A per phase. It is intended for use as a VTR capstan motor driver.

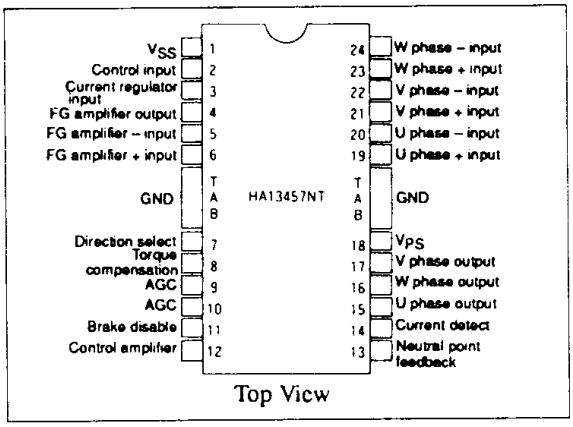
Features

- Soft switching
- Low noise
- Automatic gain controller (AGC) for the Hall amplifiers

Functions

- 1.5-A three-phase current drive
- Direction select
- Brake circuit
- Current limiter
- FG amplifier
- Overtemperature shutdown(OTSD)
- Torque ripple compensation circuit
- Output amplifier saturation prevention circuit

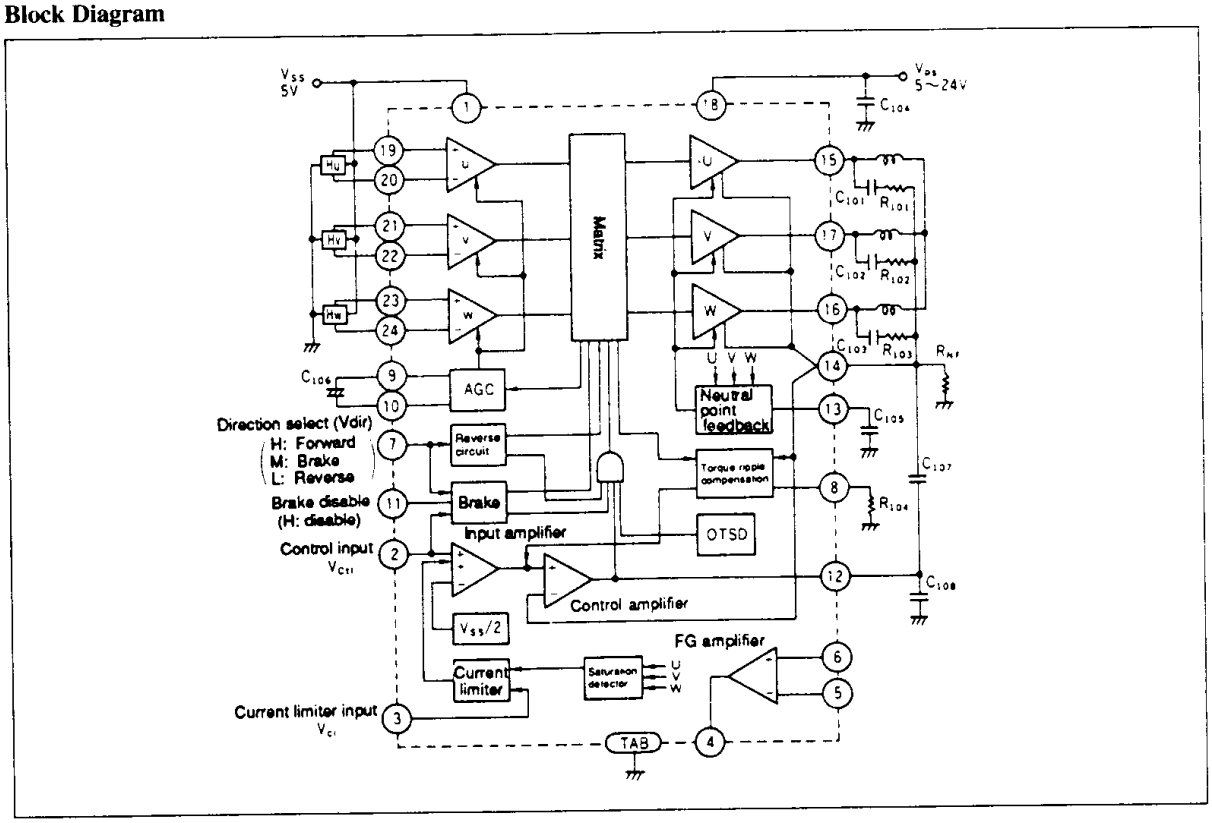
Pin Assignment



Ordering Information

Type No.	Package
HA13457NT	DP-24TSA

Block Diagram



Absolute Maximum Ratings (Ta = 25°C)

Parameter	Symbol	Rating	Unit	Notes
Control block power supply voltage	V_{SS}	7	V	1
Output block power supply voltage	V_{PS}	26	V	1
Instantaneous output current	I_{op}	1.5	A	2
Continuous output current	I_O	1.0	A	
Input voltage	V_{in}	0 to V_{SS}	V	3
Power dissipation	P_T	4	W	4
Junction temperature	T_j	150	°C	5
Storage temperature	T_{stg}	−55 to +125	°C	

The absolute maximum ratings are limiting values, to be applied individually, beyond which the device may be permanently damaged. Functional operation under any of these conditions is not guaranteed. Exposing a circuit to its absolute maximum rating for extended periods of time may affect the device's reliability.

Notes:

1. The operating voltage range is as follows:
   V_{SS} = 4.5 to 5.5 V
   V_{PS} = V_{SS} to 24 V
2. t ≤ 0.5 seconds
3. Applies to the control amplifier, current limiter, direction select, and brake disable inputs.
4. For Tc = 90°C. Thermal resistance is as follows:
   θj – c ≤ 15°C/W
   θj – a1 ≤ 20°C/W (when mounted on metal base)
   θj – a2 ≤ 60°C/W (when mounted on paper or phenol base)
5. Operating junction temperature (Tjopr) range is −20 to +125°C.

Electrical Characteristics (Ta = 25°C, V_{SS} = 5 V, V_{PS} = 16 V, R_{NF} = 0.5 Ω, R_L = 4 Ω)

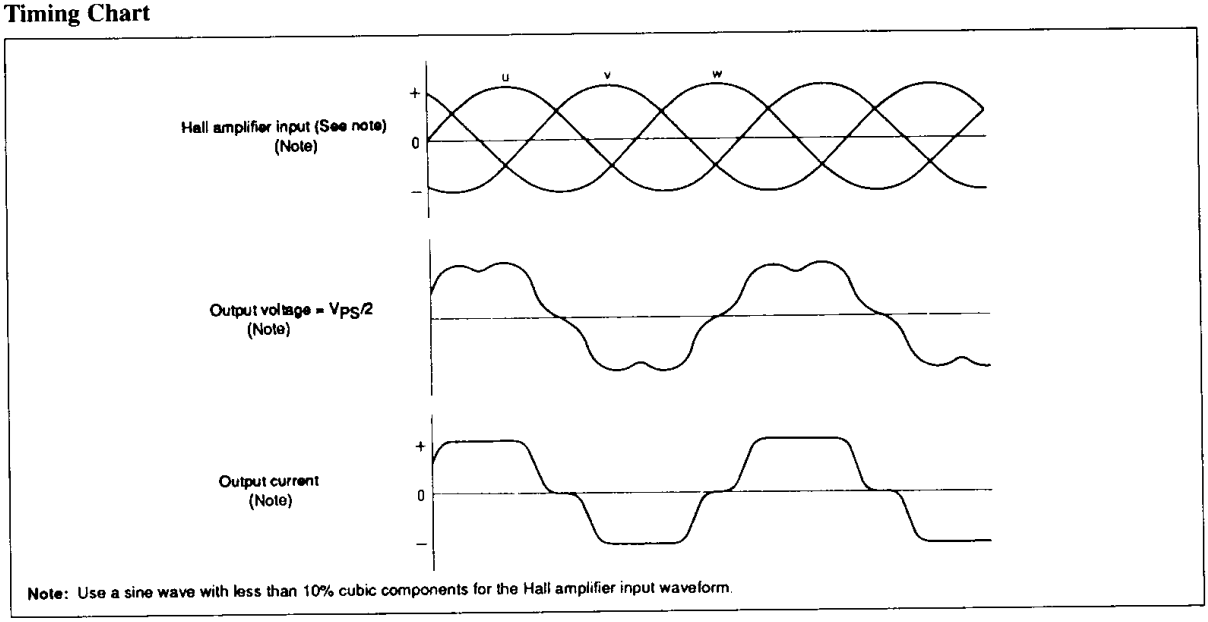
Parameter		Symbol	Min	Typ	Max	Unit	Test Conditions	Pins	Notes
Quiescent current		I_{SSO}	—	12	17	mA	V_{SS} = 5.5 V, V_{CTL} = 0 V, V_{sens} = 0 V	1	
		I_{PSO}	—	2.6	4	mA	V_{PS} = 26 V, V_{CTL} = 0 V, R_L = ∞	18	
Hall amplifier	Input resistance	R_{HI}	—	10	—	kΩ		19–24	
	Common mode input voltage range	V_H	1.5	—	3.5	V			
	Differential input voltage range	V_H	430	—	1100	mVpp			
Output amplifier	Leakage current	I_{CER1}	—	20	28	mA	V_{CE} = 26 V Upper TRS	15–17	
		I_{CER2}	—	—	1.0	mA	Lower TRS		
	Saturation voltage	$Vsat_1$	—	—	3.2	V	V_{CTL} = 5.0 V, Iout = 1.2 A, V_{sens} = 0.5 V		1
		$Vsat_2$	—	—	0.5	V	V_{CTL} = 1.25 V, Iout = 0.5 A, V_{sens} = 0 V		2
Input amplifier	Input current	I_{CTL1}	−100	—	+1.0	μA	V_{CTL} = 0 to 0.5 V	2	
		I_{CTL2}	−10	—	+1.0	μA	V_{CTL} = 0.5 to 5 V		
	Threshold voltage	V_{TH}	2.5	2.58	2.66	V	V_{sens} ≤ 5 mV		
	Brake mode voltage	V_{CTL} B	1.0	—	1.5	V			
Input amplifier to R_{NF} voltage gain		G_{CTL}	—	−6	—	dB		14	
Current limiter	Input current	I_{CL}	−2	—	+1.0	μA	V_{CT} = 1.55 V	3	
	Offset voltage	ΔV_{CL}	—	—	120	mV	V_{sens} ≤ 5 mV		
	Input sensitivity	Vlmt	—	0.50	—	V	V_{CL} = 1.25 V	14	

Electrical Characteristics (cont)

Parameter		Symbol	Min	Typ	Max	Unit	Test Conditions	Pins	Notes
Direction select	Input current	I_{DIR}	—	—	±10	μA	Vdir = 0 to 5 V	7	
	Forward mode voltage range	V_{DIR} F	4.5	—	—	V			
	Brake mode voltage range	V_{DIR} B	1.75	—	3.25	V			
	Reverse mode voltage range	V_{DIR} R	—	—	0.5	V			
Brake release	Threshold voltage	V_{BI}	—	0.66	—	V		11	
FG amplifier	Input current	I_{FG}	—	—	±1.5	μA		5, 6	
	Output current	I_{OH}	0.4	—	0.8	mA		4	
	Output low voltage	V_{OL}	—	—	0.5	V	R_L = 10 kΩ to 2.5 V		
	Output high voltage	V_{OH}	4.5	—	—	V	R_L = 10 kΩ to 2.5 V		
	Gain bandwidth	BW	—	1.5	—	kHz	G_V = 20 dB		
OTSD	Operating temperature	Tsd	—	150	—	°C			

Notes: 1. Sum of upper and lower saturation voltages. 2. Lower saturation voltage.

Timing Chart



Note: Use a sine wave with less than 10% cubic components for the Hall amplifier input waveform.

External Components

Parts No.	Recommended Value	Purpose	Notes
R_{101}, R_{102}, R_{103}	2.2 Ω	Stability	
R_{104}	2.2 kΩ	Torque compensation sensitivity adjustment	1
R_{NF}	0.47 Ω	Current detection	
C_{101}, C_{102}, C_{103}	0.1 μF	Stability	
C_{104}	≥ 0.1 μF	Power supply filter	
C_{105}	0.1 μF	Neutral point feedback phase compensation	
C_{106}	10 μF	AGC phase compensation	2
C_{107}	0.01 μF	Control amplifier phase compensation	
C_{108}	0.1 μF	Control amplifier phase compensation	

Notes:

1. Optimal value depends on the motor.
2. Should be reduced according to the number of poles. The recommended value is for an 8-pole system. Use only non-polar capacitors.