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# HA13408

## 9-Channel Power Driver

# HITACHI

ADE-207-206 (Z)  
1st Edition  
July 1996

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### Description

The HA13408 9-channel power driver IC is designed to drive dot matrix printer head. This IC can drive 9 pins without using any external components. HA13408 can be used for 2 system four-phase step drive, as every channel is used independently.

### Features

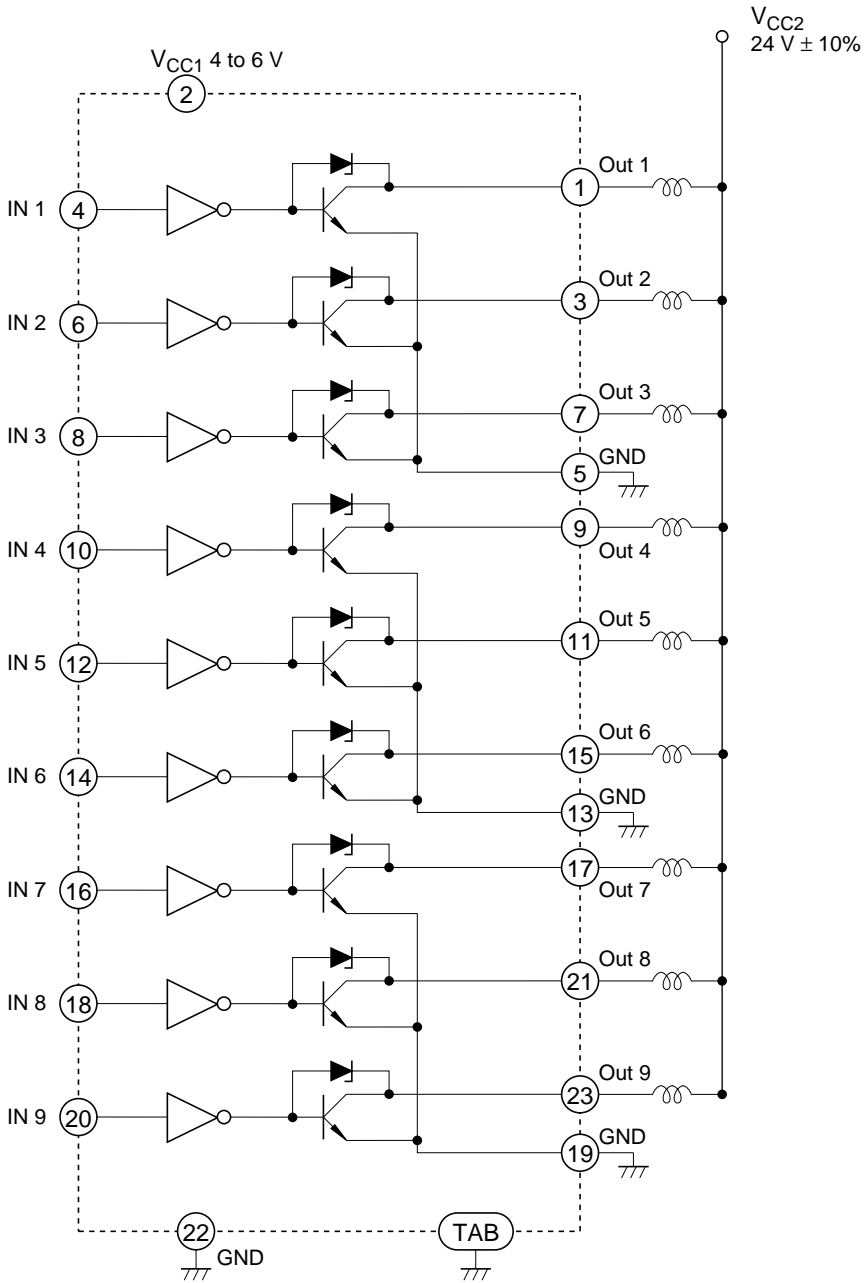
- High output current: 1.5 A/channel Max
- High sustaining voltage: 50 V Min
- Low saturation voltage
- Low supply current
- Low input current
- Compatible with TTL, LSTTL & 5 V CMOS
- Low thermal resistance package
- Zener diodes

### Truth Table

Input	Output
Low	On
High	Off
Open	Off

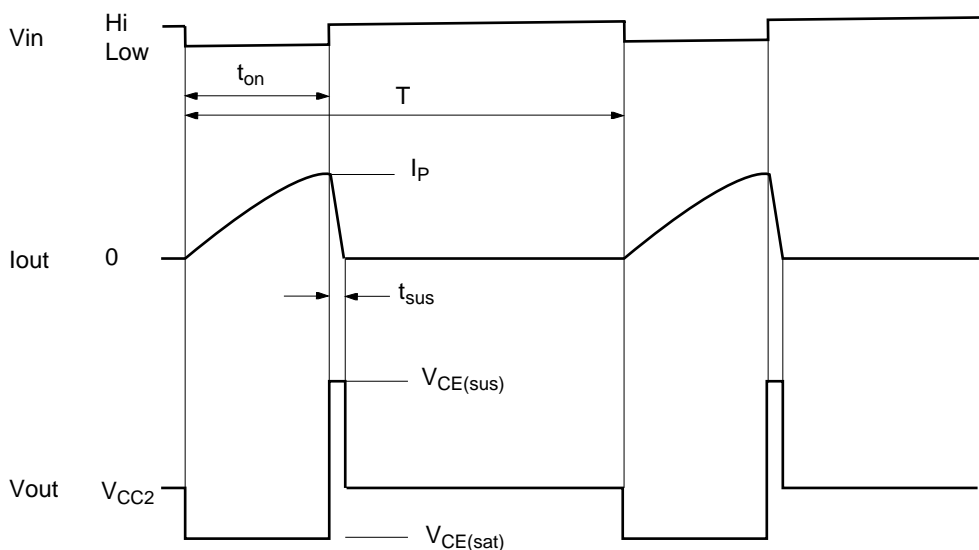
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## Block Diagram



## Peak Current and Turn-Off Time

Figure 1 shows load current ( $I_{out}$ ) and output terminal voltage ( $V_{out}$ ) waveforms for the HA13408 driving an inductive load.



**Figure 1 Output Waveforms**

The peak output current ( $I_p$ ) and sustain time ( $t_{sus}$ ) are obtained as follows;

$$I_p = \frac{V_{CC2} - V_{CE(sat)}}{R} \left( 1 - \exp\left(-\frac{R}{L} t_{on}\right) \right) \doteq \frac{V_{CC2}}{R} \left( 1 - \exp\left(-\frac{R}{L} t_{on}\right) \right) \quad (1)$$

$$t_{sus} = \frac{L}{R} \ln\left( 1 + \frac{I_p \cdot R}{V_{CE(sus)} - V_{CC2}} \right) \quad (2)$$

Where  $L$  is load self-inductance and  $R$  is load direct current resistance.

For example, under the following conditions:

$$L = 5 \text{ mH},$$

$$R = 22 \ \Omega$$

$$\text{Supply voltage } V_{CC2} = 24 \text{ V},$$

$$\text{Time to drive load } t_{on} = 0.42 \text{ ms}.$$

Peak current ( $I_p$ ) and sustain time ( $t_{sus}$ ) are then:

$$I_p = 0.87 \text{ A}$$

$$t_{\text{sus}} = 0.118 \text{ ms}$$

Where  $V_{\text{CE(sat)}} = 1.3 \text{ V typ}$  and  $V_{\text{CE(sus)}} = 52 \text{ V typ}$ .

## Power Dissipation

Power dissipation driving an inductive load for an HA13408 is determined as follows:

First, average power dissipation ( $P_{\text{on}}$ ) per channel at  $t_{\text{on}}$  is obtained as follows:

$$P_{\text{on}} \doteq V_{\text{CE(sat)}} I_{\text{P}} \left( \frac{V_{\text{CC2}}}{R \cdot I_{\text{P}}} - \frac{1}{t_{\text{on}}} \frac{L}{R} \right) \quad (3)$$

Average power dissipation ( $P_{\text{sus}}$ ) at  $t_{\text{sus}}$ :

$$P_{\text{sus}} \doteq V_{\text{CE(sus)}} I_{\text{P}} \left( \frac{1}{t_{\text{sus}}} \frac{L}{R} - \frac{V_{\text{CE(sus)}} - V_{\text{CC2}}}{R \cdot I_{\text{P}}} \right) \quad (4)$$

Where  $I_{\text{P}}$  and  $t_{\text{sus}}$  are obtained in equations (1) and (2).

Average power dissipation ( $P_{\text{T}}$ ) per channel for a period is obtained as follows:

$$P_{\text{T}} \doteq \frac{1}{T} (P_{\text{on}} \cdot t_{\text{on}} + P_{\text{sus}} \cdot t_{\text{sus}}) \quad (5)$$

Where drive period is defined as  $T$ .

Power dissipation ( $P_{\text{T}}$ ) for 9 channels driven at the same time:

$$P_{\text{T}} \doteq \frac{9}{T} (P_{\text{on}} \cdot t_{\text{on}} + P_{\text{sus}} \cdot t_{\text{sus}}) \quad (6)$$

Application

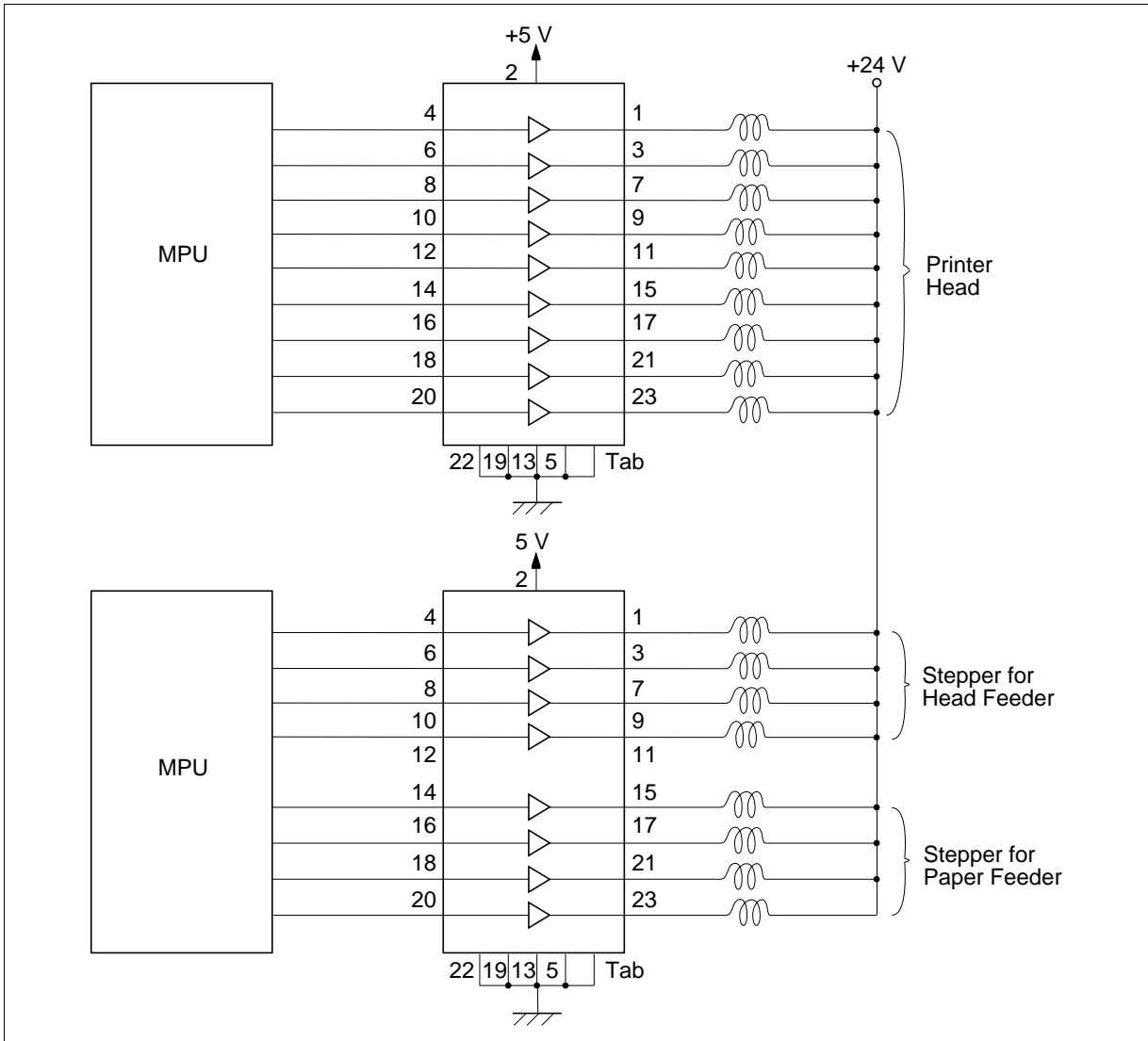


Figure 2 Dot Matrix Printer

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

Item	Symbol	Rating	Unit	Notes
Supply voltage	$V_{CC1}$	7.0	V	
Input voltage	$V_I$	$V_{CC1}$	V	
Output voltage	$V_{CE(sus)}$	50	V	
Output current	$I_O$	1.5	A	
Power dissipation	$P_T$	20	W	1
Junction temperature	$T_j$	150	°C	
Operating junction temperature range	$T_{jop}$	-20 to +125	°C	
Storage temperature range	$T_{stg}$	-55 to +125	°C	

Notes: 1. Thermal resistance  $\theta_{j-a} \leq 40^\circ\text{C/W}$   
 $\theta_{j-c} \leq 3^\circ\text{C/W}$

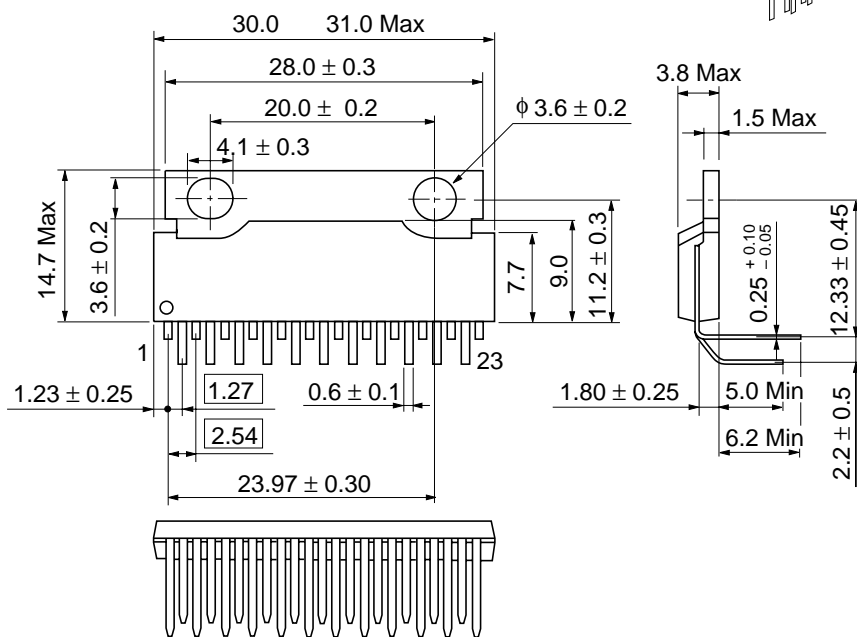
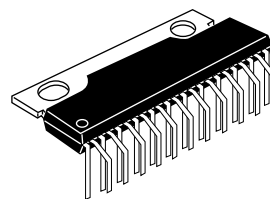
## Electrical Characteristics (Ta = 25°C, $V_{CC1} = 5\text{ V}$ )

Item	Symbol	Min	Typ	Max	Unit	Test Conditions	Note
Input Low voltage	$V_{IL}$	—	—	0.8	V	$V_{CC1} = 4.0\text{ V}$	
Input High voltage	$V_{IH}$	2.0	—	—	V	$V_{CC1} = 6.0\text{ V}$	
Input Low current	$I_{IL}$	-100	-15	+10	$\mu\text{A}$	$V_I = 0\text{ V}$	
Input High current	$I_{IH}$	-10	0	+10	$\mu\text{A}$	$V_I = 2.4\text{ V}$	
Supply current	$I_{CCO}$	—	30	45	mA	All $V_I = 2.4\text{ V}$	
	$I_{CC}$	—	33	50	mA	All $V_I = 0\text{ V}$	
Output cut off current	$I_{CEO}$	—	—	1.0	mA	$V_{CC1} = 6\text{ V}$ , $V_{CC2} = 40\text{ V}$ , $V_I = 2.0\text{ V}$	
Output saturation voltage	$V_{CE(sat)}$	—	1.6	2.2	V	$V_{CC1} = 4\text{ V}$ , $I_O = 1.0\text{ A}$ , $V_I = 0.8\text{ V}$	
Output sustaining voltage	$V_{CE(sus)}$	50	—	—	V	$I_O = 1.0\text{ A}$	1
Delay time	$t_{PLH}$	—	1.5	5	$\mu\text{s}$	Turn OFF	
	$t_{PHL}$	—	0.3	5	$\mu\text{s}$	Turn ON	

Note: 1. The conditions of loading; Measure at  $L_s = 5\text{ mH}$ ,  $R_s = 22\ \Omega$ .

Package Dimensions

Unit: mm



Hitachi Code	SP-23TA
JEDEC	—
EIAJ	—
Weight (reference value)	4.61 g

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