HA13705C

IPIC (Intelligent Power IC) High Side Solenoid Driver

HITACHI

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

Description

The HA13705C is high side power driver IC with protectors and diagnostic function. The device is especially designed to switch inductive loads.

Functions

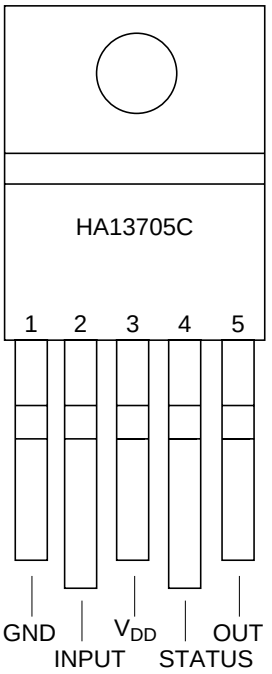
- Power MOS source follower output (2 A)
- With Over Voltage Shut Down circuit (OVSD)
- With Over Current protector circuit (OCSD)
- With Over Temperature Shut Down circuit (OTSD)
- With diagnostic circuit and status output
- With fail safe function under input open circuit condition
- With low voltage inhibit circuit (LVI)
- With output negative voltage clamp circuit

Features

- Protected against 60 V load dump condition
- Low R_{ON} (0.17 Ω Typ)
- Wide operating supply voltage range (V_{DD} = 7 V to 25 V)
- High sustaining voltage (–25 V)
- Protected against reverse supply voltage (–13 V)
- Protected against short circuit condition
- Input compatible with TTL, LS-TTL, or 5 V CMOS

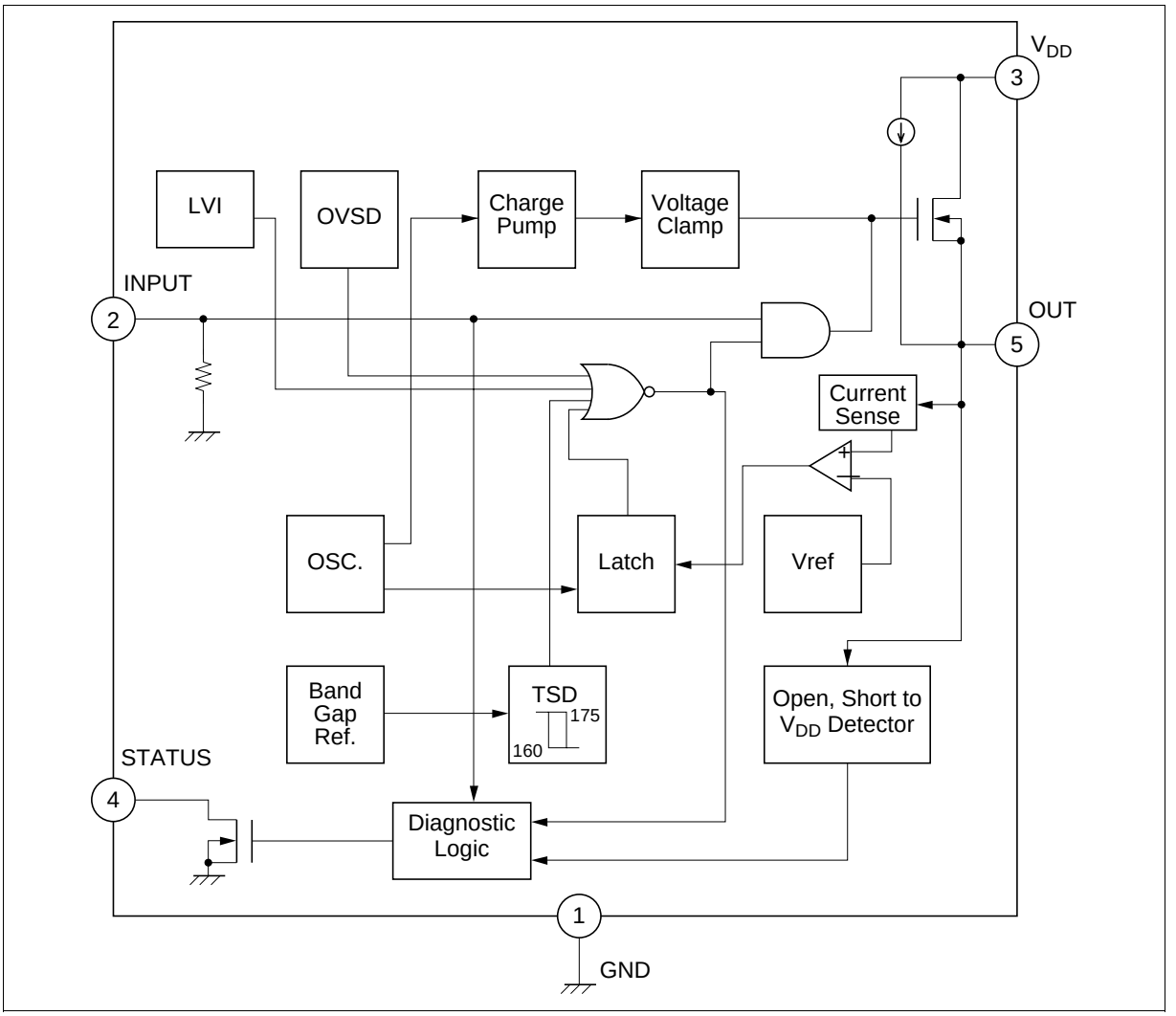
Hitachi semiconductor

Pin Arrangement



(Top View)

Block Diagram



Truth Table

Mode	In	Out	Status
Normal	L	L	L
	H	H	H
Load short	L	L	L
	H	L	L
Load open	L	H	H
	H	H	H
Short to V_{DD}	L	H	H
	H	H	H
OTSD [*1]	L	L	L
	H	L	L
OVSD [*2]	L	L	H
	H	L	H
LVI [*3]	L	L	H
	H	L	H

L : Low level (0.8 V)

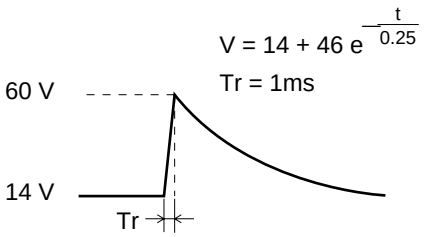
H : High level (2.0 V)

Notes: 1. OTSD: Over temperature shut down
2. OVSD: Over voltage shut down
3. LVI: Low voltage inhhibit

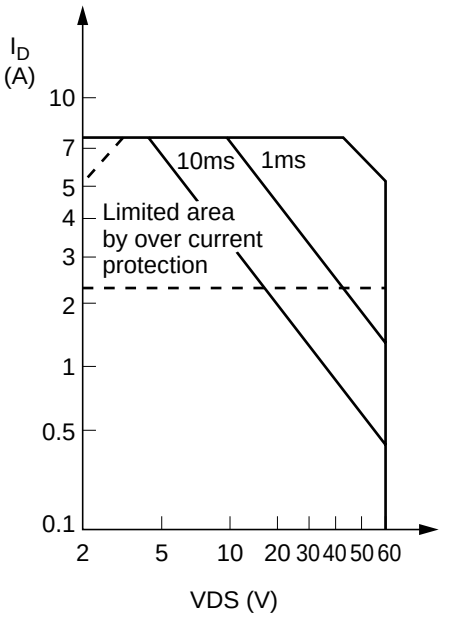
Absolute Maximum Ratings (Ta = 25°C)

Item	Symbol	Rating	Unit	Notes
Continuous supply voltage	V_{DD}	–13 to 35	V	1
Transient supply voltage	V_{DD}	60	V	2
Input voltage	V_{IN}	–0.3 to 30	V	
Output voltage	Vout	–25 to V_{DD}	V	3
Status voltage	Vs	–0.3 to +15	V	
Output current	Iout	—	A	3, 4
Status current	Is	5	mA	
Power dissipation	P_T	—	W	5
Package thermal resistance/ Junction to case	θj–c	5	°C/W	
Package thermal resistance/ Junction to air	θj–a	70	°C/W	
Junction temperature range	Tj	–40 to 150	°C	
Storage temperature range	Tstg	–55 to +150	°C	

Notes: 1. Recommended operating voltage:
V_{DD} = 7 to 16 V (Normal)
16 to 25 V (Jump up start 5 minutes MAX)
–13 V (Reverse Battely 5 minutes MAX)
2. Load dump condition



3. Output Transistor ASO (Reference Data)



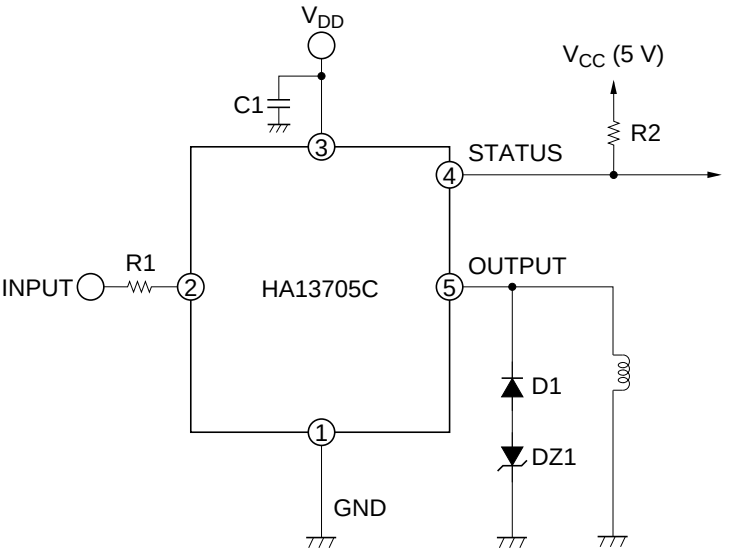
4. Internally limited
5. Maximum power dissipation (P_T (Max)) can be defined as:
   P_T (Max) = (Tjopr(Max) – Tambient) / (θj-c + θc-a)
   θc-a: Thermal resistance between case and air (Depend on heat sink size)

Electrical Characteristics (Ta = 25°C, V_{CC} = 12 V ±10%)

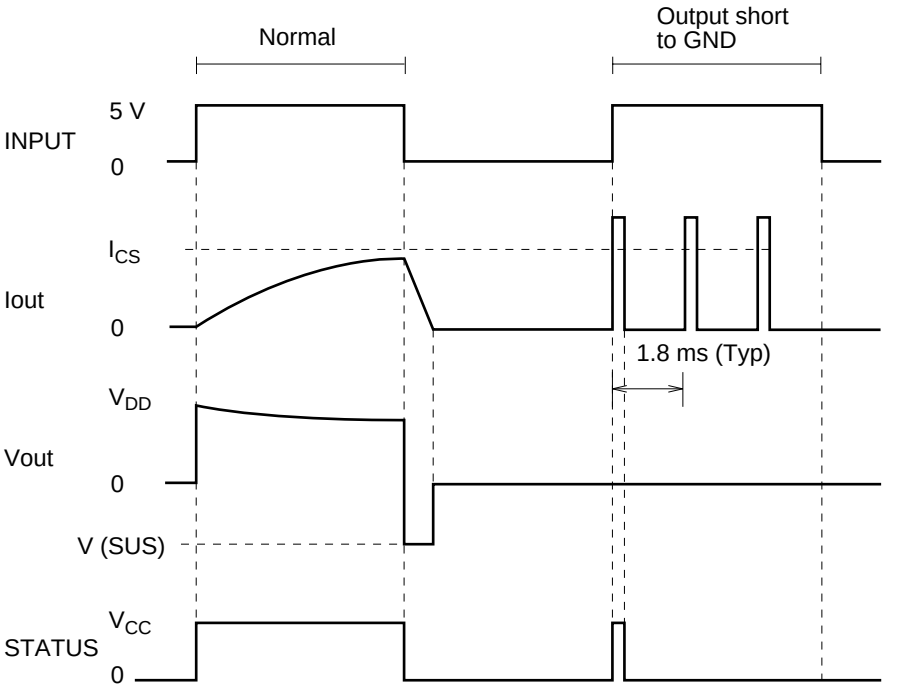
Item		Symbol	Min	Typ	Max	Unit	Test Conditions	Pin	Note
Output R (ON)		$R_{DS(ON)}$	—	0.17	0.36	Ω	I_O = 2 A (@Tj = –40 to 150°C)	5	
Operating supply voltage range		V_{DD}	7	—	25	V		3	
Quiescent current		I_{DD1}	—	—	0.3	mA	V_{IN} = 0 V, Vout = 0 V	3	
		I_{DD2}	—	6.0	10.0	mA	V_{IN} = 5.5 V, Vout = open	3	
Output leakage current		I_{LEAK}	—	—	0.1	mA	V_{DD} = 25 V, V_{IN} = 0 V, Vout = 0 V	5	
Input threshold voltage		V_{IL}	—	—	0.8	V		2	
		V_{IH}	2.0	—	—	V		2	
Input current		I_{IL}	–10	—	60	µA	V_{IN} = 0.8 V	2	
		I_{IH}	50	—	300	µA	V_{IN} = 5.0 V	2	
Propagation delay time		$t_{d(ON)}$	—	—	50	µs	I_O = 1 A	2, 5	
		t_r	—	—	90	µs		5	
		$t_{d(OFF)}$	—	—	50	µs		2, 5	
		Tf	—	—	50	µs		5	
Open det. threshold current		I_{OD}	2	10	100	µs		4, 5	
Current limiter operating level		I_{CS}	3.0	4.3	7.5	A		5	
LVI operating level		L.V.I	—	5	6	V		3	
Over voltage shut down	Operating level	OVSD	26	29	33	V		3	
	Hysteresis	VHYS	0.15	0.5	1.5	V		3	
Output sustain voltage		$V_{(SUS)}$	—	—	–25	V	Iout = 20 mA	5	
Over temper-ature shut down	Operating level	OTSD	150	175	—	°C		5	1
	Hysteresis	THYS	—	15	—	°C		5	1
Status on voltage		V_{SL}	—	—	0.4	V	I_S = 1 mA	4	
Status leakage current		$I_{S(Leak)}$	–10	—	100	µA	V_S = 5.0 V	4	

Notes: 1. Design parameter only (no test)

Solenoid Drive Application and it's Waveform

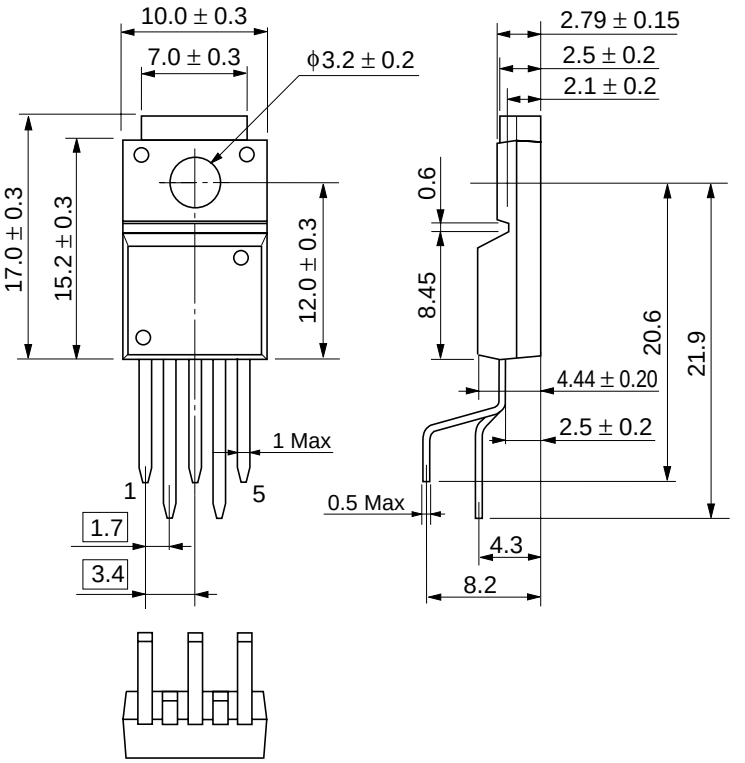


R1 : Input series resistance to protect CMOS driver.
R2 : Pull up resistance at status output.
C1 : The capacitor to compensate the inductance at V_{DD} line.
D1, DZ1 : for Reverse voltage clamp



Package Dimensions

Unit: mm



Hitachi Code	SP-5TA
JEDEC	—
EIAJ	—
Weight (reference value)	2.0 g

Cautions

1. Hitachi neither warrants nor grants licenses of any rights of Hitachi's or any third party's patent, copyright, trademark, or other intellectual property rights for information contained in this document. Hitachi bears no responsibility for problems that may arise with third party's rights, including intellectual property rights, in connection with use of the information contained in this document.
2. Products and product specifications may be subject to change without notice. Confirm that you have received the latest product standards or specifications before final design, purchase or use.
3. Hitachi makes every attempt to ensure that its products are of high quality and reliability. However, contact Hitachi's sales office before using the product in an application that demands especially high quality and reliability or where its failure or malfunction may directly threaten human life or cause risk of bodily injury, such as aerospace, aeronautics, nuclear power, combustion control, transportation, traffic, safety equipment or medical equipment for life support.
4. Design your application so that the product is used within the ranges guaranteed by Hitachi particularly for maximum rating, operating supply voltage range, heat radiation characteristics, installation conditions and other characteristics. Hitachi bears no responsibility for failure or damage when used beyond the guaranteed ranges. Even within the guaranteed ranges, consider normally foreseeable failure rates or failure modes in semiconductor devices and employ systemic measures such as fail-safes, so that the equipment incorporating Hitachi product does not cause bodily injury, fire or other consequential damage due to operation of the Hitachi product.
5. This product is not designed to be radiation resistant.
6. No one is permitted to reproduce or duplicate, in any form, the whole or part of this document without written approval from Hitachi.
7. Contact Hitachi's sales office for any questions regarding this document or Hitachi semiconductor products.

HITACHI

Hitachi, Ltd.
Semiconductor & Integrated Circuits.
Nippon Bldg., 2-6-2, Ohte-machi, Chiyoda-ku, Tokyo 100-0004, Japan
Tel: Tokyo (03) 3270-2111 Fax: (03) 3270-5109

URL
NorthAmerica : http:semiconductor.hitachi.com/
Europe : http://www.hitachi-eu.com/hel/ecg
Asia (Singapore) : http://www.has.hitachi.com.sg/grp3/sicd/index.htm
Asia (Taiwan) : http://www.hitachi.com.tw/E/Product/SICD_Frame.htm
Asia (HongKong) : http://www.hitachi.com.hk/eng/bo/grp3/index.htm
Japan : http://www.hitachi.co.jp/Sicd/indx.htm

For further information write to:

Hitachi Semiconductor
(America) Inc.
179 East Tasman Drive,
San Jose,CA 95134
Tel: <1> (408) 433-1990
Fax: <1>(408) 433-0223

Hitachi Europe GmbH
Electronic components Group
Dornacher Straße 3
D-85622 Feldkirchen, Munich
Germany
Tel: <49> (89) 9 9180-0
Fax: <49> (89) 9 29 30 00

Hitachi Europe Ltd.
Electronic Components Group.
Whitebrook Park
Lower Cookham Road
Maidenhead
Berkshire SL6 8YA, United Kingdom
Tel: <44> (1628) 585000
Fax: <44> (1628) 778322

Hitachi Asia Pte. Ltd.
16 Collyer Quay #20-00
Hitachi Tower
Singapore 049318
Tel: 535-2100
Fax: 535-1533

Hitachi Asia Ltd.
Taipei Branch Office
3F, Hung Kuo Building. No.167,
Tun-Hwa North Road, Taipei (105)
Tel: <886> (2) 2718-3666
Fax: <886> (2) 2718-8180

Hitachi Asia (Hong Kong) Ltd.
Group III (Electronic Components)
7/F., North Tower, World Finance Centre,
Harbour City, Canton Road, Tsim Sha Tsui,
Kowloon, Hong Kong
Tel: <852> (2) 735 9218
Fax: <852> (2) 730 0281
Telex: 40815 HITEC HX