IPIC* High Side Bulb Driver

Description

*(IPIC: Intelligent Power IC)

HA13702A is high side power driver IC with protectors and diagnostic function. The device is especially designed to switch automotive light bulbs using PWM current limitter system.

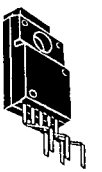
Functions

- Power MOS source follower output (4 A)
- With over voltage shut down circuit (OVSD)
- With over current protector circuit (PWM OCL)
- 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} (0.1 Ω typ)
- Wide operating supply voltage range (V_{DD} = 7 V to 25 V)
- Protected against reverse supply voltage (–13 V)
- Protected against output short circuit condition
- Suitable switching speed to have high speed operation and low EMI
- Input compatible with TTL, LS-TTL, or 5 V CMOS
- Protected against electrostatic discharge (2 kV min at 100 pF/1.5 kΩ)

HA13702A



SP-5TA

Pin Arrangement

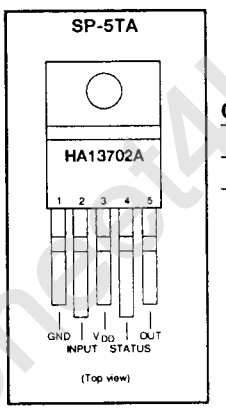


Figure 1
Pin Arrangement

Ordering Information

Type No.	Package
HA13702A	SP-5TA

Block Diagram

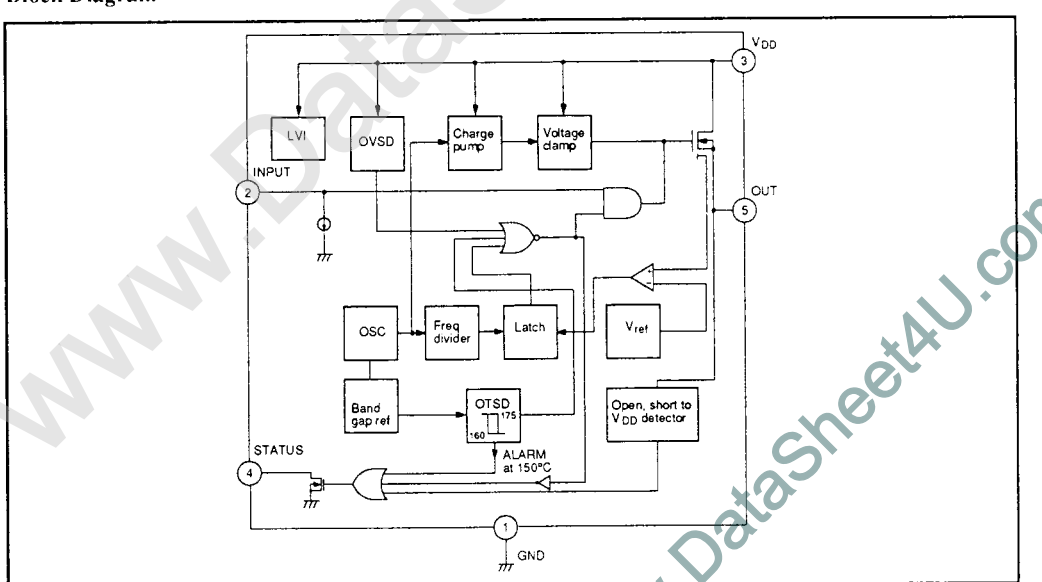


Figure 2 Block Diagram

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Table 1 Truth Table

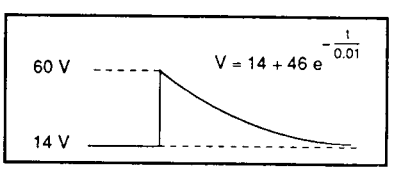
Mode		In	Out	Status
Normal		L	L	H
		H	H	H
Load short		L	L	H
		H	L	L
Load open		L	L	H
		H	H	L
Short to V_{DD}		L	H	L
		H	H	L
OTSD	*1	L	L	L
		H	L	L
OVSD	*2	L	L	L
		H	L	L
LVI	*3	L	L	H
		H	L	H

Note: L: Low level (0.8 V)
H: High level (2.0 V)
*1) OTSD: Over temperature shut down
*2) OVSD: Over voltage shut down
*3) LVI: Low voltage inhibit

Table 2 Absolute Maximum Ratings (Ta = 25°C)

Item		Symbol	HA13702A	Unit	Note
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 +15	V	
Output voltage		Vout	V_{DD}	V	
Status voltage		V_S	−0.3 to 15	V	
Output current		Iout	—	A	3
Status current		I_S	5	mA	
Power dissipation		P_T	—	W	4
Package thermal resistance	Junction to case	θjc	5	°C/W	
	Junction to air	θja	70	°C/W	
Junction temperature range		Tj	−40 to OTSD	°C	5
Storage temperature range		Tstg	−55 to 150	°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.



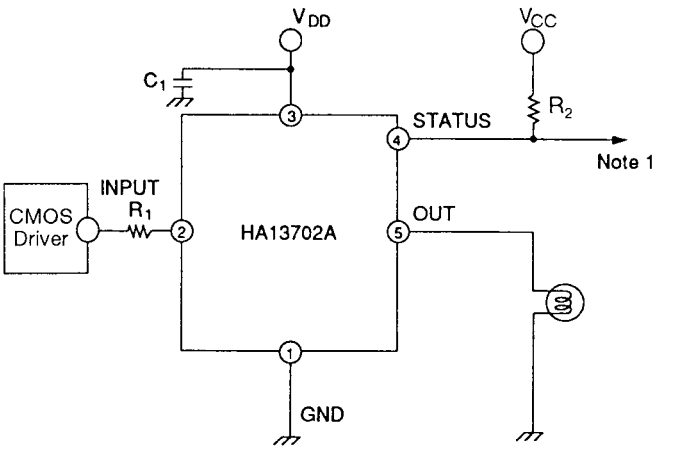
Notes: 1. Recommended operating voltage:
V_{DD} = 7 to 16 V (Normal)
16 to 25 V (Jump start)
2. Load dump condition
3. Internally limited
4. Maximum power dissipation (P_T(MAX)) can be defined as:
$P_T(MAX) = (T_{jopr}(MAX) - T_{ambient})/(\theta jc + \theta ca)$
θca: Thermal resistance between case and air (Depend on heat sink size)
5. Operating junction temperature range
T_{jopr} = −40 to +125°C

Table 3 Electrical Characteristics (Ta = 25°C)

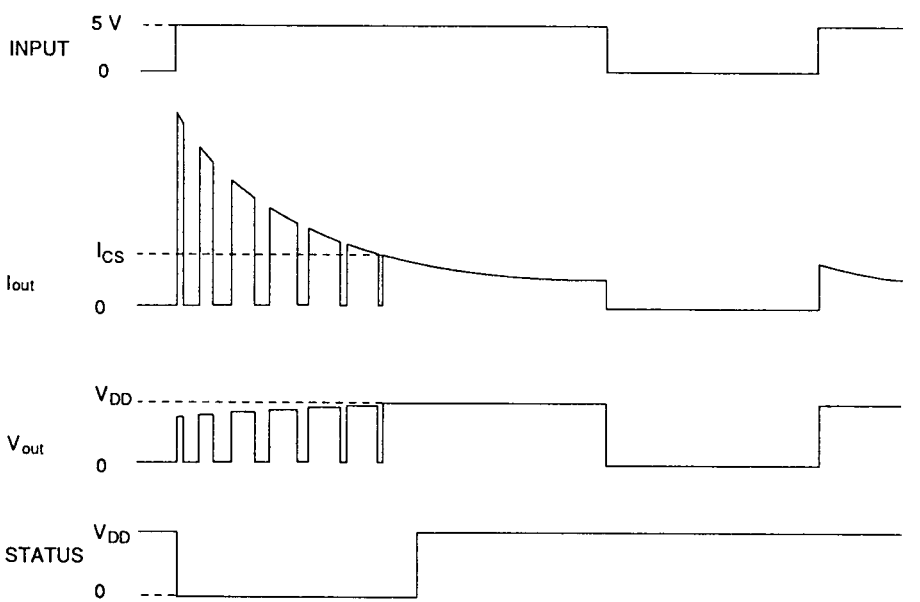
Item		Symbol	Min	Typ	Max	Unit	Test condition	Pin	Note
Output $R_{(ON)}$		$R_{DS(ON)}$	—	0.1	0.15	Ω	Io = 4 A (@Tj = −40 to 25°C)	5	
			—	0.15	0.22	Ω	Io = 4 A (@Tj = 125°C)	5	
Operating supply voltage range		V_{DD}	7	—	25	V		3	
Quiescent current		I_{DD1}	—	3	5	mA	V_{IN} = 0 V, out = open	3	
		I_{DD2}	—	6	10	mA	V_{IN} = 5.5 V, out = open	3	
Output leak current		I_{LEAK}	—	—	100	μA	V_{DD} = 35 V, V_{IN} = 0 V, Tj = 125°C	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 to 0.8 V	2	
		I_{IH}	5	35	60	μA	V_{IN} = 2.0 to 5.5 V	2	
Propagation delay time		$T_{d(ON)}$	—	20	—	μs	Io = 3 A	2, 5	
		Tr	—	50	—	μs		5	
		$T_{d(OFF)}$	—	20	—	μs		2, 5	
		Tf	—	10	—	μs		5	
Open detect threshold current		I_{OD}	0.3	0.7	1.2	A		4, 5	
Current limiter operating level		I_{CS}	10	15	20	A		5	1
Low Voltage Inhibit operating level		L.V.I	—	5	6	V			
Over voltage shut down	Operating level	OVSD	26	30	33	V		3	
	Hysteresys	V_{HYS}	—	0.5	1.0	V		3	
Over temperature shut down	Operating level	OTSD	—	175	—	°C		5	2
		OTSD (Alarm)	—	150	—			4	2
	Hysteresys	T_{HYS}	—	15	—	°C		5	2
Status on voltage		V_{SL}	—	0.1	0.4	V	I_S = 1 mA	4	
Status leak current		$I_{S(Leak)}$	—	—	100	μA	V_S = 5.5 V	4	

Notes: 1. Output current will be PWM controlled under current limit condition.
2. Design parameter only (no test)

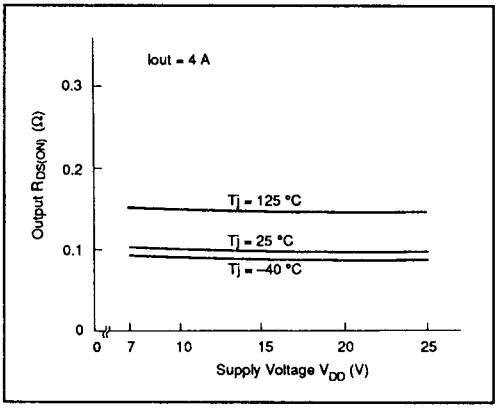
Bulb Drive Application and Its Waveform



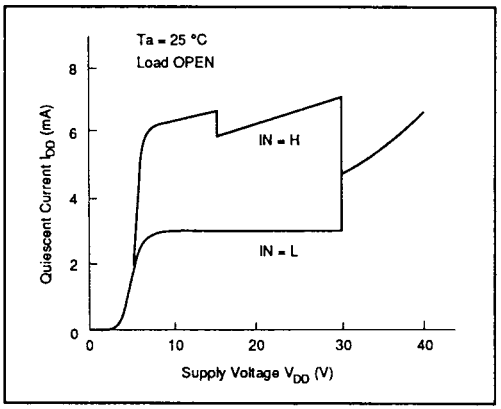
R1; Input series resistance to protect CMOS driver.
R2; Pull up resistance at status output.
C1; The capacitor to compensate the inductance at V_{DD} line.



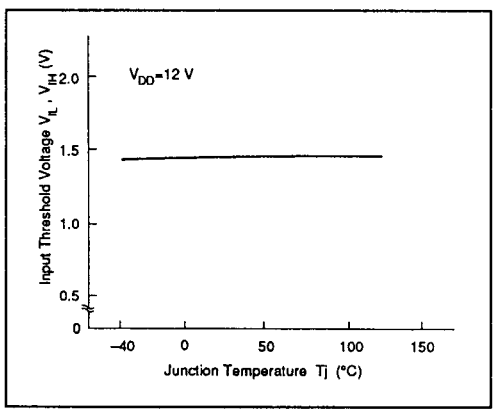
Note 1: It is required to wait more than 350 µs to judge the status output after changing the input signal level.



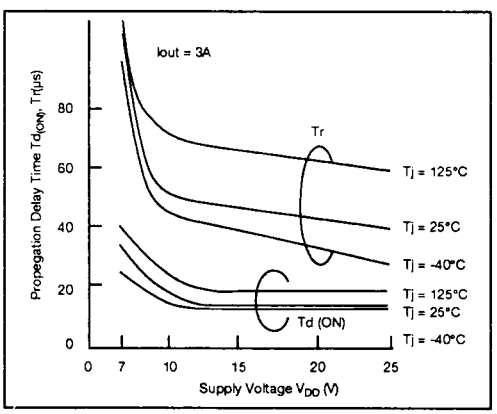
$R_{DS\ (ON)}$ vs. V_{DD}



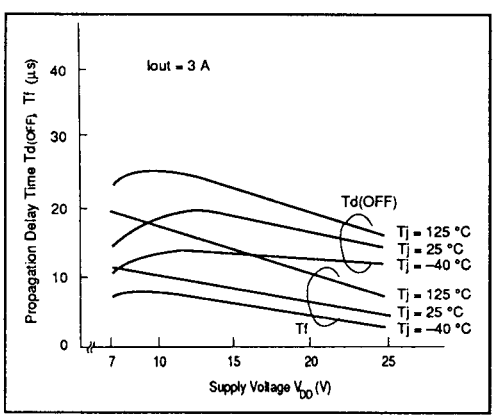
I_{DD} vs. V_{DD}



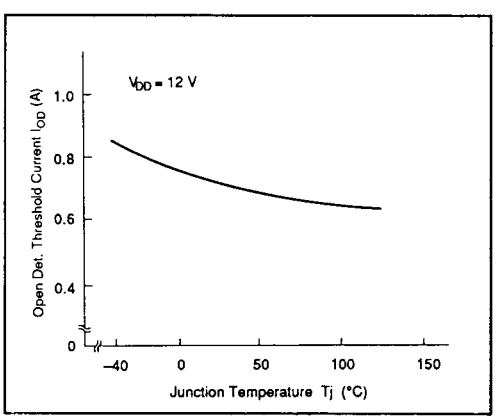
V_{IL}, V_{IH} vs. T_j



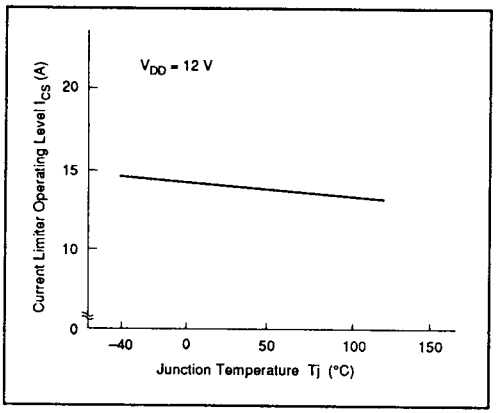
$T_{d(ON)}$, T_r vs. V_{DD}



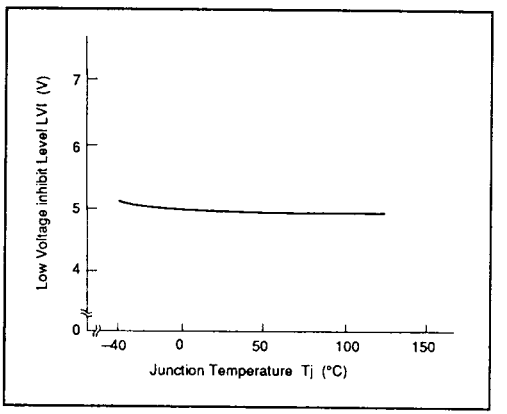
$T_{d(OFF)}$, T_f vs. V_{DD}



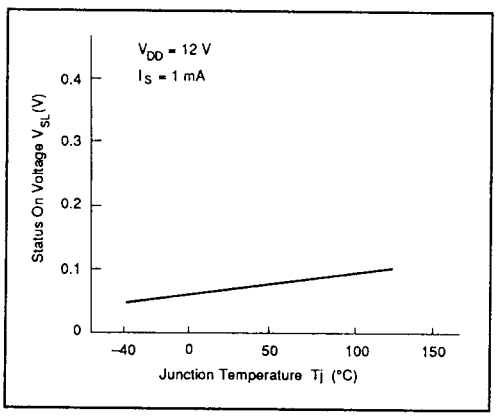
I_{OD} vs. T_j



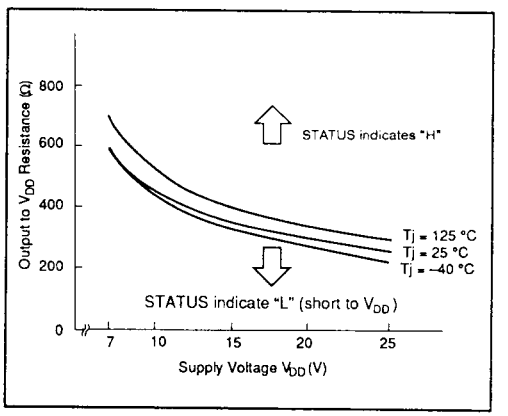
I_{CS} vs. T_j



L_{VI} vs. T_j



V_{SL} vs. T_j



Short toV_{DD}