

TOSHIBA Bipolar Linear Integrated Circuit Silicon Monolithic

# TA7291AP, TA7291AS(J), TA7291AF

Full-Bridge Driver for DC Motors (driver for controlling the forward and reverse rotations)

The TA7291AP/TA7291AS (J)/TA7291AF is a full-bridge driver to control the forward and reverse rotations. Each driver can select one of four modes: CW, CCW, stop, brake.

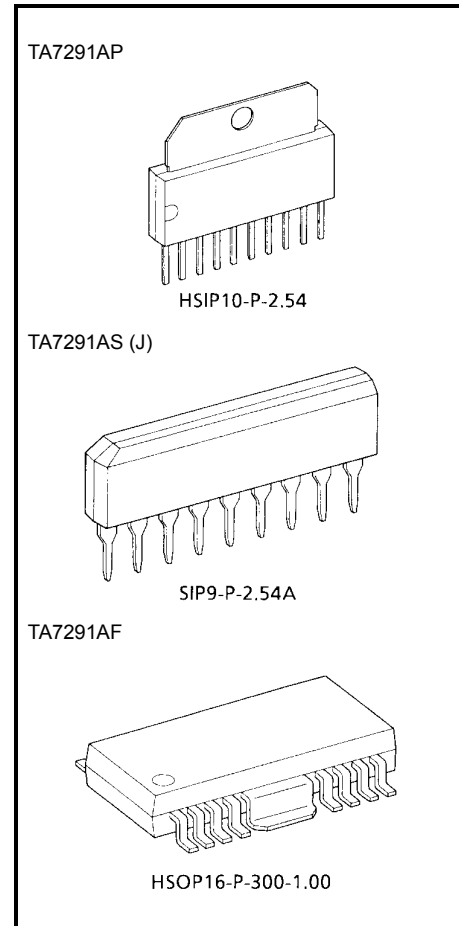
The TA7291AP is designed to provide output currents of 1.0 A (typ.) and 2.0 A (peak). The TA7291AS (J)/TA7291AF is designed to provide output currents of 0.4 A (typ.) and 1.2 A (peak).

There are two different power supply pins for each driver: one on the output side and the other on the control side of the driver. Also, there is the  $V_{ref}$  pin on the output side. This pin is available for adjusting the voltage supplied to the motor.

The input circuit of the driver is compatible with CMOS logic because it draws a small amount of input current.

## Features

- Wide range of operating voltage:  $V_{CC}$  (opr.) = 4.5 V to 27 V  
:  $V_S$  (opr.) = 4.5 V to 27 V  
:  $V_{ref}$  (opr.) = 4.5 V to 27 V  
 $V_{ref}$  must be  $\leq V_S$ .
- Output current: AP type 1.0 A (typ.) 2.0 A (peak)  
: AS (J)/AF type 0.4 A (typ.) 1.2 A (peak)
- Thermal shutdown and overcurrent protection
- Flyback diodes
- Hysteresis for all inputs
- Standby mode available



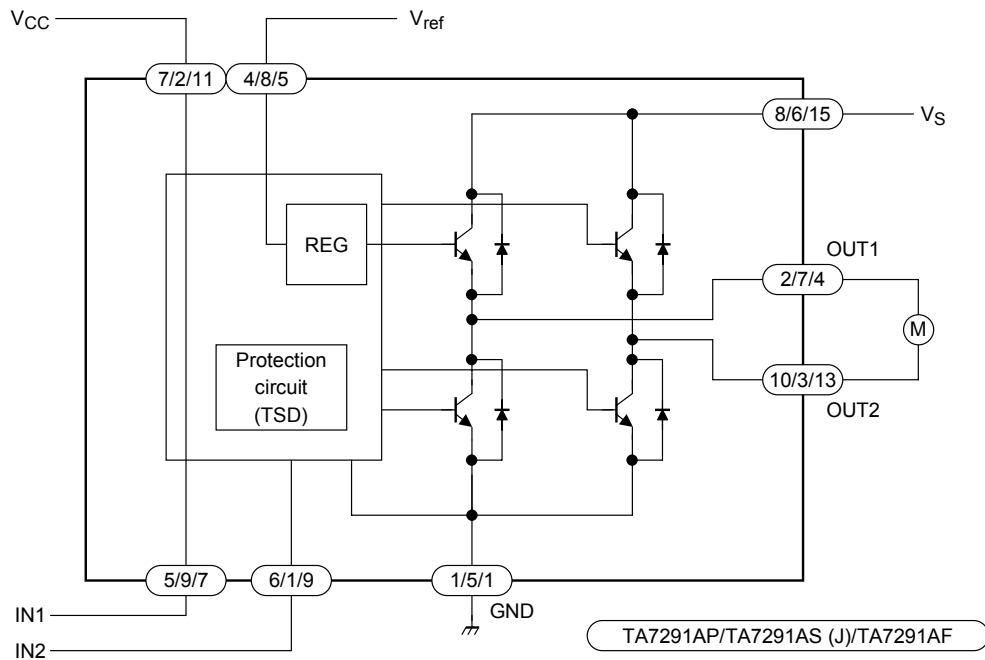
### Weight

HSIP10-P-2.54: 2.47 g (typ.)

SIP9-P-2.54A: 0.92 g (typ.)

HSOP16-P-300-1.00: 0.50 g (typ.)

## Block Diagram



## Pin Function

Symbol	Pin No.			Function Description
	AP	AS (J)	AF	
V <sub>CC</sub>	7	2	11	Supply voltage pin for Logic
V <sub>S</sub>	8	6	15	Supply voltage pin for motor driver
V <sub>ref</sub>	4	8	5	Supply voltage pin for control
GND	1	5	1	Ground pin
IN1	5	9	7	Input pin
IN2	6	1	9	Input pin
OUT1	2	7	4	Output pin
OUT2	10	3	13	Output pin

AP type: Pin 3 and 9 are NC.

AS (J) type: Pin 4 is NC.

AF type: Pin 2, 3, 6, 8, 10, 12, 14, and 16 are NC.

For F type, we recommend the fin be connected to ground.

## Function

Input		Output		Mode
IN1	IN2	OUT1	OUT2	
0	0	∞	∞	Stop
1	0	H	L	CW/CCW
0	1	L	H	CCW/CW
1	1	L	L	Brake

∞: High impedance

Note: Inputs are all active high.

## Maximum Ratings (Ta = 25°C)

Characteristics		Symbol	Rating	Unit	
Supply voltage		V <sub>CC</sub>	30	V	
		V <sub>CC (opr.)</sub>	27		
Motor drive voltage		V <sub>S</sub>	30	V	
		V <sub>S (opr.)</sub>	27		
Reference voltage		V <sub>ref</sub>	30	V	
		V <sub>ref (opr.)</sub>	27		
Output current	Peak	AP type	I <sub>O (peak)</sub>	A	
		AS (J)/AF type			2.0
	Typ.	AP type	I <sub>O (typ.)</sub>		1.2
		AS(J)/AF type			1.0
Power dissipation	AP type	P <sub>D</sub>	0.4	W	
	AS (J) type		12.5 (Note 1)		
	AF type		0.95 (Note 2)		
Operating temperature		T <sub>opr</sub>	-30 to 75	°C	
Storage temperature		T <sub>stg</sub>	-55 to 150	°C	

Note 1: T<sub>c</sub> = 25°C

Note 2: No heat sink

Note 3: When mounted on a PCB (PCB area: 60 mm × 30 mm × 1.6 mm, Cu area: 50% or more)

Wide range of operating voltage: V<sub>CC (opr.)</sub> = 4.5 V to 27 V

V<sub>S (opr.)</sub> = 4.5 V to 27 V

V<sub>ref (opr.)</sub> = 4.5 V to 27 V

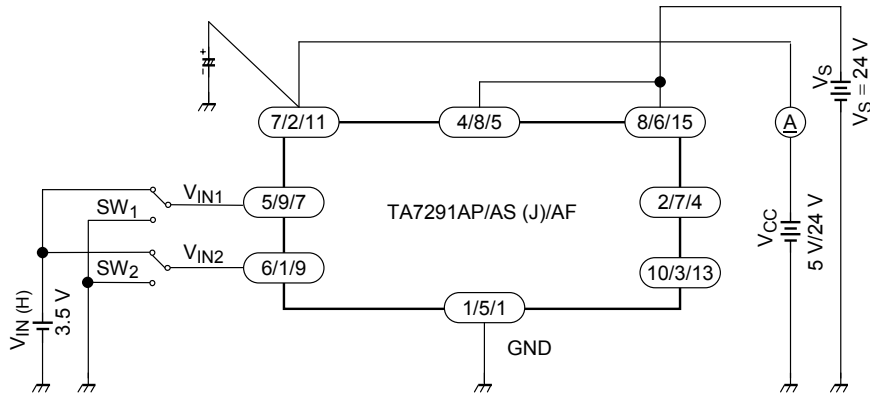
V<sub>ref</sub> ≤ V<sub>S</sub>

## Electrical Characteristics (Ta = 25°C, V<sub>CC</sub> = 5 V, V<sub>S</sub> = 24 V)

Characteristics			Symbol	Test Circuit	Test Condition	Min	Typ.	Max	Unit
Supply current			I <sub>CC1-1</sub>	1	Output OFF, CW/CCW mode	—	6.0	11.0	mA
			I <sub>CC1-2</sub>		Output OFF, CW/CCW mode, V <sub>CC</sub> = 24 V	—	8.0	13.0	
			I <sub>CC2-1</sub>		Output OFF, Stop mode	—	0	50	μA
			I <sub>CC2-2</sub>		Output OFF, Stop mode, V <sub>CC</sub> = 24 V	—	0	50	
			I <sub>CC3-1</sub>		Output OFF, Brake mode	—	4.5	8.0	mA
			I <sub>CC3-2</sub>		Output OFF, Brake mode, V <sub>CC</sub> = 24 V	—	6.5	10.0	
Input operating voltage	1 (High)	V <sub>IN1</sub>	2	T <sub>j</sub> = 25°C	3.5	—	5.5	V	
	2 (Low)	V <sub>IN2</sub>			GND	—	0.8		
Input current			I <sub>IN</sub>		V <sub>IN</sub> = 3.5 V, Sink mode	—	3	10	μA
Saturation voltage	AP/AS (J)/AF type	Upper side	V <sub>SAT U-1</sub>	3	V <sub>ref</sub> = V <sub>S</sub> , V <sub>OUT</sub> -V <sub>S</sub> measure I <sub>O</sub> = 0.2 A, CW/CCW mode	—	0.9	1.2	V
		Lower side	V <sub>SAT L-1</sub>		V <sub>ref</sub> = V <sub>S</sub> , V <sub>OUT</sub> -GND measure I <sub>O</sub> = 0.2 A, CW/CCW mode	—	0.8	1.2	
	AS (J)/AF type	Upper side	V <sub>SAT U-2</sub>		V <sub>ref</sub> = V <sub>S</sub> , V <sub>OUT</sub> -V <sub>S</sub> measure I <sub>O</sub> = 0.4 A, CW/CCW mode	—	1.0	1.35	
		Lower side	V <sub>SAT L-2</sub>		V <sub>ref</sub> = V <sub>S</sub> , V <sub>OUT</sub> -GND measure I <sub>O</sub> = 0.4 A, CW/CCW mode	—	0.9	1.35	
	AP type	Upper side	V <sub>SAT U-3</sub>		V <sub>ref</sub> = V <sub>S</sub> , V <sub>OUT</sub> -V <sub>S</sub> measure I <sub>O</sub> = 1.0 A, CW/CCW mode	—	1.3	1.8	
		Lower side	V <sub>SAT L-3</sub>		V <sub>ref</sub> = V <sub>S</sub> , V <sub>OUT</sub> -GND measure I <sub>O</sub> = 1.0 A, CW / CCW mode	—	1.2	1.85	
Output voltage (upper side)	AS (J)/AF type		V <sub>SAT U-1'</sub>	3	V <sub>ref</sub> = 10 V, V <sub>OUT</sub> -GND measure I <sub>O</sub> = 0.2 A, CW / CCW mode	—	11.2	—	V
			V <sub>SAT U-2'</sub>		V <sub>ref</sub> = 10 V, V <sub>OUT</sub> -GND measure I <sub>O</sub> = 0.4 A, CW/CCW mode	10.4	10.9	12.2	
	AP type		V <sub>SAT U-3'</sub>		V <sub>ref</sub> = 10 V, V <sub>OUT</sub> -GND measure I <sub>O</sub> = 0.5 A, CW/CCW mode	—	11.0	—	
			V <sub>SAT U-4'</sub>		V <sub>ref</sub> = 10 V, V <sub>OUT</sub> -GND measure I <sub>O</sub> = 1.0 A, CW/CCW mode	10.2	10.7	12.0	
Leakage current		Upper side	I <sub>L U</sub>	4	V <sub>L</sub> = 30 V	—	—	50	μA
		Lower side	I <sub>L L</sub>		V <sub>L</sub> = 30 V	—	—	50	
Diode forward voltage	AS (J)/AF type	Upper side	V <sub>F U-1</sub>	5	—	—	1.5	—	V
	AP type	Lower side	V <sub>F U-2</sub>		—	—	2.5	—	
	AS (J)/AF type	Upper side	V <sub>F L-1</sub>		—	—	0.9	—	
	AP type	Lower side	V <sub>F L-2</sub>		—	—	1.2	—	
Reference current			I <sub>ref</sub>	2	V <sub>ref</sub> = 10 V, Source mode	—	—	40	μA

**Test Circuit 1**

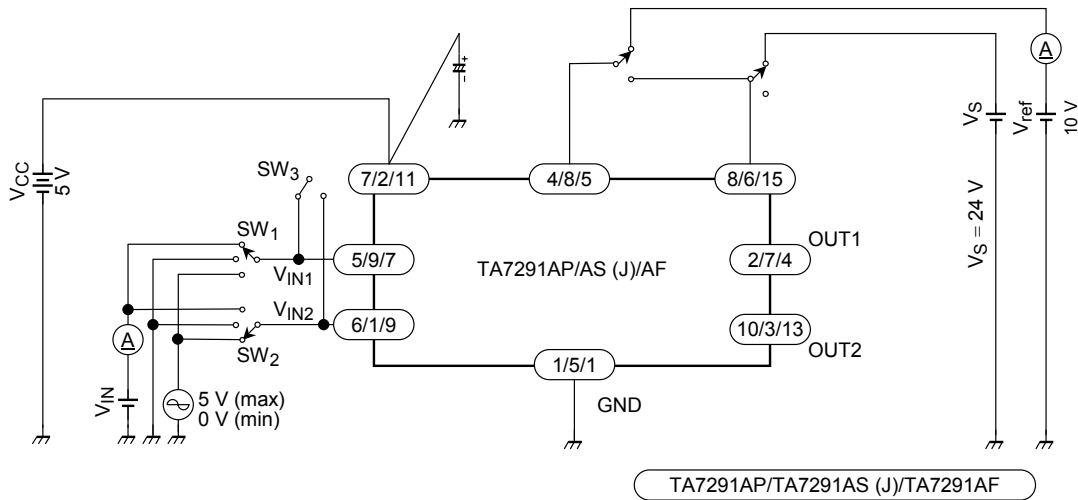
$I_{CC1-1}$ ,  $I_{CC1-2}$ ,  $I_{CC2-1}$ ,  $I_{CC2-2}$ ,  $I_{CC3-1}$ ,  $I_{CC3-2}$



Note: The heat fin of the TA7291AF is connected to ground.

**Test Circuit 2**

$V_{IN1}$ ,  $V_{IN2}$ ,  $I_{IN}$ ,  $I_{ref}$

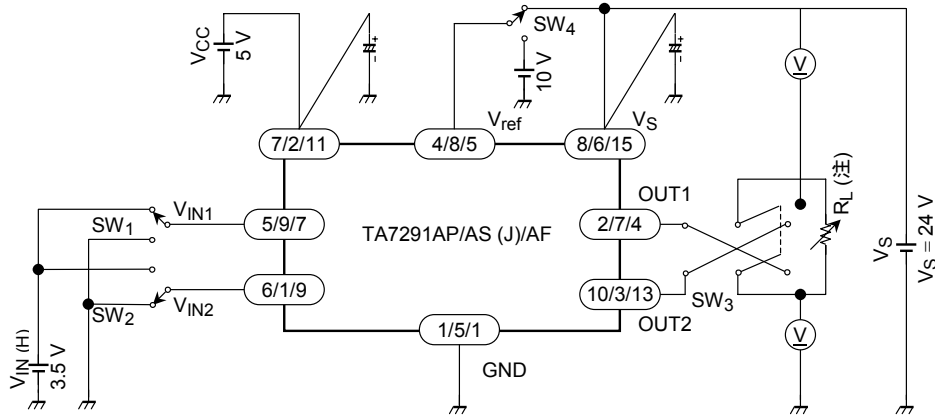


TA7291AP/TA7291AS (J)/TA7291AF

Note: The heat fin of the TA7291AF is connected to ground.

## Test Circuit 3.

$V_{SAT\ U-1, 2, 3}$   $V_{SAT\ L-1, 2, 3}$   $V_{SAT\ U-1', 2', 3', 4'}$

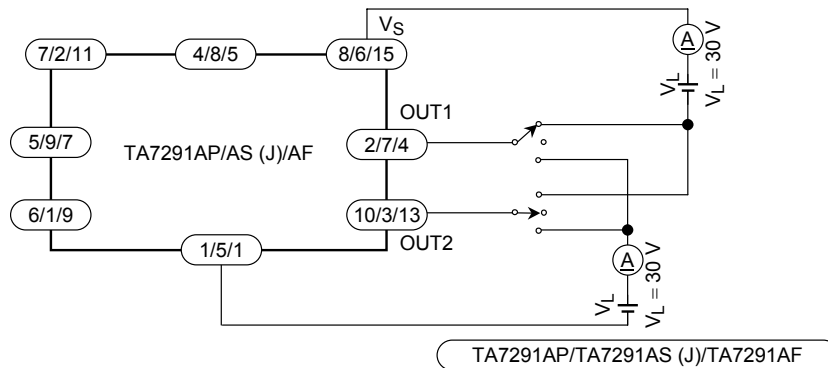


Note 1:  $I_{OUT}$  calibration is required to adjust specified values of test conditions by  $R_L$ .  
( $I_{OUT} = 0.2\text{ A}/0.4\text{ A}/0.5\text{ A}/1.0\text{ A}$ )

Note 2: The heat fin of the TA7291AF is connected to ground.

## Test Circuit 4.

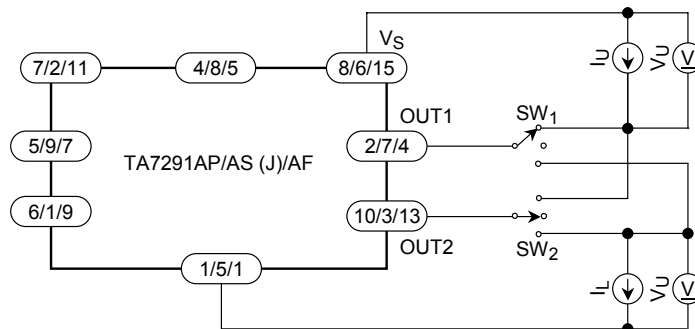
$I_{LU, L}$

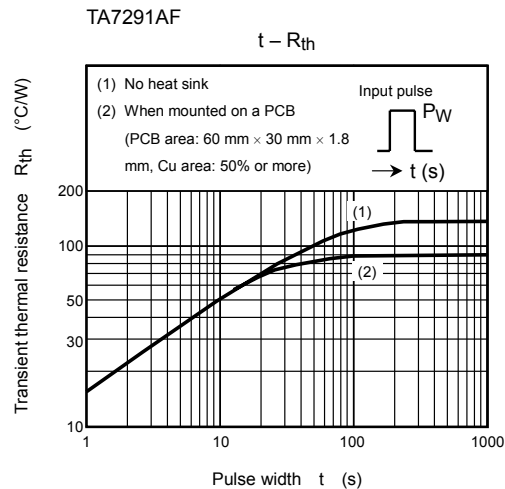
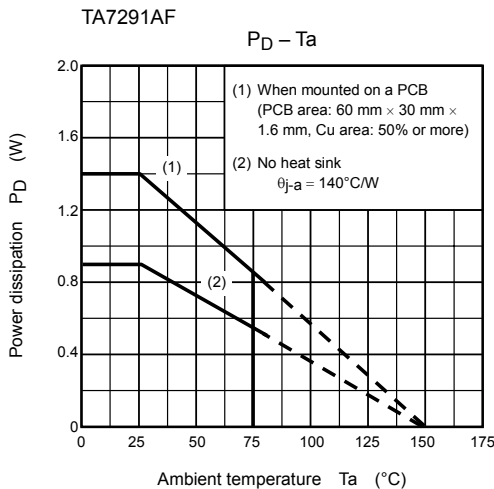
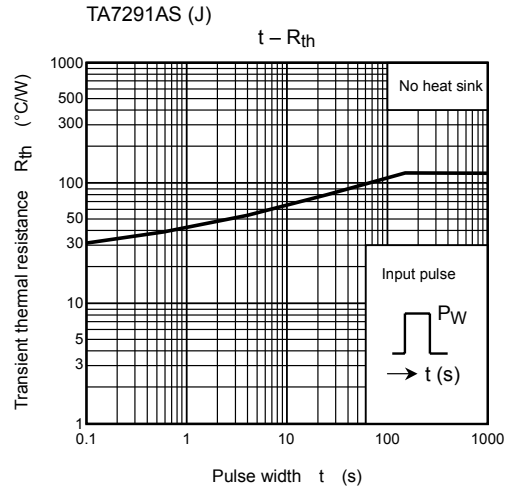
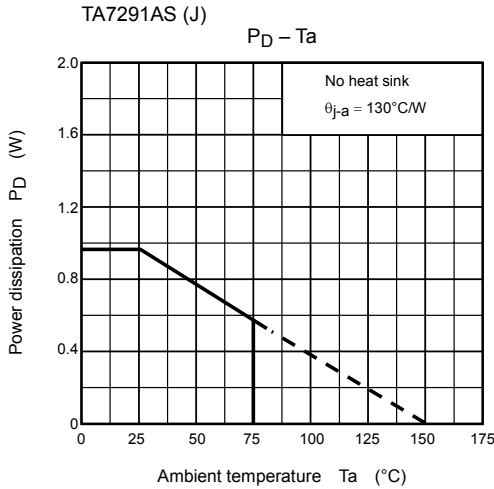
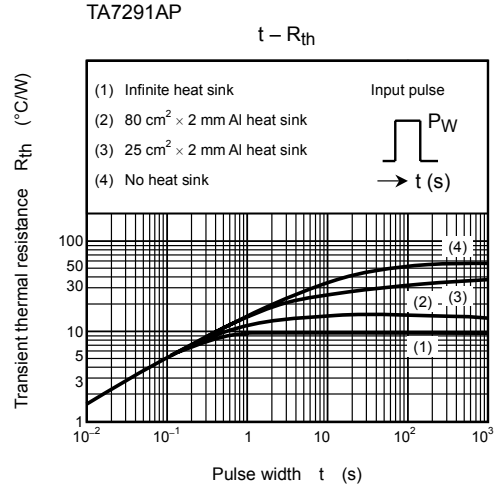
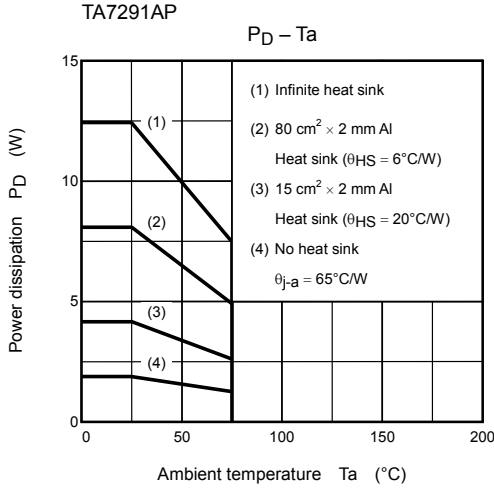


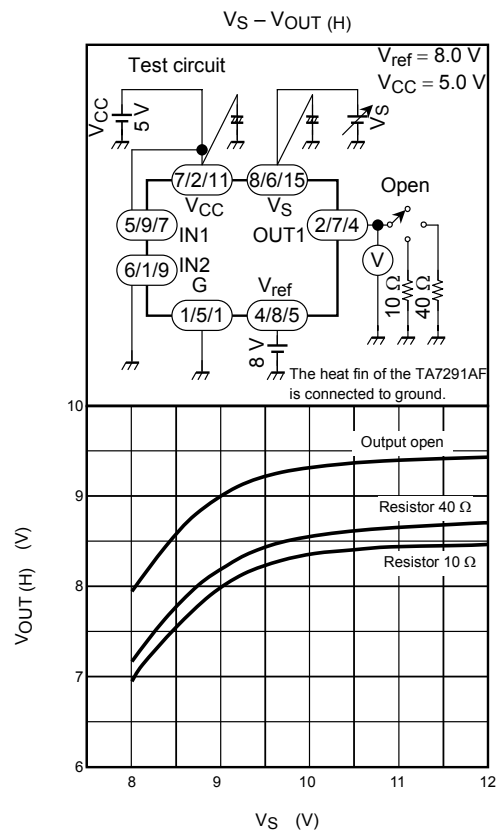
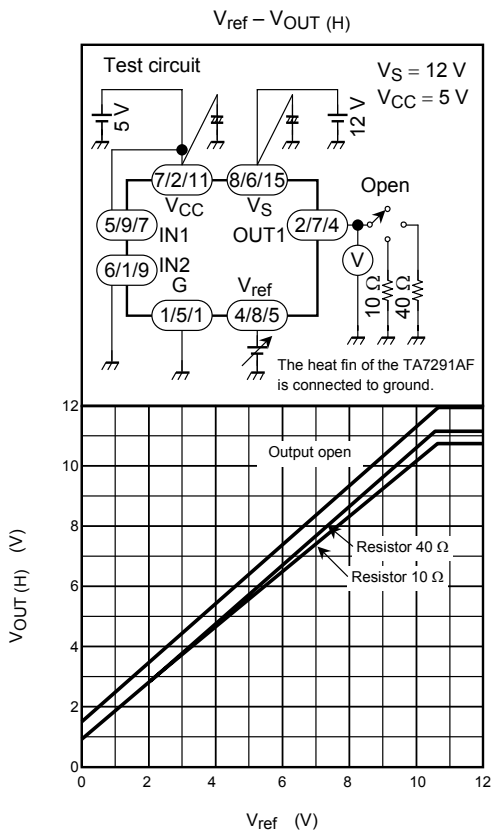
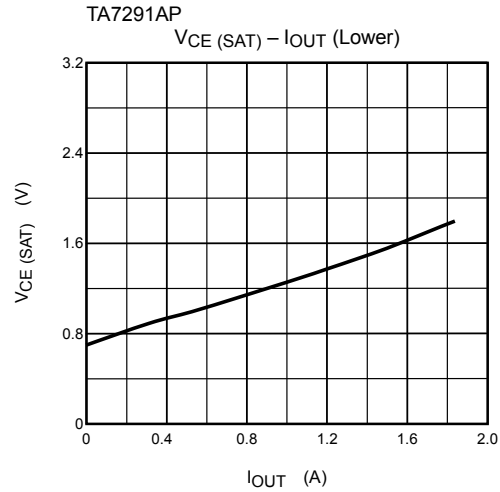
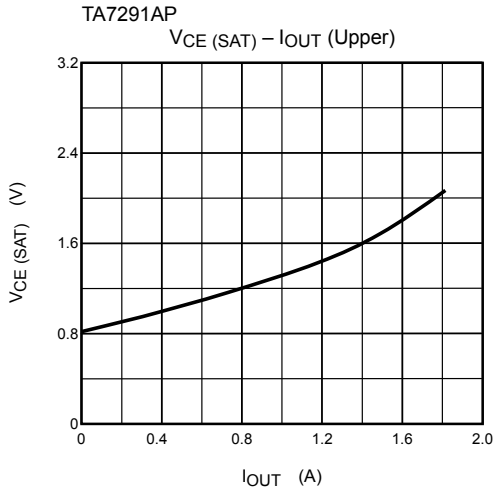
Note: The heat fin of the TA7291AF is connected to ground.

## Test Circuit 5.

$V_F\ U-1, 2$   $V_F\ L-1, 2$









## Notes

- **Power On/Off**

At power on, VCC must be applied simultaneously or before VS. At power off, VCC must be removed simultaneously or after VS.

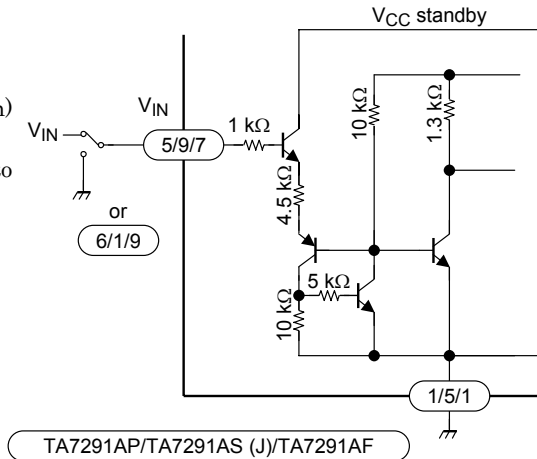
- **Input Circuit**

A logic high on the VIN pin activates the input circuit as shown in the figure.

When a voltage greater than or equal to VIN (high) is applied to the pin, the circuit is active. When a voltage less than or equal to VIN (low) is applied to the pin or the pin is grounded, the circuit is inactive.

When the pin is high, the input current IIN flows into the input circuit. So, be careful about the output impedance of the first stage.

The input hysteresis is 0.7 V (typ.). At power on (VCC), set both input pins IN1 and IN2 to low.



- **Output Circuit**

### Output high voltage

- Operation based on the Vref voltage

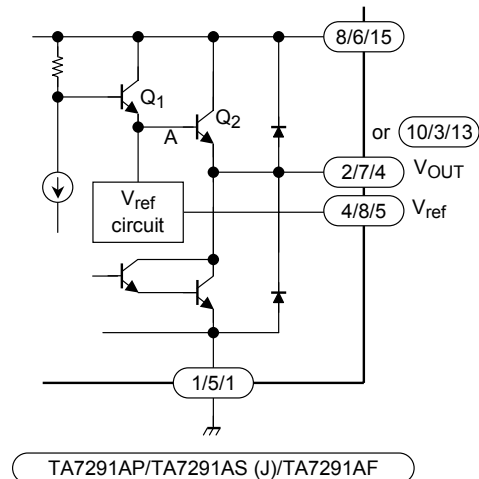
The Vref voltage is increased by twice the value of VBE (small signal) in the Vref circuit. Then, the voltage is applied to the base A of Q2 (power transistor 2). As a result, the voltage which is reduced by the value of VBE (Q2) appears on the VOUT pin.

$$V_{OUT} = V_{ref} + 2V_{BE} - V_{BE}(Q2) \approx V_{ref} + 0.7 \text{ V}$$

- Vref pin

The Vref pin must not be left open when unused. In this case, connect it via a protection resistor (3 kΩ or more) to the VS pin. Otherwise, it might cause oscillation.

Vref must be  $\leq$  VS.



## Protection Features

### Overcurrent Protection Circuit

The overcurrent protection circuit detects a current flowing through the upper power transistor. If the current exceeds a predetermined value (about 2.5 A), the circuit turns all the power transistors off.

However, it does not always prevent overcurrent. If an output pin is shorted or grounded, the IC might be destroyed before operation of the overcurrent protection circuit. So, be sure to connect a resistor or fuse to the power supply (VS) line. (See "Application Circuit.")

### Thermal Shutdown Circuit

If the chip temperature exceeds a predetermined limit (about 170°C), the thermal shutdown circuit turns all the power transistors off.



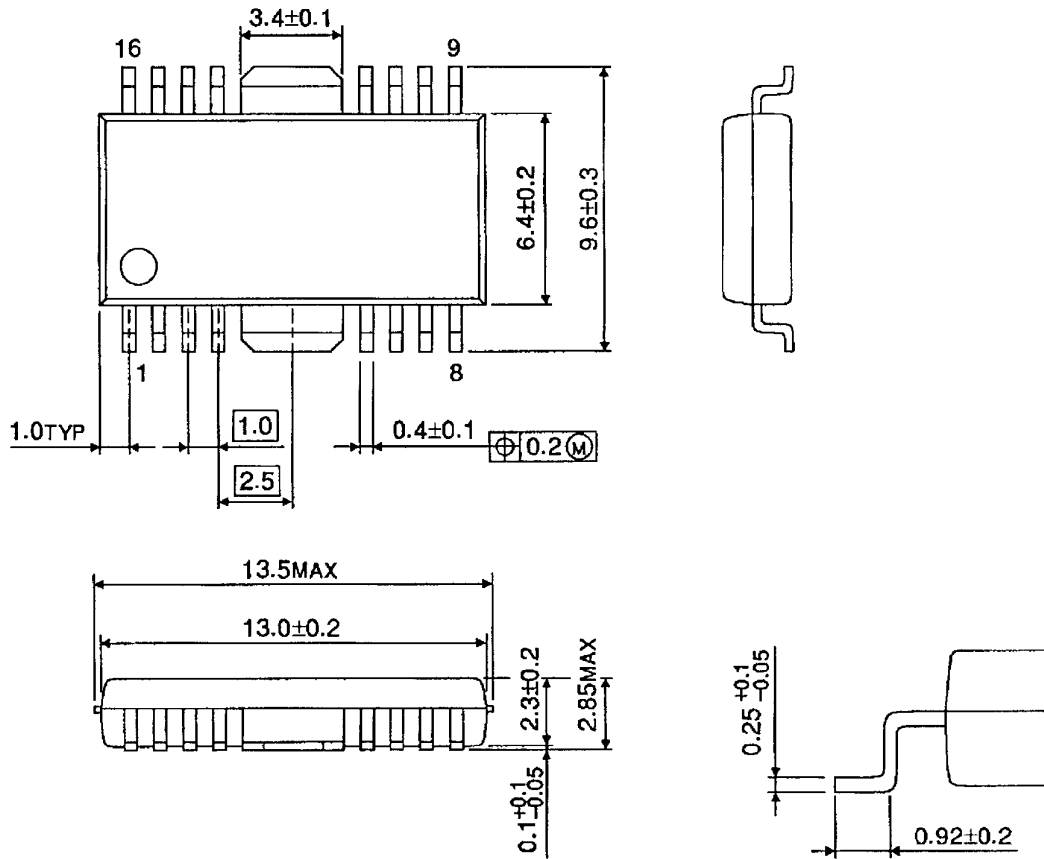




## Package Dimensions

HSOP16-P-300-1.00

Unit : mm



Weight: 0.50 g (typ.)

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