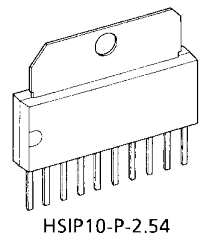
TOSHIBA Bipolar Linear Integrated Circuit Silicon Monolithic

TA7291AP, TA7291AS(J)/ ASG(J), TA7291AF/AFG

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

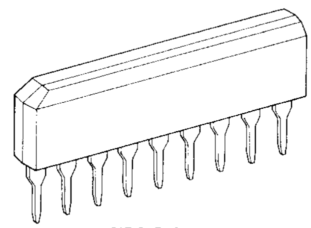
The TA7291AP/AS (J)/ASG(J)/AF/AFG is a full-bridge driver to control the forward and reverse rotations. Each driver can select one of four modes: CW, CCW, stop, brake.
The TA7291AP is designed to provide output currents of 1.0 A (typ.) and 2.0 A (peak). The TA7291AS (J)/ASG(J)/AF/AFG is designed to provide 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 a 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.

TA7291AP



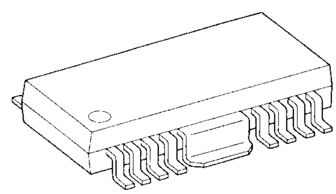
HSIP10-P-2.54

TA7291AS (J)/ASG(J)



SIP9-P-2.54A

TA7291AF/AFG



HSOP16-P-300-1.00

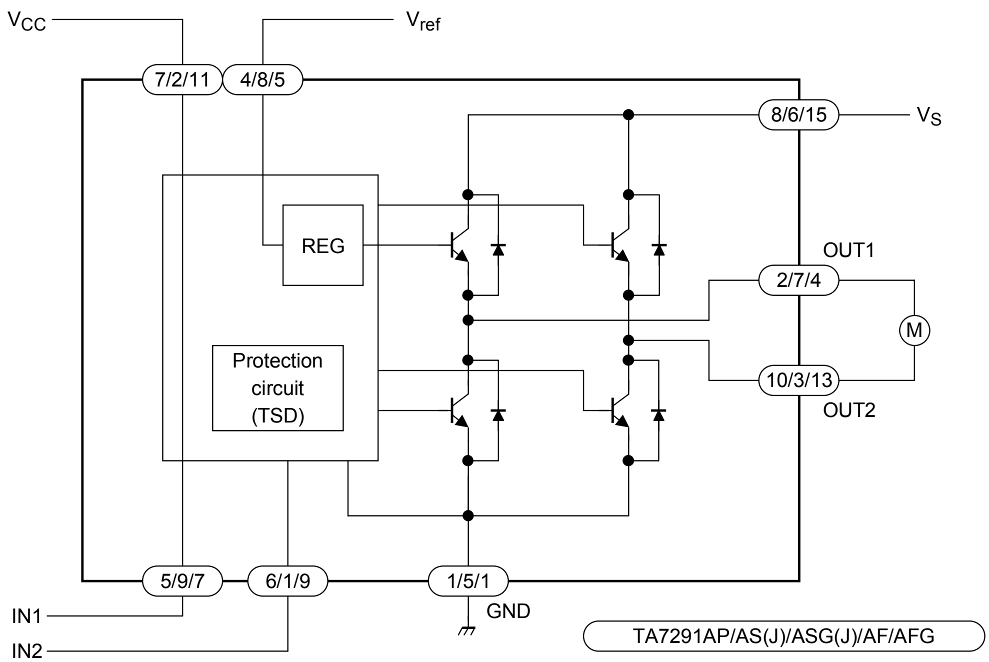
Weight
HSIP10-P-2.54: 2.47 g (typ.)
SIP9-P-2.54A: 0.92 g (typ.)
HSOP16-P-300-1.00: 0.50 g (typ.)

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 $\le V_S$.
- 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

TA7291ASG(J)/AFG:
The following conditions apply to solderability:
*Solderability
1. Use of Sn-63Pb solder bath
   *solder bath temperature=230 degrees
   *dipping time=5seconds
   *number of times=once
   *use of R-type flux
2. Use of Sn-3.0Ag-0.5Cu solder bath
   *solder bath temperature=245 degrees
   *dipping time=5seconds
   *the number of times=once

Block Diagram



Pin Function

Symbol	Pin No.			Function Description
	AP	AS (J)	AF	
V_{CC}	7	2	11	Supply voltage pin for logic
V_S	8	6	15	Supply voltage pin for motor driver
V_{ref}	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_{CC}	30	V
			$V_{CC\ (opr.)}$	27	
Motor drive voltage			V_S	30	V
			$V_{S\ (opr.)}$	27	
Reference voltage			V_{ref}	30	V
			$V_{ref\ (opr.)}$	27	
Output current	Peak	AP type	$I_{O\ (peak)}$	2.0	A
		AS (J)/AF type		1.2	
	Typ.	AP type	$I_{O\ (typ.)}$	1.0	
		AS(J)/AF type		0.4	
Power dissipation		AP type	P_D	12.5 (Note 1)	W
		AS (J) type		0.95 (Note 2)	
		AF type		1.4 (Note 3)	
Operating temperature			T_{opr}	−30 to 75	°C
Storage temperature			T_{stg}	−55 to 150	°C

Note 1: Tc = 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)

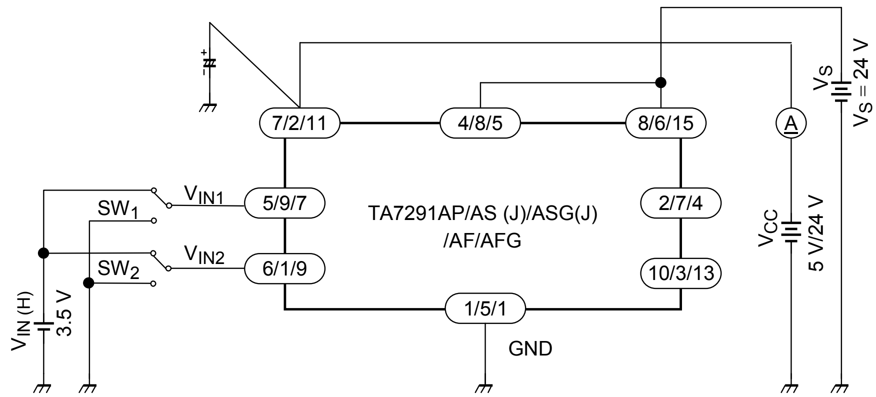
Wide range of operating voltage: $V_{CC\ (opr.)}$ = 4.5 V to 27 V
$V_{S\ (opr.)}$ = 4.5 V to 27 V
$V_{ref\ (opr.)}$ = 4.5 V to 27 V
$V_{ref} \leq V_S$

Electrical Characteristics (Ta = 25°C, V_{CC} = 5 V, V_S = 24 V)

Characteristics			Symbol	Test Circuit	Test Condition	Min	Typ.	Max	Unit
Supply current			I_{CC1-1}	1	Output OFF, CW/CCW mode	—	6.0	11.0	mA
			I_{CC1-2}		Output OFF, CW/CCW mode, V_{CC} = 24 V	—	8.0	13.0	
			I_{CC2-1}		Output OFF, Stop mode	—	0	50	μA
			I_{CC2-2}		Output OFF, Stop mode, V_{CC} = 24 V	—	0	50	
			I_{CC3-1}		Output OFF, Brake mode	—	4.5	8.0	mA
			I_{CC3-2}		Output OFF, Brake mode, V_{CC} = 24 V	—	6.5	10.0	
Input operating voltage	1 (High)		V_{IN1}	2	T_j = 25°C	3.5	—	5.5	V
	2 (Low)		V_{IN2}			GND	—	0.8	
Input current			I_{IN}		V_{IN} = 3.5 V, Sink mode	—	3	10	μA
Saturation voltage	AP/AS (J)/ AF type	Upper side	$V_{SAT\ U-1}$	3	V_{ref} = V_S, V_{OUT}-V_S measure I_O = 0.2 A, CW/CCW mode	—	0.9	1.2	V
		Lower side	$V_{SAT\ L-1}$		V_{ref} = V_S, V_{OUT}-GND measure I_O = 0.2 A, CW/CCW mode	—	0.8	1.2	
	AS (J)/AF type	Upper side	$V_{SAT\ U-2}$		V_{ref} = V_S, V_{OUT}-V_S measure I_O = 0.4 A, CW/CCW mode	—	1.0	1.35	
		Lower side	$V_{SAT\ L-2}$		V_{ref} = V_S, V_{OUT}-GND measure I_O = 0.4 A, CW/CCW mode	—	0.9	1.35	
	AP type	Upper side	$V_{SAT\ U-3}$		V_{ref} = V_S, V_{OUT}-V_S measure I_O = 1.0 A, CW/CCW mode	—	1.3	1.8	
		Lower side	$V_{SAT\ L-3}$		V_{ref} = V_S, V_{OUT}-GND measure I_O = 1.0 A, CW / CCW mode	—	1.2	1.85	
Output voltage (upper side)	AS (J)/AF type		$V_{SAT\ U-1'}$	3	V_{ref} : 10 V, V_{OUT}-GND measure I_O = 0.2 A, CW / CCW mode	—	11.2	—	V
			$V_{SAT\ U-2'}$		V_{ref} : 10 V, V_{OUT}-GND measure I_O = 0.4 A, CW/CCW mode	10.4	10.9	12.2	
	AP type		$V_{SAT\ U-3'}$		V_{ref} : 10 V, V_{OUT}-GND measure I_O = 0.5 A, CW/CCW mode	—	11.0	—	
			$V_{SAT\ U-4'}$		V_{ref} : 10 V, V_{OUT}-GND measure I_O = 1.0 A, CW/CCW mode	10.2	10.7	12.0	
Leakage current		Upper side	$I_{L\ U}$	4	V_L = 30 V	—	—	50	μA
		Lower side	$I_{L\ L}$		V_L = 30 V	—	—	50	
Diode forward voltage	AS (J)/AF type	Upper side	$V_{F\ U-1}$	5	—	—	1.5	—	V
	AP type	Lower side	$V_{F\ U-2}$		—	—	2.5	—	
	AS (J)/AF type	Upper side	$V_{F\ L-1}$		—	—	0.9	—	
	AP type	Lower side	$V_{F\ L-2}$		—	—	1.2	—	
Reference current			I_{ref}	2	V_{ref} = 10 V, Source mode	—	—	40	μA

Test Circuit 1

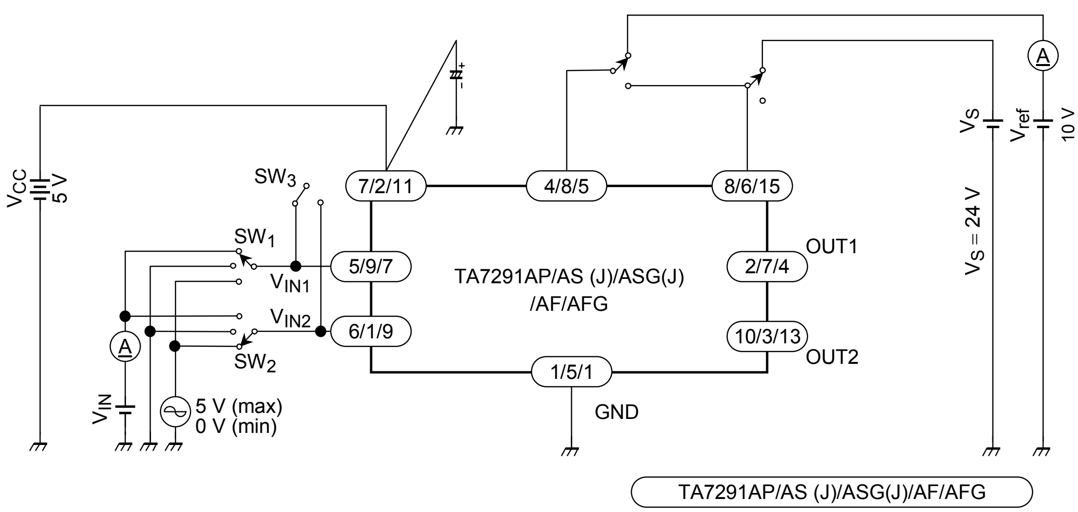
$I_{CC1\text{-}1}$, $I_{CC1\text{-}2}$, $I_{CC2\text{-}1}$, $I_{CC2\text{-}2}$, $I_{CC3\text{-}1}$, $I_{CC3\text{-}2}$



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

Test Circuit 2

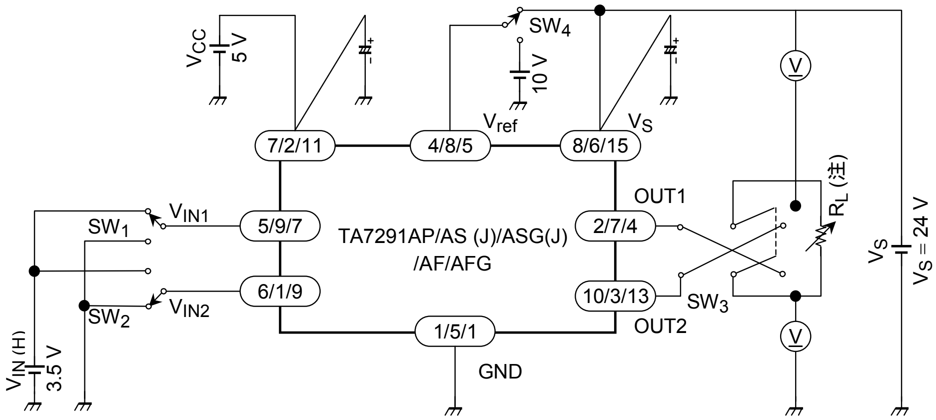
V_{IN1}, V_{IN2}, I_{IN}, I_{ref}



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

Test Circuit 3.

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

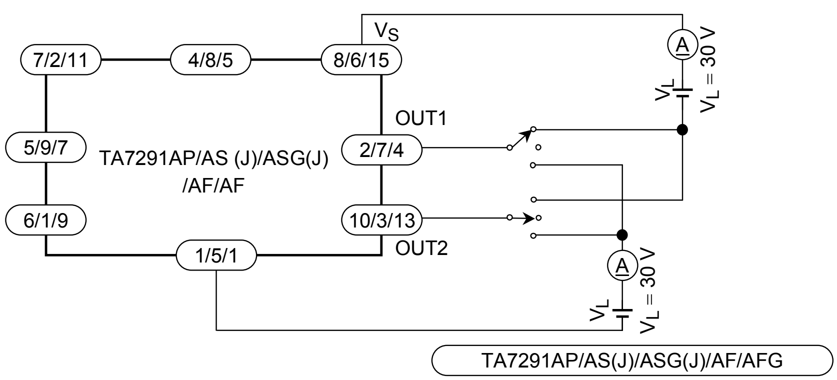


Note 1: I_{OUT} calibration is required to adjust the specified values of test conditions by R_L.
(I_{OUT} = 0.2 A/0.4 A/0.5 A/1.0 A)

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

Test Circuit 4.

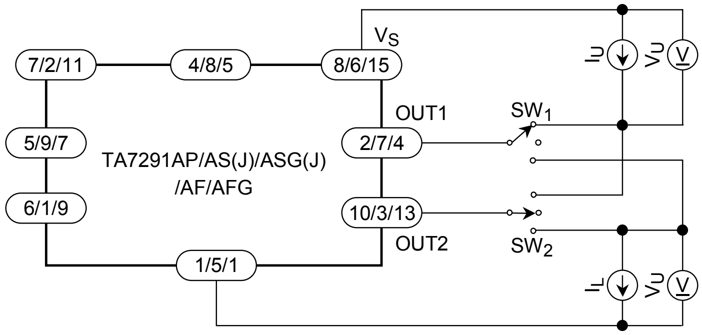
I_{LU}, L



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

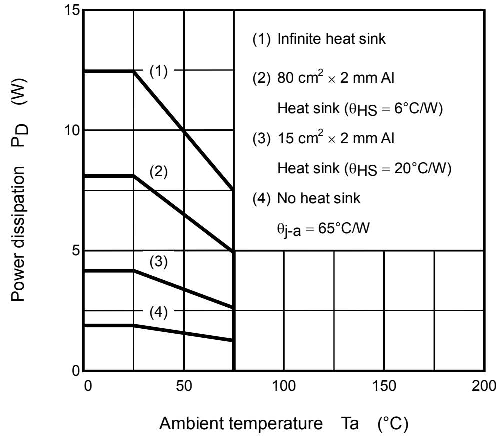
Test Circuit 5.

$V_{F\ U\text{-}1,\ 2}$ $V_{F\ L\text{-}1,\ 2}$



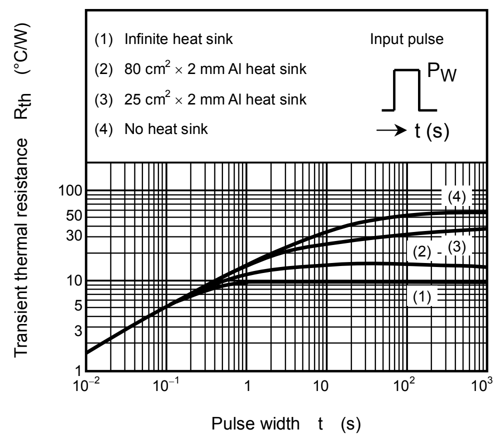
TA7291AP

P_D – Ta



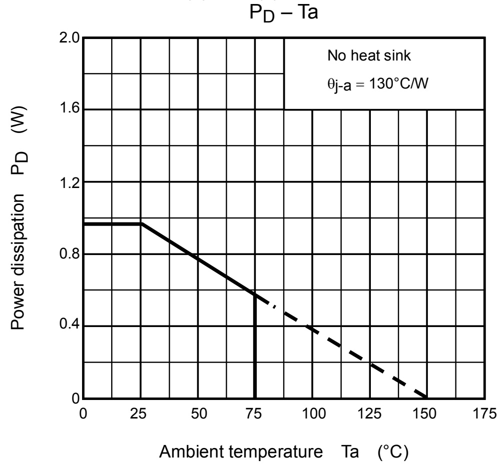
TA7291AP

t – R_{th}



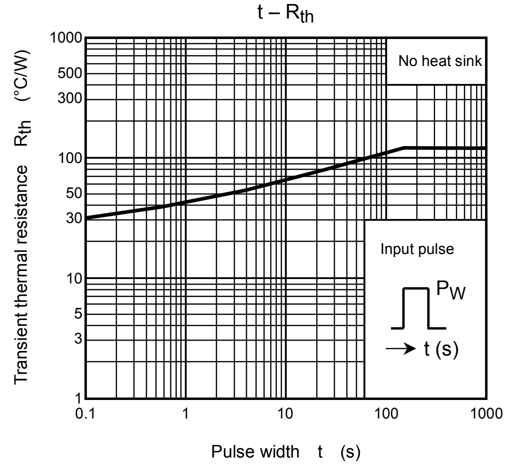
TA7291AS (J)/ASG(J)

P_D – Ta



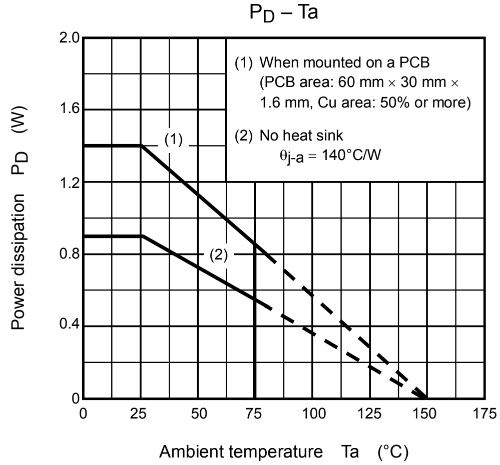
TA7291AS (J)/ASG(J)

t – R_{th}



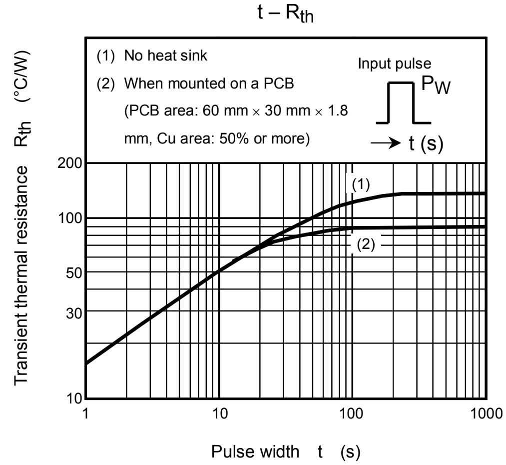
TA7291AF/AFG

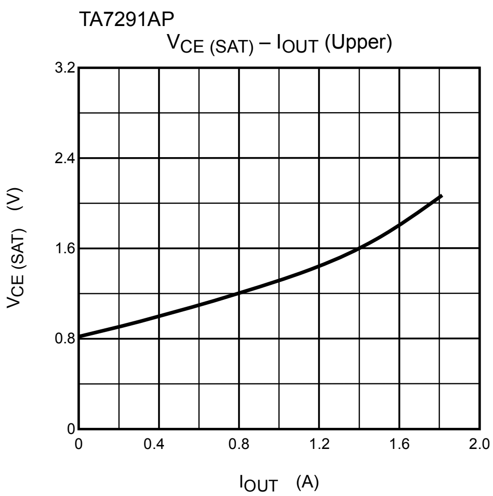
P_D – Ta

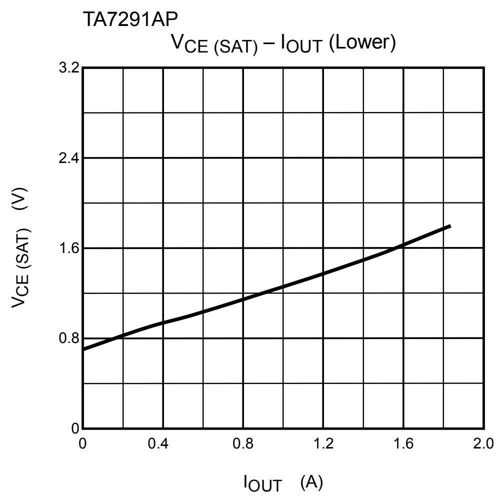


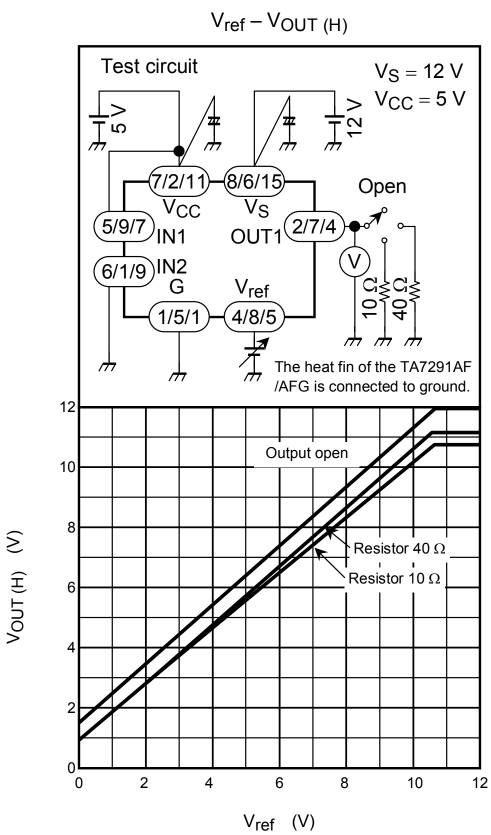
TA7291AF/AFG

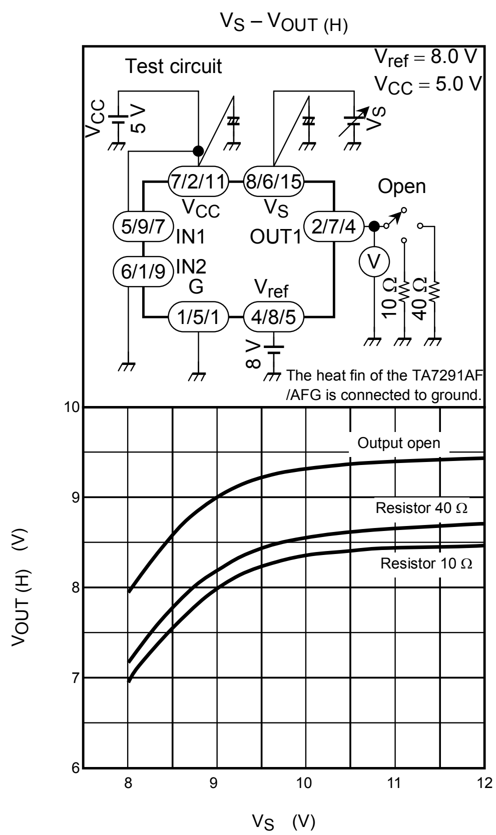
t – R_{th}




TA7291AP
VCE (SAT) – IOUT (Upper)
VCE (SAT) (V)
IOUT (A)
0
0.8
1.6
2.4
3.2
0.4
1.2
2.0


TA7291AP
VCE (SAT) – IOUT (Lower)
VCE (SAT) (V)
IOUT (A)


Vref – VOUT (H)
Test circuit
VS = 12 V
VCC = 5 V
5 V
12 V
7/2/11
8/6/15
VCC
VS
5/9/7
IN1
OUT1
2/7/4
6/1/9
IN2
G
Vref
1/5/1
4/8/5
Open
V
10 Ω
40 Ω
The heat fin of the TA7291AF /AFG is connected to ground.
Output open
Resistor 40 Ω
Resistor 10 Ω
VOUT (H) (V)
Vref (V)


VS – VOUT (H)
Test circuit
Vref = 8.0 V
VCC = 5.0 V
VCC
5 V
VS
7/2/11
8/6/15
5/9/7
IN1
OUT1
2/7/4
6/1/9
IN2
G
Vref
1/5/1
4/8/5
Open
V
10 Ω
40 Ω
8 V
The heat fin of the TA7291AF /AFG is connected to ground.
Output open
Resistor 40 Ω
Resistor 10 Ω
VOUT (H) (V)
VS (V)

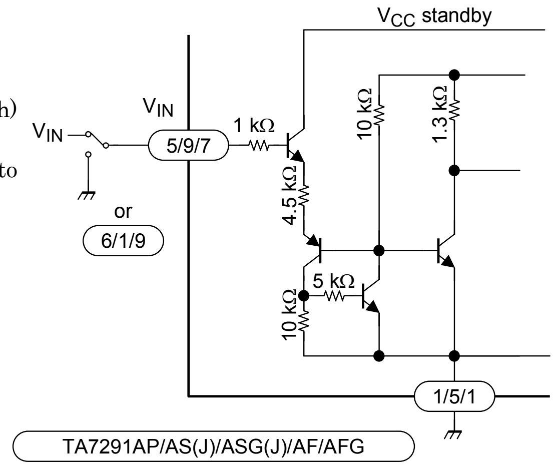
Notes

• Power On/Off

At power on, V_{CC} must be applied simultaneously or before V_S. At power off, V_{CC} must be removed simultaneously or after V_S.

• Input Circuit

A logic high on the V_{IN} pin activates the input circuit as shown in the figure.
When a voltage greater than or equal to V_{IN} (high) is applied to the pin, the circuit is active. When a voltage less than or equal to V_{IN} (low) is applied to the pin or the pin is grounded, the circuit is inactive.
When the pin is high, the input current I_{IN} flows into the input circuit. Take particular care, therefore, with the output impedance of the first stage.
The input hysteresis is 0.7 V (typ.). At power on (V_{CC}), set both input pins IN1 and IN2 to low.



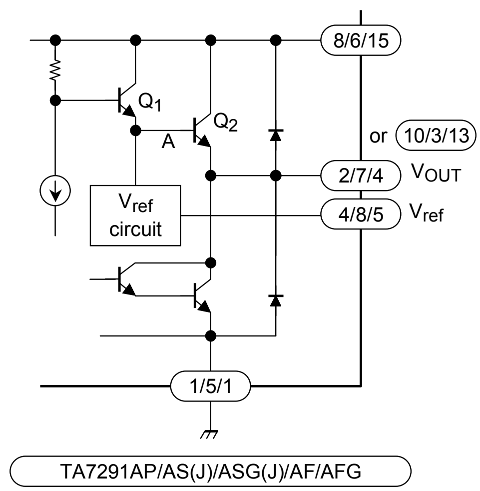
• Output Circuit

Output high voltage

- Operation based on the V_{ref} voltage

  The V_{ref} voltage is increased by twice the value of V_{BE} (small signal) in the V_{ref} circuit. The voltage is then applied to the base A of Q2 (power transistor 2). As a result, a voltage reduced by the value of V_{BE} (Q2) appears on the V_{OUT} pin.
  $V_{OUT} = V_{ref} + 2V_{BE} - V_{BE}$ (Q2) $\simeq V_{ref} + 0.7$ V
- V_{ref} pin

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



Protection Features

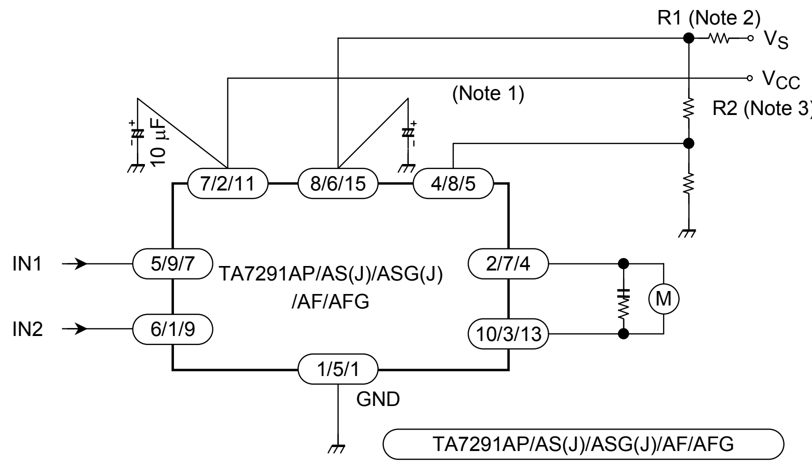
Overcurrent Protection Circuit

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. Be sure, therefore, to connect a resistor or fuse to the power supply (V_S) 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.

Application Circuit



Note 1: Select the optimum value for the capacitor by trial and error.

Note 2: Insert the current limiting resistor R1 to protect the IC from overcurrent.

Note 3: When $V_S = V_{ref}$, insert the resistor R2 (3 kΩ or more) to protect the V_{ref} pin from being damaged by a surge.

Note 4: The IC may be destroyed due to short circuit between output pins, an output pin and V_{CC}, or an output pin and ground. Design the output line, V_{CC} (V_M, V_S, V_{EE}) lines and the ground line with great care.

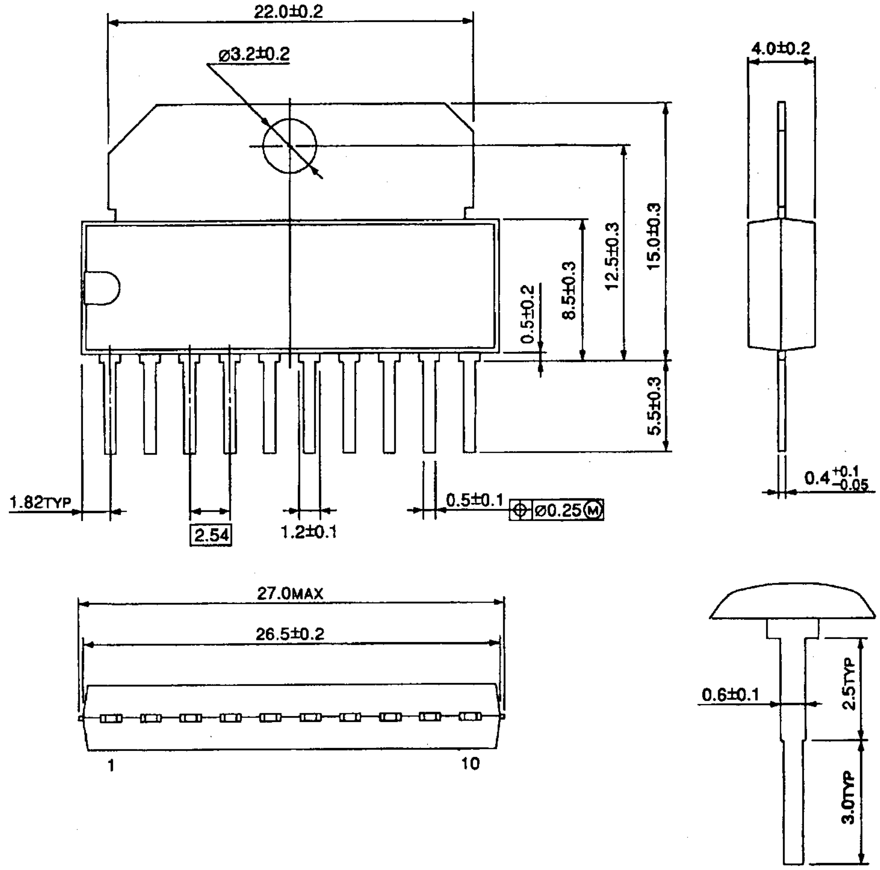
Note

- Shoot-through current occurs when the mode is switched. The driver must enter the stop mode for approximately 100 μs before switching between CW and CCW modes, or CW/CCW and brake modes.
- Normal IC functionality is not guaranteed at power on/off. Before using the IC, check that any IC malfunctions that are possible at power on/off will not cause a problem in the IC application.

Package Dimensions

HSIP10-P-2.54

Unit : mm

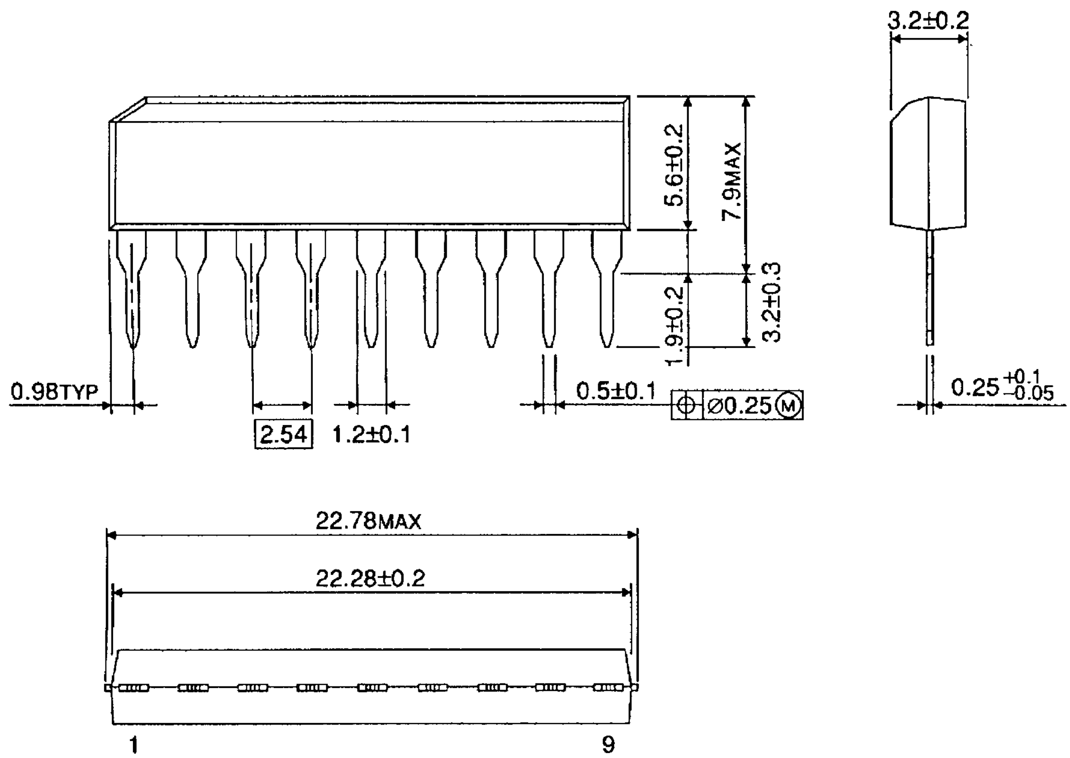


Weight: 2.47 g (typ.)

Package Dimensions

SIP9-P-2.54A

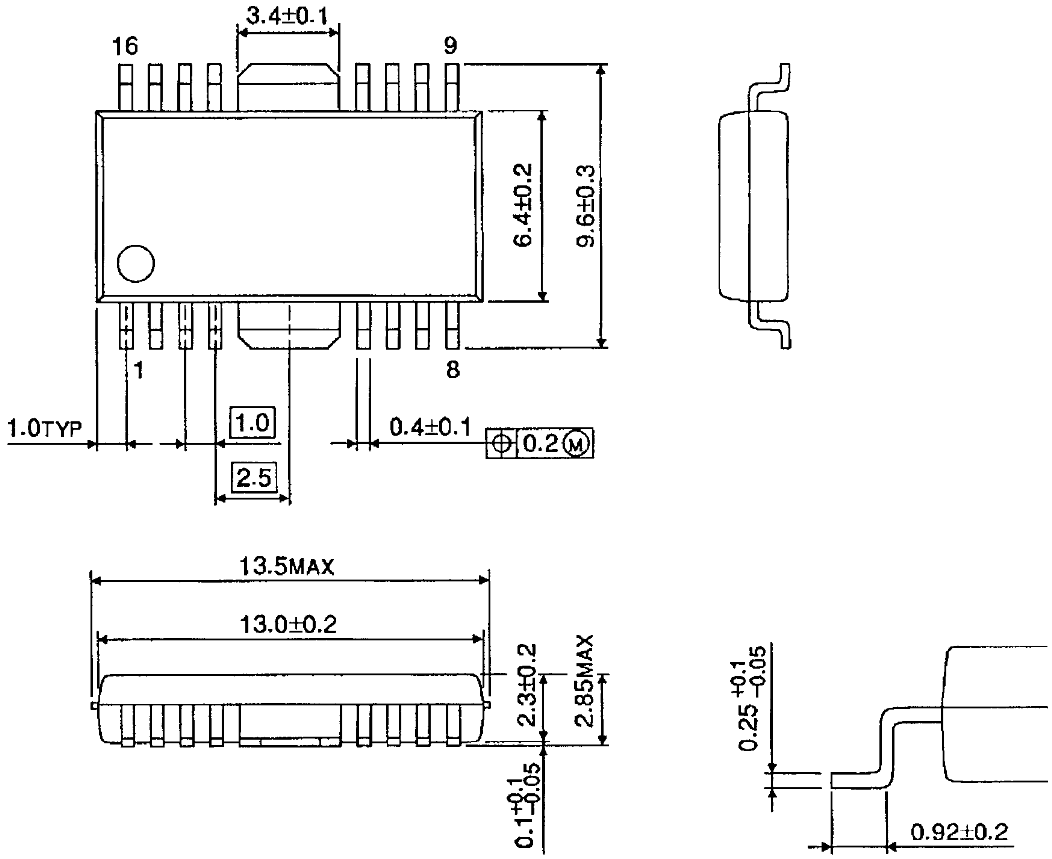
Unit : mm



Weight: 0.92 g (typ.)

Package Dimensions

HSOP16-P-300-1.00 Unit : mm



Weight: 0.50 g (typ.)

The notes of contents

1.Block Diagram

Some of the functional blocks, circuits, or constants in the block diagram may be omitted or simplified for explanatory purposes.

2.Equivalent Circuit

The equivalent circuit diagrams may be simplified or some parts of them may be omitted for explanatory purposes.

3.Timing charts

Timing charts may be simplified for explanatory purposes.

4.Maximum Ratings

The absolute maximum ratings of a semiconductor device are a set of specified parameter values which must not be exceeded during operation, even for an instant.

If any of these ratings are exceeded during operation, the device electrical characteristics may be irreparably altered and the reliability and lifetime of the device can no longer be guaranteed.

Moreover, these operations with exceeded ratings may cause breakdown, damage and/or degradation to other equipment. Applications using the device should be designed so that each maximum rating will never be exceeded in any operating conditions.

Before using, creating and/or producing designs, refer to and comply with the precautions and conditions set forth in this document.

5.Application Circuit

The application circuits shown in this document are provided for reference purposes only. Thorough evaluation is required, especially at the mass production design stage.

Toshiba does not grant any license to any industrial property rights by providing these examples of application circuits.

6.Test Circuit

Components in the test circuits are only used to obtain and confirm the device characteristics. These components and circuits are not guaranteed to prevent malfunction or failure from occurring in the application equipment.

About the handling of IC

Install the product correctly to avoid breakdown, damage and/or degradation to the product or equipment.

About overcurrent protection and heat protection circuit

These protection functions are intended to guard against certain output short circuits or other abnormal conditions with only temporary effect, and are not guaranteed to prevent the IC from being damaged.

- These protection features may not be effective if the product is operated outside the guaranteed operating ranges, and some output short circuits may result in the IC being damaged.

The overcurrent protection feature is only intended to protect the IC from a temporary short circuit.

Short circuits of longer duration may damage the IC through undue stress. The systems must be configured so that any overcurrent condition will be eliminated as soon as possible.

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