

# M5291P/FP

## DC/DC Converter

REJ03D0841-0300

Rev.3.00

Jun 15, 2007

### Description

M5291 is a semiconductor integrated circuit which is designed for switching regulator control. The device consists of a comparator, controlled pulse width oscillator (with peak current protection circuit), temperature compensated reference, and high current output switch.

Especially, this IC was designed for Step-Down and Step-Up and Voltage-Inverting applications.

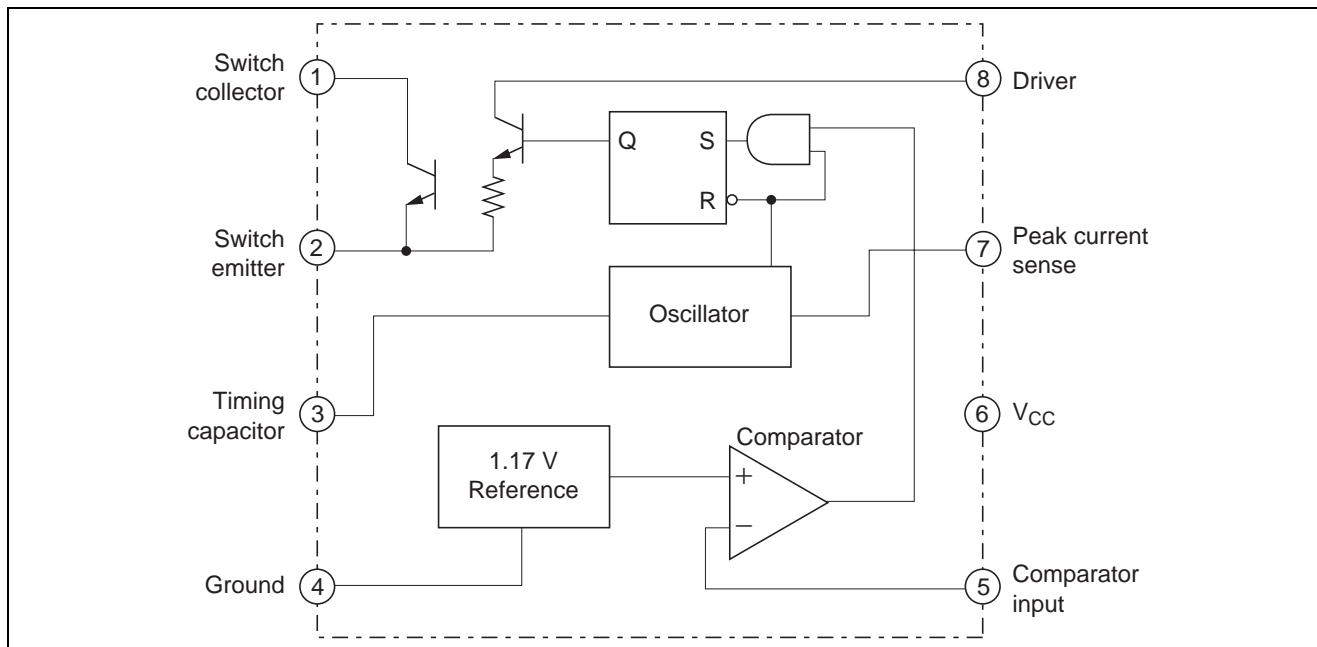
### Features

- Wide supply voltage range: 2.5 to 40 V
- Low dissipation current: 1.4 mA
- Wide range of output  
Voltage adjust: 1.17 to 40 V
- Output switch current: 200 mA
- Wide range of switching frequency: 100 Hz to 100 kHz
- Built-in peak current protection circuit

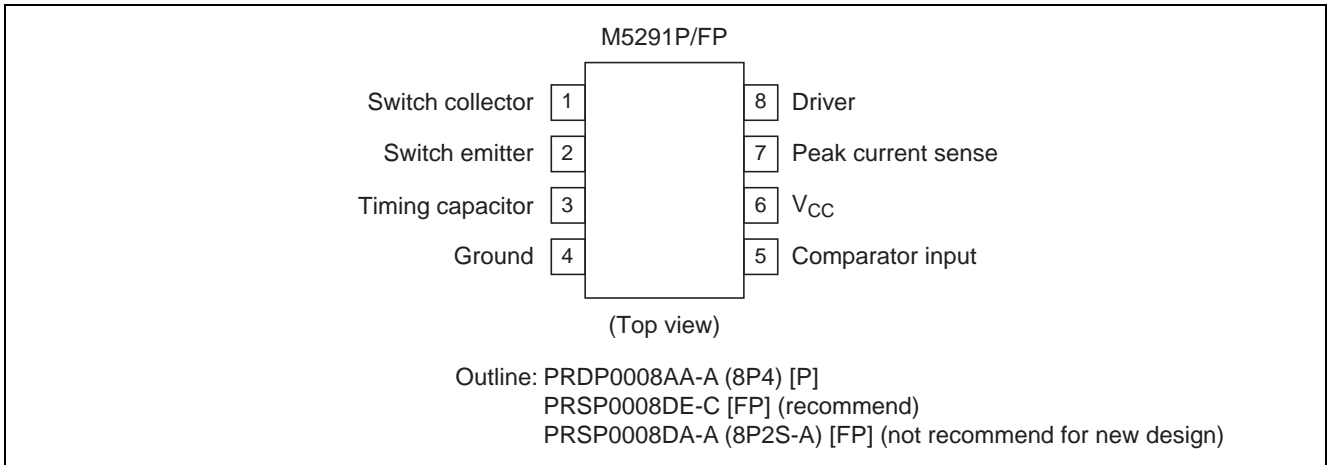
### Application

General power supply system

### Block Diagram



## Pin Arrangement



## Absolute Maximum Ratings

(Ta = 25°C, unless otherwise noted)

Item	Symbol	Ratings	Unit	Conditions
Power supply voltage	V <sub>CC</sub>	40	V	
Input voltage	V <sub>IN</sub>	-0.3 to 40	V	Comparator input
Switch collector voltage	V <sub>C(S)</sub>	40	V	
Switch emitter voltage	V <sub>E(S)</sub>	40	V	
Collector emitter voltage	V <sub>CE(S)</sub>	40	V	
Driver collector voltage	V <sub>C(D)</sub>	40	V	
Switch current	I <sub>SW</sub>	200	mA	
Internal power dissipation	Pd	625	mW	8-pin DIP
		440		8-pin FLAT
Thermal derating	Kθ	6.25	mW/°C	8-pin DIP
		4.5		8-pin FLAT
Operating ambient temperature	T <sub>opr</sub>	-20 to +75	°C	
Storage temperature	T <sub>stg</sub>	-55 to +125	°C	

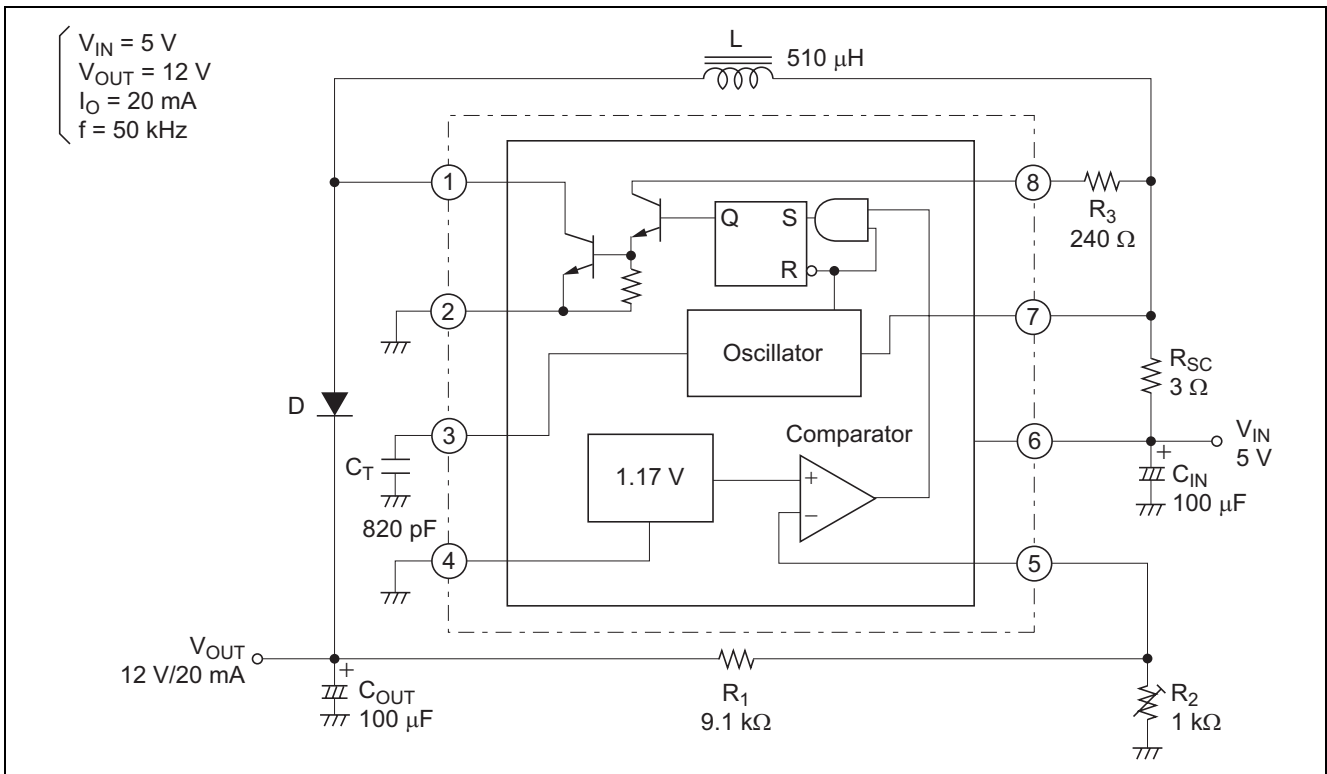
## Electrical Characteristics

(Ta = 25°C, V<sub>CC</sub> = 5 V)

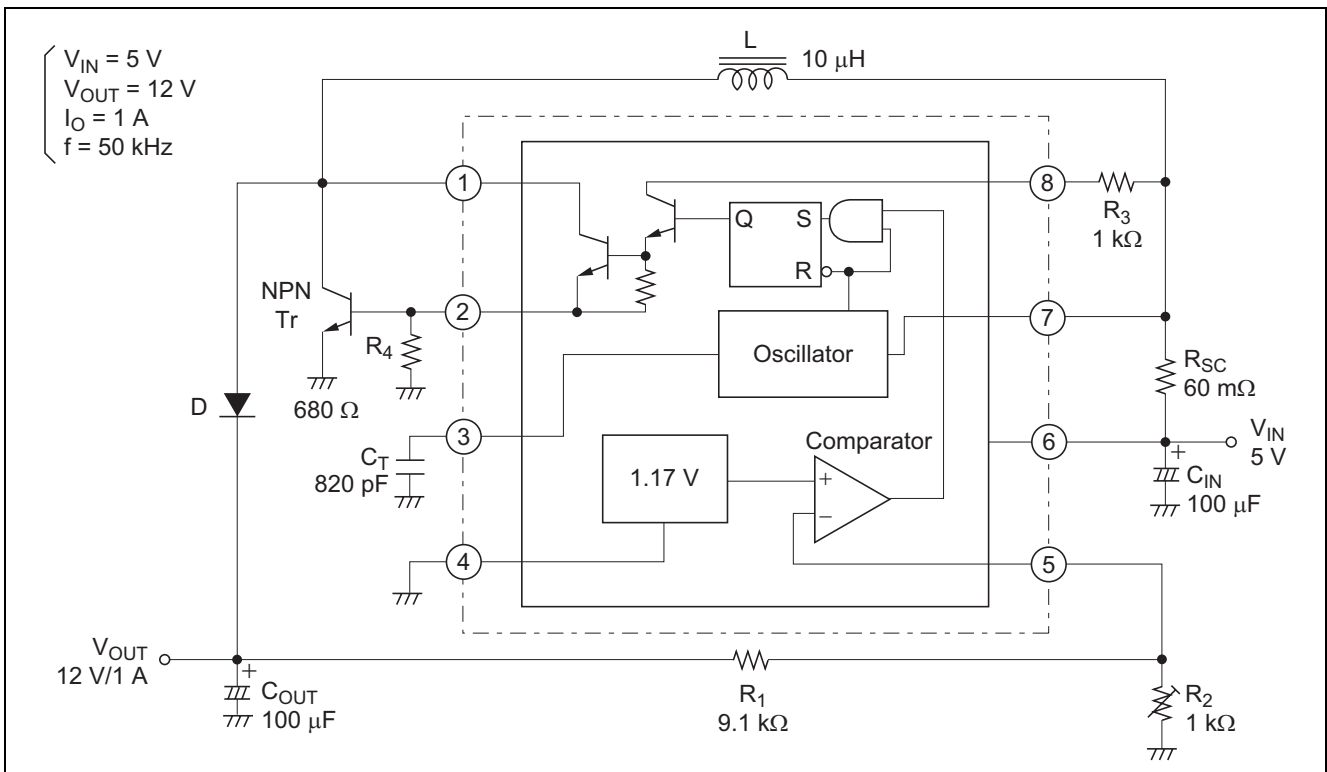
Item	Symbol	Limits			Unit	Test Conditions	
		Min	Typ	Max			
Oscillator	Charge current	I <sub>C</sub>	20	35	50	μA	
	Discharge current	I <sub>D</sub>	150	200	250	μA	
	Oscillator voltage	V <sub>OSC</sub>	—	0.6	—	V <sub>P-P</sub>	
	Charge, discharge current ratio	I <sub>D</sub> /I <sub>C</sub>	—	6	—	—	
	Current protection, detecting voltage	V <sub>IPK</sub>	270	330	390	mV	
Output	Saturation voltage	V <sub>sat1</sub>	—	1.5	2.0	V	Darlington connection I <sub>SW</sub> = 50 mA
	Saturation voltage	V <sub>sat2</sub>	—	0.3	0.6	V	I <sub>SW</sub> = 50 mA I <sub>C(D)</sub> = 10 mA
	Collector leak current	I <sub>L</sub>	—	10	—	nA	V <sub>CE</sub> = 40 V
Comparator	Threshold voltage	V <sub>TH</sub>	1.11	1.17	1.23	V	
	Threshold voltage regulation	V <sub>THREG</sub>	—	0.03	0.2	mV/V	3.0 ≤ V <sub>CC</sub> ≤ 40 V
	Input bias current	I <sub>B</sub>	—	40	200	nA	V <sub>IN</sub> = 0 V
Circuit current	I <sub>CC</sub>	—	1.4	2.5	mA		

## Application Circuits

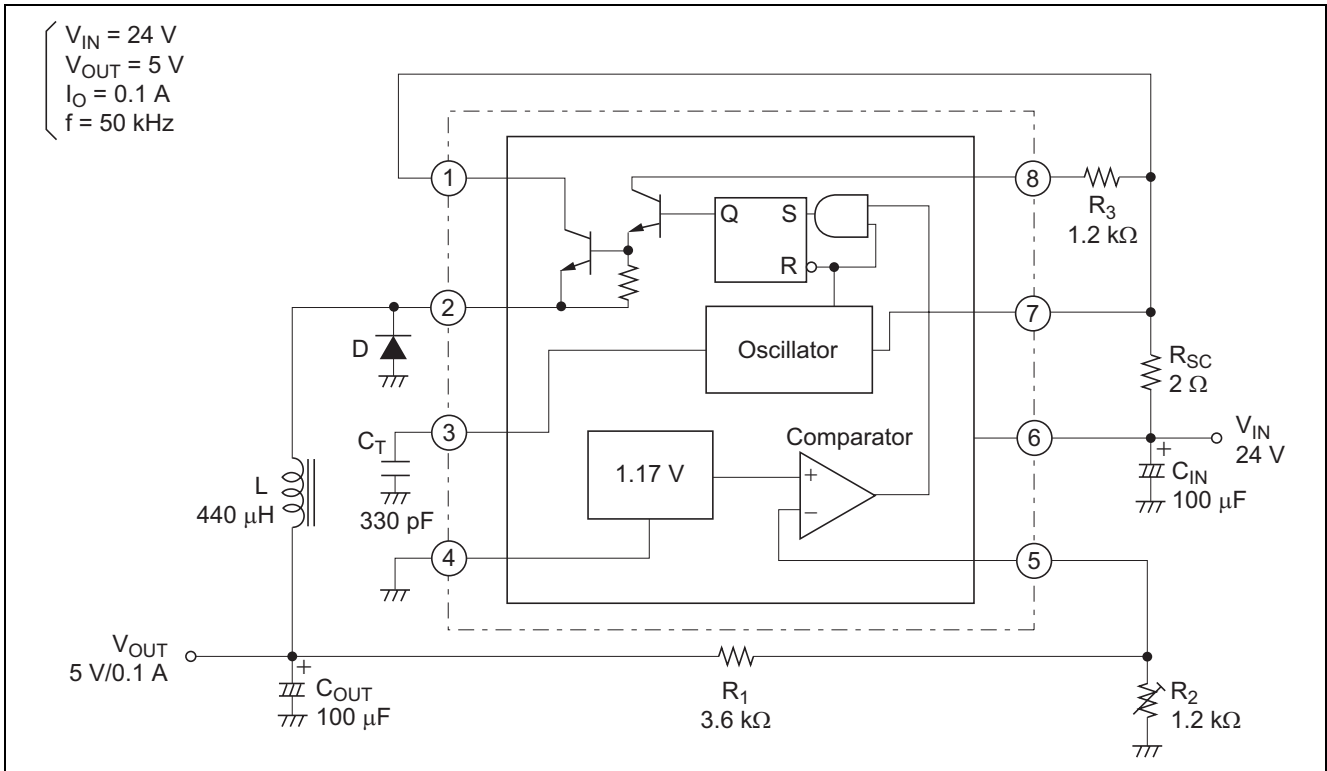
### 1. Step-up Circuit



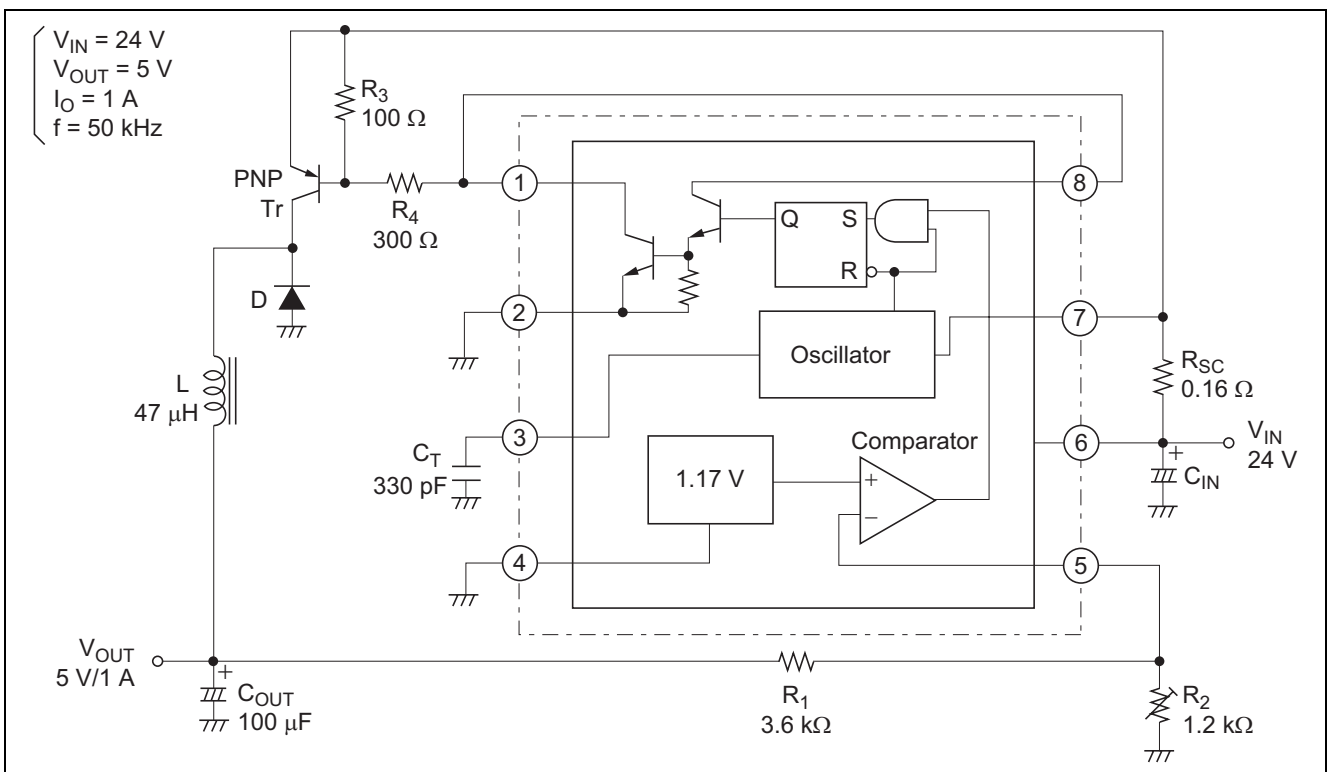
### 2. Step-up Circuit with Transistor



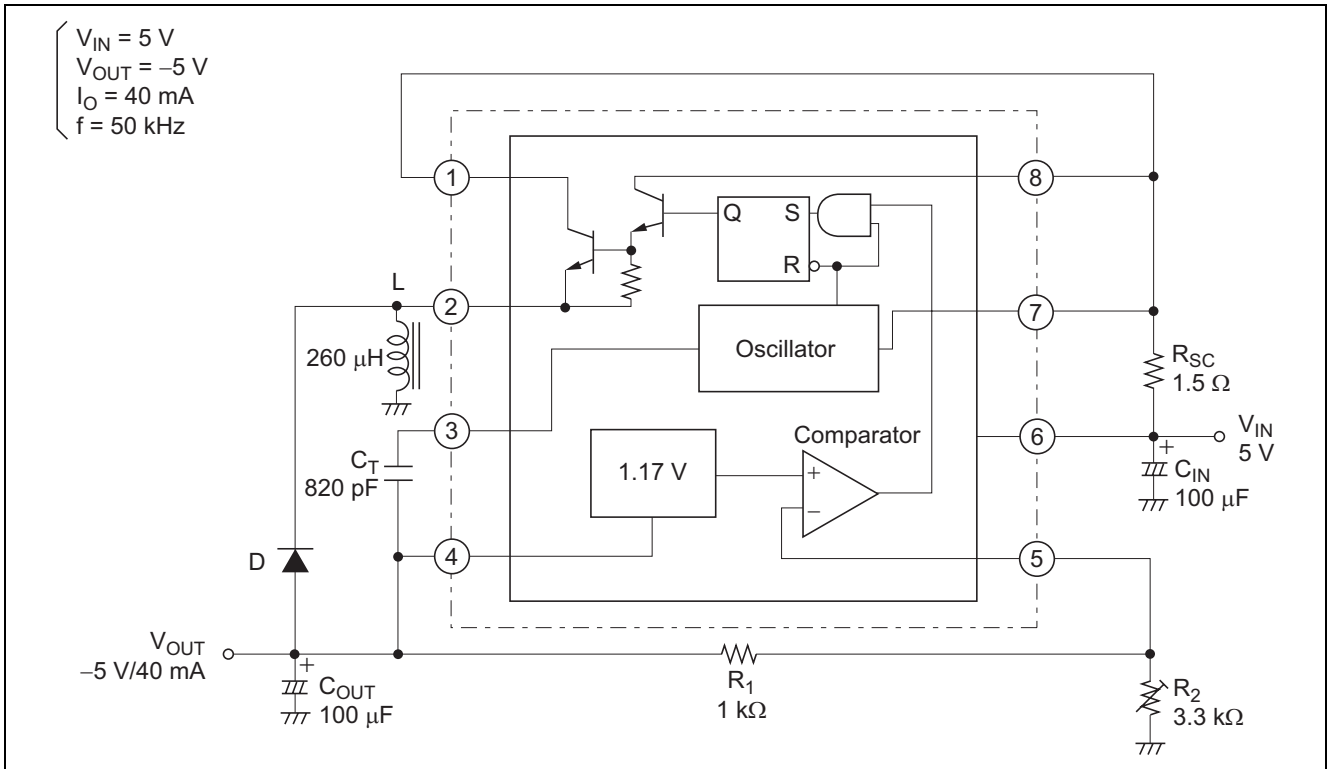
### 3. Step-down Circuit



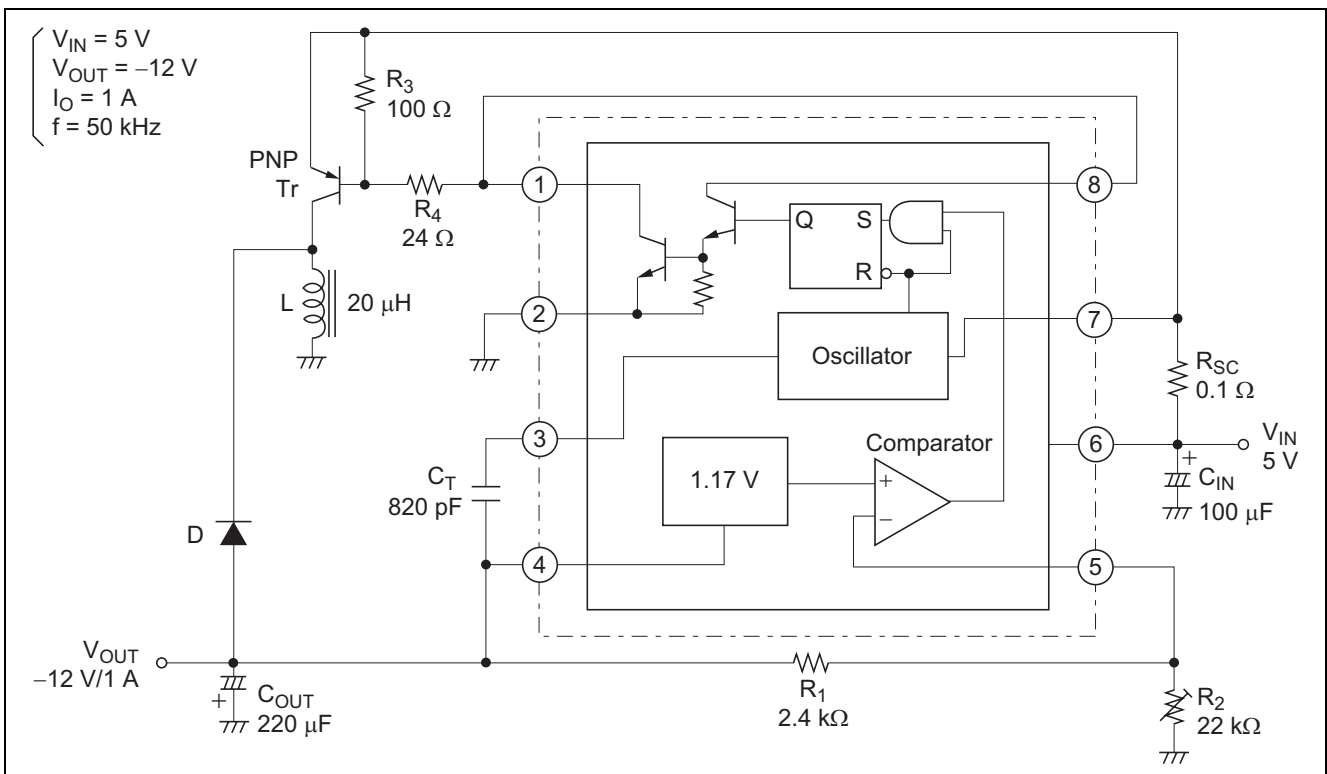
### 4. Step-down Circuit with Transistor



5. Inverse Polarity Circuit



6. Inverse Polarity Circuit with Transistor



## Constant Definition

Constant	Step-down Circuit	Step-up Circuit	Inverse Polarity Circuit
$\frac{T_{ON}}{T_{OFF}}$	$\frac{V_{OUT} + V_F}{V_{IN(MIN)} - V_{sat} - V_{OUT}}$	$\frac{V_{OUT} + V_F - V_{IN(MIN)}}{V_{IN(MIN)} - V_{sat}}$	$\frac{ V_{OUT}  + V_F}{V_{IN} - V_{sat}}$
$(T_{ON} + T_{OFF})_{MAX}$	$\frac{1}{f_{MIN}}$	$\frac{1}{f_{MIN}}$	$\frac{1}{f_{MIN}}$
$T_{OFF}$	$\frac{T_{ON} + T_{OFF}}{1 + \frac{T_{ON}}{T_{OFF}}}$	$\frac{T_{ON} + T_{OFF}}{1 + \frac{T_{ON}}{T_{OFF}}}$	$\frac{T_{ON} + T_{OFF}}{1 + \frac{T_{ON}}{T_{OFF}}}$
$T_{ON}$	$\frac{1}{f_{MIN}} - T_{OFF}$	$\frac{1}{f_{MIN}} - T_{OFF}$	$\frac{1}{f_{MIN}} - T_{OFF}$
$C_T$	$6 \times 10^{-5} \cdot T_{ON}$	$6 \times 10^{-5} \cdot T_{ON}$	$6 \times 10^{-5} \cdot T_{ON}$
$I_{PK}$	$2 \cdot I_{OUT(MAX)}$	$2 \cdot I_{OUT(MAX)} \cdot (1 + \frac{T_{ON}}{T_{OFF}})$	$2 \cdot I_{OUT(MAX)} \cdot (1 + \frac{T_{ON}}{T_{OFF}})$
$L_{(MIN)}$	$(\frac{V_{IN(MIN)} - V_{sat} - V_{OUT}}{I_{PK}}) \cdot T_{ON(MAX)}$	$(\frac{V_{IN(MIN)} - V_{sat}}{I_{PK}}) \cdot T_{ON(MAX)}$	$(\frac{V_{IN(MIN)} - V_{sat}}{I_{PK}}) \cdot T_{ON(MAX)}$
$R_{SC}$	$\frac{0.33}{I_{PK}}$	$\frac{0.33}{I_{PK}}$	$\frac{0.33}{I_{PK}}$
$V_O$	$1.17 \times (1 + \frac{R_1}{R_2})$	$1.17 \times (1 + \frac{R_1}{R_2})$	$1.17 \times (1 + \frac{R_1}{R_2})$

Note:  $V_F$ : Forward Voltage of Diode

$V_{sat}$ : Output saturation voltage of M5291 (0.6 Vmax at single output, 2.0 Vmax at Darlington output)

Setting switching frequency first and calculate each constant value.

### Notes:

1. Peak current sense

In overcurrent function, oscillator is stop, when voltage descend of external detecting resistance is more than 330 mV.

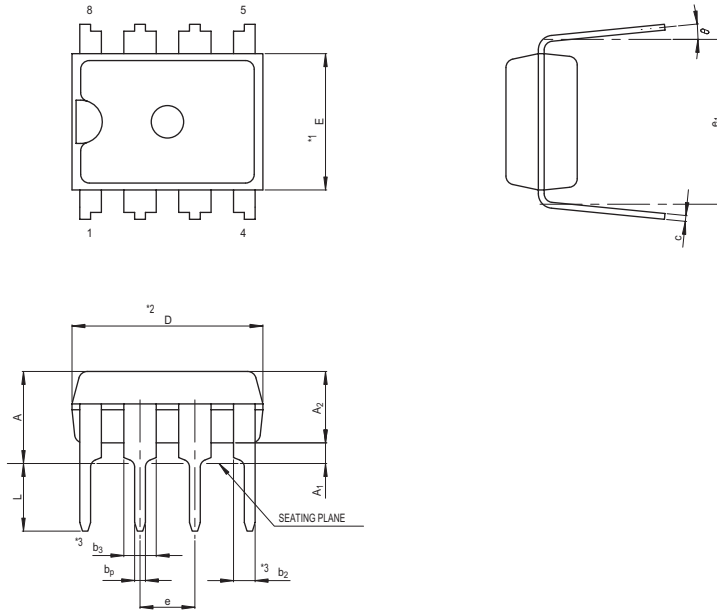
2. ON/OFF Control

If you need stop the action, connected resistance (5 to 10 kΩ) between supply voltage terminal and timing capacitor terminal.

3.  $\frac{T_{ON}}{T_{ON} + T_{OFF}}$  is not established more than 0.857, because charge and discharge current ratio fixed 1 : 6.

Package Dimensions

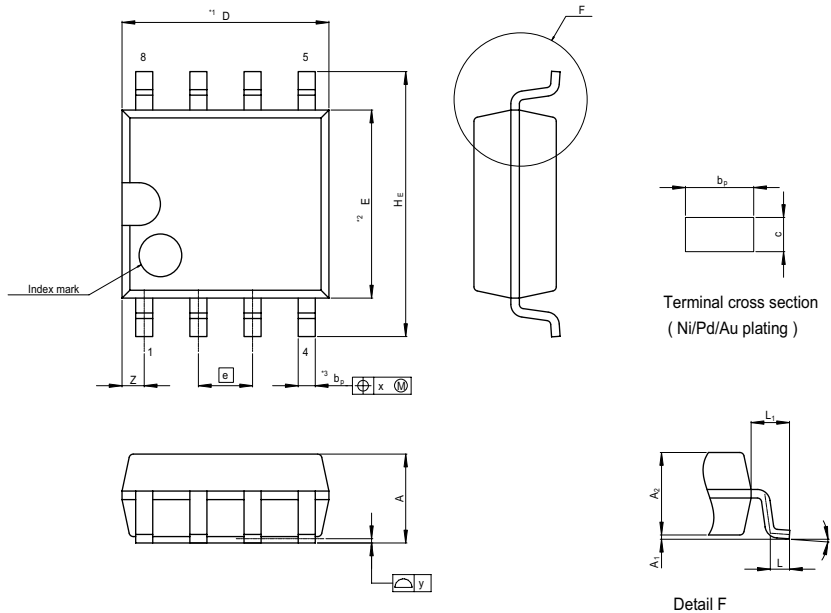
JEITA Package Code	RENEASAS Code	Previous Code	MASS[Typ.]
P-DIP8-6.3x8.84-2.54	PRDP008AA-A	8P4	0.5g



NOTE)  
 1. DIMENSIONS "1" AND "2"  
 DO NOT INCLUDE MOLD FLASH.  
 2. DIMENSION "3" DOES NOT  
 INCLUDE TRIM OFFSET.

Reference Symbol	Dimension in Millimeters		
	Min	Nom	Max
e <sub>1</sub>	7.32	7.62	7.92
D	8.7	8.9	9.1
E	6.15	6.3	6.45
A	—	—	4.5
A <sub>1</sub>	0.51	—	—
A <sub>2</sub>	—	3.3	—
b <sub>p</sub>	0.4	0.5	0.6
b <sub>2</sub>	0.9	1.0	1.3
b <sub>3</sub>	1.4	1.5	1.8
c	0.22	0.27	0.34
θ	0°	—	15°
e	2.29	2.54	2.79
L	3.0	—	—

JEITA Package Code	RENEASAS Code	Previous Code	MASS[Typ.]
P-SOP8-4.4x4.85-1.27	PRSP008DE-C	—	0.1g

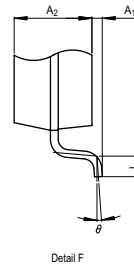
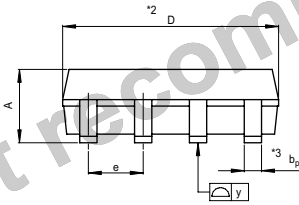
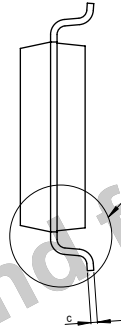
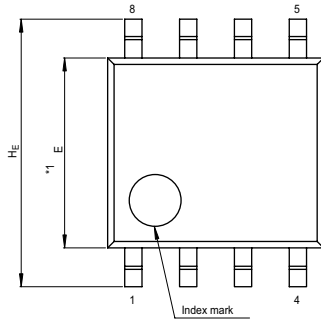


NOTE)  
 1. DIMENSIONS "1" (Nom) AND "2"  
 DO NOT INCLUDE MOLD FLASH.  
 2. DIMENSION "3" DOES NOT  
 INCLUDE TRIM OFFSET.

Reference Symbol	Dimension in Millimeters		
	Min	Nom	Max
D	4.65	4.85	5.05
E	4.2	4.4	4.6
A <sub>2</sub>	—	1.85	—
A <sub>1</sub>	0.00	0.1	0.20
A	—	—	2.03
b <sub>p</sub>	0.34	0.4	0.46
b <sub>1</sub>	—	—	—
c	0.15	0.20	0.25
c <sub>1</sub>	—	—	—
θ	0°	—	8°
H <sub>E</sub>	5.7	6.2	6.5
Ⓧ	1.12	1.27	1.42
x	—	—	0.12
y	—	—	0.10
Z	—	—	0.75
L	0.25	0.45	0.65
L <sub>1</sub>	—	0.90	—



JEITA Package Code	RENESAS Code	Previous Code	MASS[Typ.]
P-SOP8-4.4x5-1.27	PRSP0008DA-A	8P2S-A	0.07g



NOTE)  
 1. DIMENSIONS \*\*1\* AND \*\*2\* DO NOT INCLUDE MOLD FLASH.  
 2. DIMENSION \*\*3\* DOES NOT INCLUDE TRIM OFFSET.

Reference Symbol	Dimension in Millimeters		
	Min	Nom	Max
D	4.8	5.0	5.2
E	4.2	4.4	4.6
A <sub>2</sub>	—	1.5	—
A <sub>1</sub>	0.05	—	—
A	—	—	1.9
b <sub>p</sub>	0.35	0.4	0.5
c	0.13	0.15	0.2
θ	0°	—	10°
H <sub>E</sub>	5.9	6.2	6.5
e	1.12	1.27	1.42
y	—	—	0.1
L	0.2	0.4	0.6

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