M5291P/FP

DC/DC Converter

REJ03D0841-0201
Rev.2.01
Nov 14, 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.

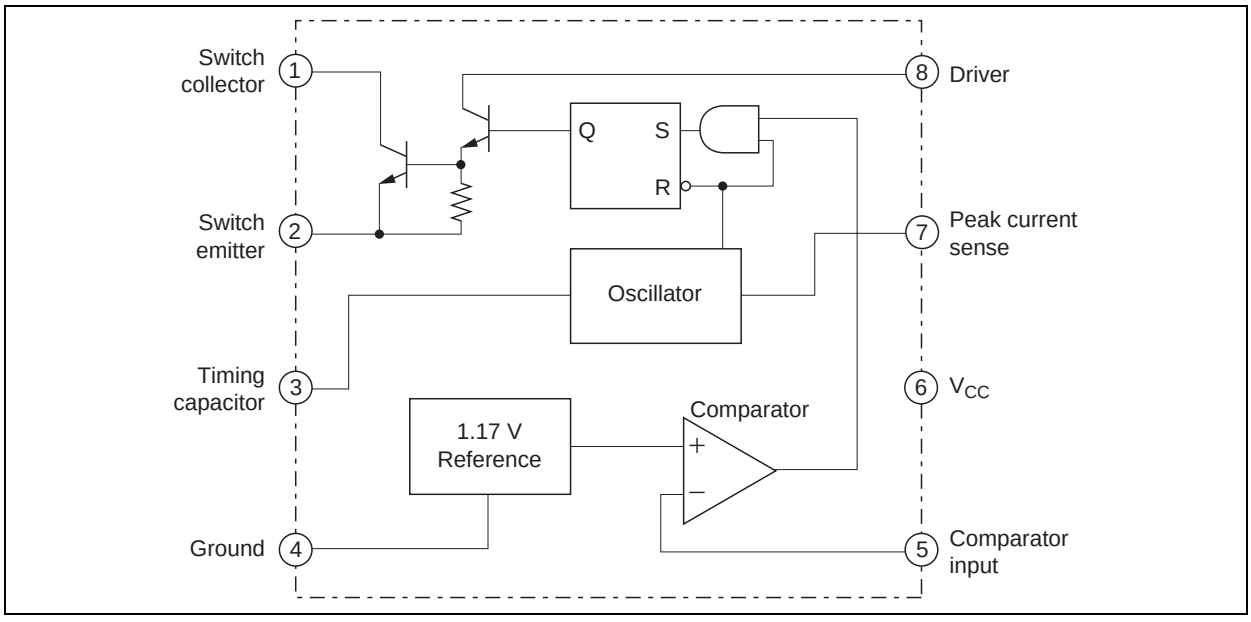
Features

- 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

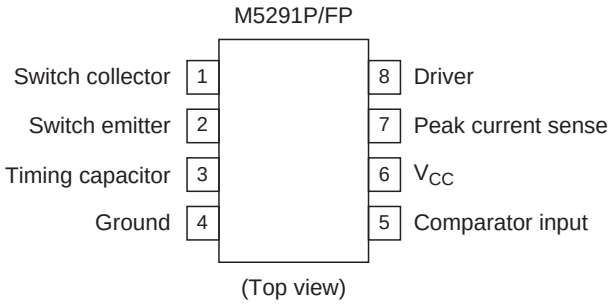
Application

General power supply system

Block Diagram



Pin Arrangement



(Top view)

Outline: PRDP0008AA-A (8P4) [P]
PRSP0008DA-A (8P2S-A) [FP]

Absolute Maximum Ratings

(Ta = 25°C, unless otherwise noted)

Item	Symbol	Ratings	Unit	Conditions
Power supply voltage	V_{CC}	40	V	
Input voltage	V_{IN}	–0.3 to 40	V	Comparator input
Switch collector voltage	$V_{C\ (S)}$	40	V	
Switch emitter voltage	$V_{E\ (S)}$	40	V	
Collector emitter voltage	$V_{CE\ (S)}$	40	V	
Driver collector voltage	$V_{C\ (D)}$	40	V	
Switch current	I_{SW}	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	Topr	–20 to +75	°C	
Storage temperature	Tstg	–55 to +125	°C	

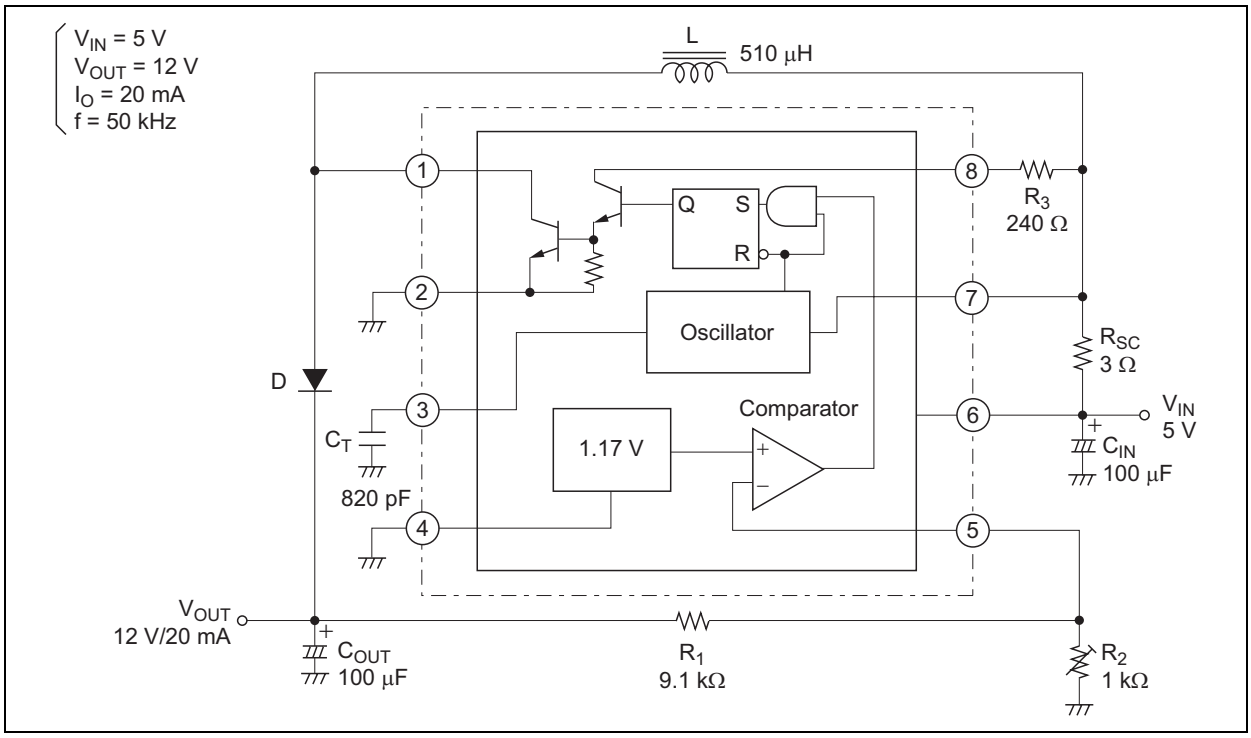
Electrical Characteristics

(Ta = 25°C, V_{CC} = 5 V)

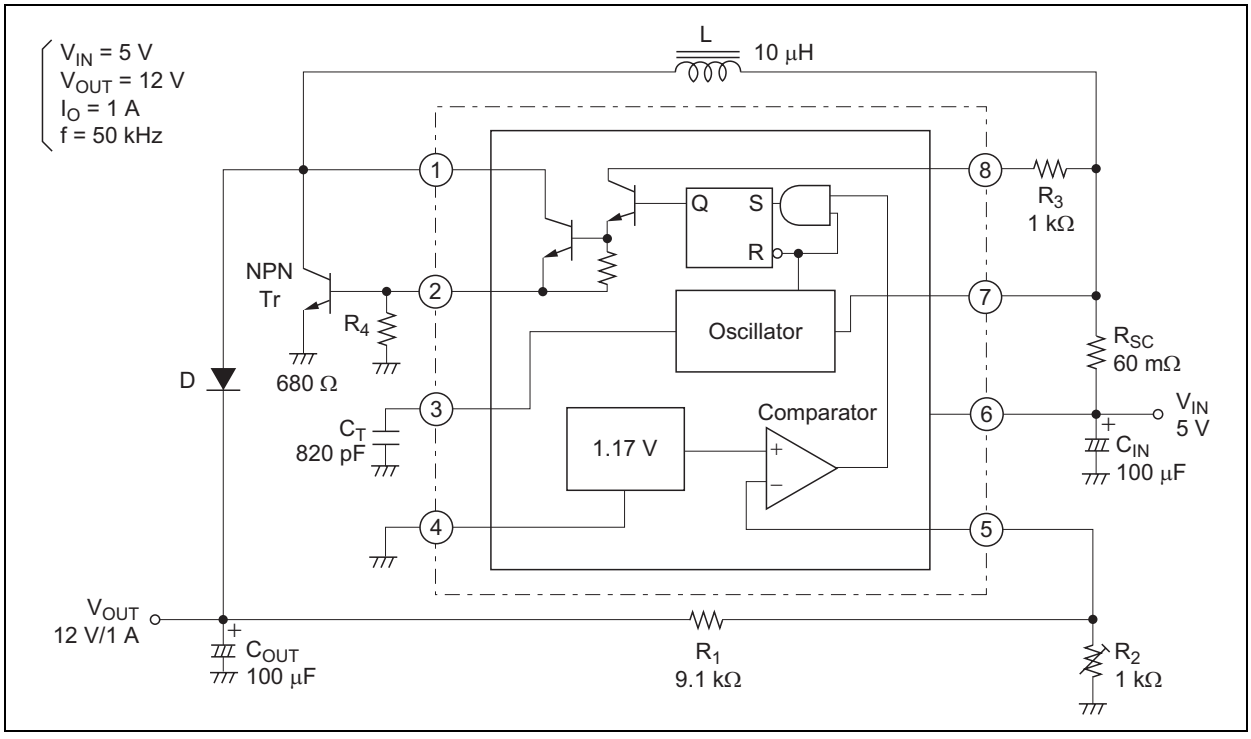
Item		Symbol	Limits			Unit	Test Conditions
			Min	Typ	Max		
Oscillator	Charge current	I_C	20	35	50	µA	
	Discharge current	I_D	150	200	250	µA	
	Oscillator voltage	V_{OSC}	—	0.6	—	V_{P-P}	
	Charge, discharge current ratio	I_D/I_C	—	6	—	—	
	Current protection, detecting voltage	V_{IPK}	270	330	390	mV	
Output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

Application Circuits

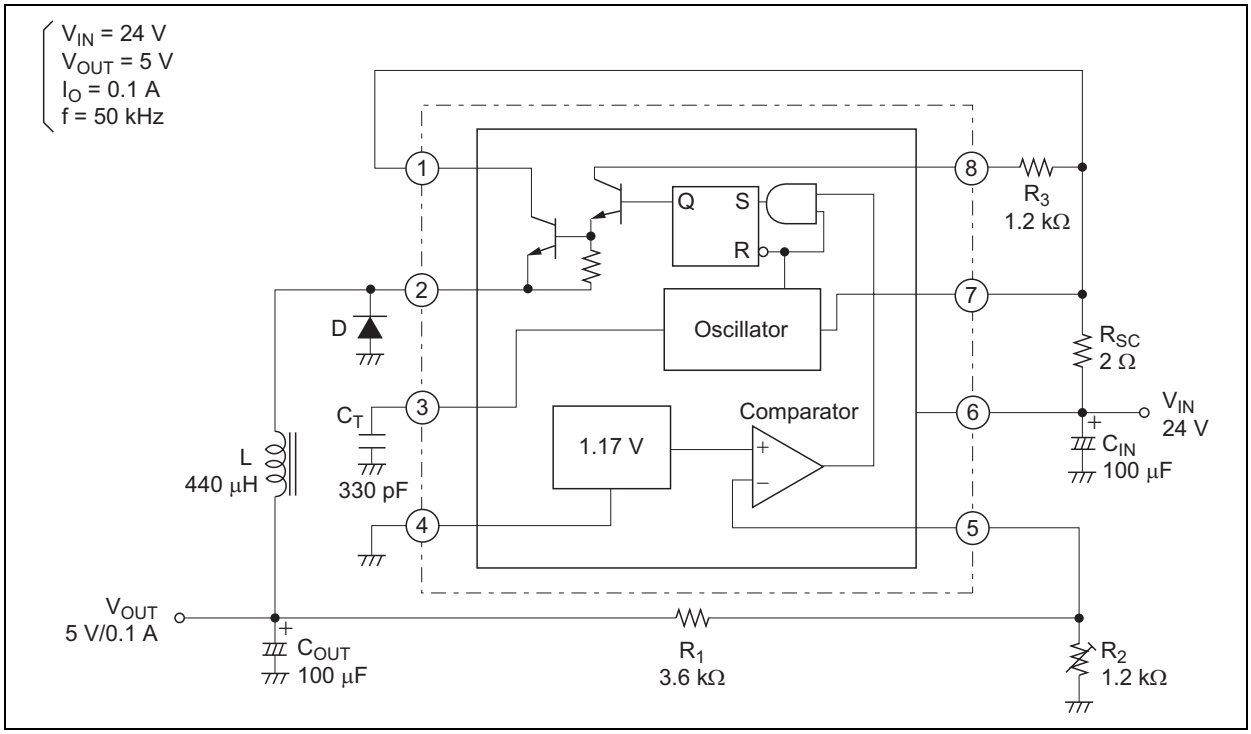
1. Step-up Circuit



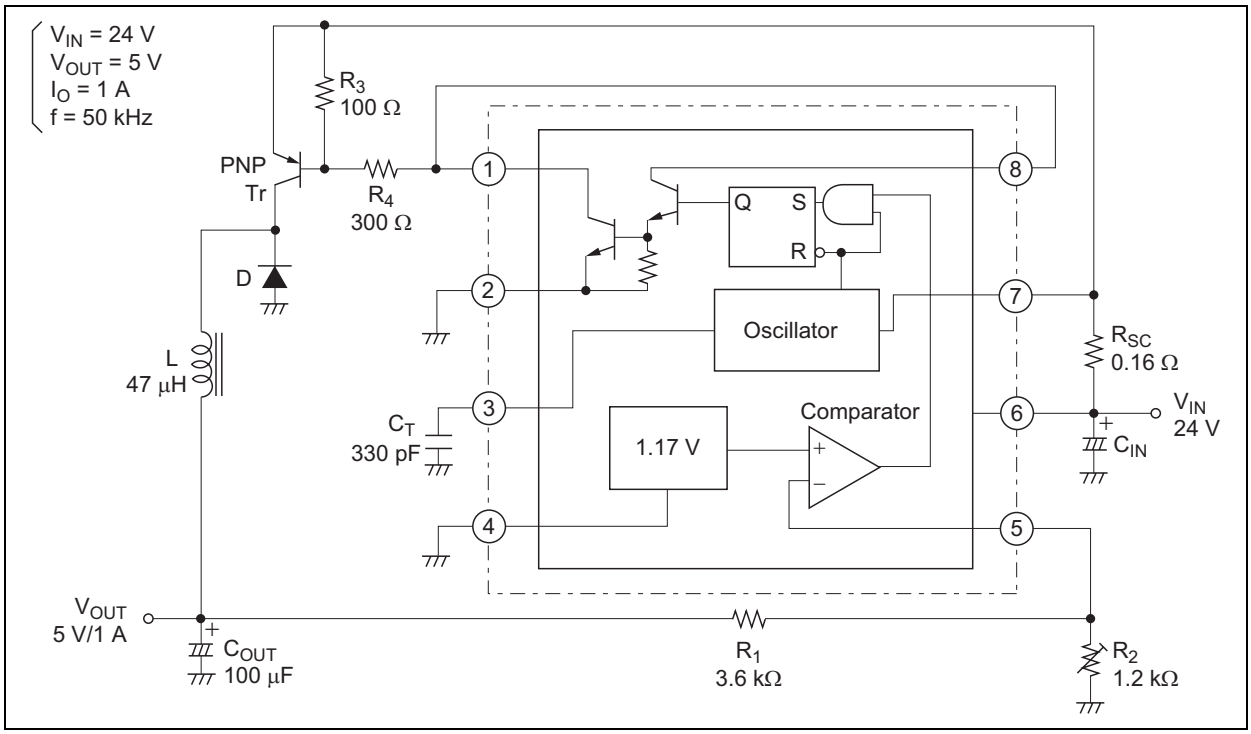
2. Step-up Circuit with Transistor



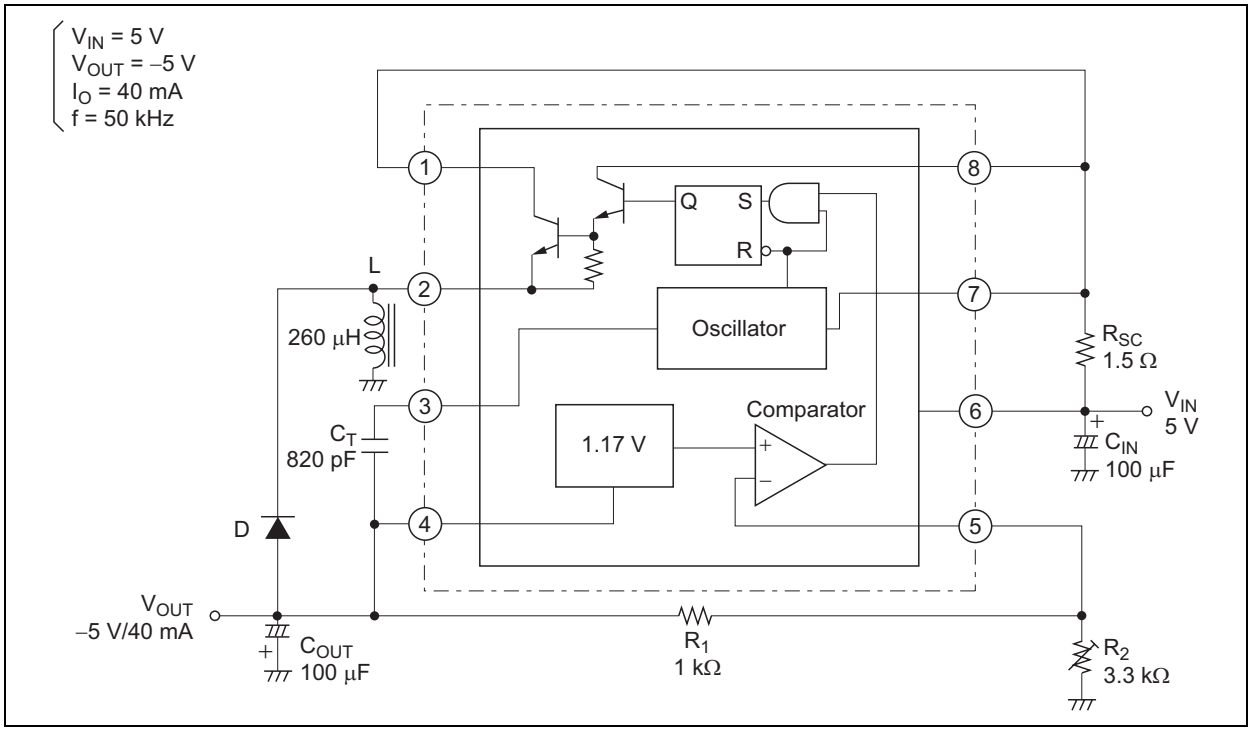
3. Step-down Circuit



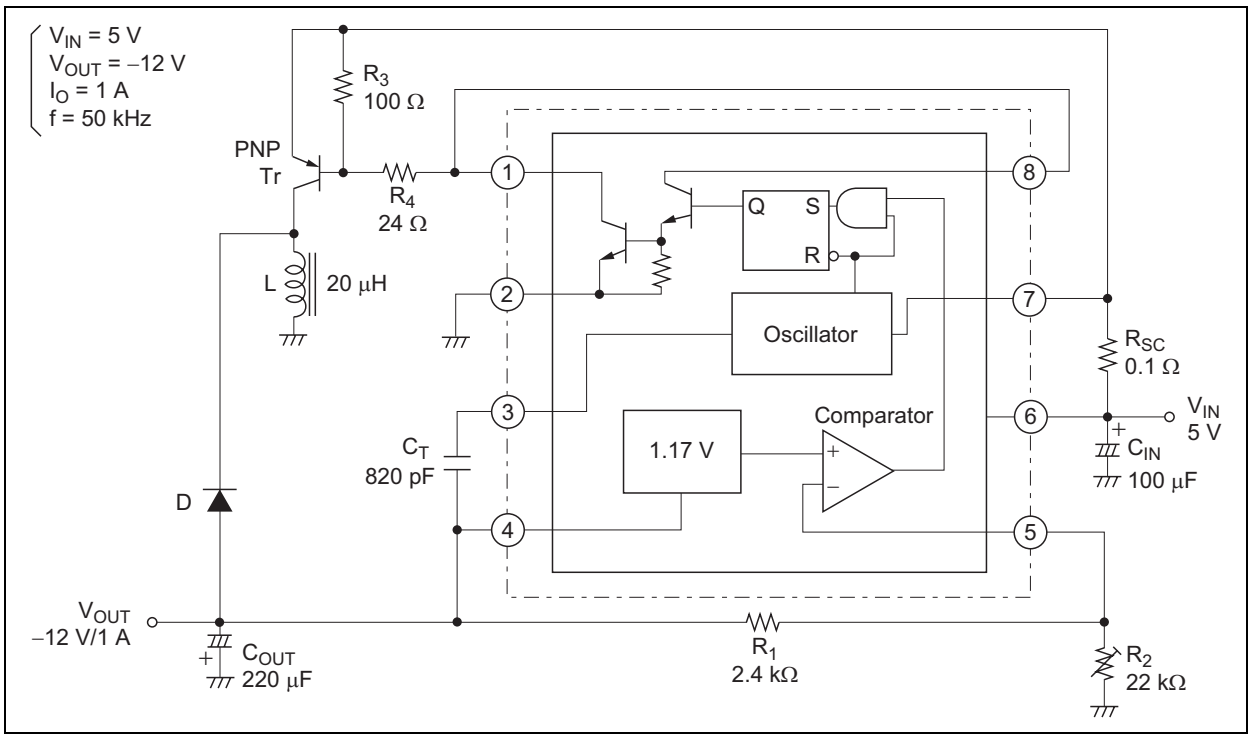
4. Step-down Circuit with Transistor



5. Inverse Polarity Circuit



6. Inverse Polarity Circuit with Transistor



Constant Definition

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

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)

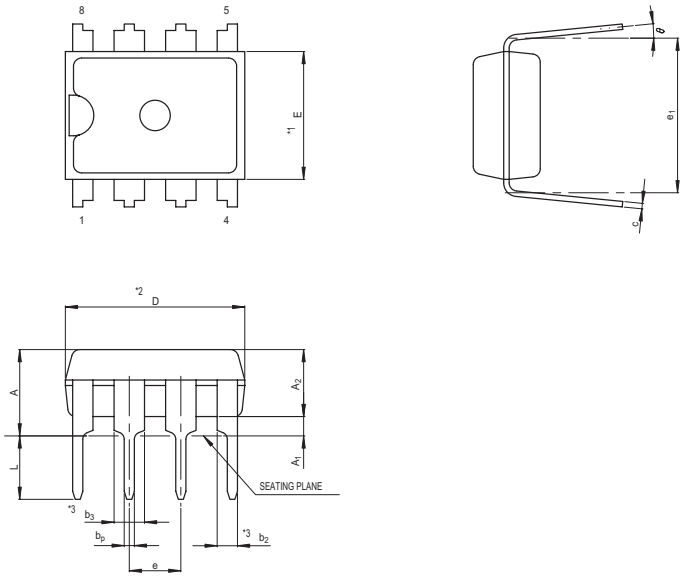
Setting switching frequency first and calculate each constant value.

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

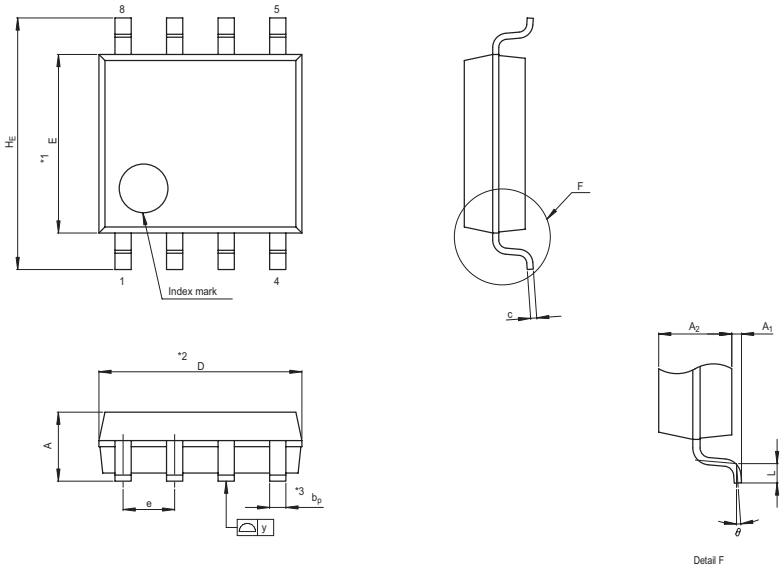
JEITA Package Code	RENESAS Code	Previous Code	MASS[Typ.]
P-DIP8-6.3x8.84-2.54	PRDP0008AA-A	8P4	0.5g



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_1	7.32	7.62	7.92
D	8.7	8.9	9.1
E	6.15	6.3	6.45
A	—	—	4.5
A_1	0.51	—	—
A_2	—	3.3	—
b_p	0.4	0.5	0.6
b_2	0.9	1.0	1.3
b_3	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	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_2	—	1.5	—
A_1	0.05	—	—
A	—	—	1.9
b_p	0.35	0.4	0.5
c	0.13	0.15	0.2
θ	0°	—	10°
H_E	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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