

To all our customers

Regarding the change of names mentioned in the document, such as Mitsubishi Electric and Mitsubishi XX, to Renesas Technology Corp.

The semiconductor operations of Hitachi and Mitsubishi Electric were transferred to Renesas Technology Corporation on April 1st 2003. These operations include microcomputer, logic, analog and discrete devices, and memory chips other than DRAMs (flash memory, SRAMs etc.)

Accordingly, although Mitsubishi Electric, Mitsubishi Electric Corporation, Mitsubishi Semiconductors, and other Mitsubishi brand names are mentioned in the document, these names have in fact all been changed to Renesas Technology Corp. Thank you for your understanding. Except for our corporate trademark, logo and corporate statement, no changes whatsoever have been made to the contents of the document, and these changes do not constitute any alteration to the contents of the document itself.

Note : Mitsubishi Electric will continue the business operations of high frequency & optical devices and power devices.

Renesas Technology Corp.
Customer Support Dept.
April 1, 2003

M5291P,FP

DC-DC CONVERTER

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.

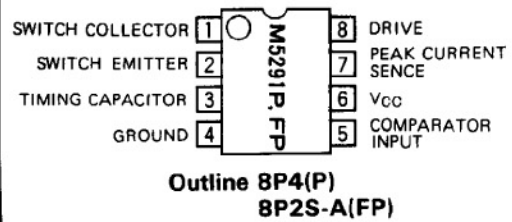
FEATURES

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

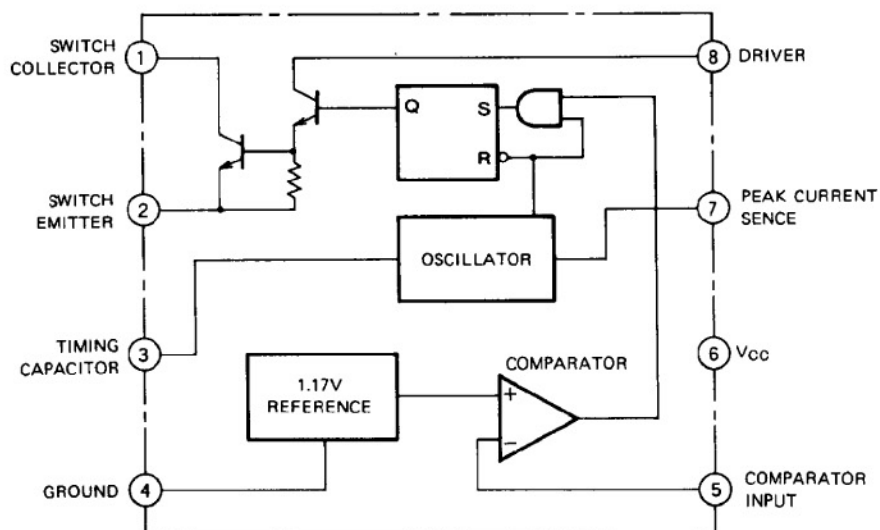
APPLICATION

General power supply system

PIN CONFIGURATION (TOP VIEW)



BLOCK DIAGRAM



DC-DC CONVERTER

ABSOLUTE MAXIMUM RATINGS ($T_a = 25^\circ\text{C}$, unless otherwise noted)

Symbol	Parameter	Conditions	Ratings	Unit
V_{CC}	Power supply voltage		40	V
V_{IN}	Input voltage	Comparator input	-0.3~40	V
$V_{C(S)}$	Switch collector voltage		40	V
$V_{E(S)}$	Switch emitter voltage		40	V
$V_{CE(S)}$	Collector emitter voltage		40	V
$V_{C(D)}$	Driver collector voltage		40	V
I_{SW}	Switch current		200	mA
P_d	Internal power dissipation	8 pin DIP	625	mW
		8 pin FLAT	440	
K	Thermal derating	8 pin DIP	6.25	mW/ $^\circ\text{C}$
		8 pin FLAT	4.5	
T_{opr}	Operating ambient temperature		-20 ~ +75	$^\circ\text{C}$
T_{stg}	Storage temperature		-55 ~ +125	$^\circ\text{C}$

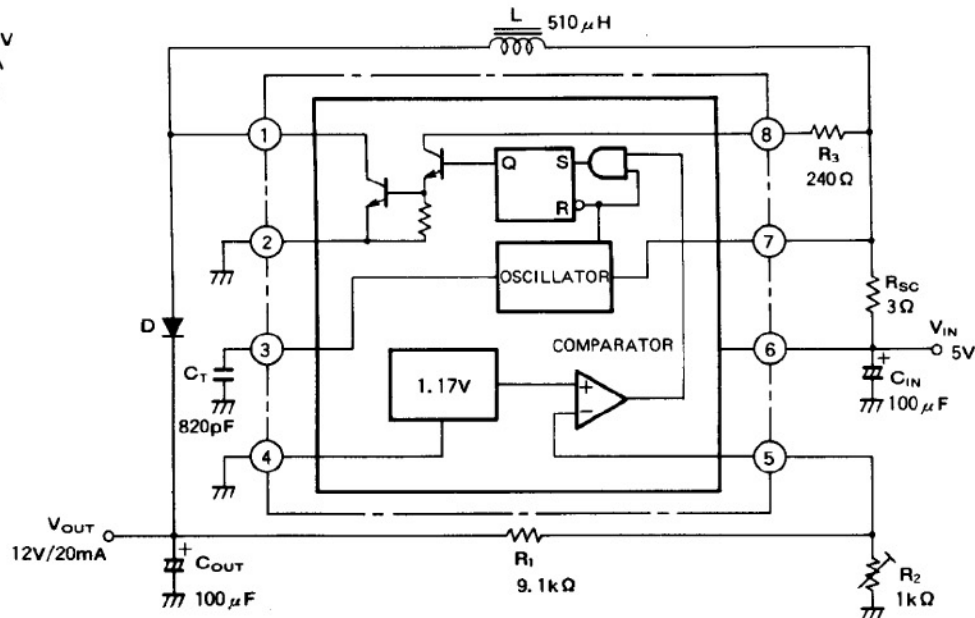
ELECTRICAL CHARACTERISTICS ($T_a = 25^\circ\text{C}$, $V_{CC} = 5\text{V}$)

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

APPLICATION CIRCUITS

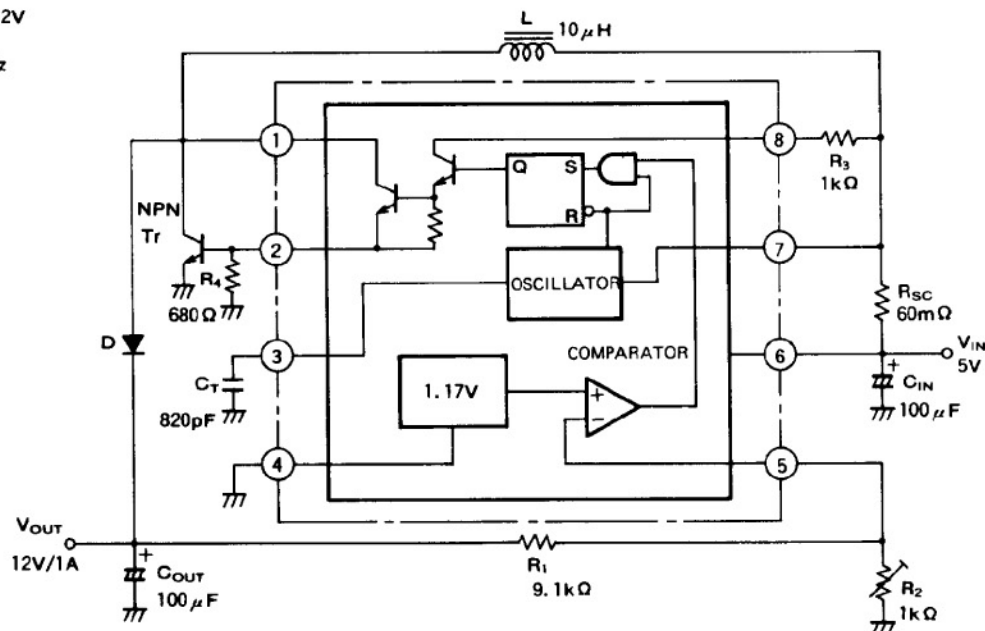
(1) Step-Up Circuit

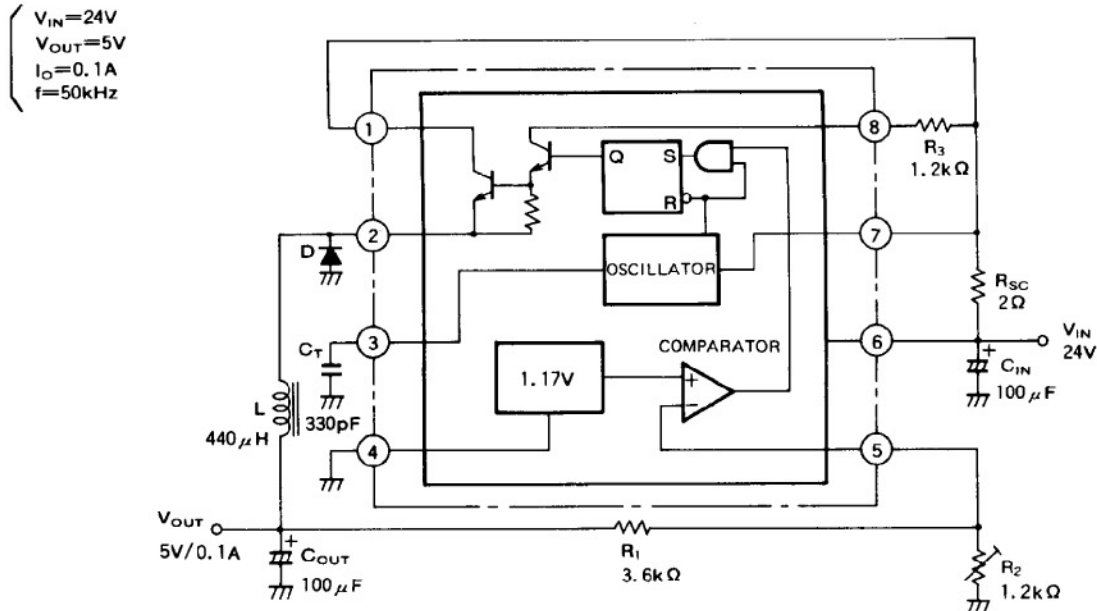
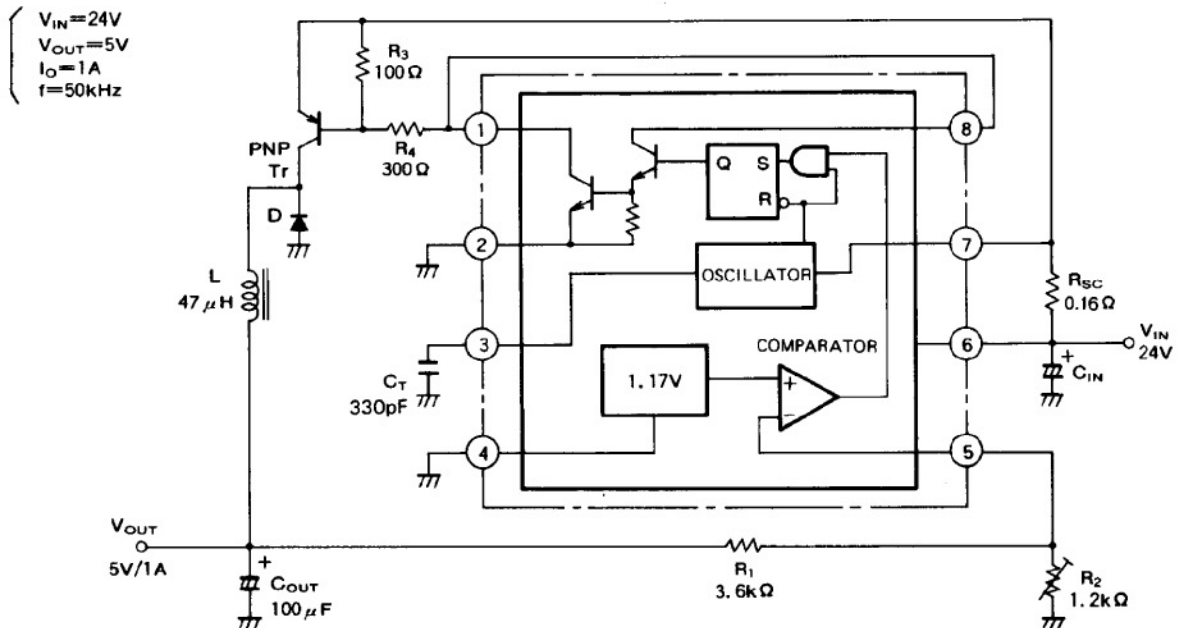
$V_{IN}=5V$
 $V_{OUT}=12V$
 $I_O=20mA$
 $f=50kHz$



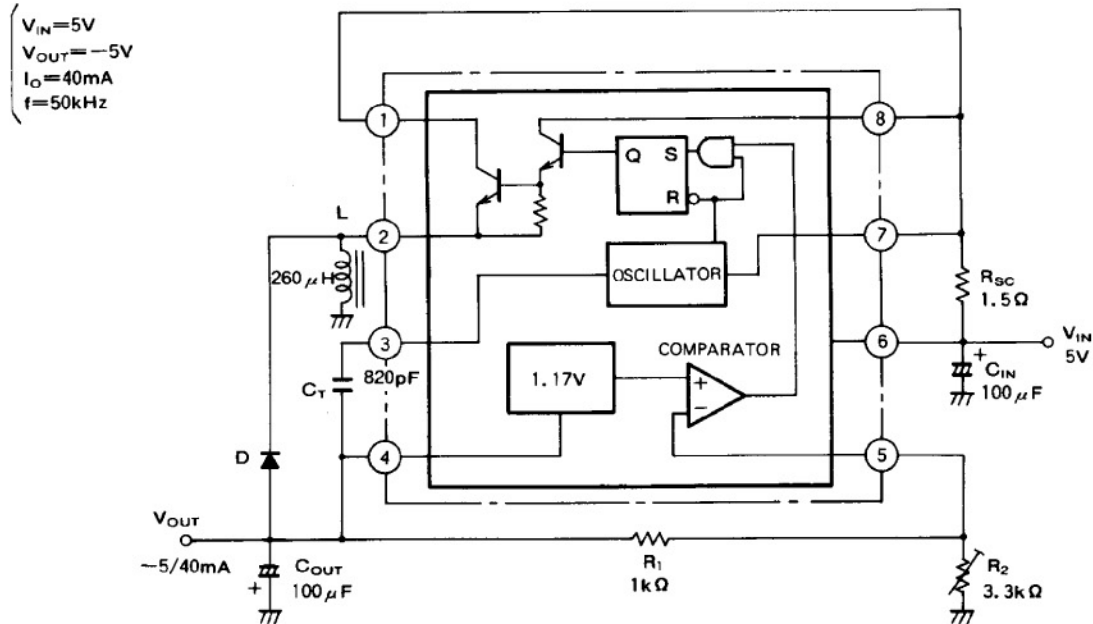
(2) Step-Up circuit with Transistor

$V_{IN}=5V$
 $V_{OUT}=12V$
 $I_O=1A$
 $f=50kHz$



DC-DC CONVERTER**(3) Step-Down Circuit****(4) Step-Down Circuit with Transistor**

(5) Inverse Polarity Circuit



$V_{IN}=5V$
 $V_{OUT}=-12V$
 $I_O=1A$
 $f=50kHz$

DC-DC CONVERTER
CONSTANT DEFINITION

Constant	Step-up circuit	Step-down circuit	Inverse polarity circuit
$\frac{T_{ON}}{T_{OFF}}$	$\frac{V_{OUT} + V_F - V_{IN(MIN)}}{V_{IN(MIN)} - V_{sat}}$	$\frac{V_{OUT} + V_F}{V_{IN(MIN)} - V_{sat} - V_{OUT}}$	$\frac{ V_{OUT} + V_F}{V_{IN} - V_{sat}}$
$(T_{ON} + T_{OFF})_{MAX}$	$\frac{1}{f_{MIN}}$	$\frac{1}{f_{MIN}}$	$\frac{1}{f_{MIN}}$
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}	$2 \cdot I_{OUT(MAX)} \cdot (1 + \frac{T_{ON}}{T_{OFF}})$	$2 \cdot I_{OUT(MAX)}$	$2 \cdot I_{OUT(MAX)} \cdot (1 + \frac{T_{ON}}{T_{OFF}})$
$L(MIN)$	$(\frac{V_{IN(MIN)} - V_{sat}}{I_{PK}}) \cdot T_{ON(MAX)}$	$(\frac{V_{IN(MIN)} - V_{sat} - V_{OUT}}{I_{PK}}) \cdot T_{ON(MAX)}$	$(\frac{V_{IN(MIN)} - V_{sat}}{I_P}) \cdot T_{ON(MAX)}$
R_{SC}	$\frac{0.33}{I_{PK}}$	$\frac{0.33}{I_{PK}}$	$\frac{0.33}{I_{PK}}$
V_O	$1.17 \times (1 + \frac{R_1}{R_2})$	$1.17 \times (1 + \frac{R_1}{R_2})$	$1.17 \times (1 + \frac{R_2}{R_1})$

V_F : Forward Voltage of Diode

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

*: Setting switching frequency first and calculate each constant value.

NOTE:
1) Peak current sense

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

2) ON/OFF Control

If you need stop the action, connected resistance (5 ~ 10k Ω) 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.