

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.

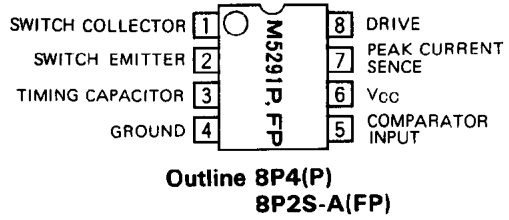
FEATURES

- 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

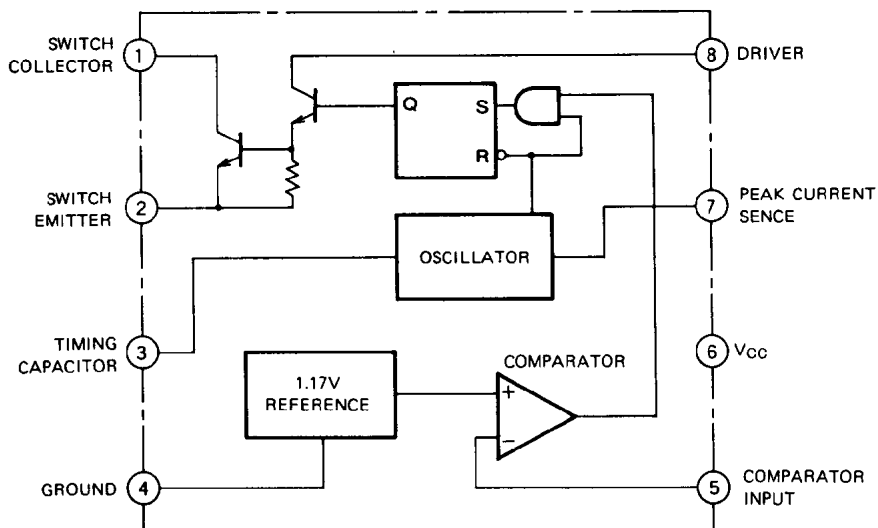
APPLICATION

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	$^\circ\text{C}$

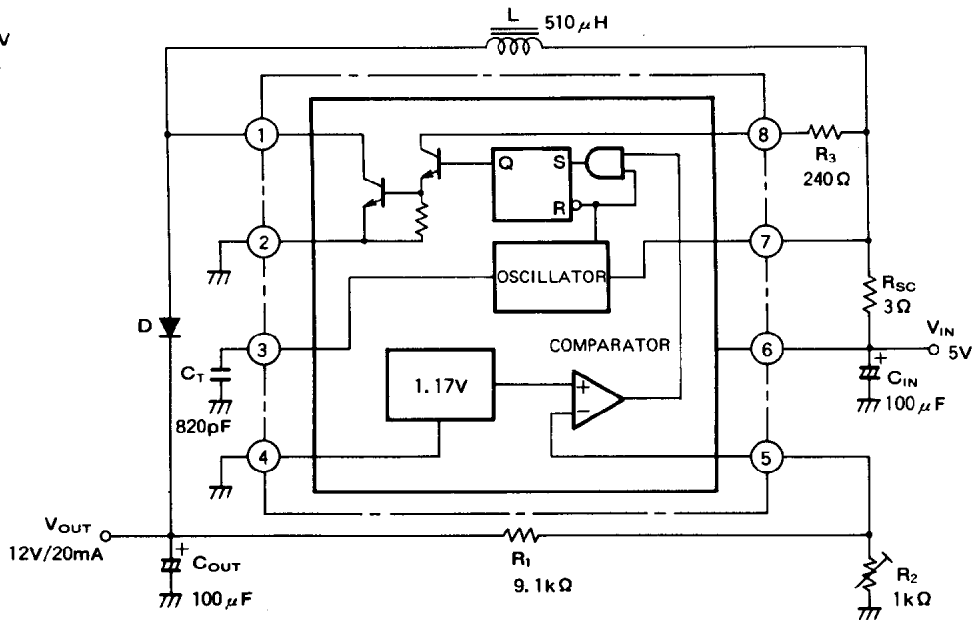
ELECTRICAL CHARACTERISTICS ($T_a = 25^\circ\text{C}$, $V_{CC} = 5\text{V}$)

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		Vp-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

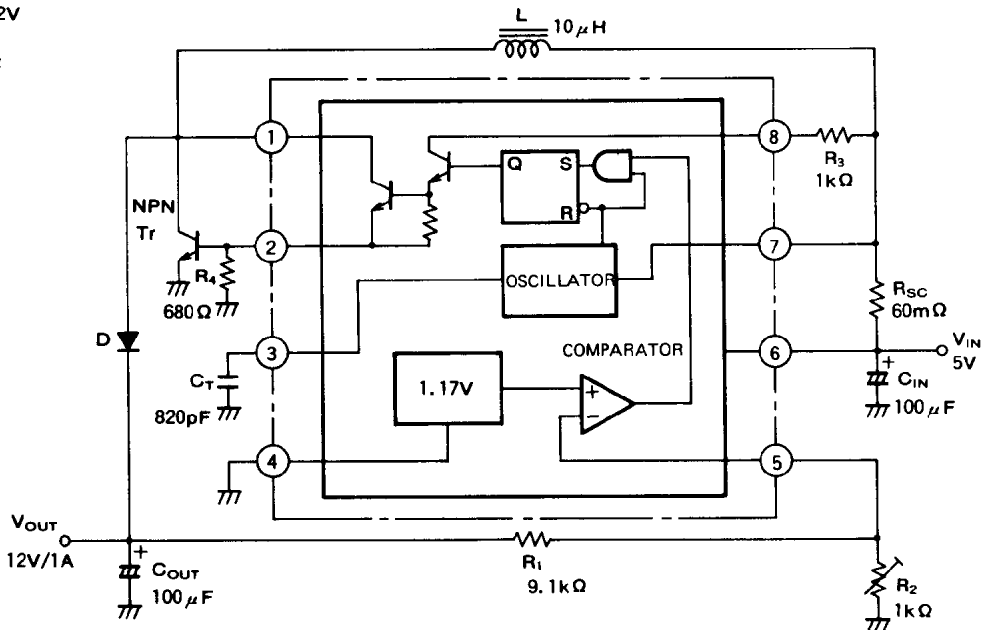
(1) Step-Up Circuit

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



(2) Step-Up circuit with Transistor

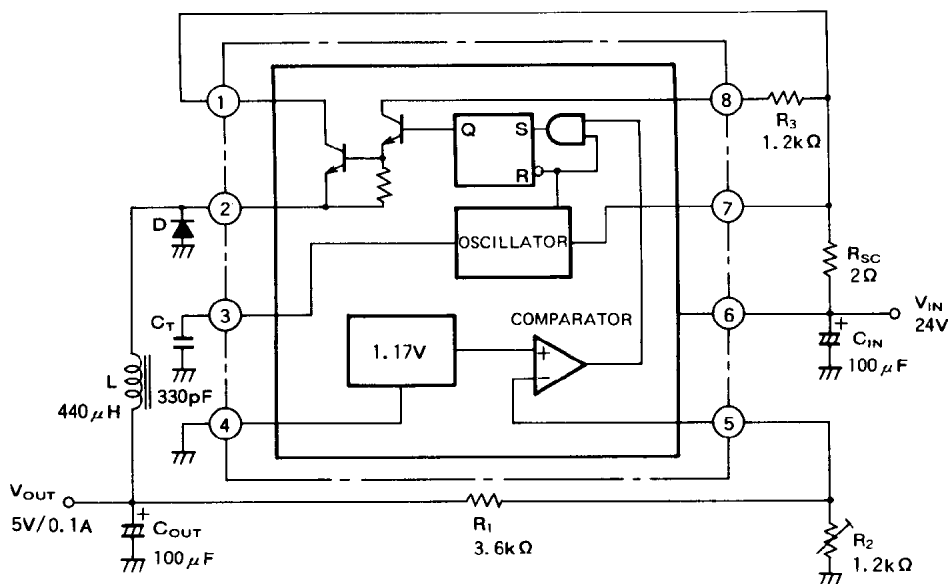
$V_{IN}=5V$
 $V_{OUT}=12V$
 $I_O=1A$
 $f=50kHz$



DC-DC CONVERTER

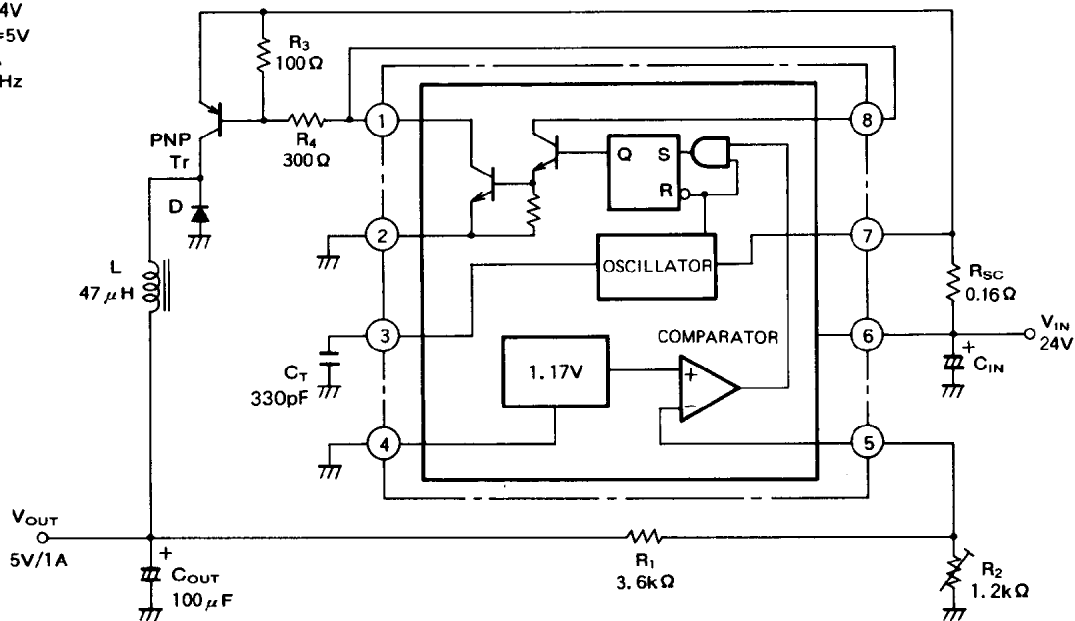
(3) Step-Down Circuit

$V_{IN}=24V$
 $V_{OUT}=5V$
 $I_O=0.1A$
 $f=50kHz$



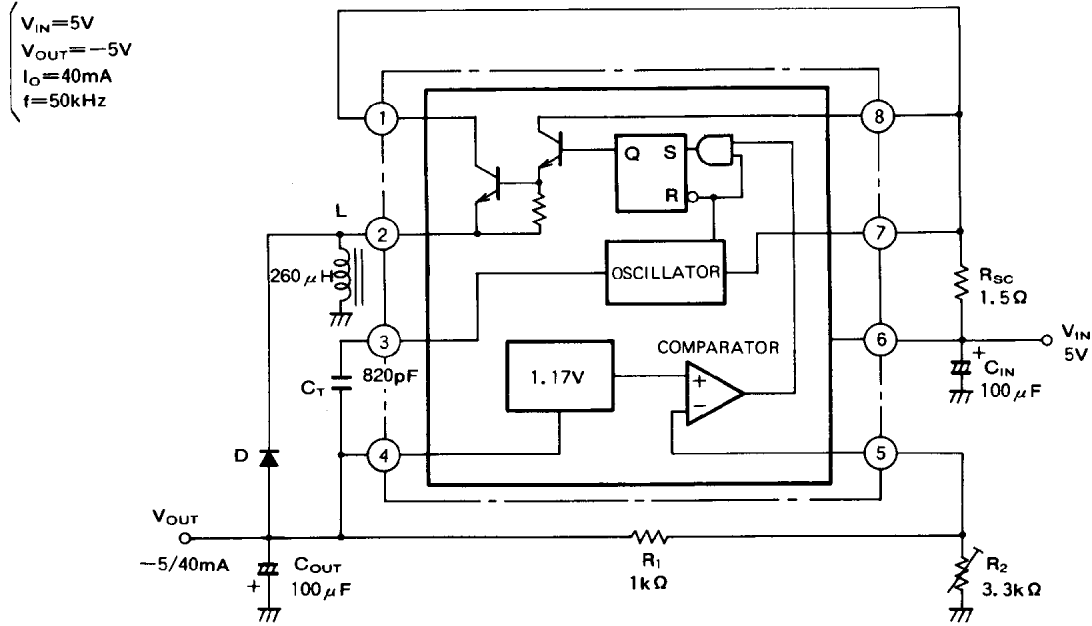
(4) Step-Down Circuit with Transistor

$V_{IN}=24V$
 $V_{OUT}=5V$
 $I_O=1A$
 $f=50kHz$

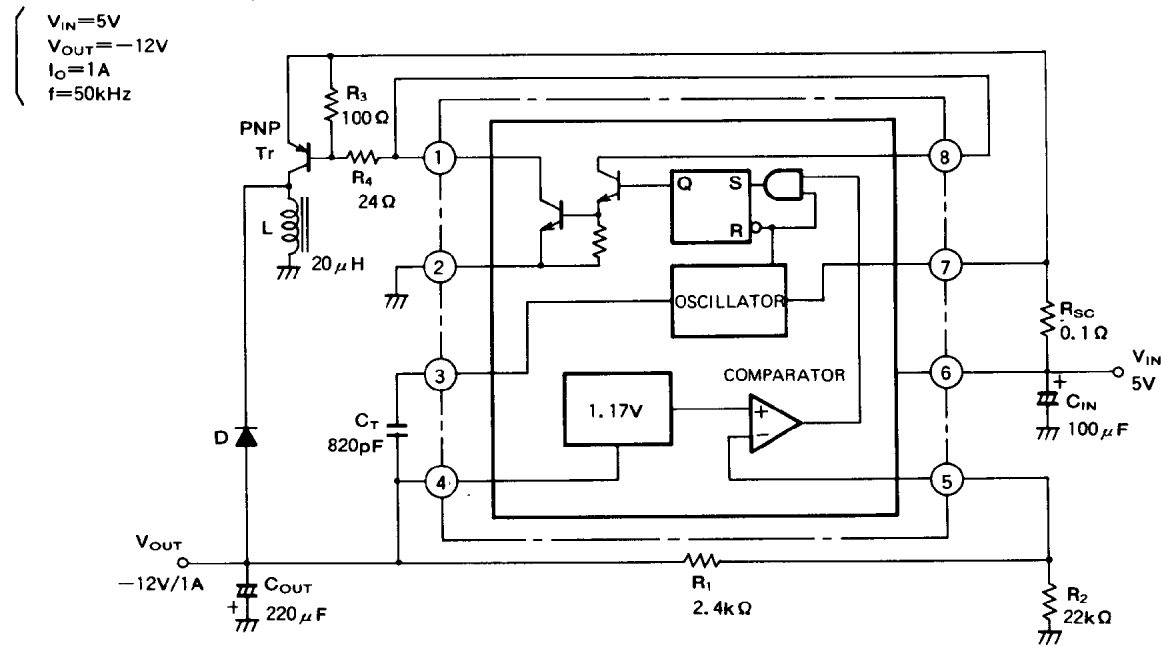


DC-DC CONVERTER

(5) Inverse Polarity Circuit



(6) Inverse Polarity Circuit with Transistor



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 (0.6V_{max} at single output, 2.0V_{max} 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 ~ 10kΩ) 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.