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

M62215FP

GENERAL PURPOSE MULTIFUNCTION DC-DC CONVERTER

Preliminary: Some limits are subject to change

DESCRIPTION

This IC is designed as general purpose multi-function DC-DC converter and is optimum also for back-light control for LCD. Small 10 pin package containing many functions simplifies peripheral circuits and set design.

Priority control circuit contained in 2 channel input allows for simpler control when back-light is on and during the stable state.

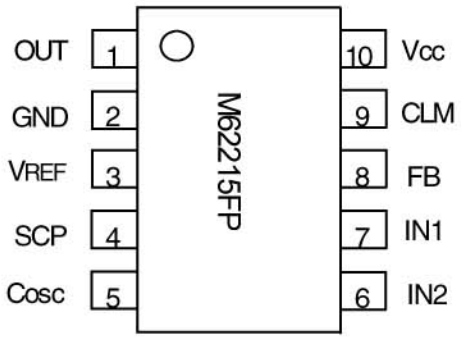
FEATURES

*Wide operating voltage range: 8.6 ~ 25V
*High precision reference voltage: 5V±1%
*2 channel priority control operation ('High' input prioritized)
*High speed switching operation (500kHz)
*Output short-circuit protection circuit, ON/OFF control, Dead time control, Soft start operation.
*Small size 10-pin SOP package
*High speed pulse-by-pulse current limit
*Totem-pole output stage
Output current Io (peak) : ±1A

APPLICATION

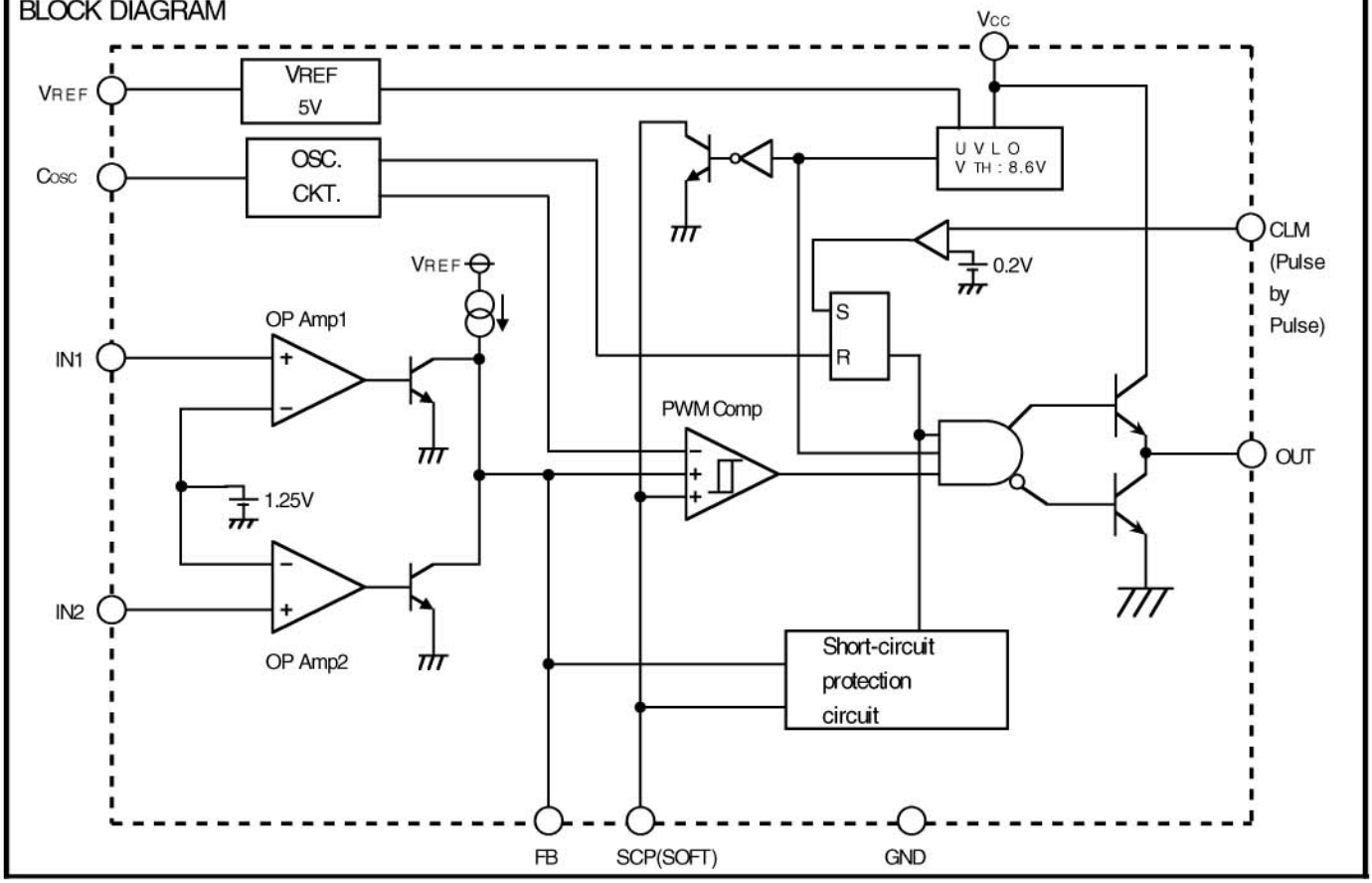
Back-light control for general electronic products such as personal computers, word processors, and portable equipments.

PIN CONFIGURATION (TOP VIEW)



OUTLINE : 10P2N-A

BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATINGS

(Ta=25°C, unless otherwise specified.)

Symbol	Parameter	Conditions	Ratings	Unit
Vcc	Supply voltage		26	V
Vo	Output voltage		26	V
Io	Output current	Continuous	150	mA
		Peak	1.0	A
Pd	Power dissipation		440	mW
Kth	Therminal derating		4.4	mW/°C
Topr	Operating temperature		-20 to +85	°C
Tstg	Storage temperature		-40 to +150	°C

ELECTRICAL CHARACTERISTICS

(Ta=25°C,VCC =12V, Cosc=390pF, IREF=-5mA,unless otherwise specified.)

Block	Symbol	Parameter	Test conditions	Limits			Unit
				Min	Typ	Max	
All	VCC	Supply voltage range		VTHON		25	V
	ICCST	Circuit current	IREF=No load	7.5	9.5	12.5	mA
Ref.voltage block	VREF	Reference voltage		4.95	5.00	5.05	V
	IREF	Max. reference current		-10			mA
	LINE	Line regulation	VCC=8.6 to 15V	0.0	2.5	12.0	mV
Error Amp. block	IB	Input bias current	VIN1=1V ,VIN2=1V	-500			nA
	AV	Open loop gain			70		dB
	GB	Gain-bandwidth product				0.6	MHz
	VOM +	Max. output voltage+		4.75	4.97	5.25	V
	VOM -	Max. output voltage-		0	280	400	mV
	IOM +	Output sink current	VFB=2.5V	3.9	5.5	20.0	mA
	IOM -	Output source current	VIN1=1V , VIN2=1V	-1.5	-1.1	-0.8	mA
	VRA	Reference voltage of amp		1.225	1.250	1.275	V
OSC. block	fOSC	Oscillation frequency		73	105	137	kHz
	VOSCH	OSC. upper limit voltage		3.255	3.500	3.745	V
	VOSCL	OSC. lower limit voltage		1.395	1.500	1.605	V
UVLO block	VTHON	ON threshold voltage		7.998	8.600	9.202	V
	VTHOFF	OFF threshold voltage		7.068	7.600	8.132	V
	VHYS	Hysteresis	VHYS = VTHON - VTHOFF	0.8	1.0	1.2	mV
Short circuit protect. block	VTHSCP	SCP threshold voltage	VIN1=1V , VIN2=1V,	4.75	5.00	5.25	V
	ISCPOUT	SCP term. output current		-26	-20	-14	µA
	VTHFB	FB threshold voltage		3.99	4.20	4.41	V
Output	Dutymax	Maximum ON duty		85	90	95	%
	VOL1	Output Low voltage	VCC=12v, Io=10mA	0.00	0.05	0.40	V
	VOL2		VCC=12v, Io=100mA	0.00	0.80	1.40	V
	VOH1	Output High voltage	VCC=12v, Io=-10mA	10.0	10.5	12.0	V
	VOH2		VCC=12v, Io=-100mA	9.5	10.0	12.0	V
CLM	VTHCLM	CLM threshold voltage		180	200	220	mV
	IOUTCLM	CLM flow-out current		-290	-225	-150	µA
	TPDCLM	CLM delay time	Delay time to OUT terminal		100		nS

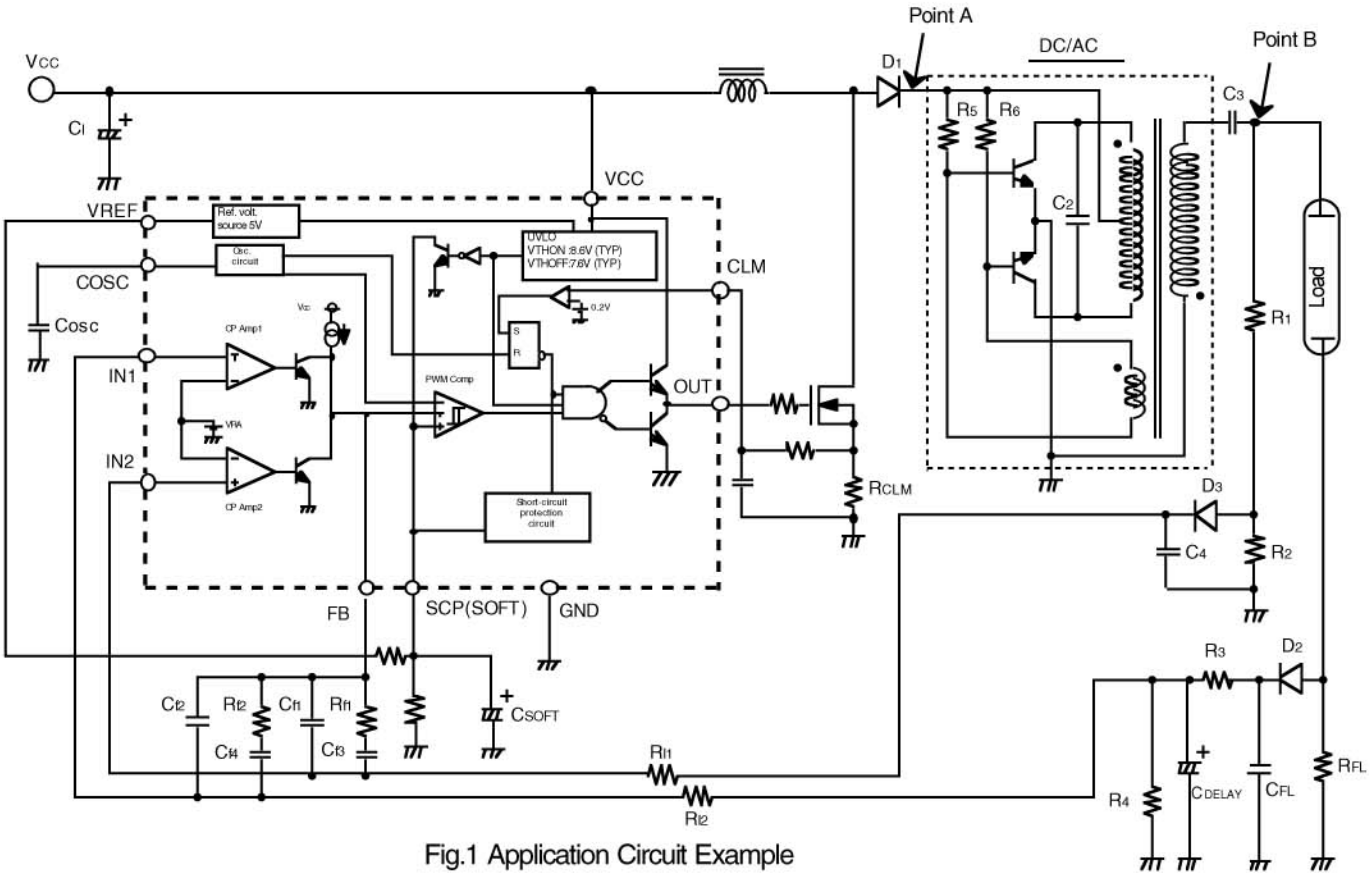
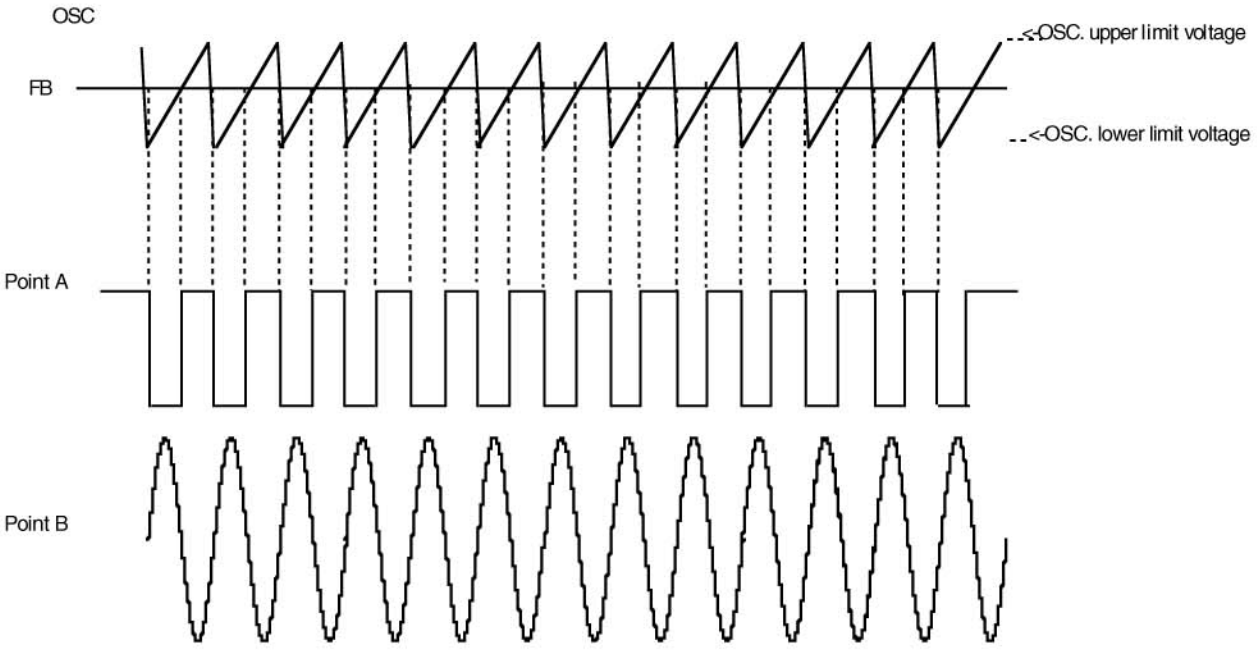


Fig.1 Application Circuit Example

Voltage waveform



1-1. Priority function

As far as OP Amp1 and OP Amp 2 are concerned, there is no problem when either IN1 or IN2 is used to control current, since the setting up to lower the output voltage of the DC-DC converter is prioritized.

1). In the application circuit in Fig.2, Vo1 is set to 24V and Vo2 is set to 15V for each output voltage.

When SW is turned off, output voltage is feed backed to IN1 with R1 and R2.

Output voltage Vo is calculated with the following equation,

$Vo = V_{RA} * (R1+R2) / R2$ (V_{RA}=1.25V typ.)

and Vo1 set to 24V .

If SW is turned on, this IC controls with priority to lower the output voltage, so output voltage is feed backed to IN2 with R3 and R4.

Output voltage Vo is calculated with the following equation,

$Vo = V_{RA} * (R3+R4) / R4$ (V_{RA}=1.25V typ.)

and Vo2 set to 15V .

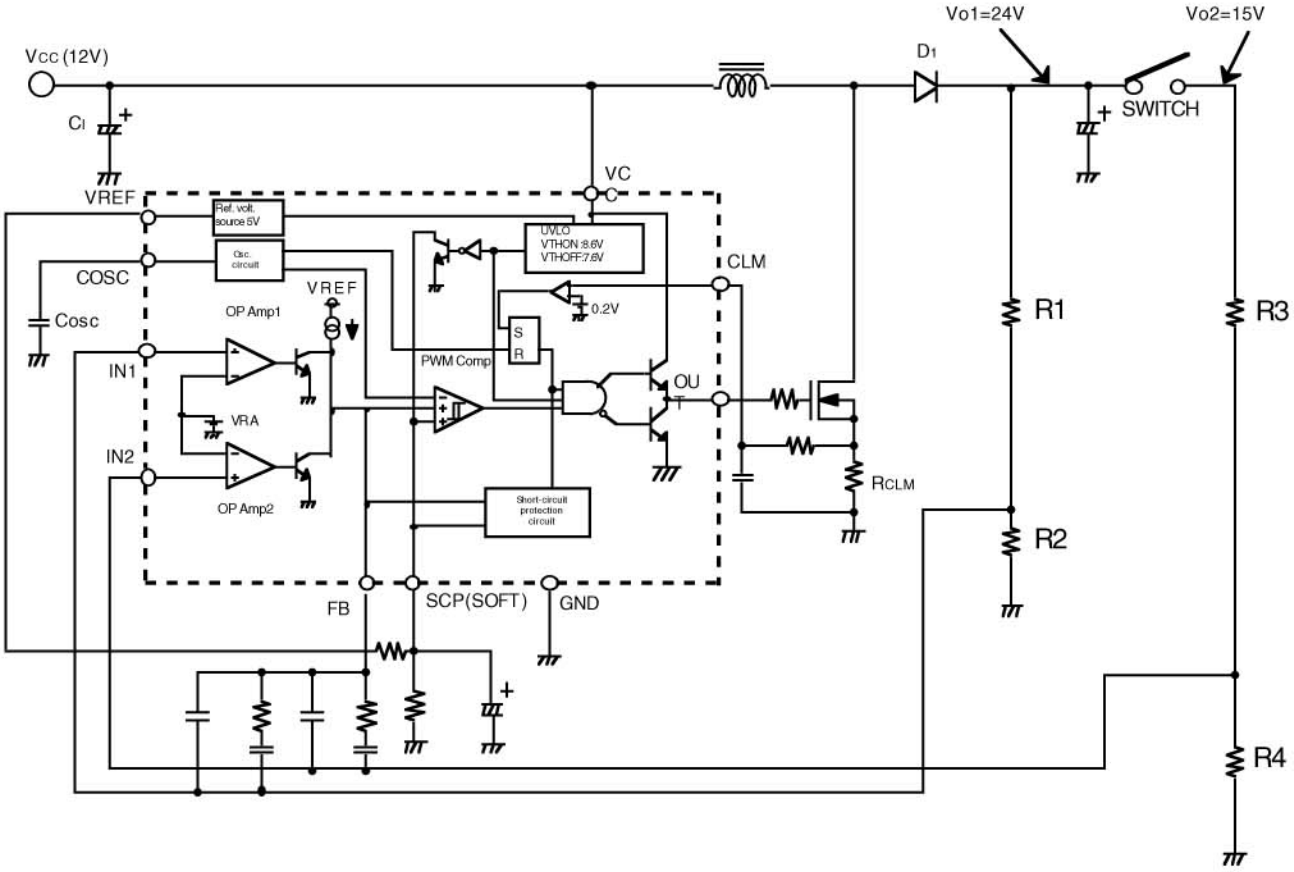


Fig.2 Application Circuit Example

1-2. Soft start function, maximum ON duty setting and short-circuit protection

1). Soft start function (Refer to Fig.3 for its application circuit)

When power supply is turned on, FB terminal is fixed to high level since IN1, IN2 are on GND level.

Voltage level of SCP terminal gradually rises up from 0V, because the internal charge current and the current flowing from the resistors dividing VREF are charged to CSCP.

When SCP terminal voltage reaches to the lower limit voltage of triangular waveform, output starts to operate making DC-DC converter output voltage Vo rise up.

Soft start time is calculated by the the following equation, (Internal charge current is designed as approx. 20μA.)

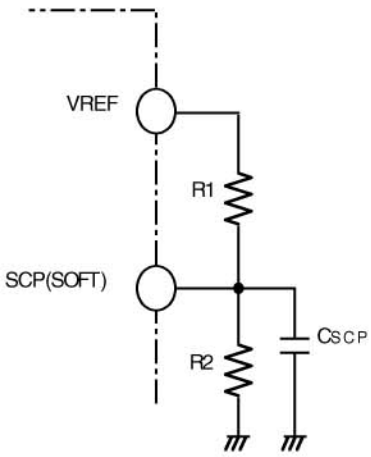


Fig.3

$$VSCP = \frac{5 * R2+20\mu A * R1 * R2}{(R1+R2)} - \frac{5 * R2+20\mu A * R1 * R2}{(R1+R2)} * e^{-\frac{(R1+R2)}{C * R1 * R2} t}$$

*VSCP in this case is the voltage when output starts to operate (equal to lower limit voltage of triangular wave form.)

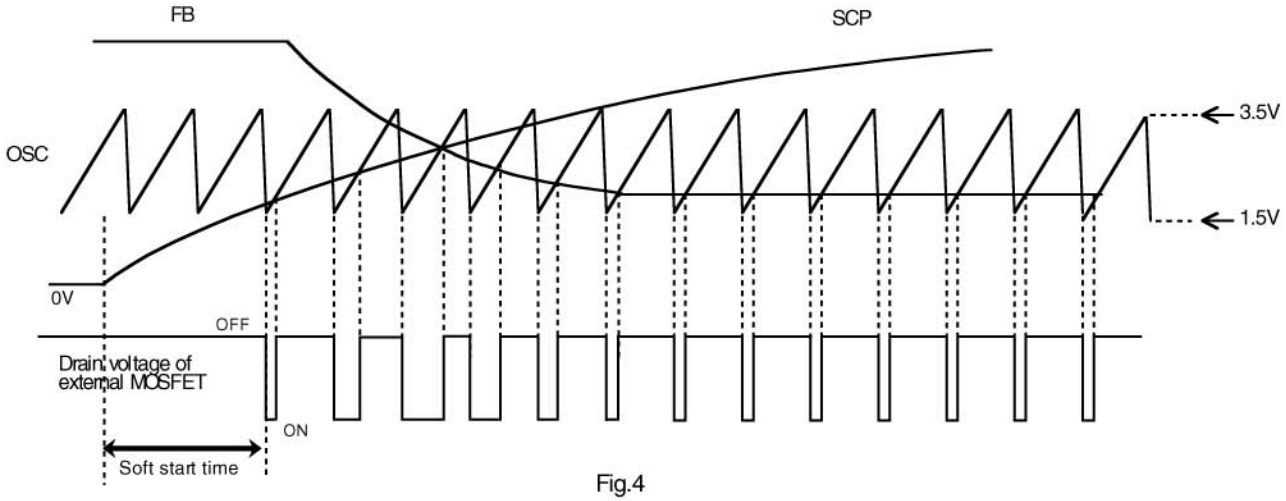


Fig.4

2). Setting for maximum ON duty

Maximum ON duty is set by the voltage applied to SCP terminal, and this is the divided voltage of VREF by resistors.

The internal circuit of SCP terminal has discharge circuit working before start-up and during output latch period (output is off) in over current mode so that soft start never fails to work when restarting.

SCP terminal also works as timer latch setting at over current or when output is short-circuited, so the way of setting differs depending upon whether or not timer latch at over current is used.

<when timer latch is used>

In this case, charge current of SCP terminal is set to approx. 20μA, R2 should be approx. 330Kohm or more.

<when timer latch is not used>

R2 should be approx. 180Kohm or less.

3). Short-circuit protection

It is timer latch system that is applied for short-circuit protection circuit. and timer latch time is set by the capacitance for soft start connected to SCP terminal.
Short-circuit protection circuit is shown in Fig.6 and the timing chart for each mode in Fig.5.
When power is turned on, FB terminal voltage is high (approx. 4.6V), SCP terminal voltage low (gradually rising from 0V).
Approximately 20µA current flows out to make the potential of SCP terminal go to high with time constant set by resistors and capacitor connected to VREF terminal.
This 20µA current continues to flow out to SCP terminal if FB terminal voltage is high and doesn't go down to the control state (FB terminal is 4.2V or more.).
SCP terminal voltage rises, by this 20µA charge current, from the divided voltage of VREF by resistors.
System starts up when FB terminal voltage goes down to under control state voltage (4.2V or less) before that of SCP terminal goes to 5V.
When output is short-circuited, whether starts up or latched depends upon how long it takes for FB terminal voltage to go down to control state from High potential.
(Refer to mode [V], [VI] for details.)
There are two ways to go back to operation after latch to shut output off.
Either method can get the system to redstart by soft start.

1. Turn Vcc on again.
2. Make FB terminal voltage 4.2V or less for cancellation.

Timer time for short-circuit protection depends on the time constant shown below.

$$VSCP = \frac{5 * R2 + 20\mu A * R1 * R2}{(R1+R2)} - 20\mu A * R1 * R2 \quad * e^{-\frac{(R1+R2)}{C * R1 * R2} t}$$

* This VSCP means SCP terminal "H" threshold voltage.

<Operation description by mode>

Mode [I]Start-up
The potential of FB terminal goes down to the control state before that of SCP terminal goes to SCP terminal "H" threshold voltage (approx. 5V).

Mode [II]Over-current --> Latch
When the over current flows in the system and CLM terminal voltage goes up to CLM term. threshold voltage, approximately 20µA charge current flows out from the SCP term.. This charge current makes the potential of SCP term. high. Output will be off (latched) when the potential of SCP term. reaches SCP term. "H" threshold voltage.

Mode [III]Latch canceled --> restart
The latch is canceled and the system is restarted when the potential of FB terminal is set lower than FB term. threshold voltage.

Mode [IV]Over-current --> recovery
The potential of SCP term. goes up by over current. The output is not turned off, because the potential of FB terminal goes down to lower than its threshold voltage before that of SCP term. reaches SCP term. "H" threshold voltage and also the latch-state is canceled.

Mode [V]Turning ON the Vcc again
The mode in which Vcc is again turned on

Mode [VI]Start-up -->Latch
At the start-up, the output is turned off, because the potential of FB term. doesn't go down to its threshold voltage due to output short-circuit before the potential of SCP term. reaches SCP "H" threshold voltage.

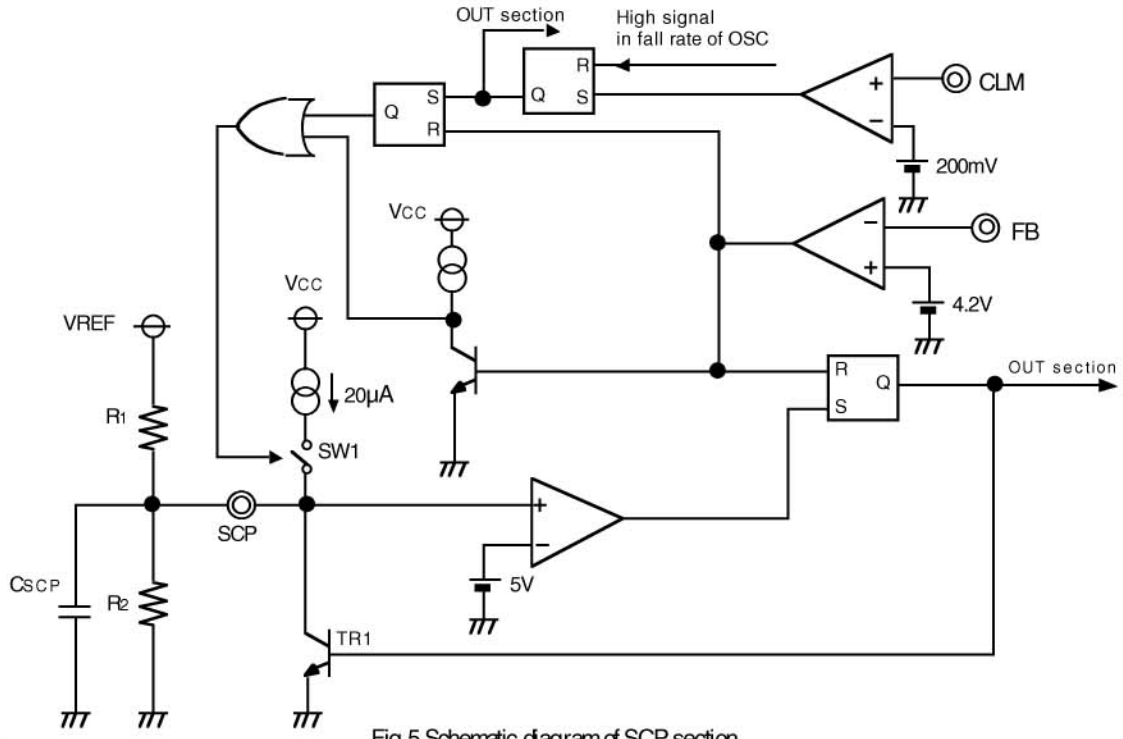


Fig.5 Schematic diagram of SCP section

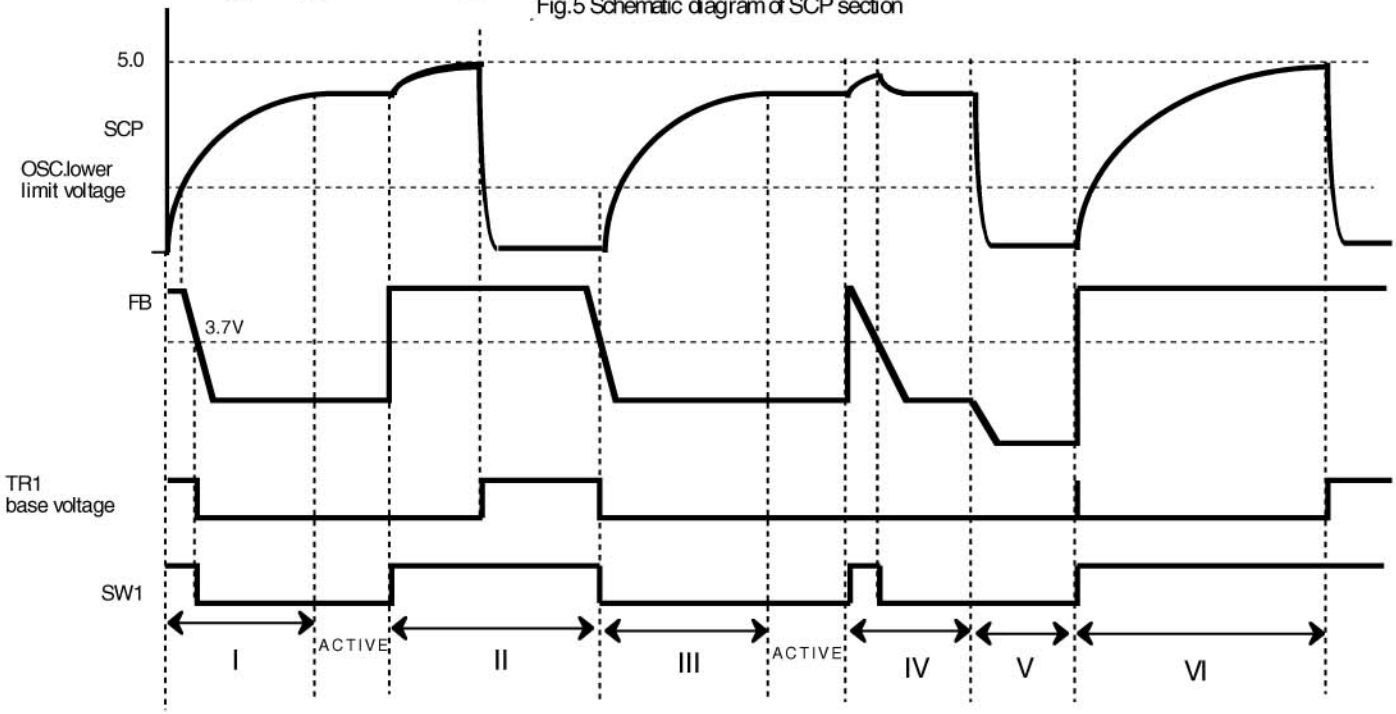


Fig.6 SCP timing chart

4) Oscillation frequency

Oscillation frequency is set by capacitance connected to OSC terminal.

Oscillating triangular waveform : Charge time : Discharge time = 9:1

Oscillation frequency (fosc) is given as:

$$fosc = \frac{1}{23.62 * 10^{3} * C + 9 * 10^{-7}}$$