

To all our customers

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

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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

# M62211P/FP

## GENERAL PURPOSE MULTI FUNCTION DC-DC CONVERTER

### DESCRIPTION

M62211FP is designed as a general purpose multi-function DC-DC converter. This small 10 pin package contains many functions allowing simpler peripheral circuits and compact set design.

The output circuit is designed OPEN-COLLECTOR output. This makes the application for STEP-UP, STEP-DOWN and INVERTING.

The input of this unit has two channels containing priority control circuit. This makes the control a simple matter when the back-light is on and during the stable state.

### FEATURE

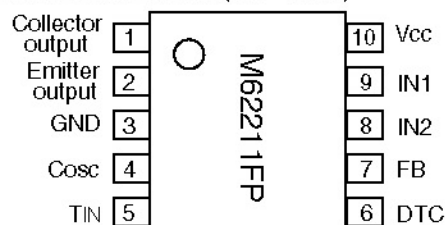
- Wide operation power supply voltage range.....2.5~35V
- Operation can be synchronized by the external sync signal
- Operation can be controlled using two prioritized systems.  
(High input has priority)
- High speed switching is possible.(500kHzmax)
- Output short protection circuit and ON/OFF control are used.  
The dead-time control and the soft-start operation are possible
- Small size 10-pin SOP package.

### APPLICATIONS

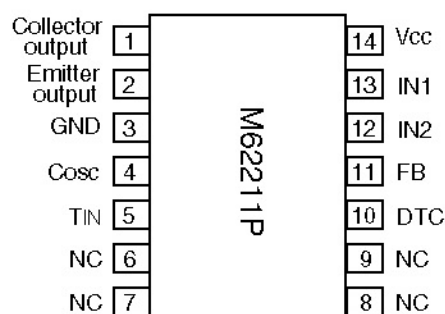
Back-light control of personal computers and word processors  
General electric products

Notice: This is not a final specification.  
Some parametric limits are subject to change.

#### PIN CONFIGURATION(TOP VIEW)



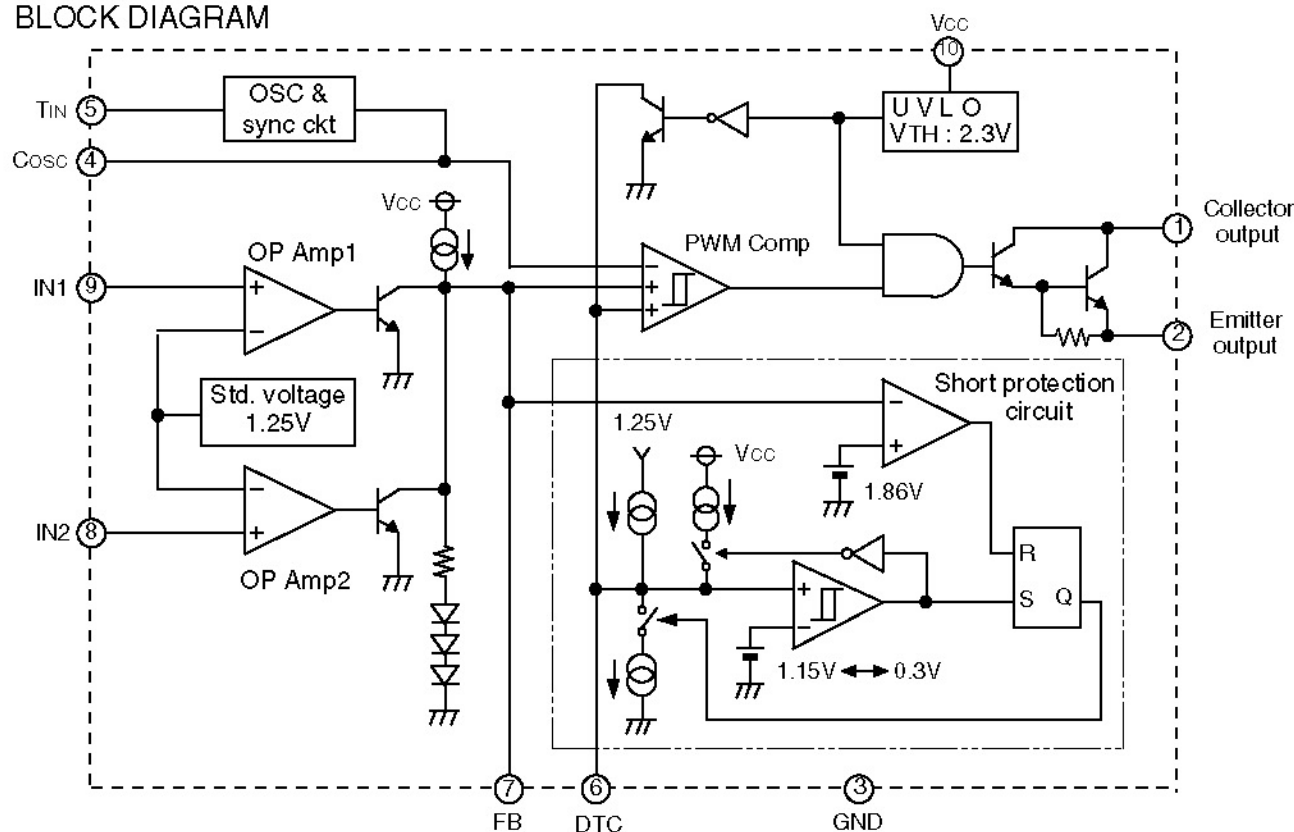
OUTLINE 10P2N-A



OUTLINE 14P4

NC: NO CONNECTION

### BLOCK DIAGRAM



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## ABSOLUTE MAXIMUM RATINGS (Ta=25°C, unless otherwise noted)

Symbols	Items	Conditions	Ratings	Units
Vcc	Power supply voltage		36	V
Vo	Output voltage		36	V
Io	Output current		150	mA
Pd	Power dissipation	Ta=25°C	1500 (P) 450 (FP)	mW
K theta	Thermal derating ratio	Ta>25°C	1.2 (P) 3.6 (FP)	mW/°C
Topr	Operating ambient temperature		-20 ~ +85	°C
Tstg	Storage temperature		-40 ~ +150	°C

## Electrical Characteristics ( Ta=25°C, Vcc =12V, Cosc=390pF unless otherwise noted )

Block	Symbol	Items	Test condition	Limits			Units
				Min	Typ	Max	
All device	Vcc	Power supply voltage range		2.5		35	V
	Icc	Circuit current	No load		2.4	3.5	mA
Std. voltage section	VREF	Standard voltage	Voltage follower	1.19	1.25	1.31	V
	LINE	Line regulation	Vcc=2.5 ~ 3.5V		5	12	mV
Error amp. section	IB	Input bias current				500	nA
	AV	Open loop gain			80		dB
	GB	Unity gain bandwidth			0.6		MHz
	VOM+	Output high voltage	VFB=1.86V	1.7		2.5	V
	VOM-	Output low voltage	VFB=1.86V			400	mV
	IOM+	Output sink current	VFB=1.86V		6		mA
	IOM-	Output source current	VIN1=1V, VIN2=1V		-100	-50	uA
Oscillator section	fosc	Oscillation frequency			110		kHz
	VOSCH	Upper limit voltage of oscillation waveform			1.0		V
	VOSCL	Lower limit voltage of oscillation waveform			0.45		V
	IOSC CH	Cosc charge current			-120		uA
	IOSC DIS1	Cosc discharge current 1			30		uA
	IOSC DIS2	Cosc discharge current 2			120		uA
	VTINH	TIN "H" level		2.2		Vcc	V
	VTINL	TIN "L" level				1.0	V

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Block	Symbol	Items	Test condition	Limits			Units
				Min	Typ	Max	
UVLO section	VTH ON	Start-up threshold voltage		2.2	2.3	2.4	V
	VTH OFF	Shut-down threshold voltage			2.25		V
	VHYS	Hysteresis		20	50	80	mV
Short protection circuit	VTH FB	FB threshold voltage	VIN1=1V, VIN2=1V, VDTC=0.7V		1.86		V
	VTH DTC	Latch mode "H" threshold voltage	VIN1=1V, VIN2=1V, VFB=2.11V		1.15		V
	VTL DTC	Latch mode "L" threshold voltage	VIN1=1V, VIN2=1V, VFB=2.11V		0.3		V
	ICH1	DTC charge current when start-up	VDTC=0.7V, VFB=2.11V		-35		μA
	IDIS1	DTC discharge current 1	VDTC=0.7V, VFB=2.11V		45		μA
	ICH2	DTC charge current when stable state	VDTC=0.7V, VFB=0.7V		-15		μA
	IDIS2	DTC discharge current 2	VDTC=0.2V, VFB=2.11V		20		μA
Output section	ICL	Collector output leak current	VCE=35V, Vcc=35V	-1		1	μA
	VSAT1	Collector output saturation voltage	Emitter follower, IE=50mA, Vc=12V		1.6		V

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## GENERAL PURPOSE MULTI FUNCTION DC-DC CONVERTER

### 1. Explanation of Back Light Control Circuit

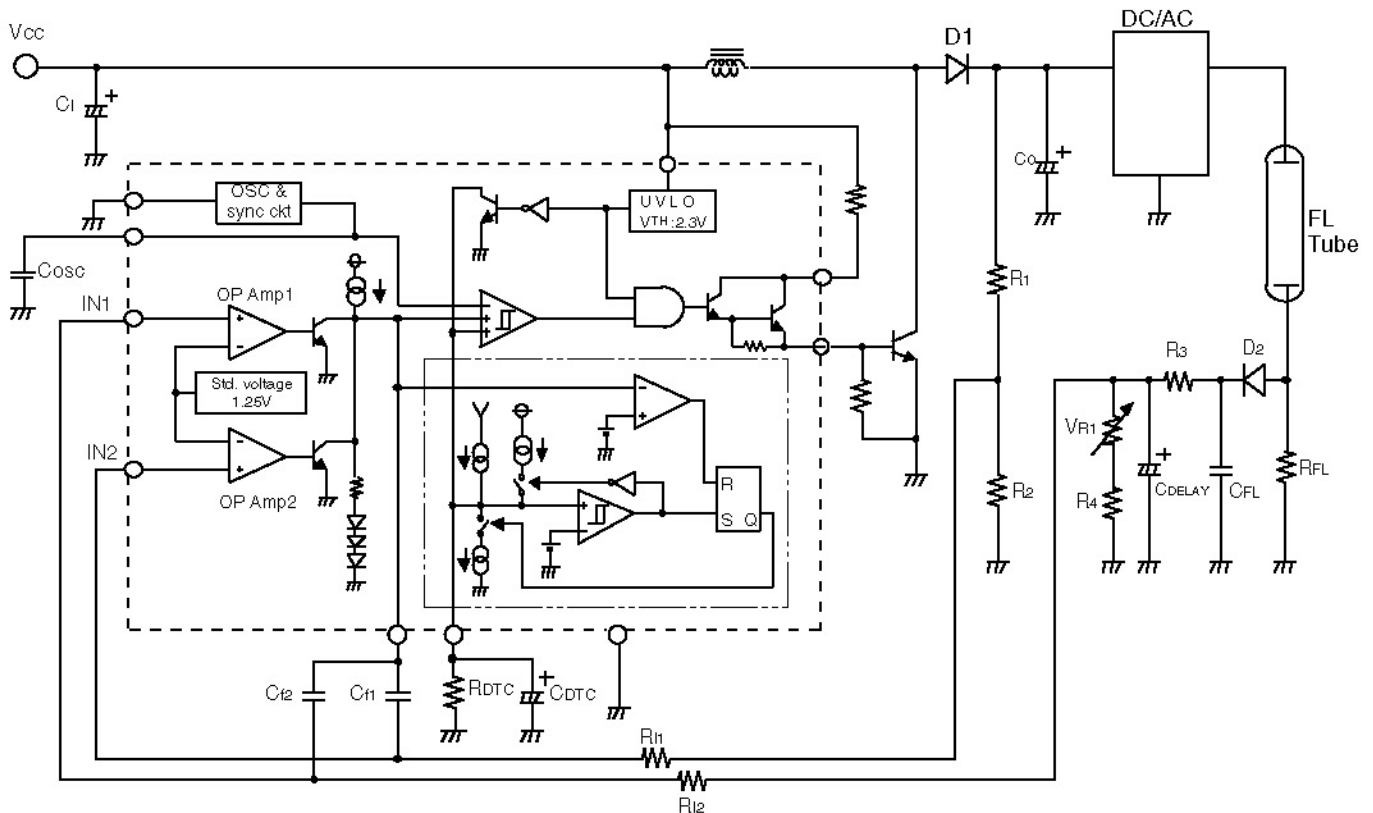


Fig.1 An Application of the Back Light Control Circuit

#### 1-1. Priority Control Operation

As far as OPamp1 and OPamp2 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. (The above figure uses IN1 to control current.)

- 1) When starting, the output voltage "Vo" is determined by the feedback to IN2 via R1 and R2 and the following equation :

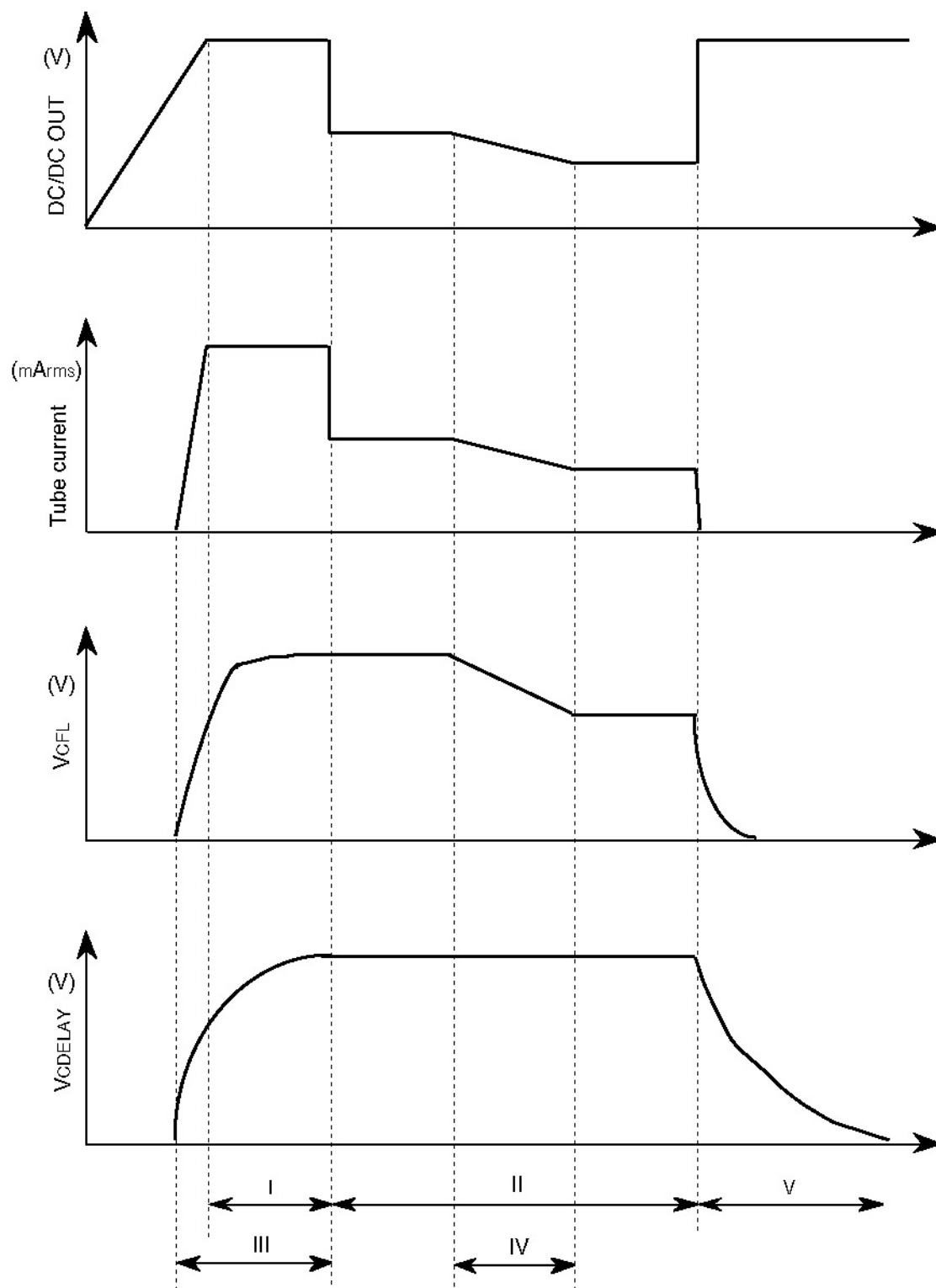
$$V_o = V_{REF} * (R_1 + R_2) / R_2 \quad (V_{REF} = 1.25V_{typ}) \quad (\text{Area of the Timing Chart 1})$$

- 2) Next, this output voltage "Vo" is used to discharge the FL tube by the inverter and causes the tube current to flow. The tube current is filtered and smoothed by RFL, D2, and CFL so that the DC voltage (VOFL) corresponding to the tube current is generated at CFL. The voltage of VOFL is divided by R3, VR1, and R4, and feedback to IN1, it can control tube current. (Area of the Timing Chart 2)
- 3) Here, CDELAY is inserted between R3 and VR1 + R4 in order to regulate the timing to switch from the voltage control to the current control. (Area of the Timing Chart 3)
- 4) When in the current control state, it is possible to adjust brightness by changing the amount of feedback of the tube current using VR1. (Area of the Timing Chart 4)
- 5) If the feedback used for controlling current is lost due to irregularities in the FL tube. etc., the control returns to the voltage control mode. (Area of the Timing Chart 5)

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<Timing Chart>



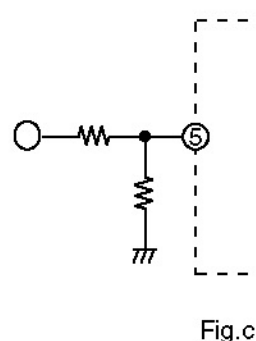
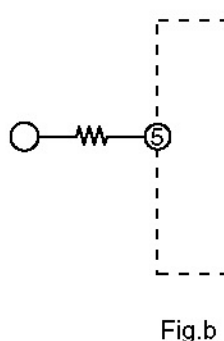
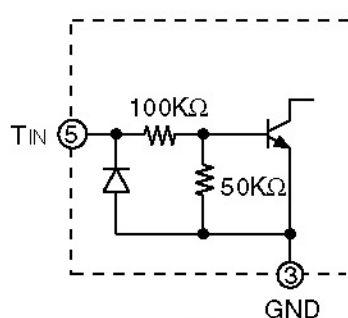
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## GENERAL PURPOSE MULTI FUNCTION DC-DC CONVERTER

### 1-2 Setting Up $T_{IN}$

#### 1) Setting Up the Level

The  $T_{IN}$  terminal is shown in Fig.a. In order for the level of  $T_{IN}$  to satisfy the conditions shown in the table below, the external circuits shown in Fig.b or Fig.c should be used when the external voltage level of the input is high.



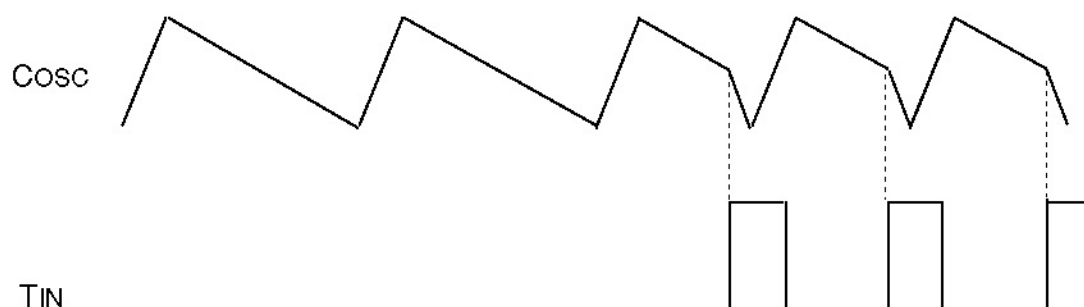
Items	Symbols	min	typ	max	Unit
$T_{IN}$ "H" level	$V_{TINH}$	2.2	—	$V_{CC}$	V
$T_{IN}$ "L" level	$V_{TINL}$	—	—	1.0	V

#### 2) Setting Up frequency

The periodical change of  $T_{IN}$  is expected to be +30% ~ -20%. The  $f_{IN}$  is set to approximately 1.5 times  $f_{OSC}$

$$f_{IN} = 1.5 * f_{OSC}$$

$$f_{OSC} \approx \frac{1}{1.3\mu s + (23 * 10^{-9} * C_{OSC})} \quad (\text{Hz})$$



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## 1-3 Soft Start, DTC, and Short Protection

### 1) Soft Start (The peripheral circuit is shown in Fig.1)

When the power is turned ON, IN1 and IN2 are at 0V level. Therefore, the FB terminal is fixed to High level. The DTC terminal goes up gradually starting from 0V due to the internal charge current and the external  $C_{DTC}$ .

When the level of DTC terminal reaches the lower limit of the triangular wave of the oscillator, PWM comparator and the output circuit go into operation causing the output voltage, "Vo" of the DC-DC converter to rise. The charge current is designed to be approximately 35 $\mu$ A.

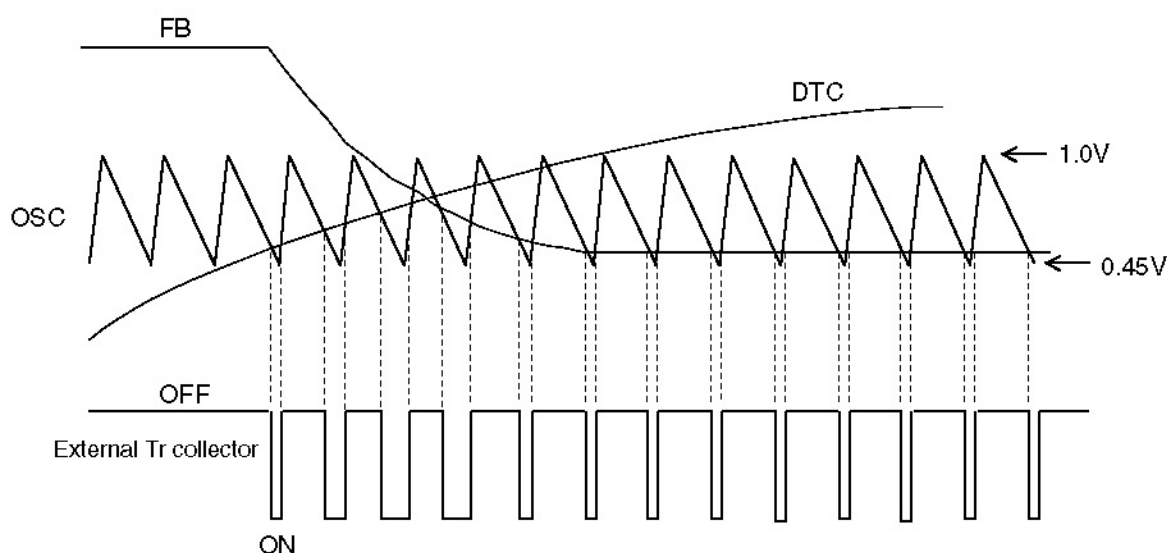


Fig.2

### 2) DTC

The dead time control is set by installing a resistor between the DTC terminal and GND. However, the DTC terminal serves as the short protection circuit also. Therefore, its set up depends on whether the short protection circuit is used and not.

(When the short protection circuit is used)

At this time, the charge current for DTC is approximately 10 $\mu$ A. Therefore,  $R_{DTC}$  should be set to 40K $\Omega$  ~ 110K $\Omega$ .

(When the short protection circuit is not used)

At this time, the charge current for DTC is approximately 45 $\mu$ A. Therefore,  $R_{DTC}$  is set to 12K $\Omega$  ~ 25K $\Omega$ .

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### 3) Short Protection Circuit

The Short Protection Circuit used the timer latch system. It is determined by setting the capacity used for the soft start connected to the DTC terminal.

Fig.3 shows the short protection circuit and the timing chart for various modes.

When the power is turned on, the FB terminal goes high (approx. 2.4V) and the DTC terminal goes low (goes up slowly from 0V). Thus, approximately 35 $\mu$ A current will flow when SW1:ON and SW2:OFF. The potential, namely the potential of the FB terminal is in the amplitude of the triangular wave, SW1 will be OFF and SW2 will be ON and approximately 45 $\mu$ A will flow into the DTC terminal. This discharge current will cause the DTC terminal to drop from 1.15V.

At this time, if the potential of the FB terminal goes to the control potential before the potential at the DTC terminal goes lower than 0.45V which is the lower limit value of the triangular wave and if the potential of the FB terminal is lower than the potential of the DTC terminal, then the system is activated.

When the output is shorted, the system is either activated or latched depending on whether the time for the high potential of the FB terminal reaches the potential of the control state is long or short. (For detail, see [II] and [IV] of the Mode)

There are two ways to go back to operation after the latch to shut off output. Either method can restart with soft start.

1. Turning ON the Vcc.
2. Make the FB terminal to go to the low potential of 1.25V or less. Then, it is cancel led.

#### [Mode Explained]

##### [ I ] Mode ..... Activation

This is used when the FB terminal goes down to the control state potential when the DTC terminal is in up slope. In order for the activation to occur when the DTC terminal is in down slope, the FB terminal potential must go below the DTC terminal before the DTC terminal goes to 0.45V.

##### [ II ] Mode ..... Output short --> Activation

The system is activated if the FB terminal potential goes below the DTC terminal potential before the DTC terminal goes to 0.45V. If there is not enough time, the output is turned OFF (Latched)

##### [ III ] Mode ..... ON/OFF Control --> Activation

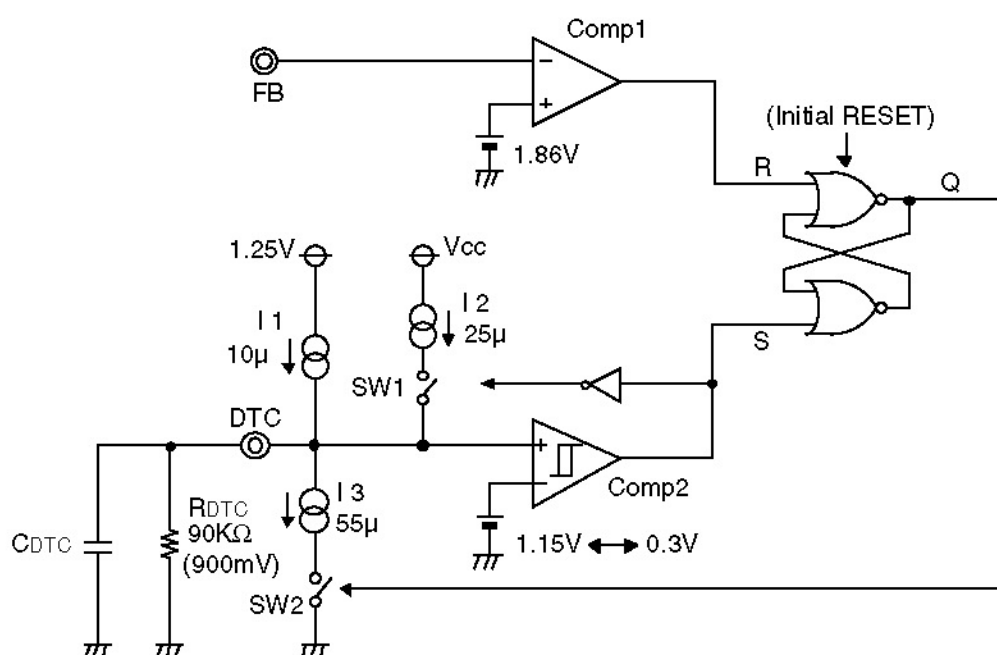
This mode turns off the output by forcing the DTC terminal to go down. (The system) returns as in the case of the activation.

##### [ IV ] Mode ..... Output Short (Latch)

The output is turned OFF when the FB terminal potential did not go down to the control state before the DTC terminal went down to 0.45V.

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\* SW1 and SW2 are turned ON by "H" signal.

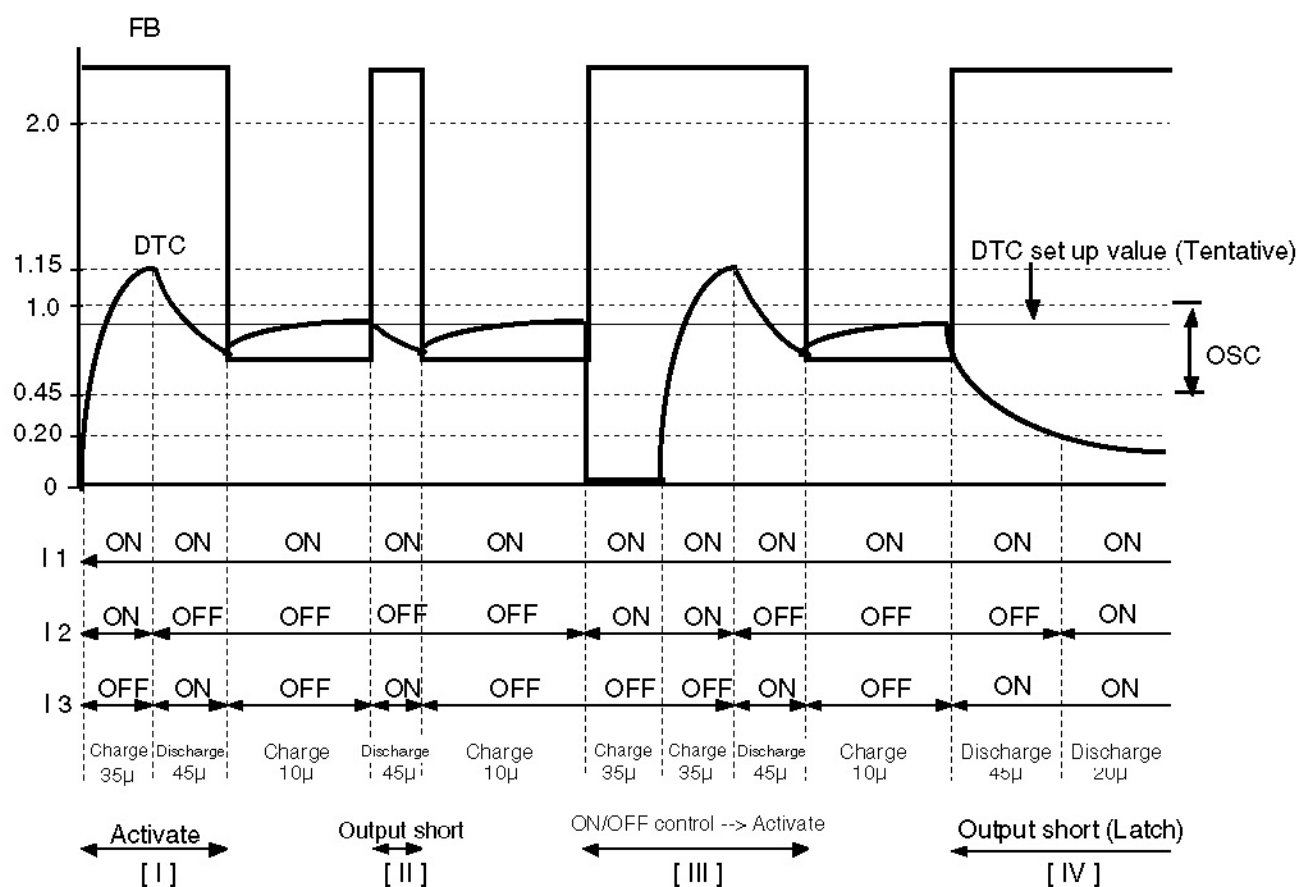


Fig.3 Short Protection Circuit and the Timing Chart of the Modes