M62211P/FP

General Purpose Multi Function DC/DC Converter

REJ03D0842-0201
Rev.2.01
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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

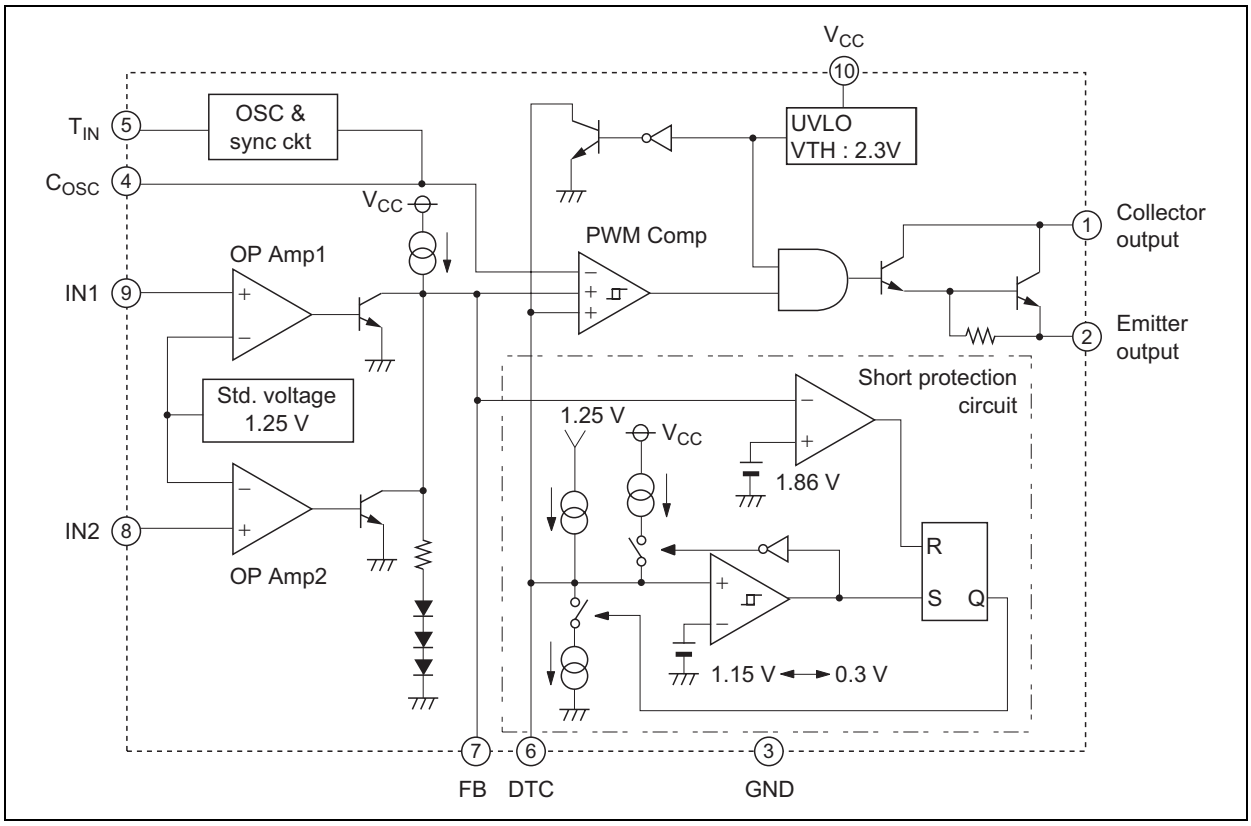
- Wide operation power supply voltage range…….. 2.5 to 35 V
- Operation can be synchronized by the external sync signal.
- Operation can be controlled using two prioritized systems. (High input has priority)
- High speed switching is possible. (500 kHz max)
- Output short protection circuit and ON/OFF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

Applications

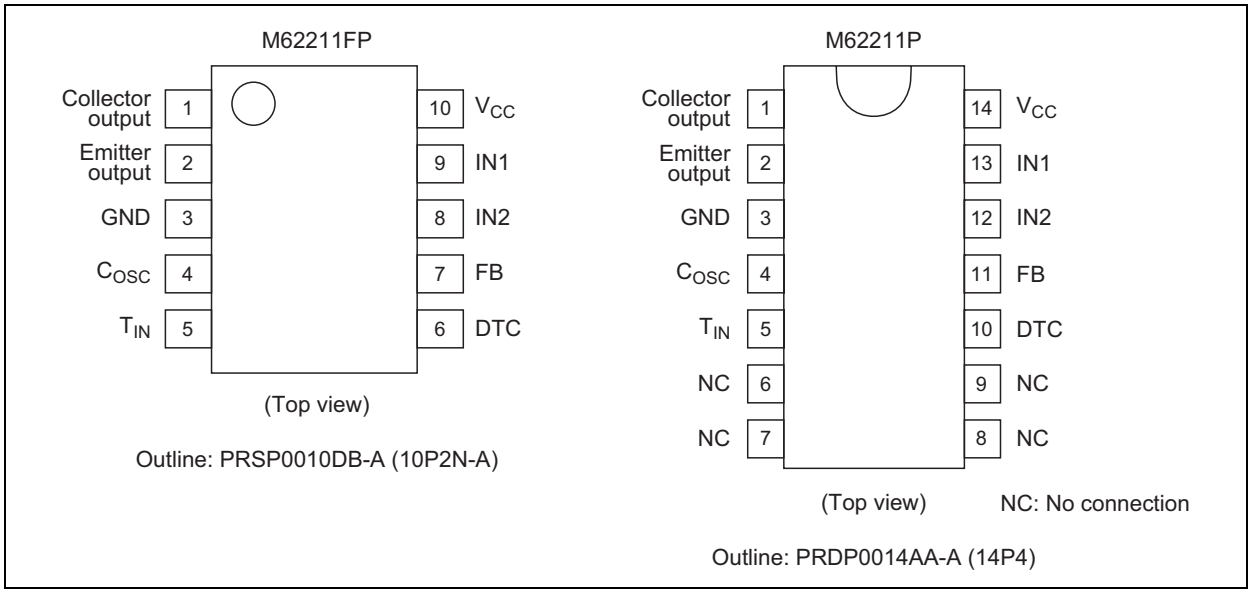
Back-light control of personal computers and word processors

General electric products

Block Diagram



Pin Arrangement



Absolute Maximum Ratings

(Ta = 25°C, unless otherwise noted)

Item	Symbol	Ratings	Units	Conditions
Power supply voltage	V_{CC}	36	V	
Output voltage	V_O	36	V	
Output current	I_O	150	mA	
Power dissipation	Pd	1500 (P) 450 (FP)	mW	Ta = 25°C
Thermal derating ratio	Kθ	1.2 (P) 3.6 (FP)	mW/°C	Ta > 25°C
Operating ambient temperature	Topr	–20 to +85	°C	
Storage temperature	Tstg	–40 to +150	°C	

Electrical Characteristics

(Ta = 25°C, V_{CC} = 12 V, C_{OSC} = 390 pF, unless otherwise noted)

Block	Item	Symbol	Limits			Units	Test Condition
			Min	Typ	Max		
All device	Power supply voltage range	V_{CC}	2.5	—	35	V	
	Circuit current	I_{CC}	—	2.4	3.5	mA	No load
Std. voltage section	Standard voltage	V_{REF}	1.19	1.25	1.31	V	Voltage follower
	Line regulation	L_{INE}	—	5	12	mV	V_{CC} = 2.5 to 3.5 V
Error Amp. section	Input bias current	I_B	—	—	500	nA	
	Open loop gain	A_V	—	80	—	dB	
	Unity gain bandwidth	G_B	—	0.6	—	MHz	
	Output high voltage	V_{OM}+	1.7	—	2.5	V	V_{FB} = 1.86 V
	Output low voltage	V_{OM}–	—	—	400	mV	V_{FB} = 1.86 V
	Output sink current	I_{OM}+	—	6	—	mA	V_{FB} = 1.86 V
	Output source current	I_{OM}–	—	–100	–50	µA	V_{IN1} = 1 V, V_{IN2} = 1 V
Oscillator section	Oscillation frequency	f_{OSC}	—	110	—	kHz	
	Upper limit voltage of oscillation waveform	V_{OSCH}	—	1.0	—	V	
	Lower limit voltage of oscillation waveform	V_{OSCL}	—	0.45	—	V	
	Cosc charge current	$I_{OSC\ CH}$	—	–120	—	µA	
	Cosc discharge current 1	$I_{OSC\ DIS1}$	—	30	—	µA	
	Cosc discharge current 2	$I_{OSC\ DIS2}$	—	120	—	µA	
	T_{IN} "H" level	V_{TINH}	2.2	—	V_{CC}	V	
	T_{IN} "L" level	V_{TINL}	—	—	1.0	V	

Electrical Characteristics

(Ta = 25°C, V_{CC} = 12 V, C_{OSC} = 390 pF, unless otherwise noted)

Block	Item	Symbol	Limits			Units	Test Condition
			Min	Typ	Max		
UVLO section	Start-up threshold voltage	$V_{TH\ ON}$	2.2	2.3	2.4	V	
	Shut-down threshold voltage	$V_{TH\ OFF}$	—	2.25	—	V	
	Hysteresis	V_{HYS}	20	50	80	mV	
Short protection circuit	FB threshold voltage	$V_{TH\ FB}$	—	1.86	—	V	V_{IN1} = 1 V, V_{IN2} = 1 V, V_{DTC} = 0.7 V
	Latch mode "H" threshold voltage	$V_{TH\ DTC}$	—	1.15	—	V	V_{IN1} = 1 V, V_{IN2} = 1 V, V_{FB} = 2.11 V
	Latch mode "L" threshold voltage	$V_{TL\ DTC}$	—	0.3	—	V	V_{IN1} = 1 V, V_{IN2} = 1 V, V_{FB} = 2.11 V
	DTC charge current when start-up	I_{CH1}	—	–35	—	µA	V_{DTC} = 0.7 V, V_{FB} = 2.11 V
	DTC discharge current 1	I_{DIS1}	—	45	—	µA	V_{DTC} = 0.7 V, V_{FB} = 2.11 V
	DTC charge current when stable state	I_{CH2}	—	–15	—	µA	V_{DTC} = 0.7 V, V_{FB} = 0.7 V
	DTC discharge current 2	I_{DIS2}	—	20	—	µA	V_{DTC} = 0.2 V, V_{FB} = 2.11 V
Output section	Collector output leak current	I_{CL}	–1	—	1	µA	V_{CE} = 35 V, V_{CC} = 35 V
	Collector output saturation voltage	V_{SAT1}	—	1.6	—	V	Emitter follower, I_E = 50 mA, V_C = 12 V

Explanation of Back Light Control Circuit

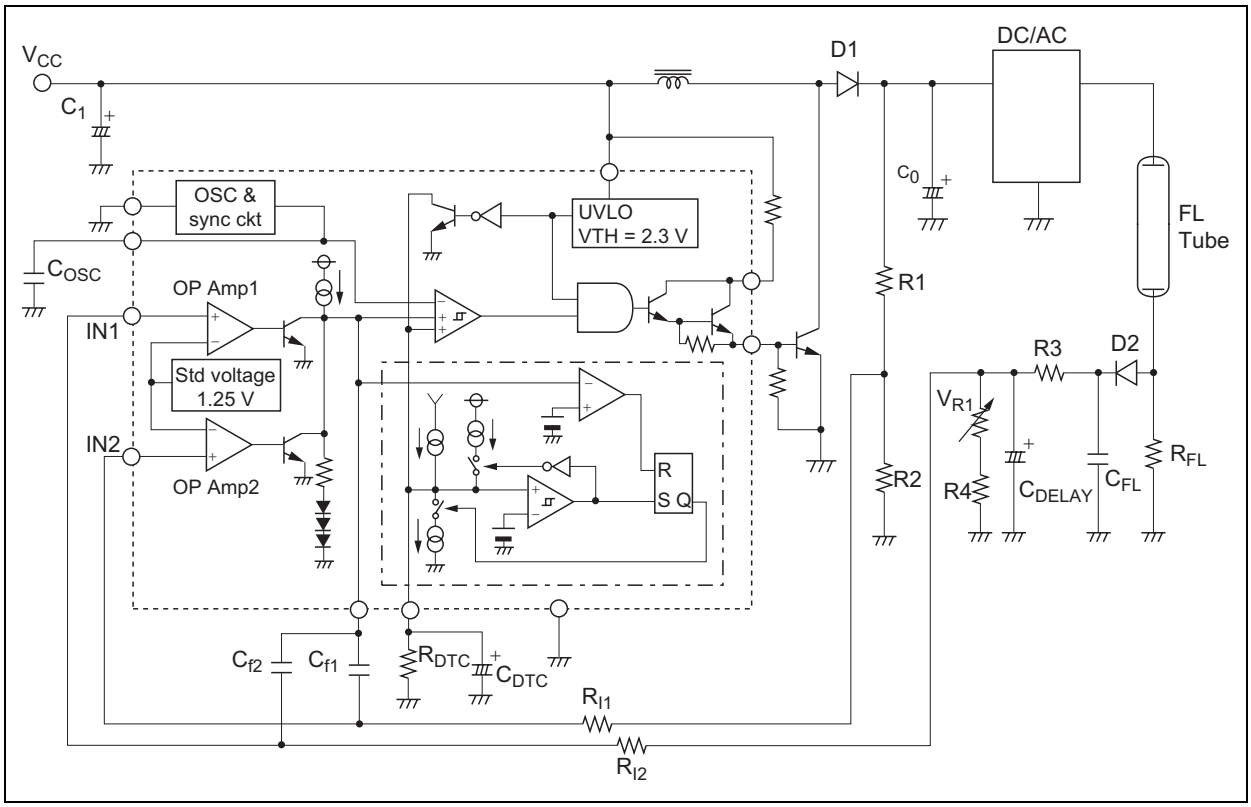


Figure 1 An Application of the Back Light Control Circuit

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 "V_O" is determined by the feedback to IN2 via R1 and R2 and the following equation:

$$V_O = V_{REF} \times (R1 + R2) / R2 \ (V_{REF} = 1.25 \text{ V typ}) \qquad \text{(Area of the Timing Chart 1)}$$

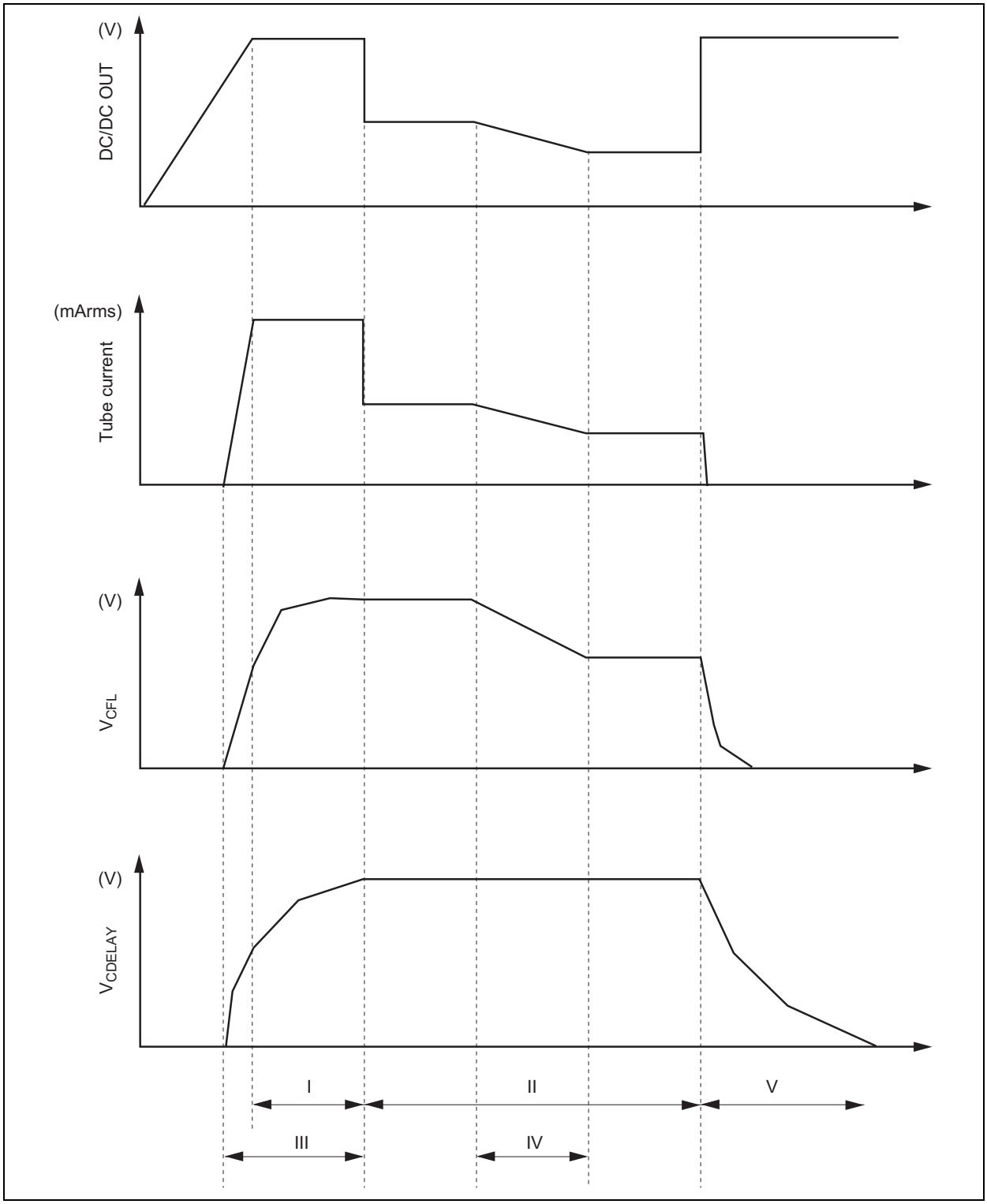
(2) Next, this output voltage "V_O" is used to discharge the FL tube by the inverter and causes the tube current to flow. The tube current is filtered and smoothed by R_{FL}, D2, and C_{FL} so that the DC voltage (V_{CFL}) corresponding to the tube current is generated at C_{FL}.
The voltage of V_{CFL} is divided by R3, V_{R1}, and R4, and feedback to IN1, it can control tube current. (Area of the Timing Chart 2)

(3) Here, C_{DELAY} is inserted between R3 and V_{R1} + 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 V_{R1}. (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)

Timing Chart



2. Setting up T_{IN}

1) Setting up the level

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

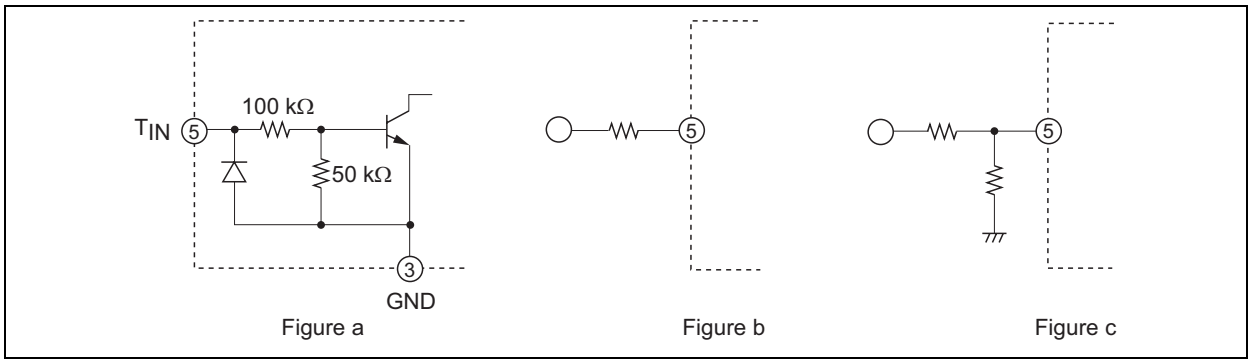


Figure a Figure b Figure c

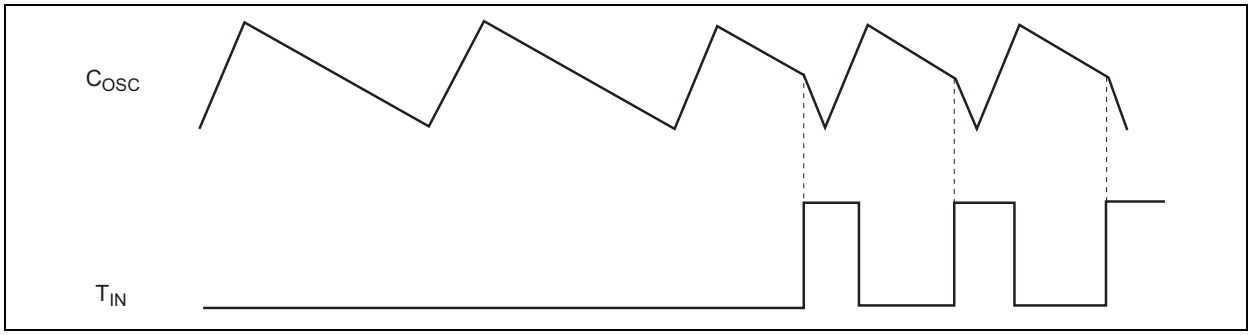
Items	Symbols	Min	Typ	Max	Unit
T_{IN} "H" level	V_{TINH}	2.2	—	V_{CC}	V
T_{IN} "L" level	V_{TINL}	—	—	1.0	V

2) Setting up frequency

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

$$f_{IN} = 1.5 \bullet f_{osc}$$

$$f_{osc} \approx \frac{1}{1.3\ \mu s + (23 \times 10^3 \times C_{osc})} \quad (Hz)$$



3. Soft Start, DTC, and Short Protection

1) Soft Start (The peripheral circuit is shown in Figure 1)

When the power is turned ON, IN1 and IN2 are at 0 V level. Therefore, the FB terminal is fixed to High level. The DTC terminal goes up gradually starting from 0 V 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, "V_O" of the DC/DC converter to rise. The charge current is designed to be approximately 35 µA.

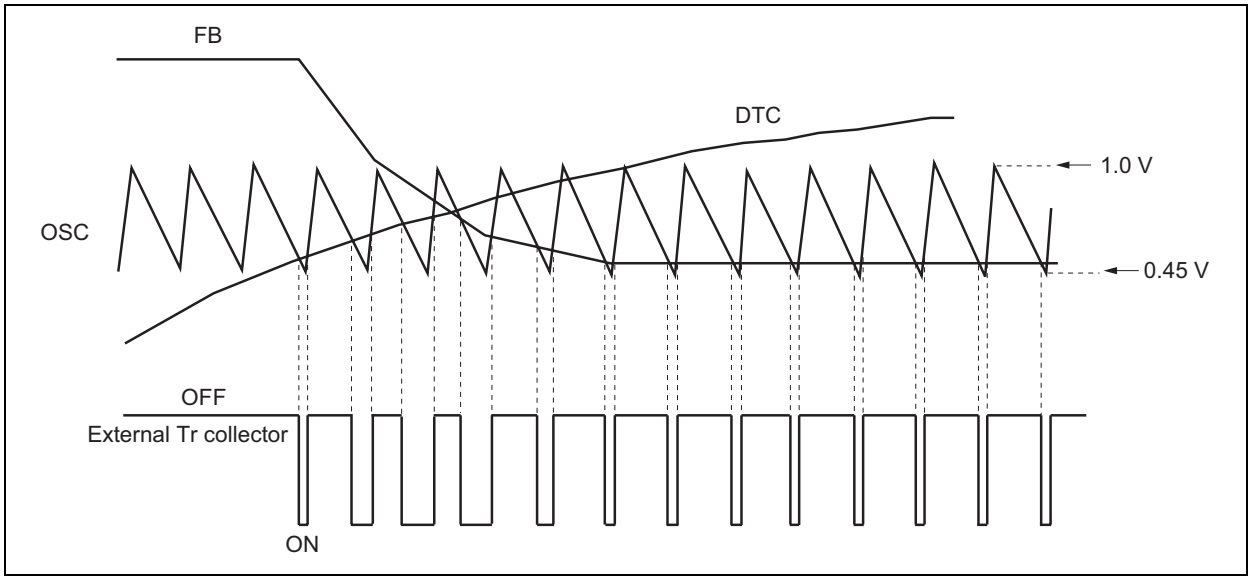


Figure 2

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 µA. Therefore, R_{DTC} should be set to 40 kΩ to 110 kΩ.

— When the short protection circuit is not used

At this time, the charge current for DTC is approximately 45 µA. Therefore, R_{DTC} is set to 12 kΩ to 25 kΩ.

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.

Figure 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. 2.4 V) and the DTC terminal goes low. (goes up slowly from 0 V) Thus, approximately 35 µA 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 µA will flow into the DTC terminal. This discharge current will cause the DTC terminal to drop from 1.15 V.

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 0.45 V 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 V_{CC}.
2. Make the FB terminal to go to the low potential of 1.25 V or less. Then, it is cancelled.

[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 0.45 V.

[II] Mode…..... Output short → Activation

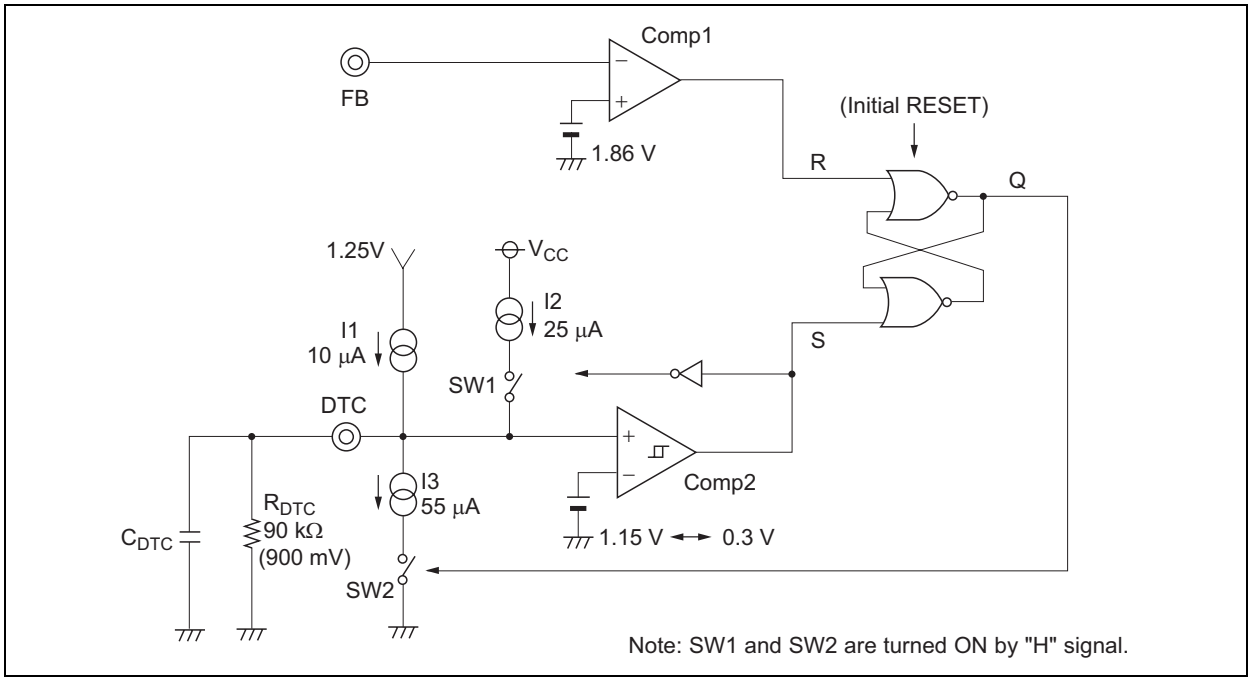
The system is activated if the FB terminal potential goes below the DTC terminal potential before the DTC terminal goes to 0.45 V. If there is not enough time, the output is turned OFF. (Latched)

[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 0.45 V.



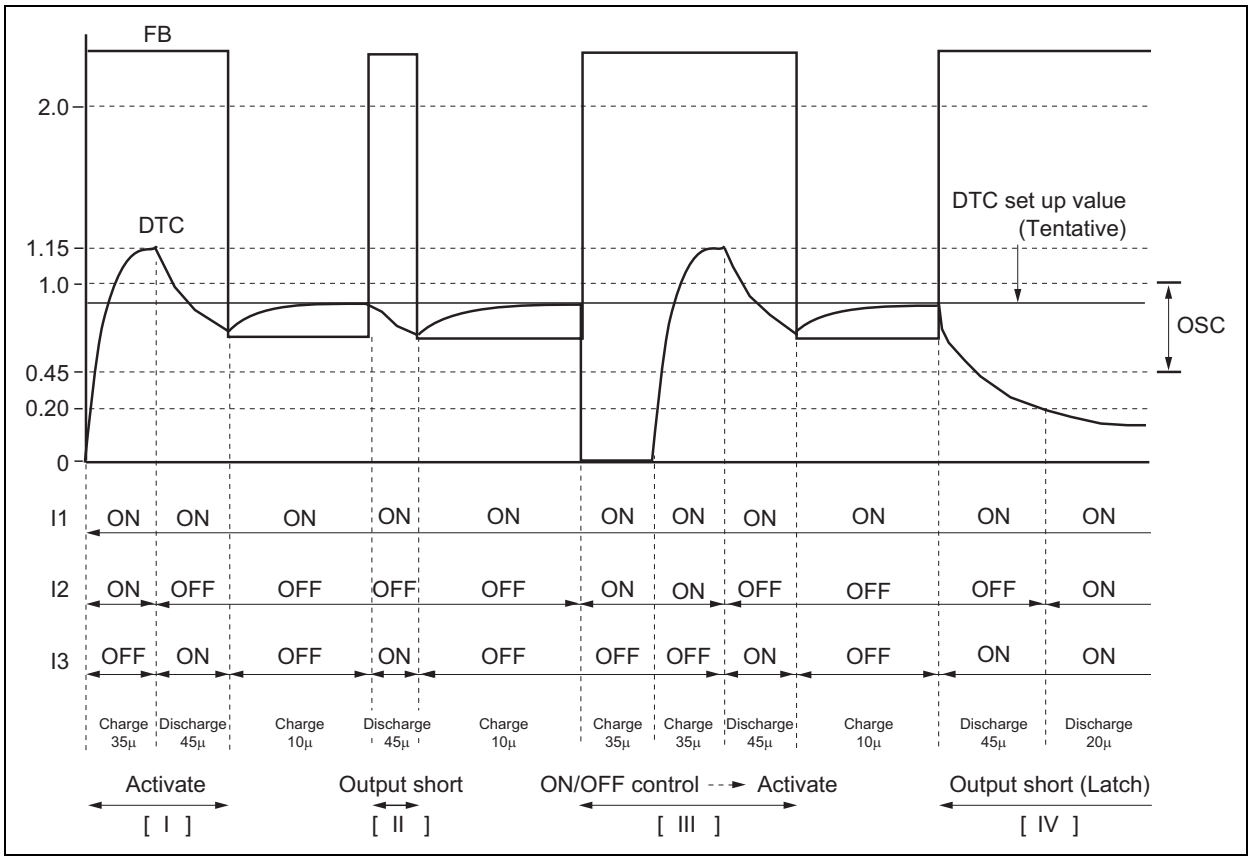
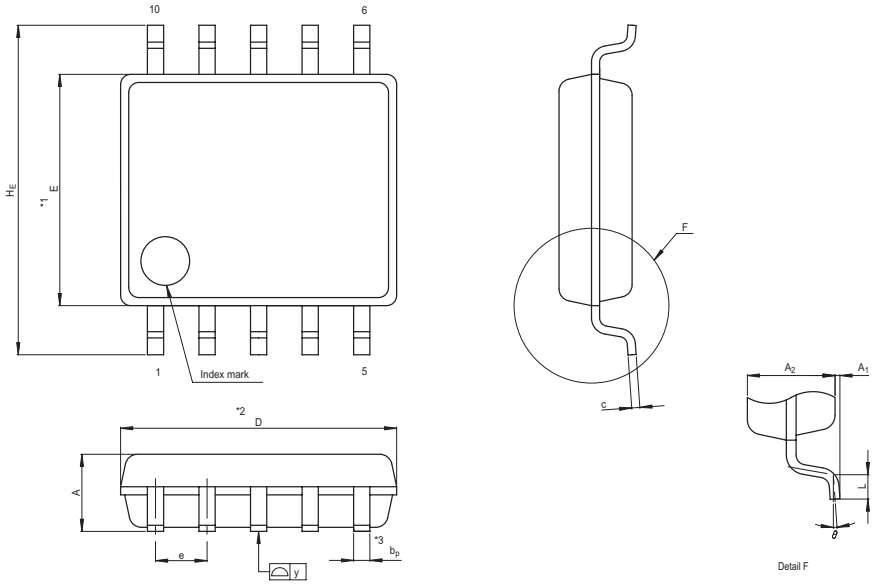


Figure 3 Short Protection Circuit and the Timing Chart of the Modes

Package Dimensions

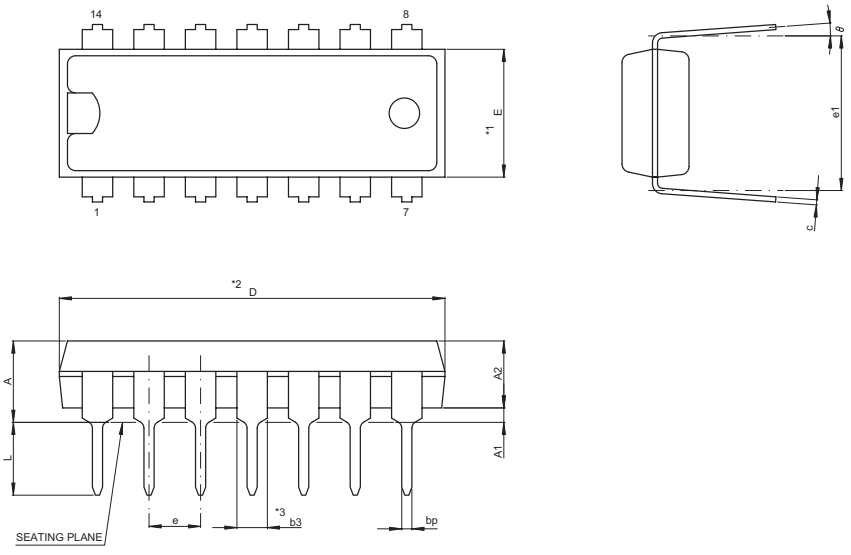
JEITA Package Code	RENESAS Code	Previous Code	MASS[Typ.]
P-SOP10-5.7x6.8-1.27	PRSP0010DB-A	10P2N-A	0.2g



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	6.7	6.8	6.9
E	5.6	5.7	5.8
A_2	—	1.8	—
A_1	0	0.1	0.2
A	—	—	2.1
b_p	0.35	0.4	0.5
c	0.18	0.2	0.25
θ	0°	—	8°
H_E	7.82	8.12	8.42
e	1.12	1.27	1.42
y	—	—	0.1
L	0.3	0.5	0.7

JEITA Package Code	RENESAS Code	Previous Code	MASS[Typ.]
P-DIP14-6.3x19-2.54	PRDP0014AA-A	14P4	1.0g



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	18.8	19.0	19.2
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_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	—	—

Renesas Technology Corp. Sales Strategic Planning Div. Nippon Bldg., 2-6-2, Ohte-machi, Chiyoda-ku, Tokyo 100-0004, Japan

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Renesas Technology America, Inc.
450 Holger Way, San Jose, CA 95134-1368, U.S.A
Tel: <1> (408) 382-7500, Fax: <1> (408) 382-7501

Renesas Technology Europe Limited
Dukes Meadow, Millboard Road, Bourne End, Buckinghamshire, SL8 5FH, U.K.
Tel: <44> (1628) 585-100, Fax: <44> (1628) 585-900

Renesas Technology (Shanghai) Co., Ltd.
Unit 204, 205, AZIACenter, No.1233 Lujiazui Ring Rd, Pudong District, Shanghai, China 200120
Tel: <86> (21) 5877-1818, Fax: <86> (21) 6887-7898

Renesas Technology Hong Kong Ltd.
7th Floor, North Tower, World Finance Centre, Harbour City, 1 Canton Road, Tsimshatsui, Kowloon, Hong Kong
Tel: <852> 2265-6688, Fax: <852> 2730-6071

Renesas Technology Taiwan Co., Ltd.
10th Floor, No.99, Fushing North Road, Taipei, Taiwan
Tel: <886> (2) 2715-2888, Fax: <886> (2) 2713-2999

Renesas Technology Singapore Pte. Ltd.
1 Harbour Front Avenue, #06-10, Keppel Bay Tower, Singapore 098632
Tel: <65> 6213-0200, Fax: <65> 6278-8001

Renesas Technology Korea Co., Ltd.
Kukje Center Bldg. 18th Fl., 191, 2-ka, Hangang-ro, Yongsan-ku, Seoul 140-702, Korea
Tel: <82> (2) 796-3115, Fax: <82> (2) 796-2145

Renesas Technology Malaysia Sdn. Bhd
Unit 906, Block B, Menara Amcorp, Amcorp Trade Centre, No.18, Jalan Persiaran Barat, 46050 Petaling Jaya, Selangor Darul Ehsan, Malaysia
Tel: <603> 7955-9390, Fax: <603> 7955-9510

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