

# M62215FP

## General Purpose Multifunction DC/DC Converter

REJ03D0844-0201  
Rev.2.01  
Nov 14, 2007

### 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.

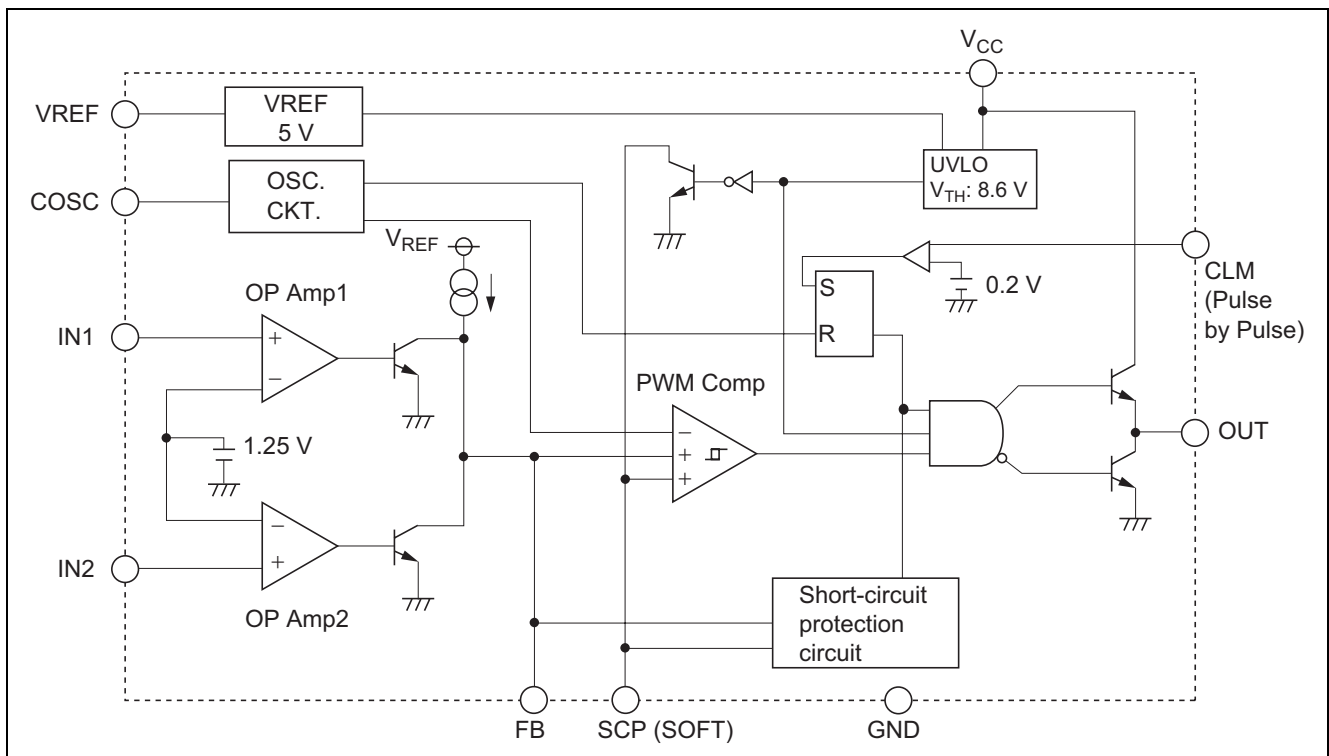
### Features

- Wide operating voltage range: 8.6 to 25 V
- High precision reference voltage: 5 V  $\pm$  1%
- 2 channel priority control operation ("High" input prioritized)
- High speed switching operation (500 kHz)
- 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  $I_O$  (peak):  $\pm$ 1 A

### Application

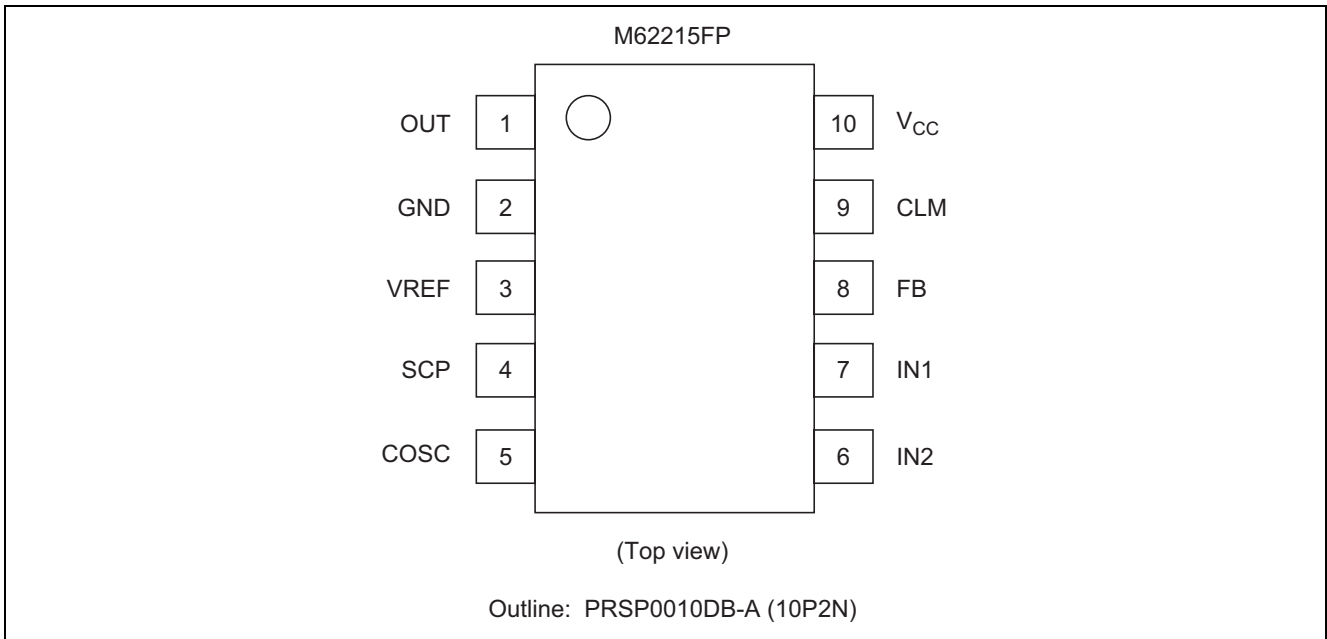
Back-light control for general electronic products such as personal computers, word processors, and portable equipments.

### Block Diagram



## Pin Arrangement

Preliminary: Some limits are subject to change



## Absolute Maximum Ratings

(Ta = 25°C, unless otherwise specified)

Item	Symbol	Ratings	Units	Conditions
Supply voltage	V <sub>CC</sub>	26	V	
Output voltage	V <sub>O</sub>	26	V	
Output current	I <sub>O</sub>	150	mA	Continuous
		1.0	A	Peak
Power dissipation	P <sub>d</sub>	440	mW	
Thermal derating	K <sub>θ</sub>	4.4	mW/°C	
Operating temperature	T <sub>opr</sub>	-20 to +85	°C	
Storage temperature	T <sub>stg</sub>	-40 to +150	°C	

## Electrical Characteristics

(Ta = 25°C, V<sub>CC</sub> = 12 V, C<sub>OSC</sub> = 390 pF, I<sub>REF</sub> = -5 mA, unless otherwise specified)

Block	Item	Symbol	Limits			Units	Test Condition
			Min	Typ	Max		
All	Supply voltage range	V <sub>CC</sub>	VTHON	—	25	V	
	Circuit current	I <sub>CC ST</sub>	7.5	9.5	12.5	mA	I <sub>REF</sub> = no load
Ref. voltage block	Reference voltage	V <sub>REF</sub>	4.95	5.00	5.05	V	
	Max. reference current	I <sub>REF</sub>	-10	—	—	mA	
	Line regulation	LINE	0.0	2.5	12.0	mV	V <sub>CC</sub> = 8.6 to 15 V
Error Amp. block	Input bias current	I <sub>B</sub>	-500	—	—	nA	V <sub>IN1</sub> = 1 V, V <sub>IN2</sub> = 1 V
	Open loop gain	A <sub>V</sub>	—	70	—	dB	
	Gain-bandwidth product	GB	—	—	0.6	MHz	
	Max. output voltage+	V <sub>OM+</sub>	4.75	4.97	5.25	V	
	Max. output voltage-	V <sub>OM-</sub>	0	280	400	mV	
	Output sink current	I <sub>OM+</sub>	3.9	5.5	20.0	mA	V <sub>FB</sub> = 2.5 V
	Output source current	I <sub>OM-</sub>	-1.5	-1.1	-0.8	mA	V <sub>IN1</sub> = 1 V, V <sub>IN2</sub> = 1 V
	Reference voltage of amp	V <sub>RA</sub>	1.225	1.250	1.275	V	
OSC. block	Oscillation frequency	f <sub>OSC</sub>	73	105	137	kHz	
	OSC. upper limit voltage	V <sub>OSCH</sub>	3.255	3.500	3.745	V	
	OSC. lower limit voltage	V <sub>OSCL</sub>	1.395	1.500	1.605	V	
UVLO block	ON threshold voltage	V <sub>TH ON</sub>	7.998	8.600	9.202	V	
	OFF threshold voltage	V <sub>TH OFF</sub>	7.068	7.600	8.132	V	
	Hysteresis	V <sub>HYS</sub>	0.8	1.0	1.2	mV	V <sub>HYS</sub> = V <sub>THON</sub> - V <sub>THOFF</sub>
Short circuit protect. block	SCP threshold voltage	V <sub>TH SCP</sub>	4.75	5.00	5.25	V	V <sub>IN1</sub> = 1 V, V <sub>IN2</sub> = 1 V
	SCP term. output current	I <sub>SCPOUT</sub>	-26	-20	-14	μA	
	FB threshold voltage	V <sub>TH FB</sub>	3.99	4.20	4.41	V	
Output	Maximum ON duty	Dutymax	85	90	95	%	
	Output low voltage	VOL1	0.00	0.05	0.40	V	V <sub>CC</sub> = 12 V, I <sub>O</sub> = 10 mA
		VOL2	0.00	0.80	1.40	V	V <sub>CC</sub> = 12 V, I <sub>O</sub> = 100 mA
	Output high voltage	VOH1	10.0	10.5	12.0	V	V <sub>CC</sub> = 12 V, I <sub>O</sub> = -10 mA
VOH2		9.5	10.0	12.0	V	V <sub>CC</sub> = 12 V, I <sub>O</sub> = -100 mA	
CLM	CLM threshold voltage	V <sub>THCLM</sub>	180	200	220	mV	
	CLM flow-out current	I <sub>OUTCLM</sub>	-290	-225	-150	μA	
	CLM delay time	TPDCLM	—	100	—	ns	Delay time to out terminal

Application Circuit

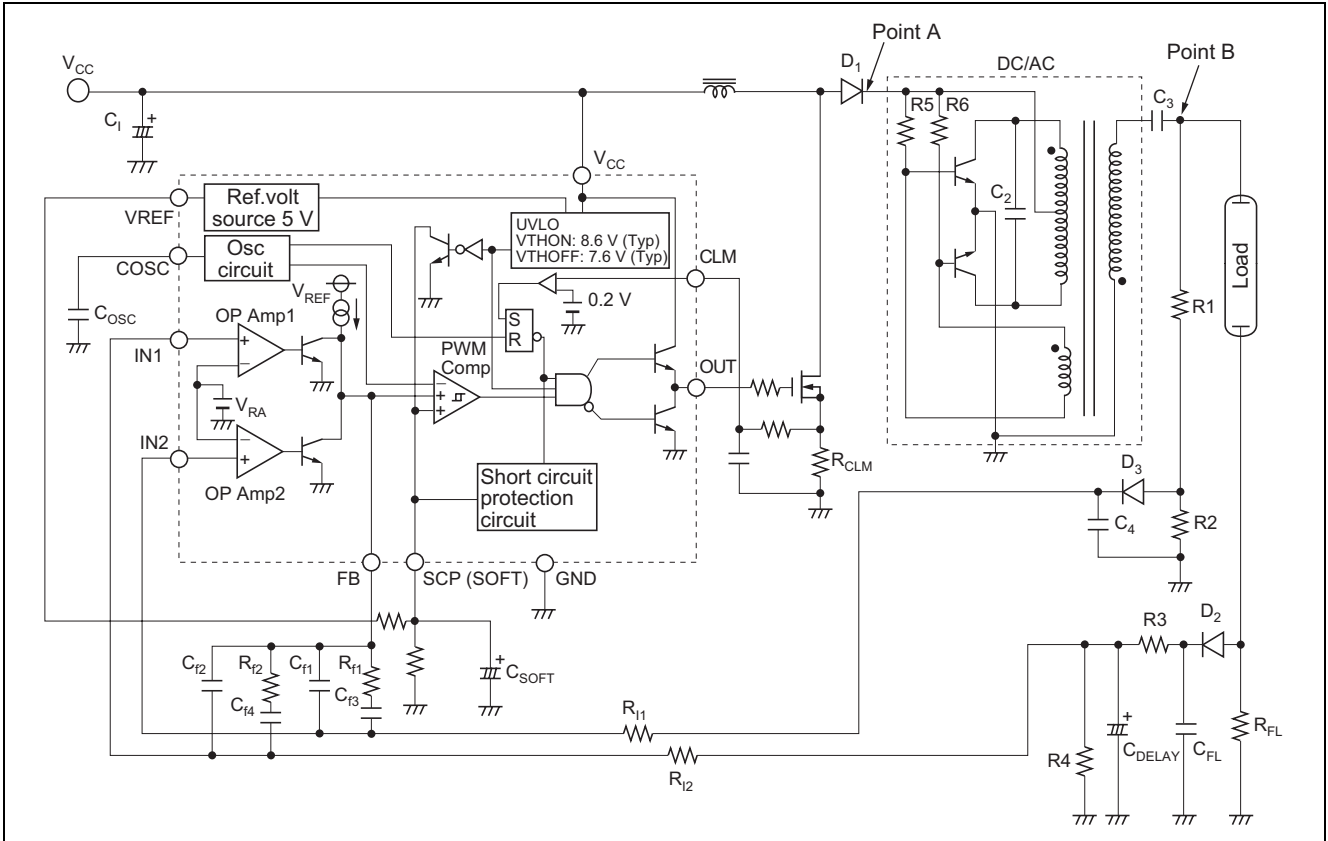


Figure 1 Application Circuit Example

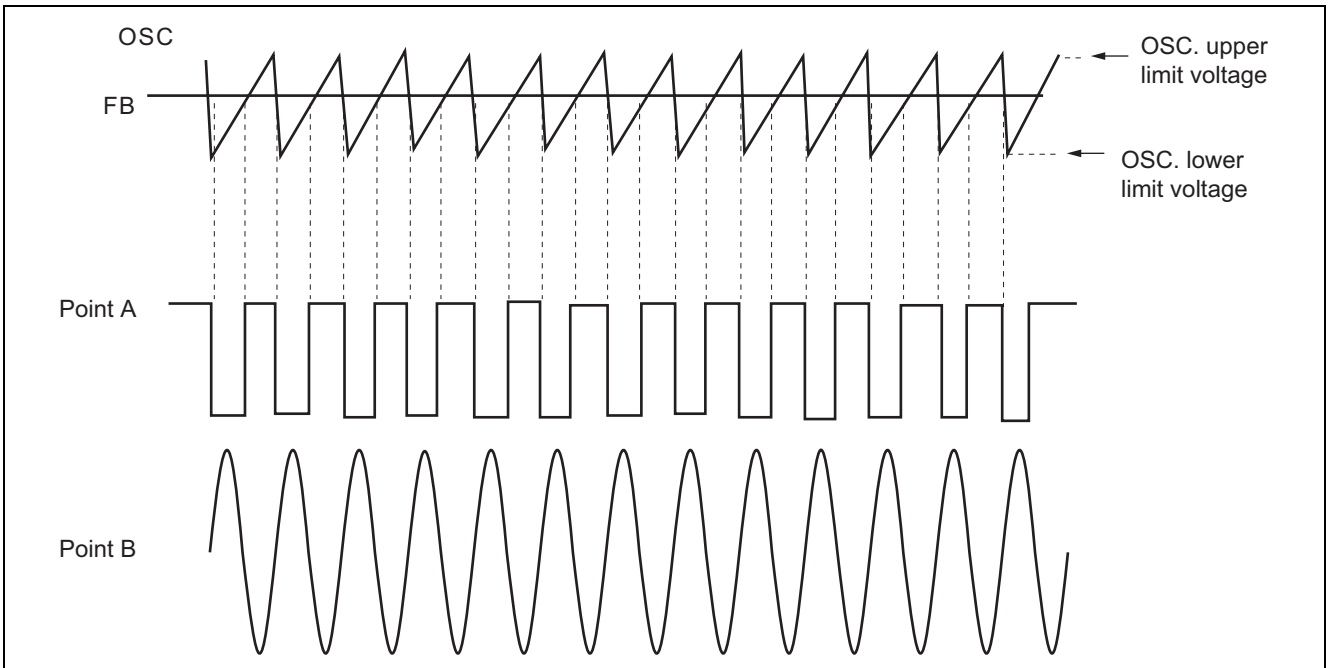


Figure 2 Voltage Waveform

## 1. Priority Function

As far as OP Amp1 and OP Amp2 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 Figure 3,  $V_{O1}$  is set to 24 V and  $V_{O2}$  is set to 15 V for each output voltage.

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

Output voltage  $V_O$  is calculated with the following equation,

$$V_O = V_{RA} \times (R1 + R2) / R2 \quad (V_{RA} = 1.25 \text{ V typ.})$$

and  $V_{O1}$  set to 24 V.

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  $V_O$  is calculated with the following equation,

$$V_O = V_{RA} \times (R3 + R4) / R4 \quad (V_{RA} = 1.25 \text{ V typ.})$$

and  $V_{O2}$  set to 15 V.

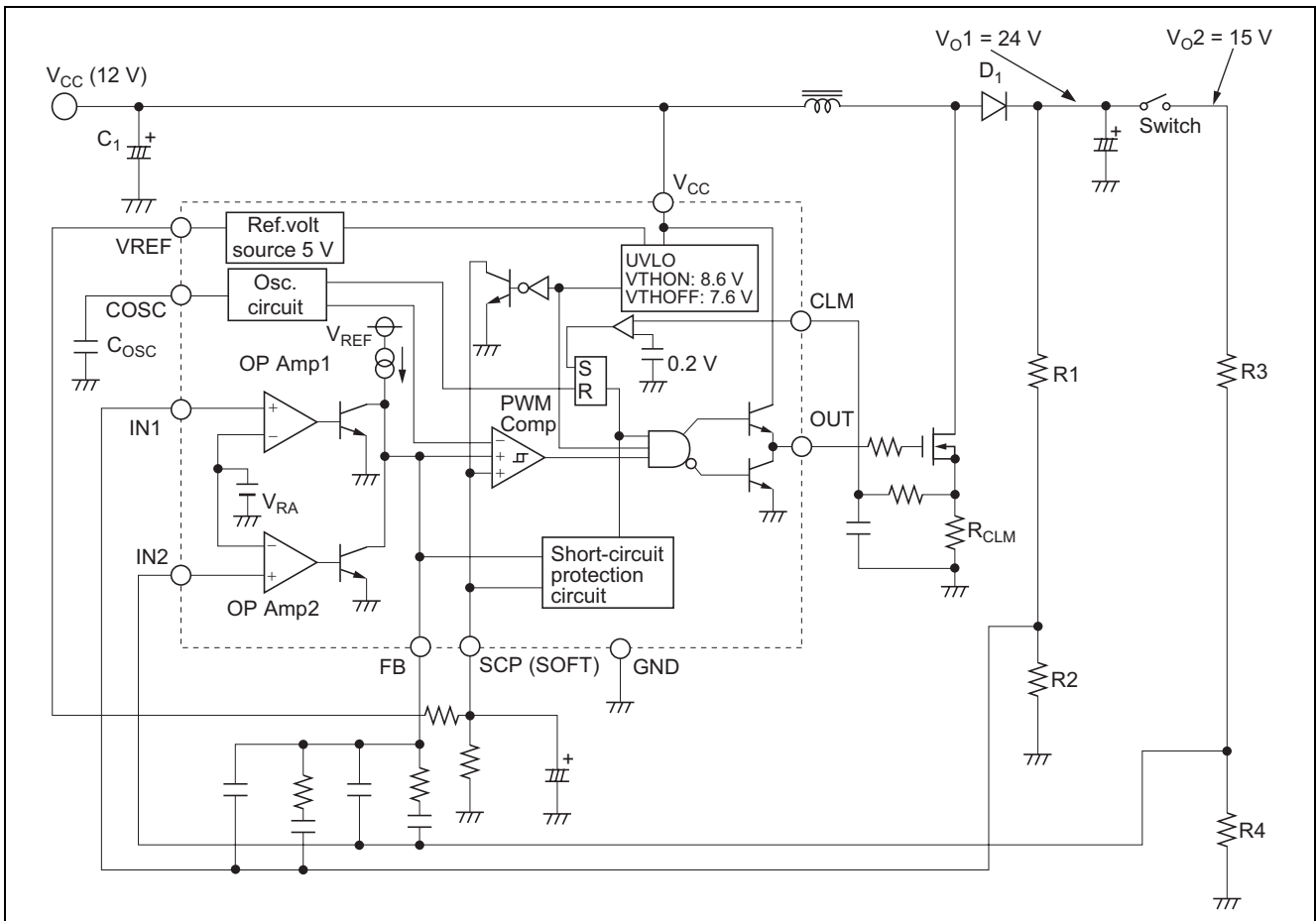


Figure 3 Application Circuit Example

## 2. Soft Start Function, Maximum ON Duty Setting and Short-circuit Protection

### 1) Soft start function (Refer to Figure 4 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 0 V, because the internal charge current and the current flowing from the resistors dividing VREF are charged to C<sub>SCP</sub>.

When SCP terminal voltage reaches to the lower limit voltage of triangular waveform, output starts to operate making DC/DC converter output voltage V<sub>O</sub> rise up.

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

$$V_{SCP} = \frac{5 \cdot R_2 + 20 \mu A \cdot R_1 \cdot R_2}{(R_1 + R_2)} - \frac{5 \cdot R_2 + 20 \mu A \cdot R_1 \cdot R_2}{(R_1 + R_2)} \cdot e^{-\frac{(R_1 + R_2)}{C \cdot R_1 \cdot R_2} t}$$

Note: V<sub>SCP</sub> in this case is the voltage when output starts to operate. (equal to lower limit voltage of triangular waveform)

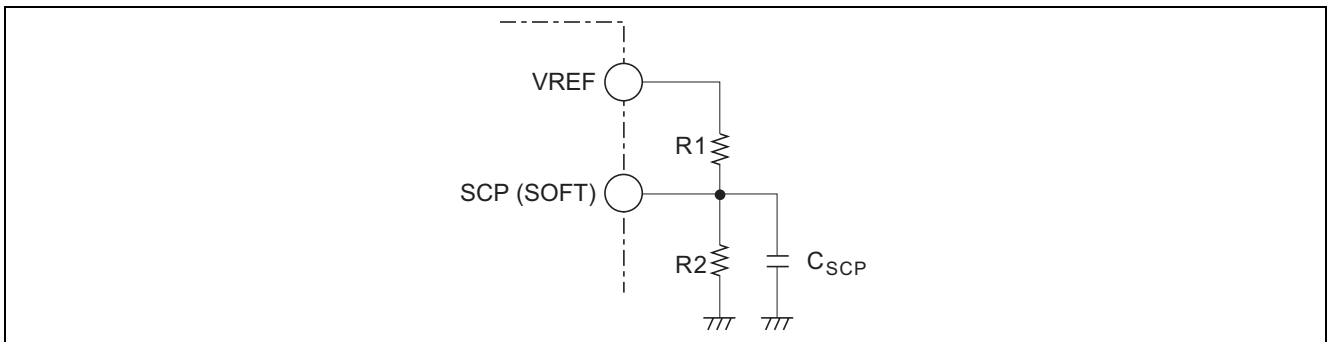


Figure 4

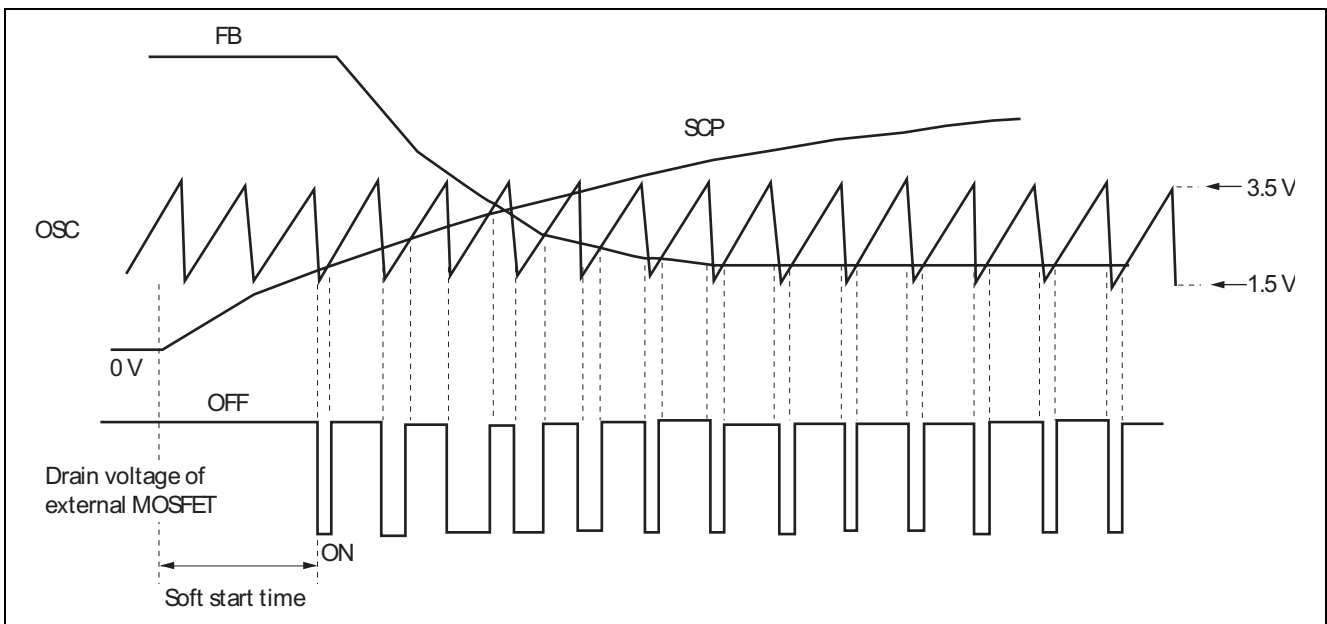


Figure 5

## 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. 20  $\mu$ A, R2 should be approx. 330 k $\Omega$  or more.

— when timer latch is not used

R2 should be approx. 180 k $\Omega$  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 Figure 7 and the timing chart for each mode in Figure 6.

When power is turned on, FB terminal voltage is high (approx. 4.6 V), SCP terminal voltage low. (gradually rising from 0 V)

Approximately 20  $\mu$ A 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 20  $\mu$ A 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 4.2 V or more)

SCP terminal voltage rises, by this 20  $\mu$ A 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 5 V.

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 V<sub>CC</sub> on again.
2. Make FB terminal voltage 4.2 V or less for cancellation.

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

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

Note: 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. 5 V)

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 20  $\mu$ A charge current flows out from 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.

More [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 V<sub>CC</sub> again

The mode in which V<sub>CC</sub> 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.

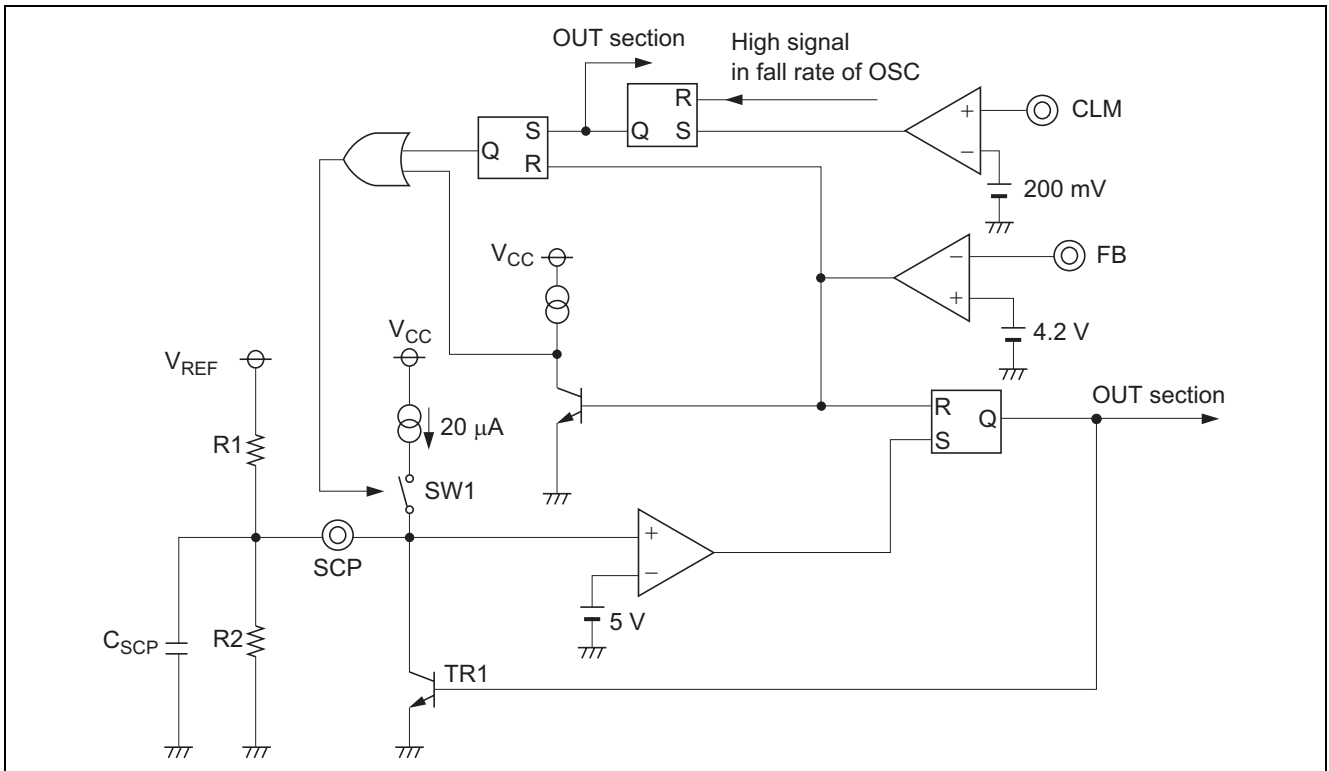


Figure 6 Schematic Diagram of SCP Section



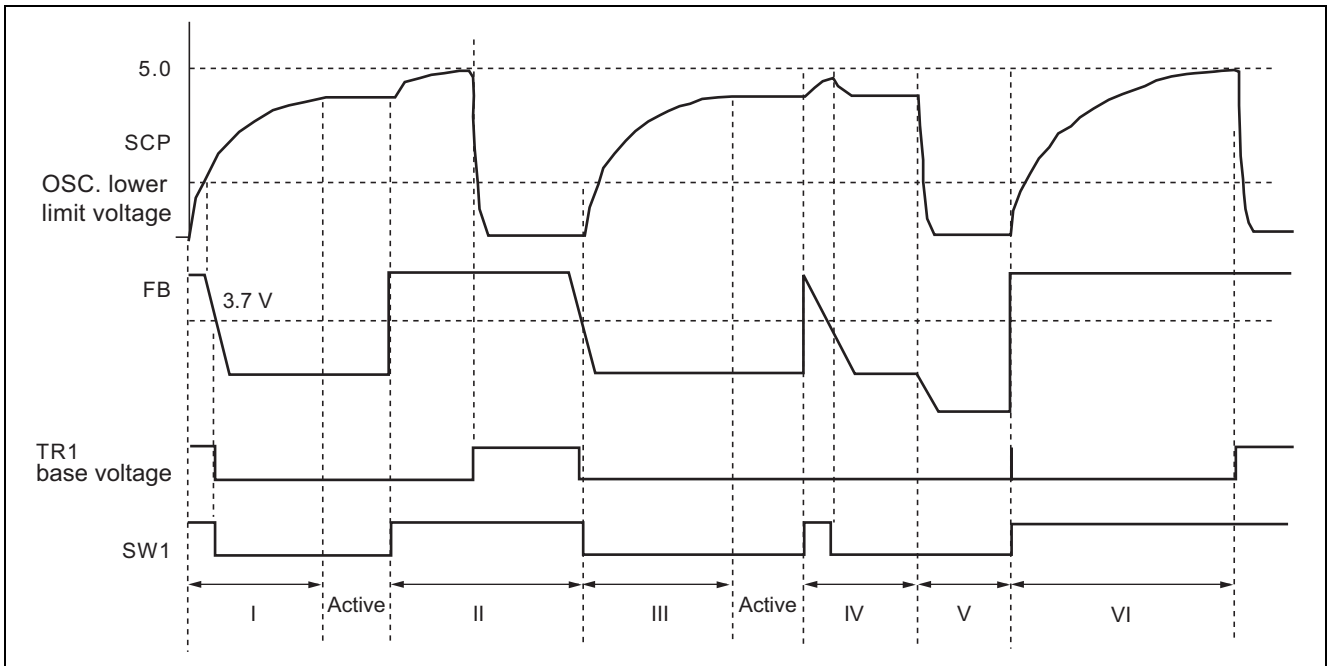


Figure 7 SCP Timing Chart

4) Oscillation frequency

Oscillation frequency is set by capacitance connected to OSC terminal.

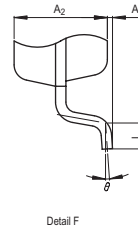
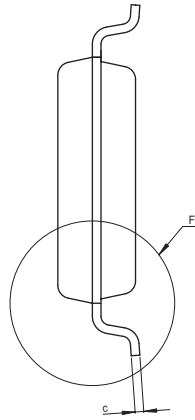
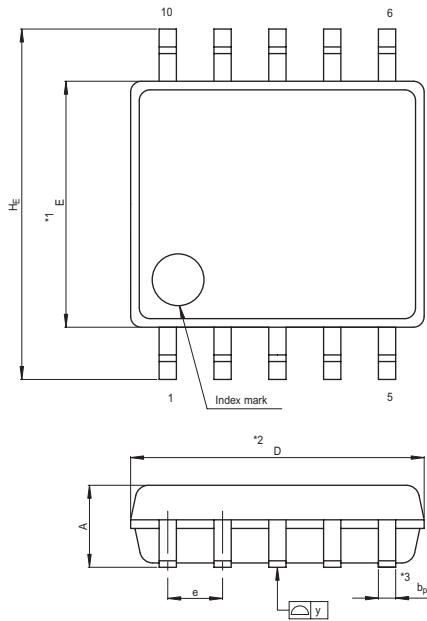
Oscillating triangular waveform: Charge time: Discharge time = 9 : 1

Oscillation frequency ( $f_{osc}$ ) is given as:

$$f_{osc} \approx \frac{1}{23.62 \times 10^3 \times C + 9 \times 10^{-7}}$$

### 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 <sub>2</sub>	—	1.8	—
A <sub>1</sub>	0	0.1	0.2
A	—	—	2.1
b <sub>p</sub>	0.35	0.4	0.5
c	0.18	0.2	0.25
θ	0°	—	8°
H <sub>E</sub>	7.82	8.12	8.42
e	1.12	1.27	1.42
y	—	—	0.1
L	0.3	0.5	0.7

Notes:

1. This document is provided for reference purposes only so that Renesas customers may select the appropriate Renesas products for their use. Renesas neither makes warranties or representations with respect to the accuracy or completeness of the information contained in this document nor grants any license to any intellectual property rights or any other rights of Renesas or any third party with respect to the information in this document.
2. Renesas shall have no liability for damages or infringement of any intellectual property or other rights arising out of the use of any information in this document, including, but not limited to, product data, diagrams, charts, programs, algorithms, and application circuit examples.
3. You should not use the products or the technology described in this document for the purpose of military applications such as the development of weapons of mass destruction or for the purpose of any other military use. When exporting the products or technology described herein, you should follow the applicable export control laws and regulations, and procedures required by such laws and regulations.
4. All information included in this document such as product data, diagrams, charts, programs, algorithms, and application circuit examples, is current as of the date this document is issued. Such information, however, is subject to change without any prior notice. Before purchasing or using any Renesas products listed in this document, please confirm the latest product information with a Renesas sales office. Also, please pay regular and careful attention to additional and different information to be disclosed by Renesas such as that disclosed through our website. (<http://www.renesas.com>)
5. Renesas has used reasonable care in compiling the information included in this document, but Renesas assumes no liability whatsoever for any damages incurred as a result of errors or omissions in the information included in this document.
6. When using or otherwise relying on the information in this document, you should evaluate the information in light of the total system before deciding about the applicability of such information to the intended application. Renesas makes no representations, warranties or guarantees regarding the suitability of its products for any particular application and specifically disclaims any liability arising out of the application and use of the information in this document or Renesas products.
7. With the exception of products specified by Renesas as suitable for automobile applications, Renesas products are not designed, manufactured or tested for applications or otherwise in systems the failure or malfunction of which may cause a direct threat to human life or create a risk of human injury or which require especially high quality and reliability such as safety systems, or equipment or systems for transportation and traffic, healthcare, combustion control, aerospace and aeronautics, nuclear power, or undersea communication transmission. If you are considering the use of our products for such purposes, please contact a Renesas sales office beforehand. Renesas shall have no liability for damages arising out of the uses set forth above.
8. Notwithstanding the preceding paragraph, you should not use Renesas products for the purposes listed below:
  - (1) artificial life support devices or systems
  - (2) surgical implantations
  - (3) healthcare intervention (e.g., excision, administration of medication, etc.)
  - (4) any other purposes that pose a direct threat to human lifeRenesas shall have no liability for damages arising out of the uses set forth in the above and purchasers who elect to use Renesas products in any of the foregoing applications shall indemnify and hold harmless Renesas Technology Corp., its affiliated companies and their officers, directors, and employees against any and all damages arising out of such applications.
9. You should use the products described herein within the range specified by Renesas, especially with respect to the maximum rating, operating supply voltage range, movement power voltage range, heat radiation characteristics, installation and other product characteristics. Renesas shall have no liability for malfunctions or damages arising out of the use of Renesas products beyond such specified ranges.
10. Although Renesas endeavors to improve the quality and reliability of its products, IC products have specific characteristics such as the occurrence of failure at a certain rate and malfunctions under certain use conditions. Please be sure to implement safety measures to guard against the possibility of physical injury, and injury or damage caused by fire in the event of the failure of a Renesas product, such as safety design for hardware and software including but not limited to redundancy, fire control and malfunction prevention, appropriate treatment for aging degradation or any other applicable measures. Among others, since the evaluation of microcomputer software alone is very difficult, please evaluate the safety of the final products or system manufactured by you.
11. In case Renesas products listed in this document are detached from the products to which the Renesas products are attached or affixed, the risk of accident such as swallowing by infants and small children is very high. You should implement safety measures so that Renesas products may not be easily detached from your products. Renesas shall have no liability for damages arising out of such detachment.
12. This document may not be reproduced or duplicated, in any form, in whole or in part, without prior written approval from Renesas.
13. Please contact a Renesas sales office if you have any questions regarding the information contained in this document, Renesas semiconductor products, or if you have any other inquiries.



**RENESAS SALES OFFICES**

<http://www.renesas.com>

Refer to "<http://www.renesas.com/en/network>" for the latest and detailed information.

**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