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.

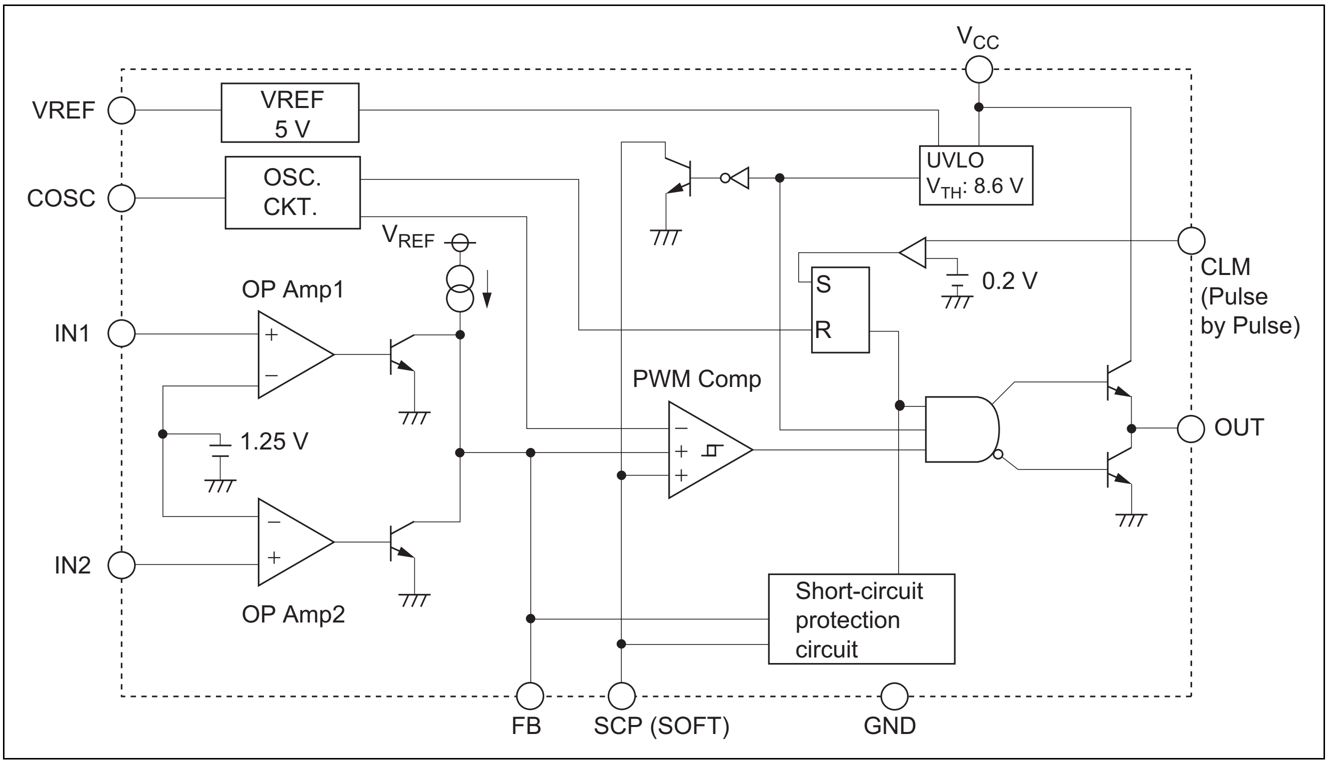
Features

- Wide operating voltage range: 8.6 to 25 V
- High precision reference voltage: 5 V ± 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): ±1 A

Application

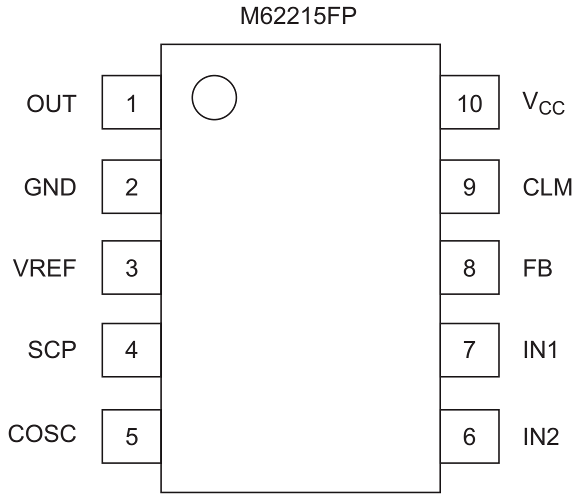
Back-light control for general electronic products such as personal computers, word processors, and portable equipments.

Block Diagram



Pin Arrangement

Preliminary: Some limits are subject to change



(Top view)

Outline: PRSP0010DB-A (10P2N)

Absolute Maximum Ratings

(Ta = 25°C, unless otherwise specified)

Item	Symbol	Ratings	Units	Conditions
Supply voltage	V_{CC}	26	V	
Output voltage	V_O	26	V	
Output current	I_O	150	mA	Continuous
		1.0	A	Peak
Power dissipation	Pd	440	mW	
Thermal derating	Kθ	4.4	mW/°C	
Operating 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, I_{REF} = –5 mA, unless otherwise specified)

Block	Item	Symbol	Limits			Units	Test Condition
			Min	Typ	Max		
All	Supply voltage range	V_{CC}	VTHON	—	25	V	
	Circuit current	$I_{CC\ ST}$	7.5	9.5	12.5	mA	I_{REF} = no load
Ref. voltage block	Reference voltage	V_{REF}	4.95	5.00	5.05	V	
	Max. reference current	I_{REF}	–10	—	—	mA	
	Line regulation	LINE	0.0	2.5	12.0	mV	V_{CC} = 8.6 to 15 V
Error Amp. block	Input bias current	IB	–500	—	—	nA	VIN1 = 1 V, VIN2 = 1 V
	Open loop gain	AV	—	70	—	dB	
	Gain-bandwidth product	GB	—	—	0.6	MHz	
	Max. output voltage+	VOM+	4.75	4.97	5.25	V	
	Max. output voltage–	VOM–	0	280	400	mV	
	Output sink current	IOM+	3.9	5.5	20.0	mA	VFB = 2.5 V
	Output source current	IOM–	–1.5	–1.1	–0.8	mA	VIN1 = 1 V, VIN2 = 1 V
	Reference voltage of amp	V_{RA}	1.225	1.250	1.275	V	
OSC. block	Oscillation frequency	f_{OSC}	73	105	137	kHz	
	OSC. upper limit voltage	VOSCH	3.255	3.500	3.745	V	
	OSC. lower limit voltage	VOSCL	1.395	1.500	1.605	V	
UVLO block	ON threshold voltage	VTH ON	7.998	8.600	9.202	V	
	OFF threshold voltage	VTH OFF	7.068	7.600	8.132	V	
	Hysteresis	VHYS	0.8	1.0	1.2	mV	VHYS = VTHON – VTHOFF
Short circuit protect. block	SCP threshold voltage	VTH SCP	4.75	5.00	5.25	V	VIN1 = 1 V, VIN2 = 1 V
	SCP term. output current	I_{SCPOUT}	–26	–20	–14	µA	
	FB threshold voltage	VTH FB	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_{CC} = 12 V, I_O = 10 mA
		VOL2	0.00	0.80	1.40	V	V_{CC} = 12 V, I_O = 100 mA
	Output high voltage	VOH1	10.0	10.5	12.0	V	V_{CC} = 12 V, I_O = –10 mA
		VOH2	9.5	10.0	12.0	V	V_{CC} = 12 V, I_O = –100 mA
CLM	CLM threshold voltage	VTHCLM	180	200	220	mV	
	CLM flow-out current	IOUTCLM	–290	–225	–150	µA	
	CLM delay time	TPDCLM	—	100	—	ns	Delay time to out terminal

Application Circuit

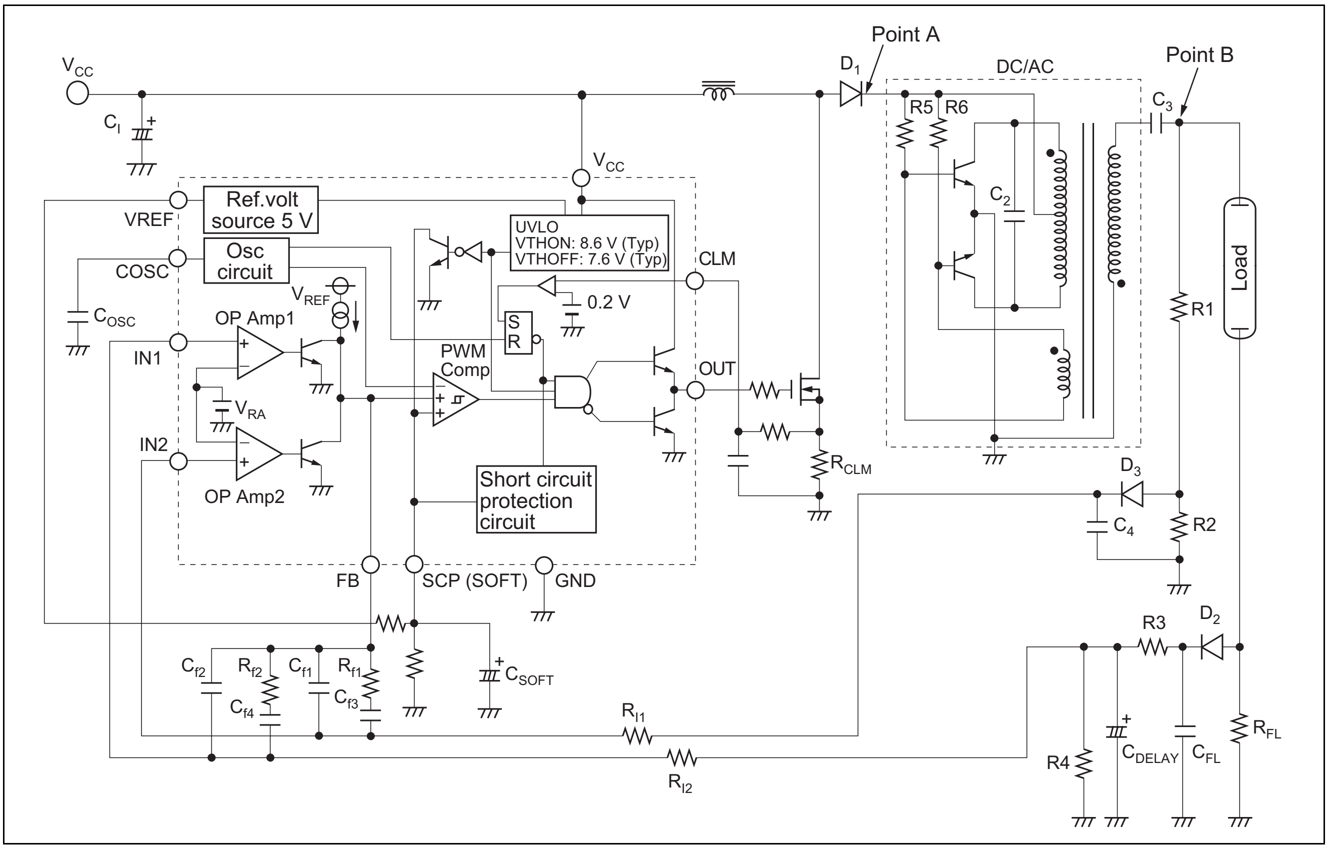


Figure 1 Application Circuit Example

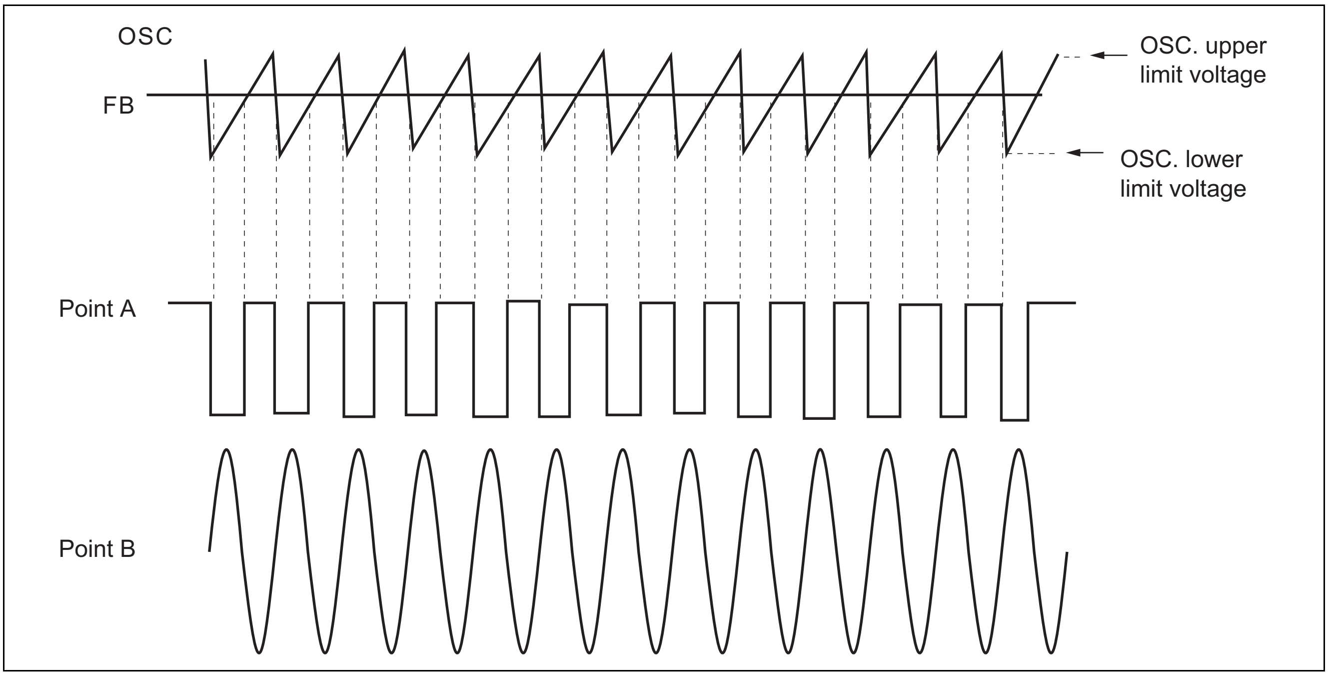


Figure 2 Voltage Waveform

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,

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

   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,

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

   and V_O2 set to 15 V.

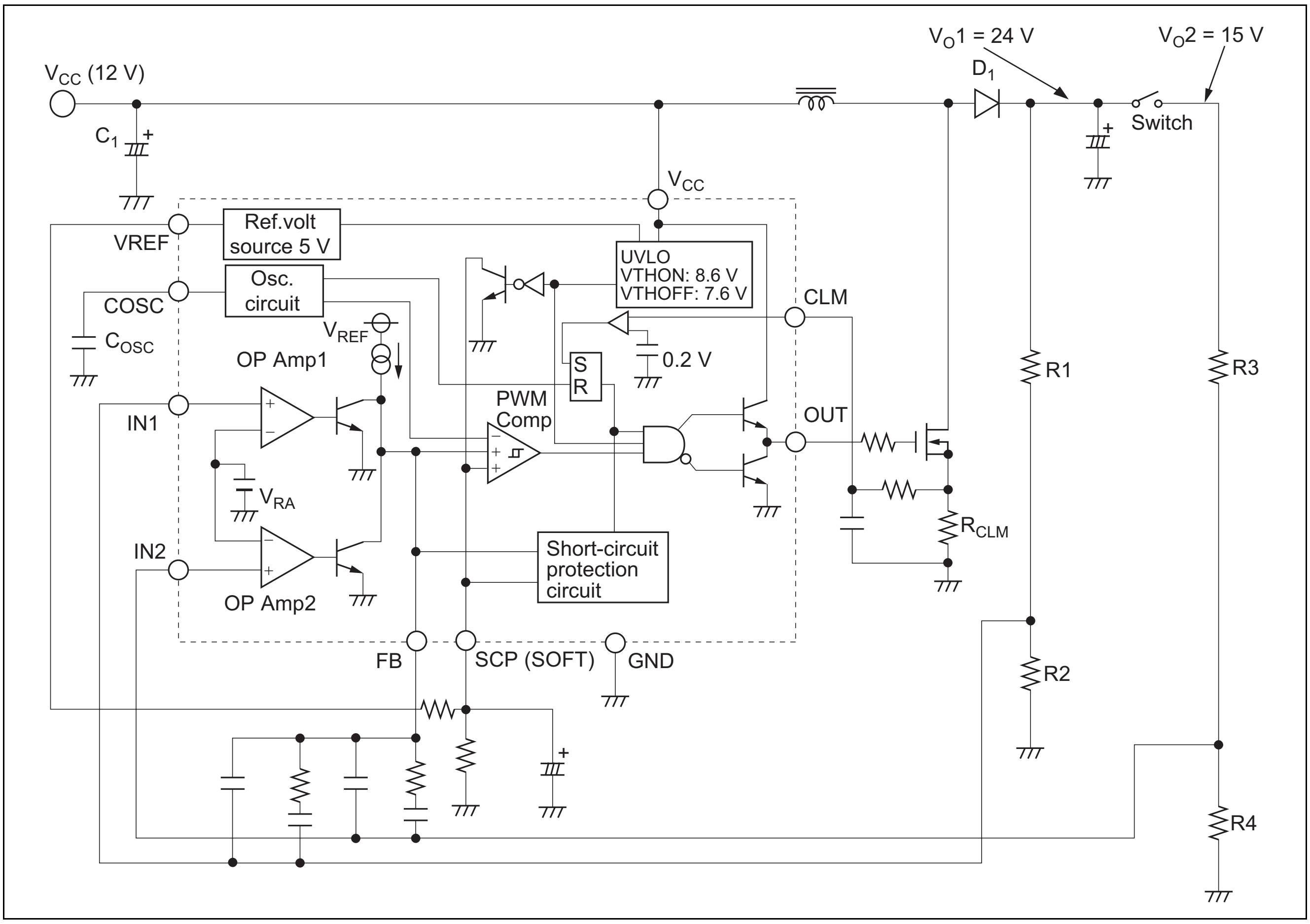


Figure 3 Application Circuit Example

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_{SCP}.
When SCP terminal voltage reaches to the lower limit voltage of triangular waveform, output starts to operate making DC/DC converter output voltage V_O rise up.
Soft start time is calculated by the following equation, (Internal charge current is designed as approx. 20 µA)

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

Note: VSCP in this case is the voltage when output starts to operate. (equal to lower limit voltage of triangular waveform)

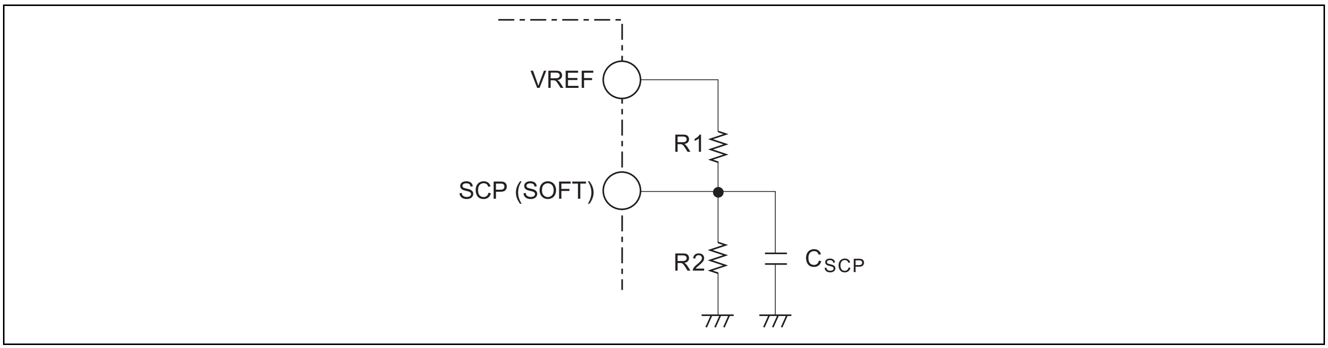


Figure 4

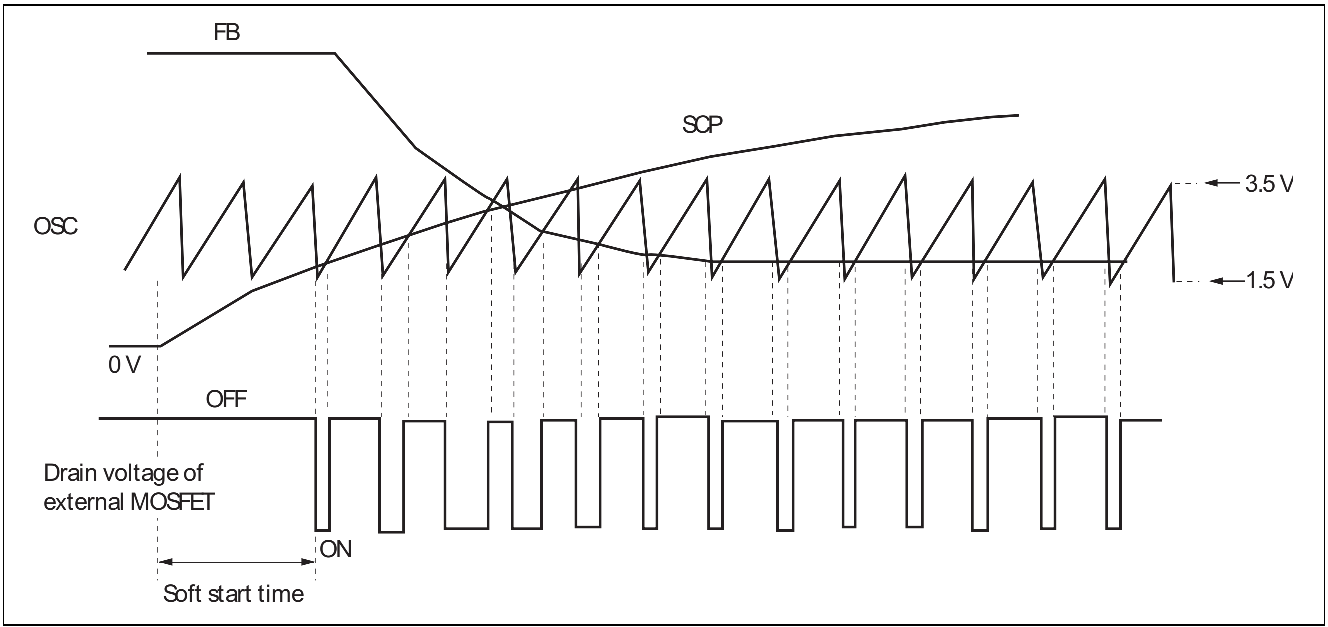


Figure 5

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 µA, R2 should be approx. 330 kΩ or more.
— when timer latch is not used
R2 should be approx. 180 kΩ 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 µA 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 µA 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 µA 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_{CC} 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.

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

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 µA 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_{CC} again

The mode in which V_{CC} 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.

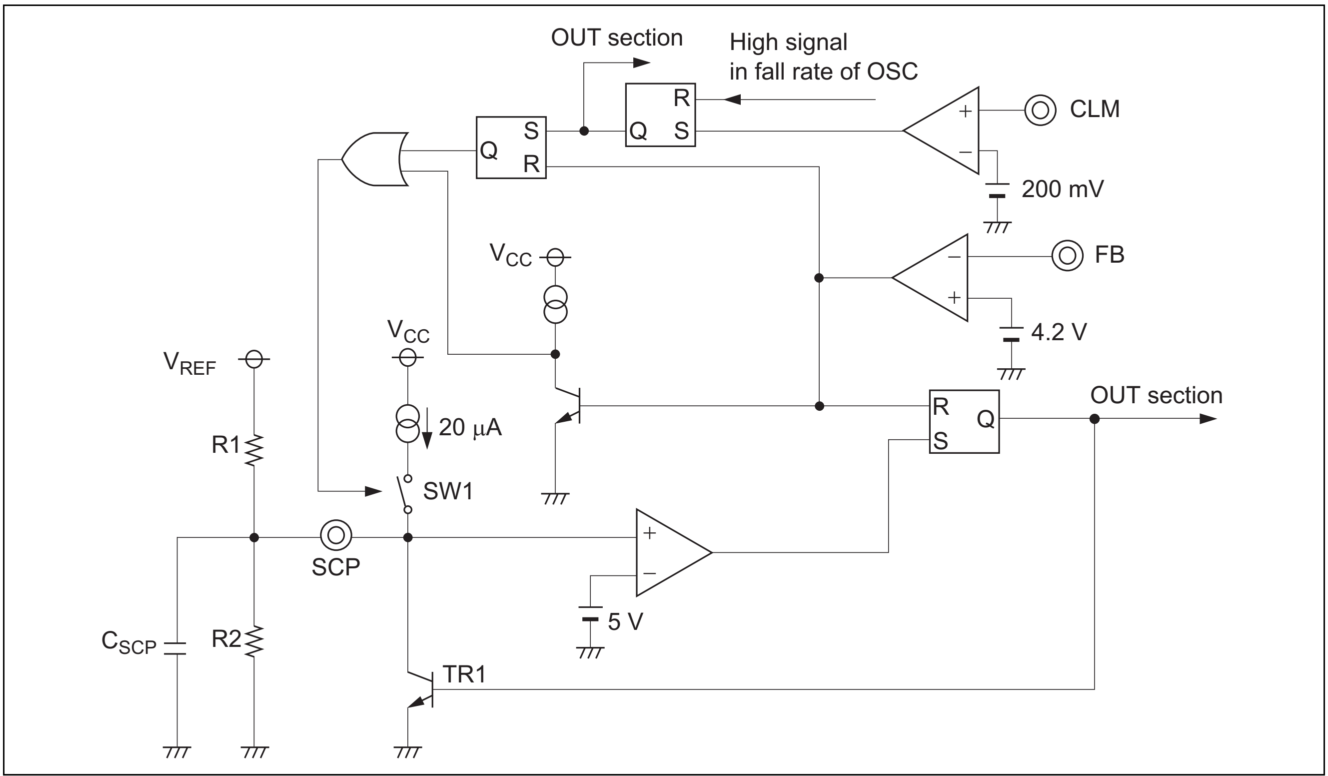


Figure 6 Schematic Diagram of SCP Section

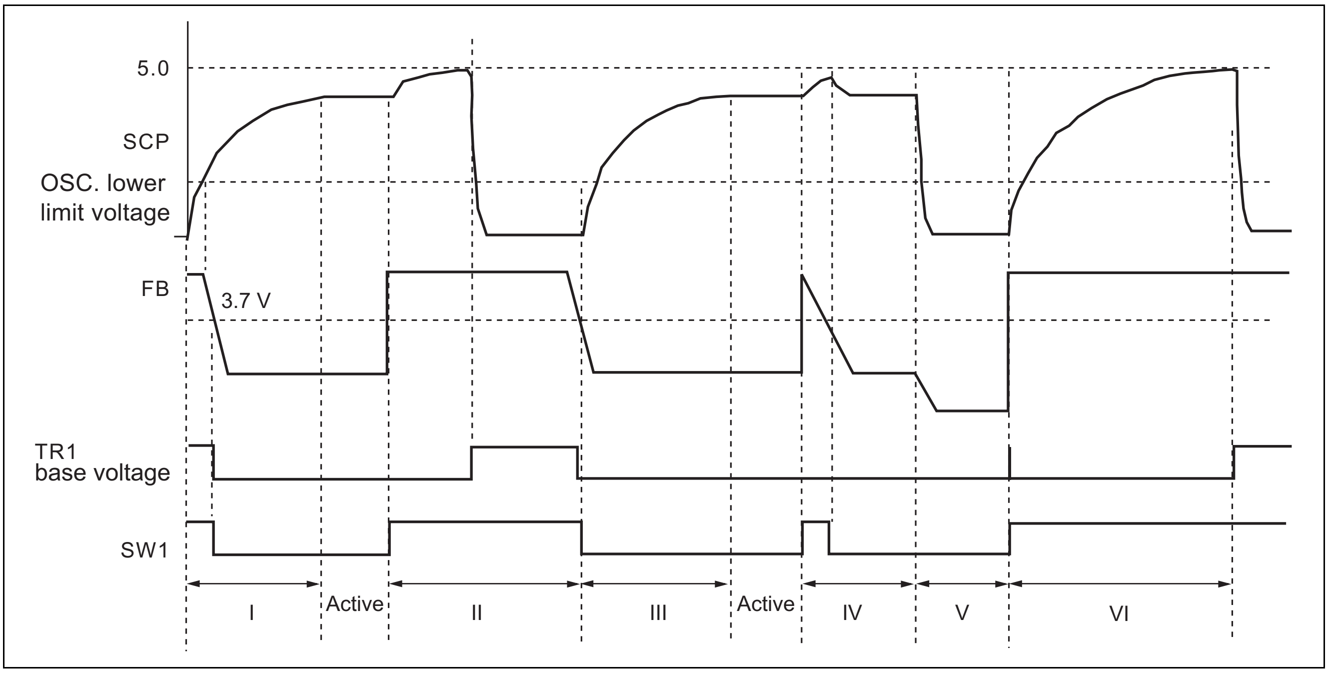


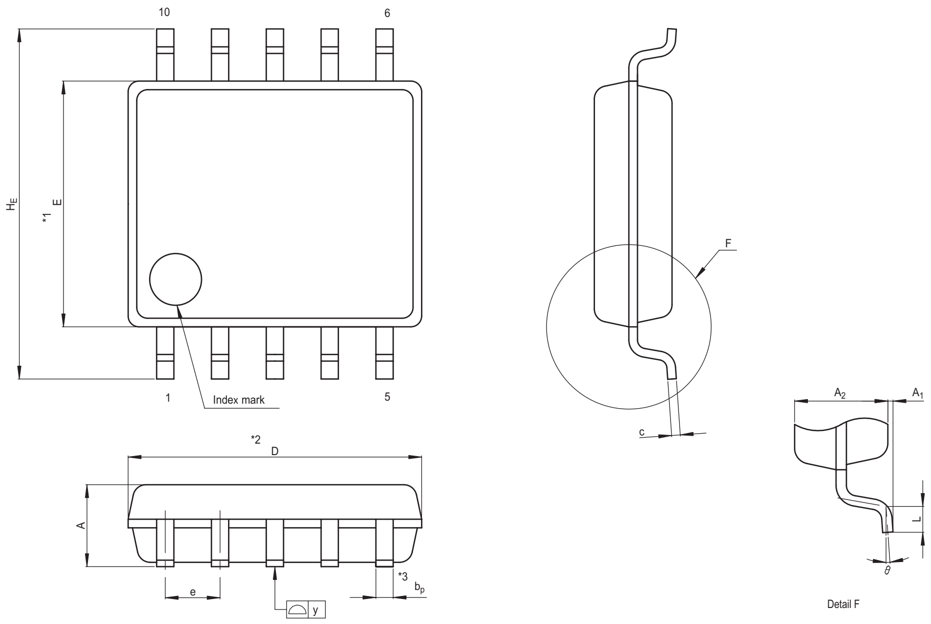
Figure 7 SCP Timing Chart

4) Oscillation frequency
   Oscillation frequency is set by capacitance connected to OSC terminal.
   Oscillating triangular waveform: Charge time: Discharge time = 9 : l
   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_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

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