M62212P/FP/GP

General Purpose DC/DC Converter

REJ03D0843-0200
Rev.2.00
Jun 14, 2006

Description

M62212 is designed as a general purpose DC/DC converter.

This small 8-pin package contains many functions allowing simpler peripheral circuits and compact set design.

The output transistor is open collector and emitter follower type. This makes the control STEP-UP, STEP-DOWN and INVERTING converter.

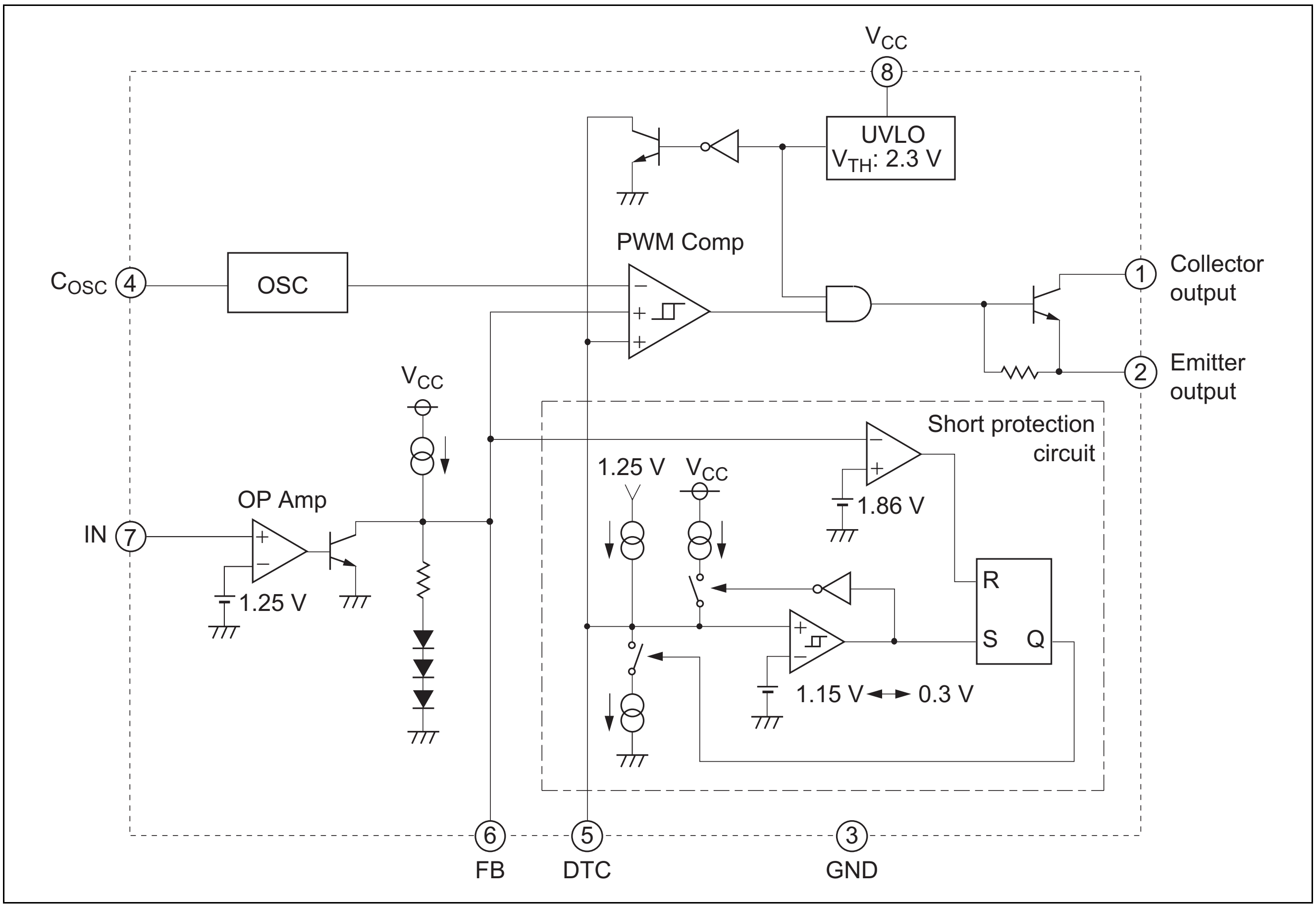
Feature

- Wide operation power supply voltage range…….. 2.5 to 18 V
- Low power consumption……….…..…….……… 1.3 mA typ
- High speed switching is possible (300 kHz).
- Output short protection circuit and ON/OFF control are used.
  The dead-time control and the soft-start operation are possible
- Package variation: 8-pin DIP/SOP/SSOP8

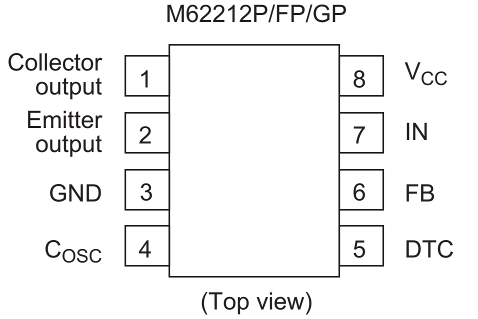
Applications

General electric products, DC/DC converter

Block Diagram



Pin Arrangement



Outline: PRDP0008AA-A (8P4) [P]
PRSP0008DA-A (8P2S-A) [FP]
8P2X-A (SSOP-8) [GP]

Absolute Maximum Ratings

(Ta = 25°C, unless otherwise noted)

Item	Symbol	Ratings	Units	Conditions
Power supply voltage	V_{CC}	19	V	
Output voltage	V_O	19	V	
Output current	I_O	150	mA	
Power dissipation	Pd	625 (P) 360 (FP) 250 (GP)	mW	Ta = 25°C
Thermal derating ratio	Kθ	5.00 (P) 2.88 (FP) 2.00 (GP)	mW/°C	Ta > 25°C
Operating ambient temperature	Topr	–20°C to +85	°C	
Storage temperature	Tstg	–40°C to +125	°C	

Electrical Characteristics

(Ta = 25°C, V_{CC} = 12 V, C_{OSC} = 100 pF, unless otherwise noted)

Block	Item	Symbol	Limits Min	Limits Typ	Limits Max	Units	Test Condition
All device	Range of power supply voltage	V_{CC}	2.5	—	18	V	
	Standby current	$I_{CC\ ST}$	—	1.3	1.8	mA	Output "OFF" status
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 18 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+}	1.82	—	2.62	V	
	Output low voltage	V_{OM-}	—	—	400	mV	
	Output sink current	I_{OM+}	—	6	—	mA	V_{FB} = 1.86 V
	Output source current	I_{OM-}	—	–60	–30	µA	V_{IN} = 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	$I_{OSC\ CH}$	—	–40	—	µA	
	Cosc discharge current 1	$I_{OSC\ DIS1}$	—	10	—	µA	
UVLO section	Start-up threshold voltage	$V_{TH\ ON}$	2.2	2.3	2.4	V	V_{IN} = 1 V
	Shut-down threshold voltage	$V_{TH\ OFF}$	—	2.25	—	V	V_{IN} = 1 V
	Hysteresis	V_{HYS}	20	50	80	mV	$V_{HYS} = V_{THON} - V_{THOFF}$
Short protection circuit	FB threshold voltage	$V_{TH\ FB}$	—	1.86	—	V	V_{IN} = 1 V, V_{DTC} = 0.7 V
	Latch mode “H” threshold voltage	$V_{TH\ DTC}$	—	1.15	—	V	V_{IN} = 1 V, V_{FB} = 2.11 V
	Latch mode “L” threshold voltage	$V_{TL\ DTC}$	—	0.3	—	V	V_{IN} = 1 V, V_{FB} = 2.11 V
	DTC charge current when start-up	I_{CH1}	—	–45	—	µA	V_{DTC} = 0.7 V, V_{FB} = 2.11 V
	DTC discharge current 1	I_{DIS1}	—	50	—	µA	V_{DTC} = 0.7 V, V_{FB} = 2.11 V
	DTC charge current when stable state	I_{CH2}	—	–10	—	µA	V_{DTC} = 0.7 V, V_{FB} = 0.7 V
	DTC discharge current 2	I_{DIS2}	—	15	—	µA	V_{DTC} = 0.2 V, V_{FB} = 2.11 V
Output section	Collector output leak current	I_{CL}	–1	—	1	µA	V_{CE} = 18 V, V_{CC} = 18 V
	Collector output saturation voltage 1	V_{SAT1}	—	0.3	1.1	V	Emitter GND, I_C = 150 mA, V_E = 0 V
	Collector output saturation voltage 2	V_{SAT2}	—	1.6	—	V	Emitter follower, I_E = 50 mA, V_C = 12 V

Application Circuit

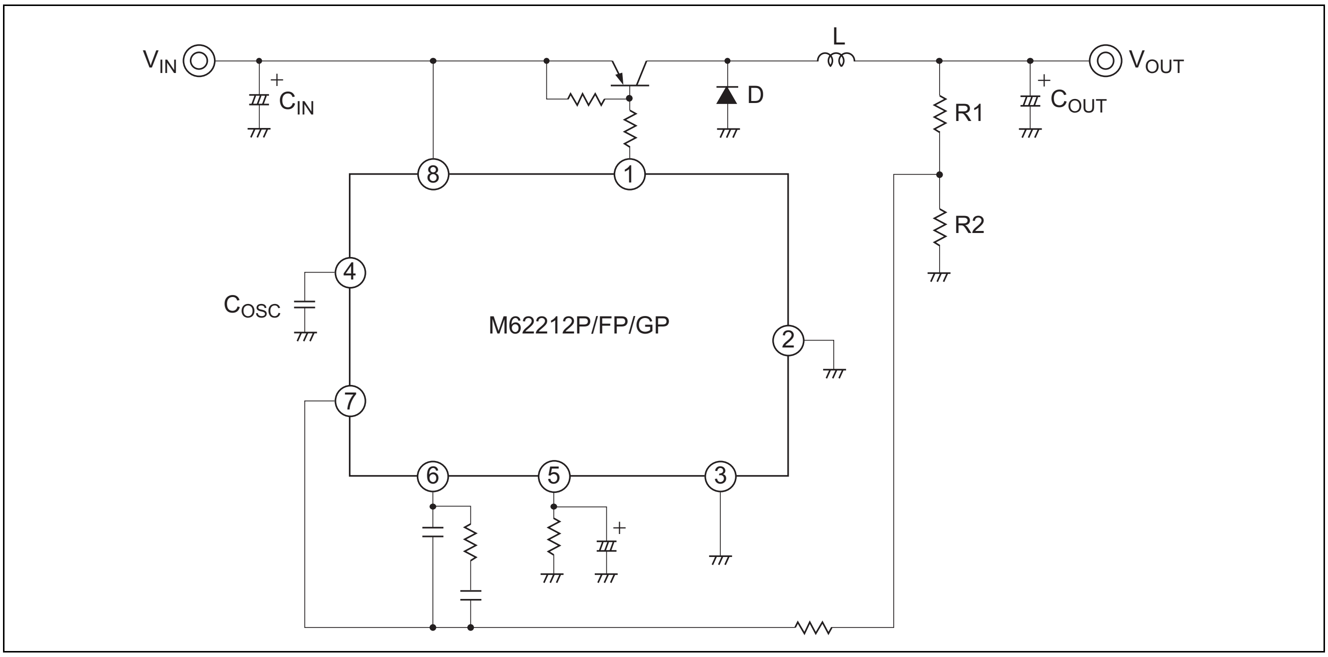


Figure 1 STEP-DOWN Converter with Current Buffer Transistor

Function Description

1) Soft start (The peripheral circuit is shown in Figure 1)
When the power is turned ON, input terminal IN is 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 45 µA.

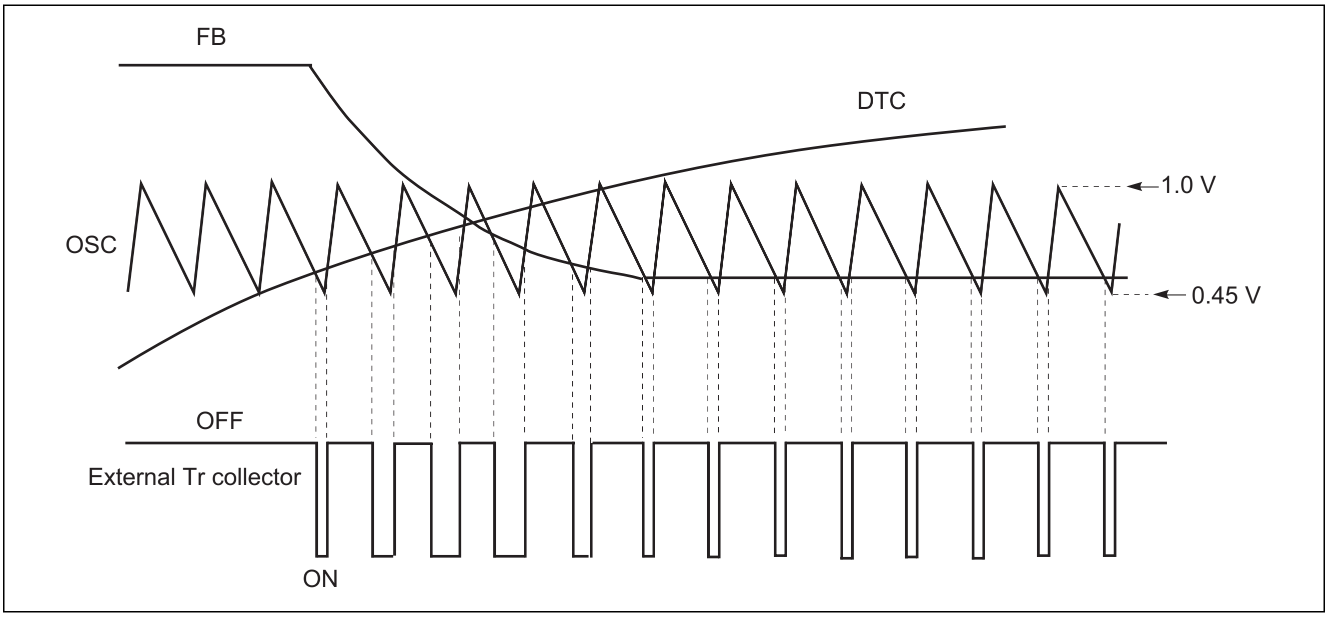


Figure 2

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. 2.3 V) and the DTC terminal goes low. (goes up slowly from 0 V) Thus, approximately 45 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 50 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 1.86 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.

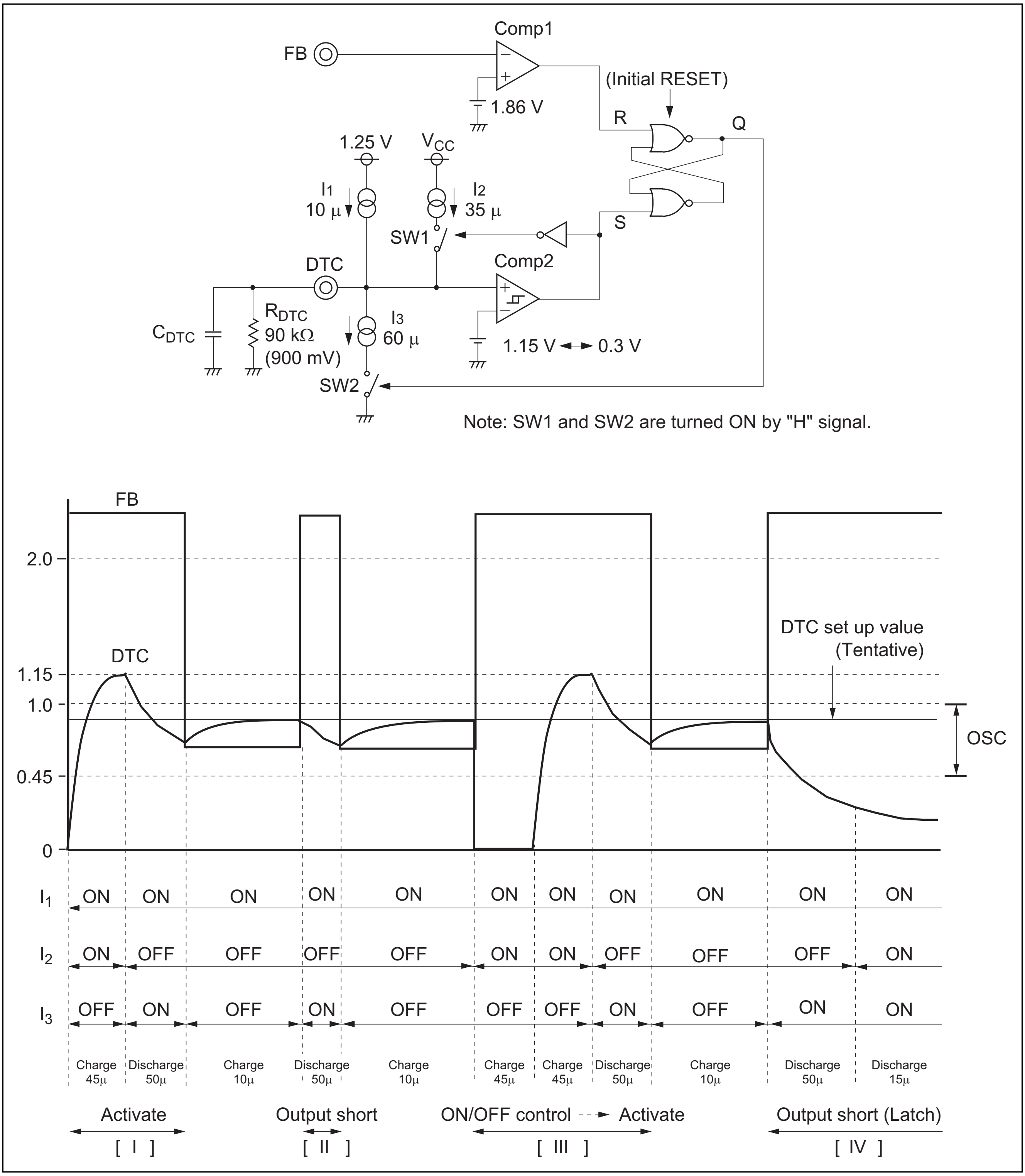


Figure 3 Short Protection Circuit and the Timing Chart of the Modes

Constant Definition

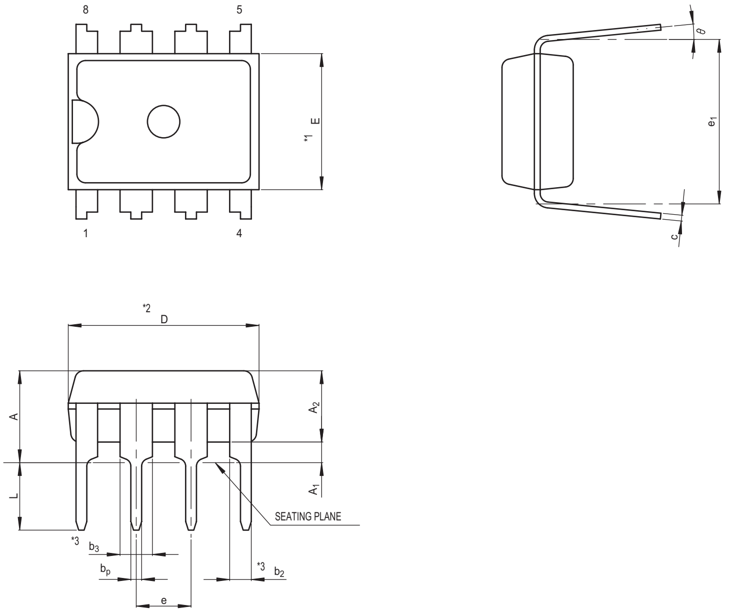
Constant		Step-down Circuit	Step-up Circuit	Inverse Polarity Circuit
$\frac{T_{ON}}{T_{OFF}}$		$\frac{V_O + V_F}{V_{IN} - V_{CE\,(sat)} - V_O}$	$\frac{V_O + V_F - V_{IN}}{V_{IN} - V_{CE\,(sat)}}$	$\frac{\lvert V_O \rvert + V_F}{V_{IN} - V_{CE\,(sat)}}$
$T_{ON} + T_{OFF}$		$\frac{1}{f_{OSC}}$	$\frac{1}{f_{OSC}}$	$\frac{1}{f_{OSC}}$
$T_{OFF\,(MIN)}$		$\frac{T_{ON} + T_{OFF}}{1 + \frac{T_{ON}}{T_{OFF}}}$	$\frac{T_{ON} + T_{OFF}}{1 + \frac{T_{ON}}{T_{OFF}}}$	$\frac{T_{ON} + T_{OFF}}{1 + \frac{T_{ON}}{T_{OFF}}}$
$T_{ON\,(MAX)}$		$\frac{1}{f_{OSC}} - T_{OFF}$	$\frac{1}{f_{OSC}} - T_{OFF}$	$\frac{1}{f_{OSC}} - T_{OFF}$
$D_{(MAX)}$		$\frac{T_{ON\,(MAX)}}{T_{ON} + T_{OFF}}$	$\frac{T_{ON\,(MAX)}}{T_{ON} + T_{OFF}}$	$\frac{T_{ON\,(MAX)}}{T_{ON} + T_{OFF}}$
C_{OSC}		$\frac{1}{75 \times 10^3 \times f_{OSC}} - 16 \times 10^{-12}$	$\frac{1}{75 \times 10^3 \times f_{OSC}} - 16 \times 10^{-12}$	$\frac{1}{75 \times 10^3 \times f_{OSC}} - 16 \times 10^{-12}$
$L_{(MIN)}$ *1		$\frac{(V_{IN} - V_{CE\,(sat)} - V_O) \times T_{ON\,(MAX)}}{\Delta I_O}$	$\frac{(V_{IN} - V_{CE\,(sat)})^2 \times T_{ON\,(MAX)}{}^2 \times f_{OSC}}{2 \times V_O \times I_O}$	$\frac{(V_{IN} - V_{CE\,(sat)})^2 \times T_{ON\,(MAX)}{}^2 \times f_{OSC}}{2 \times V_O \times I_O}$
R_1 *2, *3		$\left(\frac{V_O}{V_{REF}} - 1\right) \times R_2$	$\left(\frac{V_O}{V_{REF}} - 1\right) \times R_2$	$\left(\frac{\lvert V_O \rvert}{V_{REF}} - 1\right) \times R_2$
R_{DTC} *4	Not use short protection	$\frac{V_{DTC\,(MAX)}}{\lvert I_{CH1} \rvert}$	$\frac{V_{DTC\,(MAX)}}{\lvert I_{CH1} \rvert}$	$\frac{V_{DTC\,(MAX)}}{\lvert I_{CH1} \rvert}$
	Use short protection	$\frac{V_{DTC\,(MAX)}}{\lvert I_{CH2} \rvert}$	$\frac{V_{DTC\,(MAX)}}{\lvert I_{CH2} \rvert}$	$\frac{V_{DTC\,(MAX)}}{\lvert I_{CH2} \rvert}$
C_{DTC} *4	Calculate from start-up time	$\frac{\lvert I_{CH1} \rvert \times t_{start}}{V_{DTC\,(MAX)}}$	$\frac{\lvert I_{CH1} \rvert \times t_{start}}{V_{DTC\,(MAX)}}$	$\frac{\lvert I_{CH1} \rvert \times t_{start}}{V_{DTC\,(MAX)}}$
	Calculate from shat down time	$\frac{I_{DIS1} \times t_{short}}{V_{DTC\,(MAX)} - V_{OSCL}}$	$\frac{I_{DIS1} \times t_{short}}{V_{DTC\,(MAX)} - V_{OSCL}}$	$\frac{I_{DIS1} \times t_{short}}{V_{DTC\,(MAX)} - V_{OSCL}}$

note: V_F: Forward voltage of outer diode.
$V_{CE\,(sat)}$: Saturation voltage of M62212 or saturation voltage of current buffer transistor
Please setting the oscillation frequency first and calculate each constant value.

1. Please setting ΔI_O about 1/3 to 1/5 of maximum output current
2. $|V_O| = (1 + \frac{R1}{R2}) \times V_{REF}$
3. Please setting R2 about few kΩ to score fo kΩ because output voltage don't undergo a influence of input current (Terminal 7)
4. Please setting $V_{DTC\,(MAX)}$ to satisfy $D_{(MAX)}$, fixed from characteristics of $D_{(MAX)} - V_{DTC\,(MAX)}$. I_{CH1} means DTC charge current when start-up (–45 µA typ), I_{CH2} means DTC charge current when stable state (–10 µA typ), V_{OSCL} means lower limit voltage of oscillation waveform (0.45 V typ), and I_{DIS1} means DTC discharge current 1 (50 µA typ).
   t_{start} means time interval when terminal voltage of DTC increase to V_{OSCL} from lower voltage and to start switching at first.
   t_{short} means time interval when output is shut down after output is shorted

Package Dimensions

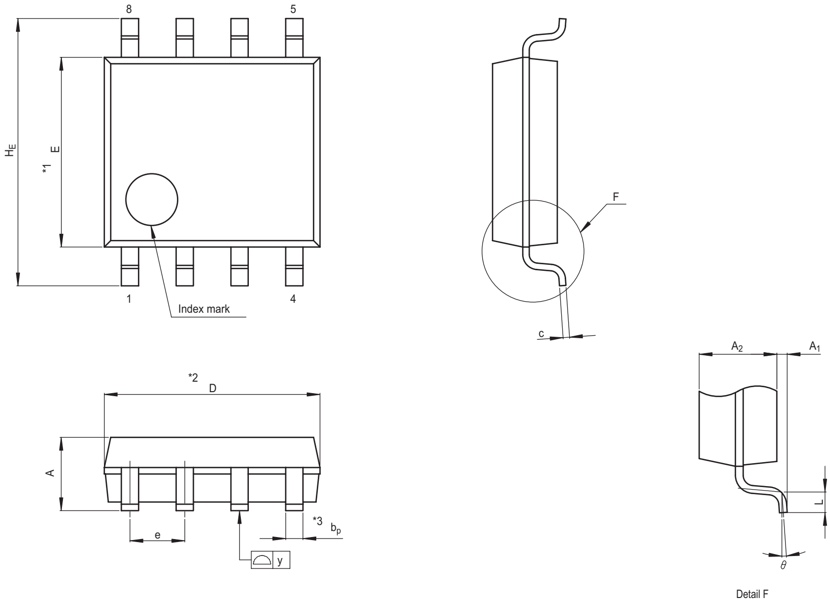
JEITA Package Code	RENESAS Code	Previous Code	MASS[Typ.]
P-DIP8-6.3x8.84-2.54	PRDP0008AA-A	8P4	0.5g



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	8.7	8.9	9.1
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_2	0.9	1.0	1.3
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	—	—

JEITA Package Code	RENESAS Code	Previous Code	MASS[Typ.]
P-SOP8-4.4x5-1.27	PRSP0008DA-A	8P2S-A	0.07g



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	4.8	5.0	5.2
E	4.2	4.4	4.6
A_2	—	1.5	—
A_1	0.05	—	—
A	—	—	1.9
b_p	0.35	0.4	0.5
c	0.13	0.15	0.2
θ	0°	—	10°
H_E	5.9	6.2	6.5
e	1.12	1.27	1.42
y	—	—	0.1
L	0.2	0.4	0.6

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