

M62281P/FP

General Purpose Current Mode PWM Control IC

REJ03D0840-0201
Rev.2.01
Nov 14, 2007

Description

M62281P/FP is designed as a high speed current mode PWM control IC.

This small 10 pin package contains many functions and protection circuits allowing simpler peripheral circuit and compact set design.

This IC can operate high speed switching (700 kHz Max.) with high speed current sense comparator and current limiting circuit.

Features

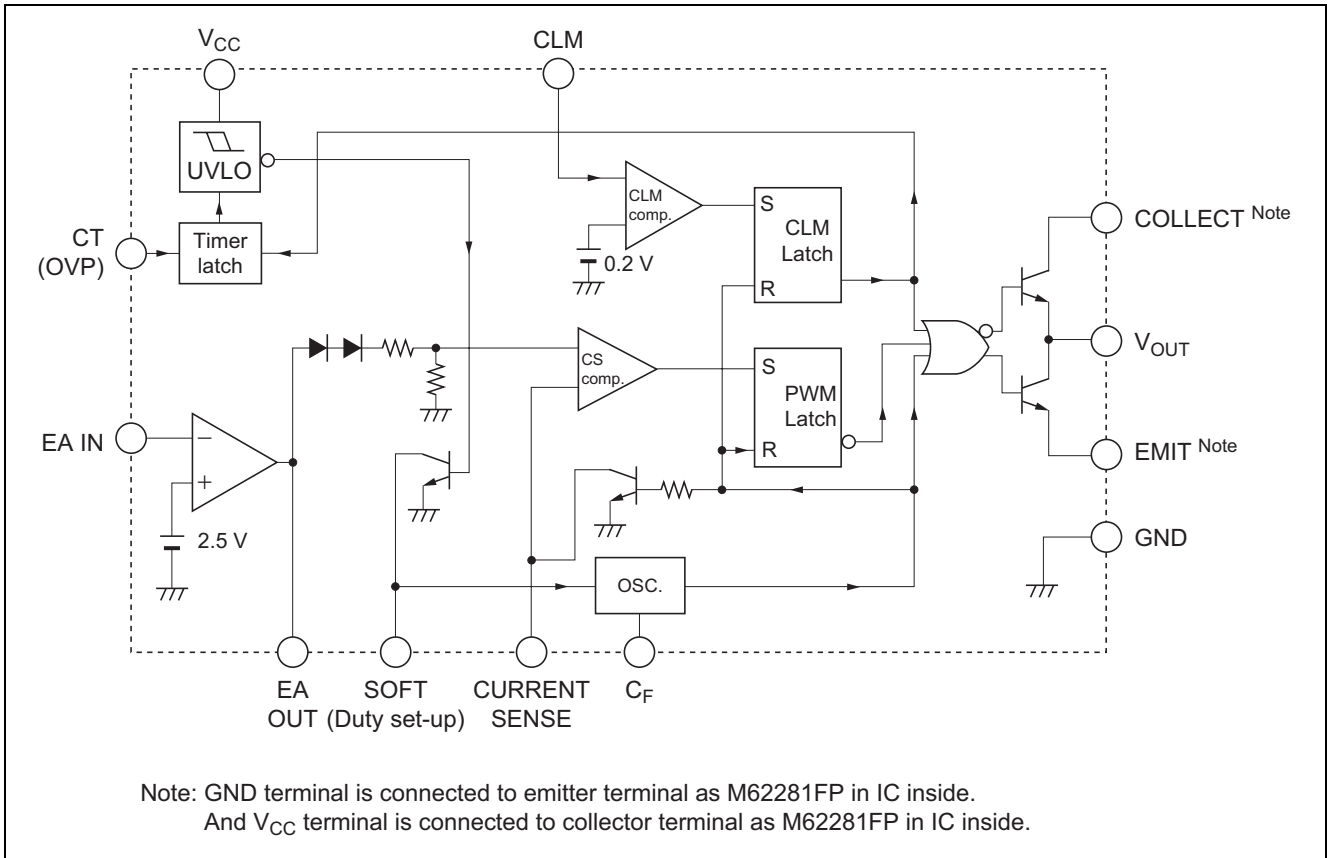
- 700 kHz applicable to MOS-FET
 - Output current $I_o(\text{peak}) = \pm 1 \text{ A}$
 - Totem-pole output
- CURRENT SENSE terminal separate from CLM terminal makes SMPS strong in noise.
- High speed pulse-by-pulse current limiting
- Timer type latch protection circuit with OVP (external reset is possible)
- Soft start operation is possible (with dead time control)
- Built-in OP Amp for feedback control (photo coupler can be driven)
- Small start-up current 180 μA
- Start-up voltage 12.5 V, Stop voltage 8.3 V

Application

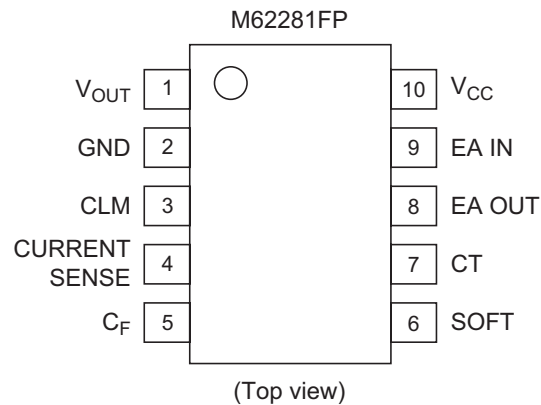
Switching Regulator

DC/DC converter

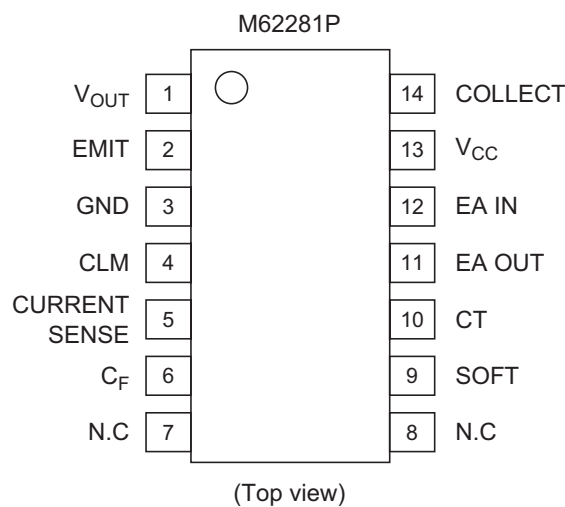
Block Diagram



Pin Arrangement



Outline: PRSP0010DB-A (10P2N-A)



Outline: PRDP0014AA-A (14P4)

Absolute Maximum Ratings

(T_a = 25°C, unless otherwise noted)

Item	Symbol	Ratings	Unit	Condition
Supply voltage	V _{CC}	36	V	
Output terminal current	I _{OUT}	150	mA	Continuous
		1.0	A	Peak
CT terminal supply voltage	V _{CT}	36	V	
EA IN terminal supply voltage	V _{EA IN}	10	V	
CLM terminal supply voltage	V _{CLM}	-0.3 to +4.0	V	
CURRENT SENSE terminal supply voltage	V _{CS}	-0.3 to +5.8	V	
Power dissipation	P _d	1500	mW	P
		440		FP
Thermal derating	K _θ	12	mW/°C	T _a ≥ 25°C
		3.52		FP
Operating temperature	T _{opr}	-20 to +85	°C	
Storage temperature	T _{stg}	-40 to +150	°C	

Electrical Characteristics

(Ta = 25°C, V_{CC} = 14 V, unless otherwise noted)

Block	Item	Symbol	Limits			Unit	Test Conditions
			Min.	Typ.	Max.		
All device	Supply voltage range	V _{CC}	V _{CC(STOP)}	—	35	V	
	Operation start-up voltage	V _{CC(START)}	11.5	12.5	13.5	V	
	Operation stop voltage	V _{CC(STOP)}	7.6	8.3	9.0	V	
	Start-up and stop Voltage difference	ΔV _{CC}	3.5	4.2	5.1	V	
	Stand-by current	I _{CCL}	90	180	270	μA	V _{CC} = V _{CC(START)} – 0.5 V
	Operating current	I _{CCO}	7.5	13	19	mA	
	Timer latch circuit current	I _{CCOFF}	0.9	2.0	3.0	mA	V _{CC} = 14 V
0.8			1.8	2.7	mA	V _{CC} = V _{CC(STOP)} + 0.2 V	
CT	CT term. "H" threshold voltage	V _{THCTH}	3.5	4.0	4.5	V	
	CT term. "L" threshold voltage	V _{THCTL}	0.4	0.7	1.0	V	
	CT term. discharge current	I _{CTDCHG}	70	110	165	μA	In normal operation
	CT term. charge current	I _{CTCHG}	–33	–14	–5	μA	In CLM actuating
Error Amp	Reference voltage	V _B	2.4	2.5	2.6	V	
	Input bias current	I _B	–300	–100	0	nA	
	Open loop gain	A _v	—	70	—	dB	
	Unity gain bandwidth	f _r	—	1	—	MHz	
	Output source current	I _{OS}	–460	–370	–240	μA	V _{EAIN} = 0 V
	Output voltage (High)	V _{Om+}	5.3	5.8	6.25	V	
	Output voltage (Low)	V _{Om-}	0	0.2	0.35	V	
Current sense	CS term. input voltage gain	A _{vCS}	—	3.0	—	V/V	
	Input bias current	I _B	–5	–1	—	μA	
	CS term. delay time	T _{PDCS}	—	150	—	ns	Delay time to output
CLM	CLM term. threshold voltage	V _{THCLM}	180	200	220	mV	
	CLM term. output current	I _{OUTCLM}	–270	–200	–140	μA	V _{CLM} = 0 V
	CLM term. delay time	T _{PDCLM}	—	100	—	ns	Delay time to output
SOFT	Input voltage range at 0% duty	V _{SOFT(0%)}	0	—	1.0	V	Soft term. voltage range to set 0% duty
	Input voltage at 50% duty	V _{SOFT(50%)}	—	2.7	—	V	Soft term. voltage at 50% duty
	Maximum duty	Duty Max	83	90	97	%	
	Soft term. input current	I _{SOFT}	–50	–43	–36		
OSC	Maximum oscillation frequency	f _{OSCMAX}	—	—	700	kHz	
	Oscillation frequency	f _{OSC}	130	180	230	kHz	C _F = 270 pF
	Oscillation upper limit voltage	V _{OSCH}	3.2	3.6	4.0	V	C _F = 270 pF
	Oscillation lower limit voltage	V _{OSCL}	1.2	1.4	1.6	V	C _F = 270 pF
	Oscillation voltage	ΔV _{OSC}	1.9	2.2	2.5	V	C _F = 270 pF

(Ta = 25°C, V_{CC} = 14 V, unless otherwise noted)

Block	Item	Symbol	Limits			Unit	Test Conditions
			Min.	Typ.	Max.		
Output	Output low voltage	V _{OL1}	—	0.04	0.4	V	V _{CC} = 14 V, I _O = 10 mA
		V _{OL2}	—	0.3	1.4	V	V _{CC} = 14 V, I _O = 100 mA
	Output high voltage	V _{OH1}	12.0	12.7	—	V	V _{CC} = 14 V, I _O = -10 mA
		V _{OH2}	11.5	12.5	—	V	V _{CC} = 14 V, I _O = -100 mA
	Output voltage rise time	T _{RISE}	—	50	—	ns	No load
	Output voltage fall time	T _{FALL}	—	35	—	ns	No load

Function Description and Application

EA IN, EA OUT Terminal

Circuit for EA OUT terminal is connected to constant current load (370 μA Typ.) shown in figure 1. Output voltage of error amp. is controlled by the output transistor to provide current-sense comp. with the controlled voltage.

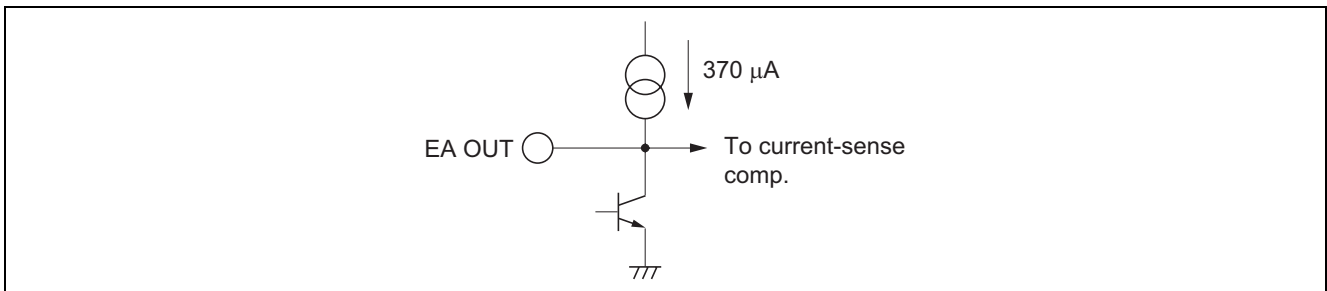


Figure 1 Circuit Diagram of EA OUT Terminal

1. Peripheral circuit of Error Amp

Detected voltage divided by R1 and R2 is input to EA IN terminal in such case as fly-back system where V_{CC} line voltage is proportional to output voltage, or in the case that the voltage detection is made on the primary side. In this case operating region is set by R1 and R2, and AC gain by R1//R2, R_F.

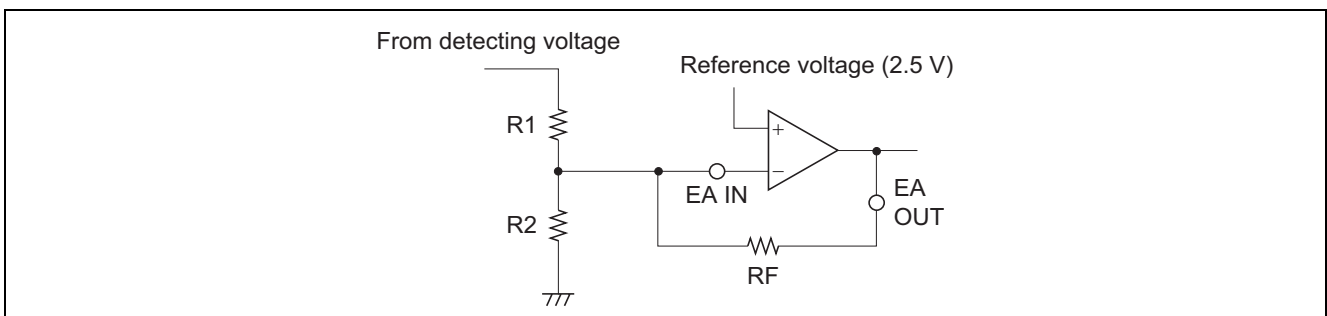


Figure 2 Method to Detect The Voltage on The Primary Side

In the case that feed forward system by photo-coupler is applied, following two methods are available. One is the method by error amp. as in figure 3-1, the other is by the direct connection to photo-coupler as in figure 3-2.

When photo-coupler is directly connected to EA OUT terminal, input terminal of error amp. is connected to GND, photo-coupler is connected directly to EA OUT terminal.

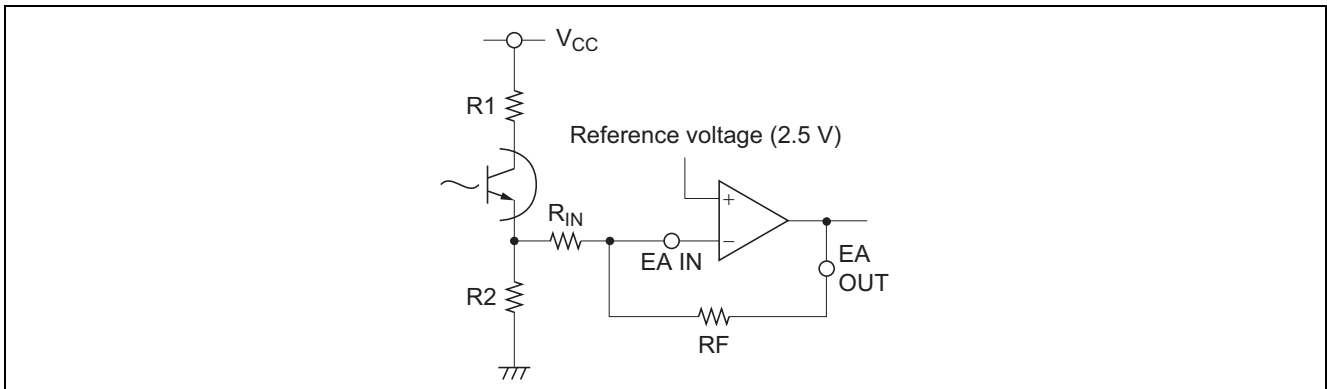


Figure 3-1 Method to Use Photo-Coupler (1)

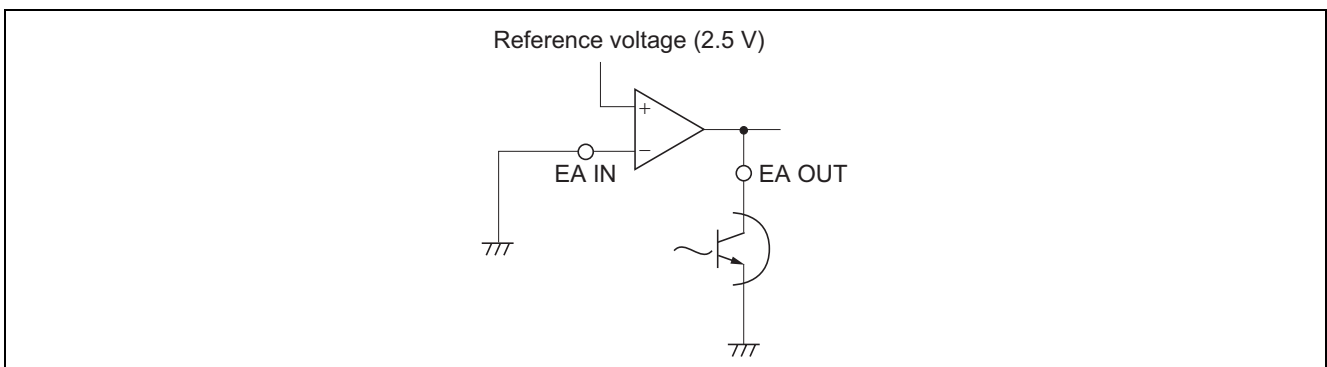


Figure 3-2 Method to Use Photo-Coupler (2)

In figure 3-1, AC gain is represented as :

$$|A_V| = |R_F / R_{IN}|$$

Proper gain setting is about 40 dB.

R_F should be 52 k Ω or more due to the current source capability of error amp.

R_1 , R_2 should meet the condition as below so that the voltage of EA IN terminal should not be over 5 V.

$$R_2 \cdot V_{CC} / (R_1 + R_2) \leq 5 \text{ V}$$

Due to the input impedance of EA IN terminal, the current in R_1 , R_2 should be less than several mA.

CT (OVP) Terminal

Timer type latch circuit works as follows.

Constant charge current flows out from CT terminal to the external capacitor when CLM is operative.

When the voltage of CT terminal rises up to over 4.0 V (Typ.), the latch circuit operates to make functions of this IC inoperative. Inoperative status is sustained until supply voltage becomes less than stop voltage. The value for start-up register has to be set so that the current over 1.8 mA (Typ.) can flow the resistor because the stop status has to be kept by the current in start-up resistor R_1 shown in application circuit.

When timer latch circuit is operative, supply current increases at high voltage as shown in figure 4 to avoid the damage caused by unnecessarily increased supply voltage.

Inoperative status goes back to operation by forcibly decreasing the voltage of CT terminal to less than 0.7 V.

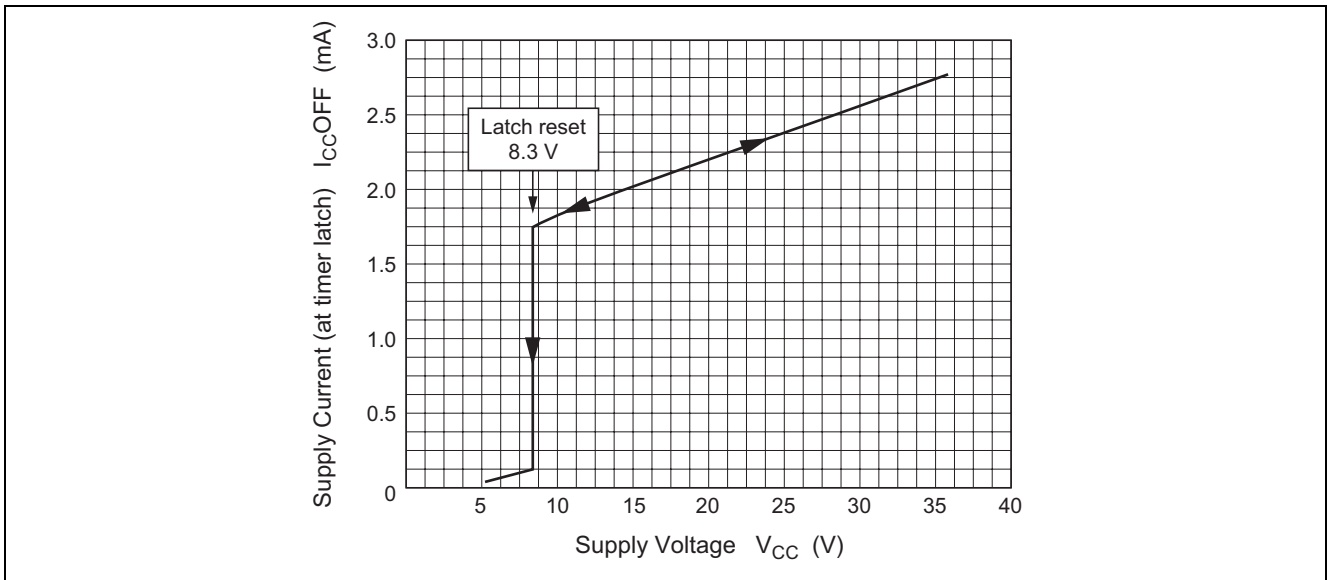


Figure 4 Supply Current vs. Supply Voltage Characteristics (at Timer Latch)

Even if the timer function is not needed, latch function operates, that is, IC becomes in operative when the voltage of CT terminal is forced to be high voltage. Therefore, CT terminal can also be used for OVP (over voltage protection).

When only OVP function is needed (timer latch function is not necessary), connect the resistor between CT terminal and GND. In this case, the above mentioned charge current cannot make the voltage of CT terminal rise up to “H” threshold, thus latch function does not operate. (Refer to figure 5-1, 5-2)

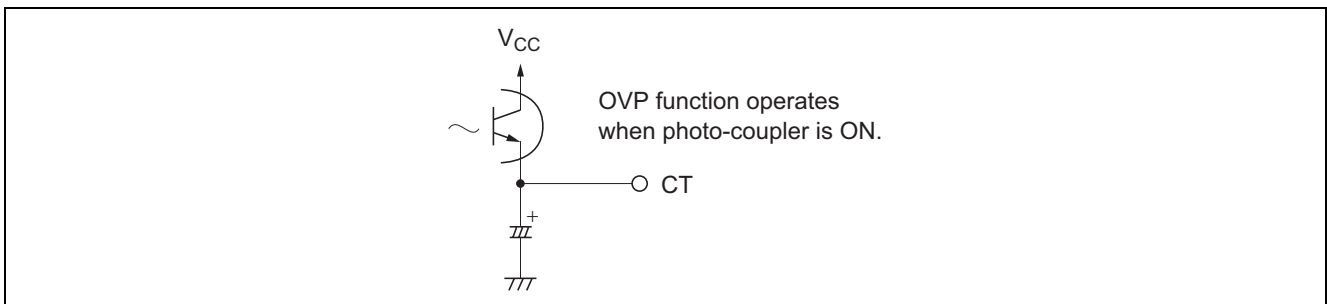


Figure 5-1 Method to Use Timer Type Latch And OVP

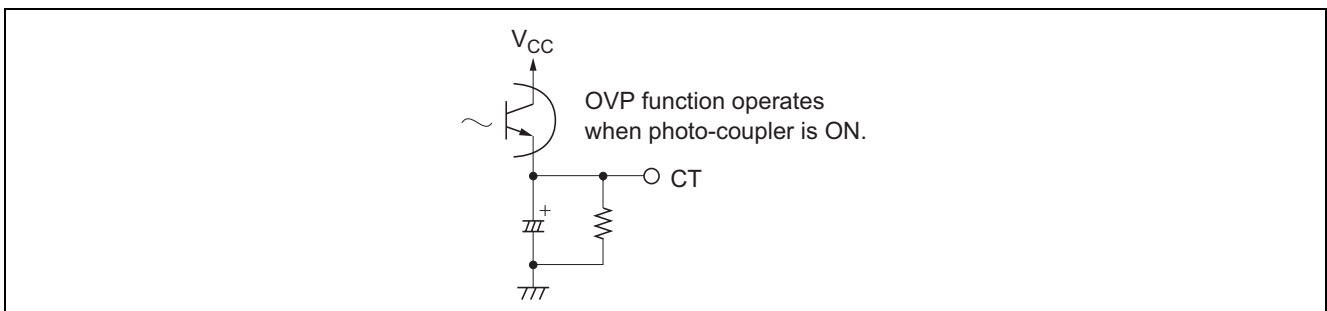


Figure 5-2 Method to Use Only OVP

SOFT (Duty Set-Up) Terminal

The voltage of SOFT terminal determines the maximum duty.

Maximum duty can be set by connecting the resistor as in figure 6 because the constant current compensated for temperature flows out of this terminal.

And by connecting the capacitor between the terminal and GND, soft start function operates. That is, we can get the gradual increase of maximum duty at start-up.

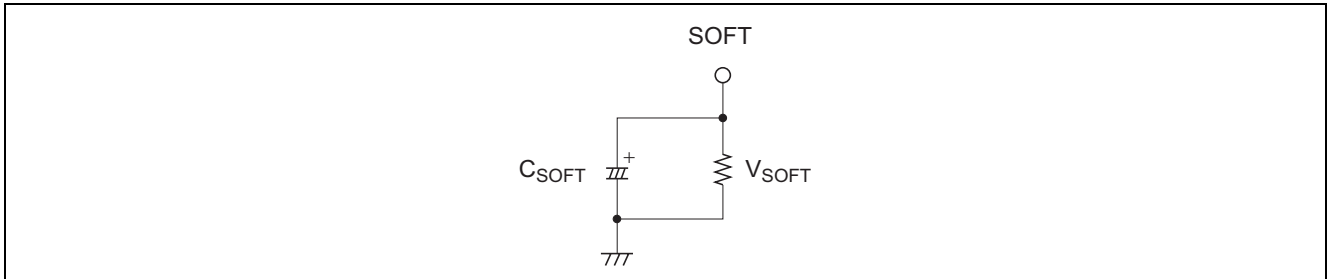


Figure 6 Method to Set Up Duty and SOFT Start Function

Maximum duty is represented as :

$$\text{Duty (Max.)} \approx (42 \cdot V_{\text{SOFT}}) - 59 (\%)$$

$$\text{where } V_{\text{SOFT}} = I_{\text{SOFT}} \cdot R_{\text{SOFT}} (\text{V}), I_{\text{SOFT}} = 43 \mu\text{A (Typ.)}$$

If the voltage of SOFT terminal is higher than 3.53 V (Typ.) (upper limit voltage of the oscillation waveform), maximum duty is internally decided to be 90%.

Soft start time (T_{SOFT}) is represented as :

$$T_{\text{SOFT}} \approx C_{\text{SOFT}} \cdot 31 \cdot 10^3 (\text{s})$$

T_{SOFT} means the time from start-up until the voltage of SOFT terminal goes up to higher than 1.4 V (Typ.) (lower limit voltage of the oscillation waveform).

Discharging circuit operative before start-up at V_{CC} is internally equipped so that the soft start never fail to operate at the restart of voltage supply.

CLM Terminal

This terminal is for pulse-by-pulse current limiting.

Current limiting circuit is almost the same as that of M51995.

CLM terminal is separate from CURRENT SENSE terminal allowing the noise filter to be optimized and the high-speed over current protection.

The voltage detected by the current detecting resistor can be directly input as shown in figure 7-1, if the detected voltage is about the threshold voltage (200 mV (Typ.)), but if the voltage is larger than the threshold, the voltage has to be input divided by resistors as shown in figure 7-2.

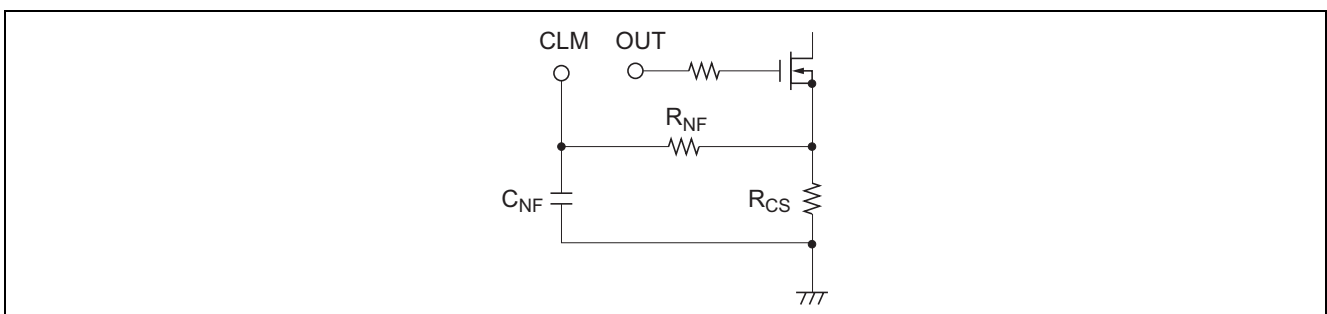


Figure 7-1 Peripheral Circuit of CLM

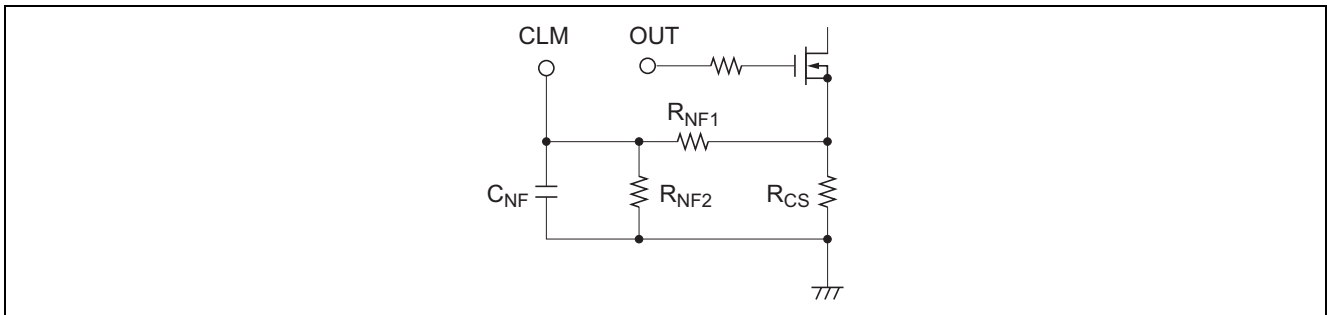


Figure 7-2 Peripheral Circuit of CLM When The Detected Voltage is High

1000 pF to 22000 pF is recommended for C_{NF} . Be sure to use 100 Ω or less for R_{NF} and $R_{NF1} // R_{NF2}$ (*) so that the detection sensitivity is not influenced by the current flow out from CLM terminal.

Non-inductive resistor is recommended for current detecting resistor.

$$* R_{NF1} // R_{NF2} = (R_{NF1} \cdot R_{NF2}) / (R_{NF1} + R_{NF2})$$

CURRENT SENSE Terminal

The voltage proportional to the switching current is supplied to this terminal.

Output duty is controlled by comparing this voltage with the output of error amp..

CLM and CURRENT SENSE terminal is separate from each other, so various settings are available depending upon the application.

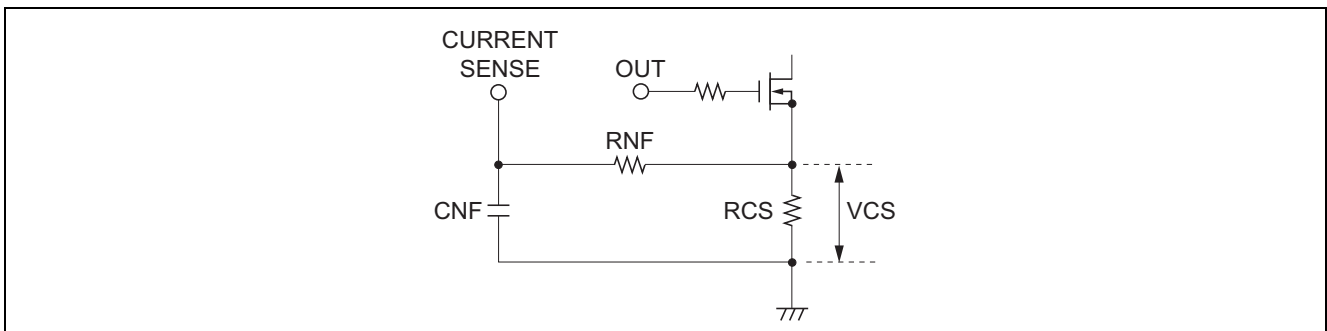


Figure 8 Peripheral Circuit of CURRENT SENSE

R_{CS} is determined by :

$$V_{CS} = (V_{EA\ OUT} - 1.3) / 3 \text{ (V)}, \text{ where } V_{EA\ OUT} \text{ represents the voltage of } E_{A\ OUT} \text{ terminal.}$$

CF Terminal

Oscillation frequency is set by capacitor connected to CF terminal.

The waveform of CF terminal is triangular one with the ratio of 9 : 1 for charge-discharge period.

Oscillation frequency is represented as :

$$f_{OSC} = \frac{1}{(19.4 \times 10^3 \times C_{OSC}) + (0.4 \times 10^{-6})} \text{ (Hz)}$$

Attention for heat generation

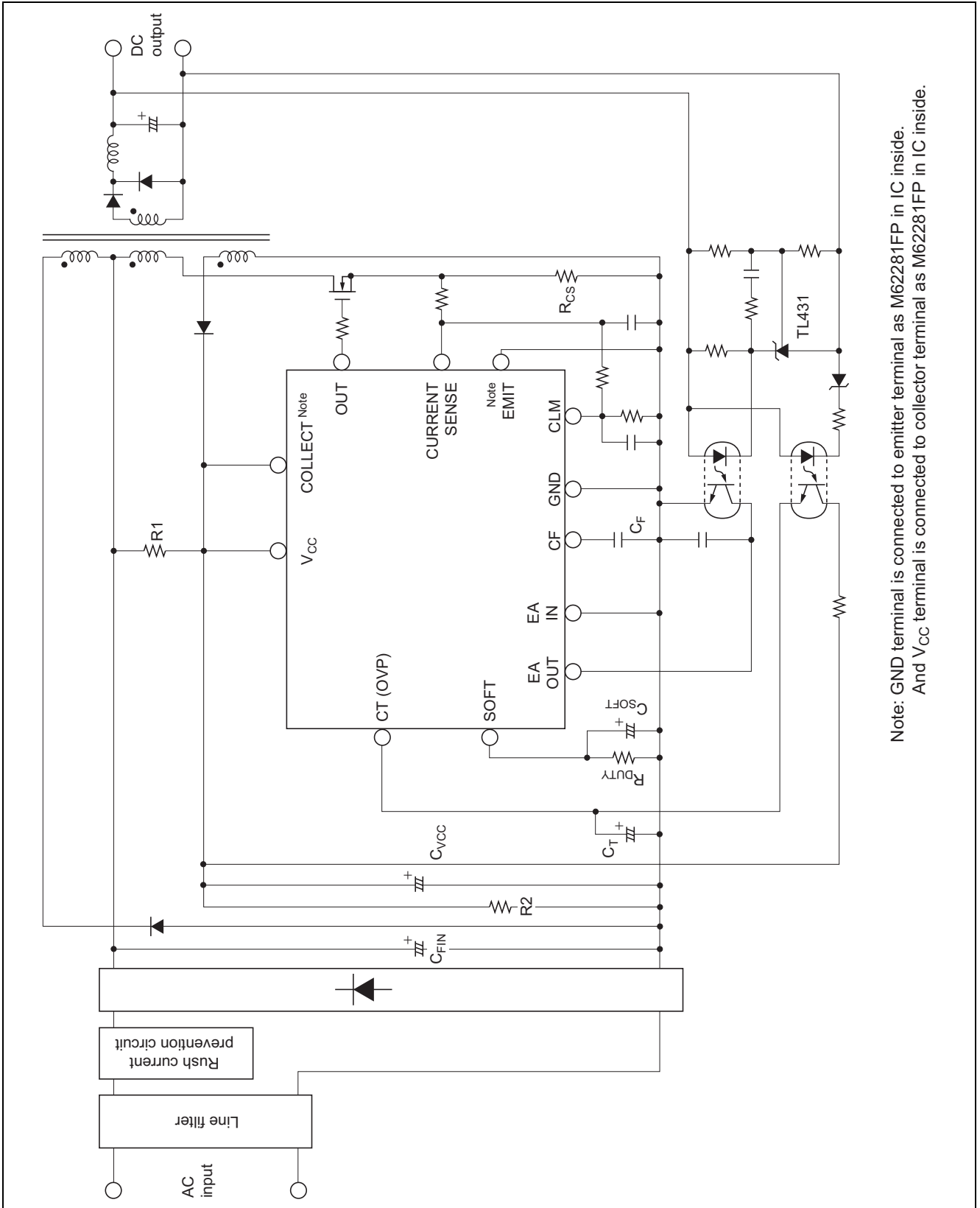
Although the absolute maximum rating of ambient temperature is spelled out as 85°C, it is always annoying to specify the location this temperature refers to because the power dissipation generated locally in switching regulator is fairly large and the temperature in the vicinity of the IC varies from place to place.

One of the recommendable ways to solve this problem is to check the temperature on the surface of the IC.

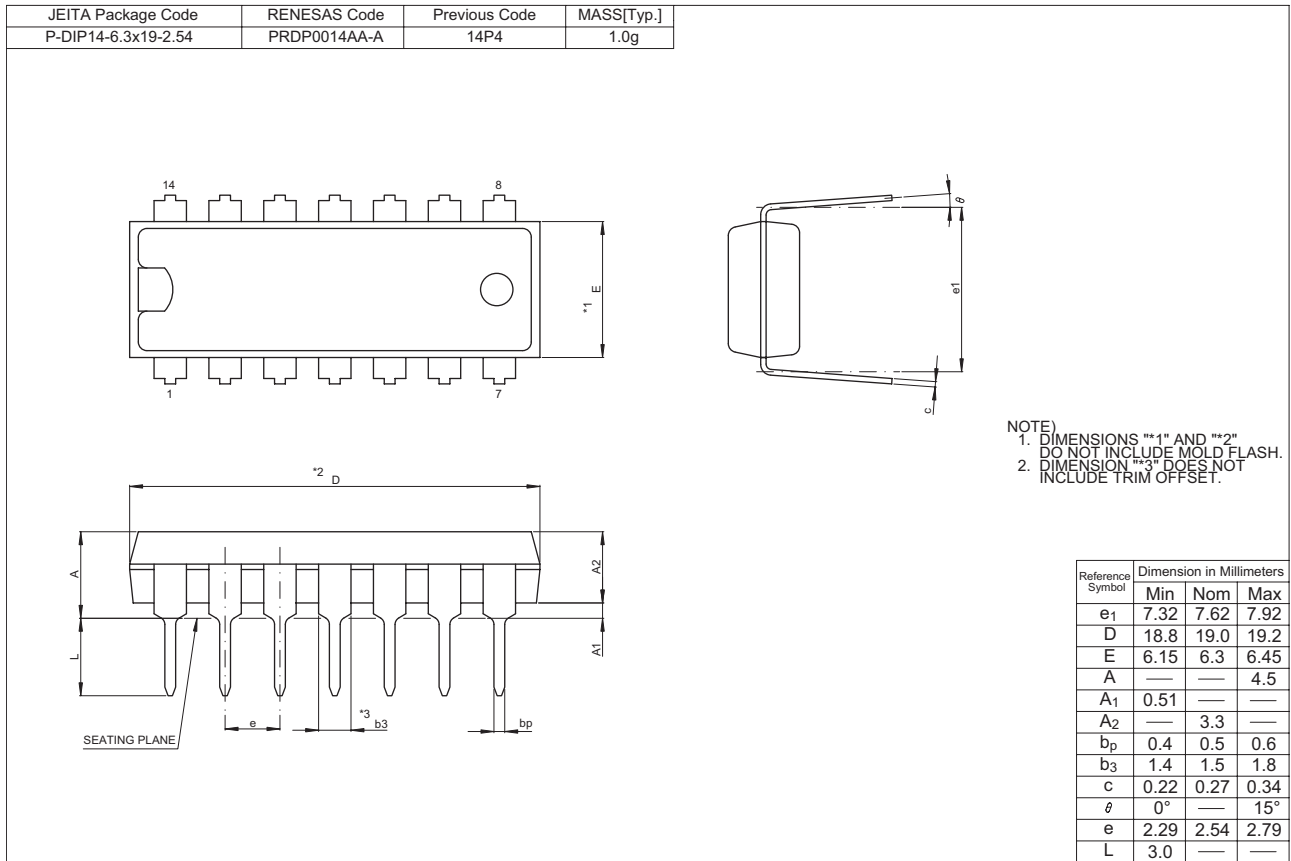
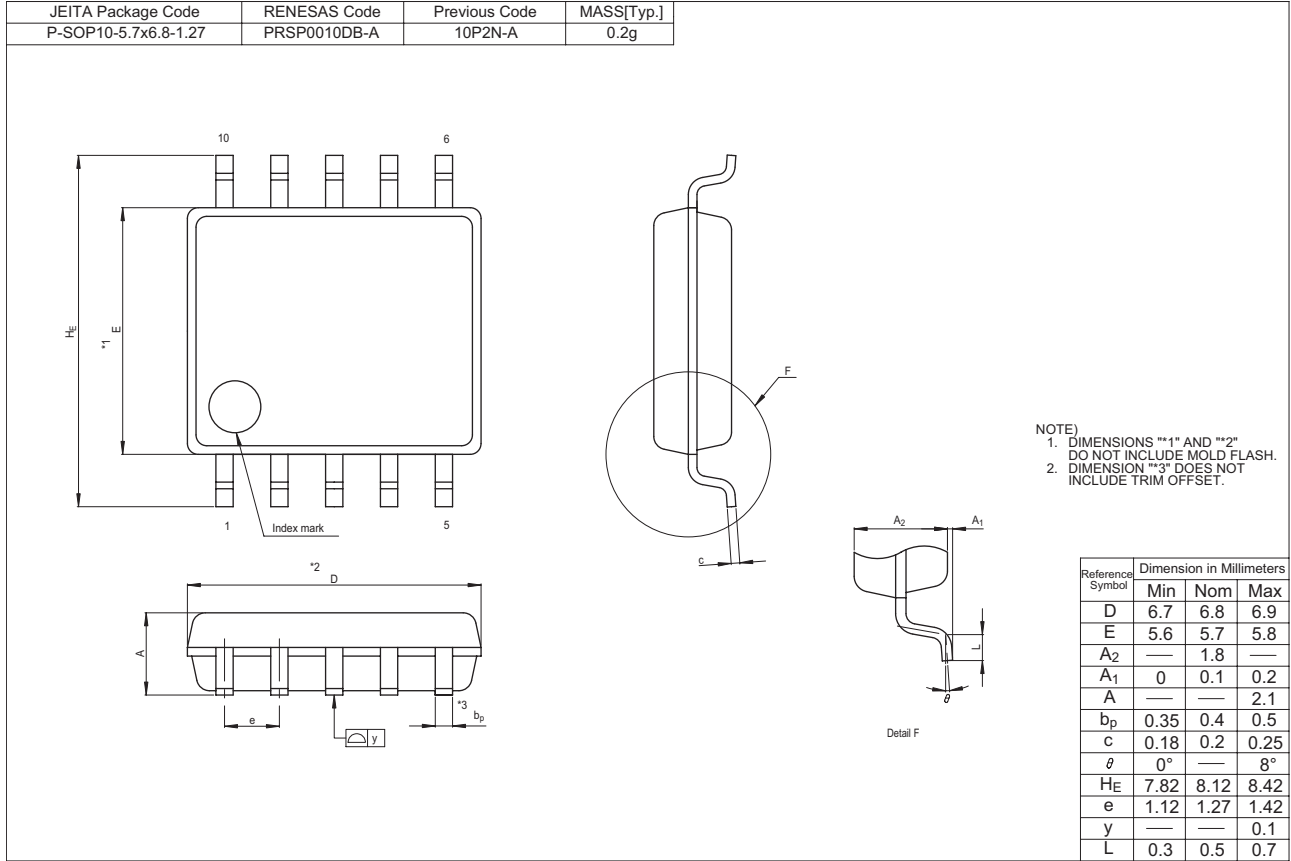
The difference in temperature between IC junction and the surface of IC package is 30°C or less when IC junction temperature is measured by utilizing the temperature characteristics of p-n junction forward voltage, and the surface temperature by "thermo-viewer" on the condition that the IC is mounted on the "phenol-base" PC board in normal atmosphere.

This concludes that maximum case temperature (surface temperature of IC package) rating is 100°C with adequate margin considering the absolute maximum rating of junction temperature is 150°C.

M62281 Application Circuit (Feed-Forward)



Package Dimensions



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