

## **Notification about the transfer of the semiconductor business**

The semiconductor business of Panasonic Corporation was transferred on September 1, 2020 to Nuvoton Technology Corporation (hereinafter referred to as "Nuvoton"). Accordingly, Panasonic Semiconductor Solutions Co., Ltd. became under the umbrella of the Nuvoton Group, with the new name of Nuvoton Technology Corporation Japan (hereinafter referred to as "NTCJ").

In accordance with this transfer, semiconductor products will be handled as NTCJ-made products after September 1, 2020. However, such products will be continuously sold through Panasonic Corporation.

Publisher of this Document is NTCJ.

If you would find description "Panasonic" or "Panasonic semiconductor solutions", please replace it with NTCJ.

※ Except below description page

"Request for your special attention and precautions in using the technical information and semiconductors described in this book"

**Nuvoton Technology Corporation Japan**

Type	Silicon MOSFET type Integrated Circuit		
Application	For Switching Power Supply Control		
Structure	Bi-CMOS type		
Equivalent Circuit	Figure 8		
Out Line	TO-220C-G3-B	Marking	MIP2N1AUK

**A . ABSOLUTE MAXIMUM RATINGS (Ta=25 ±3 )**

NO.	Item	Symbol	Rating	Unit	Note
1	DRAIN Voltage	VD	- 0.3 ~ 700	V	1: It is guaranteed within the Minimum On Pulse Width (MIN(PW)).
2	CONTROL Voltage	VC	- 0.3 ~ 8.0	V	
3	Output Peak Current 1	IDP	1.3	A	
4	Junction Temperature	Tj	+150		
5	Storage Temperature	Tstg	- 55 ~ + 150		

**B . OPERATING GUARANTEE CONDITIONS**

NO.	Item	Symbol	Rating	Unit	Note
1	Operation guarantee temperature 2	Top	- 40 ~ +125		2: Operation ambient temperature(Ta)

Attention :

The absolute maximum ratings are standards that must not be exceeded, even for an instant.  
 If any of these rating would be exceeded, it may cause deterioration or damage or destruction of the IC.  
 Moreover, these operations with exceeded ratings may cause failure to any other components.  
 Please design so as not to exceed the absolute maximum rating in any operating conditions.  
 Before using or designing, refer to and comply with the precautions and conditions set forth in these

**C . THERMAL RESISTANCE**

NO.	Item	Symbol	Typ value	Unit	Note
1	Junction to Ambient	Rthj-a	69.0	/W	10mm X 10mm Epoxy Board
2	Junction to Ambient	Rthj-a	42.7	/W	30mm X 20mm Epoxy Board
3	Junction to Case	Rthj-c	3.0	/W	

**D. ELECTRICAL CHARACTERISTICS**  
[CONTROL FUNCTIONS]

Measurement condition (Ta=25 ±3 )

\* Design Guarantee Item, \*\* Reference Item

No.	Item	Symbol	Measurement Condition(Figure 1)	Typ	Min	Max	Unit
1	Output Frequency	fosc	VC=VC(CNT)-0.4 V, VD=5 V	100	90	110	kHz
** 2	Jitter Frequency Deviation	d_fosc	See Figure 3 VC=VC(CNT)-0.4 V, VD=5 V	5.5			kHz
** 3	Jitter Frequency Modulation Rate	fM	See Figure 3 VC=VC(CNT)-0.4 V, VD=5 V	270			Hz
4	Maximum Duty Cycle	MAXDC	VC=VC(CNT)-0.4 V, VD=5 V	54	50	58	%
5	Before Auto-restart Current	IC(SB)1	VC=VC(ON)-0.06V, VD=5 V	0.50	0.20	0.63	mA
6	After Off-state Current	IC(SB)2	VC=VC(CNT), VD=5 V	0.50	0.20	0.63	mA
7	Operating Current	IC(OP)	VC=VC(CNT)-0.2 V, VD=5 V	0.60	0.20	1.00	mA
8	Auto-restart Control Pin Voltage	VC(ON)	VD=5 V	6.10	5.60	6.60	V
9	Shutdown Control Pin Voltage	VC(OFF)	VD=5 V	4.75	4.30	5.20	V
10	Auto-restart hysteresis Voltage	d_VC	VC(ON) VC(OFF)	1.35	0.95	1.75	V
11	Control Pin Clamp Voltage	VC(CLP)	IC=3 mA	6.60	6.00	7.20	V
** 12	Auto-restart duty cycle	TSW/TTIM	See Figure 4 S1=OPEN	8			%
** 13	Auto-restart frequency	fTIM	See Figure 4 S1=OPEN	40			Hz
14	Control Pin Charging Current	IC(CHG)1	VC=0 V, VD=50 V	-4.10	-5.25	-2.56	mA
		IC(CHG)2	VC=5 V, VD=50 V	-2.20	-3.10	-1.24	mA
15	Control Pin Voltage	VC(CNT)	VD=5 V	5.90	5.40	6.40	V
** 16	Control Pin Voltage hysteresis	d_VC(CNT)	VD=5 V	10			mV
* 17	Soft Start time	Tsoft	VC=VC(CNT)-0.1 V	4.5	2.5	6.5	ms
18	Control Pin Voltage-Shutdown Control Pin Voltage hysteresis	d_VC2	VC(CNT) - d_VC(CNT) VC(OFF)	1.15	0.70	1.60	V

\*Design Guarantee Item : These are the guaranteed value of as a design, and not inspected at shipment.

\*\*Reference Item : These are design reference values, and not guaranteed by shipping inspection.

[PROTECTIVE FUNCTIONS] \* Design Guarantee Item, \*\* Reference Item

No.	Item	Symbol	Measurement Condition(Figure 1)	Typ	Min	Max	Unit
** 19	Variable rate of VEAO reference value	Reao	See Figure 5 DUTY=MAXDC Reao=(VEAO_1-VEAO_2) V/0.1 V	-4.0			V/V
* 20	VEAO reference value	VEAO_MAX	See Figure 5 DUTY=MAXDC	1.68	1.44	1.92	V
* 21	VC Voltage at VEAO_MAX	VC_MAX	See Figure 5 DUTY=MAXDC	5.80	5.40	6.20	V
22	Self Protection Current Limit	ILIMIT	See Figure 2 and 6 Ton=3 μs VC=VC(CNT)-0.4 V	0.400	0.360	0.440	A
* 23	Leading Edge Blanking Delay	ton(BLK)		400	320	480	ns
** 24	Current Limit Delay	td(OCL)		150			ns
25	Minimum On Pulse Width	MIN(PW)	VD=50 V VC=VC(CNT) - d_VC(CNT)	580		780	ns
* 26	Thermal Shutdown Temperature 3	TOTP		150	140	160	
** 27	Thermal Shutdown Temperature Hysteresis	d_TOTP		70			
28	Power-up Reset Threshold Voltage	VCreset		2.60	1.80	3.50	V

\*3:The Absolute maximum Temperature of this product is 150deg.  
 This over temperature detection function does not intend to limit the CHIP temperature.  
 Thus, the above Absolute Maximum Temperature never is over to use.  
 If any of these rating would be exceeded during operation, the device electrical characteristics may be irreparably altered and the reliability and lifetime of the device can no longer be guaranteed.  
 Moreover, these operations with exceeded ratings may cause break down, damage and/or degradation to any other equipment.  
 Applications using the device should be designed such that each maximum rating will never be exceeded in any operating conditions.

About this over temperature detection function,  
 the inspection at actual temperature is not performed at shipping inspection. Only the check of detector circuit operation is performed by the TEST function.

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[Output] \* Design Guarantee Item, \*\* Reference Item

No.	Item	Symbol	Measurement Condition(Figure 1)	Typ	Min	Max	Unit
29	ON-State Resistance	RDS(ON)	ID=0.1 A	16.9		21.0	
30	OFF-State Current	IDSS	VD=650 V, VC > VC(CNT)	10		20	μ A
31	Breakdown Voltage	VDSS	ID=100 μ A, VC > VC(CNT)		700		V
** 32	Rise Time	tr	See Figure 7	50			ns
** 33	Fall Time	tf	See Figure 7	30			ns

[Supply]

No.	Item	Symbol	Measurement Condition(Figure 1)	Typ	Min	Max	Unit
34	Drain Supply Voltage	VD(MIN)	S1=OPEN Ta=-40 ~ 125 4		50		V

4: This item shows the DRAIN voltage required in order that IPD can start an oscillation within operation guarantee temperature. And the inspection at Ta= 25 deg and 125 deg is performed at shipping inspection.

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\*\*Reference Item : These are design reference values, and not guaranteed by shipping inspection.

**D . ELECTRICAL CHARACTERISTICS**  
[CONTROL FUNCTIONS]

Measure condition (Ta=125 ±5 )

\* Design Guarantee Item, \*\* Reference Item

No.	Item	Symbol	Measurement Condition(Figure 1)	Typ	Min	Max	Unit
35	Output Frequency	fosc	VC=VC(CNT)-0.4 V, VD=5 V	102	92	112	kHz
** 36	Jitter Frequency Deviation	d_fosc	See Figure 3 VC=VC(CNT)-0.4 V, VD=5 V	5.3			kHz
** 37	Jitter Frequency Modulation Rate	fM	See Figure 3 VC=VC(CNT)-0.4 V, VD=5 V	200			Hz
38	Maximum Duty Cycle	MAXDC	VC=VC(CNT)-0.4 V, VD=5 V	54	50	58	%
39	Before Auto-restart Current	IC(SB)1	VC=VC(ON)-0.06V,VD=5 V	0.48	0.18	0.63	mA
40	After Off-state Current	IC(SB)2	VC=VC(CNT),VD=5 V	0.48	0.18	0.63	mA
41	Operating Current	IC(OP)	VC=VC(CNT)-0.2 V, VD=5 V	0.57	0.17	0.97	mA
42	Auto-restart Control Pin Voltage	VC(ON)	VD=5 V	6.15	5.65	6.65	V
43	Shutdown Control Pin Voltage	VC(OFF)	VD=5 V	4.80	4.34	5.25	V
44	Auto-restart hysteresis Voltage	d_VC	VC(ON) VC(OFF)	1.35	0.95	1.75	V
45	Control Pin Clamp Voltage	VC(CLP)	IC=3 mA	6.60	6.00	7.20	V
** 46	Auto-restart duty cycle	TSW/TTIM	See Figure 4 S1=OPEN	7			%
** 47	Auto-restart frequency	fTIM	See Figure 4 S1=OPEN	37			Hz
48	Control Pin Charging Current	IC(CHG)1	VC=0 V, VD=50 V	-2.50	-3.20	-1.59	mA
		IC(CHG)2	VC=5 V, VD=50 V	-1.30	-1.80	-0.71	mA
49	Control Pin Voltage	VC(CNT)	VD=5 V	5.90	5.40	6.40	V
** 50	Control Pin Voltage hysteresis	d_VC(CNT)	VD=5 V	10			mV
* 51	Soft Start time	Tsoft	VC=VC(CNT)-0.1 V	5.5	3.1	7.9	ms
52	Control Pin Voltage-Shutdown Control Pin Voltage hysteresis	d_VC2	VC(CNT) - d_VC(CNT) VC(OFF)	1.10	0.65	1.55	V

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[PROTECTIVE FUNCTIONS] \* Design Guarantee Item, \*\* Reference Item

No.	Item	Symbol	Measurement Condition(Figure 1)	Typ	Min	Max	Unit
** 53	Variable rate of VEAO reference value	Reao	See Figure 5 DUTY=MAXDC Reao=(VEAO_1-VEAO_2) V/0.1 V	-3.8			V/V
* 54	VEAO reference value	VEAO_MAX	See Figure 5 DUTY=MAXDC	2.12	1.75	2.49	V
* 55	VC Voltage at VEAO_MAX	VC_MAX	See Figure 5 DUTY=MAXDC	5.60	5.20	6.00	V
56	Self Protection Current Limit	ILIMIT	See Figure 2 and 6 Ton=3 μs VC=VC(CNT)-0.4 V	0.380	0.312	0.440	A
* 57	Leading Edge Blanking Delay	ton(BLK)		390	310	470	ns
** 58	Current Limit Delay	td(OCL)		170			ns
59	Minimum On Pulse Width	MIN(PW)	VD=50 V VC=VC(CNT) - d_VC(CNT)	570		770	ns
60	Power-up Reset Threshold Voltage	VCreset		1.90	1.20	2.90	V

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[Output]

\* Design Guarantee Item, \*\* Reference Item

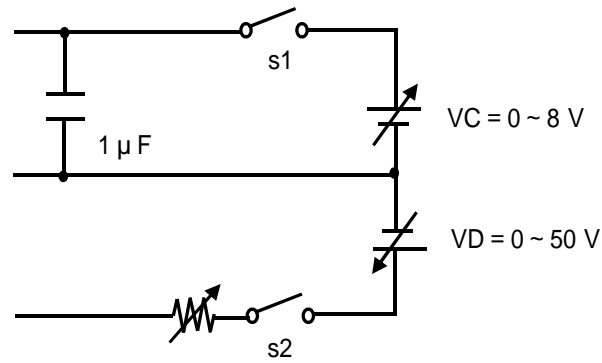
No.	Item	Symbol	Measurement Condition(Figure 1)	Typ	Min	Max	Unit
61	ON-State Resistance	RDS(ON)	ID=0.1 A	27.0		34.0	
62	OFF-State Current	IDSS	VD=650 V, VC > VC(CNT)	15		30	μ A
63	Breakdown Voltage	VDSS	ID=100 μ A, VC > VC(CNT)		700		V
** 64	Rise Time	tr	See Figure 7	80			ns
** 65	Fall Time	tf	See Figure 7	35			ns

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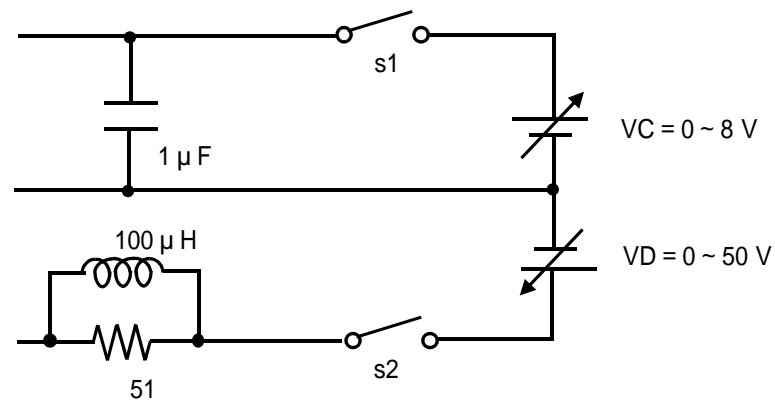


[Figure 1: Measurement Circuit] \*This measurement circuit can not be used for ILIMIT measurement.



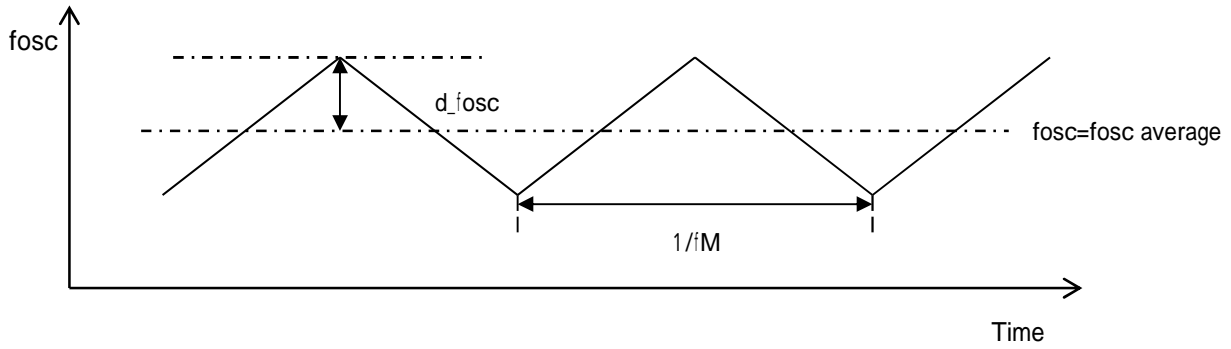
Terminal explanation  
:CONTROL  
:SOURCE  
:DRAIN

[Figure 2: Measurement Circuit] \* This measurement circuit is used for ILIMIT measurement.

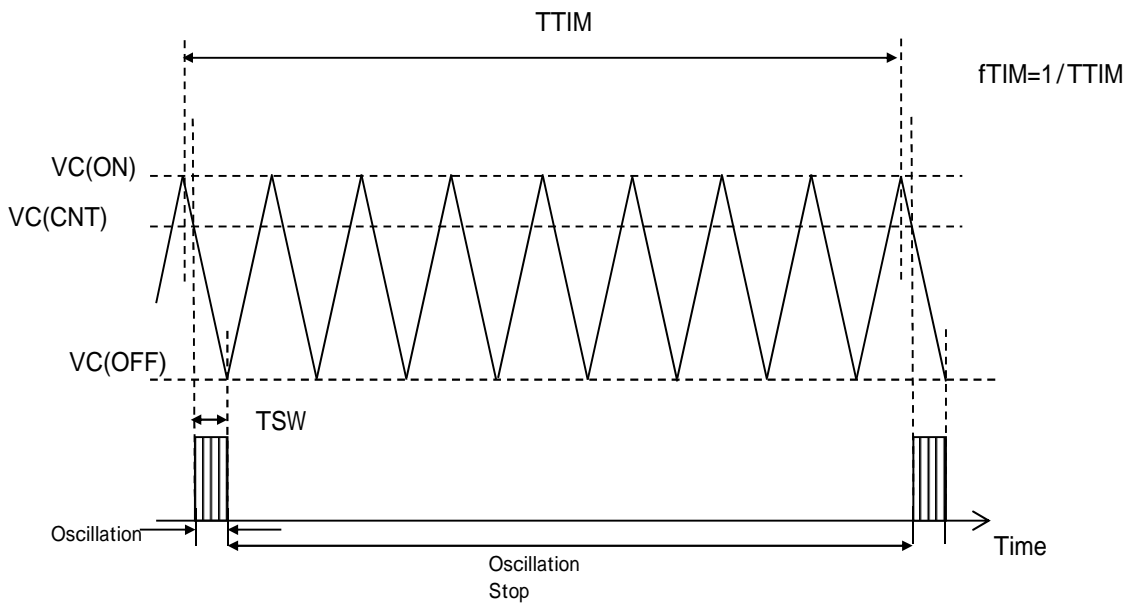


Terminal explanation  
:CONTROL  
:SOURCE  
:DRAIN

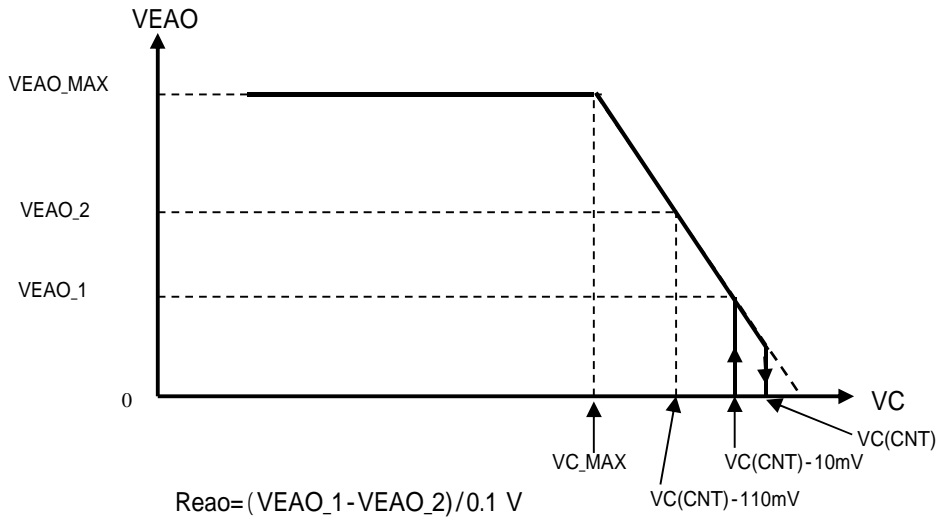
[Figure 3:  $d_{fosc}$ ,  $f_M$  Measurement Waveform]



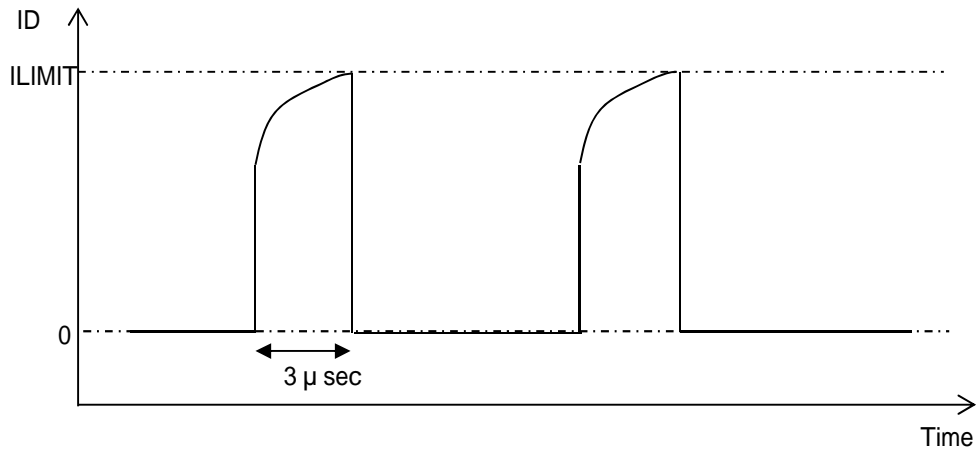
[Figure 4: TTSW, TTIM,  $f_{TIM}$  Measurement Waveform]



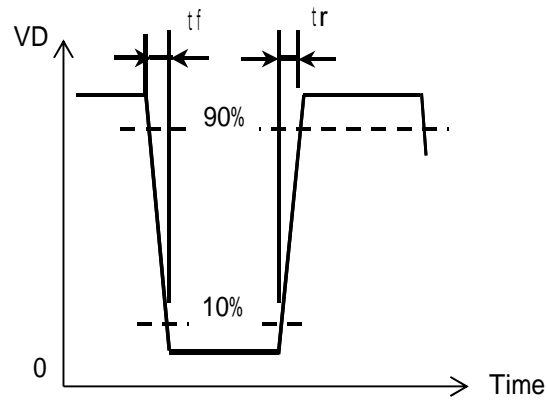
[Figure 5: VEAO Measurement]



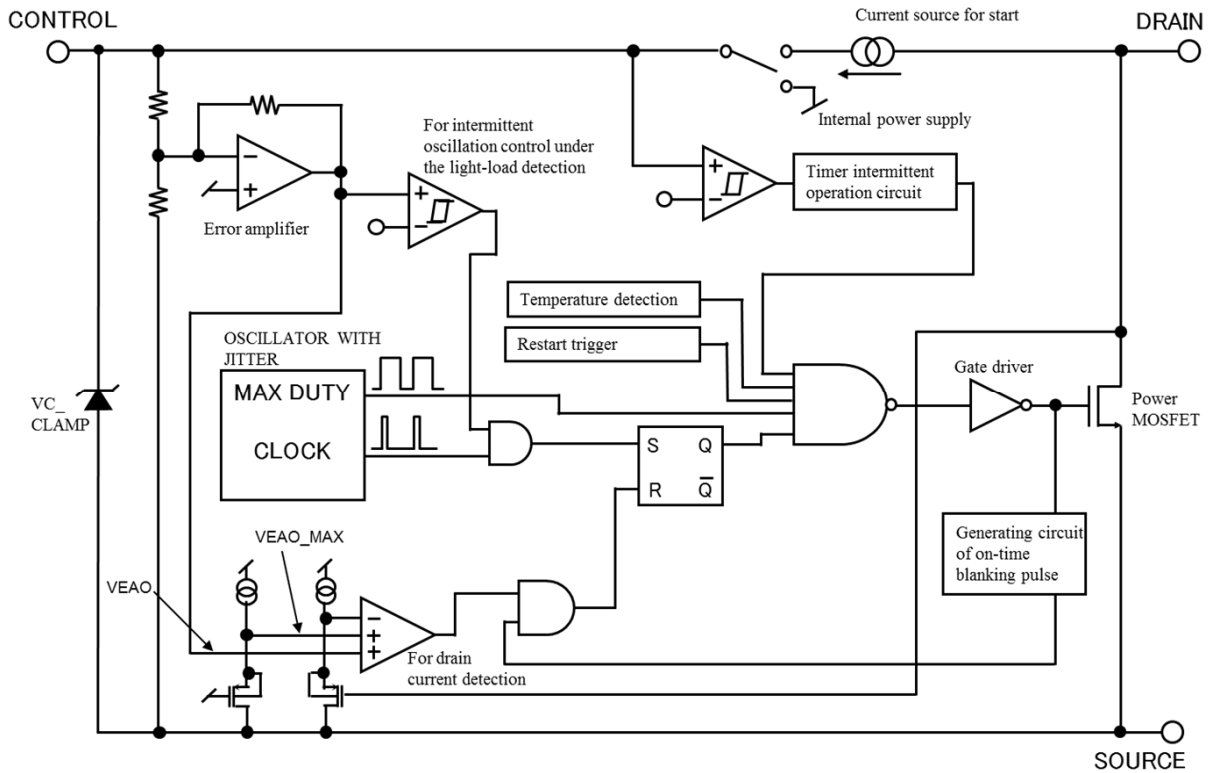
[Figure 6: ILIMIT Measurement]



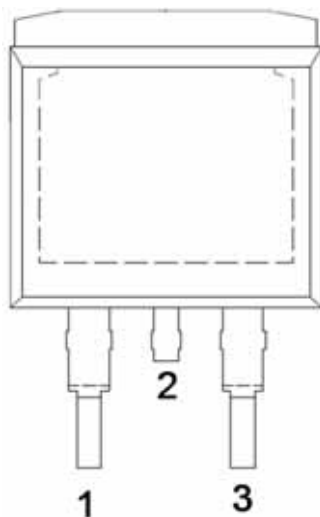
[Figure 7: tr, tf Measurement]



[Figure 8: Block Diagram]



[Figure 9: Pin Layout]



Pin No	Terminal Name
1	CONTROL
2	SOURCE
3	DRAIN

[Precautions for Use 1]

Connect a ceramic capacitor with value 0.1  $\mu$ F between CONTROL pin and SOURCE pin.

[Precautions for Use 2]

The product has risks for break-down or burst or giving off smoke in following conditions. Avoid the following use.  
Fuse should be added at the input side or connect zener diode between CONTROL pin and SOURCE pin, etc. as a countermeas  
to pass regulatory Safety Standard. Concrete countermeasure could be provided individually. However, customer should  
make the final judgment.

(1) DRAIN pin short to CONTROL pin.

(2) DRAIN pin short to SOURCE pin.

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