Type	Silicon MOSFET type Integrated Circuit		
Application	Switching Power Supply Control		
Structure	CMOSType		
Equivalent Circuit	Refer Figure 9		
Package	DIP7-A1	Marking	MIP3J2

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

NO.	Item	Symbol	Ratings	Unit	Note
1	DRAIN Voltage	VD	–0.3 to 700	V	*1 : It is guaranteed within the pulse as below. Leading Edge Blanking Pulse + Over current protection delay ton(BLK)＋td(OCL)
2	VCC Voltage	VCC	–0.3 to 45	V	
3	VDD Voltage	VDD	–0.3 to 8	V	
4	TR Voltage	VTR	–0.7 to VDD + 0.5	V	
5	TR Current	ITRrev	–5 to 0.6	mA	
6	Output Peak Current	IDP	0.6(*1)	A	
7	RecommendedOperating Temperature	Tj	–30 to +125	°C	
8	Channel Temperature	Tch	–30 to +150	°C	
9	Storage Temperature	Tstg	55 to +150	°C	

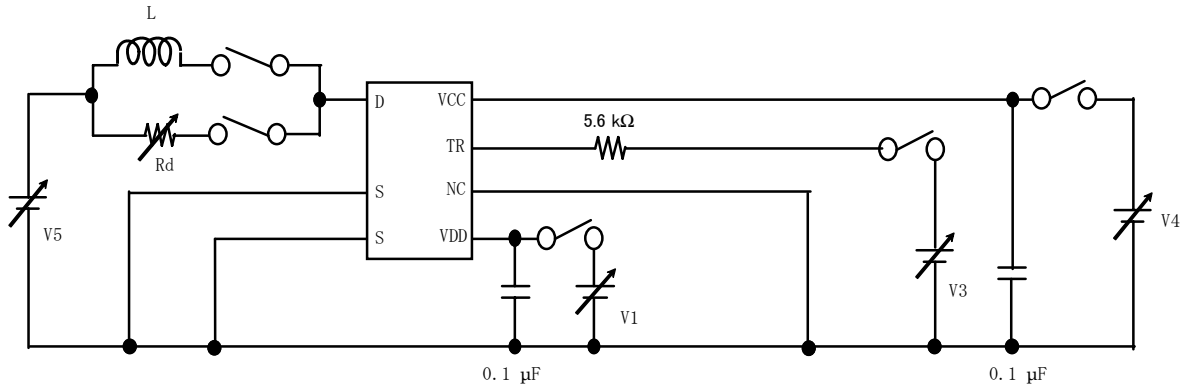
B. ELECTRICAL CHARACTERISTICS (continued) Measure condition (Tc= 25°C±3°C)

No.	Item	Symbol	Measure Condition	Typ.	Min.	Max.	Unit
1	Highest PFM output frequency at heavy load	f_pfm1	V1=VDD(ON)+0.1 V, V3=2 V, V4=0 V, V5=VDOCL	135	108	162	kHz
*2	Jitter Frequency Deviation at heavy load	d_fosc	V1=VDD(ON)+0.1 V, V3=2 V, V4=0 V, V5=VDOCL, fosc=fpm1	6.0	-	-	kHz
*3	Jitter Frequency Modulation Rate	fm	V1=VDD(ON)+0.1V, V3=2 V, V4=0 V, V5=VDOCL, fosc=f_pfm1	1	-	-	kHz
*4	PWM output frequency	f_pwm		30	-	-	kHz
5	Lowest PFM output frequency at light load	f_pfm2	V1=VDD(ON)+0.1V, V3=4.8 V, V4=0 V, V5=VDOCL	300	135	465	Hz
6	Lowest output frequency at overload protection	f_VTRL	V1=VDD(ON)+0.1V, V3=0 V, V4=0 V, V5=VDOCL	10	6	14	kHz
7	Secondary current duty ratio at contant current control	D2max	V1=VDD(ON)+0.1V, V3=2 V/9.0 µSpulse V4=0 V, V5=VDOCL	51.5	45.1	57.95	%
*8	Secondary current duty jitter at contant current control	d_D2max	V1=VDD(ON)+0.1V, V3=2 V/ 9.0 µSpulse V4=0 V, V5=VDOCL	2.0	-	-	%
9	Voltage reference for constant voltage control	VCV	V1=VDD(ON)+0.1V, V4=0 V,	2.95	2.89	3.01	V
10	TR feedback voltage threshold	VTR0	V1=VDD(ON)+0.1V, V3=2 V/ 9.0 µSpulse V4=0 V, V5=VDOCL	3.0	2.9	3.1	V
11	TR lowest voltage detection	VTRLow	V1=VDD(ON)+0.1V, V3=9.0µSpulse V4=0 V, V5=VDOCL	0.45	0.20	0.70	V
12	VCC start voltage	VCC(ON)	V3=2 V, V4=0 V, V5=0.2 V	6.8	5.8	7.8	V
13	VCC stop voltage	VCC(OFF)	V3=2 V, V4=0 V, V5=0.2 V	5.8	4.9	6.7	V
14	VDD start voltage	VDD(ON)	V3=2 V, V4=0 V, V5=0.2 V	5.7	5.2	6.2	V
15	VDD stop voltage	VDD(OFF)	V3=2 V, V4=0 V, V5=0.2 V	4.9	4.4	5.4	V
16	Start-up current consumption	ICC(SB)	V4=6.5 V	0.75	0.55	0.93	mA
17	Operating current consumption	ICC	V4=7.5 V	0.80	0.55	1.10	mA
18	Drain-VDD charging current 1	Ich1	V1=0 V, V5=40 V	–3.8	–5.7	–1.9	mA
19	Drain-VDD charging current 2	Ich2	V1=5.5 V, V5=40 V	–1.1	–1.7	–0.5	mA
20	TR Open voltage	VTRopen	V1=VDD(ON)+0.1 V	4.5	3.2	6.2	V
21	TR short current	ITR_0V	V1= VDD(ON)+0.1 V, V3=0 V	–8.5	–14.0	–3.5	µA

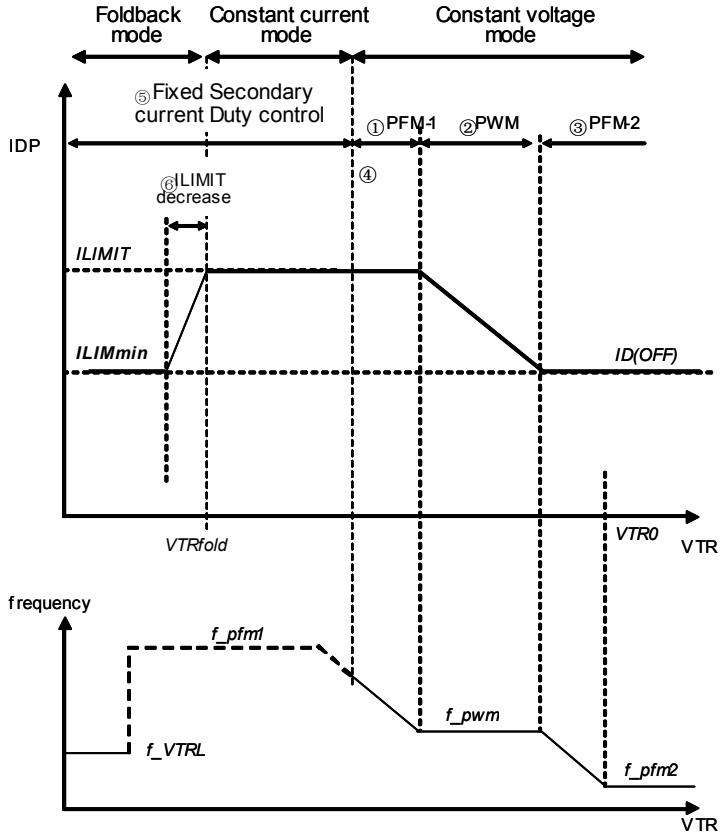
B. ELECTRICAL CHARACTERISTICS (continued) Measure condition (Tc= 25°C±3°C)

No.	Item	Symbol	Measure Condition	Typ.	Min.	Max.	Unit
[CIRCUIT PROTECTIONS]							
22	Self Protection Current Limit	ILIMIT	V1=VDD(ON)+0.1 V, V4=0 V, V5=VDOCL V3=2 V/ 9.0 µSpulse *Figure 7	210	195	225	mA
23	Constant current control coefficient	ILIMD2MX	ILIMITxD2max	108	102.6	113.4	-
24	ILIMIT Compensation slope	R_slope	*Figure 7	12	-	-	mA/µs
*25	Drain current at light load	ID(OFF)	V1=VDD(ON)+0.1V, V4=0 V, V5=VDOCL V3=5 V/ 9.0 µSpulse	162	147	176	mA
26	TR foldback protection activation voltage	VTRfold	V1=VDD(ON)+0.1V, V4=0 V, V5=VDOCL V3=2 V/ 9.0 µSpulse	1.3	1.0	1.5	V
27	Drain current at foldback protection	ILIMmin	V1=VDD(ON)+0.1V, V4=0 V, V5=VDOCL V3=0.5 V/ 9.0 µSpulse	162	152	172	mA
28	Over voltage protection Voltage	VCC(OV)	V1=VDD(ON)+0.1V, V4=0 V, V5=0.2 V	26.5	23.5	29.5	V
29	Open detection width threshold	T2open	V1=VDD(ON)+0.1V, V4=0 V, V5=VDOCL V3=2 V pulse	3.0	1.6	4.8	µs
*30	Leading Edge Blanking Delay	ton(BLK)		350	-	-	ns
*31	Over current protection delay	td(OCL)		100	-	-	ns
*32	Thermal shutdown temperature	TOTP		140	130	150	°C
33	Latch reset voltage	VDDreset		2.7	1.8	3.5	V
[Output]							
34	Drain ON-State Resistance	RDS(ON)	V4=15 V, V3=2 V, I5=100 mA,	20	-	27	Ω
35	Drain OFF-State Current	IDSS	V4=35 V, V5=650 V	10	-	20	µA
36	Drain Breakdown Voltage	VDSS	V4=35 V, I5=100 µA,	-	700	-	V
[Start-up Supply]							
37	Minimum Drain pin supply	VD(MIN)		-	50	-	V

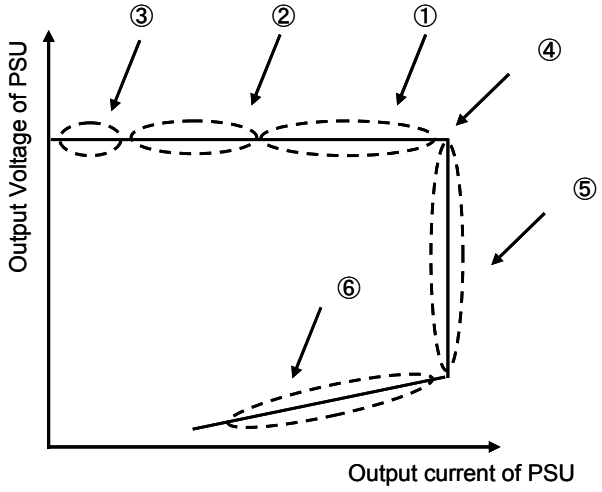
[Figure 1: Evaluation circuit]



[Figure 2: TR pin control and application characteristic]



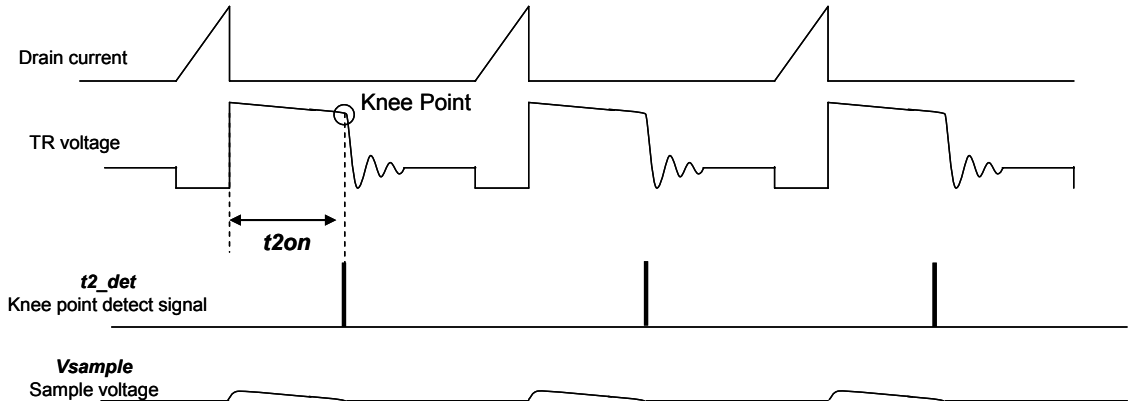
(a) IPD circuit operation with TR voltage



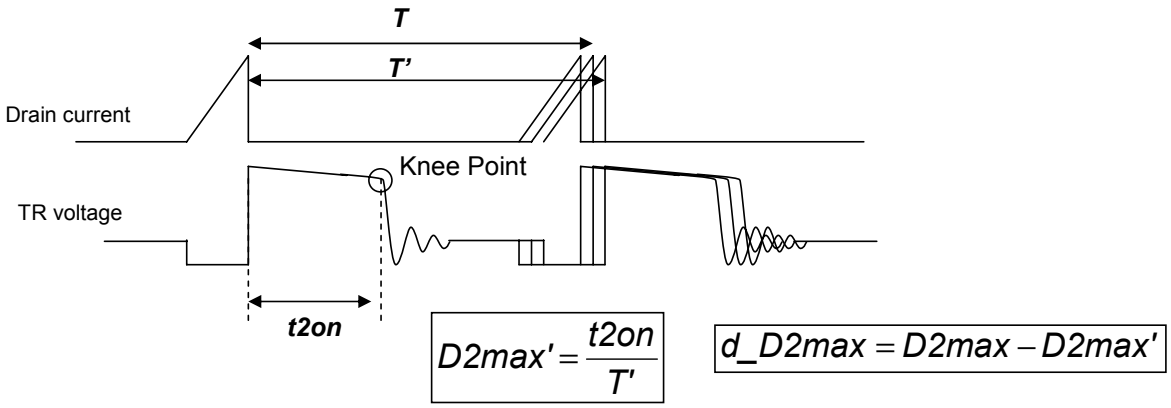
(b) Charger type Power Supply Unit output

①	Heavy load PFM control	ILIMIT peak current, PFM control Maximum operating frequency - f_pfm1
②	PWM control	Peak current vary from ID(OFF)～ILIMIT, fix frequency control ＊Mixture of PFM and PWM control could happen
③	Light load PFM control	ID(OFF) peak current, PFM control Minimum operating frequency - f_pfm2
④	Constant voltage-Contant current switching point	Output frequency & power at this point will be the maximum Frequency of switched point is determined by the design of transformer.
⑤	Constant current control	Frequency control such that secondary current duty ratio is constant. (Fixed duty for secondary current.)
⑥	Foldback protection	Drain peak current is reduces according to TR voltage. Fixed duty ratio for secondary current control is maintained, frequency will vary with load condition. At maximum load, operating frequency will be f_VTRL.

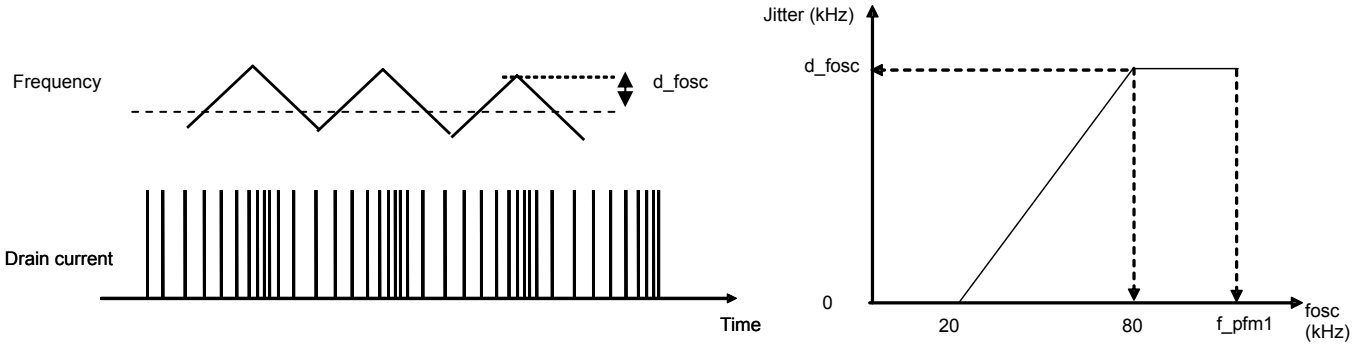
[Figure 3: TR sampling action]



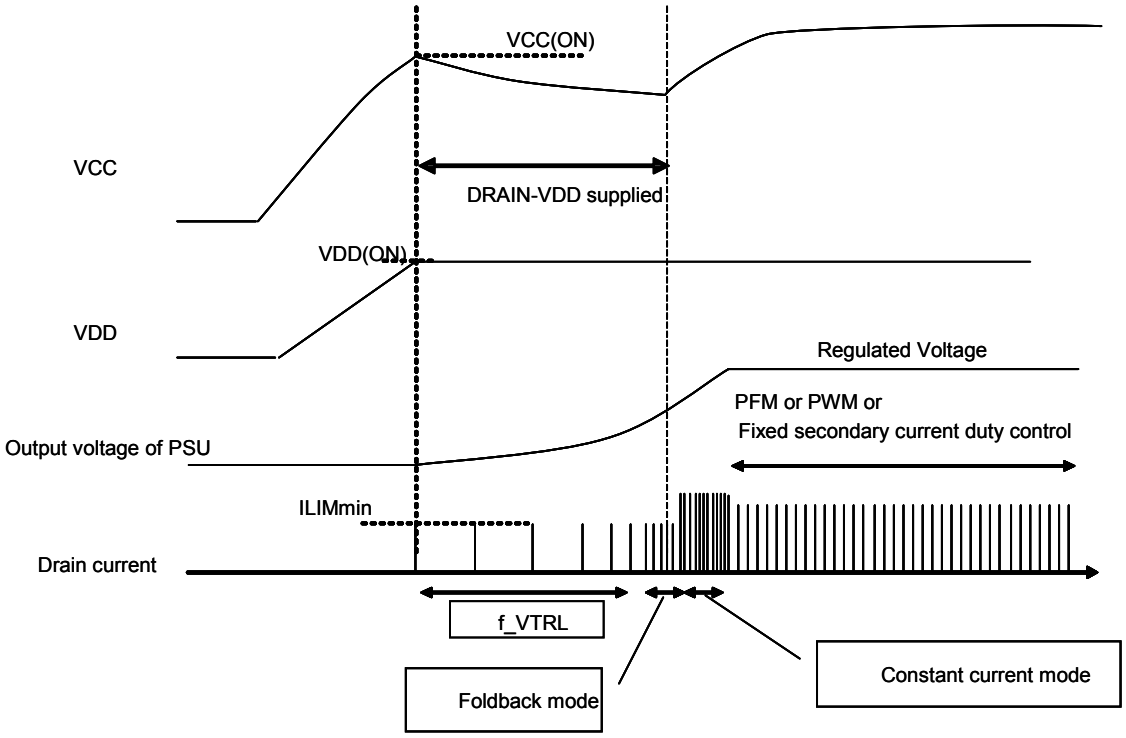
[Figure 4: Secondary current duty ratio & deviation in constant current control]



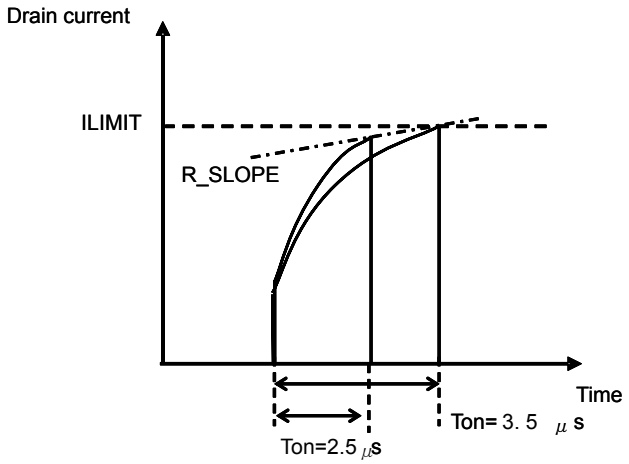
[Figure 5: PFM, PWM jitter control]



[Figure 6: Output waveform when start-up]

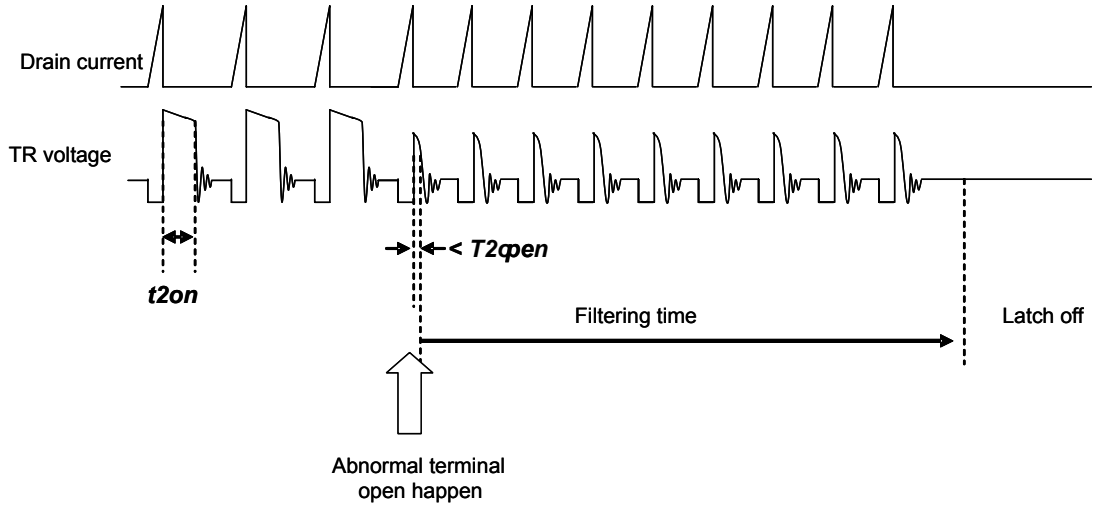


[Figure 7: ILIMIT, R_Slope Measurement waveform]

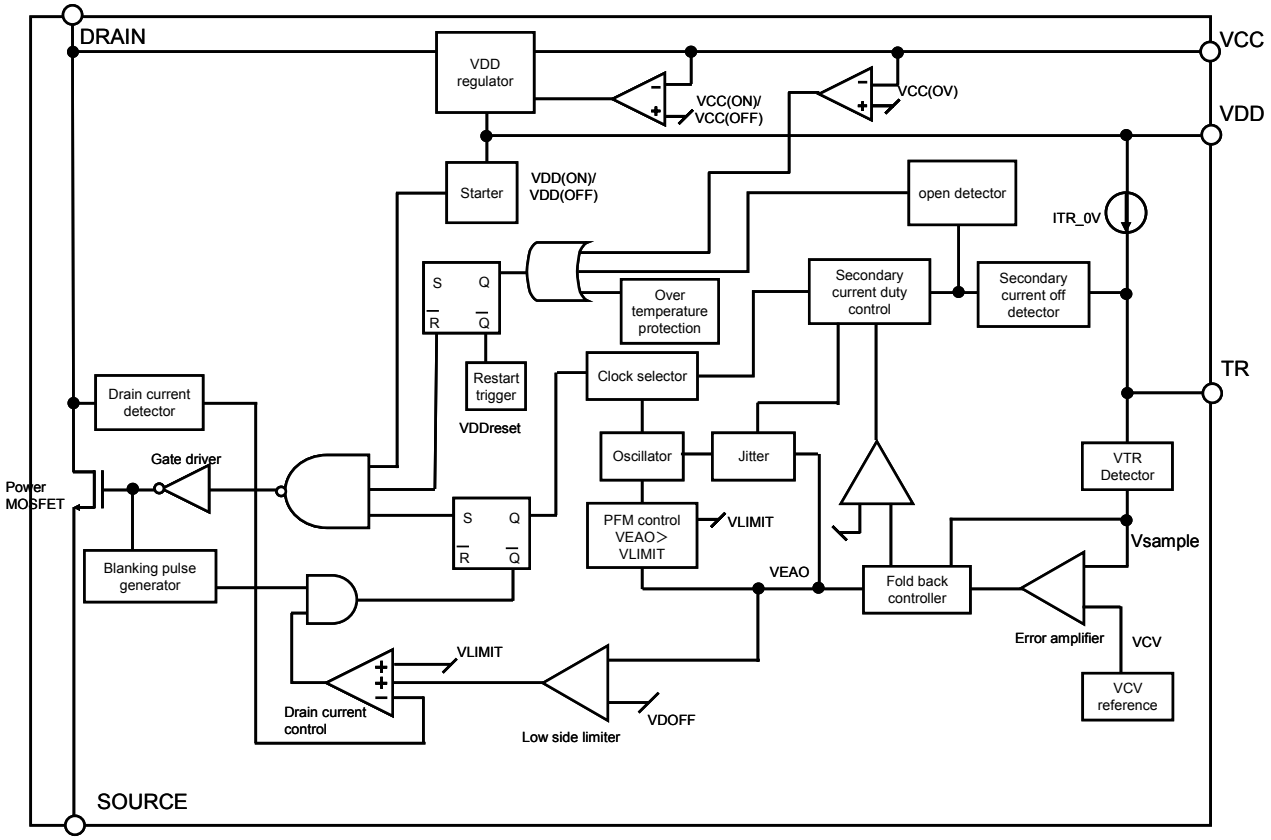


R_slope ; {(ILIMIT at Ton=3.5 μs) – (ILIMIT at Ton=2.5 μs)} / {3.5 μs – 2.5 μs}

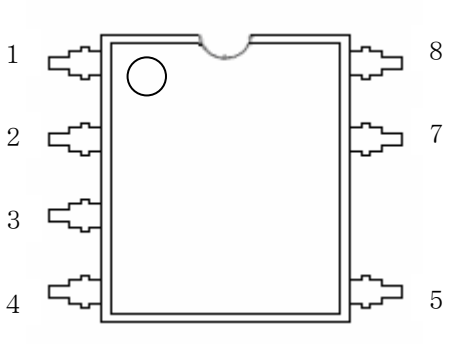
[Figure 8: Open detection function]



[Figure 9: Block Diagram]



[Figure 10: Pin Layout]



Pin No.	Terminal Name
1	VDD
2	NC
3	TR
4	VCC
5	DRAIN
6	—
7	Source
8	Source

[Precautions for Use 1]

Connect a Ceramic Capacitor (over 0.1μF) between VDD Pin and SOURCE.

[Precautions for Use 2]

The IPD 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, etc as a countermeasure to pass regulatory Safety Standard. Concrete countermeasure could be provided individually. However, customer should make the final judgment.

1. DRAIN Pin and VDD Pin invert insertion in power supply board.
2. DRAIN Pin and VDD Pin short circuit.
3. DRAIN Pin and TR Pin short circuit.
4. DRAIN Pin and VCC Pin short circuit.
5. VCC Pin and VDD Pin short circuit.
6. VCC Pin and TR Pin short circuit.

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(5) When designing your equipment, comply with the range of absolute maximum rating and the guaranteed operating conditions (operating power supply voltage and operating environment etc.). Especially, please be careful not to exceed the range of absolute maximum rating on the transient state, such as power-on, power-off and mode-switching. Otherwise, we will not be liable for any defect which may arise later in your equipment.
Even when the products are used within the guaranteed values, take into the consideration of incidence of break down and failure mode, possible to occur to semiconductor products. Measures on the systems such as redundant design, arresting the spread of fire or preventing glitch are recommended in order to prevent physical injury, fire, social damages, for example, by using the products.

(6) Comply with the instructions for use in order to prevent breakdown and characteristics change due to external factors (ESD, EOS, thermal stress and mechanical stress) at the time of handling, mounting or at customer's process. When using products for which damp-proof packing is required, satisfy the conditions, such as shelf life and the elapsed time since first opening the packages.

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1) The sale and/or the export of IPD products to customers located in certain countries is restricted by the Agreement made and executed by and between Power Integrations, Inc. and Panasonic Corporation. For details, refer to the following Attached table "IPD availability by customer."
2) IPD products purchased from our company, or its authorized agents, hereinafter referred to as our company, shall be used only for production purposes by those parties who have duly purchased IPD products. Those who have purchased IPD products shall not use such IPD products in unmodified form for re-sale, loan, or sample shipment for evaluation purposes to any other parties.
3) If a party who has duly purchased IPD products subcontracts its production to any other parties, including its subsidiaries or any other third parties inside and/or out of Japan, and the IPD products are consigned to such subcontracting parties thereat, such party is obligated to monitor and control the quantity of IPD products to prevent any of the aforementioned re-sale, loan or sample shipments from taking place.
4) In the event that any actual or threatened breach or violation of any of the above mentioned 2) or 3) has occurred or is about to occur, our company will hold all shipments of IPD products and may request the customer to disclose necessary documentation describing the status of our end-users and/or distribution channels.
Note) The products of MIP50**, MIP51**, and MIP7** are excluded from above-mentioned precautions, 1) to 3).

Attached table "IPD availability by customer"

Parts No.			Companies/areas to which products can be sold	Companies/areas to which products cannot be sold	Application
MIP01** MIP2** MIP9A**	MIP02** MIP3** MIP9L**	MIP1** MIP4**	· Japanese companies in Japan · Japanese companies in Asia (50% or more owned)	· Companies in European and American countries · Asian companies in Asia · Other local companies	· For power supply · For DC-DC converter
MIP00** MIP55** MIP816/826	MIP52** MIP56** MIP9E**	MIP53** MIP803/804	· Japanese companies in Japan · Japanese companies in Asia (50% or more owned) · Asian companies in Asia	· Companies in European and American countries · Other local companies	· For power supply · For EL driver · For LED lighting driver
MIP50**	MIP51**	MIP7**	· No restrictions in terms of contract	· No restrictions in terms of contract	· For lamp driver/ car electronics accessories

Note) For details, contact our sales division.