Type	Silicon MOSFET type Integrated Circuit		
Application	For Switching Power Supply Control		
Structure	CMOS type		
Equivalent Circuit	See Fig. 9		
Package	DIP7-A1-B	Marking	MIP355

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

NO.	Item	Symbol	Ratings	Unit	Note
1	DRAIN Voltage	VD	−0.3 ～ 700	V	※1 : It is guaranteed within the pulse as below. Leading Edge Blanking Pulse + Current Limit Delay ton(BLK)＋td(OCL)
2	VDD Voltage	VDD	−0.3 ～ 8	V	
3	Feedback Voltage	VFB	−0.3 ～ 6	V	
4	Feedback Current	IFB	500	uA	
5	f Voltage	Vf	−0.3 ～ 8	V	
6	CL Voltage	VCL	−0.3 ～ 8	V	
7	Output Peak Current	IDP	3(※1)	A	
8	Channel Temperature	Tch	150	℃	
9	Storage Temperature	Tstg	−55 ～ ＋150	℃	

B. ELECTRICAL CHARACTERISTICS Measure Condition (TC=25℃±3℃)

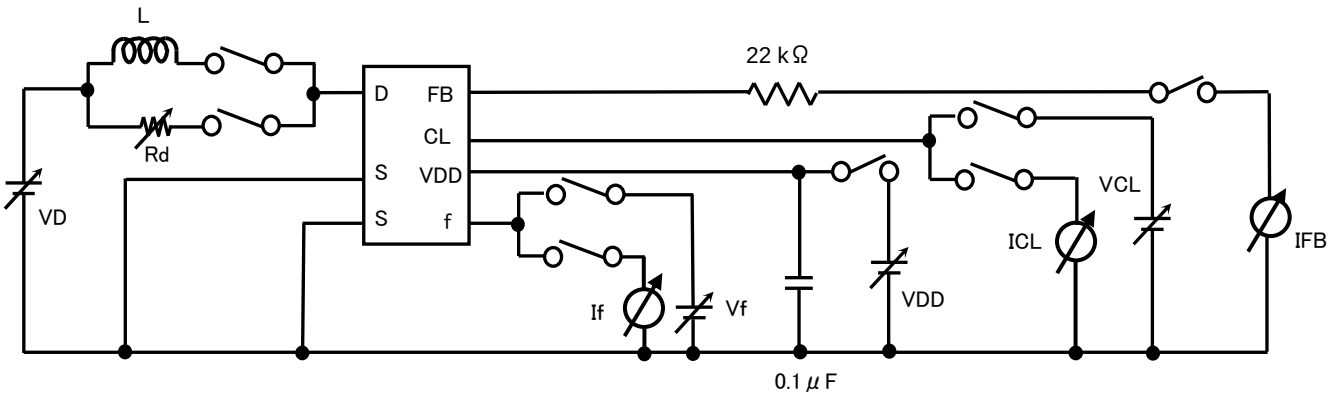
No.	Item	Symbol	Measure Condition (See Fig. 1)	Typ.	Min.	Max.	Unit
【CONTROL FUNCTIONS】 ***Design Guarantee Item**							
1	Output Frequency	fosc	VD=5V, VDD=VDD(ON)+0.1V, IFB=30uA Vf=VDD, VCL=0V, after dis_OLP	43.5	39	48	kHz
2	Jitter Frequency Deviation	Δf	VD=5V, VDD=VDD(ON)+0.1V, IFB=30uA Vf=VDD, VCL=0V, after dis_OLP	3	1.2	4.8	kHz
*3	Jitter Frequency Modulation Rate	fM	VD=5V, VDD=VDD(ON)+0.1V, IFB=30uA Vf=VDD, VCL=0V, after dis_OLP	150	—	—	Hz
4	Maximum Duty Cycle	MAXDC	VD=5V, VDD=VDD(ON)+0.1V, IFB=30uA Vf=VDD, VCL=0V, after dis_OLP	70	65	75	%
5	VDD Start Voltage	VDD(ON)	VD=5V, IFB=30uA, VCL=0V, Vf=VDD	5.9	5.4	6.4	V
6	VDD Stop Voltage	VDD(OFF)	VD=5V, IFB=30uA, VCL=0V, Vf=VDD	4.9	4.4	5.4	V
7	VDD Hysteresis	VDDHYS	VDD(ON)−VDD(OFF)	1.0	0.5	1.5	V

No.	Item	Symbol	Measure Condition (See Fig. 1)	Typ.	Min.	Max.	Unit
8	VDD Clamp Voltage	VDD(CLP)	IDD=10mA	7.4	6.9	8.9	V
9	Feedback Threshold Current	IFB1	ON⇒OFF, VD=5V, VDD=VDD(ON)+0.1V, Vf=VDD, VCL=0V	97	57	137	uA
10	Feedback Hysteresis Current	IFBHYS	VD=5V, VDD=VDD(ON)+0.1V, Vf=VDD, VCL=0V	2.5	—	—	uA
11	Feedback Pin Voltage	VFB1	VD=5V, VDD=VDD(ON)+0.1V, IFB=IFB1, Vf=VDD, VCL=0V	1.9	1.6	2.2	V
		VFB	VD=5V, VDD=VDD(ON)+0.1V, IFB=80uA, Vf=VDD, VCL=0V	1.8	1.5	2.1	V
12	Supply Current before start-up	IDD(SB)	VD=5V, VDD=VDD(ON)-0.3V, Vf=VDD, VCL=0V, FB:OPEN	350	170	530	uA
13	Supply Current	IDD	VD=5V, VDD=VDD(ON)+0.1V, IFB=30uA, Vf=VDD, VCL=0V	510	250	750	uA
14	Supply Current at light load	IDD(OFF)	VD=5V, VDD=VDD(ON)+0.1V, IFB=IFB1+5uA, Vf=VDD, VCL=0V	550	300	800	uA
15	VDD Charging Current	Ich1	VDD=0V, VD=40V, FB, CL, f: OPEN	-8.5	-13.6	-4.1	mA
		Ich2	VDD=5V, VD=40V, FB, CL, f: OPEN	-5.3	-8.5	-2.1	mA
16	f Pin Threshold Voltage	Vf1	VDD=VDD(ON)+0.1V, fosc:foscL ⇒ foscH	1.25	0.65	1.85	V
17	f Pin current before start-up	If1	VDD=VDD(ON)-0.1V, Vf=0V	-50	-70	-30	uA
18	f Pin threshold current	If2	VDD=VDD(ON), VD=5V, IFB=30uA fosc:fosc ⇒ foscH	-29	-44	-14	uA
19	f Pin Voltage for foscH change	Vf2	VDD=VDD(ON)+0.1V, If=If2	2.3	2	2.6	V
20	f Pin Short current	If_GND	VDD=VDD(ON)+0.1V, Vf=0V	-22	-37	-7	uA
21	f Pin Voltage	Vf	VD=5V, VDD=VDD(ON)+0.1V, If=-50uA	2.25	1.55	2.85	V
22	CL Pin Threshold Voltage	VCL1	VDD=VDD(ON)+0.1V, ILIMIT:ILIMIT ⇒ ILIMIIT_M	1.35	0.75	1.95	V
23	CL Pin current before start-up	ICL1	VDD=VDD(ON)-0.4V, VCL=0V	-50	-70	-30	uA
24	CL Pin threshold current	ICL2	VDD=VDD(ON)+0.1V, ILIMIT:ILIMIT_L ⇒ ILIMIT_M	-29	-44	-14	uA
25	CL Pin Voltage for ILIMIT_M change	VCL2	VDD=VDD(ON)+0.1V, ICL=ICL2	2.35	1.75	2.95	V
26	CL Pin Short current	ICL_GND	VDD=VDD(ON)+0.1V, VCL=0V	-22	-37	-7	uA
27	CL Pin Voltage	VCL	VDD=VDD(ON)+0.1V, ICL=-50uA	2.3	1.6	2.9	V
28	Output Frequency High	foscH	VD=5V,VDD=VDD(ON)+0.1V, IFB=30uA, If=-50uA, VCL=0V, after dis_OLP	64	57.5	70.5	kHz
29	Jitter Freq deviation at foscH	⊿fH	VD=5V,VDD=VDD(ON)+0.1V, IFB=30uA, If=-50uA, VCL=0V, after dis_OLP	4	1.6	6.4	kHz

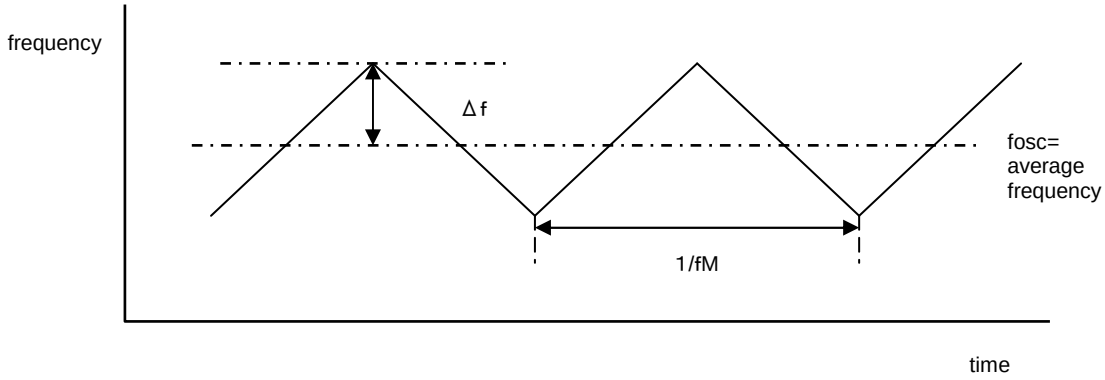
No.	Item	Symbol	Measure Condition (See Fig. 1)	Typ.	Min.	Max.	Unit
*30	Jitter Freq Modulation Rate at foscH	fMH	VD=5V,VDD=VDD(ON)+0.1V, IFB=30uA, If=−50uA, VCL=0V, after dis_OLP	250	–	–	Hz
31	Output Frequency Low	foscL	VD=5V,VDD=VDD(ON)+0.1V, IFB=30uA, Vf=0V, VCL=0V, after dis_OLP	24	22	26	kHz
32	Jitter Freq deviation at foscL	⊿fL	VD=5V,VDD=VDD(ON)+0.1V, IFB=30uA, Vf=0V, VCL=0V, after dis_OLP	1.5	0.6	2.4	kHz
*33	Jitter Freq Modulation Rate at foscL	fML	VD=5V,VDD=VDD(ON)+0.1V, IFB=30uA, Vf=0V, VCL=0V, after dis_OLP	100	–	–	Hz
【CIRCUIT PROTECTIONS】							
34	Self Protection Current Limit	ILIMIT	VDD=VDD(ON)+0.1V, *See Fig. 7 Vf=VDD, VCL=0V, FB:OPEN, DUTY=30%	1.0	0.92	1.08	A
*35	Drain current at Light Load	ID(OFF)	VDD=VDD(ON)+0.1V, IFB=IFB1−IFBHYS, Vf=VDD, VCL=0V, DUTY =30% *See Fig. 4	200	80	320	mA
*36	OLP Detection Blanking Time	dis_OLP	VD=40V, Vf=VDD, VCL=0V, VDD, FB:OPEN	16	8	25	ms
37	Self Protection Current ILIMIT_M	ILIMIT_M	VDD=VDD(ON)+0.1V, *See Fig. 4 Vf=VDD, ICL=−50uA, FB:OPEN, DUTY=30%	0.8	0.724	0.876	A
*38	Drain current at Light Load of ILIMIT_M	ID(OFF)_M	VDD=VDD(ON)+0.1V, IFB=IFB1−IFBHYS, Vf=VDD, ICL=−50uA,DUTY =30% *See Fig. 4	145	55	235	mA
39	Self Protection Current ILIMIT_L	ILIMIT_L	VDD=VDD(ON)+0.1V, *See Fig. 4 Vf=VDD, VCL=VDD, FB:OPEN, DUTY=30%	0.58	0.525	0.635	A
*40	Drain current at Light Load_L	ID(OFF)_L	VDD=VDD(ON)+0.1V, IFB=IFB1−IFBHYS, Vf=VDD, VCL=VDD, DUTY =30% *See Fig. 4	100	40	160	mA
41	VDD current at latch stop	IDD(OV)	VD=5V, IFB=30uA, VCL=0V, Vf=0V	32	22	42	mA
42	FB current at detecting OLP	IFB(OLP)	VD=20V, VCL=0V, Vf=VDD, VDD:OPEN	11.5	6	17	uA
43	Timer intermittent function	TIMER	VDD(ON)⇔VDD(OFF), ※See Fig. 5 VD=45V, IFB<IFB(OLP),	8	–	–	–
44	Timer intermittent function disabled at MAXDC	TIMER2	VDD(ON)⇔VDD(OFF), ※See Fig. 6 IFB<IFB(OLP), DUTY=MAXDC	1	–	–	–
45	Power−up Reset Threshold Voltage	VDDreset		2.6	1.8	3.5	V
*46	Over Temperature Protection	OTP		140	130	150	℃
*47	OTP Hysteresis	Δ OTP		70			℃
【OUTPUT】							
*48	Leading Edge Blanking Delay	ton(BLK)	VDD=VDD(ON)+0.1V, IFB=30uA, Vf=VDD, VCL=0V	300	240	360	ns
*49	Current Limit Delay	td(OCL)		70	20	120	ns
50	ON−State Resistance	RDS(ON)	IDS=100mA	4.6	–	5.8	Ω
51	Breakdown Voltage	VDSS	VDD:VDD(ON)+0.1V⇒VDD(OFF)−0.1V ⇒VDD(ON)+0.1V, ID=100uA, VFB=0V	–	700	–	V

No.	Item	Symbol	Measure Condition (See Fig. 1)	Typ.	Min.	Max.	Unit
52	OFF-State Current	IDSS	VDD:VDD(ON)+0.1V⇒VDD(OFF)-0.1V ⇒VDD(ON)+0.1V, VDS=650V, VFB=0V	10	–	20	uA
53	Rise Time	tr	VD=5V, VDD=VDD(ON)+0.1V, IFB=30uA, Vf=VDD, VCL=0V *See Fig. 8	110	–	–	ns
54	Fall Time	tf	VD=5V, VDD=VDD(ON)+0.1V, IFB=30uA, Vf=VDD, VCL=0V *See Fig. 8	40	–	–	ns
【SUPPLY】							
55	Drain Supply Voltage	VD(MIN)	IFB=30uA, Vf=VDD, VCL=0V, VDD:OPEN	10	–	35	V
【CONTROL FUNCTIONS during VDD=VDD(CLAMP)】							
56	Output Frequency at CLAMP	foscC	VD=5V, VDD=VDD(CLP)-0.1V, IFB=30uA, Vf=VDD, VCL=0V	46	40	52	kHz
57	Jitter Freq Deviation at CLAMP	ΔfC	VD=5V, VDD=VDD(CLP)-0.1V, IFB=30uA, Vf=VDD, VCL=0V	4.8	1.92	7.68	kHz
*58	Jitter Freq Modulation Rate at CLAMP	fMC	VD=5V, VDD=VDD(CLP)-0.1V, IFB=30uA, Vf=VDD, VCL=0V	100	–	–	Hz
【CIRCUIT PROTECTIONS during VDD=VDD(CLAMP)】							
59	Self Protection Current Limit at Clamp	ILIMIT_C	VDD=VDD(CLP)-0.1V, Vf=VDD, VCL=0V, FB:OPEN, DUTY=30%	1.06	0.95	1.17	A
【OUTPUT during VDD=VDD(CLAMP)】							
*60	Leading Edge Blanking Delay at CLAMP	ton(BLK)_C	VDD=VDD(CLP)-0.1V, IFB=30uA, Vf=VDD, VCL=0V	360	290	430	ns

【Fig. 1： Measure Circuit】



【Fig. 2: fosc, Δf, fm measurement】



【Fig. 3 : fosc, ILIMIT setting method through f, CL terminals】

Depending upon selection at f terminal and CL terminal, according to description below①~③, would output frequency (fosc) or overcurrent protection detection (ILIMIT) based on the setting in the below-mentioned table.

①Connection to S terminal

②Resistor (47kΩ) connected between S terminal(*)

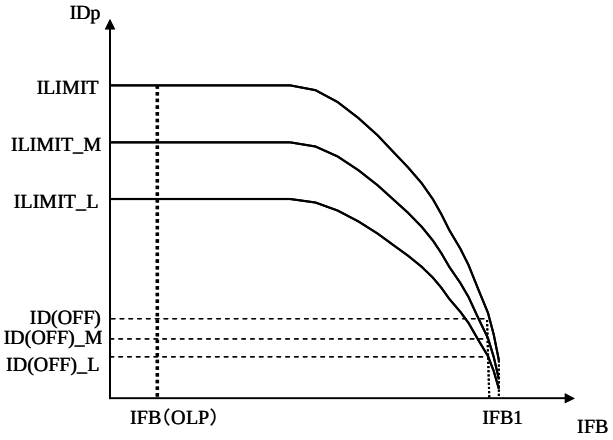
③Connection to VDD terminal

(*)②Please use resistor of 47kΩ (tolerance: within ±5%)

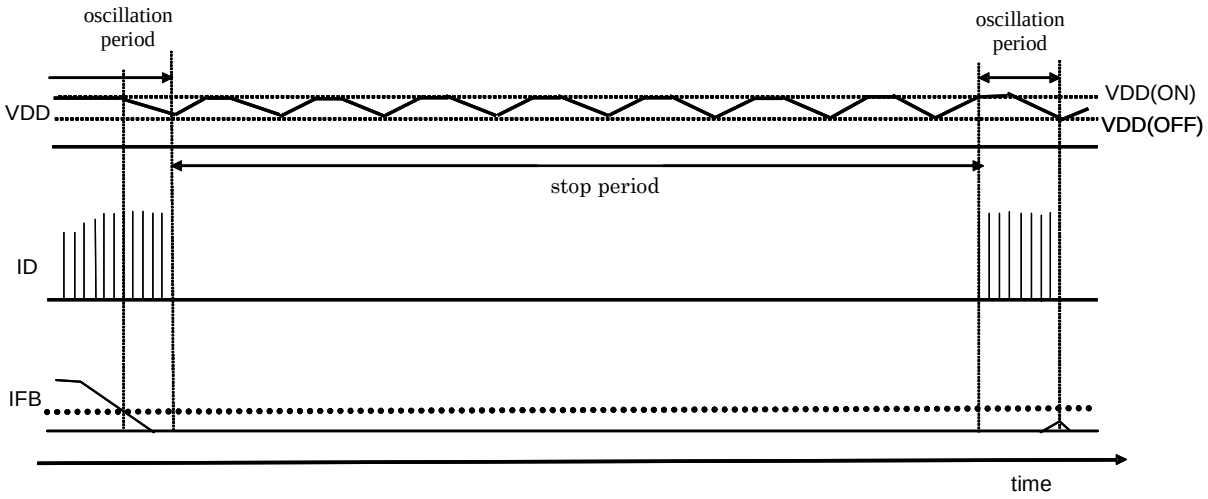
	f	fosc (kHz)
①	S	foscL
②	resistor (47kΩ)	foscH
③	VDD	fosc

	CL	ILIMIT (A)
①	S	ILIMIT
②	resistor (47kΩ)	ILIMIT_M
③	VDD	ILIMIT_L

【Fig. 4: FB current IFB vs Drain peak current IDp characteristic】

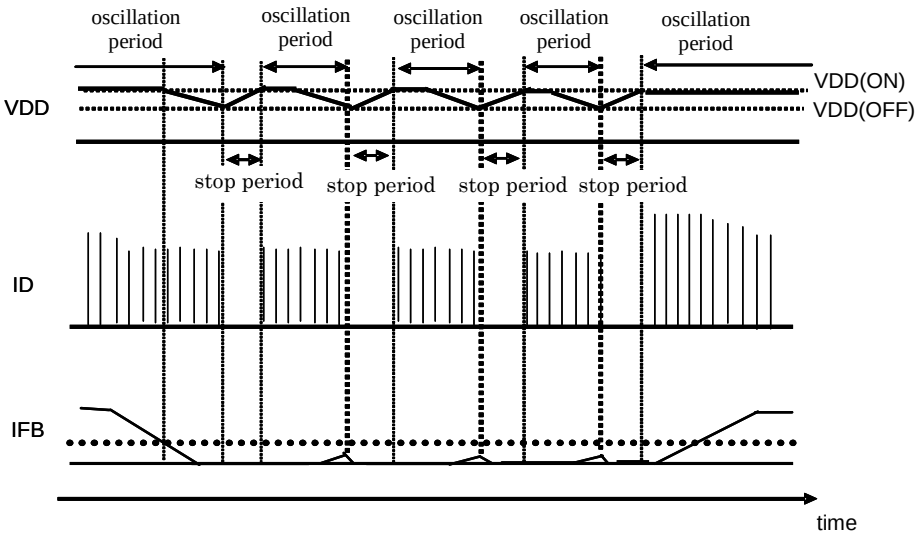


【Fig. 5: Terminal waveforms during timer intermittent operation due to the overload protection】

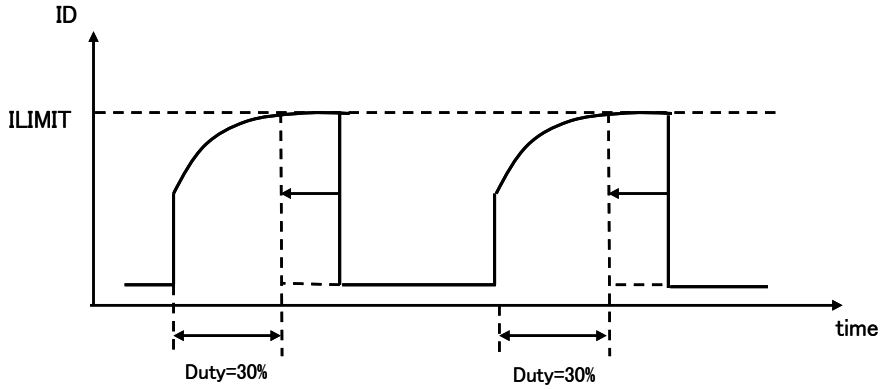


【Fig. 6: Terminal waveforms when MAXDC is detected which makes timer intermittent operation becomes invalid】

Though FB current is below IFB(OLP) which indicates the detection of overload state, if the ON duty of the Drain current is operating at MAXDC, Drain oscillation will occur in every rise and fall cycle of the VDD terminal.

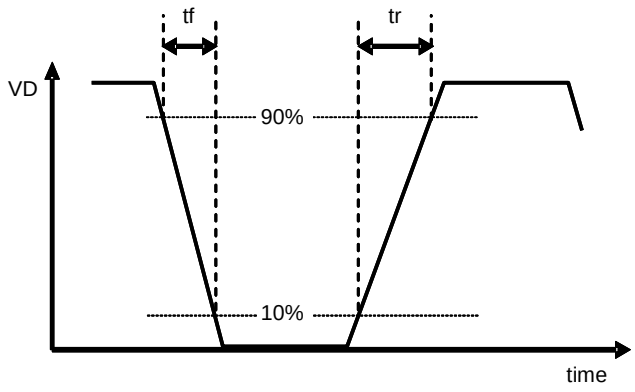


【Fig. 7: ILIMIT measurement】

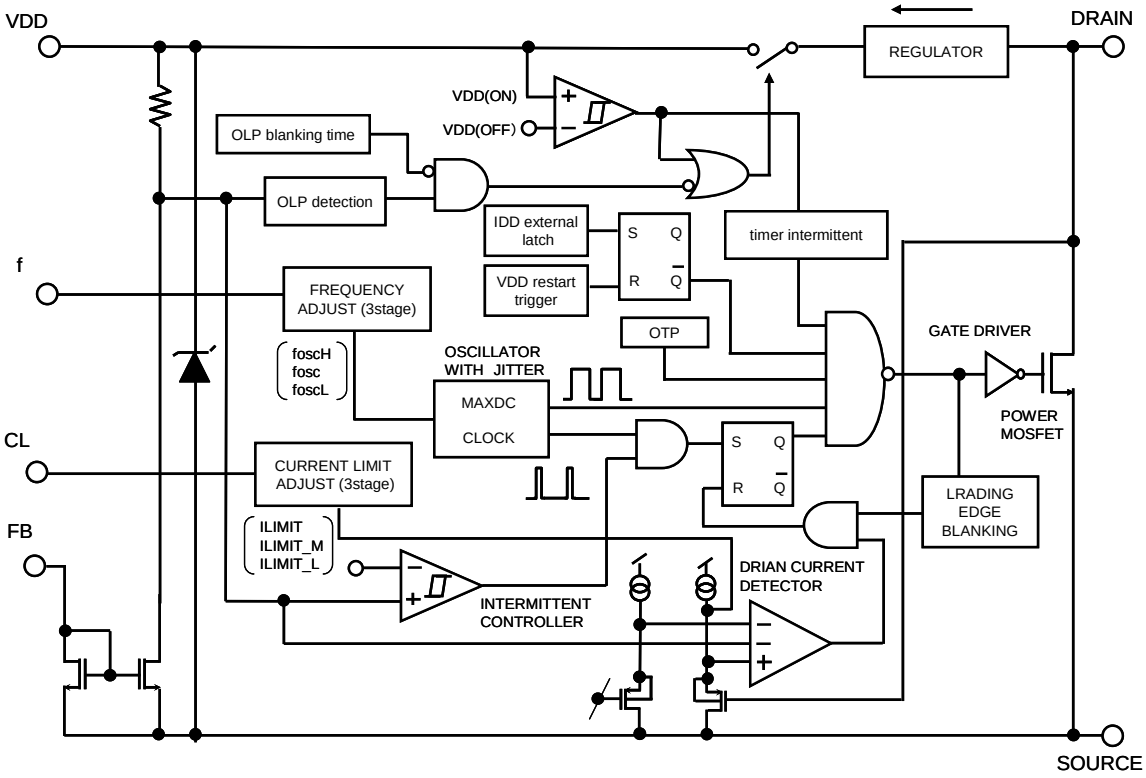


＊Load L, R during the ILIMIT measurement are: L=100uH, Rd=130Ω

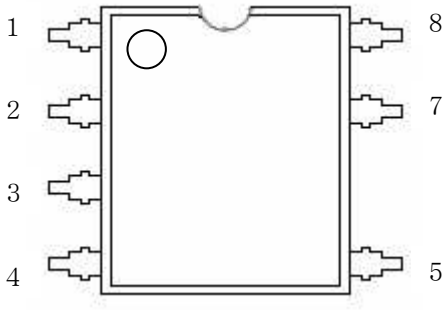
【Fig. 8： tr, tf measurement】



【Fig. 9： Block Diagram】



【Fig. 10： Pin Layout】



Pin No.	Pin Name
1	f
2	VDD
3	CL
4	FB
5	Drain
6	—
7	Source
8	Source

【Usage Precaution 1】
Connect a ceramic capacitor with value >0.1 μF between VDD pin and GND.

【Usage Precaution 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 pins and GND, etc as a countermeasure to pass regulatory Safety Standard. Concrete countermeasure could be provided individually. However, customer should make the final judgment.

(1) Reverse the DRAIN pin and VDD pin connection to the power supply board

(2) DRAIN pin short to VDD pin.

(3) DRAIN pin short to FB pin.

(4) DRAIN pin short to CL pin.

(5) DRAIN pin short to f pin.

(6) VDD pin short to FB pin.

(7) FB pin short to CL pin.

(8) FB pin short to f pin.

(9) CL pin short to f pin.

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

(1) If any of the products or technical information described in this book is to be exported or provided to non-residents, the laws and regulations of the exporting country, especially, those with regard to security export control, must be observed.

(2) The technical information described in this book is intended only to show the main characteristics and application circuit examples of the products. No license is granted in and to any intellectual property right or other right owned by Panasonic Corporation or any other company. Therefore, no responsibility is assumed by our company as to the infringement upon any such right owned by any other company which may arise as a result of the use of technical information described in this book.

(3) The products described in this book are intended to be used for general applications (such as office equipment, communications equipment, measuring instruments and household appliances), or for specific applications as expressly stated in this book.
Consult our sales staff in advance for information on the following applications:
- Special applications (such as for airplanes, aerospace, automotive equipment, traffic signaling equipment, combustion equipment, life support systems and safety devices) in which exceptional quality and reliability are required, or if the failure or malfunction of the products may directly jeopardize life or harm the human body.

It is to be understood that our company shall not be held responsible for any damage incurred as a result of or in connection with your using the products described in this book for any special application, unless our company agrees to your using the products in this book for any special application.

(4) The products and product specifications described in this book are subject to change without notice for modification and/or improvement. At the final stage of your design, purchasing, or use of the products, therefore, ask for the most up-to-date Product Standards in advance to make sure that the latest specifications satisfy your requirements.

(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.

Precautions on the Sales of IPDs

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** MIP803/804	MIP52** MIP56** MIP816/826	MIP53** MIP5S** MIP9E**	· 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.