

MIP2M40MS

Silicon MOS FET type integrated circuit

■ Features

- AC input detecting function
- By connecting SO terminal, it is able to select functions as below:
 - 1) Boot up and stop operation according to AC input or output (short-circuit SO terminal to VDD terminal)
 - 2) Signal output from SO terminal when AC input is low and transmit to the secondary side (connect an external element to SO terminal)
- Built-in jitter function
- Power consumption 30 mW or less at a no load is achieved
- Protection function is built into.
 - (over load protection, over voltage protection, over heat protection)

■ Applications

- Thin TVs and othes

■ Absolute Maximum Ratings $T_a = 25^{\circ}\text{C} \pm 3^{\circ}\text{C}$

Parameter	Symbol	Rating	Unit
DRAIN voltage	VD	- 0.3 to +700	V
VCC voltage	VCC	- 0.3 to +45	V
VDD voltage	VDD	- 0.3 to +8	V
FB voltage	VFB	- 0.3 to +6.4	V
FB current	IFB	-500	μA
LS voltage	VLS	- 0.3 to +10	V
SO voltage	VSO	- 0.3 to +7	V
Output peak current *	IDP	2.2	A
Channel temperature	Tch	150	$^{\circ}\text{C}$
Storage temperature	Tstg	-55 to +150	$^{\circ}\text{C}$

Note) *: The guarantee within the following pulse width.

Leading edge blanking delay + Current limit delay $t_{on}(\text{BLK}) + t_d(\text{OCL})$

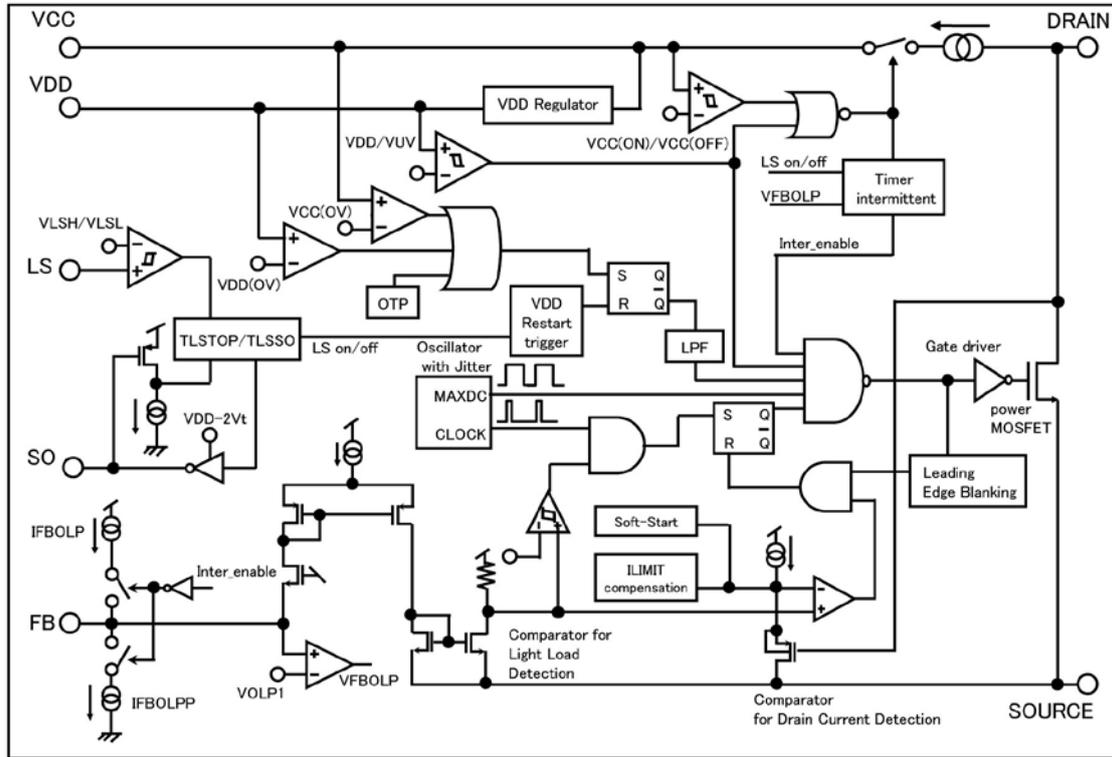
■ Package

- Code
DIP7-A1
- Pin Name

1. VDD	5. DRAIN
2. FB	6. —
3. SO	7. SOURCE
4. VCC	8. LS

■ Marking Symbol: MIP2M4

■ Block Diagram



■ Electrical Characteristics $T_C = 25^\circ\text{C} \pm 3^\circ\text{C}$

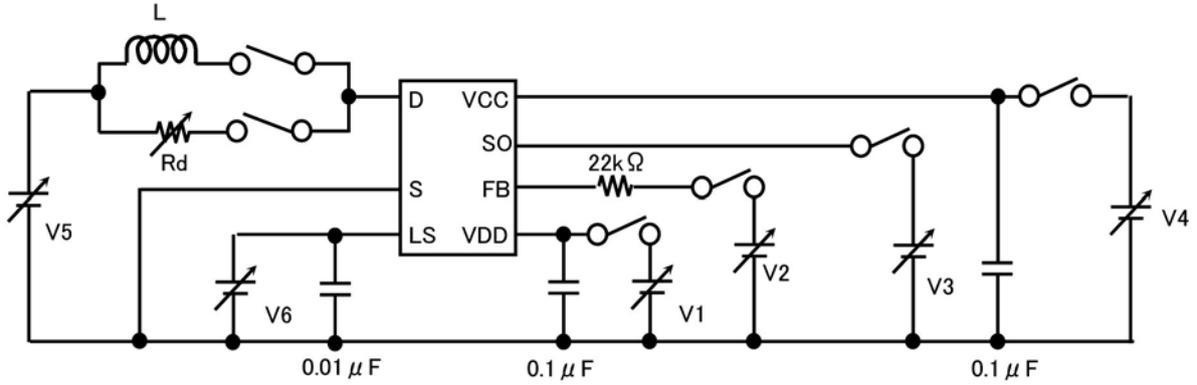
Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Control functions						
Output frequency *1	fosc	V4 = 15 V, V3 = 2 V, I2 = -20 μA , V5 = 5 V	60.3	67	73.7	kHz
Jitter frequency deviation *1	Δf	V4 = 15 V, V3 = 2 V, I2 = -20 μA , V5 = 5 V	2.4	5.0	7.6	kHz
Jitter frequency modulation rate *1	fM	V4 = 15 V, V3 = 2 V, I2 = -20 μA , V5 = 5 V		360		Hz
Maximum duty cycle	MAXDC	V4 = 15 V, V3 = 2 V, I2 = -20 μA , V5 = 5 V	50	54	58	%
VDD voltage	VDD	V4 = 15 V, V3 = 6 V, I2 = -20 μA , V5 = 5 V, V6 = 1 V	5.4	5.9	6.4	V
VCC start voltage	VCC(ON)	V3 = 6 V, I2 = -20 μA , V5 = 5 V, V6 = 1 V	11	12	13	V
VCC stop voltage	VCC(OFF)	V3 = 6 V, I2 = -20 μA , V5 = 5 V, V6 = 1 V	7.45	8.2	8.95	V
VCC start / stop hysteresis	VCC(HYS)	V3 = 6 V, I2 = -20 μA , V5 = 5 V, V6 = 1 V	3.1	3.8	4.5	V
FB threshold voltage	IFB1	ON \rightarrow OFF V4 = 15 V, V3 = 6 V, V5 = 5 V, V6 = 1 V	-140	-100	-60	μA
FB hysteresis current	IFB(HYS)	OFF \rightarrow ON V4 = 15 V, V3 = 6 V, V5 = 5 V, V6 = 1 V		5		μA
FB pin voltage	VFB1	V4 = 15 V, V3 = 6 V, I2 = IFB1, V5 = 5 V, V6 = 1 V	1.6	1.9	2.2	V
Circuit current before start	ICC(SB)	V4 = 6.5 V, V3 = 6 V, I2 = -20 μA , V5 = 5 V, V6 = 1 V	0.20	0.25	0.30	mA
Circuit current	ICC	V4 = 15 V, V3 = 6 V, I2 = -20 μA , V5 = 5 V, V6 = 1 V	0.255	0.40	0.545	mA
VDD charging current	Ich1	V1 = 0 V, V5 = 40 V	-5.25	-3.5	-1.75	mA
	Ich2	V1 = 4 V, V5 = 40 V	-3.8	-2.45	-1.1	mA
LS start voltage	VLSH	V4 = VCC(OFF) \rightarrow VCC(ON), V3 = 6 V, I2 = -20 μA , V5 = 5 V	486	540	594	mV
LS stop voltage	VLSL	V4 = 15 V, V3 = 6 V, I2 = -20 μA , V5 = 5 V	355	395	435	mV
LS detect hysteresis	VLS(HYS)	VLSH - VLSL		145		mV
LS start / stop mode filter time	TLStop	V4 = 15 V, V3 = 6 V, I2 = -20 μA , V5 = 5 V, V6 = VLSH \rightarrow VLSL	4.2	5.85	7.5	ms
LS detect SO signal mode filter time	TLSSO	V4 = 15 V, V3 = 6 V, I2 = -20 μA , V5 = 5 V	1.85	3.15	4.45	ms
SO output voltage	VSO	V4 = 15 V, I2 = -20 μA , V5 = 5 V, V6 = VLSH \rightarrow VLSL	3.2	4.2	5.2	V
SO output current	ISO	V4 = 15 V, V3 = 1 V, I2 = -20 μA , V5 = 5 V, V6 = 0 V	-1.2	-0.80	-0.4	mA
SO disable threshold	VSOTH	V4 = 15 V, I2 = -20 μA , V5 = 5 V, V6 = 0 V	4.6	5.2	5.8	V
SO disable threshold difference	D_VSO	VSOTH - VSO	0.7	1.0	1.3	V
SO pull down current	ISO_down	V4 = 15 V, V3 = 1 V, I2 = -20 μA , V5 = 5 V, V6 = 0 V	0.3	0.7	1.1	μA
Soft start time	Tsoft	V4 = VCC(OFF) \rightarrow VCC(ON), I2 = -20 μA , V5 = 5 V, V6 = 1 V	5	8.5	12	ms

■ Electrical Characteristics (continued) $T_C = 25^\circ\text{C} \pm 3^\circ\text{C}$

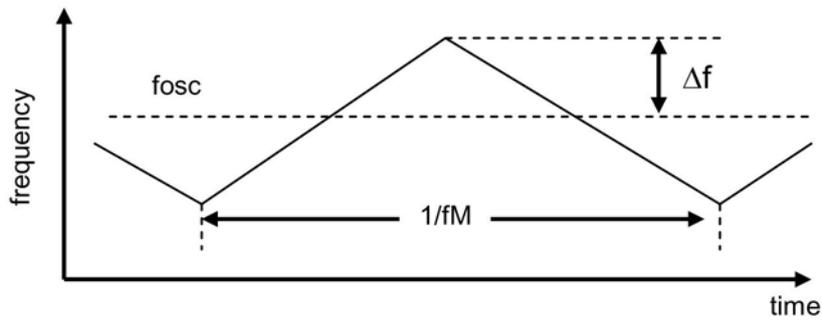
Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Circuit protections						
Self protection current limit *2	ILIMIT	V4 = 15 V, V3 = 2 V, V2 = 2.6 V, V5 = adjusted, Duty = 30%	0.315	0.35	0.385	A
ILIMIT modified coefficient *2	R_slope	V4 = 15 V, V3 = 2 V, V2 = 2.6 V, V5 = adjusted, Duty = 10%		10		mA/ μs
Drain current at light load	ID(OFF)	Ton = 4.5 μs , V4 = 15 V, V3 = 2 V, I2 = IFB1+2 μA , V5 = adjusted	40	100	160	mA
FB current at heavy load	IFBOLP	V5 = ILIMIT condition V4 = 15 V, V3 = 2 V, V2 = 3 V, V6 = 1 V	-10	-13	-7	μA
FB over load protection detect voltage	VFBOLP	V5 = ILIMIT condition V4 = 15 V, V3 = 2 V, V6 = 1 V	3.5	3.85	4.2	V
FB over load protection hysteresis	HYSVFBOLP			0.65		V
FB discharge current at timer intermittent	IFBOLPP	V5 = ILIMIT condition, V4 = VCC(OFF), V3 = 2 V, V2 = 25 V, V6 = 1 V	0.6	1.0	1.4	mA
FB current at MAXDC detect	IFBMAXDC	V4 = 15 V, V3 = 6 V, V2 = 3 V, V5 = 5 V, V6 = 1 V			0.2	μA
Timer intermittent function *3	TIMER	V4 = VCC(ON) \rightarrow VCC(OFF), V5 = ILIMIT condition, V3 = 6 V, I2 = -20 μA , V6 = 1 V		4		—
Timer intermittent function disabled at MAXDC *4	TIMER2	V4 = VCC(ON) \rightarrow VCC(OFF), V5 = 5 V, V3 = 6 V, I2 = -20 μA , V6 = 1 V		1		—
Leading edge blanking delay	ton(BLK)		230	290	350	ns
Current limit delay	td(OCL)		100	150	200	ns
VCC over voltage protection	VCC(OV)	V3 = 6 V, I2 = -20 μA , V5 = 5 V, V6 = 1 V	26	29	32	V
VDD over voltage protection	VDD(OV)	V4 = 15 V, I1 = IDD(OV), V3 = 0 V, I2 = -20 μA , V5 = 5 V, V6 = 6 V	6.2	7.0	7.8	V
VDD current at VDD over voltage protection	IDD(OV)	V4 = 15 V, V3 = 0 V, I2 = -20 μA , V5 = 5 V, V6 = 6 V	2.4	3.5	4.6	mA
VDD(OV) difference	D_VDDOV	VDD(ON) - VDD	0.4	0.9	1.5	V
Thermal shutdown temperature	TOTP		130	140	150	$^\circ\text{C}$
Latch reset VDD threshold	VDDreset		1.8	2.7	3.5	V
Output						
ON-state resistance	RDS(ON)	V4 = 15 V, V3 = 2 V, I5 = 100 mA, I2 = -20 μA , V6 = 1 V		16	21	Ω
OFF-state leakage current	IDSS	V4 = 35 V, I2 = -20 μA , V3 = 6 V, V5 = 650 V, V6 = 1 V		10	20	μA
Breakdown voltage	VDSS	V4 = 35 V, I2 = -20 μA , V3 = 6 V, I5 = 100 μA , V6 = 1 V	700			V
Rise time *5	tr	V4 = 15 V, V3 = 1 V, I2 = -20 μA , V5 = 5 V		70		ns
Fall time *5	tf	V4 = 15 V, V3 = 1 V, I2 = -20 μA , V5 = 5 V		35		ns
Supply voltage characteristics						
Drain supply voltage	VD(MIN)	V1, V2, V3, V4, V6 OPEN	50			V

■ Electrical Characteristics (continued) $T_C = 25^{\circ}\text{C} \pm 3^{\circ}\text{C}$

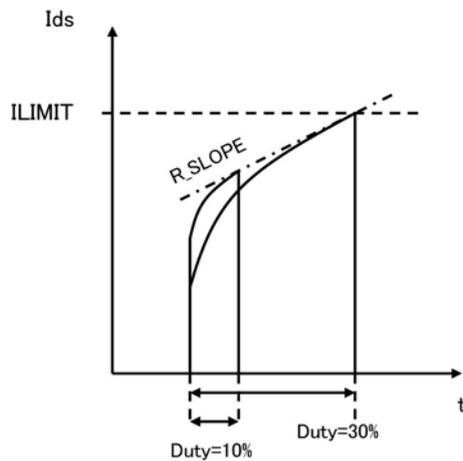
1. Measurement circuit



2. *1: Δf , fM measurement



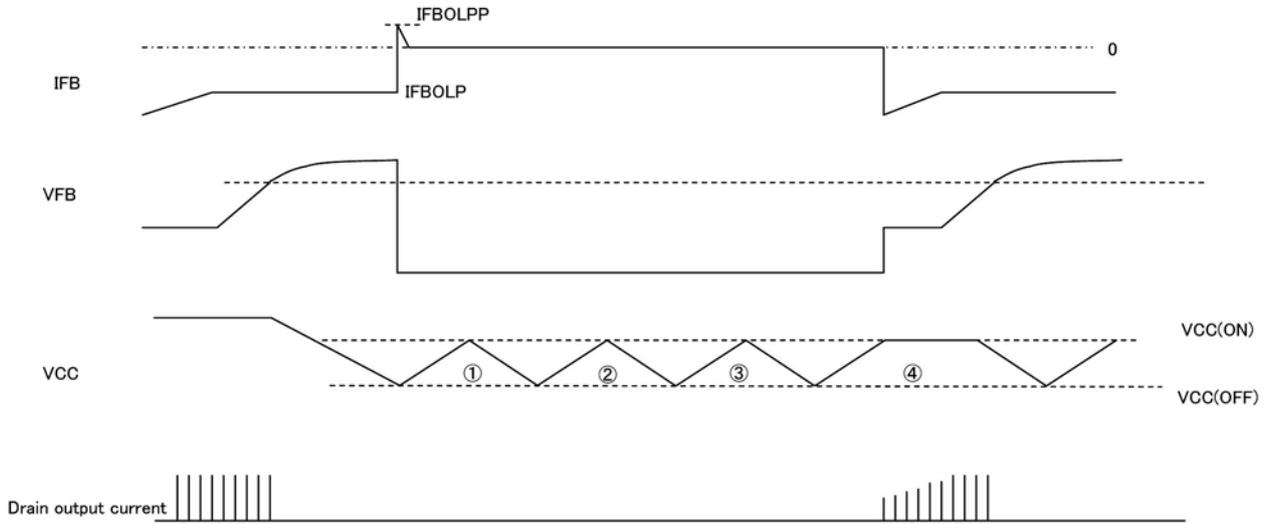
*2: ILIMIT, R_Slope measurement



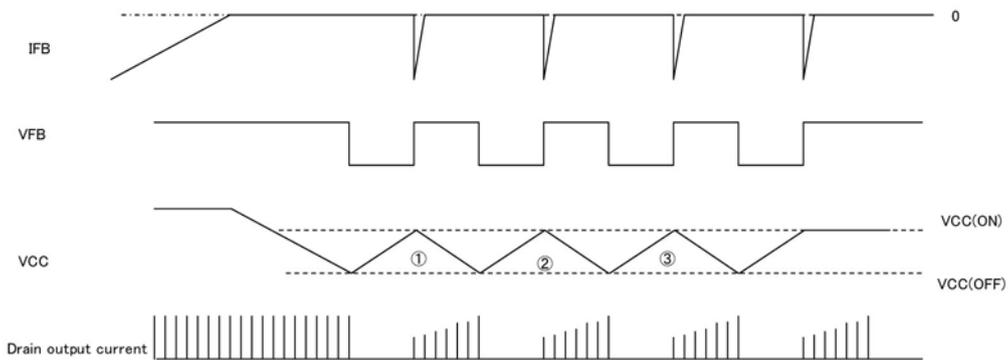
$$R_{\text{slope}} ; \{(\text{ILIMIT at Duty}=30\%) - (\text{ILIMIT at Duty}=10\%)\} / \{(\text{Ton at Duty}=30\%) - (\text{Ton at Duty}=10\%)\}$$

■ Electrical Characteristics (continued) $T_C = 25^{\circ}\text{C} \pm 3^{\circ}\text{C}$

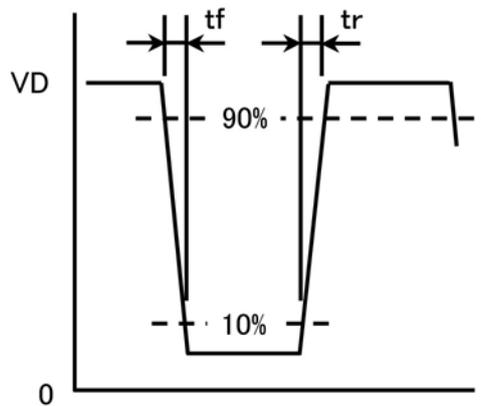
2. *3: Timer intermittent over load protection diagram



*4: OLP is disabled when MAXDC operation



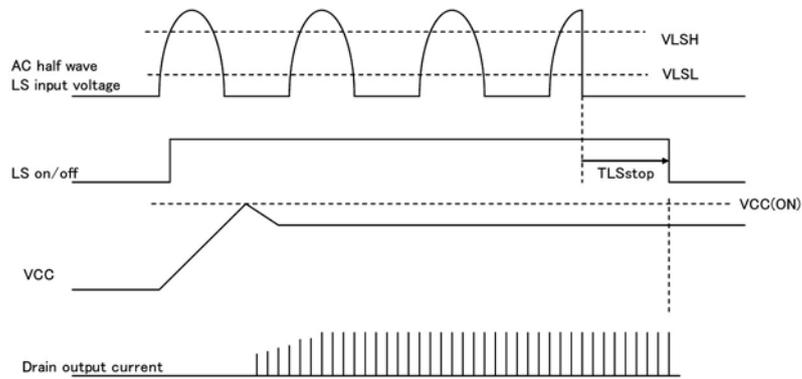
*5: tr, tf measurement



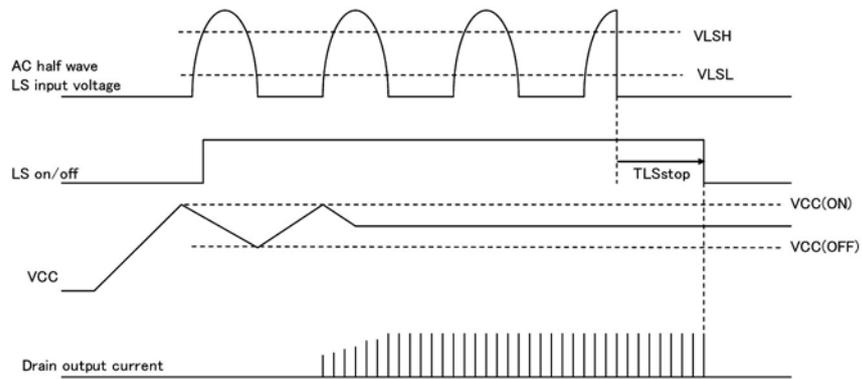
■ Electrical Characteristics (continued) $T_C = 25^{\circ}\text{C} \pm 3^{\circ}\text{C}$

3. Start up and Stop diagram

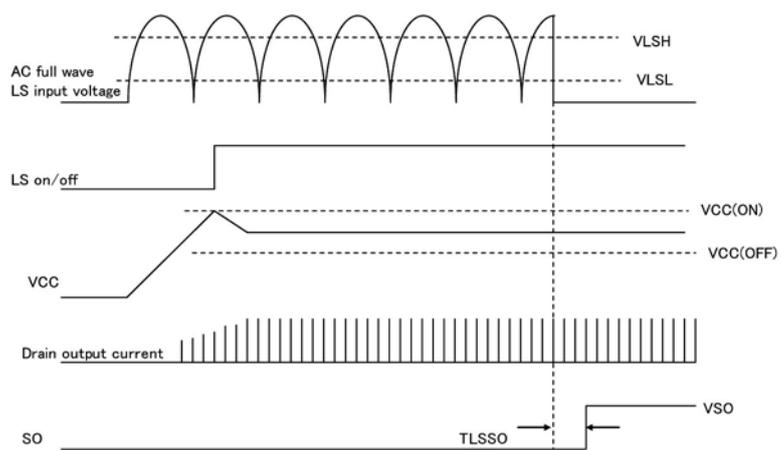
(A) Usual start and stop of LS start/stop mode (SO is connected to VDD)



(B) Slow start and stop of LS start/stop mode (SO is connected to VDD)



(C) Usual start and stop of LS detect SO signal mode (SO is connected to external parts)



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.
- (7) This book may be not reprinted or reproduced whether wholly or partially, without the prior written permission of our company.

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**	<ul style="list-style-type: none"> · Japanese companies in Japan · Japanese companies in Asia (50% or more owned) 	<ul style="list-style-type: none"> · Companies in European and American countries · Asian companies in Asia · Other local companies 	<ul style="list-style-type: none"> · For power supply · For DC-DC converter
MIP00** MIP55** MIP816/826	MIP52** MIP56** MIP9E**	MIP53** MIP803/804	<ul style="list-style-type: none"> · Japanese companies in Japan · Japanese companies in Asia (50% or more owned) · Asian companies in Asia 	<ul style="list-style-type: none"> · Companies in European and American countries · Other local companies 	<ul style="list-style-type: none"> · For power supply · For EL driver · For LED lighting driver
MIP50**	MIP51**	MIP7**	<ul style="list-style-type: none"> · No restrictions in terms of contract 	<ul style="list-style-type: none"> · No restrictions in terms of contract 	<ul style="list-style-type: none"> · For lamp driver/ car electronics accessories

Note) For details, contact our sales division.