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

MIP0060MXL

Panasonic

Type	Silicon MOSFET type Integrated Circuit		
Application	For Switching Power Supply Control		
Structure	CMOS type		
Equivalent Circuit	Figure 7		
Package	SSOP016-P-0300XZ	Marking	MIP006

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

NO.	Item	Symbol	Ratings	Unit	Note
1	VIN Voltage	VIN	−0.3 ～ 550	V	
2	VCC Voltage	VCC	−0.3 ～ 45	V	
3	VDD1 Voltage	VDD1	−0.3 ～ 10	V	
4	VDD2 Voltage	VDD2	−0.3 ～ 10	V	
5	VGD Voltage	VGD	−0.3 ～ 15	V	
6	OUT Voltage	VOUT	−0.3 ～ 15	V	
7	IS Voltage	VIS	−0.3 ～ 5	V	
8	FB Voltage	VFB	−0.3 ～ 8	V	
9	OFF Voltage	VOFF	−0.3 ～ 10	V	
10	CL Voltage	VCL	−0.3 ～ 10	V	
11	LS Voltage	VLS	−0.3 ～ 10	V	
12	SO Voltage	VSO	−0.3 ～ 10	V	
13	SO Current	ISO	−1.3	mA	
14	Junction Temperature	Tj	150	°C	
15	Storage Temperature	Tstg	−55 ～ +150	°C	

B. RECOMMENDED OPERATING CONDITIONS

NO.	Item	Symbol	Conditions	Unit	Note
1	Junction Temperature	Tj	−40 ～ +125	°C	

Established : 2013-08-01
Revised : 2015-10-07

C. ELECTRICAL CHARACTERISTICS Measure condition (TC=25°C±3°C)

No.	Item	Symbol	Measure Conditions	Typ.	Min.	Max.	Unit
[CONTROL FUNCTIONS] *Design Guarantee Item, **Reference Item							
1	VCC Start Voltage	VCC(ON)		20	18	22	V
2	VCC Stop Voltage	VCC(OFF)		10.3	9.3	11.3	V
3	VCC Start/Stop Hysteresis	D_VCC	VCC(ON) - VCC(OFF)	9.7	8.7	10.7	V
4	VDD1 Reference Voltage	VDD1	VCC = 22 V	6.0	5.5	6.5	V
5	VDD2 Reference Voltage	VDD2	VCC = 22 V, VDD1 : open	5.2	4.7	5.7	V
6	VDD2 Charge Start Voltage	VDD2(OFF)	VIN = 50 V	4.5	4.0	5.0	V
7	Reset Voltage of Power-OFF Mode	VDD2reset		2.1	1.4	2.8	V
8	Voltage Deference for keeping Power-OFF Mode	D_VDD2	VDD2(OFF) - VDD2reset	2.4	1.4	3.4	V
9	VCC Pin Current at Start-up	ICC (SB)	VCC = VCC(ON) - 0.5 V, CL : open, FB : open, SO : open	0.55	0.40	0.70	mA
10	VCC Pin Current at Low Load	ICC (STB)	VCC = 15 V, CL : open, IFB = IFB1 – 5uA, SO : open	0.73	0.63	0.83	mA
11	VCC Pin Current at Operating	ICC(OP)	VCC = 22 V, CL : open, COUT = 1 nF, IFB = -50 µA, SO : open	1.7	1.4	2.0	mA
12	VCC Pin current in Power-OFF Mode	ICC(OFF)	Power-OFF Mode, VIN = 50 V, VCC = 22 V	40	20	60	µA
13	Output Frequency	fosc	VCC = 22 V, CL : open, COUT = 1 nF, VFB = 3 V	66	61	71	kHz
14	Jitter Frequency Deviation	d_fosc	VCC = 22 V, CL : open, COUT = 1 nF, VFB = 3 V	3	1.8	4.2	kHz
**15	Jitter Frequency Modulation Rate	fM	VCC = 22 V, CL : open, COUT = 1 nF, VFB = 3 V	430	-	-	Hz
16	Maximum Duty Cycle	MAXDC	VCC = 22 V, CL : open, COUT = 1 nF, VFB = 3 V	66	60	72	%
17	Feedback Threshold Current	IFB1	ON → OFF, VCC = 22 V, CL : open	-100	-140	-60	µA
**18	Feedback Current Hysteresis	IFBHYS	OFF → ON VCC = 22 V, CL : open	1	-	-	µA
19	FB Pin Voltage	VFB1	VCC = 22 V, IFB = IFB1	1.6	1.2	2.0	V
20	FB Pin Grounded Current	IFB0	VCC = 22 V, VFB = 0 V	-330	-410	-250	µA
21	FB Pin Pull-down resistance at Output Stop	RFB(OFF)	VCC = 22 V, VFB = VFB1, ICL < ICL1	370	220	520	Ω

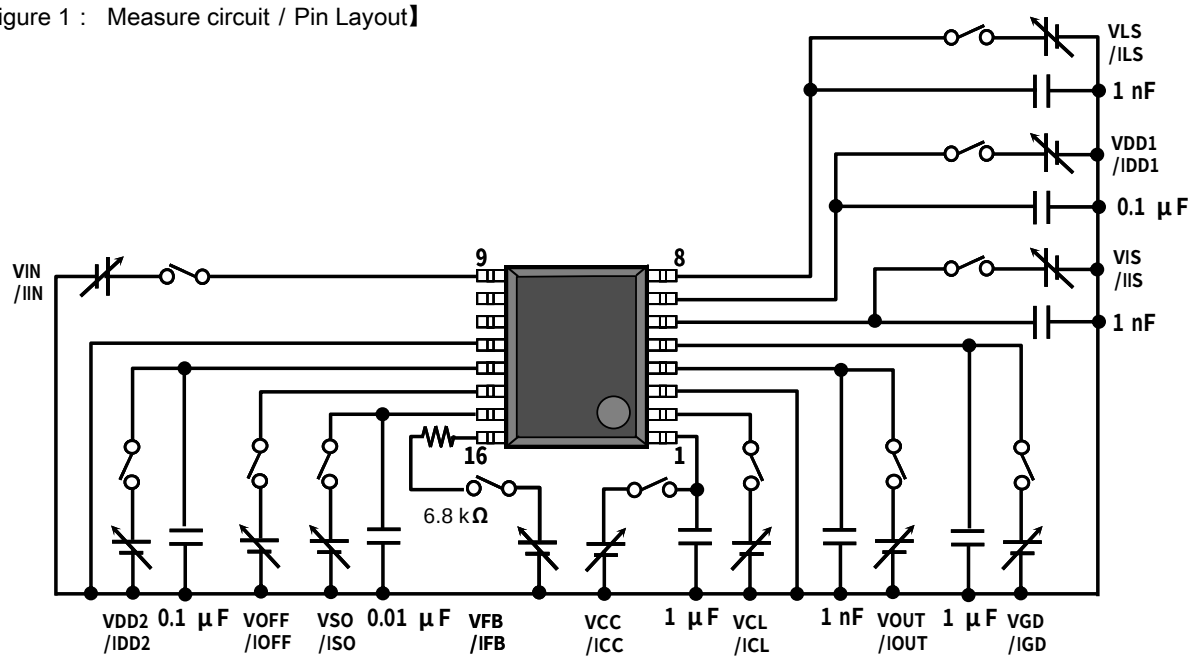
Established : 2013-08-01
Revised : 2015-10-07

No.	Item	Symbol	Measure Conditions	Typ.	Min.	Max.	Unit
22	VCC Pin Charging Current	ICCH1	VCC = 0 V, CL : open, FB : open, , SO : open, VIN = 50 V	-11.0	-15.4	-6.6	mA
		ICCH2	VCC = VCC(ON) - 0.5 V, CL : open, FB : open, , SO : open, VIN = 50 V	-3.6	-5.1	-2.1	mA
23	VDD2 Pin Charging Current	IDD2CH	Power-OFF Mode, Detection of AC input cutoff, VDD2 = VDD2(OFF) – 0.5 V, VSO = 0 V, VIN = 50 V	-8.0	-	-4.0	mA
24	LS Pin Detect Voltage	VLSH	VCC = 22 V, VFB = 3 V	1.27	1.11	1.43	V
25	LS Pin Detect Voltage Hysteresis	VLSHYS	VCC = 22 V, VFB = 3 V	0.37	0.27	0.47	V
26	LS Pin Leakage Current	ILS(LEAK)	VCC = 22 V, VLS = 10 V	0	-	0.1	µA
27	LS Pin Detect Filter Time	Td(LS)1	VCC = 22 V	36	23	55	ms
		Td(LS)2	Power-OFF Mode, VIN = 50 V	32	22	48	ms
28	VIN Current in LS Undetected State	IIN(ACCUT)1	Detection of AC input cutoff, VCC = 22 V, SO : open, VIN = 30 V	2.4	1.4	3.4	mA
		IIN(ACCUT)2	Power-OFF Mode, Detection of AC input cutoff, VCC = 22 V, SO : open, VIN = 30 V	2.2	1.2	3.2	mA
29	OFF Pin Detect Voltage	VTH(OFF)	VIN = 50 V	1.27	1.04	1.50	V
*30	Power-OFF Mode Detect Filter Time	Td(OFF)	VOFF = 0 V → VTH(OFF) + 0.2 V VIN = 50 V	1.2	0.7	1.7	ms
31	SO Pin Output Voltage	VSO1	Detection of AC input cutoff, VCC = 22 V, ISO = 0 µA, VIN = 50 V	3.7	2.7	4.7	V
		VSO2	Power-OFF Mode, Detection of AC input cutoff, ISO = 0 µA, VIN = 50 V	2.9	1.9	3.9	V
32	SO Pin Output Current	ISO	Detection of AC input cutoff, VCC = 22 V, VSO = 1 V, VIN = 50 V	-0.75	-1.2	-0.3	mA
33	SO Pin Disable Threshold	VTH(SO)		VDD2-1.0	VDD2-1.5	VDD2-0.5	V
*34	Soft Start Time	Tsoft	VCC = VCC(OFF) → VCC(ON), CL : open, VFB = 3 V, SO : open	5	2.5	7.5	ms
[CIRCUIT PROTECTIONS] *Design Guarantee Item, **Reference Item							
35	Current Limit Detection Maximum Voltage	VLIMIT(MAX)	VCC = 22 V, CL : open , VFB = 3 V	775	720	830	mV
36	Current Limit Detection Voltage at ICL = -150 µA	VLIMIT150	VCC = 22 V, ICL = -150 µA , VFB = 3 V	390	350	430	mV
37	Remote ON/OFF Threshold Current	ICL1	ON → OFF, VCC = 22 V, VFB = 3 V	-300	-390	-210	µA

No.	Item	Symbol	Measure Conditions	Typ.	Min.	Max.	Unit
**38	Remote ON/OFF Threshold Current Hysteresis	ICLHYS	OFF → ON, VCC = 22 V, VFB = 3 V	10	-	-	µA
39	CL Pin Voltage at ICL = 0 µA	VCL	VCC = 22 V, ICL = 0 µA , VFB = 3 V	1.30	0.90	1.70	V
40	CL Pin Voltage at ICL = 150 µA	VCL150	VCC = 22 V, ICL = -150 µA , VFB = 3 V	1.15	0.80	1.50	V
41	CL Pin Voltage at ICL = ICL1	VCL1	VCC = 22 V, ICL = ICL1, VFB = 3 V	1.00	0.65	1.35	V
42	CL Pin Grounded Current	ICL0	VCC = 22 V, VCL = 0 V, VFB = 3 V	-380	-560	-200	µA
43	CL Pin Current Difference	D_ICL	ICL1 - ICL0	80	30	130	µA
*44	Current Detection Minimum Voltage at IFB = IFB1	VIS(OFF)min	VCC = 22 V, ICL : open, IFB = IFB1	200	150	250	mV
**45	Jitter Deviation of Current Detection Voltage at IFB = IFB1	D_VIS(OFF)	VCC = 22 V, ICL : open, IFB = IFB1	40	-	-	mV
46	Sense Offset Current at Heavy Load	IIS1	VCC = 22 V , VFB = 3 V, VIS = 0 V	0	-2	2	µA
**47	Sense Offset Minimum Current at IFB = IFB1	IIS2	VCC = 22 V , IFB = IFB1, VIS = 0 V	-90	-	-	µA
48	Minimum On Time	Ton(MIN)	VCC = 20 V, COUT = 1 nF	800	500	1100	ns
**49	Leading Edge Blanking Delay	Ton(BLK)	VCC = 22 V, CL : open, COUT = 1 nF, VFB = 3 V	650	-	-	ns
**50	Current Limit Delay	Td(OCL)	VCC = 22 V, CL : open, COUT = 1 nF, VFB = 3 V	150	-	-	ns
51	FB Pin Over Load Protection Voltage	VFB(OL)	VCC = 22 V	4.4	3.9	4.9	V
52	FB Pin Charging Current at Over Load	IFB(OL)	VCC = 22 V, VFB = 3 V	-10	-13	-7	µA
53	VDD1 Latch Stop Threshold Voltage	VDD1(OV)	VCC = 22 V, VFB = 3 V	7.7	7.0	8.4	V
54	VDD1 Latch Stop Threshold Current	IDD1(OV)	VCC = 22 V, VFB = 3 V	1.4	0.8	2.0	mA
55	VDD1clamp Current	IDD1(CLP)	VCC = 22 V, VDD1 = 10 V	9.3	7.5	11.1	mA
**56	VDD1 Latch Reset Threshold Voltage	Td(LAT)	VCC = 22 V	125	-	-	µs
57	VDD1 Latch reset Voltage	VDD1reset		2.7	1.7	3.7	V
*58	Thermal Shutdown Temperature	TOTP		140	130	150	°C
**59	Thermal Shutdown Temperature Hysteresis	TOTPHYS		70	-	-	°C

No.	Item	Symbol	Measure Conditions	Typ.	Min.	Max.	Unit
[OUTPUT] **Reference Item							
60	VGD Reference Voltage	VGDref	VCC = 22 V	12	11	13	V
61	VGD Minimum Voltage	VGD(MIN)	VCC = VCC(OFF)	9.4	8.4	10.4	V
**62	Output Sink Current	IOUTL	VCC = 22 V, VGD = VGDref + 0.2 V, VOUT = 12 V	1.2	-	-	A
**63	Output Source Current	IOUTH	VCC = 22 V, VGD = VGDref + 0.2 V, VOUT = 0 V	-0.6	-	-	A
64	Low Level Output Voltage	VOUTL	VCC = 22 V, VGD = VGDref + 0.2 V, IOUT = 10 mA	0.05	-	0.2	V
65	High Level Output Voltage	VOUTH	VCC = 22 V, VGD = VGDref + 0.2 V, IOUT = -10 mA	VGD-0.1	VGD-0.3	-	V
**66	Rise Time	tr	VCC = 22 V, COUT = 1 nF VGD = VGDref + 0.2 V	40	-	-	ns
**67	Fall Time	tf	VCC = 22 V, COUT = 1 nF VGD = VGDref + 0.2 V	20	-	-	ns
[HIGH VOLTAGE INPUT]							
68	VIN Pin Leakage Current	IIN(LEAK)	VIN = 500 V, VCC > VCC(ON),	2.5	-	10	µA
69	VIN Pin Current in Power-OFF Mode	IIN(OFF)	Power-OFF Mode, VIN = 500 V, VCC : open	12.5	-	30	µA
70	VIN Pin Breakdown Voltage	BVVIN	IIN = 100 µA, VCC > VCC(ON)	-	550	-	V
71	Minimum VIN Supply Voltage	VIN(MIN)		26	21	31	V

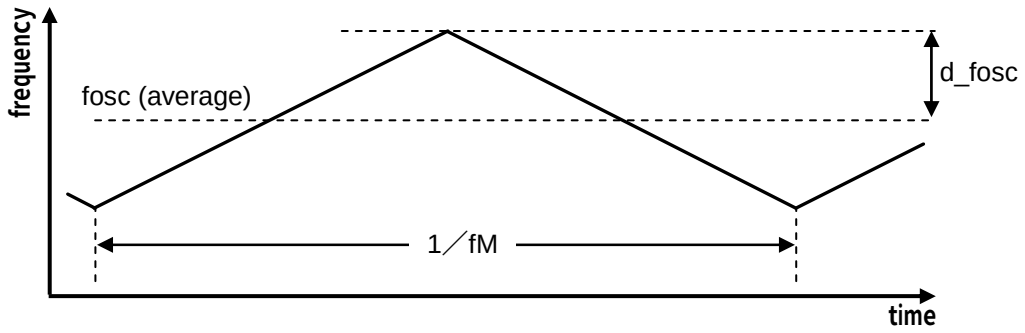
【Figure 1 : Measure circuit / Pin Layout】



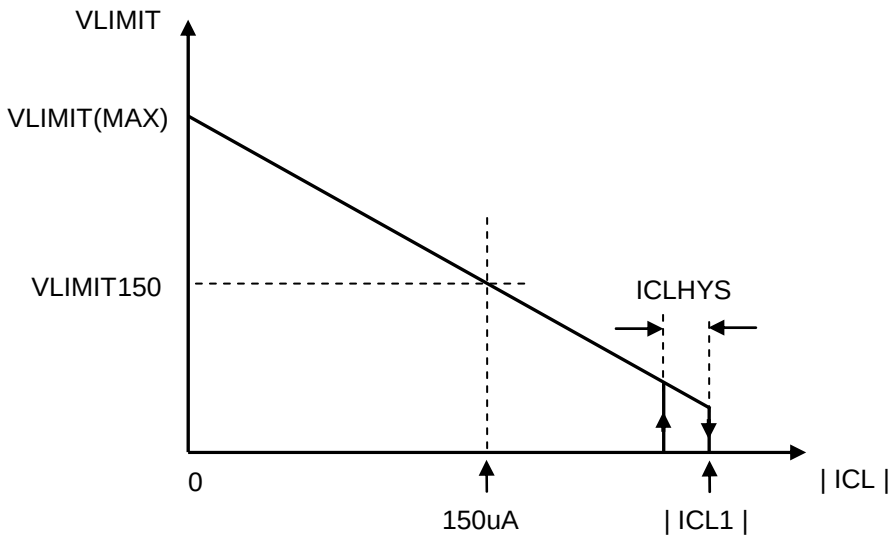
Pin No.	Pin Name	Function
1	VCC	Power supply from bias winding
2	CL	VLIMIT adjustment（Input correction）
3	GND1	Ground (※)
4	OUT	Output for gate drive
5	VGD	Power supply for gate drive
6	IS	Current detection
7	VDD1	Power Supply Voltage for circuits, External latch
8	LS	AC input cutoff detection
9	VIN	Power supply for start-up
10	NC	—
11	NC	—
12	GND2	Ground (※)
13	VDD2	Power Supply Voltage for power off mode
14	OFF	Power-off mode control
15	SO	AC input signal detection signal output
16	FB	Feedback control

※GND1 and GND2 should be shorted on this power supply board.

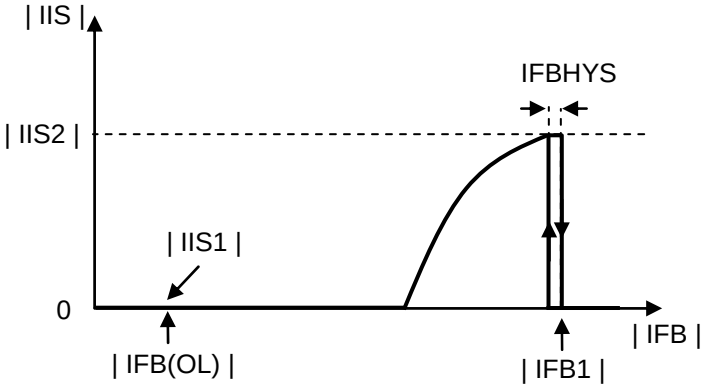
【Figure 2： fosc, d_fosc, fM measurement】



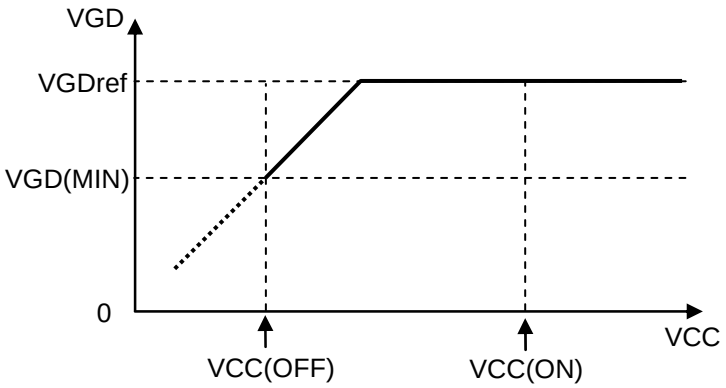
【Figure 3： ICL－VLIMIT Characteristics】



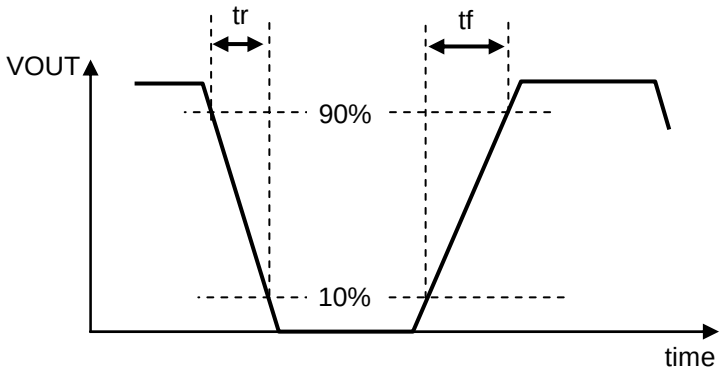
【Figure 4： IFB－IIS Characteristics】



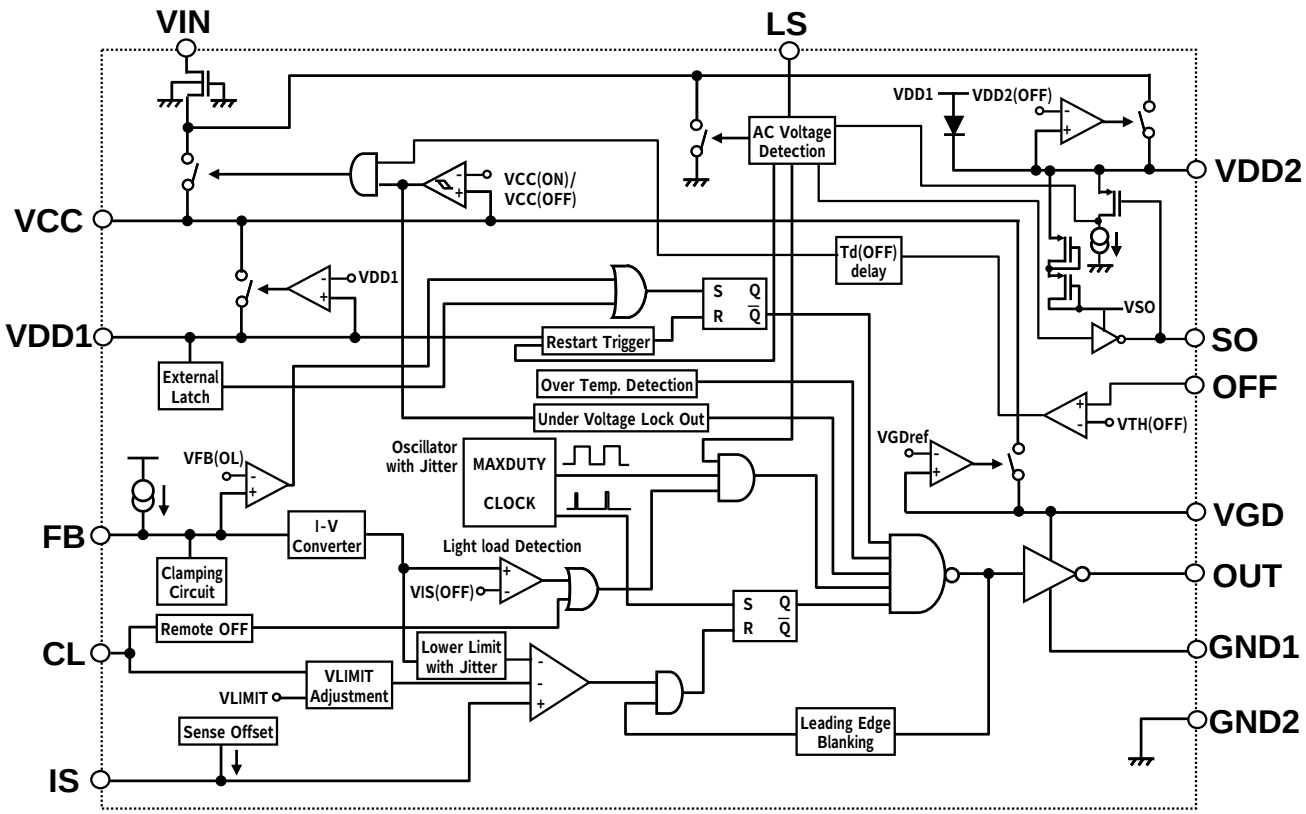
【Figure 5： VCC－VGD Characteristics】



【Figure 6： tr, tf measurement】



【Figure 7： Block Diagram】



[Precautions for Use 1]
Connect GND1 and GND2 on the power supply board.

[Precautions for Use 2]
Connect a ceramic capacitor with value ≧ 0.1μF between VDD1 pin and GND, and between VDD2 pin and GND.

[Precautions for Use 3]
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 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 VIN pin and VCC pin connection to the power supply board.
(2) Connect to pins in which different Maximum ratings.

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