



**THE DATASHEET OF  
AN8016SH-E1V**



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Total Pages

Page

15

1

# Product Standards

Part No.	AN8016SH
Package Code No.	SSOP010-P-0225A

Analogue LSI Business Unit  
Semiconductor Company  
Matsushita Electric Industrial Co., Ltd.

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	<b>Product Standards</b>	<b>AN8016SH</b>	
		Total Pages	Page
		15	2

### Contents

■ Overview	.....	3
■ Features	.....	3
■ Applications	.....	3
■ Package	.....	3
■ Type	.....	3
■ Application Circuit Example	.....	4
■ Block Diagram	.....	5
■ Pin Descriptions	.....	6
■ Absolute Maximum Ratings	.....	7
■ Operating Supply Voltage Range	.....	7
■ Recommended Operating Conditions	.....	7
■ Electrical Characteristics	.....	8
■ Electrical Characteristics (Reference values for design)	.....	9
■ Test Circuit Diagram	.....	10
■ Electrical Characteristics Test Procedures	.....	12
■ Technical Data	.....	15

2006-07-18		
Established	Revised	

	Product Standards	AN8016SH	
		Total Pages	Page
		15	3

# AN8016SH

## Single-channel 1.8-volt step-up DC-DC converter control IC

### ■ Overview

AN8016SH is a single-channel PWM DC-DC converter control IC that supports low-voltage operation.

This IC allows a stepped-up voltage output to be provided with a minimal number of external components. It features a low minimum operating voltage of 1.8 V, and due to being provided in a 10 pin surface mount package with a 0.5 mm lead pitch, is optimal for use in miniature high-efficiency power supplies for portable equipment.

### ■ Features

- Wide operating supply voltage range : 1.8 V to 14 V
- High-precision reference voltage circuit : 1.27 V (allowance :  $\pm 3\%$ )
- Supports control over a wide output frequency range : 20 kHz to 1 MHz
- Provides a fixed output current with minimal supply voltage fluctuations by using an external resistor to set the output current with a totem pole structure in the output block.
- Large maximum output current of  $\pm 50$  mA
- Timer latch short-circuit protection circuit (charge current : 1.3  $\mu$ A typical)
- Low input voltage malfunction prevention circuit (U.V.L.O.) (circuit operation start voltage : 1.6 V typical)
- On/off control function (active-high, standby current : 5  $\mu$ A maximum)
- Fixed maximum duty ratio with small sample-to sample variations ( $80\% \pm 5\%$ )
- Adjustable soft start time provided by using separate DTC and S.C.P. pins.

### ■ Applications

- LCD displays, digital still cameras, PDAs

### ■ Package

- 10 pin Plastic Shrink Small Outline Package (SSOP Type)

### ■ Type

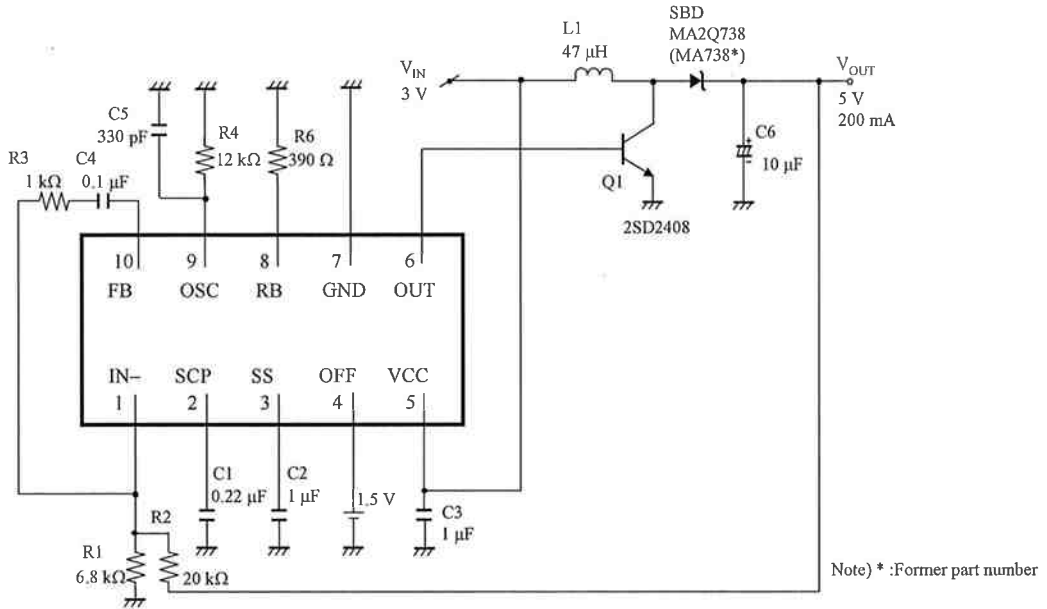
- Silicon monolithic bipolar IC

2006-07-18		
Established	Revised	

		<b>AN8016SH</b>	
		Total Pages	Page
		15	4

■ Application Circuit Example

Chopper Type Step-up Circuit



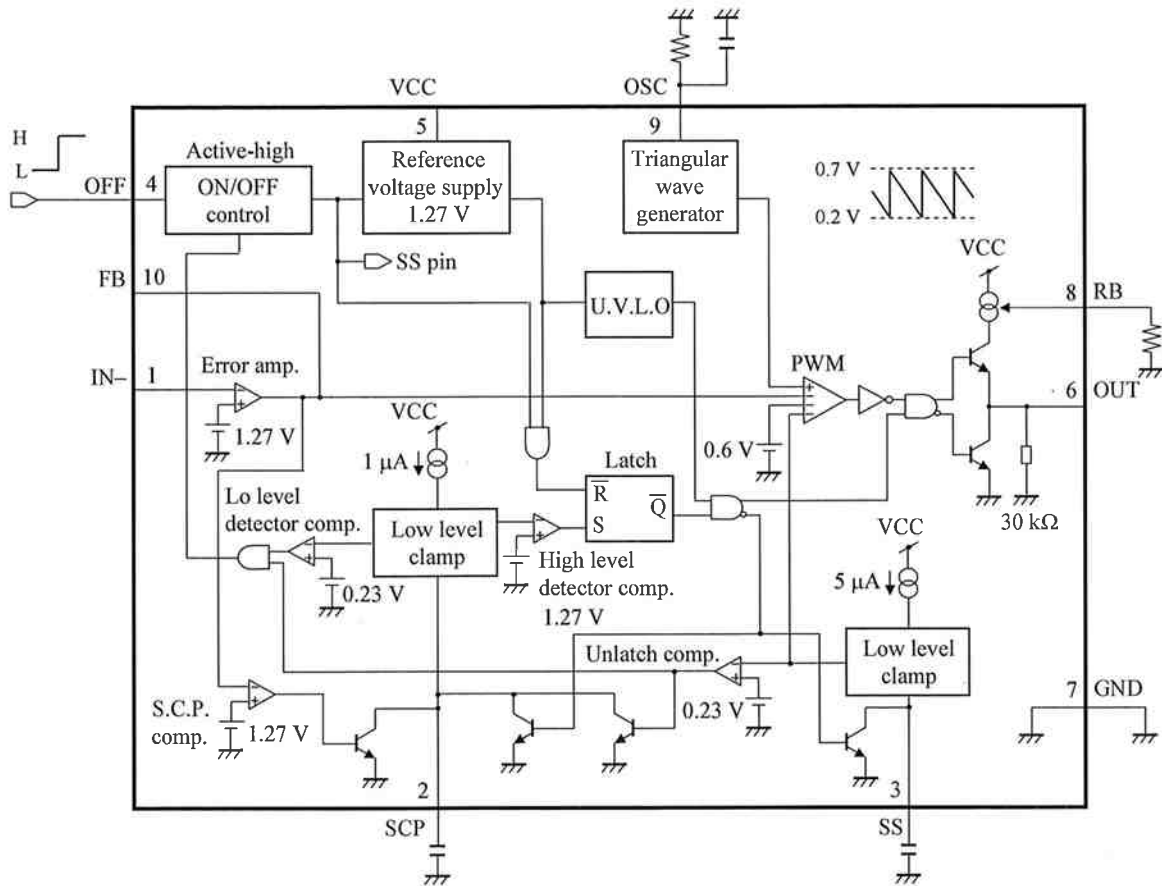
Notes) When you design printed circuit board pattern layout, consider the following in order to achieve low noise and high efficiency.

1. Use extremely wide lines for the ground lines, and isolate the IC ground from the power system ground.
2. Position the input filter capacitor C3 as close as possible to the V<sub>CC</sub> pin and the GND pin so that the internal circuit of the IC will not be affected by the switching noise.
3. The wiring length between the OUT pin and the switching elements (i.e., transistor and MOSFET) must be as short as possible in order to obtain fine switching waveforms.
4. The lead wire on the low impedance side of the output voltage detecting resistor R2 must be longer than the other side.

2006-07-18		
Established	Revised	

Product Standards		AN8016SH	
		Total Pages	Page
		15	5

■ Block Diagram



2006-07-18	
Established	Revised

	<b>Product Standards</b>	<b>AN8016SH</b>	
		Total Pages	Page
		15	6

■ Pin Descriptions

Pin No.	Pin name	Type	Description
1	IN-	Input	Error amplifier inverting input
2	SCP	—	Time constant capacitor connection for short-circuit protection
3	SS	—	Soft-start time-constant capacitor connection
4	OFF	Input	ON/off control
5	VCC	Power supply	Supply voltage
6	OUT	Output	Push-pull output
7	GND	Ground	Ground
8	RB	Output	Output-current setting resistor connection pin
9	OSC	—	Oscillator circuit timing resistor/capacitor connection pin
10	FB	Output	Error amplifier output

2006-07-18		
Established	Revised	

		Product Standards		AN8016SH	
				Total Pages	Page
		15	7		

### ■ Absolute Maximum Ratings

A No.	Parameter	Symbol	Rating	Unit	Notes
1	Supply voltage	$V_{CC}$	15	V	*1
2	Supply current	$I_{CC}$	—	mA	—
3	Power dissipation	$P_D$	186	mW	*2
4	Operating ambient temperature	$T_{opr}$	-30 to +85	°C	*3
5	Storage temperature	$T_{stg}$	-55 to +150	°C	*3
6	OFF pin allowable application voltage	$V_{OFF}$	15	V	—
7	IN- pin allowable application voltage	$V_{IN-}$	$V_{CC}$	V	—
8	OUT pin allowable application voltage	$V_{OUT}$	15	V	—
9	Output source current	$I_{SO(OUT)}$	-50	mA	—
10	Output sink current	$I_{SI(OUT)}$	+50	mA	—

Notes) \*1: The values under the condition not exceeding the above absolute maximum ratings and the power dissipation.

\*2: The power dissipation shown is the value at  $T_a = 85^\circ\text{C}$  for the independent (unmounted) IC package.

When using this IC, refer to the  $P_D$ - $T_a$  diagram of the package standard page 4 and use under the condition not exceeding the allowable value.

\*3: Except for the power dissipation, operating ambient temperature, and storage temperature, all ratings are for  $T_a = 25^\circ\text{C}$ .

### ■ Operating supply voltage range

Parameter	Symbol	Range	Unit	Notes
Supply voltage range	$V_{CC}$	1.8 to 14	V	*

Note) \*: The values under the condition not exceeding the above absolute maximum ratings and the power dissipation.

### ■ Recommended Operating Conditions

Parameter	Symbol	min	max	Unit	Notes
OFF control pin voltage	$V_{OFF}$	0	14	V	*
Output source current	$I_{SO(OUT)}$	-40	—	mA	*
Output sink current	$I_{SI(OUT)}$	—	40	mA	*
Timing resistance	$R_T$	3	30	$k\Omega$	*
Timing capacitance	$C_T$	100	10 000	pF	*
Oscillator frequency	$f_{OUT}$	20	1 000	kHz	*
Short-circuit protection time constant setting capacitance	$C_{SCP}$	1 000	—	pF	*
Output current setting resistance	$R_B$	180	1 100	$\Omega$	*

Note) \*: Do not apply current or voltage from external source to any pin not listed above.

In the circuit current, (+) means the current flowing into IC and (-) means the current flowing out of IC.

2006-07-18		
Established	Revised	

<h1>Product Standards</h1>		<b>AN8016SH</b>	
		Total Pages	Page
		15	8

■ Electrical Characteristics at  $V_{CC} = 2.4 \text{ V}$

Note)  $T_a = 25^\circ\text{C} \pm 2^\circ\text{C}$  unless otherwise specified.

B No.	Parameter	Symbol	Test circuits	Conditions	Limits			Unit	Notes
					Min	Typ	Max		
<b>U.V.L.O Block</b>									
1	Circuit operation start voltage	$V_{UON}$	1	—	1.45	1.6	1.75	V	—
<b>Error Amplifier Block</b>									
2	Input threshold voltage	$V_{TH}$	1	Voltage follower	1.23	1.27	1.31	V	—
3	Line regulation	$V_{dV}$	1	$V_{CC} = 1.8 \text{ V to } 14 \text{ V}$	—	1.0	10	mV	—
4	Input bias current	$I_B$	2	—	—	0.2	1.0	$\mu\text{A}$	—
5	High-level output voltage	$V_{EH}$	2	—	1.85	2.0	2.15	V	—
6	Low-level output voltage	$V_{EL}$	2	—	—	—	0.2	V	—
<b>PWM Comparator Block</b>									
7	Output source current	$I_{SS}$	5	$V_{SS} = 0.5 \text{ V}$	-3.5	-5	-6.5	$\mu\text{A}$	—
<b>Output Block</b>									
8	Oscillator frequency	$f_{OUT}$	3	$R_T = 12 \text{ k}\Omega, C_T = 330 \text{ pF}$	170	190	210	kHz	—
9	Maximum duty	$D_{MAX}$	3	—	75	80	85	%	—
10	High-level output voltage	$V_{OH}$	4	$I_O = -15 \text{ mA}, R_B = 390 \Omega$	1.4	—	—	V	—
11	Low-level output voltage	$V_{OL}$	4	$I_O = 10 \text{ mA}, R_B = 390 \Omega$	—	—	0.2	V	—
12	Output source current	$I_{SO(OUT)}$	4	$V_O = 0.9 \text{ V}, R_B = 390 \Omega$	-40	-30	-20	mA	—
13	Output sink current	$I_{SI(OUT)}$	4	$V_O = 0.3 \text{ V}, R_B = 390 \Omega$	20	—	—	mA	—
14	Pull-down resistor	$R_O$	4	—	20	30	40	k $\Omega$	—
<b>Unlatch Circuit Block</b>									
15	Input threshold voltage	$V_{THUL}$	5	—	0.13	0.20	0.27	V	—
<b>Short-circuit Protection Circuit Block</b>									
16	Input threshold voltage	$V_{THPC}$	6	—	1.17	1.27	1.37	V	—
17	Input standby voltage	$V_{STBY}$	6	—	—	60	120	mV	—
18	Input latch voltage	$V_{IN}$	6	—	—	40	120	mV	—
19	Charge current	$I_{CHG}$	5	$V_{SCP} = 0.5 \text{ V}$	-1.65	-1.3	-0.95	$\mu\text{A}$	—
<b>ON/OFF Control Block</b>									
20	Input threshold voltage	$V_{ON(TH)}$	7	—	0.8	1.0	1.3	V	—
21	OFF mode SS pin voltage	$V_{OFF(SS)}$	7	—	0.13	—	0.27	V	—
22	OFF mode S.C.P. pin voltage	$V_{OFF(SCP)}$	7	—	0.13	—	0.27	V	—
<b>Whole Device</b>									
23	Average consumption current	$I_{CC(AV)}$	1	$R_B = 390 \Omega, \text{ Duty ratio} = 50\%$	—	4.4	7.0	mA	—
24	Latch mode consumption current	$I_{CC(LA)}$	1	$R_B = 390 \Omega$	—	1.5	2.4	mA	—
25	Standby mode current	$I_{CC(SB)}$	1	—	—	—	5	$\mu\text{A}$	—

2006-07-18		
Established	Revised	

		<b>Product Standards</b>		<b>AN8016SH</b>	
				Total Pages	Page
		15	9		

■ Electrical Characteristics (Reference values for design) at  $V_{CC} = 2.4\text{ V}$

Note)  $T_a = 25^\circ\text{C} \pm 2^\circ\text{C}$  unless otherwise specified.

B No.	Parameter	Symbol	Test circuits	Conditions	Reference values			Unit	Notes
					Min	Typ	Max		
<b>U.V.L.O Block</b>									
26	Reset voltage	$V_R$	—	—	—	0.8	—	V	*1
<b>Error Amplifier Block</b>									
27	$V_{TH}$ temperature characteristics	$V_{THdT}$	2	$T_a = -30^\circ\text{C}$ to $85^\circ\text{C}$	—	$\pm 0.5$	—	%	*1
28	Output source current	$I_{SO(FB)}$	2	$V_{FB} = 0.5\text{ V}$	—	-40	—	$\mu\text{A}$	*1
29	Output sink current	$I_{SI(FB)}$	2	$V_{FB} = 0.5\text{ V}$	—	2	—	mA	*1
30	Open-loop gain	$A_V$	2	—	—	70	—	dB	*1
<b>PWM Comparator Block</b>									
31	SS pin voltage	$V_{SS}$	5	—	—	1.22	—	V	*1
<b>Output Block</b>									
32	RB pin voltage	$V_{RB}$	5	$R_B = 390\ \Omega$	—	0.32	—	V	*1
33	Oscillator frequency supply voltage characteristics	$f_{dV}$	3	$V_{CC} = 1.8\text{ V}$ to $14\text{ V}$	—	$\pm 1$	—	%	*1
34	Oscillator frequency temperature characteristics	$f_{dT}$	3	$T_a = -30^\circ\text{C}$ to $85^\circ\text{C}$	—	$\pm 3$	—	%	*1
<b>Short-circuit Protection Circuit Block</b>									
35	Comparator threshold voltage	$V_{THL}$	6	—	—	1.27	—	V	*1
<b>ON/OFF Control Block</b>									
36	ON/OFF pin current	$I_{OFF}$	1	$V_{OFF} = 1.5\text{ V}$	—	23	—	$\mu\text{A}$	*1

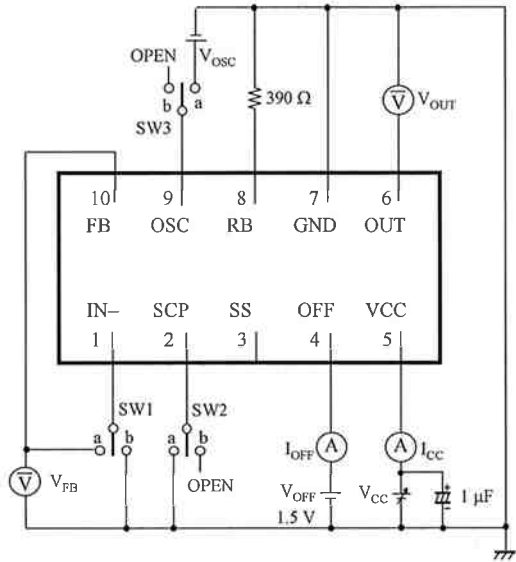
Note) \*1: The above characteristics are reference values for design of the IC and are not guaranteed by inspection.

If a problem does occur related to these characteristics, Matsushita will respond in good faith to user concerns.

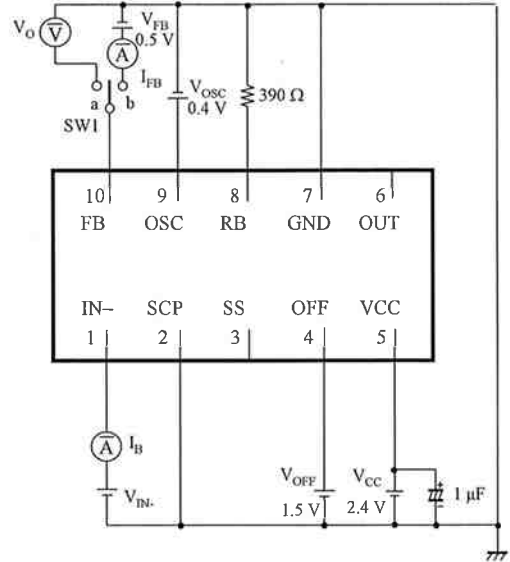
2006-07-18		
Established	Revised	

■ Test Circuit Diagram

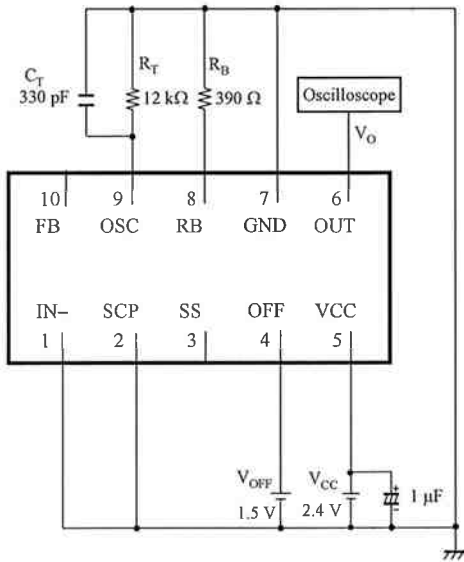
1. Test Circuit 1



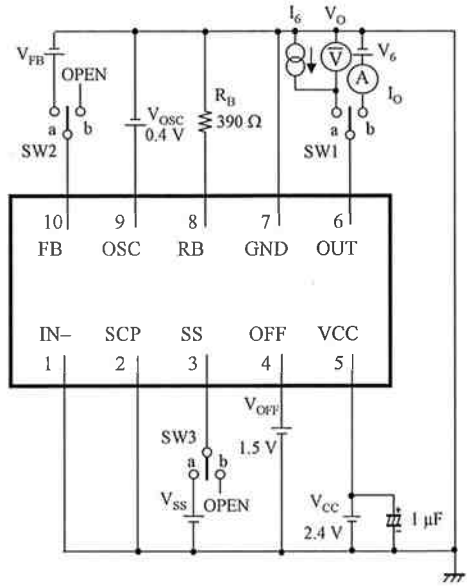
2. Test Circuit 2



3. Test Circuit 3



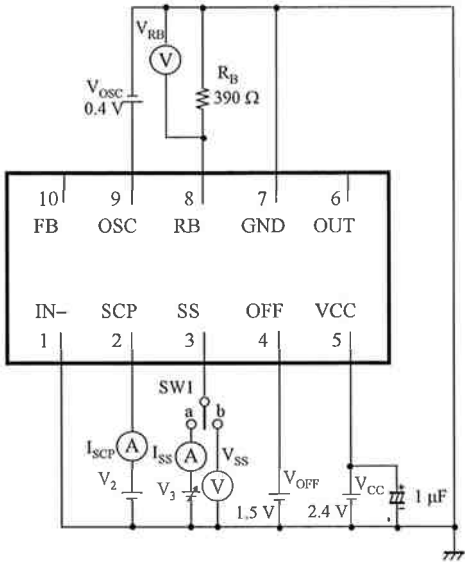
4. Test Circuit 4



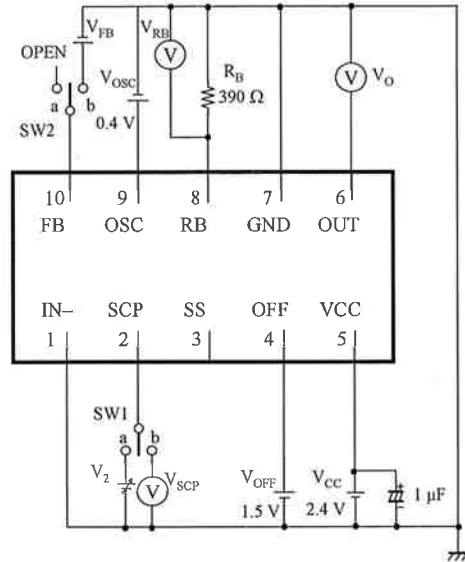
2006-07-18		
Established	Revised	

■ Test Circuit Diagram (continued)

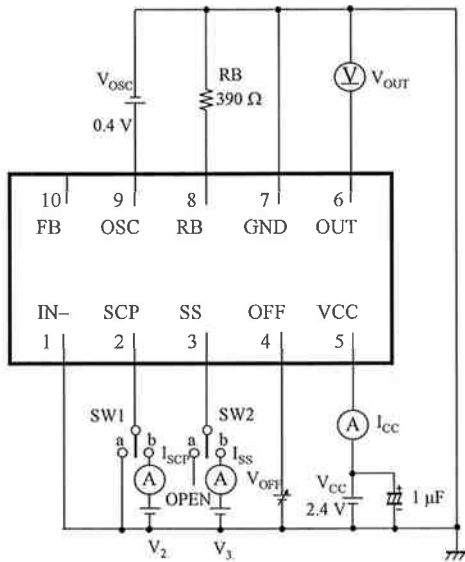
5. Test Circuit 5



6. Test Circuit 6



7. Test Circuit 7



2006-07-18		
Established	Revised	

Product Standards		AN8016SH	
		Total Pages	Page
		15	12

■ Electrical Characteristics Test Procedures

1. Test Circuit 1

C No.	Parameter	SW			Conditions	Measurement
		1	2	3		
1	Circuit operation start voltage	b	a	a	$V_{CC} = \text{variable}, V_{OFF} = 1.5 \text{ V}, V_{OSC} = 0.4 \text{ V}$	Measure the $V_{CC}$ voltage when the $V_{OUT}$ changes from Low to High level while increasing the $V_{CC}$ voltage gradually.
2	Input threshold voltage	a	a	a	$V_{CC} = 2.4 \text{ V}, V_{OFF} = 1.5 \text{ V}, V_{OSC} = 0.4 \text{ V}$	Measure the voltage of $V_{FB}$ .
3	Line regulation	a	a	a	$V_{CC} = \text{variable}, V_{OFF} = 1.5 \text{ V}, V_{OSC} = 0.4 \text{ V}$	Measure $V_d$ , which is the amount of change in $V_{FB}$ when changing $V_{CC}$ from 1.8 V to 14 V.
23	Average consumption current	b	a	a	$V_{CC} = 2.4 \text{ V}, V_{OFF} = 1.5 \text{ V}, V_{OSC} = \text{variable}$	Measure $I_{CC} = I_{CC1}$ at $V_{OSC} = 0.8 \text{ V}$ and $I_{CC} = I_{CC2}$ at $V_{OSC} = 0.4 \text{ V}$ . And then, calculate the equation ; $I_{CC(AV)} = (I_{CC1} + I_{CC2}) / 2$ .
36	ON/OFF pin current	b	a	a	$V_{CC} = 2.4 \text{ V}, V_{OFF} = 1.5 \text{ V}, V_{OSC} = 0.4 \text{ V}$	Measure the current of $I_{OFF}$ .
24	Latch mode consumption current	b	b	b	$V_{CC} = 2.4 \text{ V}, V_{OFF} = 1.5 \text{ V}$	Measure the current of $I_{CC}$ .
25	Standby mode current	b	b	b	$V_{CC} = 2.4 \text{ V}, V_{OFF} = 0 \text{ V}$	Measure the current of $I_{CC}$ .

2. Test Circuit 2

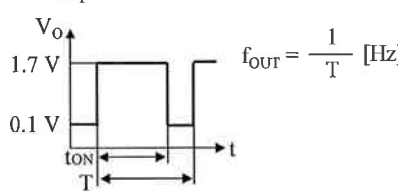
C No.	Parameter	SW	Conditions	Measurement
		1		
4	Input bias current	a	$V_{CC} = 2.4 \text{ V}, V_{OFF} = 1.5 \text{ V}, V_{IN-} = 1.5 \text{ V}, V_{OSC} = 0.4 \text{ V}$	Measure the current of $I_B$ .
5	High-level output voltage	a	$V_{CC} = 2.4 \text{ V}, V_{OFF} = 1.5 \text{ V}, V_{IN-} = 1.0 \text{ V}, V_{OSC} = 0.4 \text{ V}$	Measure the voltage of $V_O$ .
6	Low-level output voltage	a	$V_{CC} = 2.4 \text{ V}, V_{OFF} = 1.5 \text{ V}, V_{IN-} = 1.5 \text{ V}, V_{OSC} = 0.4 \text{ V}$	Measure the voltage of $V_O$ .
28	Output source current	b	$V_{CC} = 2.4 \text{ V}, V_{OFF} = 1.5 \text{ V}, V_{IN-} = 1.0 \text{ V}, V_{OSC} = 0.4 \text{ V}, V_{FB} = 0.5 \text{ V}$	Measure the current of $I_{FB}$ .
29	Output sink current	b	$V_{CC} = 2.4 \text{ V}, V_{OFF} = 1.5 \text{ V}, V_{IN-} = 1.5 \text{ V}, V_{OSC} = 0.4 \text{ V}, V_{FB} = 0.5 \text{ V}$	Measure the current of $I_{FB}$ .
30	Open-loop gain	a	$V_{CC} = 2.4 \text{ V}, V_{OFF} = 1.5 \text{ V}, V_{IN-} = \text{variable}, V_{OSC} = 0.4 \text{ V}$	$A_V = 20 \log_{10} \frac{V_{EH} - V_{EL}}{\Delta V_{IN-}} \text{ [dB]}$

2006-07-18		
Established	Revised	

	<h1>Product Standards</h1>	<b>AN8016SH</b>	
		Total Pages	Page
		15	13

■ Electrical Characteristics Test Procedures (continued)

3. Test Circuit 3

C No.	Parameter	Conditions	Measurement
8	Oscillator frequency	$V_{CC} = 2.4 \text{ V}, V_{OFF} = 1.5 \text{ V}$	Oscilloscope waveform  $f_{OUT} = \frac{1}{T} \text{ [Hz]}$
9	Maximum duty	$V_{CC} = 2.4 \text{ V}, V_{OFF} = 1.5 \text{ V}$	$D_{MAX} = \frac{t_{ON}}{T} \times 100 \text{ [%]}$

4. Test Circuit 4

C No.	Parameter	SW			Conditions	Measurement
		1	2	3		
10	High-level output voltage	a	a	b	$V_{CC} = 2.4 \text{ V}, V_{OFF} = 1.5 \text{ V}, V_{OSC} = 0.4 \text{ V}, V_{FB} = 0.5 \text{ V}, I_6 = -15 \text{ mA}$	Measure the voltage of $V_O$ .
11	Low-level output voltage	a	a	b	$V_{CC} = 2.4 \text{ V}, V_{OFF} = 1.5 \text{ V}, V_{OSC} = 0.4 \text{ V}, V_{FB} = 0.3 \text{ V}, I_6 = 10 \text{ mA}$	Measure the voltage of $V_O$ .
12	Output source current	b	b	a	$V_{CC} = 2.4 \text{ V}, V_{OFF} = 1.5 \text{ V}, V_{OSC} = 0.4 \text{ V}, V_{SS} = 0.5 \text{ V}, V_6 = 0.9 \text{ V}$	Measure the current of $I_O$ .
13	Output sink current	b	b	a	$V_{CC} = 2.4 \text{ V}, V_{OFF} = 1.5 \text{ V}, V_{OSC} = 0.4 \text{ V}, V_{SS} = 0.3 \text{ V}, V_6 = 0.3 \text{ V}$	Measure the current of $I_O$ .
14	Pull-down resistor	b	—	—	$V_6 = 0.3 \text{ V}$	$R_O = \frac{0.3}{I_O}$

2006-07-18		
Established	Revised	

		Product Standards		AN8016SH	
				Total Pages	Page
		15		14	

■ Electrical Characteristics Test Procedures (continued)

5. Test Circuit 5

C No.	Parameter	SW		Conditions	Measurement
		1			
7	Output source current	a		$V_{CC} = 2.4 \text{ V}, V_{OFF} = 1.5 \text{ V}, V_{OSC} = 0.4 \text{ V}, V_2 = V_3 = 0.5 \text{ V}$	Measure the current of $I_{SS}$ .
19	Charge current	a		$V_{CC} = 2.4 \text{ V}, V_{OFF} = 1.5 \text{ V}, V_{OSC} = 0.4 \text{ V}, V_2 = V_3 = 0.5 \text{ V}$	Measure the current of $I_{SCP}$ .
15	Input threshold voltage	a		$V_{CC} = 2.4 \text{ V}, V_{OFF} = 1.5 \text{ V}, V_{OSC} = 0.4 \text{ V}, V_2 = 0.5 \text{ V}, V_3 = \text{variable}$	Measure the $V_3$ voltage when the $I_{SCP}$ changes from sink current to source current while increasing the $V_3$ voltage gradually.
31	SS pin voltage	b		$V_{CC} = 2.4 \text{ V}, V_{OFF} = 1.5 \text{ V}, V_{OSC} = 0.4 \text{ V}, V_2 = 0 \text{ V}$	Measure the voltage of $V_{SS}$ .
32	RB pin voltage	b		$V_{CC} = 2.4 \text{ V}, V_{OFF} = 1.5 \text{ V}, V_{OSC} = 0.4 \text{ V}, V_2 = 0 \text{ V}$	Measure the voltage of $V_{RB}$ .

6. Test Circuit 6

C No.	Parameter	SW		Conditions	Measurement
		1	2		
16	Input threshold voltage	a	a	$V_{CC} = 2.4 \text{ V}, V_{OFF} = 1.5 \text{ V}, V_{OSC} = 0.4 \text{ V}, V_2 = \text{variable}$	Measure the $V_2$ voltage when the $V_O$ changes from High to Low level while increasing the $V_2$ voltage gradually.
17	Input standby voltage	b	b	$V_{CC} = 2.4 \text{ V}, V_{OFF} = 1.5 \text{ V}, V_{OSC} = 0.4 \text{ V}, V_{FB} = 0.5 \text{ V}$	Confirm that $V_{RB}$ is 0.2 V or more. Then measure $V_{SCP}$ .
18	Input latch voltage	b	a	$V_{CC} = 2.4 \text{ V}, V_{OFF} = 1.5 \text{ V}, V_{OSC} = 0.4 \text{ V}$	Confirm that $V_{RB}$ is 0.2 V or less. Then measure $V_{SCP}$ .
35	Comparator threshold voltage	b	b	$V_{CC} = 2.4 \text{ V}, V_{OFF} = 1.5 \text{ V}, V_{OSC} = 0.4 \text{ V}, V_{FB} = \text{variable}$	Measure the $V_{FB}$ voltage when the $V_O$ changes from High to Low level while increasing the $V_{FB}$ voltage gradually.

7. Test Circuit 7

C No.	Parameter	SW		Conditions	Measurement
		1	2		
20	Input threshold voltage	a	a	$V_{CC} = 2.4 \text{ V}, V_{OSC} = 0.4 \text{ V}, V_{OFF} = \text{variable}$	Measure the $V_{OFF}$ voltage when the $V_{OUT}$ changes from Low to High level while increasing the $V_{OFF}$ voltage gradually.
21	OFF mode SS pin voltage	b	b	$V_{CC} = 2.4 \text{ V}, V_{OSC} = 0.4 \text{ V}, V_{OFF} = 1.5 \text{ V}, V_2 = V_3 = 0.3 \text{ V}$	Confirm that sink current flows to $I_{SCP}$ and $I_{SS}$ when decreasing $V_{OFF}$ from 1.5 V to 0 V. Then, set $V_2$ to 0 V, decreasing $V_3$ gradually, and measure $V_3 = V_{OFF(SS)}$ at $I_{CC} = 0$ .
22	OFF mode S.C.P. pin voltage	b	b	$V_{CC} = 2.4 \text{ V}, V_{OSC} = 0.4 \text{ V}, V_{OFF} = 1.5 \text{ V}, V_2 = V_3 = 0.3 \text{ V}$	Confirm that sink current flows to $I_{SCP}$ and $I_{SS}$ when decreasing $V_{OFF}$ from 1.5 V to 0 V. Then, set $V_3$ to 0 V, decreasing $V_2$ gradually, and measure $V_3 = V_{OFF(SS)}$ at $I_{CC} = 0$ .

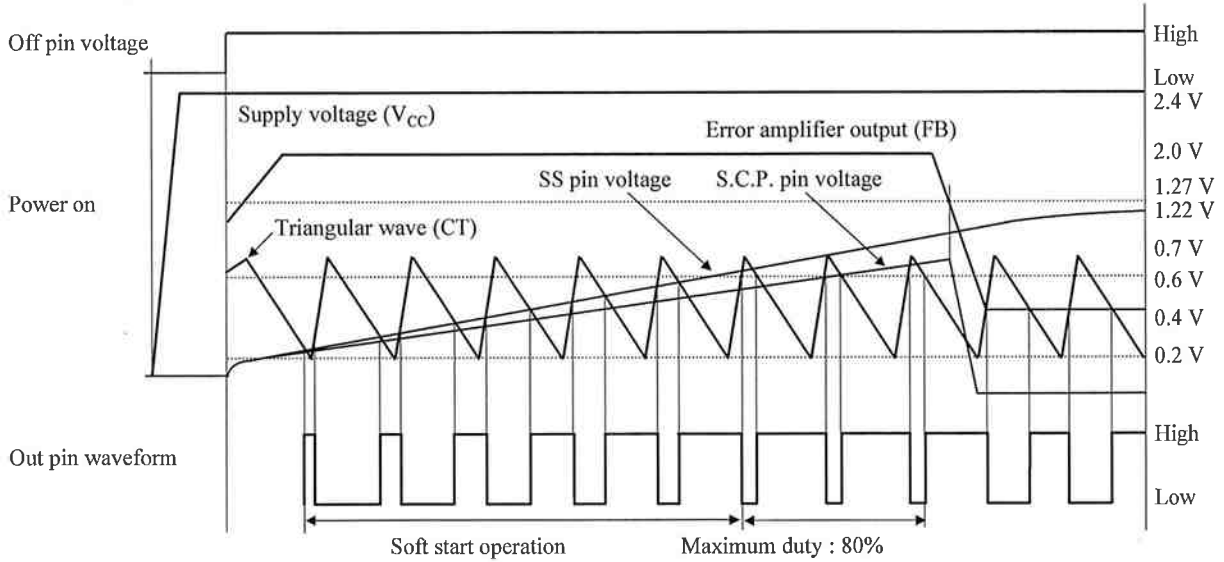
2006-07-18		
Established	Revised	

	<b>Product Standards</b>	<b>AN8016SH</b>	
		Total Pages	Page
		15	15

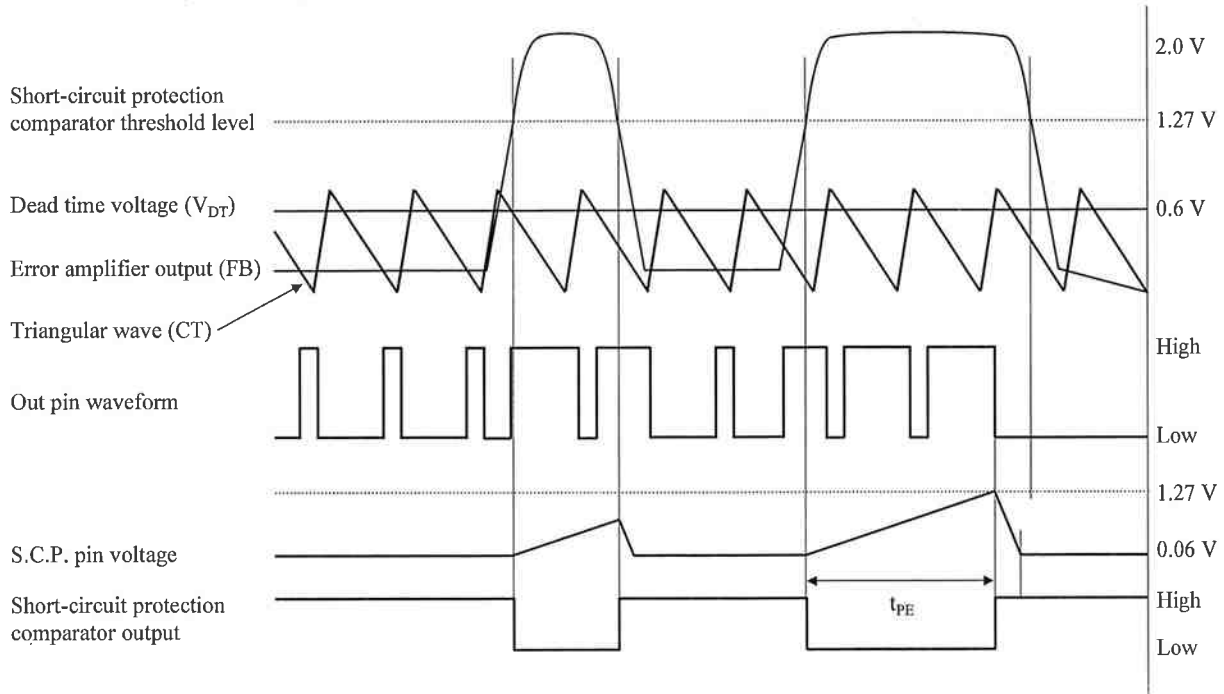
■ Technical Data

- Timing charts (internal waveforms)

1. PWM comparator operating waveforms



2. Short-circuit protection operating waveforms



2006-07-18		
Established	Revised	

# PACKAGE STANDARDS

Package Code

SSOP010-P-0225A

Semiconductor Company  
Matsushita Electric Industrial Co., Ltd.

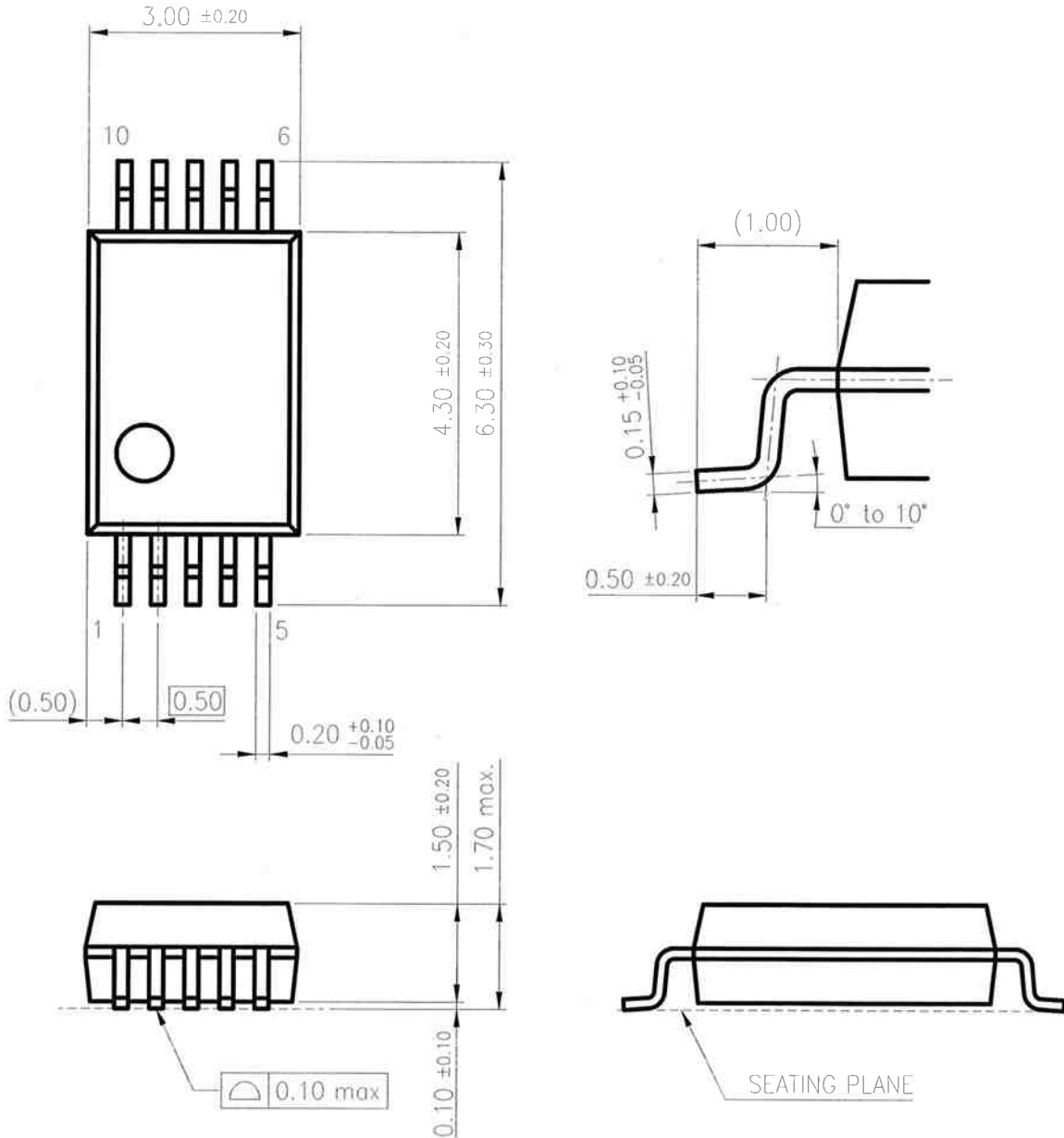
Established by	Applied by	Checked by	Prepared by
K.Komichi	H.Yoshida	M.Okajima	K.Kametaka

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	PACKAGE STANDARDS SSOP010-P-0225A		Total Pages	Page
			6	2

1. Outline Drawing

Unit:mm



Body Material :	Epoxy resin
Lead Material :	Cu Alloy
Lead Finish Method :	SnBi Plating

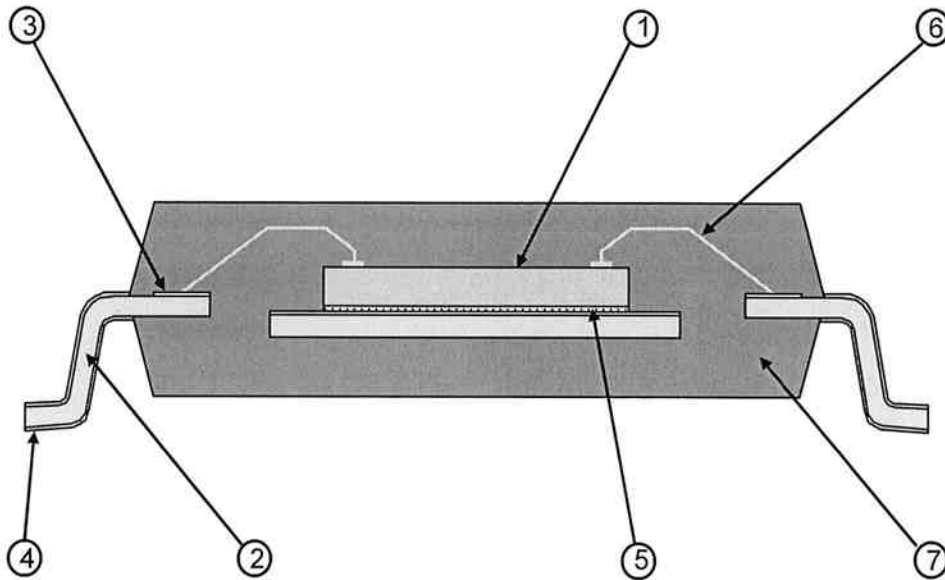
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		Total Pages	Page
		6	3

2. Package Structure (Technical Report : Reference Value)

Chip Material		Si	①
Leadframe material		Cu alloy	②
Inner lead surface		Ag plating	③
Outer lead surface		SnBi plating	④
Chip mount	Method	Resin adhesive method	⑤
	Material	Adhesive material	
Wirebond	Method	Thermo-compression bonding	⑥
	Material	Au	
Molding	Method	Transfer molding	⑦
	Material	Epoxy resin	
Mass		43mg	

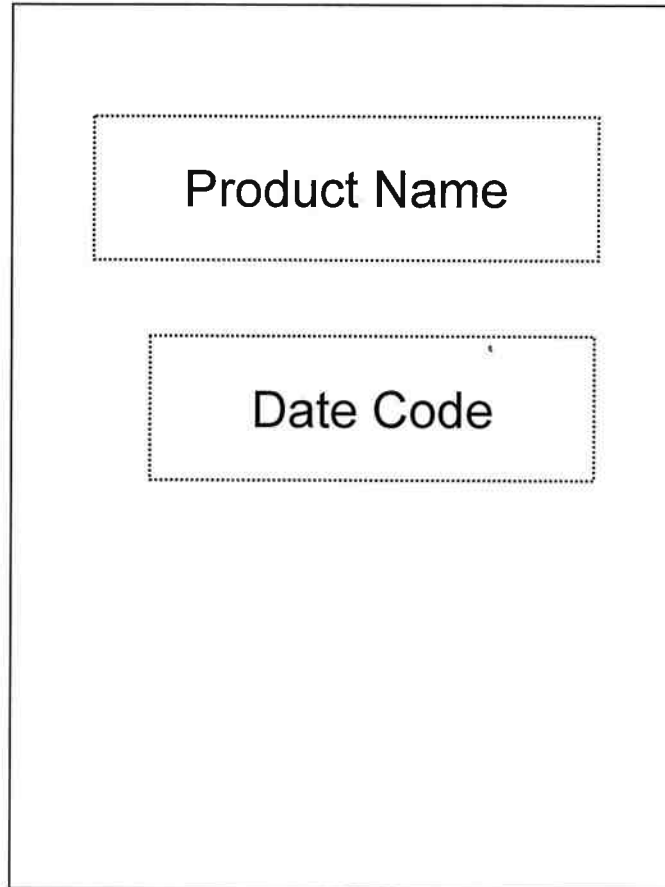


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		Total Pages	Page
	6	4	

2. Mark Drawing

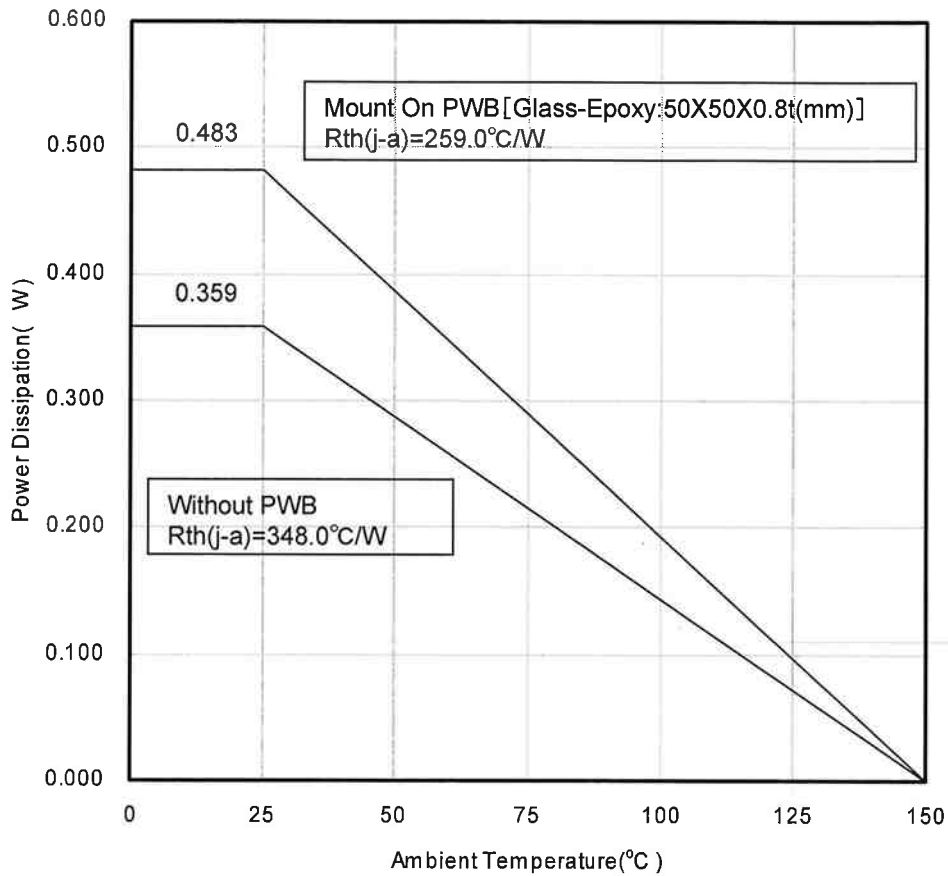


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		6	5

3. Power Dissipation (Technical Report)



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		Total Pages	Page
		6	6

#### 4. Power Dissipation (Supplementary Explanation)

##### [Experiment environment]

Power Dissipation (Technical Report) is a result in the experiment environment of SEMI standard conformity. (Ambient air temperature (Ta) is 25 degrees C)

##### [Supplementary information of PWB to be used for measurement]

The supplement of PWB information for Power Dissipation data (Technical Report) are shown below.

Indication	Total Layer	Resin Material
Glass-Epoxy	1-layer	FR-4
4-layer	4-layer	FR-4

##### [Notes about Power Dissipation (Thermal Resistance) ]

Power Dissipation values (Thermal Resistance) depend on the conditions of the surroundings, such as specification of PWB and a mounting condition, and a ambient temperature. (Power Dissipation (Thermal Resistance) is not a fixed value.)

The Power Dissipation value (Technical Report) is the experiment result in specific conditions (evaluation environment of SEMI standard conformity), and keep in mind that Power Dissipation values (Thermal resistance) depend on circumference conditions and also change.

##### [Definition of each temperature and thermal resistance]

Ta : Ambient air temperature

※The temperature of the air is defined at the position where the convection, radiation, etc. don't affect the temperature value, and it's separated from the heating elements.

Tc : It's the temperature near the center of a package surface. The package surface is defined at the opposite side if the PWB.

Tj : Semiconductor element surface temperature (Junction temperature.)

Rth(j-c) : The thermal resistance (difference of temperature of per 1 Watts) between a semiconductor element junction part and the package surface

Rth(c-a) : The thermal resistance (difference of temperature of per 1 Watts) between the package surface and the ambient air

Rth(j-a) : The thermal resistance (difference of temperature of per 1 Watts) between a semiconductor element junction part and the ambient air

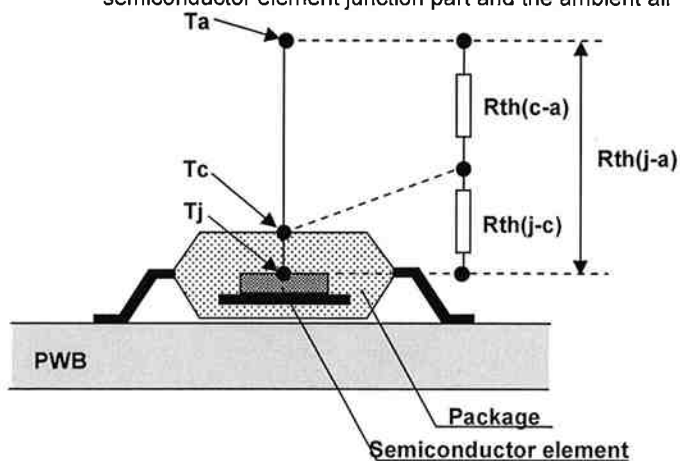


Fig1. Definition image

##### [Definition formula]

$$T_j = \{R_{th(j-c)} + R_{th(c-a)}\} \times P + T_a$$

$$= R_{th(j-a)} \times P + T_a$$

$$R_{th(j-c)} = \frac{T_j - T_c}{P} \quad (^\circ\text{C/W})$$

$$R_{th(c-a)} = \frac{T_c - T_a}{P} \quad (^\circ\text{C/W})$$

$$R_{th(j-a)} = \frac{T_j - T_a}{P} \quad (^\circ\text{C/W})$$

$$= R_{th(j-c)} + R_{th(c-a)}$$



P: power(W)

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