Product Standards

Part No.	AN30251A
Package Code No.	QFN016-P-0304B

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

Established by	Applied by	Checked by	Prepared by
S. Okada	*M. Hiramatsu*	*J. Hara*	*S. goto*
S.Okada	M.Hiramatsu	J.Hara	S.Goto

2005-09-26	2005-10-31
Established	Revised

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Semiconductor Company, Matsushita Electric Industrial Co., Ltd.

Contents

AN30251A

Driver IC for White LED's

■ Overview

AN30251A is a step-up DCDC converter that drives an external NMOS power transistor using a constant frequency PWM architecture.

■ Features

- Operation from 3.0 to 5.5 V supply voltage.
- Low Power Operation (1 mA typ.)
- Incorporates various protections (below).
  - Low Input voltage detection.
  - Short circuit detection of a timer.
  - Soft-start circuit.
  - Over voltage detection.
- 1 µA or less shutdown current
- 2 current modes (Flash Mode / Torch Mode) selectable.

■ Applications

- White LED's of Mobile Phone

■ Package

- 16 pin Plastic Quad Flat Non-leaded Package (QFN type)
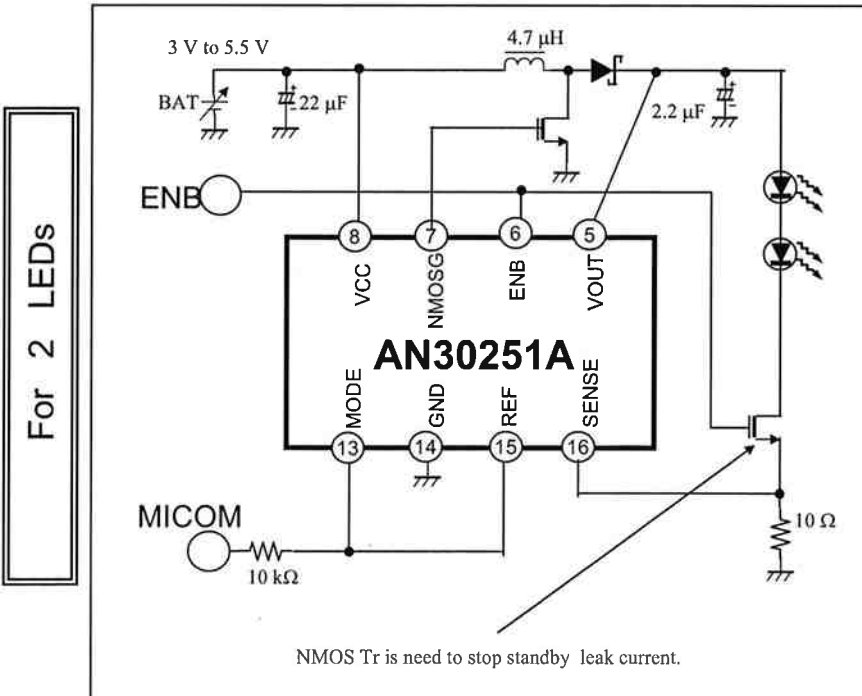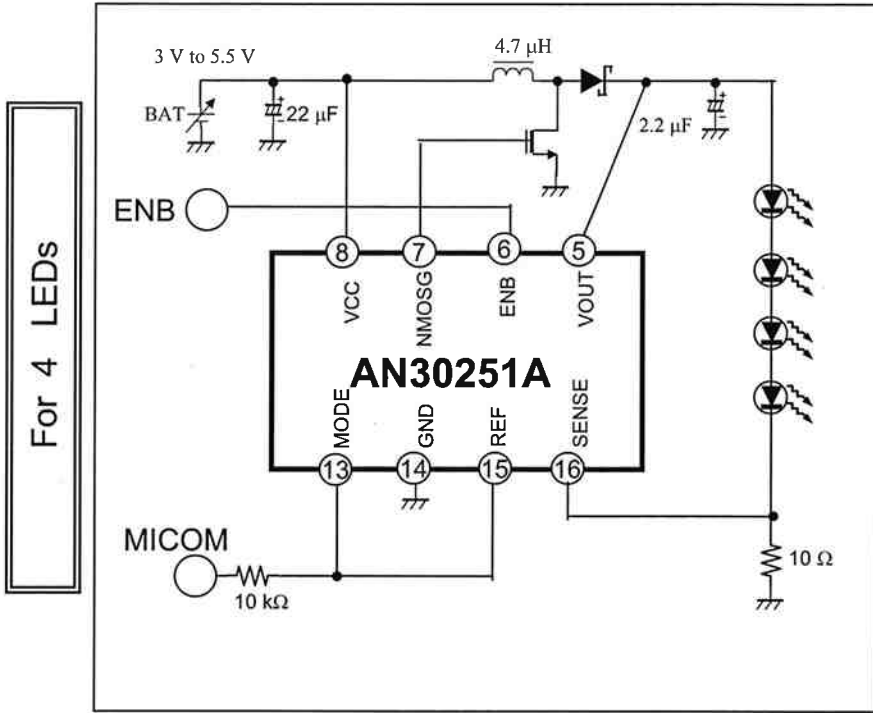
■ Type

- Bi-CMOS IC

■ Application Circuit Example

Flash Mode ……. LED CURRENT 100 mA
Torch Mode ……. LED CURRENT 20 mA

For 4 LEDs

For 2 LEDs

NMOS Tr is need to stop standby leak current.

■ Block Diagram
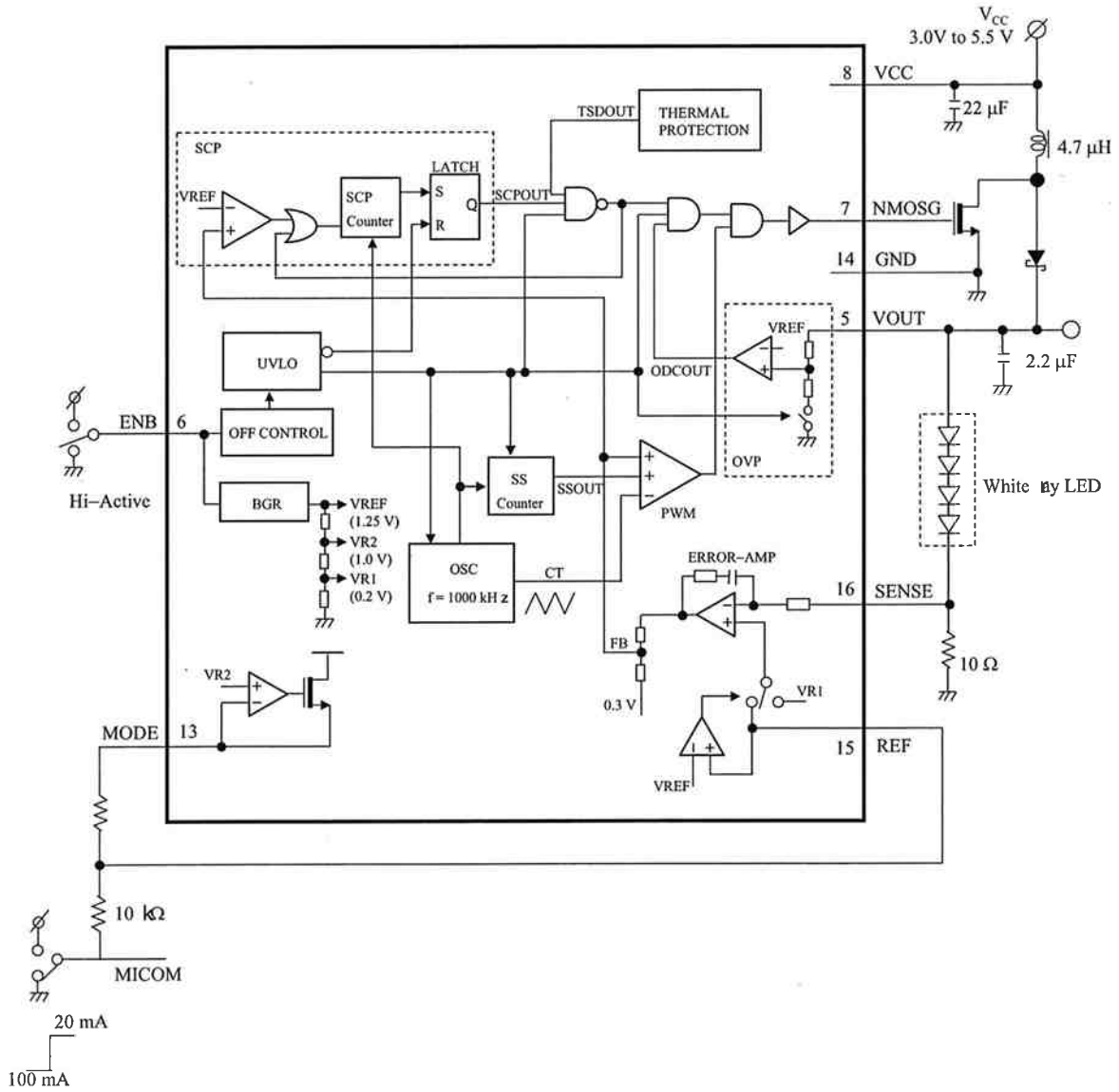
■ Pin Descriptions

Pin No.	Pin name	Type	Description
1	N.C.	—	Non connected
2	N.C.	—	Non connected
3	N.C.	—	Non connected
4	N.C.	—	Non connected
5	VOUT	Input	Booster Voltage Detection
6	ENB	Input	On / Off Control
7	NMOSG	Output	External Nch-MOS driving Pulse
8	VCC	Power Supply	Power Supply
9	N.C.	—	Non connected
10	N.C.	—	Non connected
11	N.C.	—	Non connected
12	N.C.	—	Non connected
13	MODE	Output	1 V Output
14	GND	GND	Ground
15	REF	Input	Flash Mode / Torch Mode Control and Reference Voltage Input at Flash Mode
16	SENSE	Input	LED Current Feedback

■ Absolute Maximum Ratings

A No.	Parameter	Symbol	Rating	Unit	Notes
1	Supply voltage	V_{CC}	6.0	V	*1
2	Supply current	I_{CC}	1.2	A	—
3	Power dissipation	P_D	125.8	mW	*2
4	Operating ambient temperature	T_{opr}	−30 to +85	°C	*3
5	Storage temperature	T_{stg}	−55 to +125	°C	*3

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 $T_a = 75$ °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 operating ambient temperature, and storage temperature, all ratings are for $T_a = 25$°C.

■ Operating supply voltage range

Parameter	Symbol	Range	Unit	Notes
Supply Voltage range	V_{CC}	3.0 to 5.5	V	*

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

■ Allowed Voltage Ranges

Note) • The ranges on the list are the voltages of respective pins in relation to GND.

• The VCCV represents the voltage of VCC Pin (Pin No. 8)

• Do not apply the voltages or the currents from external into the pins which are not on the list.

Pin No.	Pin name	Range	Unit	Notes	Pin No.	Pin name	Range	Unit	Notes
5	VOUT	− 0.3 to (VCCV + 0.3)	V	*1	13	MODE	− 0.3 to (VCCV+ 0.3)	V	*1
6	ENB	− 0.3 to (VCCV + 0.3)	V	*1	14	GND	0	V	*1
7	NMOSG	− 0.3 to (VCCV + 0.3)	V	*1	15	REF	− 0.3 to (VCCV + 0.3)	V	*1
8	VCC	0 ~ 6.0	V	*1	16	SENSE	− 0.3 to (VCCV + 0.3)	V	*1

Note) *1 Valid for the input mode. Do not apply the voltages or the currents from external at output mode.

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■ Electrical Characteristics at V_{CC} = 3.7 V

Note) T_a = 25°C±2°C unless otherwise specified.

B No.	Parameter	Symbol	Test circuits	Conditions	Limits			Unit	Notes
					Min	Typ	Max		
ALL Devices									
1	Average Supply Current	I_{CC}	1	ENB = High	—	—	10	mA	
2	Average Stand-by Current	ISTB	1	ENB = Low	—	—	1	μA	
3	ENB pin high-level input voltage	Venbh	2	ENB = 1.5 V	1.55	—	—	V	
4	ENB pin low-level input voltage	Venbl	2	ENB = 1.0 V	—	—	0.95	V	
5	REF pin high-level input voltage	Vrefh	3	ENB = High, SENSE = 0.5 V, REF = 1.4 V	1.50	—	—	V	
6	REF pin low-level input voltage	Vrefl	3	ENB = High, SENSE = 0.5 V, REF = 1.1 V	—	—	1.00	V	
7	SENSE pin input threshold voltage1	Vsense1	3	ENB = High, REF = 3.7 V, SENSE = 0.182 V / 0.218 V	0.18	0.20	0.22	V	
8	SENSE pin input threshold voltage2	Vsense2	3	ENB = High, REF = 1.0 V, SENSE = 0.95V / 1.05 V	0.95	1.00	1.05	V	

■ Electrical Characteristics (Reference values for design) at V_{CC} = 3.7 V

Note) T_a = 25°C±2°C unless otherwise specified.

B No.	Parameter	Symbol	Test circuits	Conditions	Reference values			Unit	Notes
					Min	Typ	Max		
DCDC-Converter Block									
9	Oscillation frequency	Fosc	4		0.7	1	1.3	MHz	*1
10	Operation start voltage	VCCon	5		2.6	2.8	3.0	V	*1 *2
11	Operation stop voltage	VCCoff	5		2.4	2.6	2.8	V	*1 *2
12	ENB Input Bias Current	Ienb	6		—	8	20	μA	*1
13	REF Input Bias Current	Iref	4		—	0.1	1	μA	*1
14	NMOSG Hi-Side On-Resistance	Ronp	—		—	6	15	Ω	*1
15	NMOSG Lo-Side On-Resistance	Ronn	—		—	6	15	Ω	*1
16	Timer time of Short Circuit Detection	Tscp			—	280	—	ms	*1
17	Mode Output Voltage	Vo1	5	I_{MODE} = −100 μA	0.96	1.00	1.04	V	*1
18	Max Duty 1 Flash mode	Duty1	4	REF = Low	—	92	—	%	*1
19	Max Duty2 Torch mode	Duty2	4	REF = High	—	78	—	%	*1
20	Recommended L value	ZL	7		—	4.7	—	μH	*1

Note) *1: The above characteristics are logical values derived from the 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.

Note) *2: V_{CC} ≠ 3.7 V

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■ Control Pin Mode Table

Note) See parameters 3 to 6 in the Electrical Characteristics for control voltage retention ranges.

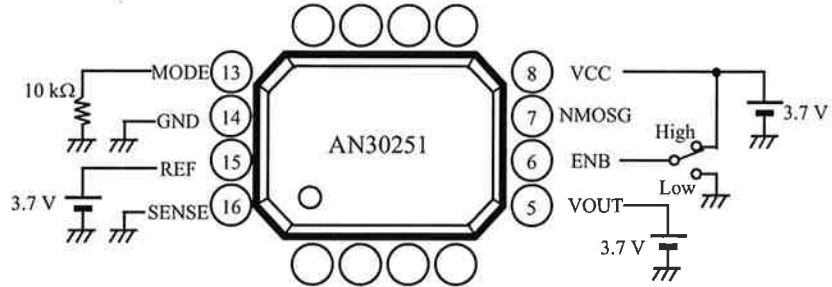| Pin No.	Description	Pin voltage		Remarks
		Low	High	
6	ENB	0.95 V or less	1.55 V or more	High : Active , Low : Standby
15	REF	to 1.00 V	1.50 V or more	High : Torch Mode , Low : Flash Mode

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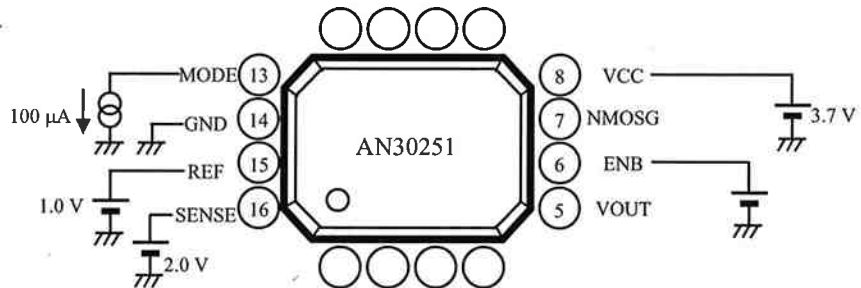Semiconductor Company, Matsushita Electric Industrial Co., Ltd.

■ Test Circuit Diagram

Test Circuit 1

Test Circuit 2

Test Circuit 3
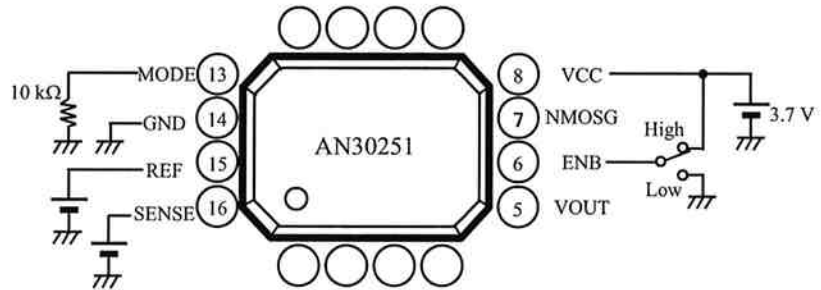
Test Circuit 4
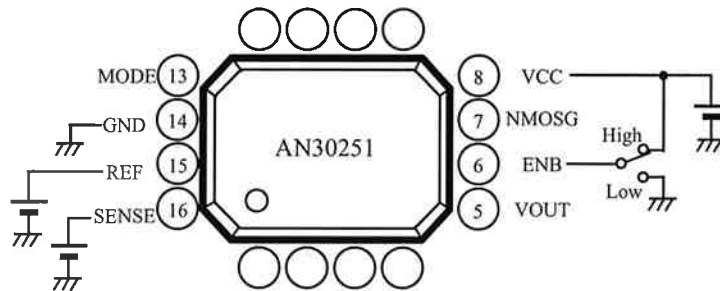
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■ Test Circuit Diagram (Continued)

Test Circuit 5
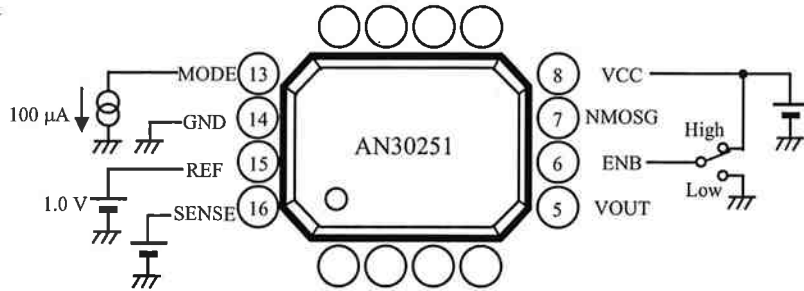
Test Circuit 6
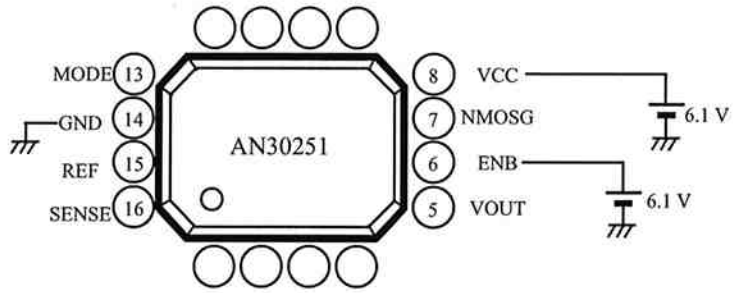
Test Circuit 7
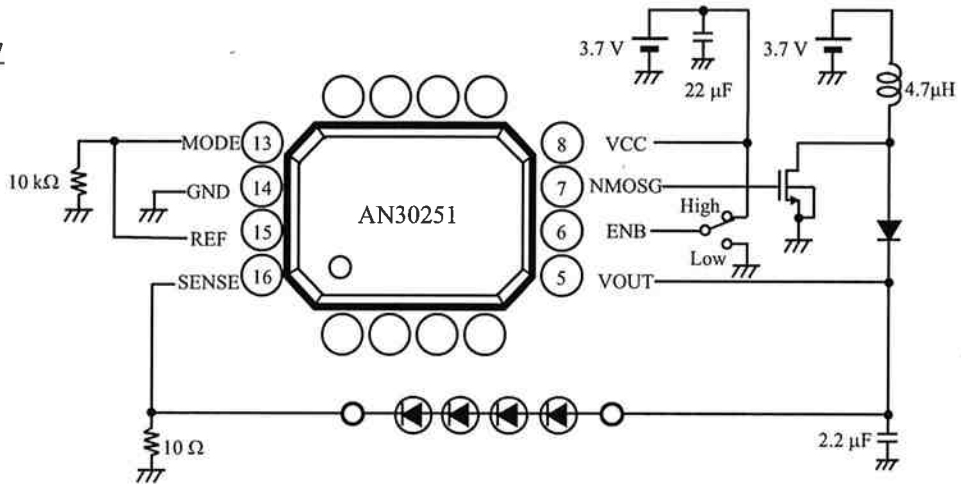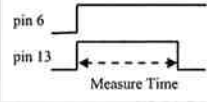
■ Electrical Characteristics Test Procedures

C No.	Parameter	Input Pin No.	Input Conditions	Output Pin No.	Output Conditions	TEST Cir. No.	5 VOUT	6 ENB	7 NMOSG	8 VCC	13 MODE	15 REF	16 SENSE
1	Average Supply Current	5, 8	V (pin 5) = 3.7 V V (pin 8) = 3.7 V	5, 8	I (pin 5) + I (pin 8)	1	3.7 V	High	open	3.7 V	10 kΩ +GND	3.7 V	0 V
2	Average Stand-by Current	5, 8	V (pin 5) = 3.7 V V (pin 8) = 3.7 V	5, 8	I (pin 5) + I (pin 8)	1	3.7 V	Low	open	3.7 V	10 kΩ +GND	3.7 V	0 V
3	ENB pin high-level input voltage	6	V (pin 6) = 0 → 3.7 V	6	V (pin 6) at V (pin 13) = 0 → 1 V	2	open	1.5 V	open	3.7 V	-100 µA	1 V	2 V
4	ENB pin low-level input voltage	6	V (pin 6) = 3.7 → 0 V	6	V (pin 6) at V (pin 13) = 1 → 0 V	2	open	1 V	open	3.7 V	-100 µA	1 V	2 V
5	REF pin high-level Input voltage	15	V (pin 15) = 0 → 3.7 V	15	V (pin 15) at waveform (pin 7) = Pulse → 0 V	3	open	High	open	3.7 V	10 kΩ +GND	1.4 V	0.5 V
6	REF pin low-level Input voltage	15	V (pin 15) = 3.7 → 0 V	15	V (pin 15) at waveform (pin 7) = 0 V → pulse	3	open	High	open	3.7 V	10 kΩ +GND	1.1 V	0.5 V
7	SENSE pin input threshold voltage1	16	V (pin 16) = 0 → 3.7 V	16	V (pin 16) at waveform (pin 7) = Pulse → 0 V	3	open	High	open	3.7 V	10 kΩ +GND	3.7 V	0.182 V ↓ 0.218 V
8	SENSE pin input threshold voltage2	16	V (pin 16) = 0 → 3.7 V	16	V (pin 16) at waveform (pin 7) = Pulse → 0 V	3	open	High	open	3.7 V	10 kΩ +GND	1 V	0.95 V ↓ 1.05 V
9	Oscillation frequency	16	V (pin 16) = 0 V	7	Frequency (pin 7)	4	open	High	open	3.7 V	open	1 V	0 V
10	Operation start voltage	8	V (pin 8) = 0 → 3.7 V	8	V (pin 8) at V (pin 13) = 0 → 1 V	5	open	High	open	2.61 V ↓ 2.99 V	-100 µA	1 V	2 V
11	Operation stop voltage	8	V (pin 8) = 3.7 → 0 V	8	V (pin 8) at V (pin 13) = 1 → 0 V	5	open	High	open	2.79 V ↓ 2.41 V	-100 µA	1 V	2 V
12	ENB input bias current	6	V (pin 6) = 6.1 V	6	I (pin 6)	6	open	6.1 V	open	6.1 V	open	open	open
13	REF Input Bias Current	15	V (pin 15) = 6.1 V	15	I (pin 15)	4	open	open	open	6.1 V	open	6.1 V	0.5 V
14	NMOSG Hi-Side On-Resistance	7	I (pin 7) = -100 mA	7	V (pin 7)	5	open	High	-10 mA	3.7 V	10 kΩ +GND	1 V	2 V
15	NMOSG Lo-Side On-Resistance	7	I (pin 7) = -100 mA	7	V (pin 7)	5	open	High	10 mA	3.7 V	10 kΩ +GND	1 V	2 V
16	Timer time of Short Circuit Detection	6, 16	V (pin 16) = 0 V, V (pin 6) = Low → High	13	pin 6 / pin 13 Measure Time	5	open	Low ↓ High	open	3.7V	-100 µA	1 V	0 V
17	Mode Output Voltage	13	I (pin 13) = -100 µA	13	V (pin 13)	5	open	High	open	3.7 V	-100 µA	1 V	2 V
18	Max Duty 1 Flash mode	15, 16	V (pin 15) = 1 V, V (pin 16) = 0 V	7	On Duty (pin 7)	4	open	High	open	3.7 V	open	1 V	0 V
19	Max Duty2 Torch mode	15, 16	V (pin 15) = 3.7 V, V (pin 16) = 0 V	7	On Duty (pin 7)	4	open	High	open	3.7 V	open	3.7 V	0 V

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■ Technical Data

1. I / O block circuit diagrams and pin function descriptions

Note) The characteristics listed below are reference values based on the IC design and are not guaranteed.

Pin No.	Waveform and voltage	Internal circuit	Impedance	Description
5 VOUT	VCC ~ 20 V		Hi–Z	Booster Voltage Detection
6 ENB	0V / VCC		486 kΩ	On/Off Control
7 NMOSG	1 MHz		202 kΩ	External Nch-MOS driving Pulse
8 VCC	VCC		—	Power Supply

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■ Technical Data(Continued)
   1. I/O block circuit diagrams and pin function descriptions(Continued)
   Note) The characteristics listed below are reference values based on the IC design and are not guaranteed.

Pin No.	Waveform and voltage	Internal circuit	Impedance	Description
13 MODE	1 V OUTPUT		Hi–Z	1 V Output
14 GND	0 V		—	GND
15 REF			Hi–Z	Flash Mode / Torch Mode Control and Reference Voltage Input at Flash Mode
16 SENSE	0.2 V /1.0 V		Hi–Z	LED Current Feedback

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■ Technical Data (Continued)
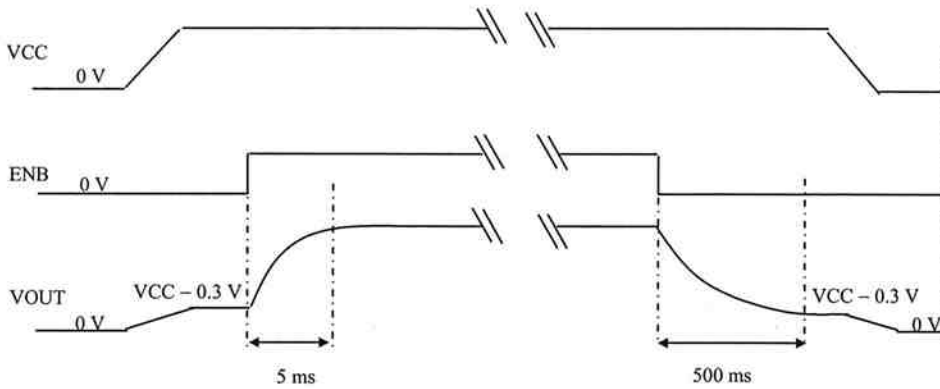 2. Timing Chart
  Note) The characteristics listed below are reference values based on the IC design and are not guaranteed.

  1) Start and stop characteristics outline

     A recommended sequence of start and stop operations is below.
     For start-up , ENB must be changed "Low" to "High" after VCC voltage supplied.
     The time of about 5 ms is necessary to stabilize VOUT.

■ Technical Data (Continued)
2. Timing Chart (Continued)
Note) The characteristics listed below are reference values based on the IC design and are not guaranteed.

2) Start up sequence of Flash Mode
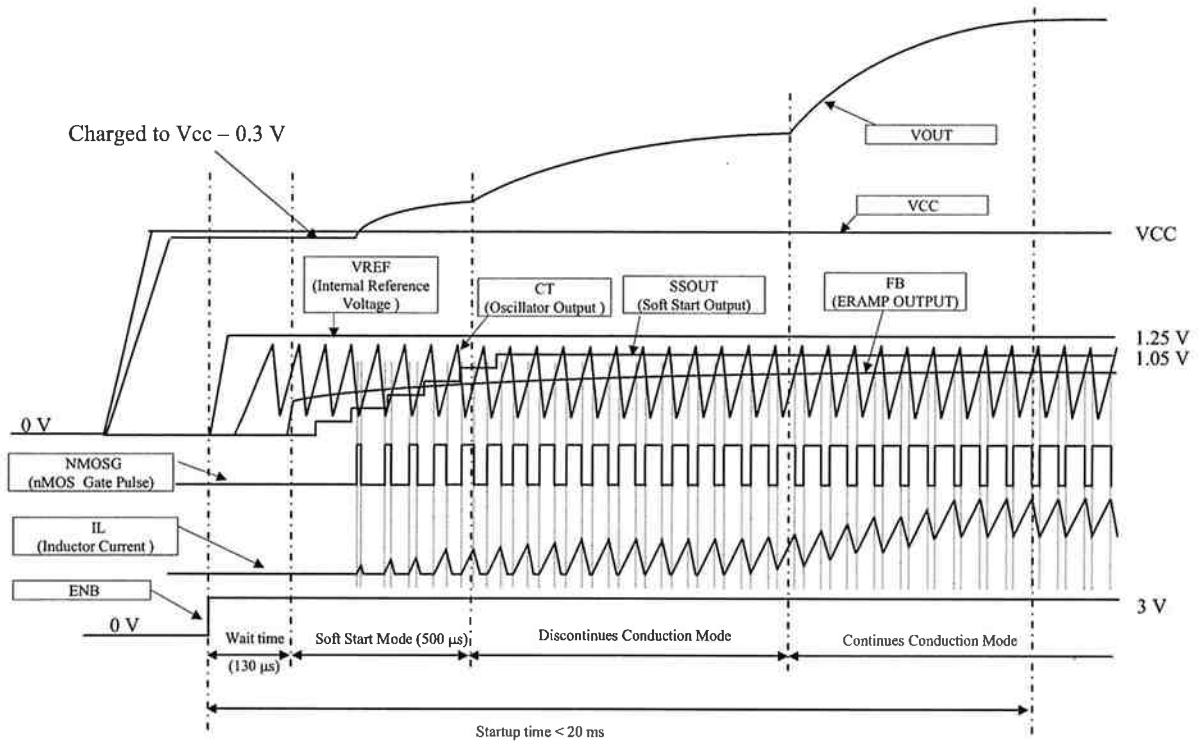
After ENB is pulled-up to "High" , the IC waits for 130 μs to stabilize internal circuits.
After that, to avoid high inrush current during start-up , SSOUT restrict the duty of NMOSG pulse for 500 μs.
SSOUT is changed discrete.
On Flash mode , The lowest value of IL is not equal to zero (Continues Conduction Mode).

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■ Technical Data (Continued)

  2. Timing Chart (Continued)

  Note) The characteristics listed below are reference values based on the IC design and are not guaranteed.

  3) Start up sequence of Torch Mode

On Torch mode, SSOUT doesn't restrict the duty of NMOSG pulse.

The lowest value of IL is equal to zero (Discontinues Conduction Mode) .

■ Technical Data (Continued)
  2. Timing Chart (Continued)
    Note) The characteristics listed below are reference values based on the IC design and are not guaranteed.

  4) Short Circuit Protection (SCP)
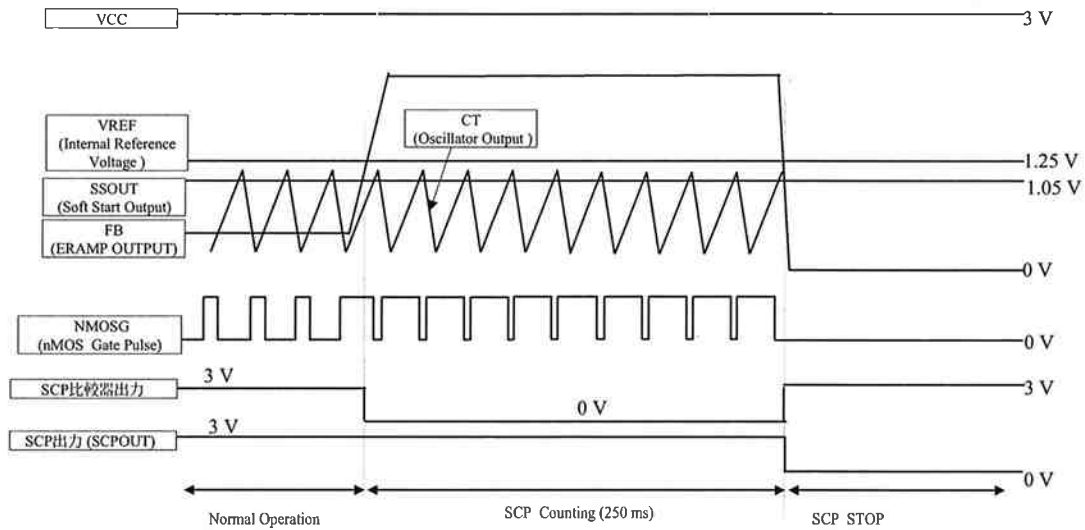
This IC has a Short-Circuit Protection (SCP) in case the output pin is shorted to ground. SCP compares FB (ERAMP OUT) and VREF (1.25 V) . SCP shuts down if the SENSE input is in the output load shorted state (ground shorted state) for a total of 250 ms (typical) or over. In this case, SCP stops almost all the circuits including OSC.
The ENB input signal must be reapplied to restart the IC operation.

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■ Technical Data (Continued)

2. Timing Chart (Continued)

Note) The characteristics listed below are reference values based on the IC design and are not guaranteed.

5) Over Detection Comparator (ODC)
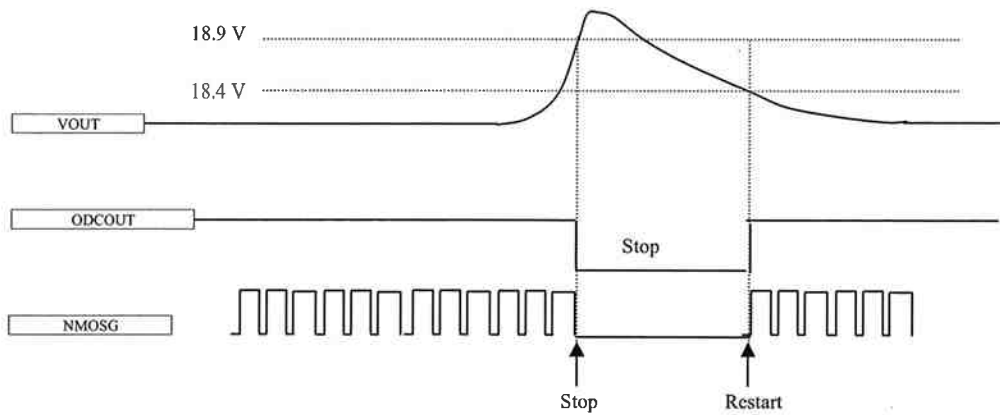
When the output gets high impedance or disconnected , VOUT voltage rises. To prevent VOUT voltage exceeding the maximum switch voltage rating (20 V) of the external n-MOSFET,

an Over Detection Comparator (ODC) is integrated. As soon as the output exceeds the ODC threshold (18.9 V), the converter stop switching and VOUT voltage falls down. When VOUT voltage falls below the ODC threshold (18.4 V) , the converter restarts operation.

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■ Usage Note

1. The following pin has an ESD withstand voltage of 2000 V to 3000 V (HBM actual value).
   Pay utmost attention to handle this pin.

                      VOUT (Pin No.5)

   The other pins except VOUT have an ESD withstand voltage of 8000 V (HBM actual value)

2. Give sufficient consideration to the change of operating conditions including the constants of peripheral components.
   Especially pay attentions to change the constants of Cin, Cout, L,R1,and R2 , because they have a influence on the phase characteristic.

3. Pin Short-circuiting
   The IC will be destructed in the following cases.
   • The short-circuiting of the NMOSG (Pin No.7) pin with the power supply (VCC) pin.
   Panasonic confirmed that there was no generation of smoke or fire with the pins short-circuited for 10 seconds after the destruction   of IC.

4. A Fuse must be inserted to VCC line for safe. (Recommended Current Limit = 2 A)

5. Don't put any capacitances to MODE pin directory. Otherwise the current on Flash Mode is not stable.

PACKAGE STANDARDS

Package Code	∗QFN016-P-0304B

Semiconductor Company
Matsushita Electric Industrial Co., Ltd.

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

Established: 2003-11-10
Revised   : 2007-07-10

1. Outline Drawing

Unit:mm
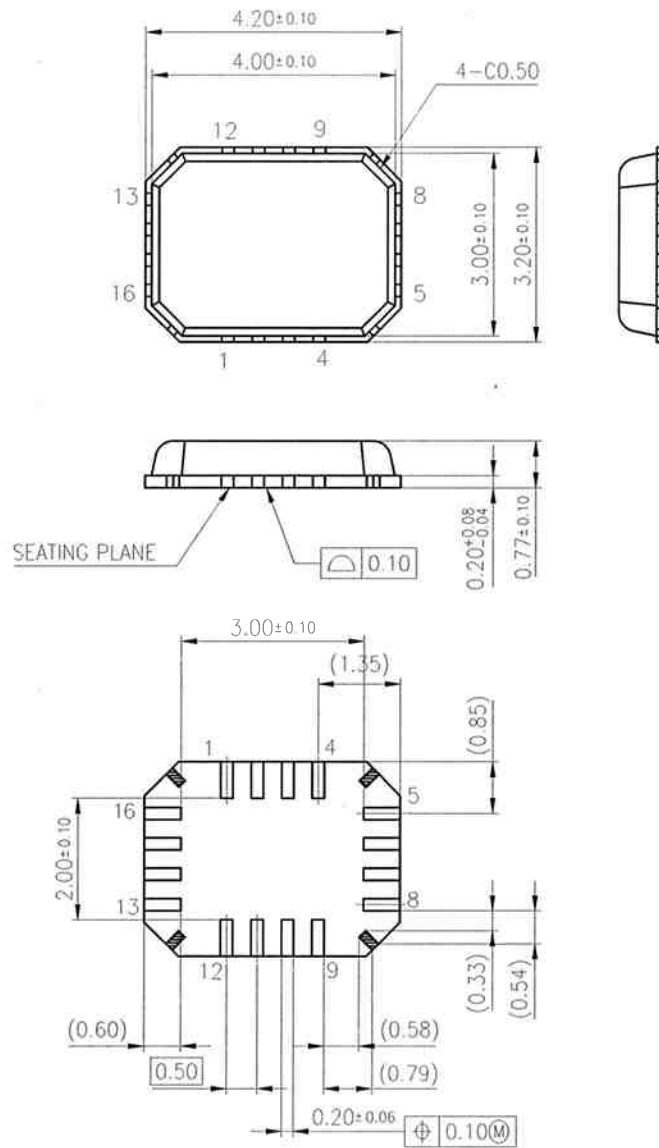
Weight	: 23.7 mg
Body Material	: Epoxy Resin
Lead Material	: Cu Alloy
Lead Finish Method	: Pd Plating

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Established: 2003-11-10
Revised : 2007-07-10

2. Package Structure (Technical Report)

Chip Material		Si	①
Leadframe material		Cu alloy	②
Inner lead surface		Pd plating	③
Outer lead surface		Pd plating	④
Die attach	Method	Resin adhesive method	⑤
	Material	Adhesive material	
Wirebond	Method	Thermo-compression bonding	⑥
	Material	Au	
Molding	Method	Transfer molding	⑦
	Material	Epoxy resin	
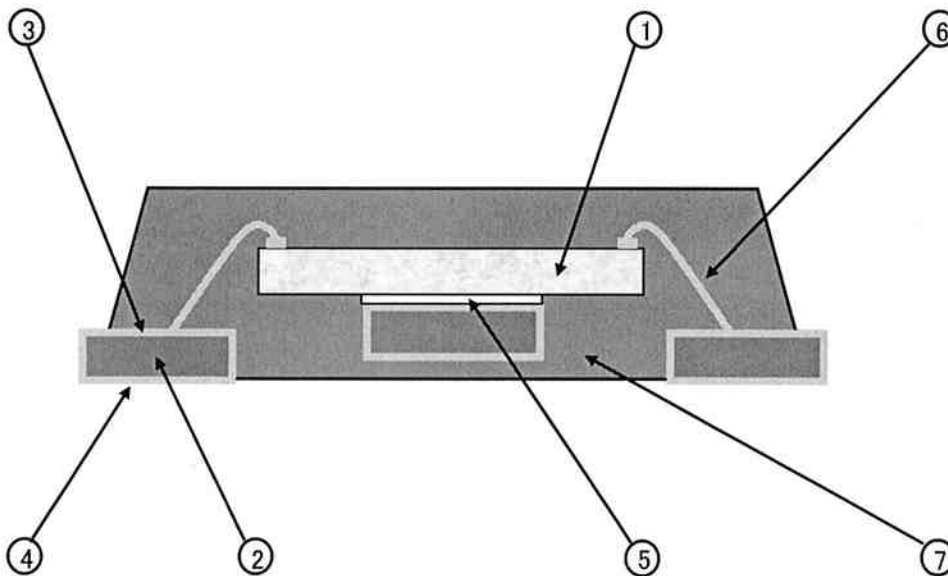
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3. Mark Drawing

Product Name

Direction Recognition

Date Code

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Established: 2003-11-10
Revised   : 2007-07-10
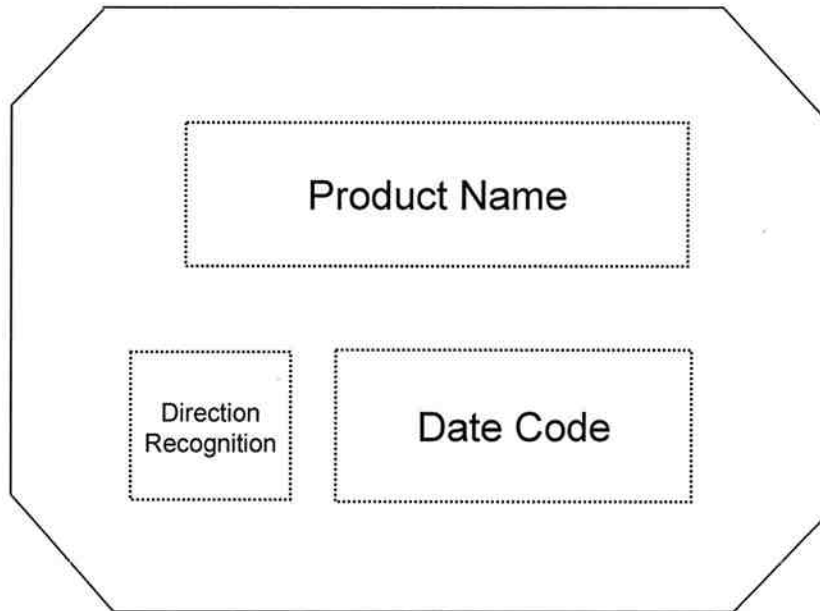
4. Power Dissipation (Technical Report)

Established: 2003-11-10
Revised   : 2007-07-10
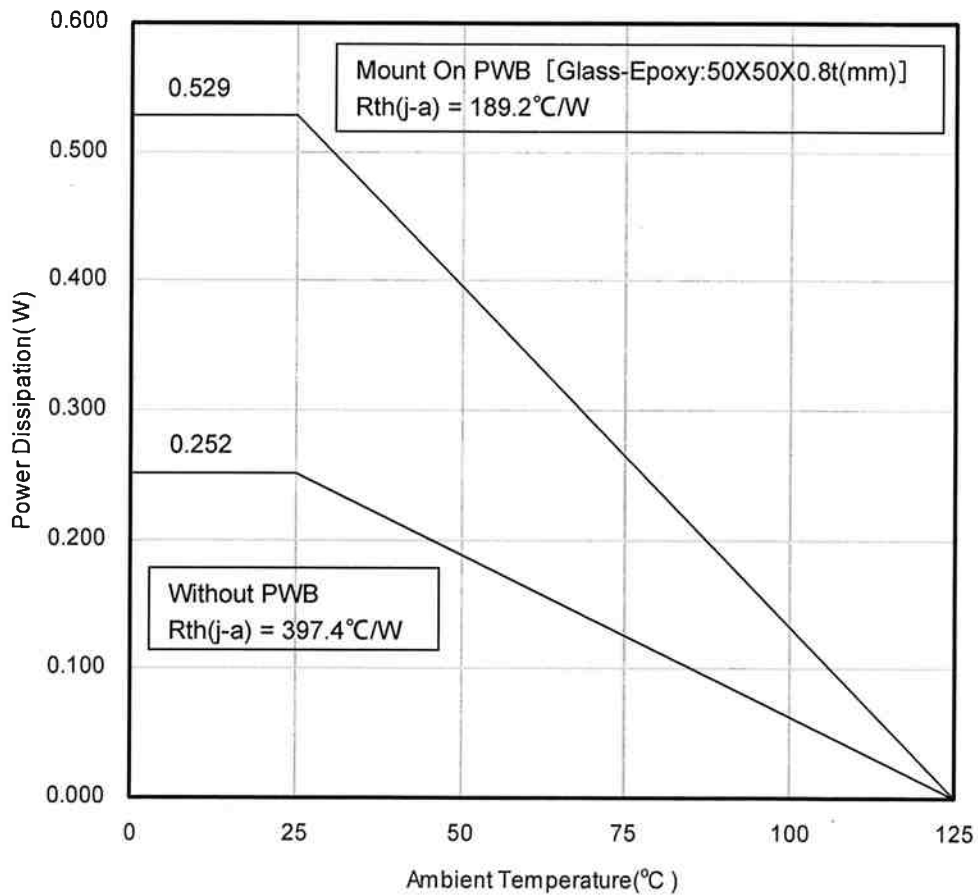
5. Power Dissipation （Supplementary Explanation）

[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
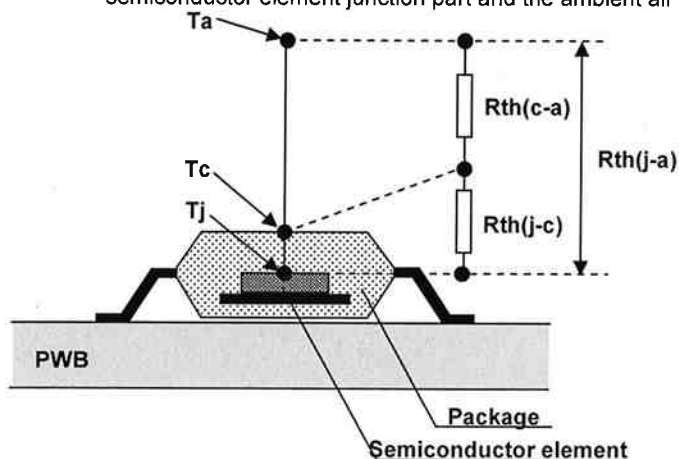

Fig1. Definition image

[Definition formula]

$$Tj = \{Rth(j\text{-}c) + Rth(c\text{-}a)\} \times P + Ta$$

$$= Rth(j\text{-}a) \times P + Ta$$

$$Rth(j\text{-}c) = \frac{Tj\text{-}Tc}{P} \quad (℃/W)$$

$$Rth(c\text{-}a) = \frac{Tc\text{-}Ta}{P} \quad (℃/W)$$

$$Rth(j\text{-}a) = \frac{Tj\text{-}Ta}{P} \quad (℃/W)$$

$$= Rth(j\text{-}c) + Rth(c\text{-}a)$$

P:power(W)

Semiconductor Company, Matsushita Electric Industrial Co., Ltd.

Established: 2003-11-10
Revised　　: 2007-07-10

Specifications of packing by the embossment tape
(Specifications for dampproof packing of the reel without the inner carton)

Embossment carrier tape

Top cover tape

C3 label (Sample)

Desiccants

Laminated aluminum bag

Corrugated cardboard for partition

Inner frame

Outer box

C3 label (Sample)

Shipment label

Semiconductor Company, Matsushita Electric industrial Co., Ltd.
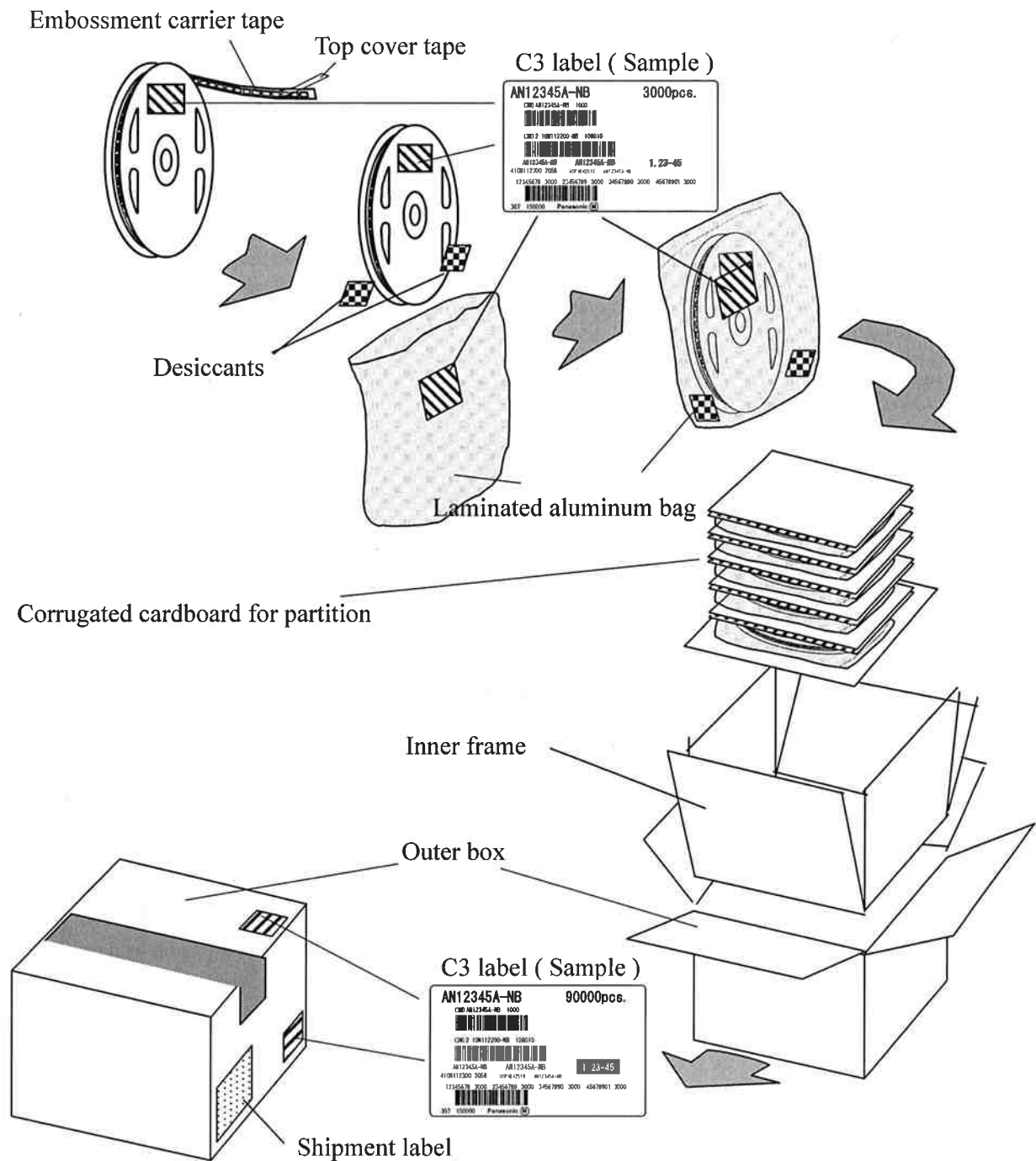
Package : *QFN016－P－0304B

Unit : mm

1 Packing

1) Tape

V B

φ1.55

1PIN

4.0

12.0

8.0

IC

2) Reel

Draw out direction

Emboss carrier tape

254

13.5

▨ ···· Label

Indication

Type	P C S
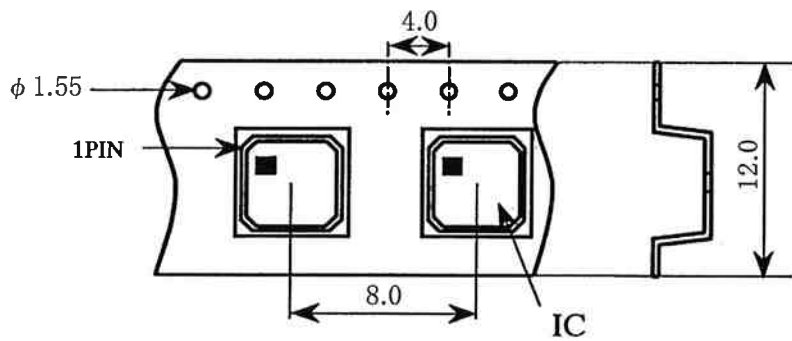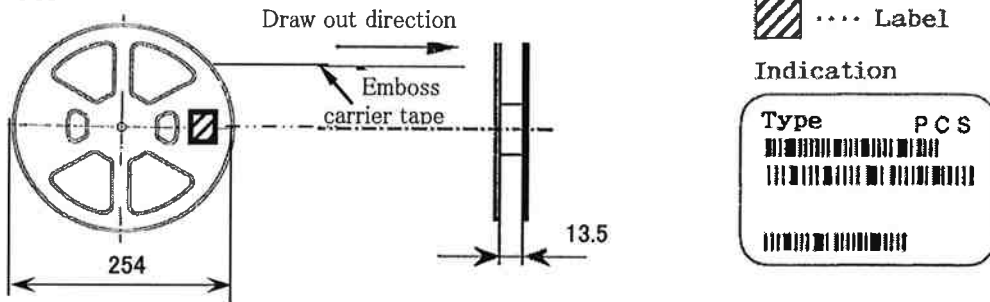
3) Exterior Packing

173

279

279
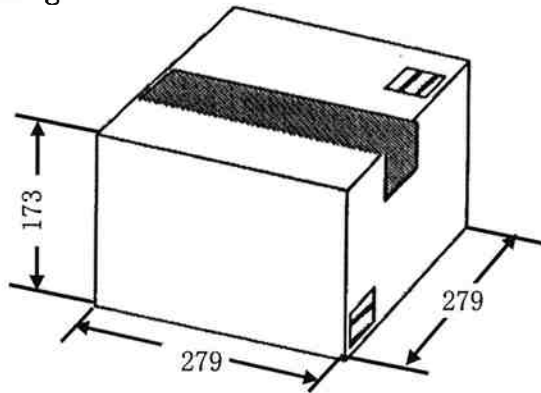
2 Packing quantity

Form	IC quantity	Contents	
Reel	2000 Pcs	Reel ×	1Pcs
Exterior Packing	10000 Pcs	Inner Box ×	5packing

SEMICONDUCTOR COMPANY , MATSUSHITA ELECTRIC INDUSTRIAL CO ., LTD .

Package : *QFN016−P−0304B
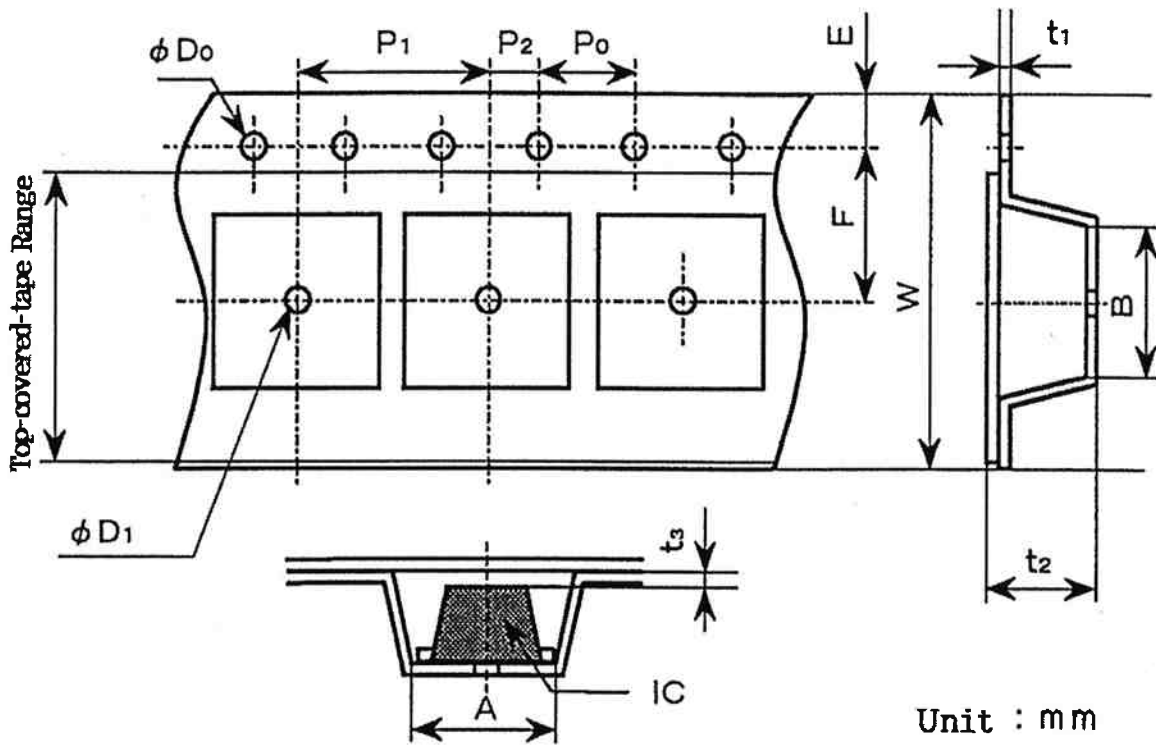
Unit : mm

Unit : mm

Dimensions & Tolerance

W	A	B	E	F	P₁
12.0±0.2	3.5±0.1	4.5±0.1	1.75±0.1	5.5±0.1	8.0±0.1

P₂	P₀	φD₁	φD₀	t₁	t₂
2.0±0.05	4.0±0.1	1.55± 0.05	1.55± 0.05	0.3±0.05	1.4max

t₃					
(0.1)					

SEMICONDUCTOR COMPANY , MATSUSHITA ELECTRIC INDUSTRIAL CO ., LTD .

单击下面可查看定价，库存，交付和生命周期等信息

>>Panasonic(松下)