Nisshinbo Micro Devices Inc.

NB7200GM Series

2-cell Li-ion Battery Protection IC with High-accuracy Overcurrent Detection

FEATURES

- Supply Current
  Normal mode: Typ. 2 µA / Max. 4 µA
  Standby mode: Max. 0.2 µA
  (V_{DET2}: Auto release type)
- Detector Selectable Range and Accuracy
  Overcharge detection voltage (V_{DET1}):
  4.2 V to 4.8 V, ±15 mV
  Overdischarge detection voltage (V_{DET2}):
  2.0 V to 3.2 V, ±35 mV
  Discharge overcurrent detection voltage 1 (V_{DET31}):
  0.0030 V to 0.0300 V, ±1.0 mV
  Discharge overcurrent detection voltage 2 (V_{DET32}):
  0.010 V to 0.090 V,
  ±2 mV (0.010 V to 0.040 V) /
  ±5% (0.040 V to 0.050 V) /
  ±2.5 mV (0.050 V to 0.090 V)
  Charge overcurrent detection voltage (V_{DET4}):
  –0.0030 V to –0.0300 V, ±1.0 mV
  Short-circuit detection voltage (V_{SHORT}):
  0.020 V to 0.100 V, ±4 mV
- 0 V Battery Charging selectable: Permission / Inhibition
- 0 V battery Charging Inhibition Voltage (V_{NOCHG}):
  1.000 V to 1.500 V
- Overcharge Release Voltage (V_{REL1}) / Overdischarge Release Voltage (V_{REL2}) Type: Auto Release
- Discharge Overcurrent Release Voltage Type:
  Auto Release1 (V- = V_{DD} × 0.8 V)
- Discharge Overcurrent Detection Voltage 2 (V_{DET32}) selectable: Available / Unavailable

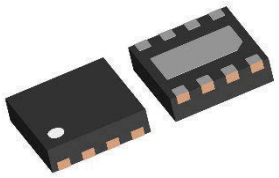
APPLICATIONS

Smart Phone, Tablet PC
Cleaner

GENERAL DESCRIPTION

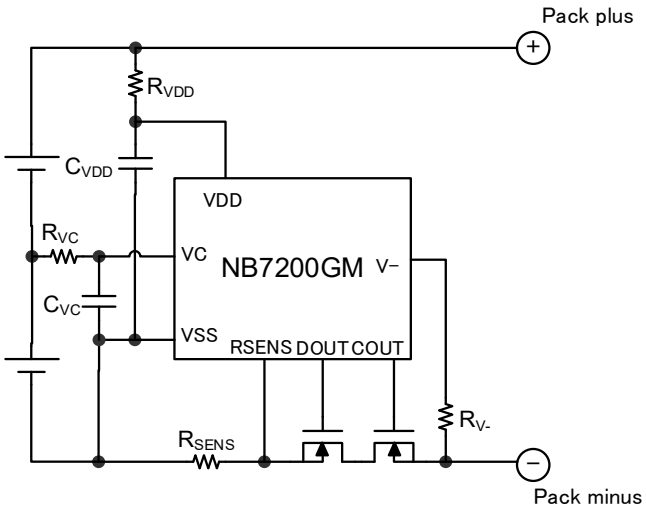
The NB7200GM is a two-cell Li- ion / polymer battery protection IC providing overcharge, overdischarge and charge / discharge overcurrent detections. Major features of this device include charge / discharge overcurrent detectors with high-accuracy of ±1.0 mV.

Lower-resistance of sense resistor by overcurrent detector achieves heat reduction on the board, and low consumption current and low standby current achieve longer driving time with batteries of small capacity.



DFN1616-8-GM
1.6 × 1.6 × 0.4 [mm]

TYPICAL APPLICATION CIRCUIT



PRODUCT NAME INFORMATION

NB7200 GM * * * E4 S**

aa bbb c d ee f

Description of configuration

Suffix	Item	Description
aa	Package code	Indicates the package code.
bbb	Specific option code	Indicates a three-digit number code that combined set voltages. Refer to the table of set voltages for details.
c		Indicates a delay time code. Refer to the table of delay times for details.
d		Indicates a function code. Refer to the table of functions for details.
ee	Packing	Indicates the taping code of the package. Refer to *Packing Specification* in the appendix *Package Information* for details.
f	Grade	Indicates the quality grade. Refer to the table of grade for details.

Table of set voltages (bbb)

Symbol	V_{DET1}	V_{REL1} *1	V_{DET2}	V_{REL2} *1	V_{DET31} *2	V_{DET32} *2	V_{SHORT} *2	V_{DET4}	V_{NOCHG}
Voltage Range	4.2 to	4.0 to	2.0 to	2.3 to	0.0030 to	0.010 to	0.020 to	−0.0030 to	1.000 to
(Step)	4.8	4.8	3.2	3.2	0.0300	0.090	0.100	−0.0300	1.500
[V]	(0.05)	(0.05)	(0.50)	(0.50)	(0.005)	(0.005)	(0.01)	(0.005)	(0.1)

*1 Under the following conditions,
V_{REL1}: $V_{DET1} - V_{REL1}$ = 0.400 V (Max.)
V_{REL2}: $V_{REL2} - V_{DET2}$ = 0.700 V (Max.)

*2 When selecting each set voltage of V_{DET31}, V_{DET32} and V_{SHORT}, keep from overlapping among them in consideration of their output voltage accuracy. Especially, V_{DET32} should be higher than 4.5 mV from V_{DET31}, and V_{SHORT} should be higher than 10 mV from V_{DET31} and V_{DET32}.

Table of delay times (c)

Symbol	t_{VDET1}	t_{VREL1}	t_{VDET2}	t_{VREL2}	t_{VDET31}	t_{VDET32}	t_{VREL3}	t_{VDET4}	t_{VREL4}	t_{SHORT}
Time [ms]	1024	1.5 17	32 64 128 256 512	1.05	12 128 256 512 3584	16	8.5	8 16 32	4	0.27 0.53

Table of functions (d)

Function	Overcharge Release	Overdishcarge Release	Discharge Overcurrent Release	Discharge Overcurrent Detection (V_{DET32})	0 V Battery Charging
Type/ Condition	Auto Release	Auto Release	Auto Release1	Available Unavailable	Permission Inhibition
A	Auto Release	Auto Release	Auto Release1	Unavailable	Inhibition
B	Auto Release	Auto Release	Auto Release1	Available	Inhibition
F	Auto Release	Auto Release	Auto Release1	Unavailable	Permission
G	Auto Release	Auto Release	Auto Release1	Available	Permission

Grade

Grade	Application	Operating Temperature Range	Test Temperature
S	General-purpose and Consumer	−40°C to 85°C	25°C

ORDER INFORMATION

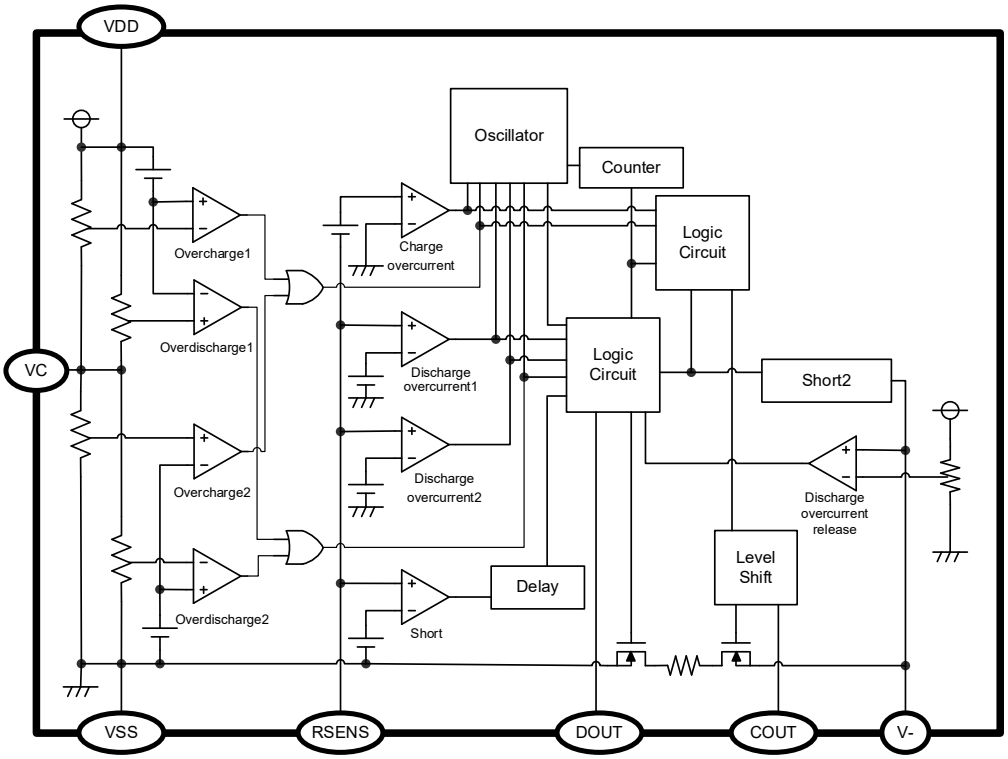
For details of the orderable products, please refer to the Appendix *"Product Code List"*.

Product Name	Package	RoHS	Halogen-Free	Plating Composition	Marking[*1]	Weight [mg]	Quantity Per Reel [pcs]
NB7200GM*****E4S	DFN1616-8-GM	Yes	Yes	NiPdAu	****	3.1	5,000

[*1] Refer to the Appendix *"Marking Specification"*.

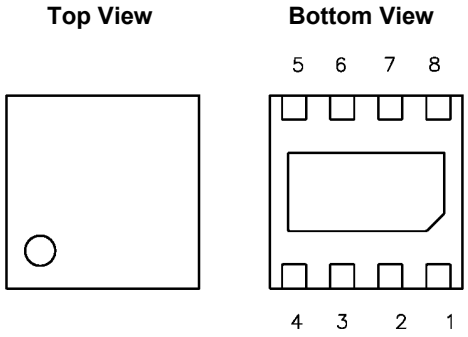
Note: Contact our sales representatives for other specific option code (indicated with the numbers in bold type).

BLOCK DIAGRAM



NB7200GM Block Diagram

PIN DESCRIPTIONS



NB7200GM (DFN1616-8-GM) Pin Configuration

Pin No.	Pin Name	I/O	Description
1	N.C.	-	No Connection. It is recommended that pin be connected to the VDD pin on the board or otherwise be left floating.
2	V-	I	Charge negative input pin
3	COUT	O	Charge detection output pin, CMOS output
4	DOUT	O	Discharge detection output pin, CMOS output
5	VSS	-	Ground in for the IC
6	RSENS	I	Overcurrent detection input pin
7	VC	I	Input pin of the center voltage between two-cell
8	VDD	-	Power supply pin, the substrate level of the IC

The tab on the bottom of the package is substrate level (V_{DD}). It is recommended that the tab be connected to the VDD pin on the board, or otherwise be left floating.

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Ratings	Unit
Supply voltage	V_{DD}	–0.3 to 12	V
VC pin input voltage	V_C	V_{SS} – 0.3 to V_{DD} + 0.3	V
V- pin input voltage	V-	V_{DD} – 30 to V_{DD} + 0.3	V
RSENS pin input voltage	V_{RSENS}	V_{SS} – 0.3 to V_{DD} + 0.3	V
COUT pin output voltage	V_{COUT}	V_{DD} – 30 to V_{DD} + 0.3	V
DOUT pin output voltage	V_{DOUT}	V_{SS} – 0.3 to V_{DD} + 0.3	V
Power dissipation	P_D	150	mW
Junction temperature range	Tj	–40 to 125	°C
Storage temperature range	Tstg	–55 to 125	°C

ABSOLUTE MAXIMUM RATINGS

Electronic and mechanical stress momentarily exceeded absolute maximum ratings may cause permanent damage and may degrade the lifetime and safety for both device and system using the device in the field. The functional operation at or over these absolute maximum ratings is not assured.

ELECTROSTATIC DISCHARGE RATINGS

Parameter	Conditions	Rating	Unit
HBM (Human Body Model)	C = 100 pF, R = 1.5 kΩ	±2000	V
CDM (Charged Device Model)	Field Included CDM (FI-CDM)	±1000	V

ELECTROSTATIC DISCHARGE RATINGS

The electrostatic discharge test is done based on JESD47.
In the HBM method, ESD is applied using the power supply pin and GND pin as reference pins.

RECOMMENDED OPERATING CONDITIONS

Parameter	Symbol	Ratings	Unit
Operating input voltage	V_{DD}	1.5 to 10.0	V
Operating temperature range	Ta	−40 to 85	°C

RECOMMENDED OPERATING CONDITIONS

All of electronic equipment should be designed that the mounted semiconductor devices operate within the recommended operating conditions. The semiconductor devices cannot operate normally over the recommended operating conditions, even if they are used over such conditions by momentary electronic noise or surge. And the semiconductor devices may receive serious damage when they continue to operate over the recommended operating conditions.

ELECTRICAL CHARACTERISTICS

n number of cells: 1 = upper cell, 2 = lower cell, voltages stated at Ta = 25°C, unless otherwise noted.

NB7200GM***E4S Electrical Characteristics**

Parameter	Symbol	Conditions		Min.	Typ.	Max.	Unit	Remark *1
Operating input voltage	V_{DD1}	$V_{DD} - V_{SS}$		1.5		10	V	A
Minimum charging voltage for 0 V battery charger *2	V_{STCHG}	$V_{DD} - V-$, $V_{DD} - V_{SS}$ = 0V				1.8	V	A
0 V battery charging inhibition voltage n (n =1, 2) *3	V_{NOCHGn}	V_{NOCHG1}: $V_{DD} - V_C$, $V_{DD} - V-$ = 4 V		V_{NOCHGn} – 0.1	V_{NOCHGn}	V_{NOCHGn} + 0.1	V	A
		V_{NOCHG2}: $V_C - V_{SS}$, $V_{DD} - V-$ = 4 V						
Overcharge detection voltage n (n =1, 2)	V_{DET1n}	V_{DET11}: $V_C - V_{SS}$ = 3.5 V	$R_{VDD} = R_{VC}$ = 330Ω, $C_{VDD} = C_{VC}$ = 0.1µF	V_{DET1n} – 0.015	V_{DET1n}	V_{DET1n} + 0.015	V	B
		V_{DET12}: $V_{DD} - V_C$ = 3.5 V						
Overcharge release voltage n (n =1, 2)	V_{REL1n}	V_{REL11}: $V_C - V_{SS}$ = 3.5 V	$R_{VDD} = R_{VC}$ = 330Ω, $C_{VDD} = C_{VC}$ = 0.1µF	V_{REL1n} – 0.030	V_{REL1n}	V_{REL1n} + 0.030	V	B
		V_{REL12}: $V_{DD} - V_C$ = 3.5 V						
Overcharge detection delay time	t_{VDET1}	$V_{DD} - V_C$ = 3.5 V → V_{DET11} + 0.1 V $V_C - V_{SS}$ = 3.5 V		t_{VDET1} × 0.80	t_{VDET1}	t_{VDET1} × 1.20	ms	B
Overcharge release delay time	t_{VREL1}	$V_{DD} - V_C$ = 4.9 V → V_{REL1} – 0.1 V	t_{VREL1} = 1.5 ms	0.7	1.5	2.5	ms	B
			t_{VREL1} = 17 ms	11.9	17	22.1		
Overdischarge detection voltage n (n =1, 2)	V_{DET2n}	Detect falling edge of supply voltage		V_{DET2n} – 0.035	V_{DET2n}	V_{DET2n} + 0.035	V	C
Overdischarge release voltage n (n =1, 2)	V_{REL2n}	Detect rising edge of supply voltage		V_{REL2n} – 0.070	V_{REL2n}	V_{REL2n} + 0.070	V	C
Overdischarge detection delay time	t_{VDET2}	$V_{DD} - V_C = V_{DET21}$ + 0.1 V → V_{DET21} – 0.1 V, $V_C - V_{SS} = V_{DET22}$ + 0.1 V		t_{VDET2} × 0.80	t_{VDET2}	t_{VDET2} × 1.20	ms	C
Overdischarge release delay time	t_{VREL2}	$V_{DD} - V_C = V_{DET21}$ – 0.1 V → V_{REL2} + 0.1 V, $V_C - V_{SS}$ = 3.5 V		0.74	1.05	1.37	ms	C
Charger connection detection voltage	V_{CHGDET}	Detect falling edge of V-, $V_{DD} - V_C = V_{DET21}$ + 0.05 V R_{V-} = 1kΩ		0.400	0.700	1.000	V	A
Discharge overcurrent detection voltage 1	V_{DET31}	$V_{DD} - V_C$ = 3.5 V, $V_C - V_{SS}$ = 3.5 V, V- = V_{RSENS}		V_{DET31} – 0.001	V_{DET31}	V_{DET31} + 0.001	V	D
Discharge overcurrent 1 detection delay time	t_{VDET31}	$V_{DD} - V_C$ = 3.5 V, $V_C - V_{SS}$ = 3.5 V, V_{RSENS} = 0 V → V_{DET31} + 0.005 V, V- = V_{RSENS}		t_{VDET31} × 0.80	t_{VDET31}	t_{VDET31} × 1.20	ms	D
Discharge overcurrent detection voltage 2	V_{DET32}	$V_{DD} - V_C$ = 3.5 V, $V_C - V_{SS}$ = 3.5 V, V- = V_{RSENS}	V_{DET32} = 0.01 to 0.04 V	V_{DET32} – 0.002	V_{DET32}	V_{DET32} + 0.002	V	D
			V_{DET32} = 0.04 to 0.05 V	V_{DET32} × 0.95		V_{DET32} × 1.05		
			V_{DET32} = 0.05 to 0.09 V	V_{DET32} – 0.0025		V_{DET32} + 0.0025		
Discharge overcurrent 2 detection delay time	t_{VDET32}	$V_{DD} - V_C$ = 3.5 V, $V_C - V_{SS}$ = 3.5 V, V_{RSENS} = 0 V → V_{DET32} + 0.005 V, V- = V_{RSENS}		t_{VDET32} × 0.80	t_{VDET32}	t_{VDET32} × 1.20	ms	D

*1 The test circuits for device evaluation. Refer to the section of *TEST CIRCUITS* for detail information.
*2 Only 0 V battery charging permission type
*3 Only 0 V battery charging inhibition type
*4 Short circuit release delay time is same as t_{VREL3}.

n number of cells: 1 = upper cell, 2 = lower cell, voltages stated at Ta = 25°C, unless otherwise noted.

NB7200GM***E4S Electrical Characteristics (Continued)**

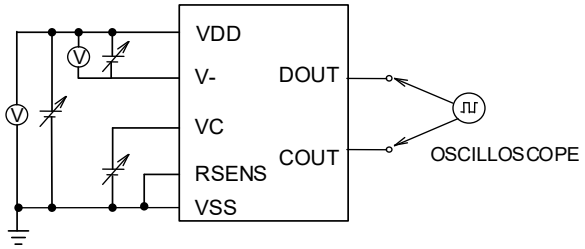
Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit	Remark *1
Short detection voltage	V_{SHORT}	Detect rising edge of RSENS pin voltage, V- = V_{RSENS}	V_{SHORT} – 0.004	V_{SHORT}	V_{SHORT} + 0.004	V	D
Short detection delay time *4	t_{SHORT}	V_{DD} – V_C = 3.5 V, V_C – V_{SS} = 3.5 V, V_{RSENS} = 0 V → V_{SHORT_MAX}, V- = V_{RSENS}	200	270	370	µs	D
			371	530	689		
Short detection voltage 2	V_{RCDET}	Detect rising edge of V-, V_{DD} – V_C = 3.5 V, V_C – V_{SS} = 3.5 V, V_{RSENS} = 0 V	V_{DD} – 2.00	V_{DD} – 1.50	V_{DD} – 1.00	V	D
Discharge overcurrent release voltage	V_{REL3}	V_{DD} – V_C = 3.5 V, V_C – V_{SS} = 3.5 V, V_{RSENS} = 0 V	V_{DD} × 0.788	V_{DD} × 0.800	V_{DD} × 0.812	V	D
Discharge overcurrent release resistance	R_{SHORT}	V_{DD} – V_C = 3.5 V, V_C – V_{SS} = 3.5 V, V- = V_{DD}	5.0	10.0	15.0	kΩ	D
Discharge overcurrent release delay time	t_{VREL3}	V_{DD} – V_C = 3.5 V, V_C – V_{SS} = 3.5 V, V- = V_{DD} → 0 V, V_{RSENS} = 0 V	6.8	8.5	10.2	ms	D
Charge overcurrent detection voltage	V_{DET4}	V_{DD} – V_C = 3.5 V, V_C – V_{SS} = 3.5 V, V- = V_{RSENS}	V_{DET4} – 0.001	V_{DET4}	V_{DET4} + 0.001	V	E
Charge overcurrent detection delay time	t_{VDET4}	V_{DD} – V_C = 3.5 V, V_C – V_{SS} = 3.5 V, V_{RSENS} = 0 V → –0.5 V, V- = V_{RSENS}	t_{VDET4} × 0.80	t_{VDET4}	t_{VDET4} × 1.20	ms	E
Charge overcurrent release voltage	V_{REL4}	V_{DD} – V_C = 3.5 V, V_C – V_{SS} = 3.5 V, V_{RSENS} = 0 V	0.055	0.100	0.145	V	E
Charge overcurrent release delay time	t_{VREL4}	V_{DD} – V_C = 3.5 V, V_C – V_{SS} = 3.5 V, V- = 0 V → 1 V, V- = V_{RSENS}	3.2	4	4.8	ms	E
COUT pin NMOS ON voltage	V_{OL1}	I_{OL} = 50µA, V_{DD} – V_C = 4.9 V, V_C – V_{SS} = 4.9 V		0.4	0.5	V	F
COUT pin PMOS ON voltage	V_{OH1}	I_{OH} = –50µA, V_{DD} – V_C = 3.5 V, V_C – V_{SS} = 3.5 V	6.5	6.8		V	G
DOUT pin NMOS ON voltage	V_{OL2}	I_{OL} = 50µA, V_{DD} – V_C = 1.9 V, V_C – V_{SS} = 1.9 V		0.2	0.5	V	H
DOUT pin PMOS ON voltage	V_{OH2}	I_{OH} = –50µA, V_{DD} – V_C = 3.5 V, V_C – V_{SS} = 3.5 V	6.5	6.8		V	I
Supply current	I_{DD}	V_{DD} – V_C = 3.5 V, V_C – V_{SS} = 3.5 V, V- = 0 V		2.0	4.0	µA	J
Standby current	$I_{STANDBY}$	V_{DD} – V_C = 1.6 V, V_C – V_{SS} = 1.6 V			0.2	µA	J

*1 The test circuits for device evaluation. Refer to the section of *TEST CIRCUITS* for detail information.

All test parameters listed in Electrical Characteristics are done under Ta = 25°C only.

Test Circuits

A



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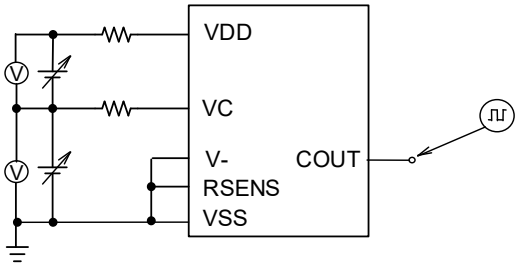

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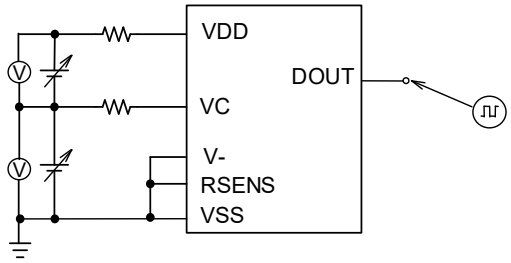

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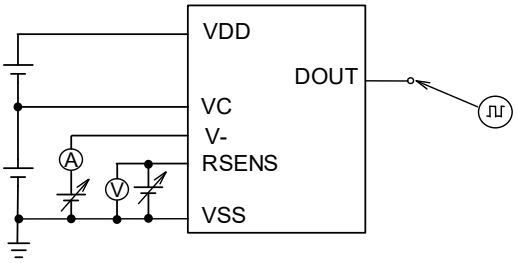

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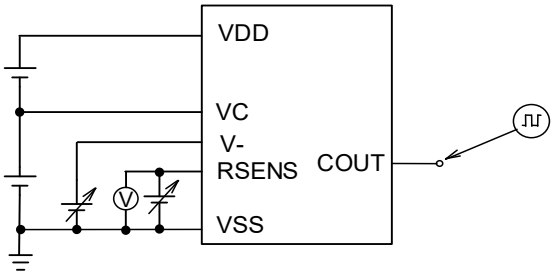

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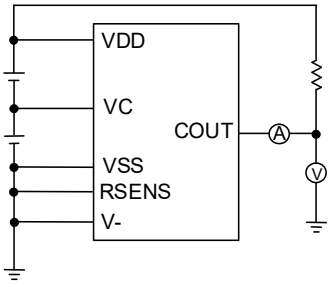

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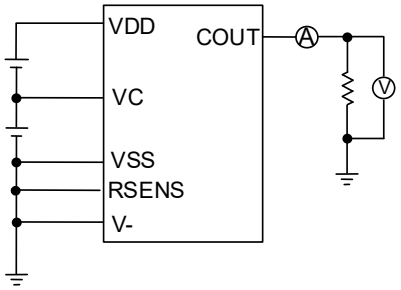

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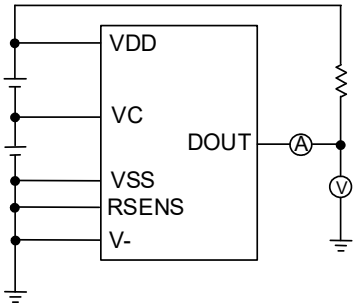

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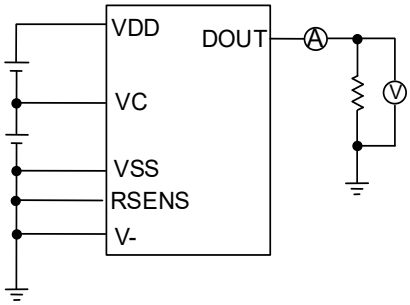

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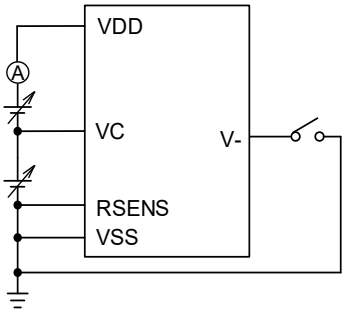


THEORY OF OPERATION

Overcharge Protection

The overcharge detection voltage (V_{DET1n}) monitors the voltage between the VDD pin and the VC pin (the voltage of CELL1) and the voltage between the VC pin and the VSS pin (the voltage of CELL2). When the overcharge detection delay time (t_{VDET1}) passes under the condition that either voltage exceeds the overcharge detection voltage (V_{DET1n}), this IC enters the over-charge state.
In this state, the COUT pin becomes Low, and the charge control FET is turned off to stop charging. The V- pin voltage (V-) increases by the Vf voltage (Vf) of the internal parasitic diode than the VSS pin voltage (V_{SS}) because the discharge current flows via the parasitic diode even when the charge control FET is off.
A release from the overcharge state must meet the following pin conditions and delay time according to the selected release type.

Type	Pin Conditions	Delay Time
Auto Release	$V- < V_{REL4}$ and $V_{CELL1} < V_{REL11}$ and $V_{CELL2} < V_{REL12}$ or $V- > V_{REL4}$ and $V_{CELL1} < V_{DET11}$ and $V_{CELL2} < V_{DET12}$	t_{VREL1}

Overdischarge Protection

When the overdischarge detection delay time (t_{VDET2}) passes under the condition that V_{CELL1} or V_{CELL2} falls below the over-discharge detection voltage (V_{DET2n}), this IC enters the over-discharge state.
In this state, the DOUT pin becomes Low, and the discharge control FET is turned off to stop discharging. The V- pin voltage (V-) decreases by the Vf voltage (Vf) of the internal parasitic diode than the VSS pin voltage (V_{SS}) because the charge current flows via the parasitic diode even when the discharge control FET is off.
In addition, when V- is pulled up to V_{DD} level and exceeds the charger detection voltage (V_{CHGDET}), the IC enters the standby state. It results in reducing the standby current ($I_{STANDBY}$) to a minimum.
A release from the overdischarge state must meet the following pin conditions and delay time according to the selected release type.

Type	Pin Conditions	Delay Time
Auto Release	$V- > V_{CHGDET}$ and $V_{CELL1} > V_{REL21}$ and $V_{CELL2} > V_{REL22}$ or $V- < V_{CHGDET}$ and $V_{CELL1} > V_{REL21}$ and $V_{CELL2} > V_{REL22}$	t_{VREL2}

Discharge Overcurrent Protection

To monitor a discharge current, this IC measures a voltage difference of the sense resistor (R_{SENS}) connected between the RSENS and the VSS pins to detect the current value.
This IC has two levels of the discharge overcurrent detection voltage 1/2 (V_{DET31} / V_{DET32}). When the discharge overcurrent detection delay time (t_{VDET31}) passes under the condition that the discharge current, which is converted through R_{SENS} for current-to-voltage conversion, exceeds V_{DET31}, this IC enters the discharge overcurrent state. In a case where V_{DET32} is enabled, this IC enters the discharge overcurrent state when the discharge overcurrent detection delay time (t_{VDET32}) passes under the condition exceeding V_{DET32}.
In this state, the DOUT pin becomes Low, and the discharge control FET is turned off to shut off the discharge current.
A release from the discharge overcurrent state must meet the following pin condition and delay time according to the selected release type.

Type	Pin Condition	Delay Time	Remarks
Auto Release 1	V- < V_{REL3}	t_{VREL3}	V- is pulled down to the V_{SS} level inside the IC. Note1

Note1: It is possible to release the abnormal condition of the load connected to the battery pack. When the discharge overcurrent release delay time (t_{VREL3}) passes under the condition V- falls below V_{REL3}, this IC releases from the discharge overcurrent state. V- can be expressed by the following equation.

$$V\text{-} = V_{DD} \times R_{SHORT} / (R_{SHORT} + R_{V\text{-}} + R_{LOAD})$$

R_{SHORT} : Discharge overcurrent release resistance
$R_{V\text{-}}$: External resistor for V- pin
R_{LOAD} : Load resistance to a battery pack

Short-circuit Current Protection

To monitor a short-circuit current, this IC measures a voltage difference of the sense resistor (R_{SENS}) connected between the RSENS and the VSS pins to detect the current value. When the short-circuit current, which is converted through RSENS for current-to-voltage conversion, exceeds the short-circuit detection voltage (V_{SHORT}), this IC enters the short-circuit state. But it is possible for this IC to avoid its state when the short-circuit current falls below V_{SHORT} within the short-circuit detection delay time (t_{SHORT}).
In this state, the DOUT pin becomes Low, and the discharge control FET is turned off to shut off the short-circuit current.
A release from the short-circuit state must meet the same condition and delay time as the discharge overcurrent protection.

Charge Overcurrent Protection

To monitor a charge current, this IC measures a voltage difference of the sense resistor (R_{SENS}) connected between the RSENS and the VSS pins to detect the current value. When the charge overcurrent detection delay time (t_{VDET4}) passes under the condition that the charge current, which is converted through RSENS for current-to-voltage conversion, falls below the charge overcurrent detection voltage (V_{DET4}), this IC enters the charge overcurrent state.
In this state, the COUT pin becomes Low, and the charge control FET is turned off to shut off the charge current.
A release from the charge overcurrent state must meet the following pin condition and delay time according to the selected release type.

Type	Pin Condition	Delay Time	Remarks
Auto Release	V- > V_{REL4}	t_{VREL4}	V- is pulled up to the V_{DD} level inside the IC. Note

Note: By disconnecting the charger, this IC releases from the charge overcurrent state.

0 V Battery Charging

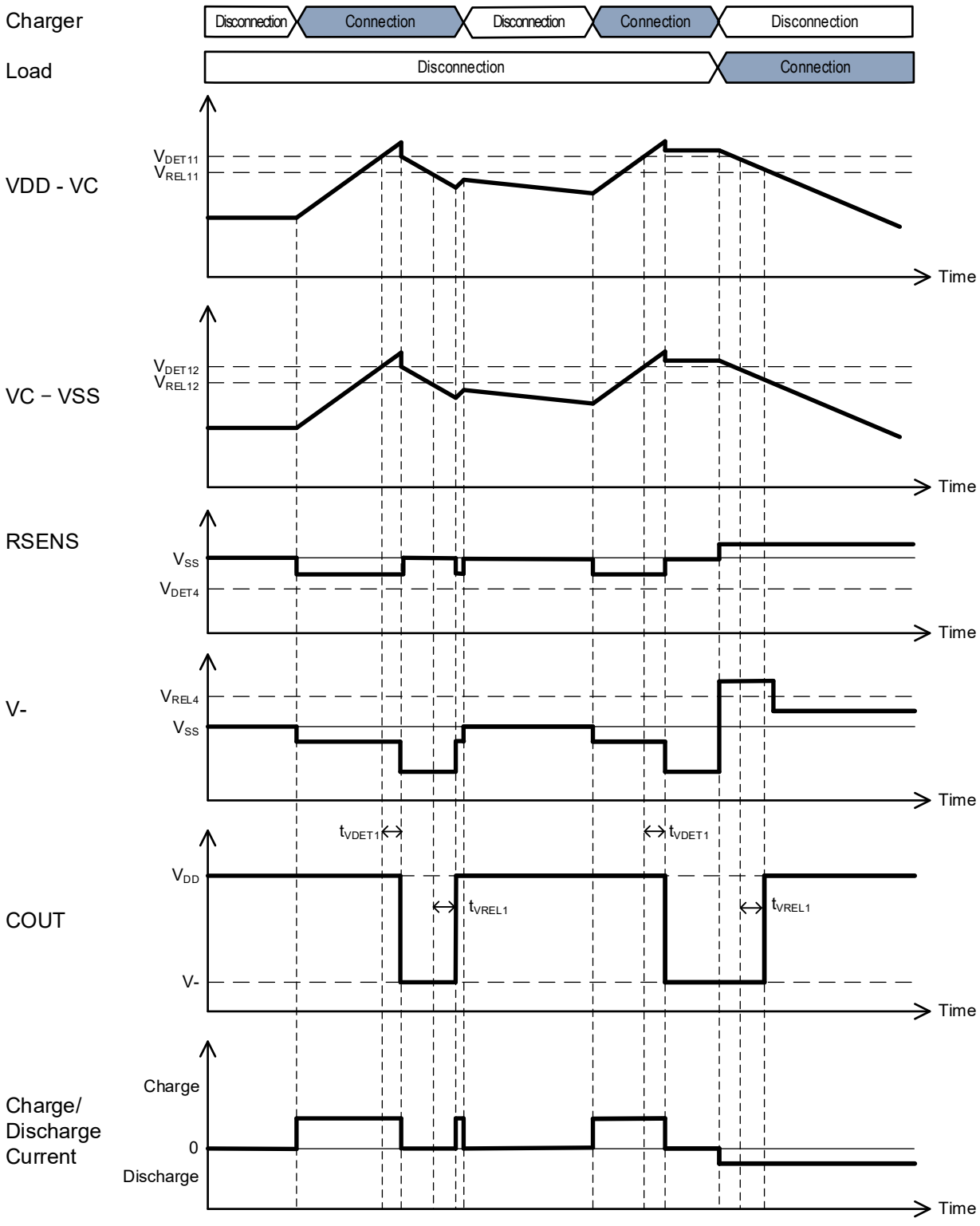
This IC has the selectable charging function for the battery discharged to 0 V.

0 V Battery Charge Function "Permission"
This function allows to charge to the 0 V battery by connecting the charger with the minimum charging voltage (V_{STCHG}) and more.

0 V Battery Charge Function "Inhibition"
This function inhibits to charge to the battery with the 0 V-battery charging inhibition voltage (V_{NOCHG}) or less even if connecting the charger.

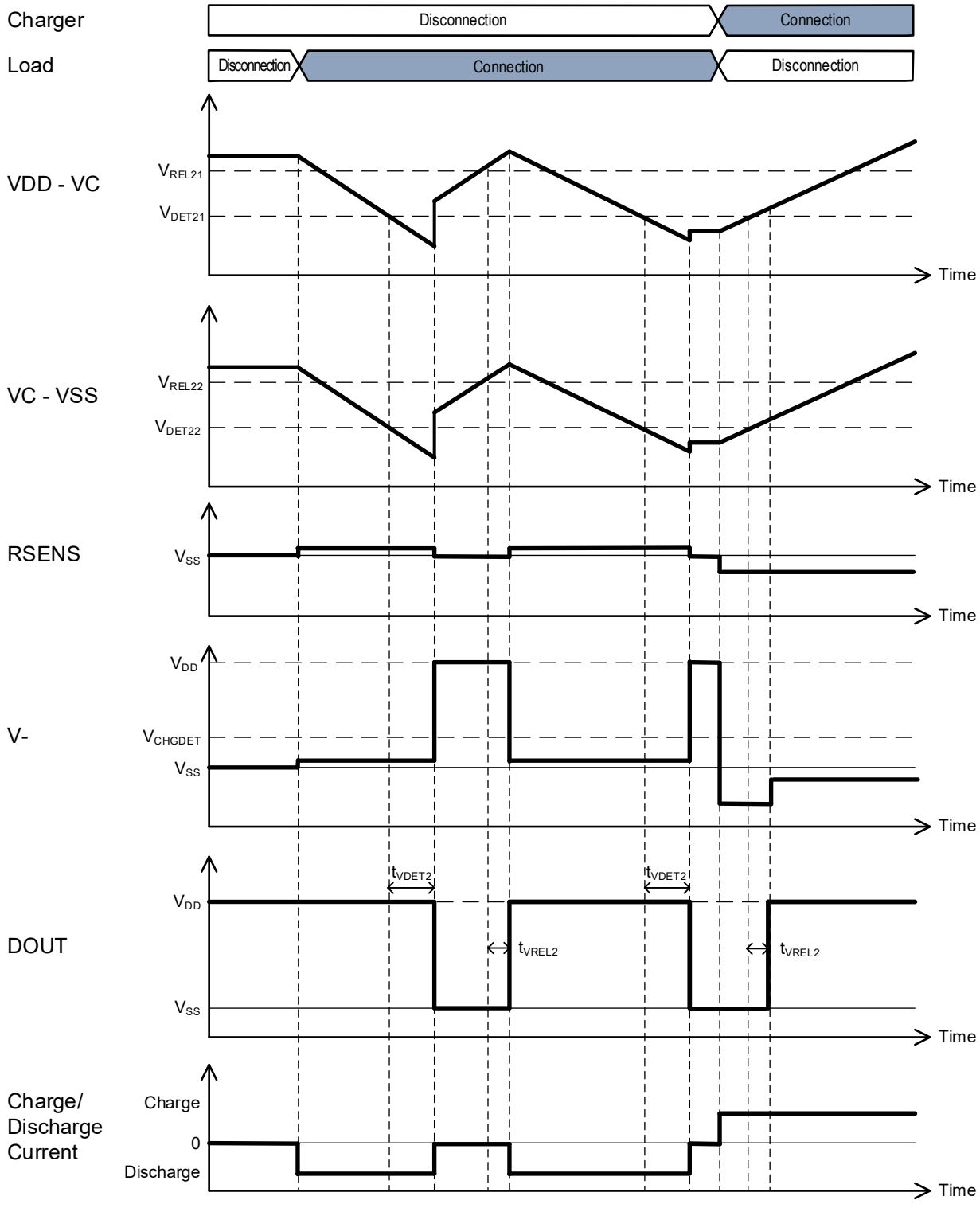
Timing Chart

Overcharge



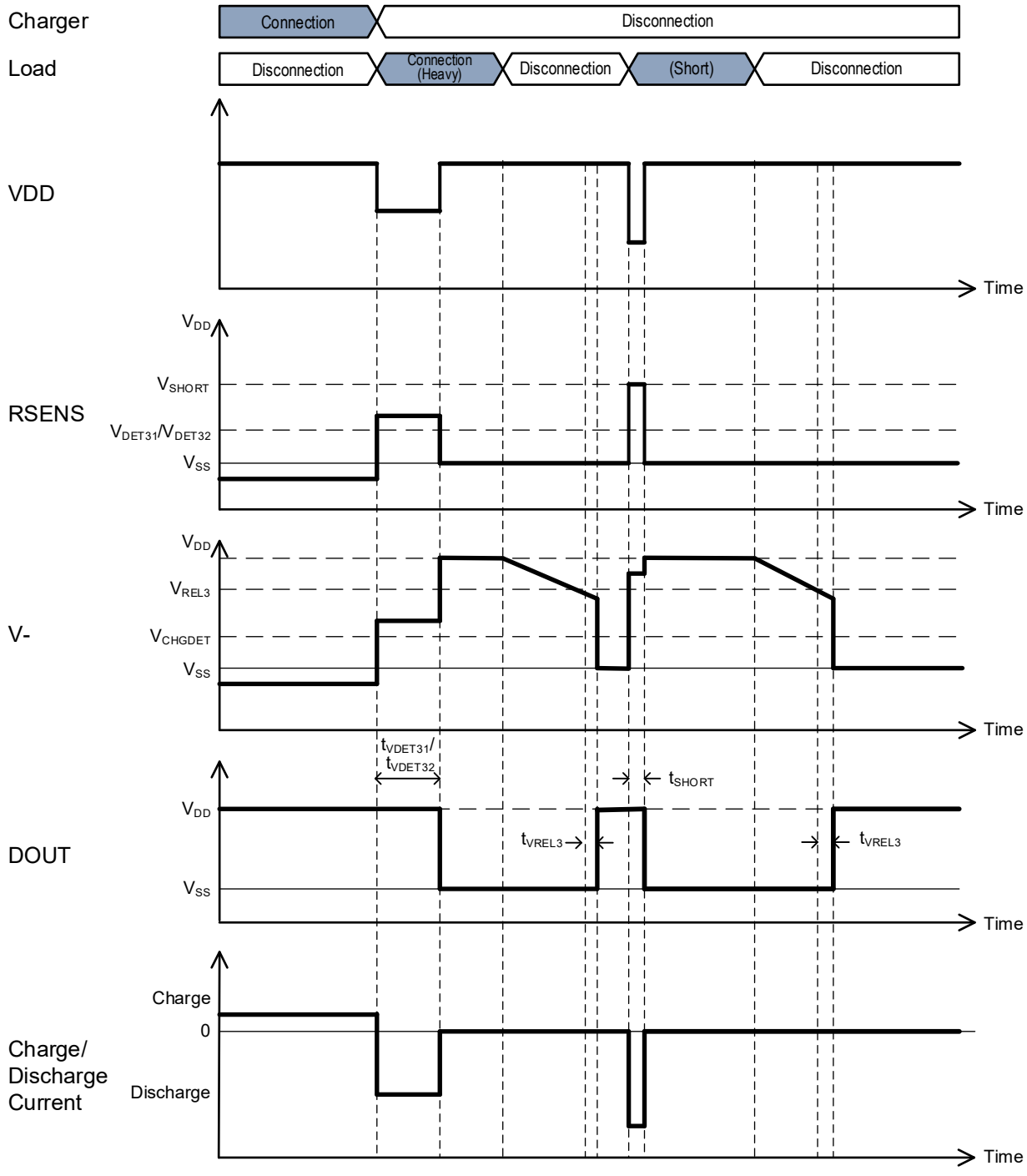
Overcharge (Auto Release) Timing Chart

Overdischarge



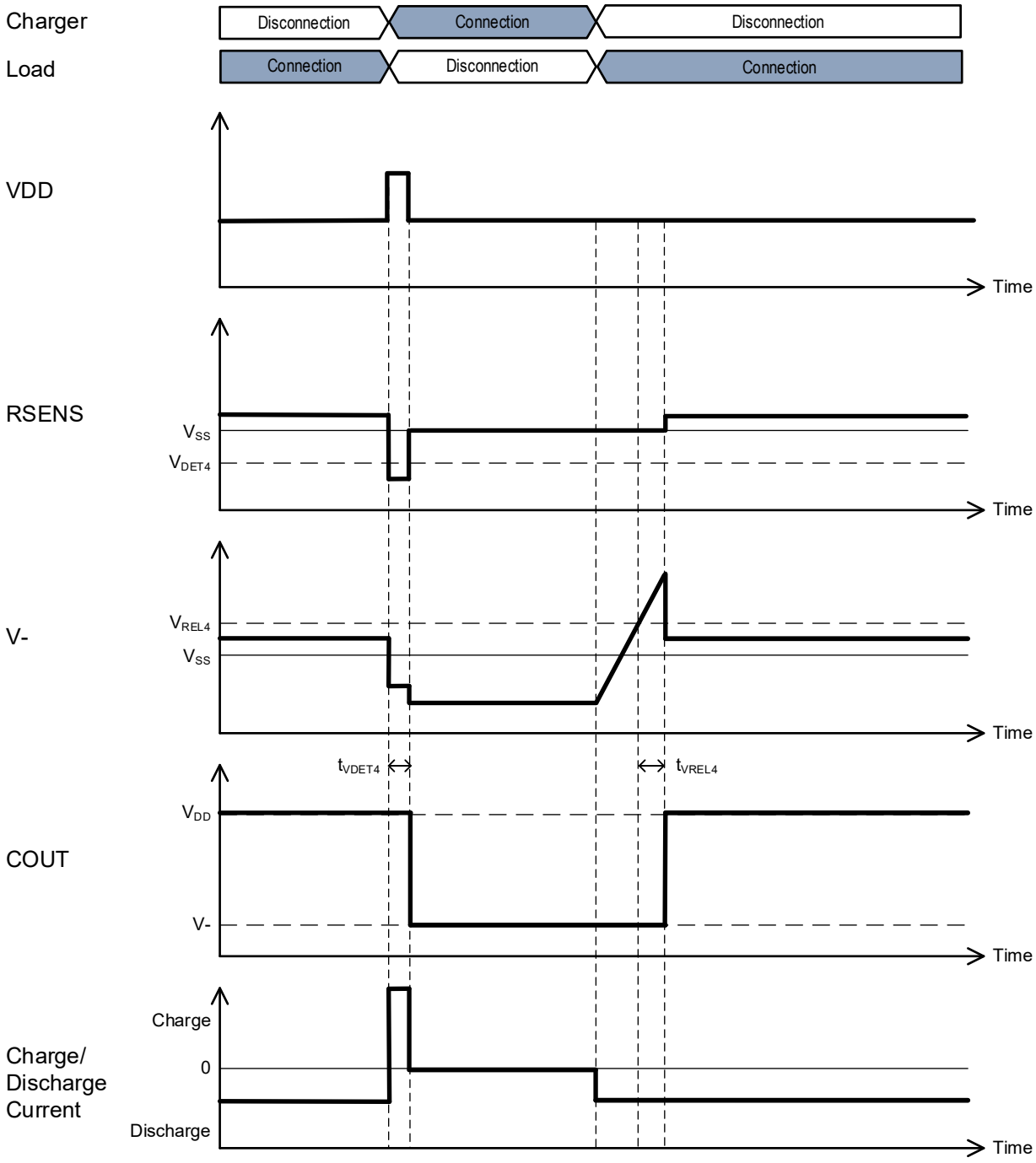
Overdischarge (Auto Release) Timing Chart

Discharge Overcurrent



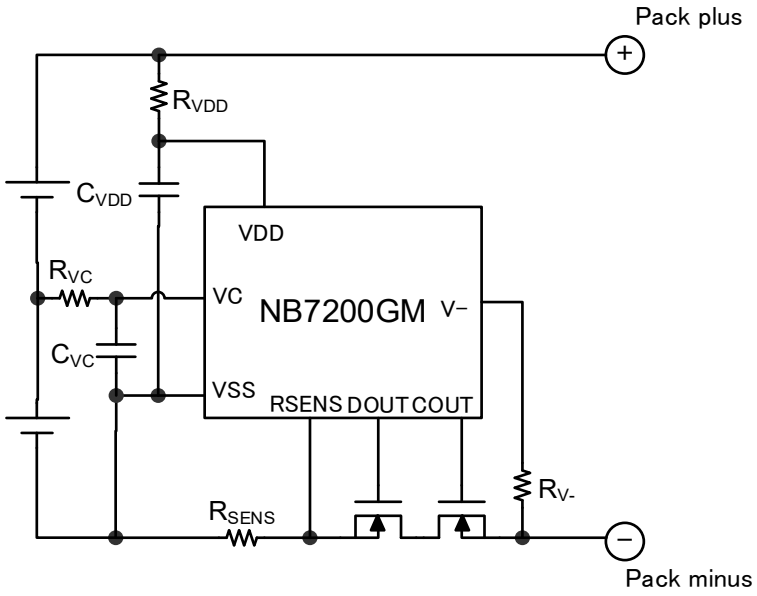
Discharge Overcurrent (Auto Release) Timing Chart

Charge Overcurrent



Charge Overcurrent Timing Chart

TYPICAL APPLICATION CIRCUIT



NB7200GM Typical Application Circuit

External Components

Symbol	Min.	Typ.	Max.
Resistor			
R_{VDD} *1	-	330Ω	1kΩ
R_{VC}	-	330Ω	1kΩ
R_{V-} *1	-	1kΩ	1.3kΩ
R_{SENS}	-	-	-
Capacitor			
C_{VDD}	0.047μF	0.1μF	1μF
C_{VC}	0.047μF	0.1μF	1μF

*1 The total resistance of R_{VDD} and R_{V-} must be 1kΩ or more.

Technical Notes Related to External Components

- The voltage fluctuation is stabilized with R_{VDD}, R_{VC}, C_{VDD} and C_{VC}. If R_{VDD} and R_{VC} is too large, the detection voltage rises by the conduction current at detection. To stabilize the operation, it is recommended to use a resistor of 1kΩ or less for R_{VDD}, R_{VC} and a capacitor of 0.01 μF to 1.0 μF for C_{VDD} and C_{VC}.

- R_{VDD} and R_{V-} serve as a current limit resistor when the battery pack is charged with reversed polarity, or a voltage of the connected charger is more than the absolute maximum rating. When using a small resistor for R_{VDD} and R_{V-}, the device's power dissipation might be exceeded. Therefore, a total of R_{VDD} and R_{V-} must be 1kΩ or more. When using a large resistor for R_{V-}, the charger might not be released by re-connecting to the battery pack after the overdischarge detection. Therefore, R_{V-} must be 1.3 kΩ or less. Production variation and temperature properties are included in the value. R_{SENS} is a resistor for sensing an overcurrent. If the resistance value is too large, power loss becomes also large. By the overcurrent, if the R_{SENS} is not appropriate, the power loss may be beyond the power dissipation of R_{SENS}. Choose an appropriate R_{SENS} according to the cell specification.

- The typical application circuit diagrams are just examples. This circuit performance largely depends on the PCB layout and external components. In the actual application, fully evaluation is necessary.

- If the positive terminal and the negative terminal of the battery pack are short even though the device has the short protection circuit, a large current may flow through the FET during the short detection delay time. Therefore, select an appropriate FET with large enough current capacitance to endure the large current during the delay time.

Selection of External Sense Resistor and MOSFET

Short mode is detected by the current base or the relation between V_{DD} at short and total on resistance of external MOSFETs for C_{OUT} and D_{OUT}. If short must be detected by the current base determined by V_{SHORT}, V_{RCDET}, and R_{SENS}, the next formula must be true, otherwise, the short current limit becomes (V_{RCDET}) / (R_{SENS} + R_{SS} (on)).

$$\frac{V_{RCDET}}{R_{SENS}+Rss(on)} \geq \frac{V_{SHORT}}{R_{SENS}}$$

V_{SHORT} = Threshold value of detecting short circuit using R_{SENS} terminal [V]
V_{RCDET} =Threshold value of detecting short circuit using V- terminal [V]
R_{SENS} = External current sense resistance [Ω]
R_{SS} (on) = external MOSFETs' total ON resistance [Ω]

In the short mode, a short current is determined by the relation between R_{SENS} and V_{SHORT} value.

TECHNICAL NOTES

A peripheral component or the device mounted on PCB should not exceed a rated voltage, a rated current or a rated power. When designing a peripheral circuit, please be fully aware of the following points.

- Please evaluate the product at the PCB level before use, as some symptoms may remain that cannot be confirmed by the evaluation at the IC level.
- When using any coating or underfill to improve moisture resistance or joining strength, evaluate them adequately before using. In certain materials or coating conditions, corrosion by contained constituents, current leakage by moisture absorption, crack and delamination by physical stress can happen. If the curing temperature of the coating material or underfill material exceeds the absolute maximum rating, the electrical characteristics of this product may change.
- When performing X-ray inspection in mass production process and evaluation build stage such as the product functions and characteristics confirmation, please confirm X-ray irradiation does not exceed 1.5Gy (absorbed dose for air).

REVISION HISTORY

Date	Version	Changes
August 9, 2022	1.10	First public release as datasheet

	Set Voltage [V] / Delay Time [ms]												Optional Function					
	V_{DET1} / t_{VDET1}	V_{REL1} / t_{VRET1}	V_{DET2}/ t_{VDET2}	V_{REL2} / t_{VREL2}	V_{DET31} / t_{VDET31}	V_{DET32} / t_{VDET32}	t_{VREL3}	V_{DET4} / t_{VDET4}	t_{VREL4}	V_{SHORT} / t_{SHORT}	V_{NOCHG}	Unit	Overcharge Release	Overdischarge Release	Discharge Overcurrent Release	Dischrage Overcurrent Detection2 *1	0V Battery Charging *2	
NB7200GM**101AA**E4S	4.600	4.400	2.600	2.900	0.0160	-	-	-0.0180	-	0.030	1.00	V	Auto	Auto	Auto1	No	No	
	1024	1.5	128	1.05	12	-	8.5	32.00	4.0	0.27	-	ms						
NB7200GM**102BB**E4S	4.600	4.400	2.300	2.500	0.0105	0.0150	-	-0.0150	-	0.042	1.20	V	Auto	Auto	Auto1	Yes	No	
	1024	1.5	64	1.05	3584	16	8.5	16.00	4.0	0.27	-	ms						

*1 Yes: Available No: Unavailable

*2 Yes: Permission No: Inhibition

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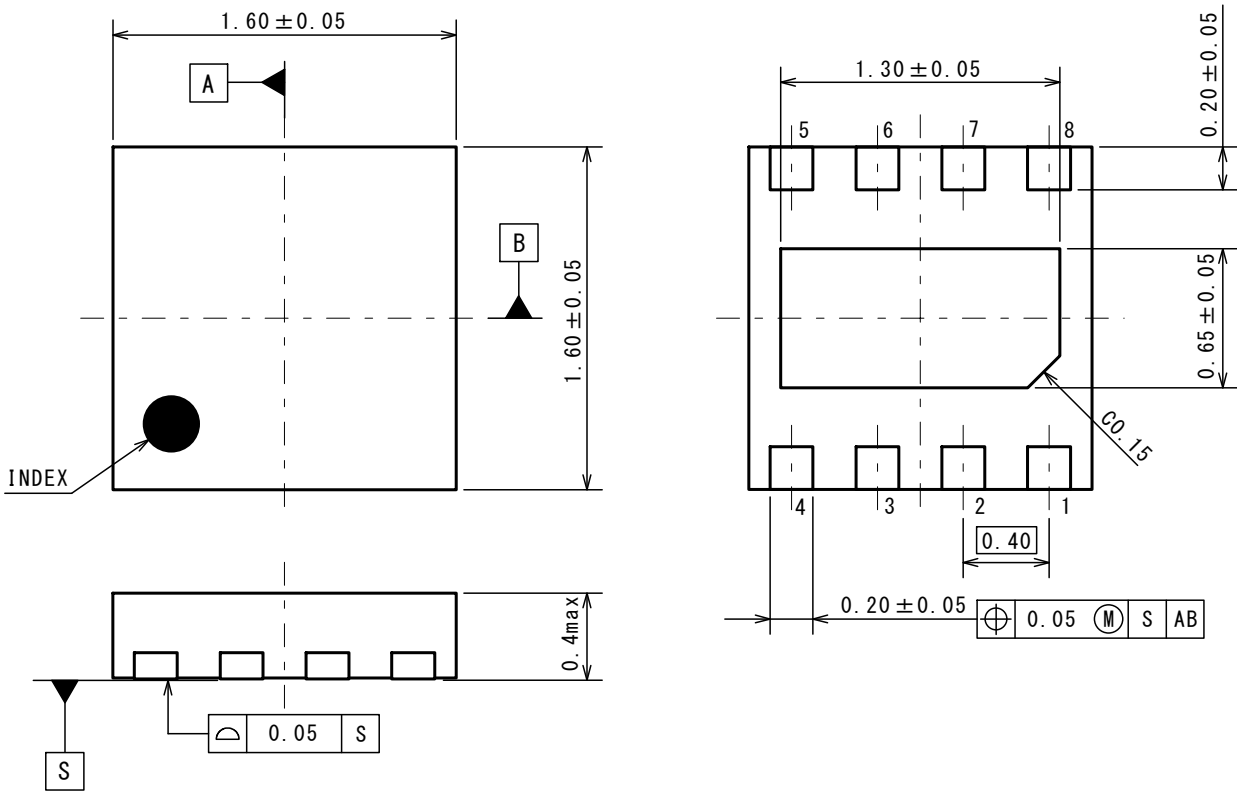
DFN1616-8-GM

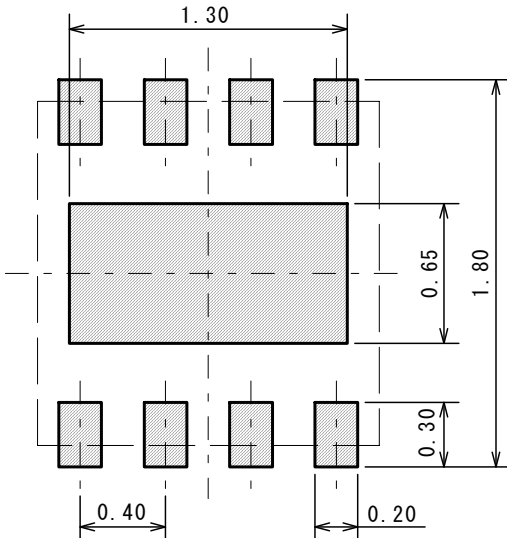
PI-DFN1616-8-GM-E-B

■ PACKAGE DIMENSIONS

UNIT: mm



■ EXAMPLE OF SOLDER PADS DIMENSIONS



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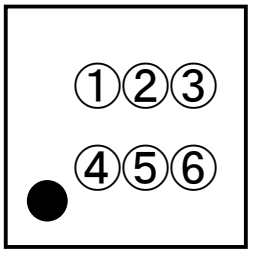
DFN1616-8-GM

■ MARKING SPECIFICATION

①②③④: Product Code
⑤⑥: Lot No. ⋯ Alphanumerical Serial Number



DFN1616-8-GM Marking

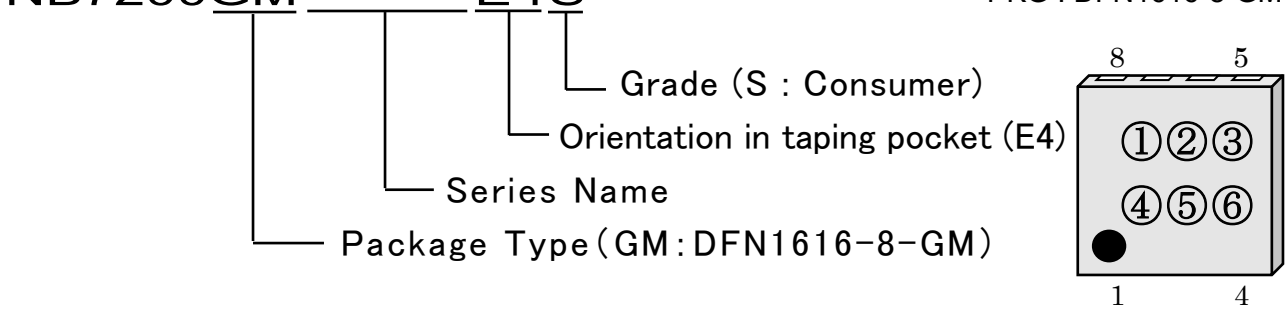
NOTICE
There can be variation in the marking when different AOI (Automated Optical Inspection) equipment is used. In the case of recognizing the marking characteristic with AOI, please contact our sales or distributor before attempting to use AOI.

Nisshinbo Micro Devices Inc.

NB7200GM Series Mark Specification

NB7200GM×××××E4S

PKG : DFN1616-8-GM



①②③④ : Product Code (See below)
⑤⑥ : Lot No. (series)

Product Name	①②③④
NB7200GM101AA	HC00
NB7200GM102BB	HC01

Nisshinbo Micro Devices Inc.

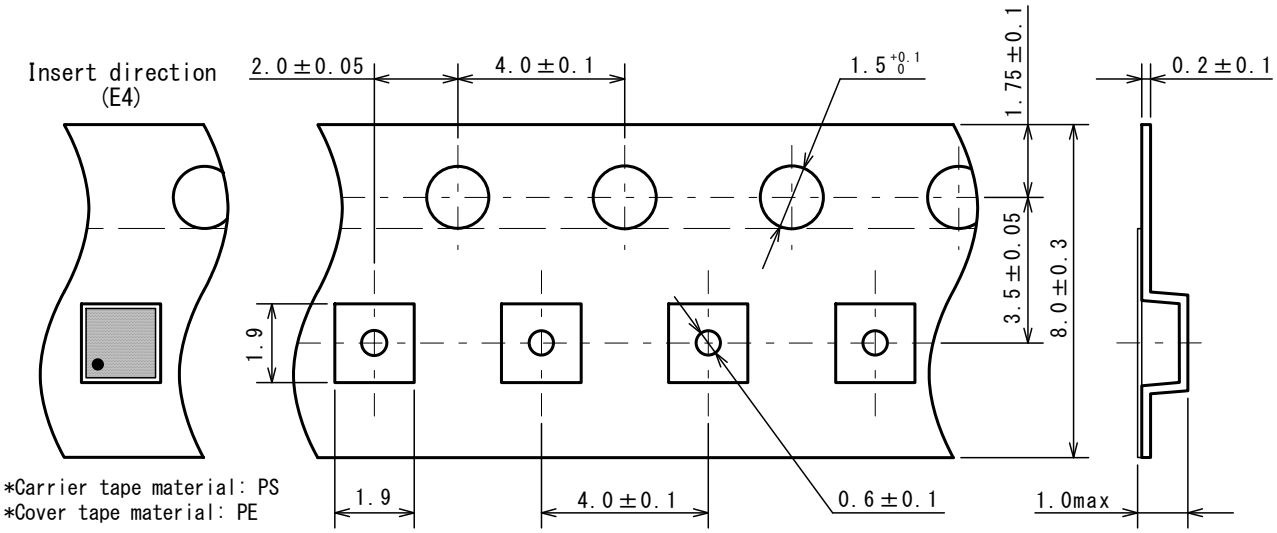
DFN1616-8-GM

PI-DFN1616-8-GM-E-B

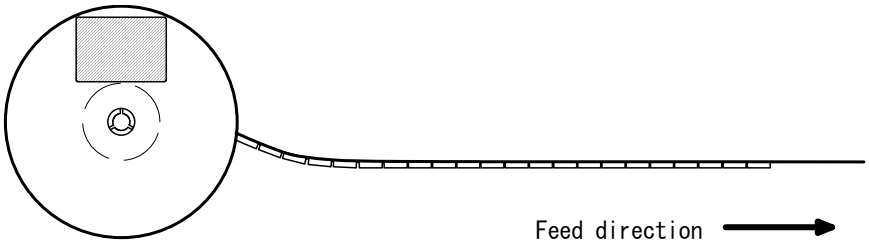
■ PACKING SPEC

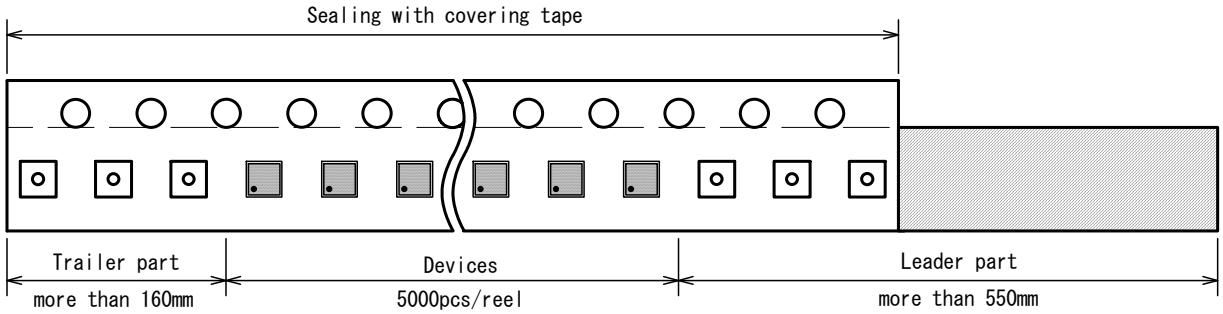
UNIT: mm

(1) Taping dimensions / Insert direction

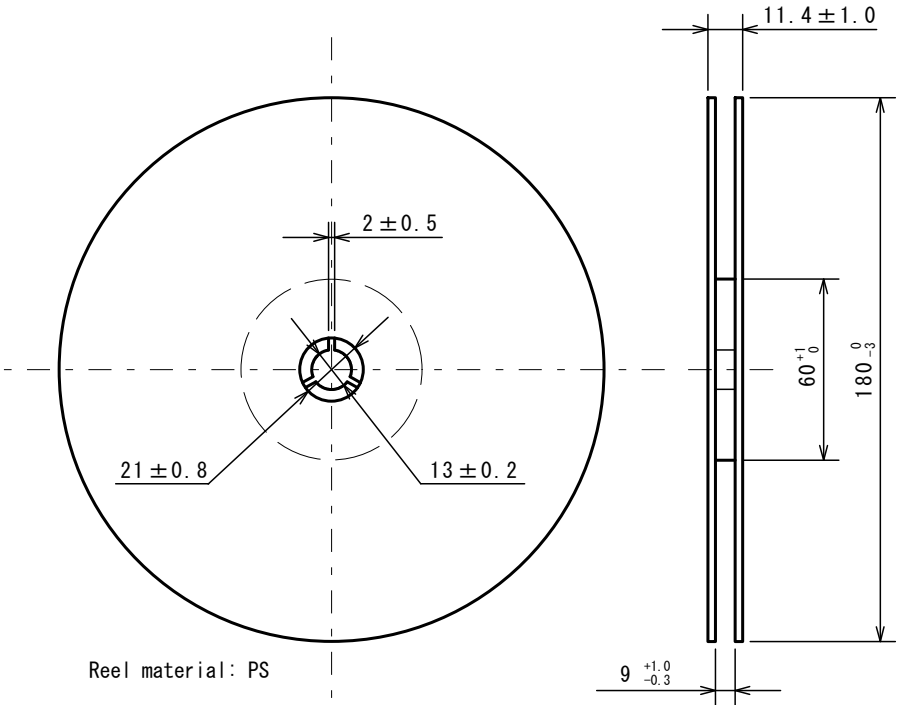


(2) Taping state





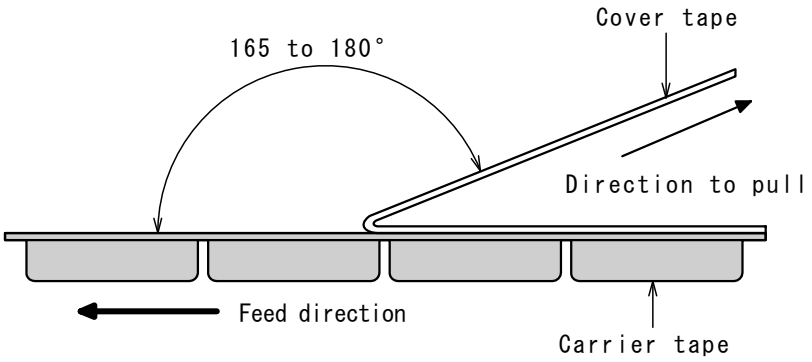
(3) Reel dimensions



(4) Peeling strength

Peeling strength of cover tape

- Peeling angle 165 to 180° degrees to the taped surface.
- Peeling speed 300mm/min
- Peeling strength 0.1 to 1.0N



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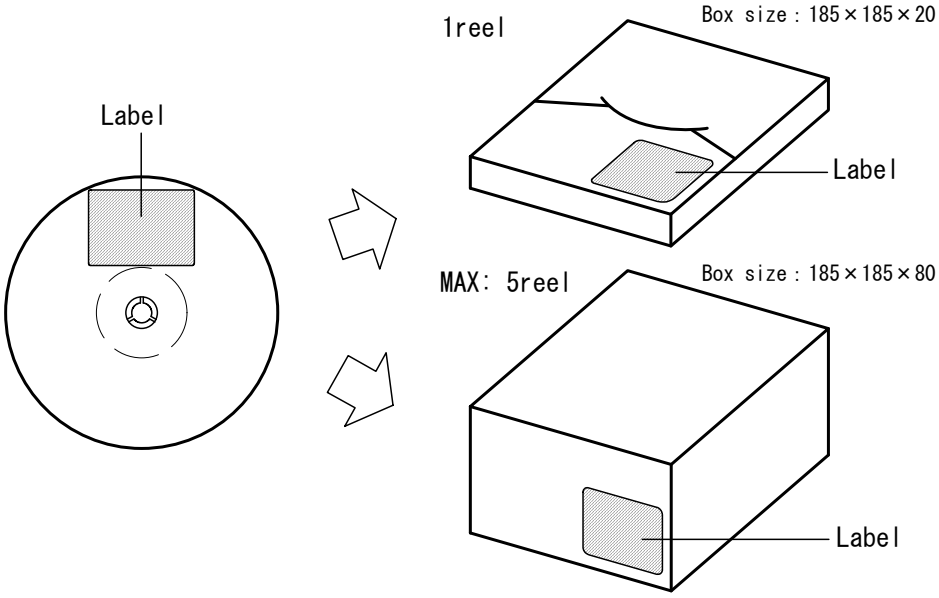
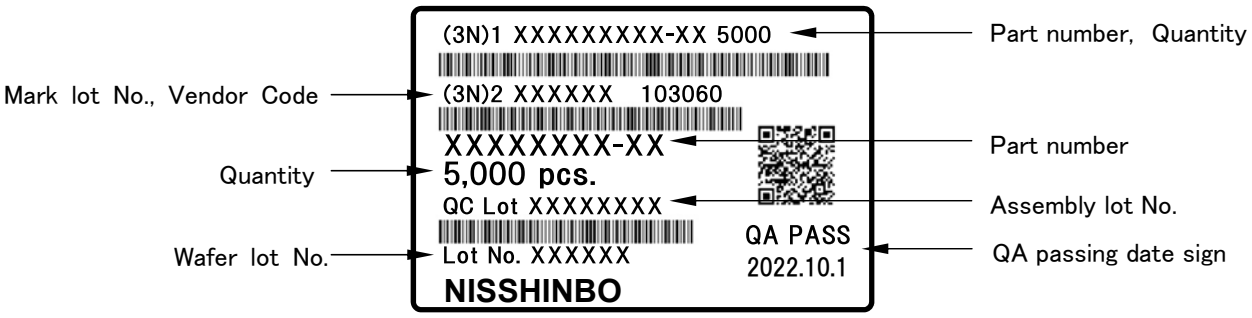
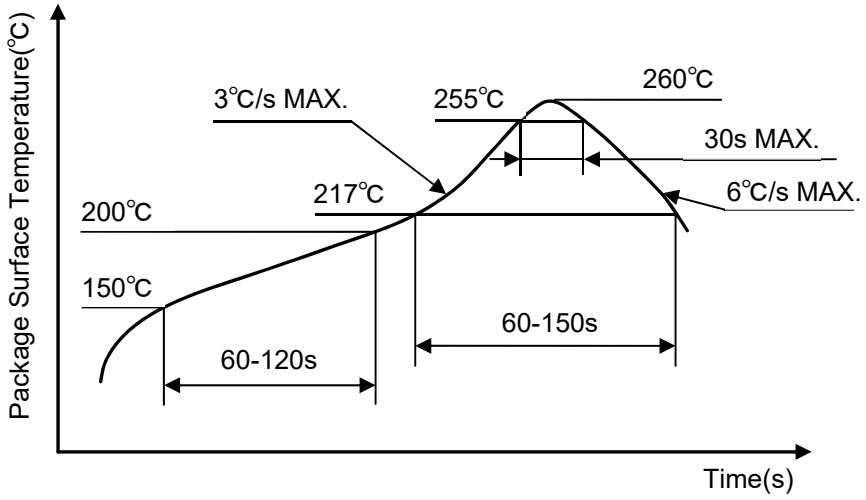
(5) Packing state



(6) Label



■ **HEAT-RESISTANCE PROFILES**



Reflow profile

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    - Various Safety Devices
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    In the case of a product purchased through an authorized distributor or directly from us, the warranty period for this product shall be one (1) year after delivery to your company. For defective products that occurred during this period, we will take the quality warranty measures described in section 8-2. However, if there is an agreement on the warranty period in the basic transaction agreement, quality assurance agreement, delivery specifications, etc., it shall be followed.
    8-2. Quality Warranty Remedies
    When it has been proved defective due to manufacturing factors as a result of defect analysis by us, we will either deliver a substitute for the defective product or refund the purchase price of the defective product.
    Note that such delivery or refund is sole and exclusive remedies to your company for the defective product.
    8-3. Remedies after Quality Warranty Period
    With respect to any defect of this product found after the quality warranty period, the defect will be analyzed by us. On the basis of the defect analysis results, the scope and amounts of damage shall be determined by mutual agreement of both parties. Then we will deal with upper limit in Section 8-2. This provision is not intended to limit any legal rights of your company.
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