Li-Ion BATTERY PROTECTOR

RN5VM1××C/D SERIES

APPLICATION MANUAL

RICOH

ELECTRONIC DEVICES DIVISION

NO. EA-041-9803

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June 1995

RN5VM1××C/D Series

APPLICATION MANUAL

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RN5VM1××C/D SERIES

OUTLINE

The RN5VM Series are protection ICs for over-charge/discharge of rechargeable one-cell Lithium-ion (Li+) batteries by CMOS process.
The RN5VM Series can detect over-charge/discharge of Li+ one-cell and excess load current, further include a short circuit protector for preventing large external short circuit current.
Each of these ICs is composed of three voltage detectors, a reference unit, a hysteresis circuit, and a short circuit protector. When charging voltage crosses the detector threshold from a low value to a value higher than V_{DET1}, the output of C_{OUT} pin, the output of over-charge detector/VD1, switches to low level, ..charger's negative pin level. After detecting over-charge the VD1 can be reset and the output of C_{OUT} pin becomes "H" when the V_{DD} voltage is coming down to a level lower than "V_{DET1} - V_{HYS1}", or when a charger is disconnected from the battery pack while the V_{DD} level is in between "V_{DET1}" and "V_{DET1} - V_{HYS1}" in the RN5VM1××C version.
While in the RN5VM1××D version after detecting over-charge, any load current can not be drawn from the battery pack when the V_{DD} voltage stays over "V_{DET1} - V_{HYS1}", excepting that the VD1 can be reset and it allows to draw load current when the V_{DD} voltage is coming down to a level lower than "V_{DET1} - V_{HYS1}" because of a cell internal discharging.
The output of D_{OUT} pin, the output of over-discharge detector/VD2, switches to "L" after internally fixed delay time passed, when discharging voltage crosses the detector threshold from a high value to a value lower than V_{DET2}. An excess load current can be sensed and cut off after internally fixed delay time passed through the built in excess current detector, VD3, with D_{OUT} being enabled to low level. Once after detecting excess current, the VD3 is released and D_{OUT} level switches to "H" by detaching a battery pack from a load system.
Further, short circuit protector makes D_{OUT} level to "L" immediately with external short circuit current and removing external short circuit leads D_{OUT} level to "H". After detecting over-discharge, supply current will be kept extremely "L" by halting some internal circuits operation. The output delay of over-charge detectors can be set by connecting external capacitors. Output type of C_{OUT} and D_{OUT} are CMOS. SOT23-6 is available.

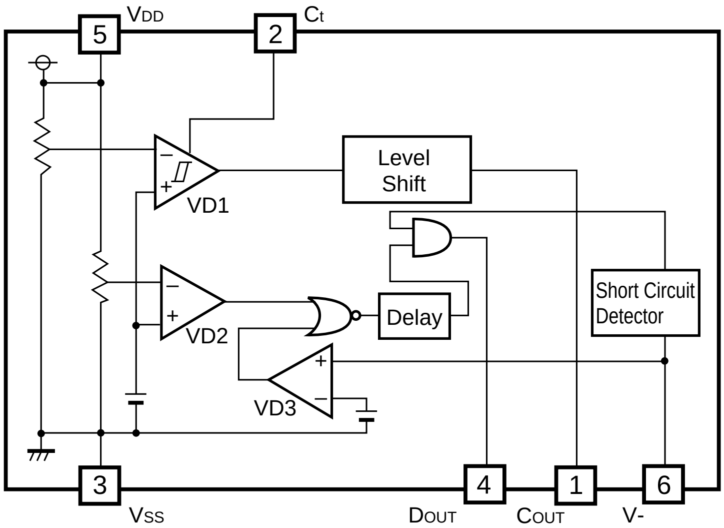
FEATURES

• Low supply current ································	Supply current	TYP. 3.0µA
	Standby current (after detecting over-discharge)	TYP. 0.3µA
• High withstand voltage··························	Absolute maximum ratings 28V (V_{DD}–V-)	
• High accuracy detector threshold ·······	Over-charge detector	±50mV
	Over-discharge detector	±2.5%
• Variety of detector threshold················	Over-charge detector threshold	4.0V to 4.4V/step of 0.01V
	Over-discharge detector threshold	2.0V to 3.0V/step of 0.05V
• Built-in protection circuit·······················	Excess current trip/Short circuit protector	
• Output delay of over-charge ················	Time delay at C_3= 0.01µF and V_{DD}=4.3V	75ms for RN5VM111×
• Ultra small package ······························	SOT-23-6	

APPLICATIONS

• Over-charge/over-discharge protection for Li+ one-cell pack
• High precision protectors for cell-phones and any other gadgets using on board Li+ one-cell battery

BLOCK DIAGRAM



SELECTION GUIDE

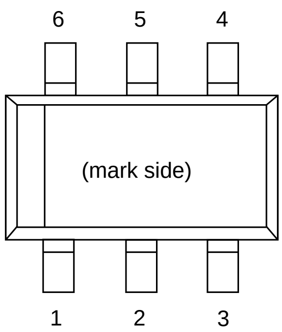
In the RN5VM1××× Series three of the input threshold for over-charge, over-discharge and excess current and taping type can be designating at the user's request by Part Number as follows:

$$\text{RN5VM1}\underbrace{\times\times}_{a}\underbrace{\times}_{b}\text{–}\underbrace{\times\times}_{c} \leftarrow \text{Part Number}$$

Code	Description
a	Serial Number for the RN5VM Series designating input threshold for over-charge, over-discharge and excess current detectors as well as hysteresis range for over-charge detector.
b	Designation of version symbols C : drawing load current is allowable after detecting over-charge. D : drawing load current is not allowable after detecting over-charge.
c	Designation of Taping Type: TR (refer to Taping Specification)

PIN CONFIGURATION

•SOT-23-6



PIN DESCRIPTION

Pin No.	Symbol	Pin description
1	COUT	Output of over-charge detection, CMOS output
2	Ct	Pin for external capacitor setting output delay of VD1
3	VSS	Ground
4	DOUT	Output of over-discharge detection, CMOS output
5	VDD	Power supply
6	V-	Pin for charger negative input

ABSOLUTE MAXIMUM RATINGS

Vss=0V

Symbol	Item		Rating	Unit
VDD	Supply Voltage		–0.3 to 12	V
V-	Input Voltage	V- pin	VDD–28 to VDD+0.3	V
Vct		Ct pin	Vss–0.3 to VDD+0.3	V
VCOUT	Output Voltage	COUT pin	VDD–28 to VDD+0.3	V
VDOUT		DOUT pin	Vss–0.3 to VDD+0.3	V
PD	Power Dissipation		150	mW
Topt	Operating Temperature Range		–40 to +85	˚C
Tstg	Storage Temperature Range		–55 to +125	˚C

ABSOLUTE MAXIMUM RATINGS

Absolute Maximum ratings are threshold limit values that must not be exceeded even for an instant under any conditions. Moreover, such values for any two items must not be reached simultaneously. Operation above these absolute maximum ratings may cause degradation or permanent damage to the device. These are stress ratings only and do not necessarily imply functional operation below these limits.

ELECTRICAL CHARACTERISTIC

• **RN5VM111C**

Topt=25°C

Symbol	Item	Conditions	MIN.	TYP.	MAX.	Unit
V_{DD1}	Operating input voltage	Voltage defined as $V_{DD}-V_{SS}$	1.5		10	V
Vst	Minimum operating voltage for 0V charging	Voltage defined as V_{DD}–V-, V_{DD}–Vss=0V			1.2	V
V_{DET1}	Over-charge threshold voltage	Detect rising edge of supply voltage	4.20	4.25	4.30	V
V_{HYS1}	Over-charge threshold hysteresis range		0.15	0.2	0.25	V
t_{VDET1}	Output delay time of over-charge	C_3=0.01µF, V_{DD}=3.6V→ 4.3V	50	75	100	ms
V_{DET2}	Over-discharge threshold voltage	Detect falling edge of supply voltage	2.437	2.50	2.563	V
t_{VDET2}	Output delay time of over-discharge	V_{DD}=3.6V→ 2.4V	7	10	13	ms
V_{DET3}	Excess current threshold voltage	Detect rising edge of "V-" pin voltage	0.17	0.20	0.23	V
t_{VDET3}	Output delay time of excess current	V_{DD}=3.0V	9	13	17	ms
Vshort	Short detection voltage	V_{DD}=3.0V	V_{DD}–1.1	V_{DD}–0.8	V_{DD}–0.5	V
tshort	Output delay time of short detection	V_{DD}=3.0V		5	50	µs
Rshort	Reset resistance for excess current protection	V_{DD}=3.6V, V-=1.0V	50	100	150	kΩ
V_{OL1}	Nch ON voltage of C_{OUT}	I_{OL}=50µA, V_{DD}=4.4V		0.2	0.5	V
V_{OH1}	Pch ON voltage of C_{OUT}	I_{OH}=–50µA, V_{DD}=3.9V	3.4	3.8		V
V_{OL2}	Nch ON voltage of D_{OUT}	I_{OL}=50µA, V_{DD}=2.4V		0.2	0.5	V
V_{OH2}	Pch ON voltage of D_{OUT}	I_{OH}=–50µA, V_{DD}=3.9V	3.4	3.7		V
I_{DD}	Supply current	V_{DD}=3.9V, V-=0V		3.0	6.0	µA
Istandby	Standby current	V_{DD}=2.0V		0.3	0.6	µA

*) Please refer to Test Circuit unless otherwise specified.

• **RN5VM112C**

Topt=25°C

Symbol	Item	Conditions	MIN.	TYP.	MAX.	Unit
V_{DD1}	Operating input voltage	Voltage defined as V_{DD}–V_{SS}	1.5		10	V
Vst	Minimum operating voltage for 0V charging	Voltage defined as V_{DD}–V-, V_{DD}–Vss=0V			1.2	V
V_{DET1}	Over-charge threshold voltage	Detect rising edge of supply voltage	4.30	4.35	4.40	V
V_{HYS1}	Over-charge threshold hysteresis range		0.15	0.20	0.25	V
t_{VDET1}	Output delay time of over-charge	C_3=0.01µF, V_{DD}=3.6V→ 4.4V	55	80	105	ms
V_{DET2}	Over-discharge threshold voltage	Detect falling edge of supply voltage	2.437	2.500	2.563	V
t_{VDET2}	Output delay time of over-discharge	V_{DD}=3.6V→ 2.4V	7	10	13	ms
V_{DET3}	Excess current threshold voltage	Detect rising edge of "V-" pin voltage	0.17	0.20	0.23	V
t_{VDET3}	Output delay time of excess current	V_{DD}=3.0V	9	13	17	ms
Vshort	Short detection voltage	V_{DD}=3.0V	V_{DD}–1.1	V_{DD}–0.8	V_{DD}–0.5	V
tshort	Output delay time of short detection	V_{DD}=3.0V		5	50	µs
Rshort	Reset resistance for excess current protection	V_{DD}=3.6V, V-=1.0V	50	100	150	kΩ
V_{OL1}	Nch ON voltage of C_{OUT}	I_{OL}=50µA, V_{DD}=4.4V		0.2	0.5	V
V_{OH1}	Pch ON voltage of C_{OUT}	I_{OH}=–50µA, V_{DD}=3.9V	3.4	3.8		V
V_{OL2}	Nch ON voltage of D_{OUT}	I_{OL}=50µA, V_{DD}=2.4V		0.2	0.5	V
V_{OH2}	Pch ON voltage of D_{OUT}	I_{OH}=–50µA, V_{DD}=3.9V	3.4	3.7		V
I_{DD}	Supply current	V_{DD}=3.9V, V-=0V		3.0	6.0	µA
Istandby	Standby current	V_{DD}=2.0V		0.3	0.6	µA

*) Please refer to Test Circuit unless otherwise specified.

• **RN5VM111D**

Topt=25°C

Symbol	Item	Conditions	MIN.	TYP.	MAX.	Unit
V_{DD1}	Operating input voltage	Voltage defined as V_{DD}–V_{SS}	1.5		10	V
Vst	Minimum operating voltage for 0V charging	Voltage defined as V_{DD}–V-, V_{DD}–Vss=0V			1.2	V
V_{DET1}	Over-charge threshold voltage	Detect rising edge of supply voltage	4.20	4.25	4.30	V
V_{HYS1}	Over-charge threshold hysteresis range		0.15	0.20	0.25	V
t_{VDET1}	Output delay time of over-charge	C_3=0.01µF, V_{DD}=3.6V→ 4.3V	50	75	100	ms
V_{DET2}	Over-discharge threshold voltage	Detect falling edge of supply voltage	2.437	2.500	2.563	V
t_{VDET2}	Output delay time of over-discharge	V_{DD}=3.6V→ 2.4V	7	10	13	ms
V_{DET3}	Excess current threshold voltage	Detect rising edge of "V-" pin voltage	0.17	0.20	0.23	V
t_{VDET3}	Output delay time of excess current	V_{DD}=3.0V	9	13	17	ms
Vshort	Short detection voltage	V_{DD}=3.0V	V_{DD}–1.1	V_{DD}–0.8	V_{DD}–0.5	V
tshort	Output delay time of short detection	V_{DD}=3.0V		5	50	µs
Rshort	Reset resistance for excess current protection	V_{DD}=3.6V, V-=1.0V	50	100	150	kΩ
V_{OL1}	Nch ON voltage of C_{OUT}	I_{OL}=50µA, V_{DD}=4.4V		0.2	0.5	V
V_{OH1}	Pch ON voltage of C_{OUT}	I_{OH}=–50µA, V_{DD}=3.9V	3.4	3.8		V
V_{OL2}	Nch ON voltage of D_{OUT}	I_{OL}=50µA, V_{DD}=2.4V		0.2	0.5	V
V_{OH2}	Pch ON voltage of D_{OUT}	I_{OH}=–50µA, V_{DD}=3.9V	3.4	3.7		V
I_{DD}	Supply current	V_{DD}=3.9V, V-=0V		3.0	6.0	µA
Istandby	Standby current	V_{DD}=2.0V		0.3	0.6	µA

*) Please refer to Test Circuit unless otherwise specified.

• **RN5VM112D**

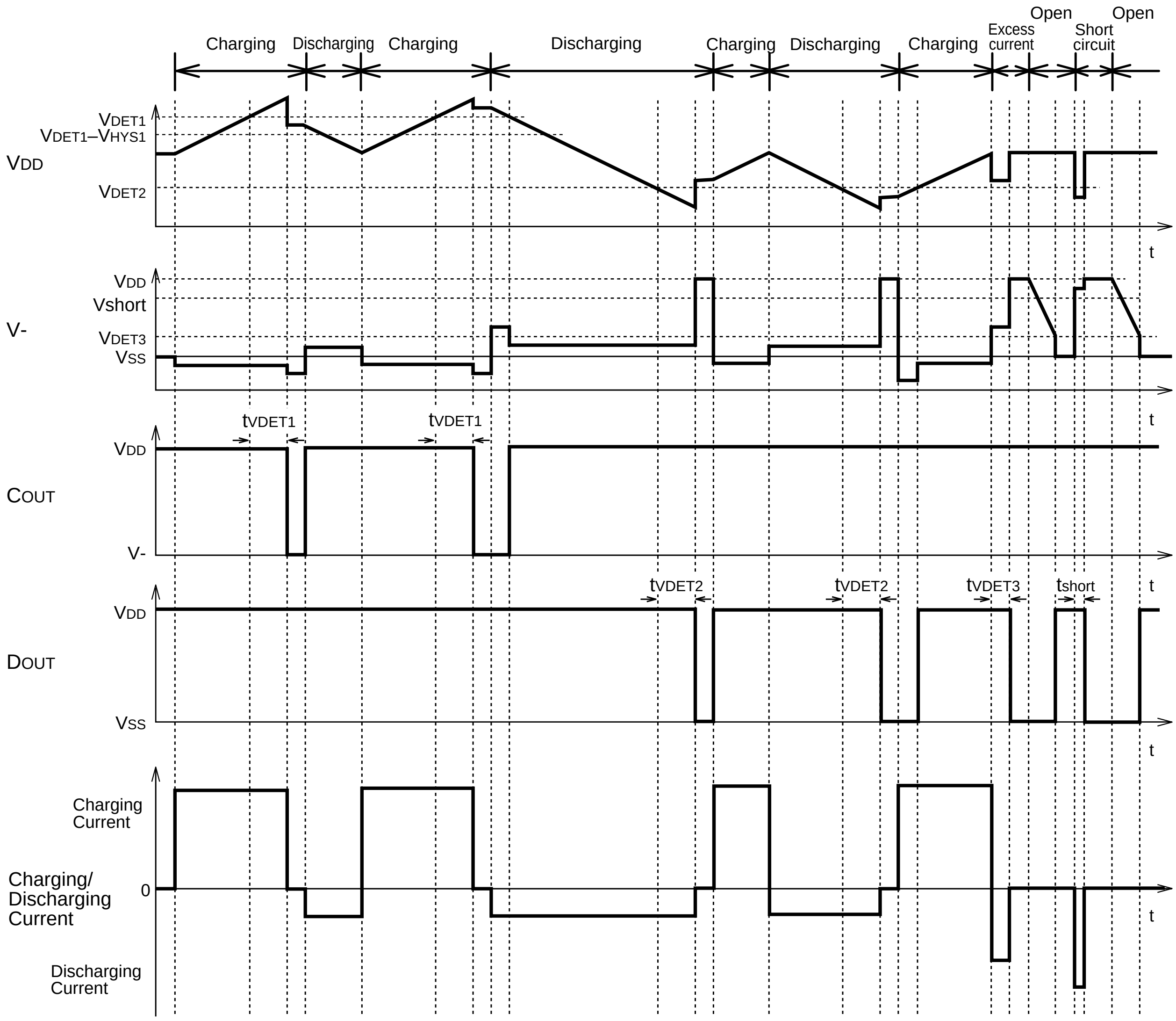
Topt=25°C

Symbol	Item	Conditions	MIN.	TYP.	MAX.	Unit
V_{DD1}	Operating input voltage	Voltage defined as V_{DD}–V_{SS}	1.5		10	V
Vst	Minimum operating voltage for 0V charging	Voltage defined as V_{DD}–V-, V_{DD}–Vss=0V			1.2	V
V_{DET1}	Over-charge threshold voltage	Detect rising edge of supply voltage	4.30	4.35	4.40	V
V_{HYS1}	Over-charge threshold hysteresis range		0.15	0.20	0.25	V
t_{VDET1}	Output delay time of over-charge	C_3=0.01µF, V_{DD}=3.6V→ 4.4V	55	80	105	ms
V_{DET2}	Over-discharge threshold voltage	Detect falling edge of supply voltage	2.437	2.500	2.563	V
t_{VDET2}	Output delay time of over-discharge	V_{DD}=3.6V→ 2.4V	7	10	13	ms
V_{DET3}	Excess current threshold voltage	Detect rising edge of "V-" pin voltage	0.17	0.20	0.23	V
t_{VDET3}	Output delay time of excess current	V_{DD}=3.0V	9	13	17	ms
Vshort	Short detection voltage	V_{DD}=3.0V	V_{DD}–1.1	V_{DD}–0.8	V_{DD}–0.5	V
tshort	Output delay time of short detection	V_{DD}=3.0V		5	50	µs
Rshort	Reset resistance for excess current protection	V_{DD}=3.6V, V-=1.0V	50	100	150	kΩ
V_{OL1}	Nch ON voltage of COUT	I_{OL}=50µA, V_{DD}=4.4V		0.2	0.5	V
V_{OH1}	Pch ON voltage of COUT	I_{OH}=–50µA, V_{DD}=3.9V	3.4	3.8		V
V_{OL2}	Nch ON voltage of DOUT	I_{OL}=50µA, V_{DD}=2.4V		0.2	0.5	V
V_{OH2}	Pch ON voltage of DOUT	I_{OH}=–50µA, V_{DD}=3.9V	3.4	3.7		V
I_{DD}	Supply current	V_{DD}=3.9V, V-=0V		3.0	6.0	µA
Istandby	Standby current	V_{DD}=2.0V		0.3	0.6	µA

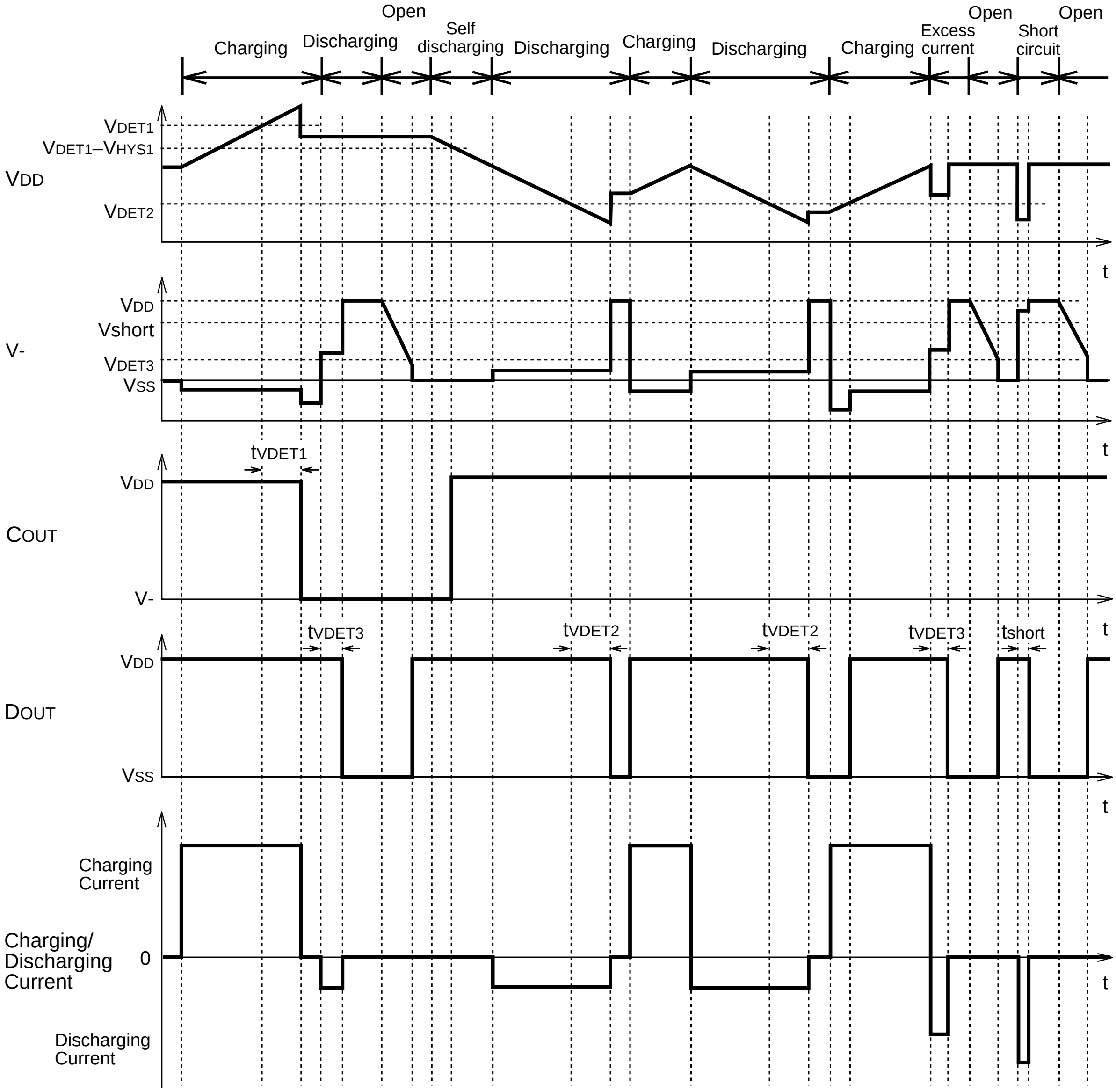
*) Please refer to Test Circuit unless otherwise specified.

TIMING DIAGRAM

• RN5VM1××C



• **RN5VM1××D**


Charging
Discharging
Open
Self discharging
Discharging
Charging
Discharging
Charging
Open
Excess current
Short circuit
Open
VDET1
VDET1–VHYS1
VDD
VDET2
t
VDD
Vshort
V-
VDET3
VSS
t
tVDET1
VDD
COUT
V-
t
tVDET3
tVDET2
tVDET2
tVDET3
tshort
VDD
DOUT
VSS
t
Charging Current
Charging/ Discharging Current
0
t
Discharging Current

OPERATION

• VD1/Over-Charge Detector

· The VD1 monitors V_{DD} pin voltage. When the V_{DD} voltage crosses over-charge detector threshold V_{DET1} from a low value to a value higher than the V_{DET1}, the VD1 can sense over-charging and an external charge control Nch-MOS-FET turns to "OFF" with C_{OUT} pin being at "L".

· An output delay time for over-charge detection can be set by an external capacitor C_3 connecting the Vss pin and Ct pin. The external capacitor can make a delay time from a moment detecting over-charge to a time output a signal which enables charge control Nch-MOS-FET for turning to "OFF". Though the V_{DD} voltage would be going up to a higher level than V_{DET1} if it is within a time period of the output delay time, VD1 would not output a signal for turning "OFF" of charg control Nch-MOS-FET. The output delay time can be calculated as below:

$$t_{VDET1} = \frac{C_3 \times (V_{DD} - 0.7)}{0.48 \times 10^{-6}}$$

· A level shifter incorporated in a buffer driver for the C_{OUT} pin makes the "L" of C_{OUT} pin to the V- pin voltage and the "H" of C_{OUT} pin is set to V_{DD} voltage with CMOS buffer.

Reset conditions from overcharging of RN5VM1××C

· There can be two cases to reset the VD1 making the C_{OUT} pin level to "H" again after detecting over-charge. Resetting the VD1 makes the charging system ready for resumption of charging process.
The first case is in such condition that a time when the V_{DD} voltage is coming down to a level lower than "V_{DET1}–V_{HYS1}". While in the second case, disconnecting a charger from the battery pack can make the VD1 resetting when the V_{DD} level is within hysteresis width ($V_{DET1} - V_{HYS1} \leq V_{DD} < V_{DET1}$)

· After detecting over-charge with the V_{DD} voltage of higher than V_{DET1}, connecting system load to the battery pack makes load current allowable through parasitic diode of external charge control Nch-MOS-FET. The C_{OUT} level would be "H" when the V_{DD} level is coming down to a level below the V_{DET1} by continuous drawing of load current.

Reset conditions from overcharging of RN5VM1××D

· After detecting over-charge, the VD1 would not be released and C_{OUT} level would not switch to "H" again with the exception that a cell voltage reaches to a lower value than "V_{DET1}–V_{HYS1}" by self discharge of cell or else. After detecting over-charge, when the V_{DD} level stays at a value higher than "V_{DET1}–V_{HYS1}", to connect battery pack to a system load makes battery pack being disabled at for charging or discharging because of excess current detector operated being D_{OUT} "L".

• VD2/Over-Discharge Detector

· The VD2 monitors a V_{DD} pin voltage. When the V_{DD} voltage crosses the over-discharge detector threshold V_{DET2} from a high value to a value lower than the V_{DET2}, the VD2 can sense an over-discharging and the external discharge control Nch-MOS-FET turns to "OFF" with the D_{OUT} pin being at "L".

· Resetting the VD2 with the D_{OUT} pin level being "H" again after detecting over-discharge is only possible by connecting a charger to the battery pack. When the V_{DD} voltage stays under over-discharge detector threshold V_{DET2} charge current can flow through parasitic diode of external discharge control Nch-MOS-FET, then after the V_{DD} voltage comes up to a value larger than V_{DET2} discharging process would be advanced through "ON" state discharge control Nch-MOS-FET. Connecting a charger to the battery pack makes the D_{OUT} level being "H" instantaneously when the V_{DD} voltage is higher than V_{DET2}.

· When a cell voltage equals to zero, connecting charger to the battery pack makes the system allowable for charge with higher charge voltage than Vst, 1.2V Max.

· An output delay time for the over-discharge detection is fixed internally. Though the V_{DD} voltage would be going down to a lower level than V_{DET2} if it is within a time period of the output delay time, VD2 would not output a signal for turning "OFF" of discharge control Nch-MOS-FET.

· After detection of an over-discharge by VD2, supply current would be reduced to 0.3µA TYP. at V_{DD}=2.0V and into standby, only the charger detector is operating.

· The output type of D_{OUT} pin is CMOS having "H" level of V_{DD} and "L" level of Vss.

• VD3/Excess Current Detector, Short Circuit Protector

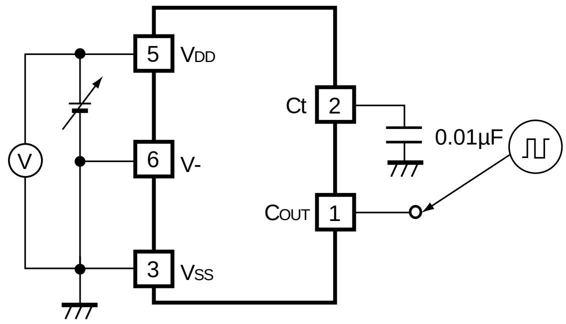
· Both of the excess current detector and short circuit protector can work when both control Nch-MOS-FETs are in "ON" state.
When the V- pin voltage is going up to a value between the short protection voltage Vshort and excess current threshold V_{DET3}, the excess current detector operates and further soaring of V- pin voltage higher than Vshort makes the short circuit protector enabled. As a result the external discharge control Nch-MOS-FET turns to "OFF" with the D_{OUT} pin being at "L".

· An output delay time for the excess current detector is internally fixed, 13ms TYP. at V_{DD}=3.0V. A quick recovery of V- pin level from a value between Vshort and V_{DET3} within the delay time keeps the discharge control FET staying "ON"state.
When the short circuit protector is enabled, the D_{OUT} would be "L" and its delay time would be 5µs TYP.

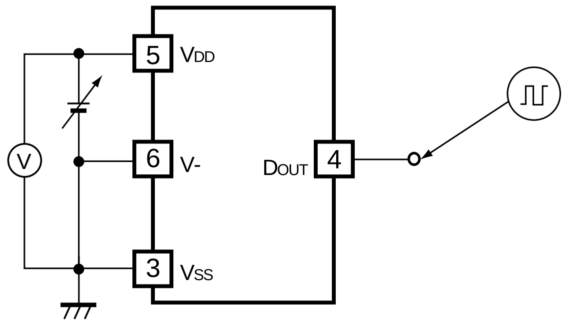
· The V- pin has a built-in pull down resistor, TYP.100kΩ, connected to the Vss pin.
After an excess current or short circuit protection is detected, removing a cause of excess current or external short circuit makes an external discharge control Nch-MOS-FET to an "ON" state automatically with the V- pin level being down to the Vss level through the built-in pull down resistor.

· When V_{DD} voltage is higher than V_{DET2} at a time when the excess current is detected the 5VM does not enter a standby mode, while V_{DD} voltage is lower than V_{DET2} the 5VM enters a standby mode.
After detecting short circuit the 5VM will not enter a standby mode.

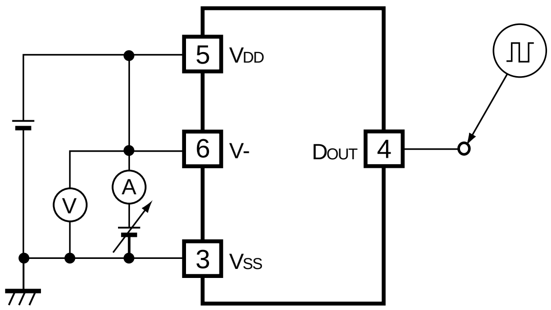
TEST CIRCUIT



Test Circuit 1



Test Circuit 2



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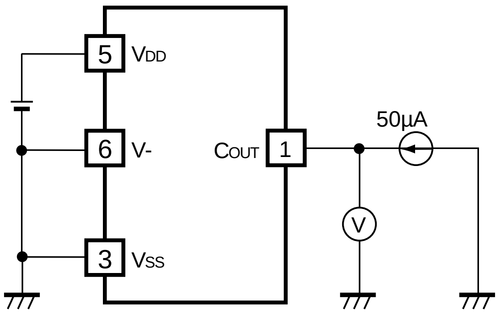

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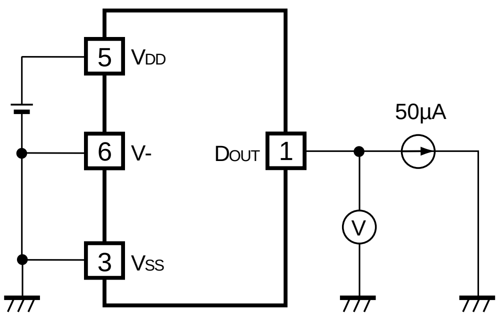

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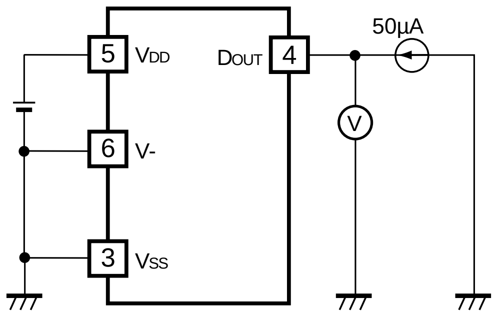

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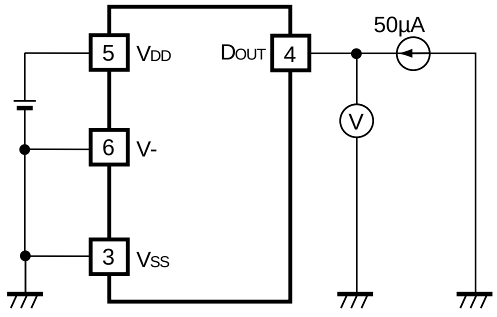
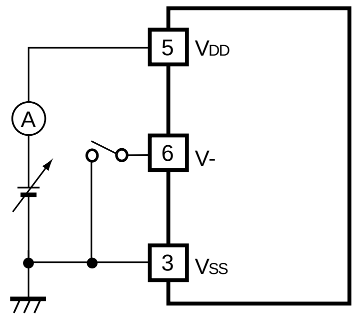
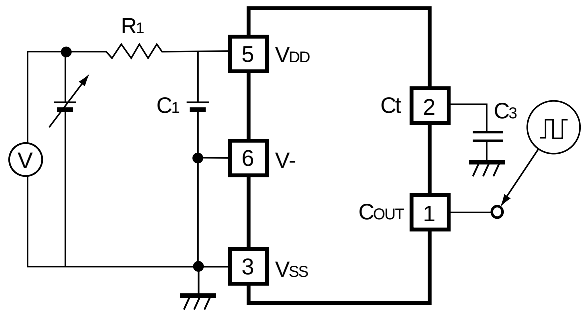


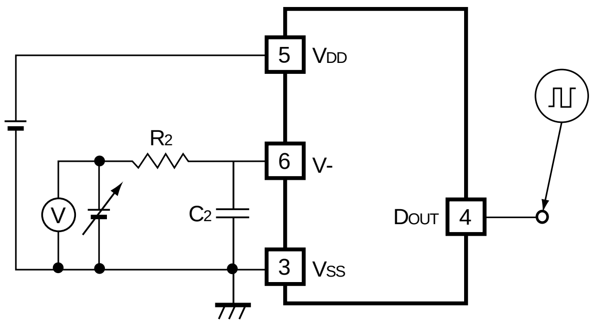
Test Circuit 7



Test Circuit 8



Test Circuit 9



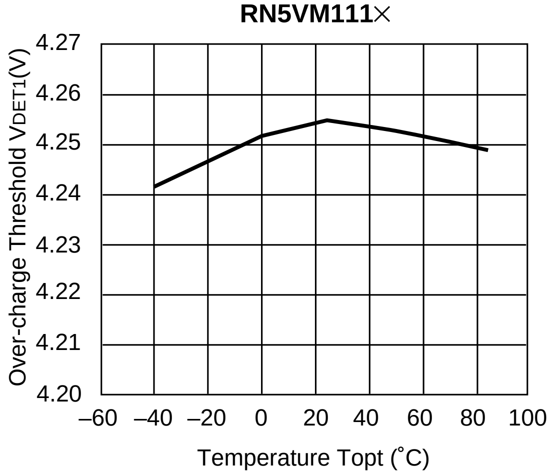
Test Circuit 10

The typical characteristics were obtained by use of these test circuits

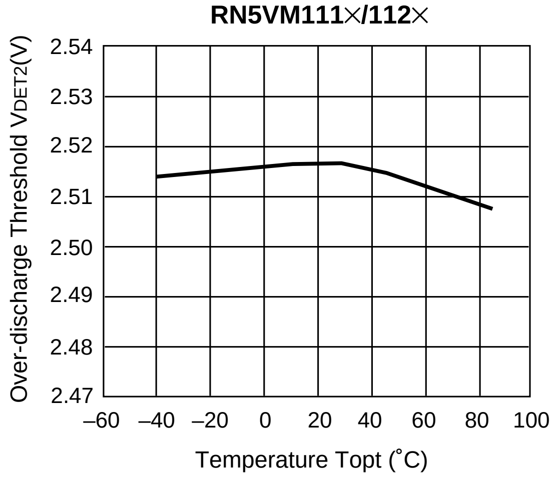
Test Circuit 1 : Typical characteristics 1) 5) 9) 16)
Test Circuit 2 : Typical characteristics 2) 6)
Test Circuit 3 : Typical characteristics 3) 4) 7) 8) 18)
Test Circuit 4 : Typical characteristics 12)
Test Circuit 5 : Typical characteristics 13)
Test Circuit 6 : Typical characteristics 14)
Test Circuit 7 : Typical characteristics 15)
Test Circuit 8 : Typical characteristics 10) 11)
Test Circuit 9 : Typical characteristics 20)
Test Circuit 10 : Typical characteristics 17) 19)

TYPICAL CHARACTERISTICS

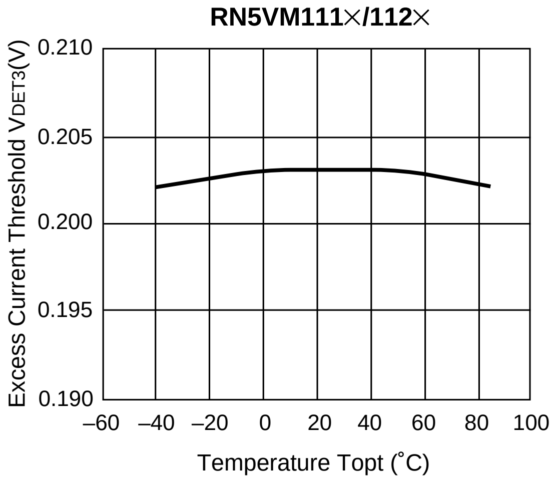
1) Over-charge threshold vs. Temperature



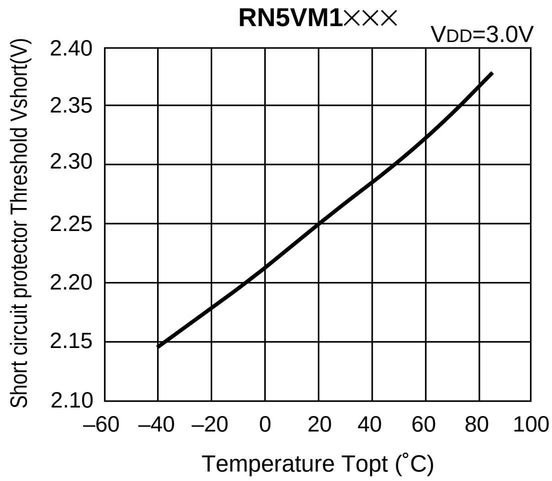
2) Over-discharge vs. Temperature



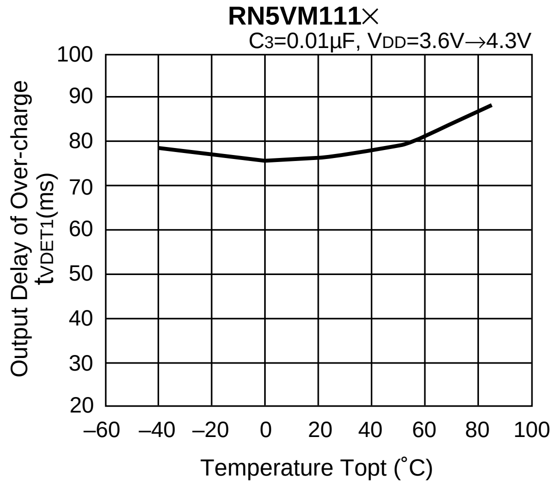
3) Excess Current Threshold vs. Temperature



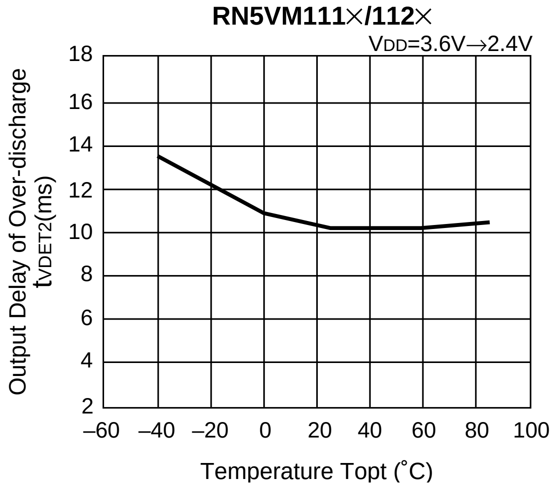
4) Short circuit protector Threshold vs. Temperature



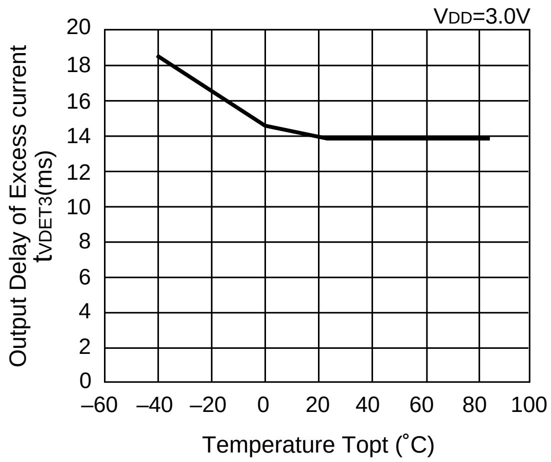
5) Output Delay of Over-charge vs. Temperature



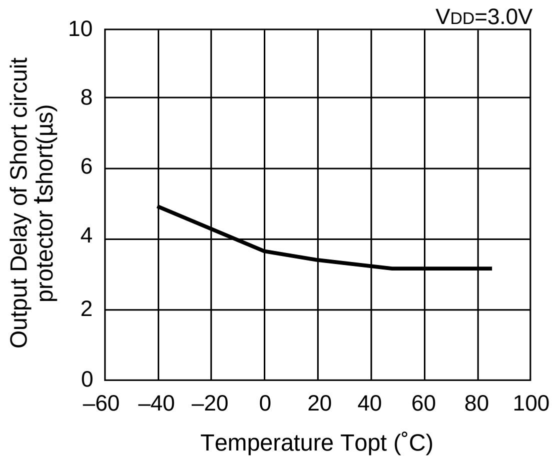
6) Output Delay of Over-discharge vs. Temperature



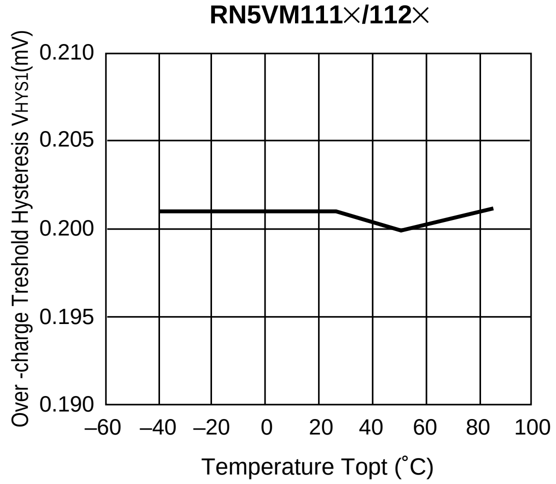
7) Output Delay of Excess current vs. Temperature



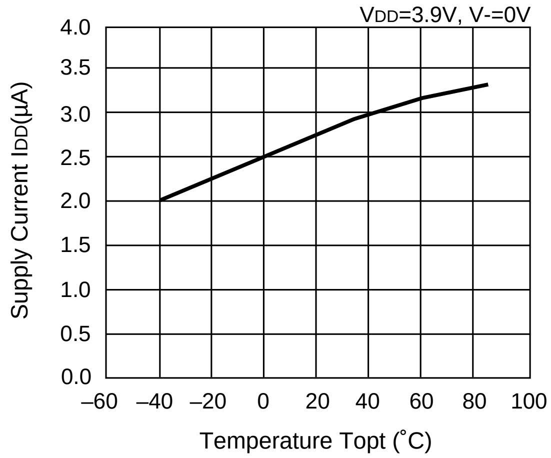
8) Output Delay of Short circuit protector vs. Temperature



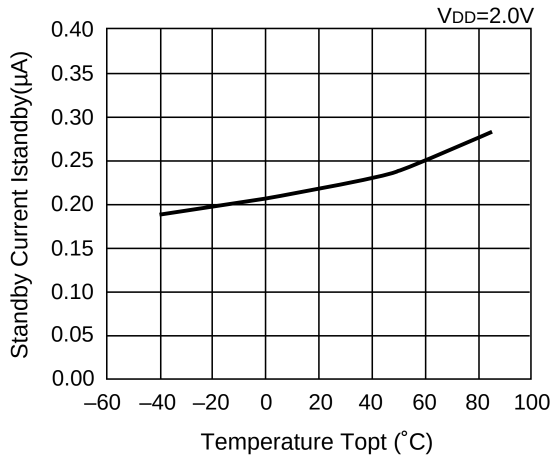
9) Over-charge Threshold Hysteresis vs.Temperature



10) Supply Current vs. Temperature



11) Standby Current vs. Temperature



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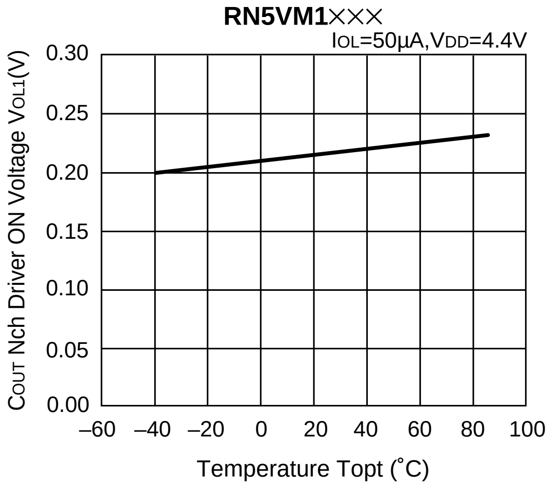
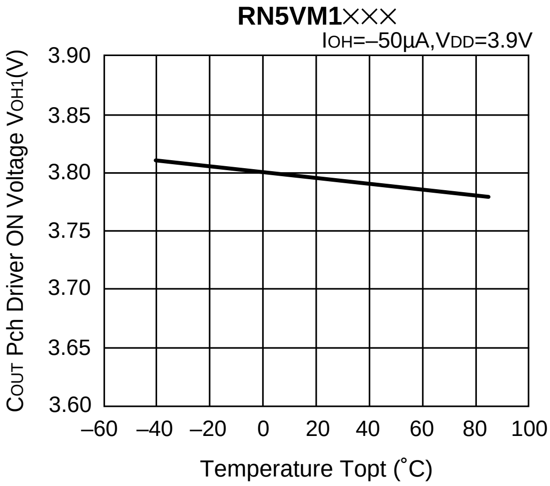
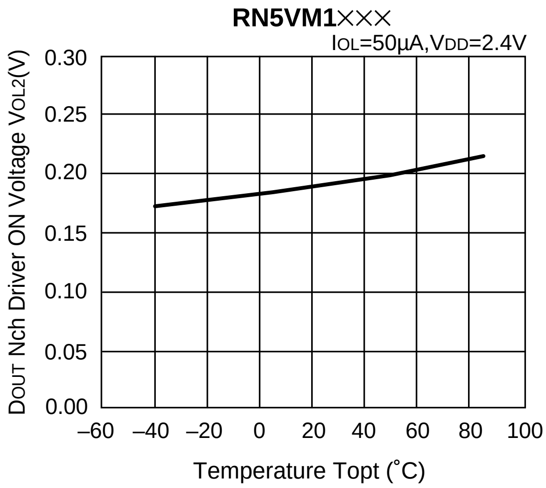
12) Cout Nch Driver On Voltage vs. Temperature



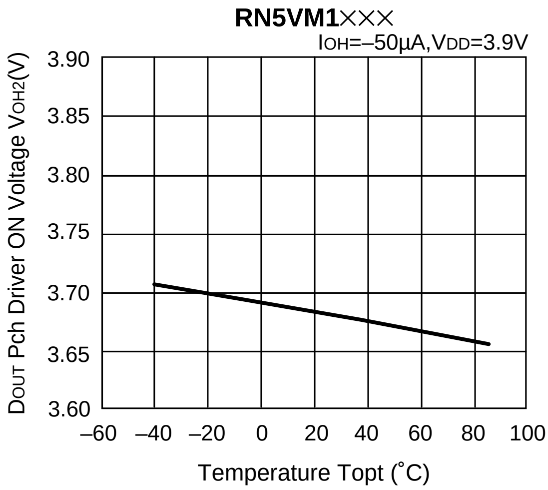
13) COUT Pch Driver ON Voltage vs. Temperature



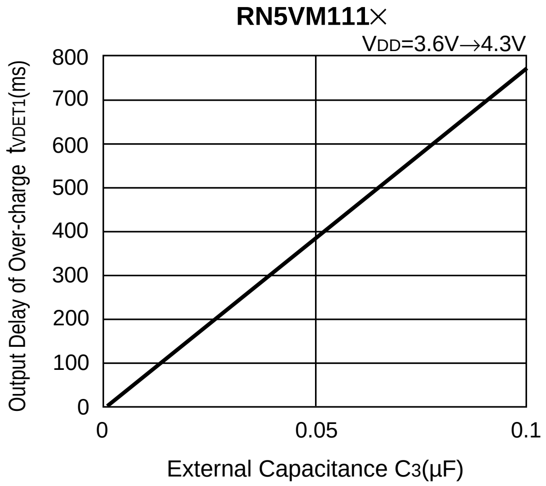
14) DOUT Nch Driver ON Voltage vs. Temperature



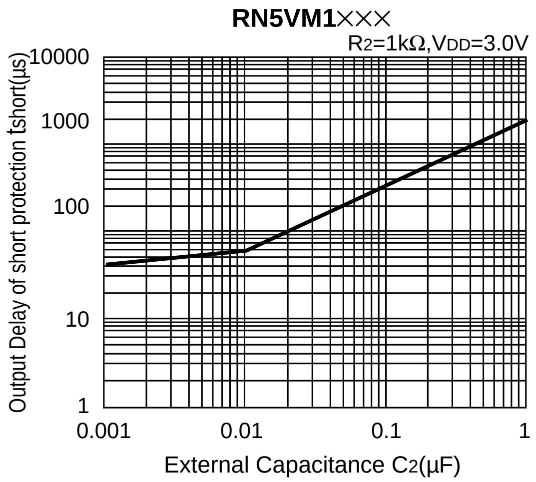
15) DOUT Pch Driver ON Voltage vs. Temperature



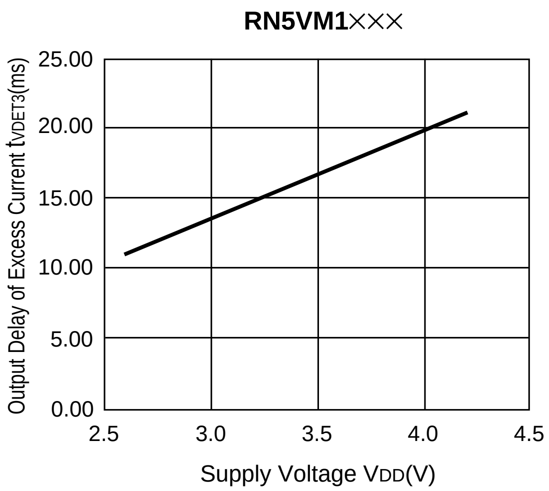
16) Output Delay of Over-charge vs. Capacitance C_3



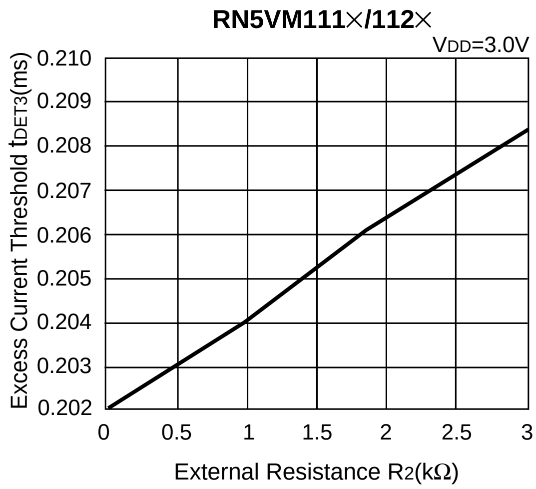
17) Output Delay of Short protection vs. Capacitance C_2



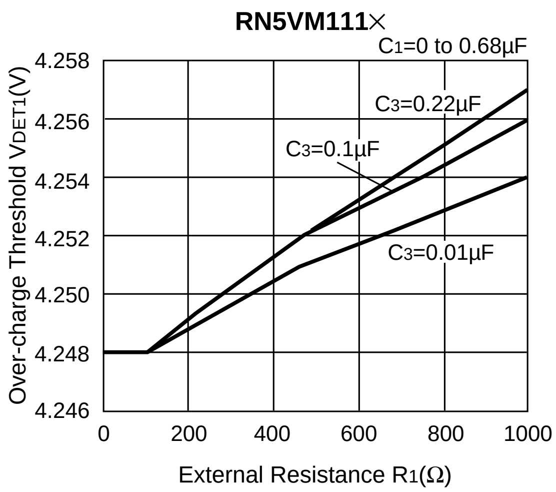
18) Output Delay of Excess Current vs. V_{DD}



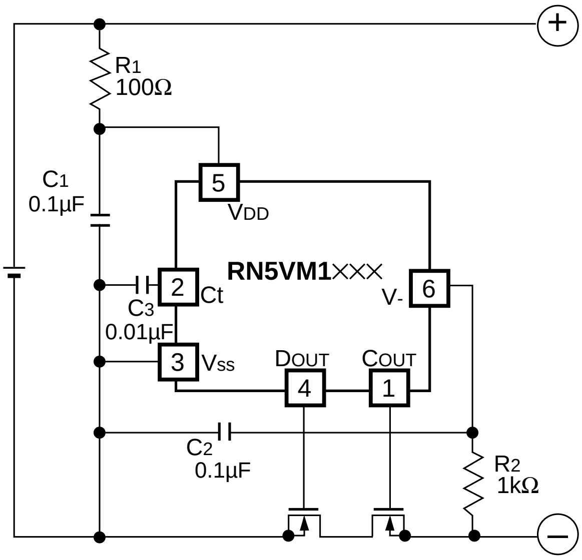
19) Excess Current Threshold vs. External resistance R_2



20) Over-charge Threshold vs. External Resistance R_1



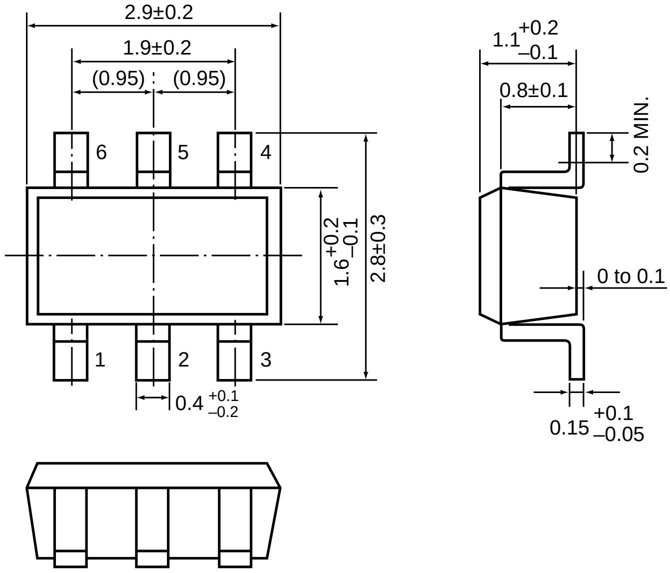
TYPICAL APPLICATION



NOTE ON EXTERNAL COMPONENTS
• R_1 and C_1 will stabilize a supply voltage to the RN5VM. A recommended R_1 value is less than 1kΩ. A larger value of R_1 leads higher detection voltage, makes some errors, because of shoot through current flowed in the RN5VM. • R_2 and C_2 will stabilize a V- pin voltage. The resetting from over-discharge with connecting charger possibly be disabled by larger value of R_2. Recommended value is less than 1kΩ. After an over-charge detection, a system may not draw load current when a battery pack is connected to it in the C version with R2 and C2 time constants at relatively larger settings. Recommended C_2 value is less than 1µF. • R_1 and R_2 can operate as a current limiter against setting cell reverse direction or for applying excess charging voltage to the 5VM. While smaller R_1 and R_2 may cause an over power dissipation rating of the RN5VM and a total of "R_1+R_2" should be more than 1kΩ. • The time constants $R_1 \times C_1$ or $R_2 \times C_2$ must have a relations as below: $R_1 \times C_1 \leq R_2 \times C_2$ Because in case that $R_1 \times C_1$, time constant for V_{DD} pin, would be larger than $R_2 \times C_2$, time constant for V- pin, then the RN5VM might be into a standby mode after detecting excess current or short circuit current.

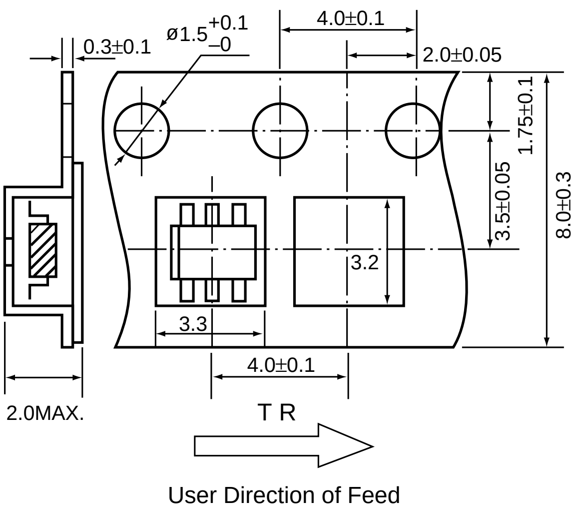
PACKAGE DIMENSION (Unit : mm)

· SOT-23-6



TAPING SPECIFICATION (Unit : mm)

· SOT-23-6



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