

## Description

The AP9101C is a protection IC developed for lithium-ion/lithium polymer rechargeable battery with a high-precision voltage, detection circuit.

The AP9101C provides a function to protect batteries by detecting overcharge voltage, overdischarge voltage, overcharge current, overdischarge current and other abnormalities and turning off the external MOSFET switch.

The AP9101C also has a built-in fixed time circuit (external capacitors are unnecessary); the protection circuitry can be comprised with fewer external components.

The AP9101C is available in standard packages of SOT25 and SOT26.

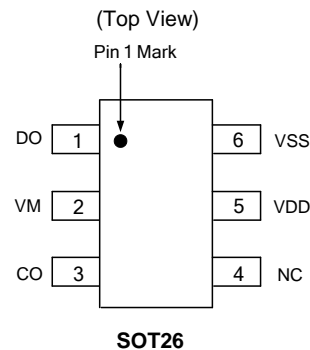
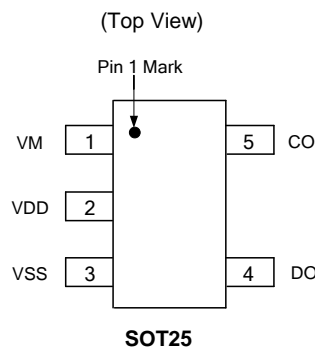
## Applications

- Lithium-Ion Battery Packs
- Lithium Polymer Battery Packs

## Features

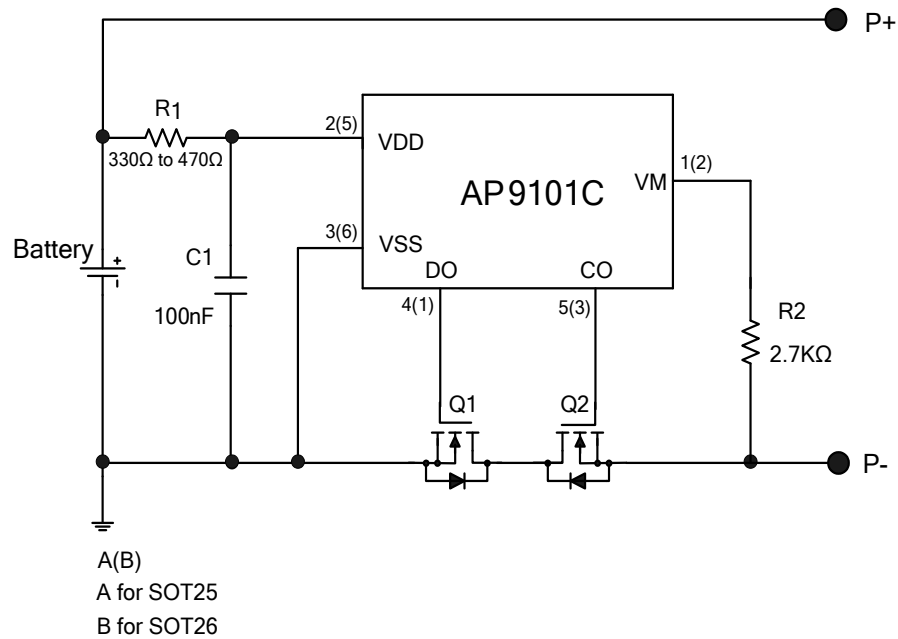
- Low Current Consumption (+25°C)
  - Operation Mode: 3.0µA (Typ)  $V_{DD} = 3.5V$
  - Power-Down Mode: 0.01µA (Typ)
- High-Accuracy Voltage Detection Circuit (+25°C)
  - Overcharge Detection Voltage: 3.5V to 4.5V (5mV Steps) Accuracy  $\pm 25mV$
  - Overcharge Hysteresis Voltage Range: 0.1V to 0.4V (50mV Steps) Accuracy  $\pm 50mV$
  - Overdischarge Detection Voltage: 2.0V to 3.4V (10mV Steps) Accuracy  $\pm 35mV$
  - Overdischarge Hysteresis Voltage Range: 0V to 0.7V (40mV Steps) Accuracy  $\pm 65mV$
  - Discharge Overcurrent Detection Voltage: 0.05V to 0.32V (10mV Steps) Accuracy  $\pm 15mV$
  - Short Current Detection Voltage: 0.45V to 0.7V (50mV Steps) Accuracy  $\pm 100mV$
  - Charge Overcurrent Detection Voltage: -0.2V to -0.05V (10mV Steps) Accuracy  $\pm 15mV$
  - Overcharger Detection Voltage: 8.0V (Fixed) Accuracy  $\pm 2V$
  - Overcharger Release Voltage: 7.3V (Fixed) Accuracy  $\pm 2V$
- Built-In Fixed Detection Delay Time (+25°C): Accuracy  $\pm 20\%$
- Power-Down Mode can be Selectable: Available/Unavailable
- 0V Battery Charge Function can be Selectable: Available/Unavailable
- Overcharge Protection Mode can be Selectable: Release/Latch
- High-Voltage CMOS Process: Up to 30V between  $V_{DD}$  and  $V_M$  Pins
- **Totally Lead-free & Fully RoHS Compliant (Note 1 & 2)**
- **Halogen and Antimony Free. "Green" Device (Note 3)**

## Pin Assignments



- Notes:
1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS) & 2011/65/EU (RoHS 2) compliant.
  2. See [http://www.diodes.com/quality/lead\\_free.html](http://www.diodes.com/quality/lead_free.html) for more information about Diodes Incorporated's definitions of Halogen- and Antimony-free, "Green" and Lead-free.
  3. Halogen- and Antimony-free "Green" products are defined as those which contain <900ppm bromine, <900ppm chlorine (<1500ppm total Br + Cl) and <1000ppm antimony compounds.

**Typical Applications Circuit** (Note 4)



Note: 4. R1 and C1 are used to stabilize the supply voltage of the AP9101C. The recommended range of R1 value is 330Ω to 470Ω and C1 value is 10nF to 1000nF, typical value is 100nF. R2 should be connected between P- to VM sense terminal to monitor the status of charger and the charge/discharge current. The R2 should be between 300Ω and 4kΩ, typical value is 2.7kΩ. R1 and R2 are also used as current limit resistors if the battery or charger is connected reversely. Polarity reversing may cause the power consumption of R1 and R2 to go over their power dissipation rating, therefore R1 and R2 values should be selected appropriately for the actual application. If R2 is more than 4kΩ resistor, CO may not cut off Q2 due to the voltage drop on R2.

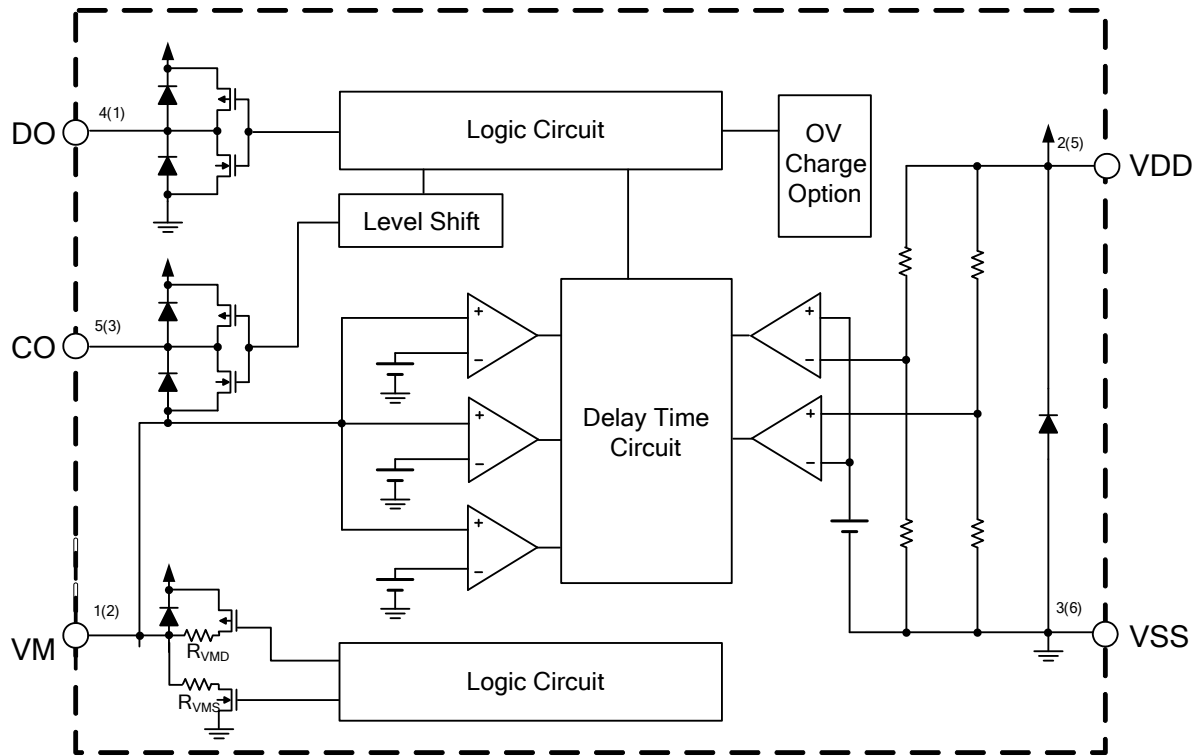
For power down mode, when first connecting AP9101C system board to the battery, it is necessary to use charger or to short P- to the battery negative polarity. Once the AP9101C is activated, the charger or connection can be removed, otherwise the battery cannot discharge current through system board.

The values selected should follow the recommended typical range mentioned above.

**Pin Descriptions**

Pin Number		Pin Name	Function
SOT25	SOT26		
1	2	V <sub>M</sub>	Charger Negative Input Pin
2	5	V <sub>DD</sub>	Positive Power Input Pin
3	6	V <sub>SS</sub>	Negative Power Input Pin
4	1	DO	FET Gate Control Pin for Discharge
5	3	CO	FET Gate Control Pin for charge
—	4	NC	No Connected

**Functional Block Diagram**



A(B)  
A for SOT25  
B for SOT26

### Absolute Maximum Ratings (Note 5)

Symbol	Parameter	Rating	Unit
$V_{DS}$	Supply Voltage (between $V_{DD}$ and $V_{SS}$ )	-0.3 to 12	V
$V_{DM}$	Charger Input Voltage (between $V_{DD}$ and $V_M$ )	-0.3 to 30	V
$V_{CO}$	CO Pin Output Voltage	$V_M-0.3$ to $V_{DD}+0.3$	V
$V_{DO}$	DO Pin Output Voltage	$V_{SS}-0.3$ to $V_{DD}+0.3$	V
$T_{OPR}$	Operating Temperature Range	-40 to +85	°C
$T_J$	Junction Temperature	+150	°C
$T_{STG}$	Storage Temperature Range	-65 to +150	°C
$T_{LEAD}$	Lead Temperature (Soldering, 10sec)	+300	°C
$P_D$	Power Dissipation (+25°C)	250	mW
—	ESD (Machine Model)	200	V
—	ESD (Human Body Model)	2,000	V

Note: 5. Stresses greater than those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under “Recommended Operating Conditions” is not implied. Exposure to “Absolute Maximum Ratings” for extended periods may affect device reliability.

### Recommended Operating Conditions

Symbol	Parameter	Min	Max	Unit
$V_{DS}$	Supply Voltage (between $V_{DD}$ and $V_{SS}$ )	1.5	5.5	V
$V_{DM}$	Charger Input Voltage (between $V_{DD}$ and $V_M$ )	-0.3	5.5	V
$T_A$	Operating Ambient Temperature	-40	+85	°C

## Electrical Characteristics

( $T_A = +25^\circ\text{C}$ ,  $V_{DD} = 3.5\text{V}$ ,  $V_{SS} = 0\text{V}$ ,  $R_1 = 330\Omega$ ,  $R_2 = 2.7\text{k}\Omega$ ,  $C_1 = 100\text{nF}$ , unless otherwise specified.)

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit	
$V_{CU}$	Overcharge Detection Voltage	—	$V_{CU}-0.025$	$V_{CU}$	$V_{CU}+0.025$	V	
$V_{CL}$	Overcharge Release Voltage	$V_{CL} \neq V_{CU}$	$V_{CL}-0.050$	$V_{CL}$	$V_{CL}+0.050$	V	
		$V_{CL} = V_{CU}$	$V_{CL}-0.025$	$V_{CL}$	$V_{CL}+0.025$	V	
$V_{DL}$	Overdischarge Detection Voltage	—	$V_{DL}-0.035$	$V_{DL}$	$V_{DL}+0.035$	V	
$V_{DU}$	Overdischarge Release Voltage	$V_{DU} \neq V_{DL}$	$V_{DU}-0.100$	$V_{DU}$	$V_{DU}+0.100$	V	
		$V_{DU} = V_{DL}$	$V_{DU}-0.035$	$V_{DU}$	$V_{DU}+0.035$	V	
$V_{DOC}$	Discharge Overcurrent Detection Voltage	—	$V_{DOC}-0.015$	$V_{DOC}$	$V_{DOC}+0.015$	V	
$V_{SHORT}$	Load Short-Circuiting Detection Voltage	—	$V_{SHORT}-0.10$	$V_{SHORT}$	$V_{SHORT}+0.10$	V	
$V_{COC}$	Charge Overcurrent Detection Voltage	—	$V_{COC}-0.015$	$V_{COC}$	$V_{COC}+0.015$	V	
$I_{CC}$	Current Consumption during Operation	$V_{DD} = 3.5\text{V}$ , $V_M = 0\text{V}$	1.5	3	4.5	$\mu\text{A}$	
$I_{STB}$	Current Consumption at Power-Down	$V_{DD}=1.8\text{V}$ , $V_M$ Pin Floating	Power-Down Mode Without Power-Down Mode (Auto-Wake-up)	—	—	0.1	$\mu\text{A}$
				—	—	5.5	
$R_{COH}$	CO Pin Resistance "H"	$V_{DD} = 3.5\text{V}$ , $V_{CO} = 3.0\text{V}$ , $V_M = 0\text{V}$	2	6	10	$\text{k}\Omega$	
$R_{COL}$	CO Pin Resistance "L"	$V_{DD} = 4.5\text{V}$ , $V_{CO} = 0.5\text{V}$ , $V_M = 0\text{V}$	2	4	10	$\text{k}\Omega$	
$R_{DOH}$	DO Pin Resistance "H"	$V_{DD} = 3.5\text{V}$ , $V_{DO} = 3.0\text{V}$ , $V_M = 0\text{V}$	2	5	10	$\text{k}\Omega$	
$R_{DOL}$	DO Pin Resistance "L"	$V_{DD} = 1.8\text{V}$ , $V_{DO} = 0.5\text{V}$ , $V_M = 0\text{V}$	2	5	10	$\text{k}\Omega$	
$R_{VMD}$	Resistance between $V_M$ Pin and $V_{DD}$ Pin	$V_{DD} = 1.8\text{V}$ , $V_M = 0\text{V}$	150	300	500	$\text{k}\Omega$	
$R_{VMS}$	Resistance between $V_M$ pin and $V_{SS}$ Pin	$V_{DD} = 3.5\text{V}$ , $V_M = 1.0\text{V}$	10	30	50	$\text{k}\Omega$	
$V_{0CHA}$	0V Battery Charge Starting Charger Voltage	0V Battery Charging "Available"	1.2	—	—	V	
$V_{0INH}$	0V Battery Charge Inhibition Battery Voltage	0V Battery Charging "Unavailable"	—	—	0.45	V	
$V_{OVCHG}$	Overvoltage Charger Detection Voltage	$V_{DD} = 3.5\text{V}$	6.0	8.0	10.0	V	
$V_{OVCHGR}$	Overvoltage Charger Release Voltage	$V_{DD} = 3.5\text{V}$	5.3	7.3	9.3	V	
$t_{CU}$	Overcharge Detection Delay Time	—	$t_{CU} \times 0.8$	$t_{CU}$	$t_{CU} \times 1.2$	ms	
$t_{DL}$	Overdischarge Detection Delay Time	—	$t_{DL} \times 0.7$	$t_{DL}$	$t_{DL} \times 1.3$	ms	
$t_{DOC}$	Discharge Overcurrent Detection Delay Time	—	$t_{DOC} \times 0.8$	$t_{DOC}$	$t_{DOC} \times 1.2$	ms	
$t_{SHORT}$	Load Short-Circuiting Detection Delay Time	—	$t_{SHORT} \times 0.8$	$t_{SHORT}$	$t_{SHORT} \times 1.2$	$\mu\text{s}$	
$t_{COC}$	Charge Overcurrent Detection Delay Time	—	$t_{COC} \times 0.8$	$t_{COC}$	$t_{COC} \times 1.2$	ms	

**Electrical Characteristics** (Continued)

 (T<sub>A</sub> = -40°C to +85°C, V<sub>DD</sub> = 3.5V, V<sub>SS</sub> = 0V, R<sub>1</sub> = 330Ω, R<sub>2</sub> = 2.7kΩ, C<sub>1</sub> = 100nF, unless otherwise specified.)

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit	
V <sub>CU</sub>	Overcharge Detection Voltage	—	V <sub>CU</sub> -0.060	V <sub>CU</sub>	V <sub>CU</sub> +0.040	V	
V <sub>CL</sub>	Overcharge Release Voltage	V <sub>CL</sub> ≠ V <sub>CU</sub>	V <sub>CL</sub> -0.080	V <sub>CL</sub>	V <sub>CL</sub> +0.065	V	
		V <sub>CL</sub> = V <sub>CU</sub>	V <sub>CL</sub> -0.060	V <sub>CL</sub>	V <sub>CL</sub> +0.040	V	
V <sub>DL</sub>	Overdischarge Detection Voltage	—	V <sub>DL</sub> -0.110	V <sub>DL</sub>	V <sub>DL</sub> +0.130	V	
V <sub>DU</sub>	Overdischarge Release Voltage	V <sub>DU</sub> ≠ V <sub>DL</sub>	V <sub>DU</sub> -0.150	V <sub>DU</sub>	V <sub>DU</sub> +0.190	V	
		V <sub>DU</sub> = V <sub>DL</sub>	V <sub>DU</sub> -0.110	V <sub>DU</sub>	V <sub>DU</sub> +0.130	V	
V <sub>DOC</sub>	Discharge Overcurrent Detection Voltage	—	V <sub>DOC</sub> -0.021	V <sub>DOC</sub>	V <sub>DOC</sub> +0.024	V	
V <sub>SHORT</sub>	Load Short-Circuiting Detection Voltage	—	V <sub>SHORT</sub> -0.34	V <sub>SHORT</sub>	V <sub>SHORT</sub> +0.34	V	
V <sub>COC</sub>	Charge Overcurrent Detection Voltage	—	V <sub>COC</sub> -0.040	V <sub>COC</sub>	V <sub>COC</sub> +0.040	V	
I <sub>CC</sub>	Current Consumption during Operation	V <sub>DD</sub> = 3.5V, V <sub>M</sub> = 0V	1.0	3.0	7.0	μA	
I <sub>STB</sub>	Current Consumption at Power-Down	V <sub>DD</sub> = 1.8V, V <sub>M</sub> Pin Floating	Power-Down Mode	—	—	1.0	μA
			Without Power-Down Mode (Auto-Wake-up)	—	—	8	
R <sub>COH</sub>	CO Pin Resistance "H"	V <sub>DD</sub> = 3.5V, V <sub>CO</sub> = 3.0V, V <sub>M</sub> = 0V	1.2	6	15	kΩ	
R <sub>COL</sub>	CO Pin Resistance "L"	V <sub>DD</sub> = 4.5V, V <sub>CO</sub> = 0.5V, V <sub>M</sub> = 0V	1.2	4	15	kΩ	
R <sub>DOH</sub>	DO Pin Resistance "H"	V <sub>DD</sub> = 3.5V, V <sub>DO</sub> = 3.0V, V <sub>M</sub> = 0V	1.2	5	15	kΩ	
R <sub>DOL</sub>	DO Pin Resistance "L"	V <sub>DD</sub> = 1.8V, V <sub>DO</sub> = 0.5V, V <sub>M</sub> = 0V	1.2	5	15	kΩ	
R <sub>VMD</sub>	Resistance between V <sub>M</sub> Pin and V <sub>DD</sub> Pin	V <sub>DD</sub> = 1.8V, V <sub>M</sub> = 0V	100	300	650	kΩ	
R <sub>VMS</sub>	Resistance between V <sub>M</sub> Pin and V <sub>SS</sub> Pin	V <sub>DD</sub> = 3.5V, V <sub>M</sub> = 1.0V	5	30	65	kΩ	
V <sub>0CHA</sub>	0V Battery Charge Starting Charger Voltage	0V Battery Charging "Available"	1.2	—	—	V	
V <sub>0INH</sub>	0V Battery Charge Inhibition Battery Voltage	0V Battery Charging "Unavailable"	—	—	0.3	V	
V <sub>OVCHG</sub>	Overvoltage Charger Detection Voltage	V <sub>DD</sub> = 3.5V	5.5	8.0	10.5	V	
V <sub>OVCHGR</sub>	Overvoltage Charger Release Voltage	V <sub>DD</sub> = 3.5V	5.0	7.3	9.5	V	
t <sub>CU</sub>	Overcharge Detection Delay Time	—	t <sub>CU</sub> ×0.6	t <sub>CU</sub>	t <sub>CU</sub> ×1.4	ms	
t <sub>DL</sub>	Overdischarge Detection Delay Time	—	t <sub>DL</sub> ×0.55	t <sub>DL</sub>	t <sub>DL</sub> ×1.45	ms	
t <sub>DOC</sub>	Discharge Overcurrent Detection Delay Time	—	t <sub>DOC</sub> ×0.6	t <sub>DOC</sub>	t <sub>DOC</sub> ×1.4	ms	
t <sub>SHORT</sub>	Load Short-Circuiting Detection Delay Time	—	t <sub>SHORT</sub> ×0.6	t <sub>SHORT</sub>	t <sub>SHORT</sub> ×1.4	μs	
t <sub>COC</sub>	Charge Overcurrent Detection Delay Time	—	t <sub>COC</sub> ×0.6	t <sub>COC</sub>	t <sub>COC</sub> ×1.4	ms	

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## Operation Description

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### Operation Mode

#### 1. Normal Status

The AP9101C monitors the battery voltage between the  $V_{DD}$  Pin and  $V_{SS}$  Pin as well as the voltage difference between the  $V_M$  Pin and  $V_{SS}$  Pin to control battery charging and discharging by CO and DO Pins. When the battery voltage is between overdischarge detection voltage ( $V_{DL}$ ) and overcharge detection voltage ( $V_{CU}$ ), as well as the  $V_M$  Pin voltage is between the charge overcurrent detection voltage ( $V_{COC}$ ) and discharge overcurrent detection voltage ( $V_{DOC}$ ), the CO and DO Pin of the AP9101C will output high level and turn on charge and discharge MOSFETs. In these conditions, the battery can charge and discharge freely. Also,  $R_{VMD}$  and  $R_{VMS}$  do not connect to  $V_{DD}$  and  $V_{SS}$  Pins in this status.

#### 2. Overcharge Status

If the battery voltage is more than  $V_{CU}$  during charging status for the overcharge detection delay time ( $t_{CU}$ ) or longer, the AP9101C turns off the charge MOSFET by setting low level to CO Pin to stop charging.  $R_{VMD}$  and  $R_{VMS}$  are not connected in overcharge status.

When  $V_M$  Pin voltage is lower than  $V_{DOC}$  and battery voltage falls below  $V_{CL}$ , the AP9101C will release from overcharge status.

When  $V_M$  Pin voltage is equal to or more than  $V_{DOC}$  and battery voltage falls below  $V_{CU}$ , the AP9101C will release from overcharge status.

#### 3. Overdischarge Status

If the battery voltage is less than  $V_{DL}$  during discharging status for the overdischarge detection delay time ( $t_{DL}$ ) or longer, the AP9101C turns off the discharge MOSFET by setting low level to DO Pin to stop discharging. In overdischarge status,  $R_{VMD}$  is connected to  $V_{DD}$  and  $V_M$  Pin voltage is pulled up to  $V_{DD}$  by  $R_{VMD}$ , but  $R_{VMS}$  is not connected. For stand-by version, the AP9101C recovers normal status from overdischarge status only by charging the battery through the charger.

When  $V_M$  Pin voltage to  $V_{SS}$  Pin voltage is less than typical -0.7V and the battery voltage rises over  $V_{DL}$ , the AP9101C will release from overdischarge status. If  $V_M$  Pin voltage to  $V_{SS}$  Pin voltage is higher than typical -0.7V, the AP9101C will release from overdischarge status until the battery voltage rises over  $V_{DU}$ .

For auto-wake-up version AP9101CA, the device recovers to normal status from overdischarge status if either of these two conditions are satisfied.

If charger is connected: the AP9101CA overdischarge status is released in the same way as described above in AP9101C Overdischarge Status section.

If no charger is connected: 1) the battery voltage reaches the overdischarge release voltage ( $V_{DU}$ ) or higher;  
2) maintains continuous time more than overdischarge release delay time  $t_{DLR}$ .

#### 4. Discharge Overcurrent and Short Current Status

When the battery is in discharge overcurrent status, if the voltage of the  $V_M$  Pin to  $V_{SS}$  Pin is equal or more than  $V_{DOC}$  to  $V_{SHORT}$ . for the overdischarge current detection delay time ( $t_{DOC}$ ) or longer, the AP9101C turns off the discharge MOSFET by setting low level to DO Pin to stop discharging.

When the battery is in short current status, if the voltage of the  $V_M$  Pin to  $V_{SS}$  Pin is equal to or more than  $V_{SHORT}$ , for the short current detection delay time or longer, the AP9101C turns off the discharge MOSFET by setting low level to DO pin to stop discharging.

In discharge overcurrent or short current status,  $R_{VMS}$  is connected to  $V_{SS}$  but  $R_{VMD}$  is not connected. The voltage of  $V_M$  Pin is almost equal to  $V_{DD}$  as long as the load is connected. When the load is disconnected, the voltage of  $V_M$  Pin will become almost equal to  $V_{SS}$  (due to  $R_{VMS}$  being connected) and then the AP9101C will release from discharge overcurrent or short current status.

#### 5. Charge Overcurrent Status

When the battery is in charge overcurrent status, if the voltage of the  $V_M$  Pin to  $V_{SS}$  Pin is equal to or less than  $V_{COC}$  for the charge overcurrent detection delay time ( $t_{COC}$ ) or longer, the AP9101C turns off the charge MOSFET by setting low level to CO Pin to stop charging.

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**Operation Description** (Continued)

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**6. 0V Battery Charging Function (Option)**

This function is available as an option and can be factory set internally. AP9101C has this function built in.

0V charging function permits charger to recharge the battery whose voltage is 0V due to self-discharge. If 0V charging function is not present, the device will prevent charger to recharge the battery whose voltage is 0V due to self-discharge. (If a device without 0V charging function is needed, please contact Diodes sales team)

**7. Overvoltage Charger Detection Circuit**

This function is used to monitor the charger voltage between the  $V_{DD}$  Pin and  $V_M$  Pin, and when this voltage exceeds overvoltage charger detection voltage (8.0V Typ), the AP9101C will set CO Pin low level to turn off charge MOSFET. When this voltage drops below overvoltage charger release voltage (7.3V Typ), CO Pin will be set to high level and turn on charge MOSFET. There are no delay times set for detection and release.

**8. Power-Down Mode or Auto-Wake-Up Function Option**

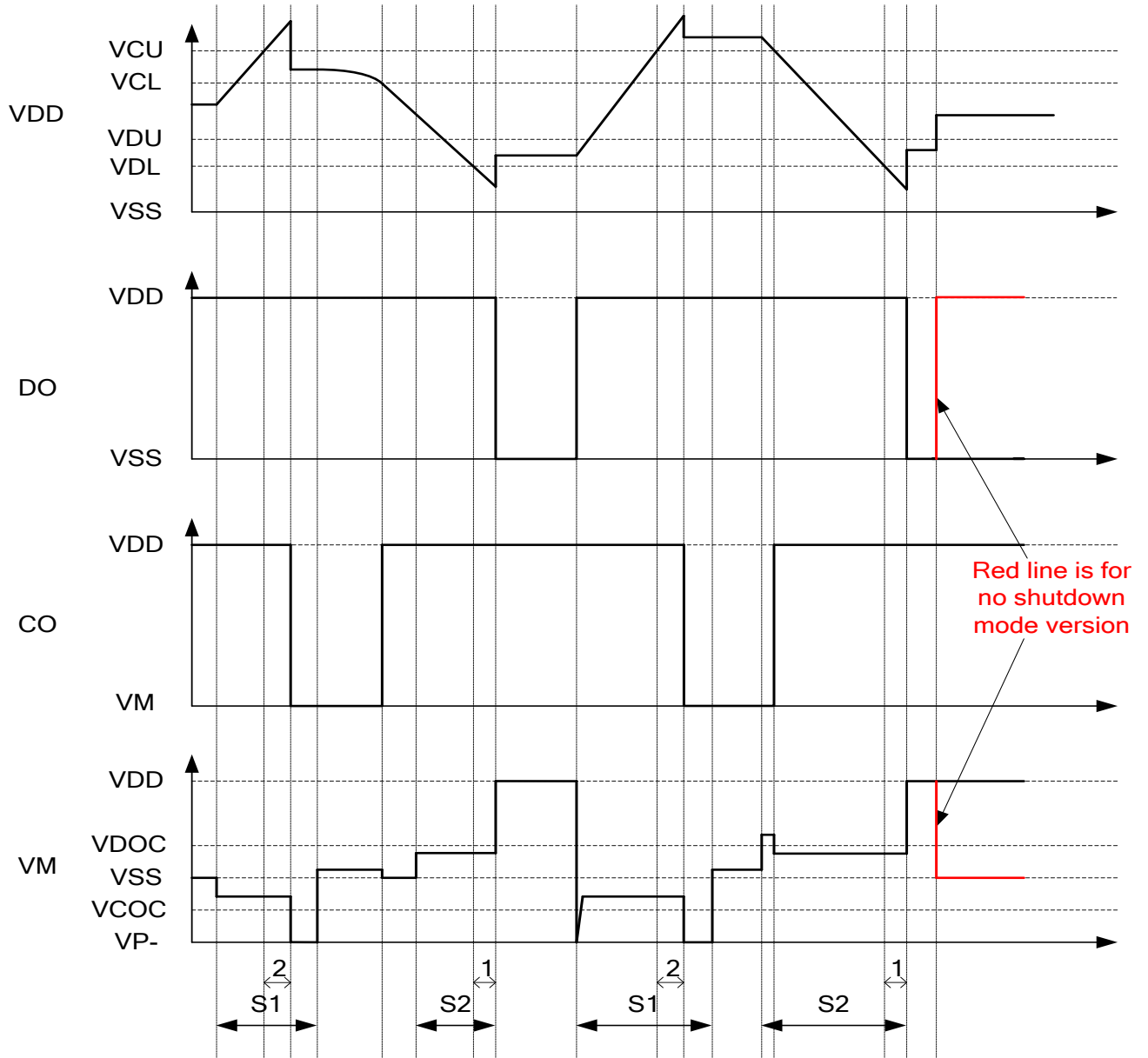
In device with power-down function, during power-down mode, device enters the overdischarge status. The IC enters sleep mode and the current consumption becomes very low, typically 0.1 $\mu$ A. To release from power-down status to the normal status, charger connection is required.

In device with auto-wakeup mode, the IC remains active in the overdischarge state. The IC is released into the normal state by the operation that increases the battery voltage more than overdischarge release voltage.



**Time Chart**

(1) Overcharge and Overdischarge Detection

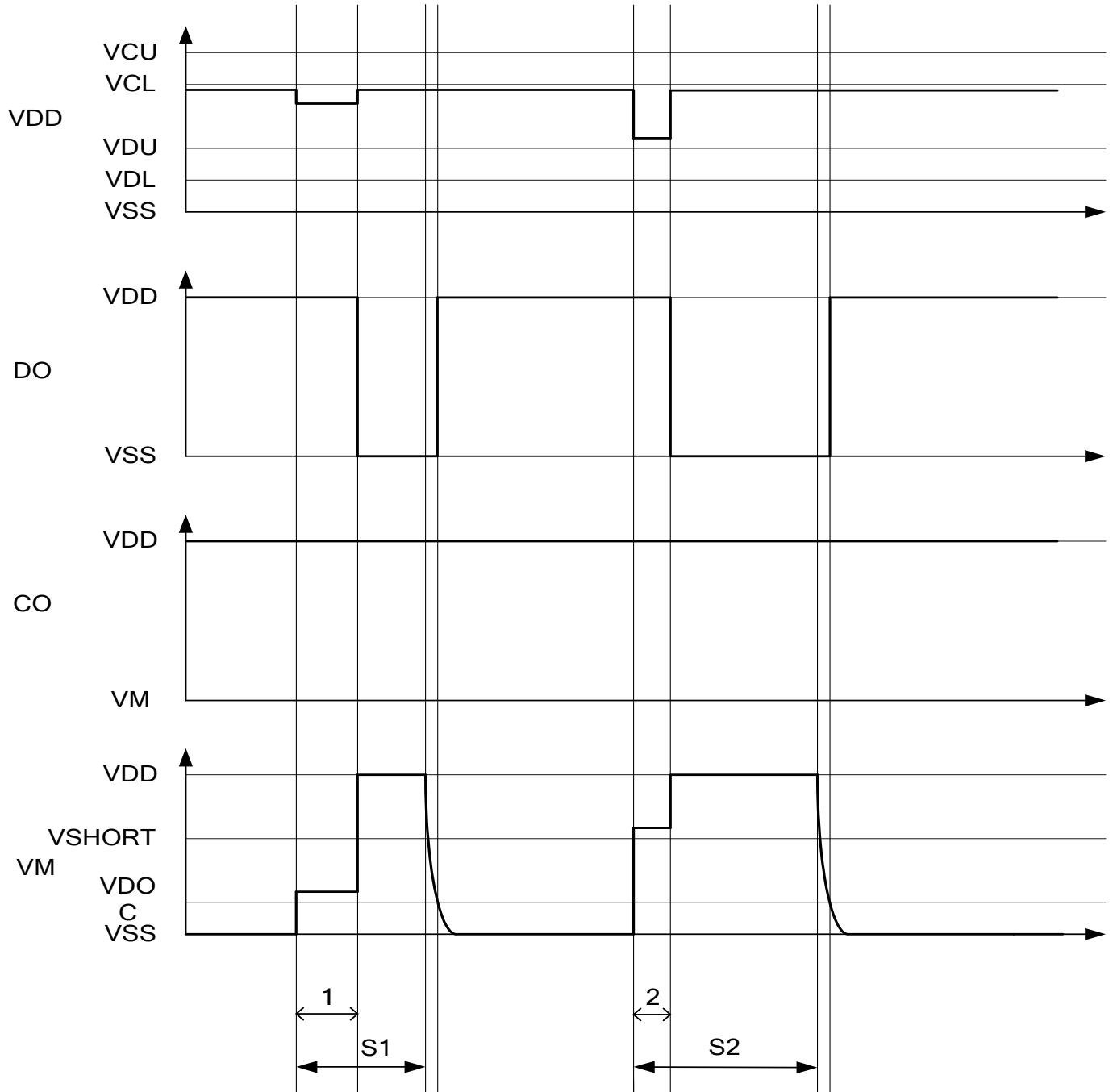


1:  $t_{DL}$   
2:  $t_{CU}$

S1: Charger connection  
S2: Load connection

**Time Chart** (Continued)

(2) Discharge Overcurrent Detection

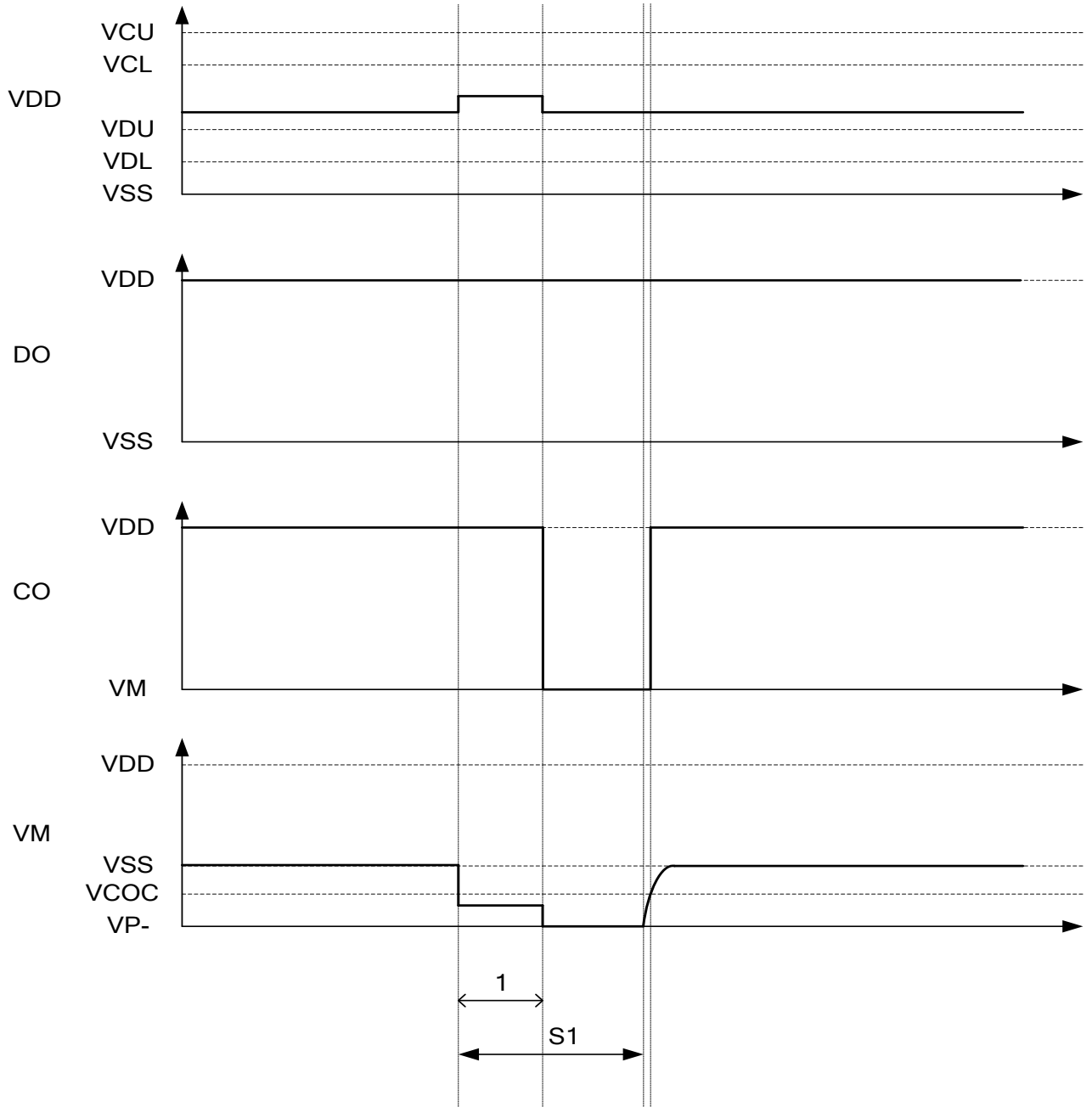


1:  $t_{DOC}$   
2:  $t_{SHORT}$

S1: Connect over current load  
S2: Connect short current load

**Time Chart** (Cont.)

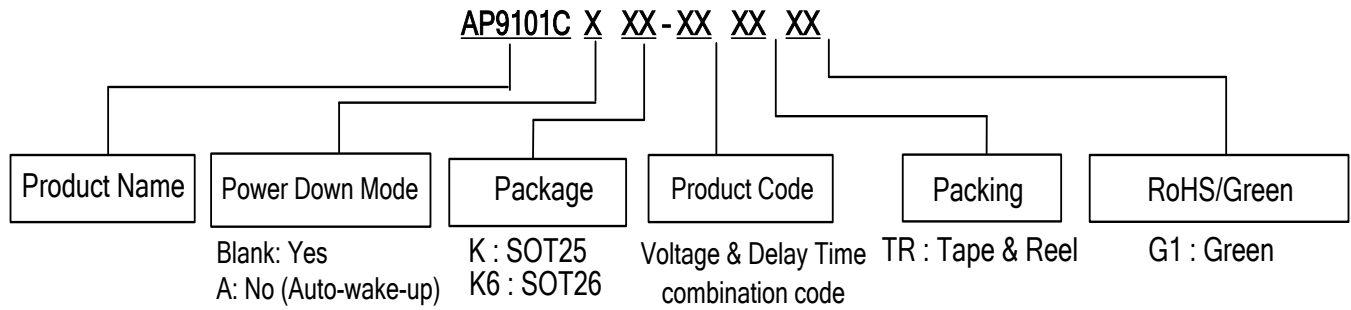
(3) Charge Overcurrent Detection



1:  $t_{coc}$

S1: Connect over current charger

## Ordering Information



### Voltage and Delay Time Combination

Part Number	Overcharge Detection Voltage VCU	Overcharge Release Voltage VCL	Over-discharge Detection Voltage VDL	Over-discharge Release Voltage VDU	Discharge Overcurrent Detection Voltage VDOC	Load Short Detection Voltage VSHORT	Charge Overcurrent Detection Voltage VCOC	Over Voltage Charger Detection Voltage VOVCHG	Over Voltage Charger Release Voltage VOVCHGR	Power-Down Function	Overcharge Protection Mode	Delay Time	0V Battery Charge Function
AP9101Cxxx-AATR1	4.375V	4.175V	2.500V	2.900V	0.150V	0.700V	-0.150V	8.0V	7.3V	Selectable	Auto Release	Option 1	Permission
AP9101Cxxx-ABTR1	4.425V	4.225V	2.500V	2.900V	0.150V	0.700V	-0.150V	8.0V	7.3V	Selectable	Auto Release	Option 1	Permission
AP9101Cxxx-ACTR1	4.375V	4.175V	2.500V	2.900V	0.095V	0.700V	-0.095V	8.0V	7.3V	Selectable	Auto Release	Option 1	Permission
AP9101Cxxx-ADTR1	4.375V	4.175V	2.500V	2.900V	0.120V	0.700V	-0.120V	8.0V	7.3V	Selectable	Auto Release	Option 1	Permission
AP9101Cxxx-AETR1	4.200V	4.100V	2.500V	3.000V	0.300V	0.550V	-0.100V	8.0V	7.3V	Selectable	Auto Release	Option 1	Permission
AP9101Cxxx-AFTR1	4.375V	4.175V	2.500V	2.900V	0.180V	0.700V	-0.180V	8.0V	7.3V	Selectable	Auto Release	Option 1	Permission
AP9101Cxxx-AGTR1	4.375V	4.175V	2.500V	2.900V	0.075V	0.700V	-0.075V	8.0V	7.3V	Selectable	Auto Release	Option 1	Permission
AP9101Cxxx-AHTR1	4.425V	4.225V	2.500V	2.900V	0.075V	0.700V	-0.075V	8.0V	7.3V	Selectable	Auto Release	Option 1	Permission
AP9101Cxxx-AITR1	4.500V	4.300V	2.400V	2.800V	0.150V	0.700V	-0.075V	8.0V	7.3V	Selectable	Auto Release	Option 1	Permission
AP9101Cxxx-AJTR1	4.375V	4.175V	2.400V	2.800V	0.125V	0.700V	-0.125V	8.0V	7.3V	Selectable	Auto Release	Option 1	Permission
AP9101Cxxx-AKTR1	4.250V	4.050V	2.400V	3.000V	0.150V	0.700V	-0.150V	8.0V	7.3V	Selectable	Auto Release	Option 1	Permission
AP9101Cxxx-ALTR1	4.275V	4.175V	2.300V	2.400V	0.180V	0.700V	-0.180V	8.0V	7.3V	Selectable	Auto Release	Option 1	Permission
AP9101Cxxx-AMTR1	4.375V	4.175V	2.300V	2.400V	0.180V	0.700V	-0.180V	8.0V	7.3V	Selectable	Auto Release	Option 1	Permission
AP9101Cxxx-ANTR1	4.225V	4.025V	3.200V	3.400V	0.060V	0.450V	-0.060V	8.0V	7.3V	Selectable	Auto Release	Option 1	Permission
AP9101Cxxx-AOTR1	4.425V	4.225V	2.500V	2.900V	0.064V	0.228V	-0.073V	8.0V	7.3V	Selectable	Auto Release	Option 1	Permission

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**Ordering Information** (Continued)
 

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**Delay Time Option Overview**

Delay Time Option	Overcharge Detection DelayTime (t <sub>cu</sub> )	Overdischarge Detection Delay Time (t <sub>dL</sub> )	Overdischarge Current Detection Delay Time (t <sub>doc</sub> )	Overcharge Current Detection Delay Time (t <sub>coc</sub> )	Load Short Circuiting Detection Delay Time (t <sub>SHORT</sub> )
1	1,000ms	115ms	10ms	10ms	320μs
2	125ms	32ms	8ms	8ms	160μs
3	1,000ms	20ms	12ms	10ms	320μs
4	1,000ms	42ms	10ms	10ms	320μs
5	1,000ms	115ms	10ms	10ms	160μs

**Marking Information** (Note 6)

Product	Package	Part Number	Marking ID	Packing Type
		Green	Green	
AP9101C	SOT25	AP9101CK-AATR1G1	GQA	Tape & Reel
		AP9101CK-ABTR1G1	G6U	Tape & Reel
		AP9101CK-ACTR1G1	GQJ	Tape & Reel
		AP9101CK-ADTR1G1	GQK	Tape & Reel
		AP9101CK-AETR1G1	GQD	Tape & Reel
		AP9101CK-AFTR1G1	GQL	Tape & Reel
		AP9101CK-AGTR1G1	GQM	Tape & Reel
		AP9101CK-AHTR1G1	GQN	Tape & Reel
		AP9101CK-AITR1G1	GQP	Tape & Reel
		AP9101CK-AJTR1G1	GQQ	Tape & Reel
		AP9101CK-AKTR1G1	GQG	Tape & Reel
		AP9101CK-ALTR1G1	GQR	Tape & Reel
		AP9101CK-AMTR1G1	GQS	Tape & Reel
		AP9101CK-ANTR1G1	GQT	Tape & Reel
		AP9101CK-AOTR1G1	GRT	Tape & Reel
		AP9101CAK-AATR1G1	GRA	Tape & Reel
		AP9101CAK-ABTR1G1	GSC	Tape & Reel
		AP9101CAK-ACTR1G1	GRJ	Tape & Reel
		AP9101CAK-ADTR1G1	GRK	Tape & Reel
		AP9101CAK-AETR1G1	GRD	Tape & Reel
		AP9101CAK-AFTR1G1	GRL	Tape & Reel
		AP9101CAK-AGTR1G1	GRM	Tape & Reel
		AP9101CAK-AHTR1G1	GRN	Tape & Reel
		AP9101CAK-AITR1G1	GRP	Tape & Reel
		AP9101CAK-AJTR1G1	GRQ	Tape & Reel
		AP9101CAK-AKTR1G1	GRG	Tape & Reel
		AP9101CAK-ALTR1G1	GRR	Tape & Reel
		AP9101CAK-AMTR1G1	GRS	Tape & Reel
		AP9101CAK-ANTR1G1	GST	Tape & Reel
		AP9101CAK-AOTR1G1	GTT	Tape & Reel

### Marking Information (Continued)

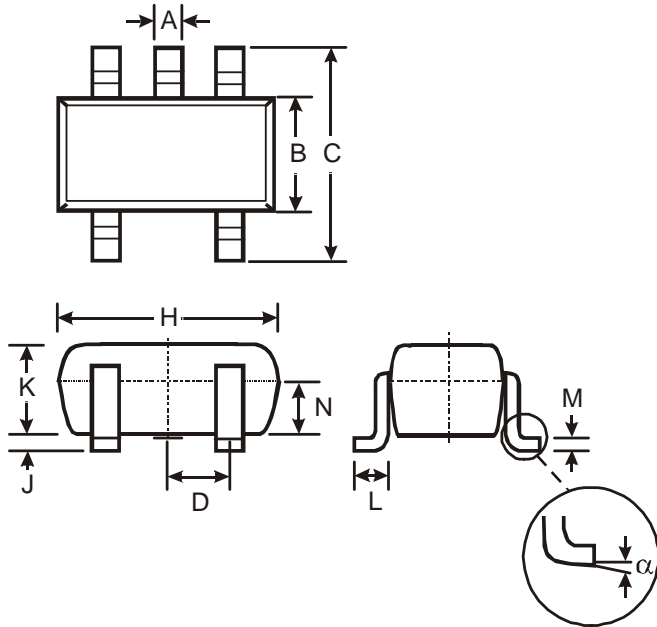
AP9101C	SOT26	AP9101CK6-AATR1	GQB	Tape & Reel
		AP9101CK6-ABTR1	GQC	Tape & Reel
		AP9101CK6-ACTR1	GSJ	Tape & Reel
		AP9101CK6-ADTR1	GSK	Tape & Reel
		AP9101CK6-AETR1	GQE	Tape & Reel
		AP9101CK6-AFTR1	GSL	Tape & Reel
		AP9101CK6-AGTR1	GSM	Tape & Reel
		AP9101CK6-AHTR1	GSN	Tape & Reel
		AP9101CK6-AITR1	GSP	Tape & Reel
		AP9101CK6-AJTR1	GSQ	Tape & Reel
		AP9101CK6-AKTR1	GQH	Tape & Reel
		AP9101CK6-ALTR1	GSR	Tape & Reel
		AP9101CK6-AMTR1	GSS	Tape & Reel
		AP9101CK6-ANTR1	GQU	Tape & Reel
		AP9101CK6-AOTR1	GRU	Tape & Reel
		AP9101CAK6-AATR1	GRB	Tape & Reel
		AP9101CAK6-ABTR1	GRC	Tape & Reel
		AP9101CAK6-ACTR1	GTJ	Tape & Reel
		AP9101CAK6-ADTR1	GTK	Tape & Reel
		AP9101CAK6-AETR1	GRE	Tape & Reel
		AP9101CAK6-AFTR1	GTL	Tape & Reel
		AP9101CAK6-AGTR1	GTM	Tape & Reel
		AP9101CAK6-AHTR1	GTN	Tape & Reel
		AP9101CAK6-AITR1	GTP	Tape & Reel
		AP9101CAK6-AJTR1	GTQ	Tape & Reel
		AP9101CAK6-AKTR1	GRH	Tape & Reel
		AP9101CAK6-ALTR1	GTR	Tape & Reel
		AP9101CAK6-AMTR1	GTS	Tape & Reel
		AP9101CAK6-ANTR1	GSU	Tape & Reel
		AP9101CAK6-AOTR1	GTU	Tape & Reel

Note: 6. Current voltage versions are built by delay time option 1. If any other voltage versions or delay time option products are needed, please contact with the local sale's office.

**Package Outline Dimensions**

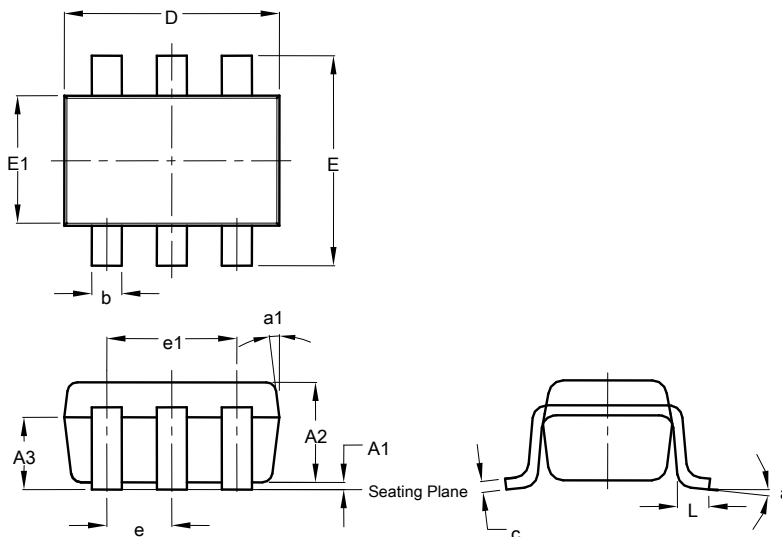
Please see AP02002 at <http://www.diodes.com/datasheets/ap02002.pdf> for the latest version.

**SOT25**



SOT25			
Dim	Min	Max	Typ
A	0.35	0.50	0.38
B	1.50	1.70	1.60
C	2.70	3.00	2.80
D	-	-	0.95
H	2.90	3.10	3.00
J	0.013	0.10	0.05
K	1.00	1.30	1.10
L	0.35	0.55	0.40
M	0.10	0.20	0.15
N	0.70	0.80	0.75
α	0°	8°	-
All Dimensions in mm			

**SOT26**



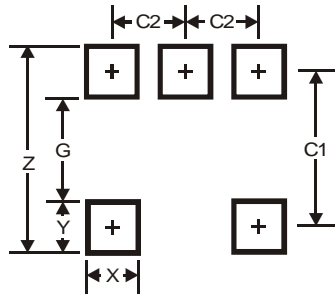
SOT26			
Dim	Min	Max	Typ
A1	0.013	0.10	0.05
A2	1.00	1.30	1.10
A3	0.70	0.80	0.75
b	0.35	0.50	0.38
c	0.10	0.20	0.15
D	2.90	3.10	3.00
e	-	-	0.95
e1	-	-	1.90
E	2.70	3.00	2.80
E1	1.50	1.70	1.60
L	0.35	0.55	0.40
a	-	-	8°
a1	-	-	7°
All Dimensions in mm			



**Suggested Pad Layout**

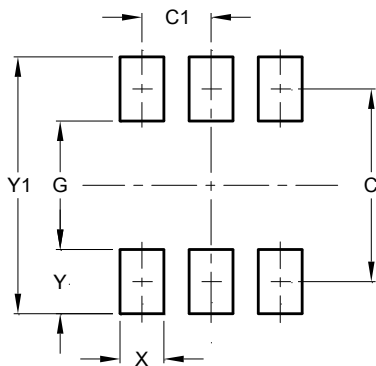
Please see AP02001 at <http://www.diodes.com/datasheets/ap02001.pdf> for the latest version.

**SOT25**



Dimensions	Value (in mm)
Z	3.20
G	1.60
X	0.55
Y	0.80
C1	2.40
C2	0.95

**SOT26**



Dimensions	Value (in mm)
C	2.40
C1	0.95
G	1.60
X	0.55
Y	0.80
Y1	3.20

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