SINGLE CHIP SOLUTION FOR 1-CELL Li+ BATTERY PACK

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 SOT-25 and SOT-26.

Applications

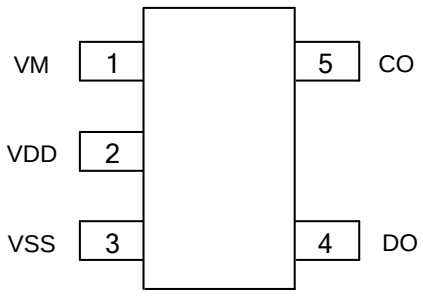
- Lithium-Ion Battery Packs
- Lithium Polymer Battery Packs

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 ±25mV
  - Overcharge Hysteresis Voltage Range: 0.1V to 0.4V (50mV Steps) Accuracy ±50mV
  - Overdischarge Detection Voltage: 2.0V to 3.4V (10mV Steps) Accuracy ±35mV
  - Overdischarge Hysteresis Voltage Range: 0V to 0.7V (40mV Steps) Accuracy ±65mV
  - Discharge Overcurrent Detection Voltage: 0.05V to 0.32V (10mV Steps) Accuracy ±15mV
  - Short Current Detection Voltage: 0.45V to 0.7V (50mV Steps) Accuracy ±100mV
  - Charge Overcurrent Detection Voltage: -0.2V to -0.05V (10mV Steps) Accuracy ±15mV
  - Overcharger Detection Voltage: 8.0V (Fixed) Accuracy ±2V
  - Overcharger Release Voltage: 7.3V (Fixed) Accuracy ±2V
- Built-in Fixed Detection Delay Time (+25°C): Accuracy ±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)**

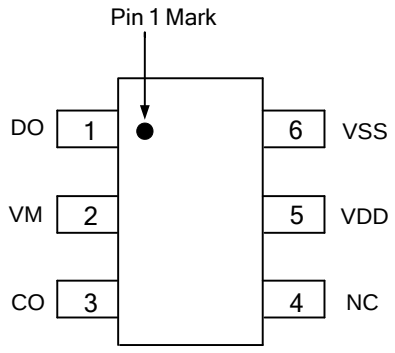
Pin Assignments

SOT-25



Top View

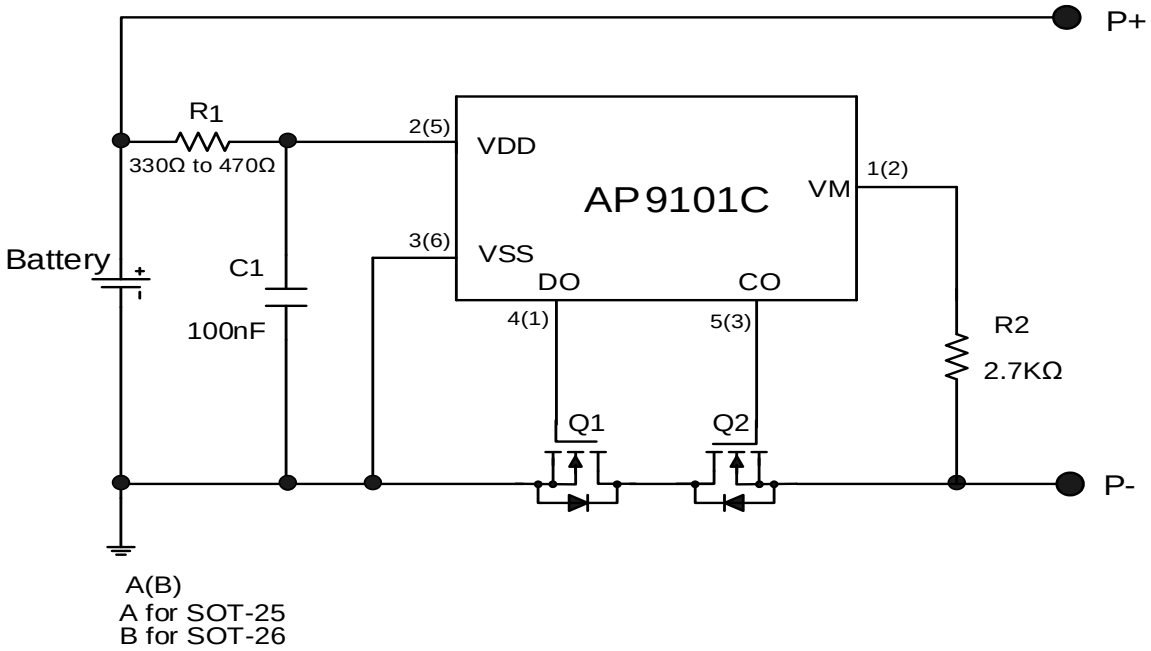
SOT-26



Top View

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 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 range of R1 we suggest is 330Ω to 470Ω. The range of C1 we suggest is 10nF to 1000nF, typical value is 100nF. R2 is used to connect P- to VM sense terminal to monitor the status of current and charger, the range of R2 we suggest is 300Ω to 4kΩ, typical value is 2.7kΩ. R1 and R2 are 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, so please select a suitable value for R1 and R2 in your current application. Using more than a 4kΩ resistor to R2 may cause CO to not cut off Q2 due to the voltage drop of R2.

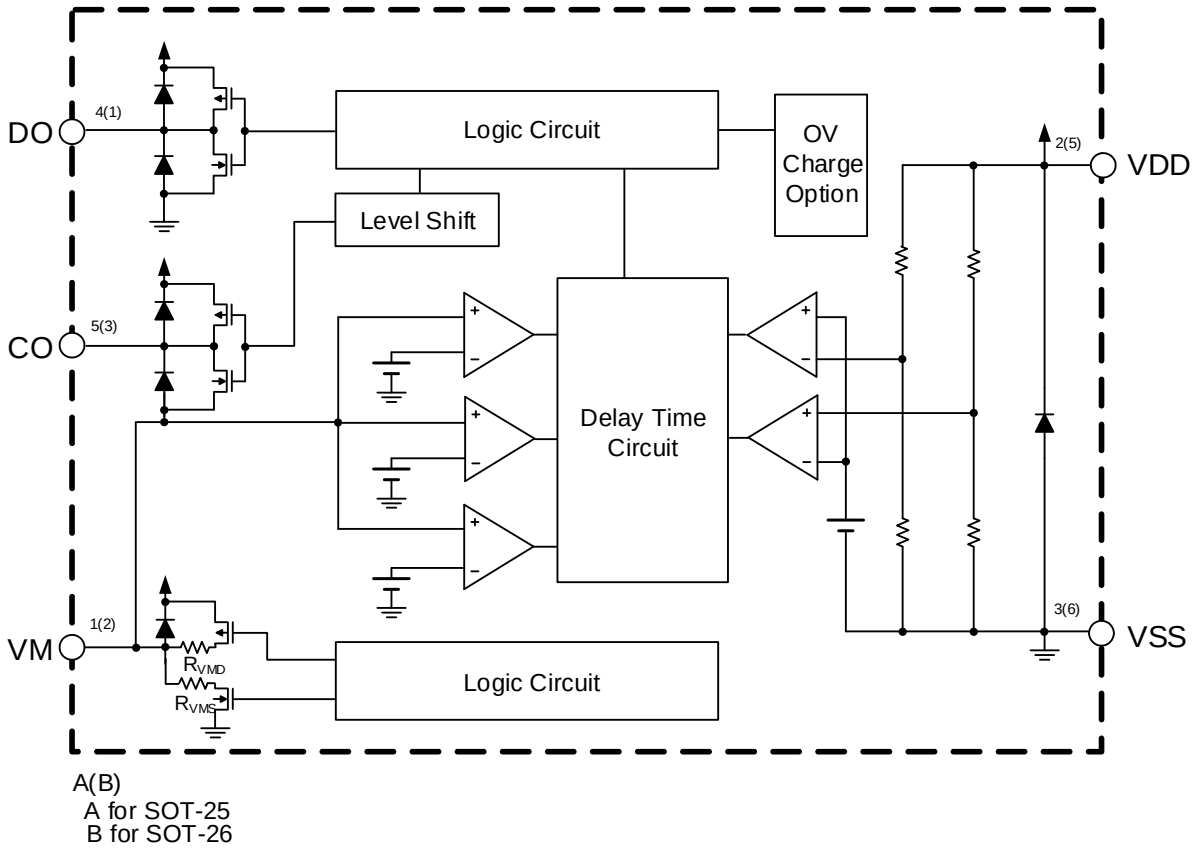
When first connecting AP9101C system board to the battery, it is necessary to use charger or to short P- to the battery negative polarity then remove it to activate the AP9101C, otherwise the battery can't discharge current through system board.

The above typical value may be changed without any notice. It has not been confirmed whether the operation is normal or not in circuits other than the above example of connection. In addition, the example of connection shown above and the typical value do not guarantee proper operation. Perform the actual application to set the suitable value through your complete evaluation.

Pin Descriptions

Pin Number		Pin Name	Function
SOT-25	SOT-26		
1	2	V_M	Charger negative input pin
2	5	V_{DD}	Positive power input pin
3	6	V_{SS}	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
—	—	Exposed Pad	The exposed pad should be connected to V_{DD} or open.

Functional Block Diagram



A(B)
A for SOT-25
B for SOT-26

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°C, V_{DD} = 3.5V, V_{SS} = 0V, R1 = 330Ω, R2 = 2.7kΩ, C1 = 100nF, 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}-0.10	V_{DU}	V_{DU}+0.10	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} = 3.5V, V_M = 0V	1.5	3	4.5	μA
I_{STB}	Current Consumption at Power Down	V_{DD}=1.8V, V_M Pin Floating; Power-Down Mode	—	—	0.1	μA
		V_{DD}=1.8V, V_M Pin Floating; Without Power-Down Mode (Auto-Wake-up)	—	—	5.5	μA
R_{COH}	CO Pin Resistance “H”	V_{DD} = 3.5V, V_{CO} = 3.0V, V_M = 0V	2	6	10	kΩ
R_{COL}	CO Pin Resistance “L”	V_{DD} = 4.5V, V_{CO} = 0.5V, V_M = 0V	2	4	10	kΩ
R_{DOH}	DO Pin Resistance “H”	V_{DD} = 3.5V, V_{DO} = 3.0V, V_M = 0V	2	5	10	kΩ
R_{DOL}	DO Pin Resistance “L”	V_{DD} = 1.8V, V_{DO} = 0.5V, V_M = 0V	2	5	10	kΩ
R_{VMD}	Resistance between V_M Pin and V_{DD} Pin	V_{DD} = 1.8V, V_M = 0V	150	300	500	kΩ
R_{VMS}	Resistance between V_M pin and V_{SS} Pin	V_{DD} = 3.5V, V_M = 1.0V	10	30	50	kΩ
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} = 3.5V	6.0	8.0	10.0	V
V_{OVCHGR}	Overvoltage Charger Release Voltage	V_{DD} = 3.5V	5.3	7.3	9.3	V
t_{CU}	Overcharge Detection Delay Time	—	t_{CU}×0.8	t_{CU}	t_{CU}×1.2	ms
t_{DL}	Overdischarge Detection Delay Time	—	t_{DL}×0.7	t_{DL}	t_{DL}×1.3	ms
t_{DOC}	Discharge Overcurrent Detection Delay Time	—	t_{DOC}×0.8	t_{DOC}	t_{DOC}×1.2	ms
t_{SHORT}	Load Short-circuiting Detection Delay Time	—	t_{SHORT}×0.8	t_{SHORT}	t_{SHORT}×1.2	μs
t_{COC}	Charge Overcurrent Detection Delay Time	—	t_{COC}×0.8	t_{COC}	t_{COC}×1.2	ms

Electrical Characteristics (Continued)

(T_A = -40°C to +85°C, V_{DD} = 3.5V, V_{SS} = 0V, R1 = 330Ω, R2 = 2.7kΩ, C1 = 100nF, unless otherwise specified.)

Symbol	Parameter	Test Conditions		Min	Typ	Max	Unit
V_{CU}	Overcharge Detection Voltage	—		V_{CU}-0.060	V_{CU}	V_{CU}+0.040	V
V_{CL}	Overcharge Release Voltage	$V_{CL} \neq V_{CU}$		V_{CL}-0.080	V_{CL}	V_{CL}+0.065	V
		$V_{CL} = V_{CU}$		V_{CL}-0.060	V_{CL}	V_{CL}+0.040	V
V_{DL}	Overdischarge Detection Voltage	—		V_{DL}-0.110	V_{DL}	V_{DL}+0.130	V
V_{DU}	Overdischarge Release Voltage	$V_{DU} \neq V_{DL}$		V_{DU}-0.150	V_{DU}	V_{DU}+0.190	V
		$V_{DU} = V_{DL}$		V_{DU}-0.110	V_{DU}	V_{DU}+0.130	V
V_{DOC}	Discharge Overcurrent Detection Voltage	—		V_{DOC}-0.021	V_{DOC}	V_{DOC}+0.024	V
V_{SHORT}	Load Short-circuiting Detection Voltage	—		V_{SHORT}-0.34	V_{SHORT}	V_{SHORT}+0.34	V
V_{COC}	Charge Overcurrent Detection Voltage	—		V_{COC}-0.040	V_{COC}	V_{COC}+0.040	V
I_{CC}	Current Consumption during Operation	V_{DD} = 3.5V, V_M = 0V		1.0	3.0	7.0	μA
I_{STB}	Current Consumption at Power Down	V_{DD} = 1.8V, V_M Pin Floating	Power-Down Mode	—	—	1.0	μA
			Without Power-Down Mode (Auto-Wake-up)	—	—	8	
R_{COH}	CO Pin Resistance “H”	V_{DD} = 3.5V, V_{CO} = 3.0V, V_M = 0V		1.2	6	15	kΩ
R_{COL}	CO Pin Resistance “L”	V_{DD} = 4.5V, V_{CO} = 0.5V, V_M = 0V		1.2	4	15	kΩ
R_{DOH}	DO Pin Resistance “H”	V_{DD} = 3.5V, V_{DO} = 3.0V, V_M = 0V		1.2	5	15	kΩ
R_{DOL}	DO Pin Resistance “L”	V_{DD} = 1.8V, V_{DO} = 0.5V, V_M = 0V		1.2	5	15	kΩ
R_{VMD}	Resistance between V_M Pin and V_{DD} Pin	V_{DD} = 1.8V, V_M = 0V		100	300	650	kΩ
R_{VMS}	Resistance between V_M pin and V_{SS} Pin	V_{DD} = 3.5V, V_M = 1.0V		5	30	65	kΩ
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”		—	—	0.3	V
V_{OVCHG}	Overvoltage Charger Detection Voltage	V_{DD} = 3.5V		5.5	8.0	10.5	V
V_{OVCHGR}	Overvoltage Charger Release Voltage	V_{DD} = 3.5V		5.0	7.3	9.5	V
t_{CU}	Overcharge Detection Delay Time	—		t_{CU}×0.6	t_{CU}	t_{CU}×1.4	ms
t_{DL}	Overdischarge Detection Delay Time	—		t_{DL}×0.55	t_{DL}	t_{DL}×1.45	ms
t_{DOC}	Discharge Overcurrent Detection Delay Time	—		t_{DOC}×0.6	t_{DOC}	t_{DOC}×1.4	ms
t_{SHORT}	Load Short-Circuiting Detection Delay Time	—		t_{SHORT}×0.6	t_{SHORT}	t_{SHORT}×1.4	μs
t_{COC}	Charge Overcurrent Detection Delay Time	—		t_{COC}×0.6	t_{COC}	t_{COC}×1.4	ms

Operation Description

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 pin. 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 discharging and charging MOSFET, then the battery can charge and discharge freely in this condition. R_{VMD} does not connect to V_{DD} pin and R_{VMS} does not connect to V_{SS} pin in this status.

2. Overcharge Status

When the battery voltage is more than V_{CU} during charging status and the detection continues for the overcharge detection delay time (t_{CU}) or longer, the AP9101C turns off the charging MOSFET by setting low level to CO pin then stopping 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 VM 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

When the battery voltage is less than V_{DL} during discharging status and detection continues for the overdischarge detection delay time (t_{DL}) or longer, the AP9101C turns off the discharging MOSFET by setting low level to DO pin, stopping discharging. In overdischarge status, R_{VMS} is not connected, but R_{VMD} is connected to V_{DD} and V_M pin voltage is pulled up to V_{DD} by R_{VMD}. For stand-by version, the AP9101C recovers normal status from overdischarge status only by charger charge to battery. 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 not less than typical -0.7V, the AP9101C will release from overdischarge status until the battery voltage rises over V_{DU}.

For auto-wake-up version, the AP9101CA recovers normal status from overdischarge status and requires that either of two conditions should be satisfied.

Condition 1: Connecting a charger, the AP9101CA overdischarge status is released in the same way as AP9101C.

Condition 2: Connect no charger; 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 current status, if the voltage of the V_M pin to V_{SS} pin is equal to or more than V_{DOC} to V_{SHORT} and detection continues for the overdischarge current detection delay time (t_{DOC}) (or the short current detection delay time or longer) the AP9101C turns off the discharging MOSFET by setting low level to DO pin, then stopping discharging.

In discharge overcurrent or short current status, R_{VMD} is not connected, but R_{VMS} is connected to V_{SS}. 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 is almost equal to V_{SS} due to R_{VMS} being connected, then the AP9101C will release from discharge overcurrent or short current.

5. Charge Overcurrent Status

When the battery is in charge current status, if the voltage of the V_M pin to V_{SS} pin is equal to or less than V_{COC} and the detection continues for the overcharge current detection delay time (t_{COC}) or longer, the AP9101C turns off the charging MOSFET by setting low level to CO pin then stopping charging.

6. 0V Battery Charging Function

This function can be set in AP9101C internal. 0V charging available will permit charger to recharge battery whose voltage is 0V due to self-discharge. 0V charging unavailable will forbid charger to recharge battery whose voltage is 0V due to self-discharge.

Operation Description (Continued)

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 charging MOSFET. When this voltage drops below overvoltage charger release voltage (7.3V Typ.), CO pin will be set to high level and turn on charging MOSFET. There are no delay times set for detection and release.

8. Power-Down Mode

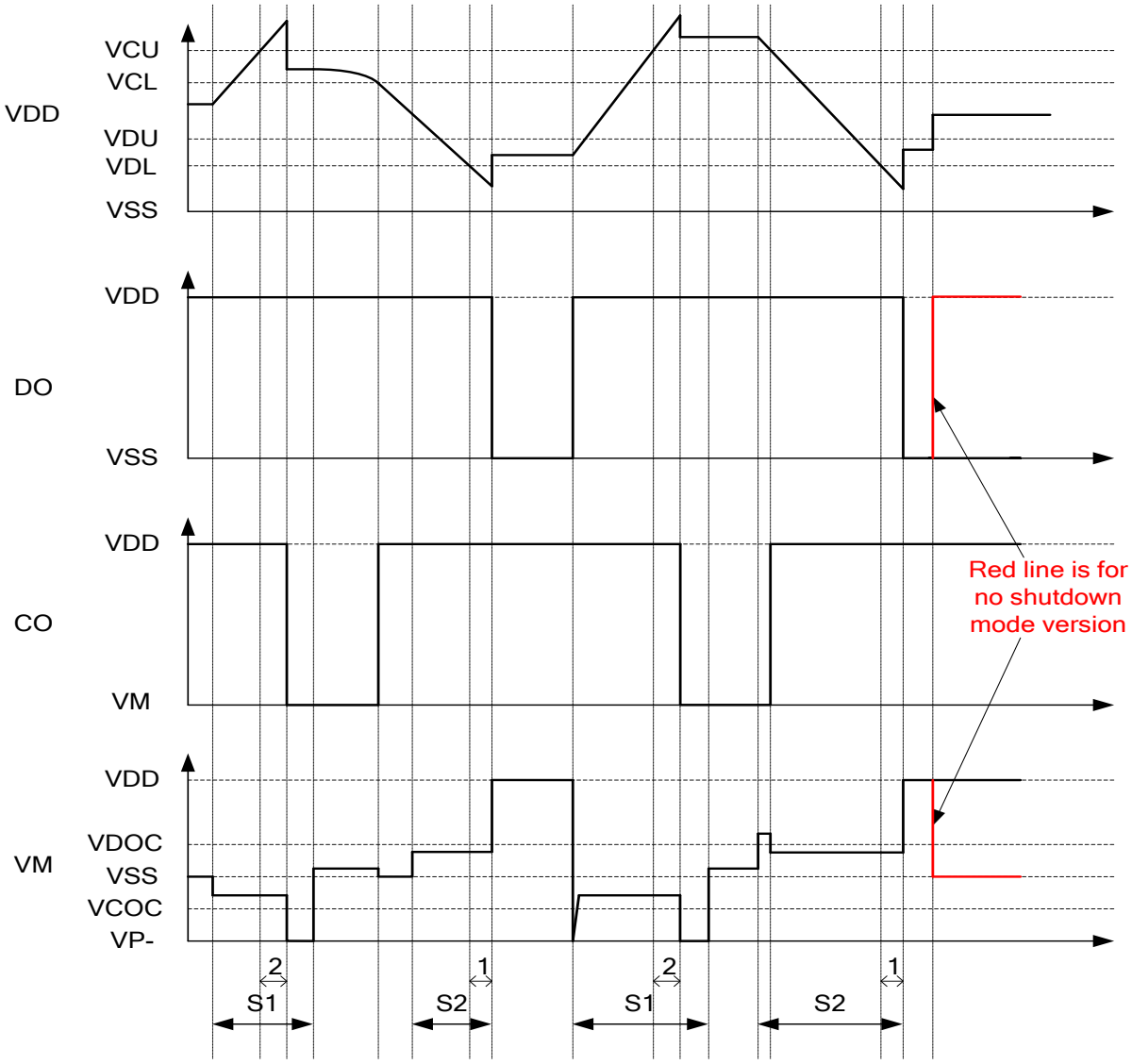
In power down mode, the AP9211 enters the overdischarge status. The IC function start sleeping and the current consumption becomes very low. To release from power-down status to the normal status, connecting a charger is required.

9. Auto-Wake-Up Function

The IC maintains 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

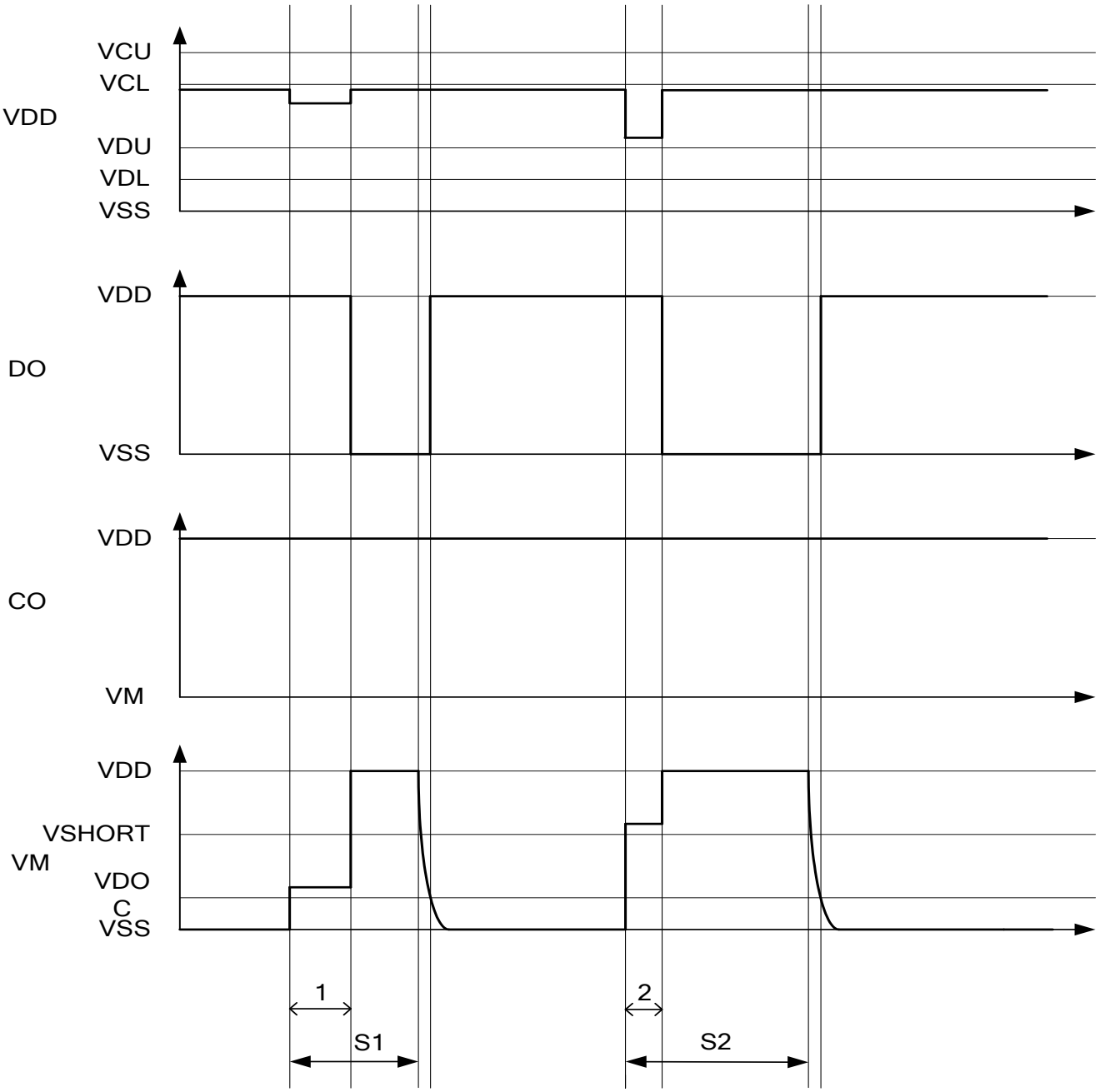


1: t_{DL}
2: t_{CU}

S1: Charger connection
S2: Load connection

Time Chart (Continued)

(2) Discharge Overcurrent Detection

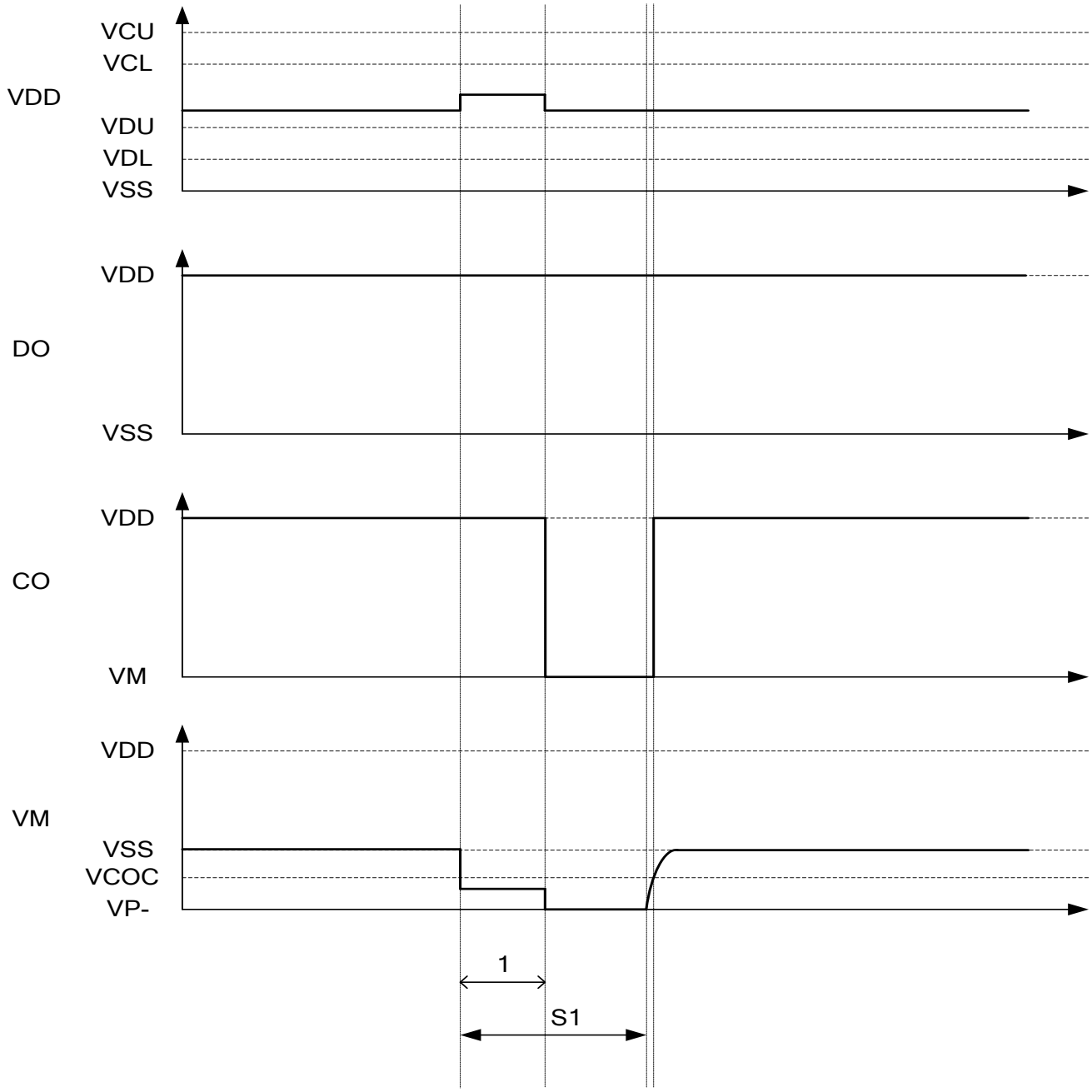


1: t_{DOC}
2: t_{SHORT}

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

Time Chart (Cont.)

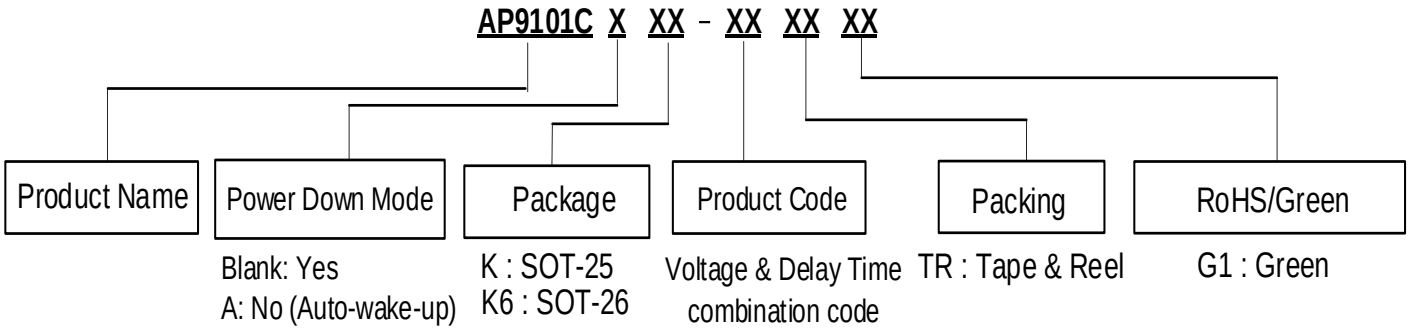
(3) Charge Overcurrent Detection



1: t_{COC}

S1: Connect over current charger

Ordering Information



Marking Information (Note 6)

Product	Package	PartNumber	MarkingID	Packing Type
		Green	Green	
AP9101C	SOT-25	AP9101CK-AATRG1	GQA	Tape & Reel
		AP9101CK-ABTRG1	G6U	Tape & Reel
		AP9101CK-ACTRG1	GQJ	Tape & Reel
		AP9101CK-ADTRG1	GQK	Tape & Reel
		AP9101CK-AETRG1	GQD	Tape & Reel
		AP9101CK-AFTRG1	GQL	Tape & Reel
		AP9101CK-AGTRG1	GQM	Tape & Reel
		AP9101CK-AHTRG1	GQN	Tape & Reel
		AP9101CK-AITRG1	GQP	Tape & Reel
		AP9101CK-AJTRG1	GQQ	Tape & Reel
		AP9101CK-AKTRG1	GQG	Tape & Reel
		AP9101CK-ALTRG1	GQR	Tape & Reel
		AP9101CK-AMTRG1	GQS	Tape & Reel
		AP9101CK-ANTRG1	GQT	Tape & Reel
		AP9101CK-AOTRG1	GRT	Tape & Reel
		AP9101CAK-AATRG1	GRA	Tape & Reel
		AP9101CAK-ABTRG1	GSC	Tape & Reel
		AP9101CAK-ACTRG1	GRJ	Tape & Reel
		AP9101CAK-ADTRG1	GRK	Tape & Reel
		AP9101CAK-AETRG1	GRD	Tape & Reel
		AP9101CAK-AFTRG1	GRL	Tape & Reel
		AP9101CAK-AGTRG1	GRM	Tape & Reel
		AP9101CAK-AHTRG1	GRN	Tape & Reel
		AP9101CAK-AITRG1	GRP	Tape & Reel
		AP9101CAK-AJTRG1	GRQ	Tape & Reel
		AP9101CAK-AKTRG1	GRG	Tape & Reel
		AP9101CAK-ALTRG1	GRR	Tape & Reel
		AP9101CAK-AMTRG1	GRS	Tape & Reel
		AP9101CAK-ANTRG1	GST	Tape & Reel
		AP9101CAK-AOTRG1	GTT	Tape & Reel

Marking Information (Continued)

AP9101C	SOT-26	AP9101CK6-AATRG1	GQB	Tape & Reel
		AP9101CK6-ABTRG1	GQC	Tape & Reel
		AP9101CK6-ACTRG1	GSJ	Tape & Reel
		AP9101CK6-ADTRG1	GSK	Tape & Reel
		AP9101CK6-AETRG1	GQE	Tape & Reel
		AP9101CK6-AFTRG1	GSL	Tape & Reel
		AP9101CK6-AGTRG1	GSM	Tape & Reel
		AP9101CK6-AHTRG1	GSN	Tape & Reel
		AP9101CK6-AITRG1	GSP	Tape & Reel
		AP9101CK6-AJTRG1	GSQ	Tape & Reel
		AP9101CK6-AKTRG1	GQH	Tape & Reel
		AP9101CK6-ALTRG1	GSR	Tape & Reel
		AP9101CK6-AMTRG1	GSS	Tape & Reel
		AP9101CK6-ANTRG1	GQU	Tape & Reel
		AP9101CK6-AOTRG1	GRU	Tape & Reel
		AP9101CAK6-AATRG1	GRB	Tape & Reel
		AP9101CAK6-ABTRG1	GRC	Tape & Reel
		AP9101CAK6-ACTRG1	GTJ	Tape & Reel
		AP9101CAK6-ADTRG1	GTK	Tape & Reel
		AP9101CAK6-AETRG1	GRE	Tape & Reel
		AP9101CAK6-AFTRG1	GTL	Tape & Reel
		AP9101CAK6-AGTRG1	GTM	Tape & Reel
		AP9101CAK6-AHTRG1	GTN	Tape & Reel
		AP9101CAK6-AITRG1	GTP	Tape & Reel
		AP9101CAK6-AJTRG1	GTQ	Tape & Reel
		AP9101CAK6-AKTRG1	GRH	Tape & Reel
		AP9101CAK6-ALTRG1	GTR	Tape & Reel
		AP9101CAK6-AMTRG1	GTS	Tape & Reel
		AP9101CAK6-ANTRG1	GSU	Tape & Reel
		AP9101CAK6-AOTRG1	GTU	Tape & Reel

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

Marking Information (Cont.)

Voltage Combination

Part Number	Overcharge Detection Voltage V_{CU}	Overcharge Release Voltage V_{CL}	Over-discharge Detection Voltage V_{DL}	Over-discharge Release Voltage V_{DU}	Discharge Overcurrent Detection Voltage V_{DOC}	Load Short Detection Voltage V_{SHORT}	Charge Overurrent Detection Voltage V_{COC}	Over Voltage Charger Detection Voltage V_{OVCHG}	Over Voltage Charger Release Voltage V_{OVCHGR}	Power-Down Function	Overcharge Protection Mode	0V Battery Charge Function
AP9101Cxxx-AATRG1	4.375V	4.175V	2.500V	2.900V	0.150V	0.700V	-0.150V	8.0V	7.3V	selectable	Auto Release	Permission
AP9101Cxxx-ABTRG1	4.425V	4.225V	2.500V	2.900V	0.150V	0.700V	-0.150V	8.0V	7.3V	selectable	Auto Release	Permission
AP9101Cxxx-ACTRG1	4.375V	4.175V	2.500V	2.900V	0.095V	0.700V	-0.095V	8.0V	7.3V	selectable	Auto Release	Permission
AP9101Cxxx-ADTRG1	4.375V	4.175V	2.500V	2.900V	0.120V	0.700V	-0.120V	8.0V	7.3V	selectable	Auto Release	Permission
AP9101Cxxx-AETRG1	4.200V	4.100V	2.500V	3.000V	0.300V	0.550V	-0.100V	8.0V	7.3V	selectable	Auto Release	Permission
AP9101Cxxx-AFTRG1	4.375V	4.175V	2.500V	2.900V	0.180V	0.700V	-0.180V	8.0V	7.3V	selectable	Auto Release	Permission
AP9101Cxxx-AGTRG1	4.375V	4.175V	2.500V	2.900V	0.075V	0.700V	-0.075V	8.0V	7.3V	selectable	Auto Release	Permission
AP9101Cxxx-AHTRG1	4.425V	4.225V	2.500V	2.900V	0.075V	0.700V	-0.075V	8.0V	7.3V	selectable	Auto Release	Permission
AP9101Cxxx-AITRG1	4.500V	4.300V	2.400V	2.800V	0.150V	0.700V	-0.075V	8.0V	7.3V	selectable	Auto Release	Permission
AP9101Cxxx-AJTRG1	4.375V	4.175V	2.400V	2.800V	0.125V	0.700V	-0.125V	8.0V	7.3V	selectable	Auto Release	Permission
AP9101Cxxx-AKTRG1	4.250V	4.050V	2.400V	3.000V	0.150V	0.700V	-0.150V	8.0V	7.3V	selectable	Auto Release	Permission
AP9101Cxxx-ALTRG1	4.275V	4.175V	2.300V	2.400V	0.180V	0.700V	-0.180V	8.0V	7.3V	selectable	Auto Release	Permission
AP9101Cxxx-AMTRG1	4.375V	4.175V	2.300V	2.400V	0.180V	0.700V	-0.180V	8.0V	7.3V	selectable	Auto Release	Permission
AP9101Cxxx-ANTRG1	4.225V	4.025V	3.200V	3.400V	0.060V	0.450V	-0.060V	8.0V	7.3V	selectable	Auto Release	Permission
AP9101Cxxx-AOTRG1	4.425V	4.225V	2.500V	2.900V	0.064V	0.228V	-0.073V	8.0V	7.3V	selectable	Auto Release	Permission

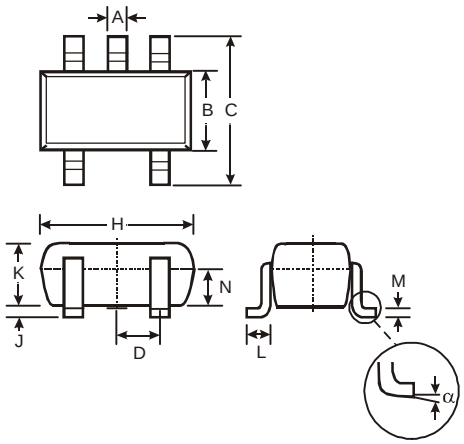
Delay time Combination

Delay Time Option	Overcharge Detection Delay Time (t_{CU})	Overdischarge Detection Delay Time (t_{DL})	Overdischarge Current Detection Delay Time (t_{DOC})	Overcharge Current Detection Delay Time (t_{COC})	Load Short Circuiting Detection Delay Time (t_{SHORT})
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

Package Outline Dimensions

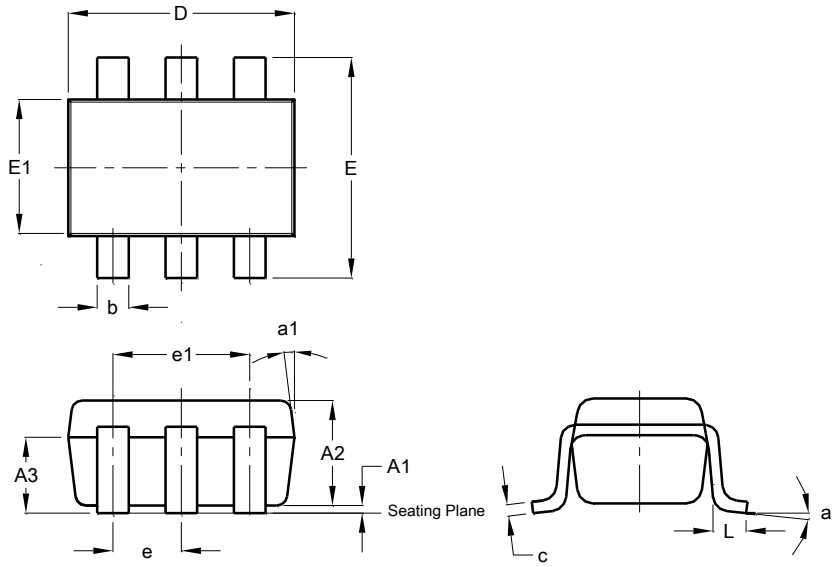
Please see AP02002 at http://www.diodes.com/datasheets/ap02002.pdf for the latest version.

SOT-25



SOT-25			
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			

SOT-26

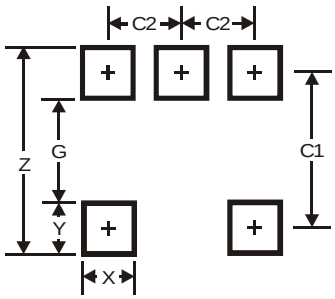


SOT-26			
Dim	**Min**	**Max**	**Typ**
A1	0.013	0.10	0.05
A2	1.00	1.30	1.10
A3	0.70	0.80	0.75
b	0.35	0.50	0.38
c	0.10	0.20	0.15
D	2.90	3.10	3.00
e	-	-	0.95
e1	-	-	1.90
E	2.70	3.00	2.80
E1	1.50	1.70	1.60
L	0.35	0.55	0.40
a	-	-	8°
a1	-	-	7°
All Dimensions in mm			

Suggested Pad Layout

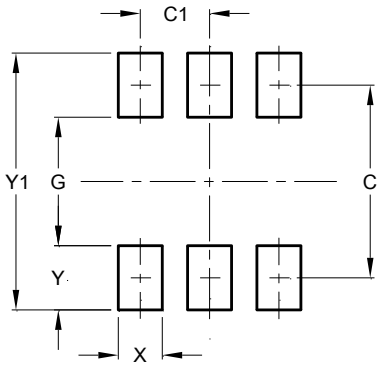
Please see AP02001 at http://www.diodes.com/datasheets/ap02001.pdf for the latest version.

SOT-25



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

SOT-26



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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