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.

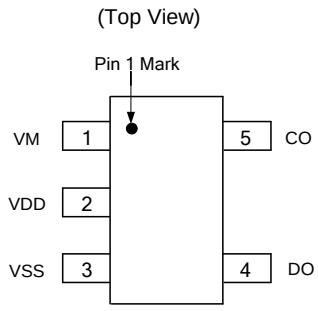
Applications

- Lithium-Ion Battery Packs
- Lithium Polymer Battery Packs

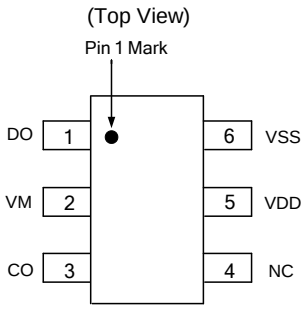
Features

- 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 ±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: Release
- 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



SOT25



SOT26

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.

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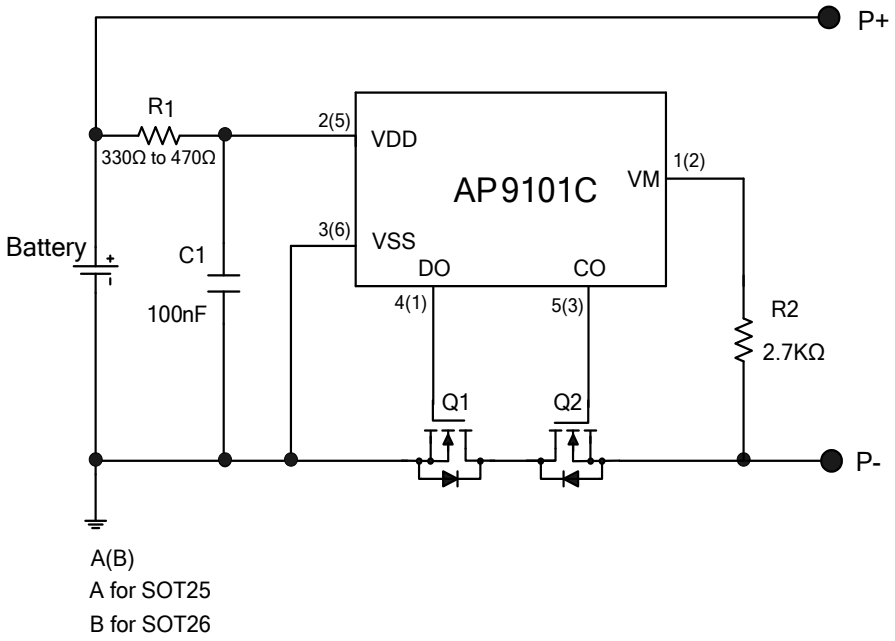
Typical Applications Circuit (Note 4)



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 V_M 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 the 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_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	Not Connected

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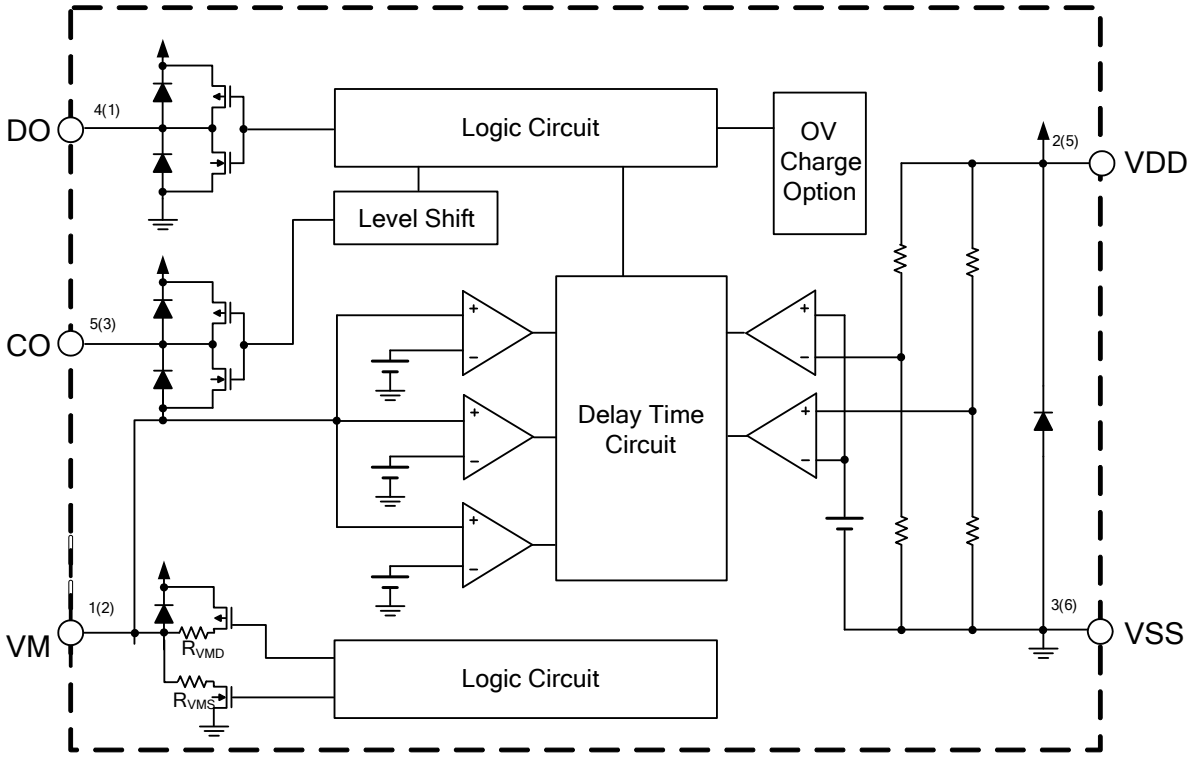
Functional Block Diagram



A(B)
A for SOT25
B for SOT26

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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

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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_M = 0	V_{CU}-0.025	V_{CU}	V_{CU}+0.025	V
V_{CL}	Overcharge Release Voltage	$V_{CL} \neq V_{CU}$, V_M = 0	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_M = 0	V_{DL}-0.035	V_{DL}	V_{DL}+0.035	V
V_{DU}	Overdischarge Release Voltage	$V_{DU} \neq V_{DL}$, V_M = 0	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} = 3.5V, 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}×0.8	t_{DL}	t_{DL}×1.2	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

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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_M = 0		V_{CU}-0.060	V_{CU}	V_{CU}+0.040	V
V_{CL}	Overcharge Release Voltage	$V_{CL} \neq V_{CU}$, V_M = 0		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_M = 0		V_{DL}-0.110	V_{DL}	V_{DL}+0.130	V
V_{DU}	Overdischarge Release Voltage	$V_{DU} \neq V_{DL}$, V_M = 0		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}×0.6	t_{DL}	t_{DL}×1.4	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

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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 the 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 being 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 the CO Pin to stop charging. R_{VMD} and R_{VMS} are not connected in overcharge status.

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

When the 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 the DO Pin to stop discharging. In overdischarge status, R_{VMD} is connected to V_{DD}, and the V_M Pin voltage is pulled up to V_{DD} by R_{VMD}, but R_{VMS} is not connected. For standby version, the AP9101C recovers normal status from overdischarge status only by charging the battery through the charger.

When the V_M Pin voltage to the 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 the V_M Pin voltage to the 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 the 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 the 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) 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 the CO pin to stop charging.

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Operation Description (Continued)

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 the 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 the CO Pin low level to turn off charge MOSFET. When this voltage drops below overvoltage charger release voltage (7.3V Typ.), the 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 the device with power-down function, during power-down mode, the device enters the overdischarge status. The IC enters sleep mode and the current consumption becomes very low, typically 0.1µA. To release from power-down status to normal status, charger connection is required.

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

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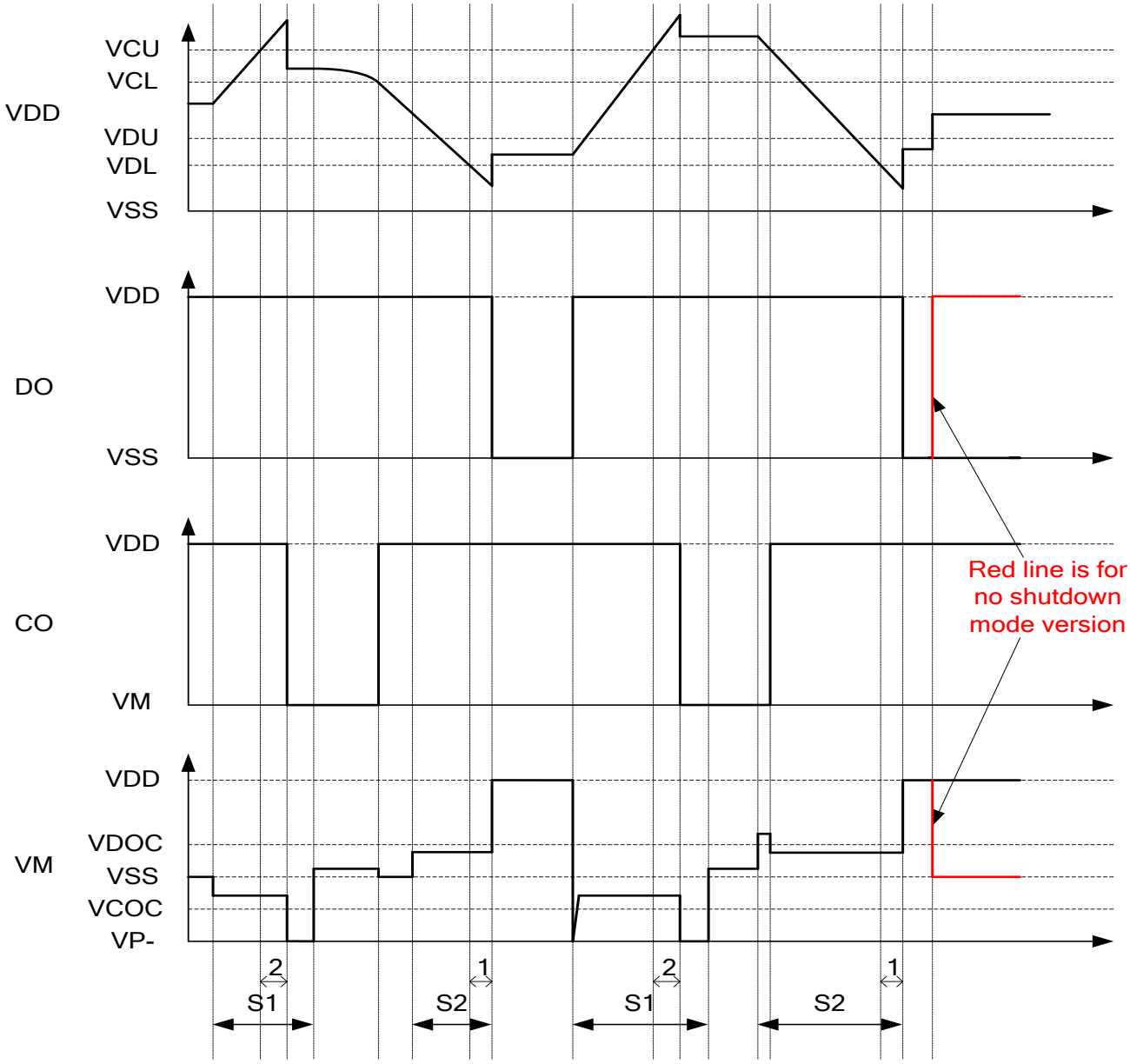
Time Chart

(1) Overcharge and Overdischarge Detection



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

S1: Charger connection
S2: Load connection

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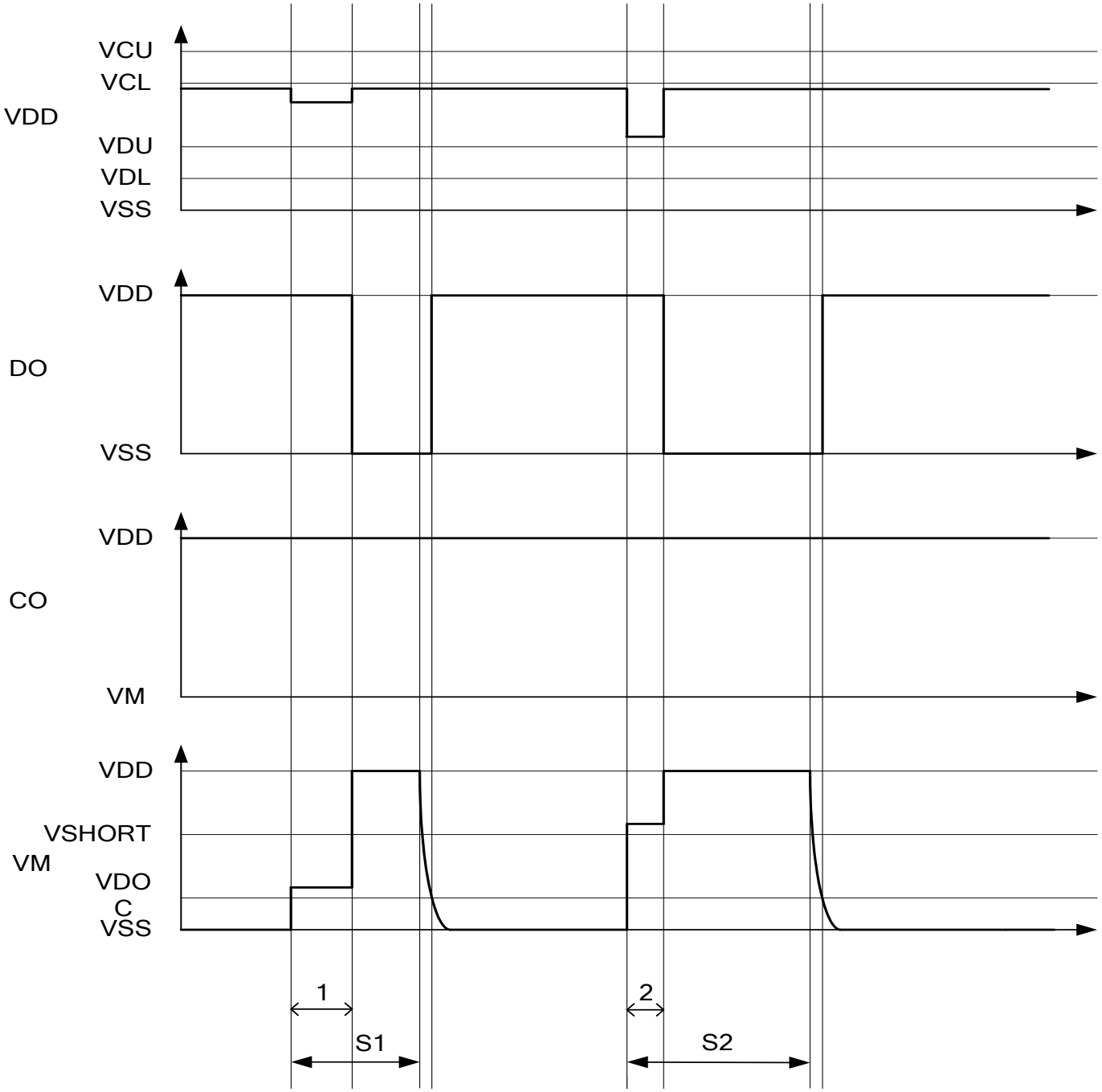
Time Chart (Continued)

(2) Discharge Overcurrent Detection



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

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

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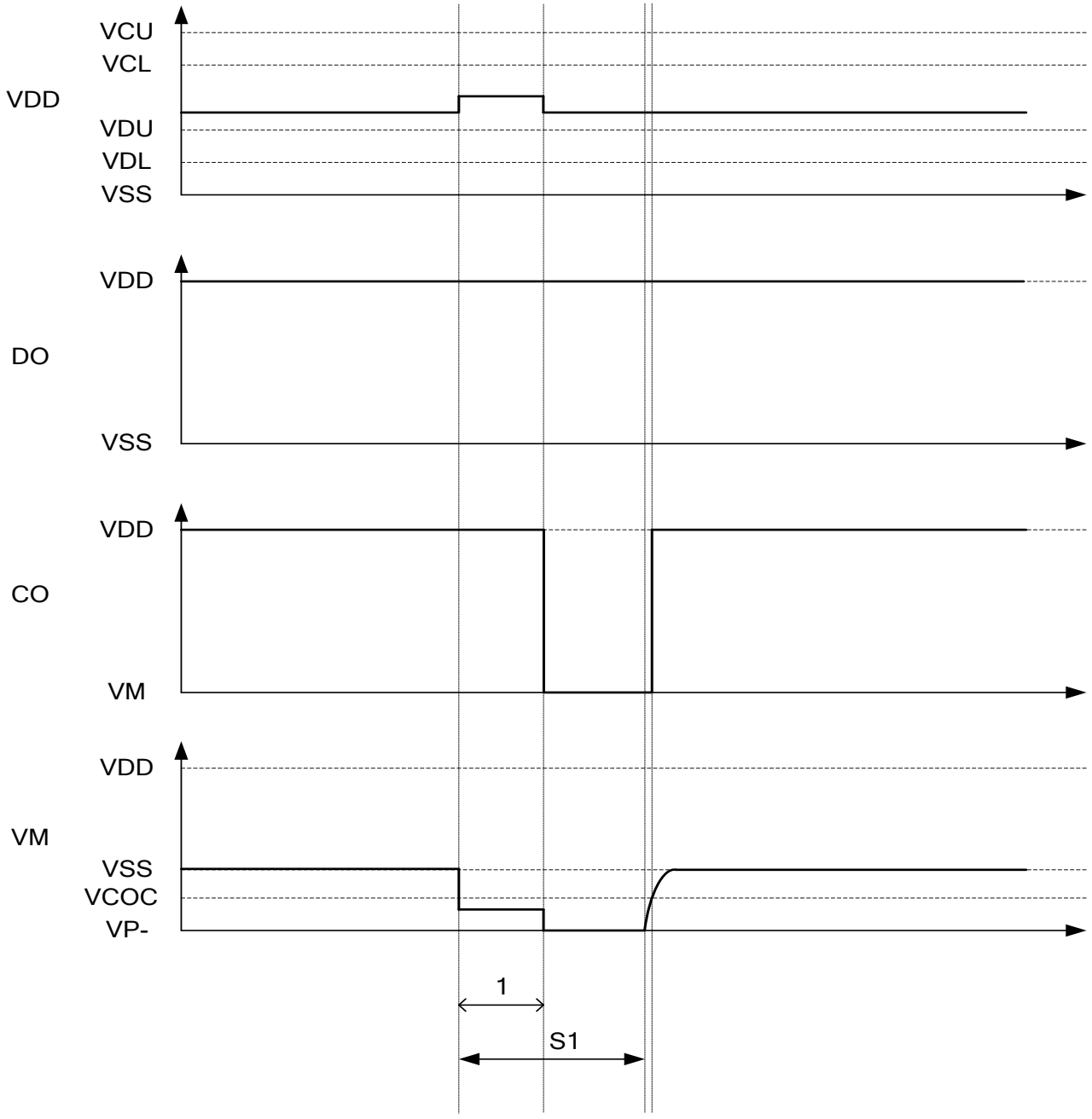
Time Chart (Cont.)

(3) Charge Overcurrent Detection



1: t_{COC}

S1: Connect over current charger

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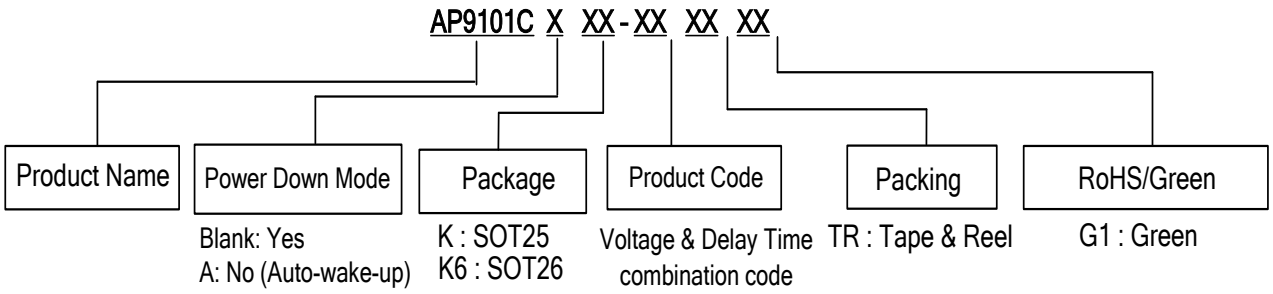
Ordering Information



Voltage and Delay Time 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	Delay Time	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	Option 1	Permission
AP9101Cxxx-ABTRG1	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-ACTRG1	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-ADTRG1	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-AETRG1	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-AFTRG1	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-AGTRG1	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-AHTRG1	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-AITRG1	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-AJTRG1	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-AKTRG1	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-ALTRG1	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-AMTRG1	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-ANTRG1	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-AOTRG1	4.425V	4.225V	2.500V	2.900V	0.064V	0.450V	-0.073V	8.0V	7.3V	Selectable	Auto Release	Option 1	Permission
AP9101Cxxx-ASTRG1	3.800V	3.700V	2.300V	2.400V	0.180V	0.700V	-0.180V	8.0V	7.3V	Selectable	Auto Release	Option 1	Permission
AP9101Cxxx-ATTRG1	4.400V	4.200V	2.800V	3.000V	0.150V	0.700V	-0.200V	8.0V	7.3V	Selectable	Auto Release	Option 1	Permission

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Ordering Information (Continued)

AP9101Cxxx-AUTRG1	4.300V	4.100V	2.500V	2.900V	0.100V	0.700V	-0.100V	8.0V	7.3V	Selectable	Auto Release	Option 1	Permission
AP9101Cxxx-AXTRG1	4.280V	4.080V	2.800V	2.800V	0.100V	0.500V	-0.100V	8.0V	7.3V	Selectable	Auto Release	Option 1	Permission
AP9101Cxxx-AYTRG1	4.275V	4.075V	2.800V	2.900V	0.150V	0.500V	-0.100V	8.0V	7.3V	Selectable	Auto Release	Option 1	Prohibition
AP9101Cxxx-AZTRG1	4.275V	4.075V	2.500V	2.900V	0.150V	0.500V	-0.100V	8.0V	7.3V	Selectable	Auto Release	Option 1	Prohibition
AP9101Cxxx-BATRG1	4.475V	4.275V	2.500V	2.900V	0.150V	0.500V	-0.150V	8.0V	7.3V	Selectable	Auto Release	Option 1	Permission
AP9101Cxxx-BBTRG1	4.475V	4.275V	2.500V	2.900V	0.200V	0.500V	-0.200V	8.0V	7.3V	Selectable	Auto Release	Option 1	Permission
AP9101Cxxx-BCTRG1	4.465V	4.265V	2.100V	2.100V	0.150V	0.500V	-0.100V	8.0V	7.3V	Selectable	Auto Release	Option 1	Permission
AP9101Cxxx-BDTRG1	4.425V	4.225V	2.500V	2.500V	0.160V	0.500V	-0.100V	8.0V	7.3V	Selectable	Auto Release	Option 1	Permission
AP9101Cxxx-BETRG1	4.425V	4.225V	2.500V	2.500V	0.160V	0.500V	-0.160V	8.0V	7.3V	Selectable	Auto Release	Option 1	Permission
AP9101Cxxx-BFTRG1	4.425V	4.225V	2.500V	2.800V	0.160V	0.500V	-0.150V	8.0V	7.3V	Selectable	Auto Release	Option 1	Permission
AP9101Cxxx-BGTRG1	4.425V	4.225V	2.500V	2.800V	0.200V	0.500V	-0.150V	8.0V	7.3V	Selectable	Auto Release	Option 1	Permission
AP9101Cxxx-BHTRG1	4.425V	4.225V	2.500V	2.900V	0.200V	0.500V	-0.200V	8.0V	7.3V	Selectable	Auto Release	Option 1	Permission
AP9101Cxxx-BITRG1	4.425V	4.225V	2.500V	2.900V	0.130V	0.500V	-0.130V	8.0V	7.3V	Selectable	Auto Release	Option 1	Permission
AP9101Cxxx-BJTRG1	4.400V	4.300V	3.000V	3.200V	0.250V	0.600V	-0.200V	8.0V	7.3V	Selectable	Auto Release	Option 1	Permission
AP9101Cxxx-BKTRG1	4.400V	4.200V	2.800V	3.000V	0.150V	0.600V	-0.200V	8.0V	7.3V	Selectable	Auto Release	Option 1	Prohibition
AP9101Cxxx-BLTRG1	4.380V	4.280V	2.600V	2.800V	0.150V	0.600V	-0.175V	8.0V	7.3V	Selectable	Auto Release	Option 1	Permission
AP9101Cxxx-BMTRG1	4.375V	4.175V	2.300V	2.400V	0.150V	0.600V	-0.150V	8.0V	7.3V	Selectable	Auto Release	Option 1	Permission
AP9101Cxxx-BNTRG1	4.325V	4.075V	2.500V	2.900V	0.150V	0.600V	-0.100V	8.0V	7.3V	Selectable	Auto Release	Option 1	Prohibition
AP9101Cxxx-BOTRG1	4.325V	4.075V	2.500V	2.900V	0.150V	0.500V	-0.150V	8.0V	7.3V	Selectable	Auto Release	Option 1	Prohibition
AP9101Cxxx-BPTRG1	4.325V	4.125V	2.500V	2.800V	0.150V	0.600V	-0.100V	8.0V	7.3V	Selectable	Auto Release	Option 1	Permission
AP9101Cxxx-BQTRG1	4.300V	4.100V	2.300V	2.300V	0.250V	0.600V	-0.100	8.0V	7.3V	Selectable	Auto Release	Option 1	Permission
AP9101Cxxx-BRTRG1	4.280V	4.080V	3.000V	3.300V	0.080V	0.500V	-0.080V	8.0V	7.3V	Selectable	Auto Release	Option 1	Permission
AP9101Cxxx-BSTRG1	4.280V	4.080V	3.000V	3.300V	0.080V	0.500V	-0.100V	8.0V	7.3V	Selectable	Auto Release	Option 1	Permission
AP9101Cxxx-BTTRG1	4.280V	4.080V	2.300V	2.300V	0.160v	0.500v	-0.100V	8.0V	7.3V	Selectable	Auto Release	Option 1	Permission
AP9101Cxxx-BUTRG1	4.280V	4.080V	2.300V	2.300V	0.125V	0.600V	-0.100V	8.0V	7.3V	Selectable	Auto Release	Option 1	Permission

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Ordering Information (Cont.)

AP9101Cxxx-BVTRG1	4.280V	4.080V	2.800V	3.000V	0.100V	0.500V	-0.100V	8.0V	7.3V	Selectable	Auto Release	Option 1	Permission
AP9101Cxxx-BWTRG1	4.280V	4.180V	3.000V	3.000V	0.180V	0.600	-0.150V	8.0V	7.3V	Selectable	Auto Release	Option 1	Permission
AP9101Cxxx-BXTRG1	4.280V	4.180V	2.800V	2.800V	0.050V	0.600V	-0.050V	8.0V	7.3V	Selectable	Auto Release	Option 1	Permission
AP9101Cxxx-BYTRG1	4.280V	4.180V	2.800V	2.800V	0.250V	0.600V	-0.100V	8.0V	7.3V	Selectable	Auto Release	Option 1	Permission
AP9101Cxxx-BZTRG1	4.280V	4.130V	2.800V	3.100V	0.100V	0.500V	-0.100V	8.0V	7.3V	Selectable	Auto Release	Option 1	Permission
AP9101Cxxx-CATRG1	4.275V	4.175V	2.300V	2.800V	0.250V	0.600V	-0.200V	8.0V	7.3V	Selectable	Auto Release	Option 1	Permission
AP9101Cxxx-CBTRG1	4.275V	4.175V	2.300V	2.400V	0.200V	0.500V	-0.200V	8.0V	7.3V	Selectable	Auto Release	Option 1	Permission
AP9101Cxxx-CCTRG1	4.275V	4.075V	2.500V	2.900V	0.150V	0.500V	-0.150V	8.0V	7.3V	Selectable	Auto Release	Option 1	Prohibition
AP9101Cxxx-CDTRG1	4.275V	4.075V	2.300V	2.300V	0.150V	0.600V	-0.100V	8.0V	7.3V	Selectable	Auto Release	Option 1	Permission
AP9101Cxxx-CETRG1	4.275V	4.175V	2.300V	2.400V	0.100V	0.600V	-0.100V	8.0V	7.3V	Selectable	Auto Release	Option 1	Permission
AP9101Cxxx-CFTRG1	4.275V	4.075V	2.800V	2.800V	0.150V	0.600V	-0.100V	8.0V	7.3V	Selectable	Auto Release	Option 1	Permission
AP9101Cxxx-CGTRG1	4.275V	4.075V	2.800V	3.000V	0.150V	0.600V	-0.100V	8.0V	7.3V	Selectable	Auto Release	Option 1	Permission
AP9101Cxxx-CHTRG1	4.250V	4.150V	2.500V	2.700V	0.250V	0.600V	-0.200V	8.0V	7.3V	Selectable	Auto Release	Option 1	Permission
AP9101Cxxx-CITRG1	4.250V	4.150V	2.700V	3.000V	0.250V	0.600V	-0.200V	8.0V	7.3V	Selectable	Auto Release	Option 1	Permission
AP9101Cxxx-CJTRG1	4.250V	4.050V	2.500V	2.800V	0.200V	0.600V	-0.100V	8.0V	7.3V	Selectable	Auto Release	Option 1	Permission
AP9101Cxxx-CKTRG1	4.250V	4.150V	2.800V	3.000V	0.150V	0.600V	-0.100V	8.0V	7.3V	Selectable	Auto Release	Option 1	Permission
AP9101Cxxx-CLTRG1	4.250V	4.150V	2.500V	3.000V	0.150V	0.600V	-0.100V	8.0V	7.3V	Selectable	Auto Release	Option 1	Permission
AP9101Cxxx-CMTRG1	4.200V	4.100V	2.800V	3.000V	0.150V	0.550V	-0.150V	8.0V	7.3V	Selectable	Auto Release	Option 1	Prohibition
AP9101Cxxx-CNTRG1	4.200V	4.100V	2.500V	2.500V	0.150V	0.600V	-0.100V	8.0V	7.3V	Selectable	Auto Release	Option 1	Permission
AP9101Cxxx-COTRG1	4.190V	4.090V	2.700V	3.000V	0.100V	0.600V	-0.050V	8.0V	7.3V	Selectable	Auto Release	Option 1	Prohibition
AP9101Cxxx-CPTRG1	3.650V	3.450V	2.100V	2.300V	0.150V	0.550V	-0.150V	8.0V	7.3V	Selectable	Auto Release	Option 1	Permission
AP9101Cxxx-CQTRG1	4.250V	4.050V	2.800V	3.000V	0.150V	0.500V	-0.100V	8.0V	7.3V	Selectable	Auto Release	Option 1	Prohibition

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Ordering Information (Cont.)

Delay Time Option Overview

Delay Time Option	Overcharge Detection DelayTime (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

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Marking Information (Note 6)

Product	Package	Part Number	Marking ID	Packing Type
		Green	Green	
AP9101C	SOT25	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
		AP9101CK-ASTRG1	GQV	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
		AP9101CAK-ASTRG1	GSV	Tape & Reel
		AP9101CAK-ATTRG1	GSW	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.

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Marking Information (Continued)

AP9101C	SOT26	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
		AP9101CK6-ASTRG1	GRW	Tape & Reel
		AP9101CK6-ATTRG1	GRV	Tape & Reel
		AP9101CK6-AUTRG1	GQW	Tape & Reel
		AP9101CK6-AXTRG1	GPU	Tape & Reel
		AP9101CK6-AYTRG1	GPV	Tape & Reel
		AP9101CK6-AZTRG1	GPW	Tape & Reel
		AP9101CK6-BATRG1	GXA	Tape & Reel
		AP9101CK6-BBTRG1	GXB	Tape & Reel
		AP9101CK6-BCTRG1	GXC	Tape & Reel
		AP9101CK6-BDTRG1	GXD	Tape & Reel
		AP9101CK6-BETRG1	GXE	Tape & Reel
		AP9101CK6-BFTRG1	GXF	Tape & Reel
		AP9101CK6-BGTRG1	GXG	Tape & Reel
		AP9101CK6-BHTRG1	GXH	Tape & Reel
		AP9101CK6-BITRG1	GXJ	Tape & Reel
		AP9101CK6-BJTRG1	GXK	Tape & Reel
		AP9101CK6-BKTRG1	GXL	Tape & Reel
		AP9101CK6-BLTRG1	GXM	Tape & Reel
		AP9101CK6-BMTRG1	GXN	Tape & Reel
		AP9101CK6-BNTRG1	GXP	Tape & Reel

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Marking Information (Cont.)

AP9101C	SOT26	AP9101CK6-BOTRG1	GXQ	Tape & Reel
		AP9101CK6-BPTRG1	GXR	Tape & Reel
		AP9101CK6-BQTRG1	GXS	Tape & Reel
		AP9101CK6-BRTRG1	GXT	Tape & Reel
		AP9101CK6-BSTRG1	GXU	Tape & Reel
		AP9101CK6-BTTRG1	GXZ	Tape & Reel
		AP9101CK6-BUTRG1	GXV	Tape & Reel
		AP9101CK6-BVTRG1	GXW	Tape & Reel
		AP9101CK6-BWTRG1	GYS	Tape & Reel
		AP9101CK6-BXTRG1	GYT	Tape & Reel
		AP9101CK6-BYTRG1	GYU	Tape & Reel
		AP9101CK6-BZTRG1	GYV	Tape & Reel
		AP9101CK6-CATRG1	GYA	Tape & Reel
		AP9101CK6-CBTRG1	GYB	Tape & Reel
		AP9101CK6-CCTRG1	GYC	Tape & Reel
		AP9101CK6-CDTRG1	GYD	Tape & Reel
		AP9101CK6-CETRG1	GYE	Tape & Reel
		AP9101CK6-CFTRG1	GYF	Tape & Reel
		AP9101CK6-CGTRG1	GYG	Tape & Reel
		AP9101CK6-CHTRG1	GYH	Tape & Reel
		AP9101CK6-CITRG1	GYJ	Tape & Reel
		AP9101CK6-CJTRG1	GYK	Tape & Reel
		AP9101CK6-CKTRG1	GYL	Tape & Reel
		AP9101CK6-CLTRG1	GYM	Tape & Reel
		AP9101CK6-CMTRG1	GYN	Tape & Reel
		AP9101CK6-CNTRG1	GYP	Tape & Reel
		AP9101CK6-COTRG1	GYQ	Tape & Reel
		AP9101CK6-CPTRG1	GYR	Tape & Reel
		AP9101CK6-CQTRG1	GYW	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

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Marking Information (Cont.)

AP9101C	SOT26	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
		AP9101CAK6-ASTRG1	GTW	Tape & Reel
		AP9101CAK6-ATTRG1	GTV	Tape & Reel
		AP9101CAK6-AUTRG1	GUT	Tape & Reel
		AP9101CAK6-AXTRG1	GUU	Tape & Reel
		AP9101CAK6-AYTRG1	GUV	Tape & Reel
		AP9101CAK6-AZTRG1	GUW	Tape & Reel
		AP9101CAK6-BATRG1	GVA	Tape & Reel
		AP9101CAK6-BBTRG1	GVB	Tape & Reel
		AP9101CAK6-BCTRG1	GVC	Tape & Reel
		AP9101CAK6-BDTRG1	GVD	Tape & Reel
		AP9101CAK6-BETRG1	GVE	Tape & Reel
		AP9101CAK6-BFTRG1	GVF	Tape & Reel
		AP9101CAK6-BGTRG1	GVG	Tape & Reel
		AP9101CAK6-BHTRG1	GVH	Tape & Reel
		AP9101CAK6-BITRG1	GVJ	Tape & Reel
		AP9101CAK6-BJTRG1	GVK	Tape & Reel
		AP9101CAK6-BKTRG1	GVL	Tape & Reel
		AP9101CAK6-BLTRG1	GVM	Tape & Reel
		AP9101CAK6-BMTRG1	GVN	Tape & Reel
		AP9101CAK6-BNTRG1	GVP	Tape & Reel
		AP9101CAK6-BOTRG1	GVQ	Tape & Reel
		AP9101CAK6-BPTRG1	GVR	Tape & Reel
		AP9101CAK6-BQTRG1	GVS	Tape & Reel
		AP9101CAK6-BRTRG1	GVT	Tape & Reel
		AP9101CAK6-BSTRG1	GVU	Tape & Reel
		AP9101CAK6-BTTRG1	GVV	Tape & Reel
		AP9101CAK6-BUTRG1	GVW	Tape & Reel
		AP9101CAK6-BVTRG1	GWS	Tape & Reel

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Marking Information (Cont.)

AP9101C	SOT26	AP9101CAK6-BWTRG1	GWT	Tape & Reel
		AP9101CAK6-BXTRG1	GWU	Tape & Reel
		AP9101CAK6-BYTRG1	GWV	Tape & Reel
		AP9101CAK6-BZTRG1	GWW	Tape & Reel
		AP9101CAK6-CATRG1	GWA	Tape & Reel
		AP9101CAK6-CBTRG1	GWB	Tape & Reel
		AP9101CAK6-CCTRG1	GWC	Tape & Reel
		AP9101CAK6-CDTRG1	GWD	Tape & Reel
		AP9101CAK6-CETRG1	GWE	Tape & Reel
		AP9101CAK6-CFTRG1	GWF	Tape & Reel
		AP9101CAK6-CGTRG1	GWG	Tape & Reel
		AP9101CAK6-CHTRG1	GWH	Tape & Reel
		AP9101CAK6-CITRG1	GWJ	Tape & Reel
		AP9101CAK6-CJTRG1	GWK	Tape & Reel
		AP9101CAK6-CKTRG1	GWL	Tape & Reel
		AP9101CAK6-CLTRG1	GWM	Tape & Reel
		AP9101CAK6-CMTRG1	GWN	Tape & Reel
		AP9101CAK6-CNTRG1	GWP	Tape & Reel
		AP9101CAK6-COTRG1	GWQ	Tape & Reel
		AP9101CAK6-CPTRG1	GWR	Tape & Reel

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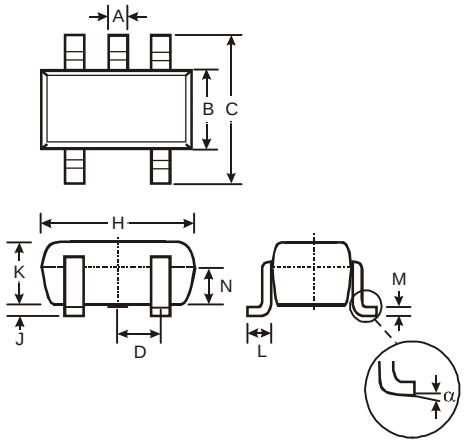
Package Outline Dimensions

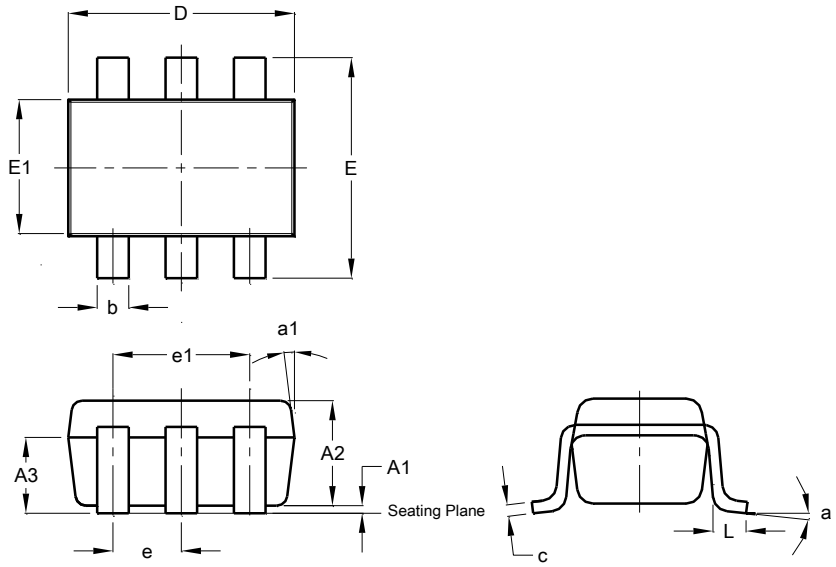
Please see http://www.diodes.com/package-outlines.html for the latest version.

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			

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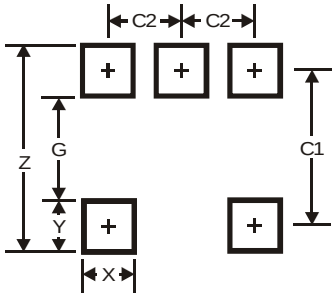
Suggested Pad Layout

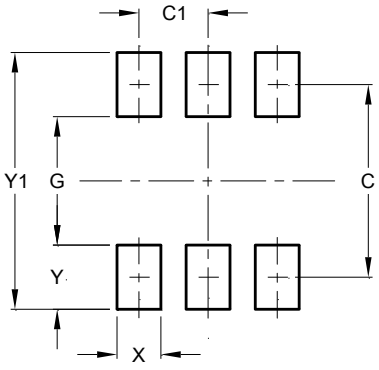
Please see http://www.diodes.com/package-outlines.html for the latest version.

SOT25



Dimensions	Value
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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