OUTLINE

The OMS240/OMS241 series is a lithium-ion/lithium polymer rechargeable battery protection IC, using high voltage CMOS process and includes high-accuracy voltage detectors and delay circuit.

By detecting an external resistor (High-accuracy), the OMS240/OMS241 Series realizes high-accuracy charging and discharging overcurrent protection with less effect from temperature change and battery voltage change.

FEATURES

(1) Internal high accuracy voltage detection circuit

Overcharge detection voltage	3.5V to 4.7V	Accuracy±15mV (Ta=+25°C)
		Accuracy±20mV (Ta=-10~+60°C)
Overcharge release voltage	3.1V to 4.6V	Accuracy±40mV
Overdischarge detection voltage	2.0V to 3.4V	Accuracy±40mV
Overdischarge release voltage	2.0V to 3.4V	Accuracy±40mV
Discharging overcurrent detection voltage	10mV to 100mV	Accuracy±5mV
Charging overcurrent detection voltage	-10mV to -200mV	Accuracy±5mV
Short detection voltage	0.050V-0.5V	Accuracy±40mV/100mV

(2) Detection delay times are generated by an internal circuit.

(3) 30V High-withstanding-voltage device is used for charger connection pins.

(4) 0 V battery charge function: “available” or “unavailable”

(5) Standby function. “available” or “unavailable”

(6) Wide operating temperature range Ta=-40°C~+85°C

(7) Low current consumption (Ta=+25°C)

Operation mode 1.5μA Typ, 5.0μA Max.

Power-down mode 0.1μA(Max).

(8) Ultra small package/Ultra-thin DFN1212 ,DFN1916

(9) Lead-free, Halogen-Free

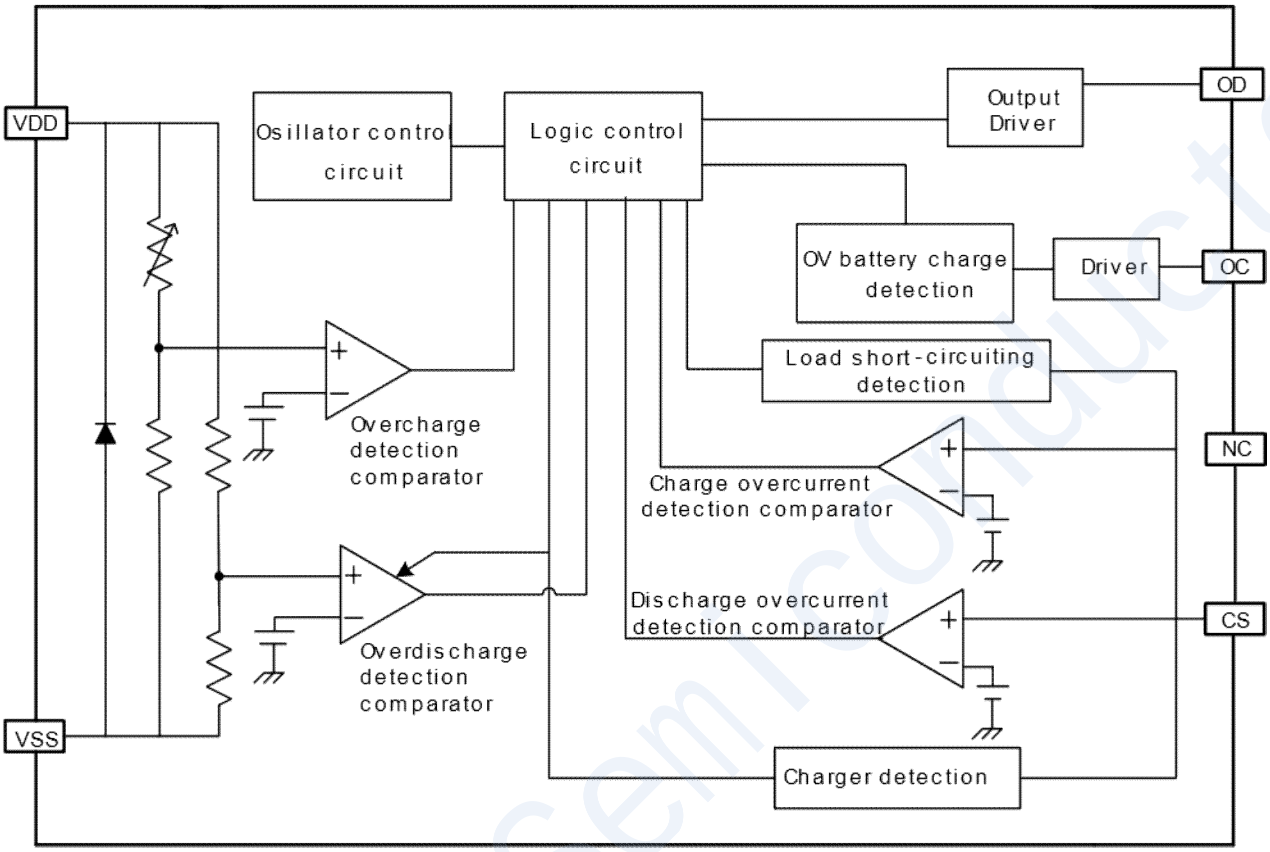
APPLICATIONS

Lithium-ion/ Lithium polymer rechargeable battery pack.

High precision protectors for cell-phones and any other gadgets using on board Lithium-ion/ Lithium polymer battery pack.

BLOCK DIAGRAM

Figure 1



PRODUCT NAME & PARAMETER

Product Name	Overcharge detection voltage	Overcharge release voltage	Over-discharge detection voltage	Over-discharge release voltage	Discharge overcurrent detection voltage	Charge over-current detection Voltage	Load Short circuiting Detection Voltage
	V_{CU}(V)	V_{CR}(V)	V_{DL}(V)	V_{DR}(V)	V_{DIP}(mV)	V_{CIP}(mV)	V_{short}(V)
OMS24X-AB	4.475	4.275	2.50	2.90	65	-50	0.19
OMS24X-ES	4.500	4.250	2.80	2.80	50	-50	0.25
OMS24X-BQ	4.425	4.225	2.80	2.80	50	-60	0.35
OMS24X-BA	4.425	4.225	2.50	2.90	100	-100	0.35
OMS24X-AY	4.475	4.275	2.50	2.90	80	-80	0.19
OMS24X-AD	4.420	4.220	2.50	2.90	50	-40	0.30
OMS24X-AE	4.425	4.225	2.50	2.90	100	-100	0.50
OMS24X-AN	4.280	4.280	2.80	2.80	50	-100	0.50
OMS24X-AP	4.550	4.250	2.00	2.30	25	-35	0.08
OMS24X-AT	4.280	4.080	3.00	3.00	30	-30	0.21
OMS24X-AV	4.475	4.275	2.50	2.50	30	-30	0.11
OMS24X-AZ	4.425	4.225	2.50	2.90	45	-45	0.10
OMS24X-BM	4.475	4.275	2.50	2.90	80	-80	0.28
OMS24X-BW	4.475	4.275	2.50	2.90	75	-60	0.30
OMS24X-BX	4.425	4.225	2.50	2.90	75	-60	0.30
OMS24X-CB	4.475	4.275	2.50	2.80	34	-30	0.11
OMS24X-CI	4.475	4.275	2.50	2.90	45	-45	0.15
OMS24X-CW	4.280	4.080	2.80	2.80	50	-50	0.15
OMS24X-FB	4.495	4.475	2.10	2.50	40	-40	0.50
OMS24X-BN	4.475	4.275	2.50	2.90	100	-100	0.30
OMS24X-CU	4.475	4.275	2.50	2.90	80	-80	0.19
OMS24X-AFN	4.500	4.300	2.50	2.90	95	95	1.0
OSM24X-AFQ	4.475	4.275	2.80	3.00	100	-100	0.30
OMS24X-AFA	4.525	4.325	2.80	3.00	50	-50	0.15
OMS24X-AFB	4.550	4.350	2.50	2.90	60	-60	0.20
OMS24X-AFI	4.550	4.350	3.00	3.20	50	-50	0.10

Table 1(1/2)

Product Name	0 V Battery Charge Function	Power-down Function	Overcharge Delay Time	Over-discharge Delay Time	Discharge Overcurrent Delay Time	Charge Overcurrent Delay Time	Short Circuit Delay Time
			T_{OC}（S）	T_{OD}(mS)	T_{DIP}(mS)	T_{CIP}(mS)	T_{SIP}(μs)
OMS24X-AB	Unavailable	Unavailable	1.0	32	16	8	280
OMS24X-ES	Available	Available	1.0	64	32	8	280
OMS24X-BQ	Available	Available	1.0	64	8	8	280
OMS24X-BA	Available	Available	1.0	32	8	8	280
OMS24X-AY	Unavailable	Unavailable	1.0	32	8	8	280
OMS24X-AD	Unavailable	Unavailable	1.0	64	16	8	280
OMS24X-AE	Available	Unavailable	1.0	32	8	8	280
OMS24X-AN	Available	Available	1.0	128	8	8	280
OMS24X-AP	Unavailable	Unavailable	1.0	32	16	16	530
OMS24X-AT	Available	Available	1.0	32	8	8	280
OMS24X-AV	Available	Available	1.0	32	8	8	280
OMS24X-AZ	Available	Unavailable	1.0	64	8	8	280
OMS24X-BM	Available	Unavailable	1.0	64	8	8	280
OMS24X-BW	Available	Unavailable	1.0	64	8	8	280
OMS24X-BX	Available	Unavailable	1.0	64	8	8	280
OMS24X-CB	Available	Unavailable	1.0	32	8	8	280
OMS24X-CI	Unavailable	Unavailable	1.0	32	16	8	280
OMS24X-CW	Unavailable	Available	1.0	32	16	16	280
OMS24X-FB	Available	Unavailable	1.0	96	32	32	300
OMS24X-BN	Available	Available	1.0	20	12	8	300
OMS24X-CU	Unavailable	Unavailable	1.0	32	8	8	280
OMS24X-AFN	Available	Unavailable	1.0	96	12	16	300
OSM24X-AFQ	Unavailable	Available	1.0	64	16	16	300
OMS24X-AFA	Available	Unavailable	1.0	96	16	8	300
OMS24X-AFB	Unavailable	Unavailable	1.0	96	16	8	300
OMS24X-AFI	Unavailable	Available	1.0	64	16	16	300

PIN CONFIGURATIONS

Table 2 Pin description

DFN1212
Top View

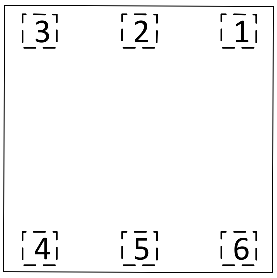
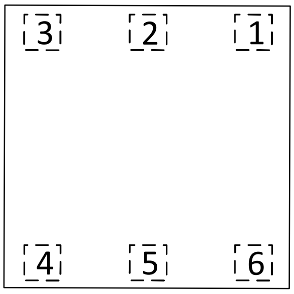


Figure 2

Pin No.	Symbol	Description
1	NC	No connection
2	OC	FET gate control pin for discharge (CMOS output)
3	OD	FET gate control pin for charge (CMOS output)
4	VSS	Negative power input
5	V_{DD}	Positive power input
6	CS	Overcurrent / charger detection

DFN1916
Top View



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5	V_{DD}	Positive power input
6	CS	Overcurrent / charger detection

Package and Ordering information

Part No.	Package	Qty of Reel
OMS240-XXX	DFN1212	5000PCS
OMS241-XXX	DFN1916	5000PCS

ABSOLUTE MAXIMUM RATINGS

Table 3 (Ta=+25°C unless otherwise specified)

Item	Symbol	Applied pin	Absolute Maximum Rating	Unit
Input voltage between V_{DD} and V_{SS}	V_{DS}	V_{DD}	V_{SS}-0.3~V_{SS}+12	V
Input pin voltage for CS	V_{CS}	CS	V_{DD}-30~V_{DD}+0.3	V
Output pin voltage for OD	V_{OD}	OD	V_{SS}-0.3~V_{DD}+0.3	V
Output pin voltage for OC	V_{OC}	OC	V_{CS}-0.3~V_{DD}+0.3	V
Operation temperature range	T_{opt}	-	-40~+85	°C
Storage temperature range	T_{stg}	-	-40~+125	°C
Power dissipation	P_D	-	480 (Mounted on board)	mW

Caution:

The absolute maximum ratings are rated values exceeding which the product could suffer physical damage. These values must therefore not be exceeded under any conditions.

ELECTRICAL CHARACTERISTICS (Ta=+25°C unless otherwise Specified) Table 4

Parameter	Symbol	Test condition	Min.	Typ.	Max.	Unit
INPUT VOLTAGE, OPERATION VOLTAGE RANGE						
Operating voltage between V_{DD} and V_{SS}	V_{DSOP1}	-	1.5	-	12	V
Operating voltage between V_{DD} and CS	V_{DSOP2}	-	1.5	-	30	V
CURRENT CONSUMPTION						
Operation current consumption	I_{OPE}	V_{DD}=3.5V, V_{CS}=0V	-	3.0	5.0	μA
Power-Down Current consumption (Power-Down Function Unavailable)	I_{PD}	V_{DD}=1.5V, V_{CS}: 0V rise to 1.5V	-	-	3.0	μA
Power-Down Current consumption (Power-Down Function Available)	I_{PD}	V_{DD}=1.6V, V_{CS}: 0V rise to 1.5V	-	-	0.1	μA
DETECTION VOLTAGE						
Overcharge Detection Voltage	V_{CU}	3.5~4.6V	V_{CU}-0.015	V_{CU}	V_{CU}+0.015	V
		3.1~4.6V, -10°C to 60°C	V_{CU}-0.020	V_{CU}	V_{CU}+0.020	V
Overcharge Release Voltage	V_{CR}	$V_{CR}≠V_{CU}$	V_{CR}-0.040	V_{CR}	V_{CR}+0.040	V
		$V_{CR}=V_{CU}$	V_{CR}-0.040	V_{CR}	V_{CR}+0.015	
Overdischarge Detection Voltage	V_{DL}	-	V_{DL}-0.040	V_{DL}	V_{DL}+0.040	V
Overdischarge Release Voltage	V_{DR}	-	V_{DR}-0.040	V_{DR}	V_{DR}+0.040	V
Discharge Overcurrent Detection voltage	V_{DIP}	-	V_{DIP}-5.0	V_{DIP}	V_{DIP}+5.0	mV
Load short-Circuit Detection Voltage	V_{SIP}	V_{DD}=3.5V	V_{SIP}-40.0	V_{SIP}	V_{SIP}+40.0	mV
		V_{DD}=3.5V/OMS24X-AFN	V_{SIP}-100	V_{SIP}	V_{SIP}+100	mV
Charge overcurrent detection voltage	V_{CIP}	-	V_{CIP}-5.0	V_{CIP}	V_{CIP}+5.0	mV
CONTROL PIN OUTPUT VOLTAGE LEVEL						
OD Pin Output "H" Voltage	V_{DH}	-	V_{DD}-0.1	V_{DD}-0.02	-	V
OD Pin Output "L" Voltage	V_{ODL}	-	-	0.1	0.5	V
OC Pin Output "H" Voltage	V_{CH}	-	V_{DD}-0.1	V_{DD}-0.02	-	V
OC Pin Output "L" Voltage	V_{CL}	-	-	0.1	0.5	V
0V BATTERY CHARGE FUNCTION						
0V battery charge starting charger voltage	V_{0CH}	0V battery charge "available"	-	0.7	1.5	V
0 V battery charge inhibition battery voltage	V_{OINH}	0V battery charge "unavailable"	0.5	0.7	1.5	V
OUTPUT IMPEDANCE OF CONTROL TERMINALS						
OD Pin Output impedance "H"	R_{DH}	V_{DD}=3.5V, V_{OD}=3.0V, V_{CS}=0V	1.25	2.5	10.0	KΩ
OD Pin Output impedance "L"	R_{DL}	V_{DD}=2.0V, V_{OD}=0.5V, V_{CS}=0V	1.25	2.5	10.0	KΩ
OC Pin Output impedance "H"	R_{CH}	V_{DD}=3.5V, V_{OC}=3.0V, V_{CS}=0V	1.5	3.0	10.0	KΩ
OC Pin Output impedance "L"	R_{CL}	V_{DD}=4.5V, V_{OC}=0.5V, V_{CS}=0V	15	30	60	KΩ
INTERNAL RESISTANCE						
Resistance between CS and V_{SS}	R_{CSS}	V_{DD}=3.5V, V_{CS}=1.0V	20	40	80	KΩ
Resistance between CS and V_{DD}	R_{CSD}	V_{DD}=1.8V, V_{CS}=0V	100	300	900	KΩ

Delay Time Combination (Ta=+25°C, unless otherwise specified)

Table 5

Delay Time Combination (Ta=+25°C, unless otherwise specified) Table 5						
Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Overcharge Delay Time	T_{OC}	VDD=3.8~4.6V	T_{OC}*70%	T_{OC}	T_{OC}*130%	ms
Overdischarge Delay Time	T_{OD}	VDD=3.6~2.0V -	T_{OD}*70%	T_{OD}	T_{OD}*130%	ms
Discharge Overcurrent Delay Time	T_{DIP}	VDD=3.5V, VCS=0.35V	T_{DIP}*70%	T_{DIP}	T_{DIP}*130%	ms
Charge Overcurrent Delay Time	T_{CIP}	VDD=3.5V, VCS=-0.3V	T_{CIP}*70%	T_{CIP}	T_{CIP}*130%	ms
Short Circuit Delay Time	T_{SIP}	VDD=3.5V, VCS=1.6V	TSIP*70%	T_{SIP}	TSIP*130%	μs

Test Methods & Test Circuits

Remark：

Unless otherwise specified, the output voltage levels "H" and "L" at OC pin (V_{OC}) and OD pin (V_{OD}) are judged by the threshold voltage (1.0V) of the N-channel FET. Judge the OC pin level with respect to VCS and the OD pin level with respect to V_{SS}.

(1) Overcharge detection voltage, overcharge release voltage (Test Circuit 1)

Overcharge detection voltage (V_{CU}) is defined as the voltage between the V_{DD} pin and V_{SS} pin at which V_{OC} goes from "H" to "L" when the voltage V1 is gradually increased from the starting condition of V1=3.5V. Overcharge release voltage (V_{CR}) is defined as the voltage between the V_{DD} pin and V_{SS} pin at which V_{OC} goes from "L" to "H" when the voltage V1 is then gradually decreased.

(2) Overdischarge Detection Voltage, Overdischarge Release Voltage (Test Circuit 2)

Overdischarge detection voltage (V_{DL}) is defined as the voltage between the V_{DD} pin and V_{SS} pin at which V_{OD} goes from "H" to "L" when the voltage V1 is gradually decreased from the starting condition of V1=3.5V, V2=0V. Overdischarge release voltage (V_{DR}) is defined as the voltage between the V_{DD} pin and V_{SS} pin at which V_{OD} goes from "L" to "H" when the voltage V1 is then gradually increased.

(3) Discharge Overcurrent Detection Voltage (Test Circuit 5)

Discharge overcurrent detection voltage (V_{DIP}) is defined as the voltage between the CS pin and V_{SS} pin whose delay time for changing V_{OD} from "H" to "L" lies between the minimum and the maximum value of discharge overcurrent delay time when the voltage V5 is increased rapidly (within 10 µs) from the starting condition of V1=3.5V, V2=1.4V, V5=0V. Discharge overcurrent release voltage is defined as the voltage V2 at which V_{OD} goes form "L" to "H" when V2=3.4V,V5=0V and the voltage V2 is then gradually decreased .when the voltage V2 falls below release voltage V_{OD} will changing to "H" after 1.0ms,and maintain "H" during load short-circuiting detection delay time.

(4) Load Short-circuiting Detection Voltage (Test Circuit 2)

Load short-circuiting detection voltage (V_{SIP}) is defined as the voltage between the CS pin and V_{SS} pin whose delay time for changing V_{OD} from "H" to "L" lies between the minimum and the maximum value of load short-circuiting delay time when the voltage V5 is increased rapidly (within 10 µs) from the starting condition of V1=3.4V, V2=0V, V5=0V.

(5) Charge Overcurrent Detection Voltage (Test Circuit 2)

Charge overcurrent detection voltage (V_{CIP}) is defined as the voltage between the CS pin and V_{SS} pin whose delay time for changing V_{OC} from "H" to "L" lies between the minimum and the maximum value of charge overcurrent delay time when the voltage V2 is decreased rapidly (within 10 µs) from the starting condition of V1=3.5V, V2=0V.

(6) Operating Current Consumption (Test Circuit 2)

The operating current consumption is the current that flows through the V_{DD} pin (I_{DD}) under the set conditions of V1=3.5V and V2=0V (normal status).

(7) Power-down Current Consumption (Test Circuit 2)

Standby function

The power-down current consumption is defined as the current that flows through the V_{DD} pin (I_{DD}) after the voltage V2 rapidly increases (within 10us) from 0V to 2V, under the set conditions of V1=2V, V2=0V (overdischarge status).

(8) Resistance between CS Pin and V_{DD} Pin (Test Circuit 3)

The resistance between CS pin and V_{DD} pin (R_{CSD}) is the resistance between CS pin and V_{DD} pin under the set conditions of V1=1.8V, V2=0V.

(9) Resistance between CS Pin and V_{SS} Pin (Test Circuit 3)

The resistance between CS pin and V_{DD} pin (R_{CSS}) is the resistance between CS pin and V_{DD} pin under the set conditions of V1=1.8V, V2=0V.

(10) OC Pin Resistance "H" (Test Circuit 4)

The OC pin resistance "H" (R_{CH}) is the resistance at the OC pin under the set conditions of V1=3.5V, V2=0V, V3=3.0V.

(11) OC Pin Resistance "L" (Test Circuit 4)

The OC pin resistance "L" (R_{CL}) is the resistance at the CO pin under the set conditions of V1=4.5V, V2=0V, V3=0.5V.

(12) OD Pin Resistance "H" (Test Circuit 4)

The OD pin H resistance (R_{DH}) is the resistance at the OD pin under the set conditions of V1=3.5V, V2=0V, V4=3.0V.

(13) OD Pin Resistance "L" (Test Circuit 4)

The OD pin L resistance (R_{DL}) is the resistance at the OD pin under the set conditions of V1=2.5V, V2=0V, V4=0.5V.

(14) Overcharge Detection Delay Time (Test Circuit 5)

The overcharge detection delay time (T_{OC}) is the time needed for V_{OC} to change from "H" to "L" just after the voltage V1 rapidly increases (within 10µs) from overcharge detection voltage (V_{CU}) −0.2V to overcharge detection voltage (V_{CU}) +0.2V under the set condition of V2=0V.

(15) Overdischarge Detection Delay Time (Test Circuit 5)

The overdischarge detection delay time (T_{OD}) is the time needed for V_{OD} to change from "H" to "L" just after the voltage V1 rapidly decreases (within 10µs) from overcharge detection voltage (V_{DL}) +0.2V to overcharge detection voltage (V_{DL}) −0.2V under the set condition of V2=0V.

(16) Discharge Overcurrent Detection Delay Time (Test Circuit 5)

Discharge overcurrent detection delay time (T_{DIP}) is the time needed for V_{OD} to go to "L" after the voltage V2 rapidly increases (within 10µs) from 0 V to 0.35V under the set conditions of V1=3.5V, V2=0V.

(17) Load Short-circuiting Detection Delay Time (Test Circuit 5)

Load short-circuiting detection delay time (T_{SIP}) is the time needed for V_{OD} to go to "L" after the voltage V2 rapidly increases (within 10µs) from 0 V to 1.6V under the set conditions of V1=3.5V, V2=0V.

(18) Charge Overcurrent Detection Delay Time (Test Circuit 5)

Charge overcurrent detection delay time (T_{CIP}) is the time needed for V_{OC} to go to "L" after the voltage V2 rapidly decreases (within 10µs) from 0V to −0.3V under the set conditions of V1=3.5V, V2=0V.

(19) 0 V Battery Charge Starting Charger Voltage ("Available") (Test Circuit 2)

The 0V charge starting charger voltage (V_{0CH}) is defined as the voltage between the V_{DD} pin and CS pin at which V_{OC} goes to "H" (V_{CS} +0.1V or higher) when the voltage V2 is gradually decreased from the starting condition of V1=V2=0V.

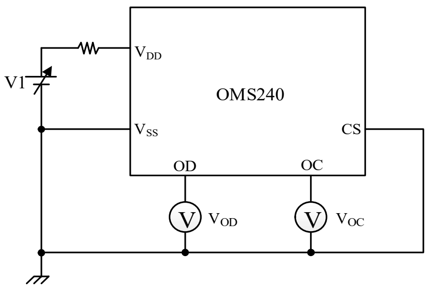


Figure 3 (Test Circuit 1)

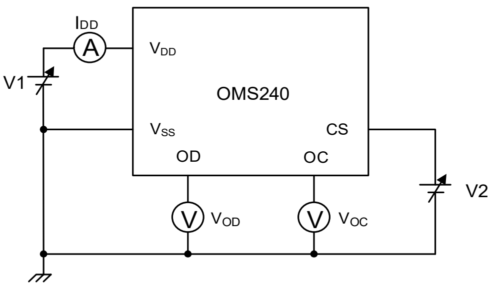


Figure 4 (Test Circuit 2)

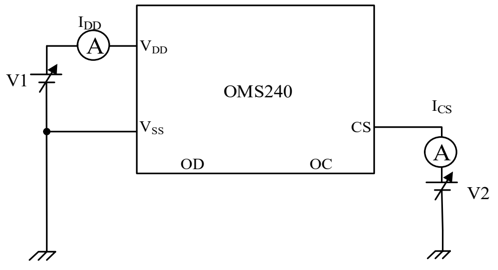


Figure 5 (Test Circuit 3)

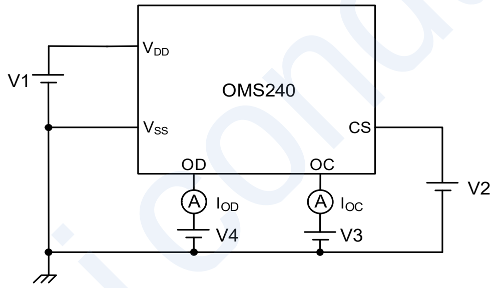


Figure 6 (Test Circuit 4)

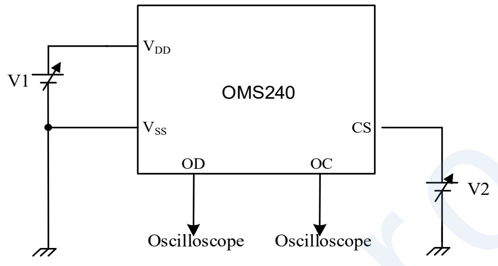


Figure 7 (Test Circuit 5)

TYPICAL APPLICATION

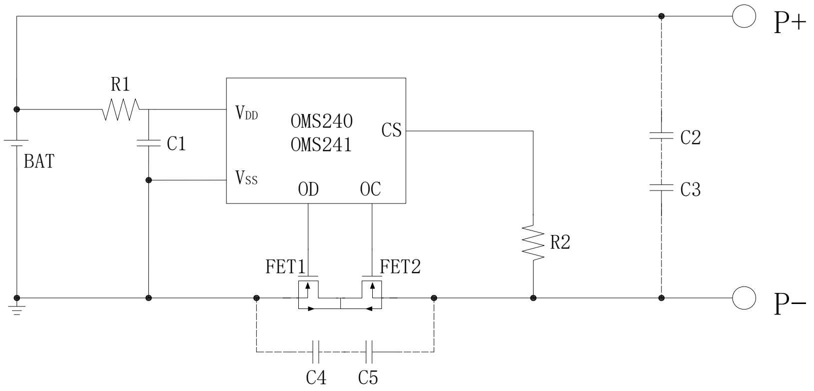


Figure 8

Table 6 Constants for External Components

Symbol	Device Name	Purpose	Min.	Typ.	Max	Remark
FET1	N-MOSFET	Discharge Control	-	-	-	*1
FET2	N-MOSFET	Charge Control	-	-	-	*2
R1	Resistor	Current limit, Stabilize V_{DD} and Strengthen ESD Protection	100Ω	100Ω	330Ω	*3
R2	Resistor	Current limit,	300Ω	2kΩ	4kΩ	*4
C1	Capacitor	Stabilize V_{DD}	0.022μF	0.1μF	1.0μF	*5
C2, C3	Capacitor	Enhanced ESD and EMI	-	0.1μF	-	*6
C4, C5	Capacitor	Enhanced anti surge capability	-	0.1μF	-	*7

APPLICATION HINTS:

*1. If the FET with a threshold voltage which is equal to or higher than the over-discharge detection voltage is applied, discharging function may be stopped before over-discharge is detected.

*2. If the FET's voltage tolerance between the gate and source is lower than the charger voltage, the FET may be destroyed.

*3. R1 should be as small as possible to avoid lowering the overcharge detection accuracy due to current consumption. When a charger is connected in reverse; the current flows from the charger to the IC. At this time, if R1 has a high resistance, the voltage between V_{DD} pin and V_{SS} pin may exceed the absolute maximum rating.

*4. If R2 has a resistance higher than 4kΩ, the charging current may not be cut when a high-voltage charger is connected. Please select as large a resistance as possible to prevent current when a charger is connected in reverse.

*5. C1 will stabilize the supply voltage of V_{DD}; the value of C1 should be equal to or more than 0.022μF.

*6. C2 C3 can be enhanced ESD and EMI, It's not necessary. It can be chosen according to the actual application scenarios

*7. C4 C5 can be enhance the ability of surge current, It's not necessary. It can be chosen according to the actual application scenarios

Caution: 1.The above constants may be changed without notice.

2. 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 constant do not guarantee proper operation. Perform thorough evaluation using the actual application to set the constant.

OPERATION

Reference the "Typical Application".

(1) Normal Status

The OMS240/OMS241 monitors the voltage of the battery connected to V_{DD} and V_{SS} pins and the voltage difference between CS and V_{SS} pins to control charging and discharging. When the battery voltage is in the range from the Overdischarge detection voltage (V_{DL}) to the overcharge detection voltage (V_{CU}) charger detection voltage (V_{CIP}) equal to or lower than a specified value, the IC turns both the charging and discharging control FETs on. This status is called normal status and in this status charging and discharging can be carried out freely. The resistance (R_{CSD}) between the CS pin and the V_{DD} pin, and the resistance (R_{CSS}) between the CS pin and the V_{SS} pin are not connected in the normal status.

Caution:

When the battery is connected for the first time, discharging may not be enabled. In this case, short the CS pin and the V_{SS} pin, or set the CS pin's voltage at the level of the charger detection voltage (V_{CIP}) or more and the discharge overcurrent detection voltage (V_{DIP}) or less by connecting the charger. The OMS240/OMS241 Series then returns to the normal status.

(2) Overcharge status

When the battery voltage becomes higher than overcharge detection voltage (V_{CU}) during charging in the normal status and detection continues for the overcharge detection delay time (T_{OC}) or longer, the OMS240/OMS241 Series turns the charging control FET off to stop charging. This condition is called the overcharge status. The resistance (R_{CSD}) between the CS pin and the V_{DD} pin, and the resistance (R_{CSS}) between the CS pin and the V_{SS} pin are not connected in the overcharge status.

The overcharge status is released in the following two cases:

a. In the case that the CS pin voltage is higher than or equal to charger detection voltage (V_{CIP}), and is lower than the discharge overcurrent detection voltage (V_{DIP}), the OMS240/OMS241 Series releases the overcharge status when the battery voltage falls below the overcharge release voltage (V_{CR}).

b. In the case that the CS pin voltage is higher than or equal to the discharge overcurrent detection voltage (V_{DIP}), the OMS240/OMS241 Series releases the overcharge status when the battery voltage falls below the overcharge detection voltage (V_{CU}).

When the discharge is started by connecting a load after the overcharge detection, the CS pin voltage rises more than the voltage at the V_{SS} pin due to the V_f voltage of the parasitic diode. This is because the discharge current flows through the parasitic diode in the charging control FET. If the CS pin voltage is higher than or equal to the discharge overcurrent detection voltage (V_{DIP}), the OMS240/OMS241 Series releases the overcharge status when the battery voltage is lower than or equal to the overcharge detection voltage (V_{CU}).

Caution:

1.If the battery is charged to a voltage higher than overcharge detection voltage (V_{CU}) and the battery voltage does not fall below overcharge detection voltage (V_{CU}) even when a heavy load is connected, discharge overcurrent detection and load short-circuiting detection do not function until the battery voltage falls below overcharge detection voltage (V_{CU}).Since an actual battery has an internal impedance of tens of mΩ, the battery voltage drops immediately after a heavy load that causes overcurrent is connected, and discharge overcurrent detection and load short-circuiting detection function.

2.When a charger is connected after overcharge detection, the overcharge status is not released even if the battery voltage is below overcharge release voltage (V_{CR}).The overcharge status is released when the CS pin voltage goes over charger detection voltage (V_{CIP}) by removing the charger.

(3) Overdischarge status

With power-down function

When the battery voltage falls below Overdischarge detection voltage (V_{DL}) during discharging in the normal status and the detection continues for the Overdischarge detection delay time (T_{OD}) or longer, the OMS240/OMS241 Series turns the discharging control FET off to stop discharging. This condition is called the Overdischarge status.

Under the Overdischarge status, the CS pin voltage is pulled up by the resistor between the CS pin and the V_{DD} pin in the OMS240/OMS241 Series (R_{CSD}).When voltage difference between the CS pin and the V_{DD} pin then is 1.3 V typ. or lower, the current consumption is reduced to the power-down current consumption (I_{PD}).This condition is called the power-down status. The resistance (R_{CSS}) between the CS pin and the V_{SS} pin is not connected in the power-down status and the Overdischarge status.

The power-down status is released when a charger is connected and the voltage difference between the CS pin and the V_{DD} pin becomes 1.3 V typ. or higher. When a battery in the Overdischarge status is connected to a charger and provided that the CS pin voltage is lower than the charger detection voltage (V_{CIP}), the OMS240/OMS241 Series releases the Overdischarge status and turns the discharging FET on when the battery voltage reaches Overdischarge detection voltage (V_{DL}) or higher. When a battery in the Overdischarge status is connected to a charger and provided that the CS pin voltage is not lower than the charger detection voltage (V_{CIP}), the OMS240/OMS241 Series releases the Overdischarge status when the battery voltage reaches Overdischarge release voltage (V_{DR}) or higher.

Auto release function(With power-down function)

When the battery voltage falls below the overdischarge detection voltage (V_{DL}) during discharging under the normal status and the detection continues for the overdischarge detection delay time (t_{DL}) or longer, the OMS261 Series turns the discharging control FET off to stop discharging. This status is called the overdischarge status. When the discharging control FET is turned off, the CS pin voltage is pulled up by the resistor between CS and VDD in the IC (R_{CSD}).When the battery voltage becomes the overdischarge detection voltage (V_DL) or higher, the OMS261 Series turns the discharging FET on and returns to the normal status.

(4) Discharge overcurrent status (discharge overcurrent, load short-circuiting)

When a battery in the normal status is in the status where the voltage of the CS pin is equal to or higher than the discharge overcurrent detection voltage (V_{DIP}) because the discharge current is higher than the specified value and the status lasts for the discharge overcurrent detection delay time (T_{DIP}), the discharge control FET is turned off and discharging is stopped. This status is called the discharge overcurrent status.

In the discharge overcurrent status, the CS pin and the V_{SS} pin are shorted by the resistor between the CS pin and the V_{SS} pin (R_{CSS}) in the OMS240/OMS241 Series. However, the voltage of the CS pin is at the V_{DD} potential due to the load as long as the load is connected. When the load is disconnected completely, the CS pin returns to the V_{SS} potential. If the OMS240/OMS241 Series detects that the voltage of the CS pin returns to discharge overcurrent detection voltage (V_{DIP}) or lower, the discharge overcurrent status is restored to the normal status.

The OMS240/OMS241 Series will be restored to the normal status from discharge overcurrent detection status even when the voltage of the CS pin becomes the discharge overcurrent detection voltage (V_{DIP}) or lower by connecting the charger. The resistance (R_{CSD}) between the CS pin and the V_{DD} pin is not connected in the discharge overcurrent detection status.

(5) Charge current status

When a battery in the normal status is in the status where the voltage of the CS pin is lower than the charge overcurrent detection voltage (V_{CIP}) because the charge current is higher than the specified value and the status lasts for the charge overcurrent detection delay time(T_{CIP}), the charge control FET is turned off and charging is stopped. This status is called the charge overcurrent status.

The OMS240/OMS241 Series will be restored to the normal status from the charge overcurrent status when, the voltage at the CS pin returns to charge overcurrent detection voltage (V_{CIP}) or higher by removing the charger. The charge overcurrent detection function does not work in the overdischarge status. The resistance (R_{CSD}) between the CS pin and V_{DD} pin, and the resistance (R_{CSS}) between the CS pin and V_{SS} pin are not connected in the charge overcurrent status.

(6) 0 V battery charge function "available"

This function is used to recharge a connected battery whose voltage is 0 V due to self-discharge. When the 0 V battery charge starting charger voltage (V_{0CH}) or a higher voltage is applied between the P+ pin and P− pin by connecting a charger, the charging control FET gate is fixed to the V_{DD} pin voltage. When the voltage between the gate and source of the charging control FET becomes equal to or higher than the turn-on voltage due to the charger voltage, the charging control FET is turned on to start charging. At this time, the discharging control FET is off and the charging current flows through the internal parasitic diode in the discharging control FET. When the battery voltage becomes equal to or higher than Overdischarge release voltage (V_{DR}), the OMS240/OMS241 Series enters the normal status.

Caution:

1. Some battery providers do not recommend charging for a completely self-discharged battery. Please ask the battery provider to determine whether to enable or inhibit the 0 V battery charging function.

2. The 0 V battery charge function has higher priority than the charge overcurrent detection function. Consequently, a product in which use of the 0V battery charging function is enabled charges a battery forcibly and the charge overcurrent cannot be detected when the battery voltage is lower than overdischarge detection voltage (V_{DL}).

(7) 0V battery charge function "unavailable"

This function inhibits recharging when a battery that is internally short-circuited (0 V battery) is connected. When the battery voltage is the 0 V battery charge inhibition battery voltage (V_{0INH}) or lower, the charge control FET gate is fixed to the P- pin voltage to inhibit charging. When the battery voltage is V_{0INH} or higher, charging can be performed.

Caution: Some battery providers do not recommend charging for a completely self-discharged lithium-ion rechargeable battery. Please ask the battery provider to determine whether to enable or inhibit the 0 V battery charge function.

TIMING CHART

(1) Overcharge detection, Overdischarge detection (The charger is assumed to charge with a constant current)

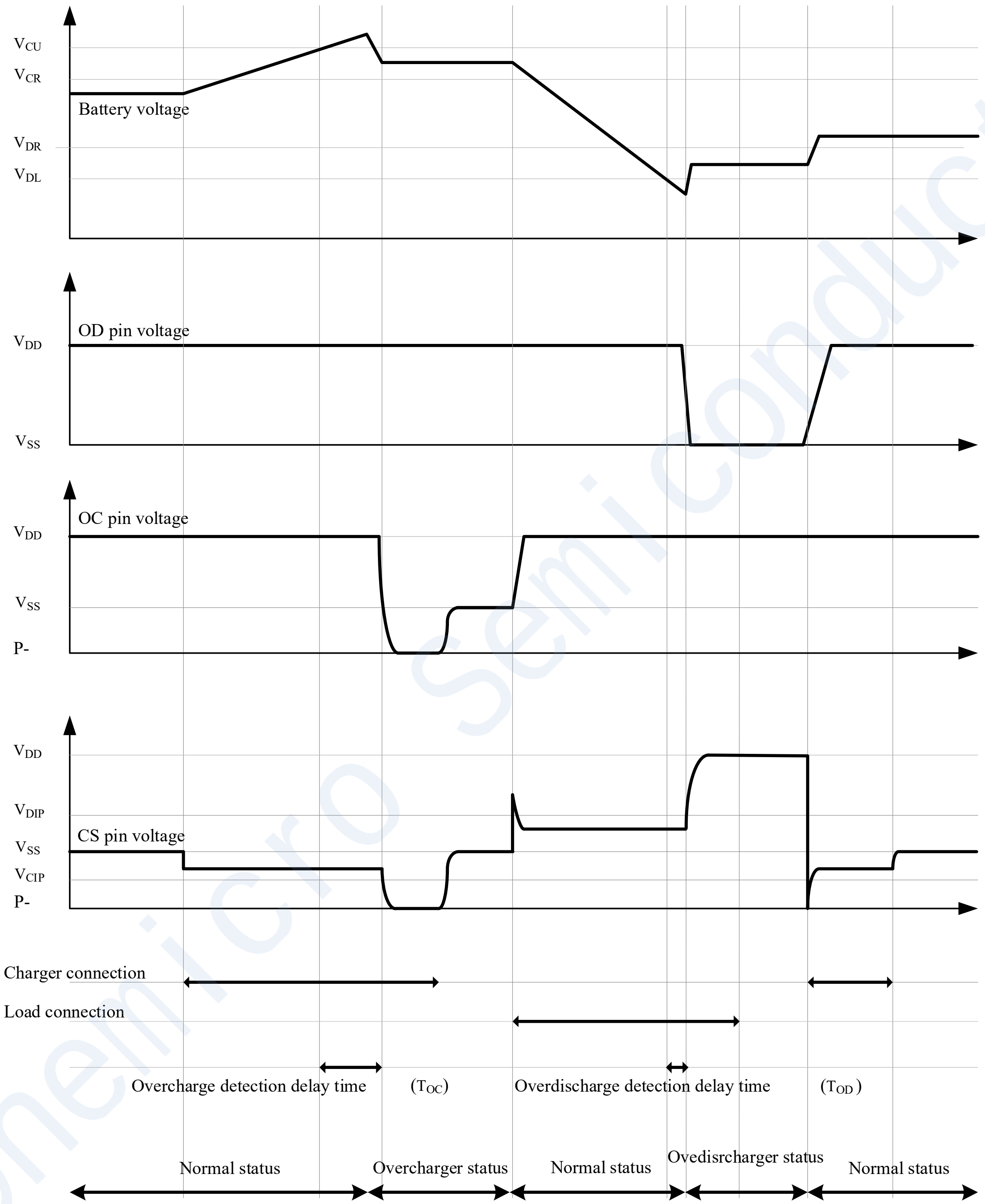


Figure 9

(2) Discharge overcurrent detection

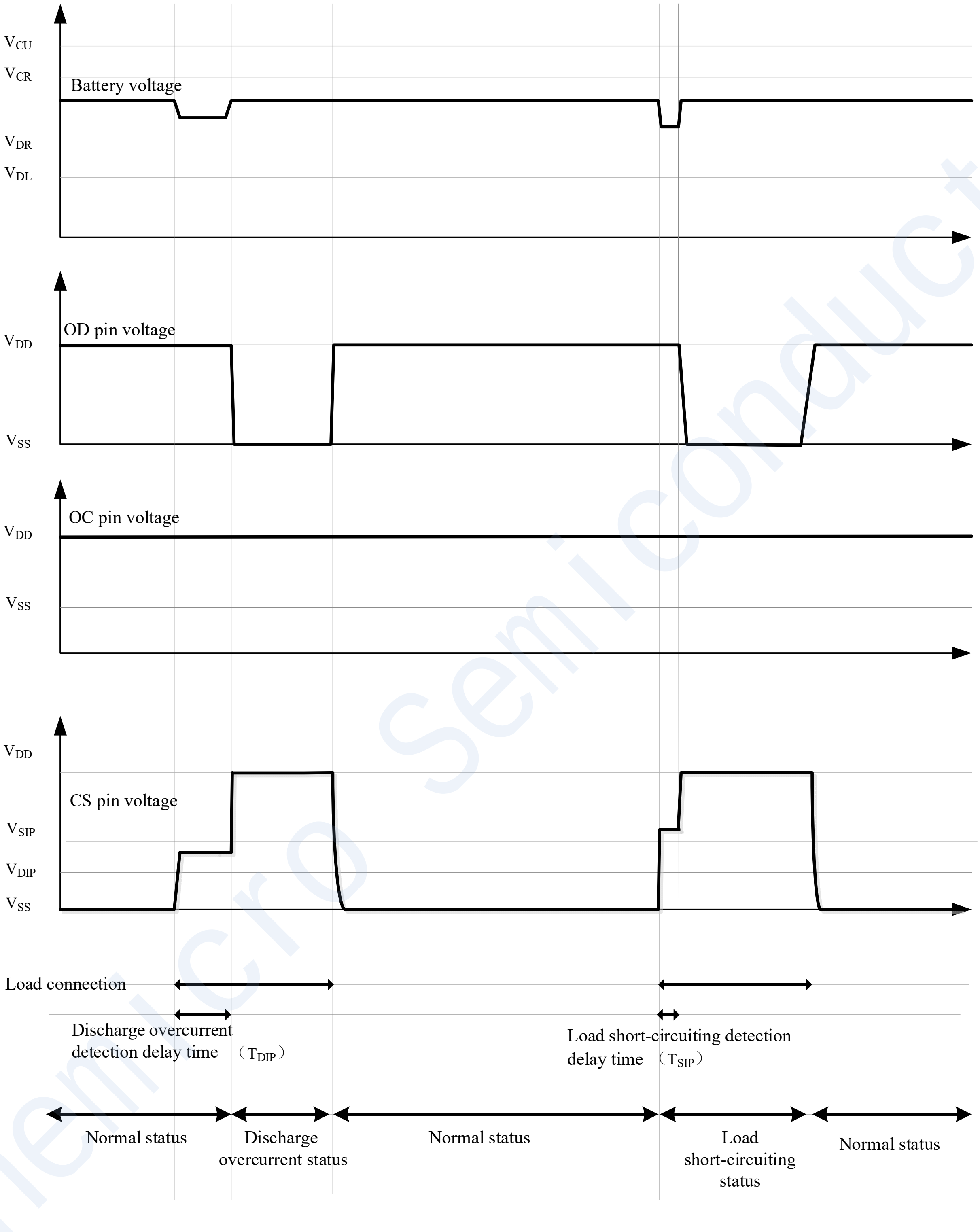


Figure 10

(3) Charger detection (The charger is assumed to charge with a constant current)

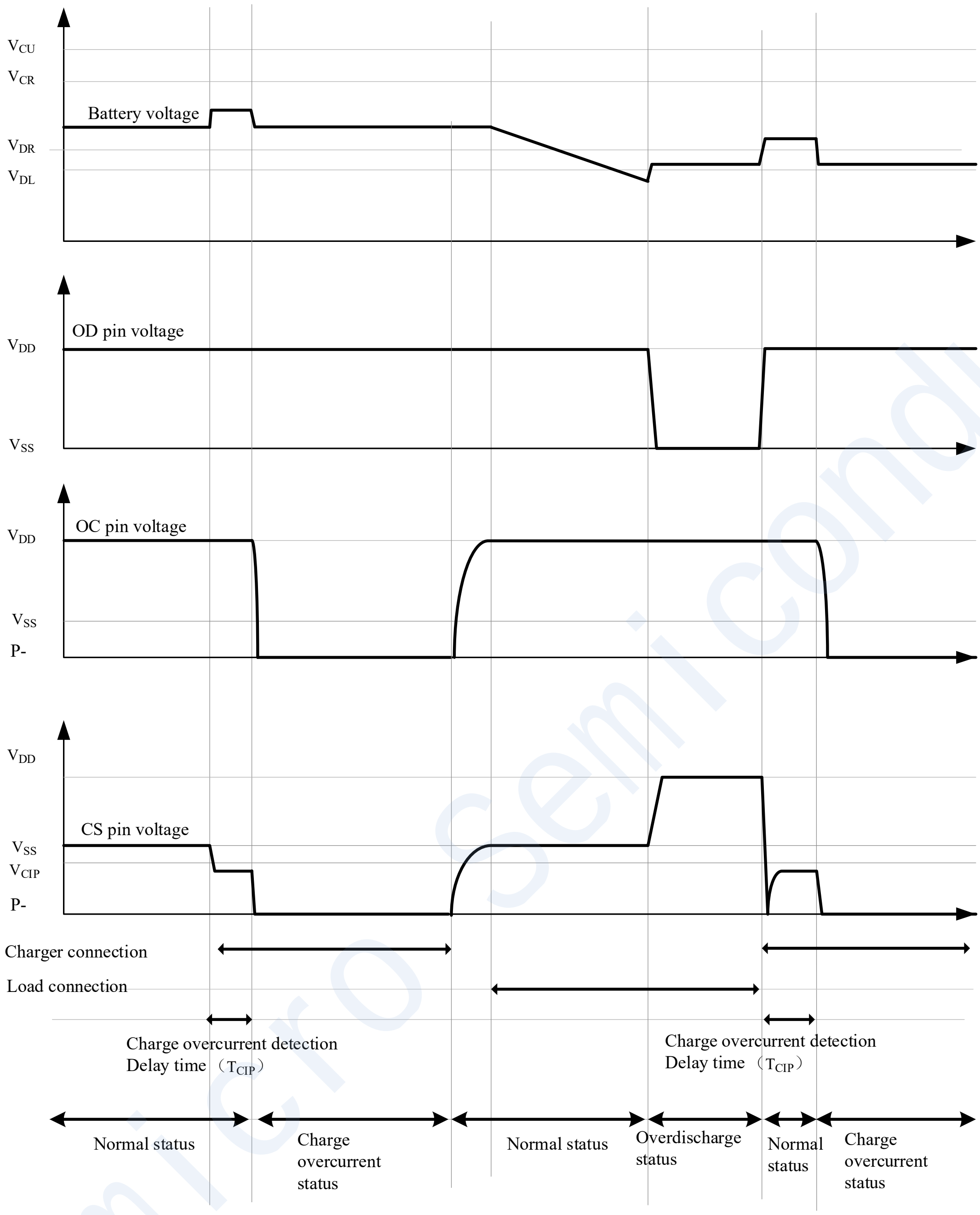


Figure 11

CHARACTERISTICS (TYPICAL DATA)

(1) Current consumption

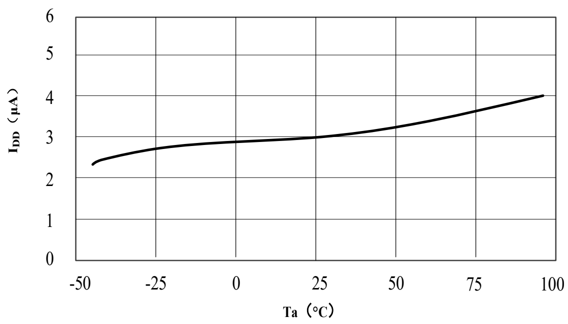


Figure 12 <**I_{DD}-Ta**>

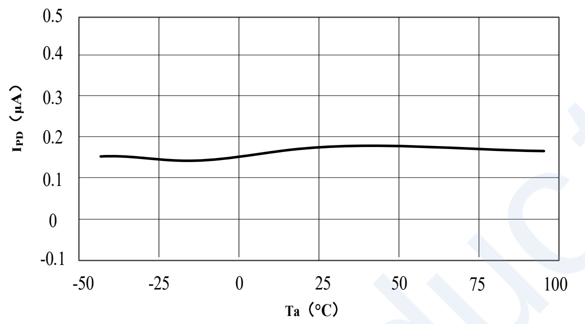


Figure 13 <**I_{PD}-Ta**>

(2) Overcharge detection / release voltage, overdischarge detection / release voltage, overcurrent detection voltage, and corresponding delay time

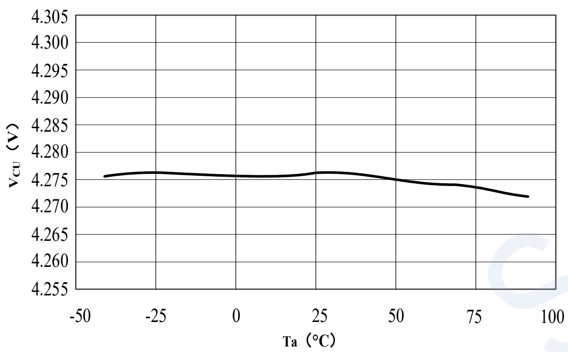


Figure 14 <**V_{CU}-Ta**>

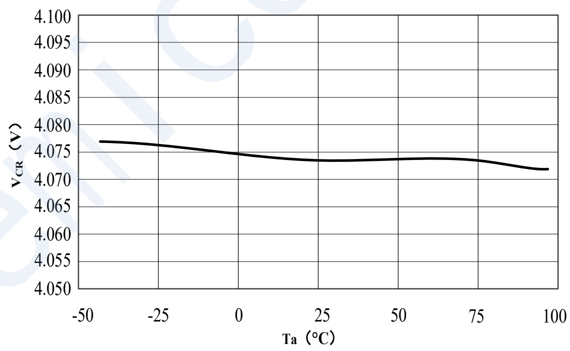


Figure 15 <**V_{CR}-Ta**>

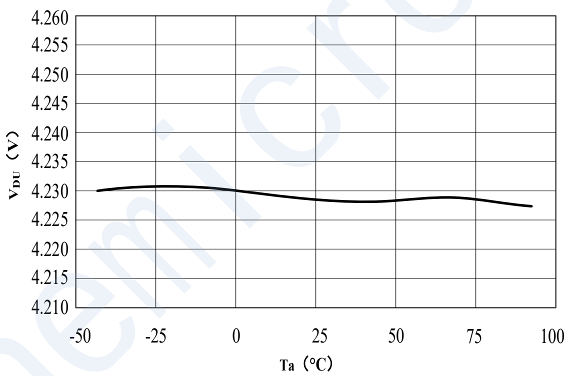


Figure 16 <**V_{DL}-Ta**>

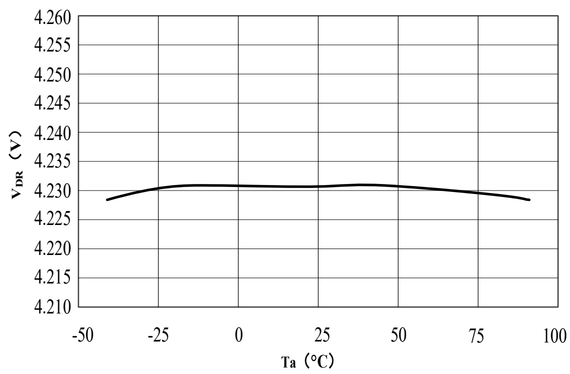


Figure 17 <**V_{DR}-Ta**>

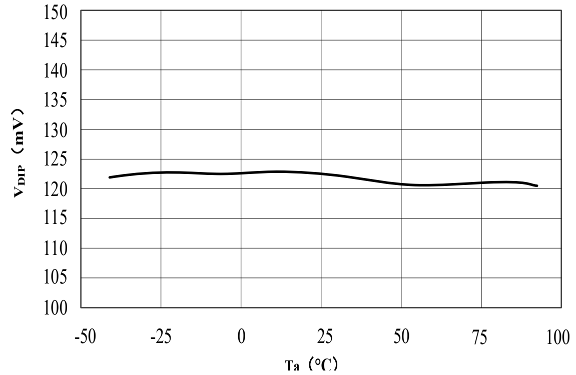


Figure 18 <**VDIP-Ta**>

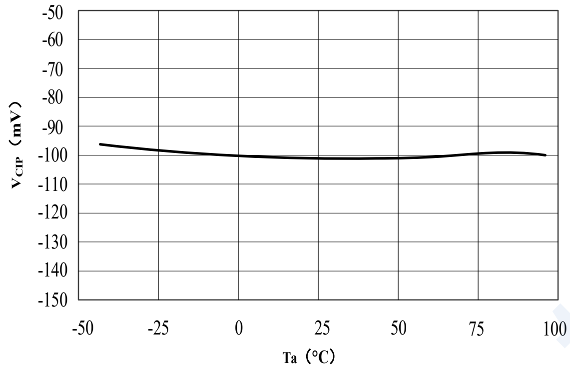


Figure 19 <**VCIP-Ta**>

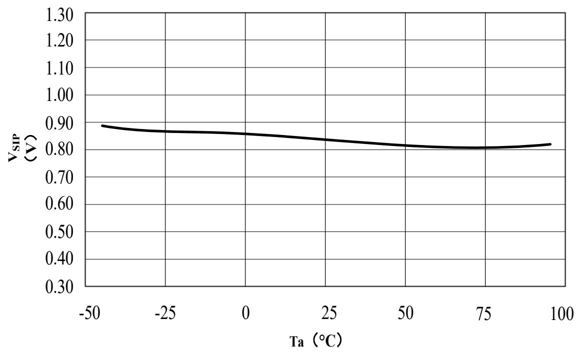


Figure 20 <**VSIP-Ta**>

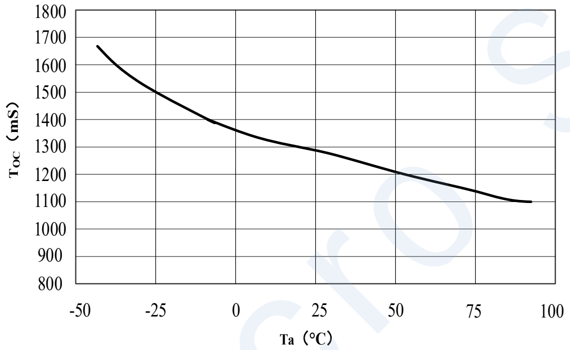


Figure 21 <**TOC-Ta**>

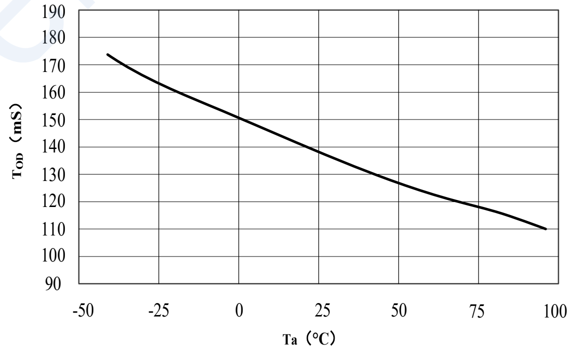


Figure 22 <**TOD-Ta**>

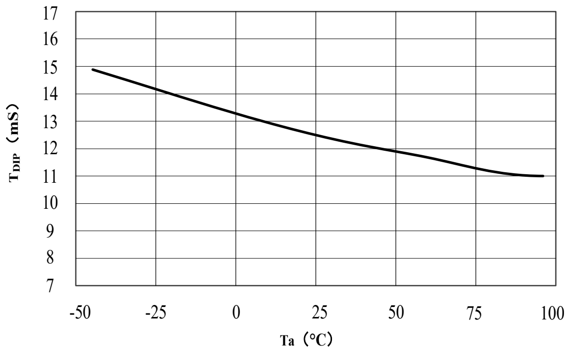


Figure 23 **<T_{DIP}-Ta>**

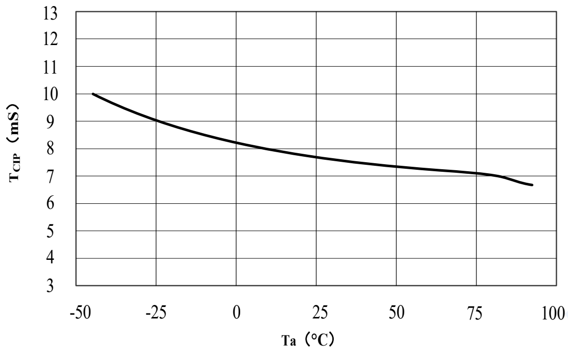


Figure 24 **<T_{CIP}-Ta>**

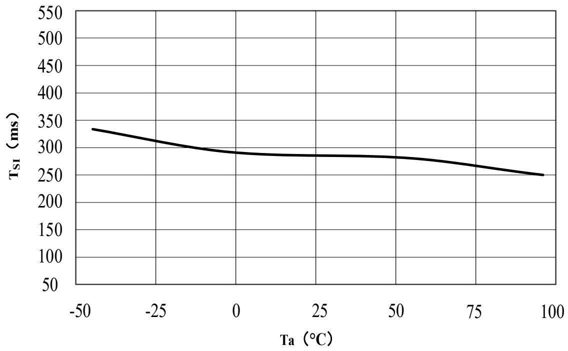
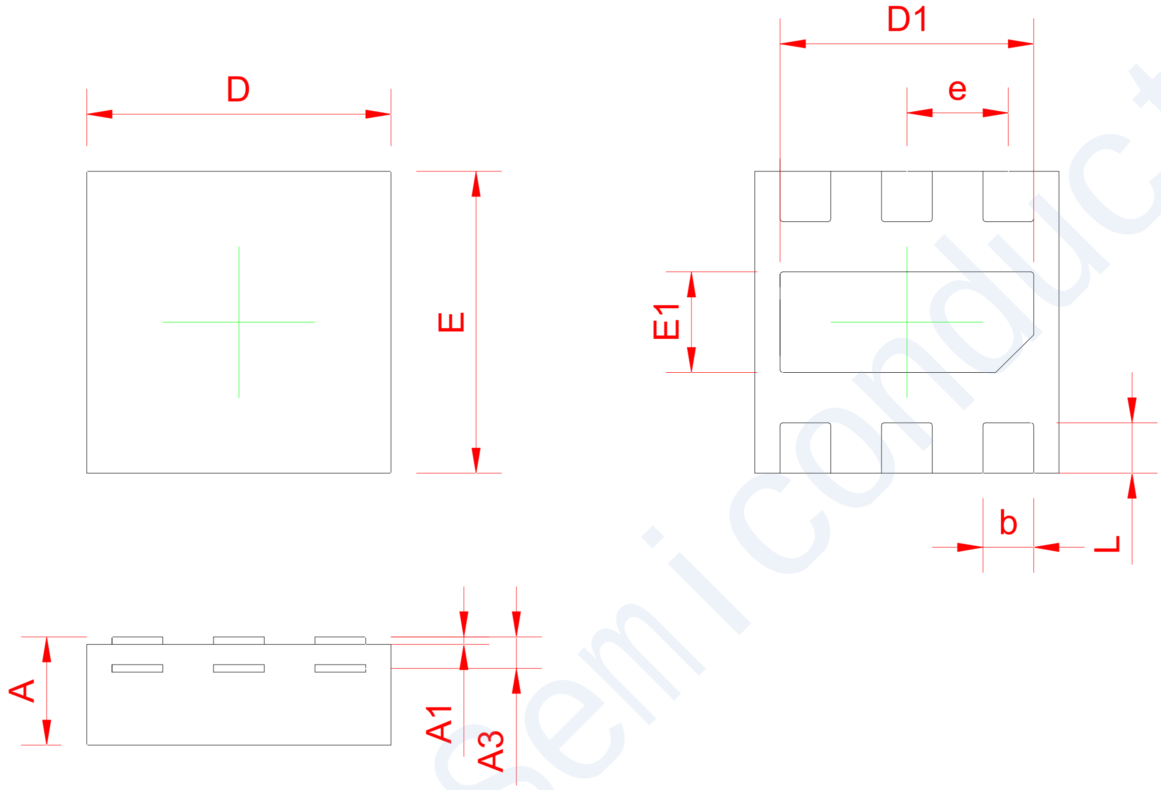


Figure 23 <T_{SIP}-Ta>

PACKAGE SPECIFICATIONS

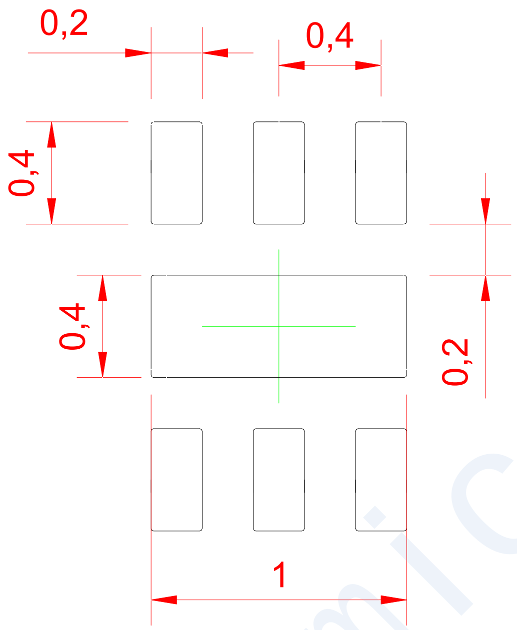
DFN1212(1.2X1.2-6L) PACKAGE OUTLINE DIMENSIONS



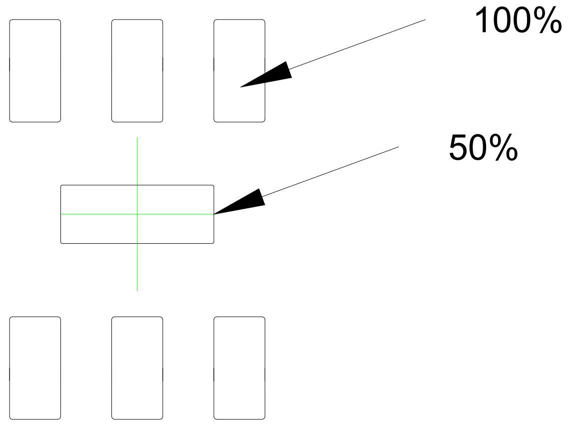
Symbol	Dimension in Millimeters		Dimension in Inches	
	Min	Max	Min	Max
A	0.35	0.40	0.013	0.016
A1	0.000	0.020	0.000	0.002
A3	0.110REF		0.004REF	
D	1.150	1.250	0.044	0.050
E	1.150	1.250	0.044	0.050
D1	0.840	1.040	0.033	0.041
E1	0.350	0.450	0.008	0.016
b	0.200REF		0.008REF	
e	0.400REF		0.016REF	
L	0.150	0.25	0.006	0.01

DFN1212(1.2X1.2-6L) PACKAGE LAYOUT SUGGEST DIMENSIONS

LAYOUT SUGGEST DIMENSIONS

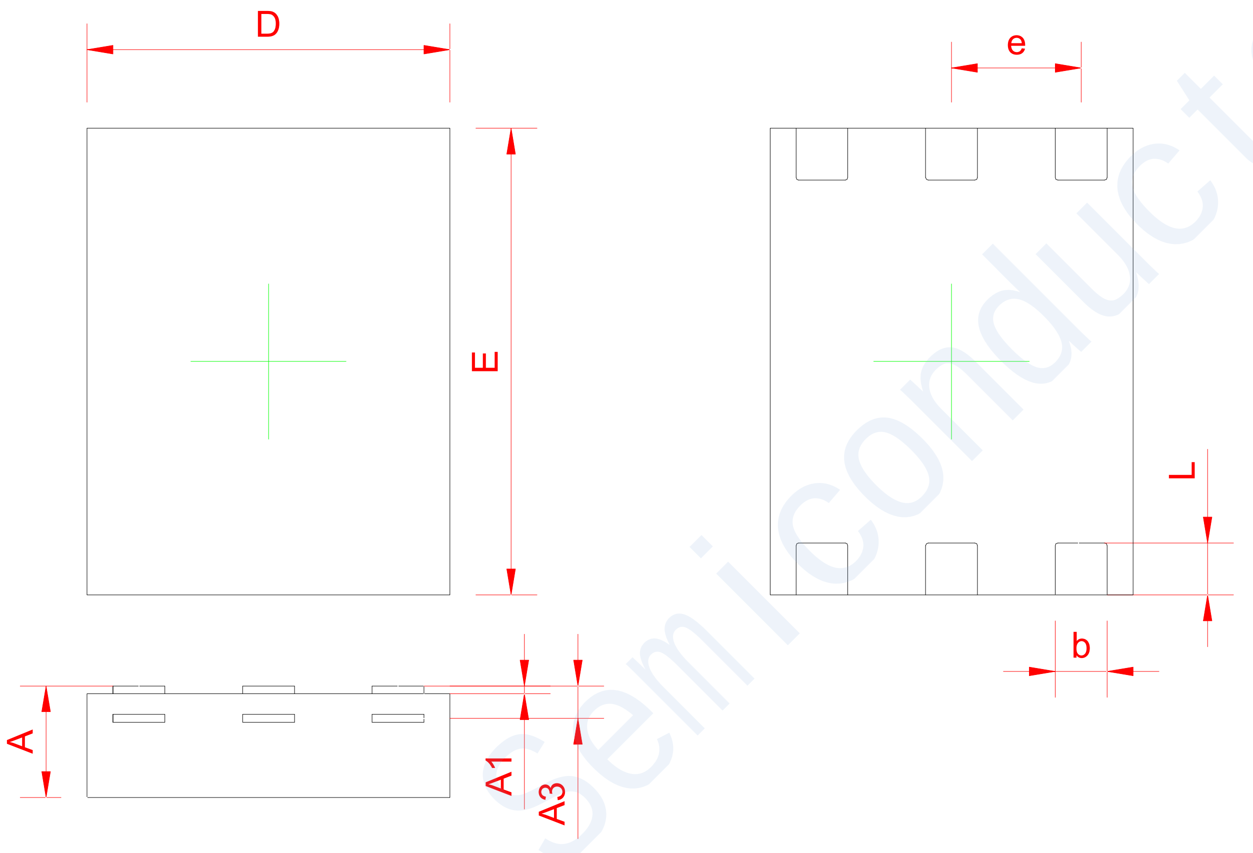


SUGGEST MASK DIMENSIONS



PACKAGE SPECIFICATIONS

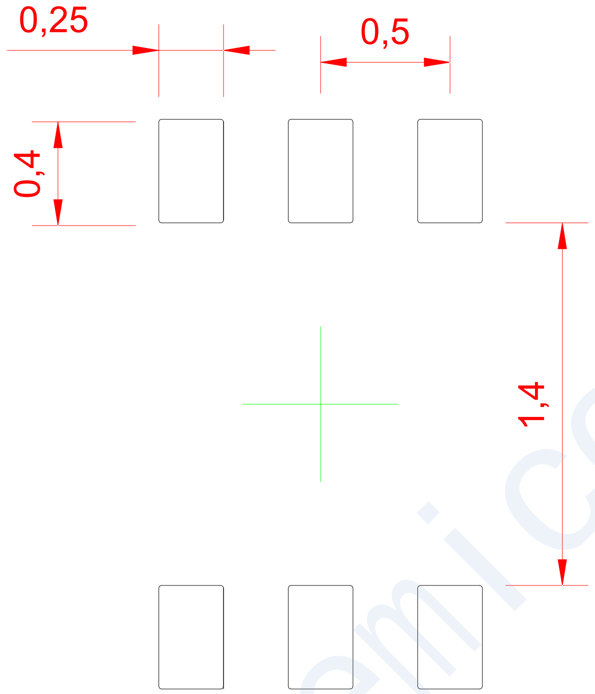
DFN1916(1.9X1.6-6L) PACKAGE OUTLINE DIMENSIONS



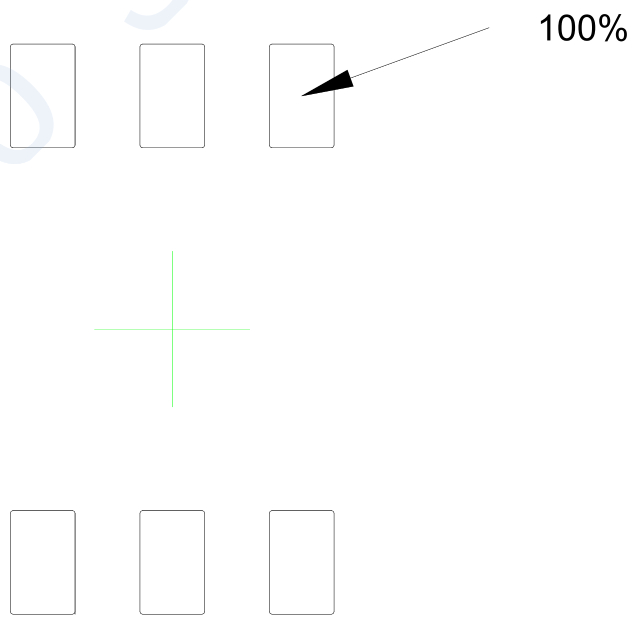
Symbol	Dimension in Millimeters		Dimension in Inches	
	Min	Max	Min	Max
A	0.35	0.40	0.013	0.016
A1	0.000	0.020	0.000	0.002
A3	0.110REF		0.004REF	
D	1.550	1.650	0.053	0.057
E	1.850	1.950	0.069	0.073
E1	0.350	0.450	0.008	0.016
b	0.250REF		0.010REF	
e	0.500REF		0.019REF	
L	0.300	0.35	0.008	0.010

DFN1916(1.9X1.6-6L) PACKAGE LAYOUT SUGGEST DIMENSIONS

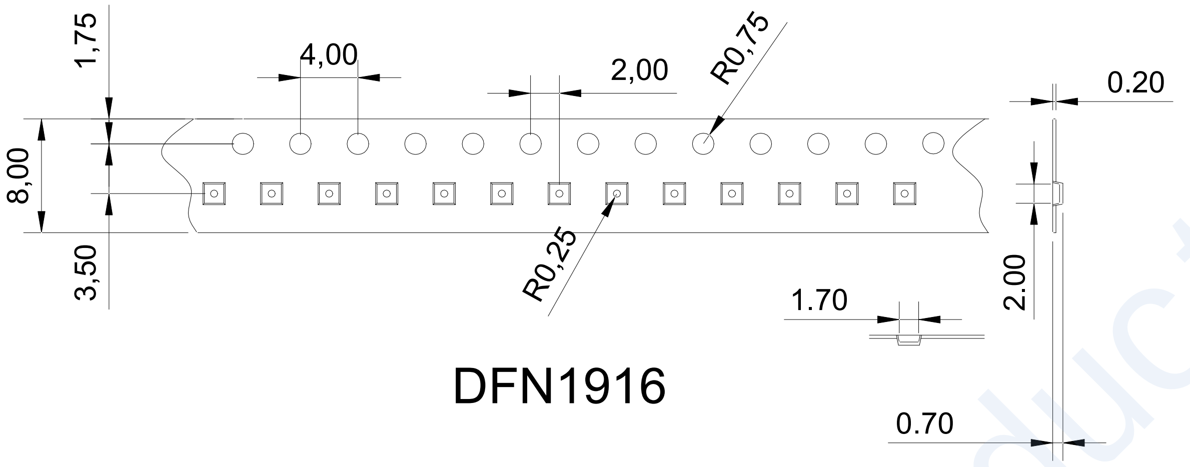
LAYOUT SUGGEST DIMENSIONS

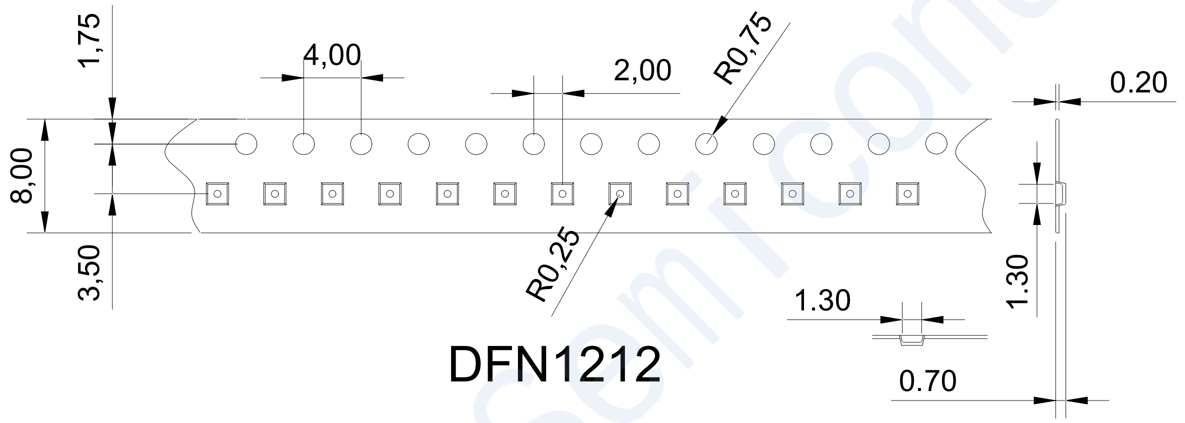


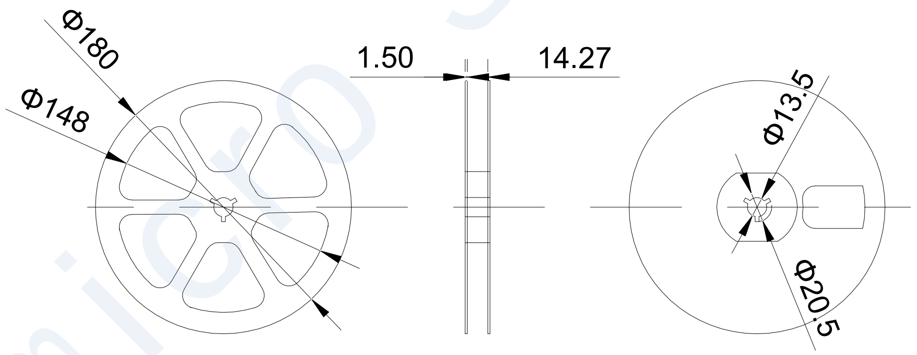
SUGGEST MASK DIMENSIONS



Package Specification







Note

a) All dimensions are in millimeters;

b) The pad color is silver.

PRECAUTIONS:

1. The application conditions for the input voltage, output voltage, and load current should not exceed the package power dissipation.
2. Do not apply an electrostatic discharge to this IC that exceeds the performance ratings of the built-in electrostatic protection circuit.
3. One-Micro Semiconductor claims no responsibility for any and all disputes arising out of or in connection with any infringement by products including this IC of patents owned by a third party.
4. The products are strictly prohibited from using, providing or exporting for the purposes of the development of weapons of mass destruction or military use. One-Micro Semiconductor is not liable for any losses, damages, claims or demands caused by any provision or export to the person or entity who intends to develop, manufacture, use or store nuclear, biological or chemical weapons or missiles, or use any other military purposes.
5. The products are not designed to be used as part of any device or equipment that may affect the human body, human life, or assets (such as medical equipment, disaster prevention systems, security systems, combustion control systems, infrastructure control systems, vehicle equipment, traffic systems, in-vehicle equipment, aviation equipment, aerospace equipment, and nuclear-related equipment), excluding when specified for in-vehicle use or other uses by One-Micro Semiconductor. Do not apply the products to the above listed devices and equipment. One-Micro Semiconductor is not liable for any losses, damages, claims or demands caused by unauthorized or unspecified use of the products.