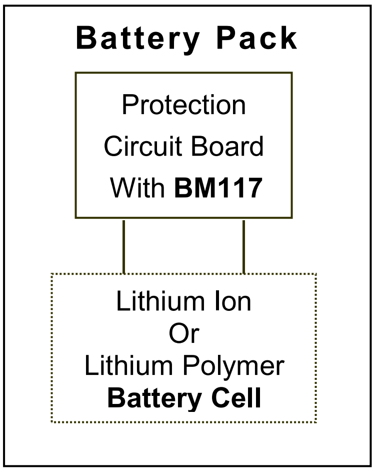
General Description

The BM117-YCSA-DE is protector for lithium-ion and lithium polymer rechargeable battery with high accuracy voltage detection. It can be used for protecting single cell lithium-ion or/and lithium polymer battery packs from overcharge, overdischarge over current and short circuit. The IC has suitable protection delay functions and low power consumption property.

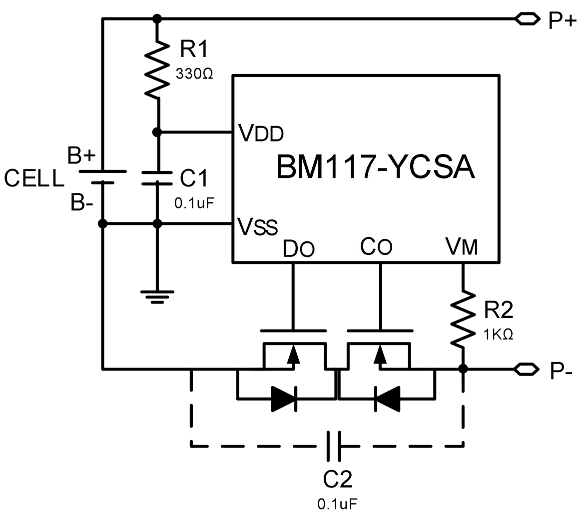
Applications



Features

- **Overcharge Detection voltage**
  - 4.495V
  - Accuracy ±20mV (25℃)
    ±45mV (-40℃~85℃)
- **Overdischarge Detection voltage**
  - 2.520V
  - Accuracy ±50mV
- **Discharge Overcurrent Detection voltage**
  - 0.060V @ V_{DD} = 3.800V
  - Accuracy ±5mV
- **Short Circuit Detection voltage**
  - Typ. 0.190V @ V_{DD} = 3.800V
  - Accuracy ±20mV
- **Low Supply Current**
  - Typ. 1.5uA @ V_{DD} = 3.400V (Standard Working)
  - Max. 0.05uA @ V_{DD} = 1.500V (Without auto wake up)
- **Small Package**
  - DFN 1.6*1.9-6L
- **ESD Rating**
  - HBM 2KV
- **Moisture Sensitivity Level 1**

Typical Application Circuits



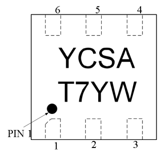
Notes

R_1 and C_1 are to stabilize the supply voltage of the BM117-YCSA-DE. R_1 C_1 is hence regarded as the time constant for V_{DD} pin. R_1 and R_2 can also be a part of current limit circuit for the BM117-YCSA-DE. Recommended values of these elements are as follows:

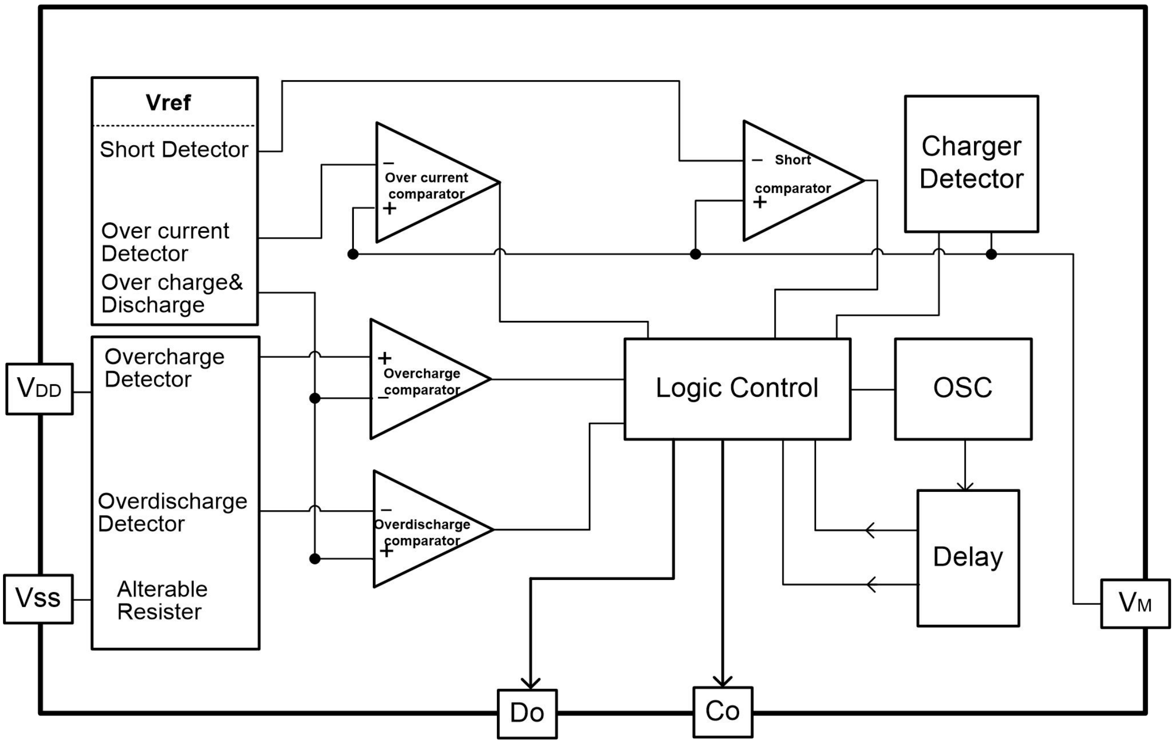
- 50Ω ＜ R_1 ＜ 500Ω. A larger value of R_1 results in higher detection voltage, introducing errors.
- 700Ω ＜ R_2 ＜ 4KΩ. A larger value of R_2 possibly prevents resetting from over-discharge even with a charger.
- R_1 ＋ R_2 ＞ 1KΩ. Smaller values may lead to power consumption over the maximum dissipation rating of the BM117-YCSA-DE.

The requirement or resistors and capacitors and the value of constants should be decided depending upon the system function and characteristics.

Marking contents

Symbol	Meaning	Top View
YCSA	Product Name	
T7	Package Code Name	
YW	Lot Number	

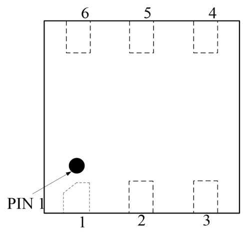
Block Diagram



Pin Description

Pin	Symbol	Description
1	NC	No connection
2	C_O	FET gate connection pin for charge control, CMOS output
3	D_O	FET gate connection pin for discharge control, CMOS output
4	V_{SS}	Ground
5	V_{DD}	Power supply
6	V_M	Voltage detection pin between VM and VSS, Overcurrent detection

Top Side



Electrical Characteristics

(Ta=25℃ unless otherwise specified)

Symbol	Item	Conditions	Min.	TYP.	Max.	Unit
DETECTION VOLTAGE AND DELAY TIME						
Vdet1	Overcharge Detection Voltage	-	4.475	**4.495**	4.515	V
		Ta=0℃~60℃	4.470	**4.495**	4.520	V
Vrel1	Release Voltage For Overcharge Detection	-	4.245	**4.295**	4.345	V
Vdet2	Overdischarge Detection Voltage	-	2.470	**2.520**	2.570	V
Vrel2	Release Voltage For Overdischarge	-	2.645	**2.720**	2.795	V
Vdet3	Discharge Overcurrent Detection Voltage	V_{DD} = 3.800V	0.055	**0.060**	0.065	V
Vshort	Short Protection Voltage	V_{DD} = 3.800V	0.170	**0.190**	0.210	V
Vcha	Charger Detection (Charge Overcurrent)	-	-0.065	**-0.060**	-0.055	V
V_{0INH}	0V Battery Charge Inhibition Battery Voltage	0V battery charging unavailable	0.9	**1.2**	1.5	V
Tvdet1	Overcharge Detection Delay Time	V_{DD} = 4.0V→4.6V	700	**1000**	1300	ms
Tvrel1	Overcharge ReleaseDelay Time	V_{DD} = 4.6V→4.0V	1	**4**	8	ms
Tvdet2	Overdischarge Detection Delay Time	V_{DD} = 4.0V→2.0V	22.4	**32**	41.6	ms
Tvrel2	Overdischarge Release Delay Time	V_{DD} = 2.0V→3.0V, V_M = 0V	1.61	**2.30**	2.99	ms
Tvdet3	Discharge Overcurrent Detection Delay Time	V_{DD} =3.8V, V_M = 0V→0.1V	11.2	**16**	20.8	ms
Tab	Charge Overcurrent Detection Delay Time	V_{DD} =3.8V, V_M = 0V→-0.1V	5.6	**8**	10.4	ms
Tshort	Short Detection Delay Time	V_{DD} =3.8V, V_M = 0V→0.5V	225	**375**	525	us
Tvrel3	Discharge Overcurrent Release Delay Time	V_{DD} =3.8V, V_M = 0.1V→0 V	1.4	**2.0**	2.6	ms
Vriov	Discharge Overcurrent Release Voltage	-	0.75* V_{DD}	**0.85* V_{DD}**	0.95* V_{DD}	V
OUTPUT RESISTANCE AND INTERNAL RESISTANCE						
R_{COH}	CO Pin Output Resistance "H"	-	2.0	**4.0**	8.0	kΩ
R_{COL}	CO Pin Output Resistance "L"	-	1.5	**3.0**	6.0	kΩ
R_{DOH}	DO Pin Output Resistance "H"	-	1.3	**2.5**	5.0	kΩ
R_{DOL}	DO Pin Output Resistance "L"	-	0.8	**1.5**	3.0	kΩ
R_{VMD}	Resistance between V_M and V_{DD}	V_{DD}=2.0V, V_M=0V	400	**800**	1600	kΩ
R_{VMS}	Resistance between V_M and V_{SS}	V_{DD}=3.3V, V_M=1V	10	**20**	40	kΩ
OPERRATION VOLTAGE AND CURRENT CONSUMPTION						
V_{DD}	Operating Input Voltage	V_{DD}-Vss	1.6	**V_{DD}**	6	V
V_M	Operating Input Voltage	V_{DD}-V_M	1.5	**-**	28	V
I_{DD}	Supply Current	V_{DD} = 3.4V, V_M = 0V	-	**1.5**	3.0	uA
$I_{STANDBY1}$	Standby Current (without auto wake up)	V_{DD} = 2.4V, V_M = 0V→2.4V	-	**-**	0.05	uA
$I_{STANDBY2}$	Standby Current (without auto wake up)	V_{DD} = 1.5V, V_M = 0V→1.5V	-	**-**	0.05	uA

Electrical Characteristics [1*]

(Ta = -25℃~70℃ unless otherwise specified)

Symbol	Item	Conditions	Min.	TYP.	Max.	Unit
DETECTION VOLTAGE AND DELAY TIME						
Vdet1	Overcharge Detection Voltage	-	4.465	**4.495**	4.520	V
Vrel1	Release Voltage For Overcharge Detection	-	4.235	**4.295**	4.355	V
Vdet2	Overdischarge Detection Voltage	-	2.465	**2.520**	2.575	V
Vrel2	Release Voltage For Overdischarge	-	2.625	**2.720**	2.815	V
Vdet3	Discharge Overcurrent Detection Voltage	V_{DD} = 3.800V	0.055	**0.060**	0.065	V
Vshort	Short Protection Voltage	V_{DD} = 3.800V	0.160	**0.190**	0.220	V
Vcha	Charger Detection (Charge Overcurrent)	-	-0.065	**-0.060**	-0.055	V
V_{0INH}	0V Battery Charge Inhibition Battery Voltage	0V battery charging unavailable	0.7	**1.2**	1.7	V
Tvdet1	Overcharge Detection Delay Time	V_{DD} = 4.0V→4.6V	500	**1000**	1500	ms
Tvrel1	Overcharge ReleaseDelay Time	V_{DD} = 4.6V→4.0V	1	**4**	8	ms
Tvdet2	Overdischarge Detection Delay Time	V_{DD} = 4.0V→2.0V	16	**32**	48	ms
Tvrel2	Overdischarge Release Delay Time	V_{DD} = 2.0V→3.0V, V_M = 0V	1.15	**2.30**	3.45	ms
Tvdet3	Discharge Overcurrent Detection Delay Time	V_{DD} =3.8V, V_M = 0V→0.1V	8	**16**	24	ms
Tab	Charge Overcurrent Detection Delay Time	V_{DD} =3.8V, V_M = 0V→-0.1V	4	**8**	12	ms
Tshort	Short Detection Delay Time	V_{DD} =3.8V, V_M = 0V→0.5V	150	**375**	600	us
Tvrel3	Discharge Overcurrent Release Delay Time	V_{DD} =3.8V, V_M = 0.1V→0 V	1	**2**	3	ms
Vriov	Discharge Overcurrent Release Voltage	-	0.75* V_{DD}	**0.85* V_{DD}**	0.95* V_{DD}	V
OUTPUT RESISTANCE AND INTERNAL RESISTANCE						
R_{COH}	CO Pin Output Resistance "H"	-	1.0	**4.0**	12.0	kΩ
R_{COL}	CO Pin Output Resistance "L"	-	0.8	**3.0**	9.0	kΩ
R_{DOH}	DO Pin Output Resistance "H"	-	0.6	**2.5**	7.5	kΩ
R_{DOL}	DO Pin Output Resistance "L"	-	0.4	**1.5**	4.5	kΩ
R_{VMD}	Resistance Between V_M And V_{DD}	V_{DD}=2.0V, V_M = 0V	200	**800**	3000	kΩ
R_{VMS}	Resistance Between V_M And V_{SS}	V_{DD}=3.3V, V_M =1V	5	**20**	50	kΩ
OPERRATION VOLTAGE AND CURRENT CONSUMPTION						
V_{DD}	Operating Input Voltage	V_{DD}-Vss	1.6	**V_{DD}**	6	V
V_M	Operating Input Voltage	V_{DD}-V_M	1.5	**-**	28	V
I_{DD}	Supply Current	V_{DD} = 3.4V, V_M = 0V	-	**1.5**	4.0	uA
$I_{STANDBY1}$	Standby Current (without auto wake up)	V_{DD} = 2.4V, V_M = 0V→2.4V	-	**-**	0.1	uA
$I_{STANDBY2}$	Standby Current (without auto wake up)	V_{DD} = 1.5V, V_M = 0V→1.5V	-	**-**	0.1	uA

1* The Electrical parameters for this temperature range is guaranteed by design, not tested in production.

Electrical Characteristics [1*]

(Ta = -40℃~85℃ unless otherwise specified)

Symbol	Item	Conditions	Min.	TYP.	Max.	Unit
DETECTION VOLTAGE AND DELAY TIME						
Vdet1	Overcharge Detection Voltage	-	4.450	**4.495**	4.540	V
Vrel1	Release Voltage For Overcharge Detection	-	4.230	**4.295**	4.360	V
Vdet2	Overdischarge Detection Voltage	-	2.420	**2.520**	2.620	V
Vrel2	Release Voltage For Overdischarge	-	2.620	**2.720**	2.820	V
Vdet3	Discharge Overcurrent Detection Voltage	V_{DD} = 3.800V	0.050	**0.060**	0.070	V
Vshort	Short Protection Voltage	V_{DD} = 3.800V	0.150	**0.190**	0.230	V
Vcha	Charger Detection (Charge Overcurrent)	-	-0.070	**-0.060**	-0.050	V
V_{0INH}	0V Battery Charge Inhibition Battery Voltage	0V battery charging unavailable	0.7	**1.2**	1.7	V
Tvdet1	Overcharge Detection Delay Time	V_{DD} = 4.0V→4.6V	500	**1000**	1500	ms
Tvrel1	Overcharge ReleaseDelay Time	V_{DD} = 4.6V→4.0V	1	**4**	8	ms
Tvdet2	Overdischarge Detection Delay Time	V_{DD} = 4.0V→2.0V	16	**32**	48	ms
Tvrel2	Overdischarge Release Delay Time	V_{DD} = 2.0V→3.0V, V_M = 0V	1.15	**2.30**	3.45	ms
Tvdet3	Discharge Overcurrent Detection Delay Time	V_{DD} =3.8V, V_M = 0V→0.1V	8	**16**	24	ms
Tab	Charge Overcurrent Detection Delay Time	V_{DD} =3.8V, V_M = 0V→-0.1V	4	**8**	12	ms
Tshort	Short Detection Delay Time	V_{DD} =3.8V, V_M = 0V→0.5V	150	**375**	600	us
Tvrel3	Discharge Overcurrent Release Delay Time	V_{DD} =3.8V, V_M = 0.1V→0 V	1	**2**	3	ms
Vriov	Discharge Overcurrent Release Voltage	-	0.65* V_{DD}	**0.75* V_{DD}**	0.85* V_{DD}	V
OUTPUT RESISTANCE AND INTERNAL RESISTANCE						
R_{COH}	CO Pin Output Resistance “H”	-	1.0	**4.0**	12.0	kΩ
R_{COL}	CO Pin Output Resistance “L”	-	0.8	**3.0**	9.0	kΩ
R_{DOH}	DO Pin Output Resistance “H”	-	0.6	**2.5**	7.5	kΩ
R_{DOL}	DO Pin Output Resistance “L”	-	0.4	**1.5**	4.5	kΩ
R_{VMD}	Resistance Between V_M And V_{DD}	V_{DD}=2.0V, V_M = 0V	200	**800**	3000	kΩ
R_{VMS}	Resistance Between V_M And V_{SS}	V_{DD}=3.3V, V_M =1V	5	**20**	50	kΩ
OPERRATION VOLTAGE AND CURRENT CONSUMPTION						
V_{DD}	Operating Input Voltage	V_{DD}-Vss	1.6	**V_{DD}**	6	V
V_M	Operating Input Voltage	V_{DD}-V_M	1.5	**-**	28	V
I_{DD}	Supply Current	V_{DD} = 3.4V, V_M = 0V	-	**1.5**	5.0	uA
$I_{STANDBY1}$	Standby Current (without auto wake up)	V_{DD} = 2.4V, V_M = 0V→2.4V	-	**-**	0.1	uA
$I_{STANDBY2}$	Standby Current (without auto wake up)	V_{DD} = 1.5V, V_M = 0V→1.5V	-	**-**	0.1	uA

1* The Electrical parameters for this temperature range is guaranteed by design, not tested in production.

Absolute Maximum Ratings (Ta=25℃ VSS=0V)

Symbol	Item	Ratings	Unit
V_{DD}	Supply Voltage	-0.3 to 6	V
V_M	V_M Pin Input Voltage	V_{DD} -28 to V_{DD} +0.3	V
V_{CO}	Co Pin Output Voltage	V_{DD} -28 to V_{DD} +0.3	V
V_{DO}	Do Pin Output Voltage	Vss-0.3 to V_{DD} +0.3	V
Pd	Power Dissipation	150	mW
Topt	Operating Temperature Range	-40 to 85	℃
Tstg	Storage Temperature Range	-55 to 150	℃

Caution: These values must not be exceeded under any conditions.

Function Description

Normal Condition:

VDD is between the Overdischarge Detection voltage (Vdet2) and Overcharge Detection voltage (Vdet1) and the VM pad voltage is between Charger Detection Voltage (Vcha) and the Discharge Overcurrent Detection voltage (Vdet3), therefore the outputs of D_O pad and C_O pad are high and the MOSFETs of charge and discharge are all on. Charging and discharging can be carried out freely.

Caution After the battery is connected, discharging may not be carried. In this case, the IC becomes the normal status by connecting a charger.

Overcharge Condition:

When VDD increases and passes Vdet1 during charging under the normal condition, the output of Co pad will change from high to low after Overcharge Detection Delay Time (Tvdet1), turning off the charging control FET.

If, within Tvdet1, V_{DD} becomes lower than Vdet1 and stays for duration shorter than Overcharge Reset Delay Time (Treset) before rising up over Vdet1 again, this type of instantaneous falling of VDD is ignored. Otherwise, if the time VDD stays lower than Vdet1 is longer than Treset, the timing related to Tvdet1 shall be reset.

Charge Overcurrent Condition:

If the VM pin voltage falls below the Charger Detection Voltage (Vcha) during charging under normal condition and it continues for the Charge Overcurrent Delay Time (Tab) or longer, the charging control FET turns off and charging stops. This action is called the Charge Overcurrent detection.

Charge Overcurrent detection works when the D_O pin voltage is “H” and the VM pin voltage falls below the Charger Detection Voltage (Vcha). To an overdischarged battery, only when charging makes the battery voltage higher than the Overdischarge Detection voltage (Vdet2), the Charge Overcurrent Detection can act. Charge overcurrent state is released, once the voltage difference between VM pin and VSS pin becomes less than the Charge Overcurrent Detection voltage (Vcha) value.

Overcharge Protection Release Condition:

The charging state can be reset and charge control FET will turn on, as follow condition:

(1) When the VM voltage is equal to or higher than Vdet3 (eg.when a charger is disconnected and a load is connected), VDD becomes lower than the Overcharge Detection Voltage (Vdet1), and stays longer than Overcharge Release Delay Time (Tvrel1), the charge control FET turns on.

(2) When the VM voltage is betwwen Vdet3 and Vcha (usually only be forced intentionally), VDD becomes lower than the Overcharge Release Voltage (Vrel1), and stays longer than Overcharge Release Delay Time (Tvrel1), the charge control FET turns on.

(3) When the VM voltage is lower than Vcha (eg.when a charger is connected), even if VDD level is lower than Vrel1, the overcharge state will not release and charge control FET keep off until disconnect the charger with the battery pack.

Note1: when a charger is disconnected and a load is connected, the VM voltage is pulled to a value higher than Vdet3. Then IC detects the load-connecting condition.

Note2: when a charger keeps connecting, the VM voltage is equal to the voltage difference betwwen VDD and charger which is lower than Vcha.

Overdischarge Condition:

While discharging, after VDD lowers below Overdischarge Detection voltage (Vdet2), Do pad goes low after Overdischarge Detection Delay Time (Tvdet2). The Do pad would switch off the discharging control FET and stop discharging.

Overdischarge Protection Release Condition:

When IC is in overdischarge condition, if a charger is connected to the battery pack, and the battery supply voltage becomes higher than Vdet2, and VM is lower than Charger Detection Voltage (Vcha), Do pad becomes high, allowing discharging action.

The discharging state also can be reset and the output of Do becomes high when VDD becomes higher than the Overdischarge Release Voltage (Vrel2), VM is between Vcha and Vdet3, stays longer than Release Delay Time (Tvrel2).

When a charger is connected from the battery pack, while the VDD level is lower than Vdet2, the battery pack makes charger current allowable through the internal parasitic diode.

Charger Detect Condition:

When a battery in the overdischarge condition is connected to a charger and provided that the VM pin voltage is lower than the Charger Detection Voltage (Vcha), IC releases the overdischarge condition and turns on the discharging control FET as the battery voltage becomes higher than the Overdischarge Detection Voltage (Vdet2) since the charger detection function works. This action is called charger detection.

When a battery in the overdischarge condition is connected to a charger and provided that the VM pin voltage is between the Charger Detection Voltage (Vcha) and overcurrent

Detection voltage (Vdet3), IC releases the Overdischarge condition when the battery voltage reaches the Overdischarge Release Voltage (Vrel2) or higher.

Discharge Overcurrent Protection:

During discharging, the current varies with load, and VM increases with the rise of the discharging current. Once VM rises up to the Discharge Overcurrent Detection voltage (Vdet3) or higher and stays longer than the Discharge Overcurrent Delay Time (Tvdet3), Do pad switches to low, turning off the discharging control FET. After that Discharge Overcurrent state is removed, i.e. VM＜Vriov, and the circuit recovers to normal condition.

Short Circuit Protection:

This function has the same principle as the overcurrent protection. But, the delay time Tshort is far shorter than Tvdet3, and the detection voltage Vshort is far higher than Vdet3. When the circuit is shorted, VM increases rapidly. Once VM≥Vshort, Do pad switches to low, turning off the discharging control FET. After the short circuit state is removed, i.e. VM＜Vriov, the circuit recovers to the normal condition. The short circuit peak current is related to Vshort and the ON resistance of the two FETs in series. Output types of Co and Do are CMOS level.

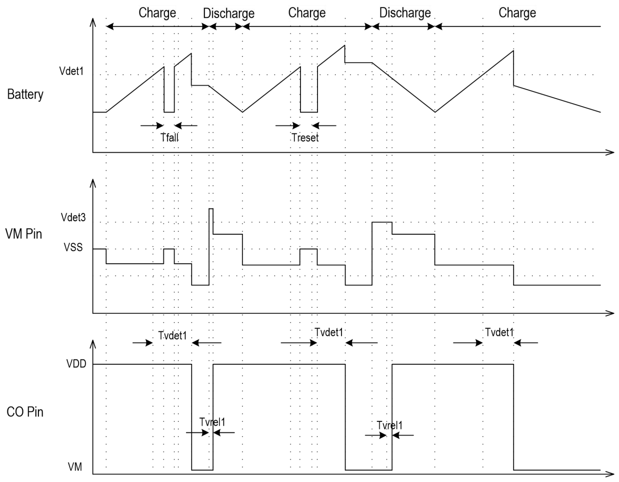
0V battery charge inhibition function

This function inhibits the recharging when a battery whose voltage is 0V due to the self-discharge is connected. When the battery voltage is the 0 V battery charge inhibition battery voltage (V_{0INH}) or lower, the charging control FET gate is fixed to the voltage of pin-VM to inhibit charging. When the battery voltage is higher than V_{0INH}, charging can be performed.

Operation Timing Chart

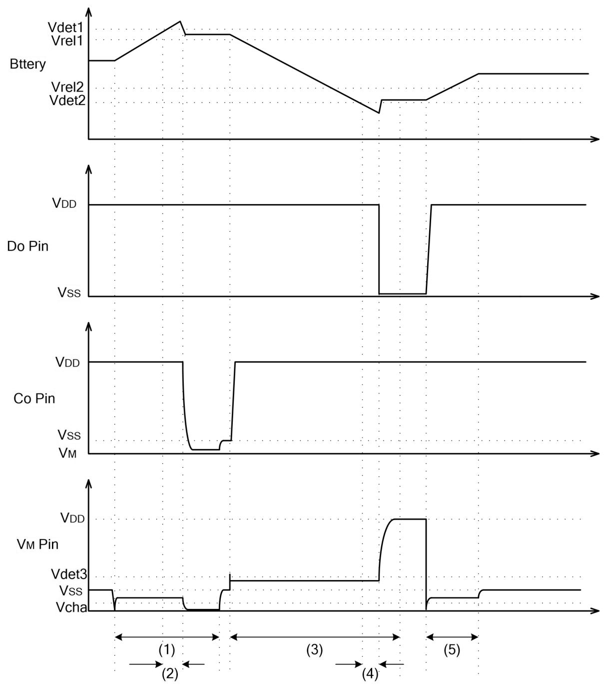
Operation Timing Chart (1)

Overcharge, Timer Reset for Overcharge



Operation Timing Chart (2)

Overcharge/Overdischarge Detection



(1) Charger connected

(2) Overcharge Detection Delay Time (Tvdet1)

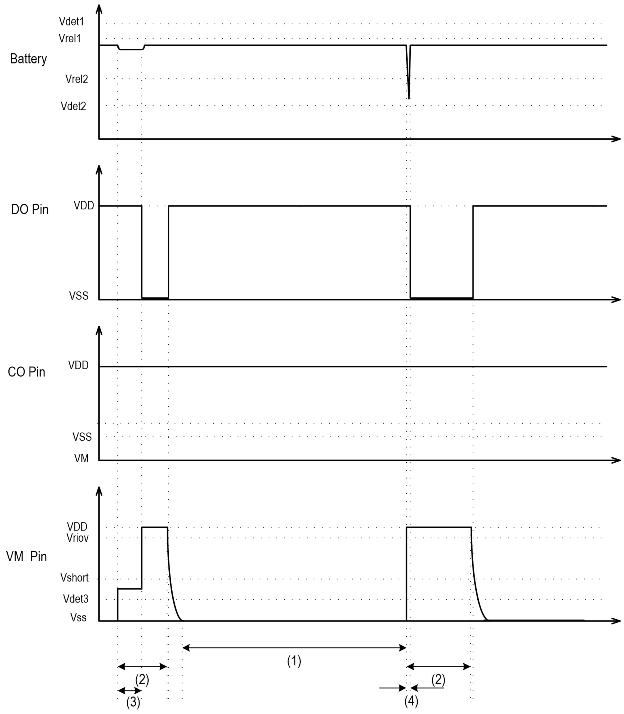
(3) Load connected

(4) Overdischarge Detection Delay Time (Tvdet2)

(5) Normal charging

Operation Timing Chart (3)

Discharge Overcurrent and Short Protection



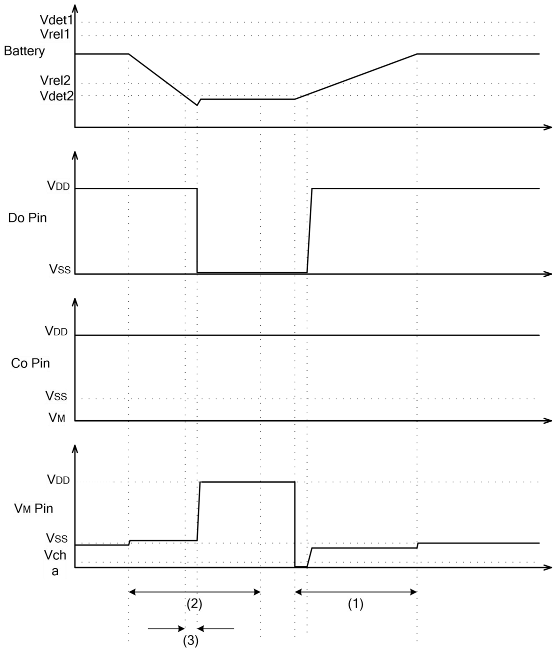
(1) Normal condition

(2) Load connection

(3) Discharge Overcurrent Delay Time (Tvdet3)

(4) Short Circuit Delay Time (Tshort)

Operation Timing Chart (4)
Charger Connection Detection

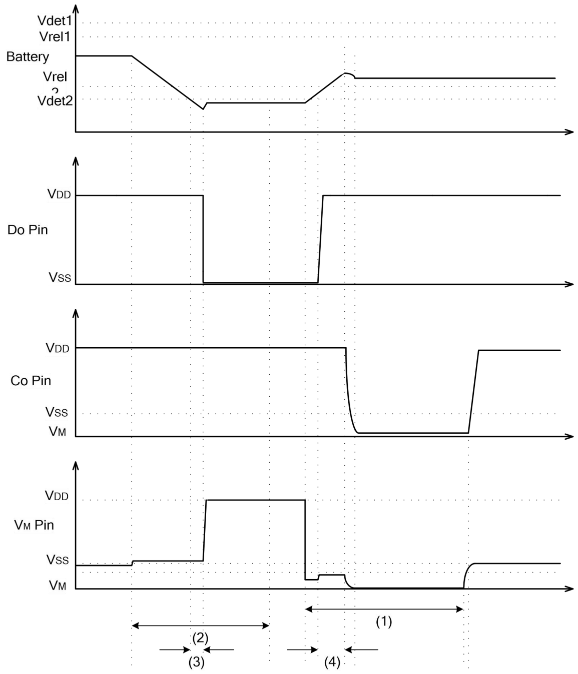


(1) Charger connection

(2) Load connection

(3) Overdischarge Detection Delay (Tvdet2)

Operation Timing Chart (5)
Charge Overcurrent Detection



(1) Charger connection

(2) Load connection

(3) Overdischarge Detection Delay Time (Tvdet2)

(4) Charging Overcurrent Detection Delay Time

Test Circuits

(1) Overcharge detection voltage and overcharge release voltage (Test circuit 1)

The Overcharge Detection Voltage (Vdet1) is the voltage between V_{DD} and V_{SS} to which when V1 increases and keeps the condition for overcharge delay time, Vco changes from "H" to "L". The Overcharge Release Voltage (Vrel1) is the voltage between V_{DD} and V_{SS} to which when V1 decreases, Vco changes from "L" to "H".

(2) Overdischarge detection voltage and over-discharge release voltage (Test circuit 1)

The Overdischarge Detection Voltage (Vdet2) is the voltage between V_{DD} and V_{SS} to which when V1 decreases and keep the condition for overdischarge delay time, V_{DO} changes from "H" to "L". The overdischarge Release Voltage (Vrel2) is the voltage between V_{DD} and VSS to which when V1 increases, V_{DO} changes from "L" to "H".

(3) Discharge Overcurrent detection voltage and short circuit detection voltage (Test circuit 2)

The Discharge Overcurrent Detection Voltage (Vdet3) is the voltage between V_M and V_{SS} to which when V_M increases within 10 us and keep the condition for Discharge Overcurrent Delay Time (Tvdet3), V_{DO} changes from "H" to "L".

The Short Circuit Detection Voltage (Vshort) is the voltage between V_M and V_{SS} to which when V_M increases within 10us and keep the condition for Short Circuit Delay Time (Tshort), V_{DO} changes from "H" to "L".

(4) Charger detection voltage and charge overcurrent detection voltage (Test circuit 2)

In the overdischarge condition, increase V1 gradually until it is between Vdet2 and Vrel2. The voltage between V_M and V_{SS} to which when V2 decreases, V_{DO} changes from "L" to "H", is the Charger Detection Voltage (Vcha).

In the normal charging condition, the voltage between V_M and V_{SS} to which when V2 decreases, Vco changes from "H" to "L" is the charge overcurrent detection voltage. It has the same value as the Charger Detection Voltage (Vcha).

(5) 0V battery charge inhibiting battery voltage (Test circuit 2)

Set V1=1.8V and V2=-2V, decrease V1 gradually. The voltage between VDD and VSS when Vco goes "L" ($V_{CO} = V_{VM}$) is the 0V battery charge inhibiting battery voltage (V_{0INH}).

(6) Normal operation current consumption and power down current consumption (Test circuit 2)

Set V1=3.5V and V2=0V under normal condition, the current I_{DD} flowing through V_{DD} pin is the normal operation consumption current (I_{DD}).

Set V1=3.5V and V2=0V， let IC work in normal condition, set V1 from 3.5V to 2.0V, then let VM floating under overdischarge condition, the current I_{DD} flowing through V_{DD} pin is the power down current consumption ($I_{STANDBY}$).

(7) Overcharge detection (release) delay time and overdischarge detection (release) delay time (Test circuit 3)

If V1 increases to be Vdet1 or over Vdet1 and keeps the condition for some time, Vco will change from "H" to "L". The time is called overcharge detection delay time. It is used to judge whether overcharge happens indeed. If V1 decreases from Vdet1 or over Vdet1 to below Vrel1, Vco will change from "L" to "H". The difference between this time and Treset is called overcharge release delay time.

If V1 decreases to be Vdet2 or below Vdet2 and keeps the condition for some time, V_{DO} will change from "H" to "L". The time is called overdischarge detection delay time. It is used to judge whether overdischarge happens indeed. If V1 increases from Vdet2 or below Vdet2 to over Vrel2 and keeps the condition for some time, V_{DO} will change from "L" to "H". The time is called overdischarge release delay time.

(8) Discharge Overcurrent detection delay time and short circuit detection delay time (Test circuit 3)

If V2 increases to be Vdet3 or over Vdet3 and keeps the condition for some time, V_{DO} will change from "H" to "L". The time is called Discharge Overcurrent delay time. It is used to judge whether Discharge Overcurrent happens indeed.

If V2 increases to be Vshort or over Vshort and keeps the condition for some time, V_{DO} will change from "H" to "L". The time is called short circuit delay time. It is used to judge whether short circuit happens indeed.

(9) Co pin H resistance, Co pin L resistance (Test circuit 4)

Set V1=3.9V, V2=0 V, I_{Co}=50uA (from Co to V3), K1 on and

K2 off. (V1-V3)/I_{Co} is the Co pin H resistance.

Set V1=4.6 V, V2=0 V, I_{Co}=-50uA (from V3 to Co), K1 on and

K2 off. V3/I_{Co} is the Co pin L resistance.

(10) Do pin H resistance, Do pin L resistance (Test circuit 4)

Set V1=3.9 V, V2=0 V, I_{Do}=50uA (from Do to V4), K1 off and

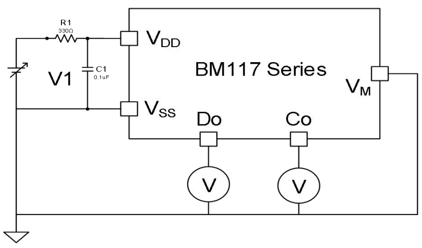
K2 on. (V1-V4)/I_{Do} is the Do pin H resistance.

Set V1=2.0 V, V2=0 V and I_{Do}=50uA (from V4 toDo), K1 off and K2 on. V4/I_{Do} is the Do pin L resistance.

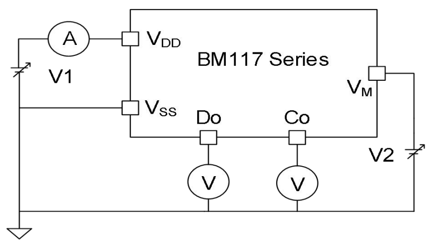
(11) Internal resistance VM -VDD and VM -VSS (Test circuit 4)

Set V1=2.0 V, V2=0 V, K1 off and K2 off, V1/I_{VM} is the internal resistance R_{VMD}.

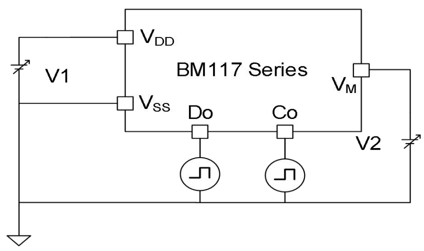
Set V1=3.3 V, V2=1 V, K1 off and K2 off, V2/I_{VM} is the internal resistance R_{VMS}.



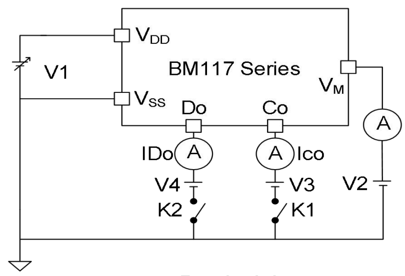
Test circuit 1



Test circuit 2



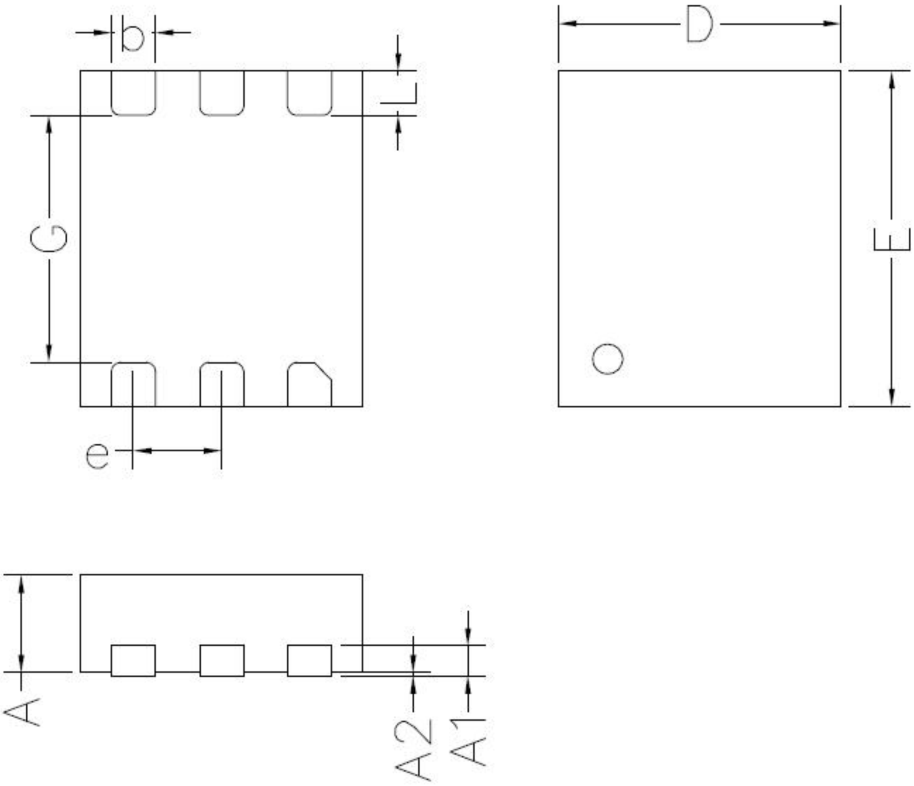
Test circuit 3



Test circuit 4

Package Outline

DFN 1.6×1.9-6L



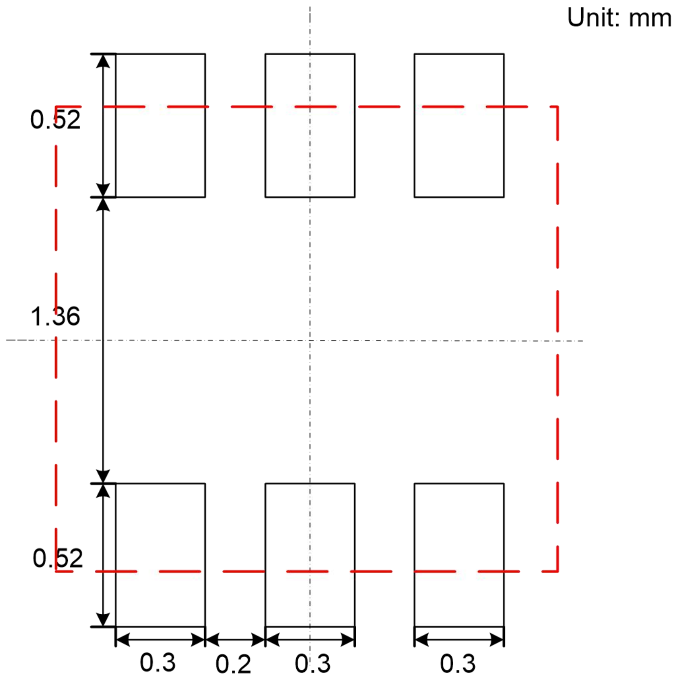
unit:mm

Package Dimensions			
Symbols	Min	Nom	Max
D	1.52	1.60	1.65
E	1.85	1.90	1.95
L	0.25	0.30	0.35
b	0.17	0.22	0.27
e	0.45	0.50	0.55
G	1.30REF		
A	0.50	0.55	0.60
A1	0.152REF		
A2	-	-	0.03

Packing

MBB packing.7”reel: 3000pcs per reel.

PCB Layout



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