

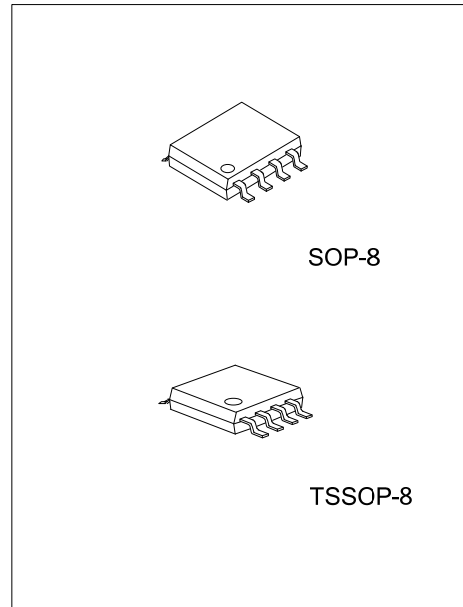


## UB240

Preliminary

CMOS IC

### LITHIUM BATTERY PROTECTION IC FOR 1-SERIAL TO 4-SERIAL-CELL PACK (SECONDARY PROTECTION)



#### DESCRIPTION

The UTC **UB240** Series is secondary protection IC for 1-, 2-, 3-, or 4-Cell lithium-ion rechargeable battery packs, and incorporates a high-accuracy voltage detection circuit.

The UTC **UB240** Series also includes a high accuracy delay circuit for over voltage detection time can be set by an external capacitor.

#### FEATURES

- \* High-accuracy voltage detection circuit for each cell
- \* Overcharge detection voltage n (n=1 to 4): 4.05V to 4.50V (in 50mV steps)
- \* Overcharge hysteresis voltage n (n=1 to 4): 0.25V±0.07V, 0.30V±0.10V
- \* Delay times for overcharge detection can be set by an external capacitor
- \* CMOS output active "H"
- \* Wide operating voltage range 3.6V to 24V
- \* Wide operating temperature range -40°C to +85°C
- \* Low current consumption: 1.5µA typ. (+25°C) at 3.5V for each cell

#### ORDERING INFORMATION

Ordering Number		Package	Packing
Lead Free	Halogen Free		
UB240L-xx-S08-R	UB240G-xx-S08-R	SOP-8	Reel Tape
UB240L-xx-P08-R	UB240G-xx-P08-R	TSSOP-8	Reel Tape

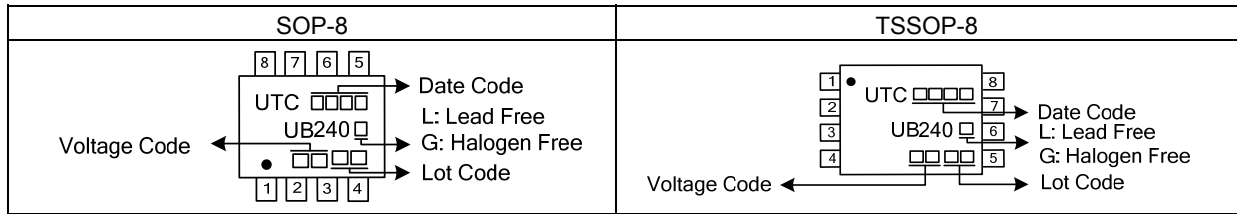
Note: xx: Output Voltage, refer SERIAL CODE LIST.

<p>UB240G-xx-S08-R</p> <ul style="list-style-type: none"> <li>(1) Packing Type</li> <li>(2) Package Type</li> <li>(3) Output Voltage Code</li> <li>(4) Green Package</li> </ul>	<ul style="list-style-type: none"> <li>(1) R: Tape Reel</li> <li>(2) S08: SOP-8, P08: TSSOP-8</li> <li>(3) xx: Refer to SERIAL CODE LIST</li> <li>(4) G: Halogen Free and Lead Free, L: Lead Free</li> </ul>
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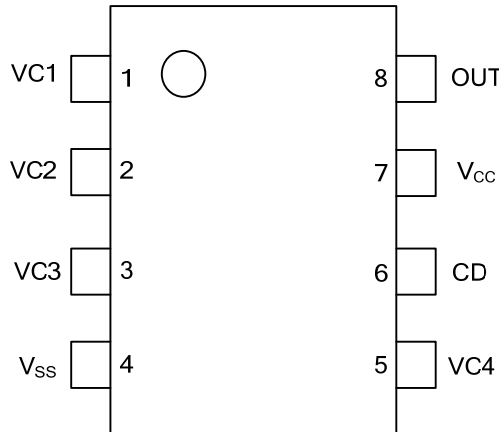
■ SERIAL CODE LIST

CODE	OVERCHARGE DETECTION VOLTAGE [V <sub>CU</sub> ](V)	OVERCHARGE HYSTERESIS VOLTAGE [V <sub>CD</sub> ](V)	OUTPUT FORM
AA	4.150±0.050	0.250±0.07	CMOS output active “H”
AB	4.250±0.050	0.250±0.07	CMOS output active “H”
AC	4.300±0.050	0.250±0.07	CMOS output active “H”
AD	4.350±0.050	0.250±0.07	CMOS output active “H”
AE	4.350±0.050	0.300±0.10	CMOS output active “H”
AF	4.450±0.050	0.300±0.10	CMOS output active “H”

■ MARKING



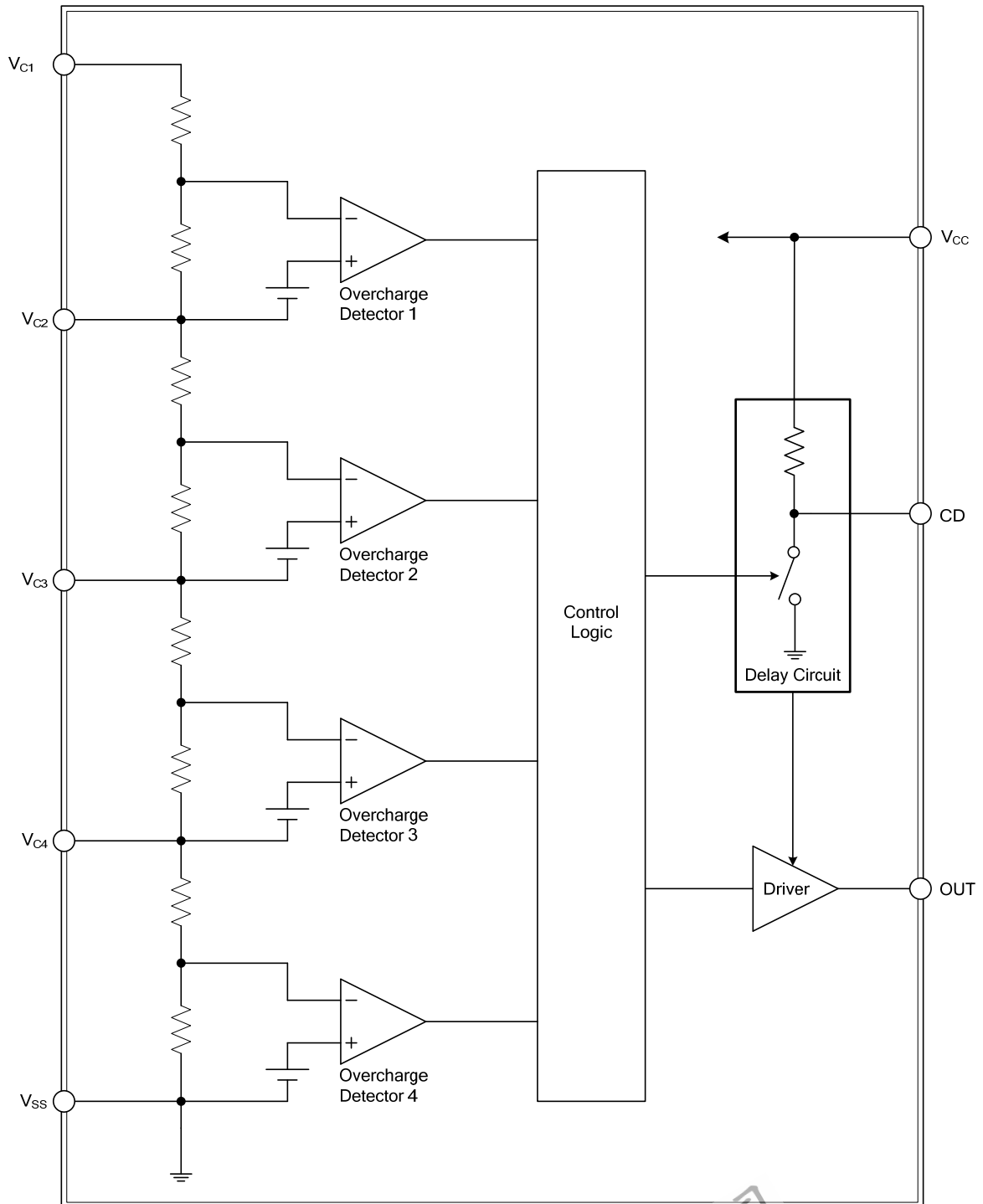
■ PIN CONFIGURATION



■ PIN DESCRIPTION

PIN NO.	PIN NAME	DESCRIPTION
1	VC1	Positive voltage connection pin of battery 1
2	VC2	Negative voltage connection pin of battery 1 Positive voltage connection pin of battery 2
3	VC3	Negative voltage connection pin of battery 2 Positive voltage connection pin of battery 3
4	V <sub>SS</sub>	Negative power input pin Negative voltage connection pin of battery 4
5	VC4	Negative voltage connection pin of battery 3 Positive voltage connection pin of battery 4
6	CD	Capacitor connection pin for overcharge detection delay
7	V <sub>CC</sub>	Positive power input pin
8	OUT	FET gate connection pin for charge

■ BLOCK DIAGRAM



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■ ABSOLUTE MAXIMUM RATING (T<sub>A</sub>= 25°C unless otherwise specified)

PARAMETER	SYMBOL	RATINGS	UNIT
Input Voltage Between V <sub>CC</sub> And V <sub>SS</sub>	V <sub>DS</sub>	V <sub>SS</sub> -0.3 ~ V <sub>SS</sub> +26	V
Input Pin Voltage (V <sub>C1</sub> /V <sub>C2</sub> /V <sub>C3</sub> /V <sub>C4</sub> )	V <sub>IN</sub>	V <sub>SS</sub> -0.3 ~ V <sub>CC</sub> +0.3	V
OUT Output Pin Voltage	V <sub>OUT</sub>	V <sub>SS</sub> -0.3 ~ V <sub>CC</sub> +0.3	V
Power Dissipation (Note 2)	P <sub>D</sub>	500	mW
Operation Ambient Temperature	T <sub>OPR</sub>	-40 ~ +85	°C
Storage Temperature	T <sub>STG</sub>	-40 ~ +125	°C

Notes: 1. Absolute maximum ratings are those values beyond which the device could be permanently damaged. Absolute maximum ratings are stress ratings only and functional device operation is not implied.  
2. When mounted on printed circuit board.

■ ELECTRICAL CHARACTERISTICS (T<sub>A</sub>=25°C unless otherwise specified)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
<b>DETECTION VOLTAGE</b>						
Overcharge Detection Voltage n (n = 1, 2, 3, 4)	V <sub>CU<sub>n</sub></sub>	4.05V ~ 4.50V Adjustment	V <sub>CU<sub>n</sub></sub> - 0.050	V <sub>CU<sub>n</sub></sub>	V <sub>CU<sub>n</sub></sub> + 0.050	V
Overcharge Hysteresis Voltage n (n = 1, 2, 3, 4) (Note 1)	V <sub>CD<sub>n</sub></sub>		0.18	0.25	0.32	V
<b>DELAY TIME</b>						
Overcharge Detection Delay Time	t <sub>CU</sub>	C <sub>CD</sub> =0.1μF	1.0	1.5	2.0	S
<b>OPERATING VOLTAGE</b>						
Operating Voltage Between V <sub>CC</sub> And V <sub>SS</sub> (Note 2)	V <sub>DSOP</sub>		3.6		24	V
<b>CURRENT CONSUMPTION</b>						
Current Consumption During Operation	I <sub>OP</sub>	V1=V2=V3=V4=3.5V		1.5	6.0	μA
Current Consumption At Power Down	I <sub>PDN</sub>	V1=V2=V3=V4=2.3V		1.2	6.0	μA
VC2 Pin Current	I <sub>VC2</sub>	V1=V2=V3=V4=3.5V	-0.5	0	0.5	μA
VC3 Pin Current	I <sub>VC3</sub>	V1=V2=V3=V4=3.5V	-0.5	0	0.5	μA
VC4 Pin Current	I <sub>VC4</sub>	V1=V2=V3=V4=3.5V	-0.5	0	0.5	μA
<b>OUTPUT VOLTAGE</b>						
OUT "H" VOLTAGE	V <sub>OUT(H)</sub>	I <sub>OUT</sub> = -10μA	V <sub>CC</sub> - 0.05			V
OUT "L" VOLTAGE	V <sub>OUT(L)</sub>	I <sub>OUT</sub> = 10μA			V <sub>SS</sub> + 0.05	V

Notes: 1. 0.25±0.07V, 0.30±0.10V.  
2. After detecting the overcharge, the delay circuit operates normally in the range of operating voltage.

■ OPERATING

1. Overcharge Detection

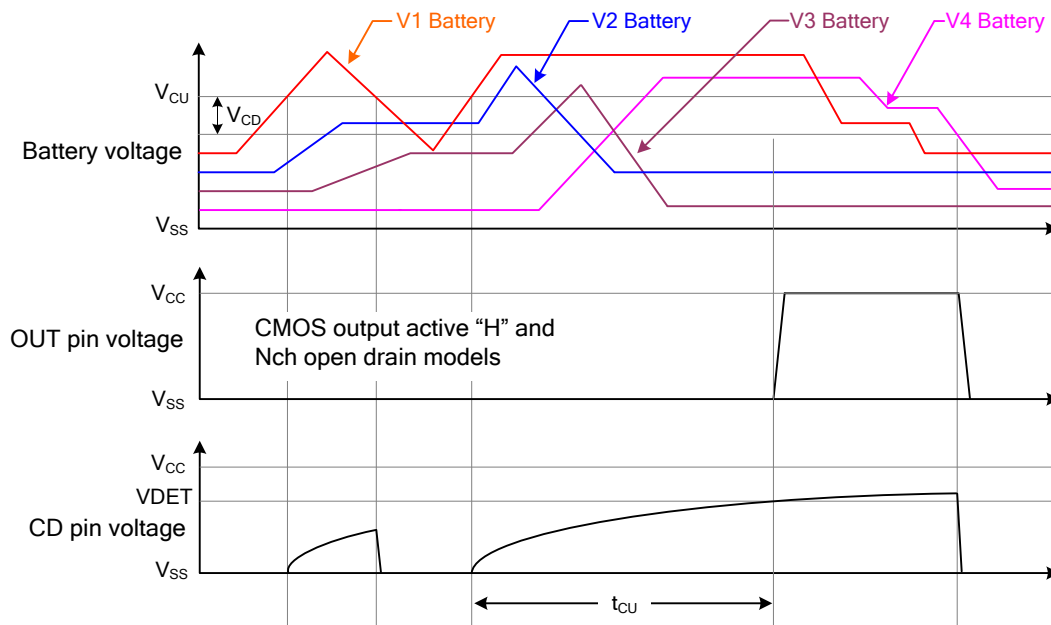
OUT is turned to “H” (for CMOS output active “H”) when the voltage of one of the batteries exceeds the overcharge detection voltage ( $V_{CU}$ ) during charging under normal conditions beyond the overcharge detection delay time ( $t_{CU}$ ). This state is called “overcharge.” Attaching FET to the OUT pin provides charge control and a second protection. At that time, the overcharge state is maintained until the voltage of all batteries decreases from the overcharge detection voltage ( $V_{CU}$ ) by the equivalent to the overcharge hysteresis voltage ( $V_{CD}$ ).

2. Delay Circuit

The overcharge detection delay time ( $t_{CU}$ ) change with an external capacitor ( $C_{CD}$ ). The delay times are calculated by the following equations:

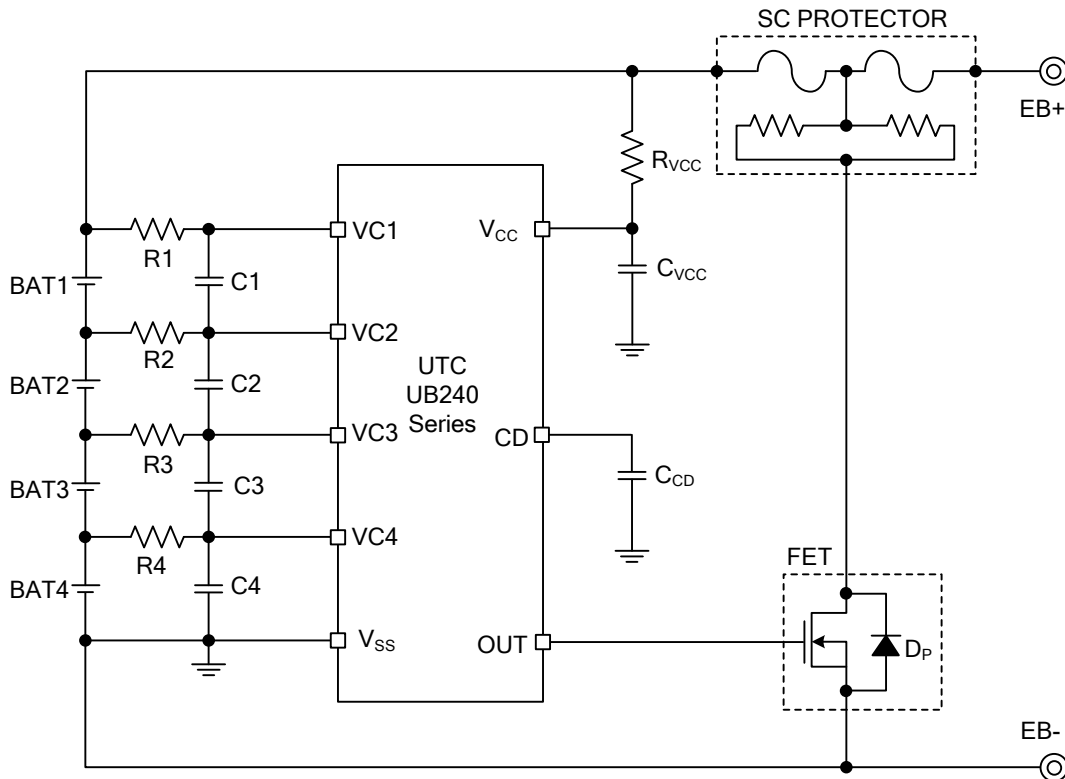
$$\text{Overcharge detection delay time } t_{CU}[s] = (15 \pm 5) \times C_{CD} [\mu F]$$

■ TIMING CHARTS



■ TYPICAL APPLICATION CIRCUIT

(1) Connection Example 1 (for 4-cells)



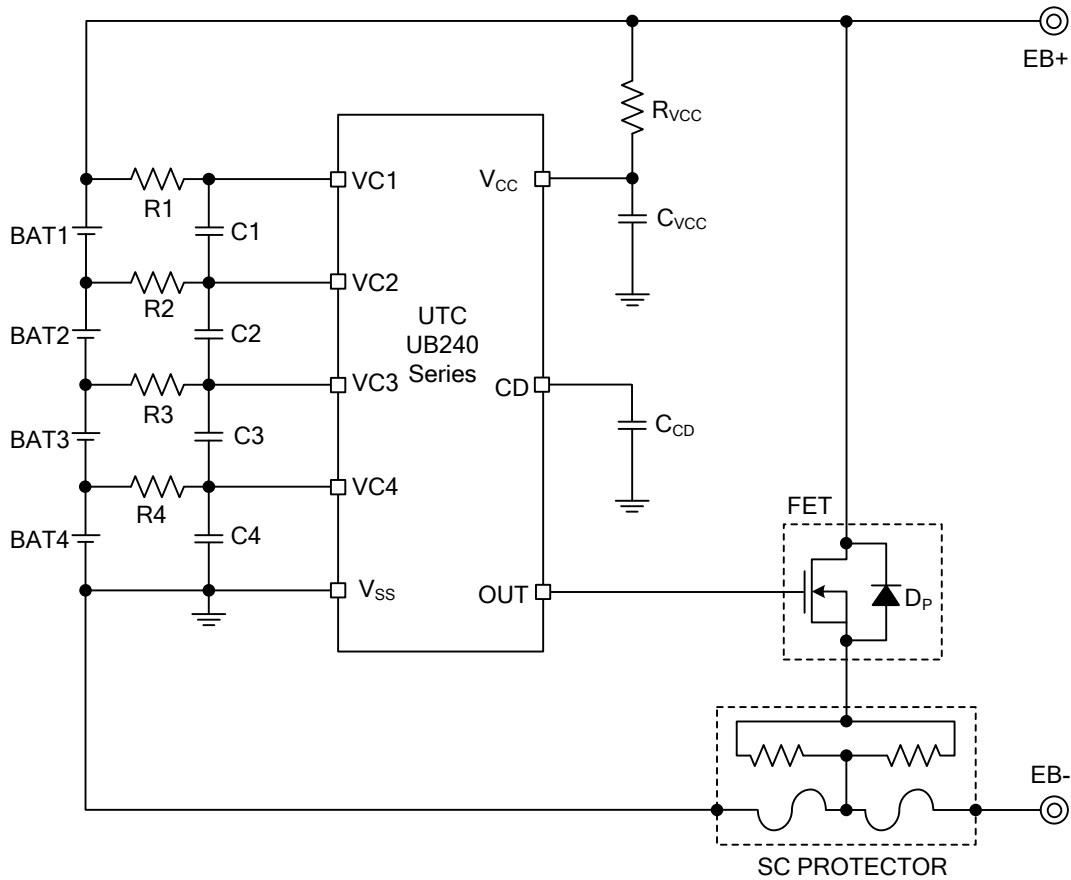
Constants for External Components 1

SYMBOL	MIN	TYP	MAX	UNIT
R1 to R4	0	1 k	10 k	Ω
C1 to C4	0	0.1	1	μF
R <sub>vcc</sub>	0	100	1 k	Ω
C <sub>vcc</sub>	0	0.1	1	μF
C <sub>cd</sub>	0	0.1	1	μF

- Notes:
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 through evaluation using the actual application to set the constant.

■ TYPICAL APPLICATION CIRCUIT(Cont.)

(2) Connection Example 2 (for 4-cells)



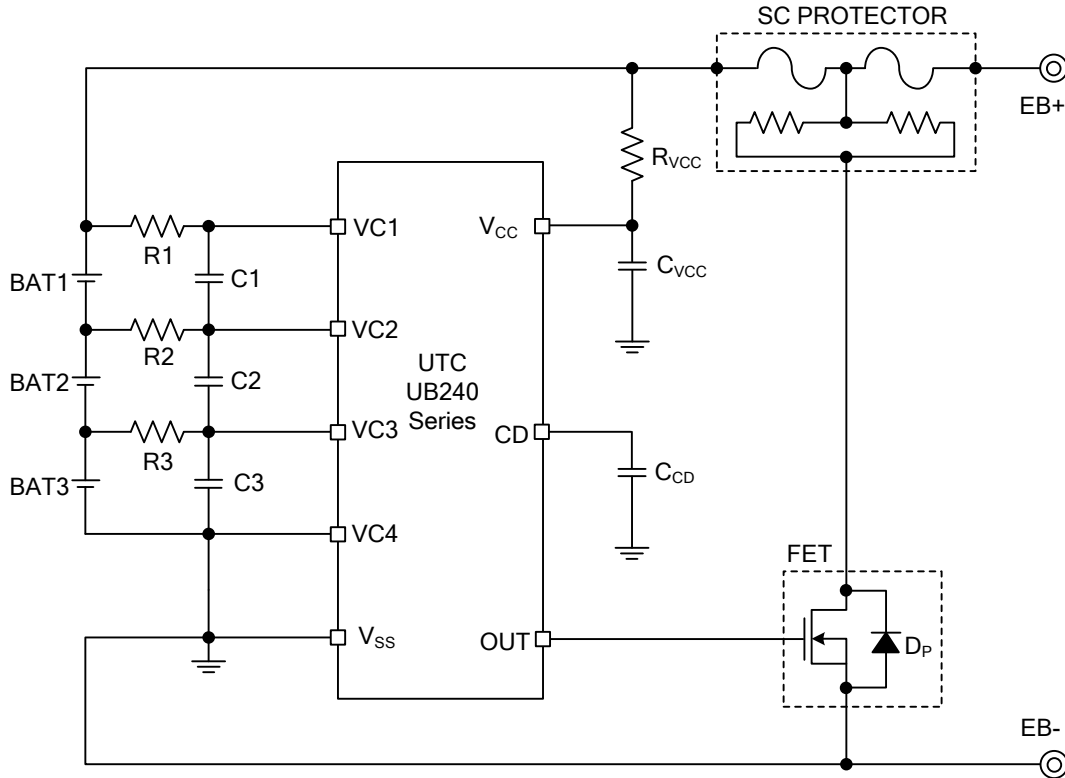
Constants for External Components 2

SYMBOL	MIN	TYP	MAX	UNIT
R1 to R4	0	1 K	10 k	Ω
C1 to C4	0	0.1	1	μF
R <sub>VCC</sub>	0	100	1 k	Ω
C <sub>VCC</sub>	0	0.1	1	μF
C <sub>CD</sub>	0	0.1	1	μF

- Notes:
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 through evaluation using the actual application to set the constant.

■ TYPICAL APPLICATION CIRCUIT(Cont.)

(3) Connection Example 3 (for 3-cells)



Constants for External Components 3

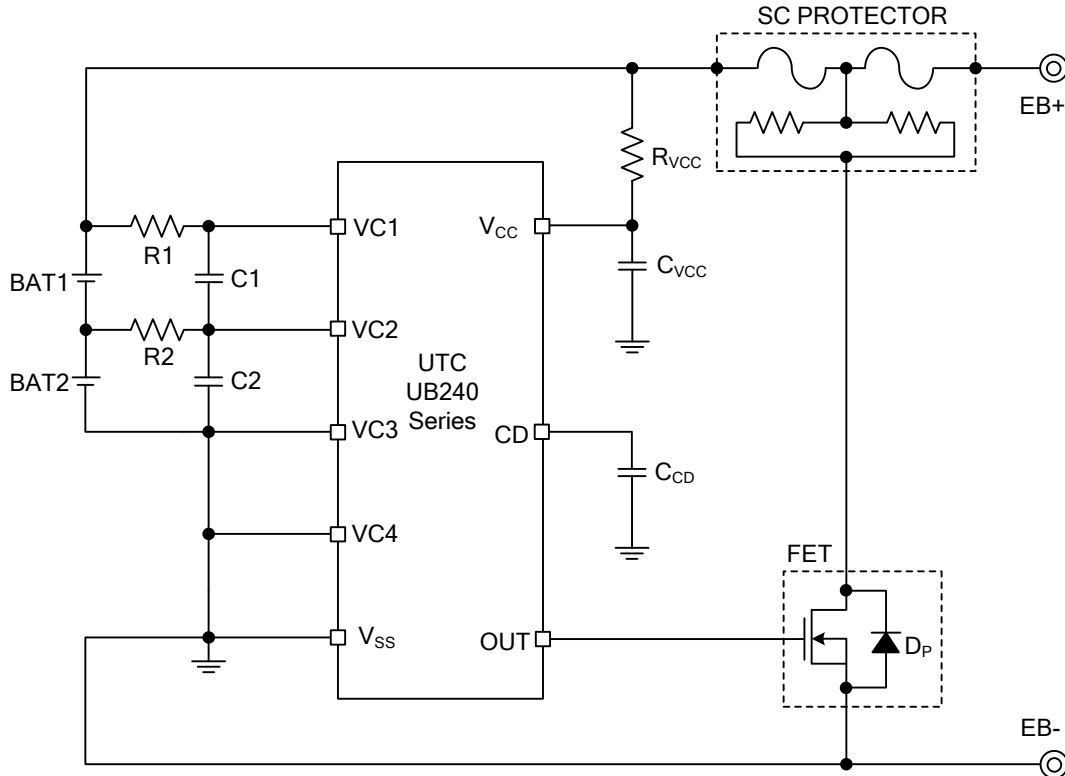
SYMBOL	MIN	TYP	MAX	UNIT
R1 to R3	0	1 k	10 k	Ω
C1 to C3	0	0.1	1	μF
RVCC	0	100	1 k	Ω
CVCC	0	0.1	1	μF
C <sub>CD</sub>	0	0.1	1	μF

- Notes:
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 through evaluation using the actual application to set the constant.



■ TYPICAL APPLICATION CIRCUIT(Cont.)

(4) Connection Example 4 (for 2-cells)



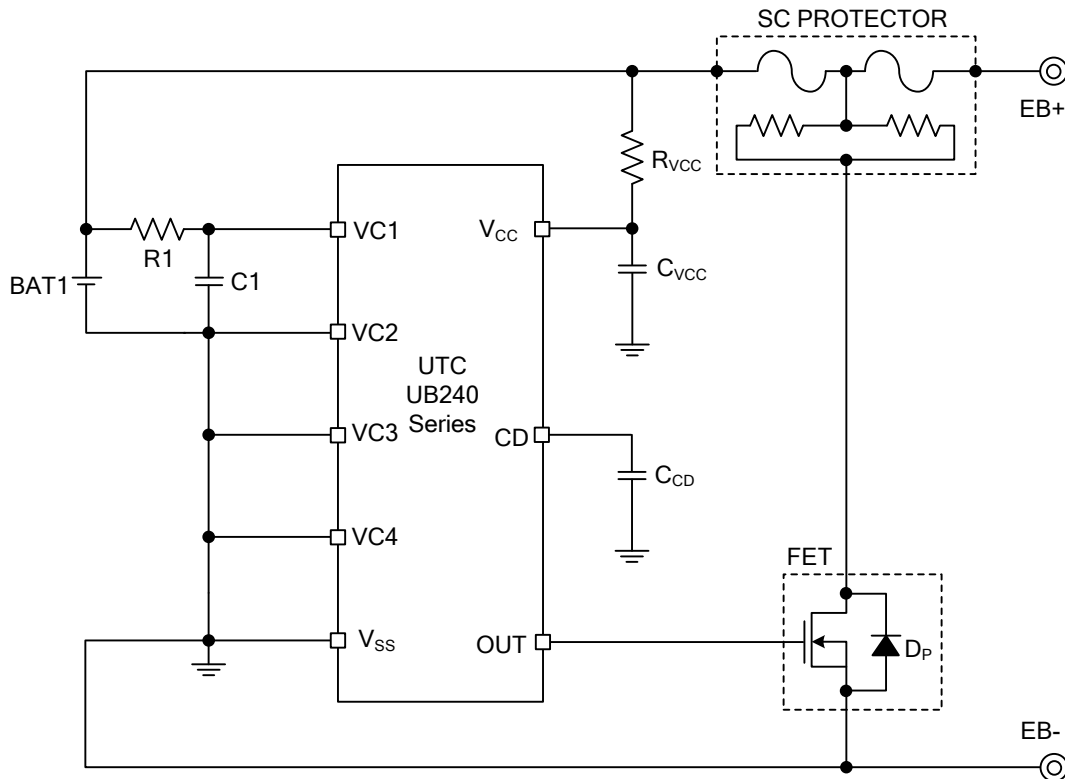
Constants for External Components 4

SYMBOL	MIN	TYP	MAX	UNIT
R1 to R2	0	1 k	10 k	Ω
C1 to C2	0	0.1	1	μF
R <sub>VCC</sub>	0	100	1 k	Ω
C <sub>VCC</sub>	0	0.1	1	μF
C <sub>CD</sub>	0	0.1	1	μF

- Notes:
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 through evaluation using the actual application to set the constant.

■ TYPICAL APPLICATION CIRCUIT(Cont.)

(5) Connection Example 5 (for 1-cell)



Constants for External Components 5

SYMBOL	MIN	TYP	MAX	UNIT
R1	0	1 k	10 k	Ω
C1	0	0.1	1	μF
RVCC	0	100	1 k	Ω
CVCC	0	0.1	1	μF
CCD	0	0.1	1	μF

- Notes:
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 through evaluation using the actual application to set the constant.

■ PRECAUTIONS

1. DO NOT connect any of overcharged batteries. Even if only one overcharged battery is connected to this IC, the IC detects overcharge, then charge current flows to the delay capacitor through the parasitic diode between pins where the battery is not connected yet. This may lead to a malfunction. Please perform sufficient evaluation in the case of use. Depending on an application circuit, even when the fault charge battery is not contained, the connection turn of a battery may be restricted in order to prevent the output of OUT detection pulse at the time of battery connection.
2. Any position from V1 to V4 can be used when applying this IC for a one to three-cell battery. However, be sure to short circuit between pins not in use ( VC1-VC2, VC2-VC3, VC3-VC4, or VC4-VSS).
3. The application conditions for the input voltage, output voltage, and load current should not exceed the package power dissipation.
4. Do not apply an electrostatic discharge to this IC that exceeds the performance ratings of the built-in electrostatic protection circuit.

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