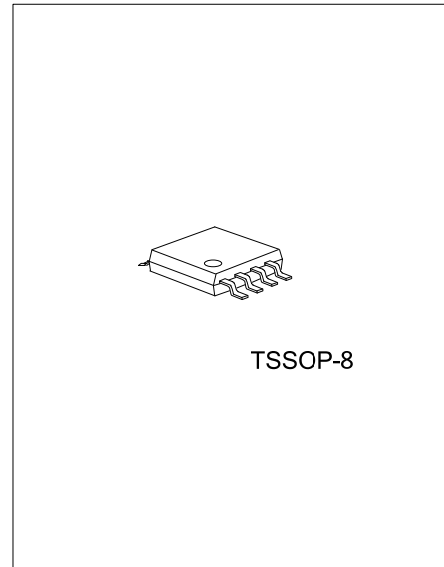




LION BATTERY PROTECTION IC FOR 2-SERIAL, 3-SERIAL, OR 4-SERIAL-CELL PACK (SECONDARY PROTECTION)



DESCRIPTION

The UTC **UB264B** Series is secondary protection IC for 2-, 3-, or 4-Cell lithium-ion rechargeable battery packs, and incorporates a high-accuracy voltage detection circuit.

The UTC **UB264B** Series also includes a high accuracy delay circuit for over voltage detection time without external capacitors.

FEATURES

- * High-accuracy voltage detection circuit for each cell
- * Overcharge detection voltage n (n=1 to 4): 4.30V to 4.80V (in 50mV steps)
- * Overcharge hysteresis voltage n (n=1 to 4): -0.52V±0.21V, -0.39V±0.16V, -0.26V±0.11V, -0.13V±0.06V, None
- * Delay times for overcharge detection can be set by an internal circuit without external capacitors
- * Output latch function after overcharge detection
- * CMOS output active "H"
- * Wide operating voltage range 3.6V to 24V
- * Wide operating temperature range -40°C to +85°C
- * Low current consumption: 2.5µA typ. (+25° C) at 3.5V for each cell

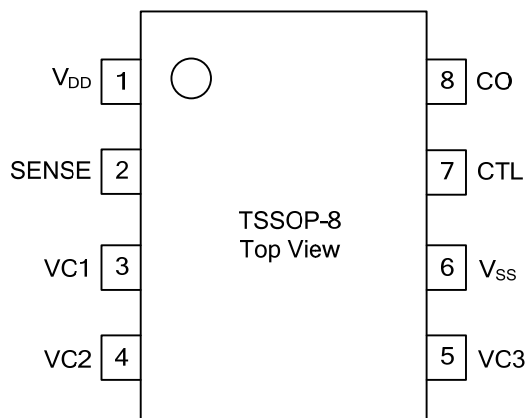
ORDERING INFORMATION

| Ordering Number | | Package | Packing |
|-----------------|---------------|---------|-----------|
| Lead Free | Halogen Free | | |
| UB264BL-P08-R | UB264BG-P08-R | TSSOP-8 | Tape Reel |

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

| | |
|-------------------------|---|
| <p>UB264BG-xx-P08-R</p> | <p>(1) R: Tape Reel (2) P08: TSSOP-8 (3) xx: Refer to SERIAL CODE LIST (4) G: Halogen Free, L: Lead Free</p> |
|-------------------------|---|

■ PIN CONFIGURATION



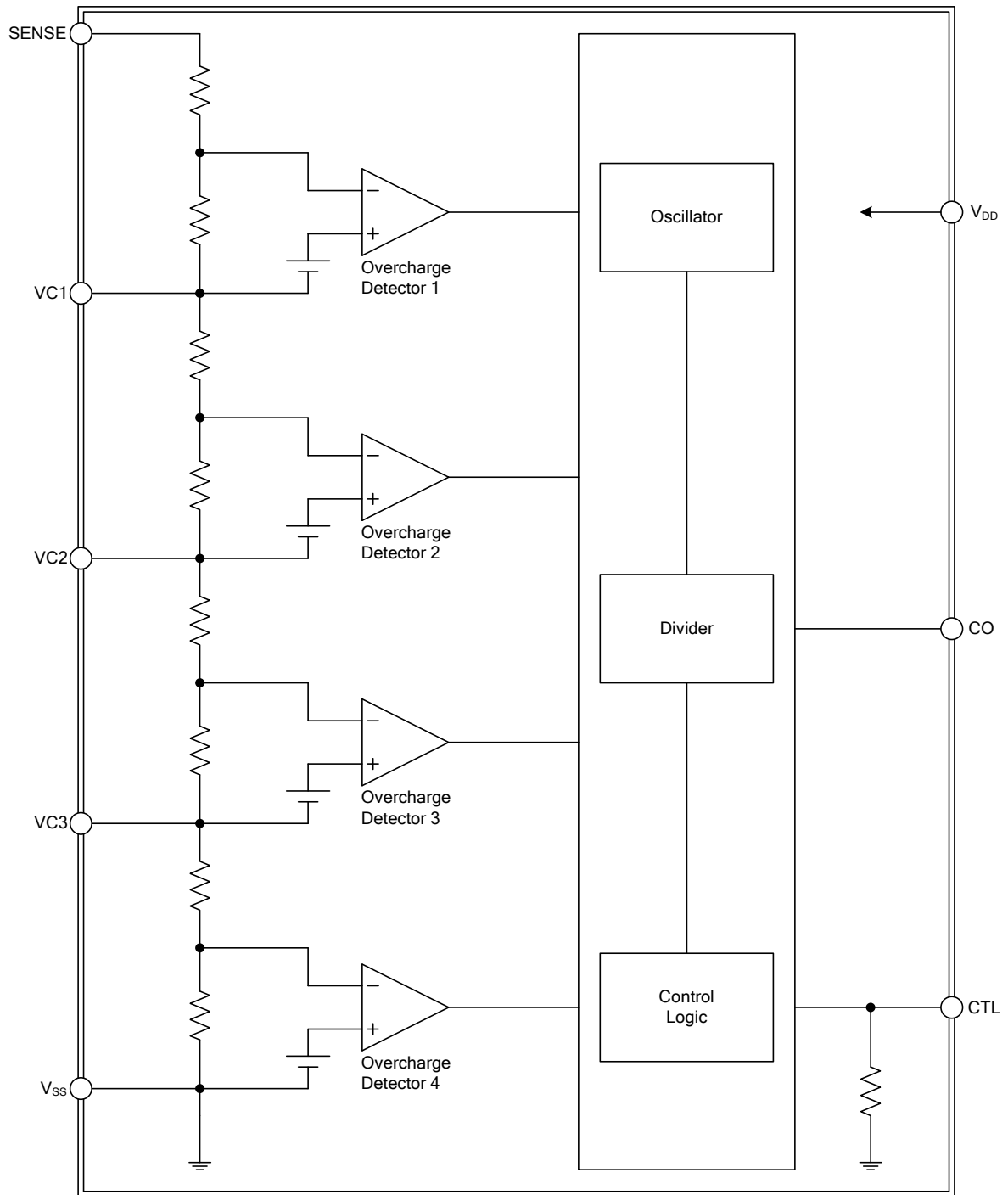
■ PIN DESCRIPTION

| PIN NO. | PIN NAME | DESCRIPTION |
|---------|-----------------|--|
| 1 | V _{DD} | Positive power input pin |
| 2 | SENSE | Positive voltage connection pin of battery 1 |
| 3 | VC1 | Negative voltage connection pin of battery 1 Positive voltage connection pin of battery 2 |
| 4 | VC2 | Negative voltage connection pin of battery 2 Positive voltage connection pin of battery 3 |
| 5 | VC3 | Negative voltage connection pin of battery 3 Positive voltage connection pin of battery 4 |
| 6 | V _{SS} | Negative power input pin Negative voltage connection pin of battery 4 |
| 7 | CTL | Overcharge detection latch reset pin |
| 8 | CO | FET gate connection pin for charge |

■ SERIAL CODE LIST

| MODEL | CODE | OVERCHARGE DETECTION VOLTAGE [V _{CU}](V) | OVERCHARGE HYSTERISIS VOLTAGE [V _{HCL}](V) | OVERCHARGE DETECTION DELAY TIME [t _{CU}](S) | OVERCHARGE RELEASE DELAY TIME [t _{CL}](mS) | OUTPUT FORM |
|--------|------|--|--|---|--|------------------------|
| UB264B | AA | 4.45±0.050 | -0.39±0.16 | 4.0±1.0 | 60.0±20.0 | CMOS output active "H" |
| | AB | 4.35±0.050 | -0.39±0.16 | 4.0±1.0 | 60.0±20.0 | CMOS output active "H" |
| | AC | 4.50±0.050 | -0.39±0.16 | 4.0±1.0 | 60.0±20.0 | CMOS output active "H" |
| | AD | 4.35±0.050 | -0.39±0.16 | 2.0±0.5 | 30.0±10.0 | CMOS output active "H" |
| | AE | 4.30±0.050 | -0.39±0.16 | 4.0±1.0 | 60.0±20.0 | CMOS output active "H" |
| | AF | 4.45±0.050 | -0.39±0.16 | 2.0±0.5 | 30.0±10.0 | CMOS output active "H" |
| | AG | 4.30±0.050 | -0.39±0.16 | 2.0±0.5 | 30.0±10.0 | CMOS output active "H" |
| | AH | 4.40±0.050 | -0.39±0.16 | 4.0±1.0 | 60.0±20.0 | CMOS output active "H" |

■ BLOCK DIAGRAM



■ ABSOLUTE MAXIMUM RATING (T_A=25°C, unless otherwise specified)

| PARAMETER | SYMBOL | RATINGS | UNIT |
|---|------------------|---|------|
| Input Voltage Between V _{DD} And V _{SS} | V _{DS} | V _{SS} -0.3 ~ V _{SS} +26 | V |
| Input Pin Voltage | V _{IN} | V _{SS} -0.3 ~ V _{DD} +0.3 | V |
| CO Output Pin Voltage | V _{CO} | V _{SS} -0.3 ~ V _{DD} +0.3 | V |
| Power Dissipation (Note 2) | P _D | 650 | mW |
| Operation Ambient Temperature | T _{opr} | -40 ~ +85 | °C |
| Storage Temperature | T _{stg} | -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_A=25°C, unless otherwise specified)

| PARAMETER | SYMBOL | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|---|-----------------------------|---|------------------------------------|-----------------------------|------------------------------------|------|
| DETECTION VOLTAGE | | | | | | |
| Overcharge Detection Voltage n (n = 1, 2, 3, 4) | V _{CU_n} | 4.30 ~ 4.80 V, adjustable | V _{CU_n} -0.050 | V _{CU_n} | V _{CU_n} +0.050 | V |
| Overcharge Hysteresis Voltage n (n = 1, 2, 3, 4) | V _{H_{Cn}} | V _{H_{Cn}} =-0.52 ±0.21V, -0.39 ±0.16V, -0.26 ±0.11V, -0.13 ±0.06V, None | | V _{H_{Cn}} | | V |
| DELAY TIME | | | | | | |
| Overcharge Detection Delay Time | t _{CU} | | 3.0 | 4.0 | 5.0 | s |
| | | For AD, AF and AG products | 1.5 | 2.0 | 2.5 | |
| Overcharge Release Delay Time | t _{CL} | | 40 | 60 | 80 | ms |
| | | For AD, AF and AG products | 20 | 30 | 40 | |
| Overcharge Timer Reset Delay Time | t _{TR} | | 10 | 15 | 20 | ms |
| | | For AD, AF and AG products | 5 | 7.5 | 10 | |
| Transition Time To Test Mode(Note1) | t _{TST} | | 40 | 60 | 80 | ms |
| | | For AD, AF and AG products | 20 | 30 | 40 | |
| CTL Pin Response Time | t _{CTL} | | | | 3.0 | ms |
| INPUT VOLTAGE | | | | | | |
| Operating Voltage Between V _{DD} And V _{SS} | V _{DSOP} | | 3.6 | | 24 | V |
| CTL Input "H" Voltage | V _{CTLH} | | V _{DD} ×0.95 | | | V |
| CTL Input "L" Voltage | V _{CTL} | | | | V _{DD} ×0.4 | V |
| INPUT CURRENT | | | | | | |
| Current Consumption During Operation | I _{OP} | V1=V2=V3=V4=3.5V | | 2.5 | 10 | μA |
| Current Consumption During Overdischarge | I _{OPED} | V1=V2=V3=V4=2.3V | | 2.0 | 10 | μA |
| SENSE Pin Current | I _{SENSE} | V1=V2=V3=V4=3.5V | | 1.5 | 6.0 | μA |
| VC1 Pin Current | I _{VC1} | V1=V2=V3=V4=3.5V | -0.5 | 0 | 0.5 | μA |
| VC2 Pin Current | I _{VC2} | V1=V2=V3=V4= 3.5 V | -0.5 | 0 | 0.5 | μA |
| VC3 Pin Current | I _{VC3} | V1=V2=V3=V4=3.5 V | -0.5 | 0 | 0.5 | μA |
| CTL Pin "H" Current | I _{CTLH} | V1=V2=V3=V4=3.5 V, V _{CTL} =V _{DD} | 1.0 | 1.5 | 2.0 | μA |
| CTL Pin "L" Current | I _{CTL} | V1=V2=V3=V4=3.5 V, V _{CTL} =0 V | -0.1 | | | μA |
| OUTPUT CURRENT | | | | | | |
| CO Pin Sink Current | I _{COL} | V _{COP} =V _{SS} +0.5V | 0.4 | | | mA |
| CO Pin Source Current | I _{COH} | V _{COP} =V _{DD} -0.5V | 20 | | | μA |

Note: 1. Test conditions: V1=V2= V3=V4=3.5 V, V_{DD} ≥ V_{SENSE} + 8.5V.

■ OPERATING

1. Overcharge Detection

Under normal conditions, when the voltage of any one cell battery exceeds the overcharge detection voltage (V_{CU}) during charging, and after the state is retained for the overcharge detection delay time (t_{CU}), CO will become “H”. This state is called overcharge. Attaching FET to the CO pin provides charge control and a second protection.

Only the voltage of all the batteries decreases below the total of the overcharge detection voltage (V_{CU}) and the overcharge hysteresis voltage (V_{HC}) and the state is retained for the overcharge release delay time (t_{CL}) or longer, the overcharge status is released; however, CO stays at “H”. When the CTL pin is switched from “L” to “H”, CO becomes “L”.

2. Overcharge Timer Reset

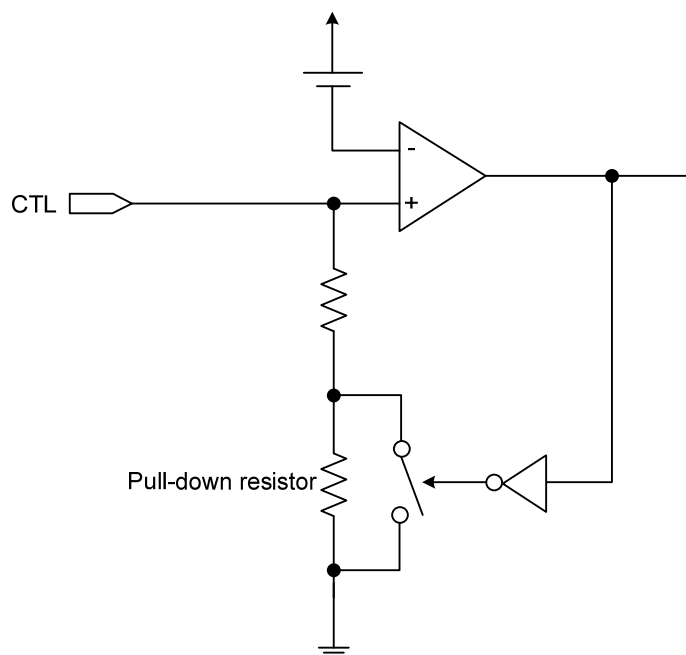
When an overcharge release noise that forces the voltage of the battery temporarily below the overcharge detection voltage (V_{CU}) is input during the overcharge detection delay time (t_{CU}) from when V_{CU} is exceeded to when charging is stopped, t_{CU} is continuously counted if the time the overcharge release noise persists is shorter than the overcharge timer reset delay time (t_{TR}). Under the same conditions, if the time the overcharge release noise persists is t_{TR} or longer, counting of t_{CU} is reset once. After that, when V_{CU} has been exceeded, counting t_{CU} resumes.

3. CTL Pin

The CTL pin is used to control the output voltage of the CO pin. In the UTC **UB264B** Series, when the CTL pin is switched from “L” to “H”, a reset signal is output to the overcharge detection latch and CO becomes “L”.

| CTL PIN | CO PIN |
|-----------|-----------------------|
| “H” | Without latch |
| Open | Normal state (Note 1) |
| “L” | Normal state (Note 1) |
| “L” → “H” | Latch reset (Note 2) |
| “H” → “L” | - |

- Notes:
1. The state is controlled by the overcharge detection circuit.
 2. Latch reset becomes effective when the voltages of all the batteries are lower than the total of the overcharge detection voltage (V_{CU}) and the overcharge hysteresis voltage (V_{HC}) and the overcharge release delay time (t_{CL}) has elapsed.

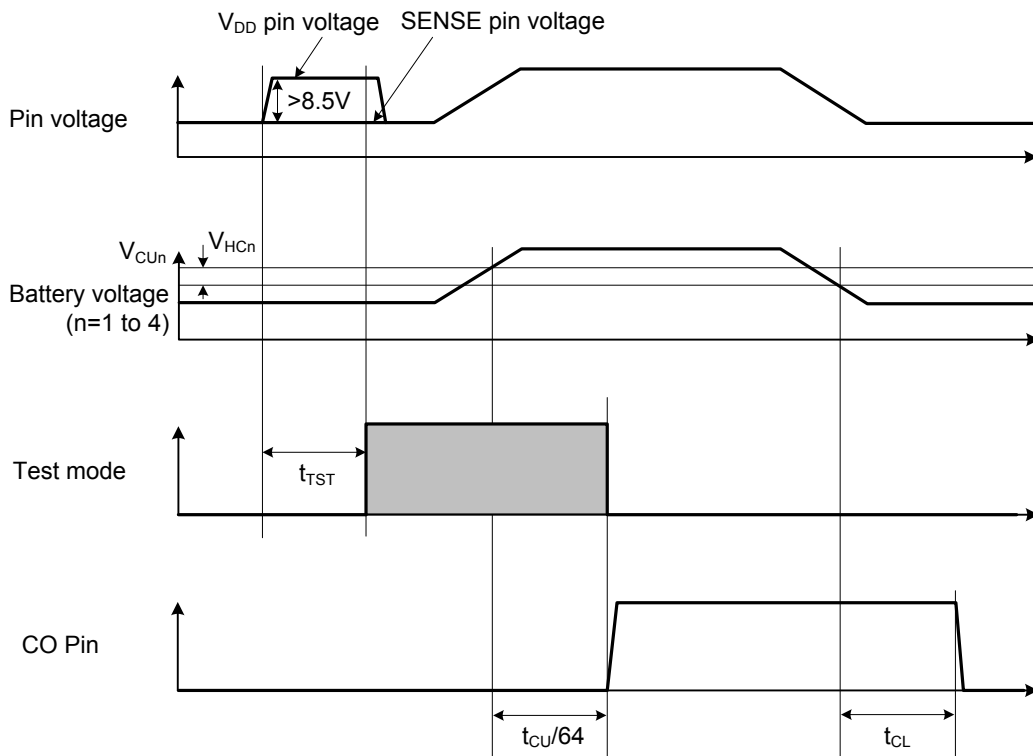


■ OPERATING(Cont.)

- Notes:
1. The reverse voltage "H" to "L" or "L" to "H" of CTL pin is V_{DD} pin voltage -2.8 V (Typ.), does not have the hysteresis.
 2. Since the CTL pin implements high resistance of $8M\Omega$ to $12M\Omega$ for pull down, be careful of external noise application. If an external noise is applied, CO may become "H". Perform thorough evaluation using the actual application.
 3. In the UTC UB264B Series, when the CTL pin is open or "L", CO latches "H". When the V_{DD} pin voltage is decreased to the UVLO voltage of 2 V (Typ.) or lower, the latch is reset.

4. Test Mode

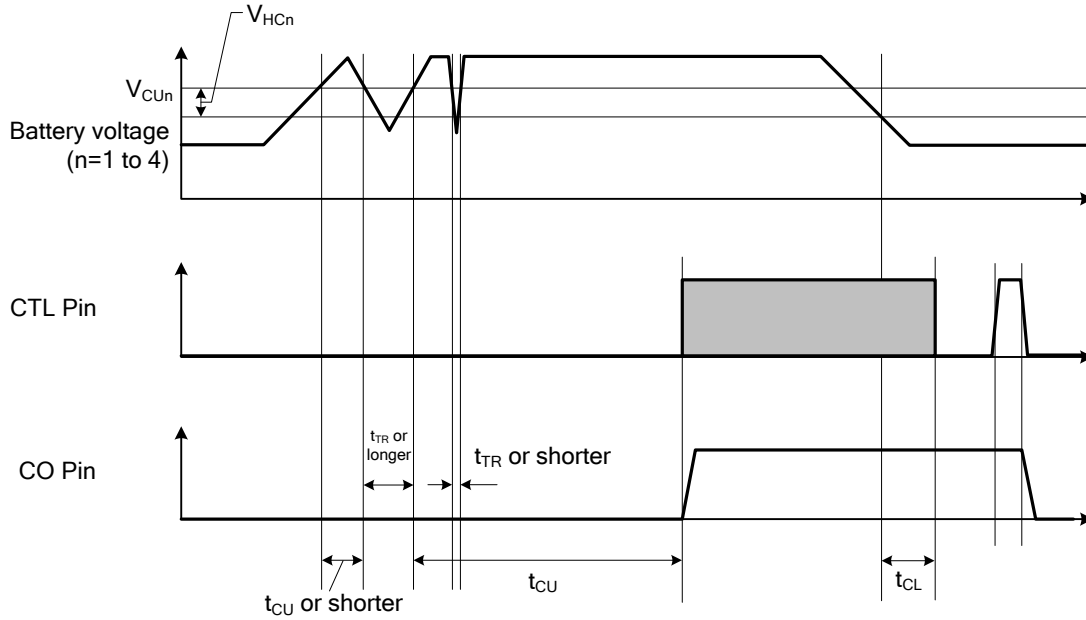
In the UTC **UB264B** Series, the overcharge detection delay time (t_{CU}) can be shortened by entering the test mode. The test mode can be set by retaining the V_{DD} pin voltage 8.5 V or more higher than the SENSE pin voltage for at least $80ms$ ($V1=V2=V3=V4=3.5$ V, $Ta=25^{\circ}C$). The status is retained by the internal latch and the test mode is retained even if the V_{DD} pin voltage is decreased to the same voltage as that of the SENSE pin. When CO becomes "H" when the delay time has elapsed after overcharge detection, the latch for retaining the test mode is reset and the UTC **UB264B** Series exits from the test mode.



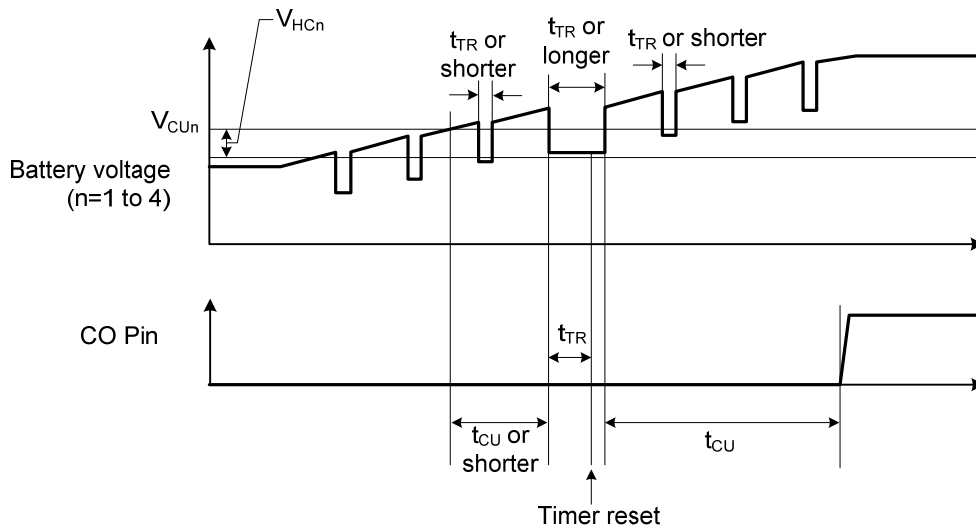
- Notes:
1. When the V_{DD} pin voltage is decreased to lower than the UVLO voltage of 2 V (Typ.), the UTC UB264B Series returns to the normal mode.
 2. Set the test mode when no batteries are overcharged.
 3. The overcharge release delay time (t_{CL}) is not shortened in the test mode.
 4. The overcharge timer reset delay time (t_{TR}) is not shortened in the test mode.

■ TIMING CHARTS

1. Overcharge Detection Operation

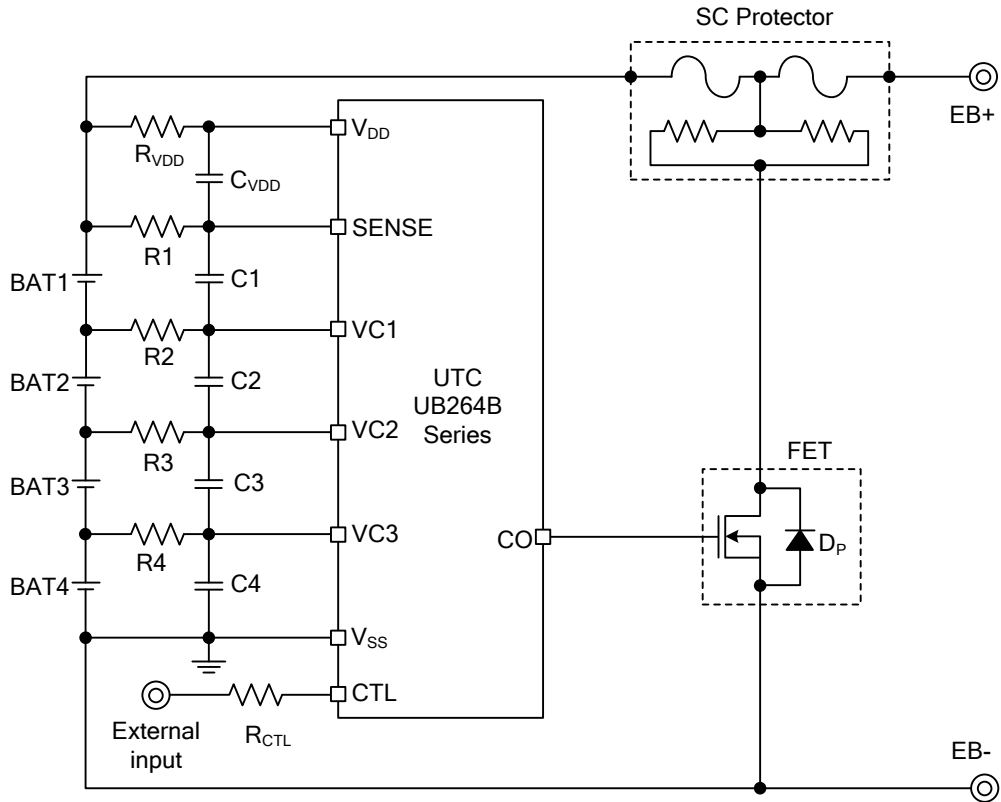


2. Overcharge Timer Reset Operation

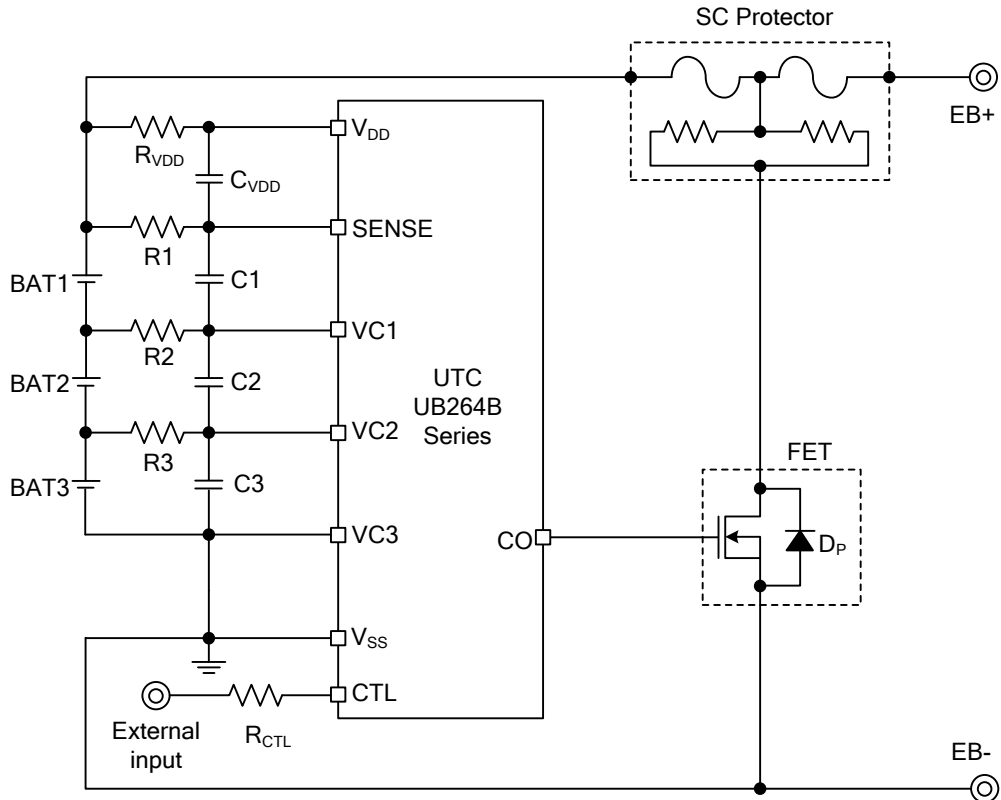


■ TYPICAL APPLICATION CIRCUIT

1. 4-serial cell

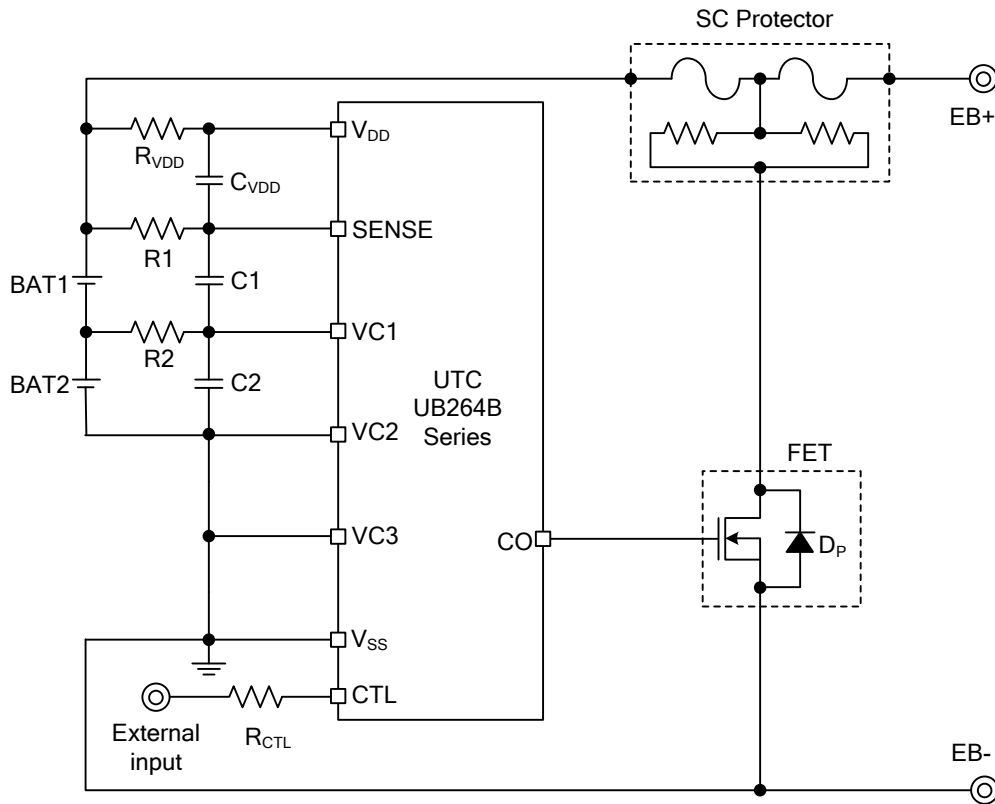


2. 3-serial cell



■ TYPICAL APPLICATION CIRCUIT(Cont.)

3. 2-serial cell



Constants for External Components

| NO. | PART | MIN | TYP | MAX | UNIT |
|-----|----------------|------|-----|-----|------|
| 1 | R1 to R4 | 0.1 | 1 | 10 | KΩ |
| 2 | C1 to C4, CVDD | 0.01 | 0.1 | 1 | μF |
| 3 | RVDD | 50 | 100 | 500 | Ω |
| 4 | RCTL | 0 | 100 | 500 | Ω |

- Notes:
1. the examples of connection shown above and the constants will not guarantee successful operation. Perform thorough evaluation using the actual application to set the constant.
 2. Set the same constants to R1 to R4 and to C1 to C4 and CVDD.
 3. Set RVDD, C1 to C4 and CVDD so that the condition $(R_{VDD}) \times (C1 \text{ to } C4, C_{VDD}) \geq 5 \times 10^{-6}$ is satisfied.
 4. T Set R1 to R4, C1 to C4, and CVDD so that the condition $(R1 \text{ to } R4) \times (C1 \text{ to } C4, C_{VDD}) \geq 1 \times 10^{-4}$ is satisfied.
 5. In some application circuits, even if an overcharged battery is not included, the order of connecting batteries may be restricted to prevent transient output of CO detection pulses when the batteries are connected. Perform thorough evaluation with the actual application circuit.
 6. Since "H" may be output at CO transiently when the battery is being connected, connect the positive terminal of BAT1 last in order to prevent the three terminal protection fuse from cutoff.
 7. Before the battery connection, short-circuit the battery side pins RVDD and R1.
 8. In the UTC UB264B Series, normally input "L" to the external input, and input "H" when releasing the latch that maintains CO at "H" after overcharge detection.

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