

For coin type battery, t_p is 3%. For cylindrical battery, t_p is 1%.

Example: A 1000mAh coin-type battery is to be used for five years.

With Equation 2, I_c is 30mAh (1000mAh x 3% (coin-type battery) = 30mAh).

With Equation 1, a diode with a reverse current of $0.7\mu\text{A}$ or less is required ($30\text{mAh} \div \text{usage period (5 years x 365 days x 24 hours)} = 0.7\mu\text{A}$).

Protection Circuit for Other Devices Without Internal Protection

For circuits that require a battery backup feature but either do not have a V_{BAT} pin or the V_{BAT} pin does not offer reverse charging protection, then a classic UL recommended three diode configuration is the best protection against reverse charging.

For example, the ISL12058 does not offer a battery switchover feature but an application requires it. The battery backup function can be added simply by connecting both main supply and backup battery to the V_{DD} pin. To have proper protection, a diode is placed in series with the main supply and two diodes are placed in series with the battery. The diode in series with the main supply is to block current from the battery into the main supply. Two diodes in series with the battery are to prevent reverse charging. The second diode is used to provide protection in the event that one should fail. Figure 3 shows the actual circuit with three diodes protection.

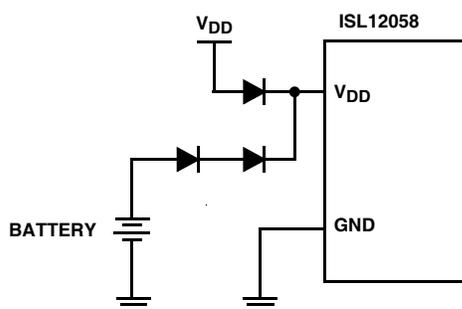


FIGURE 3. PROTECTION CIRCUIT WITH THREE DIODES

Testing

To insure the protection diodes are properly installed for the reverse charging protection, a simple test sequence is required after installation of the diodes.

A forced reverse charging test is done to insure the diodes are placed correctly to prevent reverse charging current to the battery. This is done by taking V_{DD} to 3.6V. The battery input is then forced to 1.8V and the charging current is checked with an ammeter capable of measuring current as low as 100nA to insure that it does not exceed the maximum reverse current of the protection diode. The test circuit is shown in Figure 4.

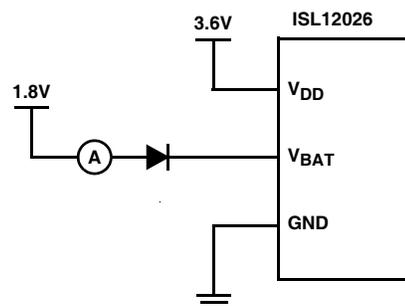


FIGURE 4. TEST CIRCUIT FOR REVERSE CHARGING PROTECTION

Conclusion

Lithium batteries are commonly used in a wide range of applications with devices requiring backup power, such as RTCs and memory devices. In order to meet UL standards for maximum charging (leakage) current, extra circuitry is required such as low leakage diodes even though a protected device has internal reverse charging protection. For a system with supplies other than the lithium battery, diode protection is not required but may be put in place to prevent any reverse charging from occurring.

Appendix

- A) Intersil devices that require one diode in series (Figure 2 on page 1) with the V_{BAT} pin for UL requirements: ISL1208, ISL1209, ISL1218, ISL1219, ISL1220, ISL1221, ISL12020, ISL12020M, ISL12022, ISL12022M, ISL12024, ISL12025, ISL12026, ISL12027, ISL12028, ISL12029.
- B) Intersil devices that require two diode in series (Figure 3) for UL requirements: ISL12057, ISL12058, ISL12059.

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Renesas Electronics America Inc.
1001 Murphy Ranch Road, Milpitas, CA 95035, U.S.A.
Tel: +1-408-432-8888, Fax: +1-408-434-5351

Renesas Electronics Canada Limited
9251 Yonge Street, Suite 8309 Richmond Hill, Ontario Canada L4C 9T3
Tel: +1-905-237-2004

Renesas Electronics Europe Limited
Dukes Meadow, Millboard Road, Bourne End, Buckinghamshire, SL8 5FH, U.K
Tel: +44-1628-651-700, Fax: +44-1628-651-804

Renesas Electronics Europe GmbH
Arcadiastrasse 10, 40472 Düsseldorf, Germany
Tel: +49-211-6503-0, Fax: +49-211-6503-1327

Renesas Electronics (China) Co., Ltd.
Room 1709 Quantum Plaza, No.27 ZhichunLu, Haidian District, Beijing, 100191 P. R. China
Tel: +86-10-8235-1155, Fax: +86-10-8235-7679

Renesas Electronics (Shanghai) Co., Ltd.
Unit 301, Tower A, Central Towers, 555 Langao Road, Putuo District, Shanghai, 200333 P. R. China
Tel: +86-21-2226-0888, Fax: +86-21-2226-0999

Renesas Electronics Hong Kong Limited
Unit 1601-1611, 16/F., Tower 2, Grand Century Place, 193 Prince Edward Road West, Mongkok, Kowloon, Hong Kong
Tel: +852-2265-6688, Fax: +852-2886-9022

Renesas Electronics Taiwan Co., Ltd.
13F, No. 363, Fu Shing North Road, Taipei 10543, Taiwan
Tel: +886-2-8175-9600, Fax: +886-2-8175-9670

Renesas Electronics Singapore Pte. Ltd.
80 Bendemeer Road, Unit #06-02 Hyflux Innovation Centre, Singapore 339949
Tel: +65-6213-0200, Fax: +65-6213-0300

Renesas Electronics Malaysia Sdn.Bhd.
Unit 1207, Block B, Menara Amcorp, Amcorp Trade Centre, No. 18, Jln Persiaran Barat, 46050 Petaling Jaya, Selangor Darul Ehsan, Malaysia
Tel: +60-3-7955-9390, Fax: +60-3-7955-9510

Renesas Electronics India Pvt. Ltd.
No.777C, 100 Feet Road, HAL 2nd Stage, Indiranagar, Bangalore 560 038, India
Tel: +91-80-67208700, Fax: +91-80-67208777

Renesas Electronics Korea Co., Ltd.
17F, KAMCO Yangjae Tower, 262, Gangnam-daero, Gangnam-gu, Seoul, 06265 Korea
Tel: +82-2-558-3737, Fax: +82-2-558-5338