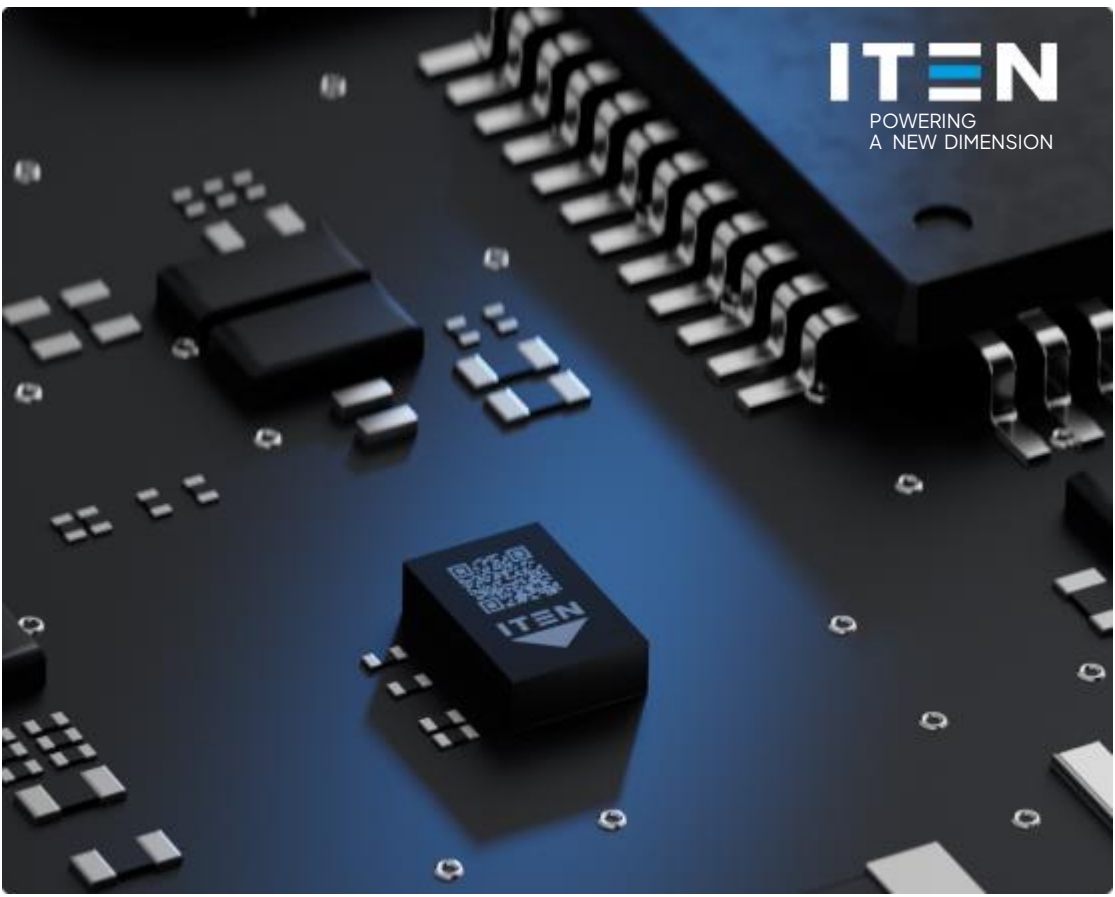
APPLICATION NOTES

# Powency Batteries for RTC Power Backup

Nowadays Real Time clocks (RTC) are commonly used in many kind of applications from consumer electronics to IoT systems. RTC keeps accurate track of time even when a power supply is turned off or a device is placed in low power mode. ITEN rechargeable batteries offer the ideal solution, providing long-lasting, stable power to ensure your RTCs perform optimally under all conditions



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Authors:
Vincent Millot, Application Engineering Manager at ITEN

# Overview

The purpose of this document is to highlight the advantages of using ITEN batteries for powering Real-Time Clock (RTC) integrated circuits (ICs). By providing a reliable power source, ITEN batteries ensure that RTCs can maintain accurate timekeeping even when the main system is powered down, thereby enhancing the overall functionality and reliability of electronic devices in an eco-friendly and compact design.

# Importance of a Reliable Battery for RTCs

RTCs need to keep accurate time even when the primary power source is unavailable. A reliable battery is critical for maintaining continuous operation and data integrity. Accurate timekeeping is vital for timestamping and logging events, especially in systems where precise timing is crucial, such as in data servers, security systems, and industrial control applications. ITEN batteries are designed to deliver consistent power, ensuring that your RTCs continuously operate during power outages, system shutdowns, or battery replacement in the main device. ITEN batteries long lifespan and rechargeable remove the need of replacement compared to standard batteries. This reduces maintenance efforts and costs, making it an economical choice for long-term projects and devices deployed in remote or hard-to-reach locations.

# Features of ITEN Batteries

## 01 Voltage

ITEN Powency PWY0150S and PWY0250S batteries can be used from 2.7V to 1.5V, which make them compatible with most of ultra-low power RTC modules. Unlike conventional batteries, ITEN technology allows the battery to safely reach 0V without damage or safety risks, ensuring superior reliability and longevity.

## 02 Fast Charge

With its unique material composition, 80% of the microbattery can be charged in 8 minutes at room temperature using a constant voltage of 2.7V as shown on Figure 1 below. Such charging configuration can be easily done with embedded trickle charging system of RTC modules.

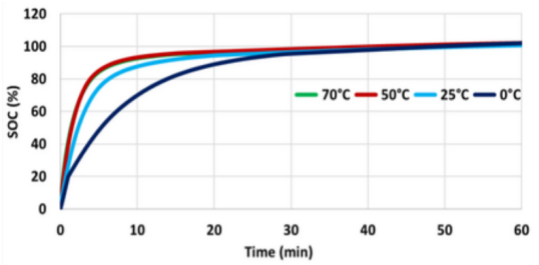


Figure 1: Charging curves of PWY0150S

## 03 Capacity

ITEN Powency portfolio includes 150µAh and 250µAh and can support low-power RTCs for weeks without main power sources (please refer to part for case study). Both models can also support 30mA peak for 100ms. If additional capacity is required, battery can be put in parallel without the need to use specific BMS IC.

## 04 Longevity

ITEN Solid-State batteries have been designed to last at least 1000 cycles at 100% DoD, which means that the system can be used for decades before needing the battery to be replaced

## 05 Low Self-Discharge

Powency batteries are designed to deliver good self-discharge performance, ensuring minimal energy loss over extended periods. Below is a summary of self-discharge performance of Powency batteries

| Powency Reference | Self-discharge per day | Self-discharge per hour |
|---|---|---|
| PWY0150S | 5µAh | 208nA |
| PWY0150S | 8.3µAh | 347nAh |

## 06 Temperature Range and Stability

Thanks to its 100% ceramic structure, ITEN batteries are designed to operate without experiencing thermal runaway, ensuring stable performance even under high-temperature conditions. ITEN batteries can operate from -20#€ to 70#€

## 07 Size and Compatibility

ITEN Powency batteries fit in a tiny QFN package (3.5 x 5.1 x 1.6 mm), which offers unmatched energy and power density. Their miniature form-factor ensure to fit in various embedded systems, such as IoT or wearable electronics applications. Its compliance with low temperature (165ºC) Solder & Reflow makes it easy to integrate on printed circuit boards.

## 08 Certification and Safety

ITEN microbatteries are RoHS and REACH compliant. Its 100% Ceramic structure makes it very safe and immune against thermal runaway.

# Benefits of Using ITEN Batteries for RTC Back-Up Applications

## Extended Device Uptime

Using ITEN battery as back-up could extends the operational uptime when the main power is missing

## Maintenance Reduction and Cost Efficiency

Thanks to its rechargeable feature, using ITEN battery would remove the need to replace the battery, hence significantly reduced the maintenance cost of the system compared to typical coin cells .

# Integration and Compatibility

## Integration Guidelines

Please follow the guidelines below to ensure proper integration of the battery for RTC backup applications, optimizing performance and reliability

1. Please make sure the RTC operating voltage match the working voltage range of the ITEN battery (2.7V – 1.5V)
2. In order to reduce the number of components on the board, hence the compactness of the design, preferably use components with integrated voltage regulators as shown in the following architecture

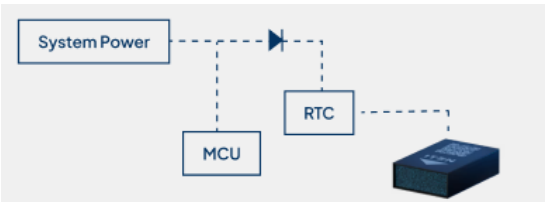


Figure 2: Architecture for RTC back-up with integrated voltage regulator

In case the RTC IC doesn't offer an integrated voltage regulator, a DC/DC converter (LDO, Boost, Buck depending on the power supply) would need to be added into your design to charge the ITEN POWENCY battery at 2.7V as required

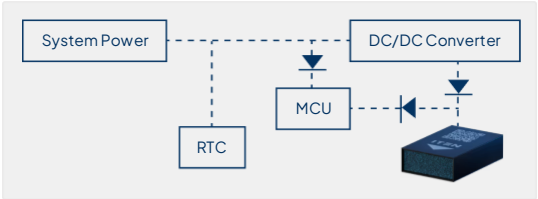


Figure 3: Architecture for RTC back-up with external DC/DC Converter

Please note that reverse current protection would be needed to avoid discharging the battery when the source goes missing.

3. In order to optimize the backup period, please select the RTC (and DC/DC converter) with the lowest consumption possible

## Supported RTC Models

Please find below a non-exhaustive list of ultra-low-power RTC ICs with trickle charger that are compatible with ITEN Powency batteries.

| Supplier | IC Reference | Operating Voltage Range | Current Consumption @ 3.0V |
|---|---|---|---|
| Ambiq | AM18X5 | 1.5 - 3.6V | 14 nA |
| Abracon | AB-RTCMC | 1.5 - 3.6V | 17nA |
| EM Micro | EM3028 | 1.2 - 5.5V | 40 nA |
| Micro Crystal | RV-3028-C7 | 1.1 - 5.5V | 45 nA |
| Analog Devices | MAX31331 | 1.1 - 5.5V | 65 nA |

Table 2: Non-exhaustive list of ultra-low-power RTC ICs compatible with ITEN Powency batteries

Please refer to the associated datasheets for further details

If you want to use ITEN battery with a RTC which isn't included in this list, feel free to contact ITEN technical support for system review and integration recommendations.

# Case Studies / Examples

## Ambiq AM18X5 and Abracon AB18X5

As both RTC ICs are quite identical, similar implementation and configuration can be used

Recommended Implementation:

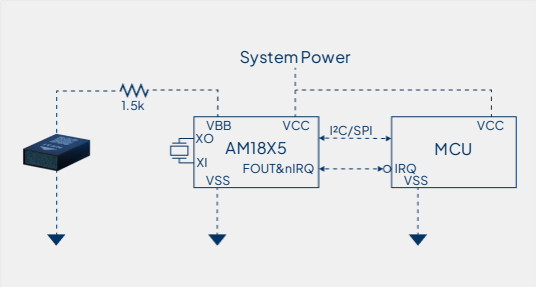


Figure 4: Recommended integration of ITEN POWENCY battery with AM18X5 and AB18X5 RTC

## Recommended RTC configuration:

- Power Supply Vcc
  Ensure that the RTC's VCC is higher than the battery's charging voltage (typically VCC>2.7V). A VCC of 3.3V is recommended.
- Oscillator mode
  In order to reduce the consumption of the RTC, RC oscillator mode is recommended
- Trickle Charge Configuration
  Set up the trickle charge path to provide a safe current and maintain the battery voltage near 2.7V. Follow these steps:
  - Enable the trickle charge function by writing value 1010 in [7:4] bits of Trickle register 0×20
  - Choose standard Diode with 0.6V voltage drop so that voltage charge of the battery = 3.3V – 0.6V = 2.7V, hence write 10 in [3:2] bits of 0×20 Trickle register
  - Trickle Charge Resistor can be disabled as no current limit is required to charge the battery, hence write 00 in [1:0] bits of 0×20 Trickle register
  - Complete 0×20 Trickle register value to write is then 10101000
- Battery Monitoring and Control
  In order to adapt the reference voltages to ITEN battery voltage in the Wakeup Control, please set 0×21 BREF Control register to the value 11010000

## Power Backup Time

Using this above configuration, here is the typical backup time that

| Component | Leakage | Power Backup Time |
|---|---|---|
| AM18X5 | 14nA | - |
| PWY0150S | 208nA | - |
| Total | 222nA | 28 days |

Table 3: Expected backup time using PWY0150S with AM18X5 RTC

| Component | Leakage | Power Backup Time |
|---|---|---|
| AM18X5 | 14nA | - |
| PWY0150S | 347nA | - |
| Total | 361nA | 29 days |

Table 4: Expected backup time using PWY0250S with AM18X5 RTC

## EM Microelectronic EM3028

Recommended Implementation:

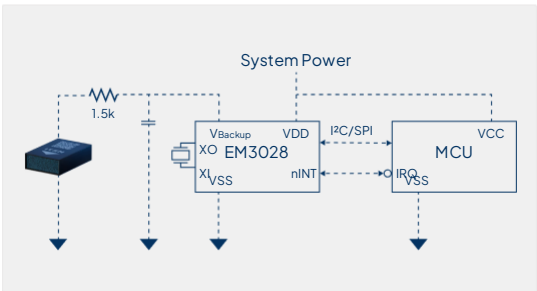


Figure 5: Recommended integration of ITEN POWENCY battery with EM3028 RTC

## Recommended RTC configuration:

- Power Supply Vcc
  Ensure that the RTC's VCC is higher than the battery's charging voltage (typically VCC>2.7V). A VCC of 3V is recommended.
- Oscillator mode
  In order to reduce the consumption of the RTC, RC oscillator mode is recommended
- Trickle Charge Configuration
  Set up the trickle charge path to provide a safe current and maintain the battery voltage near 2.7V. Follow the following steps

- Enable the trickle charge function by writing 1in bit 5 of Trickle register 0x37
- In order to optimize Switchover Function between Main Power and Back up, please write 11 in [3:2] bits of 0x37 Trickle register
- Use the smallest Trickle Charge Resistor possible (1 kΩ) as no current limit is required to charge the battery, hence write 00 in [1:0] bits of Trickle register 0x37
- Complete 0x37 Trickle register value to write is then 00101100

## Power Backup Time

Using this above configuration, here is the typical backup time that

| Component | Leakage | Power Backup Time |
|---|---|---|
| EM3028 | 45nA | - |
| PWY0150S | 208nA | - |
| Total | 253nA | 25 days |

Table 5: Expected backup time using PWY0150S with EM3028RTC

| Component | Leakage | Power Backup Time |
|---|---|---|
| EM3028 | 45nA | - |
| PWY0150S | 347nA | - |
| Total | 392nA | 27 days |

Table 6: Expected backup time using PWY0250S with EM3028 RTC

# Conclusion

RTCs need to keep accurate time even when the primary power source is unavailable. A reliable battery is critical for maintaining continuous operation and data integrity.

Accurate timekeeping is vital for timestamping and logging events, especially in systems where precise timing is crucial, such as in data servers, security systems, and industrial control applications. ITEN batteries are designed to deliver consistent power, ensuring that your RTCs continuously operate during power outages, system shutdowns, or battery replacement in the main device.

ITEN batteries long lifespan and rechargeable remove the need of replacement compared to standard batteries. This reduces maintenance efforts and costs, making it an economical choice for long-term projects and devices deployed in remote or hard-to-reach locations.

# Revision History

| Date | Version | Changes |
|---|---|---|
| 2025/04/17 | V1.1 | Update file template |
| 2025/01/31 | V1.0 | Initial Version |

# Notice



# Contact

For any technical questions, please send us an email to:

technical.support@iten.com
For any commercial questions, please send us an email to:

sales@iten.com

# About Us

ITEN is a French industrial gem, leader in the development and production of solid-state batteries with unrivalled power density. It is one of the few global players with the capacity for industrial production of this technology, mastering the entire design and production chain. These revolutionary batteries meet the power and miniaturization needs of electronic systems used in connected objects, autonomous sensors and wearables.

At the heart of the French DeepTech ecosystem, ITEN holds over 200 patents. ITEN is the two-time winner of the global innovation competition in 2015 and 2017, the French Tech 120 winner in 2023 and 2024 and won the CES 2024 Best of Innovation Awards in Las Vegas for its Powency 250µAh battery (the second French company to be honoured since CES was founded in 1967).

www.iten.com

12, chemin du Jubin

69570 Dardilly - France