

## What is a Real Time Clock (RTC)?

### Introduction

At ECS Inc. International, we offer the widest breadth of product in the electronics industry. Our portfolio includes tuning fork watch crystals, quartz crystals, oscillators, VCXOs, TCXOs, OCXOs, real time clocks (RTC), and miniature shielded power inductors. ECS Inc. is a recognized industry leader in frequency control and power management products. Our products are widely used in IoT, wearables, consumer products, automotive electronics, and medical products.

### What is a Real Time Clock (RTC)?

A real time clock, or RTC, is a digital clock with a primary function to keep accurate track of time even when a power supply is turned off or a device is placed in low power mode. RTC's are comprised of a controller, oscillator, and an embedded quartz crystal resonator. They are engineered as all-in-one devices to provide better performances than discrete components, simplify integration in new designs, and accelerate time to market.

Functions of the RTC are called registers. Register data is programmed into RAM memory. The registers are updated periodically - even during normal RTC operation. The RTC design also includes a power switch function to battery operation or another low power backup power source. This allows the RTC to maintain precise and continuous time counts even if the unit goes into sleep mode or if main power is lost. It also alleviates the need for the user to reset the time and date every time the device supply is cycled.

RTCs are used in a variety of applications where they play a critical role in keeping accurate track of the current time while also providing alarms, timers, and interrupt functions and helping to reduce power consumption.

### How RTCs are used today

Many of today's products are powered by batteries and have limited or no access to battery replacements or recharging power sources. Because of the lack of power sources, having all systems and sensor functions running continuously would quickly drain the battery of these devices. The solution is to have scheduled intermittent activation of the product to greatly extend the life of the battery. The use of a RTC allows the designer to power down the high current usage microcontroller when no task is required, resulting in significant power savings. When microcontrollers are in a deep sleep or low-power mode, the RTCs internal clock and circuitry will keep running to maintain accurate timekeeping and alarm functions. In this mode, the current draw will be as low as 0.5uA.

The real time clock (RTC) module solves the current draw problem by always staying on and being the lowest current usage device when no other task is required. Even when the RTC is not used as a power saving device, the continuous timekeeping function is critical for the proper function of today's electronics, medical devices, and industrial products where power savings and backup timekeeping are at premium.

## Overview of ECS Inc. RTC Modules

ECS Inc. International's ECS-RTC-3225-5609 and ECS-RTC-3225-5699HS are small form factor I2C bus interface real time clocks with low power consumption and an embedded 32.768 kHz TCXO. The precise temperature sensor and temperature compensated circuit ensure clock accuracy. They support specialized calendar and timer functions and are ideal for portable and small electronic devices. The real time clock module offers selectable output frequencies (32.768 kHz, 1024 Hz, 1 Hz) and enabled/disabled single CMOS output for peripheral devices.

The ECS-RTC-3225-5609 and ECS-RTC-3225-5609 real time clocks use a precise quartz resonator driving a microcontroller to control time-based functions. These real time clock modules allow engineers the flexibility to overcome modern design-based challenges. Our connected world requires interoperability with increased performance and reduced power consumption.

The real time clock module saves space, time, and money by designing the entire integrated circuit into a small form factor package. This allows engineers to reduce part counts and minimize the footprint. Because real time clocks are factory calibrated, they do not require additional oscillator adjustment during the design phase or tuning during operation.

## Size and interface of the ECS Inc. RTC Modules

To minimize the impact on the system board, both the ECS-RTC-3225-5609 and -5699HS are available in a 3.2mm x 2.5 mm x 1.0mm package.

An I<sup>2</sup>C interface is a simple, bidirectional two-wire synchronous serial bus. I2C bus supports bi-directional communications through a serial clock line (SCL) pin 5 and a serial data line in/out (SDA) pin 7. I<sup>2</sup>C bus device can be defined as 'master' and 'slave'. The ECS RTC modules can only be used as slave. I<sup>2</sup>C bus interface supports single byte read/write operations as well as multiple bytes incremental access.

## Stability of the ECS Inc. RTC Modules

The stability is linked to the performance of the 32.768 kHz crystal and oscillator embedded in the RTC. Its performance may deteriorate by changes in temperature or effects caused by the aging. With the ECS-RTC-3225-5609 and ECS-RTC-3225-5699HS being hermetically sealed, having integrated crystal resonators, and RTC circuitry, they minimize the effects temperature, pressure, and humidity have on the performance of the module.

- Operation temperature range: -40°C ~ +85°C
- Stability over temperature:
  - ECS-RTC-3225-5609
    - < ±5ppm @ -20°C ~ +70°C
    - < ±20ppm @ -40°C ~ +85°C
  - ECS-RTC-3225-5699HS
    - < ±5ppm @ -40°C ~ +85°C

## **RTC interrupts and variations**

The RTC can produce various types of interrupts (pin 10). During operation, the RTC can be programmed to send out an alarm or trigger flag to provide an entire clock and calendar. These interrupt functions are active when the RTC is operating on the backup source (Vbat power state). For every interrupt occurrence and variation, the RTC will create a digital timestamp of the event to review consistencies.

Examples of RTC interrupts include periodic time updates, periodic countdown for timers, low voltage detectors, automatic power source switchover, power on reset, and alarms. Alarms are based on timing settings in the registers. An alarm interrupt is generated when the time matches the setting's registers, then the /INT pin 10 goes to low level and triggers the alarm interrupt. This will be the same for the countdown timers for a notification that an event has occurred.

## **Do the ECS Inc. RTC modules need to be calibrated?**

No user calibration is required with the ECS-RTC-3225-5609 or ECS-RTC-3225-5699HS as they are accurately calibrated during manufacturing process using highly accurate timing reference units. Because the devices are calibrated, all errors involved in timing, measurement, and digitizing temperature values are included in the specifications.

## **Potential RTC power supply and backup sources**

An RTC will typically be powered by a main system power supply during normal operation. However, a dedicated backup power source is required for an RTC to keep accurate track of time without interruption and maintain timekeeping after a power outage. The ECS Inc. ECS-RTC-3225-5609 and ECS-RTC-3225-5699HS are built to detect low level or missing main supply voltage and will automatically switch to a battery or secondary supply that maintains the internal clock. It will continue to draw on the backup source until the main system power has been restored or battery recharged.

The most common source of backup power will be a coin cell or rechargeable battery. Other options are a MLCC or super capacitor. Power may also be available from another nearby source.

---

For more information on ECS Inc. International's full real time clock catalog, click [here](#).

To see ECS Inc. International's full product catalog, click [here](#).

For additional video resources, click [here](#).