Comparison of real time clock module products and discrete products

Characteristics of real time clock modules with built-in crystal units

Preface

Accurate time is required by countless applications (e.g., finance & security systems, power meters, industrial equipment, measuring equipment, office equipment, medical equipment and games). Two components are essential for obtaining accurate time: (1) a device that oscillates at a precise, stable frequency, and (2) an IC that controls it. Engineers who design applications that require accurate time have two options. They can either purchase discrete oscillators and ICs separately or they can use a module product in which the oscillator and IC are already integrated. The engineer's design cycle and performance of the product will differ significantly depending on whether the engineer opts to use discrete components or a module. At Epson, we manufacture and sell modules that combine into a single package a crystal unit that oscillates at a precise, stable frequency and a real time clock IC that controls the crystal. Next we will explain the features and construction of Epson's real time clock modules.

Characteristics of Epson's real time clock modules

A real time clock module is a single package that contains a 32.768 kHz crystal unit and a real time clock IC. The real time clock IC includes the oscillation circuitry, clock, calendar, alarms and can contain additional features. Epson develops and manufacture our own crystal units and real time clock ICs. This enables us to enjoy a stable supply of crystal units that have been optimized for high-precision real time clock modules along with real time clock ICs that operate under the ideal conditions for those crystal units.

In addition, Epson’s semiconductor technology is based on design processes and expertise for producing extremely stable, low-power quartz oscillators. This technology enabled Epson to become the world’s first quartz watch manufacturer. Epson’s oscillators are used at the heart of myriad timing systems and timepieces, from the official timekeeping systems used in the Olympics to luxury Seiko brand watches like the Grand Seiko.

Since Epson develops our own crystal units and real time clock ICs, we are able to match them perfectly and maximize the potential of both. This results in products that exhibit high performance.

The distinguishing characteristics of Epson's module products are described below.

Feature: Pre-adjusted for clock accuracy

Epson's real time clock modules are self-contained devices that integrate a 32.768 kHz crystal unit with a real time clock IC which are accurately tuned to the precise frequency at the factory before being shipped to customers. This eliminates the need for the external mounting of individual components and helps customers reduce the number of components on their circuit boards.

The oscillation frequency of real time clocks constructed of discrete components is affected by factors such as circuit board pattern stray capacitance and variations in IC internal capacitance and crystal units. For this reason, users of discrete components have to take into account clock accuracy adjustments along with oscillation circuit stability. In addition engineers also have to perform evaluations as shown in Figure 1, spending engineering time and effort to achieve accurate precise frequency designs.

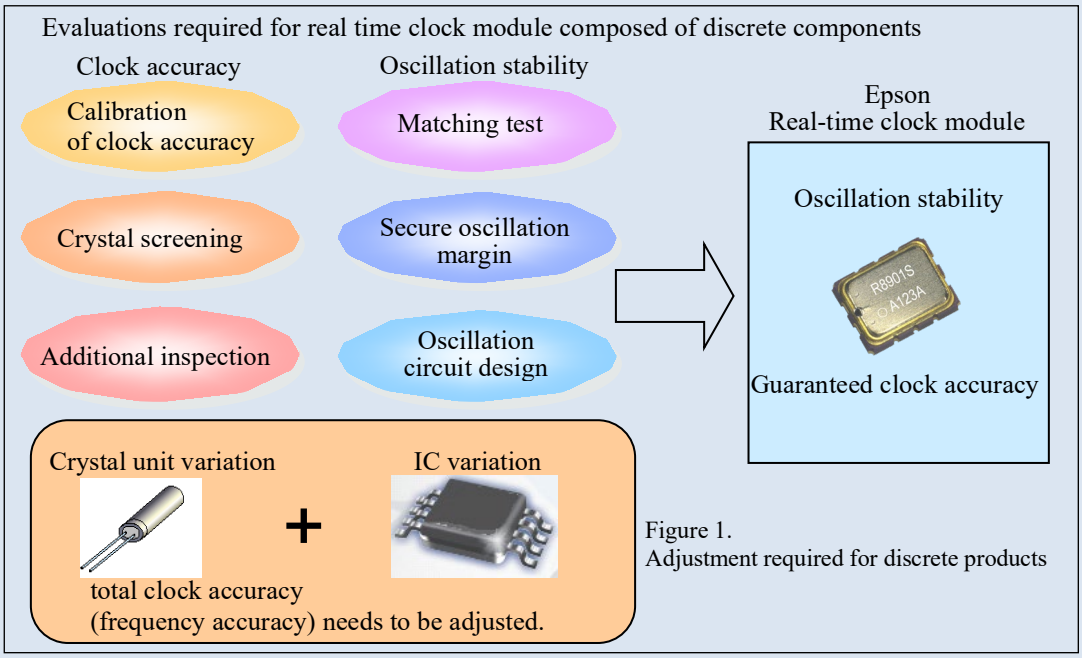

Figure 1.
Adjustment required for discrete products

The conceptually variation that occurs with discrete components is shown Figure 2.
The frequency deviation of commonly available tuning-fork crystal units is $\pm 20 \times 10^{-6}$. Since crystal unit frequencies are individually adjusted in the manufacturing process, variations exhibit a largely central distribution.
Variation among ICs is about $\pm 10 \times 10^{-6}$, with a distribution whose center differs depending on the production lot.
Real time clocks composed of these two discrete components require externally mounted capacitors and careful routing of circuit board wiring in order to adjust frequency. Figure 2 gives you an idea of the variations that these factors introduce and need to be accounted for.

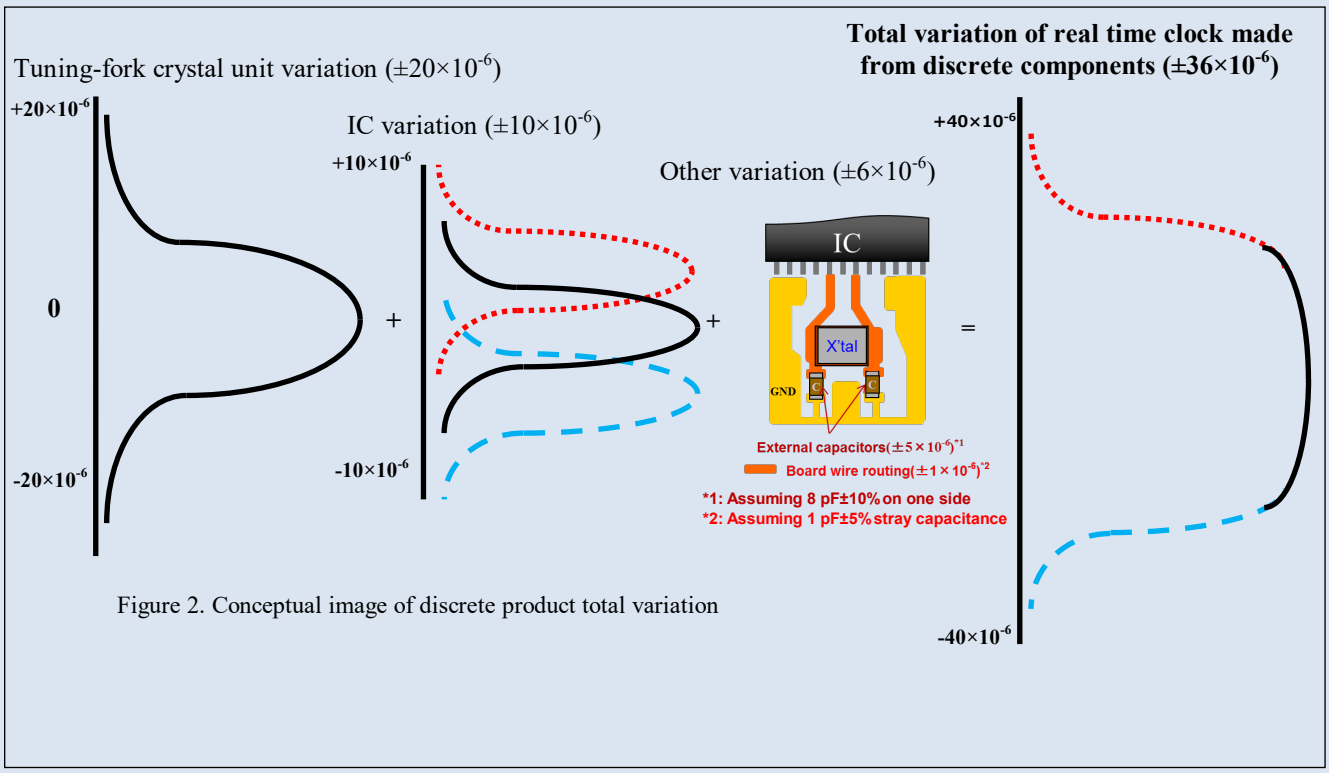

Figure 2. Conceptual image of discrete product total variation

On the other hand Epson's real time clock modules have one-third less total variation than real time clocks made of discrete components. The lower variation is achieved by adjusting Epson-engineered 32.768 kHz crystal units so as to absorb variation between Epson-engineered ICs (Figure 3). In addition external capacitors are eliminated and the wire routing needed for frequency adjustment. These are the factors customers used to have to take into account with discrete products. Epson real time clock modules can help customers reduce the amount of time spent evaluating circuits and matching components resulting in shorten development turnaround times.

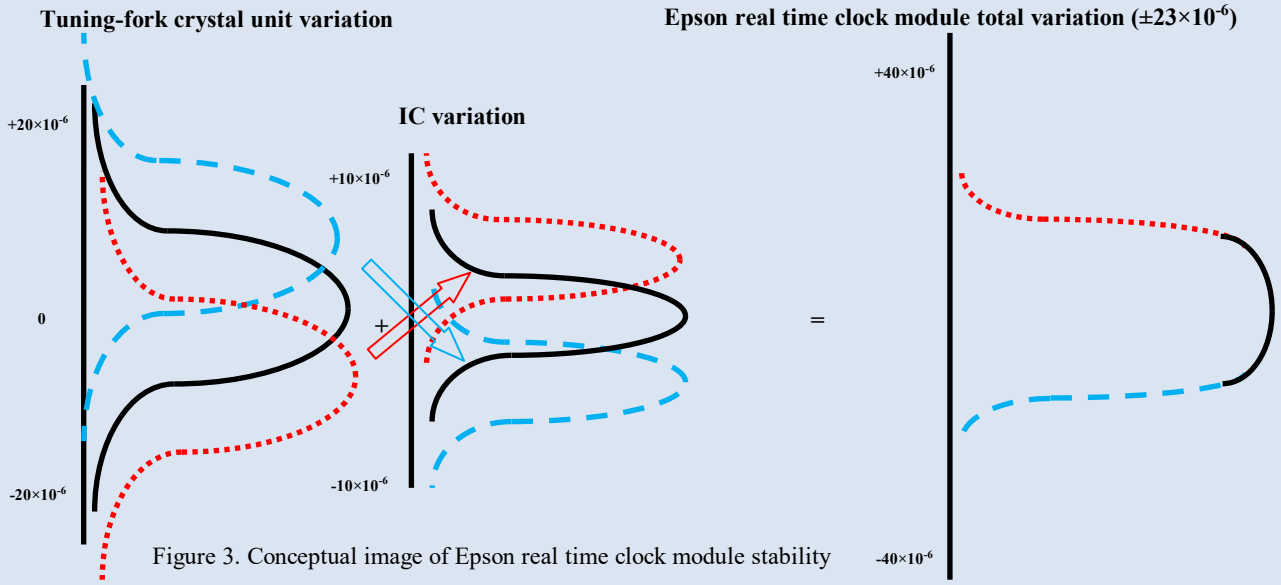

Figure 3. Conceptual image of Epson real time clock module stability

Epson has a lineup of real time clock modules with a built-in DTCXO for customers who require even greater clock accuracy. Click on this link for details:
https://www5.epsondevice.com/en/information/technical_info/pdf/wp_e231114_rtc.pdf

In conclusion, Epson uses technology to fabricate extremely low power tuning-fork crystal units and circuit technology for compensating the frequency-temperature coefficient to commercially develop high-accuracy, low-power real-time clock modules resulting in their superior total performance vs. discrete components and similar modules.
The frequency accuracy of these products is adjusted and guaranteed at the factory before shipping, so there is no need for frequency tuning by users. These products can significantly contribute to users' design-engineering efficiency and quality.