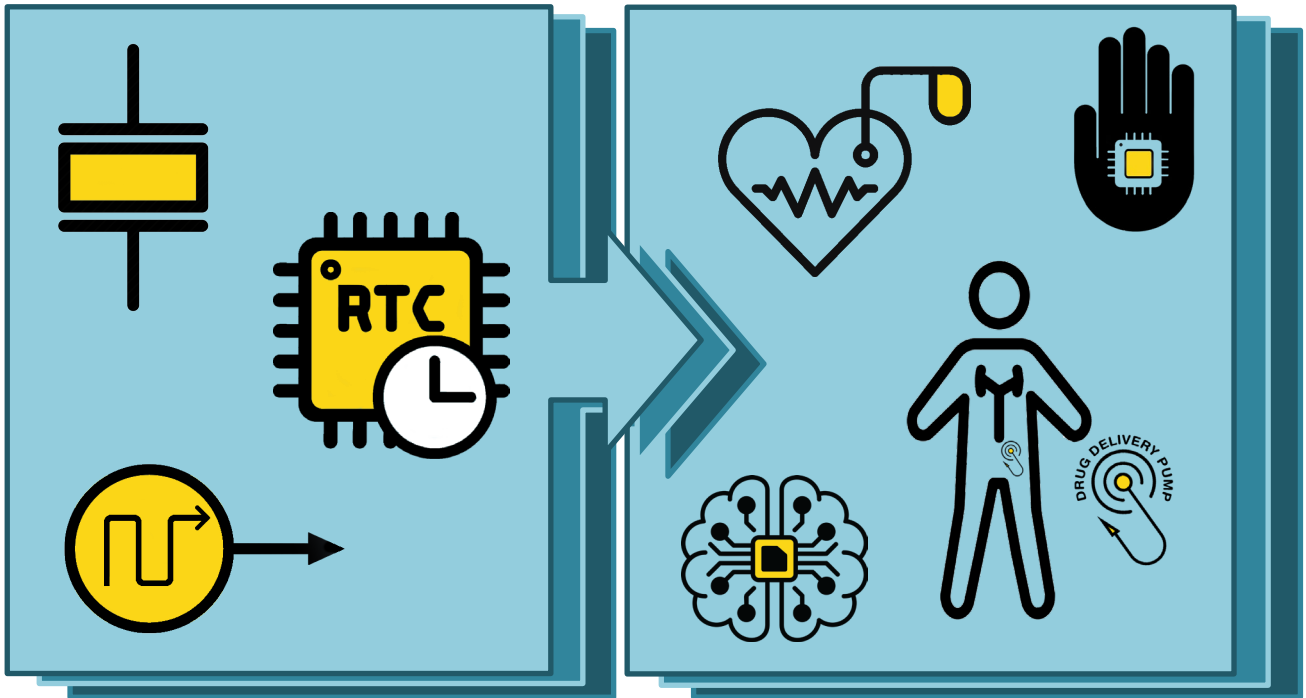



# Medical Grade Low Frequency Timing Components for Implantable Medical Devices - Selection Guide



<p>A COMPANY OF THE  SWATCH GROUP</p>	<p>Headquarters:</p>	<p>Micro Crystal AG Mühlestrasse 14 CH-2540 Grenchen Switzerland</p>	<p>Tel.  Internet Email</p>	<p>+41 32 655 82 82  <a href="http://www.microcrystal.com">www.microcrystal.com</a> <a href="mailto:sales@microcrystal.com">sales@microcrystal.com</a></p>
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**Contents**

1. Introduction..... 3

2. Our proposition for Medical Implantable design..... 3

3. Selection Guide..... 4

4. Document version ..... 5

### 1. Introduction

Micro Crystal is a recognized industry leader and innovator of extreme-low power, highly accurate, ultra small quartz-based timing components.





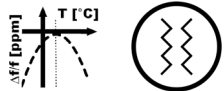
Our portfolio encompasses Quartz Crystals, Oscillators, OCXOs, and Real-Time Clock (RTC) Modules for the world’s leading manufacturers of IoT, wearables, consumer products, GPS modules, automotive electronics, industrial, healthcare, medical and medical implantable devices.

### 2. Our proposition for Medical Implantable design

Timing components, such as quartz crystal oscillators, are used to provide accurate timing for pacing pulses and synchronization with the heart’s natural rhythm, to ensure precise reference for detecting arrhythmias, helping to manage the need and occurrence of electrical shocks, and coordinating various therapeutic functions in neurostimulation devices delivering electrical impulses to specific nerves or brain regions to treat chronic pain, Parkinson’s disease, or epilepsy.

Such components are also used in insulin pumps or drug delivery system to control the precise delivery of insulin or medications doses at programmed intervals or in response to external stimuli.

When selecting timing components for medical implantable devices, the following criteria are generally considered but their importance may vary according to the specific application:

Selection Criteria	Requirement for Medical Implantable Devices	Micro Crystal Proposition
<b>Size &amp; Form Factor</b> 	The timing component should be compact and lightweight, allowing for integration into the limited space available within the device.	SMD full ceramic package with low profile and miniature footprint.
<b>Accuracy</b> 	The timing component should provide precise and stable timing over long periods to ensure proper device functionality.	Parts with high frequency ( $\pm 20$ ppm) and extreme time ( $\pm 1$ ppm for RTC) accuracy, high stability, and reliability.
<b>Reliability</b> 	Medical implantable devices require high reliability to ensure patient safety. The timing component should have a proven track record of reliability and meet relevant industry standards.	Expertise built over more than 40 years. Components manufactured, tested, and screened to ensure highest quality and best long-term reliability.
<b>Power Efficiency</b> 	Implantable devices operate on limited power sources such as batteries. Power-efficient timing components help extend the battery life and reduce the frequency of replacements or recharging.	Ultra-low power components.
<b>Environmental Considerations</b> 	Medical implantable devices are exposed to the human body’s environment. The timing component should be resistant to electromagnetic interference (EMI), environmental and mechanical stress.	Components can be trimmed to have optimized accuracy at body temperature. Already used in multiple EMI compliant designs. Helium impervious package. High shock and vibration resistance.

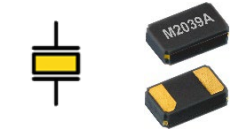
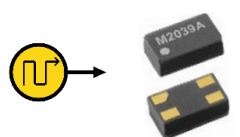
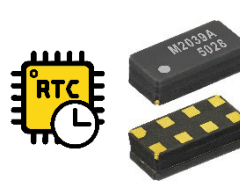
Micro Crystal’s production facilities are ISO 9001, ISO 14001 and IATF 16949 certified; adhere to best practices and comply with all social and environmental regulations.

You can learn more about Micro Crystal Medical Implantable portfolio and associated features when visiting: [www.microcrystal.com/en/applications/medical-implantable](http://www.microcrystal.com/en/applications/medical-implantable)

To simplify the process of selecting your next medical device timing component and guide you through the various options available, most of the pros and cons criteria for each approach are covered in the following table and a timing component type is proposed according to the associated use cases.

### 3. Selection Guide

Nowadays, medical implantable devices represent important challenges for electronic designers. Power consumption must be kept to a minimum, guaranteeing longest possible product longevity by extending the battery life or reducing recharge cycles. Other factors, such as accuracy, choice of frequency and more advanced features must be considered. Those factors influence the choice of components during the early design stage, when selecting the microcontroller/ASIC and defining how the timekeeping functions will interact. Several options are offered to the designer when it comes to timing components. Below is a summary of options when selecting your solution:

Timing Component Type	Pros	Cons	Most Effective Use Case
<p><b><u>Discrete crystal with MCU, ASIC</u></b></p> 	<p>Ideal and low power approach with dedicated and optimized oscillator circuitry of the microcontroller/ASIC. Smallest footprint.</p>	<p>Layout issues, close proximity of the crystal to the oscillator input. Frequency accuracy/power variations due to component tolerances. Characteristics depend on crystal manufacturer.</p>	<p>When continuous operation/therapy is required.</p>
<p><b><u>Oscillator Module, with integrated crystal</u></b></p> 	<p>Simplified design, Plug &amp; Play component. Consistent accuracy, better than discrete crystal, due to factory calibration of the hermetically sealed module. Same oscillator able to drive several recipients. Smallest footprint.</p>	<p>This solution requires a relative high driving power compared to the discrete crystal solution.</p>	<p>When enabled periodically for calibration of the RC timer. More consistent, higher accuracy is required compared to discrete crystal solution.</p>
<p><b><u>Real-Time Clock Module with integrated crystal</u></b></p> 	<p>RTC Module offers the lowest time keeping current of 45 nA during periods of inactivity in-between cycles of therapy/communication. Best time accuracy at <math>\pm 1</math> ppm (<math>\pm 0.1</math> seconds per day) due to factory calibration of the hermetically sealed module. Alarm/timer wake-up functions, event input monitoring sensors, choice of frequency output, dual interrupt feature.</p>	<p>Dedicated driver, I<sup>2</sup>C communication. Footprint: 3.2 mm x 1.5 mm x 1.0 mm. Less suited for applications requiring continuous therapy.</p>	<p>Significant power savings features for applications with periodic activities (therapy, radio). Optimized accuracy at body temperature. Full featured RTC functionality in medical implantable grade component.</p>

Micro Crystal's medical implantable grade components are manufactured, tested, and screened to ensure highest quality and best long-term reliability. With today's IPGs featuring life expectancies of 20 years and beyond, the manufacturing steps of the timing components must undergo the most stringent processes to prevent latent failures and to ensure the required longevity.

Do you have questions about the most suitable timing solution to use for your new design of Medical Implantable Device? Our technical experts are also available for further guidance and to discuss any concerns at [sales@microcrystal.com](mailto:sales@microcrystal.com).

We are looking forward to discussing how we can assist you with our miniature and highly reliable quartz-based timing components for your next-gen design!

#### 4. Document version

Date	Version #	Changes
January-24-2024	1.0	Initial version – NMO/RMU

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