

# ABS05 Tuning Fork Crystal

1.6 x 1.0 x 0.5 mm Device Optimized for Energy-Saving MCUs

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## I. Introduction

Over the past two years, supply chain challenges have significantly complicated high-volume availability of the industry-standard 3.2 x 1.5 mm and 2.0 x 1.2 mm tuning fork quartz crystals with lower plating loads. Abracon took this challenge into consideration and developed the 4.0pF plated version of its miniature ABS05 series.

Abracon's ABS07 family of 3.2 x 1.5 x 0.9 mm tuning fork quartz crystals have been the workhouse solution utilized in a broad breadth of applications from industrial and medical electronics to consumer IoT gadgets. As the utilization of next-generation MCUs has taken hold, the need for a lower plating load (down to 4.0pF) version of the ABS07 gained momentum.

Simultaneously, the industry's continuous trend to miniaturize end-product designs has given way to demand for 2.0 x 1.2 x 0.6 mm tuning fork quartz crystals, which is represented by Abracon's ABS06 family products.

In particular, Abracon's ABS06-107 at 4.0pF plating load has drawn popular interest. It presents a unique combination of lower plating load coupled with optimized equivalent series resistance (ESR) performance, making it ideally suited for energy-saving gorilla chips. This device is qualified on ST Micro's reference design for the STM32 family of MCUs, including the high-performance F2 and F4 series as well as the ultra-low-power L1 series.

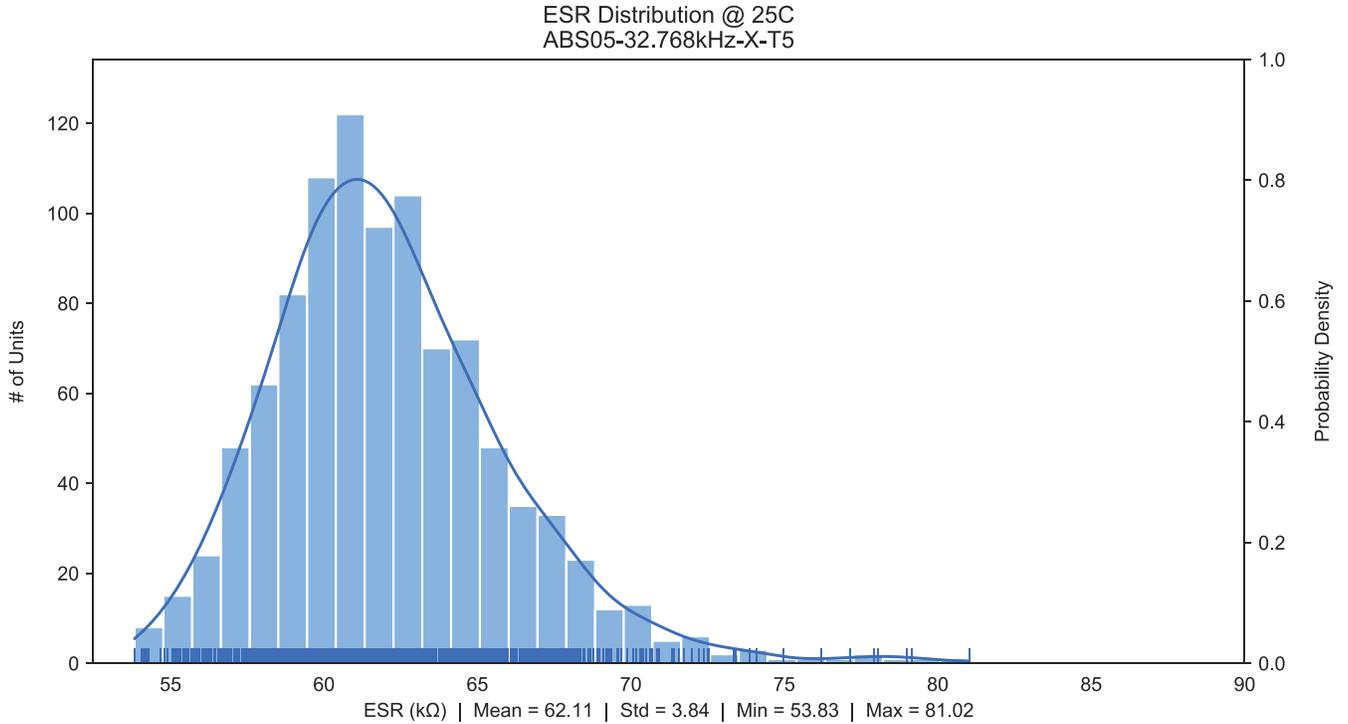
However, the 1.6 x 1.0 x 0.5 mm ABS05 family can easily replace the larger-sized ABS06 and ABS07 families in current designs without sacrificing performance requirements or adding extra design pressure. It can also enable further reduction of consumed surface area in newer designs.

Employing state-of-the-art tuning techniques, the ABS05 devices are now available with  $\pm 20$  ppm and  $\pm 25$  ppm set-tolerance into an effective oscillator-loop load capacitance of 4.0pF. Further, the ESR is optimized to maintain a threshold of 90 k $\Omega$  maximum, enabling robust operation when mating with the latest energy-saving MCUs and other gorilla chipsets.

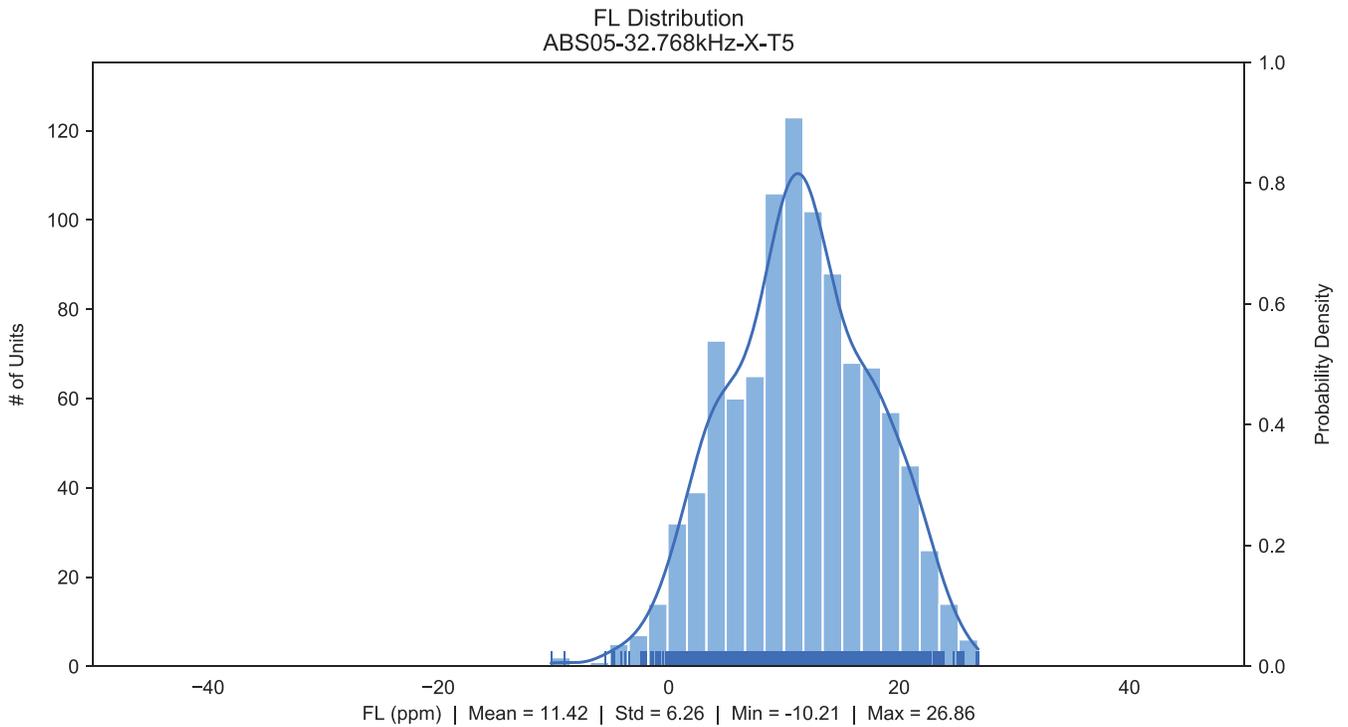
## II. Performance Data

Motional resistance ( $R_m$ ) is a key performance indicator over temperature as it relates to ESR. The ABS05 family of devices is specifically optimized to ensure a robust oscillator-loop startup with sustained oscillations over the entire operating temperature range. See Fig. 1 on the next page.

Moreover, special tuning techniques are employed to tightly control the set-tolerance at room temperature into an effective oscillator-loop load capacitance of 4.0pF. This ensures maximum accuracy in frequency domain when it relates to real-time clock (RTC) functionality and final transmit frequency. See Fig. 2 on the next page.



*Fig. 1. Motional Resistance (Rm) in kΩs @ 25°C*



*Fig. 2. Set-Tolerance FL in ppm @ 25°C*

### III. Layout Considerations

As outlined in the introduction section, designers across the spectrum have predominantly employed the 3.2 x 1.5 x 0.9 mm package, which is Abracon’s ABS07 family of devices. Further, Abracon’s 2.0 x 1.2 x 0.6 mm ABS06 devices have gained significant market traction with those who are focused on miniaturization. However, the 1.6 x 1.0 x 0.5 mm ABS05 family provides an opportunity to further reduce the consumed surface area in a design while providing optimal operational performance, as described in Section II.

Furthermore, due to the recent supply chain issues, designers might want to consider a comprehensive, all-encompassing land pattern in their designs. This approach provides design flexibility by enabling the use of either the ABS07, the ABS06 or the ABS05 package within the same layout to satisfy design requirements.

Fig. 3 and 4 below outline Abracon’s recommendation for such consideration.

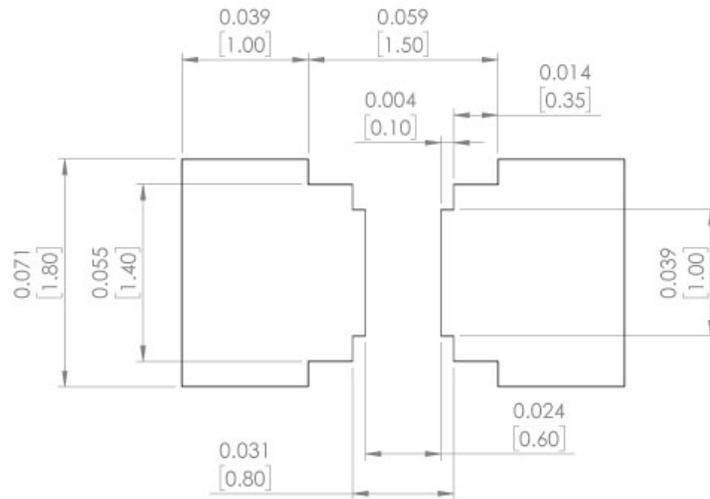


Fig. 3. Option #1: ABS07, ABS06 & ABS05 Composite Layout

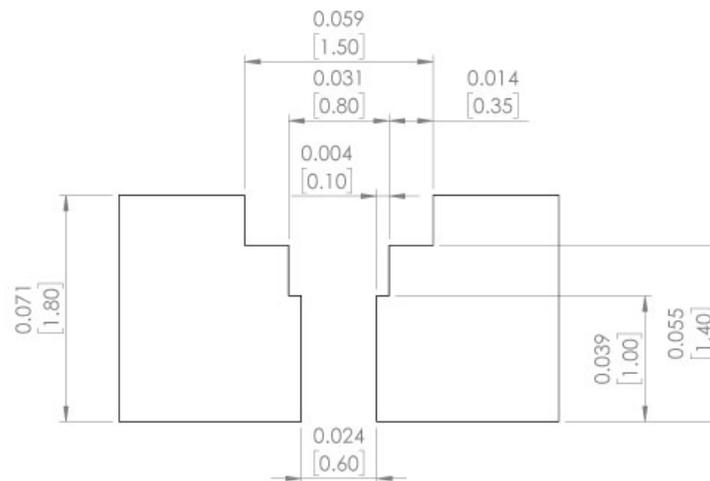
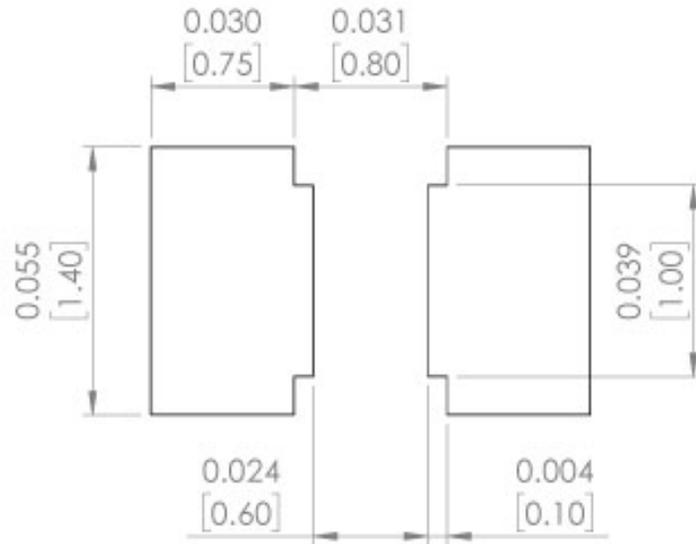
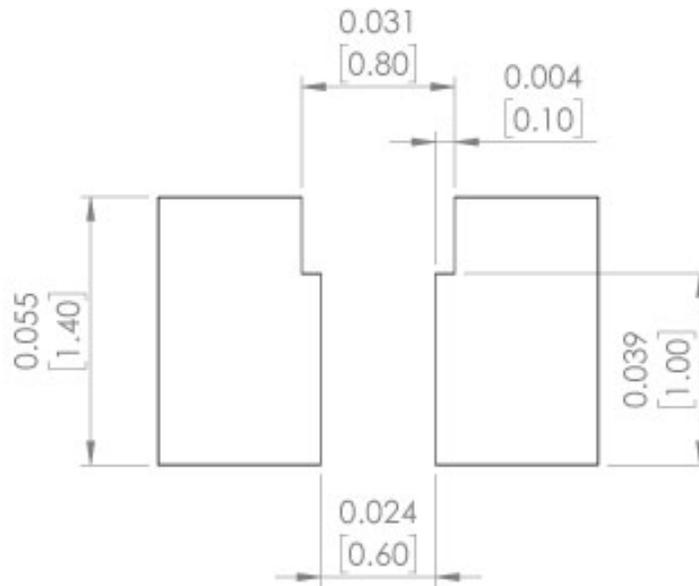


Fig. 4. Option #2: ABS07, ABS06 & ABS05 Composite Layout

Fig. 5 and 6 provide two recommendations for engineers that are currently only using the ABS06 package size in their design but would like to consider the smaller ABS05 device and employ a dual layout.



*Fig. 5. Option #1: ABS06 & ABS05 Composite Layout*



*Fig. 6. Option #2: ABS06 & ABS05 Composite Layout*

For clarity, the dimensions outlined in Fig. 3 through 6 are in inches (mm).

## IV. Conclusion

This application note outlined the performance characteristics of Abracon's miniature (1.6 x 1.0 x 0.5 mm) ABS05 tuning fork quartz crystal devices when plated at 4.0pF effective oscillator-loop load. In addition, end-customer printed circuit board (PCB) layout recommendations were made to provide a means to overcome recent supply chain challenges by employing a composite layout. The ABS05 family of devices at 4.0pF plating load are now available and in stock through Abracon's global distribution network.

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