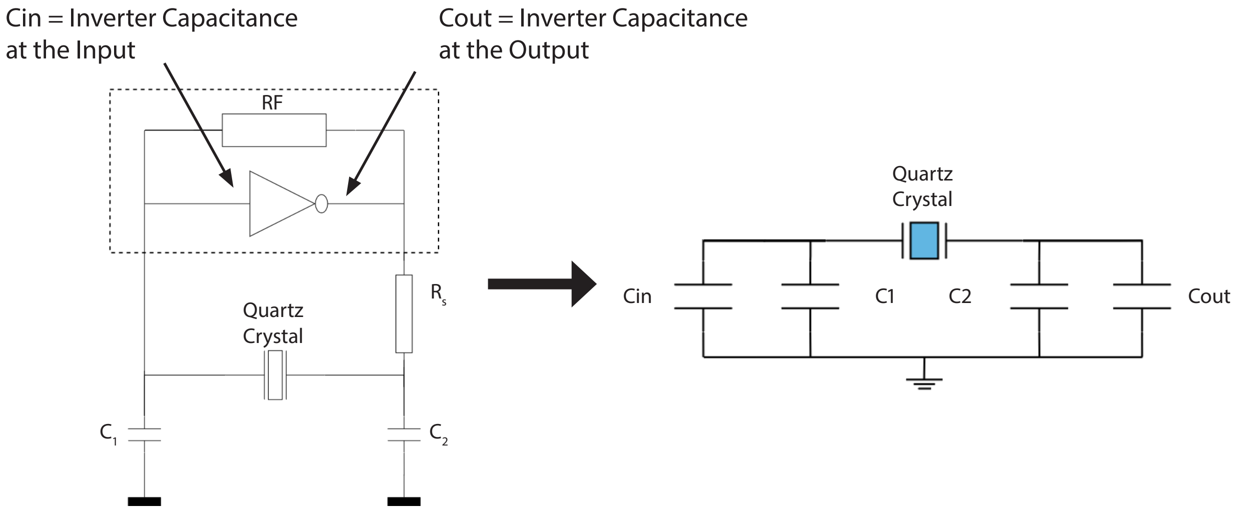
INTRODUCTION

PIERCE ANALYZER SYSTEM (PAS) ADVANCED BOARD CHARACTERIZATION SERVICE

Today's electronic designs include some form of timing device. Depending on the frequency accuracy requirements, some employ oscillators while others use off-the-shelf crystals in conjunction with the built-in oscillator circuit embedded in most microcontrollers and microprocessors. Due to their simple configuration and design, most embedded solutions use the Pierce Oscillator configuration integrated as part of the system on chip (SOC). The advantages of this solution include cost, size, and power compared to a stand-alone oscillator, while the key limitation is the proper matching of the quartz crystal with the on-board oscillator and feedback components.

The figure below outlines the oscillator block and the key components that influence the overall performance of the timing loop.



Effective Loaded Capacitance as seen by the crystal = CL

$$CL = \frac{(C_{in} + C_1)(C_2 + C_{out})}{C_{in} + C_1 + C_2 + C_{out}} + Board\ Strays$$

For example, let C1 = C2 = 27pF, Cin = 5pF, Cout = 10pF, Board Strays = 0.5pF.

$$CL = \frac{(5 + 27)(27 + 10)}{5 + 27 + 27 + 10} + 0.5 = 17.65\text{pF}$$

Therefore, specifying a crystal with 18.0 pF plating load capacitance would be the closest match for frequency accuracy.

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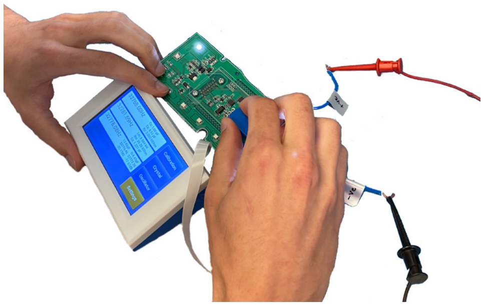
The reactive impedance (Xc) of the loop capacitors, in combination with current limiting resistor (Rs), and the presence or absence of an AGC circuit determines the drive level and frequency accuracy of the oscillator loop design.

For Pierce oscillator designs, characterizing the oscillation loop helps to understand the circuit performance and provides guidance for adjusting the loop capacitors.



Design engineers often optimize their circuit performance via trial and error, at the expense of significant investment in time. Measurements to verify the performance become increasingly sensitive if the timing loop utilizes a tuning fork (32.768kHz) crystal. These crystals are extremely sensitive to loading effects and extreme care and accuracy is essential to determine the in-circuit behavior of these components.

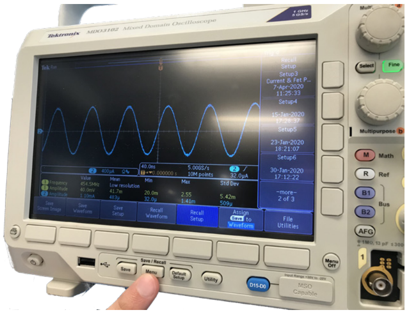
An example would be a design which has a hard boundary condition of ±40 ppm relative to the carrier, for proper operation. If the load capacitance of the oscillator loop is not optimized, most of the ±40 ppm allowance can be consumed by crystal tolerance alone, potentially causing production yield loss or timing error in the field.

In summary, a typical product launch requires a significant investment in capital and design resources. Making a very modest investment in characterizing the timing loop is a must-have to protect this investment, as well as mitigate the risk of field failures or warranty recalls.

SOLUTION AND FEATURES

PIERCE ANALYZER SYSTEM (PAS) ADVANCED BOARD CHARACTERIZATION SERVICE

SOLUTION



Abracon provides an accurate assessment of the oscillator loop dynamics to overcome these barriers. Abracon’s Engineering Team developed a proprietary Pierce Analyzer System (PAS), which is designed to analyze both the stand-alone crystal, as well as the performance of the crystal in the customer’s circuit.

FEATURES

- Circuit characterization, providing the best possible match between the quartz crystal and oscillator loop feedback components
- Eliminates production launch issues related to crystal oscillator-based timing circuits
- Provides a customer oscillator circuit overview in the form of a detailed report, providing a third-party assessment for the design history file or PPAP documentation.
- This report encompasses both the stand-alone crystal performance, as well as in-circuit closed loop oscillator performance.
- For additional information, please contact Abracon at: tech-support@abracon.com

DELIVERABLES

PIERCE ANALYZER SYSTEM (PAS) ADVANCED BOARD CHARACTERIZATION SERVICE

DETAILED TEST REPORT INCLUDES:

- Project background information
- Abracon test instrumentation and equipment setup
- Customer PCB and crystal documentation
- Customer product photographs
- Quartz crystal electrical specifications
- Pierce oscillator design and theory of operation
- Quartz Crystal AC equivalent model characteristics
- Customer's existing oscillator design configuration performance data:
    - Stand-alone quartz crystal measurements
        - Series resonant (F_S) and parallel resonant (F_L) frequencies
        - Motional parameters (Rm, Cm, Lm)
        - Shunt capacitance (Co)
    - Closed-loop oscillator circuit measurements
        - Oscillator output frequency
        - Oscillator - crystal power dissipation
    - Maximum projections
        - Calculated worst-case drive level
- Abracon Engineering recommended oscillator design configuration
- Abracon Engineering review and conclusion

ORDERING INFORMATION

- EXPEDITED-PAS-SVC
- STANDARD-PAS-SVC