PIERCE ANALYZER SYSTEM (PAS)
ADVANCED BOARD CHARACTERIZATION SERVICE

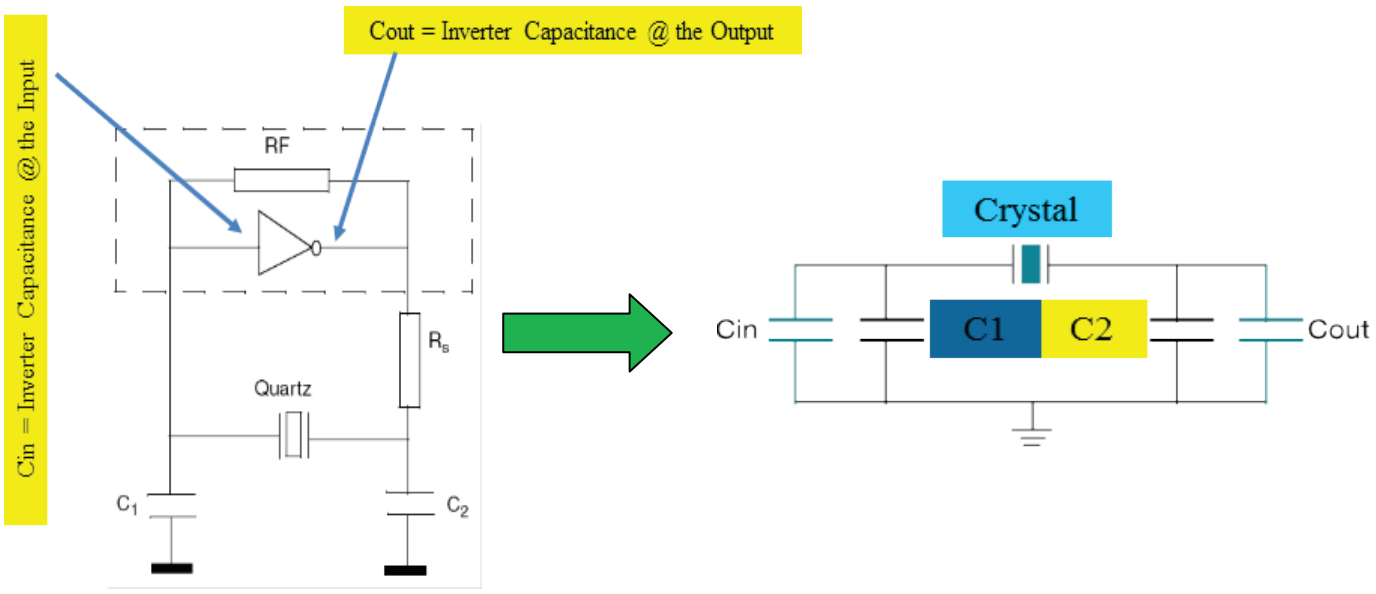
PAS-BC3WK

INTRODUCTION:

The majority of electronic designs have some form of timing associated with them. 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 µcontrollers and µprocessors.

Most if not all embedded solutions use the Pierce Oscillator configuration, integrated as part of the SOC (system on chip). The obvious advantages 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 Pierce Oscillator.

Figure (1) 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 = {((Cin+C1) x (C2+Cout)) / (Cin+C1+C2+Cout)} + Board Strays

For example; Let C1 = C2 = 27 pF; Cin = 5.0 pF & Cout = 10.0 pF and Board Strays = 0.50 pF then;

CL = { ((27+5) x (27+10)) / (5+27+27+10) } + 0.50 = 17.65 pF

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

Besides the frequency accuracy issue, while accounting for Quartz Crystal's set tolerance; the reactive impedance **(Xc)** of the loop capacitors, in combination with the Inverter Amplifier's transconductance ***(gm)***, the current limiting resistor **Rs** and the presence *or* absence of the **AGC** or **ALC** circuit as part of the oscillator loop – determines the boundary condition of the design.

This boundary condition, commonly referred to as the **Safety Factor (SF),** is an important parameter to ensure that the product design has sufficient margin to accommodate part-to-part and lot-to-lot variations; as well as eliminating product performance uncertainty in production volume.

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Historically, design engineers have optimized their circuit performance via trial & error, at the expense of significant investment in time. Further, to properly determine the oscillator loop dynamics, there is no other choice but to break the oscillator loop and make key measurements using specialized equipment such as a Current Probe.

Lastly, these measurements become increasingly sensitive if the timing loop is driven by a Tuning Fork (32.768kHz) crystal. These crystals are extremely sensitive to loading effects and to accurately determine the in-circuit behavior of these components, extreme care and accuracy is essential.

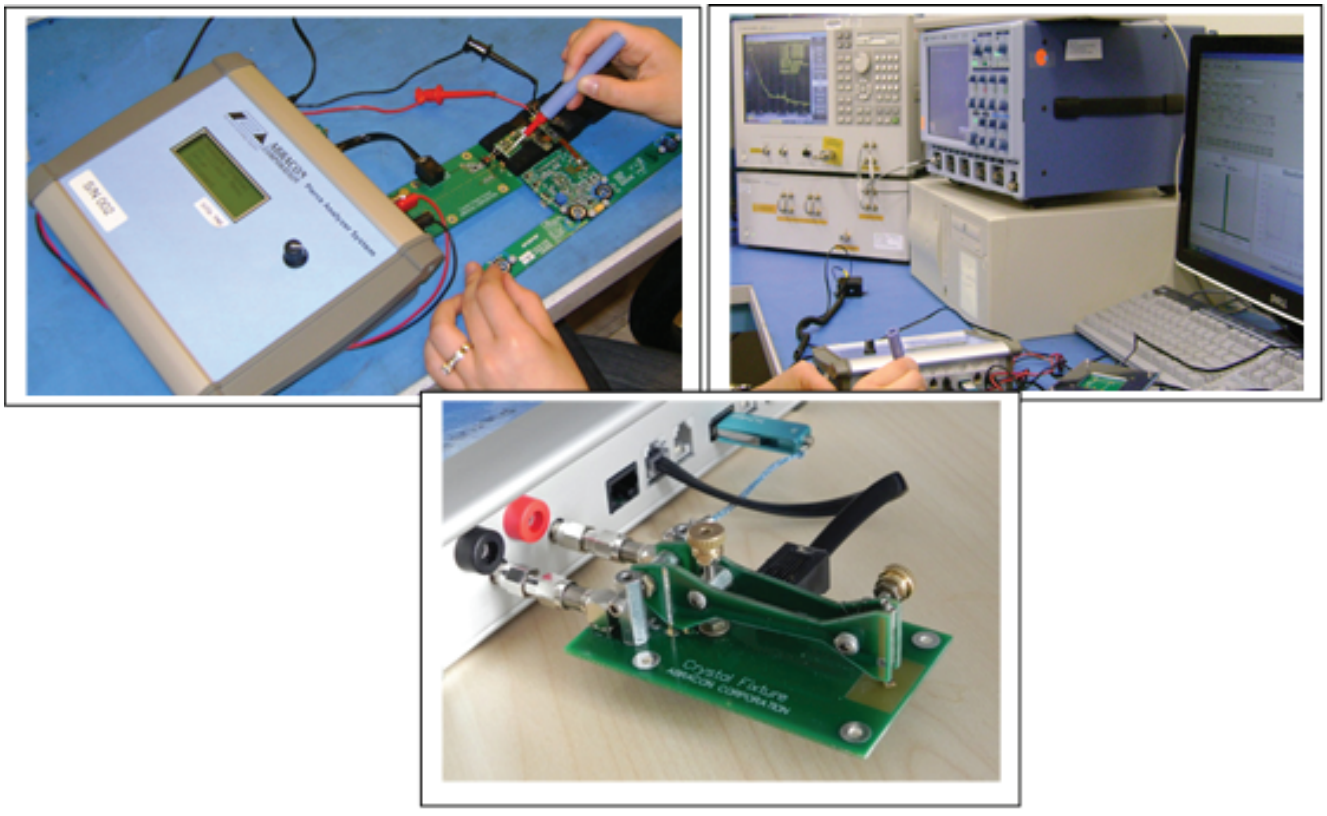
For instance, Automotive, Medical and Consumer Electronics solutions typically utilize Tuning Fork Crystals for their Real-Time-Clocking (RTC) needs. If the selected SOC has inadequate gain margin, there is a high probability that some percentage of these Crystals will not properly start under adverse conditions, such as low operating temperature.

Another example would be a Zigbee based design which has a hard boundary condition of ±40 ppm relative to the carrier, for proper operation. If the oscillator loop is not optimized, most of the ±40 ppm can be consumed by tolerance alone; thereby causing significant fall out in the field.

In summary, a typical product launch requires significant investment of 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 risk of field failures or warranty re-calls.

SOLUTION:

To overcome these barriers and provide an accurate assessment of the oscillator loop dynamics; Abracon's Advanced Engineering Team has developed a Proprietary Pierce Analyzer System (PAS); which is designed to analyze both the stand alone crystal, as well as the performance of that particular crystal in customer's circuit.



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FEATURES:

- Circuit characterization; providing best possible match between Quartz Crystal, oscillator loop and associated components
- Eliminates probability of oscillator start-up issues related to inadequate design or marginal component performance
- Eliminates production launch issues related to crystal oscillator based timing circuit
- Solves for design margin uncertainty
- Provides customer's oscillator circuit overview in the form of a detailed report, which could be an ideal 3rd party assessment for the design history file or PPAP documentation. This report encompasses both the stand-alone crystal performance, as well as in-circuit behavior outlining safety factor as a function of crystal's ESR, etc.
- For additional information, please contact Abracon at: tech-support@abracon.com

DELIVERABLES:

Abracon provides a detailed test report encompassing:

- **Stand alone Quartz Crystal characteristics including:**
  - Motional parameters (Cm, Lm, ESR &Co)
  - Narrow Band Frequency Response Plot
  - Wide Band Frequency Response PlotoAdmittance versus Suseptance Plot
  - Frequency dependence versus load capacitance plot
- **Oscillator loop**
  - Initial frequency accuracy and drive level as seen by the crystal with measured ESR
  - Worst case projected drive level with maximum specified ESR
  - Safety Factor of the oscillator loop under both typical and maximum ESR
  - Recommendation on proper component selection (C1, C2 & Rs when applicable) for best compromise with respect to Safety Factor and Frequency accuracy
  - Recommendation on the Abracon Crystal part # with proper plating load and other key attributes to enable the most robust design, specific to the µcontroller/processor implemented

ORDERING INFO:

PAS-BC1WK	Analysis & Report with 1-week maximum lead-time
PAS-BC2WK	Analysis & Report with 2-week maximum lead-time
PAS-BC3WK	Analysis & Report with 3-week maximum lead-time

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- *Специальные условия для постоянных клиентов.*
- *Подбор аналогов.*
- *Поставку компонентов в любых объемах, удовлетворяющих вашим потребностям.*

- *Приемлемые сроки поставки, возможна ускоренная поставка.*
- *Доставку товара в любую точку России и стран СНГ.*
- *Комплексную поставку.*
- *Работу по проектам и поставку образцов.*
- *Формирование склада под заказчика.*

- *Сертификаты соответствия на поставляемую продукцию (по желанию клиента).*
- *Тестирование поставляемой продукции.*
- *Поставку компонентов, требующих военную и космическую приемку.*
- *Входной контроль качества.*
- *Наличие сертификата ISO.*

В составе нашей компании организован Конструкторский отдел, призванный помогать разработчикам, и инженерам.

Конструкторский отдел помогает осуществить:

- *Регистрацию проекта у производителя компонентов.*
- *Техническую поддержку проекта.*
- *Защиту от снятия компонента с производства.*
- *Оценку стоимости проекта по компонентам.*
- *Изготовление тестовой платы монтаж и пусконаладочные работы.*

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