



APPLICATION NOTE

SHUTTERED CRYSTAL SENSORS

Quartz crystals are used to monitor or control the deposition rate of material evaporated in vacuum processes. As material condenses on the crystal, its resonant frequency decreases. This change in frequency can be converted into an accumulated thickness and corresponding rate. However, crystals will only accept a finite amount of material before they become unstable or stop oscillating.

There are several process steps during the deposition when “shuttering” the crystal sensor is beneficial. For instance, during the period when the source material is brought up to temperature, the material may emit particulates or “spits” which can cause a crystal to fail immediately. During this time, the source shutter is still closed and protects both the substrate and usually also the sensor. In applications, where the crystal sensor “sees” the evaporation source during this time, a shuttered sensor should be used.

In optical coating processes, two materials are typically deposited as alternating layers. Thickness accuracy (unless Auto-Z is used) will be improved if a separate crystal sensor is used for each material and each sensor receives only one material. Depending on the location of the sources with respect to the sensor(s), this may be accomplished by using either a dual sensor (750-212-G2) or two single shuttered sensors (750-211-G2).

In other processes, when the amount of material deposited exceeds the crystal’s ability to sustain an oscillation, the crystal fails. These processes can be controlled with a dual or other multi-position sensor or by using a shuttered crystal sensor operating in the RateWatcher™ mode.

RATEWATCHER

The RateWatcher feature of INFICON thin film deposition controllers uses a shuttered crystal sensor in a “Sample and Hold” mode to extend the life of the crystal. During the “Sample” interval, the shutter is open and the control voltage regulating the evaporant power supply is adjusted to achieve the desired deposition rate. When the desired rate is achieved, the instrument transitions to the “Hold” interval and closes

the sensor shutter. In this state the crystal no longer receives material, consequently its “life” is increased. The thickness displayed continues to increment and the power is held constant. The “Sample and Hold” cycle is repeated until Final Thickness is reached. This method is particularly well suited for control of sputtering processes where the rate is very stable and closely related to the sputter power. In sputtering, the “Hold” time can be fairly long. With an appropriately adjusted “Hold” time and if thickness tolerance allows, the RateWatcher function can also be used successfully for thermal evaporation processes.

DUAL SENSOR CONTROL

With the INFICON thin film deposition controllers, the CrystalSwitch™ feature can be used to ensure continuous rate and thickness control. CrystalSwitch employs a shutter to switch between crystals in a dual-crystal sensor (i.e. two independently operated crystal sensor heads on one body), providing redundancy if the primary crystal fails. It is also possible to dedicate each crystal to a specific material. The controller is programmed to use the appropriate crystal when the designated film (or material) is being deposited.

PROVEN RELIABILITY

The mechanism which moves the shutter consists of a pneumatically-operated (vacuum-sealed) actuator, a piston support, and a piston coupling and shaft. When air (@ 90 psig) is applied to the actuator, it forces the piston to move. The piston is linked to the shaft which rotates, moving the shutter over the crystal. A spring forces the shutter to return to its normal position, when the air is released.

The design has proven to be highly reliable. It has been incorporated in INFICON shuttered crystal sensors since April 1987.

Shutter Assembly

Part Number	Description
750-005-G1	Sputtering Sensor
750-210-G1*	Dual, Standard or Compact Sensor

*Standard equipment on the Dual Sensor.

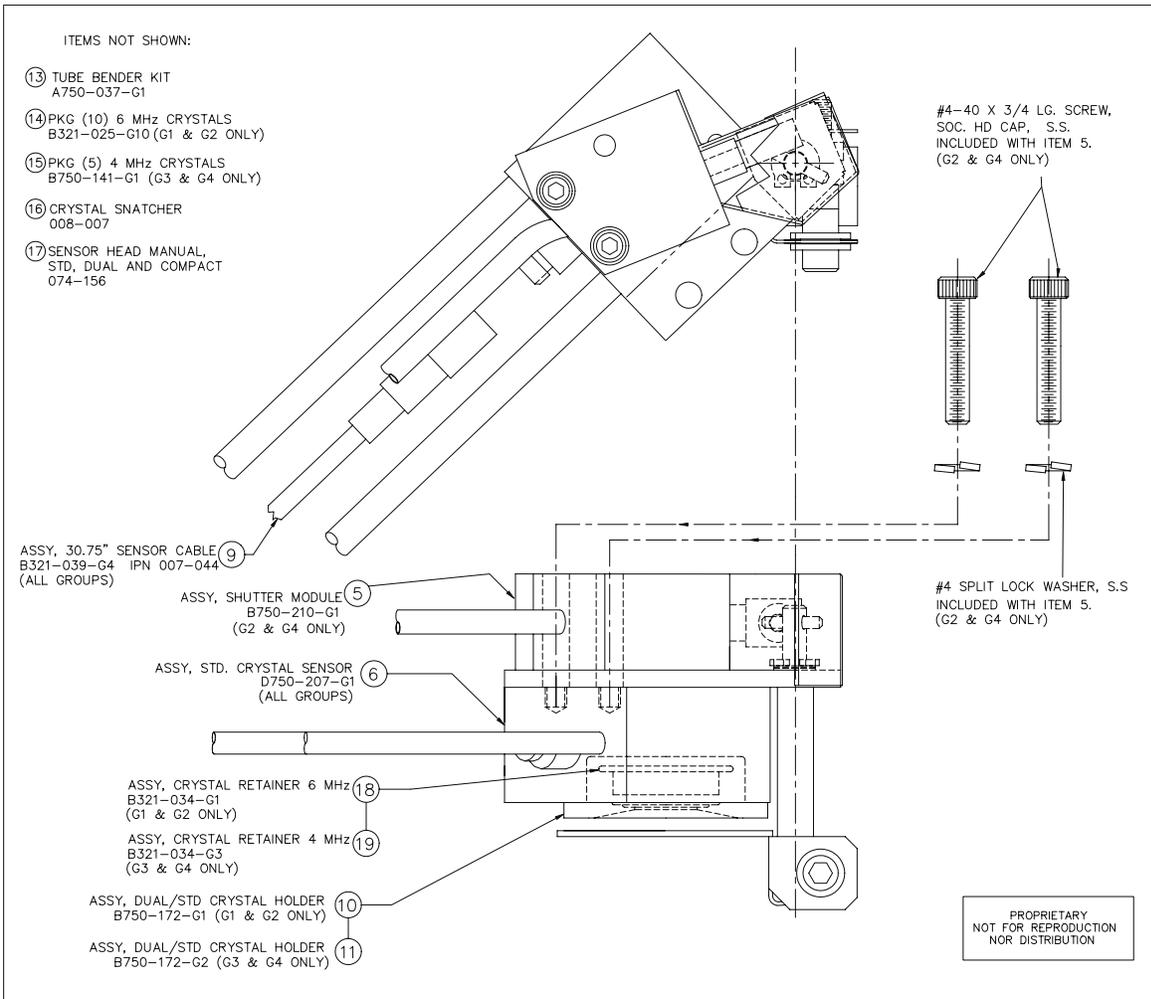
SHUTTER MODULE RETROFIT KITS

Retrofit kits for field modification are available. All retrofit kits include the mounting hardware necessary for each style of sensor.

The shuttered bakeable sensor must be returned to INFICON for refurbishment.

Please contact INFICON for more details on ordering the Shutter Module Retrofit Kits.

All shuttered sensors require the Pneumatic Shutter Actuator Control valve, part number 750-420-G1. It operates on 24V AC or DC.



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