

Frequency Lock and Hold Operation Guidelines

Introduction:

Under normal ultrasonic welding or cutting conditions, this optional operating mode is not needed or recommended. If your ultrasonic plunge welding or cutting process involves applying ultrasonic energy to a very dense material, it is possible that the ultrasonic stack will mechanically couple to the material that is being processed. This coupling will change the resonant frequency of the ultrasonic stack. When there is mechanical coupling, the iQ system will drive the stack at the wrong frequency, which is likely to cause an iQ system error, ending the welding cycle prematurely. If you have this type of application, enabling the Frequency Lock and Hold mode might allow this type of welding process to function properly, without causing an error that ends the ultrasound cycle before it has been completed.

Should the Frequency Lock and Hold Mode be used for your particular application?

If you answer YES to all six of the applications questions listed below, using the Frequency Lock and Hold mode could resolve the problems you have encountered running your difficult application.

1. Are you using an actuator to move the ultrasonic stack to contact the work piece?
2. Will the ultrasonic energy be activated periodically for a short amount of time?
3. Is the material being processed by the ultrasonic energy very dense (not malleable)?
4. During a processing cycle, does the iQ system operating frequency gradually change or suddenly hop to a significantly different frequency, compared to early in the cycle?
5. Does an iQ system error occur when the operating frequency changes during the process and terminates the ultrasound energy, before the processing cycle has been completed?
6. Is a moderate amount of ultrasonic power required for this process, when compared to the power rating of the iQ system that you are using?

Operational Guidelines to follow when Frequency Lock and Hold Mode is enabled:

1. Use this operating mode only with plunge welding (periodic cycle) type applications.
2. Do not apply ultrasonic energy any longer than needed to complete the ultrasonic process.
3. After ultrasound is activated, allow time for the iQ system to lock to the stack frequency, before the stack contacts the work piece (wait until Regulation Status output activates).
4. This operating mode is not intended for high power applications, however the maximum amount of usable ultrasound output power depends on the ultrasonic stack design you are using.
5. Keep all of the ultrasonic horn working surfaces clean and free of any material from the production process that may build-up on the horn, altering the stack operating frequency.

Examples of Applications where Frequency Lock and Hold can be used effectively:

1. Brass Threaded Inserts – Large metal inserts can easily couple to the ultrasonic horn tip and cause a peak overload, while driving them into plastic.
2. Cutting Frozen Foods – When dense baked goods such as brownies are frozen to very low temperatures, the blade of the cutting horn can couple to the solid frozen product and overload before completing the cut. Test – Running a test using the front panel or iQ Explorer II will not use the “tracked” frequency as the starting frequency, but will use the FRF instead. A scan should be run to set the FRF to the optimal frequency before using test.

How does the Frequency Lock and Hold Operating mode work?

The Frequency Lock and Hold cycle begins exactly the same as a normal welding cycle. When ultrasound is activated, the iQ system detects the mechanical resonant frequency of the attached stack and locks the output driving pulses to that frequency. This lock-on process occurs during the Ramp Up starting time. After the Ramp Up time period is finished, the ultrasound output will be at the programmed amplitude level, and the system must be locked to the stack frequency, otherwise a Frequency Lock Lost error will occur.

The Frequency Hold command will be activated, after a stable frequency lock has been achieved and the Ramp Up time has elapsed. Once the Frequency Hold command activates, the output frequency does not change and is held at that frequency for the remaining time the ultrasound is activated. When the system is in the Frequency Hold mode, the system is no longer locked to the ultrasonic stack frequency and is running at a fixed frequency that was the correct stack frequency at the end of the Ramp Up time. The iQ system does not track the ultrasonic stack frequency during the Frequency Hold mode, effectively ignoring any resonant frequency changes caused by the stack mechanically coupling to the dense loading material while the ultrasonic process is being completed. Running the ultrasonic stack at a fixed frequency during the Frequency Hold mode will only operate properly for a short amount of time. The welding or cutting process should be set up so the ultrasound output is activated for a minimum amount of time in the Frequency Hold mode, to achieve acceptable results. If the ultrasound output is activated for too long in the Frequency Hold mode, the system will time-out, terminating the ultrasound cycle.

If the application requires too much ultrasound output power while the stack is coupled to the loading material, there will be an extreme phase difference between the iQ output driving frequency and the mechanically coupled stack frequency. This phase difference will either cause an overload fault or the power transfer will be so poor, inadequate energy will be available to complete the process.

Avoid these operating conditions when Frequency Lock and Hold Mode is enabled:

1. Do not activate ultrasound once and perform multiple plunge food cutting cycles, but instead switch the ultrasound OFF after each cut is completed and then ON again to start the next cut.
2. The face of the stack must not come into contact with the work-piece before the Regulation Status output signal activates, which signals the end of the Ramp Up time.
3. Do not use this mode of operation for cut and seal fabric cutting applications, where the cutting edge of the horn contacts a solid metal anvil cutting surface.
4. Do not enable the Lock and Hold mode to avoid faults caused by the face of the ultrasonic horn contacting a solid metal fixture or anvil. (No metal to metal contact is allowed.)
5. Do not enable an Afterburst cycle when the Frequency Lock and Hold mode is enabled.
6. Do not use the Frequency Lock and Hold Mode if after following all of the usage and timing recommendations in this Application Note, you still encounter application problems. Your stack design may not operate reliably when the Frequency Hold mode is activated.

On the following page, Figure 1 illustrates the correct way to design the automation controller timing.

If a Dukane press or thruster is being used, the ultrasound trigger point, along with the down stroke distance and speed, must be set up so the face of the stack does not contact the product being processed, before the Regulation Status output signal activates.

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