Cutting Food Products or Materials with Ultrasonic Blade Horns

Dukane's standard 20kHz, 30kHz, and 40kHz ultrasonic systems can operate reliably in food or material cutting applications at extremely fast production speeds. However, to achieve fast production speeds, it is important to follow these operating guidelines.

Describing a Typical Ultrasonic Food Cutting Process

A typical ultrasonic food cutting process uses a specialized blade horn to cut through a product that is often sticky. Ultrasonic frequency vibrations, applied to the horn during the process, aid in cutting through the product as the horn is lowered to its stopping point. Vibrations also prevent the product from sticking to the horn when it retracts, after the cutting operation is completed. Most cutting applications will use either a half-wave or full-wave blade horn.

Automation control equipment is used to control this process. It must activate the ultrasonic system to apply ultrasound to the cutting blade (horn). It must also control the movement of the blade to cut the product, and then to retract the blade from the product, once the cut is completed. The sequence is then repeated, at the required production rate, to produce properly cut finished product.

Ultrasonic System - Activation Sequence

When a cutting cycle is initiated, the ultrasonic system must search for the resonant frequency of the ultrasonic stack. It then locks on to this frequency and drives the stack at the correct frequency for the remainder of the ultrasound cycle. The system requires a certain amount of time to lock on to the proper ultrasonic stack operating frequency. Each horn design has different lock-on time characteristics. If frequency overloads (Alarm code U104) or peak overloads (U106) occur, then an adjustment to the **Free Running Frequency** is required. Dukane ultrasonic systems incorporate a feature to aid in determining a frequency setting that is close to the actual operating frequency of the cutting blade. The feature is called "**Stack Scan**". An application note on using the feature can be found on Dukane's website at the following link https://documents.dukane.com/AppNote/An512.pdf

Ultrasonic System – Ramp Up / Down Times

To reduce stress on a cutting blade (horn) used in a food or material cutting application, Dukane ultrasonic systems incorporate a **Ramp Up Time**. During this time, the cutting blade accelerates smoothly from the initial non-vibrating (off) condition to vibrating at both the programmed amplitude level and at the resonant tuned frequency of the ultrasonic stack (which includes the transducer, blade horn and the booster, if one is used). The system must achieve a stable frequency lock condition before the end of the Ramp Up time. If a stable lock condition is not achieved, the system will shut down before the cutting cycle is finished. The system will indicate that a Frequency Overload Alarm condition caused the shutdown. The default Ramp Up time for Dukane systems is typically appropriate for the majority of food or material cutting applications. The Dukane ultrasonic systems can also incorporate a **Ramp Down Time**. The Ramp Down time is used to control the ring down of ultrasonic horns, which could reduce stresses in ultrasonic cutting blades. The default value of Ramp Down time is 0.000 second. Dukane does not recommend the use of Ramp Down time without consultation.

Recommended Ramp Up Times:

20kHz : 0.150s – 0.200s (Default setting 0.150 seconds)

30kHz : 0.100s – 0.150s (Default setting 0.100 seconds)

40kHz : 0.050s – 0.075s (Default setting 0.050 seconds)

Ultrasonic System – Amplitude Setting

After the Ramp Up time has elapsed, the amplitude level will be at its pre-programmed percentage. The recommended Amplitude setting, for all system frequencies, is between 70% and 100%. The default Amplitude setting for Dukane food or material cutting systems is 100%. Dukane does not typically recommend amplitudes levels below 70% without consultation.

Guidelines for Trouble Free System Operation

For the ultrasonic system to reliably lock-on to the ultrasonic stack frequency, the cutting process (cutting blade is in contact with the product), must be programmed to occur **after** the Ramp Up time, not during the Ramp Up time. While this time is user-adjustable, reducing the default Ramp Up time is not recommended, especially with blade cutting horns. On the Dukane iQ Systems, a Regulation Status output signal activates after the Ramp Up time period is completed. Using this status signal eliminates the need for the automation controller (PLC) to generate a time delay. The control system would activate ultrasound, wait for the Regulation Status output to activate, and then activate the controls to move the cutting blade down and complete the cutting process. After the cutting blade has been fully removed from the product, the ultrasound may be switched off or its amplitude might be lowered

On the pages that follow, Figure 1 illustrates an example of a correct way to design stack actuator timing. Figure 2 shows an example of an incorrect actuator timing design.

Figure 1 - Example of a Correct Actuator Timing Design

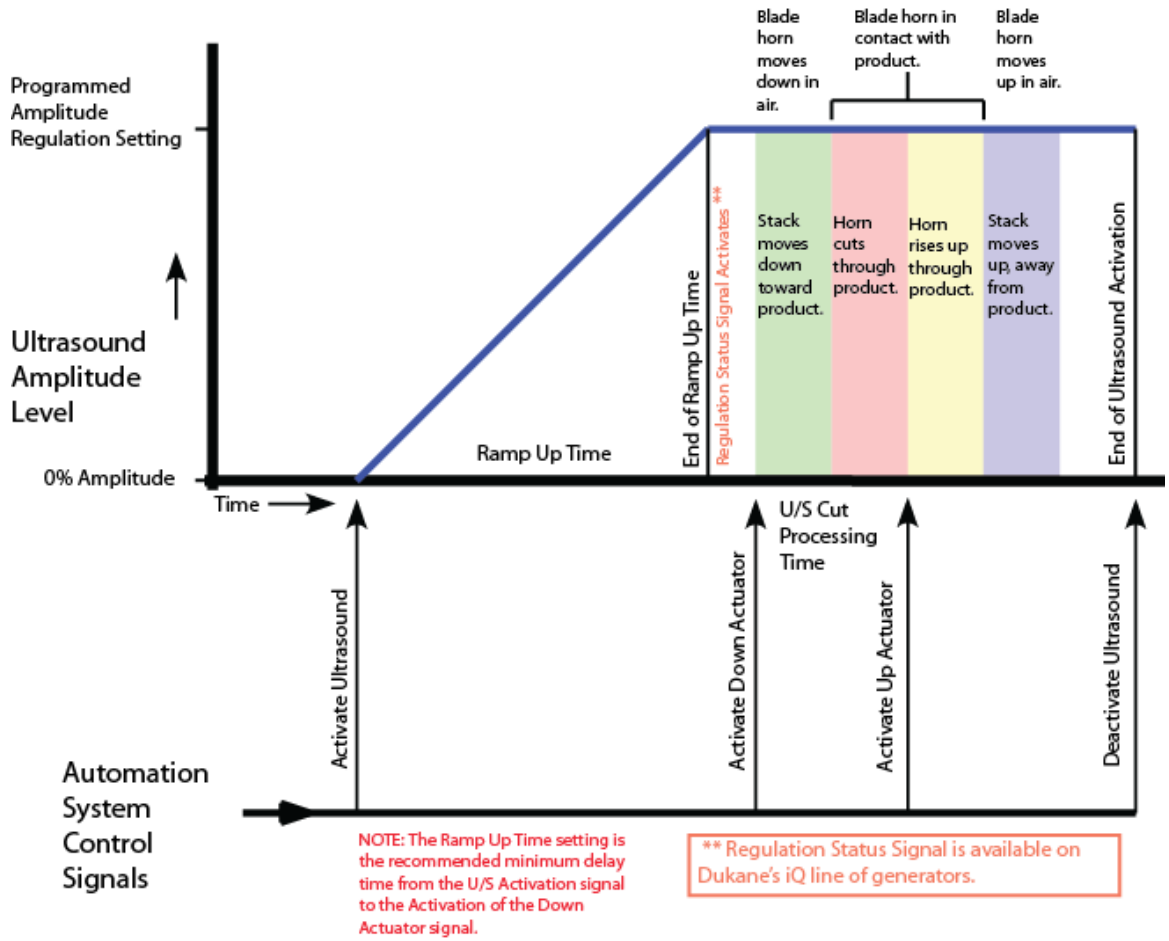
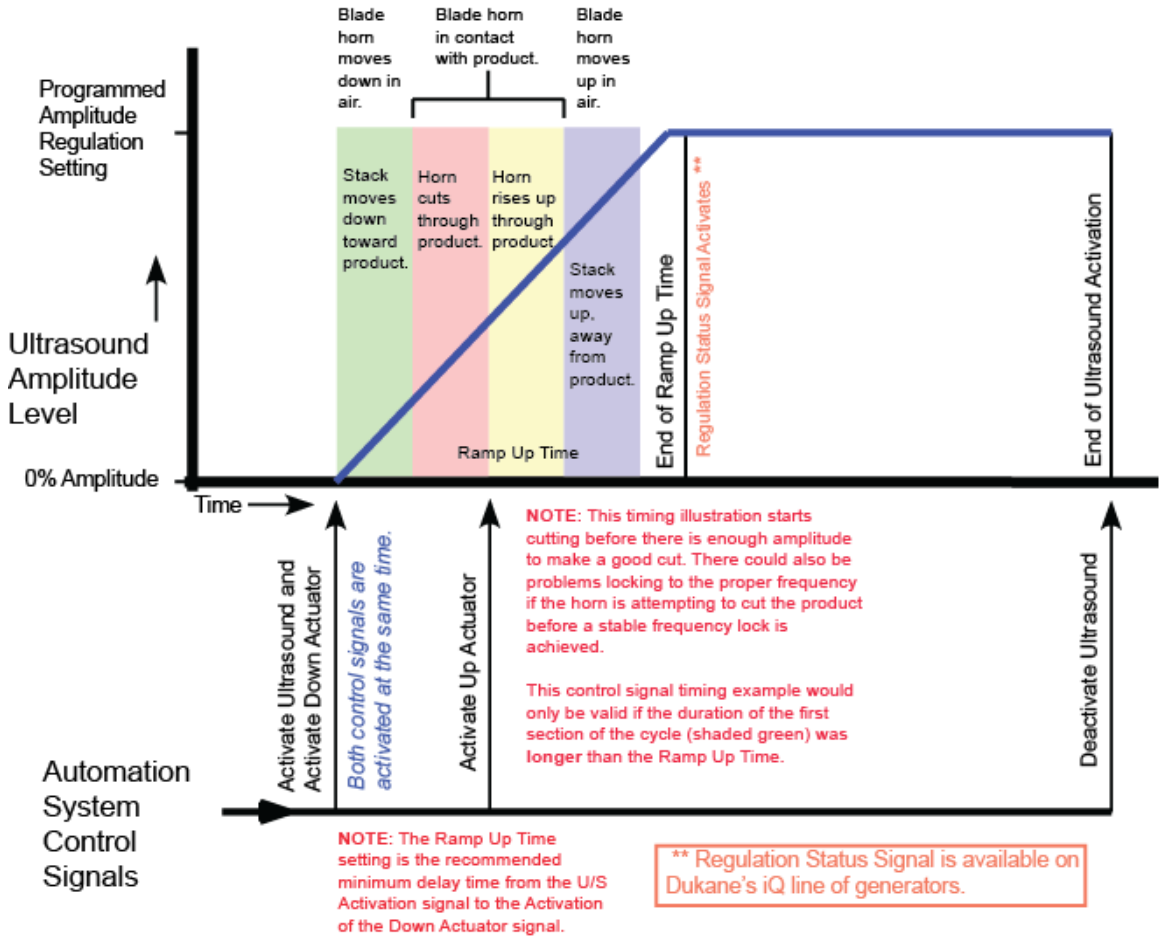


Figure 2 - Example of an *Incorrect* Actuator Timing Design



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