

## Power Regulation

### **Introduction:**

Dukane's Power Regulation feature dynamically adjusts the ultrasonic amplitude level during the welding process to maintain a constant output power level. If the output power level exceeds the user specified Power Regulation Setpoint setting (in Watts), the generator will automatically reduce the ultrasound amplitude so that the output power level is equal to or less than the setpoint. The Dukane Power Regulation feature is based on Dukane Patent #5,880,580.

**When Power Regulation may help:** In continuous weld processes where over or under welding of the processed material may occur due to changes in thickness, speed, force, etc.

**When Power Regulation should not be used:** Applications where the mechanical amplitude of the ultrasonic stack needs to be maintained throughout the weld regardless of changes to the force/pressure applied.

### **Background Information:**

**Amplitude Regulation and Power Output:** Dukane ultrasonic generators adjust the ultrasound output to maintain the mechanical amplitude of the ultrasonic stack under load changes caused by variations in the force/pressure between the ultrasonic stack and the processed material. If the force increases, the generator power output is increased so that the mechanical amplitude of the stack is maintained. For a given amplitude, the power output increases as the force of the ultrasonic horn against the processed material increases. For a given force/pressure, power output increases as amplitude increases.

**Power Regulation:** Often in continuous film and fabric applications the location of the ultrasonic horn and anvil (such as a rotary drum) are fixed. Variations in thickness of the material can therefore cause changes to the amount of pressure applied, and as discussed above, if the ultrasonic amplitude is constant it will affect the amount of power delivered to the material. Under these conditions the material being processed may over weld (melt), possibly break, or produce generally inconsistent product. By producing constant power, Power Regulation ensures a controlled amount of energy is delivered to the weld, allowing the continuous process to be material thickness (plus other factors) invariant. Historically, power regulation was accomplished by using a PLC to monitor an external power meter that measured the output of the ultrasonic generator. When the measured power exceeded a set value, the PLC would lower the amplitude setting of the ultrasonic generator using an interface such as the Remote Amplitude Control Module of a Dukane generator. If the measured power dropped below the set value, the PLC would increase the amplitude setting to try to bring the power output back to the setpoint value. However, amplitude can't be increased to greater than 100%, so if the power setting is not reached at that point then it won't be.

**Dukane Power Regulation:** The Power Regulation feature of the iQ generator eliminates the requirement for the Remote Amplitude Control Module for the iQ generator, the need for expensive analog input and output cards for the PLC, and the associated PLC code and control loop tuning, which significantly reduces system cost and complexity. Another advantage is that the iQ generator can monitor and adjust the amplitude in milliseconds rather than tens of milliseconds that the PLC requires.

### Power Regulation Details:

**Generator Settings:** In order to use this feature, the iQ generator is configured as it normally would be for a process. This would include setting the amplitude to a value between 20 and 100%. The amplitude value is determined by the maximum desired mechanical amplitude at the face of the horn. The Power Regulation feature will never produce an amplitude greater than this setting, even if the output power does not reach the Power Regulation Setpoint.

**Power Regulation Setting:** The desired Power Regulation setpoint is programmed into the generator once the amplitude is set. This setpoint is the maximum value of power output that will be allowed. It is important to remember that the maximum power output of an iQ generator is based upon the amplitude setting. For example, if the amplitude of a 1200 Watt generator is set to 50%, the maximum power output is 600 Watts (50% of 1200 Watts). In this example, a Power Regulation Setpoint of 700 Watts would effectively disable the feature because the generator will produce an Average Overload Alarm above 600 Watts, before the Power Regulation Setpoint could ever be reached.

**Example of a Power Regulation Setup:** This example is a continuous process where the material thickness varies, but the amount of energy transferred to the material needs to be constant:

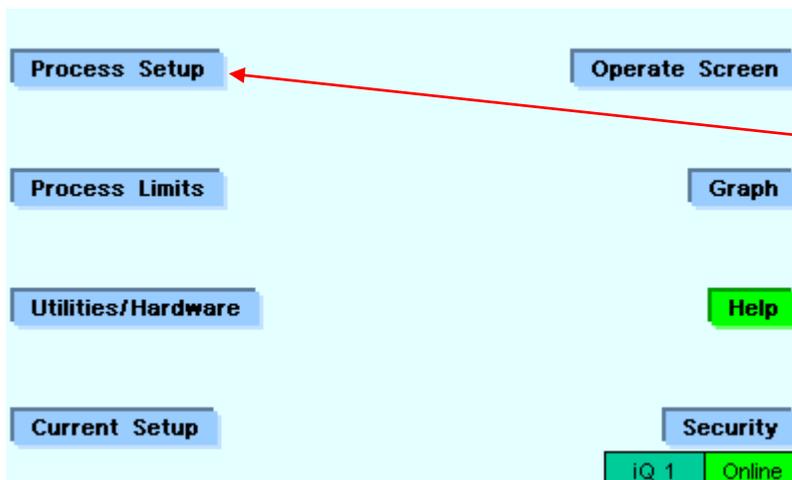
1. Set the Amplitude to 80%.
2. Adjust the distance between the horn and anvil so that a good weld is achieved with normal thickness of material.
3. Use the power reading from the previous step as the Power Regulation Setpoint.
4. Set the Amplitude to 100%.
5. Verify that a good weld is made with normal thickness material and the Power Regulation feature is limiting the amplitude while welding to about 80% (the value set in step 1). Now when the material thickness increases, the amplitude will be lowered to maintain the power output. When the material thickness is less than normal, the amplitude will increase in an attempt to reach the Power Regulation Setpoint. As long as the variation in the material thickness isn't too great, the energy transferred to the material will be constant.

**Power Regulation Operation:** Like the PLC implementation of Power Regulation, Dukane's Power Regulation feature monitors the power output and lowers the amplitude if the output exceeds the Power Regulation setting. If the output falls to less than the Power Regulation setting, then the amplitude is increased. However, the amplitude can only be increased to the amplitude setting. Because of this, power regulation can't guarantee a minimum power output, since this is also dependent on the load as mentioned in the amplitude and power output section above.

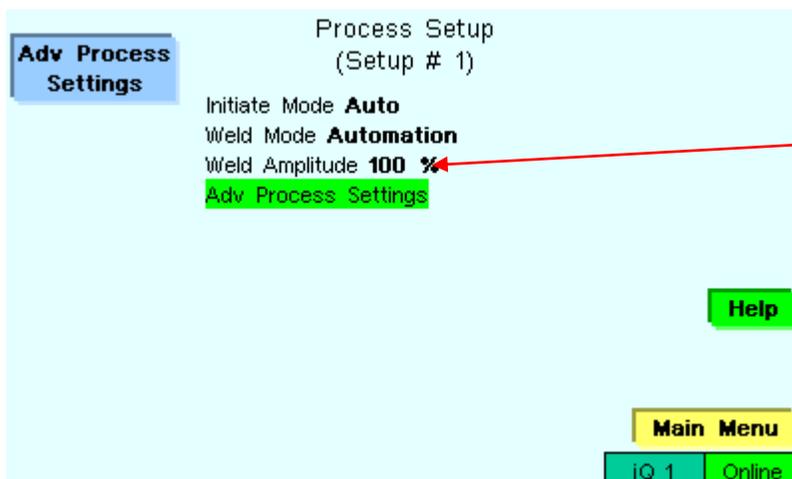
### Important things to remember about Dukane's Power Regulation feature:

1. Power Regulation affects only the operating amplitude. It does not affect the amplitude setting itself, nor can it increase the amplitude beyond its setting.
2. Power Regulation cannot guarantee that a minimum power is produced, since that is dependent upon actual load conditions. In the event that there is not enough load to produce power above the power regulation setpoint, the stack will run at the amplitude setting.
3. The power regulation status output activates when the power delivered to the load is within  $\pm 3\%$  of the power setpoint.

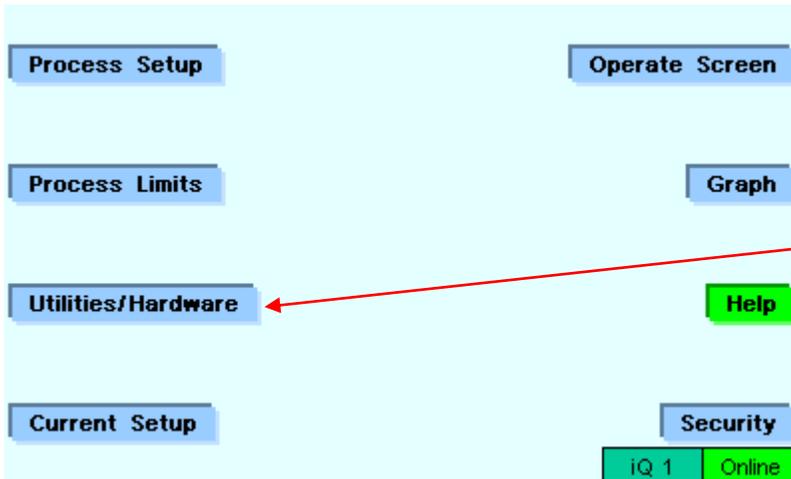
### Enabling Power Regulation on a iQ ES "Q" series generator:



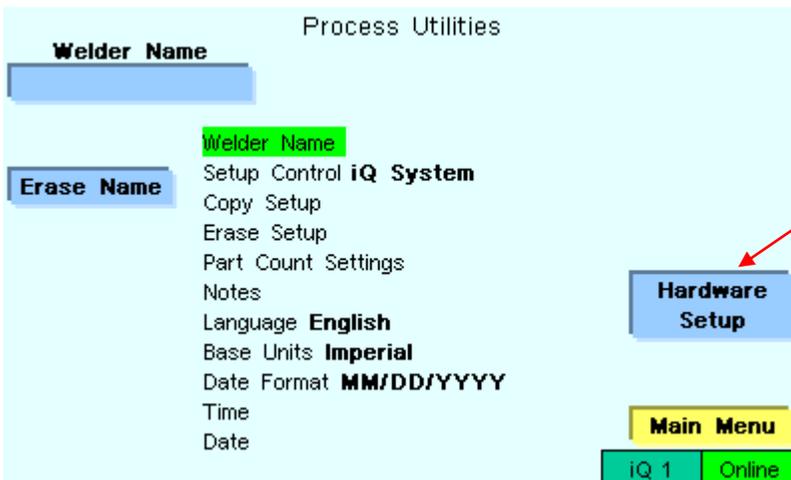
Step 1. Determine if Advanced Process Settings are enabled. To do this, press the button next to Process Setup in the Main menu screen. This will display the Process Setup menu screen.



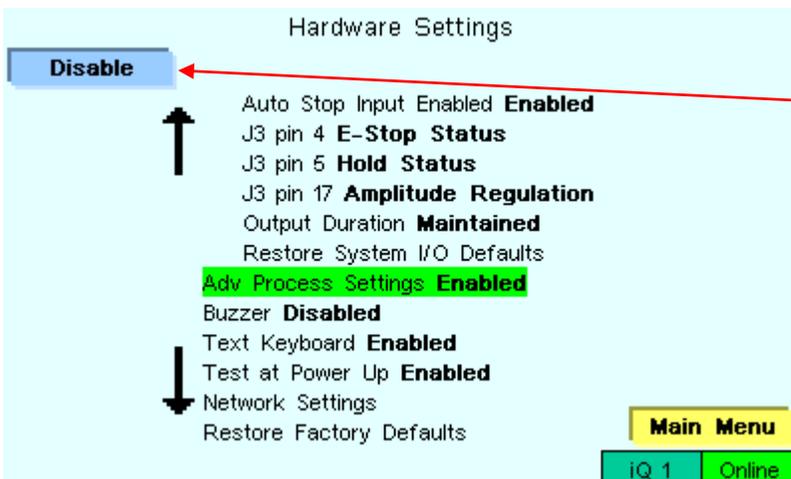
Step 2. If "Adv Process Settings" is displayed in the Process Settings menu list skip to step 7. If not, go to step 3.



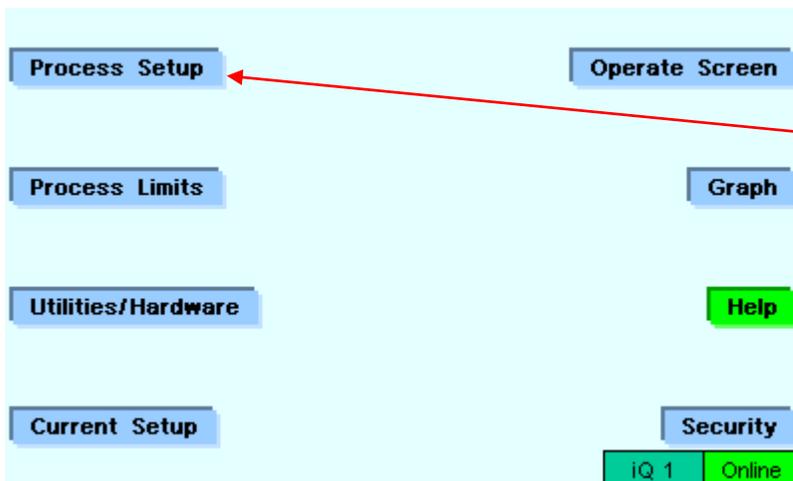
Step 3. From the Main Menu screen press the button next to Utilities/Hardware. This will take you to the Process Utilities menu.



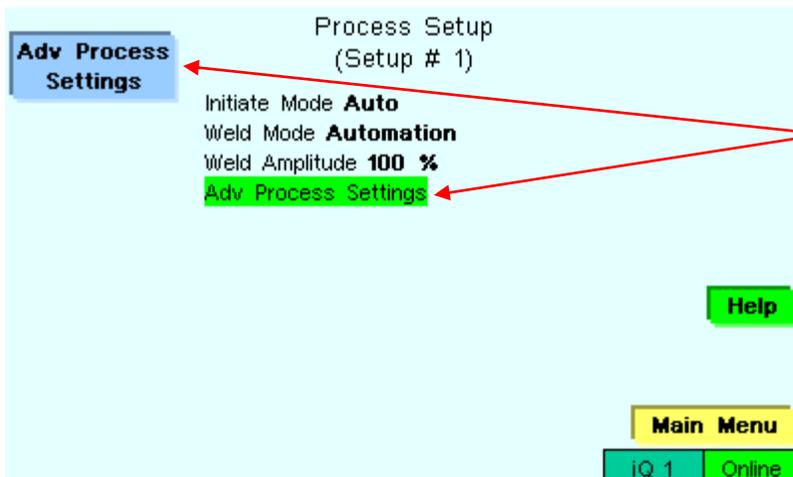
Step 4. In the Process Utilities menu press the button next to Hardware Setup. This takes you to the Hardware Settings menu.



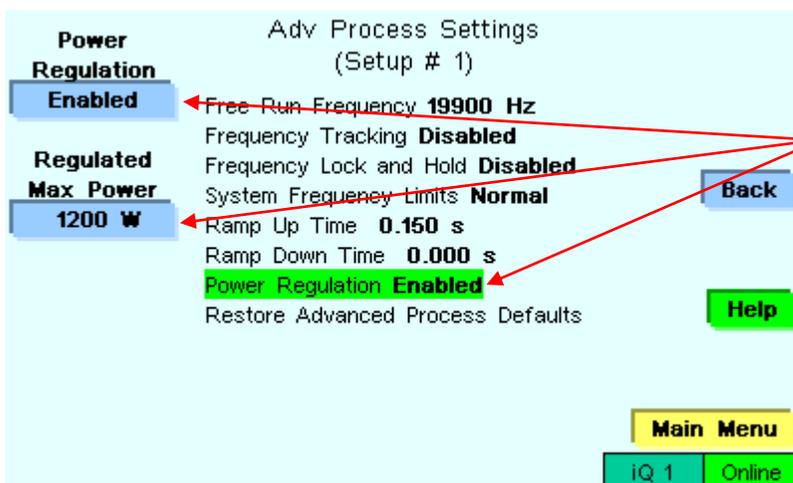
Step 5. In the Hardware Settings menu scroll up to Adv. Process Settings and press the button next to Enable change setting to Enabled.



Step 6. Return to the Main menu and select Process Setup. This will take you to the Process Setup menu.

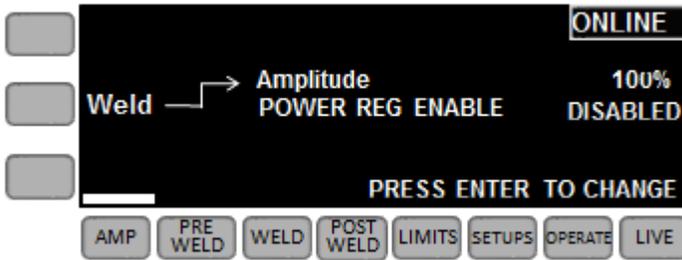


Step 7. Scroll down to Adv Process Settings and press the button next to Adv Process Settings (upper left corner). The Adv Process Settings menu will be displayed.

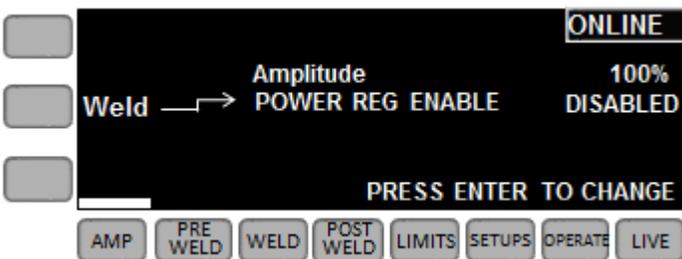


Step 8. Scroll down to Power Regulation, press the button in the top right corner next to Power Regulation, and change to Enabled. Press the button next to Regulated Max Power and change the setting to the desired value. This completes the Power Regulation setup.

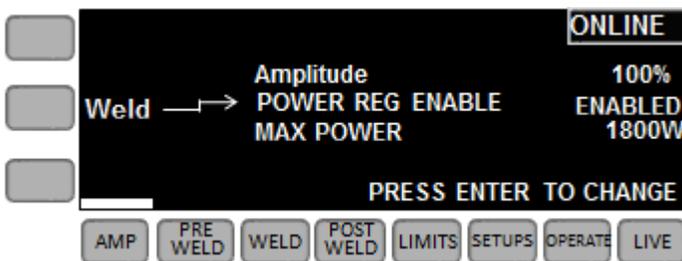
### Enabling Power Regulation on a iQ LS-E generator:



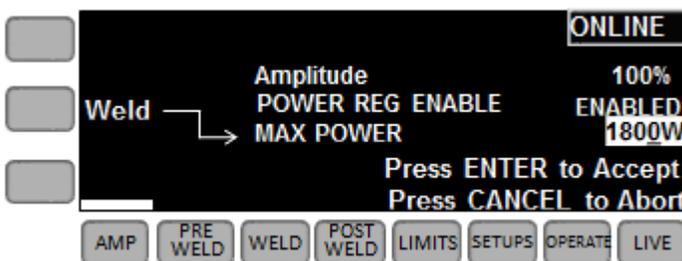
Press the AMP Button. This will take you to the Amplitude menu shown to the left. Next, press the Down arrow key



The selection arrow is now pointed at POWER REG ENABLE. Press the ENTER button to enable Power Regulation.



The power setting can be changed by Pressing the down key and then ENTER To highlight the power setting.



Use the UP, DOWN LEFT, RIGHT keys to change to the desired value. Press ENTER to accept the new setting.

**Dukane IAS, LLC**  
**Intelligent Assembly Solutions**

2900 Dukane Drive  
St. Charles, IL 60174 USA  
Tel: (630) 797-4900  
Fax: (630) 797-4949  
<http://www.dukane.com/us>

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