DUKANE

Overload Conditions

Dukane Ultrasonic Welders

Application Note AN529

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Preventing Overloads is key to the longevity of your Dukane welder. The generator overload circuitry is designed to reduce the likelihood of damage to the stack assembly or the generator, however, it is not possible to protect the stack or the generator in all situations. Repeated overloads will likely result in permanent damage to the stack assembly and potentially the generator. Care should be taken to address overloads when they occur.

There are five basic overload conditions that can occur in an Ultrasonic Welder. These conditions are as follows:

- **FREQUENCY OVERLOAD** (U104) - Occurs early in the cycle. The generator is unable to find the resonant frequency of the stack at start up.
- **FREQUENCY OVERLOAD** (U112) The operating frequency has changed so that it is outside of the generator frequency limits.
- **PEAK OVERLOAD** (U106) - Producing the ultrasound signal is resulting in excessive current draw within the generator.
- **VOLTAGE OVERLOAD** (U116) - Ultrasound voltage exceeds the nominal operating voltage.
- **AVERAGE OVERLOAD** (U108) - The weld process environment resulted in a power draw that exceeded the power rating of the generator.

FREQUENCY OVERLOAD (U104) – The generator is unable to find the resonant frequency of the stack.

Can be caused by:

- Poor coupling between stack components due to poor mating surface conditions.
- Cracked or contaminated horn or stud.
- Damaged transducer or booster.
- Excessive mechanical load on the stack at start up.
- Horn tuning is too far away from the generator Free Run frequency setting. *
- Damaged ultrasound cable or the ultrasound cable is unplugged.

*NOTE: Excessive heat can cause the horn frequency to shift downward too far from the generator Free Run frequency setting due to thermal expansion. Normal operating temperature of the entire stack should not exceed 110 degrees F (43 degrees C). While the best solution is to control the stack temperature through external cooling, smaller changes in temperature may be addressed by enabling the Frequency Tracking feature. Additional information regarding the Frequency Tracking feature can be found at the link below:
https://documents.dukane.com/AppNote/AN513.pdf

PEAK OVERLOAD (U106) - Is the result of excessive current draw within the generator. The stack will usually operate for a very short burst of time. Reoccurring Peak Overloads are likely to result in damage to the transducer and/or the generator.

A U106 alarm can be caused by:

- Poor coupling between stack components due to poor mating surface conditions.
- Cracked or contaminated horn or stud.
- Severely damaged transducer or booster.
- Excessive mechanical load on horn at start up.
- Horn tuning is too far away from generator Free Run frequency setting.
- Part coupling (see info on part coupling below under U112 alarm).
- Metal to metal horn contact.

VOLTAGE OVERLOAD (U116) - The transducer voltage exceeds the nominal generator output voltage. Typically occurs from the stack running at a frequency other than the primary resonant frequency. Can also be the result of the horn coming in contact with the fixture or severe coupling of the part with the horn.

A U116 alarm can be caused by:

- Cracked or contaminated horn or stud.
- Severely damaged transducer or booster.
- Excessive mechanical load on the horn at start up.
- Horn tuning is too far away from the generator Free Run frequency.
- An unstable vibrating fixture.

General Guidelines for Troubleshooting U104, U106 and U116 Alarms

U104, U106, and U116 alarms often have similar causes. To troubleshoot these alarms, start by pushing and holding the TEST button to see if the stack will run in free air without overloading (without any contact with the part).

If the stack does not run - Disassemble it and inspect the mating surfaces. Instructions can be found at the following link:
https://documents.dukane.com/DesignGuides/Ultrasonic Probes.pdf

Reassemble the transducer to the booster. Try to run the transducer and booster together in TEST without the horn. If these two pieces do not run, it is likely the transducer is the cause, as boosters rarely fail. If these 2 pieces do run and the power draw is ~75 watts or less, then attach the horn and test it again. If it will not run in TEST with the horn attached, it is likely the horn is the cause, and it should be returned to Dukane for evaluation or service.

If the stack does run - Observe the operating frequency and power. Most stacks will run +/- 100 Hz from the nominal generator frequency and the power will typically be less than 150 watts. Large horns may be as high as 250 watts, more for composite or steel horns. Run the stack for about 20+ seconds *. If the horn produces a harmonic ringing sound, the stack should be disassembled, and the mating surfaces inspected. After running, feel the surface temperature of the stack. If the area around the mating surface is warmer than the rest of the stack, this indicates loss in this area, and the mating surfaces should be serviced. Additional information regarding stack maintenance can be found at the following link:
https://documents.dukane.com/DesignGuides/Ultrasonic Probes.pdf

If you do not feel any heat, then optimize the Free Run frequency setting by performing a Stack Scan. A Stack Scan will set the Free Run frequency closer to the actual stack operating frequency and can significantly increase the likelihood of the generator being able to lock on to the proper stack frequency. This can be especially helpful with large horns or when high trigger forces are required. Additional information regarding the Stack Scan feature can be found at the following link:
https://documents.dukane.com/AppNote/AN512.pdf

***Note:** Certain types of cutting knives should not be run in free air for any extended period of time. Because of the thin blade, if not dampened in product, the knife can vibrate sideways and break. Consult Dukane's horn department for details.

FREQUENCY OVERLOAD (U112) - The resonant frequency of the stack has changed so that it is no longer within the programmed frequency limits of the generator.

When ultrasound first starts, the horn is excited at the Free Run frequency. As the horn begins to resonate, the generator monitors the horn frequency and adjusts its operating frequency to match the horn's natural resonant frequency. Once they match, we consider the generator to be "locked" on to the resonate frequency of the horn. As the weld occurs, due to load or heat, the horn frequency may change. The generator continues to track this change. If the change becomes too great, the generator assumes something is wrong and aborts the weld to prevent further damage.

A U112 alarm can be caused by:

> **Heat** - If the stack temperature begins to increase significantly during the weld, this will cause the frequency to drift downward. Rapid changes in temperature are often caused by a component failure, therefore the weld is aborted to prevent further damage.
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> The U112 alarm can also occur in continuous applications where heat builds up over an extended time. The entire stack temperature should not exceed 110 degrees F (43 degrees C). External cooling is typically used when running continuous applications. A U112 overload, due to heating, is usually followed by a U104 overload on the next cycle as the horn is still hot, resulting in the frequency still being too low to run.
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> **Part coupling** – If the part develops its own resonant vibration, this can be reflected into the horn vibration, thus skewing the horn operating frequency. While some frequency drift during the weld is normal, significant drift can result in damage to the stack assembly. To prevent significant drift that might cause damage, the weld is aborted.
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> Possible solutions can be:
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> 1. If the part is warped, or is not directly supported under the horn, the plastic may resonate sympathetically with the ultrasonic vibration. This additional vibration can skew the horn frequency. Higher trigger forces may help or changing the fixture geometry to prevent the part from vibrating may also help.
> 2. For weld times less than 5 seconds, the Frequency Lock and Hold feature can be enabled to prevent this frequency shift. Further information on the Frequency Lock and Hold feature can be found at the following link: https://documents.dukane.com/AppNote/AN505.pdf

The U104, U106, U112, and U116 overload alarms will most likely relate to issues with the stack. Further information on the proper assembly and maintenance of the stack assembly can be found in the following document:
https://documents.dukane.com/DesignGuides/Ultrasonic Probes.pdf

AVERAGE OVERLOAD (U108) - The demand of the weld process exceeds the generator's maximum output power. Except in rare instances, this is the result an improper setup, rather than an actual component failure.

The following considerations can be made for addressing this issue:

- Reduce weld speed (servo).
- Reduce air pressure (pneumatic).
- Reduce cutting speed (for cutting applications).
- Increase the generator amplitude setting (This may require reducing the booster gain).

NOTE: The generator will only produce its rated output power at a 100% amplitude setting. Reducing the generator amplitude setting also reduces the maximum generator output power by the same percentage. For example, a generator rated at 1200 watts will Average Overload at 600 watts when the amplitude setting is set to 50%.

- Purchase a more powerful generator.
- Rare, but also possible:

Cracked stud resulting in high power draw.

Transducer partially shorted out, resulting in high power draw, both at idle and operating with the horn removed.

To test, push and hold the TEST button to read the idle power. Typically, the idle power will be as follows:

15kHz: 100-250 watts. Large composite horns may be as high as 400 watts.
20kHz: 70-120 watts. Some larger horns may be higher, but usually not over 250 watts.
30kHz: 30-100 watts.
40kHz: 20-70 watts.
Steel horns can draw up to 50% more power than titanium horns.

Please remember this is a rough guide as to what is typical. There are exceptions. If the idle power in TEST seems unusually high, remove the horn, and run in TEST with just the booster and transducer. Without the horn attached, the idle power should be less than 100 watts for 15kHz and 20kHz and less than 50 watts for 30kHz and 40kHz. Also pay attention to any rapid heat increase under any test. This indicates an issue with one of the stack components or the mating surfaces.

It is generally recommended that at least once per year, the stack assembly is removed from its mount and completely disassembled. This allows one to inspect the mating surface to insure they are in good condition. A guide for this process can be downloaded from the following link.
https://documents.dukane.com/DesignGuides/Ultrasonic Probes.pdf

When a new stack assembly is received and put into service, it is strongly recommended to benchmark the stack. This means running it in TEST and recording the operating frequency and idle power. Also, record the amplitude setting for test environment repeatability. This provides a record that can be referenced later for comparison if issues arise.

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Website

The website has information about our products, processes, solutions, and technical data. Downloads are available for many kinds of literature.

This is the address for the main website:
www.dukane.com

Application Support

You can get application support at the following link below:
https://www.dukane.com/support/#application-support

Local Representative

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