MiniForm XL

OVERVIEW

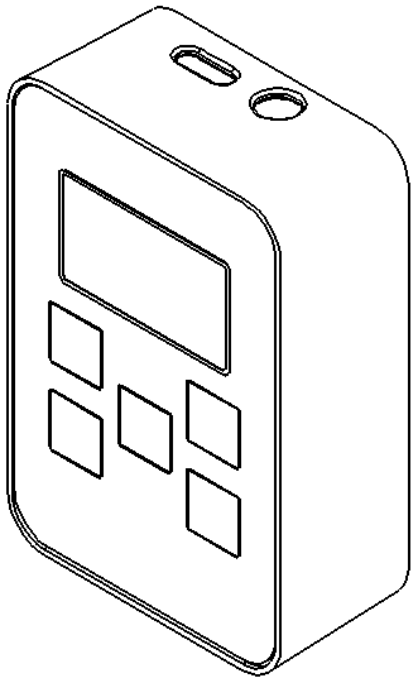
The Cu MiniForm is a software defined current regulated power supply. It is designed for copper electroforming and is a direct replacement for a standard bench-top power supply. Firmware continuously monitors the output to determine optimal settings while starting and building a copper deposit on a conductive surface.

FEATURES

- 0.10 - 5.00 amp model (0.01 amp increments)
- MilliRamp
- Automatic voltage regulation
- Compact efficient design
- Status and abnormal condition indicators
- Internal overtemperature protection
- Standard USB type C input (wall adapter included)
- Includes comprehensive guide for electroforming setup and troubleshooting.

APPLICATION

- Copper electroforming



All MiniForm XL models

Included accessories not shown

ORDERING INFORMATION

MiniForm is exclusively made for and sold by Enchanted Leaves:

Enchanted Leaves

ELECTRICAL CHARACTERISTICS

Table 1: Absolute Maximum Ratings	
	5 Amp Model
Output Current	5A
Output Voltage[1]	9V
Internal Operating Temperature[2]	158°F
Ambient Operating Temperature	95°F

1: A typical electroforming process will require less than 1 volt per series bath. Circuit voltage is dictated by an electrochemical potential, therefore it does not follow Ohm's Law. The maximum output power of MiniForm varies and is not V_{MAX} * I_{MAX}.

2: Automatically monitored.

Table 2: Typical Operating Conditions	
	5 Amp Model
Output Current	0.05A - 5A
Output Voltage	0.6V
Internal Temperature[1]	100°F
Ambient Temperature	75°F

1: At maximum output current.

Table 3: Thermal Data[1]		
Output Current	Output Voltage	ΔT
5A	1V	23°F

1: Tested on a flat level surface in an ambient temperature of 75°F

OUTPUT CHARACTERISTICS

General overview of MilliRamp operation

MilliRamp attempts to gradually increase current to the user setpoint and limit high voltages that may be caused by the resistance of conductive paint. All types of conductive paint are significantly less conductive than copper metal. Therefore, before the initial layer of copper is deposited, the current density of the suspension wire and copper growth is extremely high in comparison to the painted surface. Without MilliRamp, this can cause uneven deposits and even electrolytic separation of the electroforming solution.

Output ripple current

MiniForm XL was designed to have low output ripple even under high current conditions. Figure 1 shows MiniForm output while delivering high test current at 0.6V. Noise on the voltage signal is due to local radio interference and not from MiniForm.

Figure 1: MiniForm output ripple while delivering a high test current
Channel 1: Voltage = $4mV_{rms}$ (0.67%)
Channel 2: Current = $20mA_{rms}$ (0.33%)

APPLICATION INFORMATION

MilliRamp behavior

MilliRamp is completely automatic and requires no user input under normal conditions.

MilliRamp begins by applying an extremely low current for 30 to 60 seconds to attempt to establish a copper bond with the conductive paint. During this time, the output warning indicator will not illuminate, even if there is a poor connection.

If MiniForm is paused for less than 5 minutes, pressing start will have MilliRamp pick up where it left off. However, if the USB cable is unplugged or MiniForm is paused for more than 5 minutes, it is assumed the user has started a new project. The MilliRamp process will start over.

MilliRamp will always ramp up to the user setpoint (unless bypassed) even if the amperage setpoint is changed midway through the project. It will always immediately jump down to a lower setpoint.

View real voltage output

Press and hold the start/pause button for longer than 2 seconds, the display will show the voltage being output in real time. The display will revert to normal operation as soon as the button is released. Holding down the button for an extended time will temporarily bypass MilliRamp.

Temporarily bypass MilliRamp

If the start/pause button is held for longer than 5 seconds, the output warning indicator will blink 3 times and MiniForm will jump to the user amperage setpoint. The start/pause button may be released at any time, or held to view voltage.

APPLICATION INFORMATION CONTINUED

Series connections

For more information on series electroforming, please refer to the guides provided by Enchanted Leaves.

Table 4: Recommended Max Current for Series Connections		
Series Baths	Max Current	Combined Surface Area
2	5.0A	$100in^2$
3	4.0A	$120in^2$
4	3.0A	$120in^2$
etc.		

Temperature considerations

Independent of any power supply used for projects, recall that heat is:

$$W = I^2 * R$$

At high current, poor connections that have high resistance can generate significant heat. Although MiniForm will regulate its own temperature, it cannot sense temperatures of external connections. Keep all connections extremely clean and tight fitting. Do not use alligator clips that are damaged or have lost their springiness.

ADVANCED TROUBLESHOOTING

Indicators

Power Status

USB Warning

Output Warning

Display wont turn on

Some USB wall adapters do not power on if they are plugged into the MiniForm before they are plugged into the wall. Try plugging the wall adapter into the wall first, then plug in MiniForm. Inspect cables and check for corrosion.

Display reads: “888”

The MiniForm is performing a self test. This is normal.

Display flashes “888” and never gets to the current display

There is a problem with the USB wall adapter or cable that is not providing smooth power. This is causing MiniForm to perform a reset. Please read the accessory information page in this datasheet.

Display reads: “hot”

The internal temperature limit has been reached. MiniForm has paused the output power and will wait until it has cooled off before automatically resuming. No user action is needed. High ambient temperature will reduce MiniForms ability to cool itself, especially when plating at high current. Always use MiniForm at room temperature.

ADVANCED TROUBLESHOOTING CONTINUED

Solid output warning indicator

An abnormally high voltage is detected, this can be due to very small surface area, series connected baths, or poor connections. This will not always mean something is wrong, but that the setup should be double checked. Sometimes this indicator will temporarily illuminate if the initial copper growth is slower than normal. Refer to Table 4 for suggested series connections.

Continuous blinking output warning indicator

Miniform is close to or at the voltage limit for the requested current. This can be caused by a poor connection or too many series connections.

Electroforming and further Help

For guides, troubleshooting, and more information on the electroforming process itself, please see Enchanted Leaves.

ACCESSORY INFORMATION

USB Wall Adapter

The wall adapter provided with the 5 amp MiniForm is a standard USB type C charger. If a replacement is needed, a known compatible one may be purchased from Enchanted Leaves. Most substitutes should work as long as it is rated for delivering all three of the following outputs: 5V 3A, 12V 3A, 20V 3.25A. These types are typically sold as “65W chargers”.

Although the output will be limited, MiniForm will work with a standard USB type A wall adapter that has Power Delivery (PD). Use a USB type A to type C cable. It should have all of the following outputs: 5V 3A, 9V 2A, 12v 1.5A. The USB warning indicator above the USB plug on MiniForm will illuminate, and the maximum current output of MiniForm will be limited to less than 5amps, depending on the capabilities of the USB wall adapter.

Substitutes shall be of good quality and monitored for heat, especially when using MiniForm at high current.

Output Leads

The output leads provided with MiniForm are DC barrel jack to alligator clips. Due to the tendency of corrosion on the alligator clips from proximity to electroforming solution, the output leads can simply be unplugged for replacement. They shall be a minimum of 18 gauge with soldered connections. If a replacement is needed, a known compatible one can be purchased from Enchanted Leaves.

THIS DOCUMENT

Although every effort is made to provide accurate information, this document is not guaranteed to be valid. This datasheet contains information that is collected from real world use, and is only representative of the average MiniForm. Its purpose is only to better inform the user of the capabilities of the typical MiniForm, not to provide a lower bound on performance.

Users are solely responsible for the proper operation, care, and monitoring of all equipment. Safety mechanisms are ment as a last resort measure.

MicroDean Systems reserves the right to make changes and improvements to both MiniForm and this document at any time.

THANKYOU

Everything except the discrete components of the Cu MiniForm XL are designed, fabricated, programmed, and hand assembled in the U.S.A. by me, Mike. I would not have been able to make this possible without the help of Nedda at Enchanted Leaves, and especially not without you. Without your interest in this product, I would not be able to follow my passion of engineering. Together, we can all make awesome things.

Keep making cool stuff
-Mike Smith