



AC 3 Heating System



Design and Engineering Documentation

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1. General Description

The Magneforce Magne AC3 is a custom high frequency electromagnetic heating system specifically designed for flameless, non-contact heating of mandrels used for molding catheter ends. It consists of a compact air cooled induction heater in combination with an easily attached air cooled heating head. The heating head is small, lightweight and can be mounted to most any processing fixture.

The heater operates on a standard 120V outlet and produces up to 1200 watts power for fast heating. It incorporates a custom power connector that enables the heating heat to be easily plugged in or removed in a few seconds. The standard heating head accepts mandrels up to 5/8" in diameter with typical heating times to 500°F of a few seconds. Custom heads are available for special applications..



General Specifications

- 115V 50/60Hz Input Power. 15A Maximum. Runs off a standard wall outlet.
- 1200 watt maximum output power.
- Air cooled. No water cooling required.
- Output Frequency - 35Khz.
- Compact, rugged power supply enclosure.
- Power Supply enclosure dimensions - 11"W x 10"Dp x 6"H - 20#
- 2 digit precision pushbutton potentiometer for accurate power control.
- Plug in heating heads can be removed or installed in a few seconds.
- Hyperbolic connector front receptacle with lock facilitates easy head attachment.
- Lightweight, air cooled heating head - 2.5"L x 2.25"W x .92"H - Weighs only 4 ounces.
- Custom Head Sizes available.
- Internal head temperature control with alarm prevents overheating of heating head.
- Duty cycle up to 50% with auxiliary air cooling attached.
- Heating times to 500°F as low as 1.5 seconds.
- KW output signal to monitor operating power.

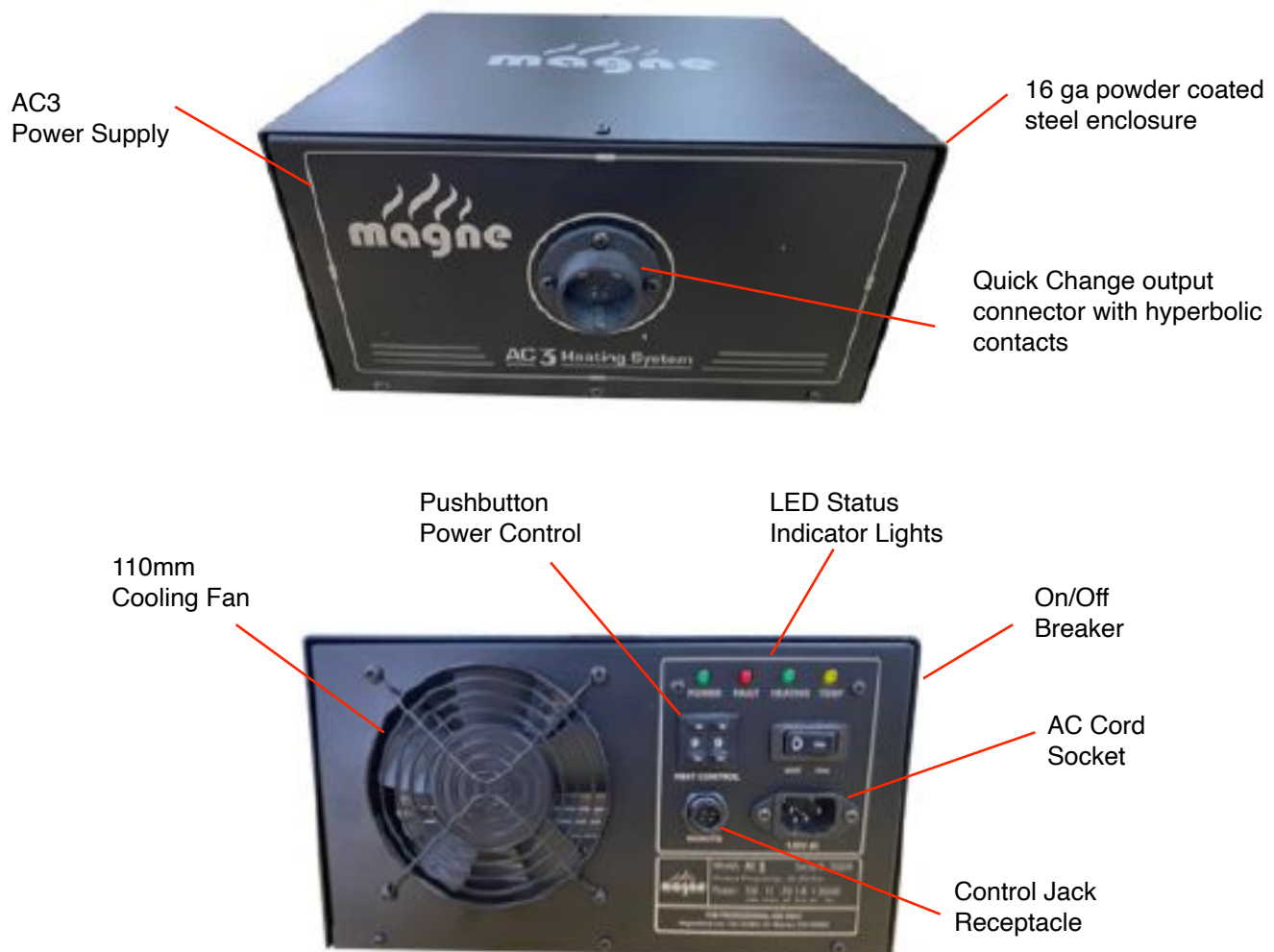
2. **MAGNE** Induction Power Supply

The Magne AC3 induction power supply is a solid state high frequency electromagnetic heater that operates at a maximum power of 1200 watts at an output frequency of 35 khz. It operates on standard 115V 50/60hz power. With a maximum power draw of 15 amps it can be plugged into any standard outlet. The power supply is air cooled and incorporates a 110mm cooling fan located at the rear of the enclosure. The unit is a small and lightweight, weighing 20#. It is housed in a rugged powder coated steel enclosure.

Standard features of the power supply include a rear mounted control panel with on/off circuit breaker, LED indicator lights for POWER ON, FAULT, HEATING and TEMPERATURE. Also included on the control panel is a precision 2 digit pushbutton power control potentiometer and a 4 pin operating jack that enables remote on/off control and also provides a 0-5 Vdc signal proportional to operating power to enable monitoring heating operation.

Other features include power tracking that delivers constant preset power with varying input voltage, internal amperage control, a fast trip semiconductor fuse to protect internal components and temperature control circuitry to monitor the temperature of the heating head.

The power supply also incorporates a unique, plug in connector mounted on the front of the unit. This connector utilizes high amperage hyperbolic contacts with integral locking feature that allows connection or replacement of the output head in a matter of seconds. It includes additional contacts to prevent heating unless the output head is properly plugged in and also to connect to the temperature sensor inside the heating head.



3. **MAGNE** Heating Head

The Magne heating head assembly concentrates the electromagnetic field produced by the power supply into a small, focused area for heating the parts. The assembly consists of the heating head with standard .62 ID central hole for the insert, a 36" long power lead with nylon convoluted tubing protective covering and a custom quick connect power plug for connection of the head to the power supply. The heating head weighs less than 4 ounces. The complete assembly with head, cable and connector weighs less than a pound.

The heating head is constructed using high temperature litz wire encapsulated with thermally conductive epoxy and a nylon outer housing. Due to the high amperage that needs to be conducted in order to generate the magnetic field required to heat the inserts, the head will heat up with use. For low duty cycle applications where there is a significant lag time between parts due to fixturing and other requirements, the head can be operated as is without additional cooling.

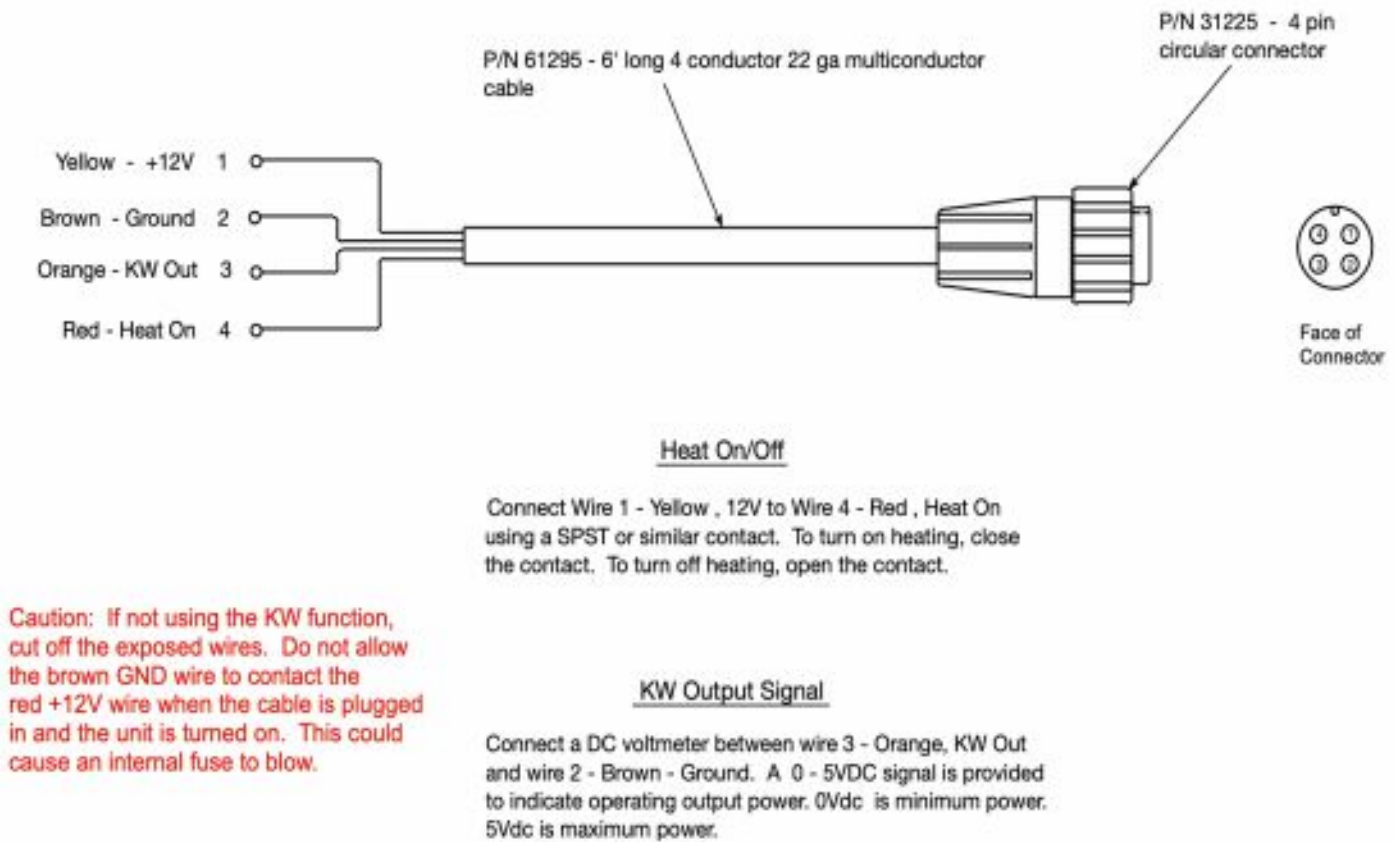
For higher duty cycle applications, an auxiliary air supply of 20-30 psi can be attached to the head. Cooling air is then circulated through the nylon outer housing and around the encapsulated litz wire to reduce the temperature of the head. This allows operation at duty cycles of up to 50% (e.g. 3 seconds heating/ 3 seconds off) which is satisfactory for most all applications. Actual duty cycle and heating times depend on the material and size of the part being heated. More information is provided in Section 7.

The heating head includes a temperature sensor embedded into the encapsulated litz wire core. This temperature is monitored by control circuitry inside the power supply. If the temperature of the head exceeds a preset temperature, the TEMP light on the rear of the power supply will turn on and an audible alarm will sound. Heating will be disabled. The temperature of the head has to drop below the preset temperature before heating can be continued. The heating head connector also includes an interlock where heating cannot be activated unless the head is properly plugged into the receptacle on the power supply.



4. Setup

- Locate the power supply in a clean, dry location. If the power supply is to be attached to a fixture, use the 4 8-32 threaded mounting holes located on the bottom plate. (See Sect.10).
- Make sure to leave at least 6" open area around the fan at the rear of the unit and the exhaust holes on the right side of the unit for proper air flow.
- Connect the control cable to the 4 pin jack on the rear of the power supply as shown in the figure below. Connect the wire leads to a SPST dry contact operator is req'd for heating on/off. Connect the KW signal wires as shown, if needed. If this signal is not going to be used, cut off the wires to prevent the chance of shorting them together.



CAUTION:

DO NOT PLUG IN THE HEATING HEAD WHEN THE POWER SUPPLY IS TURNED ON. TURN OFF POWER BEFORE PLUGGING OR UNPLUGGING THE HEATING HEAD.

4. Setup (cont'd)

- Plug in the heating head into the receptacle on the front of the power supply. To plug in the head, align the notch on the plug and push the plug in all the way. Do not force and make sure all pins are aligned properly. Make sure that it is firmly seated.



When the plug is fully inserted there should be approx. a 1/8" gap between the plug and the receptacle.



- Mount the heating head as required using the 4 corner holes in the head housing.

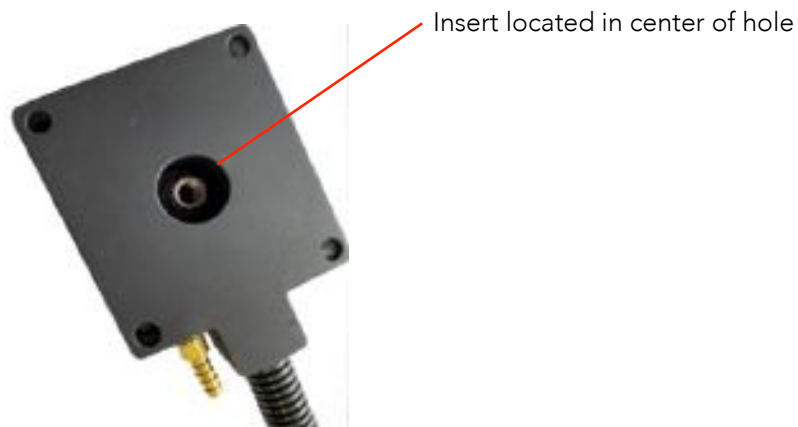
NOTE: When mounting the head, use only 6-32 or smaller 316 stainless steel or nylon screws. Larger screws or steel screws may inadvertently heat up.

NOTE: Do not mount the heating head directly against metallic materials, particularly magnetic steels. If mounted too close, these materials will be heated and it will affect heating the inserts. Maintain a minimum clearance of 1/2" for aluminum or non-magnetic stainless and 3/4" for magnetic steels.

4. Setup (cont'd)

- Plug in the power supply to a 115V outlet.
- If required, connect a clean, dry 20-30 psi air source to the tube fitting on the heating head. Use 3/16" ID tubing.
- Set the desired heating power level using the pushbutton pot on the rear of the power supply between 0 (minimum power) and 99 (maximum power).
- Turn on the power supply via the on/off circuit breaker switch on the rear of the unit. The green POWER LED will turn on.
- The system is now ready for heating.
- Place the insert into the center of the heating head.

NOTE: The part should be held firmly in position inside the heating head. If not, the magnetic field may cause it to move during heating. The materials used to locate and hold the part must be non-magnetic and surface contact should be kept to a minimum. Materials with low thermal conductivity are preferred to prevent heat sinking the parts and causing longer heating times.



5. Heating

- Initiate heating by closing the SPST contact connected to the control cable. A maintained closure is required.
- The green HEATING light on the rear of the unit will turn on indicating that the unit is heating. The part will begin to heat.
- Open the switch to stop heating. Do not maintain heating for a period over 10 seconds.

7. Duty Cycle

The Magne AC3 heating system does not require water cooling. Both the induction power supply and the heating head are air cooled. In order to provide effective heating, output current of up to 40 amps is delivered to the heating head from the induction power supply. Due to this high current requirement, the operation of the system must be duty cycled.

The heating head incorporates an imbedded NTC thermistor to monitor its' internal temperature. If the temperature exceeds 195°F an alarm will go off and heating will be disabled until the head temperature goes down. This is to prevent possible damage to the head due to overheating and eliminate any potential fire hazard.

The actual duty cycle depends on the size of the part being heated, the material and the set heating power. Steel and magnetic stainless steel parts will heat at a lower amperage than brass or 316 stainless parts and the duty cycle will be higher. To help maximize the duty cycle the Magne AC3 heating head can be air cooled by connecting a 20-30 psi compressed air supply to the air fitting located at the rear of the heating head. The addition of air cooling can significantly improve the duty cycle.

Without air cooling, the system can still be operated for many heating cycles. The actual number before the head gets too hot depends on duty cycle, type of part and power level. Estimated duty cycles for a typical steel part and temperature rise of the head are illustrated in the charts and graphs on the next pages as follows:

CHART 1. Steel part heated at 1200 watts power for 30 cycles. Duty cycles of 3s ON/3s OFF and 3s ON/10s OFF with air cooling attached (A) and without air cooling (NA)

CHART 2. NO insert heated. This represents the worst possible heating condition. Graph shows heating at a duty cycle of 3S ON/10S OFF at 50% and 99% power with auxiliary air attached and without air.

As shown in Graph 1, steel parts can typically be heated without additional air cooling, particularly at a lower duty cycle. Air cooling may be required for shorter duty cycle or long term operation.

Graph 2 is shown only to illustrate the worst possible operating condition. Without an part in place in the heating head, it will over heat rapidly. Do not operate the system without a part in the heating head.

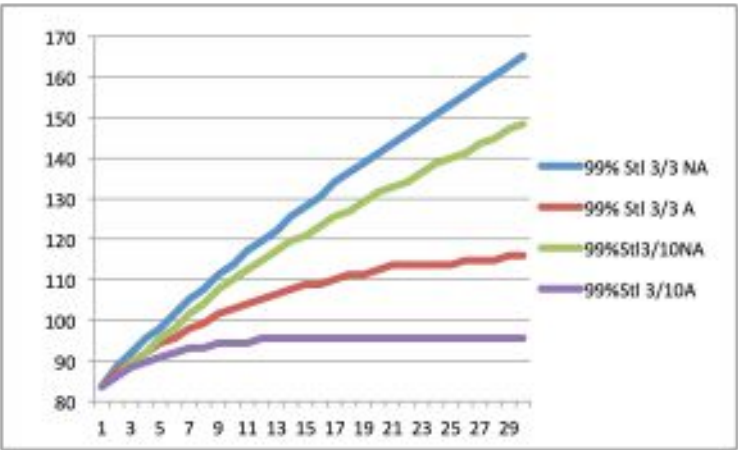
7.1 Heating Head Temperature Rise - Steel Part

The internal temperature of the heating head will increase based on the number of heating cycles, duty cycle, material being heated and whether or not air cooling is connected to the head. The data and graph below show the head temperature (°F) vs number of cycles at 99% heating power at duty cycles of 3 seconds on/ 3 seconds off and 3 seconds on/ 10 seconds off.

For the trials where air cooling was coonected, a 30 psi air source was used.

Chart 1 . Steel part heated at 99% power for 30 cycles.
Duty cycle 3s ON/3s OFF and 3s ON/10s OFF without air cooling (NA) and with air

	99% Stl 3/3 NA	99% Stl 3/3 A	99%Stl3/10NA	99%Stl 3/10A	
1	83.6	83.6	83.6	83.6	
2	88.4	87.2	86	86	
3	92	89.6	89.6	88.4	
4	95.6	92	92	89.6	
5	98	94.4	95.6	90.8	
6	101.6	95.6	98	92	
7	105.2	98	101.6	93.2	
8	107.6	99.2	104	93.2	
9	111.2	101.6	107.6	94.4	
10	113.6	102.8	110	94.4	
11	117.2	104	112.4	94.4	
12	119.6	105.2	114.8	95.6	
13	122	106.4	117.2	95.6	
14	125.6	107.6	119.6	95.6	
15	128	108.8	120.8	95.6	
16	130.4	108.8	123.2	95.6	
17	134	110	125.6	95.6	
18	136.4	111.2	126.8	95.6	
19	138.8	111.2	129.2	95.6	
20	141.2	112.4	131.6	95.6	
21	143.6	113.6	132.8	95.6	
22	146	113.6	134	95.6	
23	148.4	113.6	136.4	95.6	
24	150.8	113.6	138.8	95.6	
25	153.2	113.6	140	95.6	
26	155.6	114.8	141.2	95.6	
27	158	114.8	143.6	95.6	
28	160.4	114.8	144.8	95.6	
29	162.8	116	147.2	95.6	
30	165.2	116	148.4	95.6	



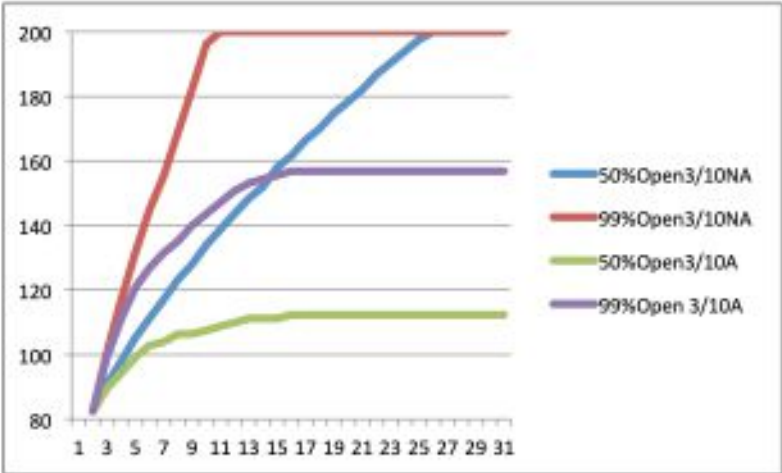
7.3 Heating Head Temperature Rise - No Part in Head

Chart 3 . No insert in coil. Duty cycle 3/3 and 3/10 without air cooling (NA) and with air cooling (A) at 50% power and 99% power

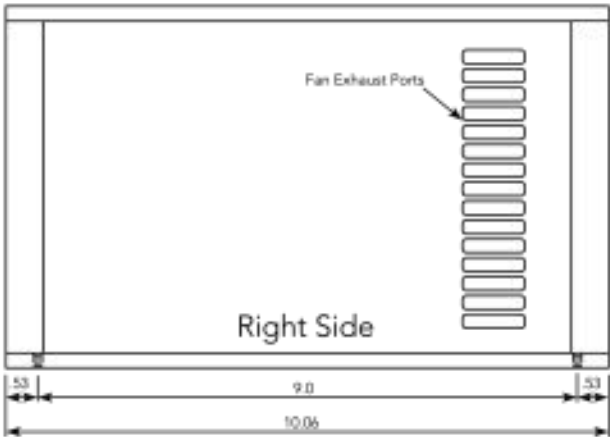
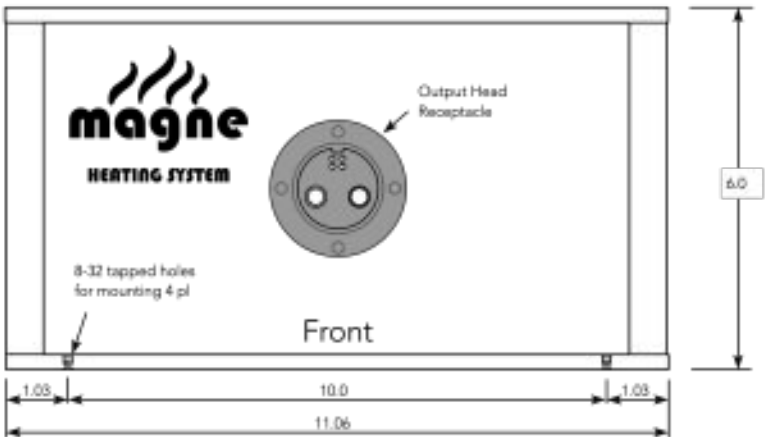
Cycles

°F

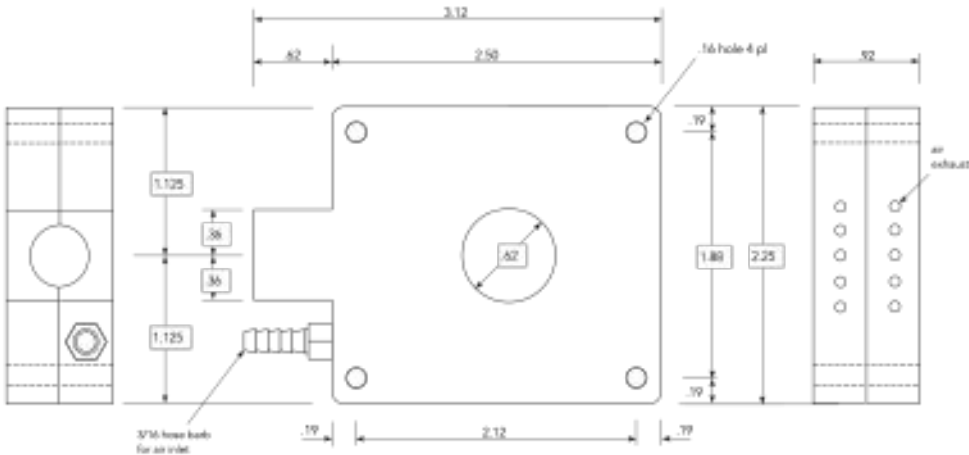
	50%Open3/10NA	99%Open3/10NA	50%Open3/10A	99%Open 3/10A
1	82.4	82.4	82.4	82.4
2	90.8	100.4	89.6	99.2
3	98	117.2	94.4	111.2
4	105.2	131.6	99.2	120.8
5	111.2	144.8	102.8	126.8
6	117.2	155.6	104	131.6
7	123.2	168.8	106.4	135.2
8	128	182	106.4	140
9	134	196.4	107.6	143.6
10	138.8	200	108.8	147.2
11	143.6	200	110	150.8
12	148.4	200	111.2	153.2
13	152	200	111.2	154.4
14	158	200	111.2	155.6
15	161.6	200	112.4	156.8
16	166.4	200	112.4	156.8
17	170	200	112.4	156.8
18	174.8	200	112.4	156.8
19	178.4	200	112.4	156.8
20	182	200	112.4	156.8
21	186.8	200	112.4	156.8
22	190.4	200	112.4	156.8
23	194	200	112.4	156.8
24	197.6	200	112.4	156.8
25	200	200	112.4	156.8
26	200	200	112.4	156.8
27	200	200	112.4	156.8
28	200	200	112.4	156.8
29	200	200	112.4	156.8
30	200	200	112.4	156.8



8. Component Dimensions

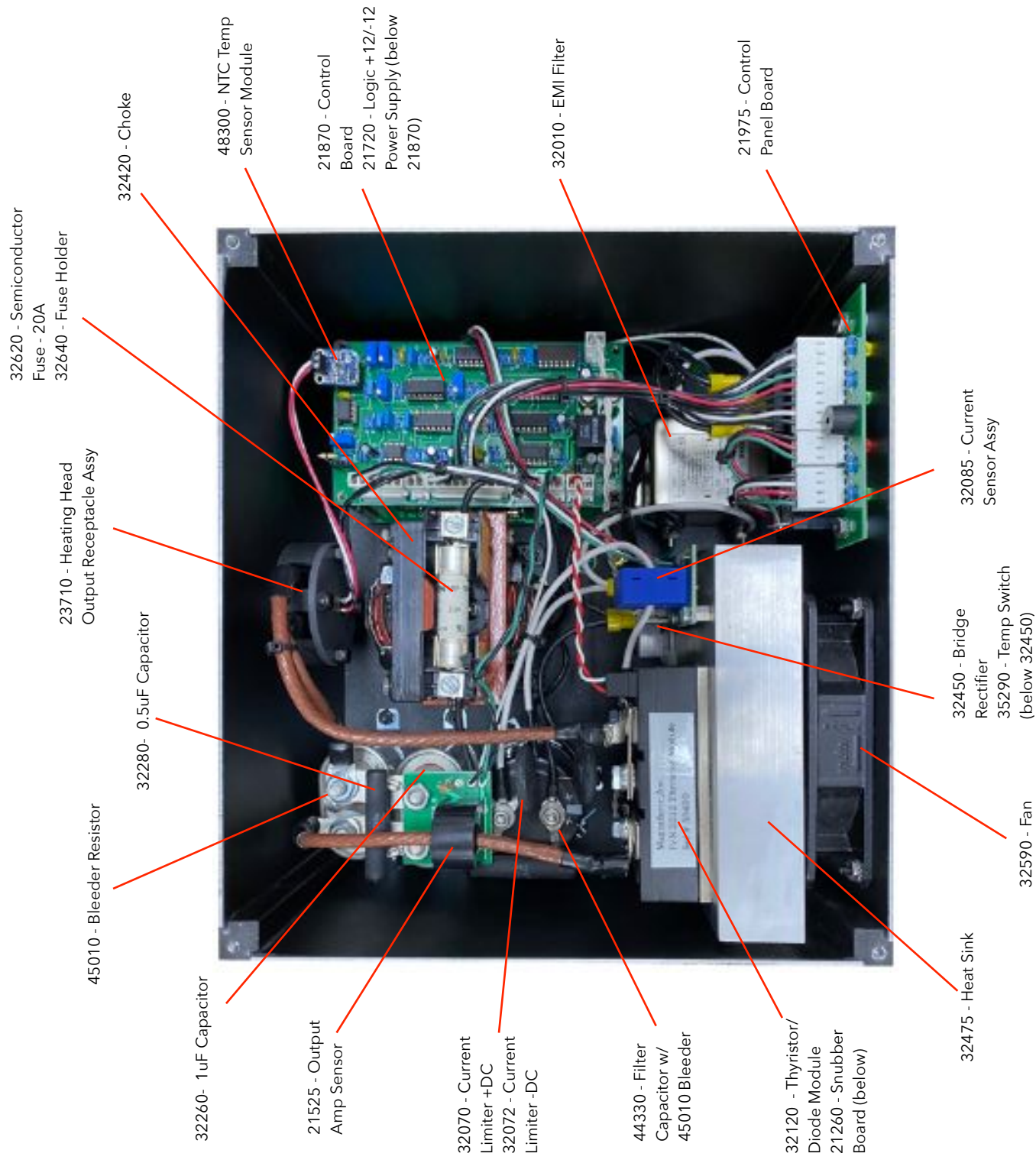


Induction Power Supply - 11" x 10" x 6" - 20#



Standard Heating Head - 2.25" x 2.5" x .92" - 4oz

2c.. Interior Component Layout





MAGNEFORCE

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