



PRECISION
INDUCTION HEATING EQUIPMENT

OPERATION AND
MAINTENANCE INSTRUCTIONS

EASYHEAT
LI

4.2kW – 10kW Induction Heating Systems
LI Models 3542, 4048, 5060, 7590, 8310

File Name	801-9526-00.doc
Part Number	801-9526
Revision	P
ECN#	1501-33
By	S. Nelson
Approved	

Date	01/19/2015
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Revisions:

- Rev J: Add Auxiliary Output feature content
- Rev K: Correct specifications (physical and electrical)
- Rev L: Correct RS485 communication kit information. Correct bend radius measurement specification.
- Rev M: Added SmartBurst content. Added Regulation, Efficiency and Power Measurement content.
- Rev N: Added WEEE disclaimer content
- Rev P: Added electrical warning to p68. Corrected contact information.

**Ambrell Companies**

Ambrell
www.ambrell.com
+1.585.889.9000

Ambrell Ltd.
www.ambrell.com
+44 (0)1242 514042

Ambrell B.V.
nl.ambrell.com
+31 (0)88-0150100

Ambrell Sàrl
fr.ambrell.com
+33 (0)970 440 335

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Notes:

In this manual, these symbols indicate:



a step in a procedure



manual sections



lighted indicators on the equipment



A notice that requires your special attention; may pertain to **safe operation** of the equipment



A notice that requires your special attention due to **potential hazards** to personnel or property



1 Introduction

Your EASYHEAT is a solid-state induction heating system that converts three-phase line voltage to 4.2, 6, 9 or 10kW terminal power output (depending on model) over a range of radio frequencies (RF) and voltages. This energy is delivered to a remote series-resonant circuit - including your coil - where a precisely controlled magnetic field is created around your work-piece. Available power to your process depends on the coupling efficiency of your coil due to its geometry and proximity. Efficiency also depends on the properties of your part; induction heating generally couples more efficiently to magnetic steel and graphite parts than it does to non-magnetic stainless steel, aluminum and copper.

Special features

Your EASYHEAT simplifies and improves your heating results with:

- Touch-pad interface for control and programming
- Backlit LCD simultaneous display of up to four data fields
- Analog output – user programmable to represent Coil current, RF power or operating frequency
- electrically isolated remote work head

The power from your supply can be controlled:

- manually from the front panel
- remotely by your signals provided to the rear panel
- remotely through a configurable serial port
- from one of four 5-step profiles you specify

This selection is made from the touch-pad and can be changed at any time.

Unpacking

Your Ambrell EASYHEAT induction heating system has been carefully packed to arrive at your facility in good condition. We suggest you inspect the shipping carton in the presence of the carrier when the unit arrives at your facility. Look for dents, crushed corners or torn cartons.

YOU MUST REPORT ALL DAMAGE DIRECTLY TO THE CARRIER.

✓ Check to see that all the parts we shipped arrived at your plant with your manual:

- EASYHEAT power supply
- remote work head with cable
- reference coil, attached to mounting blocks
- this manual

If you note damage, do not discard any of the exterior packing cartons; retain the carton(s) so that the carrier's claim agent may inspect it. We will assist you in filing a claim against the carrier should it be necessary to do so.

1.1 Safety Considerations

Your EASYHEAT uses RF energy to raise the temperature of your work-piece. Most of this RF energy is transmitted into the work-piece and some is transmitted into the air.



Electrical installations must be made by a qualified electrician and must conform to applicable safety codes.



The equipment requires a connection to earth ground and does not make use of neutral. Failure to connect earth (safety) ground will result in a potentially hazardous condition. Do not omit this step!

Physical Risks

During the ★HeatOn cycle, high RF voltages are present at your work-coil. There are several risks, which we instruct you to protect against:



- **High Temperatures:** take steps to prevent personal contact with the work-piece you are heating. Severe burns can result from contact at these temperatures! The mounting frame on the bottom can heat during normal use, mount work-head to non-flammable surface, and do not touch until cooled.
- **RF Voltages:** we recommend that you provide protection against personal contact with the work-coil when it is energized (★Heat On).
- **Induction burns:** the energized work-coil causes nearby metals to become heated; **DO NOT APPROACH ENERGIZED WORK-COIL WHILE WEARING OR CARRYING METAL OBJECTS!**
- **Electric and magnetic fields (EMF):** EMF can affect Implanted Medical Devices. Implanted Medical Device wearers should consult their doctor and the device manufacturer before going near induction heating operations.

Safety Circuits

Your optional normally-closed E-stop switch can be connected to the rear terminal block; when the switch opens, output power is hardware-stopped. When the switch is re-closed, the power supply returns to ★ Ready (non-hazardous state). Your E-stop switch must be isolated (dry-contact), capable of switching 0.1A @24Vdc.

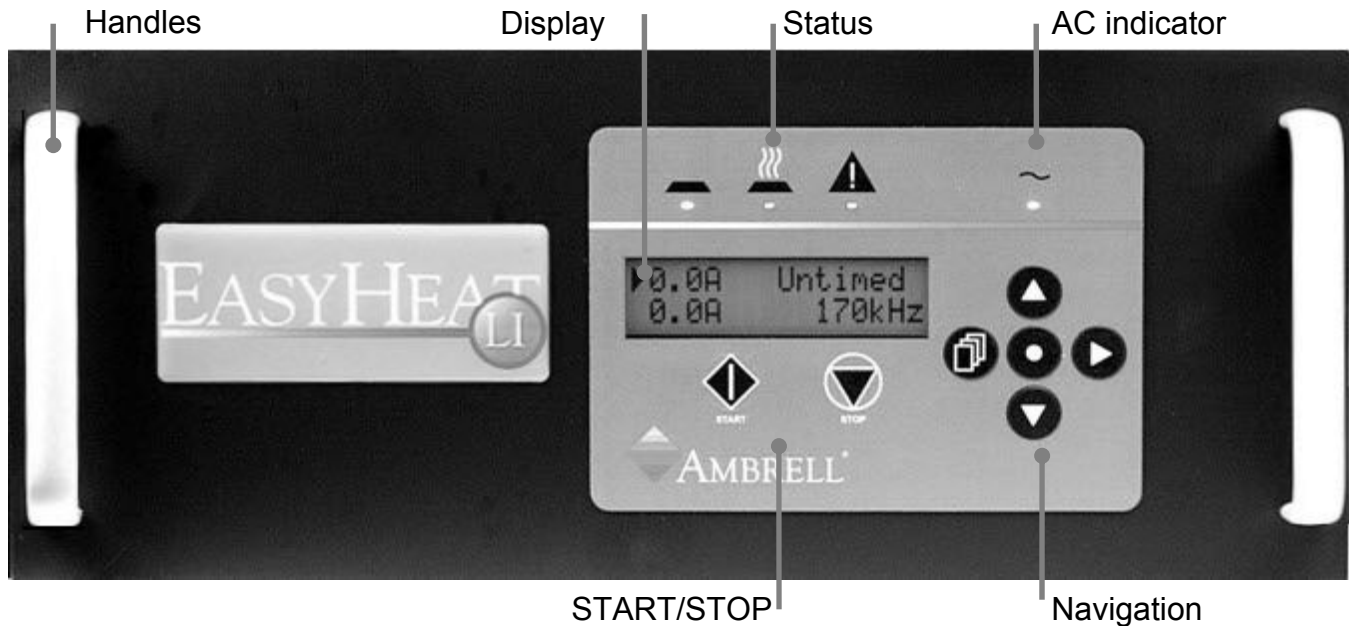
The power supply is fitted with an external rear panel jumper which must be removed to insert any safety switches required.



Class A equipment is intended for use in industrial environments. There may be difficulties in ensuring electromagnetic compatibility in other environments due to conducted and/or radiated disturbances.

Group 2 equipment intentionally generates radio frequency fields for the treatment of materials

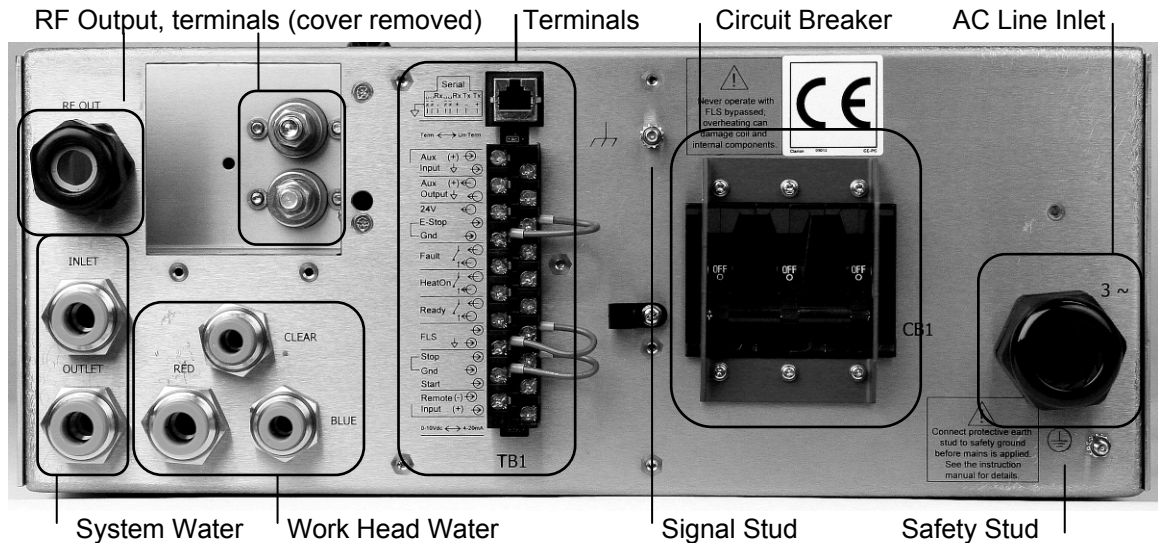
1.2 Front and Rear Panels



Touch-pad & Display

All user-interface is conducted here

- Status LEDs indicate what your EASYHEAT is doing
- AC indicator is lighted when unit is turned on
- LCD display provides operating information, navigation/programming prompts
- START/STOP buttons enable front panel control of heating
- navigation buttons are used to program and control the unit



RF Output, Water

The remote work head attaches here. A specially-designed cable conveys RF energy to the work head while plastic tubing routes cooling water to the coil (CLEAR), to the capacitors (BLUE) and from (RED) the entire work head.

Your EASYHEAT uses circulating water to cool internal components and the coil; inlet and outlet connections for the entire system are made at the rear. Internal flow switches and temperature sensors are used to interrupt heating operations if this flow is inadequate and are used to reduce heating if the internal temperature rises too high. Cooling water is directed to and from the work head through the chassis and monitored by the power supply.

Circuit breaker

This gang-switch controls the mains connection to the power supply. Trip level may vary by model; see §4.

AC Line Inlet

This strain-relief fitting secures the provided 4-wire AC mains cabling.

Terminals (TB1)

Electrical connections are made here for all input and output signals (§3).

Grounding Studs

Safety Stud: Ensure that this auxiliary protective earth is connected to your facility safety grounding before applying AC power.

Signal Stud: For signal grounding connections; **not for equipment safety ground connection!**

1.3 Work Head

The energy generated by the power supply is converted at the work head to a form you can use. The work head is comprised of an enclosure, a transformer, capacitor(s), coil (sample coil shown) and required wiring. See §3 for instructions to change your transformer tap settings.

Water is directed through the work head to draw-out excess heat developed naturally in the internal components.



In cases where your coil presents a very restrictive path for the cooling water, we may recommend the use of a 'bypass-block', §3. This may also require the use of an external flow switch. (Ask your sales representative) Wiring must then be brought back to the power supply from this switch.

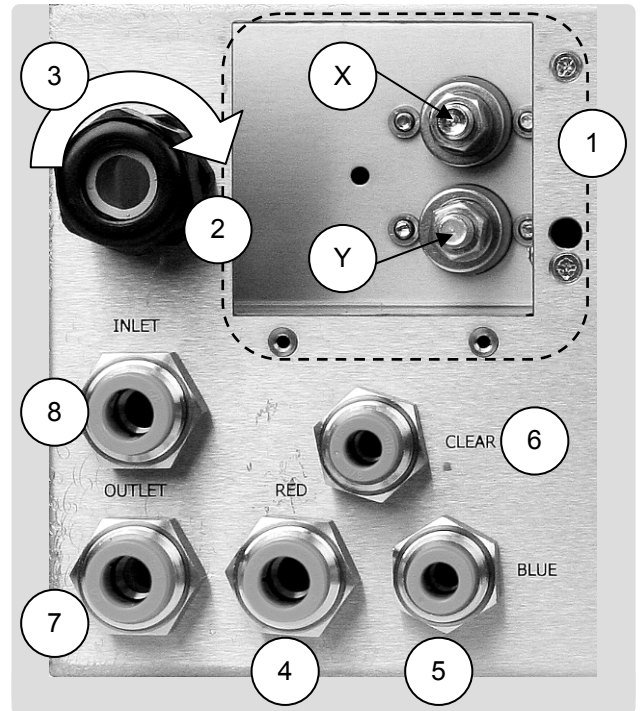
1.4 Assembly

Take these factors into consideration as you determine where to install your system:

- availability of water and drain
- availability of 3Ø AC power

Attach work head & water

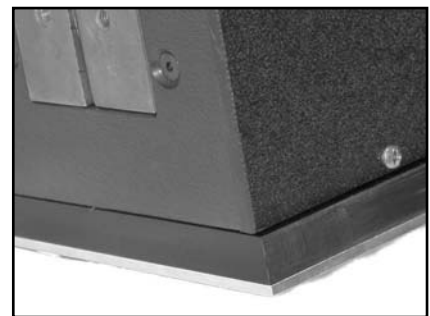
- ✓ ① remove RF cover (dotted)
 - ✓ ② insert ring-terminated cable pair from workhead; secure two ring-terminated connection at posts as labeled
 - ✓ ③ tighten strain relief nut
 - ✓ ④ insert RED tube from work head
 - ✓ ⑤ insert BLU tube from work head
 - ✓ ⑥ insert CLEAR tube from work head
 - ✓ ⑦ insert tubing for water outlet fully into bottom port
 - ✓ ⑧ insert tubing for water inlet fully into top port
 - ✓ replace RF cover
- ...to remove tubing
- ✓ push in on retaining rings, pull out tubes



Work head mounting base options

Your work head has been fitted with a two-part mounting insert, which elevates and insulates the bottom of the unit from your metal tabletop or mounting fixture, reducing the amount of secondary heating you might experience under certain sustained operating conditions. Secured with four M6 nylon screws, this base can be utilized or omitted in your mounting scheme. To mount:

- ✓ remove nylon screws. Replace with four M6 stainless steel screws long enough to pass through your mounting surface and into the work head mounting base.
- To prevent mounting screws from accidental contact with electrical componentry, use screws which only thread into the mounting base up to 12.7 mm (0.5 in.).



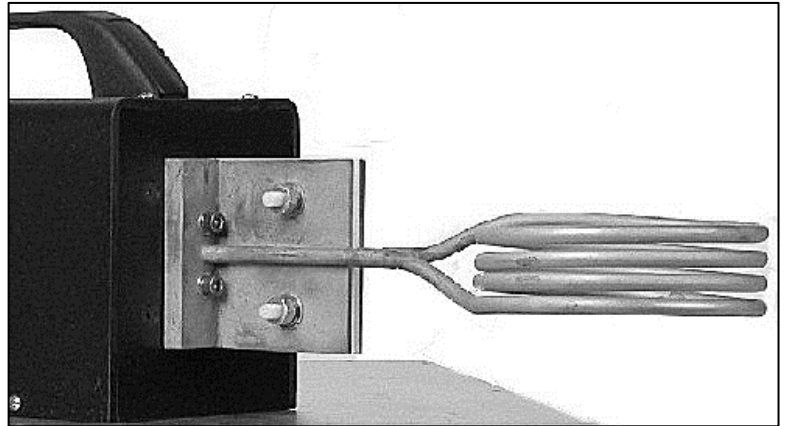
Longer screws will damage equipment and pose an electrical hazard.

Work-coil or reference coil (included with the unit)

A reference coil is included with your work head to ensure basic operation; while it is suitable for use in heating, another coil may have been ordered for your use.

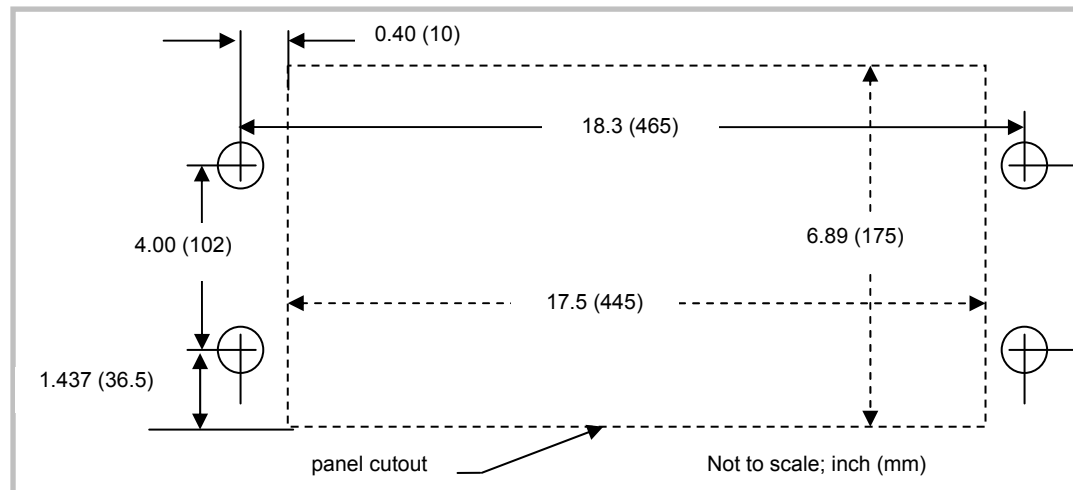
If you are attaching your own coil:

- ✓ use 4mm Allen key to remove the 4 screws securing the reference coil
- ✓ remove reference coil and retain 2 O-rings from coil mounting plate
- ✓ re-use or use new O-rings [PN 117-0021]; insert in recessed face of work head
- ✓ secure coil with 4 screws provided; tighten



Rack/panel Mounting

Your EASYHEAT is mountable in your panel or 19" rack (4U); observe these steps and requirements:



- ✓ unscrew/remove 4 rubber feet on unit base
- ✓ (panel) provide cutout and mounting pattern per above; plan for M5 or M6 screws
- ✓ ensure that rear of unit is supported when mounted
- ✓ provide at least 736mm (29") depth to permit water and AC power cable bend
- ✓ secure unit with M5 or M6 hardware

Cooling water

In the process of heating your work-piece, the current flowing in the work head and power supply heats components, too. EASYHEAT provides a means of directing fresh water into and through the components, enabling the water to pick-up the excess heat and transfer it, either to a drain or to a heat exchanger which will then be recycled back to the equipment.

✓ Follow these important restrictions:

- If used, fill re-circulating system with distilled or clean tap water
- Do not use de-ionizing water systems
- Do not use inhibited glycols in concentrations over 10% by volume as anti-rust or anti-freeze agents; these agents reduce efficiency of cooling.
- (If cooler is not supplied by us) Install a pressure regulator and a particulate matter filter (both non-ferrous) in the supply of your cooling water.
- Do not use ferrous pipe; it can lead to serious equipment damage!

✓ Establish a cooling water source capable of adequate differential pressure and flow (see §4.4)...

✓ Provide inlet and outlet water per instructions §1.4

Flow monitoring

The amount of water flowing through your equipment is monitored, since operation with inadequate or absent cooling water can result in damage to the coil or capacitor. When flow is adequate to the heat sink and to the coil – see §4 – two internal switches are closed. When flow falls off to the heat sink or the coil, one or both of the switches open and the power supply senses it, halts RF power and indicates ★Fault.

✓ No action required by you; internal connections.

1.5 Installation



Electrical installations must be made by qualified personnel and must conform to applicable safety codes.

Do not connect 230V models to 440V mains; damage and hazard will result!



The equipment requires a connection to earth ground and does not make use of neutral. Failure to connect earth (safety) ground will result in a potentially hazardous condition. Do not omit this step!

Mains service



We recommend that you install a fused disconnect switch (not supplied by Ambrell) in the branch circuit supplying the equipment. Base your selection of fuses on the equipment nameplate data.

- ✓ Plan a 4-wire routing for **three phases and earth ground**
- ✓ Determine appropriate disconnect fusing and wire gauge
- ✓ Place the disconnect near the power supply and in sight of the operator

Mains connection

- ✓ ensure fused disconnect is opened
- ✓ connect the provided AC mains cable to your 3-phase source and [GREEN] safety ground.

Re-selecting Mains Voltage

The equipment labelling indicates the mains voltage range for which your system has been configured. If you have a need to move the system into a facility with a different mains voltage range, follow the instructions in §3.6



Your system has been sealed (circle); if the seal is damaged, internal mains voltage range settings may have been changed; verify this setting before connecting to AC mains power. This label (arrow) indicates sealed mains voltage range. We provide one set of replacement seal and voltage range label.



Start-up display

You are ready to apply power to the EASYHEAT

- ✓ turn on water to your system
- ✓ turn on fused disconnect supplying your system
- ✓ turn on circuit breaker at rear of EASYHEAT
- ✓ ensure appropriate line voltage selection in **Control** settings (§2.2)

Upon power-up, certain important information about your EASYHEAT is displayed:

Output power capability: Depending on the unit you purchased.	EASYHeat 5060 6kw RF Power
Language Suite; your system display is equipped with a selectable 5-language suite: EN/ES//FR/DE/IT; this capability is reflected in this screen	440-520 VAC EN/ES/FR/DE/IT
Firmware versions: There may be instances where we need this information from you. n.nn represents the version numbers of the Display or Main firmware	Display: Vn.nn Main: Vn.nn
SYS ID #: Is used to connect to remote monitoring software. Refer to § 3.4 for more information on eVIEW Induction Heating Software	SYS ID #: nnnnn
You can also view the output power capability screen, Language Suite screen and firmware versions screen when the unit is ON; while in the Control Zone , §2.2, press ▲ to repeat the Start-up display screens	

The next section explains what you see when the unit is operating in the **Home** zone.

2 How Your EASYHEAT Works



When you turn ★HeatOn, (details, next page) this equipment concentrates an electromagnetic field within the coil diameter. When you put your metal part into the coil, this field causes internal electric currents to circulate in your part. Friction from these currents heats your part.

With ★HeatOn, both Setpoint (your selected output level) and Output Level (actual power or current delivered to your part) are displayed. Typically, the Output Power (kW) is highest when your part is in the coil and it returns to a lower level when you remove your part; output current (A) is normally held as set. (For detailed explanations or to understand operation that is not typical, see §2.3)



LED Status and system notices are relevant if your **part is in the coil during ★HeatOn**. Status and notices displayed after you remove your part can be ignored

This equipment is designed to operate simply. This section presents EASYHEAT operation in two parts:

- **Home** zone: your EASYHEAT operates in this zone when you first apply power. The factory settings enable you to get right to work heating parts by operating the front panel. From the Home zone, you can adjust output levels, set the timer and turn RF power on and off. Simple heating jobs may never require you to use features outside this zone.
-  **Control zone:** press this button to make use of the full set of EASYHEAT capabilities by changing any of the operating characteristics. Refer to §2.2 to customize your EASYHEAT.
-  **Return:** pressing this button always returns display to the Home zone

Next is a simple example of operation from the Home zone. In it you will operate your EASYHEAT by:

- starting from the front panel
- using 2-button **START** (requires **STOP** to turn off heat)

(Other operating characteristics are discussed in the Control zone section.)

After this example, the front panel display, LED and touch-pad features are explained. The Control zone is explained in detail in the next section.

2.1 Home Zone

When you turn it on, EASYHEAT operates in the **Home** zone (illustration). Within this zone, you can adjust output levels, set the timer and turn RF power on and off:

Home Zone Display

Status LEDs

indicate what your EASYHEAT is doing:

READY: waiting to heat; no faults detected

HEAT ON: power is being output

FAULT: heating interrupted, fault detected

Timer

cycle or continuous

Setpoint

required output level

Output level

(A, W, % or units)

Output frequency

AC Power

indicates your EASYHEAT is turned on

Navigation

to program and configure

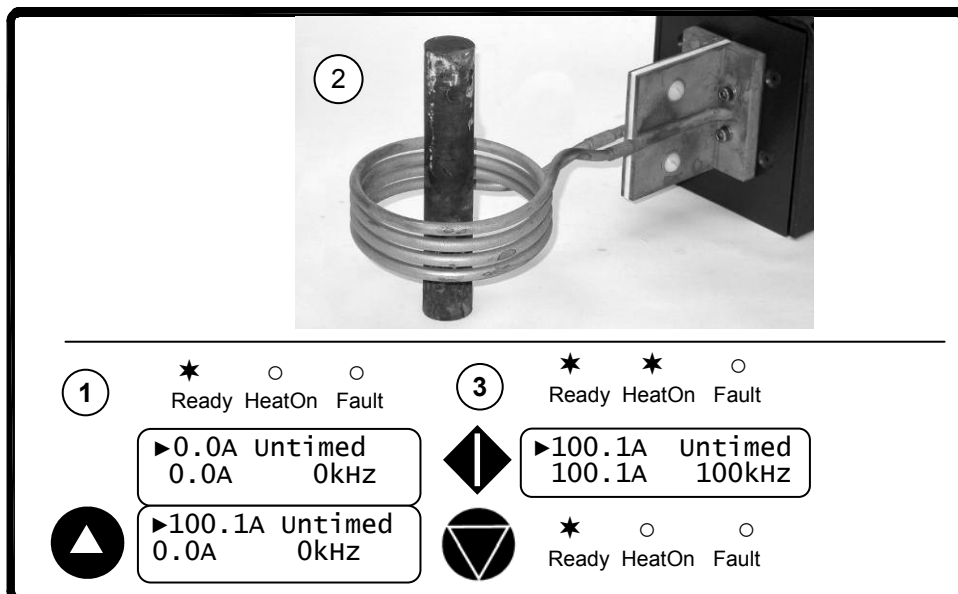


START/STOP

to initiate heating from front panel

Simplest example...

In this example, you heat the part at 100A output.



Do this...	Observe...
✓ open water-valve for the system	check drain; ensure water is flowing
✓ check the work-coil	ensure there is no work-piece yet
✓ check condition of (any) safety barriers or limit switches	all safety devices are clear, electrically closed
✓ turn on EASYHEAT	★AC Power and ★Ready LEDs (are ON)
✓ ① note display:	ensure Setpoint is selected (example)
✓ press ▲, adjust until:	100A



Within the **Home** zone, use these buttons to adjust Setpoint and Timer (indicated with the display pointer ►); press once to make a single-step adjustment, or you can hold the button to scroll quickly to a new value.

✓ ② secure unheated part in coil	part not contacting coil; do not hold
✓ ③ press START	★HeatOn, ★Ready
✓ press STOP	★Ready only




Press **START** to begin induction heating (**Home** zone only)
Press **STOP** to halt induction heating (2-button start type, below). STOP signal from front or rear panel always halts induction heating.

✓ remove heated part from coil	avoid contact with heated portions
--------------------------------	------------------------------------

Timed heating...

In this example, you heat the part at 100A output **for 10 seconds**.

Do this...	Observe...
✓ press ►, select Timer	Untimed
 Button is used to move the display pointer from one data field to the next.	
✓ press ▲, adjust until:	10.00s
✓ ② secure unheated part in coil	part not contacting coil; do not hold
✓ ③ press START	★HeatOn, ★Ready ★Ready only , when timer expires (HeatOff
✓ remove heated part from coil	avoid contact with heated portions

Display features



At the top left corner of the screen, this is your desired output level, displayed in RF amps. Larger values result in faster heating or hotter parts.

With the pointer (►) on **Setpoint**, you can increase or decrease the setting with the ▲/▼ buttons.

EASYHEAT works to match the RF output to this setting when the RF power is on (★HeatOn). In the Home Zone, ► moves the cursor between **Setpoint** and **Timer**



At top right, use the timer to control the duration of your heating.

With the pointer (►) on **Timer**, you can increase or decrease this setting to values between 30 milliseconds and 9999 seconds with the ▲/▼ buttons.

The timer begins counting down when you START. To display elapsed cycle time, move the pointer to **Untimed**, then press STOP; elapsed cycle time is then displayed during ★HeatOn. (Ensure: 2button Start §2.2 when using timer!)



At the bottom left corner of the screen, this is the actual RF output (always 0.0 when the heat is turned off).

When the output power is turned on, this displays the output in terms of RF coil power or current. The output level can be shown in RF Amps or RF Watts (press ⊙ to toggle).



At the bottom right corner of the screen, the frequency at which the supply is heating is shown.

This is the resonant operating frequency and is the result of your coil in combination with the work head's internal capacitance. (Note: You cannot 'set' this frequency other than through your selection of heating coil and capacitor.)

When ★Ready after first turning on the EASYHEAT, the frequency is displayed as 0 kHz. During the first heat cycle (★HeatOn), the frequency value shows you what the resonant (most efficient heating) point is. When the heat is turned off, the display will show you where it will begin to resonate on the next heat cycle - based on the recent heating cycle. Sometimes, you may see that the output frequency approaches either end of the operation range of EASYHEAT and the display advises you to increase or decrease capacitance. Please call your Ambrell office for assistance should this happen and we will supply you with the appropriate capacitors.

Status LEDs

This guide will help you understand the operation of your EASYHEAT.



LED Status and system notices are relevant if your **part is in the coil during ★HeatOn**. Status and notices displayed after you remove your part can be ignored



★Ready

EASYHEAT is waiting to heat; no faults detected



★Ready + ★HeatOn

START command received, outputting power per settings. Since both are lit output is within acceptable margins. It may be possible to achieve a more efficient configuration.



for possible suggestion to improve operation; refer to §3.5 for further adjusting instructions



★HeatOn (Limit):

Unit heating, not meeting setpoint



@display; output differs from setpoint by more than 2%
for suggested corrective step(s)

...Ŵ (W overscored); displayed output power is outside a preferred tolerance band. Increase tap for possible improvements

!Cap @display; you are attempting to adjust Setpoint above safe limit for capacitors used.

Limiting may also be due to a requested Setpoint which is above rated maximum, internal air or heat sink temperature exceeding maximum temperature, or temperature exceeding the maximum rated for the capacitors.



★Fault

Heating interrupted; fault detected; correction required



to Control zone, ►Status then for fault notice

★ AC Power; indicates EASYHEAT is ON; * see the Status screen for notices

Touch-panel features

START/STOP

When starting the unit from the front panel, use these buttons to (de)activate heating.



Press **START** to begin induction heating. ★HeatOn (LED) shines and the display is updated with operating data. **START** operates only within **HOME** zone



Press **STOP** to halt induction heating (2-button start type, below). The unit returns to ★Ready state. (STOP signal from front or rear panel always halts induction heating)

Next



Use it to move the display pointer (▶) from one data field to the next. For example, the display first looks like this:

▶0.0A	Untimed
0.0A	*0kHz

To program a heating time, press ▶ once; the pointer is to the left of the 'Untimed' message. Any following adjustments will apply to the timer.

0.0A	▶Untimed
0.0A	*0kHz

Up/Down



Within the **Home** zone, these are used to adjust Setpoint and Timer (indicated with the display pointer).



Within the **Control** zone (below), use the up button to 'replay' the start-up screens (to review firmware version). Use up and down buttons to adjust the RF-Set figures or to display Setup sub-fields.

To adjust Setpoint or Timer, you can press once to make a single-step adjustment, or you can hold the button to scroll quickly to a new value.

Page



From within the **Home** zone, pressing this button moves to the **Control** zone (see map) if the equipment is ★Ready. Pressing page during ★HeatOn displays the internal temperatures and notices.

Within the **Control** zone, this button is used to select and exit the feature fields.

Home



This button takes you back to the **Home** zone, no matter where you have navigated in the touch-pad map.

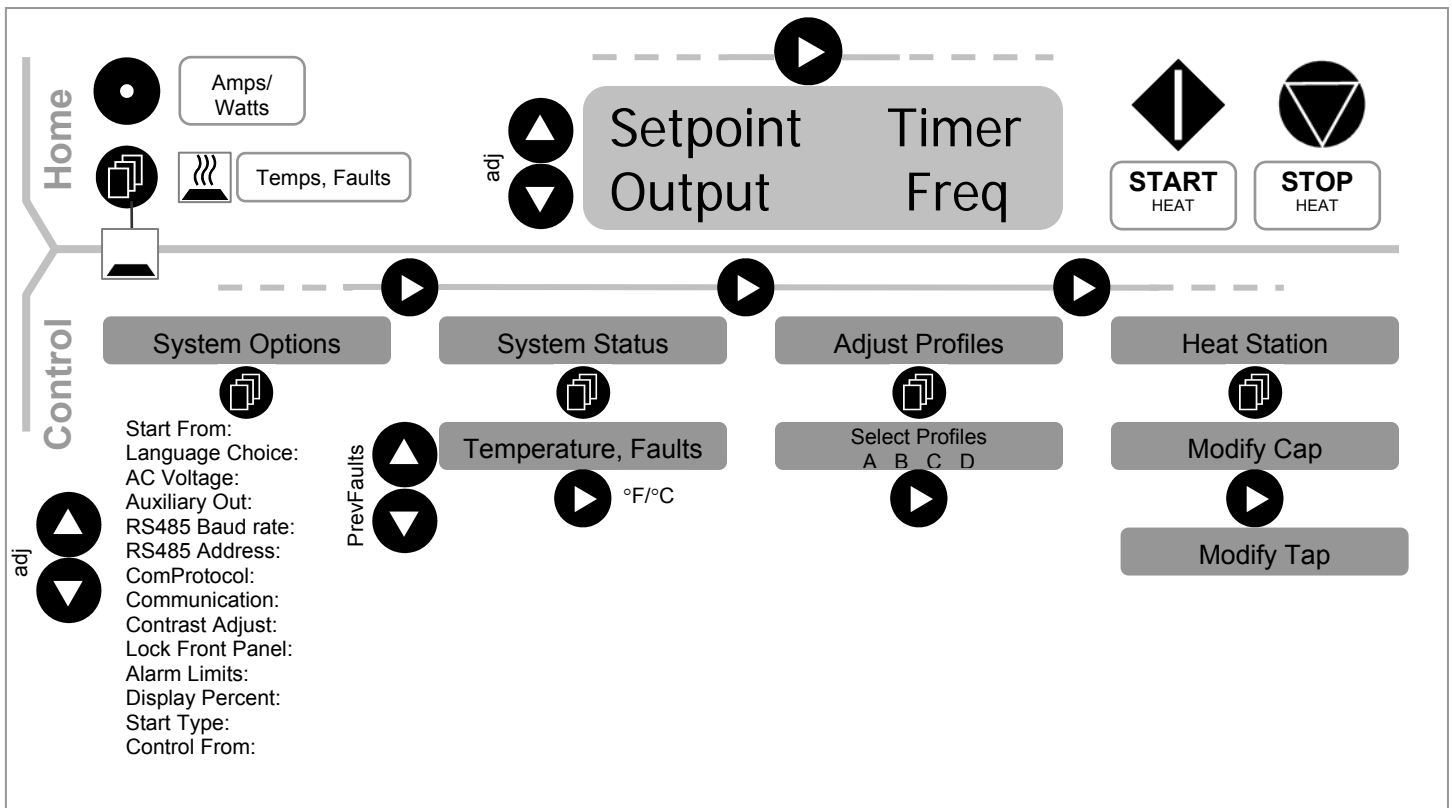
If you are already at the **Home** zone, pressing this button switches between displayed output current (A) and displayed output Watts (W).

Navigation


This map will help you understand operation and programming your EASYHEAT:



Each touch-pad button is represented in the map, showing the effect touching each one has depending on your location in the map



Normal operation is from within the **Home** zone, where you:

- adjust setpoint and timer
- turn RF power on and off
- switch displayed units or
- move to the **Control** zone using 

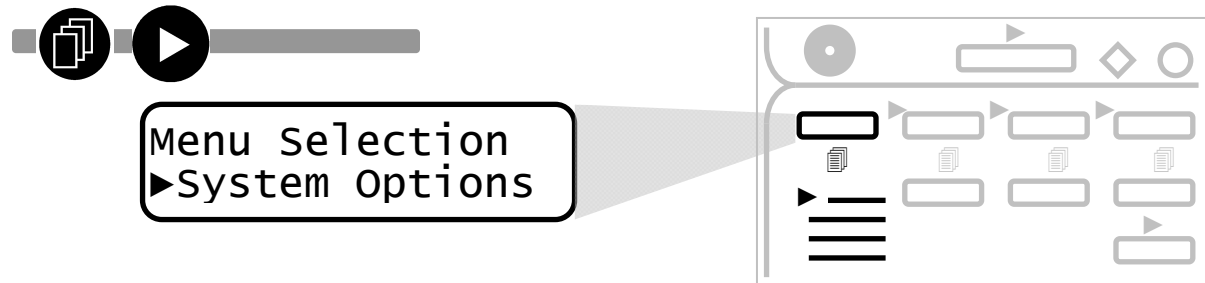
The **Control** zone is where you:


- display and select Setup options (front or rear control, etc., below)
- display Status (internal temperature, ★Fault notices)
- construct and enact heating Profiles
- adjust for RF output stage configuration (tap settings, tank capacitor)

2.2 Control Zone

This is how you review or change operating characteristics of the EASYHEAT. **Control Zone** is accessible only while heat is off.

- ✓ From the **Home** zone, press , the **Control Zone** menu is shown. Use ► to select from 4 sub-menus, detailed below (defaults underlined).



Once this screen is displayed, press ; use ▲/▼ to select operating features; we present the selections starting with the bottom of the list, working up...



Start From

Front: to START heating from the front panel

Rear: you attach your remote signaling source (PLC, relays, etc.) to CTB1 at the rear and START with those signals.

RS485 4 wire: if 'Communication = RS485 4 Wire', below, select this to start heating with serial command (STOP always works from front or rear)

Start from
► Front Panel



Language Choice

English: select arrow for available language(s)

Language Choice
► English



AC voltage

We have configured this for your model and mains level; do not change! If you must connect to another voltage range, see §3.6 or contact Ambrell Service.

230 V models: 187-230 | 230-264

440 V models: 370-440 | 440-520

AC voltage
► 440-520 VAC



Auxiliary Out

Auxiliary Output provides a scaled output of the user's selected power supply attributes: Coil Current, RF Power or operating Frequency.

Auxiliary Out
► Power (4-20mA)



RS485 Baud rate

38400: Use ► to select baud rate to be used for communications

RS485 Baud rate

►38400



RS485 Address

1: Use ► to select and ▼/▲ to adjust address. ► to save. Address is used for communications. See § 3. ID is the SYS ID, see § 1.5.

RS485 Address

►1 ID=nnnnn



Com Protocol

Terminal Mode: Use ► to select. Terminal Mode is the only mode currently supported.

Com Protocol

►Terminal Mode



Communication

None

RS485 4 Wire:

RS485 2 Wire:

RS485 4 wire and 2 wire are the only protocols supported at this time

Use ► to select, then ▲ to enable. See §3, Serial Communications

Communication

►None



Contrast Adjust

To change the contrast of the displayed characters (lower number = lighter characters)

Use ► to start, then ▲/▼ to adjust; setting is retained.)

Contrast Adjust

►To change 47



Lock Front Panel

To prevent changes to settings:

No

Yes: disables all buttons except START, STOP; select and follow instructions, enter 39889 code.

To unlock, press [] while heat is off, re-enter code

Lock Front Panel

►No



Alarm Limits

off: Future feature. Not supported at this time.

Alarm Limits

►off





Display Percent

To enable/disable use of % displaying output levels

Disable: display A/W

Enable: display A/W as a % of maximum

Display Percent
▶Disable



Start Type

To change START type

2button: ★HeatOn when START is pulsed (or CTB1 signal is closed) and remains on when released. ★HeatOn ceases when STOP is pressed or when timer expires

1button: ★HeatOn only while button is pressed (or CTB1 signal closed), ceases when button is released.(or CTB1 signal opens)

Start Type
▶2 Button



Control From

Front Panel: during ★HeatOn, RF output follows setpoint entered at front panel

Rear Panel: your analog signal controls output

File A...: use one of four profiles you specify (§2.3)

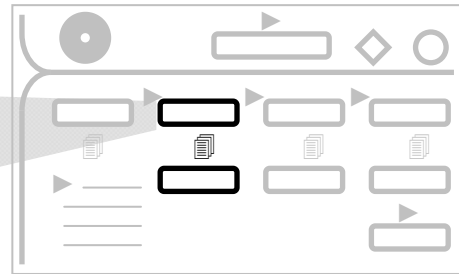
RS485 4 Wire: if 'Communication = RS485 4 Wire', below, select this to adjust output with serial command

Control From
▶Front Panel





Menu Selection
▶ System Status



(Once this screen is displayed, press ; use ▲/▼ to select operating features):

Display the temperature of active components on the heat sink (HS) and the internal ambient air (AM) and any active (unresolved) Fault notices (§2.3)

✓ use ▲▼ to display any previous Fault notices

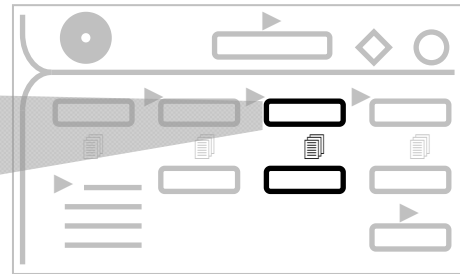
(previous = from last heat cycle)


✓ use ▶ to change between °F and °C

HS65°F AM72°F
Increase Tap



Menu Selection
▶ Adjust Profiles



(Once this screen is displayed, press ; use ▲/▼ to select operating features):

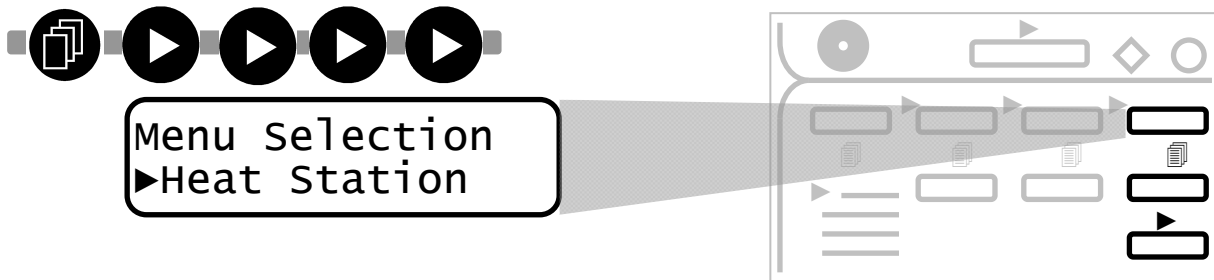
Adjust Profiles


This lets you build up to four independent sequenced-heating profiles (A-D); you set the starting and ending output levels and the duration for as many as five discrete steps per Profile (e.g., A1-A5, Multi-step, following section).

Select Profile

▶ A B C D





(Once this screen is displayed, press ; use ▲/▼ to select operating features):

Heat Station

This enables the power supply to operate after you make changes to the work head configuration, or if you select from two different work heads. (Cap settings need never be changed if you make no changes to the work head; tap settings may change with use. To change, press ► for changes to either **capacitor** or to transformer **tap** settings

Although factory-set, you must ‘inform’ the EASYHEAT of any **changes you make** to the RF transformer taps or tank capacitor (see §3.5, tap changing instructions.)

✓ select the correct work head model (▲, ▼)

1600SP Series
800S Series
800P Series
400 Series
300S Series
300P Series
150 Series
Custom


(This information provided by us)

If you have changed the transformer tap setting (§3.5), you must ‘inform’ the power supply:


✓ select the correct tap setting (▲, ▼)

Choose Menu
►Modify Tap

Choose Menu
►Modify Cap

 to select capacitance

Choose Model
↕150

 to select capacitance

C1 value
↕0.10uF

▲▼ to adjust

► to select next cap

● to save

Select Tap
↕18

Failure to match Tap or Cap settings with the workhead configuration may result in false displays and loss of component protection. This does not change capacitance.



Whenever you are unsure about the correct tap selection for your application, follow this rule: **start high, work down**. Beginning from the highest transformer taps presents the least stress to the EASYHEAT.

2.3 Detailed EASYHEAT Operation

This section details how to:

- interpret the Status LEDs
- understand system Faults and Advisories
- program and execute continuous and multi-step heat-cycles (profiles)

Interpret Status LEDs

This guide will help you understand the operation of your EASYHEAT.



LED Status and system notices are relevant if your **part is in the coil during ★HeatOn**. Status and notices displayed after you remove your part can be ignored



★Ready

EASYHEAT is waiting to heat; no faults detected



★Ready + ★HeatOn

START command received, outputting power per settings. Since both are lit output is within acceptable margins. It may be possible to achieve a more efficient configuration.



for possible suggestion to improve operation; refer to §3 for further adjusting instructions



★HeatOn (Limit):

Unit heating, not meeting setpoint



@display; output differs from setpoint by more than 2%



for suggested corrective step(s)

...**Ŵ** (W overscored); displayed output power is outside a preferred tolerance band. Increase tap for possible improvements

!Cap @display; you are attempting to adjust Setpoint above safe limit for capacitors used. Reduce Setpoint


Limiting may also be due to a requested Setpoint which is above rated maximum, internal air or heat sink temperature exceeding maximum temperature, or temperature exceeding the maximum rated for the capacitors.



★Fault

Heating interrupted; fault detected; correction required



to Control zone, ► **Status** then  for fault notice



★ AC Power; indicates EASYHEAT is ON; * see the Status screen for notices

Interpreting Faults, Limits and Advisories

Your EASYHEAT communicates information about the way it's operating. This section explains these conditions and what you can do (✓) to respond to them.

	★ Fault Heating interrupted; fault detected; correction required to Control zone, ► Status then for fault notice	
Low Coil Flow	inadequate flow to coil (FLS2, see schematic)	✓ ensure water flow thru coil ✓ ensure plug at power circuit board
Low HSink Flow	inadequate flow to unit (FLS1, see schematic)	✓ ensure water flow thru unit ✓ ensure plug at control circuit board
Coil shorted?... ...Increase caps	frequency out-of-range	✓ clean coil; remove bridging ✓ call us (new caps)







	★ HeatOn (Not regulating) This occurs when the system cannot meet your Setpoint. It lets you know that output is being restricted due to the condition mentioned in the notice; Cutback Mode may be displayed	
Cap Over-Voltage Cap Over-Current	capacitor exposed to too much voltage...	✓ reduce Setpoint ✓ Contact Us
Heat Sink Hot	heat sink near critical temp	✓ ensure adequate water flow
Enclosure Hot	internal air near critical temp	✓ ensure adequate water flow ✓ confirm internal fan op'n
Increase/decrease Taps	to improve output/setpoint match	✓ See §3.5 ✓ See HeatOn (Limit) on previous page
Cutback Mode CAP TEMP PROTECT + REDUCE OUTPUT	peak current protection; you note output falls with increased setpoint	✓ reduce setpoint ✓ part out of coil, thru Curie? ✓ follow 'adjust taps' notices

You may be able to correct frequency (Adjust Caps message) by adjusting coil with more (lowers frequency) or fewer (increases frequency) turns; if your coil design is fixed, call us for replacement caps

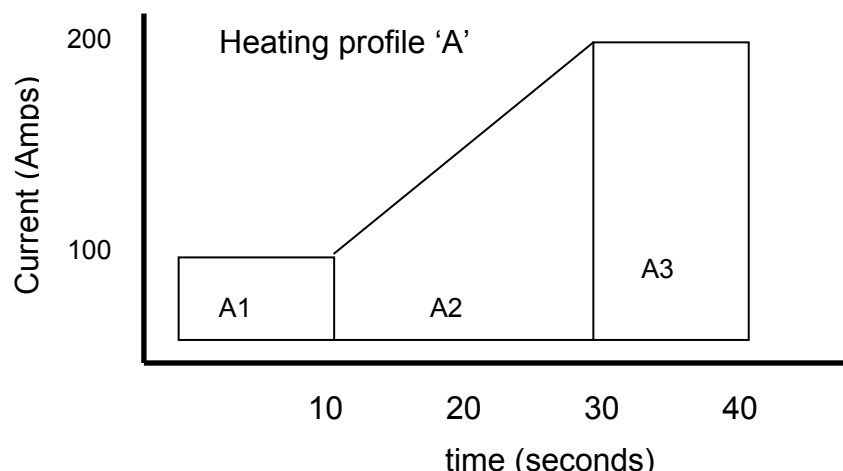
	★ Advisory * See asterisk on display. Indicates output/setpoint are not well matched; more efficient configuration may be possible.	
--	---	--

Multi-step profile

Case: the part is brought to temperature and held in three steps (see chart on next page)
From Control zone:

Do this...	Observe...
<ul style="list-style-type: none"> ✓ select ►Adjust Profiles then  	<div> Select Profile ►A B C D </div>
<ul style="list-style-type: none"> ✓ press ; this selects Profile A 	
<ul style="list-style-type: none"> ✓ with A1 selected, press ► 	<div> <div> End Start → 0.0A Time → Untimed </div> <div> 0.0A ►A1 Data </div> </div>
<ul style="list-style-type: none"> ✓ use ▲/▼, set A1 Start level (ex: sets A1 Start = 100A) ✓ press ► 	<div> Each step has 3 data points: </div> <div> ►100A Start A1 Data </div>
<ul style="list-style-type: none"> ✓ use ▲/▼, set A1 End level (ex: sets A1 End = 100A) ✓ press ► 	<div> ►100A End A1 Data </div>
<ul style="list-style-type: none"> ✓ use ▲/▼, set A1 step Time (ex: sets A1 Time = 10s) ✓ press ► 	<div> ►10s Time A1 Data </div>
<p>Note A1 data points are displayed</p>	<div> 100A 100A 10s ►A1 Data </div>
<ul style="list-style-type: none"> ✓ use ▲, select A2 ✓ set A2 Start = 100A ✓ set A2 End = 200A ✓ set A2 Time = 20s ✓ use ▲, select A3 ✓ set A3 Data points as shown 	<div> 100A 200A 20s ►A2 Data </div>
<ul style="list-style-type: none"> ✓  Clears all data for indicated step 	<div> 200A 200A 10s ►A3 Data </div>
<ul style="list-style-type: none"> ✓ select ►System Options, , then ▲ ✓ select Control from: ►File A then select using  	<div> This step 'activates' File A; FileA can be (de)activated any time by selecting Control from: ►Front Panel or ►Rear Panel </div>
<ul style="list-style-type: none"> ✓  Home ✓ press START 	<div> ★Ready, ★HeatOn, note three- stage countdown until ΩReady only </div>

The graph represents the 3-step heating profile in the example



- Untimed profile steps are skipped (if they have non zero-setpoints)
 - Untimed and zero-Setpoint steps are interpreted as STOP by EASYHEAT (A4 implied, above).
- From the Home zone, Untimed heat cycles are continuous (until STOP).

Frequency Compensation

EASYHEAT LI power supplies incorporate frequency compensation technology to maximize the power that can be transferred to a load for which the heat station has too low a tap.. Frequency compensation equals zero for a well matched load.

Frequency compensation is enabled by default and is suitable for most applications. For short heat cycles (less than 500 msec), disabling frequency compensation may improve heating performance because the software controlled compensation may not have enough time to respond. Longer heat cycles may also be effected for severely undertapped conditions.

To disable frequency compensation:

Enter the Control Zone (press the page key while in the Home Zone).

Press the Down key.

Follow the on screen instructions to turn FreqOffTune off.

2.4 Equipment Maintenance

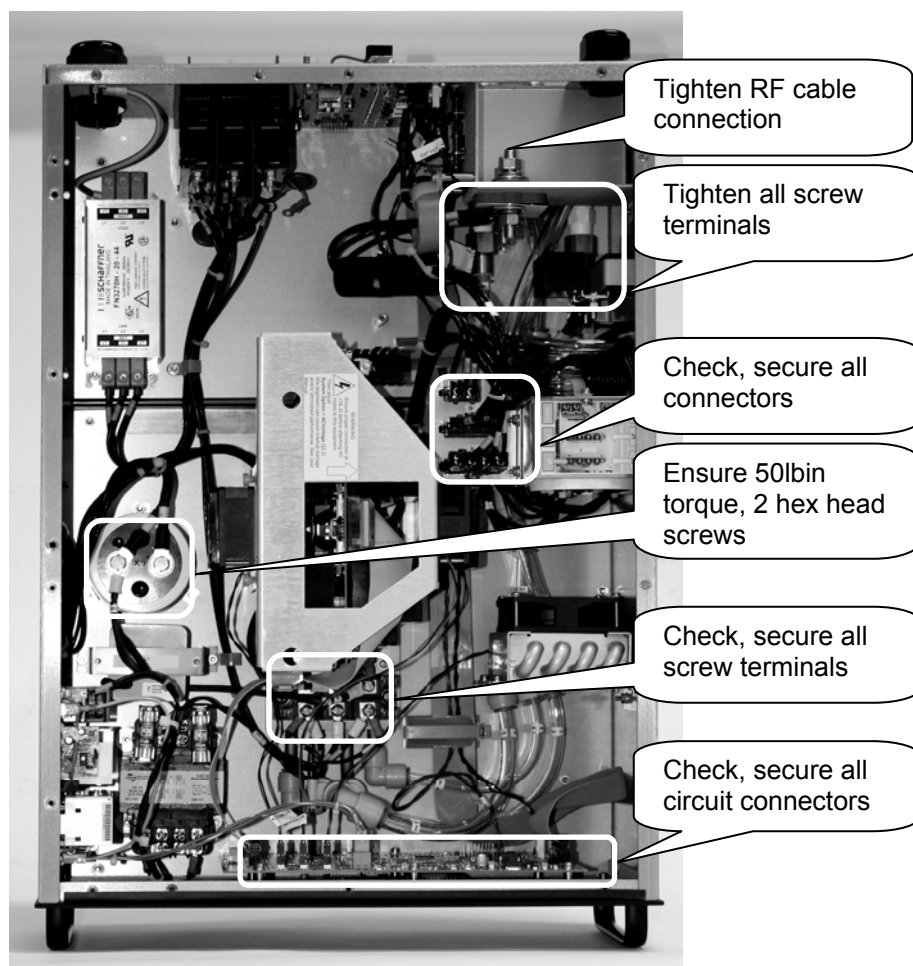
The effectiveness and safety of your EASYHEAT equipment can be ensured for years by following these simple maintenance steps:

Frequency	Check
1 month	<p>safety</p> <p>while ★Ready, turn off water; ensure ★Fault; restore water. If no ★Fault, flow switch is stuck; do not operate further! Equipment safety is compromised. Call your Ambrell office</p>
6 months	<p>coolant</p> <p>level; top-off if required appearance; flush & replace if dark or cloudy system; for signs of leaks; repair</p>
12 months	<p>coolant</p> <p>dump, flush, replace coolant</p> <p>equipment</p> <p>wiring; ensure all wiring is OK; replace if damaged setup; confirm ►RF-Setup, Caps, Taps correct</p>
<p>NOTE: if you use a heat transfer fluid in your equipment, dispose of spent chemicals responsibly; call an expert.</p>	

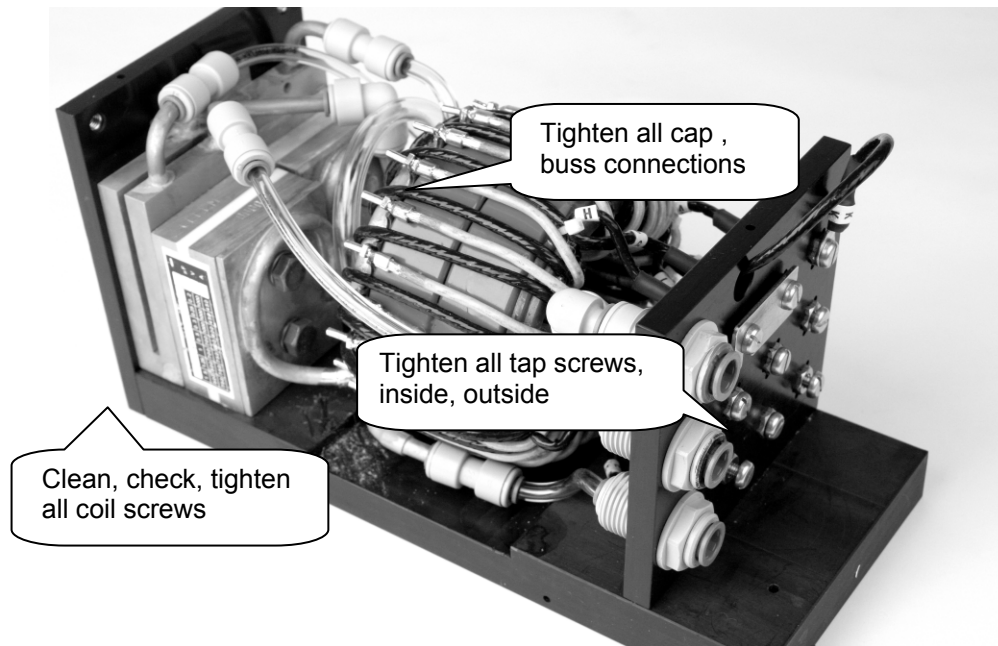
2.5 Before You Call Service...

If your heating results are inconsistent or have fallen below an earlier level, please refer to this section first to ensure that all electrical connections are secure.

- ✓ ensure tap wiring and internal settings agree
- ✓ if ★Ready turns off while heating, see §3.5
- ✓ remove all power and water from your system; wait 5 minutes
- ✓ use Philips screwdriver to remove cover screws
- ✓ examine all connections in boxed areas; ensure secure connections
- ✓ check RF power cable connection (arrow)



- ✓ remove cover from your workhead
- ✓ examine all connections in both sides of boxed areas; ensure secure connections
- ✓ examine your coil mounting connections; ensure secure connections



2.6 Calibration

Your EASYHEAT system has been calibrated by our test facilities; this means that the **displayed output level** accurately represents the rms current circulating through the RF coil.

If you have recurring calibration requirements for your EASYHEAT equipment, we offer this calibration service:

- return the power supply to us for us to perform this service; there will be a charge for this and a renewed Calibration Certificate will accompany the returned equipment. Contact Ambrell for details.

2.7 Smartburst Technology

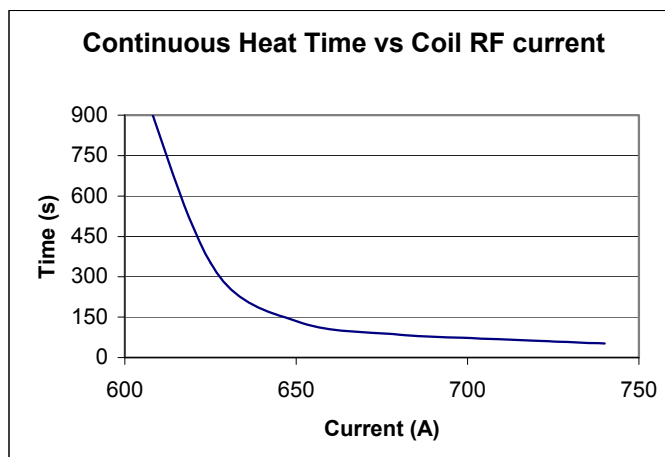
The EASYHEAT work heads contain one or more water cooled capacitors, rated for current under laboratory (rather than real-world) conditions. The EASYHEAT systems make use of Smartburst technology which allows users to approach these higher current limits in actual use under many real world conditions while maintaining the safety margins required for long operating life.

Smartburst considers both thermal time constants and self-heating in the capacitors and work head components to allow higher currents out of the work head as long as the average value is safe, and if the continuous on time is within limits for the levels in use. Beyond these limits,

CAP TEMP PROTECT and
REDUCE OUTPUT

messages are displayed on the status page, and levels are brought to a safe value.

This chart illustrates operation for a capacitor with a laboratory current rating of 750A. When the limit becomes active, coil current is held with a ceiling of about 80% of the laboratory value ($\cong 600\text{A}$).



3 Customizing Your EASYHEAT

You can control your EASYHEAT in different ways:

- **START / STOP** can be controlled from the front panel or remotely
- output level can be set from the front panel, remotely or with optional multi-step profiles you specify
- the state of your unit can be monitored remotely
- your load can be efficiently matched to the output with RF tap settings
- change capacitor when your coil design requires it

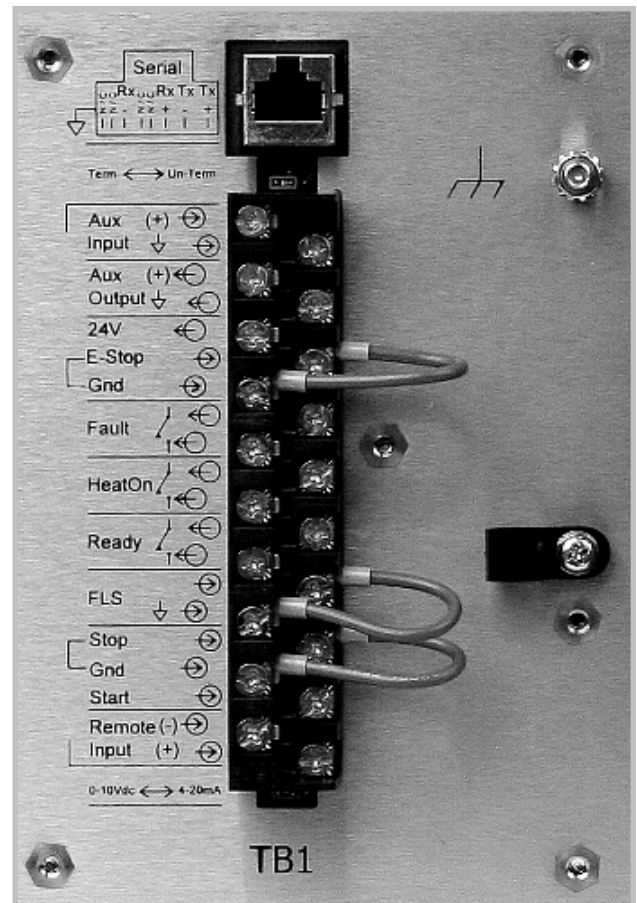
3.1 Rear Panel Connections

Remote operation of your EASYHEAT requires electrical connections at TB1 and – in some cases — unit configuration from the touch-pad.

This terminal block is where you make all hardware control and monitoring connections to your EASYHEAT. All TB1 contacts are touch-safe (24Vdc or less). The entire 20-pin terminal block can be removed with all connections intact, easing maintenance and equipment moving.

Three jumpers are attached and included with your unit:

- E-Stop > Gnd: this jumper is required for RF operation; remove this to insert your E-Stop switch. Operation is interrupted when this connection opens
- Stop > Gnd: this jumper is required for RF operation; enables STOP from a pendant or your equipment. Operation is interrupted when this connection opens
- FLS: remove this jumper to attach auxiliary (N.O.) flow-switch. Operation is interrupted when this connection opens.






Configuring Auxiliary Output

Case: If your Quality Assurance requires external monitoring of System output, you can configure the System to provide scaled output (0—20 mA or 4—20 mA)** in Power, Amps, and Frequency modes.

Auxiliary Output is provided on the rear connector panel (TB1) as “Aux Output”.

Auxiliary Output is disabled by default.

To enable and choose an output mode:

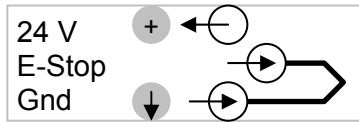
Do this...	Observe...
✓ From the Home zone and with the system in a “Ready” state, select  .	
✓ press ► to get to System Options .	If System Options was the last feature field used, it will appear first.
✓ press  again.	
✓ use ▲/▼, and scroll to Auxiliary Out .	
✓ press ► to scroll through output modes and their respective scaled ranges.	Choices: <ul style="list-style-type: none"> • Power (0—20mA) • Power (4—20mA) • Amps (0—20mA) • Amps (4—20mA) • Frequency (0—20mA) • Frequency (4—20mA) • Disabled
✓ Select  Home button to lock in your selection.	

** = To convert 0—20 mA to 0—10 V output, a 499 ohm, 1% tolerance, 0.5W (min) metal film resistor can be placed across the Aux Output terminals. This is best used to drive a high impedance input on external equipment.

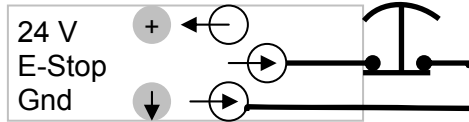
Note: The Auxiliary Output is updated about three times a second when the heat is on, under internal computer control. When mains power is first applied, there is an interval of about a second during which the computer is coming out of reset. During this time, approximately 35mA may be seen at the output.

For more information about Auxiliary Output scaling, see “Auxiliary Output Modes and Scaling Examples”.

24V source & E-stop



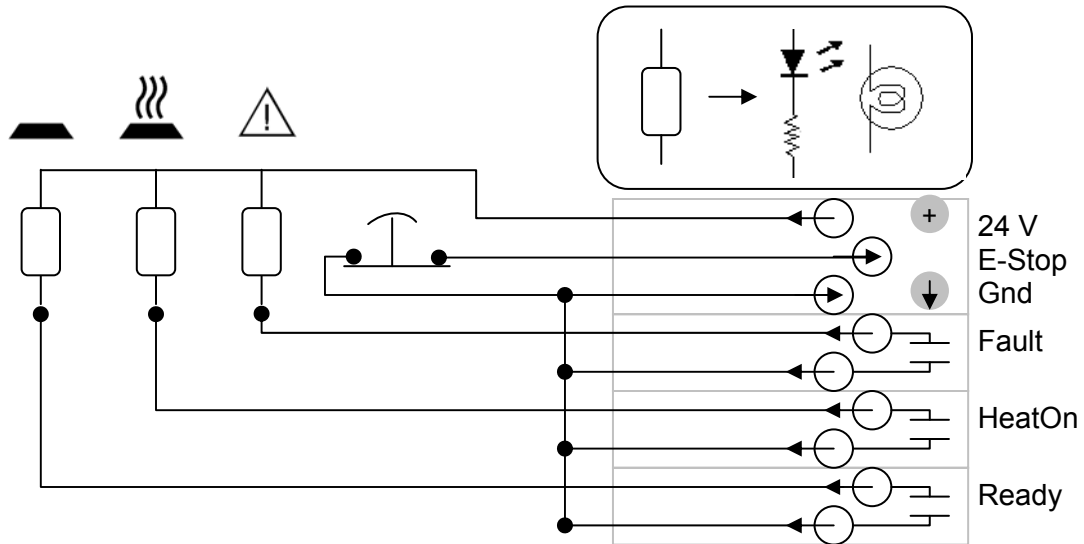
Case: (default) jumper ensures that operation is not interrupted



Case: you include your E-stop switch; upon switch activation, RF heating is prevented or interrupted

24V source Signal Outputs

24V is an output from the EASYHEAT. **Do Not** connect an external voltage supply to this terminal!



Electrical	Touch-pad
<p>Connect to internal solid-state contacts to complete your indicator signaling (shown);</p> <p>READY pair closure = ★Ready</p> <p>HeatOn pair closure = ★HeatOn</p> <p>Fault pair closure = ★Fault</p> <p>No polarity to these connections; 1A limit each</p> <p>Connect your N.C. E-stop (rated 24V @ 3A min.) as shown.</p>	None

Result: Your remote 24Vdc status signals echo EASYHEAT status LEDs; E-stop trip halts RF power output and equipment operation. Reset E-stop to restart EASYHEAT at Home zone.

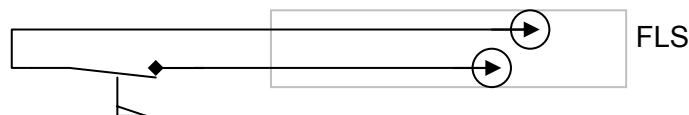
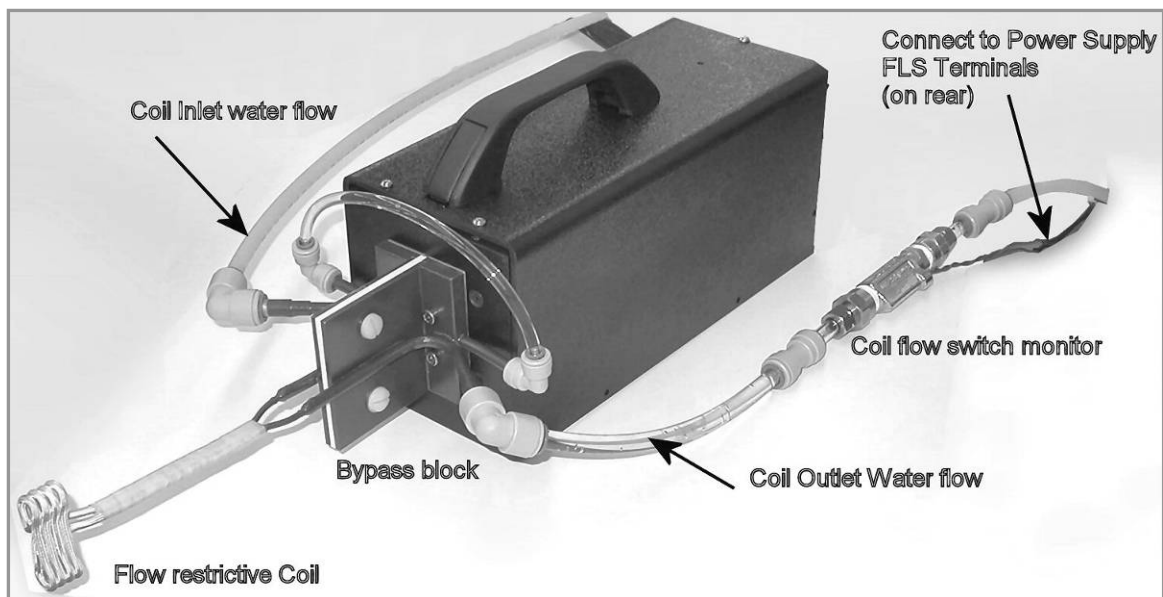


If no E-stop device is used, EStop>Gnd terminals **must be jumpered** (factory configuration) for the EASYHEAT to operate.

Flow switches (FLS)

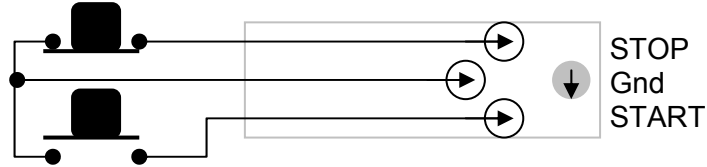
Internal flow switches protect your EASYHEAT from thermal damage if cooling water to the heat sink or to the coil is inadequate. You don't have to make any connections to TB1 for this internal protection.

If your bypass coil presents a restricted water path, we may recommend the use of a 'bypass-block' with your work head (Ask your sales representative.). In this case you may be required to complete wiring for an external flow switch (sold separately).



To add your optional normally-open flow switch, remove jumper at FLS, connect your flow switch wires. Inadequate flow to your flow switch or to either the internal flow switches will then result in ★Fault.

START/STOP





Case: use **two** external signals, switches or isolated contacts to control RF heating:
START signal is normally-open, active-closed, **STOP** is normally-closed, active-open.

2-Button...			
Electrical			Touch-pad
Attach your signal:			▶System Options Start From ▶Rear Panel Start Type ▶2 button 🏠 to Control, 🏠 to Home
START	N.O.		
Gnd			
STOP		N.C.	
START: normally-open, active-closed STOP: normally-closed; active-open			

Result: **START** signal (momentary closure) initiates heating; opening **STOP** signal halts heating. Heating cannot commence whenever normally closed **STOP** signal is opened.

Case: You use **one** external signal, switch or isolated contact to control RF heating

1-Button...			
Electrical			Touch-pad
Attach your signal:			▶System Options Start From ▶Rear Panel Start Type ▶1 button  to Control,  to Home
START	N.O.		
Gnd			
STOP		Jumper	

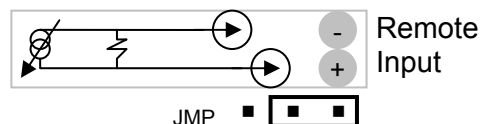
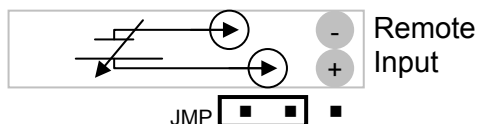
Result: Closing, holding **START** initiates heating, which continues while **START** is active; opening **START** signal halts heating. Heating cannot occur whenever (jumped) **STOP** signal is opened.



1-button Start is not recommended if you are using the timer (§2.1); the timer may re-start if button is partially depressed or is held too long.

Remote Input

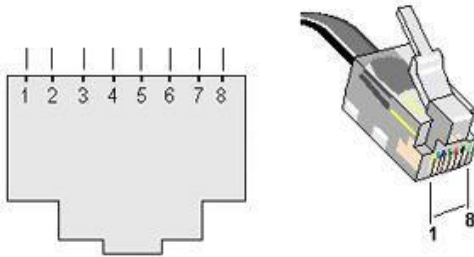
Case: use an external signal to set the desired output level of the EASYHEAT. Depending on the signal source you plan to use (0-10Vdc is the default configuration), follow these instructions to change.



Electrical	Touch-pad
<p>Using 0-10Vdc source: (left) upper terminal = negative lower terminal = positive set jumper left (illustration)</p> <p>Using 4-20mA source: (right) upper terminal = negative lower terminal = positive across both = 250Ω resistor (included) set jumper right (illustration)</p> <p>Observe polarity with these connections!</p>	<p>► System Options Control From ► Rear Panel</p> <p>⏏ to Control, ⦿ to Home</p>

Result: Setpoint established and held with your analog voltage or current source. To START/STOP remotely, also, see previous.

3.2 Serial Port (RJ45 modular)



Why RS485?

You can use this feature to control, adjust and collect data from your EASYHEAT either from a remote terminal (PC) or from your PLC.

Optional “eView” software is available, which offers a robust solution for external process monitoring and recording. See [eView Induction Heating Software](#), and contact Ambrell for further information.

RS485 serial communication protocol is selected for its noise immunity, its performance with long data lines and its ability to address multiple units connected in parallel.

Converter Kit Purchased Separately

The RS485 serial communication port is a standard feature of EASYHEAT. **To enable serial communications, a converter kit is required.** This kit with installation instructions is available (PN 305-0247). Contact Ambrell to order this kit.

You can configure your own serial communication hardware and software to address EASYHEAT. However, this manual assumes you are using the optional converter kit.

Required equipment:

- PC running Windows95 or higher
- HyperTerminal or equivalent
- **Appropriate Ambrell RS485 kit**
The option kit and cables are ready-to-use; if you wish to configure your own serial link:
 - 1) Tx+
 - 2) Tx-
 - 3) Rx+
 - 6) Rx-


To Configure the EASYHEAT

If the converter kit (PN 305-0247) has been purchased and installed, follow these steps to prepare your EASYHEAT to make use of the serial communication option.



Serial communication with EASYHEAT takes place when **Home** zone is displayed; while in **Control** mode, the EASYHEAT will not respond to all serial commands.

Case: You employ the serial port to monitor and control heat-cycle times in your process

Do this...	Observe...
<ul style="list-style-type: none"> ✓ select ► System Options then  ✓ press ▲/▼ until... 	<div>Menu Selection</div> <div>► System Options</div>
<ul style="list-style-type: none"> ✓ select RS485 4 wire to enable the serial communications feature; after this step, the port is activated, but you must take the next steps to enable serial Start From and Control From ✓ press ▲/▼ until... 	<div>Communication</div> <div>► RS485 4 wire</div>
<ul style="list-style-type: none"> ✓ once this selection has been made, press ▲ ✓ press ► to select Terminal Mode 	<div>Com Protocol</div> <div>► Terminal Mode</div>
<ul style="list-style-type: none"> ✓ select ▲ for addressing (default = 1) ✓ press ► to modify; 1-32 valid, 0 used for broadcast; cannot be selected as address 	<div>RS485 Address</div> <div>► 1</div>
<ul style="list-style-type: none"> ✓ select ▲ to select baud rate ✓ press ► to modify; (default = 38400; max 115,200) 	<div>RS485 Baud Rate</div> <div>► 38400</div>
<ul style="list-style-type: none"> ✓ select ▲ to select Start From ✓ press ► to select RS485 4 wire 	<div>Start From</div> <div>► RS485 4 wire</div>
<ul style="list-style-type: none"> ✓ select ▲ to select Control From ✓ press ► to select RS485 4 wire 	<div>Control From</div> <div>► RS485 4 wire</div>
<ul style="list-style-type: none"> ✓ complete wiring per previous guide: 	

To Configure Your Computer

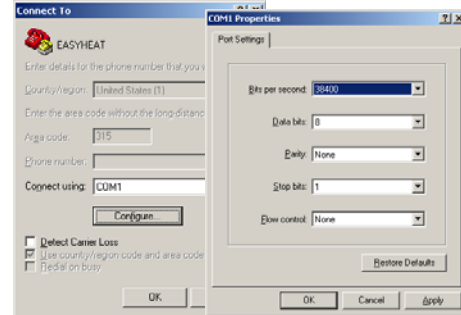
The following is one way to configure the serial port of your computer; you may have your own devices or means of making the communications connection.

Do this...

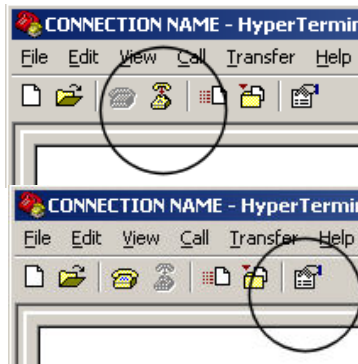
✓ launch HyperTerminal from Programs > Accessories > Communication (or other serial communication application).

- 1 ✓ enter a 'connection name' such as EASYHEAT then select:
 - COM1 (or appropriate for your device)
 - 38400 baud (or appropriate for your device)
 - 8 data bits; parity = none; stop bits = 1
 - flow control NONE
- ✓ click OK

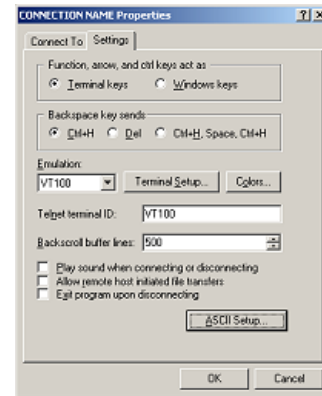
Observe...



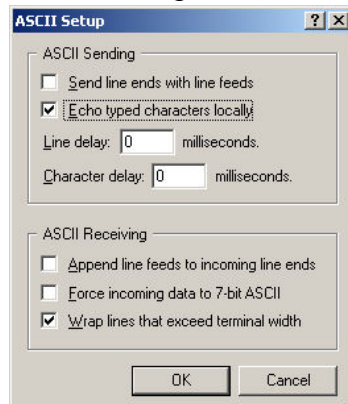
- 2 ✓ Click Disconnect (upper image)
✓ Click Properties (lower)



- 3 ✓ Select Settings; set like this



- 4 ✓ Select ASCII setup; set like this:



- 5 ✓ Select File >> Save to keep these changes

- 6 ✓ attach the converter kit (9 – pin D-submin or USB) to the selected comm. port of your PC

- 7 ✓ attach RJ-45 modular plug of converter to rear of EASYHEAT

- 8 ✓ follow steps to install driver for converter

- 9 ✓ (some units) ensure converter settings →

Data device type		Comm Mode
DCE	SIM	TxON/RxON

Using the Converter

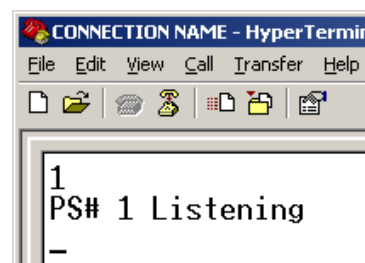
With the converter attached to your EKOHEAT and your PC as instructed above,

Do this...

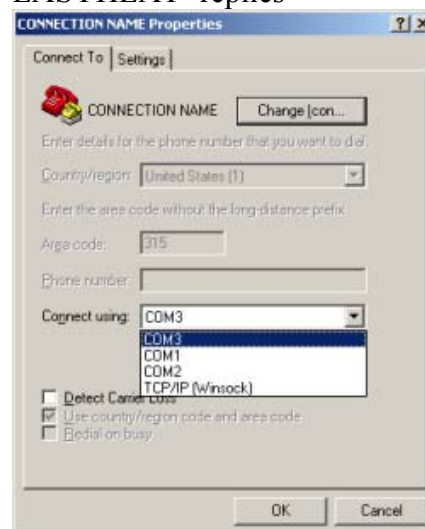
- ✓ launch Hyper Terminal
- ✓ Select File >> Open...
- ✓ Select your connection, Open
- ✓ type '1' (or your device address) [ENTER]

Observe...

dialog box listing 'Connections'



EASYHEAT 'replies'



If the EASYHEAT does not reply to this command

- ✓ select 'disconnect' at HyperTerminal
- ✓ select Properties >> Connect To
- ✓ select another available COM port
- ✓ re-connect, re-try

- ✓ refer to command set table, next page,

Notes:

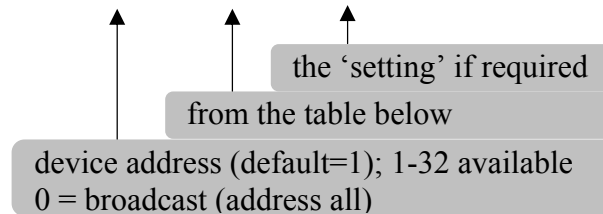
- EASYHEAT doesn't read backspaces or deletes; if you make a mistake, just [ENTER] and re-try
- EASYHEAT attends serial commands only when the **Home** screen is displayed
- to stop a continuous data display, type 1 [ENTER] ; that will halt the display

Command set

This table gives examples of each command's use and the range of the data you can use in the command 'argument'. The **address** is required and the commas between the address, command and arguments are required; do not insert spaces! Input is not case-sensitive.

Each command must be arranged like this:

address,command,argument



The multi-line data display (data) looks like this:

```
PS# 1
Heat      On (OFF)
Setpoint   xx V
Amps Out   x.x A
Power Out  xx W
Frequency  xx kHz
Timer      xx ms
HeatOn     xx
```

2-line display is arranged like this:

header:	SETPOINT	AMPS OUT	POWER OUT	FREQUENCY	TIMER	[CR/LF]
data:	1200.0A	0.0A	0W	0kHz	0ms	[CR/LF]

 csv data arranged per this example:

address	heating	setpoint	amps	watts	frequency	timer	counter	[CR/LF]
1	0	1200.0	10	3	140	1826	214	[CR/LF]

heating 0=off, 1=on; some fields may be blank

Example csv output string

1,0,1200.0,10,3,140,1826,214

Comm.	Arg.	Result	Example
%amps	#	Sets the amps setpoint to a percentage of amps output. % must be enabled in the configuration menu to use this command.	1,%amps,45
?	none	Returns a list of commands and abbreviated descriptions of each command.	1,?
aldelay	###	Sets the alarm delay value in Seconds (two decimal places only). This is the delay time after heat is turned on before the system will check if the actual present power value falls outside of the minimum or maximum settings. (ADDED V5.02 display firmware)	1,aldelay,10.21
almax	#	Sets the alarm maximum value in WATTS. (ADDED V5.02 display firmware)	1,almax,1200
almin	#	Sets the alarm minimum value in WATTS. (ADDED V5.02 display firmware)	1,almin,800
aloff	none	Turns on the alarm function. If after the programmed delay time as extinguished if the power falls outside of the minimum or maximum power levels the alarm symbol will be displayed. (ADDED V5.02 display firmware)	1,aloff
alon	none	Turns on the alarm function. If after the programmed delay time as extinguished if the power falls outside of the minimum or maximum power levels the alarm symbol will be displayed. (ADDED V5.02 display firmware)	1,alon
amps	###	Sets the amps setpoint of the power supply if the control from location is RS485. Variable can be 0 to max amps. See maxamps command.	1,amps,100
c?	none	Returns the CHDR and CTIME settings of the power supply. See CHDR and CTIME commands for description.	1,c?
cdata	none	Continuous reply includes a description header line followed by a data line. The data line includes Heat status, set point, amps out, power out, frequency and timer. The header line may be changed to repeat at different intervals based on CHDR command. The rate at which the response is sent is based on the CTIME command. See ctime for description. If the timer is set on the power supply the timer will count down during heat on. If the timer is not set then the timer will count up during heat on.	1,cdata
chdata	none	Continuous 2 line response. Same as cdata without a line feed. Terminal window will not scroll. The rate at which the response is sent is based on the CTIME command. See ctime for description.	1,chdata

801-9526-00.doc

chdr	#	Sets the number of data lines between header lines. Example will place a descriptive header line every 25 replies when using the CDATE or CTEMP commands. The value range is 1 to 254. The default setting is 1 data line between headers.	1,chdr,25
chrdata	none	Continuous raw data while the heat is on. Same format as crdata.	1,chrdata
config	none	Returns the configuration of the power supply including all user settings and heat station settings.	1,config
crdata	none	Continuous raw data. Same format as rdata, see rdata for descriptions.	1,crdata
crtemp	none	Continuous raw temperature data while the heat is on	1,crtemp
ctap	#	Changes selected RF transformer tap. Note: Tap must be physically moved by the user to match the selected tap setting. Typing "1,ctap" with no argument will return the current tap setting.	1,ctap,42
ctemp	none	Returns continuous temperature of heat sink and power supply with a descriptive header line. The header line rate can be changed using the CHDR command. The interval of response time can be set using the CTIME command.	1,ctemp
ctime	#	Example will set the system to send a response every 500msec. 1=100msec. The variable can be 1 to 65534. This is used for CDATE, SLCDATA, RDATA, SLRDATA, CTEMP and SLCTEMP commands. The default is "2" for 200mSec.	1,ctime,5
ctl-filea/b/c/d		Selects a profile to load and run. Example select profile B. Selectable profiles are A, B, C and D.	1,ctl-fileb
ctl-fpan	none	Selects control to be front panel.	1,ctl-fpan
ctl-rpan0-10	none	Selects control to be rear panel 0-10V analog input.	1,ctl-rpan0-10
ctl-rpan4-20	none	Selects control to be rear panel 4-20ma analog input. Note: 4-20 rear panel jumper must be in correct location.	1,ctl-rpan4-20
ctl-rs485	none	Selects control location to be RS485.	1,ctl-rs485
ctrlloff	none	Turns off RS485 keyboard control of set point.	1,ctrlloff
ctrlon	none	Enables RS485 control of set point. Use "]" right bracket key to increase set point. Use "[" left bracket key to lower set point.	1,ctrlon
data	none	Multi-line single reply, PS address, Heat status, Setpoint, Amps output, Frequency and Timer setting.	1,data
hoff	none	Heat off command. Will turn heat off regardless of start from location selection.	1,hoff
hon	none	Heat on command. Will turn heat on if start from RS485 is selected.	1,hon
hst	none	Returns the heat station configuration.	1,hst
maxamps	none	Returns the maximum attainable set point in amps based on the heat station tap setting, heat station maximum current capability, or the maximum current carrying capacity of the heat station cable	1,maxamps
pstat	none	Returns the previous heat on cycle status messages of the power supply.	1,pstat
rdata	none	Returns raw data only with a comma separating each data field. The response includes: Address,heat-status,setpoint,amps-out,frequency,timer,counter	1,rdata
rtemp	none	Provides raw temperature data including heat sink and air temperature.	1,rtemp

slcdata	none	Continuous 2 line response. Same as cdata without a line feed. Terminal window will not scroll. The rate at which the response is sent is based on the CTIME command. See ctime for description.	1,slcdata
slcrdata	none	Continuous comma delimited raw data using the same format as rdata. Will not scroll. The line feed is removed	1,slcrdata
slctemp	none	Returns single line of temperature including heat sink and air data will not scroll and requires heat on for data to be returned.	1,slctemp
start-1button	none	Selects start type to be 1 button mode. Heat will remain on as long as start signal is present. Heat will turn off when start signal is removed.	1,start-1button
start-2button	none	Selects 2 button start type. Heat will turn on when start signal is pulsed. Requires stop signal pulse or button press to turn heat off.	1,start-2button
start-fpan	none	Selects start from location to be front panel.	1,start-fpan
start-rpan	none	Selects start from location to be rear panel.	1,start-rpan
start-rs485	none	Selects start from location to be RS485.	1,start-rs485
stat	none	Provides present system status messages	1,stat
temp	none	Responds with heat sink and internal temperature of the power supply.	1,temp
temp-c	none	Selects temperature to be displayed in degrees Celsius.	1,temp-c
temp-f	none	Selects temperature to be displayed in degrees Fahrenheit.	1,temp-f
timer	###	Example sets the power supply timer to 10.20 seconds. The variable can be 0.00 to 99999.99 a maximum of 2 places after the decimal point is required.	1,timer,20.4
txoff	none	Disables the RS485 transmitter continuous on mode as described in the txon command above. Only needs to be used if the user has the system in the TXON mode. (ADDED V5.02 display firmware).	1,txoff
txon	none	Turns the EKOHEAT RS485 transmitter on continuously. Normally the transmitter is disabled after a transmission, this command will cause the transmitter to remain in the transmit state all the time. This will aid with noise problems that can be caused while the RF is on and the RS485 cable is picking up random noise characters. NOTE: This command may only be used when a single power supply is connected via the RS485 converter and must be initiated each timer the system is powered on. (ADDED V5.02 display firmware)	1,txon

bold: indicates valid broadcast commands (address=0); all units will respond (Ex: 0.hoff)

3.3 Optional Equipment

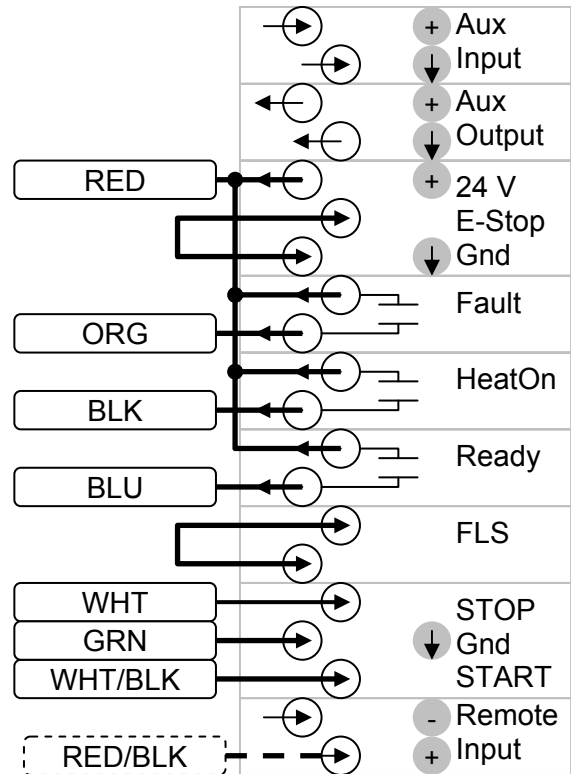
Pendant Styles

At this writing, there are two models available:

- 3-lights, Start/Stop (upper)
- 2-lights, Start/Stop, Power Control (lower)



The 3-light model puts Stop, Start and Status indicator in your hand. The 2-light (Power Control) model lets you adjust the Setpoint from the pendant. ★Fault indication is not provided at the pendant, but it is implied (★Ready and ★HeatOn are both dark). ★Fault status is always available at the front panel.



See :§2.2 for **Control** instructions to configure the unit.

3-light model	Touch panel
STOP>Gnd (default) jumper is removed from TB1	►System Options Start From ►Rear Panel Control From ►Front Panel Start Type ►2 button

2-light model	Touch panel
J8 set left (illustration, Remote Input)	►System Options Start From ►Rear Panel Control From ►Rear Panel Start Type ►2 button

Do this...	Observe...
✓ follow instruction under §1.4 to assemble your equipment	
✓ attach pendant terminal block to TB1	polarized; fits one way
✓ secure cable with P-clip provided	middle chassis screw, rear
✓ turn on AC power	★Ready at pendant
✓ (3-light) adjust Setpoint at front panel; use pendant to Start/Stop heating	★Ready + ★HeatOn
✓ (2-light) adjust, lock Setpoint at pendant; use pendant to Start/Stop heating, change Setpoint	★Ready + ★HeatOn

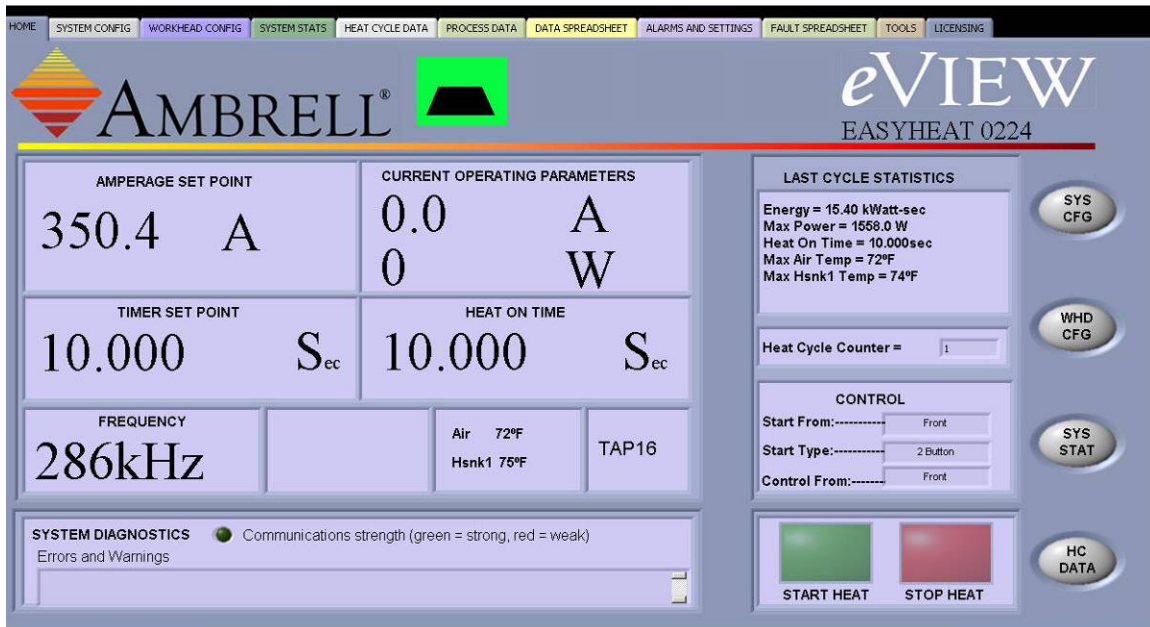
Footswitch

You can attach an optional footswitch to your EASYHEAT, enabling you to toggle ★HeatOn remotely. In the first example, heating occurs only while you depress the switch; in the second, the footswitch starts a timed cycle

Continuous	Touch panel
STOP→Gnd: Jumper retained START→Gnd: N.O. contact	►System Options Start From ►Rear Panel Start Type ►1 button
Timer	Touch panel
STOP→Gnd: Jumper retained START→Gnd: N.O. contact	►System Options Start From ►Rear Panel Start Type ►2 button
✓ Adjust Timer for desired duration	
✓ Depress footswitch to start timer	

3.4 eVIEW Induction Heating Software

eVIEW is a PC based application that interfaces with EASYHEAT and EKOHEAT power supplies.



eVIEW allows the operator to visualize, analyze, and store induction heating data while the power supply runs. Key parameters such as power, frequency, and tank voltage (or current) are displayed on a real time chart and saved in a spreadsheet.



With eVIEW, you can...

- Monitor key induction heating parameters from a remote location.
- Capture time stamped heating data in a csv file for easy exporting to spreadsheet applications.
- Set alarms around all key heating parameters to identify deviations as they occur.
- Capture external analog signals such as temperature.

eVIEW is an accessory product offered for EASYHEAT and EKOHEAT power supplies. Contact Ambrell to learn more about eVIEW and see for yourself how PC based monitoring can improve your efficiency and productivity!

3.5 Tap Adjustment

Under certain heating conditions, EASYHEAT may ‘suggest’ or require changing your RF transformer tap settings (§2, Advisories...). For example:

during ★HeatOn, an asterisk * is shown on the display. To read the message,

✓ press  for Status

There may be a message like this:

▶250A 234.00s
220A *190kHz

HS65□F AM72□F
Increase Tap

‘Increase...’ means a higher tap number; ‘Decrease...’ means a lower tap number.





You can ignore this suggestion if:

- your heating results are satisfactory
- the * is displayed only when there is no part in the coil

Tap		8	10	12	14	16	18	20	22	24
Wire	X	A						E	F	F
	Y	C	G	B	D	C	C	G	B	D
	Cu									
	K	J	C	A	C	B	A	C	A	C
Tap		26	28	30	32	34	36	38	40	42
Wire	X	F	F					E		
	Y	C	C	J	B	D	C	C	D	D
	Cu									
	K	B	A	C	A	C	B	A	B	A

H	G	A
F	J	B
E	D	C

Tap adjustments are made with **3 wires (X, Y, K) and jumper(s) (Cu)**, which are attached as needed in a 3x3 terminal block:

-  and  deliver power from the supply
-  selects a winding scale
-  completes winding selection (see next page to find tabs)

Each of these connections and menu setting must be made for the work head to work properly. Compare the position of the wires with the table to determine the TAP setting.



Work heads are labeled per model; this example may differ from yours.

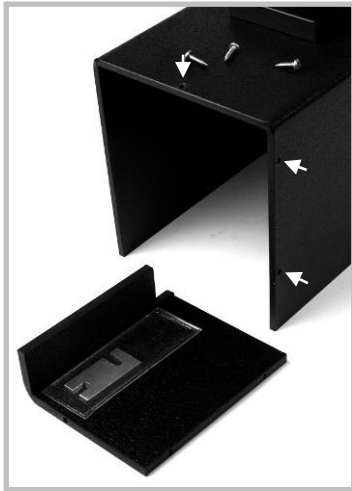
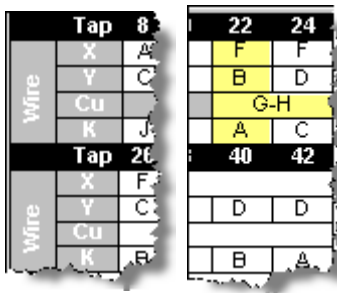
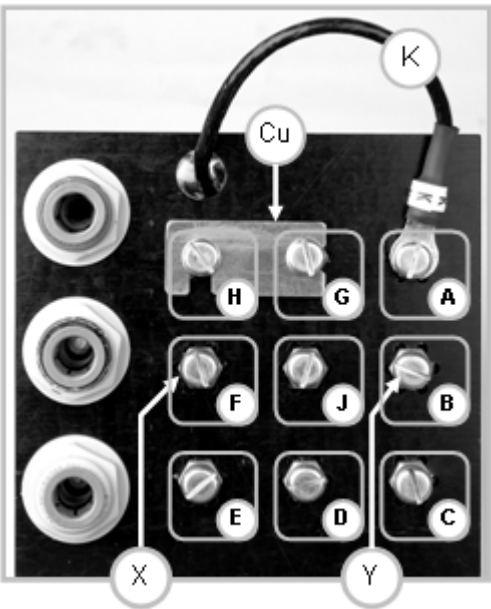


If your unit cannot meet Setpoint and a Tap change is indicated, you must adjust Tap



Whenever you are unsure about the correct tap selection for your application, follow this rule: **begin with highest tap, work down.** Beginning from the highest transformer taps presents the least stress to the EASYHEAT.

Follow these steps to change taps at the work head:

Do this...	Observe...
<ul style="list-style-type: none"> ✓ STOP ✓ turn off AC power switch at rear ✓ use Philips screwdriver to remove 3 work head cover screws (arrows) ✓ note envelope containing tabs (Cu) for use in some tap settings 	<ul style="list-style-type: none"> unit is ★Ready AC power LED is not lighted 
<ul style="list-style-type: none"> ✓ view work head from wiring-side (shown) ✓ determine present setting from previous table above (example = TAP 22) 	
<ul style="list-style-type: none"> ✓ depending on the message, select the TAP on the chart which is numerically higher or lower than the present setting ✓ use slotted screw driver, loosen the wire(s) (K), (X) and (Y) or tab(s) (Cu) to be moved ✓ re-install the wire(s) and tab(s) as required by the table for the TAP you've selected ✓ ensure unused screws are tight ✓ replace work head cover with 3 screws 	
<ul style="list-style-type: none"> ✓ Navigate to Menu Selection > Heat Station ✓ select ► Modify Tap ✓ select the new tap setting ✓ ⊙ returns to Home zone 	<div>Choose Menu ► Modify Tap</div>
<ul style="list-style-type: none"> ✓ if * persists, follow instructions 	...until heating without *

3.6 Re-selecting Mains Voltage Range

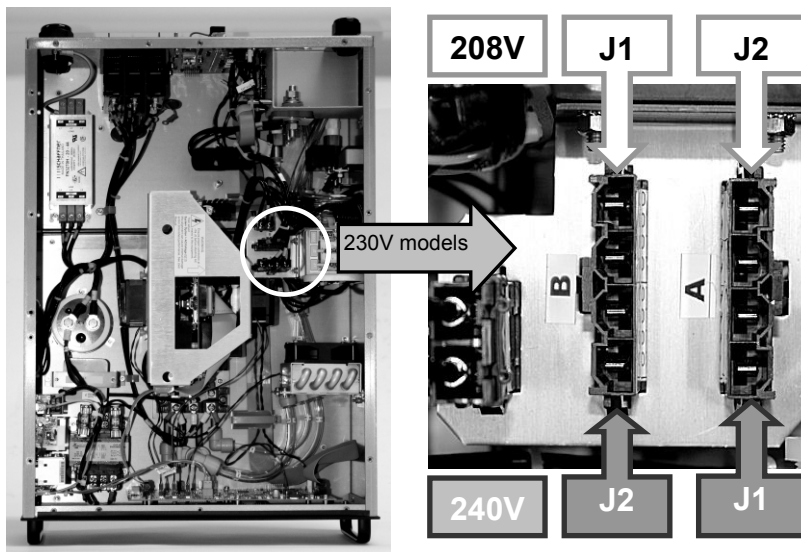
The equipment labelling indicates the mains voltage range for which your system has been configured. If you have a need to move the system into a facility with a different mains voltage range, follow these instructions:



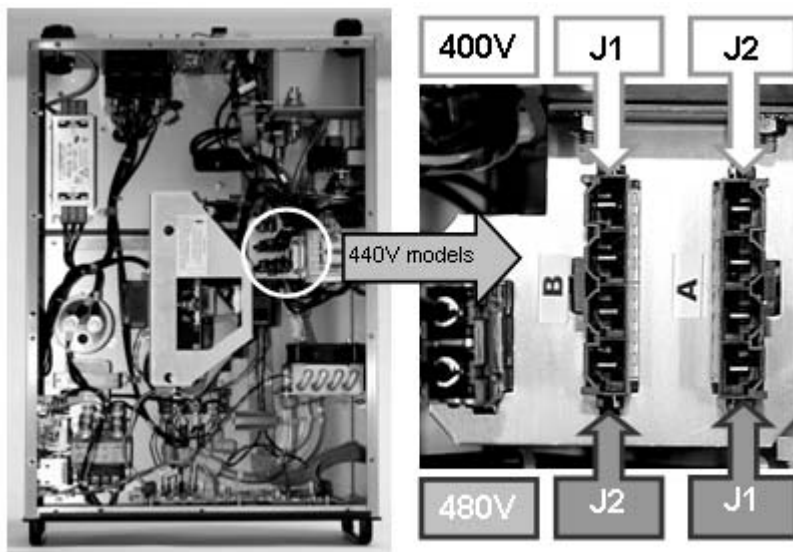
Electrical installations must be made by qualified personnel and must conform to applicable safety codes.

Do not connect 230V models to 440V mains; damage and hazard will result!

230V Models



440V Models



Do this...	Observe...
✓ STOP	unit is ★Ready
✓ turn off AC power switch at rear	AC power LED is not lighted
✓ ensure fused disconnect is open to remove all AC power from the system	
✓ use Philips screwdriver to remove power supply cover; retain cover and screws ✓ locate J1,J2 connectors (shown) ✓ to select lower mains range, set: <ul style="list-style-type: none"> • J1→B; J2→A ✓ to select higher mains range, set: <ul style="list-style-type: none"> • J1→A; J2→B ✓ replace unit cover and secure screws ✓ restore AC power ✓ Navigate to Menu Selection > System Options ✓ select ►AC voltage ✓ select the new mains range setting ✓ Ⓢ returns to Home zone	



Your system has been sealed (circle); if the seal is damaged, internal mains voltage range settings may have been changed; verify this setting before connecting to AC mains power. This label (arrow) indicates sealed mains voltage range. We provide one set of replacement seal and voltage range label.





4 Storing the System

1. Turn System off.
2. Switch off mains and disconnect the System from the mains supply.
3. Using compressed air at $P < 1.5$ bar (22psi), blow out all water circuits. This protects the water circuit and paths from corrosion, and from freezing in temperatures below 0 degrees Celsius. Make sure to apply the air to the inlet side of the water circuit.
4. Disconnect all media and media lines.
5. Cover the System with plastic sheeting to protect it from dust.
6. The System must be stored in its original packing materials.
7. The storage area's temperature/humidity should be maintained at 0-50 degrees Celsius/30-80%.

4.1 System Disposal

The end user is responsible for the proper disposal of the equipment in keeping with relevant regulations. The end user must hand over the system to either a licensed private or public disposal company, or must recycle the unit himself.

		If the end user hands over the system to a disposal company, the end user must also forward a copy of the system manual to the disposal company.
---	---	--

4.2 Sorting

Subsequent to dismantling the system, you must sort the individual system parts into their respective waste categories. Do this in accordance with the classifications contained in the current European waste catalog (EWC) or other similar statutes. The EWC catalog is valid for all waste material. It makes no difference if the waste material is destined for disposal or recycling.

5 Regulation, Efficiency and Power Measurement

5.1 RF Regulation and Efficiency

EASYHEAT is unique in the way it regulates RF output. To obtain its many benefits, EASYHEAT should be properly matched to the application.

5.1.1 Primary regulation techniques not used in EASYHEAT products:

- **Adjustable DC power supply feed into the RF power stage** - This method requires two power sections: one to adjust the DC level and the other to deliver RF. Examples of this can be found in the older Ameritherm Nova Star line, and in some competitor units. The method requires many additional components and whole circuit boards for this type of regulation. It is the most costly to produce.
- **Frequency Offset** - This approach is only appropriate in a series resonant power supply. Power regulation is obtained by adjusting the RF frequency away from resonance which reduces the output. This technique is limited with respect to wide band tuning and can be problematic for those applications where controlled frequency is required. EASYHEAT uses this as a secondary regulation technique, requiring only small frequency variations when lower percentage outputs are called for.
- **Pulse Width Modulation** - This technique is used on the EKOHEAT product line, and is commonly used in the industry.

EASYHEAT products borrow from a technique used for precision audio equipment called “Modified Delta Sigma Modulation” for most of its dynamic range. This technique switches between “run” and “coast” modes at high speeds, measuring and regulating true RMS current. The current waveform can be seen to “ring up” during run intervals, and “ring down” during coast. The intervals of each adapt to variations in load (including Q), line and frequency and can be as fast as a single RF cycle. The method results in accurate regulation while using fewer components.

EASYHEATs behave in a way similar to a current source. That is, they maintain regulation of their controlled parameter - RF current. An ideal current source would work with any load; from short circuit to open circuit (an ideal current source would also arc across an open circuit to maintain its current). Like any real current source, EASYHEAT has a finite compliance range. It protects itself when working into a shorted coil by having a very short run interval.

The load may be thought of as being in series with the coil. At any fixed tap, the EASYHEAT is presented with higher impedances corresponding to better coupling. Alternatively, an open coil or a very lightly loaded coil presents the EASYHEAT with a lower impedance. The lower the impedance, the more closely the application resembles a shorted coil with corresponding shorter run intervals.

Tapping the EASYHEAT workhead transformer is done to match an application's load impedance to the EASYHEAT's output impedance and is done at the transformer primary. Higher taps can generate higher secondary currents but at the expense of lower compliance voltage. Increasing the transformer tap causes a particular load to look like a higher impedance to the EASYHEAT. In contrast, lowering the tap will generate less current than higher taps, but it does so at a higher compliance voltage and causes the same load to look like a lower impedance.

Correct tapping is critical, assuring proper regulation and eliminating excessive peak currents (hence, voltages) from being generated at the coil and resonating capacitor.

When an EASYHEAT's workhead transformer tap has been incorrectly set to too low a tap for a particular load (worst case would be an open coil), the run interval is kept very brief as this condition is seen as approaching a shorted coil. While the generator may be able to maintain regulation at low levels and meet application requirements, the short run time is less efficient and the heat sink will run hotter than it needs to when at high levels, increasing mains current draw. Additionally, even when in regulation, short run times can require very high peak currents to meet the average current setpoint. These higher current peaks will correspond to a higher voltage peaks across the resonating capacitor and coil.

Current peaks are hardware limited to protect the power module and to protect the resonating capacitor against excessive voltage peaks as determined by the capacitor rating set at the workhead menu. An incorrectly-tapped workhead transformer can make the generator unable to achieve setpoint due to the proper action of one of these protection circuits.

In contrast, a heavily loaded coil is a poor fit for a high tap because the available voltage may not be enough to generate the desired current level, even with a continuous run interval. While operation remains efficient, output current would be unregulated and seen as not matching the setpoint.

Importantly, EASYHEAT LI limits the maximum continuous coil current to 600A. This is to keep the internal workhead buss and capacitor temperature within an acceptable level. While more current is allowed to be generated, it is only for a limited duty cycle.

In practice, the recommended method of setting the workhead transformer tap is to begin with the highest tap available and see if the needs of the application can be met. This must be done with the actual load in the coil. If the desired setpoint current cannot be reached, the “Decrease tap” message is displayed in the status page during the heat interval, and remembered as the last message in the memory page. The tap must then be incrementally decreased until regulation is achieved. Doing this yields the highest system efficiency, requires the least from the water cooling system and mains current and minimizes the peak currents and voltages required for regulation. A similar “Increase tap” message is available should the need arise.

5.1.2 Power Measurement

Typically, the front panel power display is calculated using signals derived from the mains input voltage and current and correction factors relating to efficiency of the RF conversion process. The EASYHEAT series samples information from the mains input as well, but also from the RF output. The value displayed represents an estimate of terminal power. The displayed value cannot be directly related to mains input current (and the circuit breaker limit) without taking into account power module efficiency and power factor. Both efficiency and power factor change with operating conditions.

While power factor can be removed from measurement concern by using an external measurement device that can distinguish between real and reactive power, efficiency is more problematic as it requires knowledge of the RF output power.

RF output power is particularly difficult to measure in the EASYHEAT series as RF currents can have a very high peak to average ratio, or crest factor. Conventional true RMS meters will have difficulty with this waveform at EASYHEAT frequencies and the difficulty will be compounded by the harmonics visible at the chassis terminals. Voltage waveforms will present the same problem.

The EASYHEAT normally runs at a frequency slightly offset from resonance to improve circuit efficiency, eliminating the ability to obtain accurate power measurements by simply multiplying RMS voltage with RMS current. A user planning to measure output power would require a high speed multiplying scope or similar product to give usable information. The measurement instrument must be much faster than one would expect, to accommodate harmonics. The delays on the voltage and current probes must be equalized prior to multiplication, and have a dynamic range able to accurately measure in the face of a high peak to average ratio.

Errors accumulate quickly:

- Scope input gains must be turned down to accommodate higher crest factors, resulting in loss of scope resolution and accuracy.
- The required use of two scope channels - with attendant differential phase and gain errors.
- The required use of differential voltage probes and current probes and their errors.

It is recommended that load power measurements be performed instead of terminal power, using calorimeter techniques. These techniques will include the losses of coil coupling efficiency to the load, losses in the coil, cable and heat station. While yielding a reasonably accurate load power, the result is not intended to match the RF terminal power that the EASYHEAT reports.

In general, when the workhead tap is optimized for the application, errors due to crest factor are minimized and the reported EASYHEAT power output is most accurate.

6 Technical Information

6.1 Mechanical

Power Supply

Feature	Value	Units
Dimensions	437x687x183 (17x27x7)	WxDxH mm (in)
Internal access	limited; cover secured with screws	
Mounting	19" rack or bench-top	
Weight	12.7 (28)	kg (lb)
Construction:	aluminum	
Finish	front panel black painted	



Your system uses and produces high voltages! Only trained or guided service persons are authorized inside the equipment. Always turn off the unit and remove the AC power cable before attempting any internal service.

Remote Heat Station

Feature	Value	Units
Dimensions ¹	130x286x146 (5.1x11.3x5.7)	WxDxH mm (in)
Internal access	philips-head screws	
Mounting	reference your drawing package	
Weight (no coil)	5 (11) w cable 9.1 (20)	kg (lb)
Cable	3.0 (10)	m (ft)
Bend radius	152 (6)	mm (in) min

1) includes mounting inserts; add 2" for handle

6.2 Electrical



Electrical installations must be made by qualified personnel and must conform to applicable safety codes.

Do not connect 230V models to 440V mains; damage and hazard will result!



The equipment requires a connection to earth ground and does not make use of neutral. Failure to connect earth (safety) ground will result in a potentially hazardous condition. Do not omit this step!

Equipment output

Model	3542	4048	5060	7590	8310	units
RF Terminal Power	4.2	4.8	6	9	10 ²	kW
RF Deliverable Power	3.5	4.0	5	7.5	8.3 ²	kW
AC Line Power	5.2	5.9	7.4	11.2	12.4 ²	kVA
Frequency	150 - 400					kHz
RF Coil Current ¹	750					A max

1) maximum current reduced under some operating conditions

2) De-rates linearly from 10 kW, 8.3 kW, 12.4 kVA at 205 Vac, to 9.1 kW, 7.6 kW, 11.3 kVA at 187 Vac.

Equipment input (230V models)

Model	3542	4048	5060	7590	8310	units
AC Line Power	5.2	5.9	7.4	11.2	12.4 ²	kVA
AC Line Protection	25	30	30	35	35	A
Frequency	50/60					Hz
AC Line Voltage ¹	187 - 230 or 230 - 264					Vac, 3Ø

1) Level determined by model; range factory set per order; field selectable; see §3.6 for instructions

2) De-rates linearly from 12.4 kVA at 205 Vac, to 11.3 kVA at 187 Vac.



Electrical installations must be made by qualified personnel and must conform to applicable safety codes.

Do not connect 440V models to 230V mains; damage and hazard will result!

Equipment input (440V models)

Model	3542	4048	5060	7590	8310	units
AC Line Power	5.2	5.9	7.4	11.2	12.4	kVA
AC Line Protection	15	15	15	25	25	A
Frequency	50/60					Hz
AC Line Voltage ¹	370 - 440 or 440 - 520					Vac, 3Ø

1) Level determined by model; range factory set per order; field selectable; see §3.6 for instructions

Customer input

Port	Active	Description	Limits
Remote Input	analog	0 – 10 Vdc (Zin = 21kΩ) 4-20mA (Zin = 250Ω)	see §3
Start	closed	provide isolated contact closure*	
Stop	open		
FLS	closed	opened contact = * Fault	19Vdc @ 0.1A
E-Stop	open	opened contact = stop	

*) contacts rated for 24Vdc min, required wetting current 3mA

Customer output

Port	Active	Description	Limits
Ready	closed	isolated solid-state output, non-polarized	24Vdc @ 1A
Heat On	closed		
Fault	closed		
24V dc		ground referenced	24V±2% @1A
Aux Port		0-20 mA or 4-20 mA*	
Serial Port		RS485	

* = For more information, see "Auxiliary Output Modes and Scaling Examples".

6.3 Auxiliary Output Modes and Scaling Examples

Note: Full scale power is model-dependant. For example, model 8310 has a max power of 10kW. See “Equipment Input/Output” for complete listing of specifications for all models.

0—20mA Scale in “Power” mode: Model 8310 (10,000 Watts max rated)	
Where (Power in Watts)=(Aux_out_mA)*(max power in watts)/20	
mA output	Watts
1	500
5	2,500
10	5,000
20	10,000

4—20mA Scale in “Power” mode: Model 8310	
Where (Power in Watts)=(Aux_out_mA-4)*(max power in watts)/16	
mA output	Watts
5.6	1,000
8	2,500
12	5,000
20	10,000

Note: Full scale Amps depends on the tap number in use. Refer to the Workhead Operations Manual for complete specifications. See also “Heat Station” and “Tap Adjustment”.

0—20mA Scale in “Amps” mode	
Where Max Amps = Tap*25 (i.e., tap 22 would result in a full scale value of 22*25=550 amps.)	
(Current in Amps)=(Aux_Out_mA)*(Max_Amps)/20	
mA output	Amps
0	0
2	55
10	275
20	550

4—20mA Scale in “Amps” mode	
Where Max Amps = Tap*25 (i.e., tap 22 would result in a full scale value of 22*25=550 amps.)	
(Current in Amps)=(Aux_Out_mA - 4)*(Max_Amps)/16	
mA output	Amps
4	0
6	68.75
14	343.75
20	550

All EASYHEAT LI's have a frequency range scaled to 140-410kHz.

0—20mA Scale in “Frequency” mode	
In 0-20mA scale, Frequency_in_kHz=((Aux_Out_mA*13.5) +140. For example, if Aux out is 3.59mA, then 3.59*13.5+140=188.46 kHz.	
mA output	Frequency in kHz
0	140
3	180.5
12	302
20	410

4—20mA Scale in “Frequency” mode	
In 4-20mA scale, Frequency_in_kHz=(Aux_Out_mA-4) *(16.875) +140. For example, if Aux out is 14.88mA, then (14.88-4)*(16.875) +140=323.6kHz.	
mA output	Frequency in kHz
4	140
7	190.6
16	342.5
20	410

Note: The Auxiliary Output is updated about three times a second when the heat is on, under internal computer control. When mains power is first applied, there is an interval of about a second during which the computer is coming out of reset. During this time, approximately 35mA may be seen at the output.

6.4 Environmental

Value	Range		Units
ambient temp	4 – 41 (40 – 105)		°C (°F)
water temp ¹	20 – 35 (68 – 95)		
	3542	other models	
flow (system minimum)	3.8 (1.0)	5.7 (1.5)	l/m (g/m)
pressure ²	2.8 – 5.5 (40 – 80)		bar (lb/in ²)
pH	7		pH
conductivity	less than 50000		μS
resistivity @25°C	greater than 2000		Ω•cm
solids	less than 150		ppm

1.) Water temperature must not fall below the dew point in any case; condensation may result in nuisance problems or damage to the equipment

2.) You must ensure that the differential (inlet minus outlet) pressure falls within this range.

6.5 Contact Information

USA

Ambrell
39 Main Street
Scottsville, NY 14546
www.ambrell.com
Tel: +1 585 889 9000
Fax: +1 585 889 4030

United Kingdom

Ambrell Ltd.
Phoenix Works, Saxon Way
Cheltenham, Gloucestershire GL52 6RU
salesuk@ambrell.com
Tel: +44 (0)1242 514042
Fax: + 44 (0)1242 312011

France

Ambrell Sarl
Tour Sébastopol, 3 quai Kléber
67000 Strasbourg
France
saleseu@ambrell.com
Tél: +33 970 440 335
Fax: +33 367 840 019

Netherlands

Ambrell BV
Holtersweg 1
7556 BS Hengelo
The Netherlands
saleseu@ambrell.com
Tel: +31 (0)88- 0150100
Fax: +31 (0)546 788 154

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