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OPERATOR MANUAL 990-228
Revision D September 2007

UNIFLOW® 2
PULSED THERMODE CONTROL
(BIPOLAR LOGIC)



MODEL NUMBERS

1-292-01 1-292-01-01 1-292-01-02

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REVISION RECORD

Revision	EO	Date	Basis of Revision
A	19896	12/03	Original Release.
B	19957	2/04	Added Communication *Appendix D, Communication* and *Appendix E, Guide to Reflow Soldering*.
C	20174	11/04	Updated technical information.
D	21578	9/07	Added checksum to communications.

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CONTACT US

Thank you for purchasing a Unitek Miyachi® Uniflow® 2 Pulsed Thermode Control. Upon receipt, please inspect it thoroughly for shipping damage ***before*** you install it. If there is any damage, contact the shipping company immediately to file a claim, and notify Unitek Miyachi at:

Unitek Miyachi
1820 South Myrtle Avenue
P.O. Box 5033
Monrovia, CA 91017-7133

Telephone:	**(626) 303-5676**
FAX:	**(626) 358-8048**
e-mail:	**info@unitekmiyachi.com**

The contents of this manual are subject to change without notice. If you have any questions, or find any errors or omissions in this manual, please contact us.

Unitek Miyachi is not responsible for any losses due to improper use of this product.

SAFETY PRECAUTIONS

General

This instruction manual describes the operation and maintenance of the Control and provides instructions relating to its safe use. Procedures described in this manual ***must*** be performed as detailed by ***Qualified*** and ***Trained*** personnel.

For ***Safety***, and to effectively take advantage of the full capabilities of the Control, please read this instruction thoroughly ***before*** attempting to use it.

After reading this manual, retain it for future reference when any questions arise regarding the proper and ***safe*** operation of the Control.

Operation

Procedures other than those described in this manual or not performed as prescribed in this manual, may expose personnel to ***electrical shock*** or ***DEATH***.

When operating any Reflow unit, ***always*** wear appropriate personal protective gear.

Maintenance/Service

Before performing any maintenance on the Control unit, read *Chapter 5, Maintenance* thoroughly. Use the appropriate tools for terminating the connecting cables, being careful not to nick the wire conductors.

Do ***not*** modify the Control without prior written approval from Unitek Miyachi.

HIGH VOLTAGE is used in the operation of this equipment.

DEATH ON CONTACT may result if personnel fail to observe the safety precautions labeled on the equipment and noted in this manual.

WHEN REFLOWING ***always*** wear safety glasses.

Before using this equipment, read the **SAFETY PRECAUTIONS** carefully to understand the correct usage of the equipment.

- These precautions are given for safe use of the equipment and for prevention of injury to operators or others.
- Be sure to read each of the instructions, as they are all important for safe operation.
- The meanings of the words and symbols are as follows:

⚠ WARNING

Denotes operations and practices that may result in serious injury or loss of life if not correctly followed.

⚠ DANGER

Denotes operations and practices that may imminently result in serious injury or loss of life if not correctly followed.

⚠ CAUTION

Denotes operations and practices that may result in personal injury or damage to the equipment if not correctly followed.



These symbols denote **PROHIBITION.** They are warnings about actions that should ***not*** be performed because they can damage the equipment and will void the warranty.



These symbols denote actions which operators ***must*** take.



Each symbol with a triangle denotes that the contents gives notice of **DANGER, WARNING,** or **CAUTION** to the operator.

⚠ DANGER



DO NOT TOUCH THE INSIDE OF THE CONTROL UNNECESSARILY.

High Voltages are present inside the Control Cabinet. Do ***not*** touch the inside of the Control unnecessarily with the power turned ON. You may receive an electric shock. When inspecting the inside of the Power Supply, be sure to turn the power source OFF.



NEVER DISASSEMBLE, REPAIR, OR MODIFY THE CONTROL.

These actions can cause electric shock and fire. Do ***not*** do anything other than the maintenance described in the Operator Manual.

WARNING



Do NOT put your hands or fingers on the Thermode.

When soldering, keep your hands and fingers away from the thermode.



Do NOT touch any soldered part or Thermode during, or just after reflow soldering.

The soldered parts and the Thermode are very ***hot***. If you touch them you may be burned.



Ground the equipment.

If the equipment is not grounded, you may get an electric shock.



Use a ground fault breaker.

Use a ground fault breaker to prevent an electric shock.



Only use specified cables.

A cable with insufficient capacity or loose connections can cause electric shock or fire.



Do NOT use a damaged power cable, connecting cables, or plugs.

Do ***not*** step on, twist, or tense any cable. The power cable and connecting cables may be damaged which can cause electric shock, short circuit, or fire. If any part needs to be repaired or replaced, consult Unitek Miyachi or your distributor.



Stop operation if any trouble occurs.

If you detect a burning smell, abnormal sounds, abnormal heat, smoke, etc., turn power OFF immediately to prevent fire or electric shock. Contact Unitek Miyachi or your distributor for help.



People with pacemakers MUST stay away from the Control.

When the Control is operating, it generates a magnetic field, which adversely affects pacemakers. People who use a pacemaker must ***not*** approach the Control, or walk around the soldering shop while the Control is operating, ***unless*** their medical doctor has deemed it safe to do so.



Wear protective gear.

Put on protective gear such as protective gloves, long sleeved jacket, and leather apron to avoid being burned.

CAUTION



Apply the specified source voltage.

Applying the ***wrong*** voltage can cause fire and electrical shock.



Keep water and water containers away from the Control.

Water spilled on the Control can cause a short circuit, electrical shock, or fire.



Use proper tools (wire strippers, pressure wire connectors, etc.) for terminations of the connecting cables.

Do ***not*** nick the wire conductor. Doing so can cause a short circuit, electric shock, or fire.



Install the Control on a firm, level surface.

Injury may result if the Control falls over or drops from an uneven surface.



Keep combustible matter away from the Control.

Spatter can ignite combustible materials. If you cannot remove all combustible materials, cover them with a non-combustible material.



Do NOT cover the Control with a blanket, cloth, etc.

Heat generated by the operating Control may ignite a blanket or cover.



Keep a fire extinguisher nearby.

Make sure there is a fire extinguisher in or near the shop in case of fire.



Regularly inspect and maintain the Control.

Regular inspection and maintenance is essential to safe operation and long life of the equipment. If you see any damage, make necessary repairs before operation.

CHAPTER 1
DESCRIPTION

Section I: Features

Overview

For the rest of this manual, the **Uniflow® 2 Pulsed Thermode™ Control** will simply be referred to as ***the Control***. This manual describes the most common or "typical" components and options. If you have questions about custom items in your Control that are not covered in this manual, contact Unitek Miyachi using the phone, e-mail, or mailing information in the *Foreword* of this manual.

The Control is a power supply designed for reflow soldering or heat sealing electronic interconnections using a precisely controlled temperature profile.

The design of the Control is directed toward compactness, reliability, safety and simplicity, and ease of repair.

The operator is coached by visual displays on a Liquid Crystal Display (LCD) screen if out-of-range entries are made, or when alarm/error conditions occur.

Up to 15 heat profiles (the records containing the joining parameters to be used during the joining cycles) can be programmed, stored, and recalled for use.



Reflow soldering is a multi-step metal joining process where:

- Two solder-coated parts are brought into intimate contact, using a preset force.
- The temperature of the two parts is raised to a preheat temperature for a preset time to activate the pre-applied flux. The flux removes the surface oxides from the solder-plated parts.
- The temperature is then raised to the reflow temperature for a pre-set time to melt the solder between the parts.
- Cooling is then initiated to allow the solder to solidify.
- Upon reaching the pre-set cool temperature, the reflow head can be retracted, removing force from the parts.

Control Models

The standard model of the Control has a front panel with controls and a display for operator control of the Control.

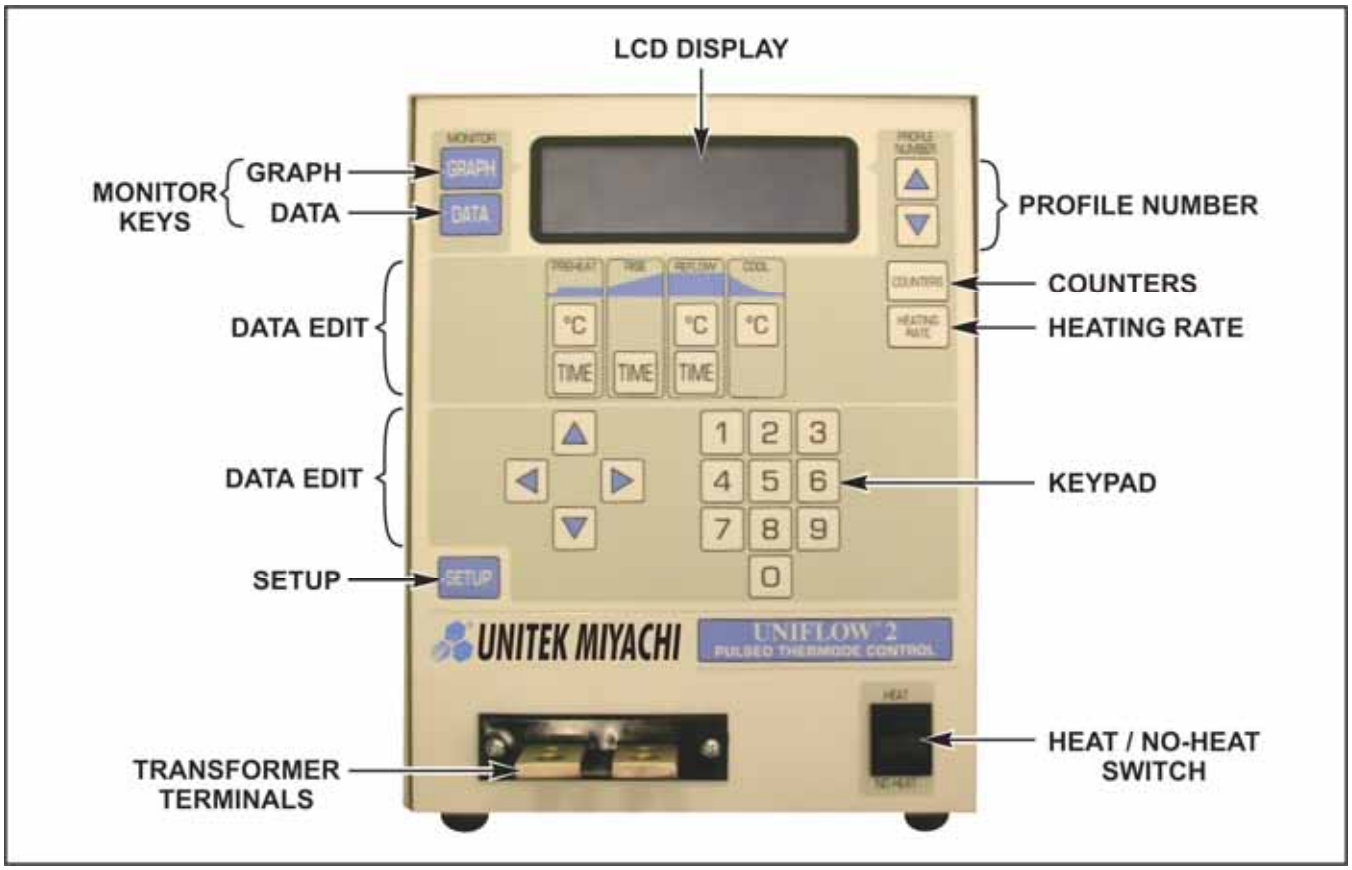
Model/Part #	Type of Operation	AC Input Voltage	Output Heating Capability
1-292-01	**Front panel.** Has front panel controls and display for local operator programming. 24 VAC valve outputs	120	2 KVA For thermodes up to 2.3" (60 mm) long
1-292-01-01	**Front panel.** Has front panel controls and display for local operator programming. 24 VAC valve outputs	240	4 KVA For thermodes up to 4" (100 mm) long
1-292-01-02	**Front panel.** Has front panel controls and display for local operator programming. 24 VDC valve outputs	240	4 KVA For thermodes up to 4" (100 mm) long

Heads, Thermodes and Accessories

For details of solder reflow and heat seal heads, thermodes and accessories available from Unitek Miyachi, see Technical Manual 990-230, *Applying Process Control to Pulse Heated Reflow Soldering,* or contact Unitek Miyachi using the phone, e-mail, or mailing information in the *Foreword* of this manual.

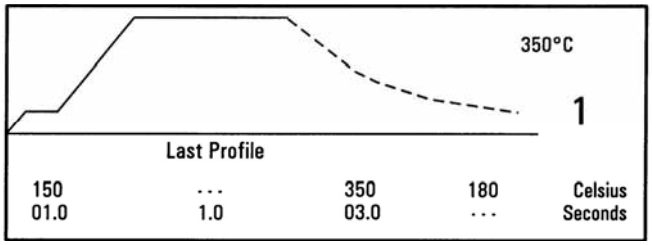
Section II: Controls and Indicators

Front Panel



Display (LCD)

The LCD on the front panel displays both graphic and alphanumeric data depending on the function chosen by the Operator.



Graphic Data

< SETUP MENU >

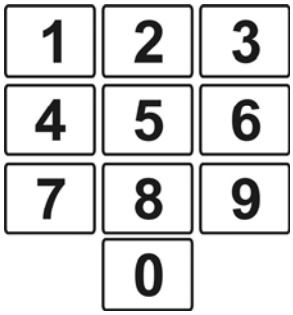
1. HARDWARE SETUP
2. COMMUNICATIONS
3. REFLOW SETUP
4. SYSTEM SECURITY
5. COPY PROFILE

NUMBER Select an item, Graph or Data

Alphanumeric Data

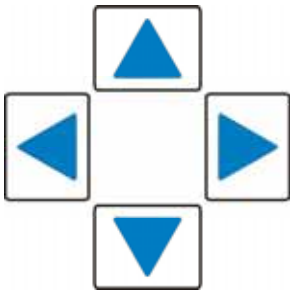
NOTE: These screens, their functions and displays are described in *Chapter 3, Using Uniflow 2™ Programming Functions*.

Keypad



The keypad allows you to edit the numeric values of the display screens.

Cursor Keys

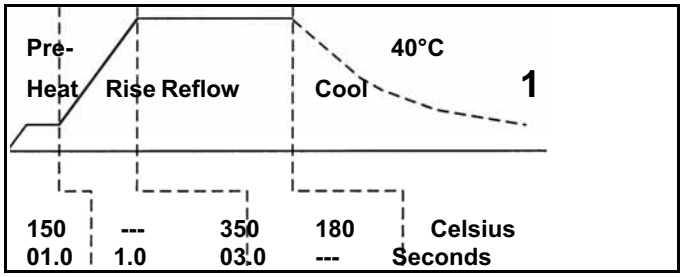


The cursor keys allow you to move the editing cursor up, down and sideways. You use the ▲ (Up) and ▼ (Down) keys to select multiple pages in a single menu or setup screen. You use the ◄ (Left) and ► (Right) keys to decrease or increase a numeric field value.

Graph Key



This key displays the graphic screen for editing the heat profile parameters with the keypad or cursor keys. After editing the heat profile parameters, pressing the **GRAPH** key saves the new parameters to the heat profile noted on the display. Pressing the **GRAPH** key while in the setup, counter, or heating rate menus returns the Control to the graphic display mode.



DATA Key



The **DATA** key brings up the data screen to the display.

The data screen reports the most recent heat cycle parameters in numerical format: time, temperature, duty cycle, and counter status (when enabled). You may initiate the **HEAT** cycle while the **DATA** screen (rather than the graphic screen) is displayed.

```
TEMPERATURE:   Thermode =              40°C
  Peak= 354°C Final=351°C  Average = 349°C
TIME: (Seconds)   Preheat =01.0    Rise = 01.0
Heat= 03.0       Cool= 05.5    Total= 009.5
PROFILE:  2   RATE=Medium
          System Ready
Reflows before cleaning       =  +000250
Reflows before replacement  =  +000500
```

PROFILE NUMBER ▲▼ Keys



With the graphics screen on the display, these keys will increment/decrement the heat profile number on the graphics screen. With the data screen on the display, pressing either **PROFILE NUMBER** key returns the graphics screen to the display; the keys will then increment/decrement the profile number on the screen. The **PROFILE NUMBER** up/down keys are disabled when any screen other than the graphic screen or data screen is on the display.

The number of possible heat profiles than can be stored ranges from 1 to 15.

COUNTERS Key



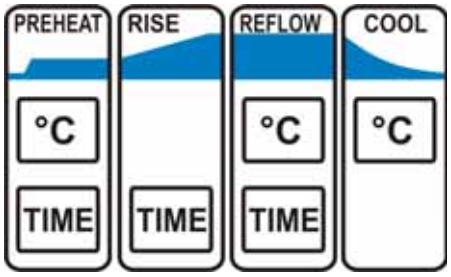
This key brings up the **REFLOW COUNTERS** screen.

This screen provides a menu of selections for setting the thermode cleaning and thermode replacement counters, and choosing responses to the counter settings.

```
              < REFLOW COUNTERS>
1. TOTAL USAGE COUNTER        : 0000020
2. GOOD REFLOW COUNTER        : 0000010
3. CLEAN COUNTER            : +999999
4. REPLACE COUNTER            : +999999


NUMBER Select an item,    Graph or Data
```

DATA EDIT Keys



The data edit keys allow you to edit the time and temperature parameters of the heat profile on the graphic display. The **PREHEAT**, **RISE**, **REFLOW** and **COOL** keys are vertically aligned with the profile heating states as displayed on the graphic screen.

These keys are ***only*** active when the graphic screen is displayed.

HEATING RATE Key



The **HEATING RATE** key brings up the **MANUAL TUNING** screen. This screen screen allows you to go to the **SET COARSE HEATING RATE** and **SET FINE HEATING RATE** heating rate capability to match the heat generating capability of the thermode to minimize the temperature overshoot and undershoot. See *Chapter 3, Using Programming Functions* for details.

<MANUAL TUNING >
1. Set Coarse Heating Rate : MEDIUM
2. Set Fine Heating Rate : 98%

NUMBER Select an item, Graph or Data

<SET COARSE HEATING RATE >
1. Very Slow
2. Slow
3. Medium
4. Fast

NUMBER Select , ▲ Page, Graph or Data

SETUP Key



This key brings up the **SETUP MENU** screen.

The **SETUP MENU** screen provides a menu of operating characteristics for the Control.

< SETUP MENU >
1. HARDWARE SETUP 4. SYSTEM SECURITY
2. COMMUNICATIONS 5. COPY PROFILE
3. REFLOW SETUP

NUMBER Select an item, Graph or Data

HEAT / NO HEAT Switch



When this switch is in the **HEAT** position, the programmed profile can initiate heating energy.

When you set the switch to the **NO HEAT** position, no heating current can flow. This function is required to adjust a new thermode to the work pieces prior to initiating a heating cycle.

CHAPTER 2
INSTALLATION AND SETUP

Section I: Planning for Installation

Space Requirements

Dimensions (including all projections from the housing, but ***excluding*** cabling):

Height: 12.5 inches (317 millimeters)

Width: 10 inches (254 millimeters)

Depth: 20.75 inches (527 millimeters)

Weight:

4 KVA models: 58 pounds (26.3 kilograms)
2 KVA models: 46 pounds (20.86 kilograms)

- Install the Control in a well-ventilated area that is free from excessive dust, acids, corrosive gases, salt and moisture.
- Allow sufficient clearance around both sides and back of the Control for power and signal cabling runs, and to ensure adequate inflow and exhaust of air for the cooling system.
- Allow ample workspace around the Control so that it will not be jostled or struck while in use.
- The work surface must be level, stable, free from vibration, and capable of supporting the combined weight of the total joining system.
- There are no sources of high-frequency energy close by.

Utilities

Input power requirements for the Control are as listed below.

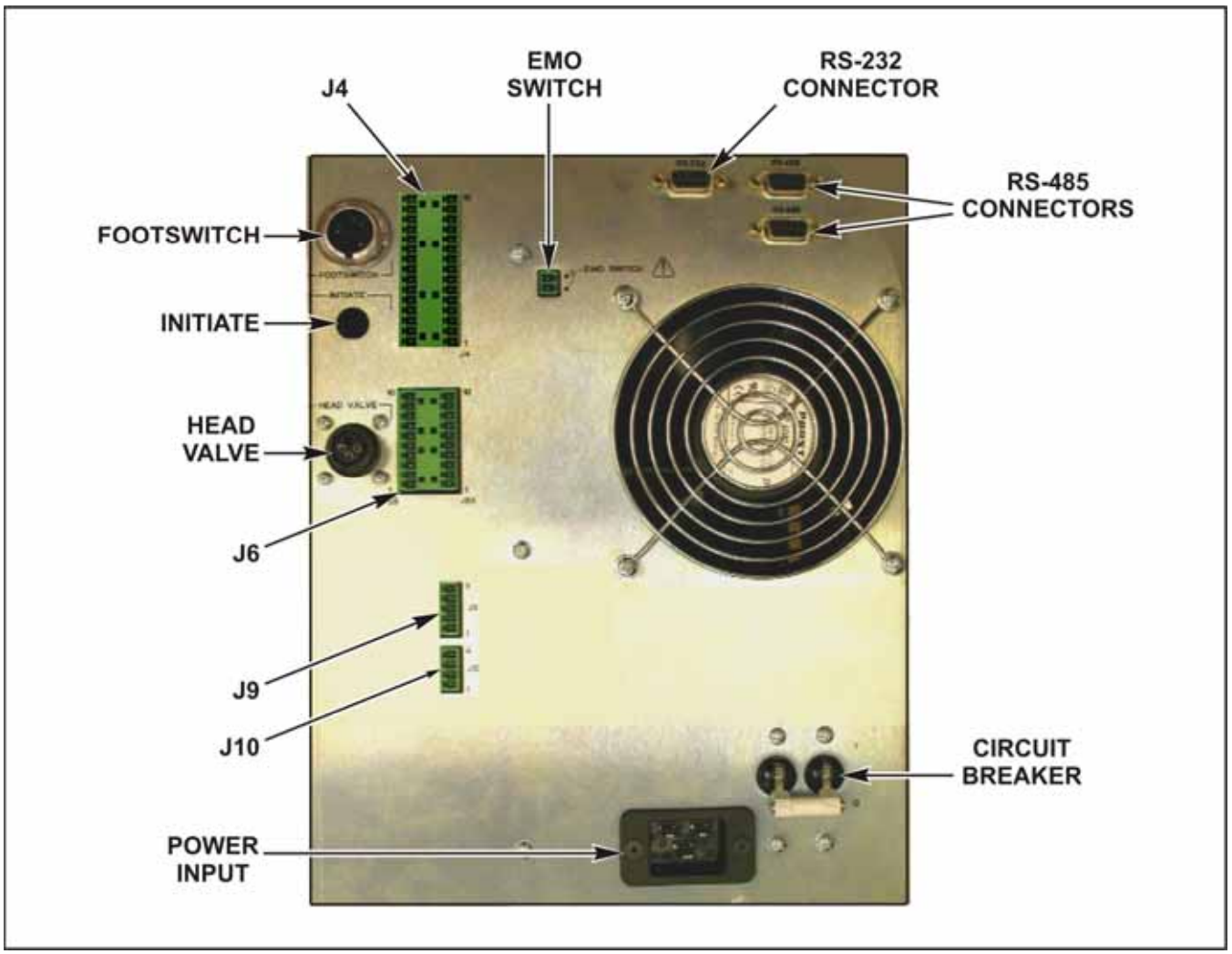
Control Model	Input Voltage, 50 or 60 Hz, Single phase (Vrms)	Circuit Breaker Rating (Amps)
1-292-01	120	15
1-292-01-01 & 1-292-01-02	240	

Section II: Connections To External Equipment

Overview

All connections, other than the transformer cable connections, between the Control and external equipment are made through the rear panel. The transformer cable connections from the reflow soldering or heat seal head are made at the transformer cable terminals on the front panel.

NOTE: If you require compressed air, cover gas, and cooling water service for the reflow soldering or heat seal head, please refer to the head manufacturer's user's manual for service specifications.



Input Power Connections

CAUTION

Be sure that the source power is appropriate for your Uniflow 2 Control model.

Connect the Control power cable to a single-phase, 50/60Hz power source. The nominal voltage range for each model is set at the factory: either 100 to 120 VAC, or 208 to 240 VAC.

Control to Head Connections

To connect the Control to the reflow soldering or heat seal head, refer to the head manufacturer's manual as you follow the instructions below.

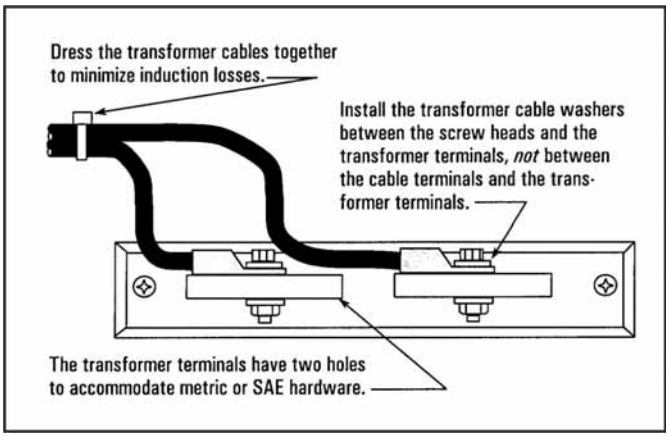
1. Connect the reflow soldering or heat seal head thermocouple cable to Control terminal block **J9**.

   NOTES:

   - The connector is keyed so that it cannot be installed improperly.
   - Do ***not*** run thermocouple cables next to the power cables (together) in order to reduce noise pickup.
   - If you are using two individual thermocouple wires, they ***must*** be twisted together in order to reduce noise pickup.
   - The Control will ***not*** respond to an initiation signal until the thermocouple is properly connected. The LCD will display an error message if the thermocouple is not connected.

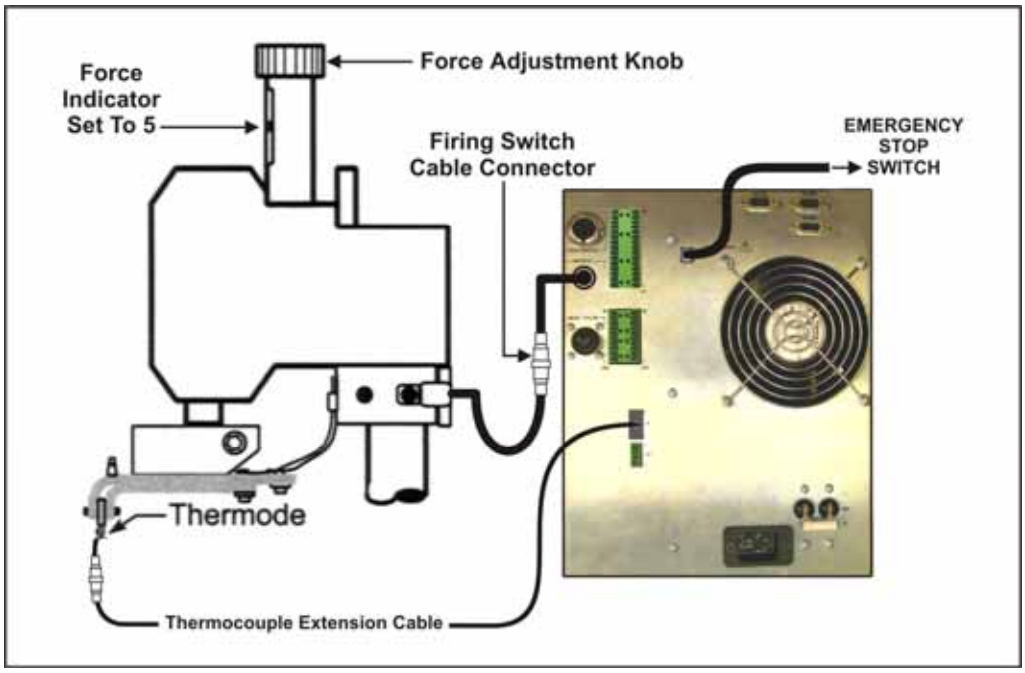
2. Plug the green **CONTROL INPUT JUMPER** plug (marked **P4B)** into connector **J4B** on the rear panel.
3. Connect the data interface connectors on the rear panel to the PLC using the Phoenix-type connector, J6A/J6B
4. If you are working in a CE standards environment using an Emergency Stop Switch, it ***must*** be connected across pins 1 and 2 of the **EMO SWITCH** connector. If you are ***not*** using an Emergency Stop Switch, you ***must*** install the EMO jumper plug on the **EMO SWITCH** connector. This plug shorts Pins 1 and 2, labeled **EMO SWITCH** on the rear panel. See *Appendix B, Electrical and Data Connections* for details.

5. Connect the two transformer cables from the head to the transformer terminals on the Control front panel.



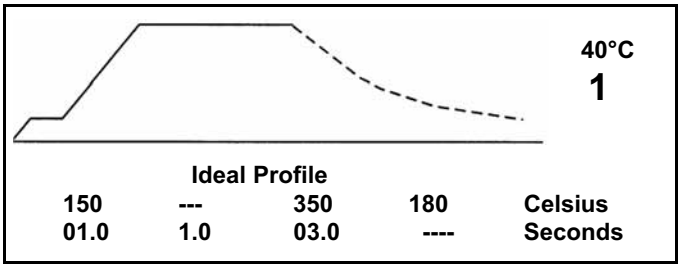
Section III: Equipment Setup

Force Fired, Mechanically Actuated Head

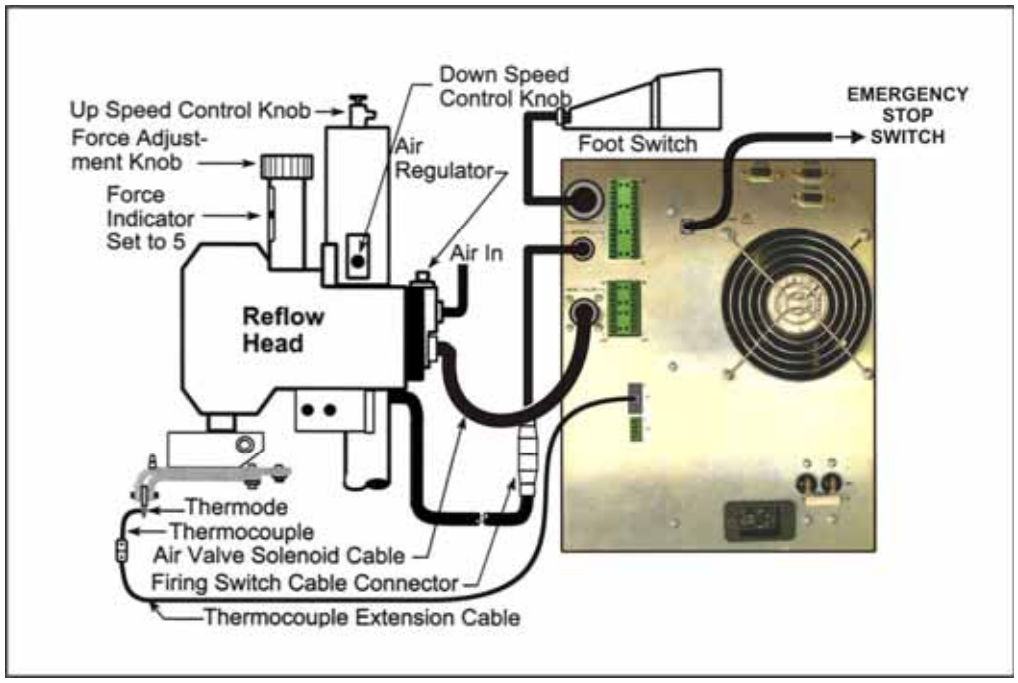


1. Adjust the reflow soldering head force adjustment knob to produce 5 units of force, as displayed on the force indicator index.
2. Connect the reflow soldering head firing switch cable connector to the Control firing switch **INITIATE** cable connector.
3. Remove the **EMO** jumper on connector EMO, pins 1 and 2 on the Control rear panel.
4. Connect a normally closed, CE approved, emergency stop switch to connector EMO, pins 1 and 2 on the Control rear panel. (See *Appendix B, Electrical and Data Connections* for more details.)

   NOTE: If Connector EMO, Pins 1 and 2, on the rear panel are ***not*** shorted, either by an EMO switch or the jumper plug, this screen will include the message: **NOTE: EMO JUMPER NOT INSTALLED**.
5. Set the **HEAT/NO HEAT** switch on the Control front panel to the **NO HEAT** position. In this position, the Control cannot deliver heating energy to the thermode.
6. Set the circuit breaker on the rear panel of the Control to the ON position. The default graphic screen will display. You will use this screen to enter heating parameters.



Force Fired, Air Actuated Head



1. Adjust the head force adjustment knob to produce **5** units of force, as displayed on the force indicator index.
2. Connect the head firing switch cable connector to the Control firing switch **INITIATE** cable connector.
3. Remove the **EMO** jumper on connector EMO, pins 1 and 2 on the Control rear panel.
4. Connect a normally closed, CE approved, emergency stop switch to connector EMO, pins 1 and 2 on the Control rear panel. (See *Appendix B, Electrical and Data Connections* for more details.) When this switch is operated (open), it will immediately stop the heating cycle and retract the thermode from the parts.

   NOTE: If Connector EMO, Pins 1 and 2, on the rear panel are ***not*** shorted, either by an EMO switch or the jumper plug, this screen will include the message: **NOTE: EMO JUMPER NOT INSTALLED**.
5. Using the air-head manufacturer's user manual for reference, connect the head air valve solenoid cable connector to the Control **HEAD VALVE** connector.

   NOTE: This connector supplies 24 VDC or 24 VAC power only -- it will ***not*** drive 115 VAC air valves.

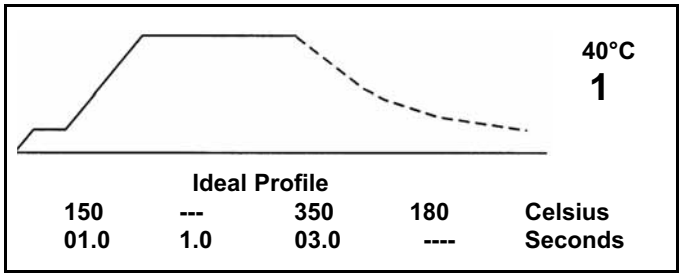
6. Connect a properly filtered air line to the air inlet fitting on the head. Use 0.25 inch O.D. by 0.17 inch I.D. plastic hose with a rated burst pressure of 250 psi. Limit the length of the air line to less than 40 in. (1 m) or thermode motion will be very slow.

   NOTE: Use a lubricator ***only*** with automated installations.

7. Turn on the air system and check for leaks.

8. Set the **HEAT/NO HEAT** switch on the Control front panel to the **NO HEAT** position. In this position, the Control can ***not*** deliver heating energy to the thermode, but it ***will*** automatically control the head.

9. Set the circuit breaker on the rear panel of the Control to the ON position. The default graphic screen will display. You will use this screen to enter heating parameters



10. Turn the air regulator clockwise to produce **10 psi** on the air regulator pressure gauge.

11. Press the foot switch down to close the first level, and hold the foot switch at the first level. The thermode should descend to the parts.

12. If the parts are properly positioned under the thermode, press the foot switch to the second (bottom) level. The Control should begin a process cycle without applying heat and the head should immediately retract. If the head ***does*** retract, go to Step 14. If the head does ***not*** retract, go to Step 13.

13. Increase air pressure in **5 psi increments** and repeat Steps 11 and 12 until the thermode automatically retracts at the end of the process cycle.

14. Press the foot switch to actuate to the first level. The thermode should descend smoothly to the surface of the parts. When it reaches the parts, release the foot switch and go to Step 16. If it does not descend ***smoothly***, go to Step 15.

15. Adjust the head down speed control knob and repeat Step 14 until the thermode descends smoothly.

16. Press the foot switch to actuate the first level and set the thermode on the parts. Release the foot switch and verify that thermode does ***not*** impact during retraction. If it ***does*** impact during retraction, go to Step 17.

17. Repeat Step 16, adjusting the Head Up Speed Control Knob until the thermode does ***not*** impact at the UP position.

CHAPTER 3
USING PROGRAMMING FUNCTIONS

Overview

To ensure accurate, consistent soldering, the Control delivers extremely precise pulses of energy to the reflow head. Each pulse is comprised of time and energy values pre-programmed by the user. *Chapter 1, Description* told you *where* the Controls and Indicators are located. This chapter describes *how to use* them in order to program the precise temperature profiles needed for reflow soldering or heat sealing electronic interconnections.

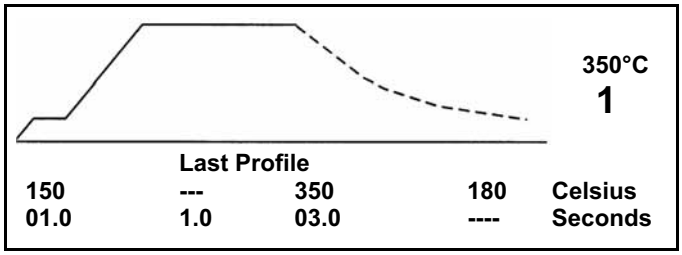
Front Panel Display

The LCD on the front panel displays both the graphic and numeric heat profile information before a heating cycle. It also shows the results of a heating cycle following its completion. The display has several functions, depending on the active mode of the Control.

Run Mode

Press the **GRAPH** or **DATA** key to enter the **RUN** mode. With the graphic screen on the display:

- Reports the current thermode temperature in the upper right hand corner, the heat profile number, the time and temperature settings of the current heat profile.

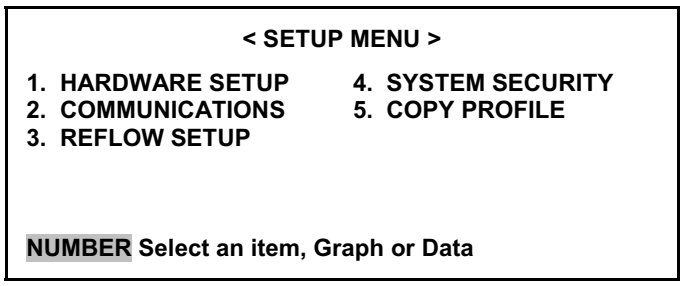


- Displays the time and temperature settings while in the editing (non-heating) mode. For details, refer to *Data Edit Keys* later in this chapter.
- Displays the correct range of parameters if you request values that are outside the acceptable range.
- With the data screen on the display, reports the results of the last heating cycle numerically. For details, refer to *DATA Key* later in this chapter.

Setup Mode

Press the **SETUP** key to enter the setup mode. In the setup mode, the display presents system setup options for you to select.

For details, refer to *SETUP Key* later in this chapter.



Graph Key

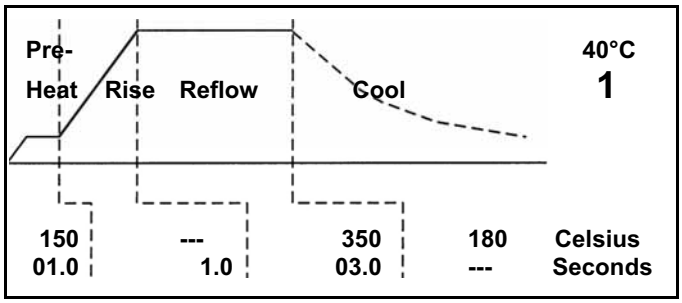


This key displays the graphic screen for editing the heat profile parameters with the keypad or cursor keys. After editing the heat profile parameters, pressing the **GRAPH** key saves the new parameters to the heat profile noted on the display. Pressing the **GRAPH** key while in the setup, counter, or heating rate menus returns the Control to the graphic display mode.

NOTE: The vertical broken lines and curve captions are shown only to identify the four profile states.

Graph Curve

An approximate analog representation of the profile. The Cool time axis is foreshortened for convenient viewing.



Preheat

You can use **Preheat** to activate flux for removing solder oxides between solder plated parts. You can also use **Preheat** to reduce warping on large thermodes by decreasing the temperature difference between **Preheat** and **Reflow** periods.

The temperature for this state is displayed as 150°C (note the Celsius units at the right hand side of the screen) and 01.0 seconds. **Preheat** can be set from 0 to 99.9 seconds. When it is set to 00.0, the **Preheat** state is omitted from the heat profile.

Rise

You use **Rise** to reduce the thermode warping caused by rapidly heating from the **Preheat** setting to the **Reflow** setting. **Rise** is shown as being set for 1.0 seconds. It can be set from 0 to 9.9 seconds. When it is set to 0.0, the **Rise** state is omitted. The rise time you select will ***not*** necessarily be implemented, depending on the lower temperature limit that you select (see *Lower Temperature Limit* in the *Reflow Setup* section later in this chapter).

For example, if you select a rise time of 2 seconds, a reflow temperature of 350°C, and a lower temperature limit of 340°C, a rise time of 1.7 seconds instead of 2 seconds will be reported on the data screen if the reflow temperature reaches 340°C in 1.7 seconds.

Reflow

You use the **Reflow** period to actually melt the solder for a reflow solder joint, or set thermoplastic or thermoset conductive adhesives for a heat-seal joint.

NOTE: The Reflow temperature will always be higher than the actual melting point of the solder or heat seal adhesives due to heat losses in both the thermode and parts.

Reflow is shown as having a time-at-temperature of 3.0 seconds and a set-point temperature of 350°C. Time-at-temperature can be set for 0.1 to 99.9 seconds. Set-point temperature can be set from 60°C to 600°C.

Cool

You use **Cool** to ensure that a solder joint or heat seal adhesive has solidified. An air actuated reflow soldering head or a heat seal head retracts the thermode from the parts upon reaching the **Cool** temperature. The Cool parameter shows 180°C. The **Cool** time is not controlled.

Profile Number

The large 1 shown at the right-hand side of the screen is the number of the currently displayed heat profile. The number of the profile to be displayed is selected with the **PROFILE NUMBER ▲▼** keys and may range from 1 to 15.

Present Temperature

The present temperature of the thermode, shown in the example screen as 40C, is displayed in the upper right-hand corner of the graphic screen.

DATA Key



The **DATA** key brings up the data screen to the display. The data screen reports the most recent heat cycle parameters in numerical format: time, temperature, and counter status (when enabled).

You may initiate the **HEAT** cycle while the **DATA** screen (rather than the graphic screen) is displayed.

TEMPERATURE: Thermode= 40 °C

Peak= 354°C	**Final=351°C**	**Average=349°C**
TIME: (Seconds)	**Preheat = 01.0**	**Rise = 01.0**
Heat= 03.0	**Cool= 05.5**	**Total= 009.5**
PROFILE: 2	**RATE=Medium**	
	System Ready	

Reflows before cleaning = +000100
Reflows before replacement = +000500

PROFILE NUMBER ▲▼ Keys



With the graphics screen on the display, these keys will increment/decrement the heat profile number on the graphics screen. With the data screen on the display, pressing either **PROFILE NUMBER** key returns the graphics screen to the display; the keys will then increment/decrement the profile number on the screen. The **PROFILE NUMBER** up/down keys are disabled when any screen other than the graphic screen or data screen is on the display.

The number of possible heat profiles than can be stored ranges from 1 to 15.

COUNTERS Key



This key brings up the **REFLOW COUNTERS** screen.

This screen provides a menu of selections for setting the thermode cleaning and thermode replacement counters, and choosing responses to the counter settings.

NOTE: With this and all other menu screens on the display, you will not be able to initiate the heating cycle.

```
< REFLOW COUNTERS >
1. TOTAL USAGE COUNTER    : 0000020
2. GOOD REFLOW COUNTER    : 0000010
3. CLEAN COUNTER          : +999999
4. REPLACE COUNTER        : +999999

NUMBER Select an item,     Graph or Data
```

Total Usage Counter

Press the **1** key to edit the total usage counter. With the numeric keys, you may select a number up to 9999999. The selected number is the total number of reflows completed since the counter was last edited. When that number is reached, an alarm will be set.

Good Reflow Counter

Press the **2** key to edit the good reflow counter. This option is the same as the total usage counter except that only good reflows are counted.

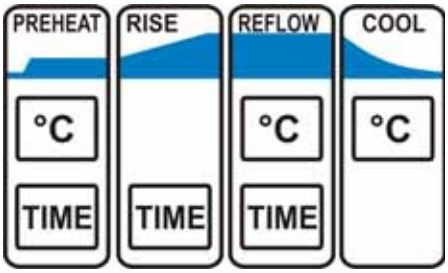
Clean Counter

Press the **3** key to edit the clean counter. The count that you enter will raise an alarm to signal the operator to remove baked-on flux and other residues from the face of the thermode. Particle buildup slows down heat transfer from the thermode to the parts. Use an initial **Clean Thermode** value that is based on real factory operating conditions.

Replace Counter

Press the **4** key to edit the replace counter. The count that you enter will raise an alarm to signal the operator that it is time to replace the thermode. Thermodes ultimately fail due to repeated heat cycles that cause internal cracking, slowing down heat generation in the thermode. In addition, repeated heating cycles cause the thermocouple junction to oxidize and, eventually, break free of the thermode.

DATA EDIT Keys

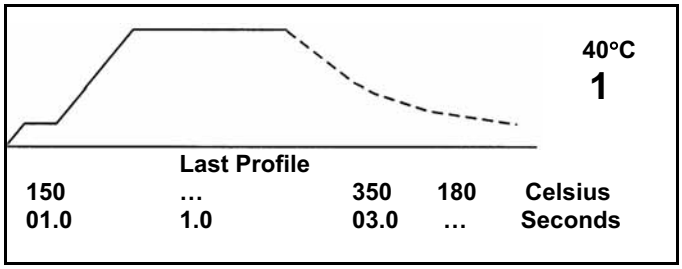


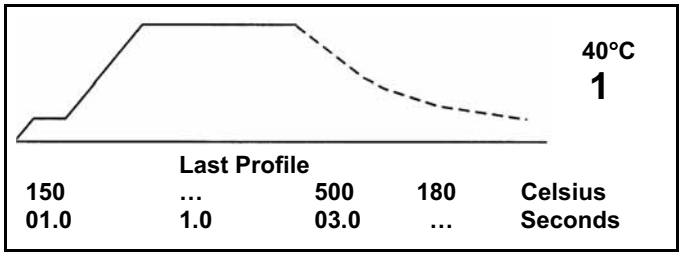
The data edit keys allow you to edit the time and temperature parameters of the heat profile on the graphic display. The **PREHEAT**, **RISE**, **REFLOW** and **COOL** keys are vertically aligned with the profile heating states as displayed on the graphic screen.

The keys are ***only*** active when the graphic screen is displayed.

Example: To change the temperature of the Reflow period for Heating Profile 1 to 500°C:

1. Press the **GRAPH** key to display the graphic screen.
2. Press the data edit **REFLOW [°C]** key. The **Reflow** temperature value of 350 will now be highlighted.
3. Enter **500** with the keypad.
4. Press the **GRAPH** key to store the new **Reflow** temperature value to **Heating Profile 1**. The graph will now display **500** as shown on the right.





Saving Changed Values

When you change values, they are saved in the Control's flash memory ("flash" for short) when the **GRAPH**, **DATA**, **COUNTERS**, **HEATING RATE**, or **SETUP** screens are used.

CAUTION: ***Before*** you power down, go to one or more of the screens above and verify your changes. If you do ***not*** use one of these screens before powering down, your changes will ***not*** be saved.

NOTE: While data is being saved to flash, the screen will display ******* SAVING CHANGES *******

HEATING RATE Key

HEATING RATE

The **HEATING RATE** key brings up the **MANUAL TUNING** screen. This screen allows you to go to the **SET COARSE HEATING RATE** and **SET FINE HEATING RATE** heating rate capability to match the heat generating capability of the thermode to minimize the temperature overshoot and undershoot.

For example, given a very small peg-tip thermode with a heat generating tip diameter of 0.020 inch (0.5mm), the **COARSE** heating rate should range from **SLOW** to **MEDIUM** to prevent sever temperature overshoot.

Conversely, given a very large fold-up thermode with a tip face of 0.12 inch by 2.37 inch (3mm by 60mm) requires a coarse heating rate of **FAST** to produce the optimum temperature profile response.

Selecting **1** on the **MANUAL TUNING** screen brings up the **SET COARSE HEATING RATE** screen.

<SET COARSE HEATING RATE >
1. **Very Slow**
2. **Slow**
3. **Medium**
4. **Fast**

NUMBER Select , ▲ Page, Graph or Data

The progression from **Very Slow** to **Fast** provides more energy to heat the thermode. The table below is a guide to optimize the coarse heating rate. Change **COARSE HEATING RATE** to optimize temperature profile output.

The default value is **Medium**, which is appropriate for 90% of all thermodes. The progression from Very **Slow** to **Fast** provides more energy to heat the thermode. Use the table below as a guide to optimizing the coarse heating rate. Select the recommended coarse heating rate by pressing keys **1** through **4**.

Thermode Family Series	Coarse Heating Rate			
	Very Slow	Slow	Medium	Fast
17T	✓			
17P	✓	✓		
17BM, up to 10 mm (0.37 in.)		✓	✓	
17BM, 10 to 30 mm (0.37 to 1.2 in.)		✓	✓	✓
17BW, 30 to 60 mm (1.2 to 2.4 in.)		✓	✓	✓
17BW, 60 to 100 mm (2.4 to 4.0 in.)*			✓	✓
17F, up to 10 mm (0.37 in.)		✓	✓	
17F, 10 to 30 mm (0.37 to 1.2 in.)		✓	✓	✓
17FW, 30 to 60 mm (1.2 to 2.4 in.)			✓	✓
17FW, 60 to 100 mm (2.4 to 4.0 in.)*			✓	✓

NOTE: 17BW and 17FW thermodes, 60 to 100 mm long, can ***only*** be heated using Model 1-292-01-01.

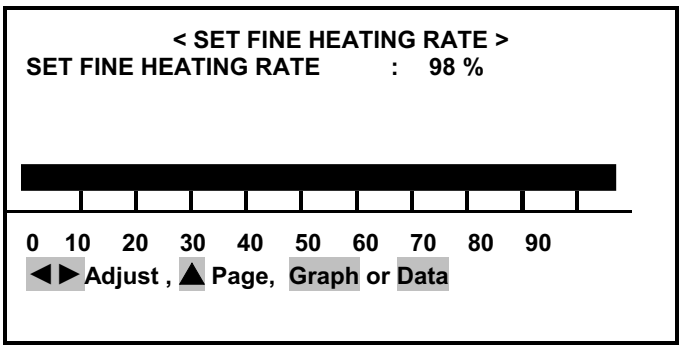
Refer to the bottom line of the display. The contents are prompts (instructions) for editing and exiting the screen. You will find operation-specific instructions like these on every menu screen. The highlighted word or symbol indicates the key you must press to perform the operation listed next to the highlighted word or symbol.

In general, there are three kinds of instructions on the bottom line of the screen:

- The instruction on the left briefly describes the appropriate response for the options on the current screen. For example, to select the **Medium** function on this screen, you would press the **3** key.
- The next instruction is usually a page up or page down instruction. For example, press the ▼ cursor key to scroll back to the **MANUAL TUNING** screen.
- The instruction on the right is an "escape" function, returning the Control to its **Ready** mode in the graphics or data display screens. For example, pressing the **GRAPH** key to returns you to the graphic display.

Selecting **2** on the **MANUAL TUNING** screen will bring up the **SET FINE HEATING RATE** screen.

The default value is 98% (maximum), which is appropriate for 90% of thermodes. A larger percentage means that more energy is available to heat the thermode. Use the fine heating rate adjustment to reduce temperature overshoot ranging from 5° to 15°C. If the actual temperature overshoot is greater than 20 C, use a slower coarse heating rate before you adjust the fine
heating rate.



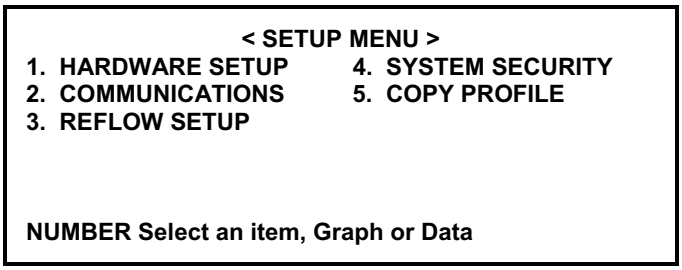
Use the ◄► cursor keys to adjust the fine heating rate, from 0 to 98%. The selected rate will be displayed graphically as a percentage of the indexed grid, and as a numerical value.

SETUP Key



This key brings up the **SETUP MENU** screen.

The **SETUP MENU** screen provides a menu of operating characteristics for the Control.



HARDWARE SETUP, Page 1

Pressing **1** with the **SETUP MENU** screen displayed will bring up **Page 1** of the **HARDWARE SETUP** screen.

```
< HARDWARE SETUP, page 1 of 2 >
1. HEAD COOL VALVE IS          : OFF
2. SOLDER COOL VALVE IS        : OFF
3. FOOTSWITCH RESPONSE MODE    : ABORT

4. LIST OF HARDWARE

NUMBER Select, ▼▲ Page,  Graph or Data
```

HEAD COOL VALVE IS, Page 1

Press the **1** key to toggle between **OFF** and **ON**. Selecting **ON** continuously activates the head cool valve, which supplies drive power for a user-supplied air solenoid valve. The drive power is connector-selectable at either 24 VAC or +24 VDC

NOTE: If Preheat is turned **ON**, the head cool valve is automatically turned on. This valve controls air to cool a hot thermode holder on a reflow solder or heat seal head. See *Appendix B, Electrical and Data Connections* for connection details.

SOLDER COOL VALVE IS, Page 1

Press the **2** key to toggle between **OFF** and **ON**. Selecting **ON** will activate the solder cool valve starting at the end of the **Heat** period and de-activating when the thermode reaches the Cool temperature. The solder cool valve is used to direct the cool air onto the thermode to force it to cool faster. The solder cool valve supplies a connector-selectable 24 VAC or +24 VDC signal for controlling a user supplied air solenoid valve.

FOOTSWITCH RESPONSE MODE, Page 1

Press the **3** key toggle between **ABORT** and **LATCH**. This will deselect and select how the foot switch initiates a Control process cycle when an air actuated head is used.

Use **ABORT** when employing an operator to position parts. Releasing the foot switch at any time during the heating cycle immediately turns off thermode heating and retracts the thermode from the surface of the parts.

Use **LATCH** with automated or fixtured applications. Once the second level of a 2-level foot switch is activated, the heating cycle will continue to completion unless the **EMERGENCY STOP** switch is actuated.

LIST OF HARDWARE, Page 1

Press the **4** key to bring up the **AUTO RECOGNIZED HARDWARE** screen. This screen lists the system software-recognized hardware complement.

See *Appendix B, Electrical and Data Connections* for connection details.

```
< AUTO RECOGNIZED HARDWARE >
a. MANUAL HEAD IS CONNECTED
b. LINE FREQUENCY DETECTION IS : 60HZ
c. E TYPE THERMOCOUPLE IS CONNECTED


▲ Page, Graph or Data
```

HARDWARE SETUP, Page 2

With Page 1 of the **HARDWARE SETUP** screen displayed, press the ▼ (down) key to bring up Page 2 of the **HARDWARE SETUP** screen

```
< HARDWARE SETUP, page 2 of 2 >
1. DISPLAY CONTRAST          : 50%
2. BUZZER LOUDNESS           : 30%
3. END OF CYCLE BUZZER       : ON
4. SET OUTPUT RELAYS

NUMBER Select, ▲ Page, Graph or Data
```

DISPLAY CONTRAST, Page 2

Press the **1** key to bring up the **DISPLAY CONTRAST** adjustment screen. With this screen, you may adjust the contrast of the display with the ◄► (left/right) cursor keys for comfortable viewing.

```
<DISPLAY CONTRAST >
DISPLAY CONTRAST          : 50 %

0  10  20  30  40  50  60  70  80  90
◄►Adjust , ▲ Page, Graph or Data
```

BUZZER LOUDNESS, Page 2

Press the **2** key to bring up the **BUZZER LOUDNESS** adjustment screen. With this screen, you may adjust the loudness of the end of cycle buzzer so that it may be heard reliably against background noise.

```
<BUZZER LOUDNESS >
BUZZER LOUDNESS           :      30 %
--------------------------------------------------------------------------

0  10  20  30  40  50  60  70  80  90
◄►Adjust , ▲ Page, Graph or Data
```

END OF CYCLE BUZZER, Page 2

Press the **3** key to toggle between **OFF** and **ON** for the end of cycle buzzer. When you select the **ON** option, a buzzer will sound when the actual thermode temperature reaches the **Cool** temperature setting.

SET OUTPUT RELAYS, Page 2

Press the **4** key to bring up the **RELAY** screen. The **RELAY** screen allows you to select the Alarm for Status actuation states or each relay. Each relay requires user-provided power, and is rated for 250 VAC at 5 amps, or 30 VDC at 5 amps.

```
< RELAY >
1. RELAY 1: NC WHEN ALARM
2. RELAY 2: NC WHEN ALARM
3. RELAY 3: NC WHEN ALARM
4. RELAY 4: NC WHEN ALARM

NO=NORMALLY OPEN, NC=NORMALLY CLOSED
NUMBER Select, ▲ Page, Graph or Data
```

See *Appendix B, Electrical and Data Connections* for the relay contact pin assignments at Control Status Connector **J6A**.

Press the **1** through **4** keys to bring up the desired relay screen. For example, press **1** to bring up the **RELAY 1** screen.

Press the **1** key to toggle **SET RELAY** to between **NC** and **NO**. **NC** is normally closed, **NO** is normally open.

```
< RELAY 1 >
1. SET RELAY TO    : NC
2. WHEN            : NOT ACTIVE


NUMBER Select, ▲ Page, Graph or Data
```

The **2** key will bring up the **RELAY 1** status option screen.

The **1** through **9** keys on the keypad set the **RELAY 1** status options.

```
< RELAY 1 >
1. REFLOW              6. END OF REFLOW
2. PREHEAT ON          7. HEAD IS UP
3. ALARM               8. SYSTEM READY
4. CLEAN THERMODE      9. NOT ACTIVE
5. REPLACE THERMODE

NUMBER Select, ▲ Page, Graph or Data
```

1. **REFLOW**: Relay is **NC/NO** during the reflow process cycle.
2. **PREHEAT**: Relay is **NC/NO** for continuous preheat.
3. **ALARM**: Relay is **NC/NO** for alarm conditions. Auto reset when the alarm clears.
4. **CLEAN THERMODE:** Relay is **NC/NO** when the clean thermode counter has expired. Auto reset when the counter is edited or reset by pushing the zero key at the Graph or Data screen.
5. **REPLACE THERMODE**: Relay is **NC/NO** when the replace thermode counter has expired. Auto reset when the counter is edited or reset by pushing the zero key at the Graph or Data screen.
6. **END OF REFLOW:** Relay is **NC/NO** when the reflow process cycle has ended. Auto reset at the start of the next cycle.
7. **HEAD IS UP:** Reflow head is in home position.
8. **SYSTEM READY:** Control is ready for reflow operation.
9. **NOT ACTIVE:** Relay is not active.

See *Appendix B, Electrical and Data Connections* for the relay description that includes the timing diagram showing the sequence of the status options.

COMMUNICATIONS

The **SETUP** key returns you to the **SETUP MENU** screen. The **2** key on the **SETUP MENU** brings up the **COMMUNICATION** screen.

COMMUNICATION ROLE

Press the **1** key to toggle between **MASTER** and **SLAVE** to set the role of the RS485 communication interface.

```
< COMMUNICATION >

1. COMMUNICATION ROLE     : MASTER
2. BAUD RATE              : 38.4K
3. RS232/485 SELECT       : RS232
4. RS485 ID NUMBER        : 01


NUMBER Select, ▲ Page,  Graph or Data
```

When **MASTER** is selected, the Control will automatically send data out of the RS232 or RS485 serial port to the host computer after each heating cycle.

When **SLAVE** is selected, the Control will send data to the host computer only when requested by the host computer. The Default value is SLAVE.

RS232/485 SELECT

Pressing the 3 key will alternately select either RS232 or RS485 communications. Default value is RS232.

BAUD RATE

The **2** key on the **COMMUNICATION** menu brings up the **BAUD RATE** screen. Use the keypad to select the required data transfer rate, from 1200 to 38.4K baud. The Default value is 38.4K.

```
< BAUD RATE >

1. 1200          5. 19.2K
2. 2400          6. 38.4K
3. 4800
4. 9600


NUMBER Select, ▲ Page,  Graph or Data
```

I.D. NUMBER

Press the **4** key to bring up the **RS485 ID NUMBER** screen.

Use the ◄ ► keys to adjust. Unit IDs range from 01 – 31. The Default ID value is 01.

```
< RS485 ID NUMBER >

RS485 Unit ID Number    :    01


NUMBER Change, ◄► Adjust,  Graph,  Data
```

With the **SETUP MENU** screen displayed, press the **3** key to bring up **Page 1** of the **REFLOW TEMPERATURE SETUP** screen.

```
< SETUP MENU >
1. HARDWARE SETUP        4. SYSTEM SECURITY
2. COMMUNICATIONS        5. COPY PROFILE
3. REFLOW SETUP

NUMBER Select an item, Graph or Data
```

PREHEAT IS ALWAYS: Press the **1** key to toggle between **TIMED** and **ON**. Selecting **TIMED** enables the front panel **Preheat Time** value. Selecting **ON** forces the thermode temperature to rise to the **Preheat** temperature and to continuously stay at the **Preheat** temperature except during a heating cycle.

```
< REFLOW TEMPERATURE SETUP, page 1 of 2 >
1. PREHEAT IS ALWAYS              : TIMED
2. UPPER TEMPERATURE LIMIT        : + 050°C
3. LOWER TEMPERATURE LIMIT        : - 050°C
4. AUTOSCALING FEATURE            : OFF

Number Select ▼▲ Page,  Graph or Data
```

UPPER TEMPERATURE LIMIT: Press the **2** key to bring up the **UPPER TEMPERATURE LIMIT** screen.

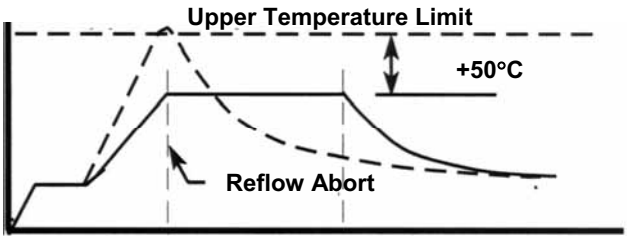
Use the ◀ ▶ keys to adjust the limit.

```
< UPPER TEMPERATURE LIMIT >

UPPER TEMPERATURE LIMIT      :     050

NUMBER Change, ◀▶ Adjust, Graph, Data
```

The upper temperature limit covers the entire heating period, as shown in the diagram to the right. Exceeding the upper temperature limit, as shown by the dashed temperature curve, immediately terminates thermode heating, retracts the thermode from the parts in the case of an air actuated head, and produces an alarm.



Use the number or ◀ ▶ keys to set the desired limit value.

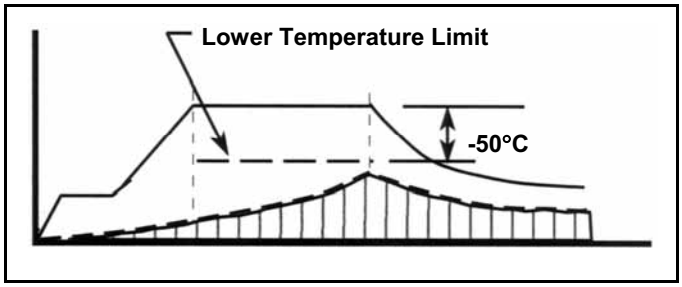
LOWER TEMPERATURE LIMIT: Press the **3** key to bring up the **LOWER TEMPERATURE LIMIT** screen.

```
< LOWER TEMPERATURE LIMIT >

LOWER TEMPERATURE LIMIT      : -050

NUMBER Change, ◀▶ Adjust, Graph, Data
```

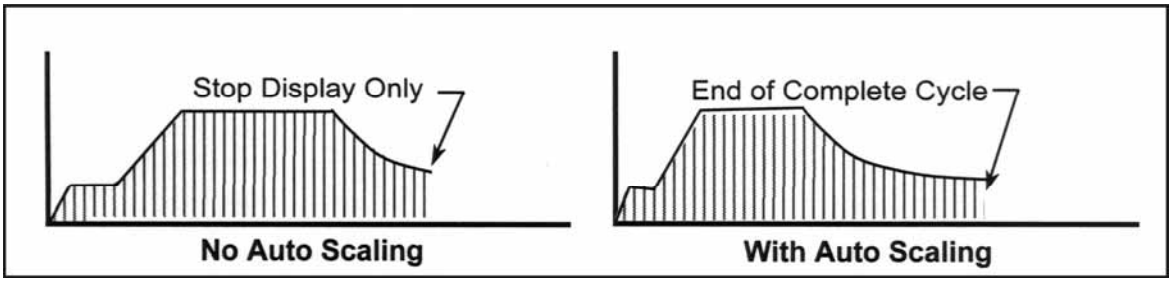
The **Lower Temperature Limit** only covers the Reflow period as shown on the right. The actual temperature must be above the lower temperature limit by the end of the Reflow period to avoid triggering the alarm. Going below the **Lower Temperature Limit**, as shown by the dashed temperature curve, does not terminate thermode heating or retract the thermode from the parts, but it ***does*** produce an alarm.



AUTOSCALING FEATURE: Press the **4** key to toggle between **OFF** and **ON**.

Selecting **OFF** means that the actual graphic temperature display will fill in over the **Ideal Profile** on the screen until the fill reaches the end of the display.

Selecting **ON** causes the graphic display to automatically re-scale at Cool time to capture more of the reflow , including a longer portion of the cooling cycle.



REFLOW TEMPERATURE SETUP, Page 2.

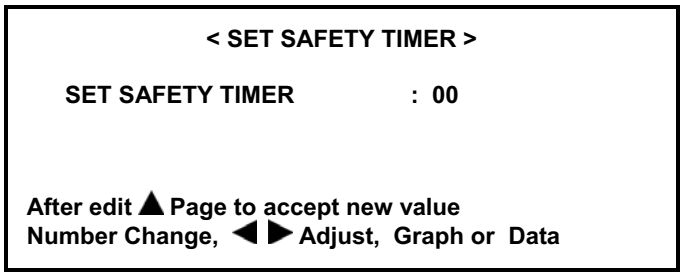
From the **REFLOW TEMPERATURE SETUP page 1** screen showing, press the ▼ key to bring up the **REFLOW TEMPERATURE SETUP page 2** screen.

```
< REFLOW TEMPERATURE SETUP, page 2 of 2 >
1. SET SAFETY TIMER          : 10 SEC
2. SET RELEASE TIMER         : 00 SEC
3. MAX. TEMPERATURE LIMIT    : 600°C
4. MAX IDLE TEMP LIMIT       : 500°C

Number Select ▲ Page,  Graph or Data
```

SET SAFETY TIMER

Press the **1** to bring up the **SET SAFETY TIMER SCREEN**. Use the safety timer to abort the reflow cycle if temperature has ***not*** risen to the temperature set point by the time set in the safety timer. If the time is exceeded, a **SAFETY TIME EXCEEDED** alarm will be set.

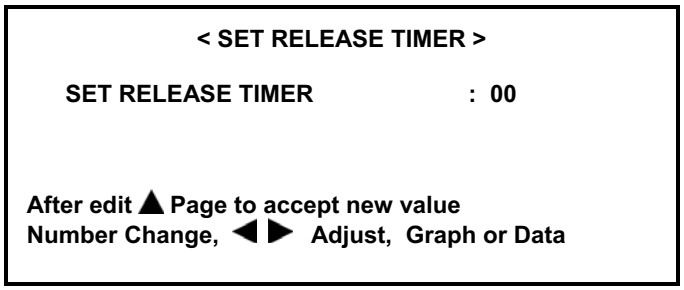


Use the number or ◀ ▶ keys to select a safety timer value of 00 to 99 seconds.

SET RELEASE TIMER

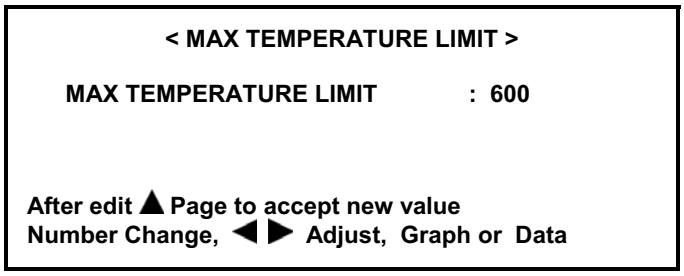
Press the **2** key to bring up the **SET RELEASE TIMER** screen. You can use the release timer to delay the initiation of a new heating cycle after the thermode has cooled down to the Cool temperature and the release timer has expired.

Use the number or ◀ ▶ keys to select a release timer value of 00 to 99 seconds.



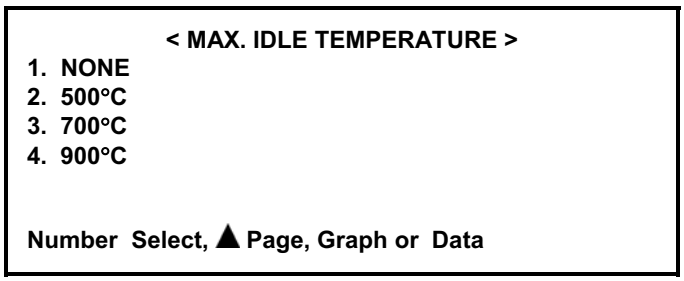
MAX. TEMPERATURE LIMIT

Press the **3** key to bring up the **MAX TEMPERATURE LIMIT** screen. With this screen, you may set the maximum temperature required for an application. The default temperature of 600°C is shown on the screen to the right. Use the ◀ ▶ keys to edit the value.



MAX IDLE TEMP LIMIT

Press the **4** key to bring up the **MAX IDLE TEMPERATURE LIMIT** screen. With this screen, you may set the maximum idle temperature required for an application. The default temperature of 500°C is shown on the screen to the right. Use the Number keys to edit the value.



SYSTEM SECURITY

From the **SETUP MENU** screen the **4** key will bring up the **SYSTEM SECURITY** screen.

```
< SETUP MENU >
1. HARDWARE SETUP      4. SYSTEM SECURITY
2. COMMUNICATIONS      5. COPY PROFILE
3. REFLOW SETUP

NUMBER Select an item, Graph or Data
```

This **SYSTEM SECURITY** screen allows you to activate password-only access for changing the three listed system functions.

When you select any one of the three system functions with the keypad, you will bring up the **CHANGE PASSWORD** screen.

```
<SYSTEM SECURITY >
1. PROFILE LOCK          : OFF
2. SYSTEM LOCK           : OFF
3. PROFILE TUNING LOCK   : OFF

NUMBER Select, ▲ Page, Graph or Data
```

Enter a user-selected five-digit (or less) password, using the keypad. When you enter the password, followed by pressing the ► cursor key, the **OFF** indication on the **SYSTEM SECURITY** screen will change to **ON**.

```
< CHANGE PASSWORD >

PASSWORD                 : ******

Enter NUMBERS followed by the ► arrow

▲ Page, Setup or Data
```

Once you have returned to the graph or data screens, you can only unlock system security by entering the password again via the **CHANGE PASSWORD** screen.

PROFILE LOCK inhibits the user from modifying any reflow parameters and from selecting different profile schedules.

SYSTEM LOCK prevents the user from making changes to menu items.

PROFILE TUNING LOCK prevents modifying any reflow parameters, but allows users to select different profile schedules.

COPY PROFILE

On the **SETUP MENU** screen, the **5** key will bring up the **COPY PROFILE** screen. This screen allows you to copy the current or a different heat profile to another heat profile.

Use the ► cursor key to advance from the **COPY PROFILE** field to the **TO PROFILE** field.

```
< COPY PROFILE >

COPY PROFILE [ 2]    TO PROFILE [ 4]

Enter NUMBERS followed by the ► arrow
Use  Graph or Setup to abort
```

In the **COPY PROFILE** screen shown, for example, Profile 2 will be copied to Profile 4 when you press the right cursor key to exit the **COPY PROFILE** screen.

CHAPTER 4
OPERATING INSTRUCTIONS

Section I: Before You Start

Preparation

Before operating the Control:

- You ***must*** be familiar with the principles of reflow soldering.
- You ***must*** be familiar with the **location** and **function** of Controls and Indicators. For more information, see *Chapter 1, Description*.
- ***Verify*** that all equipment has been connected properly. See *Chapter 2, Installation and Setup* ***and*** the instructions supplied with the Reflow Head.
- You ***must*** be familiar with how to **select** and **use** the Control functions for your specific applications. For more information, see *Chapter 3, Using Programming Functions*.

General Operator Safety



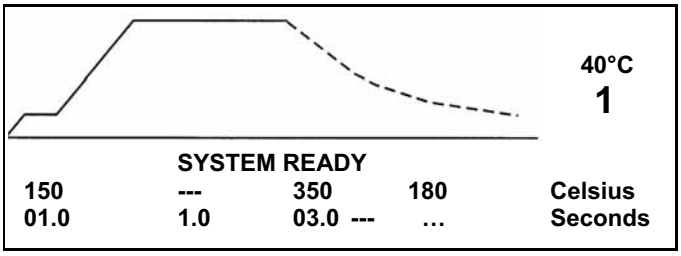
WARNING

- To prevent blindness or eye injury, ***wear safety goggles at all times during reflow soldering***.
- ***Be careful of moving parts.*** You can be injured by moving parts during the reflow.
- Do ***not*** wear loose clothing or jewelry around moving parts. They could get caught and cause injury.

Section II: Operating Instructions

Powering Up

To turn the Control power ON, set the circuit breaker/power switch on the rear panel to the ON position. After two introductory screens are displayed, the **SYSTEM READY** screen will be displayed.



NOTE: If the EMO jumper plug is ***not*** installed as described in *Chapter 2, Installation and Setup*, the LCD Screen will display a message saying that an emergency stop is in effect. The Control will ***not*** operate until the jumper is installed.

When the **SYSTEM READY** screen displays, the Control is ready for operation using either of the following options:

- **Pre-Defined Reflow Profiles**. For convenience, you may quickly select a profile stored in the Control that has been pre-defined for your most common reflow applications.
- **Direct Input**. You may use the front panel controls to input the parameters for a reflow application.

Pre-Defined Reflow Profiles

1. Push the **PROFILE NUMBER** up/down keys until the profile you want (**1 ➔ 15**) is displayed on the LCD screen.

   NOTE: The PROFILE NUMBER up/down keys are disabled when any screen *other than* the graphic screen or data screen is displayed on the LCD.



2. Set the **HEAT/NO HEAT** switch to **HEAT**. The Control is now ready to use.



Direct Input

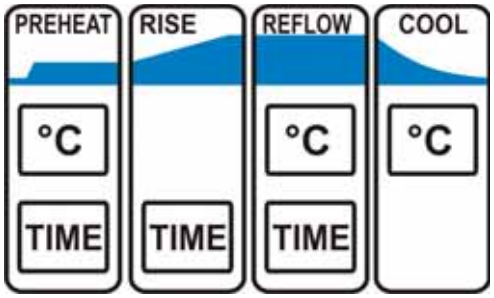
CAUTION

You can accidentally overwrite (erase) an existing stored profile when using the front panel controls. Before you start **Direct Input**, use the **PROFILE NUMBER** up/down keys to select a profile number that is "blank" or "expendable" to prevent overwriting a profile you want to keep.

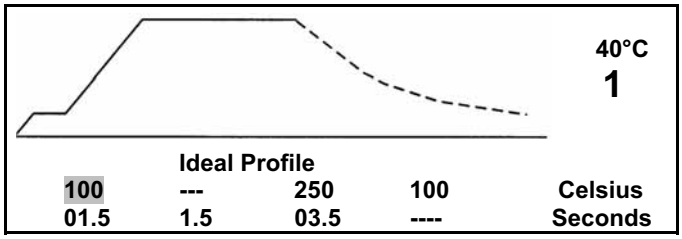
1. Set the **HEAT/NO HEAT** switch to **HEAT**. In this position, the Control will deliver heating energy to the thermode when you initiate the heating cycle.



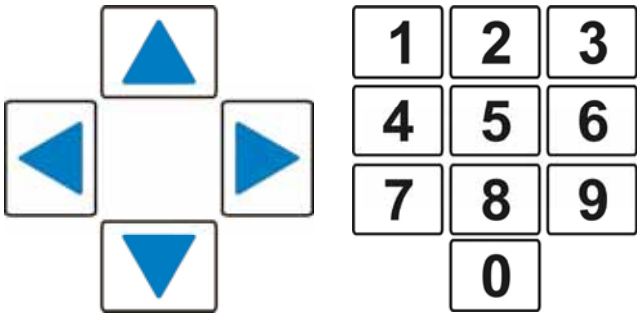
2. Press the **PREHEAT °C** key to select the **PREHEAT** temperature value for editing.



NOTE: The **PREHEAT** temperature value will be highlighted when it is selected.



3. Set the temperature value to 100°C with the number keys on the keypad, then press the **GRAPH** key.
4. Press the **PREHEAT TIME** key to select the **PREHEAT** time field. Use the keypad to enter a **PREHEAT** time of 01.5 (1.5 seconds), then press the **GRAPH** key.



NOTE: After changing any period temperature or time value, the graphic screen trace will automatically re-size.

5. Press the **RISE TIME** key to select the **RISE** time field for editing. Use the keypad to enter a **RISE** time to 1.5 (1.5 seconds), then press the **GRAPH** key.
6. Press the **REFLOW °C** key to select the **REFLOW** temperature value for editing. Use the keypad to enter a temperature 250°C, then press the **GRAPH** key.
7. Press the **REFLOW TIME** key to select the **REFLOW** time field for editing. Use the keypad to enter a **REFLOW** time to 03.5 (3.5 seconds), then press the **GRAPH** key.
8. Press the **COOL °C** key to select the **COOL** temperature value for editing. Use the keypad to enter a **COOL** temperature of **100°C**, then press the **GRAPH** key.
9. Make a test joint by pressing the foot pedal or foot switch to initiate a complete heating cycle.
   - For **manual** reflow soldering heads, release the foot pedal when the alarm "beep" sounds indicating that the thermode has reached the **COOL** temperature.
   - For **air actuated** reflow solder heads, release the foot switch after the head has automatically retracted the thermode.
10. If the joint ***is*** good, use the present Control settings for your soldering application. If it is ***not*** good, go to Step 11.
11. Repeat Steps 6 and 9, and use the keypad to increase the **REFLOW** temperature in 25°C increments. Make a test joint ***after each*** **REFLOW** ***change***.
12. Upon reaching a temperature of 450°C, use the keypad to increase the **TIME** in 0.5 second increments, repeating 6 and 9 until you have achieved a good joint.

CHAPTER 5
MAINTENANCE

Section I. Before You Start

Precautions

DANGER

DEATH ***may result from contact with lethal voltages inside the Control***. ***Never*** attempt to repair the Control with power applied.

Turn power to the unit OFF ***before*** starting maintenance work. Tag (and preferably lock) the switch so that power is *not* accidentally restored.

- Do ***not*** modify the unit without prior written approval from Unitek Miyachi Corporation.
- Use the appropriate tools for terminating the connecting cables, being careful not to nick the wire conductors.
- ***Never*** use paint thinner, benzene or acetone to clean the exterior of the Control. Use a dry cloth or, if it is heavily soiled, use a cloth moistened with a mild detergent or alcohol.

Status Messages

Message	Description
Auto Scaling	The LCD Graph display automatically re-scales during the entire reflow soldering process to provide the user with a complete picture of the entire process. This feature can be turned on or off by the user.
Calibration set to default	The Control must be re-calibrated after calibration parameters have been reset to default value.
Cooling	The Control is operating in the Cool period.
Head is down	Reflow soldering head sensor is sending a signal to the Control indicating that the thermode is touching the parts.
Heating Time	The Control is operating in the Preheat, Rise, or Reflow periods.
Preheat Time	The Control is operating in the Preheat Time period.
Ready	The Control is ready to begin a reflow process cycle.
Rise Time	The Control is operating in the Rise Time period.
System and Profiles reset to defaults	All system and heat profiles have been reset to default values.

Section II. Troubleshooting

Alarm Message	Description	Corrective Action
ABORT REFLOW: Decrease Heating Rate	Actual thermode temperature exceeded the HI LIMIT value.	Set Course Heating Rate one setting slower. Increase the HI LIMIT value. Increase the Preheat Time.
ABORT REFLOW: Firing Switch Open	When the FOOTSWITCH RESPONSE MODE is set to ABORT, lifting the head during a weld aborts the reflow and produces this message.	Lift the footswitch all the way up and try the reflow again.
ABORT REFLOW: Safety Timer expired	Thermode is taking longer than 10 seconds to reach Pre-heat or Reflow temperature.	Verify that all electrical connections between the thermode and the Control output are tight. Increase coarse heating rate.
ABSOLUTE MAXIMUM TEMPERATURE IS 999°C	New Reflow temperature value, while in the extended temperature control option, is greater than the 999°C limit.	Press the Reflow °C key and re-enter a value that is less than 999°C.
ACCESS DENIED! PROFILE LOCK ON	Operator has attempted to change the heat Profile variables or the Profile Number while the System Security is in effect.	Access the SYSTEM SECURITY menu. Re-enter user password to unlock the System Security feature.
ACCESS DENIED! REMOTE PROFILE SELECTED	Operator has attempted to change profile numbers at the Unit's panel while the remote inputs are already specifying a profile.	Ignore, or remove the remote profile selection before changing profile numbers at the panel.
ACCESS DENIED! SYSTEM SECURITY ON	The operator has attempted to change a system or profile value that is locked out by the Security Screen.	Set the appropriate lock out value to OFF at the Security Screen.
CLEAN THERMODE: Reset Cleaning Counter	Clean Thermode Counter has reached zero.	Reset Clean Thermode Counter.
COOL TEMP EXCEEDS REFLOW SETTING	New Cool temperature value exceeds Reflow temperature value.	Press the Cool °C key and re-enter a value that is less than the Reflow temperature.
EMERGENCY STOP ACTIVATED	Reflow soldering head will not activate without installing a CE required Emergency Stop switch or jumper wire. The system has detected a potentially hazardous condition necessitating operator intervention. Normal reflow operation is inhibited.	Connect a normally closed relay or switch between pin 1 and pin 2 on the Control rear panel connector, EMO. Using a jumper wire in place of a relay or switch will work, but will not meet CE safety requirements. Operator must clear the condition causing the emergency stop before reflowing can continue.
EXCEEDED MAXIMUM TEMPERATURE OF 600°C	New Reflow temperature value is greater than the 600°C limit.	Press the Reflow °C key and re-enter a value that is less than 600°C.

Alarm Message	Description	Corrective Action
FIRING SWITCH NOT ACTUATED	Air Actuated Reflow Soldering Head Firing Switch has not actuated. Switch must actuate within 10 seconds after initiating a new reflow process cycle.	Initiate another reflow process cycle. Increase Air Actuated Reflow Soldering Head air pressure until heating begins. Check Reflow Soldering Head stroke specification. If stroke is exceeded, the Firing Switch will *never* actuate.
HEAT SWITCH IN NO HEAT POSITION	Thermode does not heat, but reflow process cycle continues to the end.	Verify that the Heat Switch is in the HEAT position.
ILLEGAL SECURITY CODE ENTERED	Operator has attempted to enter a security code that does not match the password code.	Re-enter a new security code.
MAX TEMP ALARM. Check System, Cycle Power	Maximum Temperature detected at the Thermode or 100 degrees C above the Programed Set Point	a) Cycle the Main Power, then reduce the Heating Rate. b) Check to see that the Thermocouple is connected. c) Check to see if the SCR has shorted. When finished, recycle the Power on the unit.
MINIMUM COOL TEMP OF 60°C REQUIRED	New Cool temperature value is less than the 60°C limit.	Press the Cool °C key and re-enter a value that is more than 60°C.
MINIMUM PREHEAT TEMP OF 60°C REQUIRED	New Preheat temperature value is less than the 60°C limit.	Press the Preheat °C key and re-enter a value that is more than 60°C.
OVER_POWER ALARM - Check Thermocouple	An increase in Power did not result in an increase in Temperature.	Make sure that the Thermocouple is plugged in, is undamaged, and is still bonded to the Thermode. Then recycle the Power on the unit.
PREHEAT EXCEEDS 300°C TEMP SETTING	New Preheat temperature value is greater than the 300°C limit.	Press the Preheat °C key and re-enter a value that is less than 300°C.
PREHEAT EXCEEDS COOL TEMPERATURE SETTING	New Preheat temperature value is greater than the Cool temperature.	Press the Preheat °C key and re-enter a value that is less than the Cool temperature.
PREHEAT EXCEEDS REFLOW TEMP SETTING	New Preheat temperature value is greater than the Reflow temperature.	Press the Preheat °C key and re-enter a value that is less than the Reflow temperature.

Alarm Message	Description	Corrective Action
REFLOW ALARM: Increase Heating Rate	Actual thermode temperature never reaches the LOW LIMIT value during the Reflow time period.	Set Course Heating Rate one setting faster. Increase the LOW LIMIT value. Increase the Preheat Time. Check cables between the Control output and the Reflow Soldering Head for loose connections. Check connection between the thermode and thermode holder for loose connections. Increase the diameter of the cables between the Control output and the Reflow Soldering Head.
REFLOW BELOW PREHEAT TEMP SETTING	New Reflow temperature value is less than the Preheat temperature.	Press the Reflow °C key and re-enter a value that is more than the Preheat temperature.
REPLACE THERMODE: Reset Replace Counter	Replace Thermode Counter has reached zero.	Reset Replace Thermode Counter.
WARNING! PREHEAT IS ALWAYS ON	Thermode remains at Preheat temperature continuously when not in a reflow process cycle after being programmed to remain on.	Press the Setup key. Select Reflow Settings. Set Preheat to Timed or continuously on, depending on application requirements.
WARNING! POWER MODE IS ON	Power mode is turned on or off while in the Graph or Data screen by entering the sequence 1, 0, 1, 2, 9. This mode means that the upper and lower temperature limits programmed at the Reflow screen are ignored.	Turn this mode ON / OFF.
WRONG THERMOCOUPLE.	Thermode or thermocouple extension cable mismatch with calibration T/C type.	Use correct thermocouple and thermocouple extension cable.

Section III. Maintenance

Thermode Maintenance

When a heat profile has been suitable for a particular application over many bonds, but poor quality bonds are now resulting, thermode surface deterioration could be the problem. If you need to increase heat period temperature and time to maintain the same bond quality, the thermode surface is probably coated with heavy flux, adhesive or polyimide ribbon flex cable residue.

Clean the thermode surface either chemically with your vendor-recommended solvents, or mechanically using number 600 grit (or finer) silicon carbide paper.

Replace thermodes that have become warped or cracked.

- Warped thermodes will not adequately transfer heat to the parts.
- Cracked thermodes will not heat, ***or*** they may overheat in the cracked area.

Repair Service

If you have problems with your Control that you cannot resolve, please contact our service department at the address, phone number, or e-mail address indicated in the *Foreword* of this manual.

CHAPTER 6
CALIBRATION

Overview

This reflow equipment does ***not*** use internal calibration adjustments. High precision temperature capturing electronics is used which does not drift with age or use. This procedure allows the user to verify the calibration condition of the unit.

Any out-of-calibration condition can only be caused by an internal part failure on the main board and can only be remedied by replacing the broken part.

Required Equipment

- OMEGA Digital Calibrator/Thermometer Model CL26 or equivalent
- Calibration Kit with **J**, **K** and **E** type thermocouple cable (UMC Part Number: 10-359-01)

NOTE: The appropriate thermocouple and connector for the selected thermocouple type ***must*** be used to get accurate readings.



Before You Start

Ensure that reflow cable is ***disconnected*** from the weld head/thermode.

Calibration

1. Install a **J**, **K** or **E** type thermocouple cable between **J9** of the unit and the Calibrator output.
2. Turn the unit ON.
3. Select the thermocouple type on the Calibrator according to the cable used.
4. Set the Calibrator to an output temperature of 250° C.
5. Observe the temperature reading in the upper right hand corner of the screen.
6. Verify the temperature reading is within +/-6° C or +/-2% of reading.
7. Turn the test unit OFF.
8. Remove the calibration cable, then re-attach the thermodes, thermocouple, and reflow cables.

APPENDIX A
TECHNICAL SPECIFICATIONS

Electrical Mains

AC Voltage Ranges:
Model 1-292-01 ..... 90 to 132 VAC
Models 1-292-01-01 & 1-292-01-02 ..... 180 to 264 VAC

Line Frequency ..... 50 or 60 Hz

Line Phase ..... Single

Input Circuit Breaker Rating ..... 15 A

Power Cord Connection ..... European CE Harmonized Wiring Code, or NEMA Wiring Code

Environment

Location ..... Indoor Use

Ambient Temperature:
Maximum ..... 104°F (40°C)
Minimum ..... 59°F (15°C)

Relative Humidity, Maximum ..... 93% at 104°F (40°C)

Dimensions

Height • Width • Depth ..... 12.5 in. (317 mm) 10 in. (254 mm) 20.75 in. (527 mm)

Weight:
4 KVA Models ..... 58 lbs (26.31 kg)
2 KVA Models ..... 46 lbs (20.86 kg)

Performance

User Programmable Heat Profiles 15
Flash Memory

Thermocouple Inputs (automatic recognition):
Type E ..... For temperatures below 900°C
Type J ..... For temperatures below 750°C
Type K ..... For temperatures below 1000°C

Thermocouple Calibration Input Standards ..... User provided NIST standard (separate calibration required for each thermocouple type)

APPENDIX A: TECHNICAL SPECIFICATIONS

Temperature Control

Accuracy:
- 600°C and below ..... ±6°C or ±2% of reading, whichever is greater
- Above 600°C ..... ±3% of reading

Repeatability ..... ±1% of setting
Display Range ..... 15°C to 999°C
Settings:
- Preheat ..... 60° to 300°C
- Reflow (default) ..... 60° to 600°C
- Reflow (extended mode operation) ..... 60° to 999°C

Periods:
- Preheat ..... 0 to 99.9 seconds
- Rise ..... 0.0 to 9.9 seconds
- Reflow ..... 0.1 to 99.9 seconds

Heating Rate Control
- Coarse ..... Fast, Medium, Slow, Very Slow

Switched Input Electrical Requirements

Form and Rating ..... Switch or sensor inputs must be normally open SPST switches, transistors or opto-isolators rated at 24 VDC, 20 MA minimum

Heat Profile Select ..... Select 15 heat profiles using four inputs activated in a binary coded pattern

Operator Initiation Switch ..... 1-level or 2-level foot switch

Heat Initiation Sensor ..... Heat force or Uniflow 2 head down sensor for initiating thermode heating

No Heat Switch ..... Heat only inhibit

Emergency Stop (CE Requirement) ..... SPST switch open to remove valve driver power and retract head

Analog Inputs

Thermocouple ..... E, J, or K type

Thermocouple Extension Cables, Omega Standard:
- Type E, Unitek PN 10-355-01 ..... 60 in. (152.4 cm)
- Type J, Unitek PN 10-355-01-01 ..... 60 in. (152.4 cm)
- Type K, Unitek PN 10-355-01-02 ..... 60 in. (152.4 cm)

Outputs

Audible Alarm.....Buzzer, duration and volume adjustable

Coarse Heating Output Voltage (nominal) at 120 VRMS or 240 VRMS transformer primary voltage.

Fast ..... 3.81 VAC
Medium ..... 1.90 VAC
Slow ..... 1.27 VAC
Very Slow ..... 0.95 VAC

Course Heating Output Power (nominal):

Model 1-292-01 .....2.0 KVA
Models 1-292-01-01 & 1-292-01-02 .....4.0 KVA

Solid State Relays:

Power (Uniflow 2 control provided) ..... 24 VAC or +24 VDC
Contact Rating.....24 VAC/24 VDC, 0.3 A
Head Cool Valve ..... ON/OFF for cooling thermode holder
Solder Cool Valve ..... ON at COOL period, OFF at PREHEAT period

Programmable Electromechanical Relays:

Relays Available.....4
Power.....User provided
Contact Rating.....1 A at 250 VAC or 30 VDC

Programmable Electromechanical Relays Functions:

Reflow ..... On/Off during heating process cycle
Preheat .....On/Off for continuous preheat
Alarm..... On/Off for any alarm condition
Clean Thermode ..... On/Off when clean thermode counter expires
Replace Thermode.....On/Off when replace thermode counter expires
End of Reflow.....On/Off when heating process cycle is complete
Head Is Up .....On/Off when head is retracted
System Ready ……On/Off when Uniflow 2 Control is ready for reflow operation
Output Timing ..... See *Appendix C, System Timing*

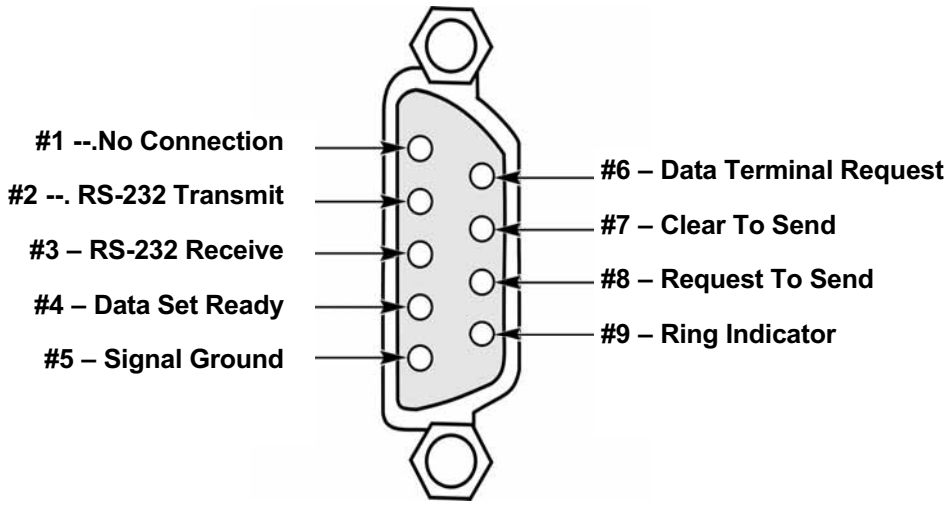
Front Panel Switches

User Interface Buttons ..... 27 membrane keys

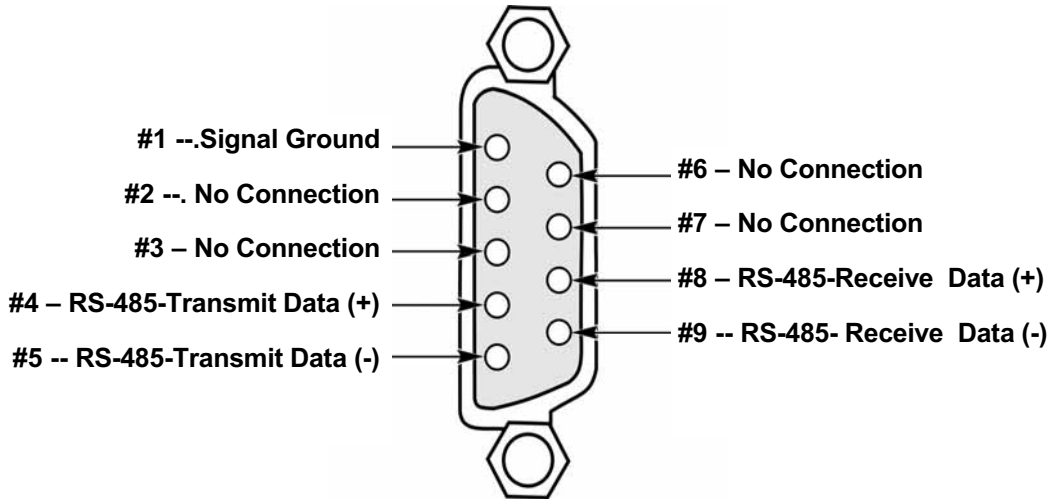
HEAT/NO HEAT Switch..... Heat only inhibit

APPENDIX B
ELECTRICAL AND DATA CONNECTIONS

RS-232 Connections



RS-485 Connections



Negative/Positive Logic Operation

Your Control is factory-configured for positive logic, active low. That is, when an input terminal is unterminated, an internal resistor pulls the input terminal to a positive voltage and the input terminal is considered to be inactive. When a switch connects the input terminal to common, the input terminal is considered as active.

The voltage source may be supplied by the Control or an external source (see *Automation Control Inputs Connections,* page B-15).

You may reverse the logic sense of the inputs to negative logic, active high, by rejumpering connector J4 on the rear panel. In the rejumpered configuration, an internal resistor pulls an unterminated input terminal to common and the input is considered as inactive. Supplying 24 volts to the input terminal will make it become active.

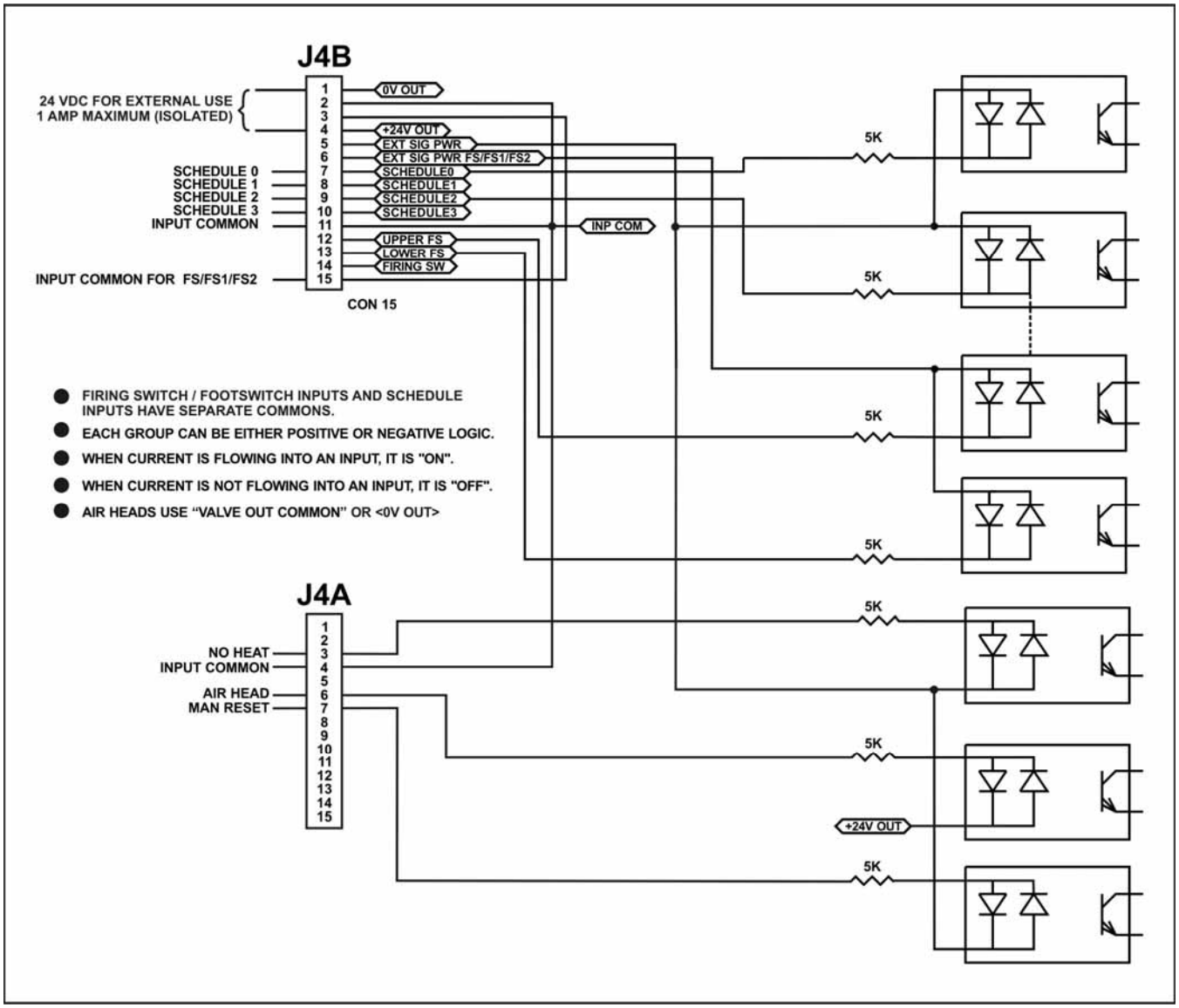
NOTE: For jumper information, see pages B-4 ➔ B-9.

The inputs that have bipolar logic selection capability are in two groups: Input switches and control switches. The devices within these groups are as follows:

Input Switches	Control Switches
Upper Footswitch Lower Footswitch Firing Switch	All other inputs except **HEAT/NO HEAT** **PNEUMATIC/ MANUAL**

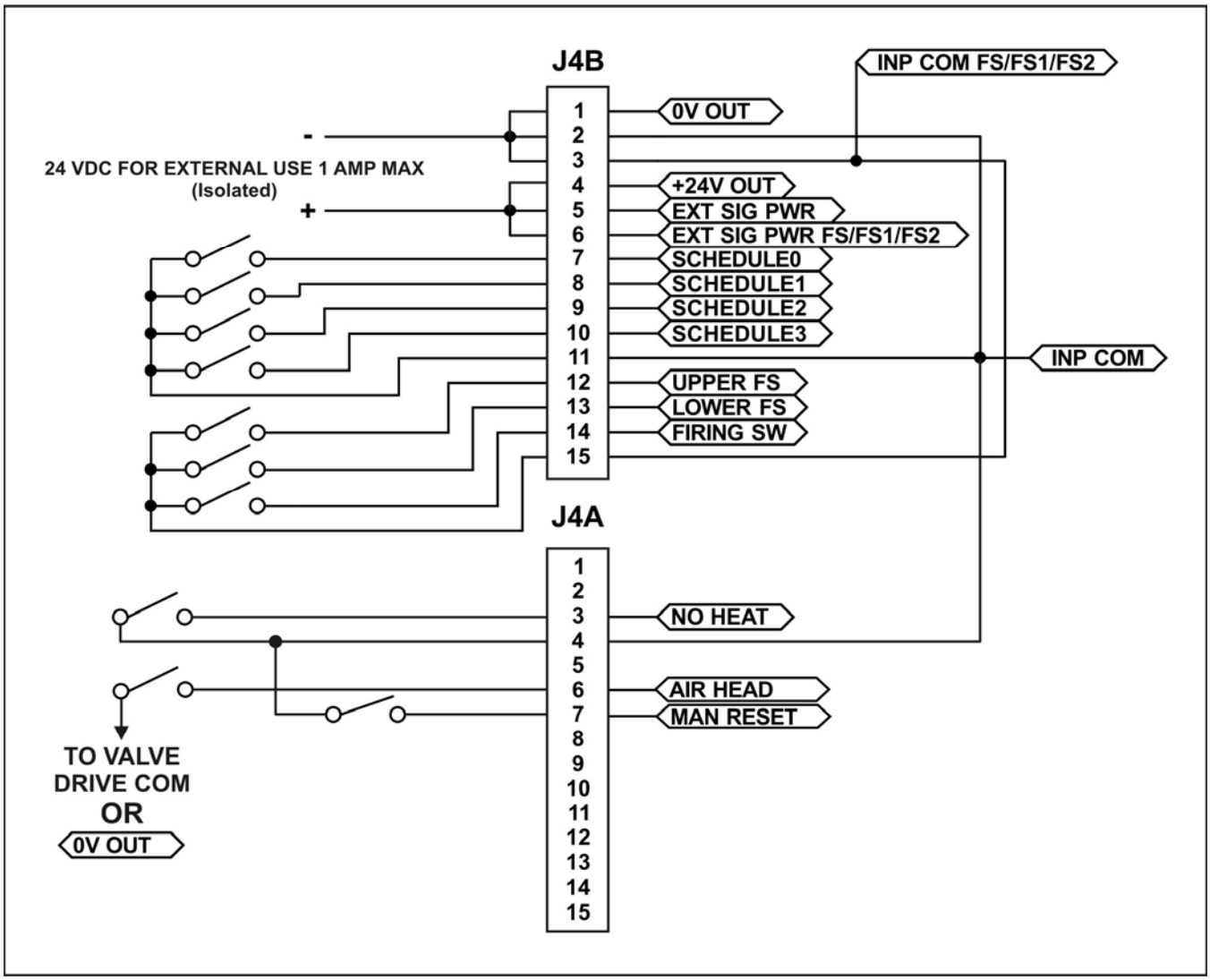
NOTE: The heat/no heat input pull-up/pull-down configuration will change along with the jumper selection; however, the active sense will ***not*** change. Pneumatic/Manual is always positive logic with pull-up to a positive voltage.

Control Input Interface

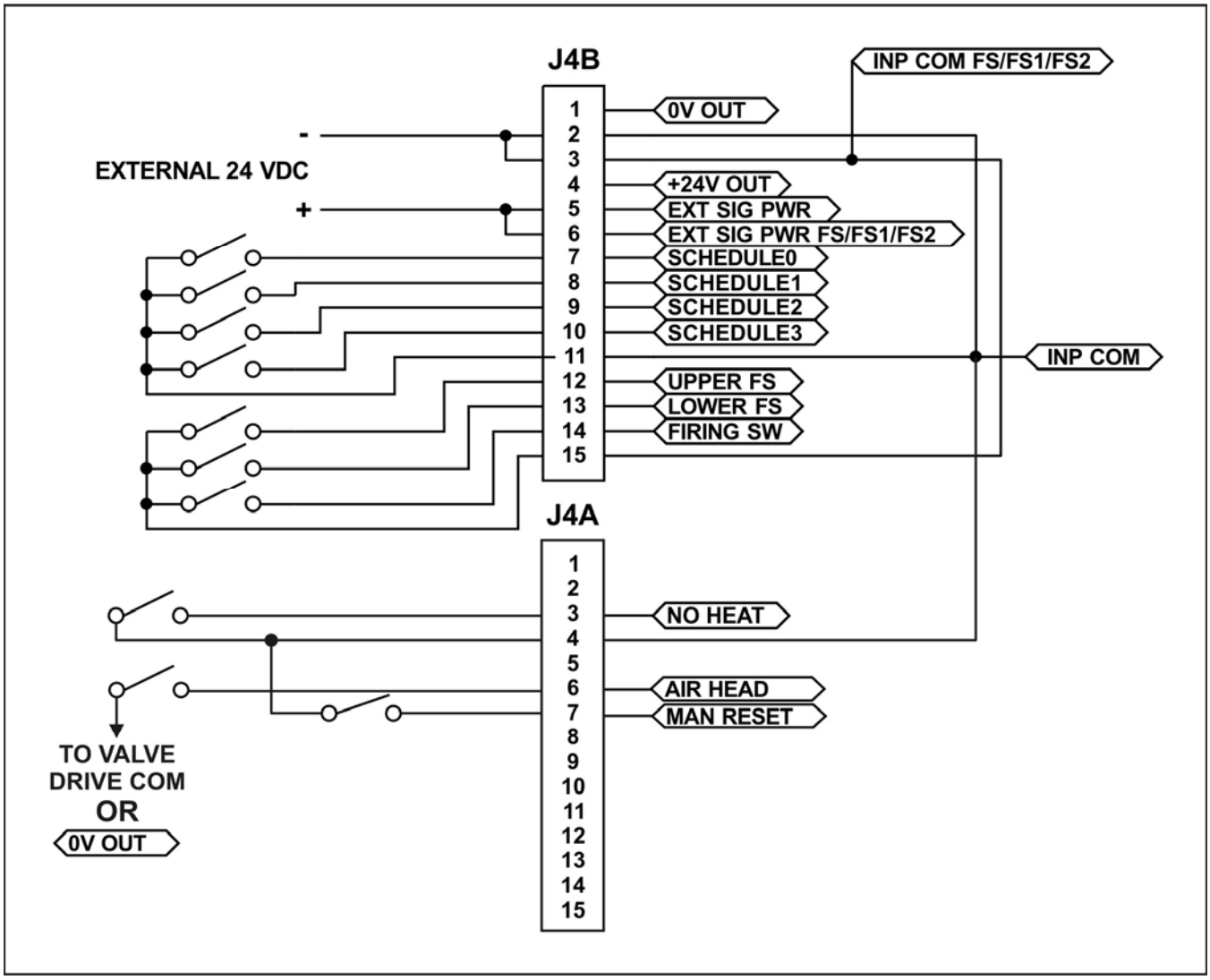


NOTE: The **Control Input Interface** may be connected to a PLC or other interface in the configurations shown on pages B-4 ➔ B-9.

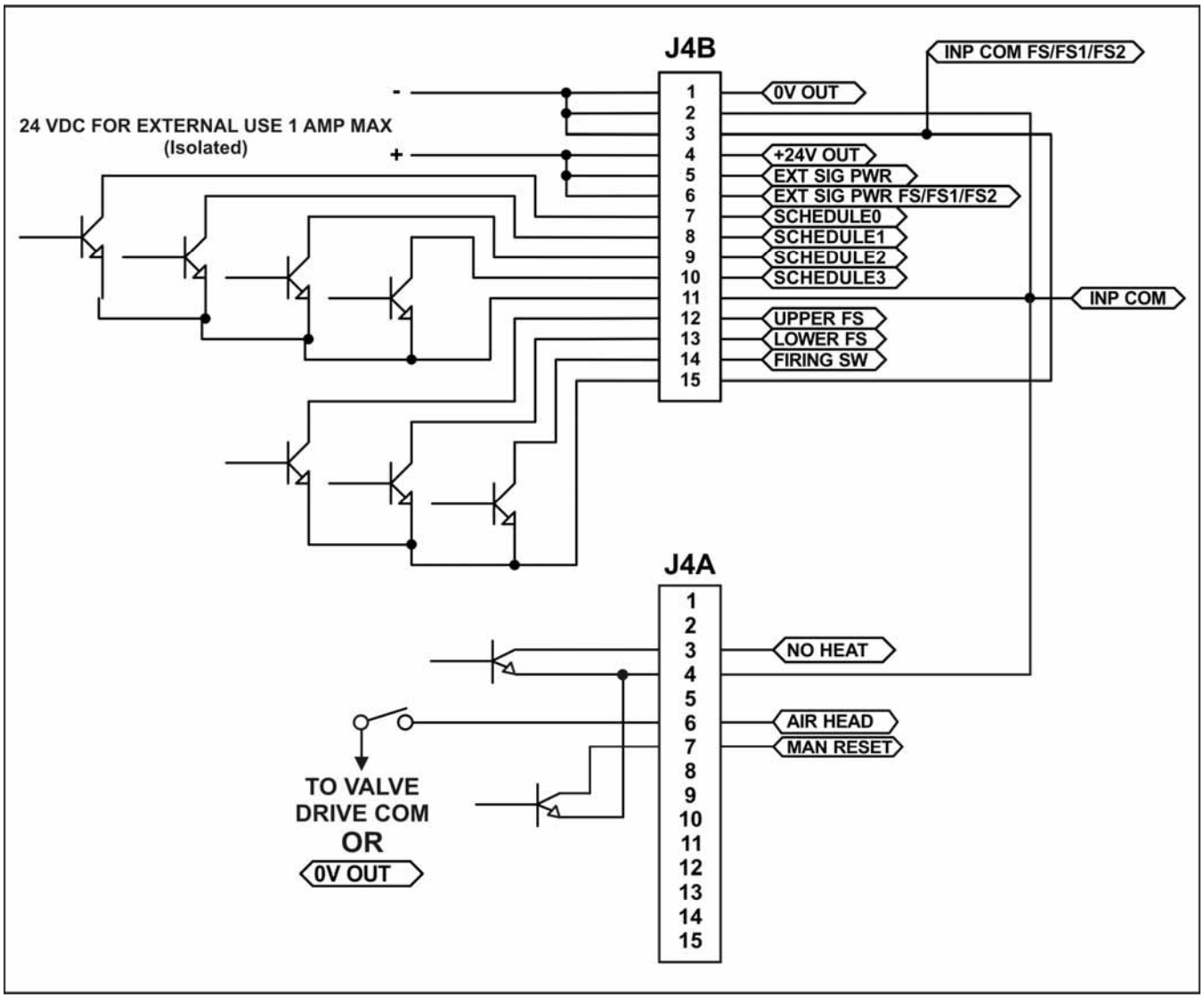
Switch Contact Input (Internal Power)



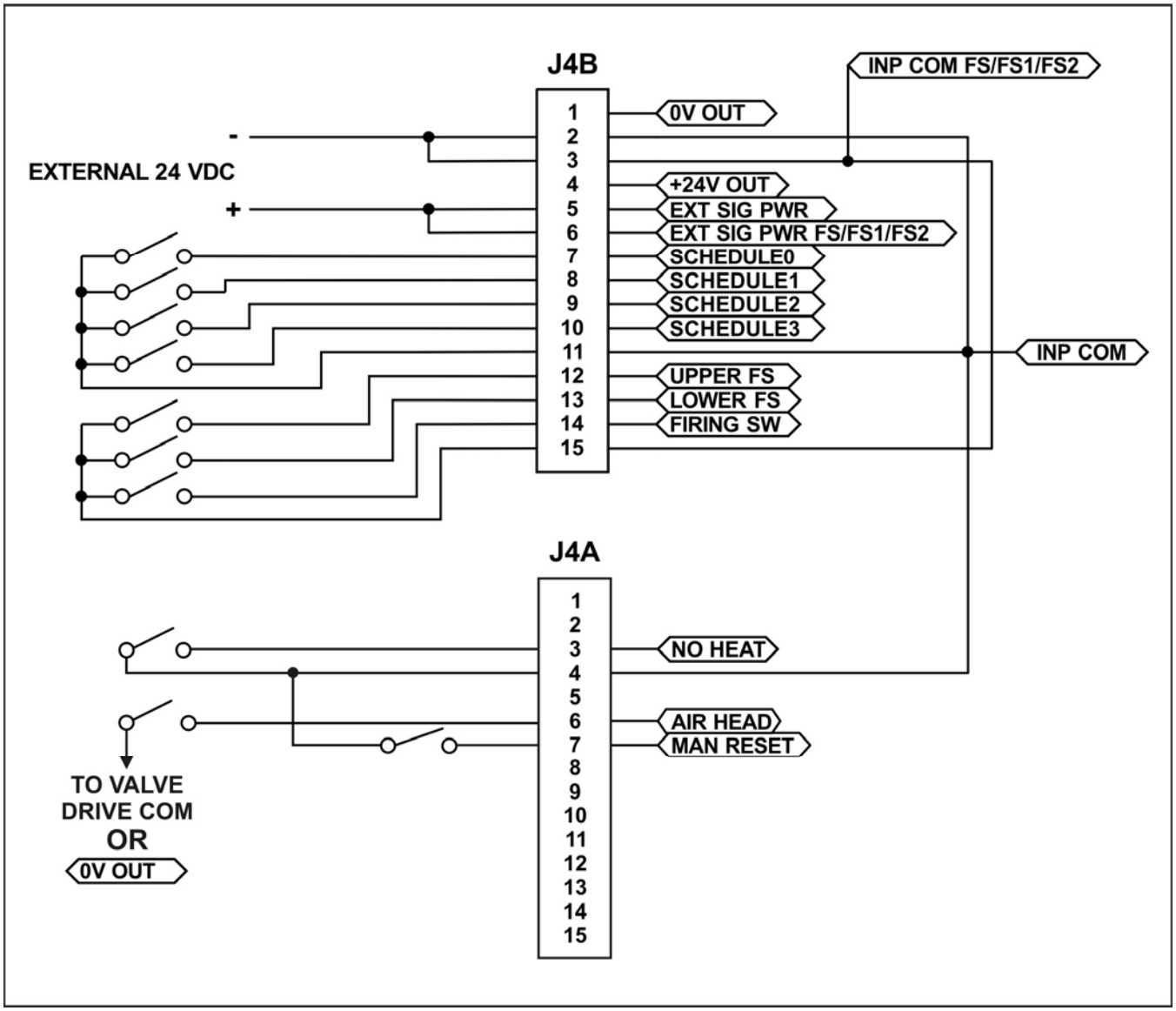
Switch Contact Input (External Power)



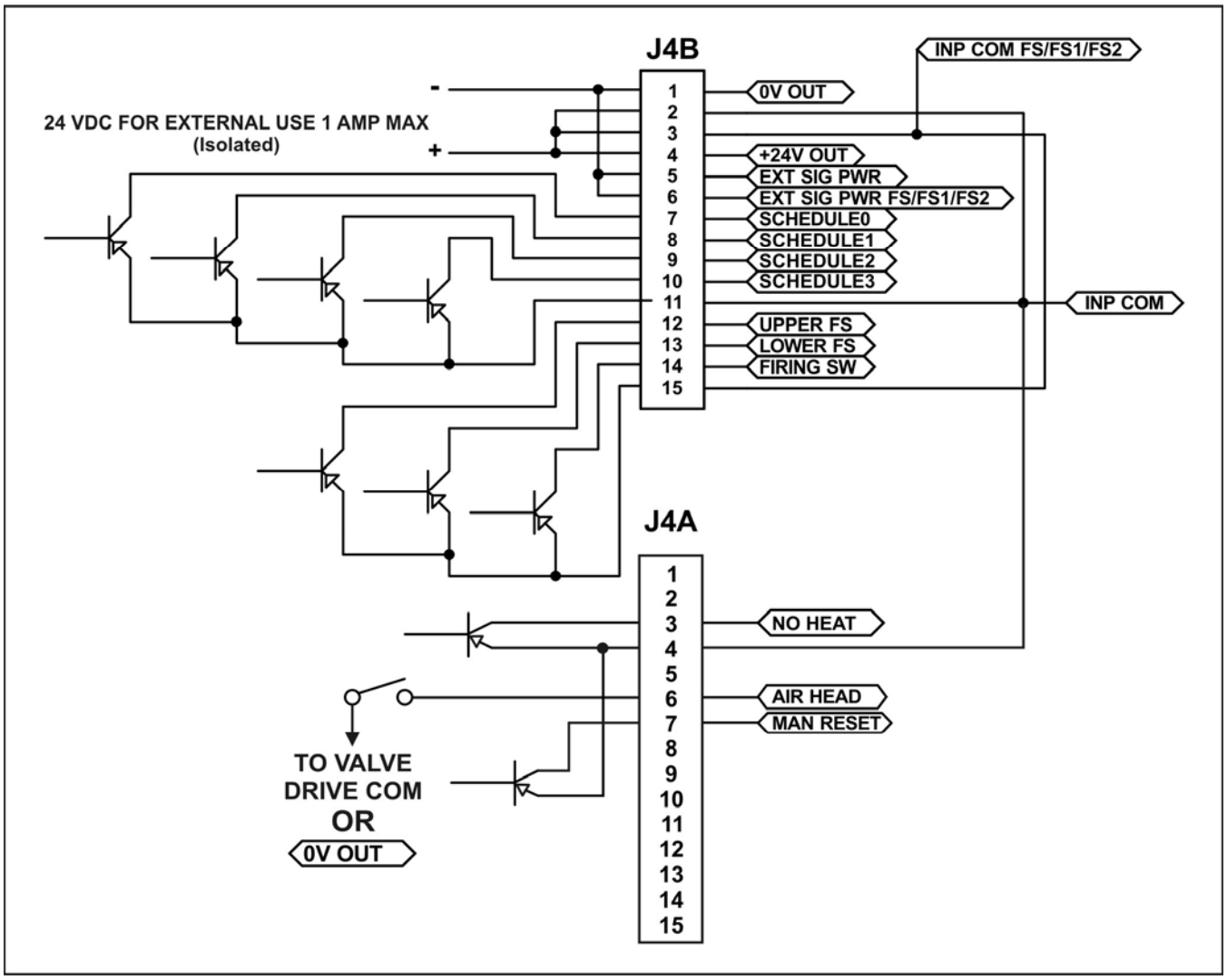
Common Negative Input (Internal Power)



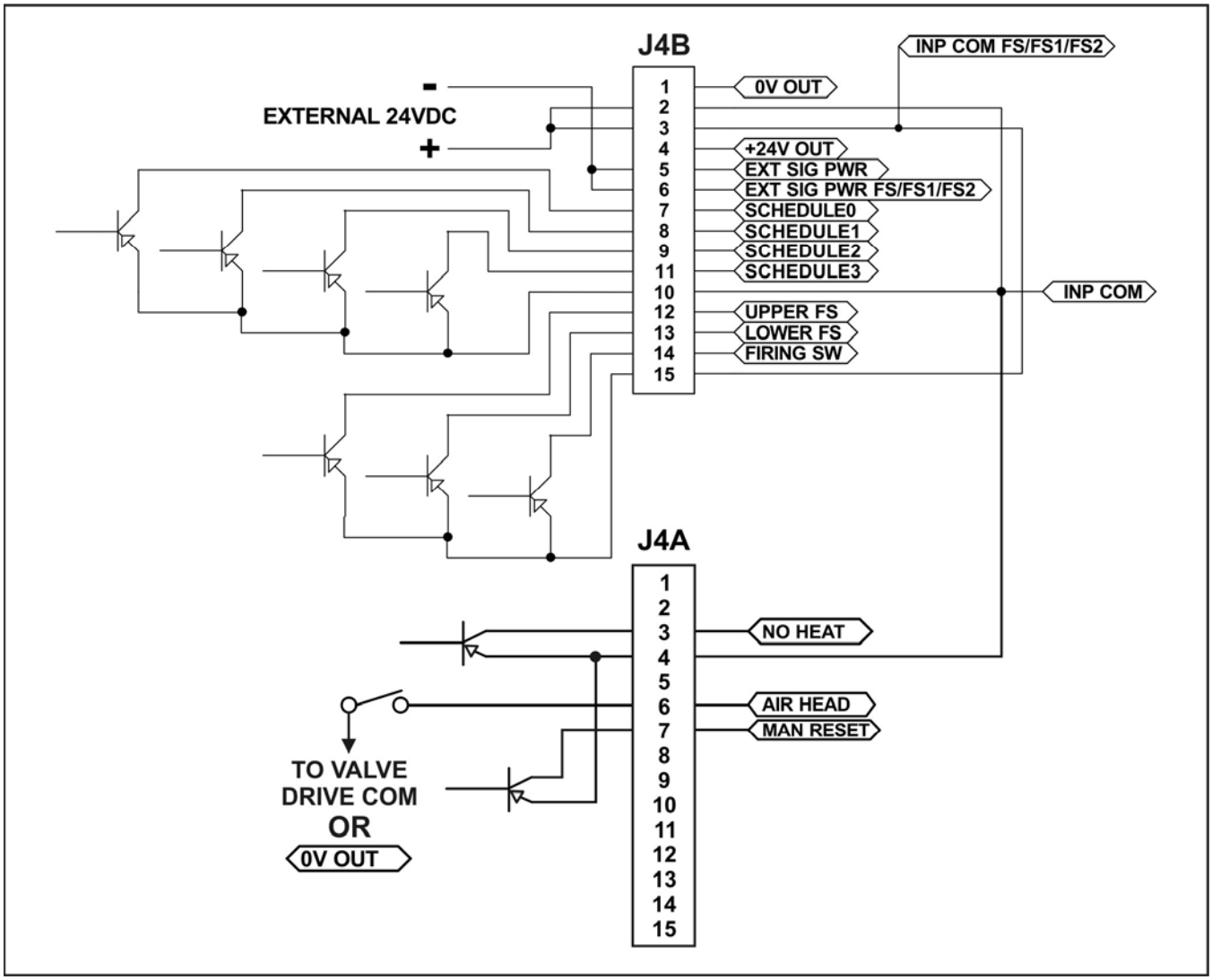
Common Negative Input (External Power)



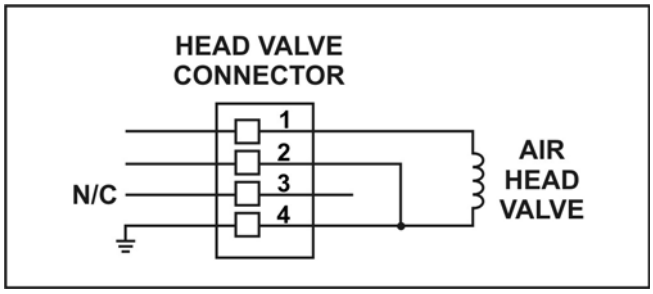
Common Positive Input (Internal Power)



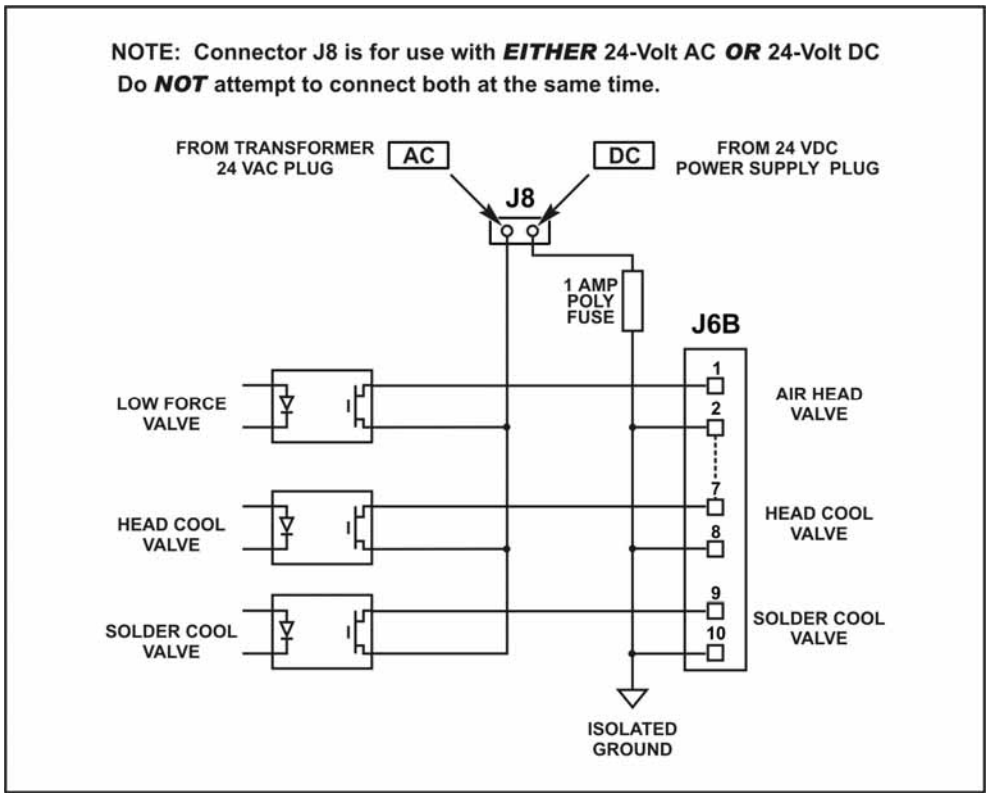
Common Positive Input (External Power)



Force Valve Drive Connections



Valve Driver Outputs



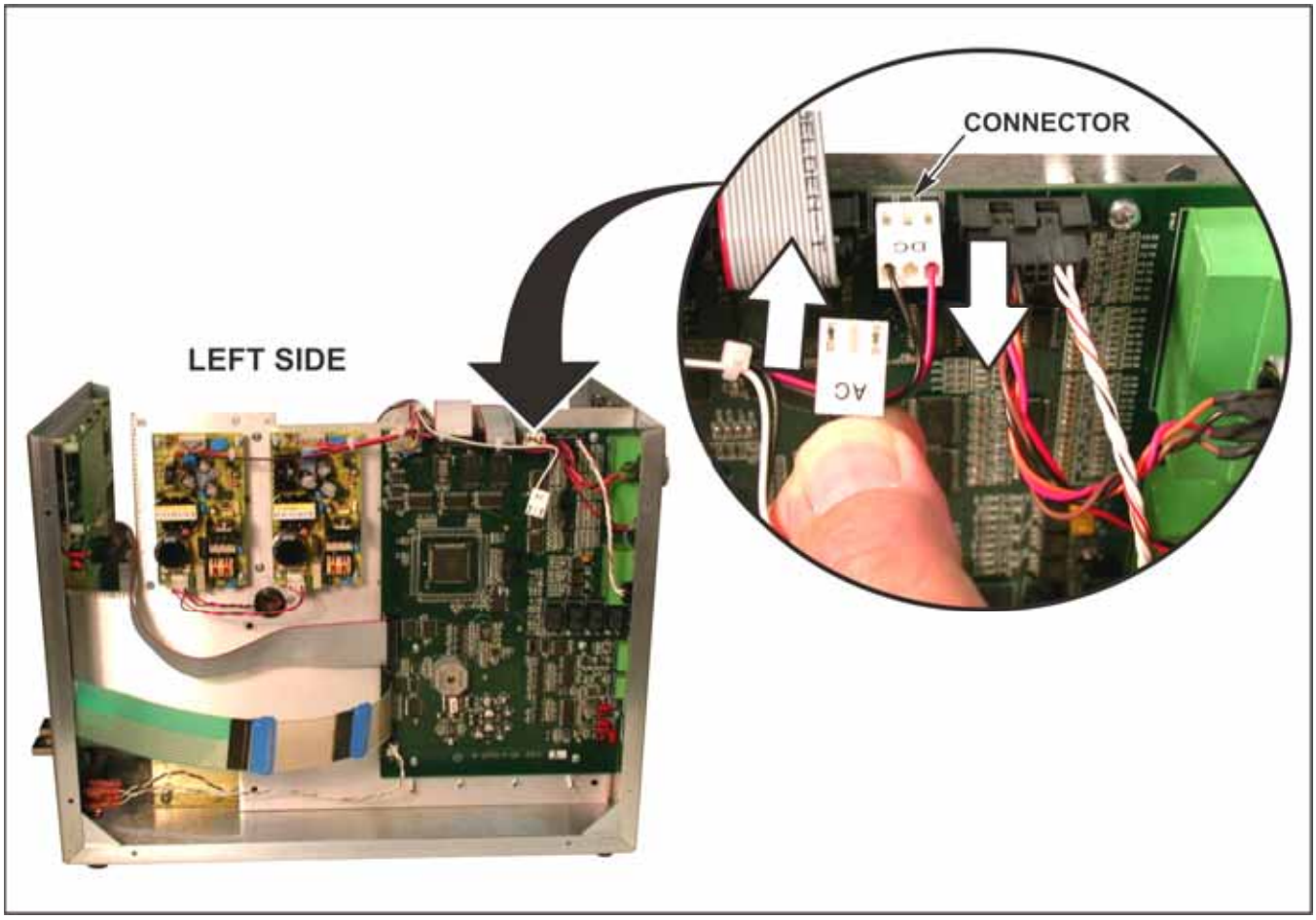
Output Rating: 24 VAC/VDC, 0.3 A max

Output Voltage Selection: AC or DC 24 volt output power is selectable by connecting the proper **AC** or **DC** plug as shown on the next page.

NOTES:

- For AIR HEAD VALVE operation either (1) jumper HEAD VALVE CONNECTOR pin 2 and pin 4 or (2) jumper J4A pin 6 (AIR HEAD) to VALVE DRIVER COMMON or <0V OUT> (see J4A/B pin out)
- If using connection configuration SWITCH CONTACT INPUT (INTERNAL POWER) or COMMON NEGATIVE INPUT (INTERNAL POWER), J4A pin 4 is <0V OUT>.

Output Voltage Selection: **(Continued)** To change from 24VAC output power to 24 VDC output power , unplug the white **AC** plug from the connector shown below and plug in the white **DC** plug.



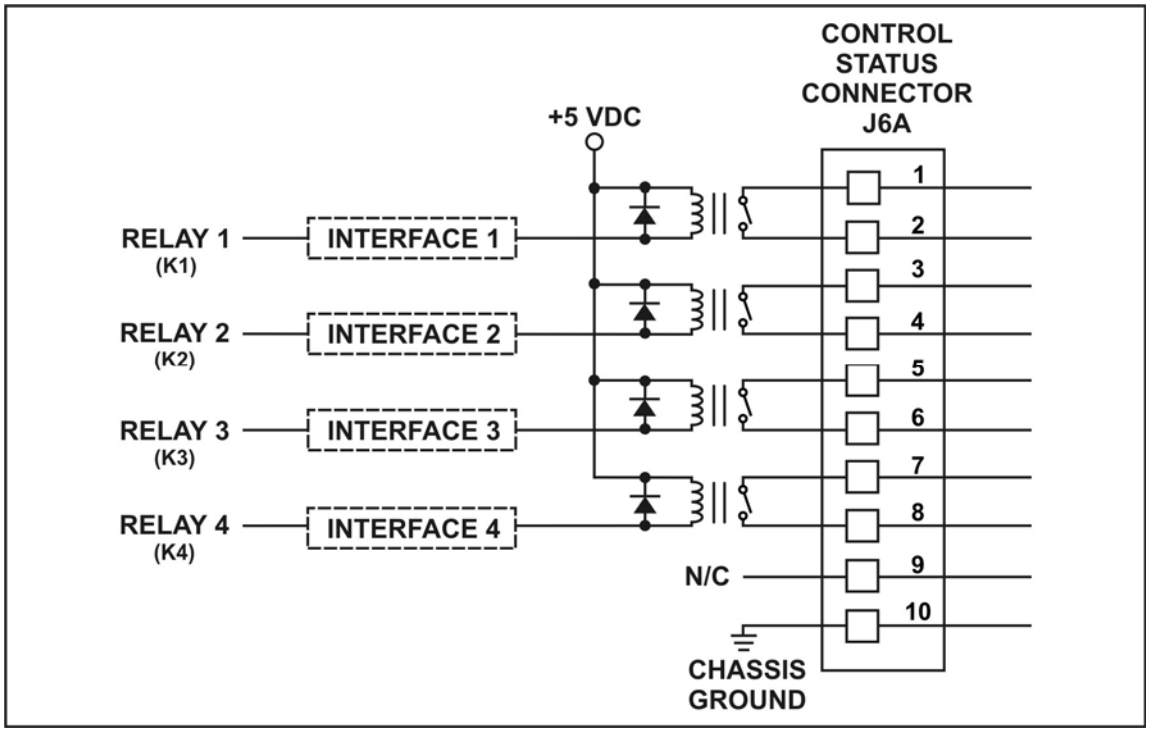
Timing:

The force valve actuates when the first level of the foot switch is closed. It automatically de-activates when the **COOL** temperature is reached, or in the event of a reflow alarm.

The head cool valve is user-programmable to be ON or OFF. It is independent of the reflow process cycle. It is used to prevent the thermocouple holder from overheating.

The solder cool valve can be user-programmed to activate at the start of the **COOL** period. It automatically de-activates when the thermode temperature reaches either the **COOL** or **PREHEAT** temperature which ever is lower. It is used to cool the hot thermode quicker.

Alarm/Status Relays Connections



Relay Rating: 250 VAC or 30 VDC at 5 A

User Programmable Options for Relay States:

Reflow: ON/OFF during reflow process cycle

Preheat: ON/OFF for continuous preheat (also known as the idle state)

Alarm: ON/OFF for alarm conditions. Auto reset when alarm is cleared

Clean Thermode: ON/OFF when clean thermode counter expires. Auto reset when counter is edited.

Replace Thermode: ON/OFF when replace thermode counter expires. Auto reset when counter is edited.

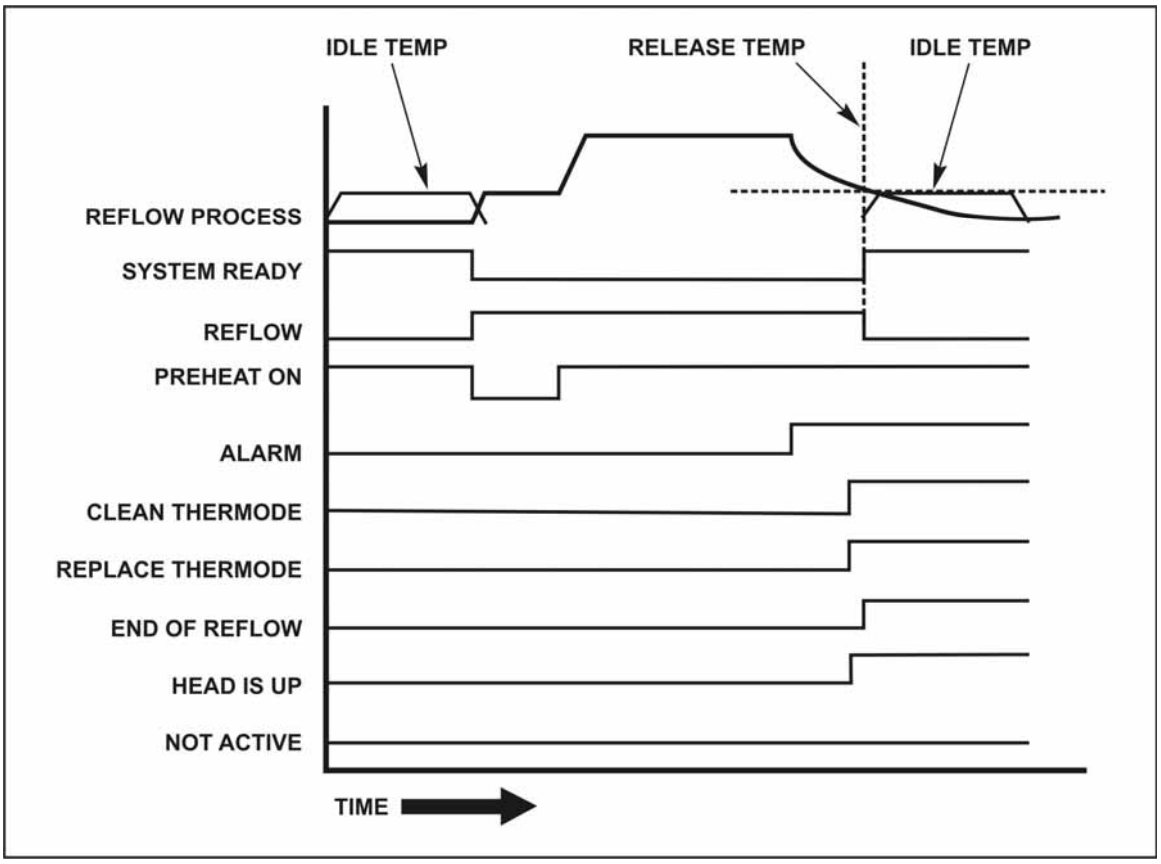
End of Reflow: ON/OFF when reflow process cycle is complete. Auto reset at start of the next cycle.

Head is Up: The weld head is in home position.

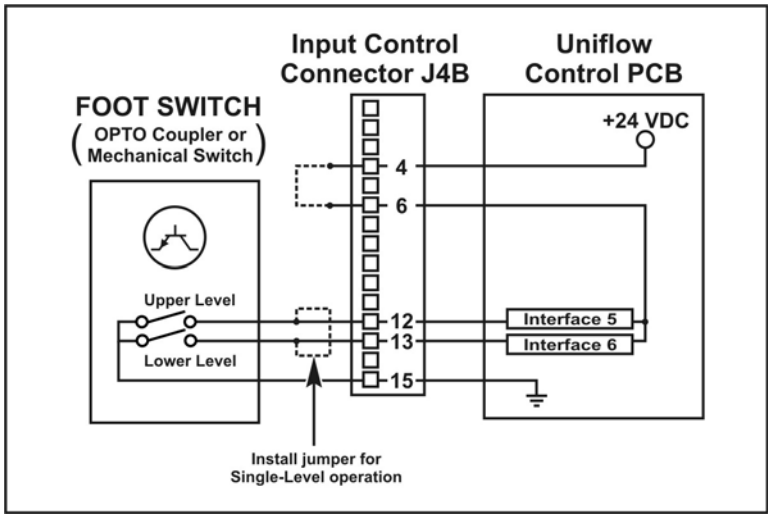
System Ready: Control is ready for reflow operation.

Not Active: The relay is not active.

Relay State Timing



Remote Selection with Switches or Opto-Couplers



Foot Switch Inputs:

You may use either a 1-level or 2-level foot switch with the Control. When using a 1-level foot switch, you must jumper the two-level inputs together so that the two levels operate as an OR-function, as shown in the Figure above.

When using a 2-level foot switch, when the first level closes, the Control energizes the air-actuated head. The thermode descends and applies force to the work pieces. If you release the foot switch before pressing it to the second level, the Control will automatically return the thermode to the home position so that you may reposition the work pieces.

If you do not release the foot switch and proceed to the second level, the force firing switch in the head will close. Heating current will flow, and the Control will return the thermode to the home position following the heating cycle.

Connect the Unitek FS2L or Unitek FS1L, a double-pole single-throw reed relay, or the open collectors of opto-couplers to Input Control Connector **J4B.** If using opto-couplers, connect the emitters to Pin 15 of **J4B** (**INPUT COM FS/FS1/FS2**).

NO HEAT Input:

The **NO HEAT** input is the remote equivalent of the front panel **HEAT/NO HEAT** switch, as described in *Chapter 1, Description*.

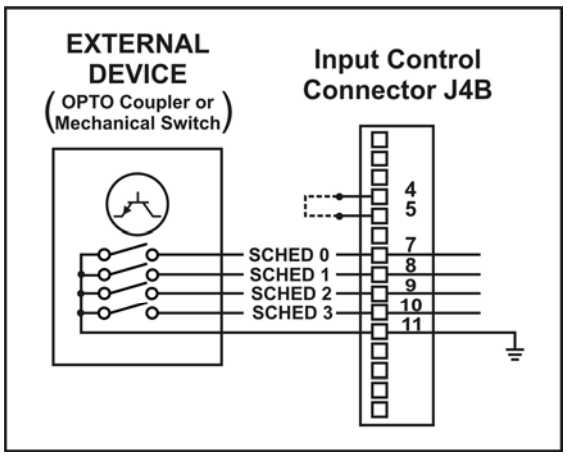
Automation Control Inputs Connections

Input Signal Rating: 0 or 24 VDC, 2 mA max

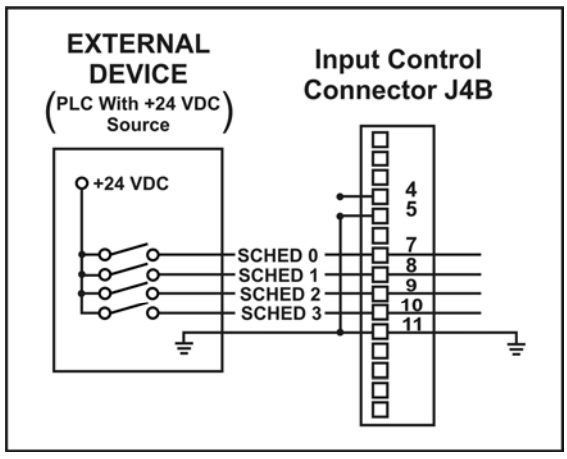
Remote Profile Inputs: All Profiles must be entered and saved in the Control memory locally (from the Front Panel). Once they are saved, they can be recalled prior to initiating the Reflow process by placing a binary value on the four **SCHED** lines. This may be done with an external PLC (Programmed Logic Controller) or host computer. When all of the **SCHED** Inputs are inactive (**0000**), the Profile Number (**1-15**) can be selected from the Front Panel. When any of the **SCHED** Inputs are active the Profile Number Keys on the Front Panel become disabled and the Profile Number is selected through the Profile Remote Inputs, **SCHED 0**, **SCHED 1**, **SCHED 2** and **SCHED 3**. The Profile Number Zero (**0**) is not a displayable selection.

Remote Profile Inputs Binary Profile				
Profile Number	**SCHED 0 Pin 7**	**SCHED 1 Pin 8**	**SCHED 2 Pin 9**	**SCHED 3 Pin 10**
0	0	0	0	0
1	1	0	0	0
2	0	1	0	0
3	1	1	0	0
4	0	0	1	0
5-14	Binary progression from 5 to 14			
15	1	1	1	1

You may use mechanical switches, opto couplers, or a PLC for remote profile selection.

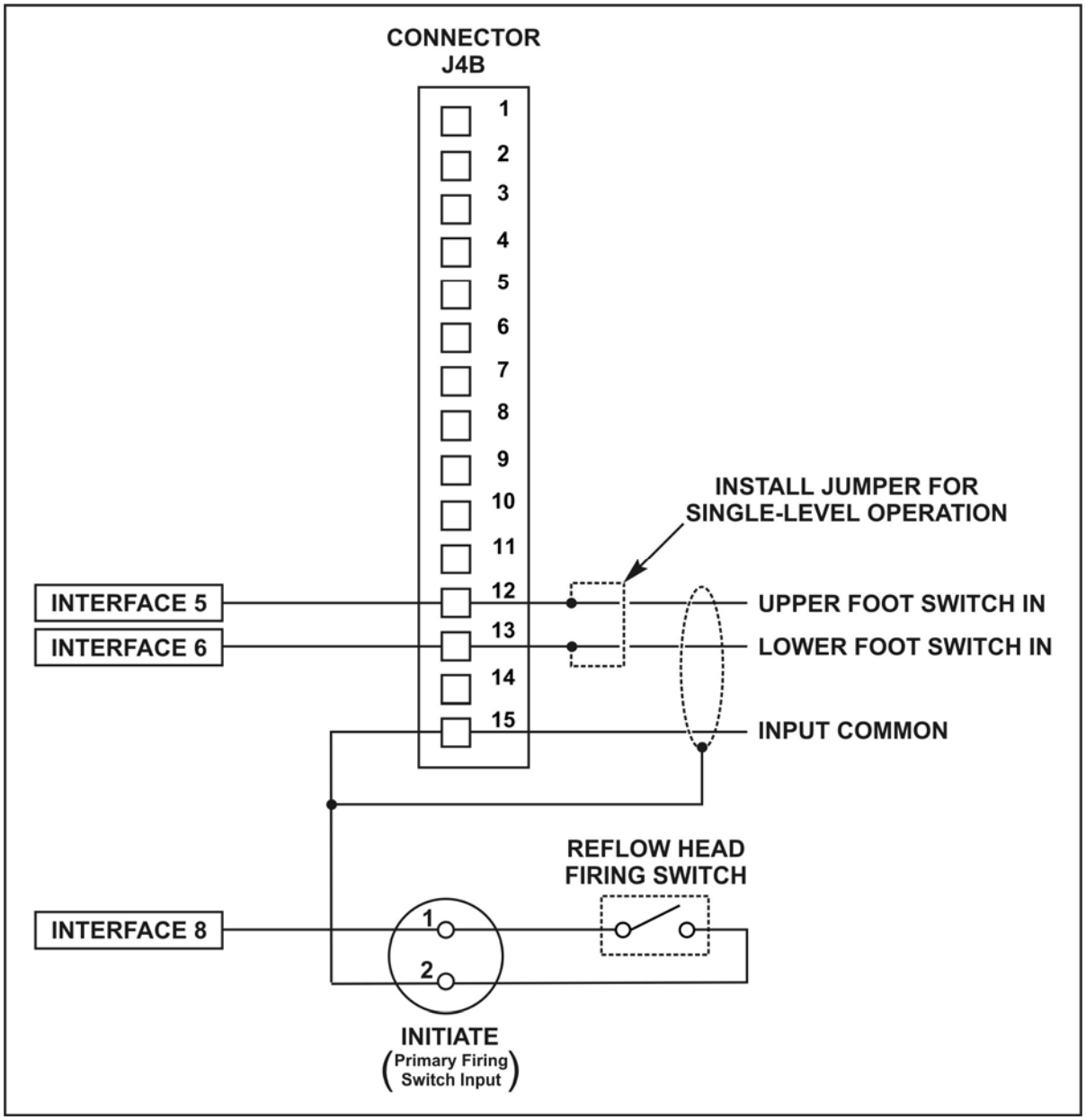


Remote Profile Selection with Switches or Opto-Couplers



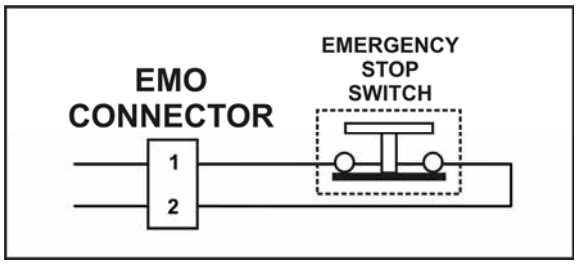
Remote Profile Selection with PLC

Operator Initiation Switch and Firing Switch Inputs



Input Signal Rating: 0 or 24 VDC, 2 mA maximum

EMERGENCY STOP Input

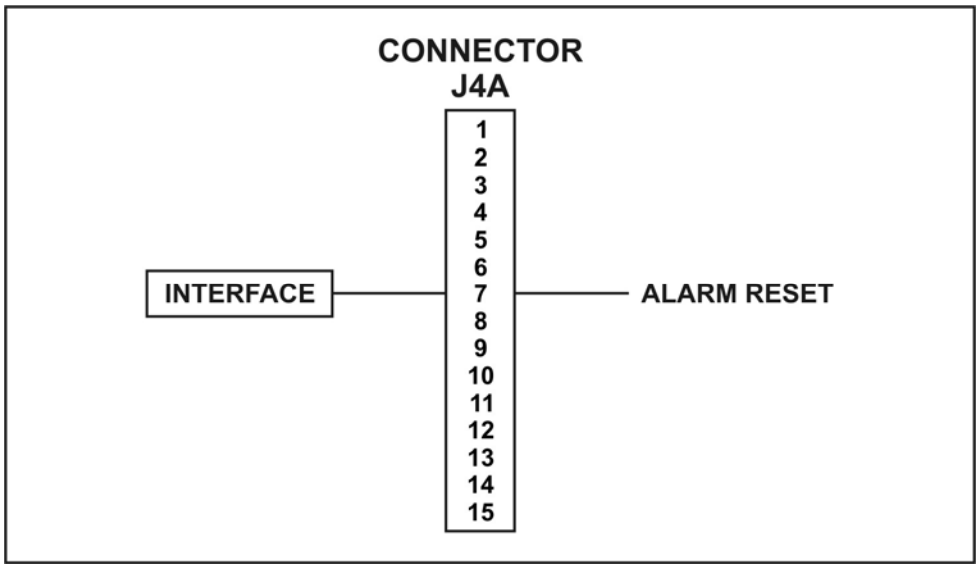


Input Signal Rating: 24 VDC at 2 mA maximum

Type of Switch: Normally closed pushbutton

Timing: When the **EMERGENCY STOP** switch is pressed, it removes 24-volt power from the reflow head, causing it to retract immediately.

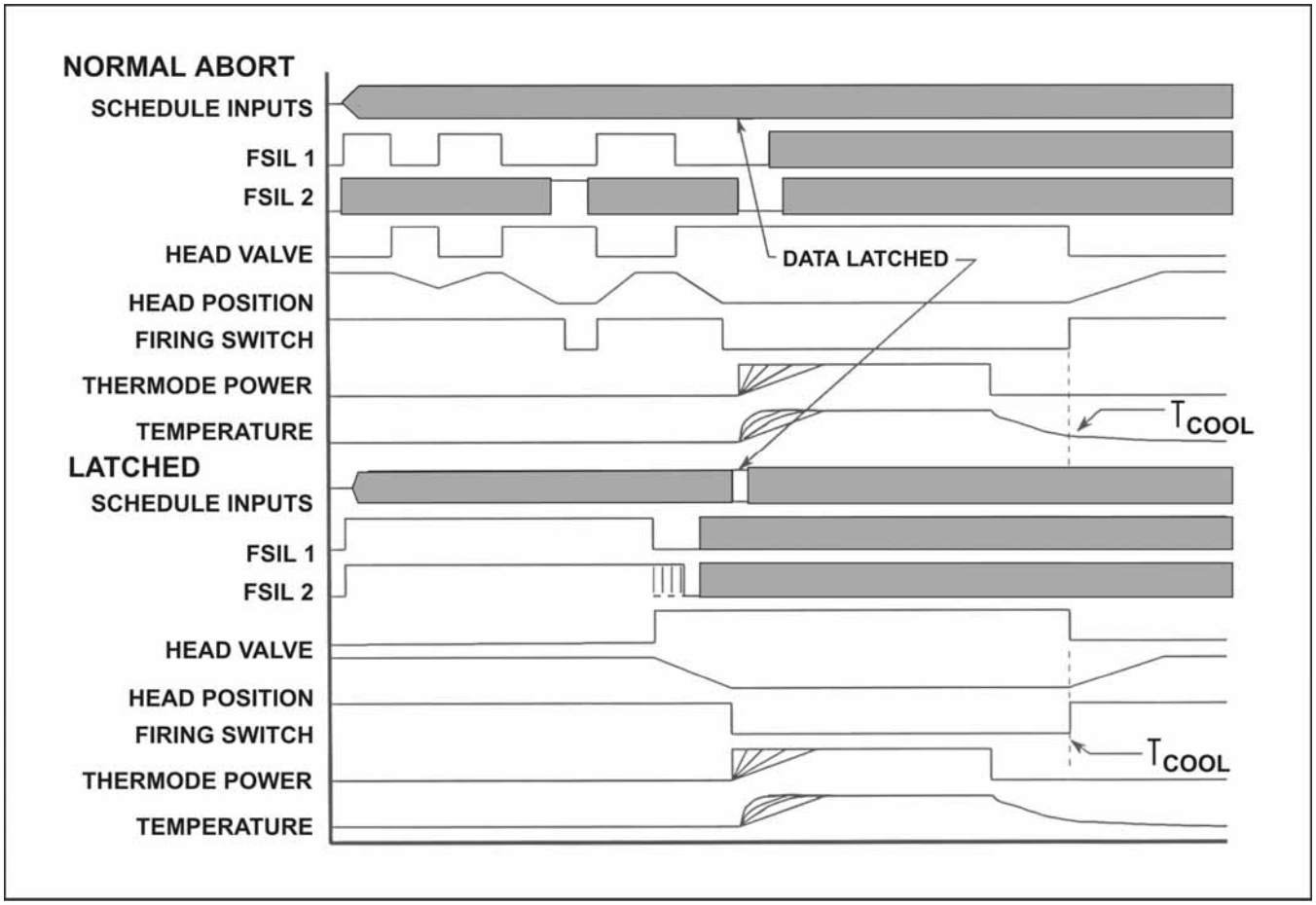
Manual Alarm Reset



Input Signal Rating: 0 to 24 VDC, 2 mA maximum

Timing: By applying a signal at **J4A-7**, a PLC or external computer can readily reset all alarms before proceeding with the next reflow process.

APPENDIX C
SYSTEM TIMING



NOTE: All inputs are debounced for a fixed 30ms period.

APPENDIX D
COMMUNICATION CODES

Section I. Command Format

COMMAND KEYWORDS: **BOLD.**

VARIABLE: *italics.*

REQUIRED PARAMETERS: {enclosed in braces} (one required and only one parameter allowed).

CHOICE OF PARAMETERS: separated by vertical bar **" | "** indicates one ***or*** another of choices presented.

ON = 1 ASCII

OFF = 0 ASCII

Baud Rate is adjustable at 9600, 19.2k, and 38.4k Baud, 8 Data bits, 1 Stop, No Parity.

Section II. UNIFLOW 2 Communication Codes

RS-232 and RS-485 Communication Protocol

Each command will be formatted as follows:

<soh> <@> <cmd> <cnt> <data> <cksum> <eot>.

Definition of Command Elements

<soh>	1 BYTE	The data packet will start with a **SOH** (start of header **0x01**) character .
<@>	2 BYTES	This is the address of the unit to which data is requested converted into ASCII decimal numbers. **(“01" - “31").** Note: this is the **RS-485** unit address.
<cmd>	2 BYTES	This is a two character ASCII string denoting the command. **(i.e. “SR”)**.
<cnt>	3 BYTES	This is a count of data bytes to follow, converted into a ASCII decimal number. **(“000" - “999").**
<data>	n BYTES	This is optional **ASCII** data formatted into fields with each field separated by a comma
<cksum>	2 BYTES	This is a two charter ASCII HEX string calculated from the sum of all bytes except <soh>, <cksum>, and <eot> and then masked with 255 (0xFF).
<eot>	1 BYTE	This terminates the transmission. (End transmit **0x04**).

Response to Errors or Unsupported Commands

The UNIFLOW 2 will respond to the receipt of incorrect transmitted data with a NAK command under the following conditions.

The format of the NAK command string is:
<soh> <@> “NK” “001” <nak value> <cksum> <eot>.

Where <nak value> is: '1' NO <soh >. ‘2’ BAD checksum. ‘4’ Timeout.
‘3’ Unrecognized command. ‘6’ Data Bad.

There is No Acknowledgement sent when the data is correct and accepted by the Uniflow 2.

When you issue a command to the Uniflow 2, you need to wait about 250 ms. before you issue the next command. The answer timeout is set to about 250 ms. in case the Uniflow 2 doesn't respond to a command.

Error checking at the unit is as follows:

1. If the Uniflow 2 unit decodes an RS-485 address that does not match the unit's address, the command is ignored.
2. The Uniflow 2 unit will ignore an external command that does not end with an <eot> or one that does not have the correct number of data bytes specified in the message.
3. If the Uniflow 2 unit reflows during reception or transmission of a command there is a possibility that bytes may be missed or the message truncated.
4. Unsupported commands will return a Nak #3.
5. Incorrect checksums will return a Nak #2.
6. If the Uniflow 2 is dropping incoming characters, the Uniflow 2 may return either a Nak #1, #2 or #4 depending on which character was dropped.
7. When the temperature data in the DS command is set to '0', or any of the data is out of range, the Uniflow 2 Will return a Nak #6.

Suggested error checking procedure on the external host side of the interface:

1. For a host "read" command, e.g. read profile data, the host must timeout if the unit does not send a complete response within a reasonable amount of time. Host can also check the number of bytes received against the expected number for that message, range check the received data, or do whatever else is thought necessary to have confidence in the received data.
2. Following a host "set" command, the host must subsequently read the data just "set" and make sure the data "set" matches data "read." For example, if a "set profile 1" command is sent, the unit must then do a "read profile 1" and compare the set data against the read data.

Significance of the unit's COMMUNICATIONS ROLE parameter on the Communications screen:

1. This parameter must be set to MASTER under normal running conditions to turn on the "Read Report" command which sends the results of the latest reflow to the host automatically.
2. When the parameter is set to SLAVE, this reporting will be turned off and the unit will accept both "Read" and "Set" from the host.
3. When MASTER, the unit will not accept any commands from the host. This avoids potential collisions between these commands and the automatic reporting of reflow results.
4. MASTER or SLAVE must be set at the Uniflow 2 unit's panel by pressing the SETUP key and selecting option 2. COMMUNICATIONS.

Significance of the unit's RS232/485 SELECT parameter on the Communications screen:

1. RS-232 and RS-485 are mutually exclusive. One or the other is selected at the Communications screen.
2. The serial link to the host computer should be plugged into the proper socket on the back of the unit. If RS-232 is the selection, this socket would be labeled RS 232. Likewise, if RS-485 is selected, the serial link to the host should be plugged into the socket labeled RS 485.

   NOTE: Due to the way RS-232 handles line logic states, it will work even if RS-485 is selected and even if the serial link is plugged into the RS 485 socket. The reverse is ***not*** true, however. RS-485 will work ***only*** if selected and the link plugged into the correct socket. For consistency and clarity, please follow the guidelines in 1 and 2 above.

Host Originated Command Set

These are commands sent by the host computer, via the RS-485/RS-232 port to the UNIFLOW 2.

NAME	COMMAND	DATA	SIZE
COPY	"CP" Set	Source schedule #	2 Bytes
		,	1 Byte
		Destination schedule #	2 Bytes
			5 Bytes Total
COUNTER	"CR" Read	Read the Counters Data	0 Bytes
	"CS" Set	ReflowCntrs.dwTotalUsageCnt (Total Usage Cntr: 0000000 – 9999999)	7 Bytes
		,	1 Byte
		ReflowCntrs.dwGoodReflowCnt (Good Rflo Cntr: 0000000 – 9999999)	7 Bytes
		,	1 Byte
		ReflowCntrs.stClean.sdCnt (Clean Counter: 000000 – 999999)	6 Bytes
		,	1 Byte
		ReflowCntrs.stReplace.sdCnt (Replace counter: 000000 – 999999)	6 Bytes
		,	1 Byte
		ReflowCntrs.stClean.fStatus (Clean counter status: 0 = OFF, 1 = ON)	1 Byte
		,	1 Byte
		ReflowCntrs.stReplace.fStatus (Replace counter status: 0 = OFF, 1 = ON)	1 Byte
		,	1 Byte
		ReflowCntrs.stClean.enAction (Clean counter action: 0 – 1) 0 = STOP 1 = CONTINUE	1 Byte
		,	1 Byte
		ReflowCntrs.stReplace.enAction (Replace counter action: 0 – 1) 0 = STOP 1 = CONTINUE	1 Byte
			37 Bytes Total
LOAD	"LS" Set	The profile # to become active	2 Bytes
	"LR" Read	Returns the current active profile	0 Bytes
MONITOR	"MR" Read	Read System State	0 Byte
	"MS" Set	DispProfile.ProfileNum (Active screen number 000 – 255) 00 = NO_SCRN_DEF 01 = ALLPIXELSON 02 = ALLPIXELSOFF 03 = BAUDSCR 04 = BUZZER 05 = CLEAN_CNTR 06 = CLEAN_CNTR_SETUP 07 = COARSE_HEATING 08 = COMMID 09 = COMMSCR 10 = CONTRAST 11 = COPYSCR	3 Bytes

12 = COPYSCR2
13 = COPYRIGHT
14 = DATASCR
15 = DEFAULTS
16 = (not used)
17 = FREQ_DETECT
18 = GOOD_REFLOW_CNTR
19 = GRAPHSCR
20 = HARDWARE1
21 = HARDWARE2
22 = HEATSWTEST
23 = HIDDEN
24 = HW_LIST
25 = KBDTEST
26 = KDSCR
27 = KISCR
28 = KPSCR
29 = LOGO_SCR
30 = LOWER_TEMP
31 = MANUAL_TUNING
32 = MAX_TEMP
33 = PASSWORD
34 = PIDPARAMS
35 = PIXELONTEST
36 = PIXELOFFTEST
37 = REFLOW1
38 = REFLOW2
39 = REFLOW_COUNTERS
40 = RELAY
41 = RELAY1
42 = RELAY2
43 = RELAY3
44 = RELAY4
45 = RELAY1WHENSCR
46 = RELAY2WHENSCR
47 = RELAY3WHENSCR
48 = RELAY4WHENSCR
49 = RELEASE_TIMER
50 = REPLACE_CNTR
51 = REPLACE_CNTR_SETUP
52 = SETTODEFAULTS
53 = SAFETY_TIMER
54 = SETUP
55 = SHOWPASSWD
56 = SYSTEM_SEC
57 = SYSTEMTESTS
58 = TESTRELAYS
59 = TOTAL_USAGE
60 = UPPER_TEMP
61 = IDLE_TEMP_SCR

3 Bytes Total

PROFILE	"DR" Read	Profile #	2 Bytes
	"DS" Set	ProfileNum (Profile number to be modified: 01 - 15)	2 Bytes
		,	1 Byte
		PreheatTemp (Preheat temperature: 060 - 999)	3 Bytes
		,	1 Byte
		ReflowTemp (Reflow temperature: 060 - 999)	3 Bytes
		,	1 Byte
		CoolTemp (Cool temperature: 060 - 999)	3 Bytes
		,	1 Byte
		PreheatTime (Preheat time: 000 – 999)	3 Bytes
		,	1 Byte
		RiseTime (Rise time: 00 – 99)	2 Bytes
		,	1 Byte
		ReflowTime (Reflow time: 000 – 999)	3 Bytes
		,	1 Byte
		CoarseRate (Coarse heating rate: 0 – 3) 0 = Very Slow 1 = Slow 2 = Medium 3 = Fast	1 Byte
			27 Bytes Total
RELAY	"VR"	Read relay values	0 Bytes
	"VS"	Relays1.on_off (0 = NORMALOPEN, 1 = NORMALCLOSED)	1 Byte
		,	1 Byte
		Relays1.when REFLOW_TRIG = 0, PREHEATON_TRIG = 1 ALARM_TRIG = 2 CLEANTHERM_TRIG = 3 REPLACETHERM_TRIG = 4 ENDOFREFLOW_TRIG = 5 HEADACTIVE_TRIG = 6 SYSTEMREADY_TRIG = 7 NOTACTIVE_TRIG = 8	1 Byte
		,	1 Byte
		Relays2.on_off (As above)	1 Byte
		,	1 Byte
		Relays2.when (As above)	1 Byte
		,	1 Byte
		Relays3.on_off (As above)	1 Byte
		,	1 Byte
		Relays3.when (As above)	1 Byte
		,	1 Byte
		Relays4.on_off (As above)	1 Byte
		,	1 Byte
		Relays4.when (As above)	1 Byte
			15 Bytes Total

RESET	"RX" Reset	Resets system	0 Bytes
SECURITY	"SR" Read	Read Security Locks	0 Bytes
	"SS" Set	Password (0000000 – 9999999)	7 Bytes
(Note: Password is not set by this command. It must match the password in the unit in order to set security locks below)			
		,	1 Byte
		ProfileLock (Profile Lock: 0 = OFF, 1 = ON)	1 Byte
		,	1 Byte
		SystemLock (System Lock: 0 = OFF, 1 = ON)	1 Byte
		,	1 Byte
		ProfileTuneLock (Profile Tuning Lock: 0 = OFF, 1 = ON)	1 Byte
			13 Bytes Total
SYSTEM	"YR" Read	Read system values	0 Bytes
	"YS" Set	HeadCoolValveStatus (0 = OFF, 1 = ON)	1 Byte
		,	1 Byte
		SolderCoolValveStatus (0 = OFF, 1 = ON)	1 Byte
		,	1 Byte
		FootSwResponseMode (0 = ABORT, 1 = LATCH)	1 Byte
		,	1 Byte
		Contrast (00 – 99)	2 Bytes
		,	1 Byte
		BuzzerLoudness (00 – 99)	2 Bytes
		,	1 Byte
		BuzzerAtEnd (0 = OFF, 1 = ON)	1 Byte
		,	1 Byte
		PreheatStatus (0 =ON, 1 = TIMED)	1 Byte
		,	1 Byte
		UpperTempLimit (000 – 999)	3 Bytes
		,	1 Byte
		LowerTempLimit (0 – 999)	3 Bytes
		,	1 Byte
		AutoscalingEnabled (0 = OFF, 1 = ON)	1 Byte
		,	1 Byte
		SafetyTimerTime (00 – 99)	2 Bytes
		,	1 Byte
		ReleaseTimerTime (00 – 99)	2 Bytes
		,	1 Byte
		MaxTempLimit (000 – 999)	3 Bytes
		,	1 Byte
		MaxIdleTemp (0 = NONE, 1 = 500, 2 = 700, 3 = 900)	1 Byte
			37 Bytes Total
TEMP	"TR" Read	Read current temperature	0 Bytes
TYPE	"TY" Read	none	0 Bytes

UNIFLOW 2 Originated Response Command Set

These are commands returned by the UNIFLOW 2, via the RS-485/RS-232 port.

NAME	COMMAND	DATA	SIZE
COUNTER	"CS" Set	ReflowCntrs.dwTotalUsageCnt (Total Usage Cntr: 0000000 – 9999999)	7 Bytes
		,	1 Byte
		ReflowCntrs.dwGoodReflowCnt (Good Rflo Cntr: 0000000 – 9999999)	7 Bytes
		,	1 Byte
		Sign (Clean Counter plus or minus sign: + or -)	1 Byte
		ReflowCntrs.stClean.sdCnt (Clean Counter: 000000 – 999999)	6 Bytes
		,	1 Byte
		Sign (Replace Counter plus or minus sign: + or -)	1 Byte
		ReflowCntrs.stReplace.sdCnt (Replace counter: 000000 – 999999)	6 Bytes
		,	1 Byte
		ReflowCntrs.stClean.fStatus (Clean counter status: 0 = OFF, 1 = ON)	1 Byte
		,	1 Byte
		ReflowCntrs.stReplace.fStatus (Replace counter status: 0 = OFF, 1 = ON)	1 Byte
		,	1 Byte
		ReflowCntrs.stClean.enAction (Clean counter action: 0 – 1) 0 = STOP 1 = CONTINUE	1 Byte
		,	1 Byte
		ReflowCntrs.stReplace.enAction (Replace counter action: 0 – 1) 0 = STOP 1 = CONTINUE	1 Byte
			39 Bytes Total
LOAD	"LR" Read	Returns the current active profile (01 – 15)	2 Bytes
MONITOR	"MR" Read	DispProfile.ProfileNum (Active screen number 000 – 255) 00 = NO_SCRN_DEF 01 = ALLPIXELSON 02 = ALLPIXELSOFF 03 = BAUDSCR 04 = BUZZER 05 = CLEAN_CNTR 06 = CLEAN_CNTR_SETUP 07 = COARSE_HEATING 08 = COMMID 09 = COMMSCR 10 = CONTRAST 11 = COPYSCR 12 = COPYSCR2 13 = COPYRIGHT 14 = DATASCR 15 = DEFAULTS 16 = (not used) 17 = FREQ_DETECT 18 = GOOD_REFLOW_CNTR 19 = GRAPHSCR 20 = HARDWARE1	3 Bytes

21 = HARDWARE2
22 = HEATSWTEST
23 = HIDDEN
24 = HW_LIST
25 = KBDTEST
26 = KDSCR
27 = KISCR
28 = KPSCR
29 = LOGO_SCR
30 = LOWER_TEMP
31 = MANUAL_TUNING
32 = MAX_TEMP
33 = PASSWORD
34 = PIDPARAMS
35 = PIXELONTEST
36 = PIXELOFFTEST
37 = REFLOW1
38 = REFLOW2
39 = REFLOW_COUNTERS
40 = RELAY
41 = RELAY1
42 = RELAY2
43 = RELAY3
44 = RELAY4
45 = RELAY1WHENSCR
46 = RELAY2WHENSCR
47 = RELAY3WHENSCR
48 = RELAY4WHENSCR
49 = RELEASE_TIMER
50 = REPLACE_CNTR
51 = REPLACE_CNTR_SETUP
52 = SETTODEFAULTS
53 = SAFETY_TIMER
54 = SETUP
55 = SHOWPASSWD
56 = SYSTEM_SEC
57 = SYSTEMTESTS
58 = TESTRELAYS
59 = TOTAL_USAGE
60 = UPPER_TEMP
61 = IDLE_TEMP_SCR

, 1 Byte

CurrStatusMsg (0 – 39) 2 Bytes

0 = SYSTEMREADY
1 = EMERJMPR
2 = PREHEAT_LOWLIMIT
3 = PREHEAT_HIGHLIMIT
4 = PREHEAT_HIGHERREFLOW
5 = COOL_HIGHERREFLOW
6 = PREHEAT_HIGHERCOOL
7 = REFLOW_HIGHLIMIT
8 = REFLOW_EXTENDED_HIGHLIMIT
9 = REFLOW_BELOWCOOL

		10 = REFLOW_BELOWPREHEAT 11 = ACCESSDENIED 12 = SETDEFAULTS 13 = FIRINGSWOPEN 14 = SAFETYTIMER 15 = FIRINGSWNOTACTIVATED 16 = DECREASEHEATINGRATE 17 = INCREASEHEATINGRATE 18 = REPLACE 19 = CLEAN 20 = REPLACERESET 21 = CLEANRESET 22 = POWERMODE 23 = NOHEATSWITCH 24 = PREHEATON 25 = AUTOSCALE 26 = HEADDOWN 27 = PREHEATTIME 28 = RISETIME 29 = HEATTIME 30 = COOLTIME 31 = MODIFYPROFILE 32 = LASTPROFILE 33 = IDEALPROFILE 34 = EMERSTOP 35 = MAXTEMP 36 = NOPWR 37 = OVPWR 38 = THERMODE 39 = ACCESSDENIEDREM 40 = FOOTSWOPEN	6 Bytes Total
PROFILE	"DR" Read	ProfileNum (Profile number read: 01 - 15) , PreheatTemp (Preheat temperature: 060 - 999) , ReflowTemp (Reflow temperature: 060 - 999) , CoolTemp (Cool temperature: 060 - 999) , PreheatTime (Preheat time: 000 – 999) , RiseTime (Rise time: 00 – 99) , ReflowTime (Reflow time: 000 – 999) , CoarseRate (Coarse heating rate: 0 – 3) 0 = Very Slow 1 = Slow 2 = Medium 3 = Fast	2 Bytes 1 Byte 3 Bytes 1 Byte 3 Bytes 1 Byte 3 Bytes 1 Byte 3 Bytes 1 Byte 2 Bytes 1 Byte 3 Bytes 1 Byte 1 Byte 27 Bytes Total

RELAY	"VS"	Relays1.on_off (0 = NORMALOPEN, 1 = NORMALCLOSED)	1 Byte
		,	1 Byte
		Relays1.when REFLOW_TRIG = 0, PREHEATON_TRIG = 1 ALARM_TRIG = 2 CLEANTHERM_TRIG = 3 REPLACETHERM_TRIG = 4 ENDOFREFLOW_TRIG = 5 HEADACTIVE_TRIG = 6 SYSTEMREADY_TRIG = 7 NOTACTIVE_TRIG = 8	1 Byte
		,	1 Byte
		Relays2.on_off (As above)	1 Byte
		,	1 Byte
		Relays2.when (As above)	1 Byte
		,	1 Byte
		Relays3.on_off (As above)	1 Byte
		,	1 Byte
		Relays3.when (As above)	1 Byte
		,	1 Byte
		Relays4.on_off (As above)	1 Byte
		,	1 Byte
		Relays4.when (As above)	1 Byte
			15 Bytes Total
REPORT	"RR" Read	(Reports the results of the last reflow. Sent automatically by the Uniflow Unit at the end of the reflow.)	
		ProfileNum (Profile number: 01 – 15)	2 Bytes
		,	1 Byte
		StartTemp (Starting Temperature: 000 – 999)	3 Bytes
		,	1 Byte
		PeakTemp (Peak Temperature: 000 – 999)	3 Bytes
		,	1 Byte
		FinalTemp (Final Temperature: 000 – 999)	3 Bytes
		,	1 Byte
		AverageTemp (Average Temperature: 000 – 999)	3 Bytes
		,	1 Byte
		CoolTime (Actual Cool time: 000 – 999)	3 Bytes
		,	1 Byte
		StatusMsg (Resulting Status Msg: 00 – 40) 0 = SYSTEMREADY 1 = EMERJMPR 2 = PREHEAT_LOWLIMIT 3 = PREHEAT_HIGHLIMIT 4 = PREHEAT_HIGHERREFLOW 5 = COOL_HIGHERREFLOW 6 = PREHEAT_HIGHERCOOL 7 = REFLOW_HIGHLIMIT 8 = REFLOW_EXTENDED_HIGHLIMIT 9 = REFLOW_BELOWCOOL 10 = REFLOW_BELOWPREHEAT	2 Bytes

		11 = ACCESSDENIED 12 = SETDEFAULTS 13 = FIRINGSWOPEN 14 = SAFETYTIMER 15 = FIRINGSWNOTACTIVATED 16 = DECREASEHEATINGRATE 17 = INCREASEHEATINGRATE 18 = REPLACE 19 = CLEAN 20 = REPLACERESET 21 = CLEANRESET 22 = POWERMODE 23 = NOHEATSWITCH 24 = PREHEATON 25 = AUTOSCALE 26 = HEADDOWN 27 = PREHEATTIME 28 = RISETIME 29 = HEATTIME 30 = COOLTIME 31 = MODIFYPROFILE 32 = LASTPROFILE 33 = IDEALPROFILE 34 = EMERSTOP 35 = MAXTEMP 36 = NOPWR 37 = OVPWR 38 = THERMODE 39 = ACCESSDENIEDREM 40 = FOOTSWOPEN	25 Bytes Total
SECURITY	"SR" Read	ProfileLock (Profile Lock: 0 = OFF, 1 = ON) , SystemLock (System Lock: 0 = OFF, 1 = ON) , ProfileTuneLock (Profile Tuning Lock: 0 = OFF, 1 = ON)	1 Byte 1 Byte 1 Byte 1 Byte 1 Byte 5 Bytes Total
SYSTEM	"YR" Read	HeadCoolValveStatus (0 = OFF, 1 = ON) , SolderCoolValveStatus (0 = OFF, 1 = ON) , FootSwResponseMode (0 = ABORT, 1 = LATCH) , Contrast (00 – 99) , BuzzerLoudness (00 – 99) , BuzzerAtEnd (0 = OFF, 1 = ON) , PreheatStatus (0 = ON, 1 = TIMED) ,	1 Byte 1 Byte 1 Byte 1 Byte 1 Byte 1 Byte 2 Bytes 1 Byte 2 Bytes 1 Byte 1 Byte 1 Byte 1 Byte 1 Byte

		UpperTempLimit (000 – 999)	3 Bytes
		,	1 Byte
		LowerTempLimit (0 – 999)	3 Bytes
		,	1 Byte
		AutoscalingEnabled (0 = OFF, 1 = ON)	1 Byte
		,	1 Byte
		SafetyTimerTime (00 – 99)	2 Bytes
		,	1 Byte
		ReleaseTimerTime (00 – 99)	2 Bytes
		,	1 Byte
		MaxTempLimit (000 – 999)	3 Bytes
		,	1 Byte
		MaxIdleTemp (0 = NONE, 1 = 500, 2 = 700, 3 = 900)	1 Byte
			37 Bytes Total
TEMP	"TR" Read	CurrTemp (Current temperature of the thermode:	
TYPE	"TY" Read	"Uniflow2", Release #, Revision # Example: "Uniflow2 1.00 AxP"	17 Bytes

EXAMPLES:

1) An example of sending a TYPE command to the Uniflow 2: <soh>"01TY0009E"<eot>

The Unit's address is "01"

The command: "TY"

The Count is: "000"

The check sum is "9E". Which is calculated from the ASCII (American Standard code for information interchange) and is a two charter ASCII HEX string calculated from the sum of all bytes except <soh>, <cksum>, and <eot>. '0' + '1' + 'T' + 'Y' + '0' + '0' + '0'

Looking up the value for each character, We get 0x30 + 0x31 + 0x54 + 0x59 + 0x30 + 0x30 + 0x30 = 0x19E HEX

In decimal 48 + 49 + 84 + 89 + 48 + 48 + 48 = 414 decimal.

The check sum is a value between 0 and 255; Therefore, 414 – 255*n = 158 decimal = 19E hex.

Where n = (check sum / 255). Here it is only 1.

If the check sum were 9C4 hex = 2500 decimal. Then n = 2500 / 256 = 9.7.

Using only the hole number n = 9

The final check sum is (2500 – (256 * 9)) = 196 decimal.

A better way is to take the final check sum and AND it with 255 (0x0FF).

In hex, taking the final check sum 0x9C4 and ANDing it with 0xFF = 0xC4, or in decimal 2500 AND 255 = 196.

2) Now we wish to change the profile we are on to number 5.

The command would be: <soh>"01LS00205F7"<eot>. "01" is the unit address, "LS" is the command, "002" is the count, 05 is the new profile to go to, and "F7" is the check sum.

Calculating the checksum in HEX we get 0x30 + 0x 31 + 0x4C + 0x53 + 0x30 + 0x30 + 0x32 + 0x30 + 0x35 = 0x1F7 HEX. ANDing it with 0xFF yields a checksum of 0xF7.

In decimal 48 + 49 + 76 + 83 + 48 + 48 + 50 + 48 + 53 = 503.

503 / 256 = 1.96. Therefore the check sum is 503 – (256*1) = 247 decimal or F7 hex.

3) We wish to set the security. The Command is:

<soh>"01SS0141234321,1,0,112"<eot>. "01" is the unit address. "SS" is the set security command. "014" is the count. "1234321," is the password. "1," is Profile lock ON. "0," is System lock OFF. "1" is Profile Tune Lock ON. And "12" is the check sum. The check sum is 412 HEX ANDed with 0xFF is 12.

APPENDIX E
GUIDELINES FOR REFLOW SOLDERING

Overview

This Appendix covers the process definition and components used in the pulse heated reflow soldering of flexible circuits to printed circuit boards. We will look in depth at the component part design criteria necessary to achieve the optimum quality and consistency of a flex to PCB assembly, concentrating on the most popular joint designs and component parts used in the process today.

Definition Of Process Technology

Pulse heated reflow soldering is a process where two pre-fluxed, solder coated parts are heated to a temperature sufficient to cause the solder to melt, flow, and solidify, forming a permanent electro-mechanical bond between the parts and solder. Pulse heated soldering differs from the traditional soldering process in that the reflow of solder is accomplished using a heating element called a thermode which is heated and cooled down for each connection. Pressure is applied during the entire cycle including heating, reflow, and cooling. A pulse-heated control delivers energy to the thermode, which is mounted on the reflow soldering head. A thermocouple, attached to the thermode, provides feedback to the control for repeatable, consistent heat generation.

The soldering head brings the two parts into intimate contact. At a precise pressure the head signals the control to begin the heating cycle of the thermode. The thermode conducts heat to the parts, and the subsequent thermal transfer of heat melts the solder between the parts. The molten areas begin to flow resulting in coalescence between the two solder masses. When the reflow cycle is terminated by the Control, the parts continue to be held together during the cooling cycle such that the solder re-solidifies and a joint is formed. A good solder joint is defined as one where the solder adequately joins both surfaces and wetting (flow of solder) has occurred on both part surfaces.

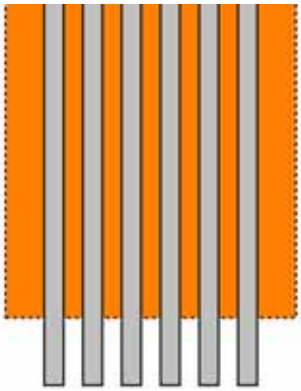
Flex Components

The most common type of flex used in the pulse heated reflow soldering process is manufactured from polyimide (also known under the trade name of Kapton). Two layers of polyimide encapsulate the copper traces (normally 0.5 – 2 oz). The two most common copper conductors are rolled annealed (RA) copper and electro-deposited copper (ED). ED is most cost effective and widely used. The thickness of copper traces ranges from 0.0007 – 0.004 inches. The polyimide can have operating temperatures ranging from 130 – 200°C and withstand soldering temperatures up to 300°C for a short time. The temperature of the thermode is always higher than that of the parts that are heated by the thermode. A temperature drop of 50-80ºC can occur between the thermode and joint, across the Kapton flex, depending on the thickness. Thickness of the flex ranges from 0.001 – 0.0047 inches.

APPENDIX E: GUIDELINES FOR REFLOW SOLDERING

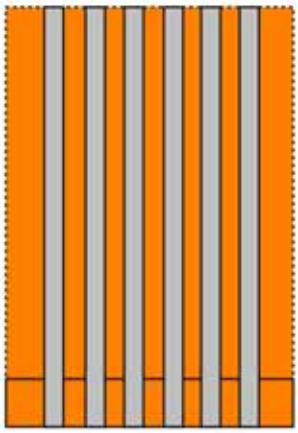
There are three common types of termination designs used on flex circuits for the pulse heated reflow process:

1. The “exposed lead” design has both sides of the polyimide material removed, leaving the traces free of insulation. This allows the thermode to contact the traces directly, and conduct heat to the parts. If the PCB pads and thermode footprint are sized correctly, this design will tolerate some excess solder on the pads, as there will be open areas into which the solder may flow. During the process, solder will also wet to the top of the trace. Caution must be exercised for part handling as the traces can be easily bent or damaged.



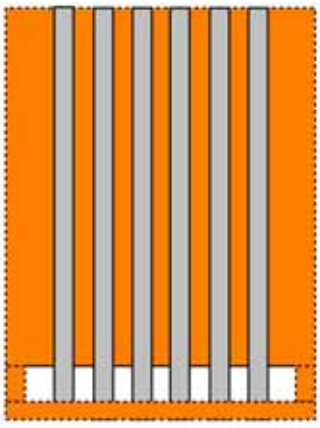
EXPOSED LEAD

2. The “single-sided” flex design has the polyimide removed on one side only. Heat is conducted from the thermode through the solid polyimide surface to the exposed traces underneath. The polyimide conducts heat through the insulation to the exposed traces and pads on the PCB. The polyimide thickness in the joint area is limited to 0.002” enabling conduction. If the polyimide has to be heated much past 260°C, burning of the surface and thermode contamination can result. This design is not tolerant of excess solder on the PCB pads, as there is little room for excess to flow.



SINGLE SIDED

3. The “open windowed” flex design has both sides of the polyimide material removed from the joint area, but has support from the remaining polyimide material on the sides and also along the end of the traces. This design gives some strength to the assembly and is resilient to harsher handling. As the traces are exposed, the thermal transfer to the parts is good and excess solder has extra space to flow. Thermode sizing is critical as it must fit into the window and allow space for the molten solder to flow.



OPEN WINDOWED

Flex and PCB Trace Sizes

Ideally, the flexible circuit pads should be narrower in width than that of the pads on the printed circuit board. As the solder melts and the parts compress, solder is forced to the side. This design will allow space for the solder to flow on either side of the flex pad and will be more tolerant of solder quantity on the PCB, avoiding solder bridging problems.

A smaller pad width on the flex will help with registration and alignment of the two parts. For fine pitch applications, the width of the PCB trace is designed to be 50% of the pitch. This reduces the risk of short circuits due to misalignment.



Printed Circuit Boards (Pcb) And Other Substrates: General Part Design Guidelines

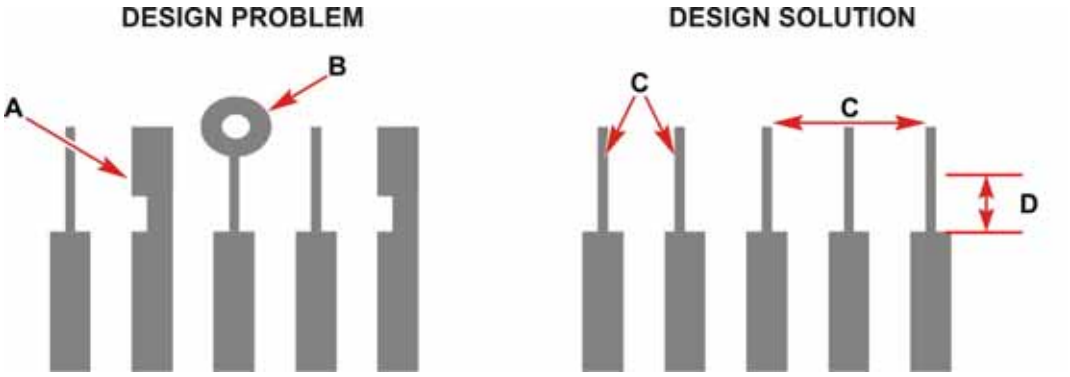
Most PCB materials such as FR2 and FR4 are very resilient to the local application of heat during the process. Materials such as ceramic substrates have to be heated in a more controlled fashion to minimize the chance of cracking. Excessive differences in the heat sinking capability of the two parts can also cause solder cracking during cooling.

Heat sinking differentials along the solder joint length are the most common design problem to overcome. Small differences can have minimal effect, but any large thermal mass change along the joint area will cause inconsistency of temperature and solder joint quality.

Heat Sinks And Land Areas

Common problems and their possible solutions are detailed below:

Design Problems And Solutions Notes



A. Heat is easily transferred away from the joint area to the large landmass, which is positioned too near to the joint area.

B. Increased trace width and plated through-hole draw heat from the joint area.

C. The reduced width trace acts as a thermal dam and prevents any heat sinking of the pad.

D. 0.08” is the effective minimum area in which there must be no heat sinks if small trace heat dams are used.

E. Equally sized small traces act as a thermal dam and ensure equal heating across joint area.

Traces leading from pads should be of equal width and be as narrow as possible. This design will act as a thermal dam, and prevent excessive heat drain from the pad area during soldering.

Alternate designs:



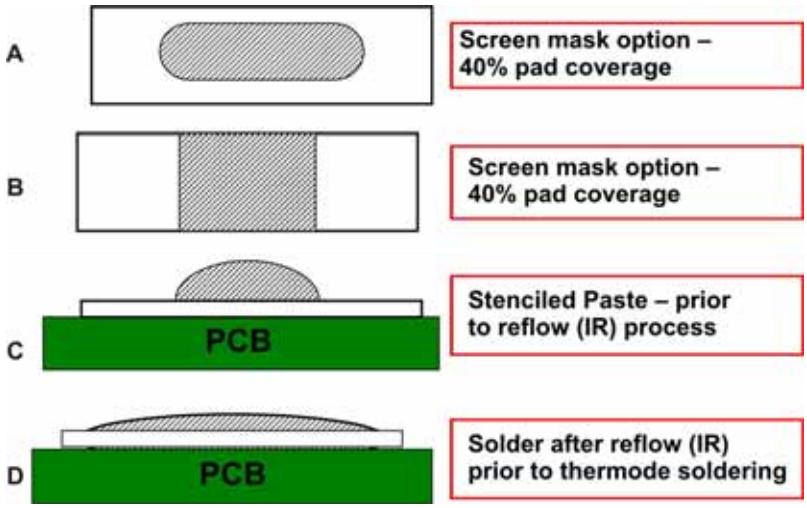
For multi-layer boards, restrict the traces under the bonding area to the smallest width (signal) traces and spread equally under the pads on the PCB. Any shielding on the PCB should have an equal effect along the joint area.

Amount Of Solder Required On Printed Circuit Board Pad

The repeatability of solder deposit is critical in order to achieve good process control. In many cases a certain amount of experimentation is required to achieve the ideal solder volume. A good starting point is using a 0.006” screen print stencil, masked to give 40% pad coverage.

The amount of solder required on the pad of the printed circuit board is dependent on a number of factors. The pad size and pitch determine the maximum and minimum solder quantity that can be applied, using the screen stenciling process. Stenciled solder should be fused prior to the reflow process. Small pad and pitch dimensions require less solder thus preventing bridged joints.

The flex design will also influence the volume of solder. Windowed flex and the exposed trace flex, will stand a slightly greater solder volume in comparison to the single sided flex.



A. A smaller screen aperture can provide 40% solder coverage of pad.

B. Shows an alternate screen design.

C. Resulting solder deposit prior to the reflow (IR) process.

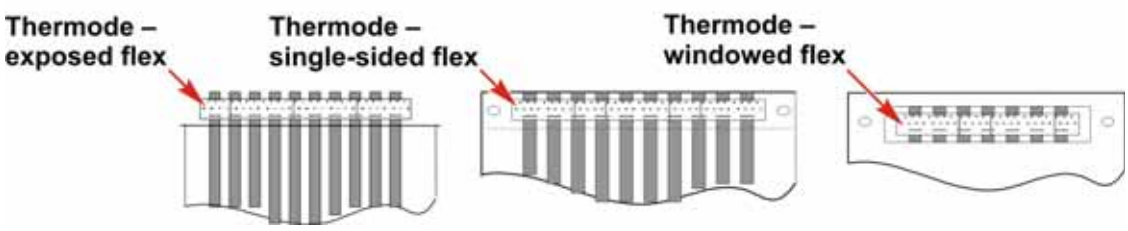
D. Solder is spread evenly across pad after the reflow (IR) process. Note smaller height profile.

PAD SIZE AND PITCH Mm/ inches	TARGET SOLDER VOLUME mm^3 / inches	SCREEN THICKNESS Microns / inches	OPENING CHEM.NI/AU HOT AIR LEVEL mm / inches	Cu PASSIVE / PALLADIUM mm / inches
Pad size 0.4 x 3.2mm 0.016 x 0.126” Pitch – 0.8 mm 0.031”	0.02 – 0.03mm 0.00079 – 0.0012”	100 micron / 0.004”	0.36 x 1.2 / 0.014 x 0.047	0.36 x 1.6 / 0.014 x 0.063
		150 micron / 0.006”	0.30 x 1 / 0.012 x 0.039	0.30 x 1.2 / 0.012 x 0.047
		175 micron / 0.007”	0.26 x 1/ 0.010 x 0.039	0.26 x 1.2 / 0.010 x 0.047
Pad size 0.8 x 5.5 mm 0.031 x 0.216” Pitch – 1.5 0.059”	0.07 – 0.10 mm 0.0028 – 0.0039”	100 micron / 0.004”	0.74 x 1.9 / 0.029 x 0.075	0.74 x 2.7 / 0.029 x 0.106
		150 micron / 0.006”	0.6 x 1.5 / 0.024 x 0.059	0.6 x 2.2 / 0.024 x 0.086
		175 micron / 0.007”	0.5 x 1.6 / 0.020 x 0.063	0.5 x 2.3 / 0.020 x 0.091
		200 micron / 0.008”	0.4 x 1.7 / 0.016 x 0.067	0.4 x 2.5 / 0.016 x 0.098
Pad size 0.8 x 4.5 mm 0.031 x 0.177” Pitch 1.6 mm 0.063”	0.057 – 0.08 mm 0.002 – 0.0032”	100 micron / 0.004”	0.7 x 1.6 / 0.028 x 0.063	0.7 x 2.3 / 0.028 x 0.091
		150 micron / 0.006”	0.6 x 1.3 / 0.024 x 0.052	0.6 x 1.8 / 0.024 x 0.071
		175 micron / 0.007”	0.5 x 1.3 / 0.020 x 0.052	0.5 x 1.8 / 0.020 x 0.071

PAD SIZE AND PITCH Mm/ inches	TARGET SOLDER VOLUME mm³ / inches	SCREEN THICKNESS Microns / inches	OPENING CHEM.NI/AU HOT AIR LEVEL mm / inches	Cu PASSIVE / PALLADIUM mm / inches
		200 micron / 0.008”	0.4 x 1.4 / 0.016 x 0.055	0.4 x 2.0 / 0.016 x 0.055
Pad size 1 x 4.5mm 0.039 x 0.177” Pitch – 2.0 mm 0.079”	0.07 – 0.1 mm 0.0028 – 0.0039”	100 micron / 0.004”	0.74 x 1.9 / 0.029 x 0.075	0.74 x 2.7 / 0.029 x 0.106
		150 micron / 0.006”	0.6 x 1.5 / 0.024 x 0.059	0.6 x 2.2 / 0.024 x 0.086
		175 micron / 0.007”	0.5 x 1.6 / 0.020 x 0.063	0.5 x 2.3 / 0.020 x 0.091
		200 micron / 0.008”	0.4 x 1.7 / 0.016 x 0.067	0.4 x 2.5 / 0.016 x 0.098
Pad size 1.5 x 5.5 mm 0.059” x 0.216” Pitch – 3.0 0.118”	0.13 – 0.19 mm 0.0051 – 0.0075”	100 micron / 0.004”	1.2 x 2.2 / 0.047 x 0.087	1.2 x 3.1 / 0.047 x 0.122
		150 micron / 0.006”	1.1 x 1.6 / 0.043 x 0.063	1.1 x 2.3 / 0.043 x 0.091
		175 micron / 0.007”	1.0 x 1.5 / 0.039 x 0.059	1.0 x 2.1 / 0.039 x 0.083
		200 micron / 0.008”	0.9 x 1.4 / 0.035 x 0.055	0.9 x 2.0 / 0.035 x 0.055

Thermode Sizing And Positioning To Parts

Thermodes should be sized according to the pad and flex sizes as shown in the figure below. The thermode length must completely cover the traces and overlap by a minimum of one pad pitch on each side. The thermode width should provide enough thermal transfer of heat to achieve the solder joint in the minimum time thereby eliminating the chance of thermal damage to the parts. The width of the thermode should also accommodate enough room for the molten solder to be displaced, eliminating any chance of solder bridging.



Thermode Width

For the best thermal performance and lifetime of the thermode, the minimum size should be 0.059”. The standard size is 0.079”, due to better performance and longevity. Where solder amounts are not well controlled or room is limited, it is possible to use a 0.047” wide thermode however thermode life and performance will be reduced.

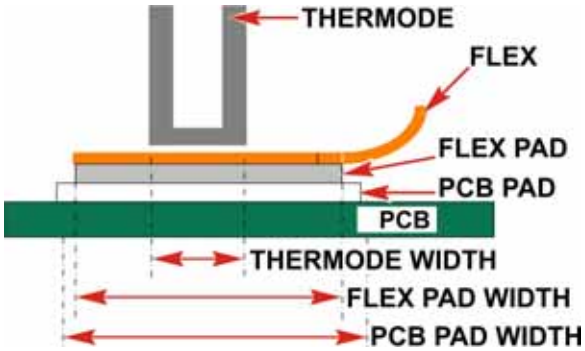
Flex Pad Width

Note that the flex pad finishes short of the PCB pad. This is to allow easy inspection of the joint.

PCB Pad Width

Extra width allows for excess solder and ease of inspection. PCB pad is approximately three times the width of thermode.

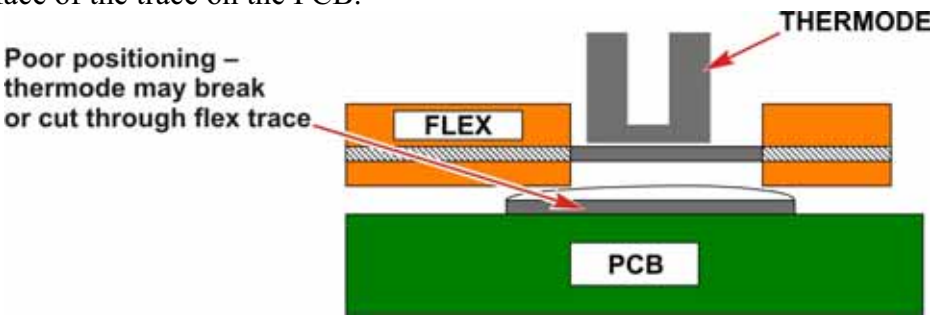
SUGGESTED THERMODE WIDTH / PAD LENGTH AND PITCH		
PCB		
Pad Pitch		Thermode Width
mm / inches		mm/ inches
0.8 / 0.031		1.5 / 0.059
1.2 / 0.047		1.5 / 0.059
1.4 / 0.055		2.0 / 0.079
1.5 / 0.059		2.5 / 0.098
1.6 / 0.063		2.5 / 0.098
1.8 / 0.071		2.5 / 0.098
2.0 / 0.079		3.0 / 0.118
3.0 / 0.119		3.0 / 0.118



The dimensions above are guidelines only. Some experimentation may be required, due to different solder volumes.

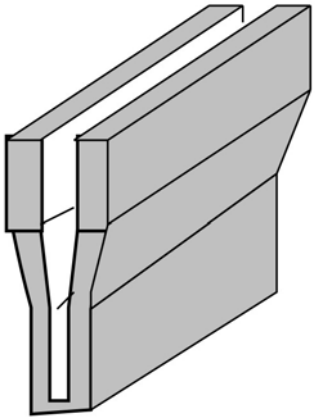
Thermode Positioning

When positioning a thermode on an exposed or windowed flex, it is important that the thermode is not positioned too close to the edge of the main body of the flex. Some flex circuits have thinner and thicker coatings on either side of the traces running through them. If this is the case position the thinner side next to the PCB. This will reduce the chance of the thermode damaging the trace as it pushes it down to the surface of the trace on the PCB.



Thermode Manufacturing And Temperature Characteristics

Modern wire erosion techniques such as EDM and advanced materials have allowed the manufacture of precisely designed thermodes to suit most applications. Three-dimensional thermodes pass the current around the face and thus have zero voltage potential across the traces. These technological advances in machining processes produce designs with constant temperature across the length, and special alloys achieve flatness and co-planarity under heating. Solder will not wet to the materials used and they are resilient to oxidization.



Tooling And Part Positioning

Heat resilient high temperature plastic such as peek (trade name Ketron) or tuffnel should be used under the reflow area to prevent heat sinking from the bond area. Tooling nests should be totally flat as the quality of the process depends upon achieving an equal distribution of heat when the pressure from the thermode is applied. The best finishing technique is to grind the surface in preference to milling. If possible, parts should be located on tooling pins adjacent to the reflow area. It is common practice for the tooling holes in the flex to be reinforced with copper trace for strength and accuracy. If no tooling holes are possible, the parts can be positioned and tooled from a square edge. As the flex is not rigid vacuum holes in the part nest may be required to hold it flat. For fine pitch flex, an alignment x-y stage and camera system may be useful. It is important to take into account any tolerances or batch-to-batch variations in size when designing the part fixturing.

Preparation

It is more common for both parts to be previously solder plated. If this is not the case, it is still possible to achieve wetting between a single sided flex design and a base pad plated with gold or tin. The base plating of the two parts is often enough solder to achieve a reliable joint with a single sided flex.

Most flex designs, however, will require additional solder normally applied by the screen printing process and previously reflowed (quantities are described earlier). For finer pitch applications the solder is normally hot air leveled prior to the reflow process. Hot air leveling allows even distribution of the solder along the pad and good thermal transfer resulting from a flatter surface. This process also makes alignment under the pressure of the heated bar easier to maintain. Parts must be free of dirt and dust and generally clean and oxide free. Flux is normally used to ensure any oxide barrier is removed to allow proper wetting to occur.

Flux

Flux has two important features. It conducts the heat to the solder and it promotes the wetting of the surfaces by cleaning and removal of surface oxides. For easy to solder parts, the pulse heated soldering process requires only a minimum of non-activated flux. No clean fluxes are commonly used. The use of a low solids content flux is recommended. The lower solids content the less pollution of the thermode. Any solvents present should be allowed to dry prior to commencing the soldering process.

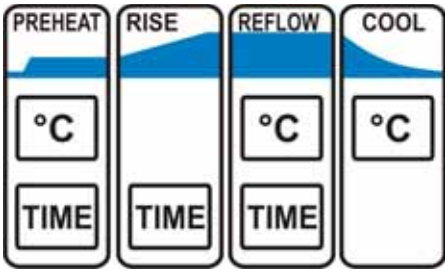
Safety

In comparison to conventional soldering the pulse heat thermode soldering process is very safe, as the heating element is only hot when it is pressed to the parts. In addition, only a very small amount of flux is needed and therefore there are much less fumes generated. Operators should still be prevented from touching the thermode during the cycle and should also be protected from entrapment hazards.

Soldering Method -- Process Steps

1. The base substrate is located in a fixture and flux applied to the pads.
2. The flex is positioned in the parts fixture ensuring alignment of both sets of pads.
3. A process start signal is given to the soldering control (footswitch input).
4. The soldering control then actuates the bonding head and thermode module to the parts.
5. At a pre set pressure the heating process is initiated.

The Heating Process



Preheat

It takes approximately two seconds to heat a modern designed thermode of up to 2” in length to soldering temperature. During this time, the flux activates and starts to promote wetting by removal of the oxide layer. Preheat is only used where there are excessive heat sinks affecting the thermode or where the application has delicate substrates, like ceramic that need to be heated in a more controlled fashion to avoid cracking.

Rise

Rise time to soldering temperature is also programmable and allows precise heating rate control. This again is particularly useful where delicate substrates can be easily damaged by too fast a heating rate. Normal rise time for most thermodes is 1.5 – 2 seconds.

Reflow

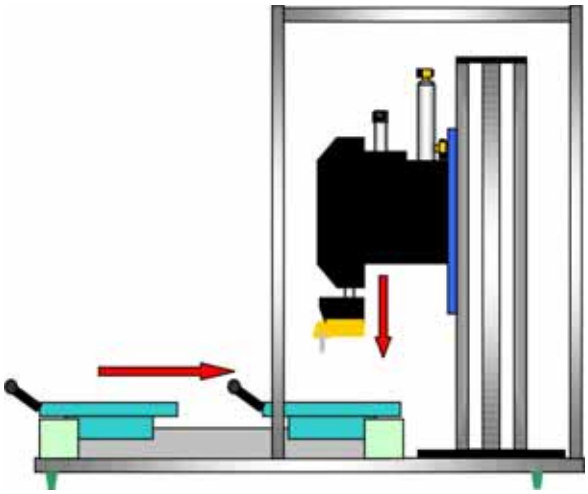
The actual time and temperature can be programmed for this stage of the process. Time is programmable in 0.1-second increments and temperature in 1-degree increments. Typically, the temperature set point for an open solder joint with direct thermode contact to parts will be between 280 - 330°C. Although normal solder will reflow at 180°C the thermode must be set higher due to the thermal transfer losses. A typical single sided flex will require between 330 - 400°C due to the thermal losses in the Kapton material. It is preferred to use the minimum time and temperature to achieve the desired joint, so as to minimize the parts exposure to heat and chance of damage.

Cool

Cool is a programmable temperature at which the control unit will actuate the head to the up position. This temperature is set to just below the solder solidification temperature. Therefore as soon as the solder becomes solid the process is ended and a joint is formed. The cooling process can be shortened by the use of forced air cooling. The power supply can be programmed to switch a relay that controls the flow of air at the end of the reflow period and cool the joint and thermode rapidly. Because most connections have a relatively high heat sink, the temperature in the solder is lower than the measured thermode temperature, even when using cooling air. Therefore the release temperature can be set to 180º C in most cases without the chance of encountering a dry joint.

Force Control And Simple System Examples

Most reflow joints of this nature require fewer than 20lbs. (9 Kg.) pressure. A range of force control modules is available to suit all applications up to 150lbs. (68Kg.). Force must be precisely controlled. Force can be calibrated and set to the correct level to achieve the right thermal transfer of heat to the solder joint. It is desirable to have co-planarity adjustment in the thermode mounting or the head itself, for ease of set up. Modern designs have either air or motorized actuation and built in valves for thermode cooling. Many heads are modular in construction and therefore versatile for integration into tooled or semi automatic fixtures. Linear slides allow loading and unloading of the parts away from the bonding area.



Rotary table systems are preferred for high volume production. The operator can be loading one set of parts concurrent with another set of parts being soldered. This doubles the output from one operator, thus reducing the labor cost.

Quality Control And Inspection

Pressure is maintained as the joint is cooled. Therefore there is little chance of a dry joint occurring. The imprint of the thermode should be seen on the solder joint and be even in width and length. There should be visual evidence that reflow has occurred and when the parts are peeled apart the resulting joint will have a granular appearance over the soldered area. There should be no evidence of burning or delamination of the pads to board or flex. Where a single sided flex is used, there maybe marking or discoloration on the top of the polyimide but no burning or separation should be seen. Any flux residues can be cleaned after the reflow process. No clean, low residue fluxes do not require post cleaning.

Temperature and time process data can be collected from the control and displayed in graphical format to illustrate process stability.

Process Maintenance

Maintenance of the cleanliness of part fixtures is required to ensure that the parts continue to sit flush to the base. Periodic maintenance of the thermode is also needed to prevent the build up of baked on flux. Using a flux solvent, or cleaning the thermode with a very fine emery or grit paper mounted to a flat rigid surface will maintain good thermal transfer to the parts. Care must be taken so as not to round the edges of the thermode or spoil the flatness. There is a distinct difference between the pollution of the thermode for soldering processes where the thermode is positioned directly on the leads in contact with the solder and those where the thermode is in contact with a Kapton surface. In the first case the pollution and thermode wear is much higher, and cleaning must be done on a more regular basis. The thermocouple joint connection must be kept clean and in good order to ensure repeatable temperature control. Thermocouple types K and E are not eroded by flux but type J can be attacked and eroded.

Conclusion

Pulse heated thermode reflow soldering of flex to PCB is a stable and well controlled process if certain basic design guide rules are followed. These rules differ from the rules that apply to conventional soldering processes. The process window can be made substantially wider by a joint design that promotes easy and equal heat generation. Even more by a design that accommodates the flow of solder and can compensate for variations in the prior processing steps.

Good joint design and repeatable fine control over solder quantities are the keys to production success. The growing need for product miniaturization and reduced weight are major drivers increasing the use of flexible circuit technology with the electronic industry. Today's control over the thermode soldering process offers a production oriented, reliable solution to the interconnection demands of this growing market.

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