

# iRad-B

## Dual Infrared High Intensity PCB Assembly/Rework Station

### Introduction

The I-Rad B system is a bench top unit designed for non-production rework of SMT printed circuit boards. The system consists of a lower and upper emitter that provides optically focused infrared radiation to effectively remove and replace SMT components in a matter of seconds. Because it is not necessary to preheat the PCB before reflow occurs, the entire operation can be done while hand holding the PCB with no concern for burning. The unit can be supplied with two optional foot controls for more convenient working conditions.

### Operational Description

The I-Rad B can be operated manually where independent control of the lower and upper emitter is accomplished with front panel buttons or optional foot controls. In most situations, only the lower emitter is used to remove and replace components. However, with densely populated double sided PCBs, the upper emitter can be used while not disturbing components directly underneath.

Operation can also be easily switched to the automatic programmable mode. In this mode, a "profile" can be programmed into the MCU controller which will enable multiple repetitive cycles of the same power and duration. Automatic operation is especially useful for removing and replacing similar components.

### Power Console Installation

Attach the optional foot controls (if supplied) to the two jacks on the rear panel. Plug the power cord into the power receptacle on the rear panel. **CAUTION** ... the system **MUST** be factory configured for 120VAC or 230VAC operation. Using the wrong power cord could result in immediate catastrophic failure. **BE CERTAIN** that the unit is configured for the power input to be used. Plug the power cord into an appropriate voltage wall receptacle.

### Power Console Operation - MANUAL Mode

Depress the PWR button. The unit will now be in the manual default operation mode and the MANUAL "ON" indicator will illuminate. In addition, the lower and upper emitter default power setting is 50%. If it is desired to change the power of either emitter, depress the Power Setting "SLCT" button and keep depressed for more than 3 seconds. The "%P" indicator for POWER 1 and POWER 2 will illuminate alternately. When the desired choice is illuminated, release the "SLCT" button. By depressing and holding the "SET" button, POWER 1 and POWER 2 may be set from 0.1 (10%) to 1.0 (100%).

In a similar procedure, the Lower Emitter and Upper Emitter can be selected and set to operate at either the Power 1 or Power 2 levels. Use caution if either emitter is set to greater than 0.7 as damage to the PCB may occur in less than 30 seconds. After the emitters are set, momentarily depressing the "ON" buttons will activate the respective emitter. To turn the emitter off, depress the "ON" button again. Identical operation is possible with the optional foot controls. For safety, if any emitter is on for 5 minutes, the unit will shut down automatically.

### Power Console Operation - Automatic PROGRAM Mode

The PROGRAM mode is used mostly for identical repetitive operations such as removing and replacing the same component on a number of PCBs. To access this mode, depress and hold the "MODE" button for more than 3 seconds. The Operation Mode "ON" indicators will illuminate alternately. When the PROGRAM "ON" indicator illuminates, release the "MODE" button. The unit is now in the automatic programmable mode. Depress and hold the "PRGM" button for greater than 3 seconds. A sequential series of events will happen at 2 second intervals as follows:

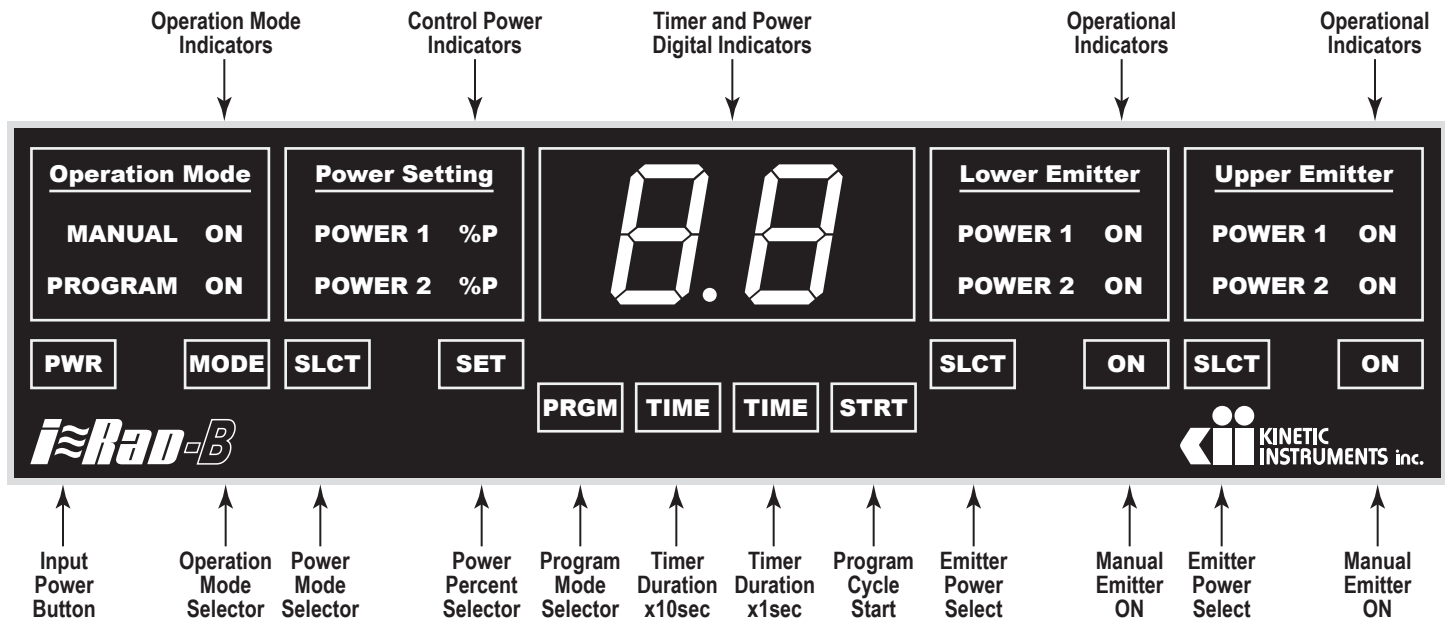
- (1) POWER 1 "%P" will illuminate and digital display will read 0.5.
- (2) POWER 2 "%P" will illuminate and digital display will read 0.5.
- (3) Lower Emitter POWER 1 "ON" will illuminate and digital display will read 00.
- (4) Lower Emitter POWER 2 "ON" will illuminate and digital display will read 00.
- (5) Upper Emitter POWER 1 "ON" will illuminate and digital display will read 00.
- (6) Upper Emitter POWER 2 "ON" will illuminate and digital display will read 00.

If "PRGM" is held depressed, this sequence will repeat indefinitely. When the sequence reaches a parameter where a change is desired, release the "PRGM" button at that point. The parameter may then be changed using the Power Setting "SET" button, Lower Emitter "SLCT" or Upper Emitter "SLCT" buttons. In addition to the power selection, an on time can be selected for each emitter and each power setting. This is accomplished using the 2 "TIME" buttons.

As an example, the desired automatic operation is for the lower and upper emitters to be on for 30 seconds at 40% then to increase only the lower emitter to 70% for 10 seconds. Programming would proceed as follows:

- (1) Hold "MODE" button depressed until PROGRAM "ON" indicator illuminates.
- (2) Hold "PRGM" button depressed until POWER 1 "%P" indicator illuminates.
- (3) Hold "SET" button depressed until digital display reads 0.4.
- (4) Hold "PRGM" button depressed until POWER 2 "%P" indicator illuminates.
- (5) Hold "SET" button depressed until digital display reads 0.7.
- (6) Depress "PRGM" until Lower Emitter, POWER 1 "ON" indicator illuminates.
- (7) Using the 2 "TIME" buttons, set the digital display to read 30.
- (8) Depress "PRGM" until Lower Emitter, POWER 2 "ON" indicator illuminates.
- (9) Using the 2 "TIME" buttons, set the digital display to read 10.
- (10) Depress "PRGM" until Upper Emitter, POWER 1 "ON" indicator illuminates.
- (11) Using the 2 "TIME" buttons, set the digital display to read 40 (30s + 10s).
- (12) Depress "PRGM" until Upper Emitter, POWER 2 "ON" indicator illuminates.
- (13) Using the 2 "TIME" buttons, set the digital display to read 00.
- (14) Depress "PRGM" button until all indicators are off except PROGRAM "ON".

The unit is now programmed and will retain this sequence as long as it is connected to main power. Depressing the "PWR" button will shut off all indicators but will not erase the program. Momentarily depressing the "STRT" button will commence the programmed cycle and will terminate automatically. To stop the cycle prematurely, depress the "STRT" button again.



# Additional Usage Instructions and Guidelines

## General Usage Guidelines

The I-Rad B system is designed to easily and conveniently remove and replace SMT components that are of a reasonably small size. Larger components can also be removed but a different technique must be utilized. Usually, the lower emitter is all that is necessary to effectively rework components on the top side of the PCB. The lower emitter works by heating the underside of the board which causes reflow on the top side. Because the heating is performed with IR radiation, the "hot spot" is very localized and does not conduct thru the board very rapidly. A resistor 0603 package can easily be reworked without affecting another 0603 package that is only .100 inches away.

Experience with the unit plays a vital role in deciding how to perform the rework operations. As an example, a SOIC 8-pin package can be reworked in 10 seconds using only the lower emitter set at 0.7 (70%) power on a .062 FR4 PCB with green soldermask. If the board is of a different thickness or contains a ground plane layer, times could vary significantly. It must be noted, however, that speed should not be the primary concern. PCBs can easily be damaged if emitter settings are above 0.6 (60%).

## Small Component Rework

For the purposes of these guidelines, a small part is considered anything that will fit in a circle having a diameter of 12mm (.470"). These parts can almost always be reworked from the underside of the board using the lower emitter set at about 0.7 (70%). An exception would be a PCB populated on both sides where there is a component directly underneath. In this case, the upper emitter would be used at approximately the same power setting.

After removing the component, it is recommended that all excess solder from all pads be removed with solderwick and cleaned with flux remover. This will make replacement with a new part substantially easier while insuring that reflow takes place on all the connection pads. Using a solder paste dispenser or other tool, place a small "dot" of paste on each of the pads. Using tweezers, carefully place the new component in place and align the leads with the pads. Reflow the new component in the same fashion as that used for removal.

## Large Component Rework

Large SMT parts can be removed only if the component is to be discarded and replaced with a new device. There are two techniques for removing large parts. The first is to simply place the center of the part under the upper emitter and use both the upper and lower emitters to heat the component from above and the PCB from below until reflow occurs. This procedure may damage the surface of the part being removed since the part is absorbing large quantities of infrared radiation from the upper emitter.

The second technique for removing larger parts involves using only the upper emitter to de-solder each leg of the package individually. This process can be time consuming since it may require that each leg of the device be exposed to the IR radiation for up to 10 seconds. However, it has been found that since the legs are relatively small, 3 or 4 of them can be de-soldered together. Again, the component will generally be destroyed in the de-soldering process.

The objective in this technique is when the leg of the component is de-soldered, it is lifted up off the PCB so that it will not be re-soldered when the upper emitter is moved to the next set of legs. It has been found that a common dental probe called a "pick" is very effective at lifting the legs off the PCB. To remove a SOIC 40-pin package using this process takes about 10-15 minutes.

Likewise, replacing a large component requires a different technique than replacing a small part. Normally, for small parts, after all pads have been cleaned of solder and flux, a small "dot" of solder paste would be placed on each pad. This procedure **SHOULD NOT** be used for large parts. What happens is that the part is actually sitting on top of the solder paste and proper connection cannot be guaranteed unless the entire device can be heated and all legs reflowed at the same time. Since this isn't possible, many of the legs will not be properly reflowed and therefore not electrically connected.

Instead, after cleaning all the pads, place the component on the PCB without any solder paste and align it carefully with the pads. Then, put a small "dot" of solder paste on the pad and the end of the leg of the component where they touch each other. Do this in at least two places on opposite corners of the part. The objective here is to "tack" the part in place so it cannot move during reflow of the other legs. Use the upper emitter to reflow these legs. Once the tacking process has been completed, place similar "dots" of solder paste on all of the remaining legs where they meet the pads. Using the upper emitter, move the PCB slowly under the upper emitter somewhat like a "sewing machine" motion and reflow the legs one at a time until completed.

## Heat Sensitive Component Rework

Some components are somewhat heat sensitive and just require slightly more caution than others. For example, electrolytic capacitors. These devices usually have a plastic base that can melt and the plastic will stick to the PCB. To avoid cleaning up this melted plastic, simply use a pair of tweezers to "wiggle" the part while it is being heated from underneath so that removal can be made at the instant the solder melts thereby protecting the plastic base from excess heat. Avoid being too aggressive when "wiggling" since with some poorer quality PCBs the entire pad can be lifted off.

## Thru-Hole Component Rework

Although the I-Rad B is not designed for thru-hole PCBs, experience with the unit has proven effective on a wide variety of thru-hole components. The lower emitter set at 0.7 (70%) will easily remove a DIP-8 package as well as any thru-hole component using 300mil to 500mil pad spacing such as 1/4 or 1/2 watt resistors. Using the upper emitter set at 0.8 (80%) will remove a DIP-14 package in less than 15 seconds. However, damage to a DIP-14 will result and therefore replacement should be accomplished with a conventional soldering iron.

## Activation of Heat Shrink Tubing

As an added bonus to the functionality of the I-Rad B system, the lower emitter can be used to easily activate heat shrink tubing. Since the heat source is IR, darker color objects will absorb more infrared energy than lighter colored ones. Activation of black heat shrink tubing takes only a few seconds therefore is the recommended color. To use this added feature, the lower emitter should be set at 0.5 (50%). The wire cable with the heat shrink tubing should be held about one to two inches from the lower emitter and rotated by hand to obtain a uniform shrinkage. Human hands do not absorb much IR and therefore this technique will not present a burn hazard. However, **DO NOT** place hands directly over or on top of the emitter as there is sufficient energy at that point to cause injury.

## Exposure Guidelines

As mentioned previously, experience with the I-Rad B is the best and only method to determine the various combinations of exposure to the emitters that will function the most efficiently for each particular application. It is highly recommended that many "test" procedures be accomplished using PCBs that are to be discarded before using the unit for actual rework. The chart below is intended to be used as a starting point to determine the effect of the emitters on a typical two layer FR4 PCB with green soldermask.

PCB TEMPERATURE vs. TIME  
2-LAYER FR4, 1oz CU, LOWER EMITTER ONLY

Time (sec)	Power (%)	Temp (°C)	Time (sec)	Power (%)	Temp (°C)	Time (sec)	Power (%)	Temp (°C)
0	25%	25	0	50%	25	0	75%	25
1	25%	26	1	50%	34	1	75%	30
2	25%	28	2	50%	47	2	75%	55
3	25%	29	3	50%	58	3	75%	85
4	25%	31	4	50%	69	4	75%	116
5	25%	33	5	50%	76	5	75%	131
6	25%	35	6	50%	81	6	75%	146
7	25%	36	7	50%	87	7	75%	160
8	25%	38	8	50%	92	8	75%	171
9	25%	40	9	50%	99	9	75%	183
10	25%	42	10	50%	111	10	75%	192
15	25%	47	15	50%	133	15	75%	225
20	25%	51	20	50%	147	20	75%	252
30	25%	57	30	50%	166	30	75%	285
40	25%	60	40	50%	178	40	75%	damage
50	25%	63	50	50%	185	50	75%	damage
60	25%	64	60	50%	190	60	75%	damage