Reflow Controller

Jan 2017

Features:

- Plug-and-solder
- LCD display of temperature and state
- LED state indication
- USB connectivity for monitoring/controlling
- Optional RF connectivity (433MHz transceiver)
- Can change mode to be a temperature controller

Description:

The Reflow Controller is specifically designed to control the soldering of surface mount technology (SMT) components onto pc-boards using a small batch compact oven. The controller follows the correct temperature profile for SMT soldering. This allows for production quality prototyping or small batch manufacturing to be completed effortlessly.

The Reflow Controller is intended to be used by hobbyist, technicians, engineers and the like for prototype or low volume assembly of pc-boards with SMT components. The Reflow Controller constantly monitors the temperature inside the oven and using a PID control algorithm, tracks the reflow soldering profile ensuring components are not over heated or over stressed.

Specifications:

Model		NSB006	NSB006-RF[1]
Electrical	Nominal Voltage	230Vac (50Hz)	
	Maximum Switching Power	2000 Watt	
	Switching Technology	Solid State Relay	
	Protection Fuse	10A @ 250V Fast Blow	
	Input / Output Connection	IEC C14 M / IEC C13 F	
Temperature Sensor	Thermocouple	K-Type (PTFE)	
	Range	0 to 300°C	
	Accuracy	+-2°C	
	Resolution	0.25°C	
	Cable Length	1meter	
USB Connection	Connector	USB B	
	Baud-rate	9600 baud	
	Data Bits, Parity, Stop Bits, Flow Ctr	8, None, 1, None	
Other	Wireless Conectivity	-	433MHz Transceiver
	Mounting Holes[2]	M3	
	Dimensions (L*W*H)	136*74*52mm	
	Weight	0.5kg	
Notes	1. See NSB011 RF - USB Master Unit to connect wirelessly to the controller 2. See drawing for details		

*Images for reference only

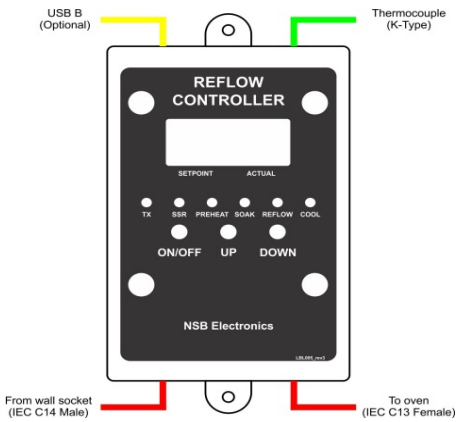
*Specifications subject to change due to continuous improvements

Reflow Controller

Jan 2017

Connection:

1. Unpack the oven from the packaging material.
2. Fasten the Reflow Controller bracket to the side of the oven using the self tapping screws supplied.
3. Fasten the Reflow Controller to the bracket using the nuts and washers supplied.
4. Connect the thermocouple connector to the top of the Reflow Controller.
5. Install the bare PCB with the thermocouple end connected into the middle left side of the oven.
6. Plug the oven power cable into the bottom right power connector on the Reflow Controller.
7. Connect the supplied power lead into the bottom left power connector on the Reflow Controller.
8. Plug the power lead into an earthed electrical wall socket.



Package Content:

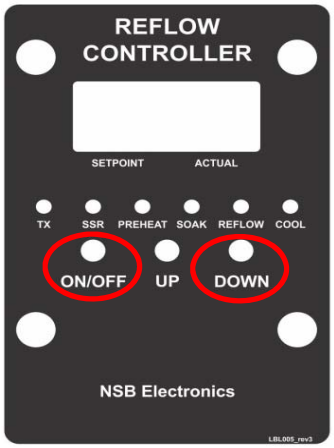
- 1x Reflow Controller Unit
- 1x IEC C14 Male cable mount conntector
- 1.8m 3 Pin Plug to IEC C13 Female cable
- 1.0m K-Type Thermocouple
- 1x Oven mounting bracket

Changing Controller Mode:

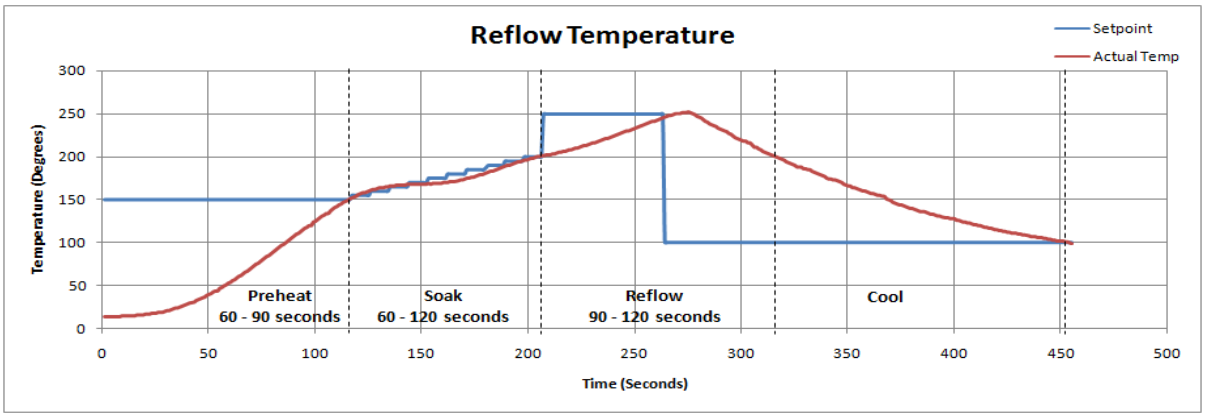
1. Press both the "ON/OFF" and "DOWN" buttons simultaneously for ±3 seconds.
2. The LCD display will show the new mode the controller has been configured to, either Temp or Reflow.

NOTES:

1. By default the controller will revert to Reflow Mode when power is cycled.



Typical Reflow Profile:



*Images for reference only

*Specifications subject to change due to continuous improvements

NSB Electronics
Everything • Electronic

Reflow Controller

Jan 2017

Reflow Controller Operation (Default):

1. Press the "ON/OFF" button on the Reflow Controller to start the reflow process.
2. Each time a stage is completed, the unit will beep briefly:
   - Preheat - Slowly warms up the board and components
   - Soak - Slowly increases heat to under melting point of flux
   - Reflow - Increases heat rapidly to melting point of flux
   - Cool - Open the oven door to allow board to slowly cool
3. After the Reflow stage, the Reflow Controller will beep for 3 seconds. Open the oven door to start the cooling stage.
4. Once the temperature drops below 100°C, the reflow process is complete (1 second beep).
5. Switch off the power to the Reflow Controller if no more boards are to be soldered.

NOTES:

1. The soldering process can be stopped at any stage by pressing any button on the controller.
2. The temperature inside the oven needs to be below 50°C before a new reflow cycle can be started.
3. It the thermocouple is not connected or has an error, the controller will beep for 3/4seconds every second. The LCD will display the fault. The reflow process will also stop.

Temp Controller Operation:

1. Press the "UP" button on the Reflow Controller to increase the setpoint temperature.
2. Press the "DOWN" button to reduce the setpoint temperature.
3. The cursor on the LCD will show the incremented digit, to change to the other digit, press both the "UP" and "DOWN" buttons together. The cursor will move to the new in/decremented digit.
4. Once the correct setpoint is reached, press the "ON/OFF" button to start the controller.
5. The controller will heat up to the setpoint and wait 60 seconds to settle.
6. The LCD will display when the desired temperature has been reached and will keep the temperature at this point.

NOTES:

1. During the process, pressing the "UP" or "DOWN" button will change the temperature without switching off the oven. The "ON/OFF" button must be pressed to switch off the controller.
2. The temperature inside the oven needs to be below the setpoint before a new cycle can be started.

Recommended Profile Settings:

Depending on the type of solder paste used, the reflow profile might need to be adjusted to get optimal results. The profile settings can either be changed using a PC connected to the serial port and using the serial commands, or by using the buttons and LCD display to adjust the settings. The table below gives typical recommended profile settings for leaded and lead free solder pastes.

The Reflow Controller is setup to use the Lead Free solder profile with Preheat = 150°C, Soak = 180°C, Reflow = 240°C.

Zone	Leaded (Sn63 Pb37)	Lead Free (SAC305)
Preheat	To 150°C in 60 to 90 seconds	To 150°C in 60 to 90 seconds
Soak	From 150°C to 170°C in 60 to 90 seconds	From 150°C to 180°C in 60 to 120 seconds
Reflow	To between 225°C to 235°C for 30 to 60 seconds	To between 240°C to 255°C for 30 to 75 seconds
Cooling	Less than 4°C/s to reduce thermal shock damage	Less than 4°C/s to reduce thermal shock damage
Reflow	Total profile 3.0 to 4.0 minutes	Total profile 3.5 to 4.5 minutes

Useful Links:

Stenciling Tutorial	https://youtu.be/WDIqtGMROjM
Stenciling Process	http://www.soldertools.net/prototype-stencil-printing-process/
Lasercut Scencil Manufacturer	http://www.scanditron.com/af
Rejuvenate Old Solder Paste	https://www.youtube.com/watch?v=TCyki2frm3Q
DIY Metal Stencils	http://lowpowerlab.com/blog/2013/01/23/diy-home-made-metal-stencils-step-through/
Reflow Solder Profiles	http://www.compuphase.com/electronics/reflowsolderprofiles.htm
Aim Solder - Soldering Handbook	http://www.aimsolder.com/sites/default/files/soldering_handbook_rev_10-13.pdf

*Images for reference only
*Specifications subject to change due to continuous improvements

Button Functions:

The buttons on the controller are used to start and stop the reflow process. They also allow for changing the temperature settings for the preheat, soak and reflow setpoint temperatures. The oven can also be set to temperature controller mode. The button presses allowed are explained below.

Reflow Controller Mode (Default):

Button/s Pressed	Function	Description
ON/OFF	Reflow Start/Stop	Used to start and stop the reflow process
UP	N/A	Not used, but will stop the reflow process if running
DOWN	N/A	Not used, but will stop the reflow process if running
ON/OFF + UP	Settings Mode	Hold down for three seconds to enter/exit Settings Mode (Reflow only)
ON/OFF + DOWN	Temperature Mode	Hold down for three seconds to change to Temperature Mode

Settings Mode:

Button/s Pressed	Function	Description
ON/OFF	Next setting	Jump to next setting, will wrap around
UP	Setpoint +	Increment setpoint temperature
DOWN	Setpoint -	Decrement setpoint temperature
ON/OFF + UP	Exit	Hold down for three seconds to exit Settings Mode (Reflow only)

Temperature Controller Mode:

Button/s Pressed	Function	Description
ON/OFF	Start/Stop	Used to start and stop the temperature control process
UP	Setpoint +	Increment setpoint temperature
DOWN	Setpoint -	Decrement setpoint temperature
ON/OFF + UP	N/A	Hold down for three seconds to enter/exit Settings Mode (Reflow only)
ON/OFF + DOWN	Reflow Mode	Hold down for three seconds to change to Reflow Mode
UP + DOWN	Setpoint position	Change in/decrement digit position (1 or 10)

Error Messages:

If the controller has an error, it displays the error on the LCD and stops the current process to prevent damage to the components inside the oven. Below a list of expected error codes and possible solutions to correct the problem.

Error	Description	Possible Reasons/Solutions
TC OPEN	Thermocouple open circuit detected	Thermocouple not connected or the cable is damaged. Check the connection or replace the thermocouple
TC SHORT	Thermocouple short circuit detected	Thermocouple is touching an earth point or the cable is damaged. Make sure the thermocouple is not touching any metal surface of the oven
TC ERROR	Thermocouple error detected	Unknown thermocouple error. Check the connection or replace the thermocouple
TIMEOUT	Reflow process timeout (> 6 minutes to reach reflow temperature)	The reflow process took longer than expected and stopped to protect the PCB's. Check that the door is properly closed and the oven setup is correct (see page 2). Check that the oven is plugged into the controller and its LED is on when the process is running. If it is plugged in but the oven LED does not come on, the controller fuse may be blown. Only replace with the fuse with same type/rating fuse to ensure continued protection!
UNKNOWN	Unknown error	Not supposed to get this, is a catch all for in case

*Images for reference only
*Specifications subject to change due to continuous improvements

USB Connection:

The Reflow Controller can be connected to a PC using a USB A to USB B cable. The controller outputs the parameters once the soldering process has been started and this can be used for logging purposes. The time, setpoint, temperature and PWM output are sent with comma separation between data.

Notes:

1. The Arduino Leonardo driver is required to be able to use the USB connection.
2. In PID mode, the current PID settings are sent just before the data in the table below.

Data Value	Description	Units
Time (seconds)	Counter in seconds since process was started	Seconds
Setpoint (°C)	Temperature the controller is aiming to achieve	°C
Temperature (°C)	Actual temperature inside the oven	°C
PWM Output (ms)	PWM output to SSR (0 - 2000ms)	Milliseconds

Serial Commands: (Firmware 2.20 and up only)

The controller can be configured and controlled by sending special serial commands via the serial USB connection to the controller using a terminal program such as Putty. See below for the commands and their description. Note the commands are case sensitive and certain commands are only applicable in the current mode the controller is in.

General Commands:

Command	Description	Format	Range
F	Get controller firmware revision	N/A	N/A
Mx	Change oven mode (x=0->Reflow, x=1->Temp)	Integer	0 - 1
Ox	Turn oven OFF or ON (x=0->OFF, x=1->ON)	Integer	0 - 1
T	Print current data as in table above	N/A	N/A
C	Print current mode's settings to serial	N/A	N/A
W	Write current mode's settings to EEPROM	N/A	N/A
X	Reset current mode's settings to defaults Reflow Mode: Preheat=150, Soak=200, Reflow=240 Temp Mode: P=5.00, I=0.01, D=10.00	N/A	N/A

The below commands function differently depending on the mode the controller is in. Some commands are also not applicable to a specific mode and will be ignored if sent to the controller while in that mode.

Reflow Commands Only:

Command	Description	Format	Range
Pxxx	Set Preheat setpoint to xxx (Default: 150)	Integer	100 - 150
Sxxx	Set Soak setpoint to xxx (Default: 180)	Integer	150 - 200
Rxxx	Set Reflow setpoint to xxx (Default: 240)	Integer	200 - 255

Temperature Commands Only:

Command	Description	Format	Range
Pxx.xx	Set Proportional gain to xx.xx (Default: 5.00)	Float	-
Ixx.xx	Set Integral gain to xx.xx (Default: 0.01)	Float	-
Dxx.xx	Set Derivative gain to xx.xx (Default: 10)	Float	-
Uxxx	Set setpoint temperature to xxx	Integer	20 - 200
R	Reset oven PID to defaults (Depreciated, rather use X)	N/A	N/A
S	Read current PID settings (Depreciated, rather use C)	N/A	N/A

Reflow Controller

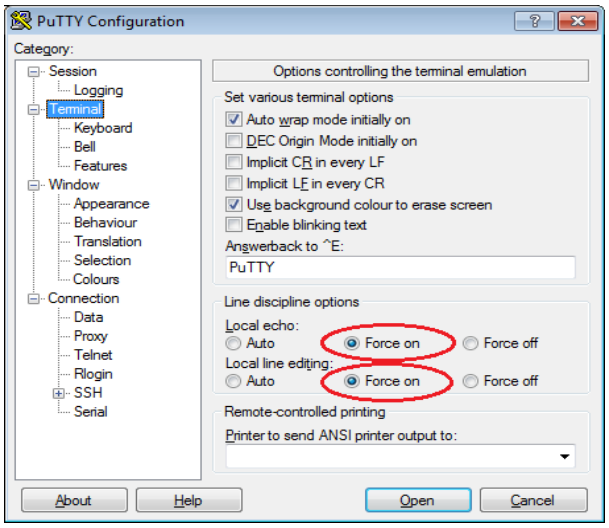
Jan 2017

Terminal Program Configuration (Putty):

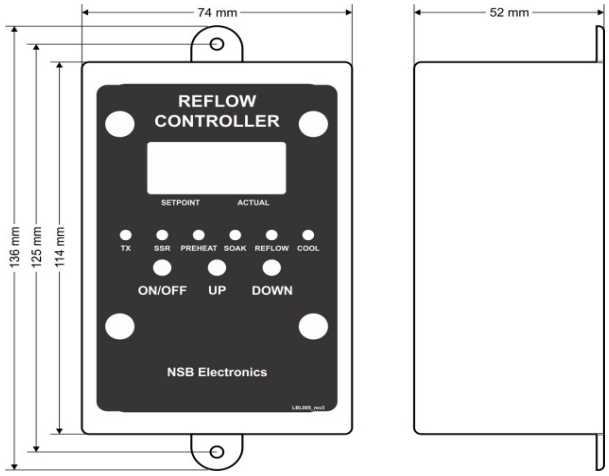
Below are settings that a useful when using Putty as terminal program. Setup a new Serial connection selecting the correct COM port for your oven controller. Before opening, configure the terminal settings as follows:

Under the Terminal Category:

1. Local echo -> Force on (allows you to see what you are typing)
2. Local line editing -> Force on (allows you to finish typing and once you press enter itsends the compete command)



Dimensional Drawing:



Temperature Oven in Action:

Safety Instructions:

- This unit must only be used for the purpose of soldering SMT components or heating components and products.
- Read the manual and ensure you understand the operation and use of the product fully before proceeding to use the product.
- The product is designed to operate from the mains supply only and must be properly earthed.
- Keep the product out of reach of children as it is not a toy and can cause electrical shock if used incorrectly.
- Do not use the product in damp or wet conditions. It is intended for indoor use only.
- Do not leave the product unsupervised at any stage of the soldering/heating process.
- Do not use the product if there is any damage to the housing of the unit as this may result in electrical shock.

Guarantee:

The product comes with a 1 year manufacturer warranty. The warranty covers the product against defective materials and workmanship for the period of the warranty.

NSB Electronics reserves the right to repair, rework, or replace the product at its discretion.

The following will void the warranty:

- Alteration or repairs attempted to the product in any way
- Incorrect voltage connected
- Damage caused by incorrect connection
- Damage as a result of neglect or misuse

Liability:

NSB Electronics denies any liability for damages to property or persons caused by any of the following:

- Using the product for any purpose other than which it is intended for
- Incorrect installation, operation or use
- Neglect of the product

The customer shall have no claim against NSB Electronics, its directors, employees or resellers of whatsoever nature.

*Images for reference only

*Specifications subject to change due to continuous improvements