BrewManiacEx Manual

Version 0.3 draft v1
July 5 2017

0. Software Configuration

If you are using different configuration from mine, like different pin assignment or different IO Expander address, some of the compile options must be changed. Two files are involved: *config.h* and *pins.h*.

config.h contains most important options. Two important options are

- line 32@config.h
  ```
  #define MaximumNumberOfSensors 1
  ```

  Define MaximumNumberOfSensors to 1 for single sensor, and 5 for multiple sensors. The real number of sensors is determined by scanning when setup, so 5 is good for all multiple sensor setup.

- line 38@config.h
  ```
  #define UsePaddleInsteadOfPump false
  ```

  If you are using mixer or stirrer, change this option to true. The differences from using PUMP are
  - no "pump priming" at the start of automatic mode
  - The unit of Pump(stir) Rest/Pump(stir) cycle is **second** instead of minute
  - Heating control(PID) is **not** turned off during "Stir Rest"
  - 'stir' is used in place of 'pump' for button labels.

- line 39@config.h
  ```
  #define SecondaryHeaterSupport false
  ```

  Dual heaters support.

- line 38@config.h
  ```
  #define SpargeHeaterSupport false
  ```

  Sparge heater support is default to false since v0.3

pins.h contains the hardware configuration, include buttions, IO expander, and etc. You should know what you are using before changing them. Two of these options you might need to change are

- line 25@pins.h
  ```
  #define PUMP_INVERTED_LOGIC false
  ```

  SSR(Solid State Relay) is recommended for heating control, and mechanical relay is usually good enough for PUMP control. Some relay modules on eBay use inverted logic. Change this option when necessary.

- line 27@pins.h
  ```
  #define PCF8574_ADDRESS 0x20
  ```

  Address of the IO Expander.

1.Sensor Configuration

There are two configurations of BrewManiacEx: single sensor and multiple sensors.
It is necessary to assign and identify the sensors before use for multi-sensor configuration.
For single sensor configuration this is not necessary, you can however use just one sensor in multiple sensor configuration, but sensor setup is still necessary.
For multi-sensor configuration, the sensor setting must be configured before all other functions.

2.Settings

2.1 PID-PWM

Setting	Values	Description
Constant kP	-100~100	PID parameters (can be auto tuned.)
Constant kI	-100~155	PID parameters (can be auto tuned.)
Constant kD	-100~100	PID parameters (can be auto tuned.)
Sample Time	1500~3500	PID algorithm parameters
WindowSet	4000~7500	PID algorithm parameters. It should be greater than 2x Sample Time
Heat/PWM in Boil	0~100	The default PWM after Boil Point reached.
Sensor Calibration	-5 ~ +5	Calibration value of sensor(s)
PID Start	1 ~ 3.5	PID will be applied when the difference between the current and the set temperature is smaller than this value. For example, if set point is 65, and PID start is 1.5, then the PID will be applied when the temperature reaches 63.5. Before that, the heating is full-on.

*Note1: for **multi-sensor configuration**, the "calibration value" should be the the number of sensors.*

Note2: PID is used to maintain the temperature of the mashing stages only. For the boiling stage, or when the setting point is greater or equal to boiling temperature, the heating is full-on until the boil temperature is reached. After reaching the boil temperature, the heating output is controlled by PWM.

Note 3: If `SecondaryHeaterSupport` *is "true", there will be 3 set of P,I,D settings. The corresponding values will be used when heating elements configuration changes.*

2.2 Unit Parameters

Setting	Values	Description
Temperature Unit	°C/°F	Celius or Fahrenheit
Disable Delay Start	No/Yes	Yes: Disable Delay Start
Boil Temperature	80-120°C 176-248°F	The temperature regarded as "Boiling". Note: the set temperature must be greater or equal to this setting to be regarded as "boiling". PWM is enabled once the measured temperature is greater than the set temperature AND the Boil temperature.
Pump Cycle	5 ~ 15	
Pump Rest	0 ~ 5	Set to 1-4 to enable auto pump rest. During mash stages, pump will run for "Pump Cycle" time and stop for "Pump Rest" time.
Pump PreMash	OFF/ON	Turn on pump before Mash-in.
Pump on Mash	OFF/ON	
Pump MashOut	OFF/ON	
Pump on Boil	OFF/ON	
Pump Stop Temperature	80-120°C 176-248°F	The temperature at which to stop the pump.
PID DoughtIn	OFF/ON	Specify if HEATING is no during dought-in.
PID MaltOut	OFF/ON	Specify if HEATING is no during removing malt pipe.
Skip Add	No/Yes	Skip asking "Add Malt", go direct into first Mash step after "Mash-in" temperature reached.
Skip Remove	No/Yes	Skip asking "Remove Malt", go direct into Boiling after mashout.
Skip Iodine	No/Yes	Skip iodine test, go directly to Mashout after last mash step.
Iodine Time	0-120	The time to wait for iodine test.
Whirlpool	Off/Cool/Hot	The time to run Whirlpool.

		Off: no whirlpool Cool: whirlpool after cooling phase. Hot: whirlpool before cooling phase.

2.3 Misc Setting

Setting	Values	Description
Disable Delay Start	No/Yes	Yes: Disable Delay Start. The controller won't delay start.
Buzz On Button	OFF/ON	Button pressing feedback.
Pump Prime Cycle	0~10	The number of pump priming cycle.
Pump Prime On Time	250-10,000 ms	To prime the pump before automatic mode, the pump will be turned on and then off for multiple times. This setting defines the duration of ON. It increases in 250ms step.
Pump Prime Off Time	0-10,000 ms	see above.
Sparge Water heating Control *1		
Control Sparge Heating	No/Yes	disable/enable the sparge water heating control
Temp. Ctrl	No/Yes	Whether or not to control the temperature of spage water heating
Sparge Sensor	1-[max sensor id]	the sensor id for sparge water
Sparge Temp	75 ~ 80°C	the desired temperature for sparge water
Temp. Diff	0.5 ~ 2.0°C	the temperature range to keep
Heating Element Usage		
PreMash Heating Element	Primary Secondary Both	The elements used for PreMash stage, that is before dough-in.
Mashing Heating Element	Primary Secondary Both	The heating element used during mashing.

Boiling Heating Element	Primary Secondary Both	The heating element used during boiling.
Post Boil Heating Element	Primary Secondary Both	The heating element used for Hop Stand, if necesssary.

The advantage of using sparge water heating control is that the sparge heater and main heater will run *exclusively* so that they can share one 120V/20A GFI socket(loop) (American system)

The heating of sparge water can be temperature controlled if required. If temperature control is not applied, the heating is ON when the main heating is OFF, in this case the temperature of the sparge water should be controlled manually or by another controller. The temperature control options are only available in multi-sensor configuration.

You don't need to specify all P.I.D parameters for all usage of heating element. For example, if BOTH is used only for boiling, P.I.D. is not applied in boiling stage so it is not necessary to supply the setting values. (However, it might be used in manual mode.)

2.4 Sensor Setting

Connect all the sensors, and run sensor setting before all other actions.
The maximum number of sensors supported is 5.

There are two steps in sensor setting, **identifying sensors** and assigning **sensor usage**. In the first step, the sensor is identified and assigned to a *number* as its ID. In the second step, the primary sensor for temperature control and the auxiliary sensor reading to be displayed are assigned for each step, including Pre-Mash, Mashing, Boiling, Cooling, Manual mode, and Main screen.

Step 1: Assign sensors

Assign the sensor to the number displayed, #1 in this picture. Use up/down to change sensors. The last 8 digits of the sensor address and current temperature reading is displayed. *To get updated temperature reading, use UP/DOWN to change to other sensors and get lastest reading.*

Step 2: Assign sensor usage

Only two readings can be displayed on the 20x4 LCD, the **primary** one is used for temperature control while the **auxiliary** one is for display only. The primary and auxiliary sensors can be set for the following stages: Pre-Mash, Mashing, Boiling, Cooling, Manual Mode, and Main screen. The reading of primary sensor is always the number at **TOP** or **LEFT**.

Note: if temperature controlled sparge water heating control is applied, the secondary reading is always the sensor assigned to the sparge water temperature during Mashing.

3. Manual Mode and PID autotune

3.1 Manual Mode

In manual mode, the heating system the and pump are controlled manually.
The time starts running when the temperature reaches the set point, and it will be reset when the set temperature is changed 1 degree away.

Buttons	Functions
Up	Increse setting temperature. Long press to speed up.
Down	Decrease setting temperature. Long press to speed up.
Heat(Start)	Toggle heating element. In dual element mode, it controls primary heating element.
Pump(Enter)	Toggle pump.
Heat + Pump	Enter countdown mode to input count down time. After input of countdown time, press Heat + Pump again to end editing countdown

	timer. The countdown will begin when the set temperature is reached. After the countdown finishes, there will be a buzzing sound and the time starts to count "up".
Down + Heat	Toggle sparge heating, if supported.
Up + Heat	Toggle Secondary heating, if supported.
Long press Heat	Enter PID autotune. The P.I.D tuned will be the configuration of heating elements used.
Long press Pump	Enable Pump rest.

3.2 PID AutoTune

The PID autoTune function is used to derive the kP, kI, and kP values. To run PID AutoTune:

1. Add water
2. Enter Manual Mode, set the desired temperature to the temperature you usually mash at.
3. After the set point is reached, **LONG PRESS the "Heat" button**, and answer "Yes" to enter PID AutoTune.

4. The PID AutoTune function will run to get the optimal parameters which can keep the temperature steady at current temperature.

5. When the process is finished, the parameters are stored automatically. The controller will return to Manual mode. You can stop the auto tune anytime before it finishes.

Note:

The PID AutoTune function derives the optimal parameters by kicking the target either way and seeing how far and how quickly it goes. Therefore, the parameters derived are best for the conditions in which it runs. To get the best result, use the same volume of water as your brew size, and put your device in the place where you usually brew. Running the PUMP is also recommended if the pump is on during mashing, which is usually true.

4. Brew with Automatic mode

Automation is the heart of BrewManiacEx controller. The brew process starts from heating strike water to optional whirlpool and cooling. It prompts for user interactions, including:
-Malt In
-Malt Out
-Iodine test
-Hop throwing

4.1 Setup Automation

Before starting automation, the mash schedule, boil time, and hop time need to be specified. To edit the automation procedure, enter "Setup" then select "Automation".

The first item to edit is the temperature of "Mash In", or the temperature of the strike water.

Then, specify the first mash step temperature:

and, the rest time.

After entering the time by **Up/Down** buttons, press "**Done**"(Start button) if this is the final mash step(rest), or "**More**"(Enter button) if more rests are needed.
Repeat the input of temperature and time until all steps are input or the maximum 6 steps are input.
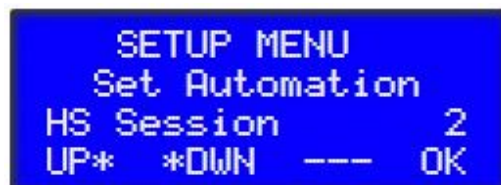

Then mashout temp and time:

Input number of hops, **Boil Time,** and the time of each hop.

The automation settings are saved. Therefore, if the same recipe is brewed, it is not necessary to setup again.

HopStand editing:

A HopStand Session is a span of temperature range. Maximum number of sessions is 5.

```
        SETUP MENU
      Set Automation
  Start HS01 100.00ºc
  UP*   *DWN  ---   OK
```

The "start" of hop stand. For FlameOut(KnockOff) hopping, set this number to greater or equal to boiling point. After boiling, when the temperature drops to this value, the controller will alarm to prompt for hop dropping and start counting time.

```
        SETUP MENU
      Set Automation
  Keep HS01   90.00ºc
  UP*   *DWN  ---   OK
```

The minimu temperature of this hopstand session. If the temperature drops below this setting before the specified hop time expires, the heating will be kicked start. If using of heating element is not desired, set this value to a lower value. However, the "start" temperature of next session should be lower than previous "keep" temperature. If precise and specific temperature is desired, set the start and keep temperature to exact the same value.

```
        SETUP MENU
      Set Automation
  PBH #01           30m
  UP*   *DWN Done More
```

Set the time of PostBoilHop #01. The first hop in the hopstand session defines the time of the hop stand. Press "Done" if no more hop, "More" else.
Repeat editing HopStand Session and PostBoilHop time until finished.

4.2 Running Automation

The automation will run through the brew process that is specified by the automation setup. When user interaction is needed, it will alert the user.
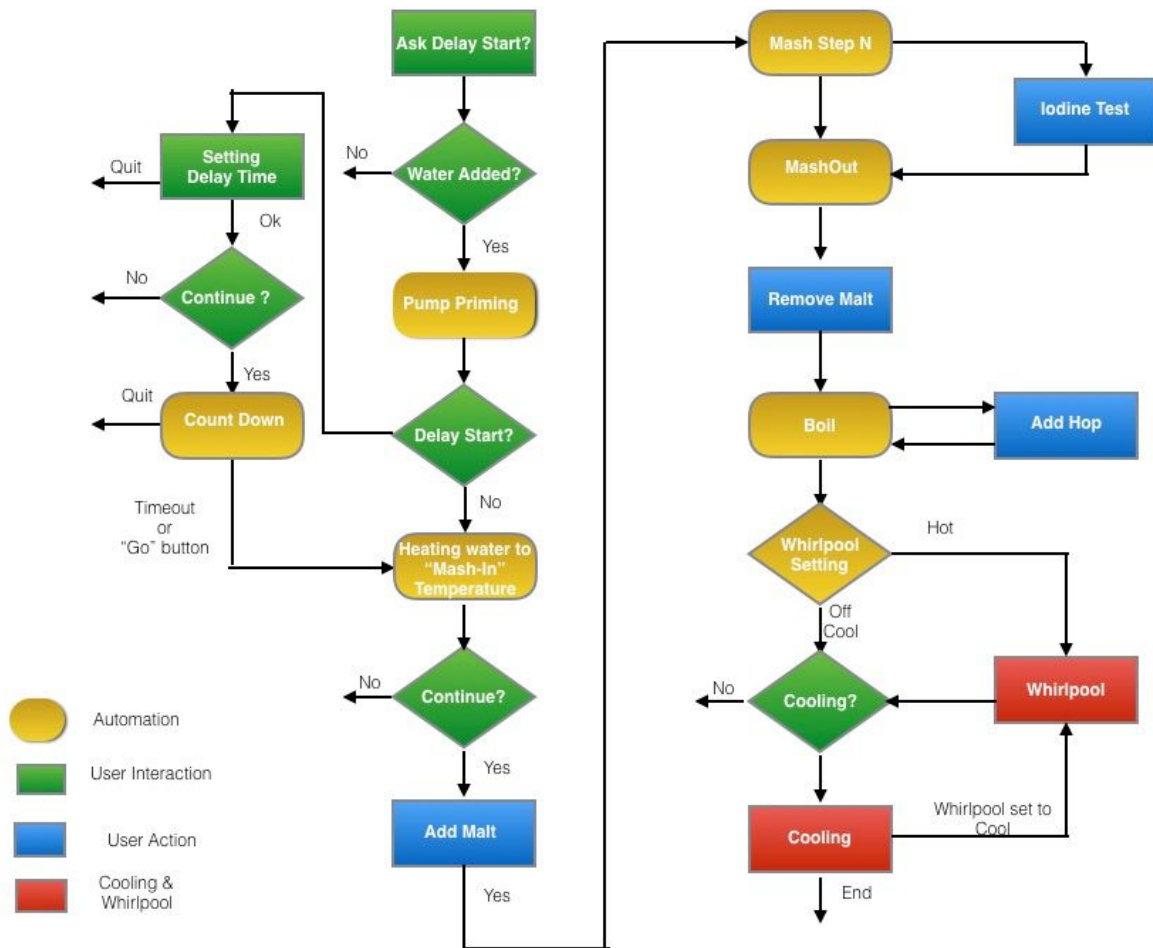
During automated processes, like mashing and boil, additional control is possible. For example, the mash step can be skipped, and the pump can be controlled manually during mashing and boiling.

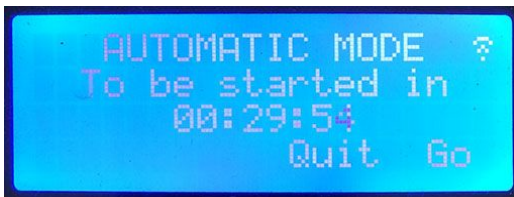Automatic Brewing Screens:

- Delay Start

```
AUTOMATIC MODE    📶
  Delay Start?

              No Yes
```
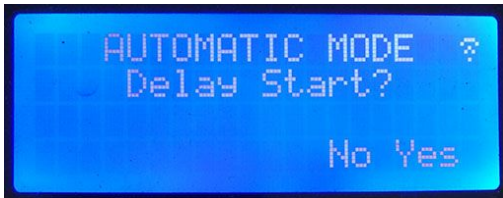
If "Disable Delay Start" is set to "NO", you will have the option to delay-start the brew.

- Edit Delay Start Time

```
AUTOMATIC MODE    📶
Setting Delay
     00:30:00
Up    Dwn   Quit   Ok
```

Use Up/Down to change the delay time. 15min a step.

- Delay Start Waiting

```
AUTOMATIC MODE    📶
To be started in
     00:29:54
             Quit   Go
```

The brew process will begin after the time counts to zero.
Go: start immediately.
Quit: quit the brew.

- Mashing

```
AUTO --> Mash 1/3 ?
H 62.25°C      55.00%P
            00:09:55
UP* *DWN PmPus STP
```

Up/Down: adjust the setting temperature.
PmPus (Pump & Pause): Press to toggle pump.
                              Long press to Pause the brew.
STP: long press to extend or skip this rest step.

Multi-sensor Mashing Screen

```
AUTO --> Mash 1/3
H 62.25°C    55.00   P
  61.75        00:09:55
 UP* *DWN PmPus   STP
```

The upper reading is the main temperature reading which is under PID control.
The lower reading is AUXiliary temperature reading.

- Paused

```
          61.75°C -----
        In Pause
----- -- 00:09:47 -----
----- --- Exit ---
```
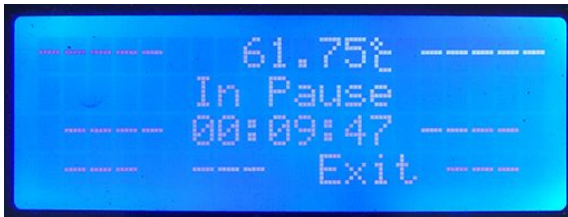
Paused mash step. The brew is paused until "Exit" pressed. The timer is stopped, as well as the pump and temperature control(heating).

- Modify Mash Step

```
AUTO --> Mash 1/3+
H 61.13°c      55.00 P
   Extend, or Skip?
Extend - Skip Back
```
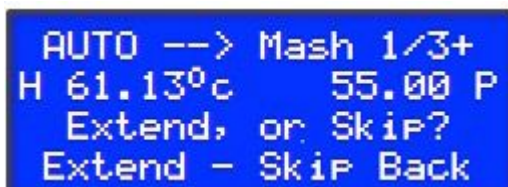
The mash step can be modified by **LONG PRESS** the "**STP**" button.
Extend: toggle rest extension. The extension status is displayed as "+" sign or nothing after the "Mash 1/3" title line.
Skip: Skip this rest step.
Back: back to mashing screen.

- Extended Mashing

```
AUTO --> Mash 1/3+
H 61.13ºc    55.00 P
             00:10:00
UP* *DWN PmPus STP
```

The duration of mash rest can be extended when necessary. It is useful under certain circumstances, like when decoction is used or conversion isn't finished yet. When extended status is set, a "+"(plus sign) will be shown. When time runs out, the timer starts to **count UP**, and the "+"(plus sign) turns into "*"(star sign).

```
AUTO --> Mash 1/3*
H 61.13ºc    55.00 P
             00:00:12
UP* *DWN PmPus STP
```

Press "STP" to finsih current rest step.

- Iodine Test

If enabled (skip iodine set to No), the controller will prompt for "Iodine Test" after last mash step finished and before Mashout start.

```
-----    70.00ºc -----
      IODINE TEST
-----  00:05:45 -----
             M.Out  Ext
```

If the Iodine test reveals the conversion is finished, press "M.Out" to go to mashout. If the conversionis not finished, press "Ext". The last mashing step will be extended and run until "STP" is pressed.

- Before Boiling

```
AUTO --> Boil       ?
□ 59.44℃     99.00$
             01:00:00
UP* *DWN   ---    Pmp
```

Up/Down: adjust target temperature.
Pmp: toogle pump.

- Boiling

```
AUTO --> Boil       ?
□100.87℃     99.00$
PWM= 85%  00:59:57
UP* *DWN Pause Pmp
```

Up/Down: adjust target temperature or PWM.
Pause: pause timer. The timer will paused, but the heating control remain active. Use this to extend boil time when needed.
Pmp: toogle pump.

Note: Only when the temperature is higher than **Target Temperature and the Boil Temperature** will the heating be controlled by PWM, the PWM value will be shown.
Boiling Screen for Multi-sensor

```
AUTO --> Boil
H100.00ºC    99.00   P
   99.75  85%00:09:55
 UP* *DWN  Pause Pmp
```

```
AUTO --> Boil
H100.00ºC    99.00   P
   99.75  HH%00:09:55
 UP* *DWN  Pause Pmp
```

The PWM duty cycle is displayed before the timer. When it is 100%, it is displayed as "HH%".

●   HopStand

If hopstand is specified, the controller will prompt "chilling" to drop temperature for hopstand. ("Cooling" is for final cooling.)

```
AUTO --> Chilling
  99.25ºc   90.00sp
            00:00:03
 ----  ----    Ok    ----
```

Press OK, and start chilling

```
AUTO --> Chilling
  90.25ºc   88.00sp
            00:30:00
 UP* *DWN   Skip Pmp
```

The temperature can be adjusted. The chilling can be skipped by **LONG PRESS** "Skip", and the controller will go to HopStand directly without checking the temperature.

```
AUTO --> HopStand
  99.25ºc    90.00sp
            00:00:03
 UP* *DWN   Skip Pmp
```

When temperature reaches the "start" temperature, the controller prompts for hop adding and start counting time. When time is up, the controller prompt for chilling again if another hopstand follows.
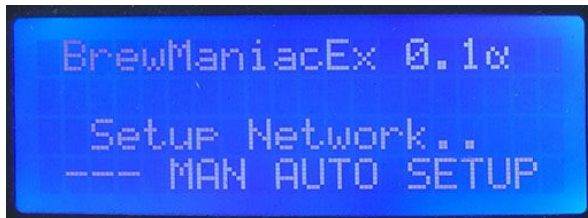
4.3 Automation Resumption

If a brew is not ended "normally" by pressing the "END" button after boiling finishes, the brew is considered "unfinished", and BrewManiacEx will ask for resumption when entering automation.
The system will try to resume from last step.

5. Web Interface

5.1 Serving page

BrewManiacEx will try to connect to the previously connected network at startup. If the connection is successful, the IP address will be shown. If it can't connect to the network, it will stay at the "Setup Network.." screen and setup a network named "bm". Using a computer or phone to connect to that "bm" network, and specify the WiFi network and optional password. If BrewManiacEx connects the network successfully, it will show the IP address on LCD.

The web interface can be accessed by browsers that support HTML5 and SSE(ServerSideEvent), like **Chrome** and **Safari**. Microsoft IE and Edge are **not** compatible due to lack of SSE support at the time of writing.
The hostname which by default is 'bm', can be used if mDNS is supported by your phone or computer, which is true for Apple's products. The serving page can be accessed from

http://bm.local
or
http://*[IP Address]*

5.2 Main/Panel

This tab is used to control and watch the status of BrewManiacEx. There is a "cover" above the buttons to prevent fat fingers.
NOTE: it is not recommended to control the brew remotely.

5.3 Settings

Panel
Settings
Automation
Recipes
Brew Logs
Network
Calculators
About

BrewManiacEx

Settings [Set] [Save]

PID — PWM	
Constant kP	-
Constant kI	-
Constant kD	-
Sample Time	-
WindowSet	- ms
Heat/PWM in Boil	- %
Sensor Calibration	-°C
PID Start	- °C
Unit Parameters	
Temperature Unit	°C
Disable Delay Start	-
Boil Temperature	- °C
Pump Cycle	- minutes
Pump Rest	- minutes
Pump PreMash	-
Pump on Mash	-
Pump MashOut	-
Pump on Boil	-
Pump Stop Temperature	-°C
PID Pipe	-
Skip Add	-
Skip Remove	-
Skip Iodine	-
Iodine Time	-
Whirlpool	-
Sparge Water Heating Control	
Control Sparge Heating	-
Temperature Control	-
Sensor Index	-
Target Temperature	-°C
Temp. Difference	-

5.4 Automation

5.5 Recipes

Recipes are created by the import of BeerXML files. The imported BeerXML should have the following information so that it can be used and translated into automation settings:
- Boil time
- Mash profile

The following fields are also referenced if available
- Hop and other additions schedules
  - The information will be translated into time of "Hop#1", "Hop #2", etc.
- Water amount of first mash step
  - If the mash-in temperature is set to "calculated", this field is used in the formula to derive mash-in temperature.

Other fields are display only.

5.5.1 Recipe Options

Panel	≡	BrewManiacEx
Settings		
Automation	**Options**	**Recipe Options**
Recipes	Import	
Brew Logs	SarahHughesDarkRubyMild	
Network		
Calculators		
About		

Unit	Metric ○ US			
Gravity/Plato	○ Gravity ○ °Plato			
Mash In Temperature	○ As First Rest			
	○ Calculated	Grain Temperature	20	°C
		Equipment Adjust	0	°C
		Kettle equiv. mass	0	L
○ Specified	Temperature	55	°C	
Default Mash Out	Temperature		77.2	°C
	Time		10	M

- Mash-in temperature will be inserted automatically based on the settings. The formula to calculate mash-in temperature is based on Palmer's formula.
- Temp = R * [Grain weight] / [Water amount] * ([First rest temp] – [Grain temp]) + [First rest temp] + [Equipment Adjustment]
- R: is the heat capacity coefficient of grain.
- General speaking, the "Equipment Adjust" should be a minus value because the kettle is at the "mash-in" temperature when doughing in.
- A mash-out is necessary for BrewManiacEx. If the last mash step in the BeerXML recipe is in the mash-out range(>75°C), it will be regarded as the Mashout step. Otherwise a "Default Mash Out" will be inserted automatically.

5.5.2 Import

Used to import the beer.xml file

- Your BeerXML file may contain more than one recipe, if so you can select your desired recipe.
- You can "Save" or "Brew" your recipe only if it specifies at least the Boil Time and Mash Profile.
- The saved name can't contain special characters and spaces. The maximum length is 28.
- Caution: Using the same recipe name as an existing saved recipe will overwrite the existing saved recipe.

- You can "Brew" a recipe without having used "Save". Pressing "Brew" button will set the automation settings.
- The "Mash-In" temperature is derived from the settings at the time it is shown. The "Mash-out" is set to a default if it is not present in the imported BeerXML file. **The original BeerXML is saved**, and you can have different Mash-In and Mash-out(if not present in the BeerXML) if you change the options before "viewing" a recipe

5.5.3 Saved recipe view

Name		Porter				
Style		15A-Robust Porter				
Batch Size		5.00Gal				
Boil Time		60Min				

Efficiency	OG	FG	ABV	Color		IBU
72%	1.054	1.018	4.7%	● 44.9		29.5

Fermentables					

Fermentable	Weight	PPG	Color	Note
Pale Malt (2 Row) Bel	8.00lb	37	3.2L	
Black (Patent) Malt	1.00lb	25	500L	
Caramel/Crystal Malt - 10L	1.00lb	35	10L	
Chocolate Malt	0.50lb	28	350L	
Munich Malt - 10L	0.50lb	36	10L	

Hops & Misc					

	Time	Name	Weight	alpha	Note
Hop#1	60Min	Fuggles	2.00oz	4.5%	
Hop#2	10Min	Irish Moss	0.04oz		Fining
		Gypsum (Calcium Sulfate)	0.35oz		Mash

Mash Profile					

	Name	Temperature	Time	Type	Water
Mash In		167.8°F			
Mash Step 1	Mash In	154.0°F	60Min	Infusion	13.75qt
Mash Out	Mash Out	168.0°F	10Min	Infusion	8.80qt

Yeast			

Name	Lab/Product	Temperature	Attenuation
English Ale	White Labs WLP002	65.0 ~ 68.0°F	66.5%

Fermentation		

Stage	Temperature	Duration
Primary	68.0°F	4.0 days
Secondary	68.0°F	7.0 days

Note:
Used For: General purpose bittering/aroma for English Ales, Dark Lagers Aroma: Mild, soft, grassy, floral aroma Substitute: East Kent Goldings, Williamette Examples: Samuel Smith's Pale Ale, Old Peculiar, Thomas Hardy's Ale

- You can "Delete" and "Brew" the saved recipes.
- You can change the options to get a different Mash-In temperature just before you "Brew" it.

5.6 Calculators

For convenience when brewing a series of calculators are provided as follows

5.7 Brew Logs

5.8 Network

The serving page can be password-protected if "Always need password" option is checked. It is not protected by default.

The username, password, and hostname can be changed in "Network Settings" page. To change the setting in "Network Settings" page, the correct username and password must be provided. *The change of network settings will be effective after next power on.*

Default values: Host Name: bm
                    UserName: brewmaniac
                    Password: rdwhahb

5.9 Update page

5.9.1 Firmware update

!!BE CAREFUL!! Uploading the wrong image might brick your controller.
The firmware can be updated by uploading new *.bin file from browser at this url

http://bm.local:8008/systemupdate

5.9.2 Web file update

!!BE CAREFUL!! Messing up the files might result in misbehavior of BrewManiacEx.
To access the SPIFFS file sytem, use the url,

http://bm.local:8008/filemanager

Take care not to mess up the files.

Be Warned! Dangerous!!!
Dangerous!!! Don't read the following content
There is a way to format the file system by which all the files and logs will be gone. The url is at http://bm.local/format-spiffs
Dangerous!!! Don't read the content brefore

5.9.3 Automatic OTA Update
Functionality currently unstable

By accessing the url below, BrewManiacEx will check the availability of new firmware and new web page files.
http://bm.local/update

If BrewManiacEx can't find the files, the update page will be present when main page is accessed. The data files can be downloaded from the network instead of using SPIFFS tool.

Appendix

A1.Q&A
Q1: PID AutoTune.
A1: Check the detail at this page:
http://brettbeauregard.com/blog/2012/01/arduino-pid-autotune-library/

Q2: First Wort Gravity?
A2: The first wort gravity is calculated based on 80% yield of grain, so it's a approximate value.

Brix of First Wort = (grain in kg) * 0.8 / [(grain in kg) * 0.8 + (water in L)]
Convertion from Brix to Gravity:

SG = 1 + (Brix/(258.6-((Brix/258.2)*227.1)))

Q3: Zero crossing relay and heater switch.
A3:
  Zero crossing relays switch ON/OFF when the voltage crosses zero, which introduces a lag or delay. If both the main heater and sparger heater are controlled by zero crossing relays, it should be fine because they will be turned on and off at the same time when the voltage crosses zero. However, if one of the relay isn't zero crossing and switches immediately, it

might result in overload of power when the turned-off zero crossing relay "waits" for the voltage to cross zero and the non zero crossing relay turns on immediately.

A minimum 10ms delay between heater switch is introduced to solve this issue. The delay might sometimes extends over 100ms because of the limitation of software structure.

Q4: Time in brew logs.
A4: The real clock time will be recorded in the brew log as long as the time is known when the brew starts. BrewManiacEx will try to get time from the internet, NTP servers, at startup. If that fails, it can still get time from the computer or phone that connects to it. Therefore, connect to BrewManaicEx before the brew starts so that it can get the time of your computer or phone if it doesn't have internet access.

Revision:

Dec 7, 2016	0.1 draft V1	Vito Tai
Jan 19, 2017	0.1 draft V2	Iain Hay
Mar 8, 2017	0.2 draft V1	Iain Hay
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July 5, 2017	0.3 drat V1	Vito Tai