

QATCH openQCM Real-Time FW Change Control Document			
Release Version	Date	Author	Description
v2.6b1	06/18/2023	A. Ross	<b>SWEEP PERFORMANCE:</b> <b>FW: 1.5-7.5ms E2E: 1.5-7.5ms CAL: &lt;2s</b> <ul style="list-style-type: none"> <li>- Initial beta version for the v2.6 branch</li> <li>- Updated build information</li> <li>- Initial support for ILI9341 TFT touchscreen</li> <li>- Add custom font and icon support files</li> <li>- Move Temp Control stability checks to FW</li> <li>- Keep track of "ready" status and label states</li> <li>- Bug Fix: Add FW weak pullup to SDO of MAX31855</li> <li>- Remove support for Seven Segment Display</li> <li>- Increase Temp Control timeout from 1 to 15 minutes</li> <li>- Remove LED_SEGMENT pin definitions</li> <li>- Add screensaver support for touchscreen</li> <li>- Improve error detection of MAX31855 readings</li> <li>- Add ledWrite() method to allow PWM led states</li> <li>- Revert to old HW GPIO configs if not 'USE_ILI9341'</li> <li>- Blink BLUE led during FW update instead of DP seg</li> <li>- Re-detect HW errors on each read, no reboot req'd</li> <li>- Flush serial data at end of calibration sweep</li> <li>- Add UI interface support screens for ILI9341</li> </ul>
v2.6b1	06/20/2023	A. Ross	<b>SWEEP PERFORMANCE:</b> <b>FW: 1.5-7.5ms E2E: 1.5-7.5ms CAL: &lt;2s</b> <ul style="list-style-type: none"> <li>- Updated build information</li> <li>- Bug Fix: Set proper TFT rotation for LCD orientation</li> </ul>
v2.6b1*	07/12/2023	A. Ross	<b>SWEEP PERFORMANCE:</b> <b>FW: 1.5-7.5ms E2E: 1.5-7.5ms CAL: &lt;2s</b> <p>The source code for a half-baked version of FW v2.6b1 was released with SW v2.6b3 that indicates HEATING vs COOLING but which has a completely re-worked PID controller in the L298NHB driver which was later decided not yet ready for release due to a lack of testing and so it was not included in the v2.6b4 release. The executable "QATCH_Q-1_FW_py_v2.6b1.ino.TEENSY41.hex" in SW v2.6b3 is identical to that of the previous build and it is therefore not a high risk of this code being programmed into a device; however, you should NOT compile the FW source from SW v2.6b3 since it is only half-baked. You have been warned!</p>

<b>v2.6b4</b>	07/18/2023	A. Ross	<b>SWEEP PERFORMANCE:</b> <b>FW: 1.5-7.5ms E2E: 1.5-7.5ms CAL: &lt;2s</b> <ul style="list-style-type: none"> <li>- Updated build information</li> <li>- Improve MAX31855 error detection and reporting</li> <li>- Detect TFT error on power up</li> <li>- Report hardware errors (if any) in "INFO" reply</li> <li>- Only draw idle UI on "STOP" if it was streaming</li> <li>- Indicate "SERVICE REQUIRED" on HW errors</li> <li>- Reduce unneeded UI redraws on Temp Control</li> <li>- Indicate HEATING vs COOLING when cycling</li> </ul>
<b>v2.6b5</b>	08/24/2023	A. Ross	<b>SWEEP PERFORMANCE:</b> <b>FW: 1.5-7.5ms E2E: 1.5-7.5ms CAL: &lt;2s</b> <ul style="list-style-type: none"> <li>- Updated build information</li> <li>- Ignore "-Wunused-const-variable" in icon files</li> <li>- Breakout icon imports into 'icons.h' header file</li> <li>- Rework TEMP CONTROL PID logic flows (faster)</li> <li>- Allow transient TEMP READ errors without stopping</li> <li>- Report temperature probe errors in messaging</li> <li>- Breakout EEPROM structures into 'NvMem' module</li> <li>- Move main project code into separate 'main.c' file</li> <li>- Main Arduino project .ino file now calls main.c stubs</li> <li>- Increase TEMP_AVG to 8 for more stable readings</li> <li>- Move function declarations from sketch to 'main.h'</li> <li>- Add nv_init and byte &lt;--&gt; float conversion methods</li> <li>- All EEPROM read/write moved to NvMem module</li> <li>- Detect and HW errors to LCD on device startup</li> <li>- Reformat code to comply with VS Code standard</li> <li>- Re-write PV color on transient temp read failure</li> </ul>
<b>v2.6b6</b>	09/12/2023	A. Ross	<b>SWEEP PERFORMANCE:</b> <b>FW: 1.5-7.5ms E2E: 1.5-7.5ms CAL: &lt;2s</b> <ul style="list-style-type: none"> <li>- Updated build information</li> <li>- Revert L298NHB to v2.6b4</li> <li>- Dynamically detect and support all HW revisions</li> <li>- Apply a fixed -0.75C offset when TEC on, but Idle</li> <li>- Set ambient temp to external temp for old PID code</li> <li>- Remove TEMP_AVG support, no temp averaging</li> <li>- Update formatting of MAX31855 library to VS Code</li> <li>- Set default MAX31855._status = MAX_STATUS_OK</li> <li>- Add support for HW_Revision in NvMem library</li> </ul>
<b>v2.6b7</b>	09/17/2023	A. Ross	<b>SWEEP PERFORMANCE:</b> <b>FW: 1.5-7.5ms E2E: 1.5-7.5ms CAL: &lt;2s</b> <ul style="list-style-type: none"> <li>- Updated build information</li> <li>- Support for variable MAX31855 OffsetM temperature</li> <li>- Removed fixed -0.75C offset, in favor of OffsetM</li> <li>- Use OffsetM when streaming an active measure run</li> </ul>

# FW Changes

<b>v2.6b8</b>	09/25/2023	A. Ross	<b>SWEEP PERFORMANCE:</b> <b>FW: 1.5-7.5ms E2E: 1.5-7.5ms CAL: &lt;2s</b> <ul style="list-style-type: none"> <li>- Updated build information</li> <li>- Untested cooldown code, keep fan on for 5 mins</li> <li>- Allow set for OffsetM using serial commands</li> <li>- Detect and report voltage error on TEMP command</li> </ul>
<b>v2.6b9</b>	10/03/2023	A. Ross	<b>SWEEP PERFORMANCE:</b> <b>FW: 1.5-7.5ms E2E: 1.5-7.5ms CAL: &lt;2s</b> <ul style="list-style-type: none"> <li>- Updated build information</li> <li>- Add support for cooldown/venting mode</li> <li>- Add UI support for circular progress bar</li> <li>- Cooldown period changed from 5 to 4 mins</li> <li>- FAN_HIGH_LOW (pin 6) removed as unused</li> <li>- Only enter cooldown mode after stopping TEC</li> <li>- Trigger "auto-off" if voltage error on 1st TEC start</li> <li>- Auto-stop "IDENTIFY" mode on run sweep start</li> <li>- Remain in cooldown mode after MAX31855 fault</li> <li>- Remain in cooldown mode after "auto-off" (if running)</li> <li>- Do not enter cooldown mode if volts out-of-bounds</li> <li>- Pause and resume countdown UI after other activity</li> <li>- Perform advanced pixel updates to correct "holes"</li> <li>- Adjust label text and position for better uniformity</li> </ul>
<b>v2.6b10</b>	10/10/2023	A. Ross	<b>SWEEP PERFORMANCE:</b> <b>FW: 1.5-7.5ms E2E: 1.5-7.5ms CAL: &lt;2s</b> <ul style="list-style-type: none"> <li>- Updated build information</li> <li>- BUG FIX: Turn off 'identify' when programming FW</li> </ul>
<b>v2.6b11</b>	10/11/2023	A. Ross	<b>BUILD DOES NOT EXIST</b> SW v2.6b11 uses FW v2.6b10
<b>v2.6b12</b>	10/31/2023	A. Ross	<b>SWEEP PERFORMANCE:</b> <b>FW: 1.5-7.5ms E2E: 1.5-7.5ms CAL: &lt;2s</b> <ul style="list-style-type: none"> <li>- Updated build information</li> <li>- Add support for setting REF_CLK multiplier</li> <li>- Dynamically set REF_CLK based on HW REV</li> <li>- Add support for HW REVISION 2 (30 MHZ XTAL)</li> <li>- Refactor LED_GREEN_PIN to LED_RED_PIN</li> <li>- Suppress HW errors for secondary PID devices</li> <li>- BUG FIX: Correctly print digits during TEMP mode</li> </ul>

## FW Changes

<b>v2.6b13</b>	11/03/2023	A. Ross	<b>SWEEP PERFORMANCE:</b> <b>FW: 1.5-7.5ms E2E: 1.5-7.5ms CAL: &lt;2s</b> <ul style="list-style-type: none"> <li>- Updated build information</li> <li>- Increase MAX_PWR_HEAT from 150 to 200</li> <li>- Increase EXT_5V voltage deviation to +/- 1V</li> <li>- Ignore OPEN_FAULT from MAX31855 on HW detect</li> <li>- BUG FIX: Ignore transient temp errors on secondary</li> <li>- BUG FIX: Skip "TEMP CHECK" test on secondaries</li> <li>- BUG FIX: Temp jumps on measurement stream start</li> <li>- Report internal (ambient) temp on secondary initialize</li> <li>- Consider temperature jumps &gt; 5C as read errors</li> </ul>
<b>v2.6b14</b>	11/10/2023	A. Ross	<b>SWEEP PERFORMANCE:</b> <b>FW: 1.5-7.5ms E2E: 1.5-7.5ms CAL: &lt;2s</b> <ul style="list-style-type: none"> <li>- Updated build information</li> <li>- TEC controller PID re-tuned for speed/overshoot</li> <li>- BUG FIX: Screensaver can interrupt TEC cooldown</li> <li>- Reduce L298NHB_AUTOOFF from 15 to 10 mins</li> <li>- Increase TEMP_AVG from 1 to 4 for PID control</li> <li>- Report external temperature resolution as 0.25 C</li> <li>- Pre-seed ambient temperature with internal on start</li> <li>- BUG FIX: TEC cooldown timer ends 2s prematurely</li> <li>- Detect spurious temp reads (&gt;5C off) as bad reads</li> <li>- BUG FIX: Temp can be spurious for a brief period</li> </ul>
<b>v2.6b15</b>	11/28/2023	A. Ross	<b>SWEEP PERFORMANCE:</b> <b>FW: 1.5-7.5ms E2E: 1.5-7.5ms CAL: &lt;2s</b> <ul style="list-style-type: none"> <li>- Updated build information</li> <li>- PID controller retuned to better track near ambient</li> <li>- Initial support for "MULTI" and "MSGBOX" cmds</li> </ul>
<b>v2.6b16</b>	12/12/2023	A. Ross	<b>SWEEP PERFORMANCE:</b> <b>FW: 1.5-7.5ms E2E: 1.5-7.5ms CAL: &lt;2s</b> <ul style="list-style-type: none"> <li>- Updated build information</li> <li>- Improved MSGBOX performance pixel drawing</li> <li>- Hide MSGBOX text when device in cooldown</li> </ul>
<b>v2.6b17</b>	12/19/2023	A. Ross	<b>SWEEP PERFORMANCE:</b> <b>FW: 1.5-7.5ms E2E: 1.5-7.5ms CAL: &lt;2s</b> <ul style="list-style-type: none"> <li>- Updated build information</li> <li>- Take temperature prior to starting a sweep</li> <li>- No temperature reads in first 3 seconds of run</li> </ul>

## FW Changes

<b>v2.6b18</b>	01/05/2024	A. Ross	<b>SWEEP PERFORMANCE:</b> <b>FW: 1.5-7.5ms E2E: 1.5-7.5ms CAL: &lt;2s</b> <ul style="list-style-type: none"> <li>- Updated build information</li> <li>- BUG FIX: Temp control can pick wrong direction</li> <li>- Improved mode hopping performance</li> <li>- Internal ambient temperature is always 21C now</li> </ul>
<b>v2.6b19</b>	01/15/2024	A. Ross	<b>SWEEP PERFORMANCE:</b> <b>FW: 1.5-7.5ms E2E: 1.5-7.5ms CAL: &lt;2s</b> <ul style="list-style-type: none"> <li>- Updated build information</li> <li>- Decrease 'kd' for temperature PID control to 100</li> </ul>
<b>v2.6b20</b>	01/23/2024	A. Ross	<b>SWEEP PERFORMANCE:</b> <b>FW: 1.5-7.5ms E2E: 1.5-7.5ms CAL: &lt;2s</b> <ul style="list-style-type: none"> <li>- Updated build information</li> <li>- Add ability to tune PID parameters from SW</li> <li>- PID parameters are constant, ki and kd are fixed</li> </ul>
<b>v2.6b21</b>	02/06/2024	A. Ross	<b>SWEEP PERFORMANCE:</b> <b>FW: 1.5-7.5ms E2E: 1.5-7.5ms CAL: &lt;2s</b> <ul style="list-style-type: none"> <li>- Updated build information</li> <li>- Modified L298NHB PID controller logic</li> <li>- L298NHB now has standard PID logic, no "magic"</li> </ul>
<b>v2.6b22</b>	02/13/2024	A. Ross	<b>BUILD DOES NOT EXIST</b> SW v2.6b22 uses FW v2.6b21
<b>v2.6b23</b>	02/21/2024	A. Ross	<b>BUILD DOES NOT EXIST</b> SW v2.6b23 uses FW v2.6b21
<b>v2.6b24</b>	02/22/2024	A. Ross	<b>BUILD DOES NOT EXIST</b> SW v2.6b24 uses FW v2.6b21
<b>v2.6b25</b>	02/26/2024	A. Ross	<b>BUILD DOES NOT EXIST</b> SW v2.6b25 uses FW v2.6b21
<b>v2.6b26</b>	02/27/2024	A. Ross	<b>BUILD DOES NOT EXIST</b> SW v2.6b26 uses FW v2.6b21
<b>v2.6b27</b>	03/01/2024	A. Ross	<b>BUILD DOES NOT EXIST</b> SW v2.6b27 uses FW v2.6b21

## FW Changes

<b>v2.6r27</b>	03/05/2024	A. Ross	<b>SWEEP PERFORMANCE:</b> <b>FW: 1.5-7.5ms E2E: 1.5-7.5ms CAL: &lt;2s</b> <ul style="list-style-type: none"> <li>- Updated build information</li> <li>- Release candidate build equivalent of v2.6b21</li> </ul>
<b>v2.6b28</b>	03/13/2024	A. Ross	<b>BUILD DOES NOT EXIST</b> SW v2.6b28 uses FW v2.6b21
<b>v2.6r28</b>	03/13/2024	A. Ross	<b>SWEEP PERFORMANCE:</b> <b>FW: 1.5-7.5ms E2E: 1.5-7.5ms CAL: &lt;2s</b> <ul style="list-style-type: none"> <li>- Updated build information</li> <li>- Release candidate build equivalent of v2.6b21</li> </ul>
<b>v2.6b29</b>	03/19/2024	A. Ross	<b>BUILD DOES NOT EXIST</b> SW v2.6b29 uses FW v2.6b21
<b>v2.6r29</b>	03/19/2024	A. Ross	<b>SWEEP PERFORMANCE:</b> <b>FW: 1.5-7.5ms E2E: 1.5-7.5ms CAL: &lt;2s</b> <ul style="list-style-type: none"> <li>- Updated build information</li> <li>- Release candidate build equivalent of v2.6b21</li> </ul>
<b>v2.6b30</b>	04/09/2024	A. Ross	<b>SWEEP PERFORMANCE:</b> <b>FW: 1.5-7.5ms E2E: 1.5-7.5ms CAL: &lt;2s</b> <ul style="list-style-type: none"> <li>- Updated build information</li> <li>- FlasherX updated from v2.1 to v2.4 (hid support)</li> <li>- BUG FIX: Correct for rare millis() rollover issue</li> <li>- Calibration format modified for HID devices</li> <li>- Indicate "Press start then apply drop" when ready</li> </ul>
<b>v2.6b31</b>	04/11/2024	A. Ross	<b>BUILD DOES NOT EXIST</b> SW v2.6b31 uses FW v2.6b30
<b>v2.6b32</b>	04/18/2024	A. Ross	<b>SWEEP PERFORMANCE:</b> <b>FW: 1.5-7.5ms E2E: 1.5-7.5ms CAL: &lt;2s</b> <ul style="list-style-type: none"> <li>- Updated build information</li> <li>- Toggle D41 when toggling D5 (TEMP_CIRCUIT)</li> <li>- Doing this avoids a rework requirement on PCBs</li> <li>- D41 (TEC_SENSE) will be repurposed in the future</li> <li>- Detect physical presence of PHY chip at boot</li> <li>- Prevent TEENSY41_NE hw from using NET mode</li> <li>- BUG FIX: TEENSY41_NE boards report IP address</li> </ul>
<b>v2.6b33</b>	05/13/2024	A. Ross	<b>BUILD DOES NOT EXIST</b> SW v2.6b33 uses FW v2.6b32

## FW Changes

<b>v2.6r33</b>	05/13/2024	A. Ross	<b>SWEEP PERFORMANCE:</b> <b>FW: 1.5-7.5ms E2E: 1.5-7.5ms CAL: &lt;2s</b> <ul style="list-style-type: none"> <li>- Updated build information</li> <li>- FlasherX updated from v2.1 to v2.4 (hid support)</li> <li>- BUG FIX: Correct for rare millis() rollover issue</li> <li>- Calibration format modified for HID devices</li> <li>- Indicate "Press start then apply drop" when ready</li> <li>- Toggle D41 when toggling D5 (TEMP_CIRCUIT)</li> <li>- Detect physical presence of PHY chip at boot</li> <li>- BUG FIX: TEENSY41_NE boards report IP address</li> </ul>
<b>v2.6b34</b>	05/17/2024	A. Ross	<b>BUILD DOES NOT EXIST</b> SW v2.6b34 uses FW v2.6b32
<b>v2.6b35</b>	05/21/2024	A. Ross	<b>BUILD DOES NOT EXIST</b> SW v2.6b35 uses FW v2.6b32
<b>v2.6r35</b>	05/21/2024	A. Ross	<b>SWEEP PERFORMANCE:</b> <b>FW: 1.5-7.5ms E2E: 1.5-7.5ms CAL: &lt;2s</b> <ul style="list-style-type: none"> <li>- Updated build information</li> <li>- No functional changes from v2.6r33</li> </ul>
<b>v2.6b36</b>	05/23/2024	A. Ross	<b>BUILD DOES NOT EXIST</b> SW v2.6b36 uses FW v2.6b32
<b>v2.6r36</b>	05/23/2024	A. Ross	<b>SWEEP PERFORMANCE:</b> <b>FW: 1.5-7.5ms E2E: 1.5-7.5ms CAL: &lt;2s</b> <ul style="list-style-type: none"> <li>- Updated build information</li> <li>- No functional changes from v2.6r33</li> </ul>
<b>v2.6b37</b>	05/27/2024	A. Ross	<b>SWEEP PERFORMANCE:</b> <b>FW: 1.5-7.5ms E2E: 1.5-7.5ms CAL: &lt;2s</b> <ul style="list-style-type: none"> <li>- Updated build information</li> <li>- Disable Ethernet chip in NV features by default Use command 'EEPROM 4 1' to enable Ethernet</li> <li>- Initialize 'ambient' variable to NAN in global scope</li> </ul>
<b>v2.6r37</b>	05/27/2024	A. Ross	<b>SWEEP PERFORMANCE:</b> <b>FW: 1.5-7.5ms E2E: 1.5-7.5ms CAL: &lt;2s</b> <ul style="list-style-type: none"> <li>- Updated build information</li> <li>- Disable Ethernet chip in NV features by default Use command 'EEPROM 4 1' to enable Ethernet</li> <li>- Initialize 'ambient' variable to NAN in global scope</li> </ul>

## FW Changes

<b>v2.6b38</b>	06/07/2024	A. Ross	<b>BUILD DOES NOT EXIST</b> SW v2.6b38 uses FW v2.6b37
<b>v2.6b39</b>	06/17/2024	A. Ross	<b>BUILD DOES NOT EXIST</b> SW v2.6b39 uses FW v2.6b37
<b>v2.6b40</b>	06/25/2024	A. Ross	<b>SWEEP PERFORMANCE:</b> <b>FW: 1.5-7.5ms E2E: 1.5-7.5ms CAL: &lt;2s</b>  - Updated build information - Remove CAL blips on left of 2nd-ary devices
<b>v2.6b41</b>	06/28/2024	A. Ross	<b>BUILD DOES NOT EXIST</b> SW v2.6b41 uses FW v2.6b40
<b>v2.6r41</b>	06/28/2024	A. Ross	<b>SWEEP PERFORMANCE:</b> <b>FW: 1.5-7.5ms E2E: 1.5-7.5ms CAL: &lt;2s</b>  - Updated build information - Remove CAL blips on left of 2nd-ary devices
<b>v2.6b42</b>	07/09/2024	A. Ross	<b>BUILD DOES NOT EXIST</b> SW v2.6b42 uses FW v2.6b40
<b>v2.6b43</b>	07/26/2024	A. Ross	<b>BUILD DOES NOT EXIST</b> SW v2.6b43 uses FW v2.6b40
<b>v2.6b44</b>	07/30/2024	A. Ross	<b>BUILD DOES NOT EXIST</b> SW v2.6b44 uses FW v2.6b40
<b>v2.6b45</b>	08/01/2024	A. Ross	<b>BUILD DOES NOT EXIST</b> SW v2.6b44 uses FW v2.6b40
<b>v2.6r45</b>	08/01/2024	A. Ross	<b>SWEEP PERFORMANCE:</b> <b>FW: 1.5-7.5ms E2E: 1.5-7.5ms CAL: &lt;2s</b>  - Updated build information - No intentional changes from FW v2.6r41 - BUG: This version has a slower calibration sweep
<b>v2.6b46</b>	08/18/2024	A. Ross	<b>SWEEP PERFORMANCE:</b> <b>FW: 1.5-7.5ms E2E: 1.5-7.5ms CAL: &lt;2s</b>  - Updated build information - Tread PIDs A-D as secondary devices



## FW Changes

<b>v2.6r46</b>	08/18/2024	A. Ross	<b>SWEEP PERFORMANCE:</b> <b>FW: 1.5-7.5ms E2E: 1.5-7.5ms CAL: &lt;2s</b>  - Updated build information - Tread PIDs A-D as secondary devices
<b>v2.6b47</b>	10/03/2024	A. Ross	<b>BUILD DOES NOT EXIST</b> SW v2.6b47 uses FW v2.6b46
<b>v2.6b48</b>	11/01/2024	A. Ross	<b>BUILD DOES NOT EXIST</b> SW v2.6b48 uses FW v2.6b46