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PRE-PRODUCTION
PCBA INSPECTION

Date: 26-10-2020

Revision: 1.0

Author: Tony Little

Product: Electric Skateboard

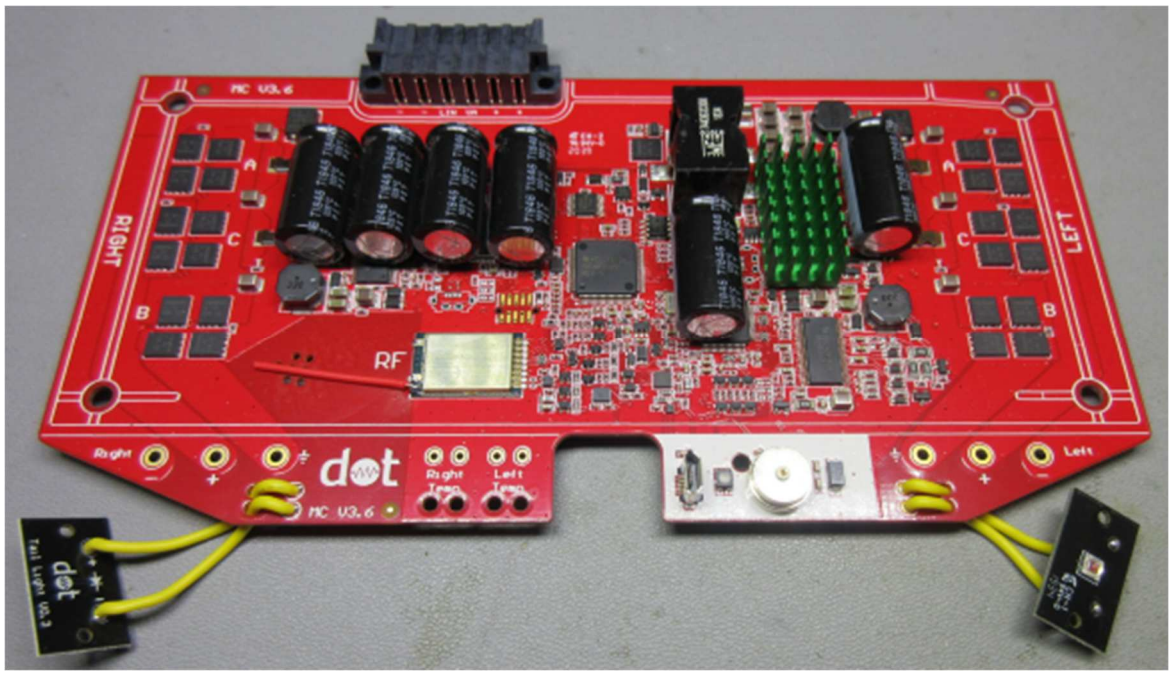
Company: Globe Brand

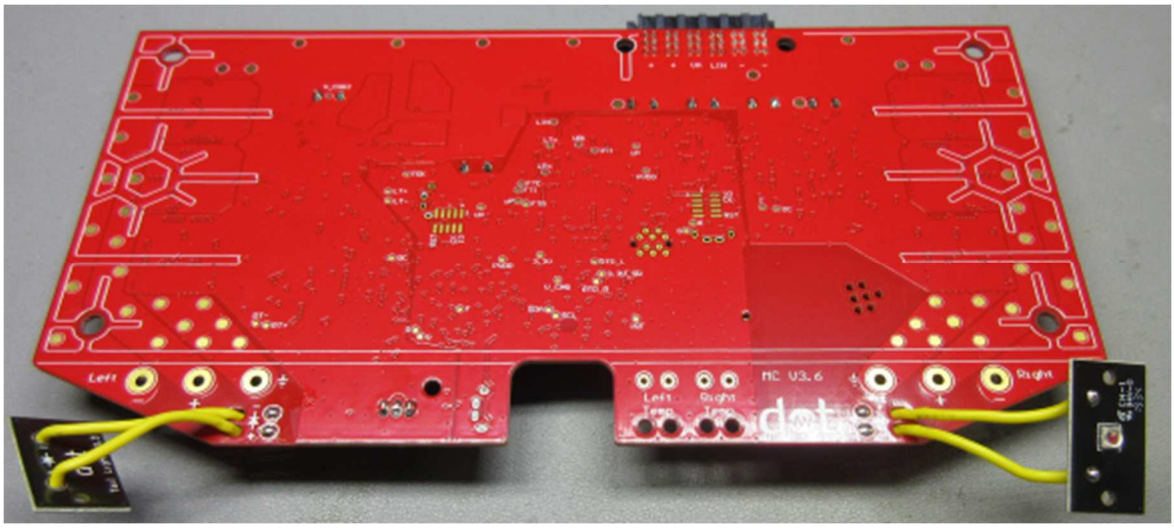
1 CONTENTS

2 MAIN CONTROLLER

5x V3.6 samples received. Motor & RTD wiring missing, due to sample unavailability.

Heatsinks were fitted. Requirement is for separate supply.



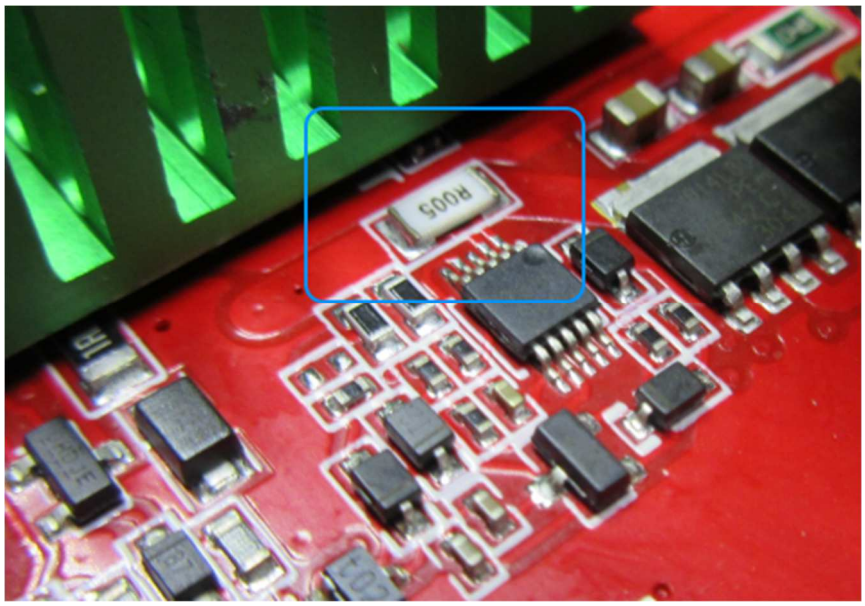


2.1 PCB DESIGN AND PRODUCTION UPDATES

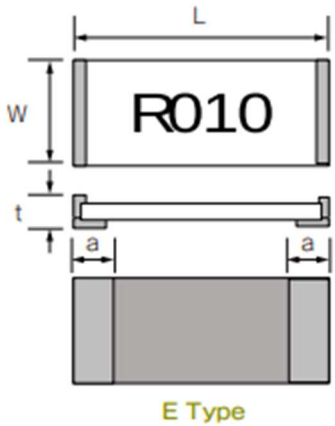
2.1.1 MAGNETIC CONNECTOR SENSE RESISTOR

R50 Changed. Prior production required manual soldering of additional 10mohm in parallel. V3.6 to feature revised 5mohm requirement.

Susumu KRL1632E-M-R005-G-T5, 5mOhms ±2% 0.75W



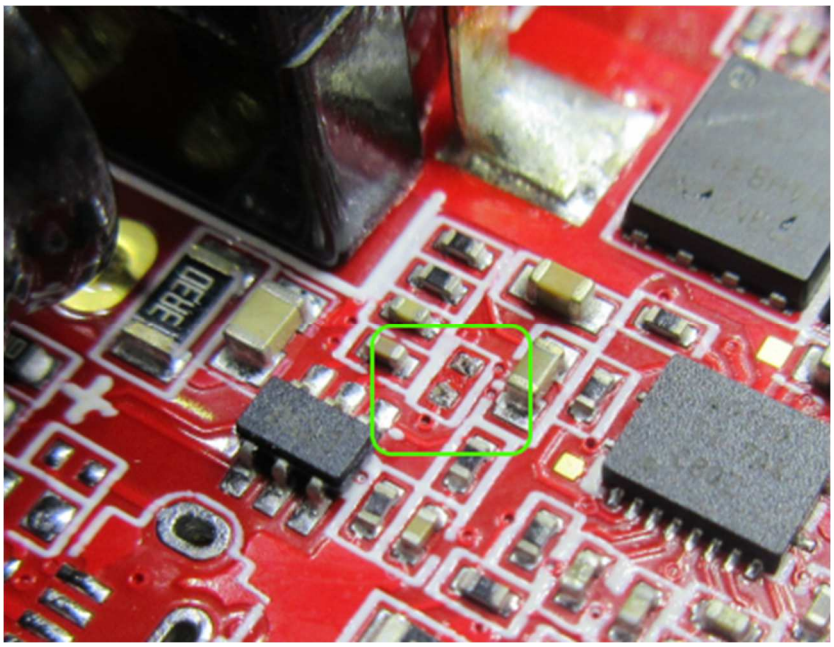
Resistor appearance consistent with brand, series and marking (for 5mohm) as expected for the E terminal type. Resistor not removed to verify, as difficult to measure and markings give confidence change was implemented.



2.1.2 BATTERY CHARGER VOLTAGE RANGE ADJUSTMENT

R26 47k → 45.3kohm

Removed part and measured 45.255kohm.



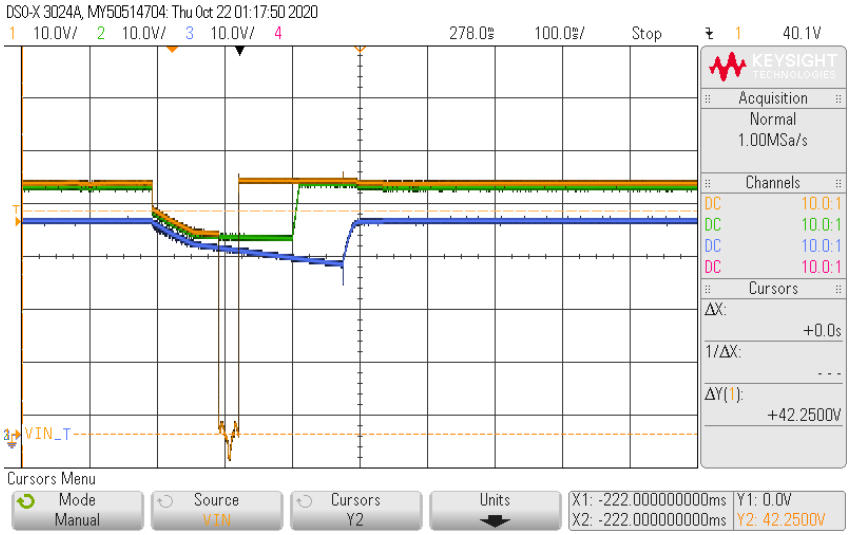
The BOM has an error. Manufacturer part is correct for 45.3k, however comment uses 43.5k (incorrect).

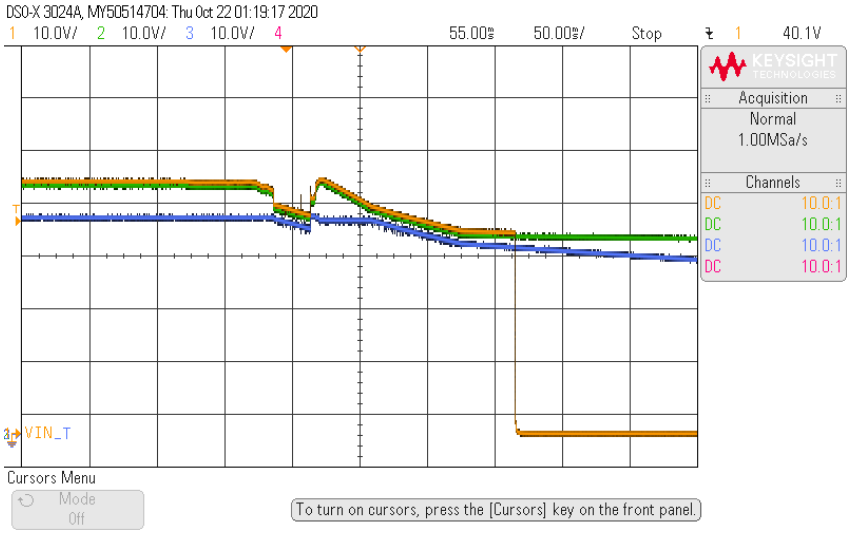
2.1.3 BATTERY CHARGER UNDERVOLTAGE LOCKOUT

R177, R178, C59 added. Under voltage lockout for regulator.

Component placement moved. R168, D9, F20

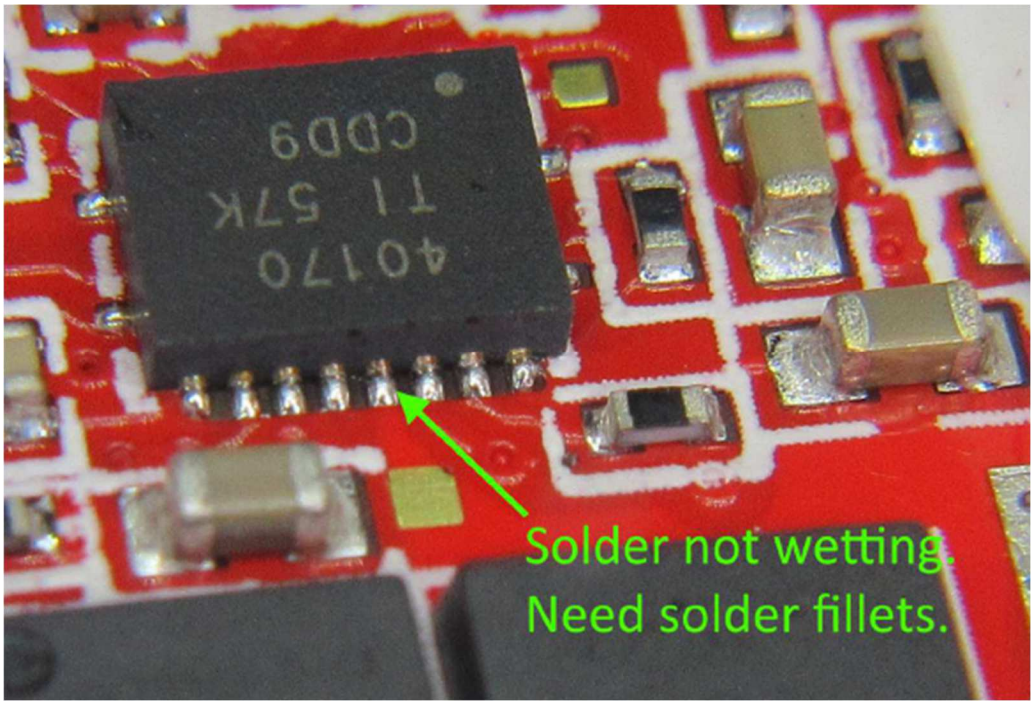
Under voltage lockout performed as expected. Disturbance and disconnection.



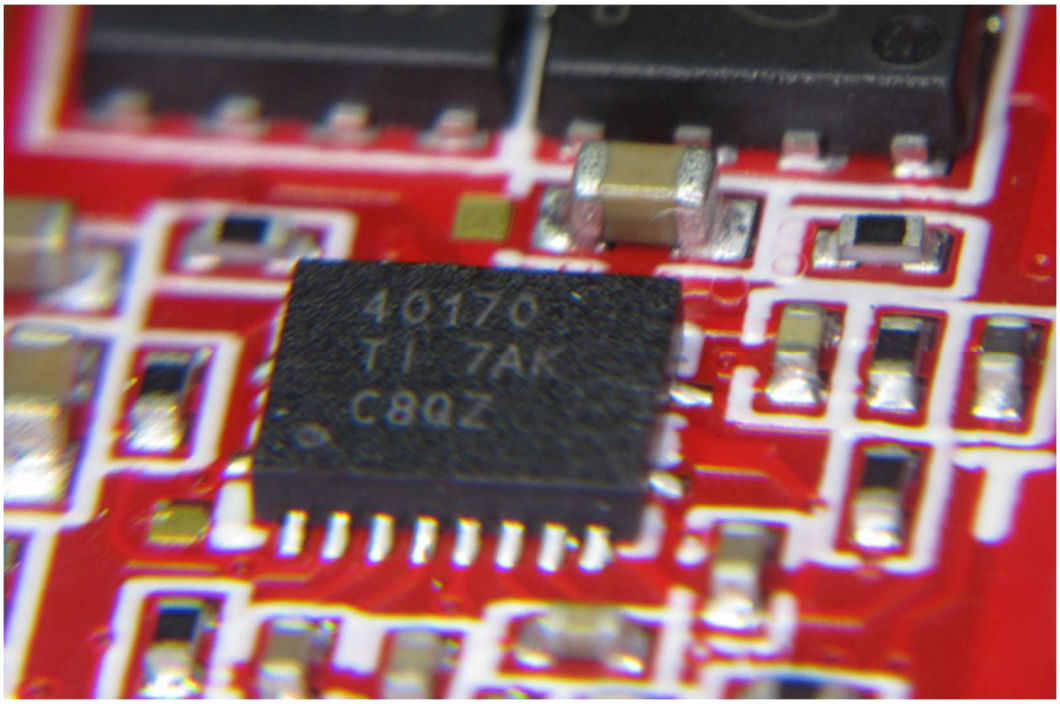


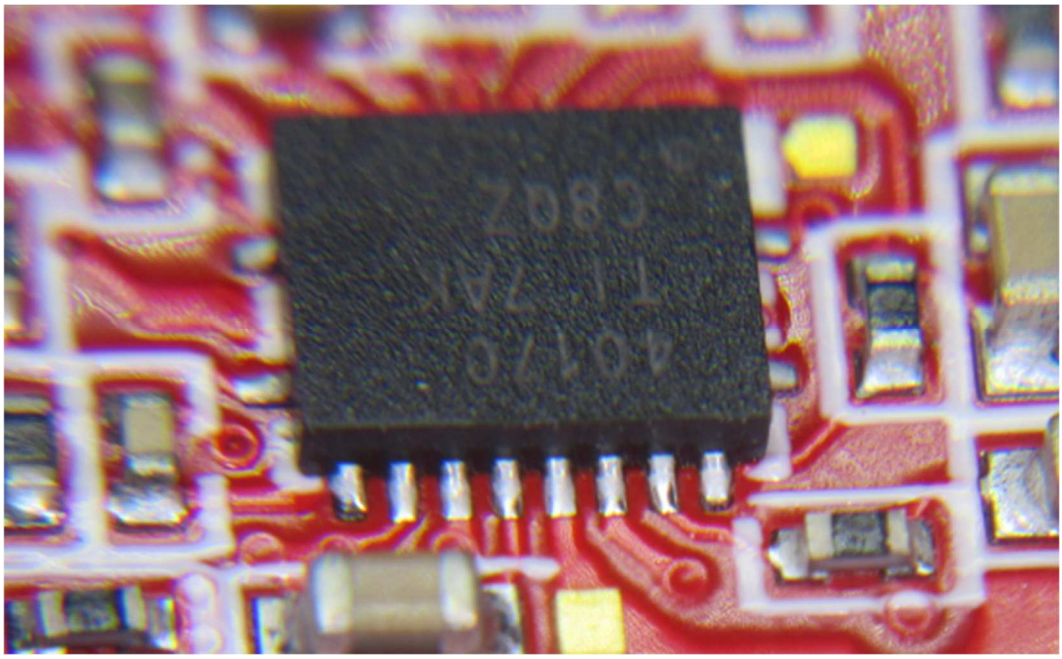
2.1.4 BATTERY CHARGER REGULATOR SOLDERING

Previous concern has been the poor solder wetting on IC2, which may have contributed to battery charger failures. It is likely the parts have oxidized, resulting in poor solderability. Example below.

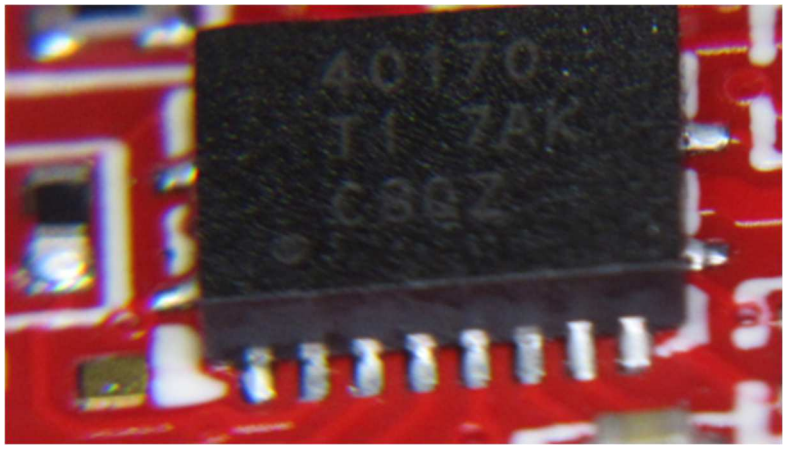


Union applied addition flux prior to reflow, which has resulted in a significant improvement.



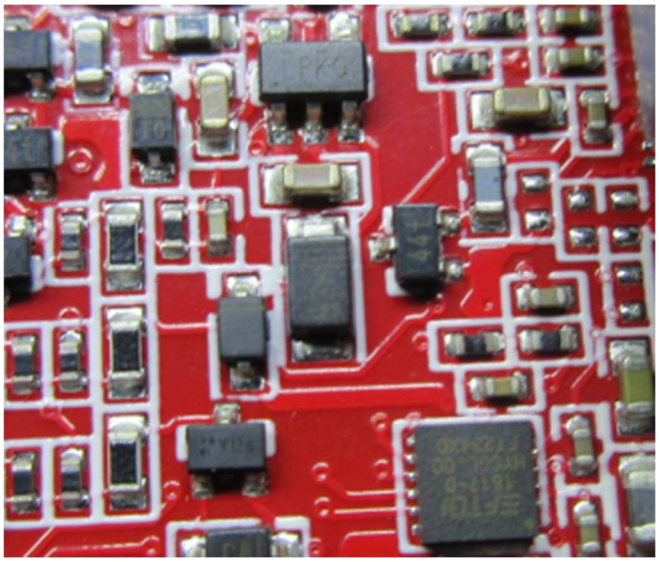


The worst example from the set of 5 is shown below. Possible indication of production variation.



2.1.5 USB POWER / VSYS

D44 moved, D49 added.



USB Connected…

VUSB = 5.043V

V_Sys = 3.985V while BM connected.

V_Sys = 3.77V (multimeter reading) with no BM connected.

```
Measurements
- V_Bus                  : 53mV       * FAIL *
- V_Aux                  : 4mV        * FAIL *
- V_Sys                  : 3770mV     * FAIL *
- V_USB                  : 4995mV       --
- VCC                    : 3293mV       --
```

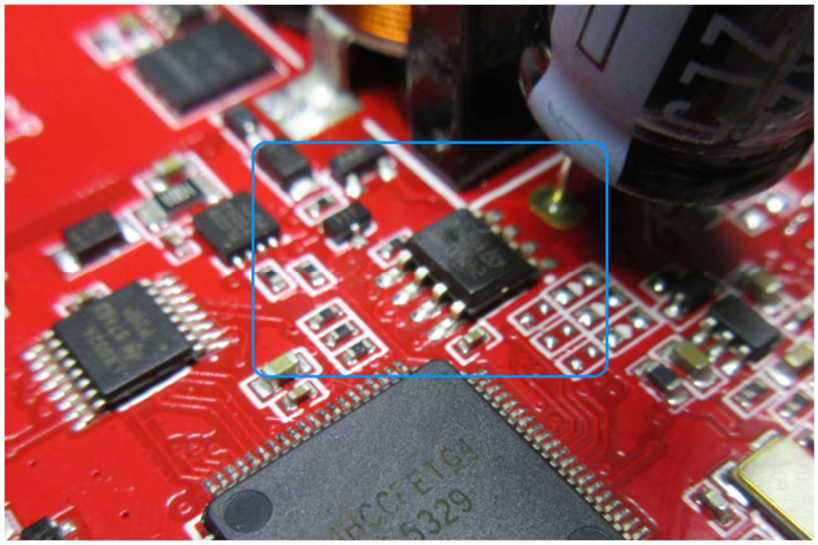
USB power connection does not generate previous interference with V_Sys level.

2.1.6 LOG MEMORY

EEPROM Components added. C60, IC17, R179. Change evident.

STMicroelectronics M24M01-RMN6TP

EEPROM Memory IC 1Mb (128K x 8) I²C 1MHz 500ns 8-SO

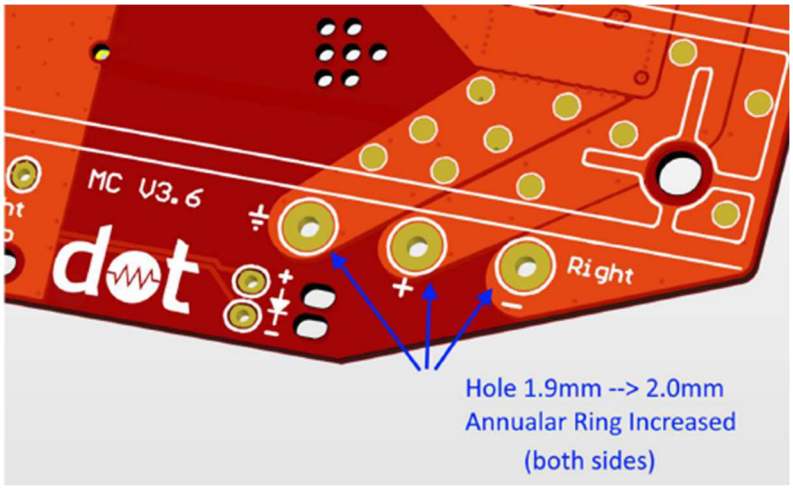


```
dot Skateboard

Model                    : MC100
Hardware Version         : 36
Software Version         : 85
Bootloader Version       : 4
Serial Number            : FFFFE022
Paired Remote Serial     : FFFFF000
Batch Number             : 0
Custom Change Index      : 0
Production Date          : 21-10-2020
EEPROM                   : Fitted        --
Factory Tested           : No
```

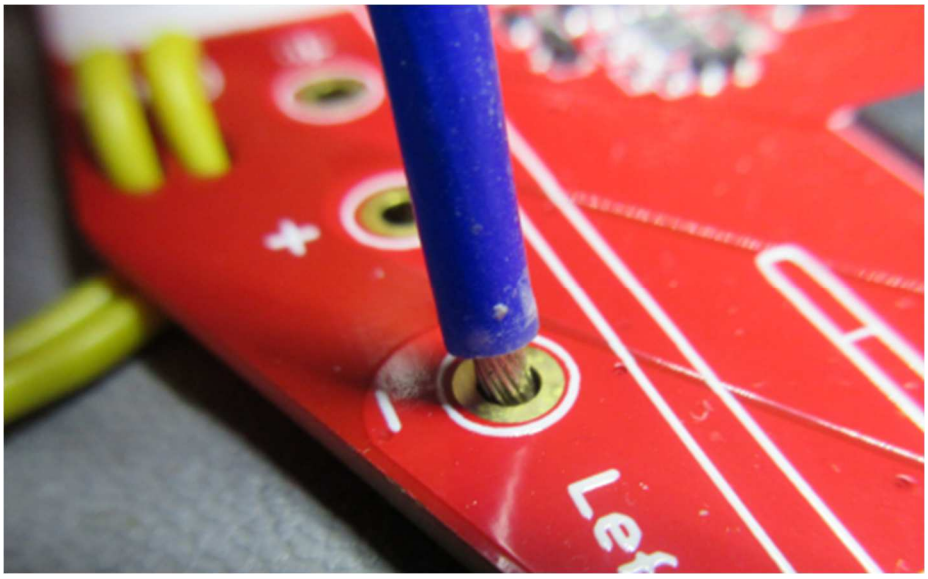
EEPROM communication confirmed via diagnostics function.

2.1.7 WIRING HOLE ADJUSTMENT

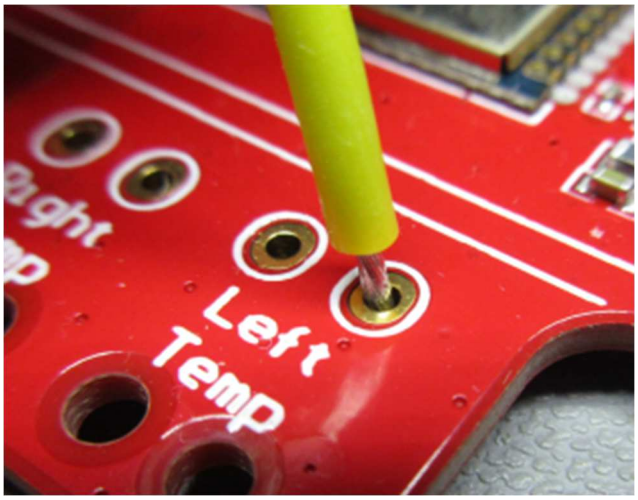
Motor wire pads increased from 1.9mm to 2.0mm. Pad size on solder side increased.



Wire fitment is considered loose, but acceptable.



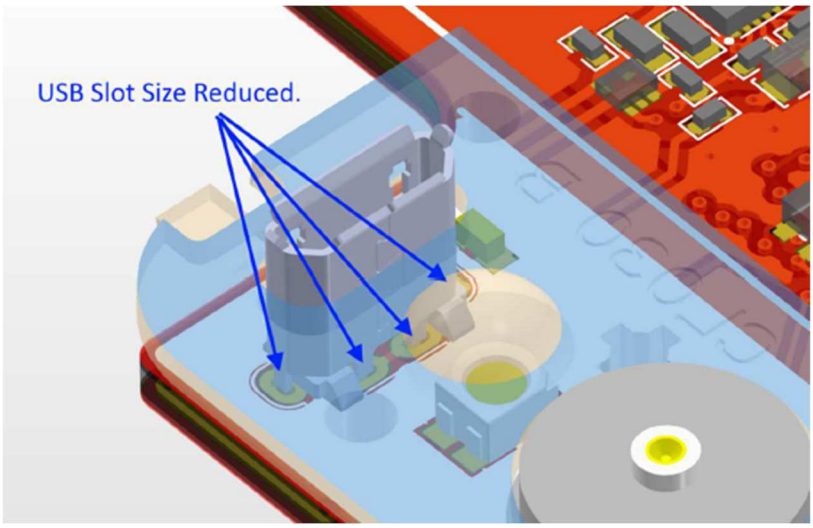
The RTD wiring fits acceptably loose. The ground connection on L2 & L3 for RTD ground wire pads was removed to improve solderability.



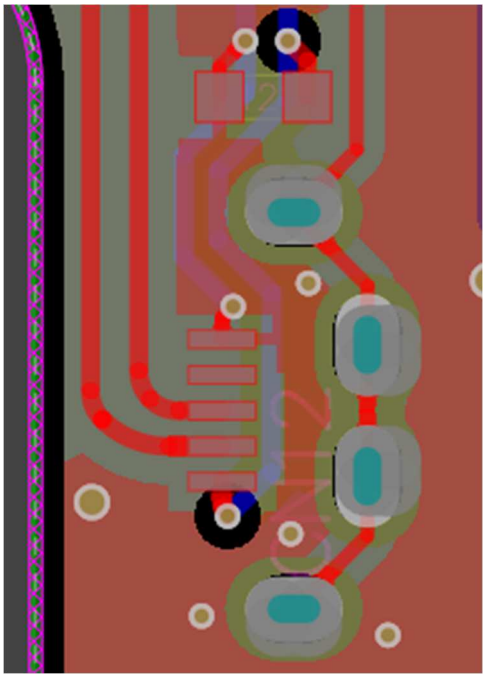
Soldering ok.

2.1.8 USB CONNECTOR SOLDERING

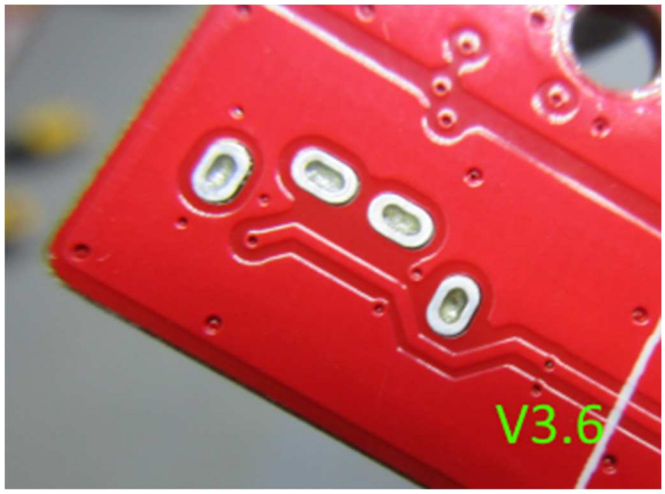
The same USB connector footprint update on the remote was applied to the MC. The changes were to improvement alignment and to increase solder fill.



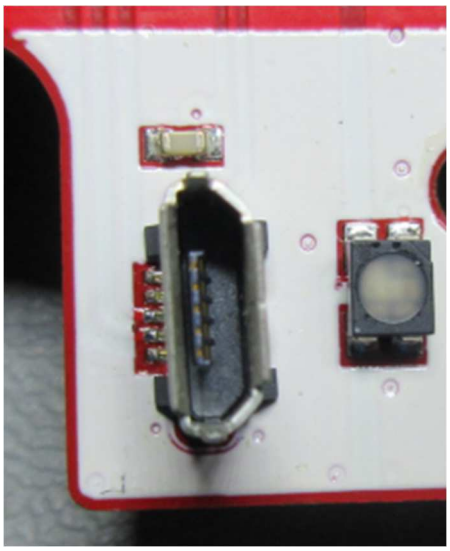
The paste geometry update as shown below. Paste increased beyond mask perimeter for chassis pins.



The improvement in solder fill is quite noticeable. Below shows V3.5 in comparison to V3.6. This may both improve USB connector retention/strength as well as make Jesse happy.

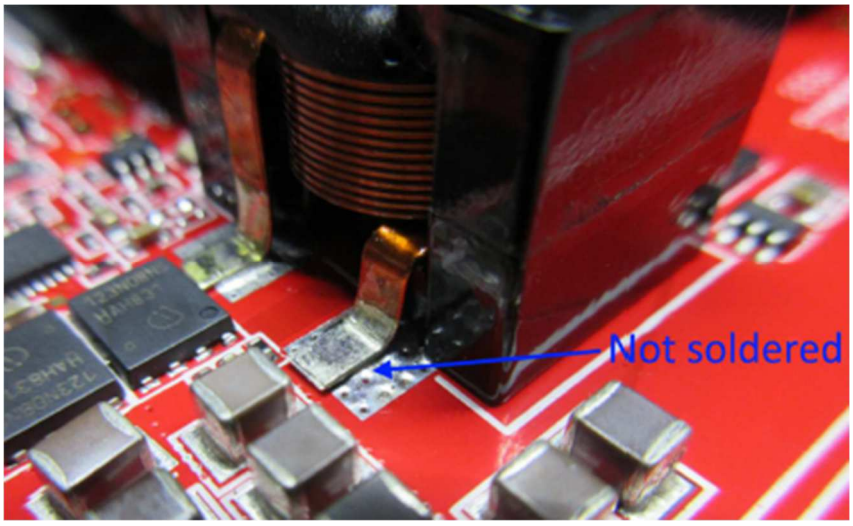


All USB connectors are well aligned.

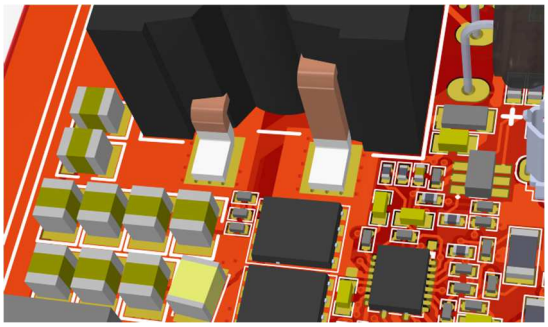


2.1.9 INDUCTOR L3 SOLDER MASK CHANGE

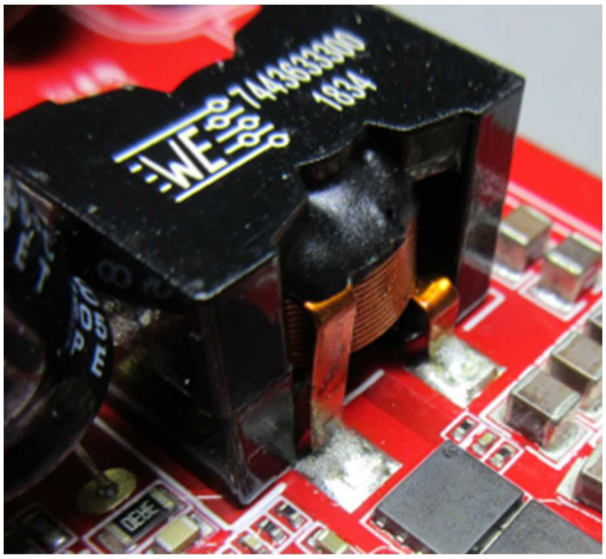
Several prior production faults were due to soldering issues with the large battery charger inductor. Both joint and inductor mis-alignment issues. Footprint used was as specified by the manufacturer.

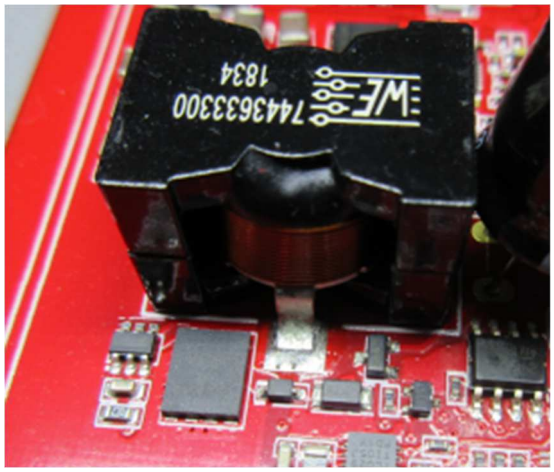


The PCB footprint design was updated with a reduced mask area, while maintaining paste beyond mask perimeter.

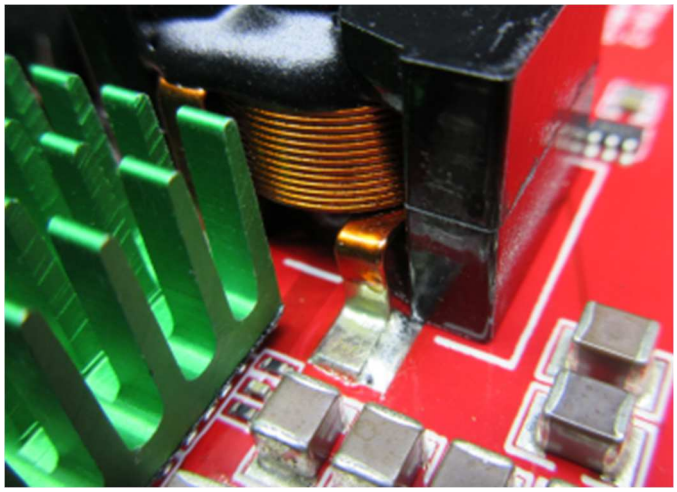


Significant improvement in solder fillet/volume observed. Change most evident.





Worst case example below. Mis-alignment considered minor.



2.2 SAMPLE INSPECTION

Functional testing is failing several items…

1. The positive speed error fails on expected motor RPM window.
2. Under voltage lockout is resulting in higher residual voltage charge. Test failing to accommodate decay.
3. Charger 36V failure likely due to firmware not accommodating change in programmable voltage scale. Timeout occurs quicker than decay rate from previous set point.

2.2.1 FFFFE022

Right VESC has a motor start issue. Jolts from certain phase angles.

Resoldered many joints, no impact.

Re-flashed firmware.

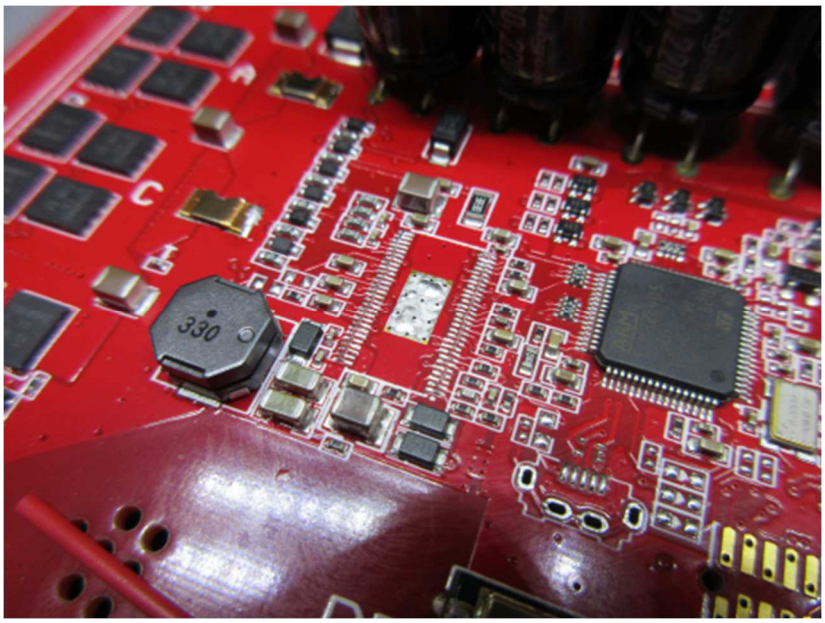
Checked bridge commutation signals. Clean.

Checked bridge gate signals. Clean.

Drives motor under load.

Engaging brake causes jolt and no brake for a period.

Replaced bridge driver, no change.



Log file captured right VESC over current fault.

Fault not yet determined.

```
FUNCTIONAL TEST


dot Skateboard

Model                     : MC100
Hardware Version          : 36
Software Version          : 85
Bootloader Version        : 4
Serial Number             : FFFFE022
Paired Remote Serial      : FFFFF000
Batch Number              : 0
Custom Change Index       : 0
Production Date           : 21-10-2020
EEPROM                    : Fitted        --
Factory Tested            : Yes



Pre-Conditions
- 48V Charger Connection  : 47847mV       --
- Battery Module          : Present       --
- Battery                 : 40251mV       --


Settings
-Wheel Diameter (mm)x10   : 830
- Options                 : 0009
- Auto Power Off Period   : 60000
- Power Down Timer        : 60000

Measurements
- V_Bus                   : 40256mV       --
- V_Aux                   : 6486mV        --
- V_Sys                   : 3979mV        --  USB Power Interfering
- V_USB                   : 5010mV        --
- VCC                     : 3293mV        --

Inertial_Module
- Module                  : Present       --
- Angular XYZ             : -4      -62     -411
- Linear XYZ              : -131    -460    16470

LIN Bus
- Bus State               : Active        --
- Discovered Devices      : 1             --

Communications
- Wireless RF             : Present       --
- Packet Count Tx/Rx      : 2615/2651     --
- Paired Remote Serial    : FFFFF000
- Paired Status           : Synced        --

Battery Charger
- V_Charger_Input         : 47842mV       --
- V_Charger_Output        : 5560mV
- Temperature             : 33.8'C        --
- Connector Temperature   : 27.3'C        --
- Power Limit             : 168W
- Power Consumption       : 19W           --

- Voltage Target 25V      : 25083mV       --

- Charger Power Disable   : 15935mV    * FAIL *
```

```
- Voltage Target 36V     : 36087mV       --

- Voltage Target 42V     : 42087mV       --

- Active diode FWD Bias  : 40mV          --

- Active diode REV Bias  : 2411mV        --

VESC Left
- Module                : Present       --
- Battery Online        : 40872mV       --
- Firmware              : V3.54         --
- Fault Code            : None          --
- Input Voltage         : 41400mV       --
- AD_Phase_B_Avg        : 1788          --
- RPM x10               : 20069      * FAIL *
- Current               : 240mA         --
- Duty Cycle        : 949           --
- Temperature           : 27.4'C        --
- Left Motor Temp       : 21.7'C        --


VESC Right
- Module                : Present       --
- Battery Online        : 40861mV       --
- Firmware              : V3.54         --
- Fault Code            : None          --
- Input Voltage         : 41100mV       --
- AD_Phase_B_Avg        : 1802          --
- RPM x10               : 20231      * FAIL *
- Current               : 170mA         --
- Duty Cycle        : 950           --
- Temperature           : 24.1'C        --
- Right Motor Temp      : 21.5'C        --


Fault Codes
- Not Implemented

TEST SUMMARY
- Factory Test History  : * FAIL *
- Current Testing       : * FAIL *
```

2.2.2 FFFFE023

Charger voltage ramping has audible capacitor noise.

```
FUNCTIONAL TEST


dot Skateboard

Model                  : MC100
Hardware Version       : 36
Software Version       : 84
Bootloader Version     : 4
Serial Number          : FFFFE023
Paired Remote Serial   : FFFFF000
Batch Number           : 0
Custom Change Index    : 0
Production Date        : 21-10-2020
Factory Tested         : Yes
```

```
Pre-Conditions
- 48V Charger Connection : 47983mV       --
- Battery Module         : Present       --
- Battery                : 40473mV       --


Settings
-Wheel Diameter (mm)x10  : 830
- Options                : 0009
- Auto Power Off Period  : 60000
- Power Down Timer       : 60000

Measurements
- V_Bus                  : 40481mV       --
- V_Aux                  : 6541mV        --
- V_Sys                  : 4005mV        --  USB Power Interfering
- V_USB                  : 5058mV        --
- VCC                    : 3295mV        --

Inertial_Module
- Module                 : Present       --
- Angular XYZ            : 104     -638    -250
- Linear XYZ             : -131    -438    16861

LIN Bus
- Bus State              : Active        --
- Discovered Devices     : 1             --

Communications
- Wireless RF            : Present       --
- Packet Count Tx/Rx     : 568/603       --
- Paired Remote Serial   : FFFFF000
- Paired Status          : Synced        --

Battery Charger
- V_Charger_Input        : 47979mV       --
- V_Charger_Output       : 2331mV
- Temperature            : 32.4'C        --
- Connector Temperature  : 26.2'C        --
- Power Limit            : 168W
- Power Consumption      : 0W            --

- Voltage Target 25V     : 25098mV       --

- Charger Power Disable  : 16125mV    * FAIL *

FT Output Fault          :            * FAIL *
- Target                 : 36000mV
- Measured               : 36271mV

VESC Left
- Module                 : Present       --
- Battery Online         : 41062mV       --
- Firmware               : V3.54         --
- Fault Code             : None          --
- Input Voltage          : 41400mV       --
- AD_Phase_B_Avg         : 1807          --
- RPM x10                : 20124      * FAIL *
- Current                : 240mA         --
- Duty Cycle        : 950           --
- Temperature            : 26.6'C        --
- Left Motor Temp        : 22.8'C        --


VESC Right
- Module                 : Present       --
- Battery Online         : 41063mV       --
- Firmware               : V3.54         --
- Fault Code             : None          --
- Input Voltage          : 41400mV       --
- AD_Phase_B_Avg         : 1799          --
```

```
- RPM x10                : 20262      * FAIL *
- Current                : 180mA         --
- Duty Cycle        : 949           --
- Temperature            : 23.2'C        --
- Right Motor Temp       : 22.6'C        --


Fault Codes
- Not Implemented

TEST SUMMARY
- Factory Test History   : * FAIL *
- Current Testing        : * FAIL *
```

2.2.3 FFFFE024

```
FUNCTIONAL TEST


dot Skateboard

Model                    : MC100
Hardware Version         : 36
Software Version         : 84
Bootloader Version       : 4
Serial Number            : FFFFE024
Paired Remote Serial     : FFFFF000
Batch Number             : 0
Custom Change Index      : 0
Production Date          : 21-10-2020
Factory Tested           : Yes



Pre-Conditions
- 48V Charger Connection : 48023mV       --
- Battery Module         : Present       --
- Battery                : 40355mV       --


Settings
-Wheel Diameter (mm)x10  : 830
- Options                : 0009
- Auto Power Off Period  : 60000
- Power Down Timer       : 60000

Measurements
- V_Bus                  : 40363mV       --
- V_Aux                  : 6576mV        --
- V_Sys                  : 3997mV        --  USB Power Interfering
- V_USB                  : 5042mV        --
- VCC                    : 3306mV        --

Inertial_Module
- Module                 : Present       --
- Angular XYZ            : 280     -320    -290
- Linear XYZ             : 31      -557    16567

LIN Bus
- Bus State              : Active        --
- Discovered Devices     : 1             --

Communications
- Wireless RF            : Present       --
- Packet Count Tx/Rx     : 409/443       --
- Paired Remote Serial   : FFFFF000
- Paired Status          : Synced        --
```

```
Battery Charger
- V_Charger_Input        : 48004mV       --
- V_Charger_Output       : 1653mV
- Temperature            : 22.7'C        --
- Connector Temperature  : 22.2'C        --
- Power Limit            : 168W
- Power Consumption      : 0W            --

- Voltage Target 25V     : 25087mV       --

- Charger Power Disable  : 15805mV    * FAIL *

- Voltage Target 36V     : 36088mV       --

- Voltage Target 42V     : 42058mV       --

- Active diode FWD Bias  : 37mV          --

- Active diode REV Bias  : 2349mV        --

VESC Left
- Module                 : Present       --
- Battery Online         : 41005mV       --
- Firmware               : V3.54         --
- Fault Code             : None          --
- Input Voltage          : 41400mV       --
- AD_Phase_B_Avg         : 1796          --
- RPM x10                : 20070      * FAIL *
- Current                : 260mA         --
- Duty Cycle        : 950           --
- Temperature            : 22.8'C        --
- Left Motor Temp        : 22.3'C        --


VESC Right
- Module                 : Present       --
- Battery Online         : 41044mV       --
- Firmware               : V3.54         --
- Fault Code             : None          --
- Input Voltage          : 41100mV       --
- AD_Phase_B_Avg         : 1796          --
- RPM x10                : 20212      * FAIL *
- Current                : 180mA         --
- Duty Cycle        : 950           --
- Temperature            : 21.8'C        --
- Right Motor Temp       : 22.3'C        --


Fault Codes
- Not Implemented

TEST SUMMARY
- Factory Test History   : * FAIL *
- Current Testing        : * FAIL *
```

2.2.4 FFFFE025

```
FUNCTIONAL TEST


dot Skateboard
```

```
Model                     : MC100
Hardware Version          : 36
Software Version          : 84
Bootloader Version        : 4
Serial Number             : FFFFE025
Paired Remote Serial      : FFFFF000
Batch Number              : 0
Custom Change Index       : 0
Production Date           : 21-10-2020
Factory Tested            : Yes



Pre-Conditions
- 48V Charger Connection : 47896mV       --
- Battery Module         : Present       --
- Battery                : 40269mV       --


Settings
-Wheel Diameter (mm)x10  : 830
- Options                : 0009
- Auto Power Off Period  : 60000
- Power Down Timer       : 60000

Measurements
- V_Bus                  : 40269mV       --
- V_Aux                  : 6478mV        --
- V_Sys                  : 3996mV        --  USB Power Interfering
- V_USB                  : 5055mV        --
- VCC                    : 3281mV        --

Inertial_Module
- Module                 : Present       --
- Angular XYZ            : 244     -502    -335
- Linear XYZ             : 33      -316    16940

LIN Bus
- Bus State              : Active        --
- Discovered Devices     : 1             --

Communications
- Wireless RF            : Present       --
- Packet Count Tx/Rx     : 691/725       --
- Paired Remote Serial   : FFFFF000
- Paired Status          : Synced        --

Battery Charger
- V_Charger_Input        : 47896mV       --
- V_Charger_Output       : 1875mV
- Temperature            : 25.5'C        --
- Connector Temperature  : 23.4'C        --
- Power Limit            : 168W
- Power Consumption      : 0W            --

- Voltage Target 25V     : 25090mV       --

- Charger Power Disable  : 15809mV    * FAIL *

- Voltage Target 36V     : 36080mV       --

- Voltage Target 42V     : 42088mV       --

- Active diode FWD Bias  : 6mV           --

- Active diode REV Bias  : 2343mV        --

VESC Left
- Module                 : Present       --
- Battery Online         : 40892mV       --
- Firmware               : V3.54         --
- Fault Code             : None          --
- Input Voltage          : 41200mV       --
```

```
- AD_Phase_B_Avg         : 1788          --
- RPM x10                : 20058      * FAIL *
- Current                : 210mA         --
- Duty Cycle        : 950           --
- Temperature            : 23.6'C        --
- Left Motor Temp        : 22.2'C        --


VESC Right
- Module                 : Present       --
- Battery Online         : 40890mV       --
- Firmware               : V3.54         --
- Fault Code             : None          --
- Input Voltage          : 41100mV       --
- AD_Phase_B_Avg         : 1795          --
- RPM x10                : 20212      * FAIL *
- Current                : 150mA         --
- Duty Cycle        : 950           --
- Temperature            : 22.6'C        --
- Right Motor Temp       : 22.0'C        --


Fault Codes
- Not Implemented

TEST SUMMARY
- Factory Test History   : * FAIL *
- Current Testing        : * FAIL *
```

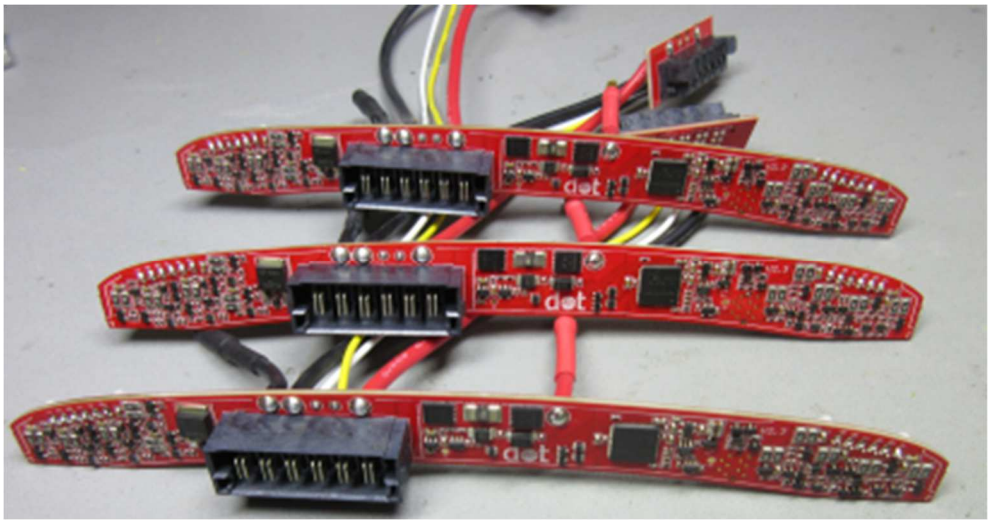
2.2.5 FFFFE026

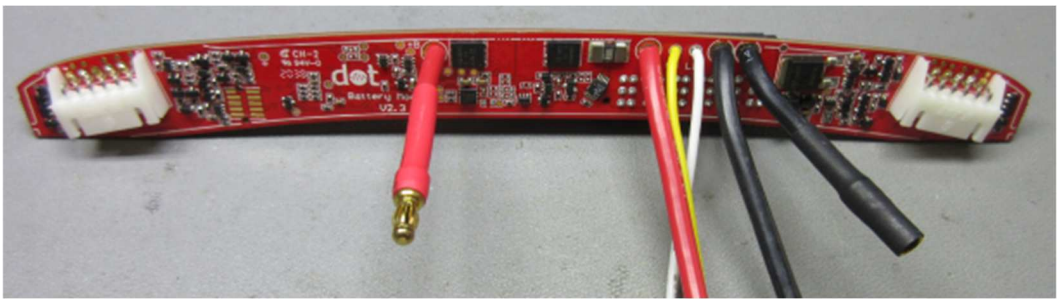
```
FUNCTIONAL TEST


dot Skateboard

Model                    : MC100
Hardware Version         : 36
Software Version         : 84
Bootloader Version       : 4
Serial Number            : FFFFE026
Paired Remote Serial     : FFFFF000
Batch Number             : 0
Custom Change Index      : 0
Production Date          : 21-10-2020
Factory Tested           : Yes



Pre-Conditions
- 48V Charger Connection : 47955mV       --
- Battery Module         : Present       --
- Battery                : 36790mV       --


Settings
-Wheel Diameter (mm)x10  : 830
- Options                : 0009
- Auto Power Off Period  : 60000
- Power Down Timer       : 60000

Measurements
- V_Bus                  : 36791mV       --
- V_Aux                  : 6502mV        --
- V_Sys                  : 3998mV        --  USB Power Interfering
- V_USB                  : 5062mV        --
```

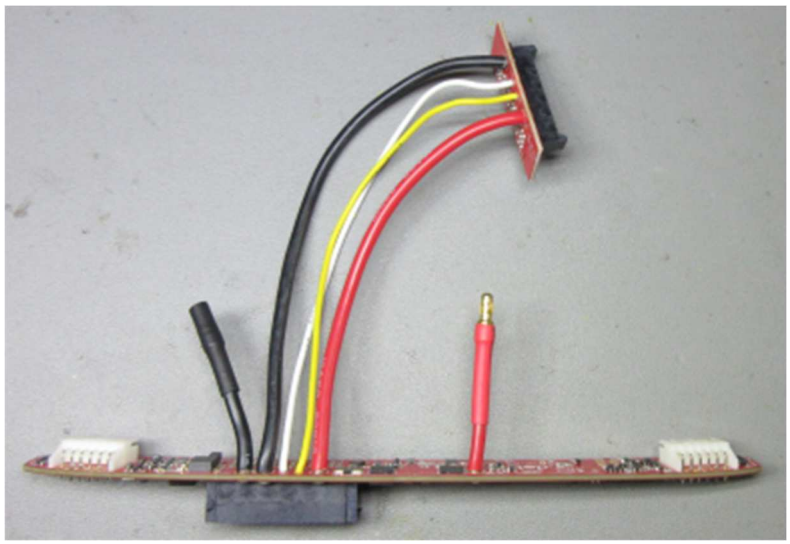
```
- VCC                    : 3297mV        --

Inertial_Module
- Module                 : Present       --
- Angular XYZ            : 18      -268    -147
- Linear XYZ             : -130    1120    16655

LIN Bus
- Bus State              : Active        --
- Discovered Devices     : 1             --

Communications
- Wireless RF            : Present       --
- Packet Count Tx/Rx     : 448/483       --
- Paired Remote Serial   : FFFFF000
- Paired Status          : Synced        --

Battery Charger
- V_Charger_Input        : 47943mV       --
- V_Charger_Output       : 1976mV
- Temperature            : 31.7'C        --
- Connector Temperature  : 25.8'C        --
- Power Limit            : 168W
- Power Consumption      : 0W            --

- Voltage Target 25V     : 25099mV       --

- Charger Power Disable  : 15999mV    * FAIL *

- Voltage Target 36V     : 36094mV       --

- Voltage Target 42V     : 42095mV       --

- Active diode FWD Bias  : 8mV           --

- Active diode REV Bias  : 2423mV        --

VESC Left
- Module                 : Present       --
- Battery Online         : 37371mV       --
- Firmware               : V3.54         --
- Fault Code             : None          --
- Input Voltage          : 37600mV       --
- AD_Phase_B_Avg         : 1629          --
- RPM x10                : 18312         --
- Current                : 210mA         --
- Duty Cycle        : 950           --
- Temperature            : 26.3'C        --
- Left Motor Temp        : 21.2'C        --


VESC Right
- Module                 : Present       --
- Battery Online         : 37370mV       --
- Firmware               : V3.54         --
- Fault Code             : None          --
- Input Voltage          : 37500mV       --
- AD_Phase_B_Avg         : 1639          --
- RPM x10                : 18440         --
- Current                : 190mA         --
- Duty Cycle        : 949           --
- Temperature            : 23.7'C        --
- Right Motor Temp       : 21.2'C        --


Fault Codes
- Not Implemented

TEST SUMMARY
- Factory Test History   : * FAIL *
- Current Testing        : * FAIL *
```

3 BATTERY MODULES

3.1 PCBAS





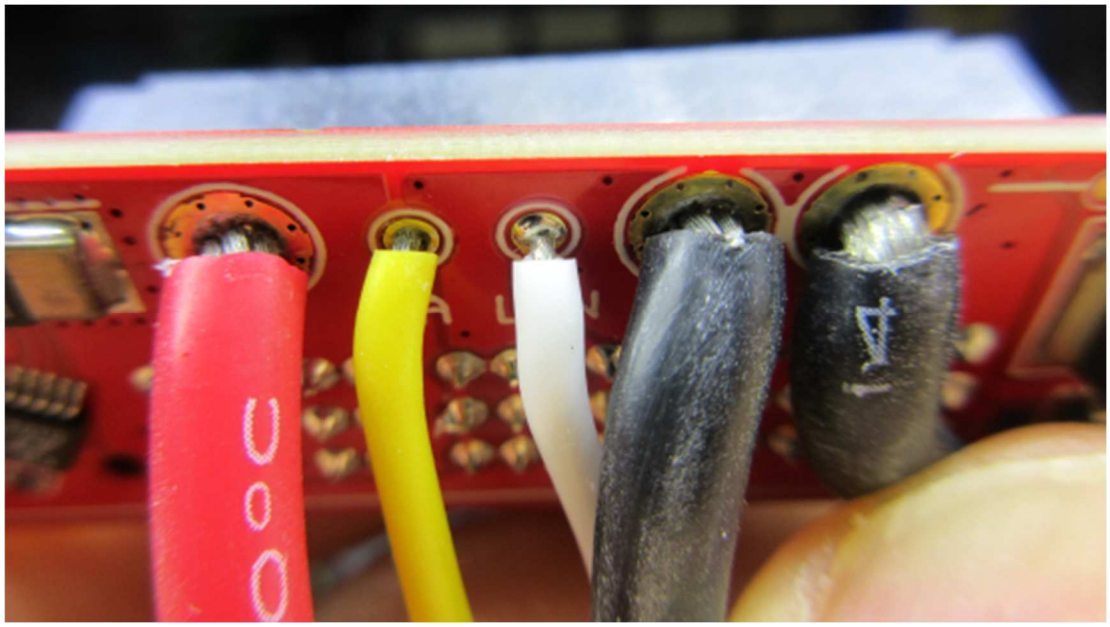


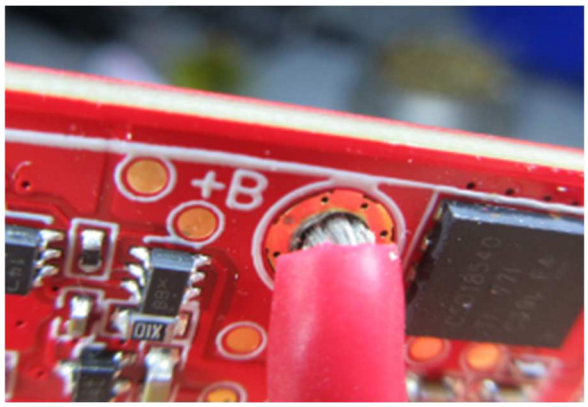
3.2 WIRE SOLDERING

The wire soldering has historically not been at the desired level, however has never been a functional issue. The wiring holes were increased slightly at Unions request to improve the through hole fill and filleting on the opposite solder side. The land area was also increased slightly.

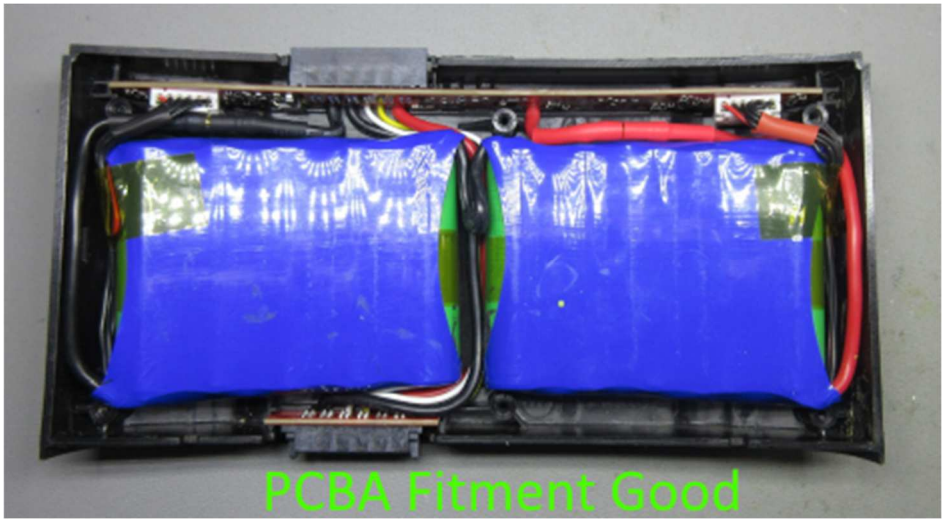
The through hole is getting sufficient fill for the functional requirement. Operator soldering speed is likely pushed too fast. Hot air pre-heating would also be preferrable.

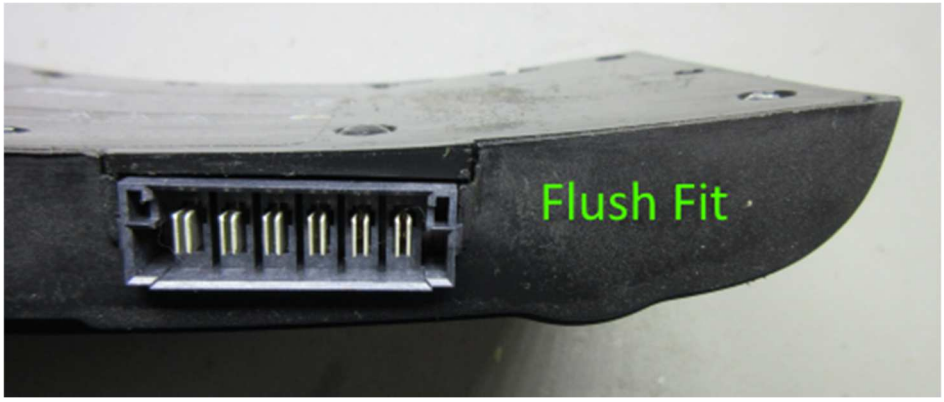
Although still not at the desired level, there is no historical functional issue to pursue further changes.





3.3 MECHANICAL FITMENT





3.4 SAMPLE INSPECTION

3.4.1 BBBB0098

Current tested up to 8A.

3.4.1.1 Voltage Calibration

```
-------------------------------------------
Battery Accepted          : BBBB0098

Reference Connected       :                --
- Cell 0                  : 4165mV
- Cell 9                  : 41848mV

Calibration in Range      :                --
- Voltage Offset          : 18             --
- Voltage Gain            : 13167          --

Calibration Verified      :                --
- Cell 0                  : 4184mV
- Cell 9                  : 42000mV

Power Switch              :                --
- V_Switch_Off            : 648mV

TEST SUMMARY
- Voltage Calibration     :              PASS
- Power Switch            :              PASS
```

3.4.1.2 Current Calibration

```
-------------------------------------------
Battery Accepted          : BBBB0098

- Calibration at 0V       : 9              --
- V_Switch                : 32mV
- I_Current_Sense         : -10mA          --

- Negative Reference      :                --
- Cell 0                  : 750mV
- Cell 1                  : 1496mV
- Cell 9                  : 8080mV

- Cell Balancing          :                --
- Cell 9                  : 25156mV

- Cell Measurement        :                --

- Calibration at 25V      : 11             --
- V_Switch                : 25066mV
- I_Current_Sense         : 10mA           --

- Calibration at 36V      : 11             --
- V_Switch                : 36137mV
- I_Current_Sense         : 0mA            --

- Calibration at 41V      : 11             --
- V_Switch                : 41173mV
- I_Current_Sense         : -10mA          --
```

```
- Calibration at 42V     : 11            --
- V_Switch               : 42064mV
- I_Current_Sense        : 0mA           --

- Calibration Verified   :               --

TEST SUMMARY
- Testing                :              PASS
- Calibration            :              PASS
```

3.4.1.3 Functional Test

```
-------------------------------------------

Battery Position: 0
Model                    : BM100
Hardware Version         : 23
Software Version         : 19
Serial Number            : BBBB0098
Batch Number             : 0
Production Date          : 10-9-2020
Factory Tested           : Yes

Measurements
- V_Bus                  : 39724mV       --
- Battery                : 39699mV       --
- V_Switch               : 39724mV       --
- V_Switch_Off           : 133mV         --
- VCC                    : 3290mV        --
- V_Offset               : 2995mV        --
- V_Current_Sense        : 1492mV        --
- I_Current_Sense        : 30mA          --

Cell Voltages
- Cell 0                 : 3952mV        --
- Cell 1                 : 3961mV        --
- Cell 2                 : 3960mV        --
- Cell 3                 : 3960mV        --
- Cell 4                 : 3965mV        --
- Cell 5                 : 3961mV        --
- Cell 6                 : 3973mV        --
- Cell 7                 : 3985mV        --
- Cell 8                 : 3986mV        --
- Cell 9                 : 3986mV        --

Temperature Sensors
- PCB                    : 23.1'C        --
- Cells 0-4              : 21.8'C        --
- Cells 5-9              : 21.8'C        --

Calibration
- Voltage Offset         : 18            --
- Voltage Gain           : 13167         --
- Current Offset 0V      : 9             --
- Current Offset 25V     : 11            --
- Current Offset 36V     : 11            --
- Current Offset 41V     : 11            --
- Current Offset 42V     : 11            --
- Voltage Calibrated     : Yes           --
- Current Calibrated     : Yes           --

Factory Tested
- Power Switch           :               --
- Cell Balancing         :               --
- Cell Measurement       :               --
- Negative Reference     :               --

TEST SUMMARY
- Factory Test History   :              PASS
- Current Testing        :              PASS
```

```
-------------------------------------------
```

3.4.2 BBBB0099

3.4.2.1 Voltage Calibration

```
-------------------------------------------
Battery Accepted          : BBBB0099

Reference Connected       :                --
- Cell 0                  : 4178mV
- Cell 9                  : 41848mV

Calibration in Range      :                --
- Voltage Offset          : 6              --
- Voltage Gain            : 13170          --

Calibration Verified      :                --
- Cell 0                  : 4198mV
- Cell 9                  : 41998mV

Power Switch              :                --
- V_Switch_Off            : 469mV

TEST SUMMARY
- Voltage Calibration     :              PASS
- Power Switch            :              PASS
```

3.4.2.2 Current Calibration

```
-------------------------------------------
Battery Accepted          : BBBB0099

- Calibration at 0V       : 26             --
- V_Switch                : 31mV
- I_Current_Sense         : 0mA            --

- Negative Reference      :                --
- Cell 0                  : 751mV
- Cell 1                  : 1497mV
- Cell 9                  : 8082mV

- Cell Balancing          :                --
- Cell 9                  : 25072mV

- Cell Measurement        :                --

- Calibration at 25V      : 22             --
- V_Switch                : 25064mV
- I_Current_Sense         : -20mA          --

- Calibration at 36V      : 22             --
- V_Switch                : 36069mV
- I_Current_Sense         : 0mA            --

- Calibration at 41V      : 23             --
- V_Switch                : 41085mV
- I_Current_Sense         : 10mA           --

- Calibration at 42V      : 22             --
- V_Switch                : 42062mV
```

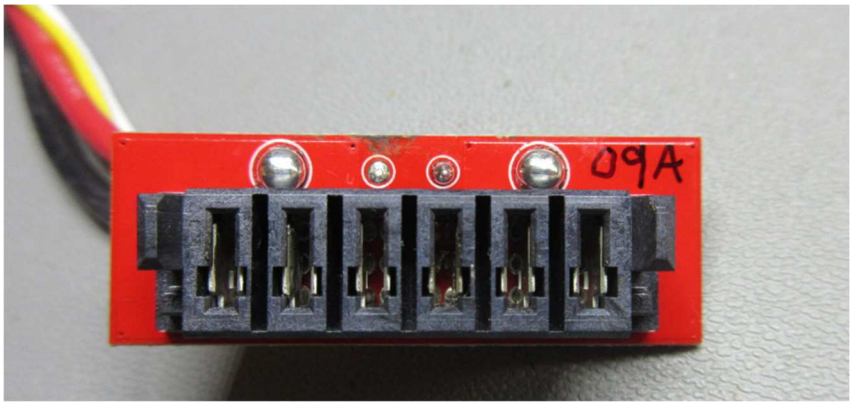
```
- I_Current_Sense        : 0mA           --

- Calibration Verified   :               --

TEST SUMMARY
- Testing                :              PASS
- Calibration            :              PASS
```

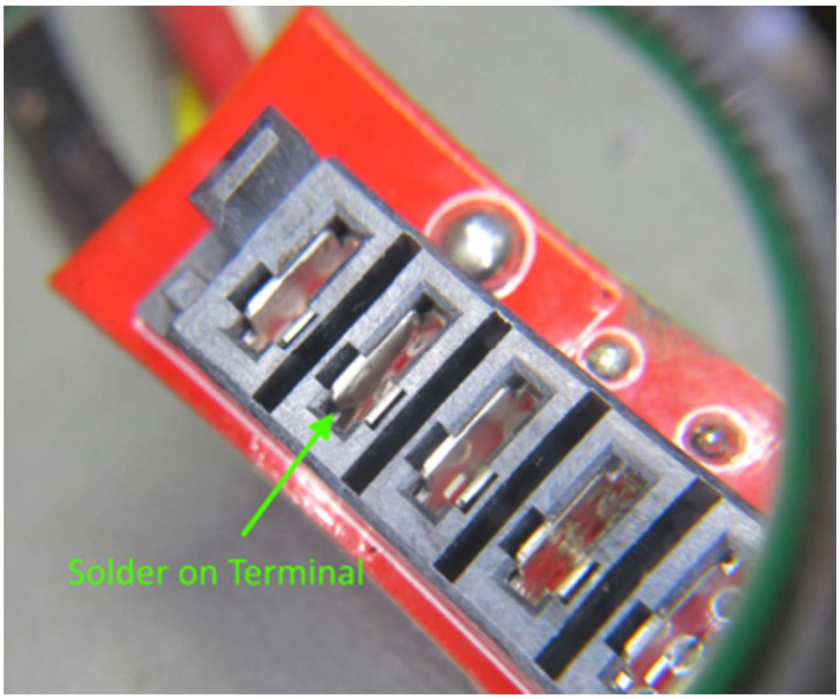
3.4.2.3 Functional Test

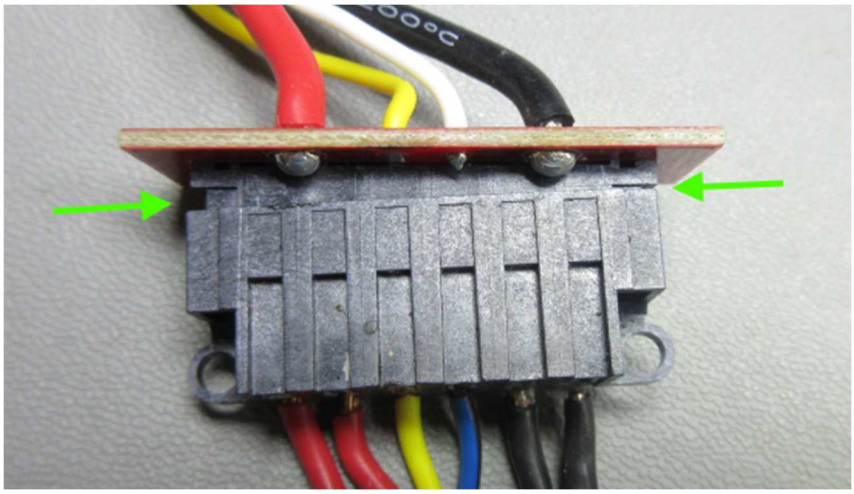
```
-----------------------------------------

Battery Position: 0
Model                    : BM100
Hardware Version         : 23
Software Version         : 19
Serial Number            : BBBB0099
Batch Number             : 0
Production Date          : 10-9-2020
Factory Tested           : No

Measurements
- V_Bus                  : 39718mV       --
- Battery                : 39703mV       --
- V_Switch               : 39716mV       --
- V_Switch_Off           : 57mV          --
- VCC                    : 3312mV        --
- V_Offset               : 2988mV        --
- V_Current_Sense        : 1481mV        --
- I_Current_Sense        : 40mA          --

Cell Voltages
- Cell 0                 : 3954mV        --
- Cell 1                 : 3948mV        --
- Cell 2                 : 3952mV        --
- Cell 3                 : 3961mV        --
- Cell 4                 : 3974mV        --
- Cell 5                 : 3974mV        --
- Cell 6                 : 3974mV        --
- Cell 7                 : 3975mV        --
- Cell 8                 : 3990mV        --
- Cell 9                 : 3987mV        --

Temperature Sensors
- PCB                    : 22.7'C        --
- Cells 0-4              : 21.8'C        --
- Cells 5-9              : 21.9'C        --

Calibration
- Voltage Offset         : 6             --
- Voltage Gain           : 13170         --
- Current Offset 0V      : 26            --
- Current Offset 25V     : 22            --
- Current Offset 36V     : 22            --
- Current Offset 41V     : 23            --
- Current Offset 42V     : 22            --
- Voltage Calibrated     : Yes           --
- Current Calibrated     : Yes           --

Factory Tested
- Power Switch           :               --
- Cell Balancing         :               --
- Cell Measurement       :               --
- Negative Reference     :               --

TEST SUMMARY
- Factory Test History   :              PASS
- Current Testing        :              PASS
```

3.4.3 BBBB009A

Inspection found the front connector to have solder wicked into terminal contact. This causes a fitment issue for full connector mating.







3.4.3.1 Voltage Calibration

```
-------------------------------------------
Battery Accepted          : BBBB009A

Reference Connected       :                --
- Cell 0                  : 4229mV
- Cell 9                  : 41861mV

Calibration in Range      :                --
- Voltage Offset          : -39            --
- Voltage Gain            : 13180          --

Calibration Verified      :                --
- Cell 0                  : 4208mV
- Cell 9                  : 42010mV

Power Switch              :                --
- V_Switch_Off            : 89mV

TEST SUMMARY
- Voltage Calibration     :              PASS
- Power Switch            :              PASS
```

3.4.3.2 Current Calibration

```
-------------------------------------------
Battery Accepted          : BBBB009A

- Calibration at 0V       : 252            --
- V_Switch                : 49mV
- I_Current_Sense         : 20mA           --

- Negative Reference      :                --
- Cell 0                  : 759mV
- Cell 1                  : 1505mV
- Cell 9                  : 8095mV

- Cell Balancing          :                --
- Cell 9                  : 25162mV
```

```
- Cell Measurement       :                --

- Calibration at 25V     : 239            --
- V_Switch               : 25100mV
- I_Current_Sense        : 0mA            --

- Calibration at 36V     : 236            --
- V_Switch               : 36154mV
- I_Current_Sense        : 10mA           --

- Calibration at 41V     : 232            --
- V_Switch               : 41156mV
- I_Current_Sense        : 0mA            --

- Calibration at 42V     : 235            --
- V_Switch               : 42144mV
- I_Current_Sense        : 0mA            --

- Calibration Verified   :                --

TEST SUMMARY
- Testing                :              PASS
- Calibration            :              PASS
```

3.4.3.3 Functional Test

```
-------------------------------------------

Battery Position: 0
Model                    : BM100
Hardware Version         : 23
Software Version         : 19
Serial Number            : BBBB009A
Batch Number             : 0
Production Date          : 10-9-2020
Factory Tested           : No

Measurements
- V_Bus                  : 39730mV        --
- Battery                : 39719mV        --
- V_Switch               : 39732mV        --
- V_Switch_Off           : 76mV           --
- VCC                    : 3300mV         --
- V_Offset               : 3001mV         --
- V_Current_Sense        : 1524mV         --
- I_Current_Sense        : 20mA           --

Cell Voltages
- Cell 0                 : 3963mV         --
- Cell 1                 : 3965mV         --
- Cell 2                 : 3964mV         --
- Cell 3                 : 3964mV         --
- Cell 4                 : 3965mV         --
- Cell 5                 : 3973mV         --
- Cell 6                 : 3988mV         --
- Cell 7                 : 3973mV         --
- Cell 8                 : 3990mV         --
- Cell 9                 : 3964mV         --

Temperature Sensors
- PCB                    : 22.8'C         --
- Cells 0-4              : 21.8'C         --
- Cells 5-9              : 22.0'C         --

Calibration
- Voltage Offset         : -39            --
- Voltage Gain           : 13180          --
- Current Offset 0V      : -4             --
- Current Offset 25V     : -17            --
- Current Offset 36V     : -20            --
```

```
- Current Offset 41V     : -24           --
- Current Offset 42V     : -21           --
- Voltage Calibrated     : Yes           --
- Current Calibrated     : Yes           --

Factory Tested
- Power Switch           :               --
- Cell Balancing         :               --
- Cell Measurement       :               --
- Negative Reference     :               --

TEST SUMMARY
- Factory Test History   :             PASS
- Current Testing        :             PASS

-------------------------------------------
```

3.4.4 BBBB009B

3.4.4.1 Voltage Calibration

```
-------------------------------------------
Battery Accepted         : BBBB009B

Reference Connected      :               --
- Cell 0                 : 4216mV
- Cell 9                 : 41848mV

Calibration in Range     :               --
- Voltage Offset         : -28           --
- Voltage Gain           : 13181         --

Calibration Verified     :               --
- Cell 0                 : 4206mV
- Cell 9                 : 42025mV

Power Switch             :               --
- V_Switch_Off           : 396mV

TEST SUMMARY
- Voltage Calibration    :             PASS
- Power Switch           :             PASS
```

3.4.4.2 Current Calibration

```
-------------------------------------------
Battery Accepted         : BBBB009B

- Calibration at 0V      : 0             --
- V_Switch               : 49mV
- I_Current_Sense        : 0mA           --

- Negative Reference     :               --
- Cell 0                 : 770mV
- Cell 1                 : 1516mV
```

```
- Cell 9                 : 8120mV

- Cell Balancing         :               --
- Cell 9                 : 25149mV

- Cell Measurement       :               --

- Calibration at 25V     : 255           --
- V_Switch               : 25068mV
- I_Current_Sense        : -10mA         --

- Calibration at 36V     : 255           --
- V_Switch               : 36134mV
- I_Current_Sense        : 0mA           --

- Calibration at 41V     : 0             --
- V_Switch               : 41136mV
- I_Current_Sense        : 0mA           --

- Calibration at 42V     : 0             --
- V_Switch               : 42138mV
- I_Current_Sense        : 0mA           --

- Calibration Verified   :               --

TEST SUMMARY
- Testing                :             PASS
- Calibration            :             PASS
```

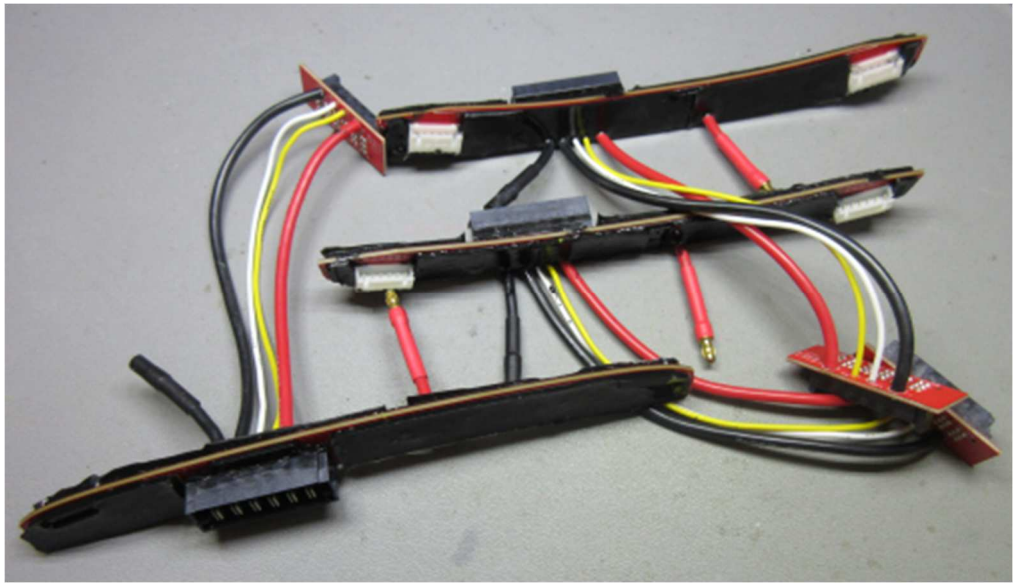
3.4.4.3 Functional Test

```
-------------------------------------------

Battery Position: 0
Model                   : BM100
Hardware Version        : 23
Software Version        : 19
Serial Number           : BBBB009B
Batch Number            : 0
Production Date         : 10-9-2020
Factory Tested          : No

Measurements
- V_Bus                 : 39746mV       --
- Battery               : 39738mV       --
- V_Switch              : 39746mV       --
- V_Switch_Off          : 74mV          --
- VCC                   : 3295mV        --
- V_Offset              : 3005mV        --
- V_Current_Sense       : 1501mV        --
- I_Current_Sense       : 10mA          --

Cell Voltages
- Cell 0                : 3962mV        --
- Cell 1                : 3964mV        --
- Cell 2                : 3965mV        --
- Cell 3                : 3965mV        --
- Cell 4                : 3964mV        --
- Cell 5                : 3977mV        --
- Cell 6                : 3977mV        --
- Cell 7                : 3978mV        --
- Cell 8                : 3992mV        --
- Cell 9                : 3978mV        --

Temperature Sensors
- PCB                   : 22.8'C        --
- Cells 0-4             : 21.8'C        --
- Cells 5-9             : 21.8'C        --

Calibration
- Voltage Offset        : -28           --
```

```
- Voltage Gain           : 13181         --
- Current Offset 0V      : 0             --
- Current Offset 25V     : -1            --
- Current Offset 36V     : -1            --
- Current Offset 41V     : 0             --
- Current Offset 42V     : 0             --
- Voltage Calibrated     : Yes           --
- Current Calibrated     : Yes           --

Factory Tested
- Power Switch           :               --
- Cell Balancing         :               --
- Cell Measurement       :               --
- Negative Reference     :               --

TEST SUMMARY
- Factory Test History   :              PASS
- Current Testing        :              PASS

-------------------------------------------
```

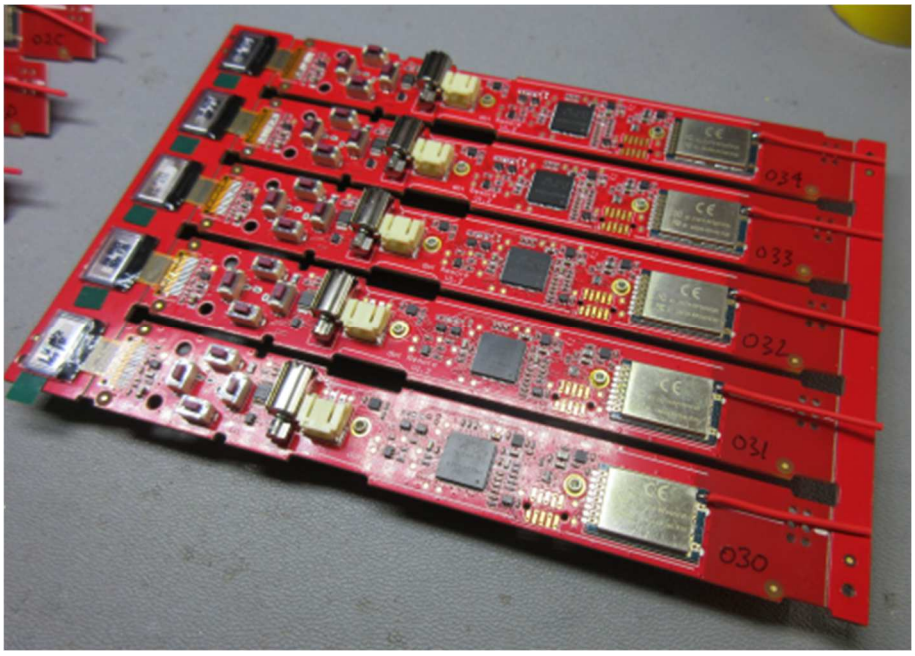
3.5 RESIN COATING

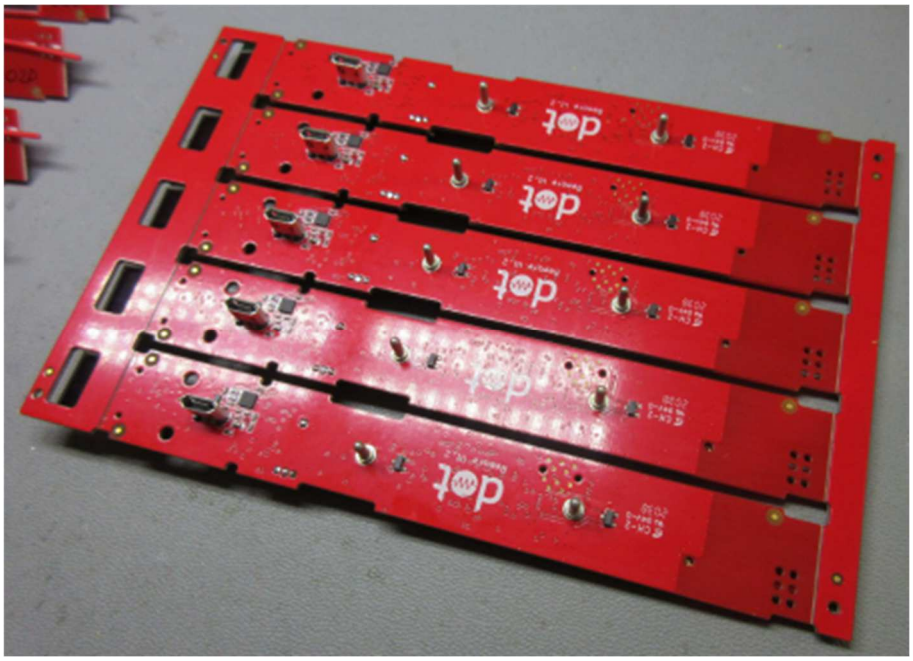
3 of the 4 samples were resin coated for testing.



4 REMOTE CONTROL

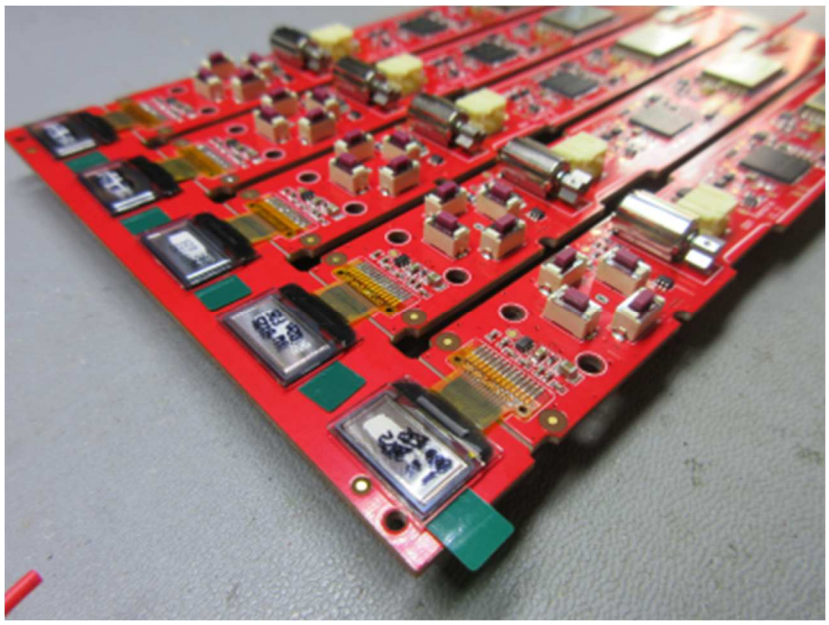
4.1 PANEL UPDATE

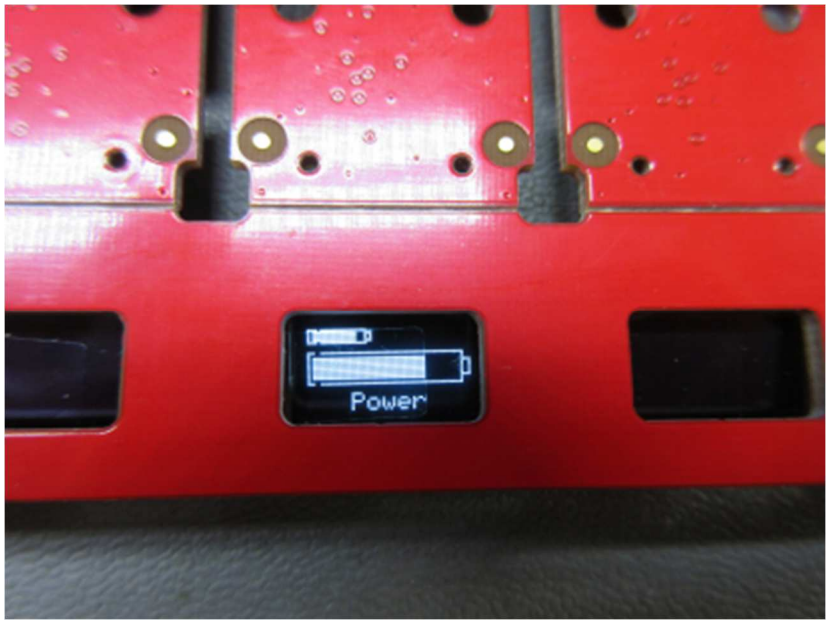




4.2 OLED PROTECTION

OLEDs have the desired additional support for handling and shipment.

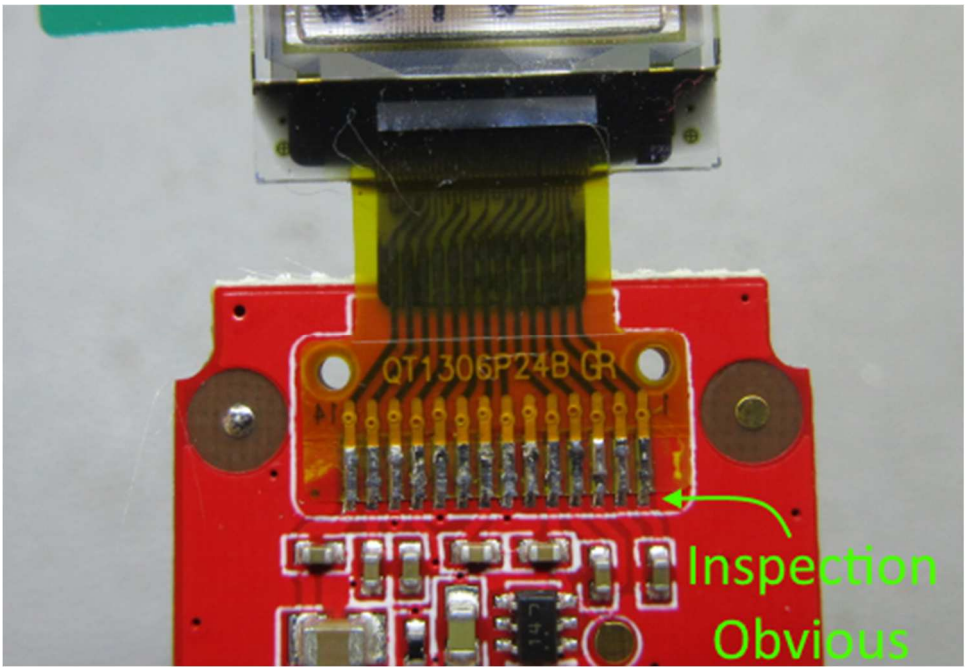




4.3 OLED ALIGNMENT HOLES

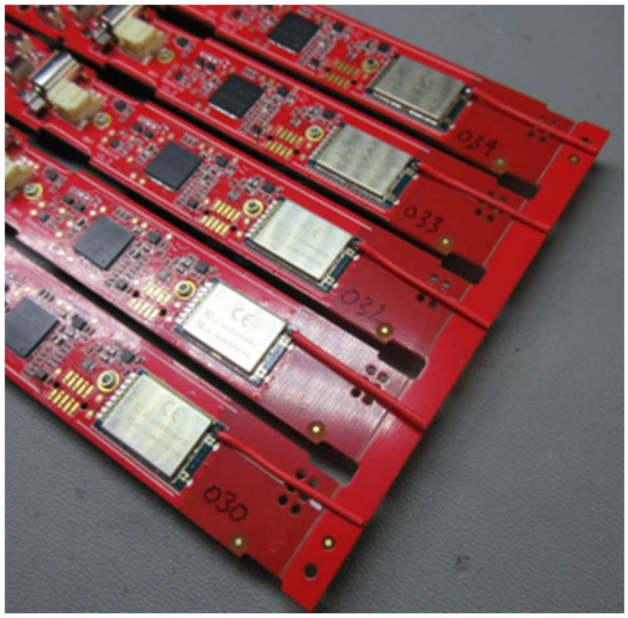
OLED alignment holes moved 0.25mm and increased to 1.1mm diameter. This is to improve tab soldering inspection and jig alignment fitment.

Samples would have been prepared without a jig for alignment, which is noticeable. Given due consideration, change gives the desired obvious soldering edge inspection.



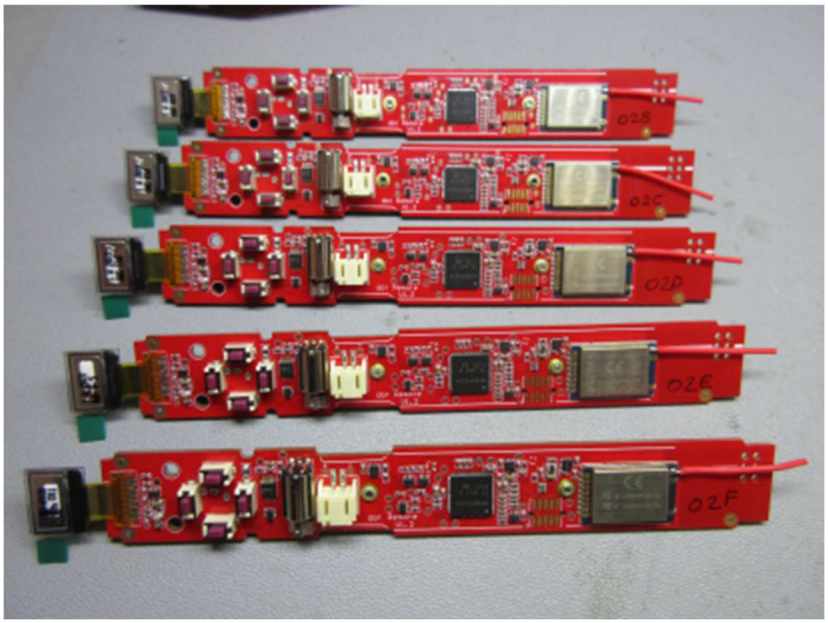
4.4 ANTENNA PROTECTION

The extended panel breakoff is just enough to avoid a lot of antenna displacement while handling and being packaged.



4.5 DE-PANELED

De-paneling easy. The OLED end should be broken off without touching the OLED.

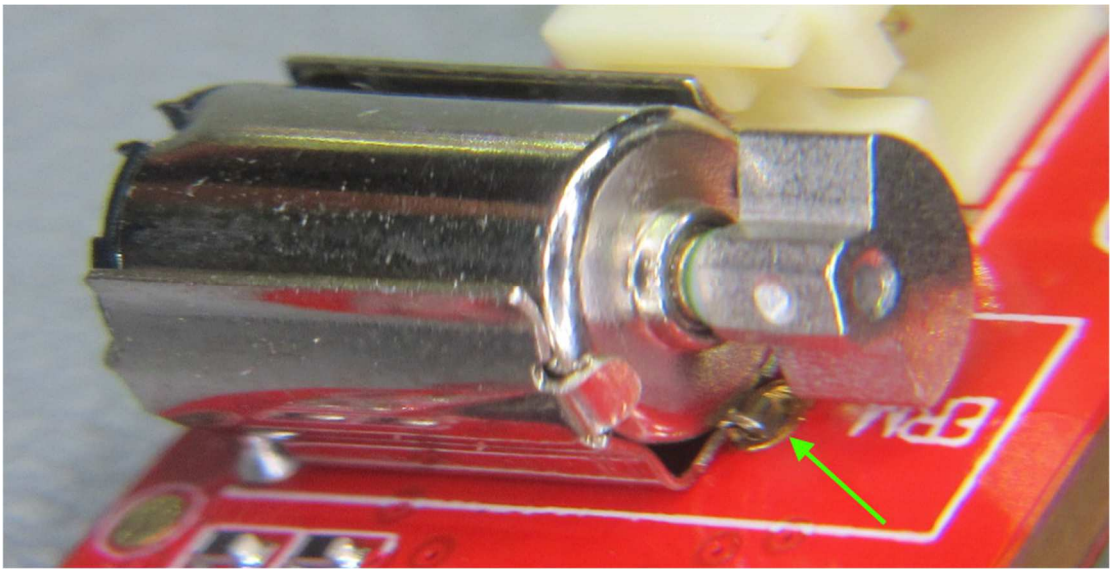


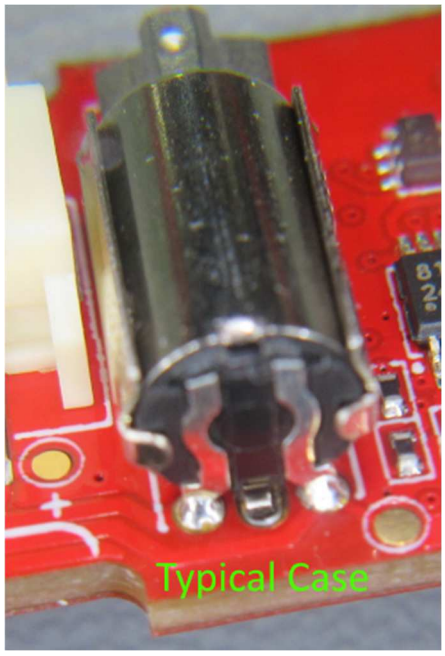
4.6 PRIOR ISSUE INSPECTION

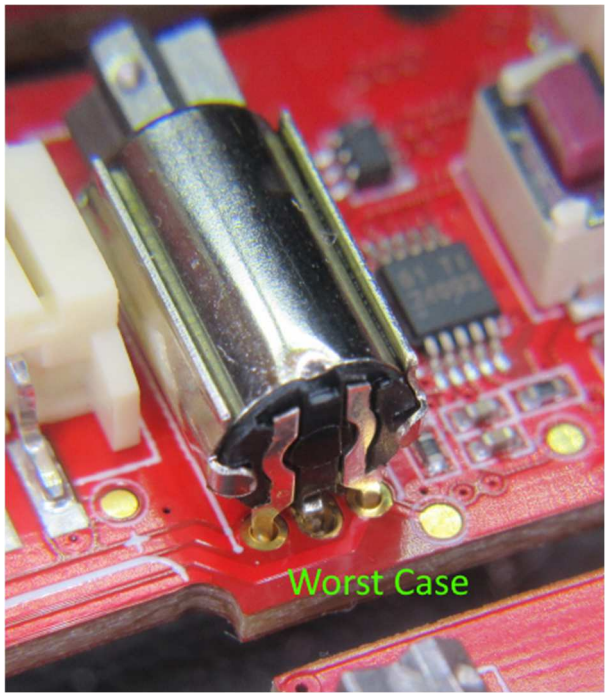
4.6.1 ERM SOLDERING

The soldering to the ERM frame pins is still insufficient. The PCB design was tweaked to provide more thermal relief and a greater opening. Those holes were changed to slot to improve solder flow. The likely soldering issue is more related to the short length of the pins, along with the high thermal bleed to the chassis.

The pins to the electrical connections have significantly less thermal bleed. The soldering is good, although one was borderline. Given production history, there should be no reliability concern given the ERMs are continued to be glued to the PCB.

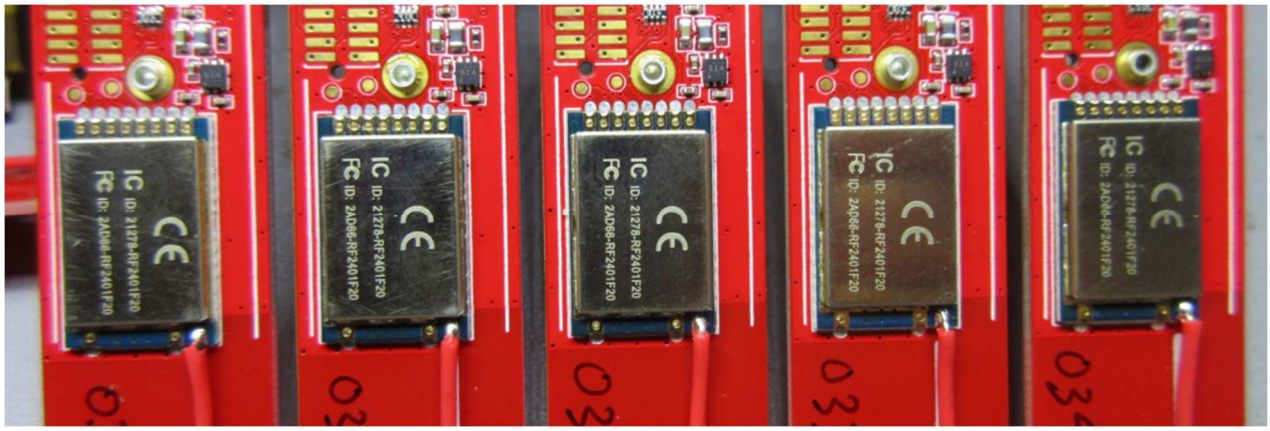






4.6.2 WIRELESS MODULE ALIGNMENT

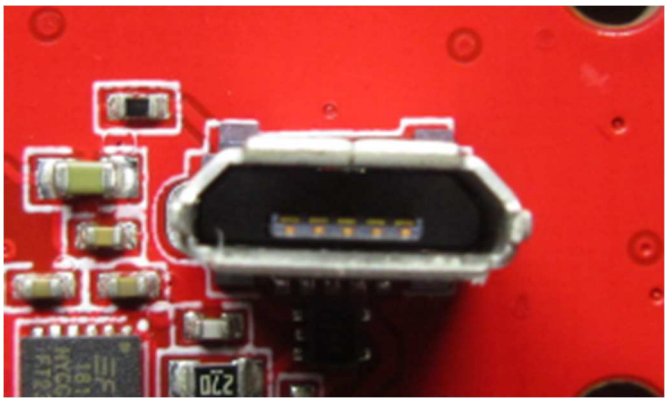
Reflowed alignment is good.

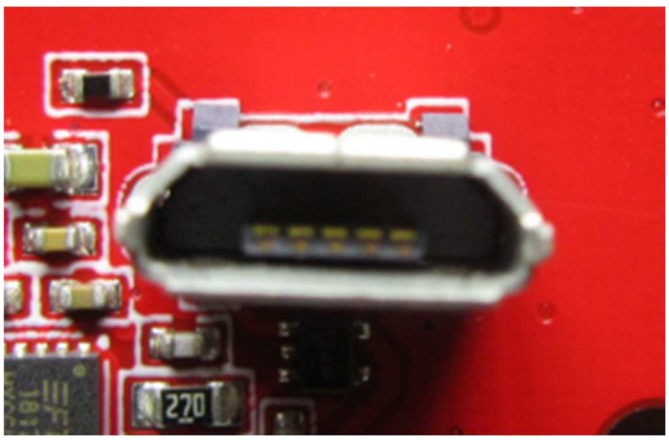


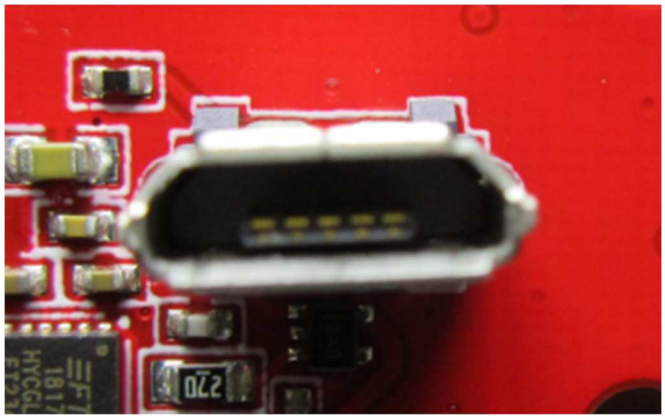
4.6.3 USB CONNECTOR ALIGNMENT

7 units had very good USB connector. The 3 below were not ideal.

Units FFFFF030, FFFFF02C (worst example), FFFFF02D.





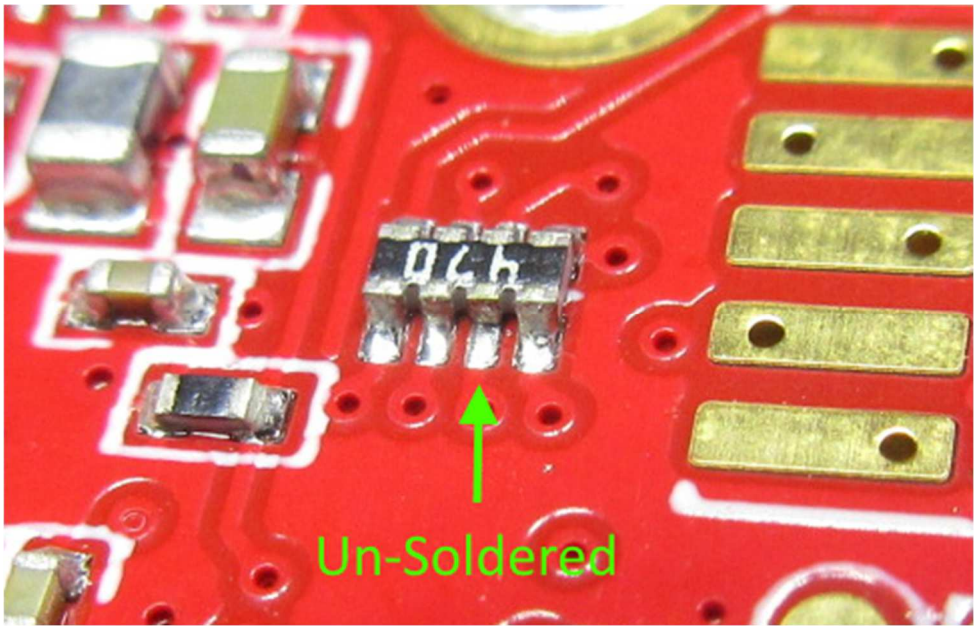

220

4.7 REMOTE SAMPLE INSPECTION

4.7.1 FFFFF02B

Wireless not functioning.

Found R25 with un-soldered contact.



Passed FT

```
dot Remote Control

Model                : RC100
Hardware Version     : 12
Software Version     : 45
Bootloader Version   : 4
Serial Number        : FFFFF02B
Paired MC Serial     : FFFFE000
Batch Number         : 0
Production Date      : 20-10-2020


Push Buttons
- LEFT               : -             ----
- RIGHT              : -             ----
- UP                 : -             ----
- DOWN               : 307           ----

Throttle
- Curve              : 0
- Upper Deadband     : 250
- Lower Deadband     : 150
- Sensor Min         : 1885          ----
- Sensor Current     : 1909          ----
```

```
- Sensor Max         : 3823          ----
- Recall             : 1721/2420

Brake
- Curve              : 0
- Upper Deadband     : 250
- Lower Deadband     : 200
- Sensor Min         : 1993          ----
- Sensor Current     : 2011          ----
- Sensor Max         : 3890          ----
- Recall             : 1650/2402

Measurements
- VCC                : 2507mV        ----
- Battery Voltage    : 4020mV        ----
- Charging Current   : 461mA         ----

Communications
- Wireless RF        : Present       ----
- Packet Count Tx/Rx : 1130/255
- Paired Serial      : FFFFE000
- Paired Status      : Synced        ----

Other
- Ride Level         : Novice
- Handbrake Level    : Off
- Battery Display    : Basic
- Auto Off Timer     : 10mins
- Units              : Metric
- Display Brightness : 7
- OLED Display       : Present       ----

Factory Tested       : PASS
Test Result          : PASS

-------------------------------------------
```

4.7.2 FFFFF02C

Passed FT

```
dot Remote Control

Model                : RC100
Hardware Version     : 12
Software Version     : 45
Bootloader Version   : 4
Serial Number        : FFFFF02C
Paired MC Serial     : FFFFE000
Batch Number         : 0
Production Date      : 20-10-2020


Push Buttons
- LEFT               : -             ----
- RIGHT              : -             ----
- UP                 : -             ----
- DOWN               : 289           ----

Throttle
- Curve              : 0
- Upper Deadband     : 250
- Lower Deadband     : 150
- Sensor Min         : 1747          ----
- Sensor Current     : 1783          ----
- Sensor Max         : 3677          ----
```

```
- Recall             : 0/0

Brake
- Curve              : 0
- Upper Deadband     : 250
- Lower Deadband     : 200
- Sensor Min         : 1691          ----
- Sensor Current     : 1708          ----
- Sensor Max         : 3543          ----
- Recall             : 0/0

Measurements
- VCC                : 2510mV        ----
- Battery Voltage    : 3984mV        ----
- Charging Current   : 460mA         ----

Communications
- Wireless RF        : Present       ----
- Packet Count Tx/Rx : 1356/1356
- Paired Serial      : FFFFE000
- Paired Status      : Synced        ----

Other
- Ride Level         : Novice
- Handbrake Level    : Off
- Battery Display    : Basic
- Auto Off Timer     : 10mins
- Units              : Metric
- Display Brightness : 7
- OLED Display       : Present       ----

Factory Tested       : PASS
Test Result          : PASS
```

4.7.3 FFFFF02D

Passed FT

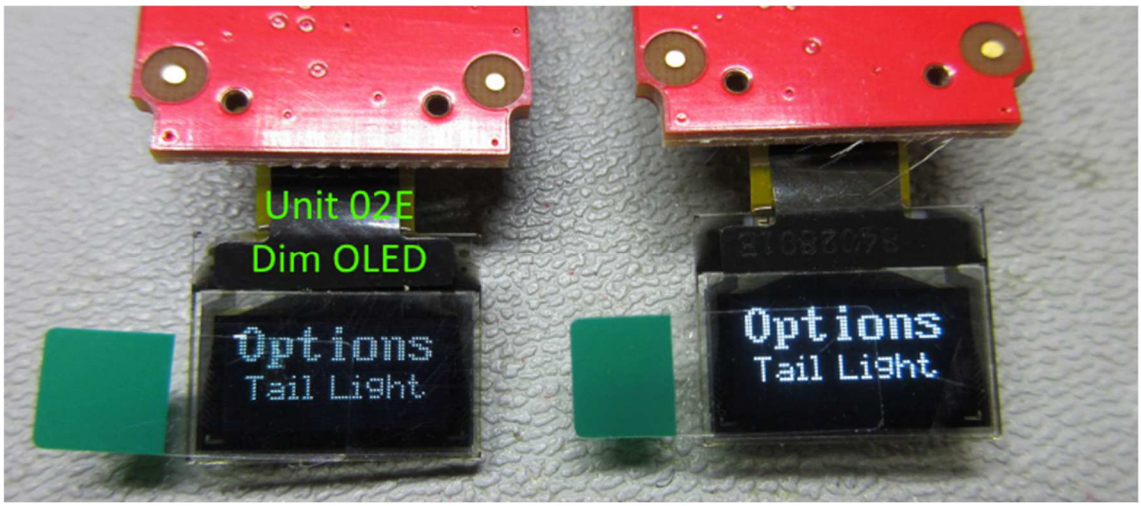
```
dot Remote Control

Model                : RC100
Hardware Version     : 12
Software Version     : 45
Bootloader Version   : 4
Serial Number        : FFFFF02D
Paired MC Serial     : FFFFE000
Batch Number         : 0
Production Date      : 20-10-2020


Push Buttons
- LEFT               : -             ----
- RIGHT              : -             ----
- UP                 : -             ----
- DOWN               : 285           ----

Throttle
- Curve              : 0
- Upper Deadband     : 250
- Lower Deadband     : 150
- Sensor Min         : 1742          ----
- Sensor Current     : 1787          ----
- Sensor Max         : 3668          ----
- Recall             : 0/0
```

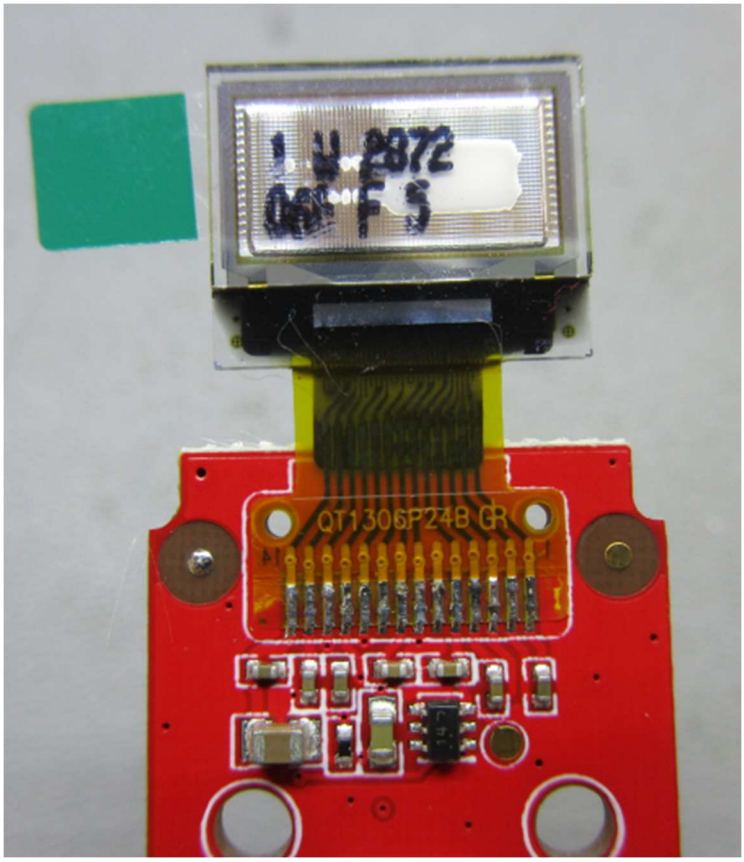
```
Brake
- Curve               : 0
- Upper Deadband      : 250
- Lower Deadband      : 200
- Sensor Min          : 1703          ----
- Sensor Current      : 1745          ----
- Sensor Max          : 3583          ----
- Recall              : 0/0

Measurements
- VCC                 : 2510mV        ----
- Battery Voltage     : 3984mV        ----
- Charging Current    : 461mA         ----

Communications
- Wireless RF         : Present       ----
- Packet Count Tx/Rx  : 1293/1292
- Paired Serial       : FFFFE000
- Paired Status       : Synced        ----

Other
- Ride Level          : Novice
- Handbrake Level     : Off
- Battery Display     : Basic
- Auto Off Timer      : 10mins
- Units               : Metric
- Display Brightness  : 7
- OLED Display        : Present       ----

Factory Tested        : PASS
Test Result           : PASS
```

4.7.4 FFFFF02E

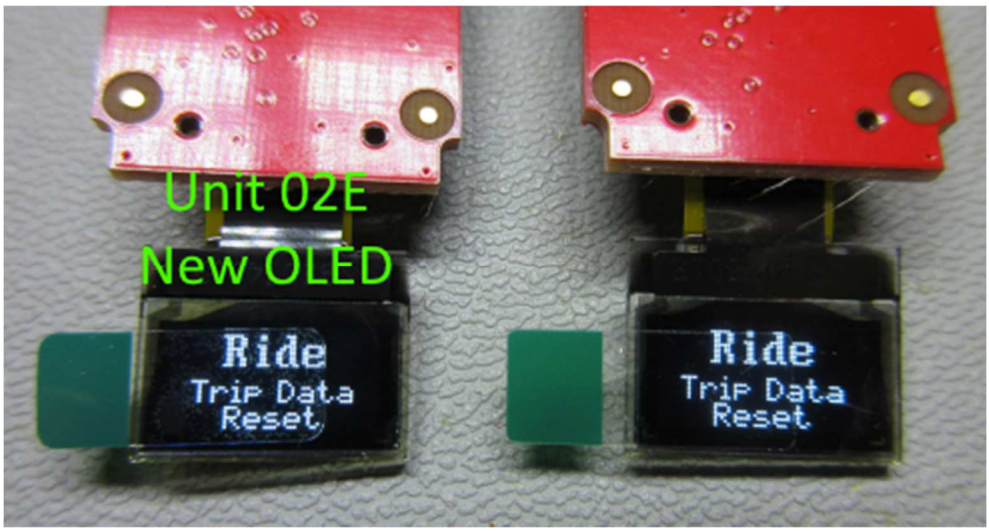
Sensor calibration issue

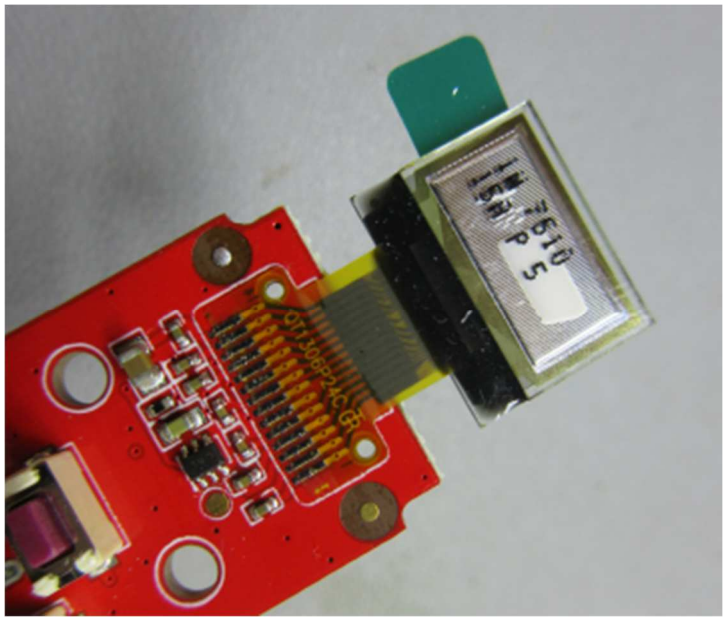
OLED Dim.





Replaced OLED. Brightness correct.





```
Model                 : RC100
Hardware Version      : 12
Software Version      : 45
Bootloader Version    : 4
Serial Number         : FFFFF02E
Paired MC Serial      : FFFFE000
Batch Number          : 0
Production Date       : 20-10-2020


Push Buttons
- LEFT                : -             ----
- RIGHT               : -             ----
- UP                  : -             ----
- DOWN                : 303           ----

Throttle
- Curve               : 0
- Upper Deadband      : 250
- Lower Deadband      : 150
- Sensor Min          : 1934          ----
- Sensor Current      : 1936          ----
- Sensor Max          : 3835          ----
- Recall              : 0/0

Brake
- Curve               : 0
- Upper Deadband      : 250
- Lower Deadband      : 200
- Sensor Min          : 1967          ----
- Sensor Current      : 1990          ----
- Sensor Max          : 3897          ----
- Recall              : 0/0

Measurements
- VCC                 : 2516mV        ----
- Battery Voltage     : 4022mV        ----
- Charging Current    : 462mA         ----

Communications
- Wireless RF         : Present       ----
- Packet Count Tx/Rx  : 737/377
- Paired Serial       : FFFFE000
- Paired Status       : Synced        ----

Other
```

```
- Ride Level          : Novice
- Handbrake Level     : Off
- Battery Display     : Basic
- Auto Off Timer      : 10mins
- Units               : Metric
- Display Brightness  : 7
- OLED Display        : Present       ----

Factory Tested        : PASS
Test Result           : PASS
```

4.7.5 FFFFF02F

Unit was resetting itself and reporting low voltage. Suspect was insufficient battery connection, as subsequent re-testing was successful.

Passed FT

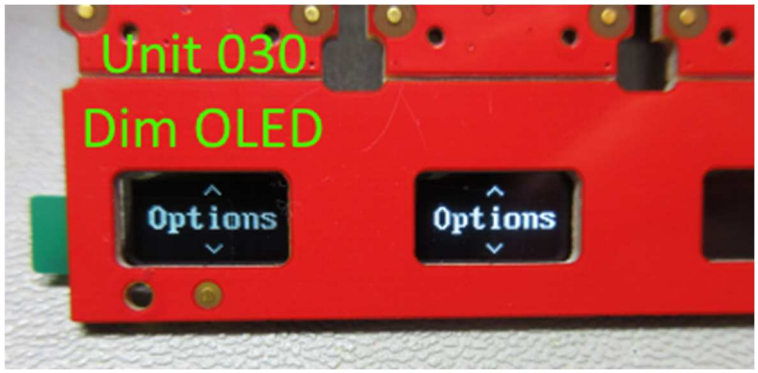
```
dot Remote Control

Model                 : RC100
Hardware Version      : 12
Software Version      : 45
Bootloader Version    : 4
Serial Number         : FFFFF02F
Paired MC Serial      : FFFFE000
Batch Number          : 0
Production Date       : 20-10-2020


Push Buttons
- LEFT                : -             ----
- RIGHT               : -             ----
- UP                  : -             ----
- DOWN                : 296           ----

Throttle
- Curve               : 0
- Upper Deadband      : 250
- Lower Deadband      : 150
- Sensor Min          : 1921          ----
- Sensor Current      : 1940          ----
- Sensor Max          : 3835          ----
- Recall              : 1721/2449

Brake
- Curve               : 0
- Upper Deadband      : 250
- Lower Deadband      : 200
- Sensor Min          : 1984          ----
- Sensor Current      : 1990          ----
- Sensor Max          : 3896          ----
- Recall              : 1650/2441

Measurements
- VCC                 : 2512mV        ----
- Battery Voltage     : 4117mV        ----
- Charging Current    : 417mA         ----

Communications
- Wireless RF         : Present       ----
- Packet Count Tx/Rx  : 409/169
- Paired Serial       : FFFFE000
- Paired Status       : Synced        ----
```

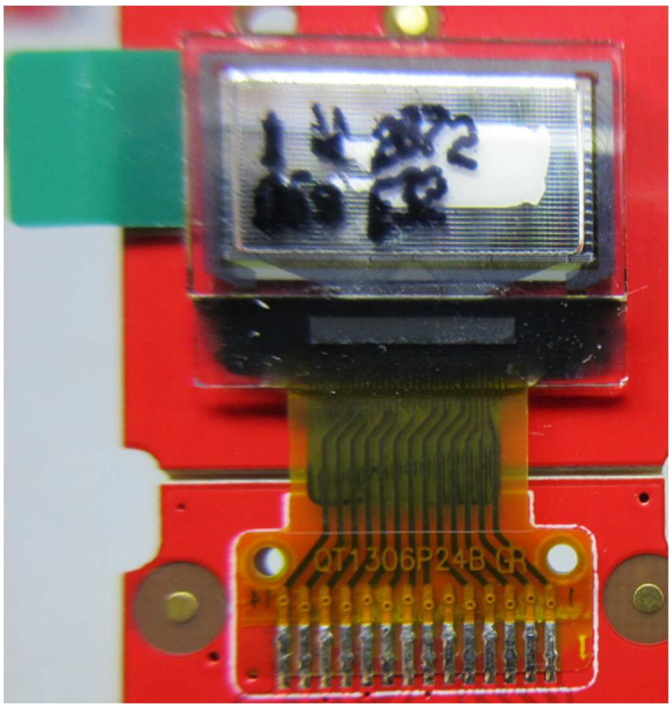
```
Other
- Ride Level          : Novice
- Handbrake Level     : Off
- Battery Display     : Basic
- Auto Off Timer      : 10mins
- Units               : Metric
- Display Brightness  : 7
- OLED Display        : Present       ----

Factory Tested        : PASS
Test Result           : PASS
```

4.7.6 FFFFF030

2 attempts to initially pair with MC. Subsequent pairing worked instantly.

OLED is dim.





Re-soldered tab with flux. OLED is still dim.

Measurements

VCOMH = 7.49V

VOLED = 4.02V

VDD = 2.498V

C1 = 1.42V

C2 = -4.45V

IREF = 4.70V

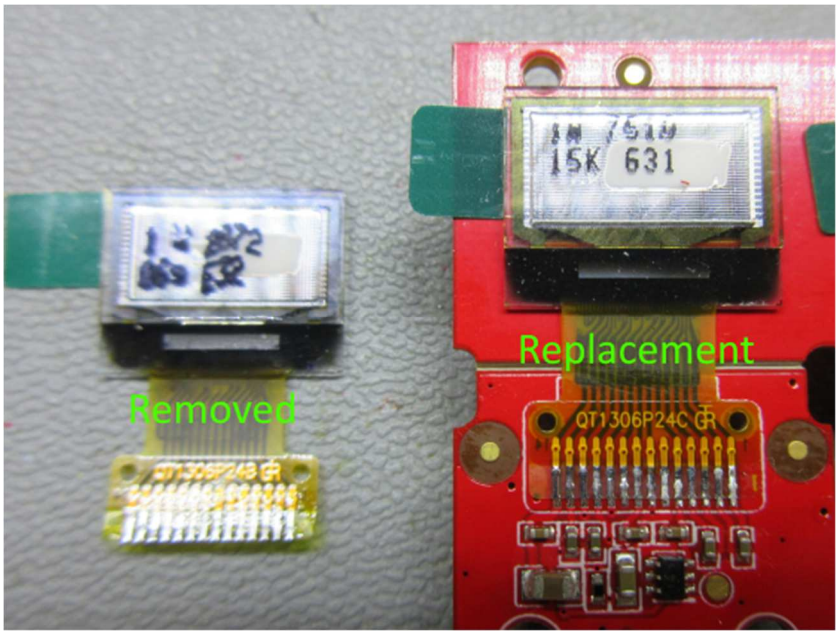
Replaced OLED. Display brightness as expected.

VCOMH = 7.49V

C1 = 1.29V

C2 = -4.58V

IREF = 4.68V



4.7.7 FFFFF030 .. FFFFF034 FUNCTIONAL TESTING

Need to leave the PCBA's in-panel for OLED alignment jig development. Therefore could not fit trigger to pass sensor readings for full functional testing. Preliminary functional testing performed to determine no other issue expected.

5 TEST SUMMARY

5.1 MAIN CONTROLLERS

Sample FFFFE022 has an unexpected jolt on rotation start and brake engagement. Cause not yet determined.

Sample FFFFE023 has audible capacitor noise on voltage ramping.

Functional test software requires adjustments to accommodate changes.

Follow up items:

- Flux on charger IC improves soldering. Continue for production.
- Advise Union R26 uses correct manufacturing part from BOM, 45.3k. However, Digi-key part# and comment are incorrect.
- Remind Union heatsink to be supplied separately, non-fitted.
- Functional testing firmware requires revision.
- Further investigate FFFFE022 RHS VESC issue.

5.2 BATTERY MODULES

Battery modules pass inspection.

Follow up items:

- BBBB009A front connector has soldered wicked into terminal contact area. Advise Union.
- Resin coat for field testing.

5.3 REMOTES

Two failed OLEDs is a concern.

Follow up items:

- Test remote FFFFF02C for USB connector fitment with enclosure housing.
- Test remote wireless range.
- Advise Union of failed OLEDs. Likely return for inspection.
- Create OLED solder jig to suit new panel.
- OLED position has moved 0.25mm, which will push the tab bend half this distance more than the previous revision. Not expected to make any difference, but should checked on assembly.

<end of report>