Moto X Play/DROID MAXX 2 BASEBAND TROUBLESHOOTING GUIDE V1.0

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SNAPSHOTS OF MAIN BOARD

Snapshots of Main PCB

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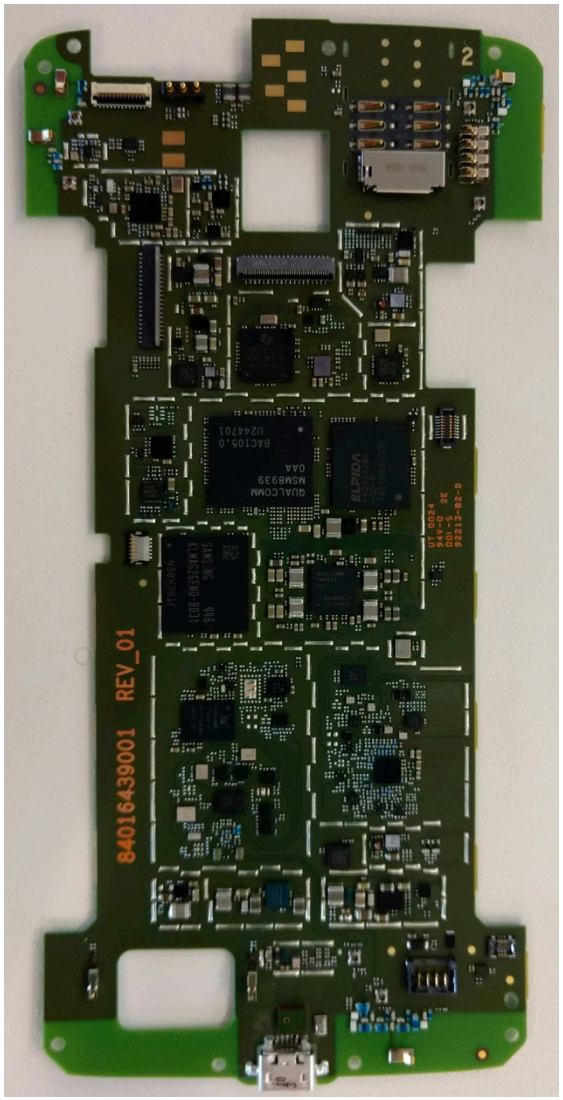
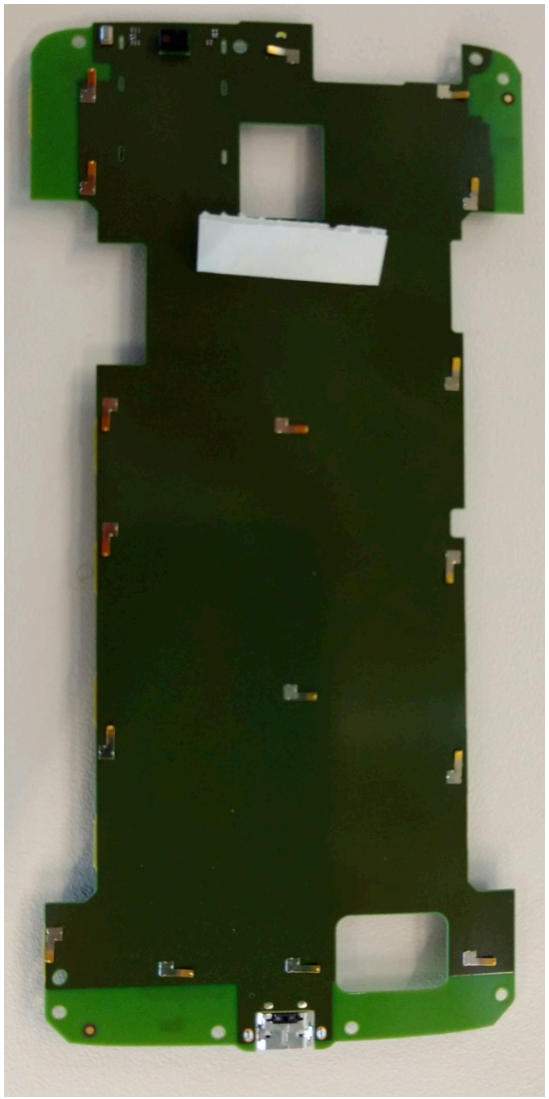
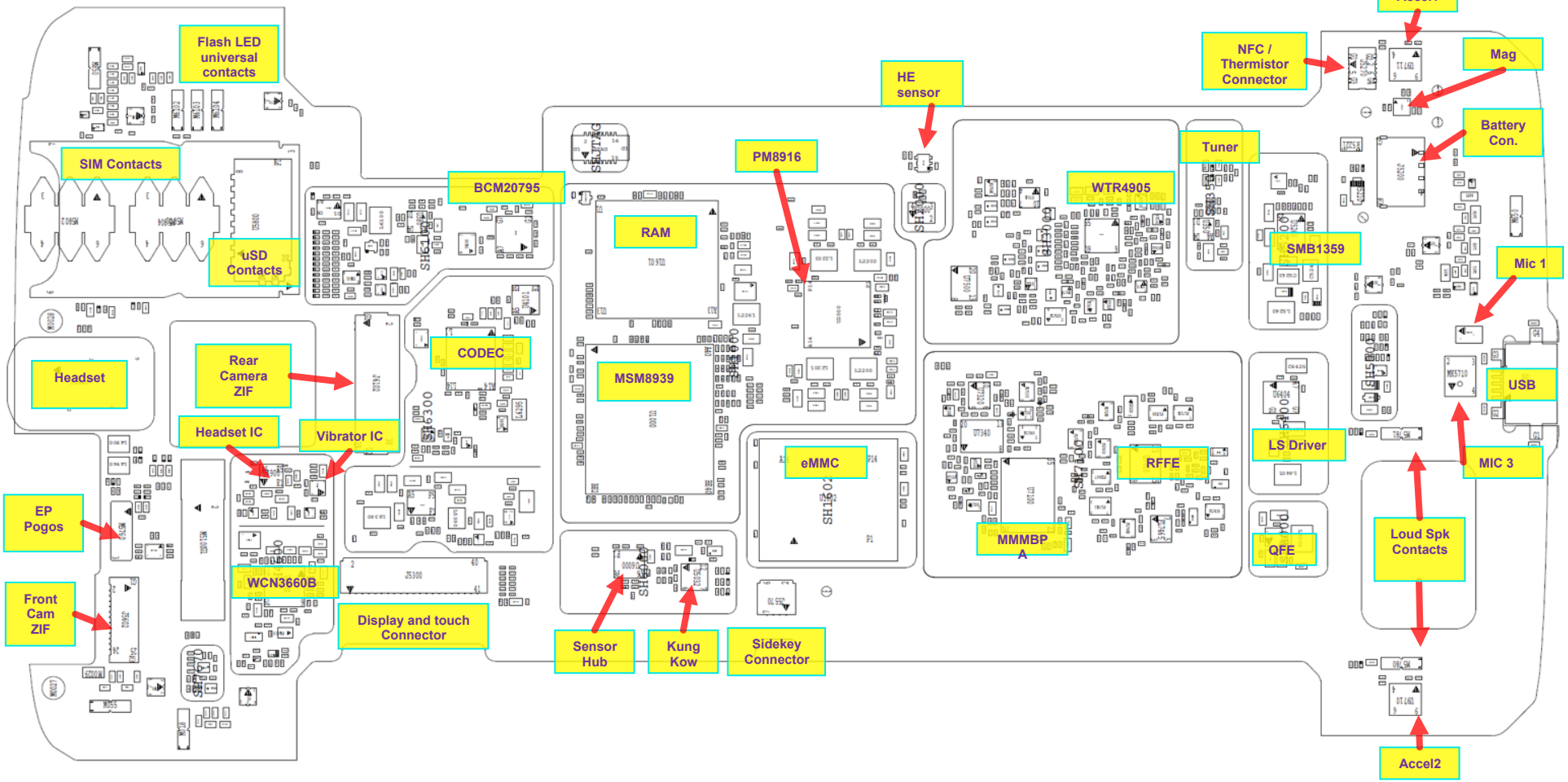


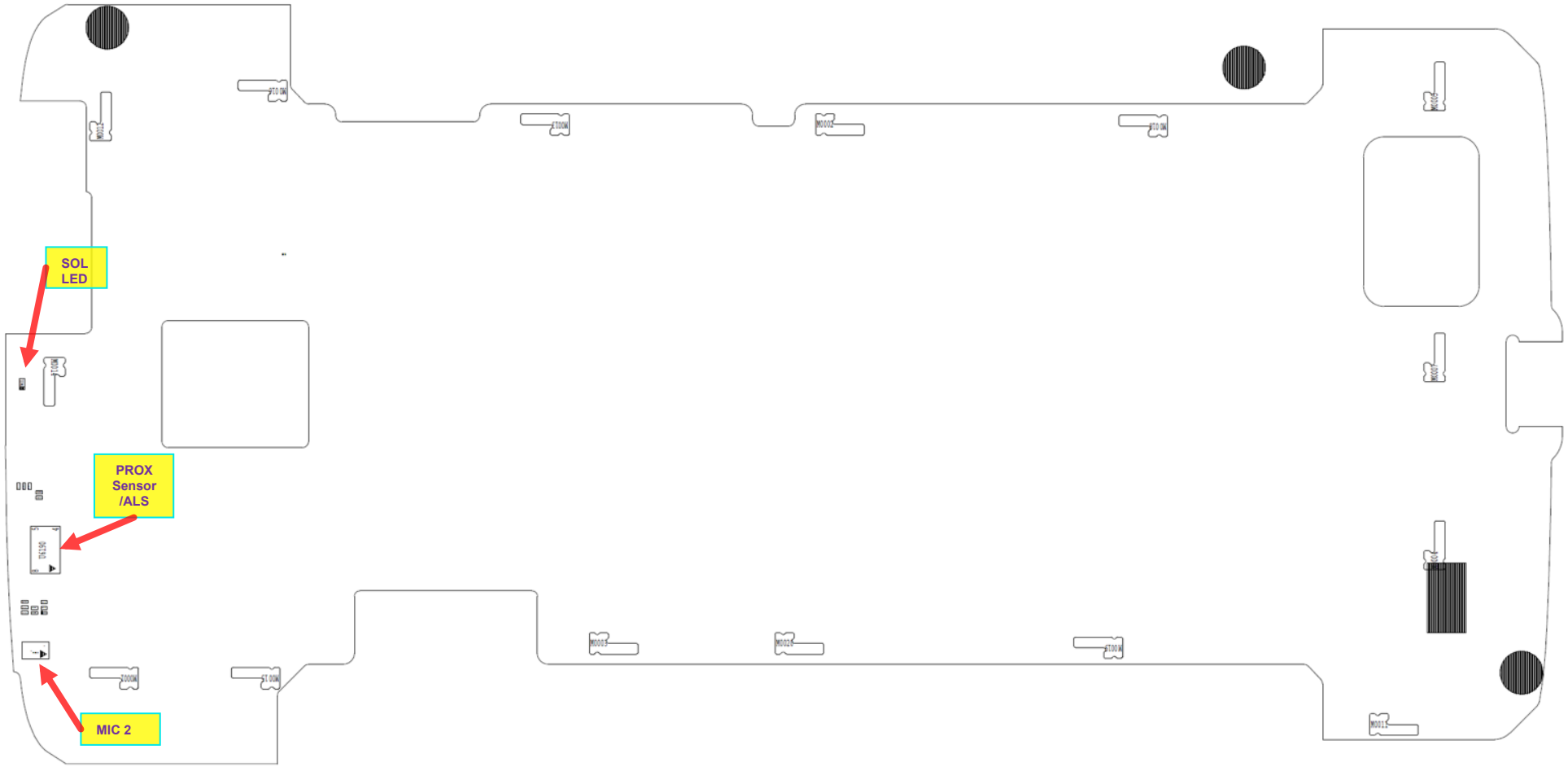
Top Side (Display)



Main Board – Top Placement

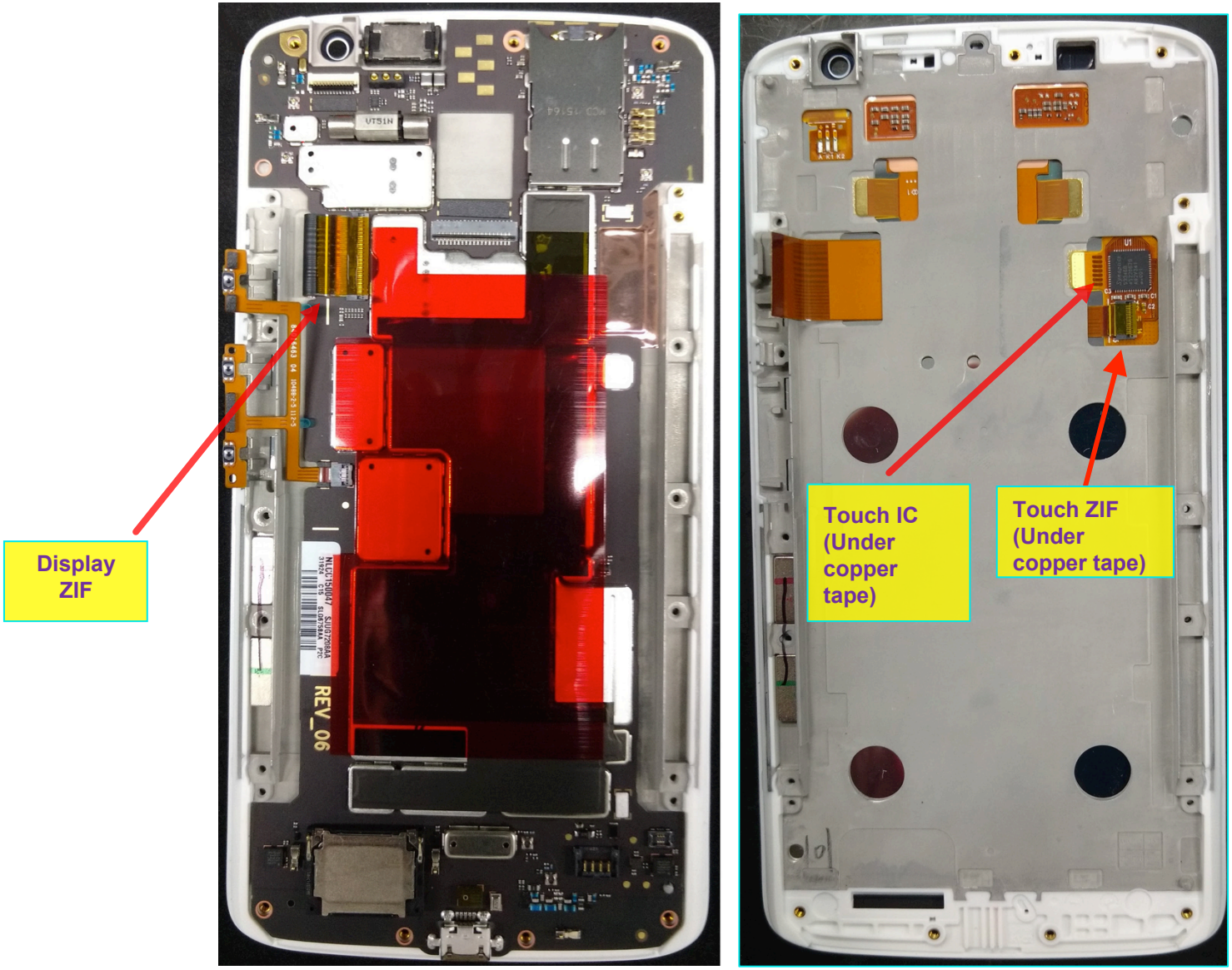


Main Board – Bottom Placement



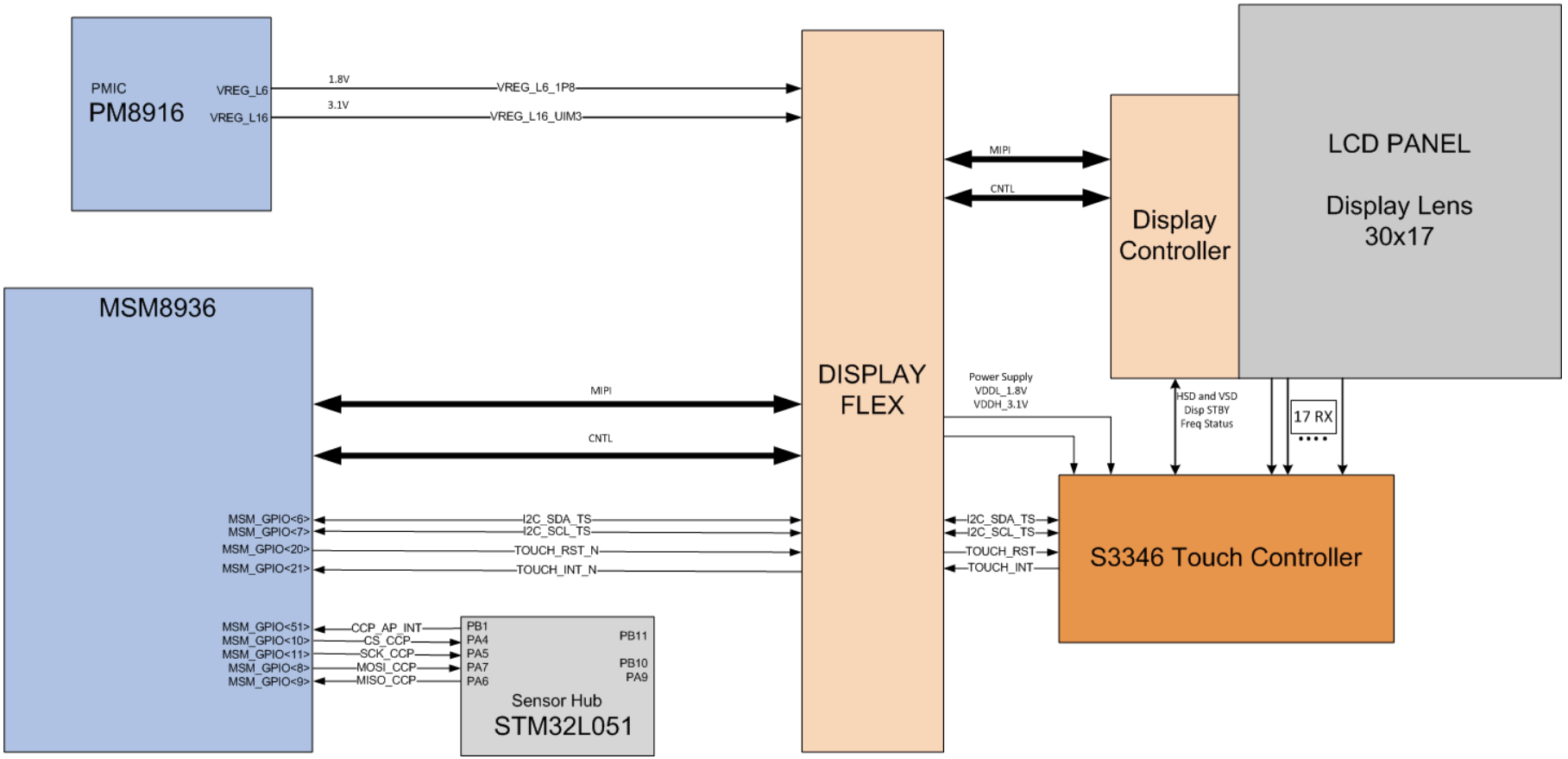
TOUCH TROUBLESHOOTING

Main Board – Location of LCD & Touch ZIF Connectors

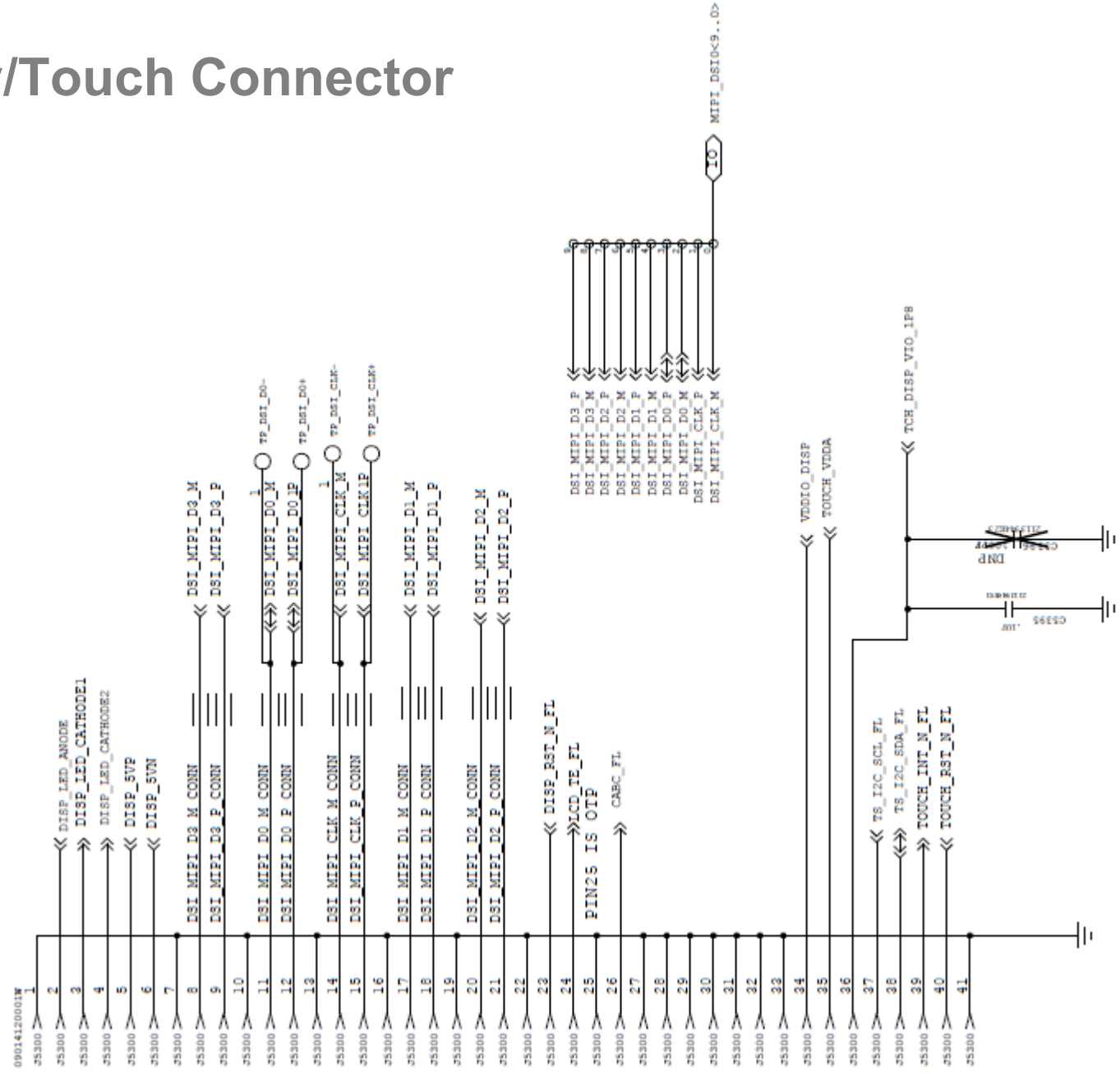


Capacitive Touch System – Block Diagram

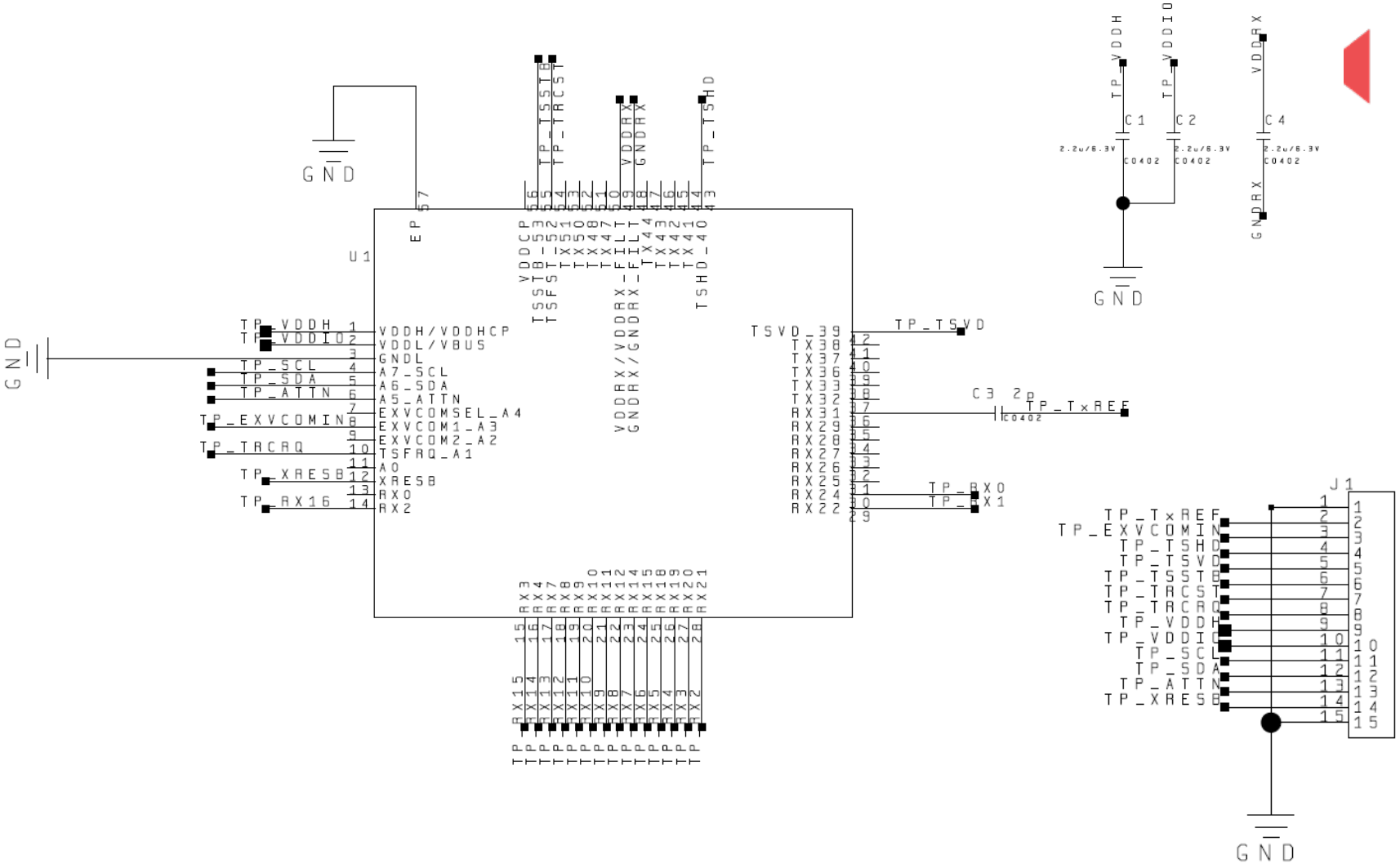
Capacitive Touch Block Diagram



Display/Touch Connector



Touch IC Schematic



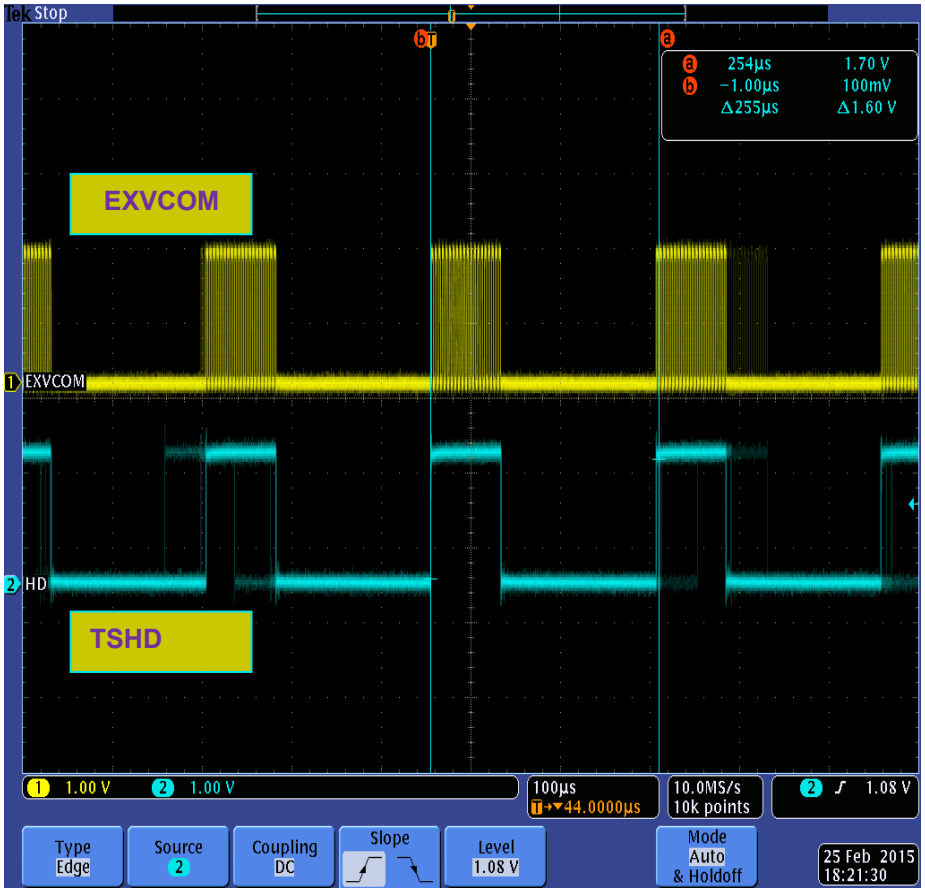
Touch Troubleshooting

1. No Touch response when display touched
    - Swap display panels with known good panel. If touch works, problem with display flex or IC (Go to Step 2). If still not working, problem with main board (Go to Step 3).

2. Display panel issue
    - Check Touch flex for any damage
    - Ensure 3.1VDC and 1.8VDC power is at bypass caps C1 and C2
    - Verify Reset signal is high on Touch ZIF pin 14, IRQ is high on ZIF pin 13
    - I2C Data and I2C Clock at 1.8VDC
    - With scope, probe TSHD pin 4 of ZIF, EXVCOM pin 3 of Touch ZIF (with display active) (Waveform on next page)
    - When touching panel and moving finger, INT should toggle low, I2C data and clk will toggle

Touch Troubleshooting (cont'd)

Waveforms of display signals



3. Main Board Issue
   - Check touch connector for proper insertion of flex
   - Ensure 3.1VDC and 1.8 VDC supplies are on the 41 pin main board display ZIF, pin 35 & 36
   - Verify Reset signal is high, IRQ is high, I2C Data and Clock at 1.8VDC
   - When touching panel, INT should toggle low, I2C data and clk will toggle

DISPLAY TROUBLESHOOTING

Display

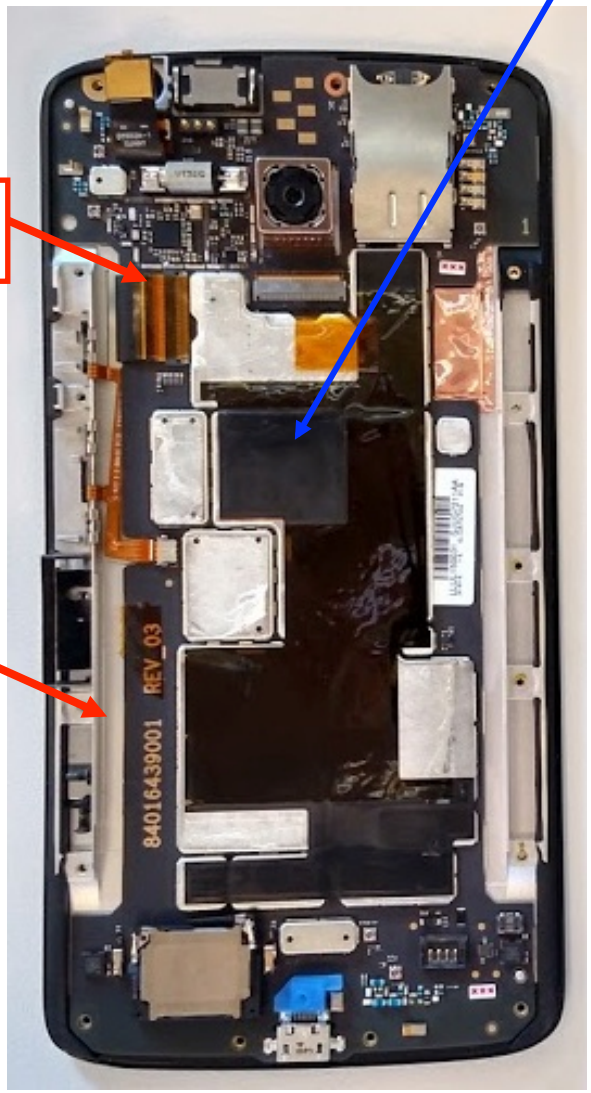
- This display is a color Active Matrix Liquid Crystal Display (AMLCD) of glass construction with White pixels on a black background.
- The 5.46’ display consists of 1080 (sRGB) x 1920 pixels with a color depth of 16.7 M colors (24 bpp).
- Chip-on-glass (COG) with the driver located at top front of panel.
- Display operates in MIPI command mode with onboard RAM.

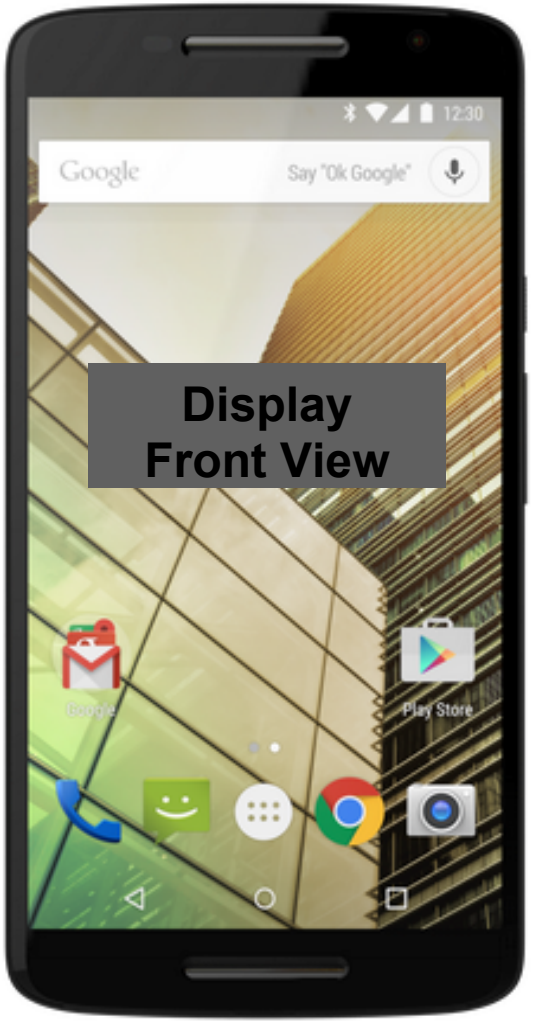
Display Assembly

Main PCB

Pin1 End
J5300, 41-pin Disp ZIF Connector

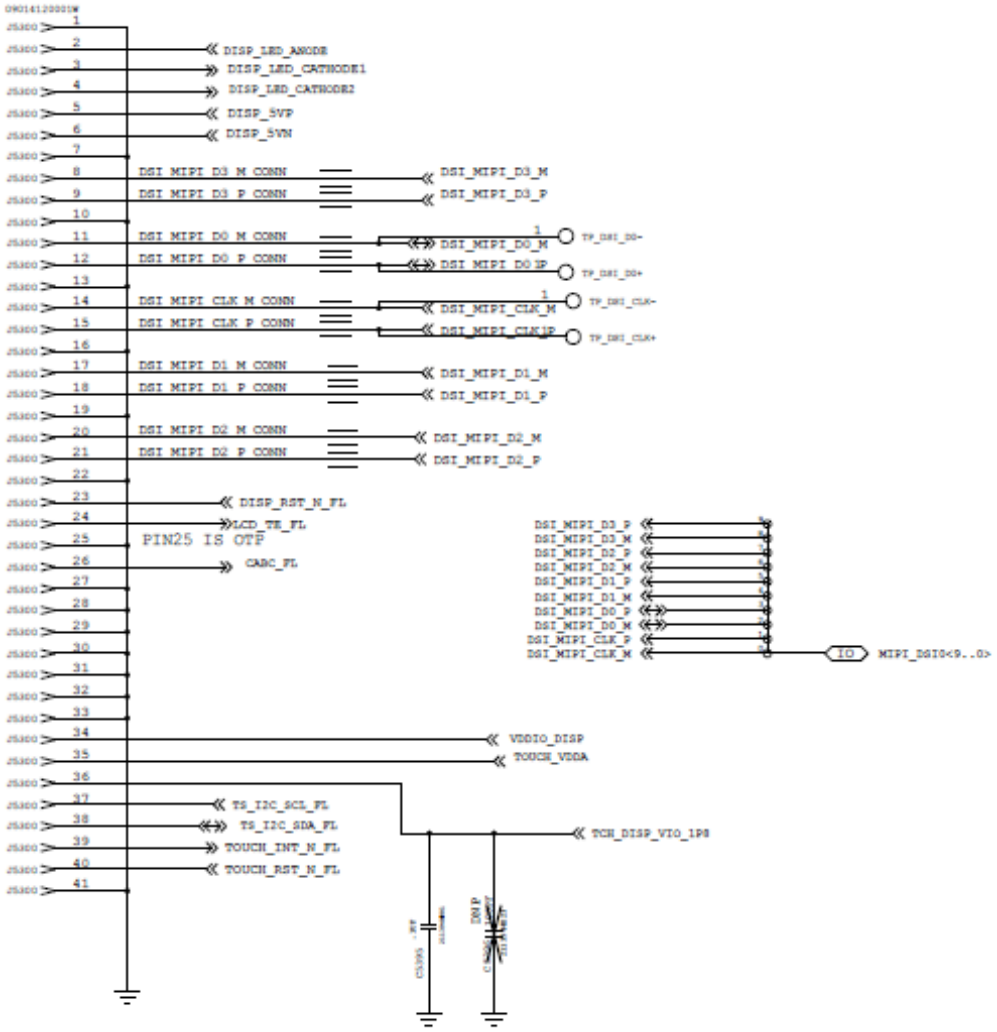
Display Module bonded to
Front housing



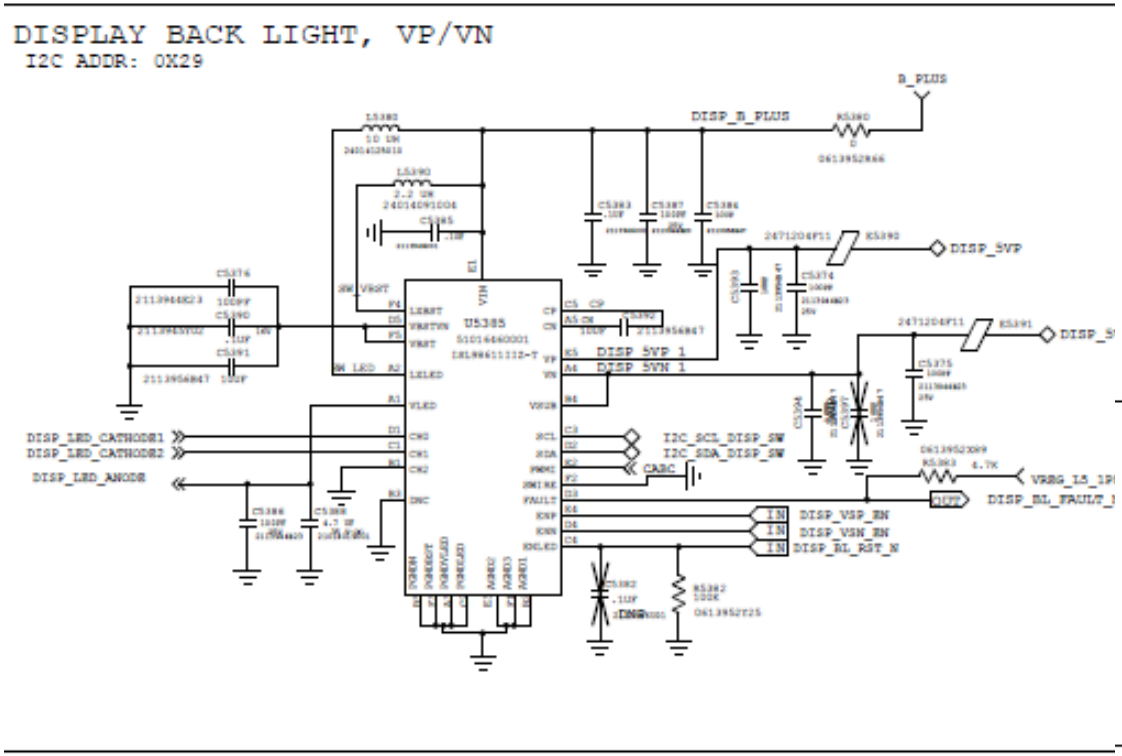


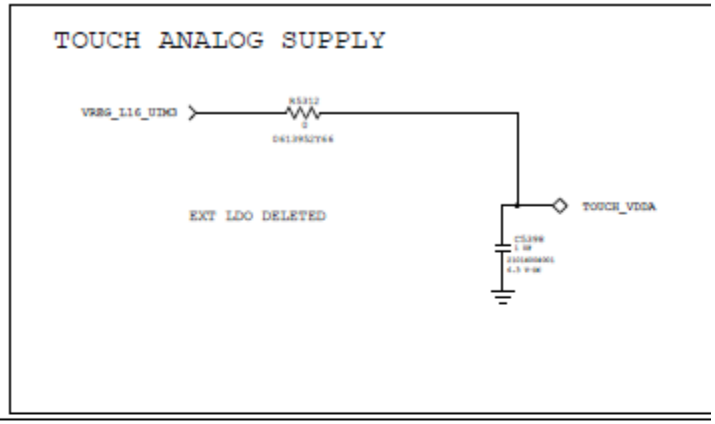
Display
Front View

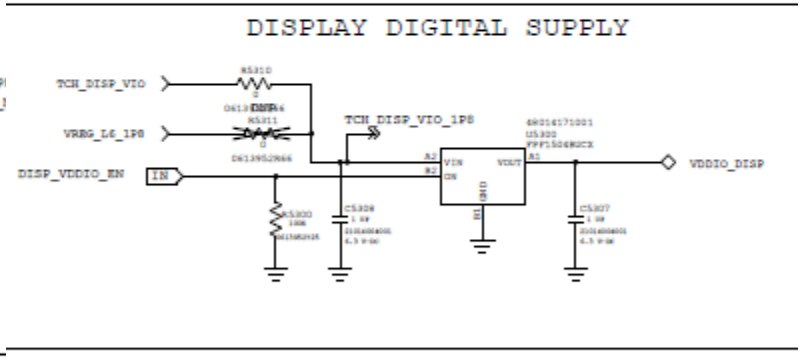
Display Main Schematic



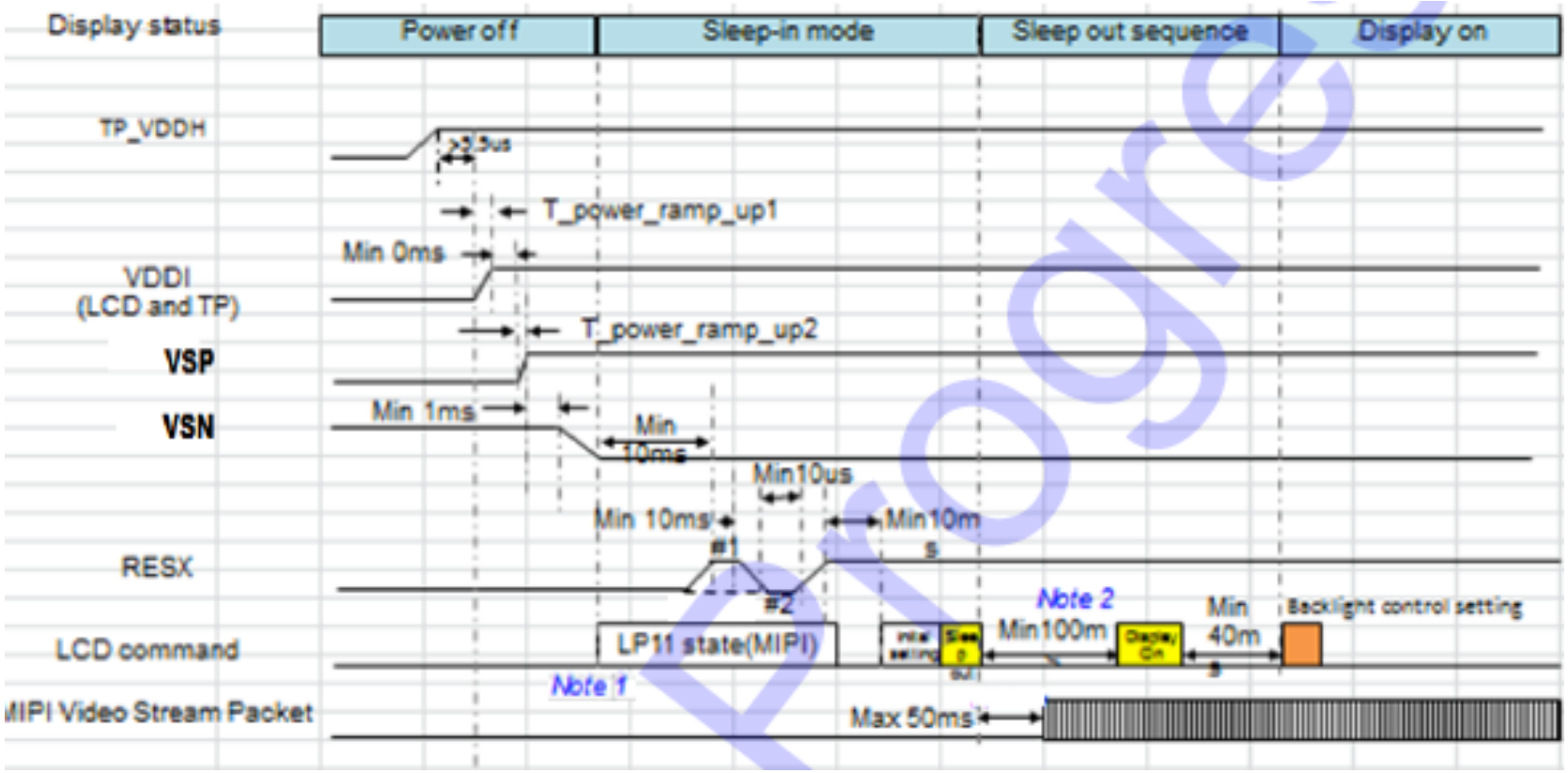
Display Power Schematic







Display Power-up Sequence



Display Troubleshooting

- Check 41pin display ZIF connector
  1. Properly inserted
  2. Any damage to ZIF receptacle on main PCB or plug on disp flex tail
  3. Swap in known good main PCB or good disp module to see if issue follows main PCB or display flex

- If the issue follows main PCB
  1. If no backlight (BL),
     a. check no damage sign of BL driver U5382
     b. check disp_bl_rst_n (R5382), if not High (1.8V), the connection to MSM pin BB33 may be bad
     c. check cabc (off E5301), if not High (1.8V), check E5301 soldered correctly
     d. check disp_bl_fault_n (off R5383), if it stuck low, BL driver U5382 is in fault_mode. Check no short circuit on outputs (Vp,Vn, VLED)

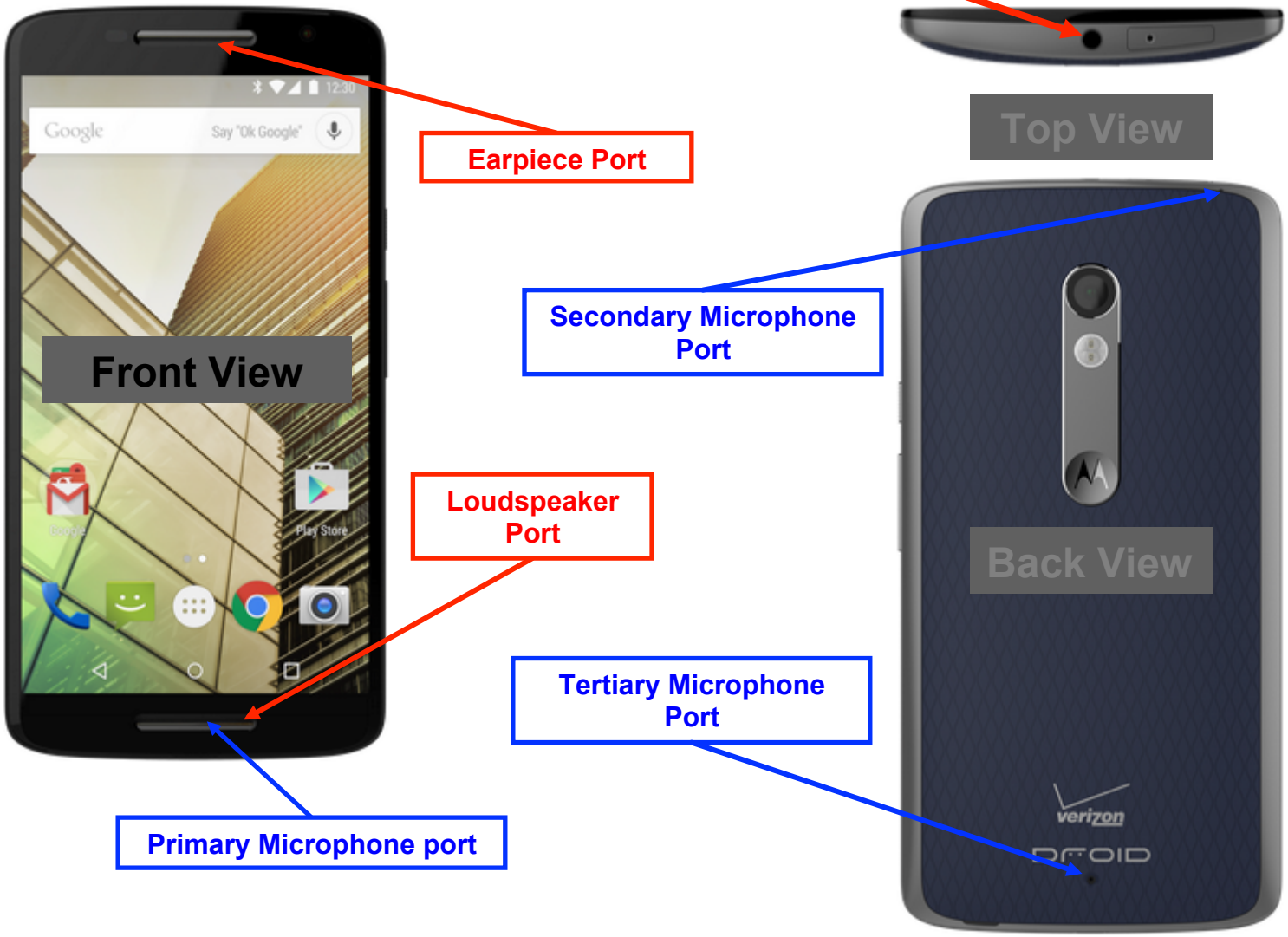
Display Troubleshooting (cont'd)

2. If backlight (BL) is OK, still no display
    a. Check Vddio (1.8V, off Pin34 of J5300), if not 1.8V, check SW U5300
    b. Check Vsp (Pin5 of J5300; Vsp from C5302), if not +5.5V, check BL driver U5385 (not in fault mode, outputs not shorted)
    c. Check Vsn (Pin6 of J5300; Vsn from C5351), if not +5.5V, check BL driver U5385 (not in fault mode, outputs not shorted)

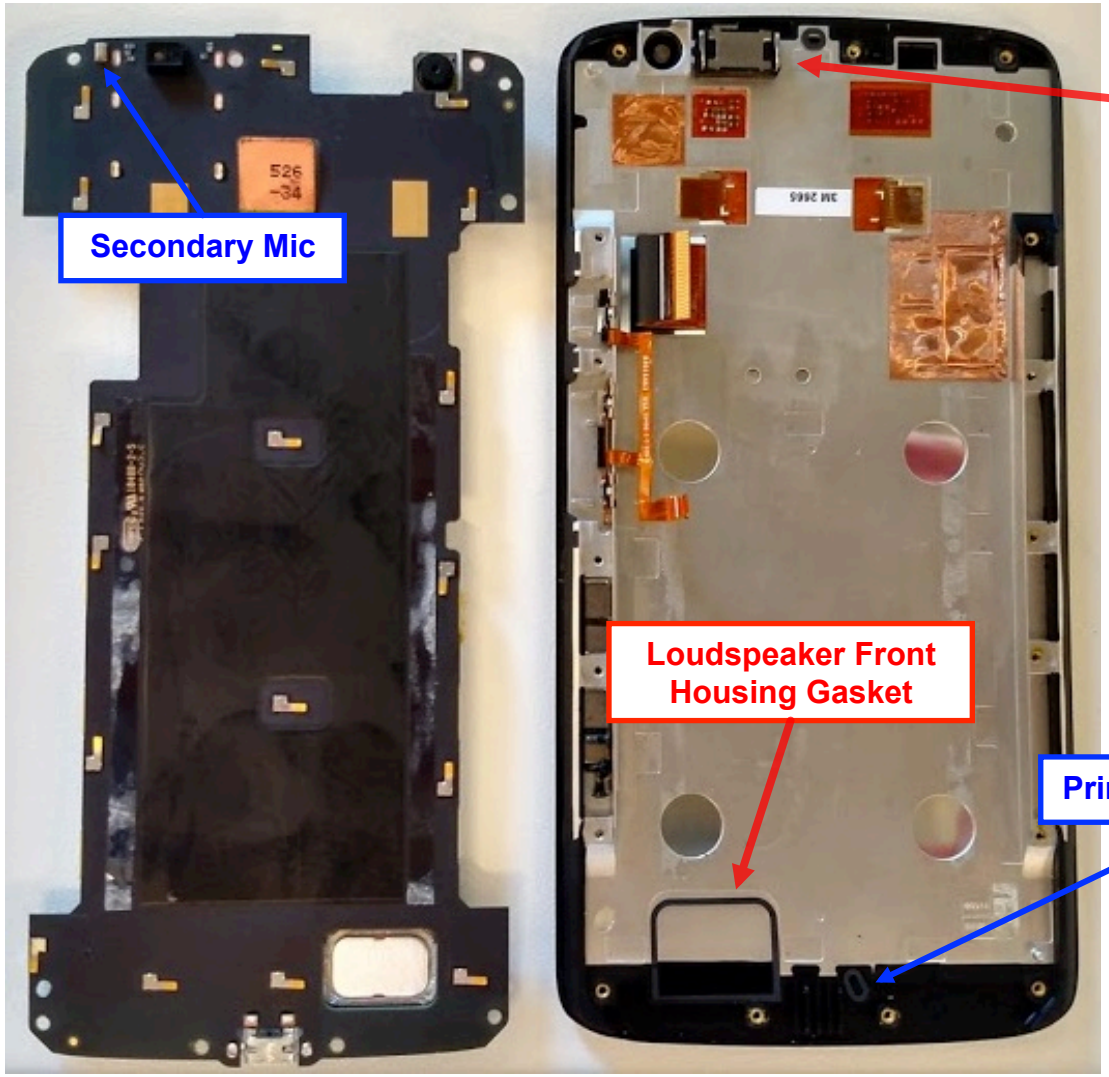
- If the issue follows display module, replace the displaymodule

AUDIO TROUBLESHOOTING

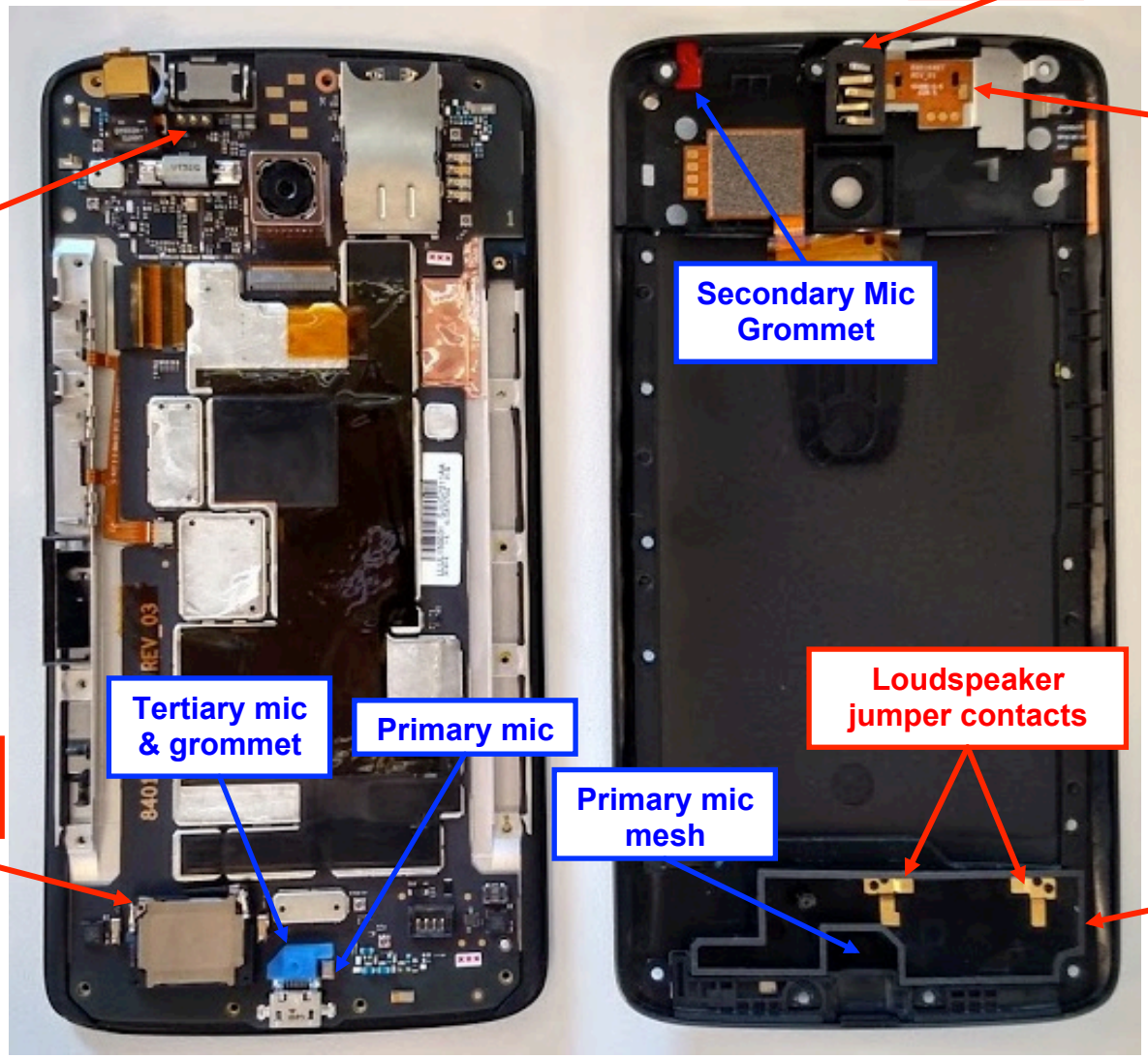
Audio Devices



Audio Devices (PCB View)



Audio Devices (PCB View) (cont'd)



CQA Application

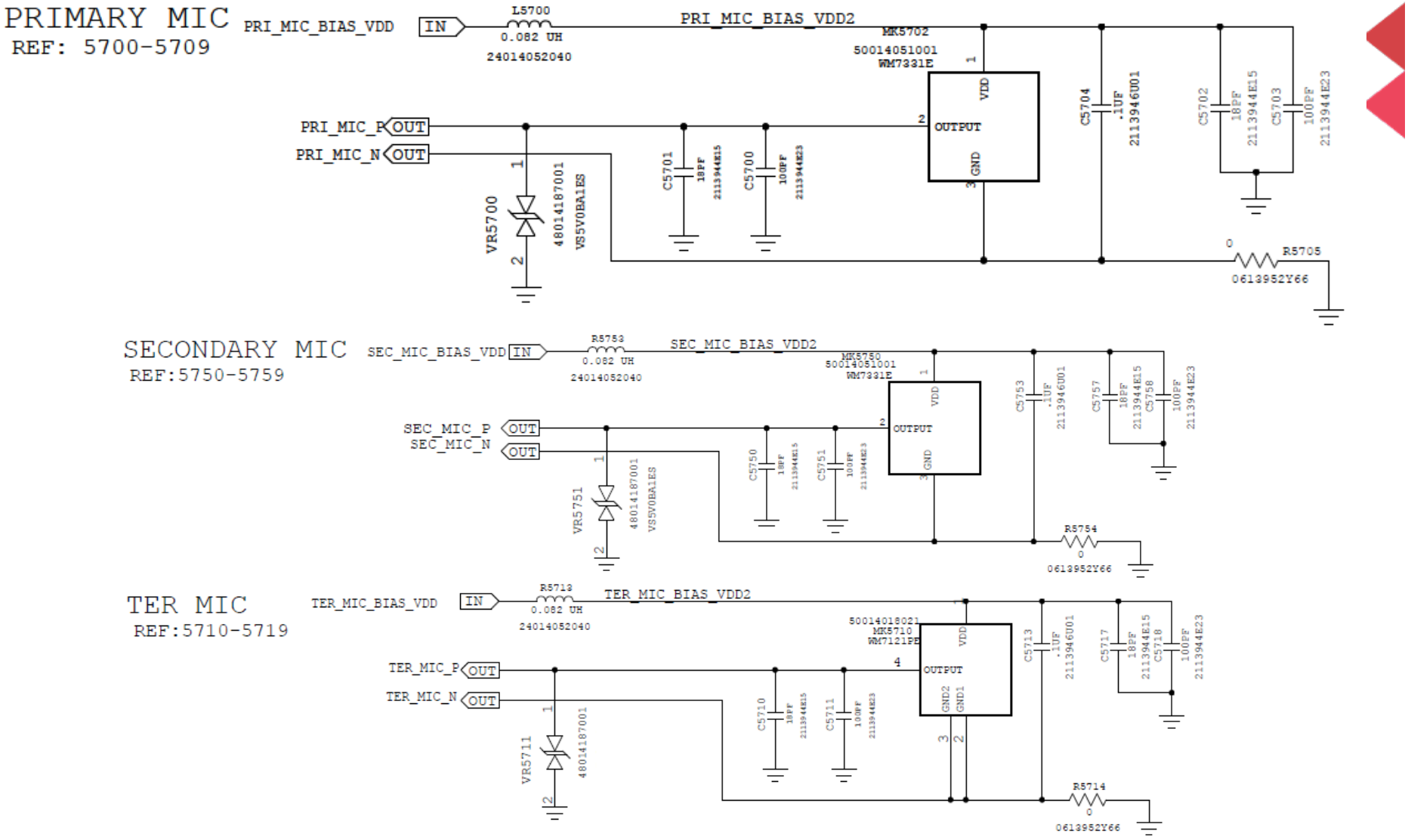
- Launching the CQA app will help resolve and root-cause the vast majority of problems.
- **Go to the phone/dialer and enter *#*#2486#*#***
- The CQA main menu will pop-up – select “Start CQA Test in Menu Mode”.
- Select the appropriate debug area – for Audio, primarily you will use AUDIO and HEADSET
- The AUDIO CQA area has test capability for microphones, earpiece, and loudspeaker
- The HEADSET CQA area should be used to debug any detection, or lack of audio on the headset jack path

“No Audio” Complaints

- The CQA apk can be used to verify a broken audio path. Under the “Audio” menu, select “Mic Loopback”.
  - The “PRIMARY MIC” setting allows a mic1 to earpiece loopback **(recommended)**
    - Note* - The “DEFAULT MIC” setting also allows this, if a headset device is not plugged in.
  - The “SECONDARY MIC” setting loops mic2 to the earpiece, and so on.
  - If a headset is inserted, the “DEFAULT MIC” setting will loopback the headset mic if one exists.
  - Selecting the other microphone paths while a headset is inserted will loopback the audio to the headset speakers.

- If both of those are not functional, the earpiece speaker path is likely damaged. In the “AUDIO” menu of the CQA apk, select “Ear Speaker” and then “Play Harvard speech pattern” and/or “Buzz Sweep”.
- The loudspeaker can be tested by selecting “Loudspeaker” via the CQA apk. A musical composition should start playing and be easily heard.
- If audio is not present on the HEADSET path, select the “Headset” entry in the main menu of the CQA app, then plug-in the headset device to view whether the lack of audio is a detection-cycling issue or other anomaly.

Microphones

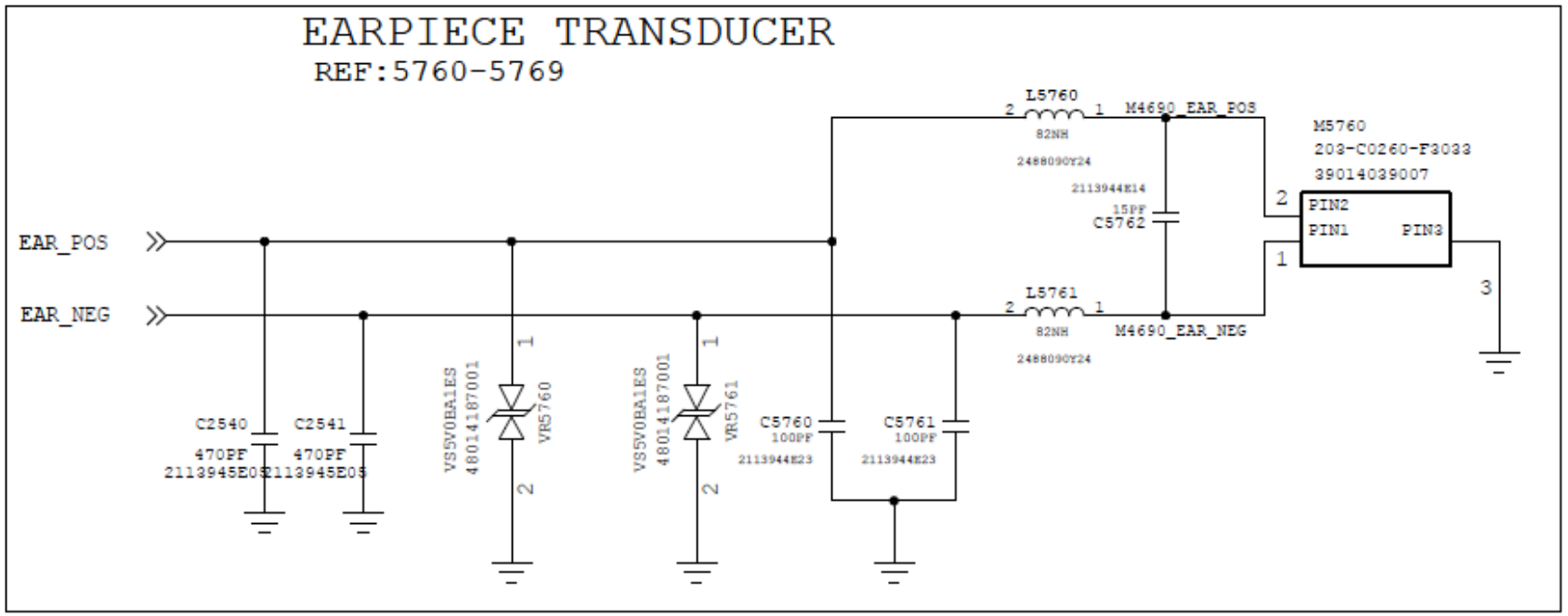


Microphones Troubleshooting

If a mic is not functioning…

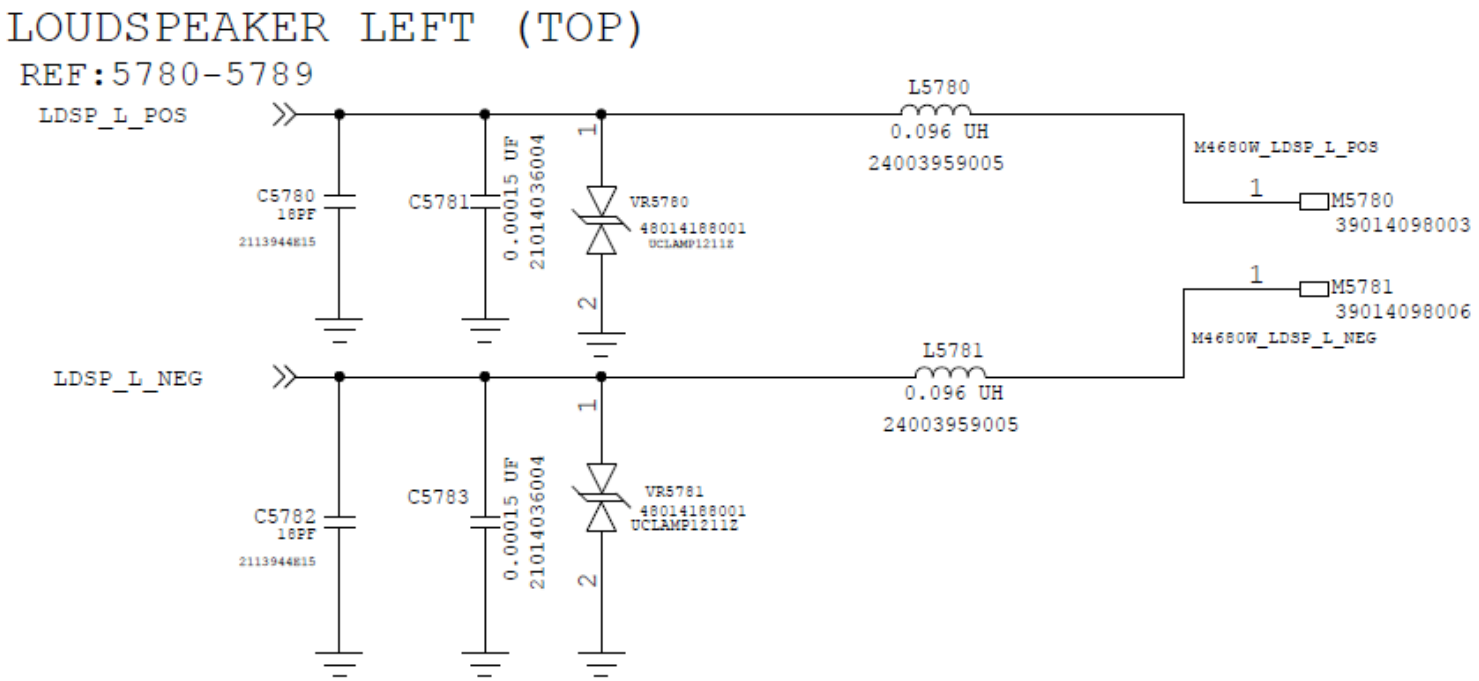
- Check to make sure the microphone and mic ports are not blocked.
- Check to make sure the mic gasket and mic grommets are seated properly.
- Check the microphone for diaphragm debris indicating a shattered diaphragm. Look under a microscope to view inside the microphone port for damage or debris.
- Check to make sure none of the capacitors on the mic lines are shorted or damaged.
- Check the mic bias C5702 (Mic1), C5757 (Mic2), C5717 (Mic3). The mic bias should be 2.8V when the microphone is enabled.
- If the failure is no microphone audio, check mic loopback through CQA at the board level with a display connected. (Mic loopback may be easier to check with a headset plugged in)
- If there is no audio during mic loopback, inject a 35mVrms, 1kHz sine wave onto the mic signal side of C5700 (Mic1), C5751 (Mic2), C5711 (Mic3) and listen for the tone during loopback. If you can hear the tone now, you know either the mic is bad, or there's a process defect with the mic-to-PCB connection.
- X-ray the mic to check for process defects.
- If swapping the microphone fixes the issue, the bad microphone should be sent to the supplier for FA.

Earpiece Speaker (Handset Mode DOWNLINK)



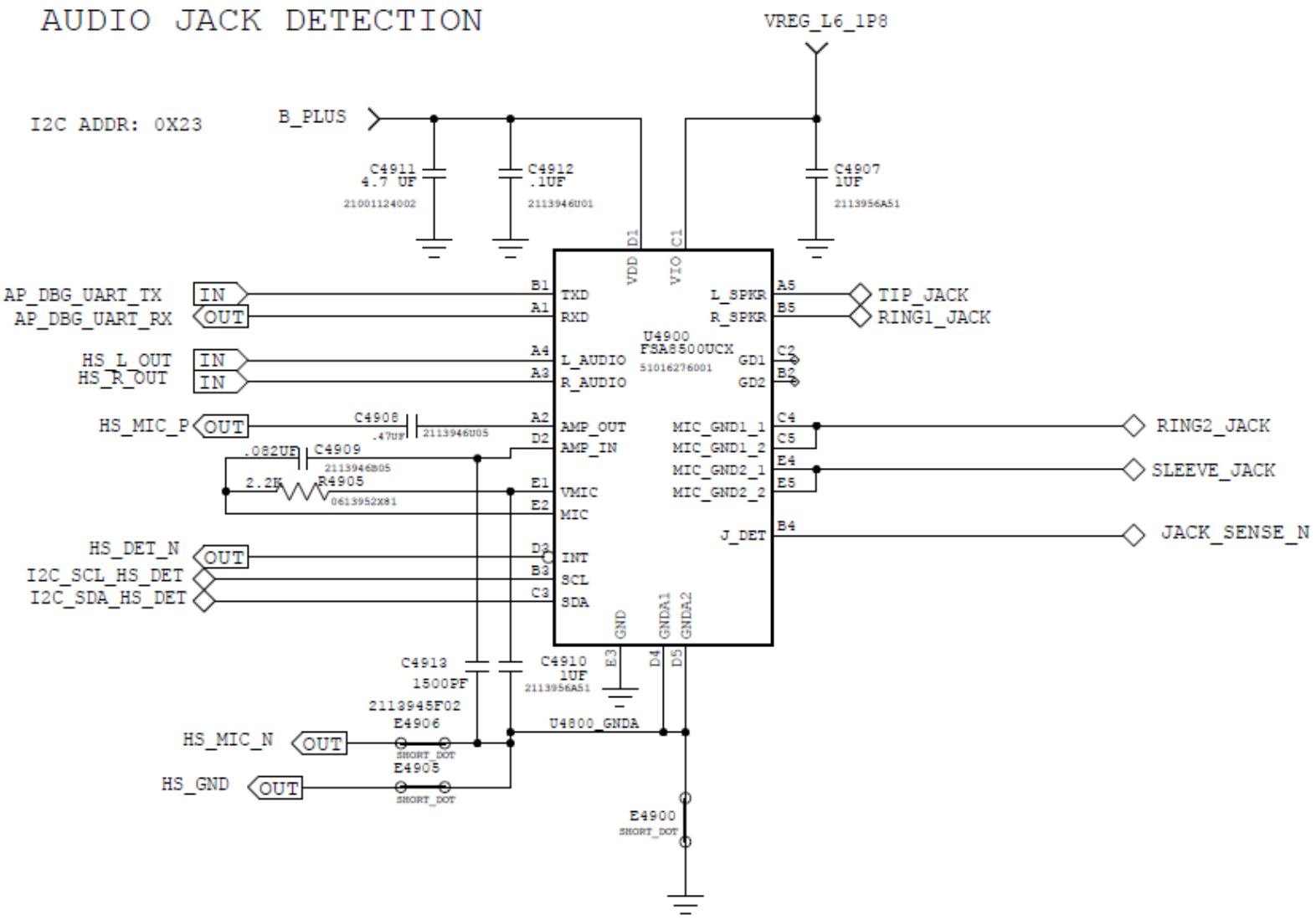
- Check that the impedance of the earpiece speaker is 32 ohms, and that the spring contacts are not bent.
- Check that the earpiece flex is seated properly in the top carrier with no debris on it. You should also be able to see slight imprints in the gold pads where both the speaker contacts and PCB pogo contacts were touching the flex, these imprints should be centered - if they are on the edge of the pad, there is an alignment issue.
- Check that the earpiece pogo connector on the PCB is seated properly with no bent or stuck pogos.
- Check that L5760 and L5761 are not damaged or skewed. Also check C5760, C5761, C5762, VR5760, VR5761, C2540, and C2541 for any placement issues.

Loudspeaker

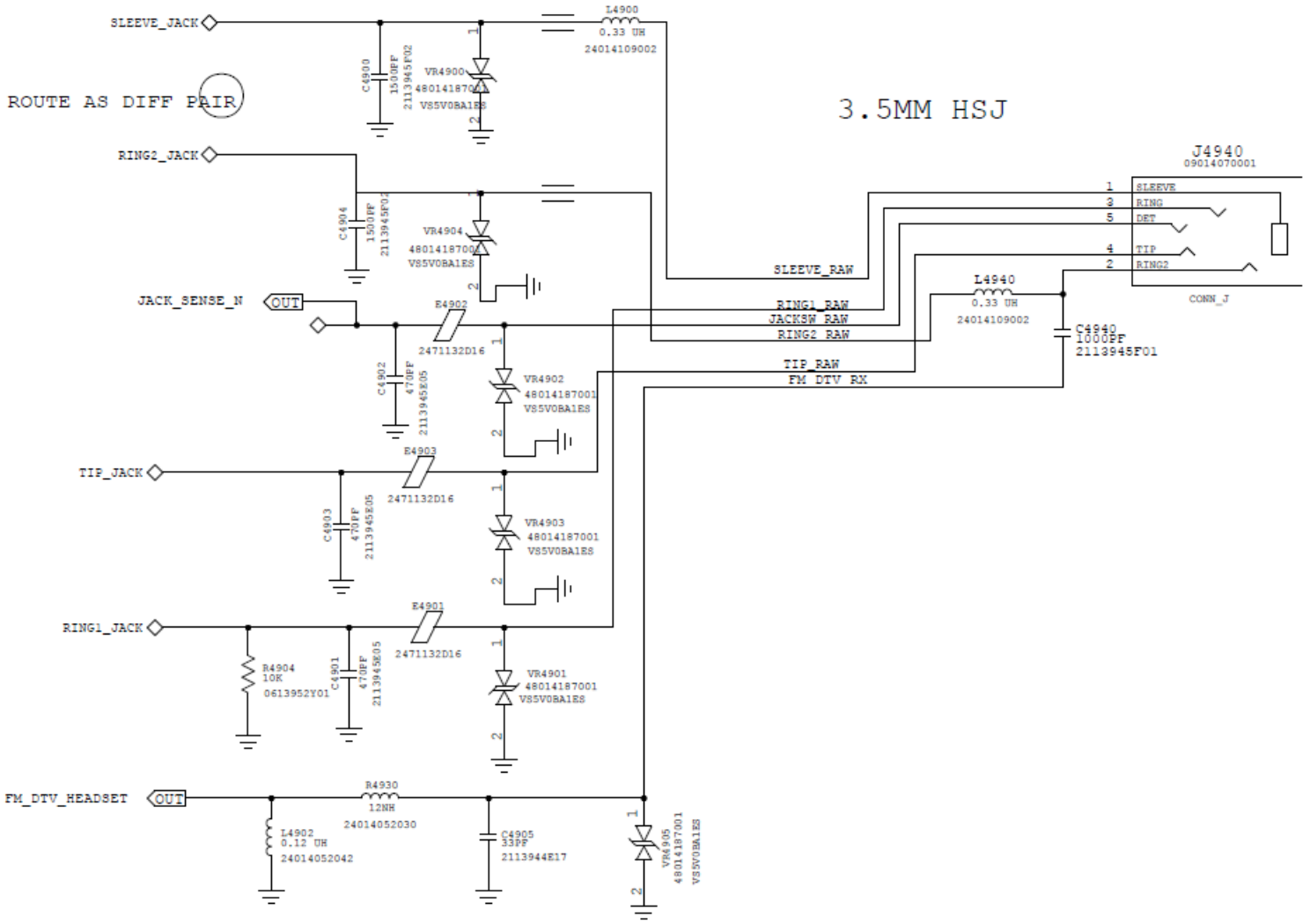


- Verify the impedance of the loudspeaker is 8 ohms.
- Verify the loudspeaker and gaskets are placed correctly on the front and rear housing.
- Lack of mechanical contact should also be checked (bent loudspeaker pins on speaker or bent/missing jumper contact on rear housing).
- Make sure L5780 and L5781 are not skewed or damaged.
- Check C5780, C5781, C5782, C5783, VR5780, and VR5781 for any placement issues.

3.5mm Headset Path



3.5mm Headset Path (cont'd)



Debug Procedure: Headset

- Check the pins on the headset jack for any bent pins or missing pins (Top Carrier)
- **On the PCB:**
  - Series components L4900,E4901, E4902, E4903, and L4940 must be physically placed and measured using a DMM. Replace if any are found to be open circuit.
  - ESD Diodes VR4900, VR4901, VR4902, VR4903, VR4904 must be open circuit. Measure these with a DMM to ground. If any short circuit is found, replace the ESD diode.
  - Shunt caps C4900, C4901, C4902, C4903, and C4904 must not be shorted across.
  - U4900 must have voltage on the VDD line, and can be probed on C4907. This should measure 1.8V nominally.

NO POWER UP DEBUGGING

No Power Up Debugging

Purpose of this section is to cover the debugging steps used to root cause PCB that do not power up properly so that they may be used again to initiate corrective actions.

Glossary/Synonyms

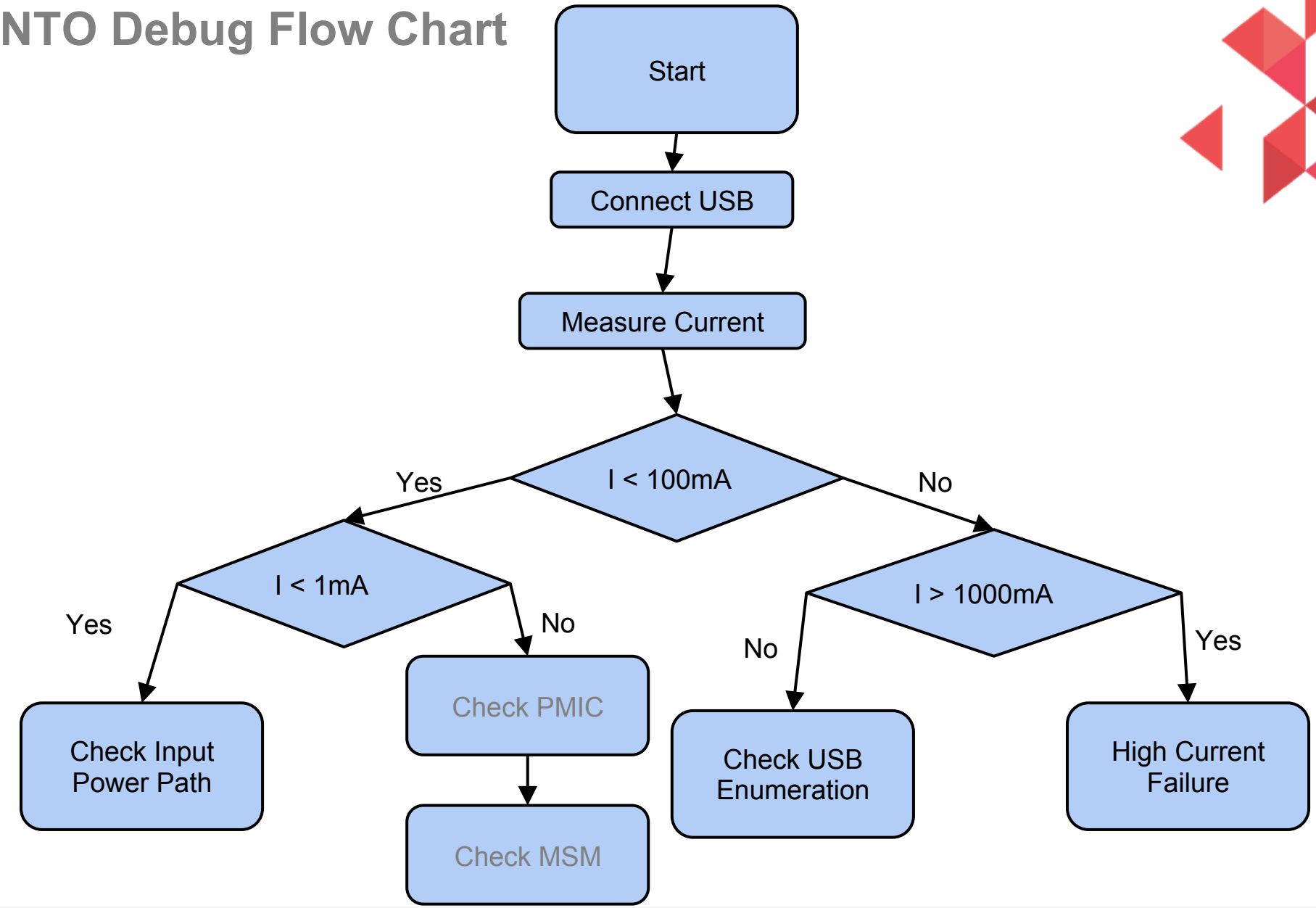
Terms on the same row are synonyms and will be used interchangeably in this section.

MSM	AP/BP	MSM8939	U1000
Power Management IC	PM8916	PMIC	U2000
SMB	Charging IC	SMB1359	U5240
Kung Kow	Factory Kill IC	User Reset IC	U5032
B_PLUS	VSYS	System Battery Voltage	
VBUS	USB Voltage	Charger Voltage	

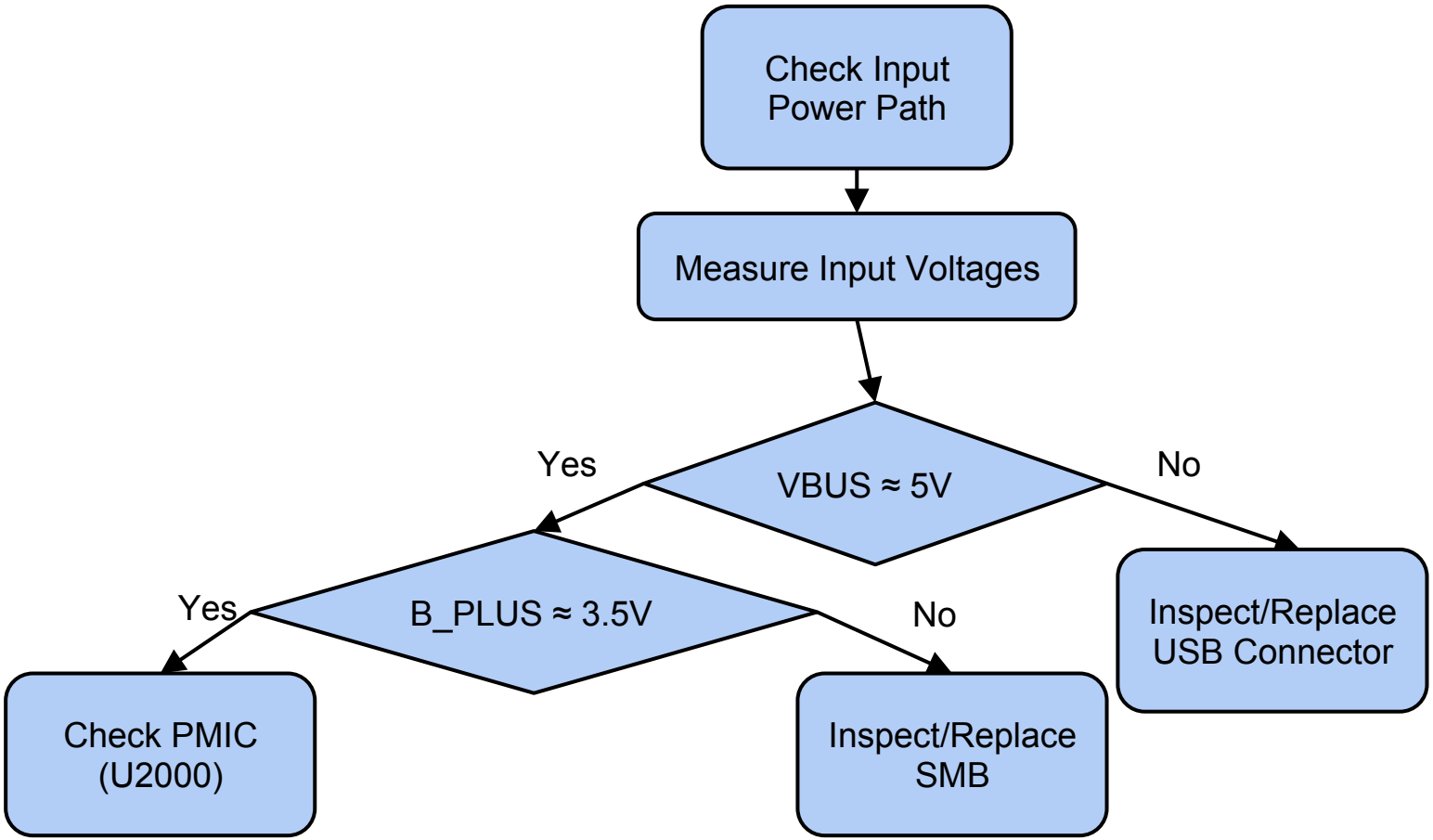
Debug Procedure

- Generally the first step to troubleshooting a no turn on PCB is to look at its boot current. A blank board (no software flashed yet) will normally draw about 60mA at a constant level.
- Also it is helpful to find out what level of functionality is available. These distinct modes were observed:
    1. Blank Flash mode
        - Normally will enter this mode for a newly built PCB.
        - Can be forced by shorting debug connector as shown in later slides.
    2. Fastboot mode
        - Normally will enter this mode after flashing bootloader into newly built PCB.
        - Can be forced using volume down key during bootup
    3. Full Power up
        - Will enumerate to PC as Motorola Network device and ready for board test.
- Failed boards will be able to achieve one of these modes but fail to get to the next. This bit of information is useful for debugging.
- Start with the phone off, then plug in the USB cable. If the phone does not turn on when the USB cable is inserted, there is most likely an issue with the connector.
- If the current is abnormally high for a blank board, the root cause is most likely a short. Going through the power on sequence is helpful for finding shorts, it is shown on the next page.

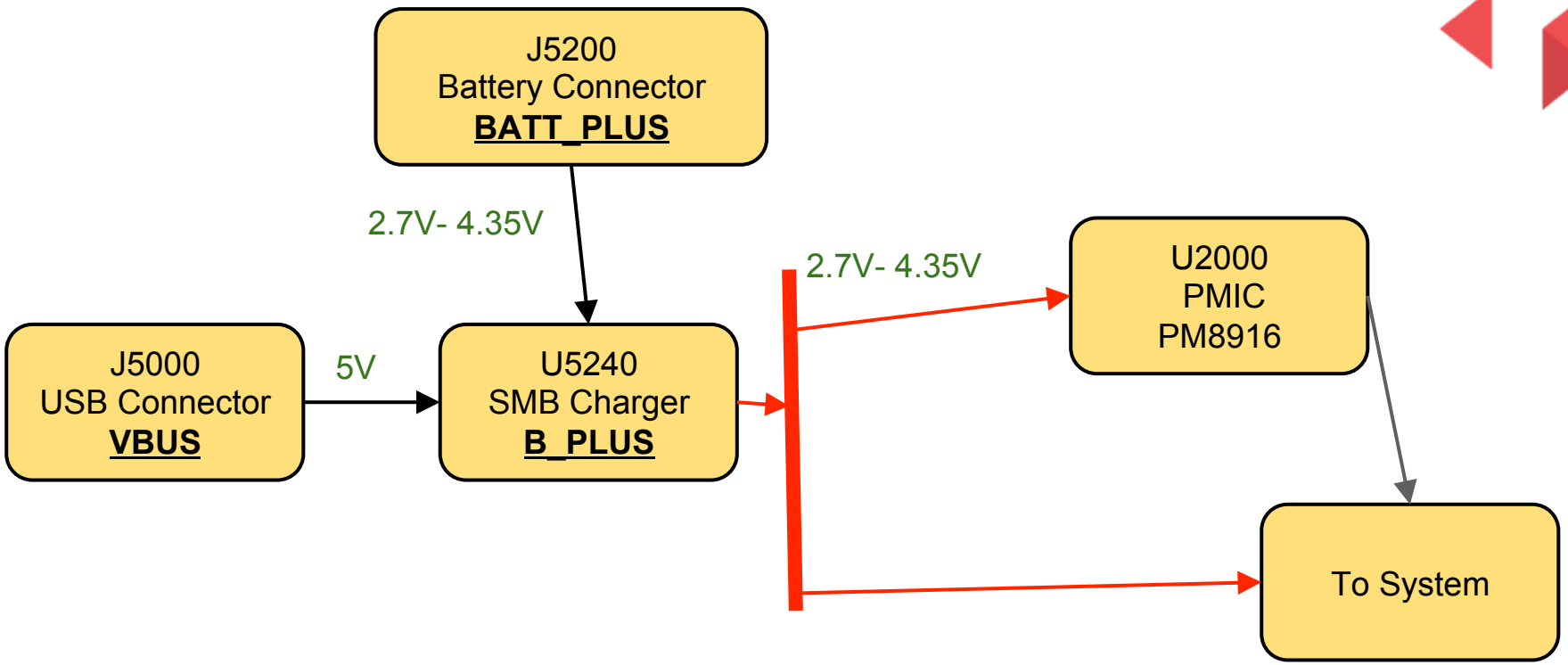
NTO Debug Flow Chart



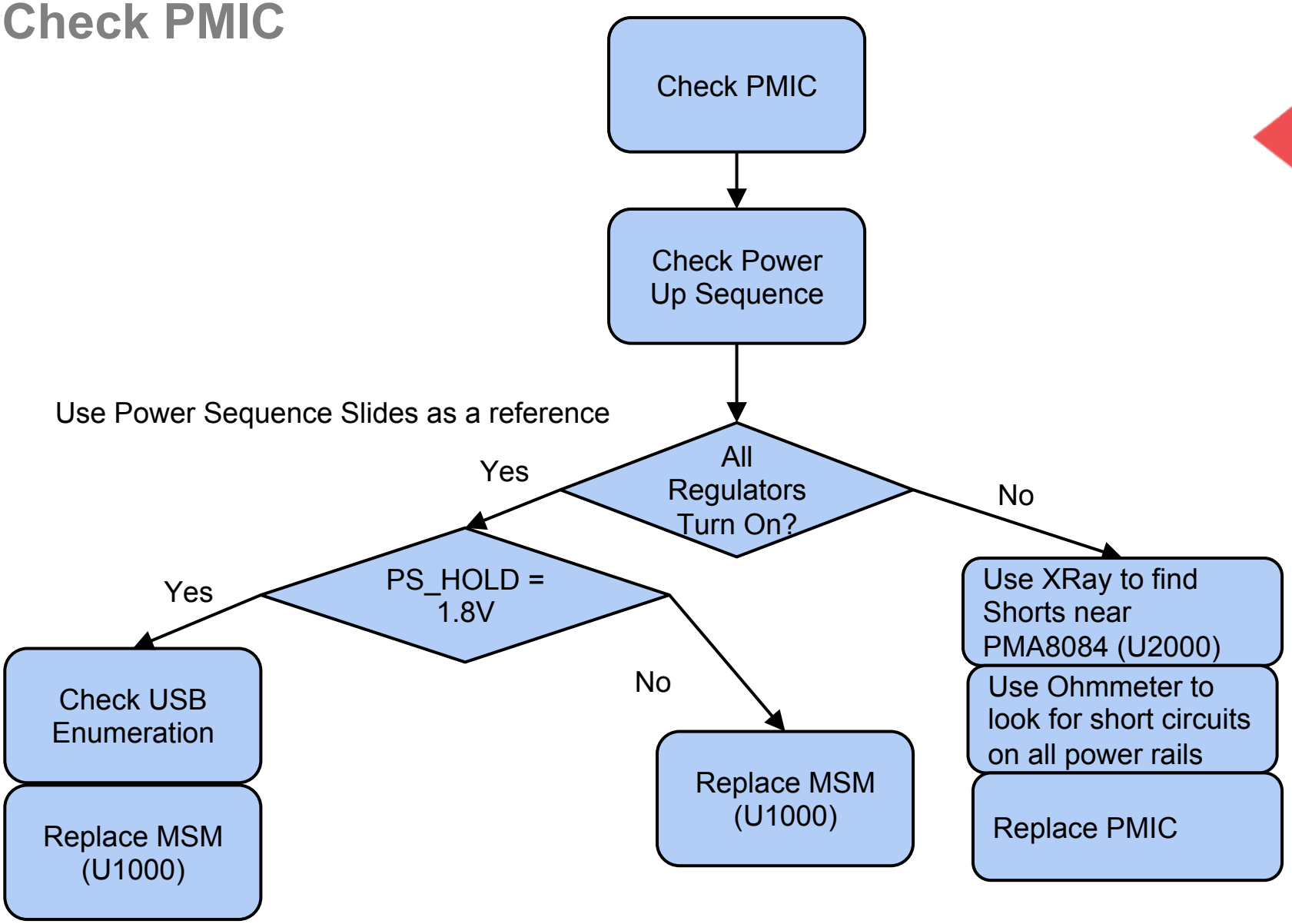
Check Input Power Path



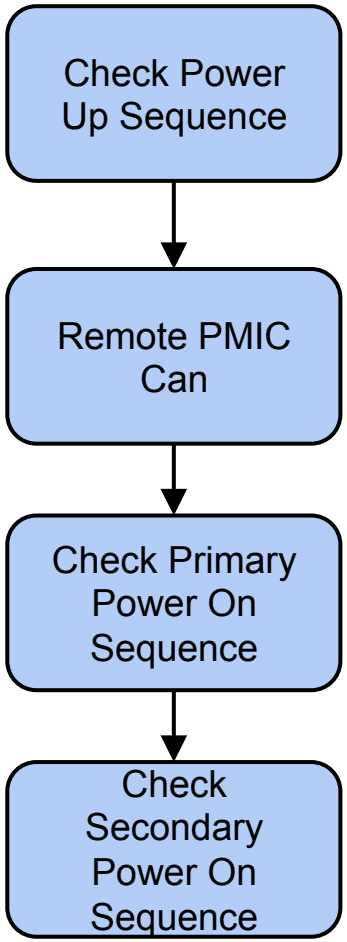
Simplified Input Power Tree



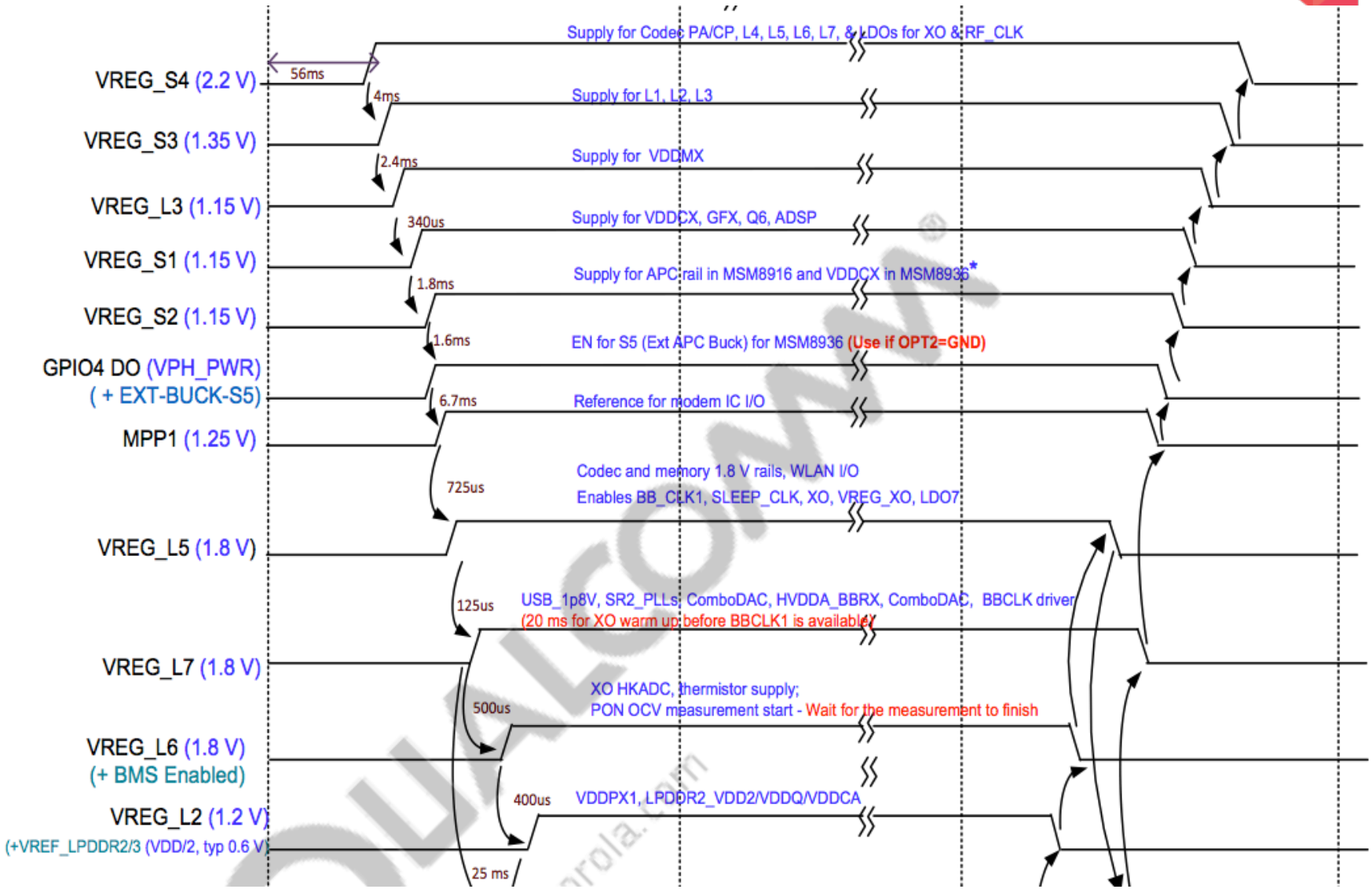
Check PMIC


Check PMIC
Check Power Up Sequence
Use Power Sequence Slides as a reference
All Regulators Turn On?
Yes
No
PS_HOLD = 1.8V
Yes
No
Check USB Enumeration
Replace MSM (U1000)
Replace MSM (U1000)
Use XRay to find Shorts near PMA8084 (U2000)
Use Ohmmeter to look for short circuits on all power rails
Replace PMIC

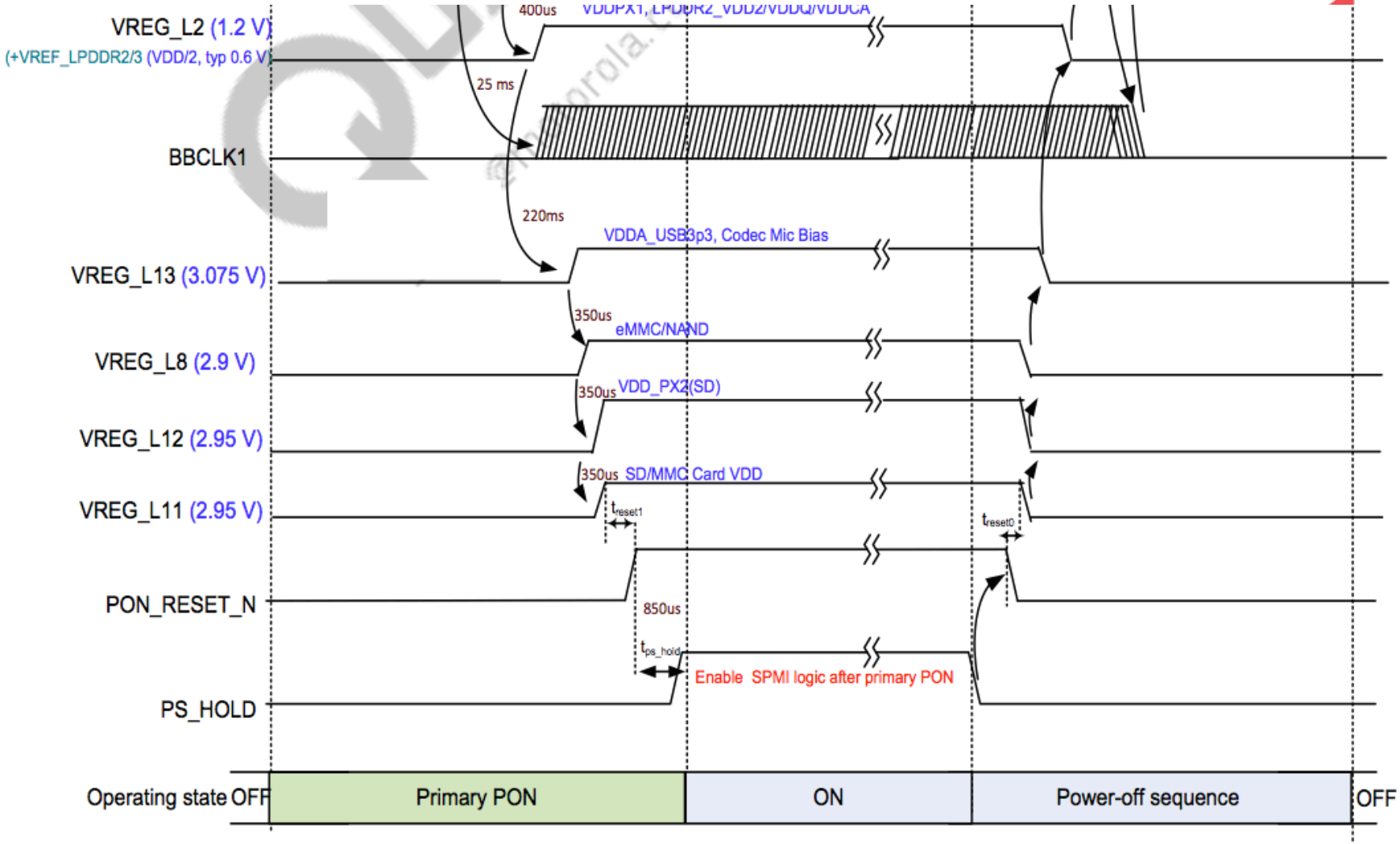
Check Power Up Sequence



Primary Sequence (1)



Primary Sequence (2)

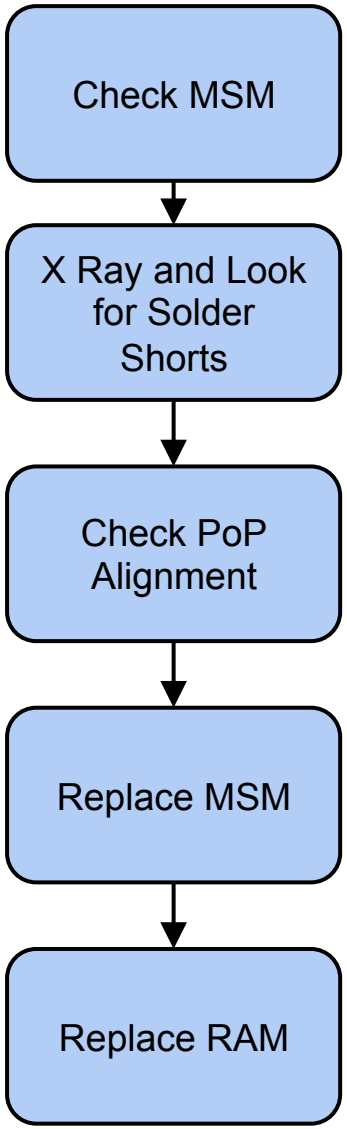


Secondary Power Up Sequence

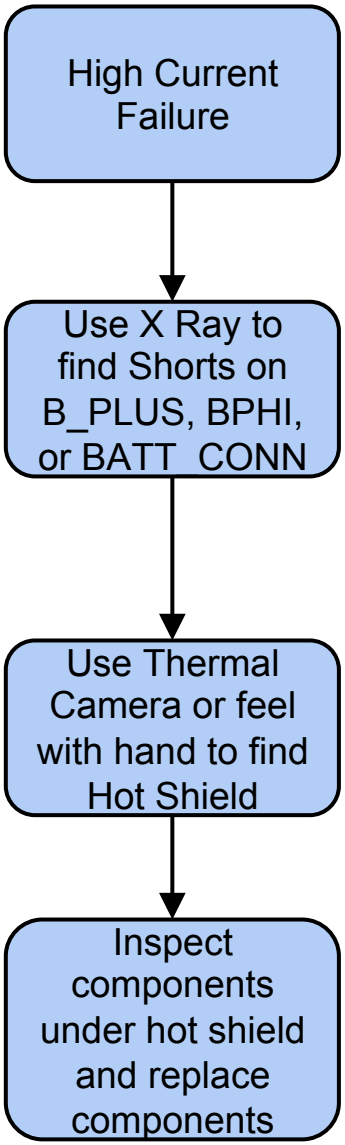
After the primary power up sequence, the secondary rails will be turned on by software. The timing was measured in the lab and recorded in this table.

Power Rail	Voltage [V]	Time [ms]
S4	2.22	0
S3	1.35	3.04
L3	1.14	4.77
S1	1.16	4.95
S2	1.14	5.88
S5	1.15	7.6
L5	1.8	11.8
L7	1.79	11.84
L6	1.79	12.24
L2	1.2	12.35
L12	2.94	155.1
L8	2.86	155.2
L13	3.07	155.2
L11	2.94	190.2
L17	2.84	381
L16	3.08	469.2
L18	2.68	13000
L15	1.8/2.99	13130
L1	0.986	13200
L9	3.29	13250
L10	2.79	14410
L4	1.8 then 2.05	14450
L14	1.8/2.98	14880

Check MSM


Check MSM
X Ray and Look for Solder Shorts
Check PoP Alignment
Replace MSM
Replace RAM

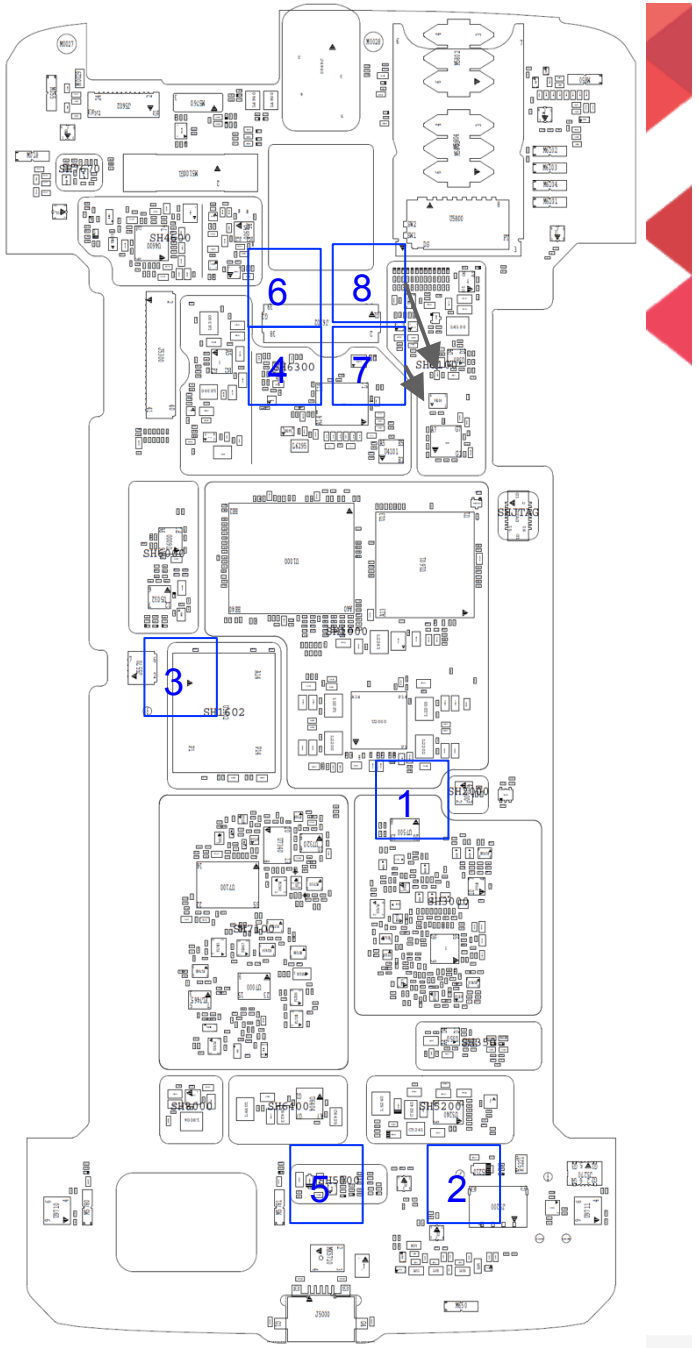
High Current Failure



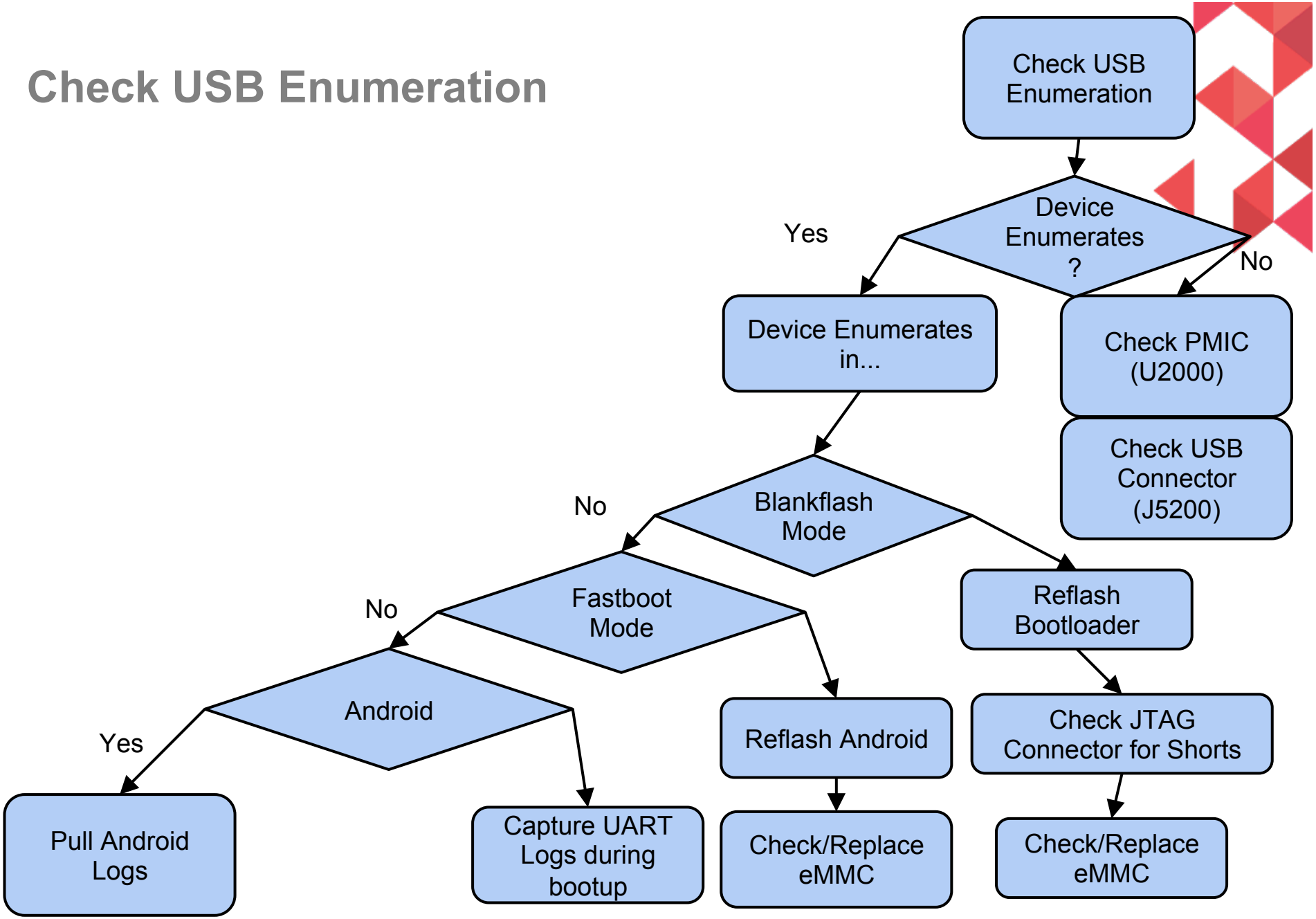
High Kill or Off Current

- First check for solder ball shorts on major ICs or discrete resistors or capacitors that are skewed and shorting to each other
- Follow the list at right
- Replace parts in order
- Recheck test after removing each shield and after removing each component

Circuit	Typ [uA]	Max [uA]	Ref
PM8916	5	18	1
SMB	12	20	2
Kung Kow	1	1	3
Vibe Driver	1.75	4	4
Loud Speaker	1	1	5
HSJ	20	20	6
Rear Cam ALDO	1	1	7
uSD LDO	1	1	8
Rear Cam LDO Bia	1	1	9
Rear Cam AFLDO	1	1	10
LED Cam Flash	1	1	11
Front Cam ALDO	1	1	12
Display PMU	1	3	13
Prox LED	1	10	14
QFE	1	5	15
NFC	3.9	3.9	16
Fuel Gauge	25	42	17
Tuner	1	2.8	18
TOTAL	**79.65**	**136.7**	

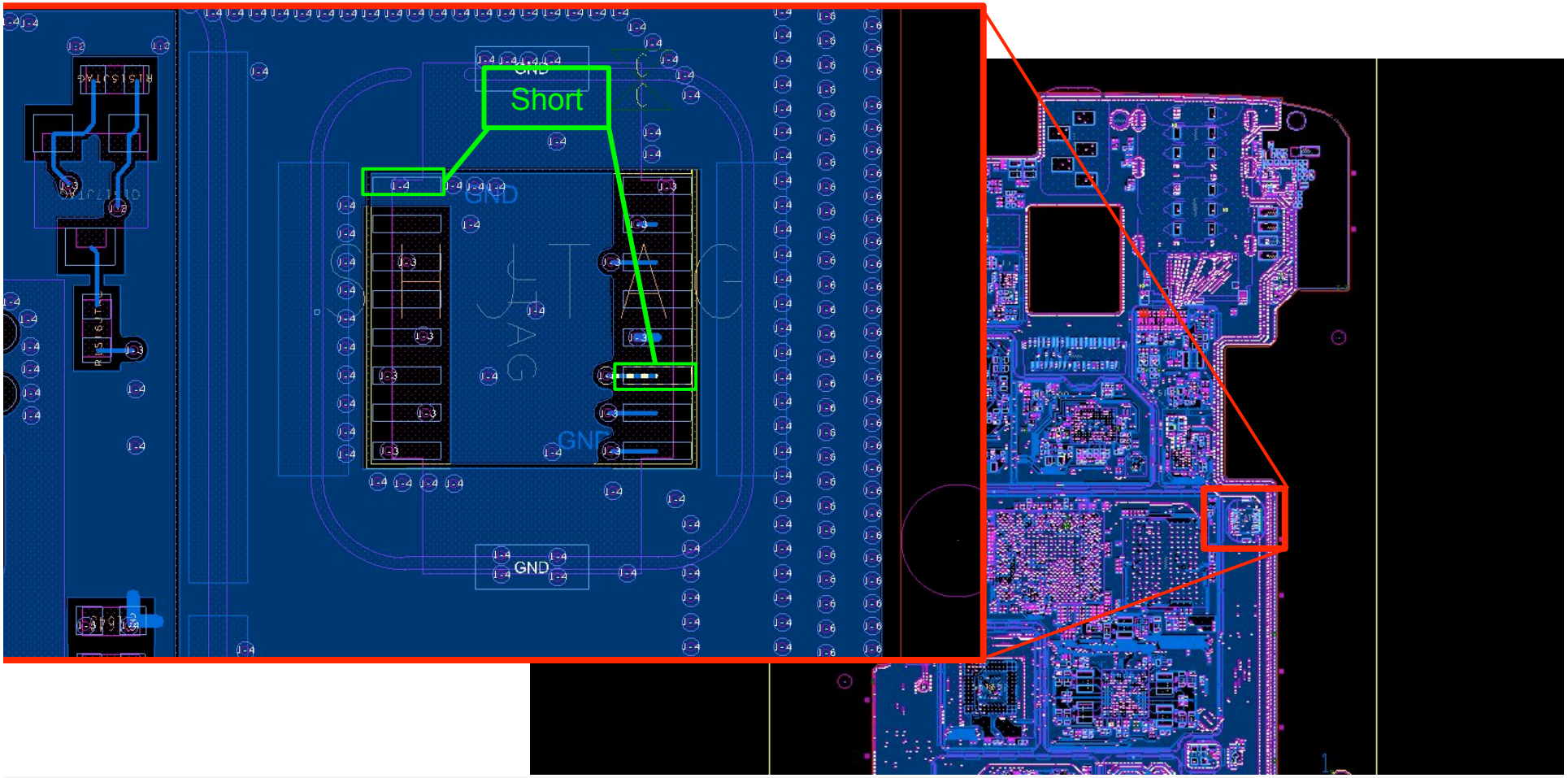


Check USB Enumeration



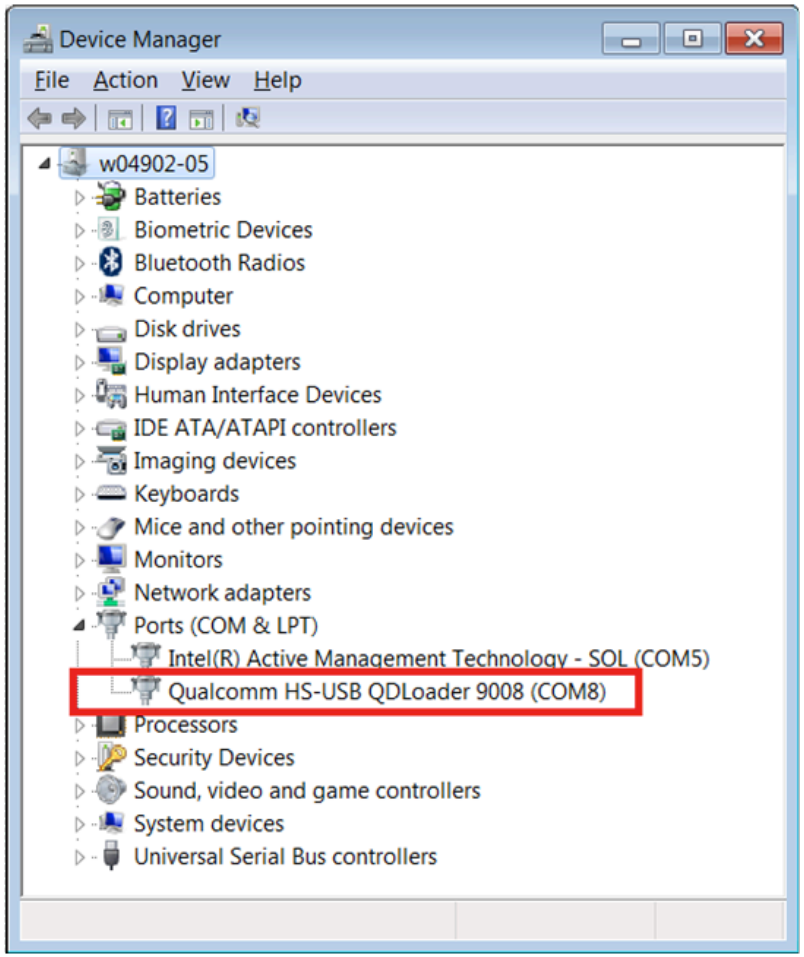
Force Blankflash Mode

- Sometimes if a board has software already flashed, or there was some problem with software, a board can be forced into this mode by shorting two highlighted pins on the debug connector:
- Then when board is in this mode, blank flashing can be attempted to reflash the device and/or find more information on the failure.



Blankflash Mode

- If in blankflash Mode, the device will enumerate like this



BATTERY AND CHARGER TROUBLESHOOTING

Battery and Thermistor

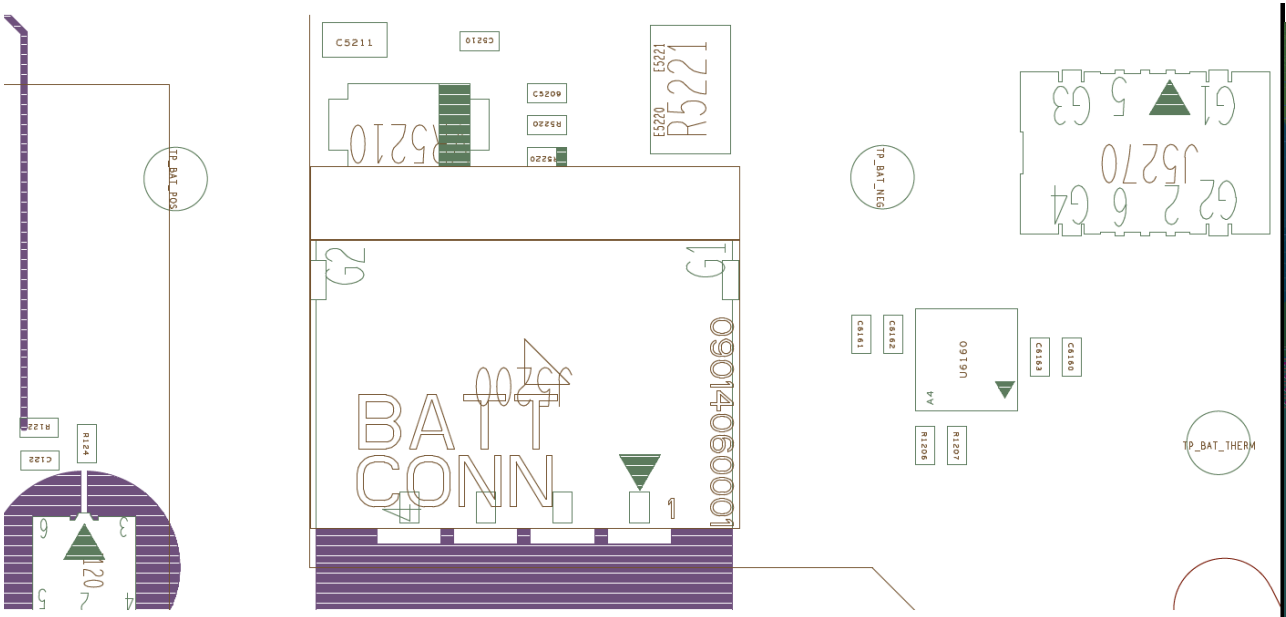
No turn on with battery only:

- If the device does not power up with battery alone, it could have a dead battery, there could be an issue with the battery safety control FETs or safety IC, or an intermittent or broken trace or via in the battery PCB or the flex, or with the board-to-board connection of the battery to the board. If you cannot recover the dead battery with charger, measure the battery voltage. And if it is normal, monitor on a scope for voltage dipping below 3V while attempting to power it up with battery. This can happen due to high impedance FET or IC in the battery or excess current drain.
- If it powers up with factory cable, replace the battery, and if the issue is resolved, send the battery to development team.

Thermistor reading out of the spec:

- This should be usually 20 to 30C, or 40C depending on the ambient temperature and if the phone has been in use or charging for a while. This can be read with adb commands or under battery info in CQA mode.
- Notify the mechanical engineer in charge of the battery and thermistor to inspect the back housing of device for any signs of the thermistor damage or dents.
- X-ray the NFC connector to ensure that it is seated properly and shorts/debris are not present
- Carefully lift and cut a hole in the back housing cover to expose the thermistor, and carefully measure its resistance with a meter. Take care not to apply unnecessary pressure on the device so that condition can be preserved for analysis. If the measurement is out of spec of 8-12K-Ohms, hand the device as it is to the mechanical engineer for further analysis and corrective action.

Battery, Thermistor, USB Connector Test Points and Signals on PCB



USB Charging Issue

Ensure the device is not in factory mode. Ensure battery temperature reading is as expected (see previous slide).

Inspect the battery for any damage or abuse. Ensure by measurement or from CQA battery info menu that the battery pack voltage and cell plus sense voltage levels are according to the expected charge current level.

There could be an issue with the USB connector or its connections to the board and the charge IC. Measure VBUS (5V, or 9V for turbo charger), D+, D-. Measure this at the charger cable if possible or preferred at first, then on the PCB and, as needed, next to the charge IC. See table below for expected Turbo charger D+/D- levels.

HVDCP FOURTH DETECTION VOLTAGE TABLE

Portable Device		HVDCP
D+	D-	Adapter Voltage
0.6V	0.6V	12V
3.3V	0.6V	9V
0.6V	3.3V	Reserved
3.3V	3.3V	20V
0.6V	GND	5V

The lightning bolt in the battery meter icon represents a valid VBUS voltage. Also “Turbo charger connected” is displayed if a turbo charger is connected. It is not displayed otherwise, or if a turbo charger is connected partially into the device, and inserted all the way in more than a second or two later.

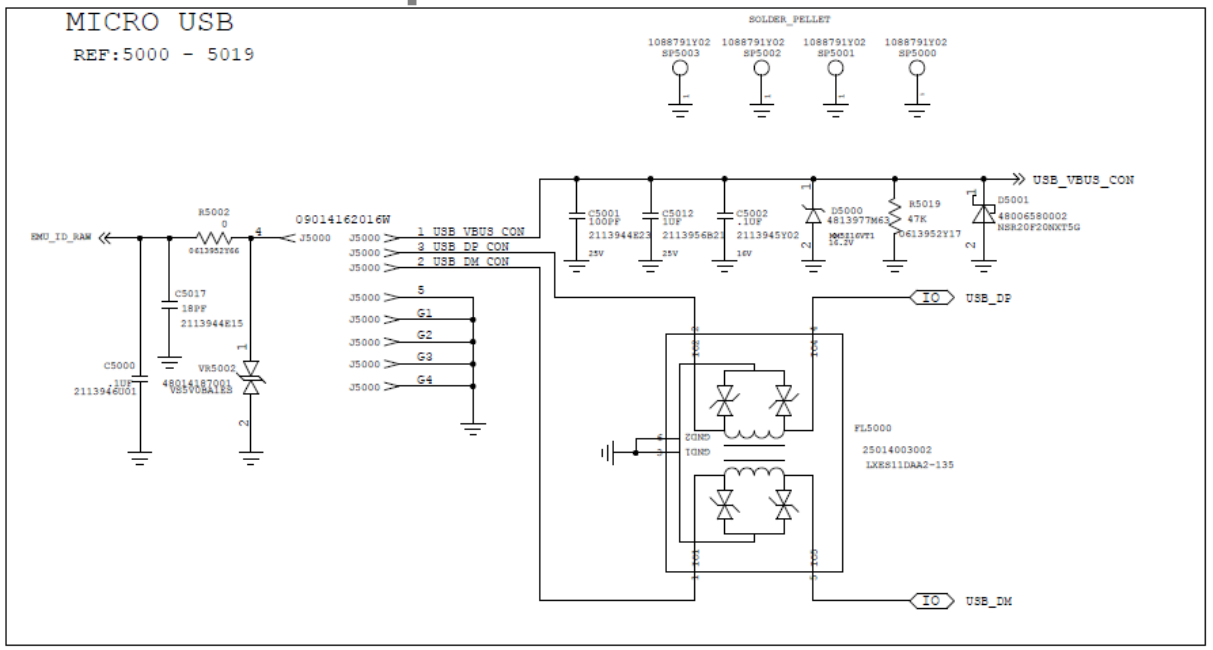
USB Charging Issue (cont'd)

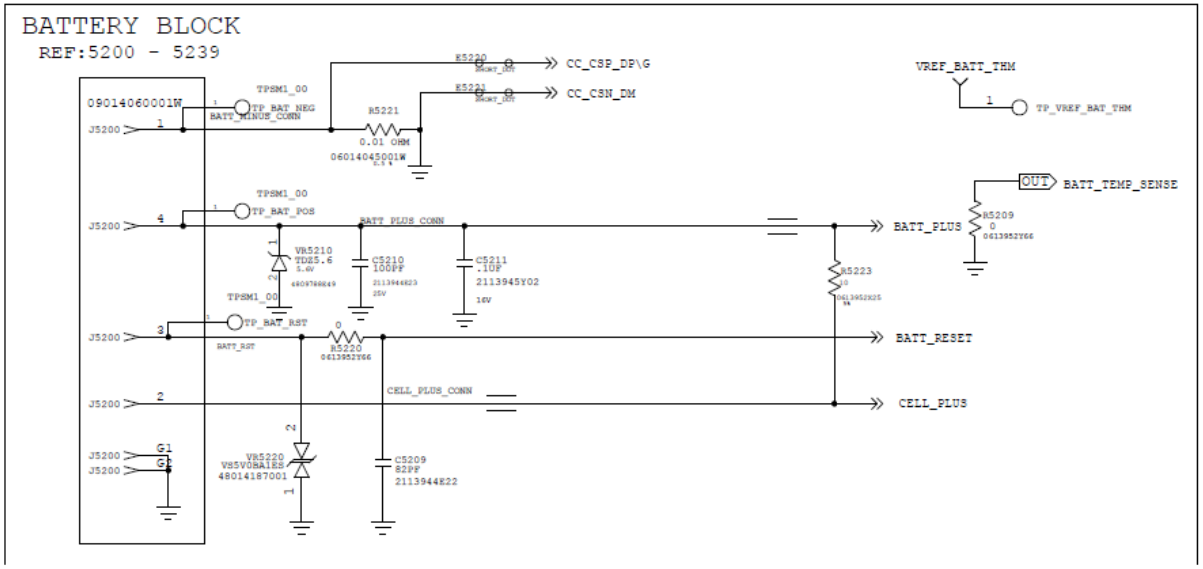
Ensure the phone current drain does not exceed the charger supply current capacity in the use case where battery is not able to charge.

If the device power cycles when the battery is low and USB charger is connected, monitor the current drain in or out of the battery as well as the battery voltage with a scope across the sense resistor.

There is also the rare possibility of charge IC itself damaged or have damaged or intermittent BGAs where a reflow followed by replacement of the IC might be needed as a last attempt to recover charge operation. This should be done after exhausting all other possible root-causes and discussing with development team.

Battery and USB Components



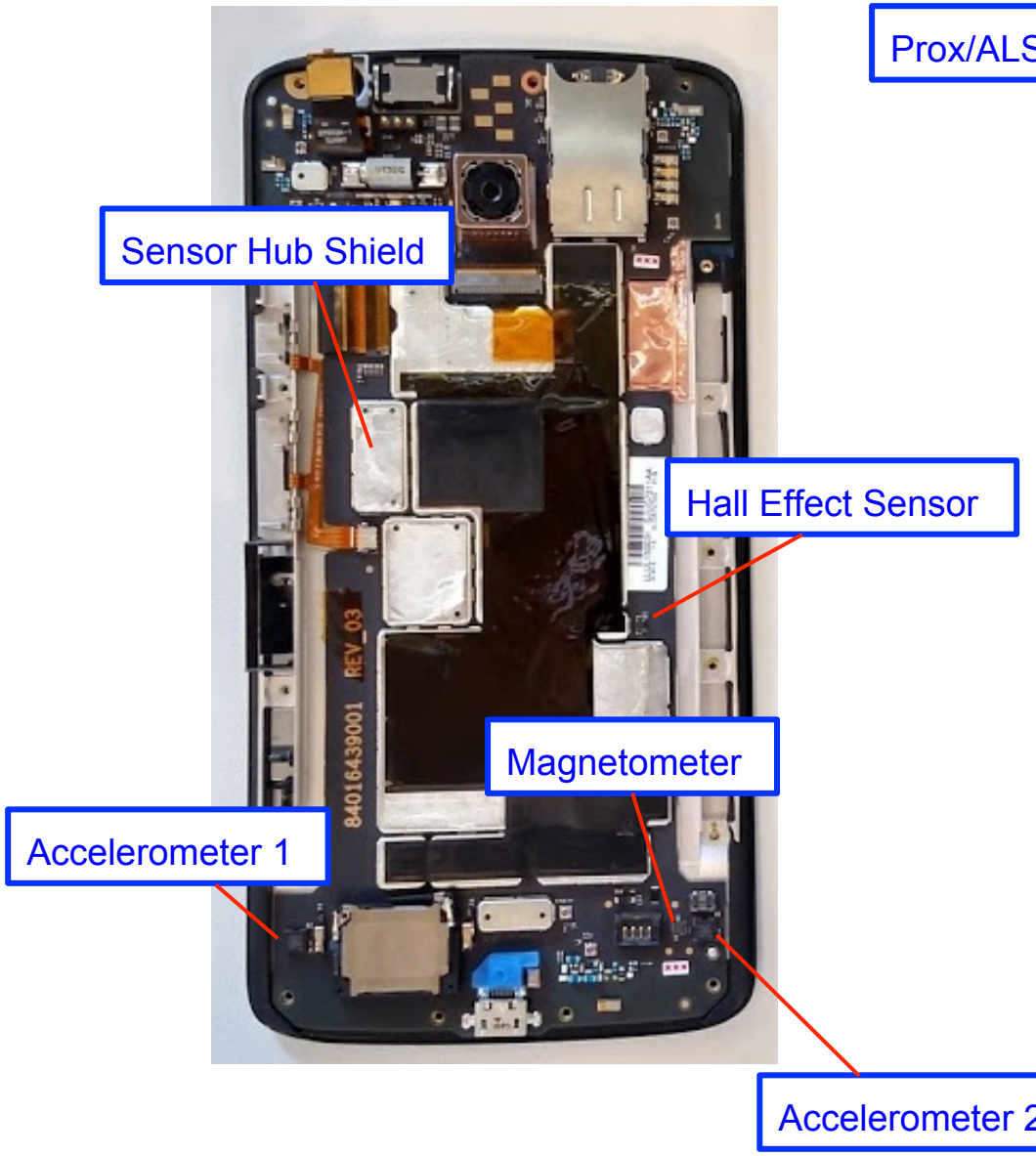


Debug Procedure: Battery Level

- If battery level reads 0%
  - Unplug factory cable, wait at least 3 seconds, then plug back in
  - If this does not work, try plugging in charger. If charge level is 1% or higher, leave on charger until 100% is reached.
- If battery level is too low but 1% or higher
  - Plug in charger and leave until 100% full

SENSORS AND SIM TROUBLESHOOTING

Sensors


Sensor Hub Shield
Hall Effect Sensor
Magnetometer
Accelerometer 1
Accelerometer 2
84016439001 REV_03


Prox/ALS

Sensor Hub Troubleshooting

- Firmware download failing/no communication with hub
  - Check U6000 supply at C6000 - Should be 1.8V
  - Check U6000 orientation
  - Check that reset line properly toggles during boot (can be probed at R6003)
  - If everything else looks good, try replacing U6000

Proximity Sensor Troubleshooting

- Proximity Sensor is part U6190
- If reading is failing:
  - Check black grommet in housing is not obscuring the top of the part
  - Try replacing replacing the part
- If no reading at all:
  - Verify part orientation
  - Verify voltage at C6192 is 2.85V.
  - Verify voltage at R6000 and R6001 is 1.8V
    - If voltage is missing try replacing U6190, U6000, or U2000 in that order

Ambient Light Sensor (ALS) Troubleshooting

- ALS Sensor is the same part as Proximity Sensor (U6190)

- If reading is failing:
  - Check black grommet in housing is not obscuring the top of the part
  - Inspect opening in lens. It should be translucent when holding front housing up to a light. Try swapping front housings.
  - Try replacing U6190
  - Test on different fixture, bulbs in fixture may be too old and dim.

- If no reading at all (error code):
  - Check part orientation of U6190
  - Verify voltage on C6192 is 2.85V
  - Verify voltage at R6000 and R6001 is 1.8V
    - If voltage is missing try replacing U6190, U6000, or U2000 in that order

Accelerometer Troubleshooting

- There are two accelerometers (U9710 and U9711)

- If no reading:
  - Check U6150 orientation.
  - Check that supplies at C9710 and C9712 are 1.8V.
  - Replace U9710 (primary) or U9711 (secondary), or possibly PMIC (U2000)

- If reading is failing:
  - Primary: Replace U9710, likely damaged accelerometer part.
  - Secondary: Replace U9711, likely damaged accelerometer part.

Magnetometer Troubleshooting

- Magnetometer Part is U6160

- If no reading:
  - Check U6160 orientation.
  - Check that supply at C6160 is 1.8V.
  - Replace U6160

- If reading is failing:
  - Replace U6160, likely damaged magnetometer part.
  - Test at board level if radio level testing is failing to determine if magnetic component in the housing is somehow affecting readings.

Hall Effect Sensor Troubleshooting

- Hall Effect Part is U6170.

- If no toggling:
  - Check U6170 orientation.
  - Check that supply at C6170 is 1.8V.
  - Make sure U6000 is placed and oriented correctly
  - Replace U6170, likely damaged hall effect part.
  - Can also replace U6000 if failure persists

Vibrator Troubleshooting

- Check that the vibrator motor is seated properly (correct alignment and pads are not lifted) and the counter weight is not bent and can rotate freely.
- Measure the resistance across the vibrator, it should be 14ohms +/- 4ohms.
- Check that E5101 and E5102 are not skewed or damaged.
- Check C5105, C5106, C5107 for damage or any process related defects.
- Check the motor itself by applying 2.4V across the C5105, it should spin freely and continuously. If the motor spins when 2.4V is applied externally, but not when driven from CQA app, x-ray U5101 for defects and replace as needed.

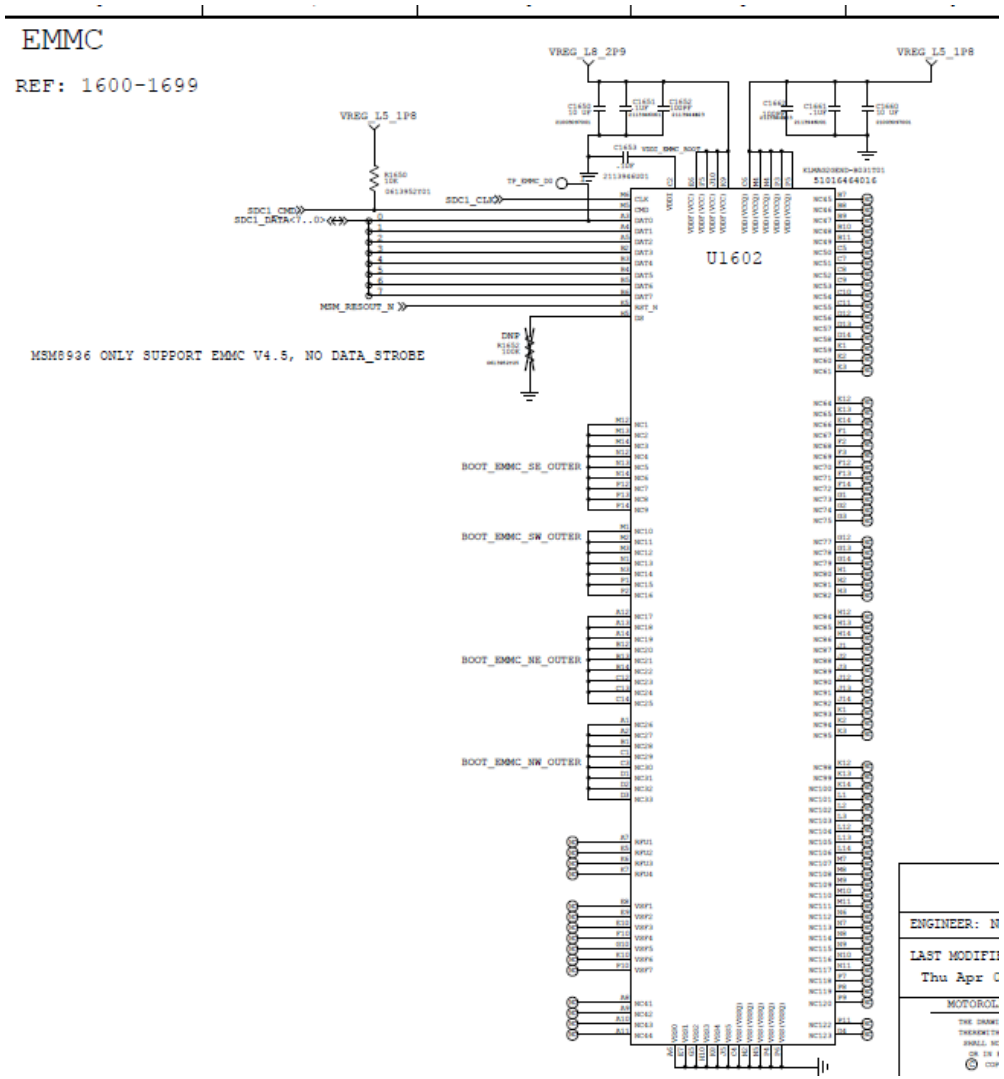
NOTE: If motor does not spin, or if motor stutters, but starts working normally after turning it manually, it has a “dead-spot”. Consider it a failure and replace the motor.

UIM (uSIM) Troubleshooting

- If SIM card errors occur:
  - Check orientation on ESD parts
    - SIM1: D5500, D5501, D5502
    - SIM2: D5510, D5511, D5512
  - Inspect card reader for bent or broken contacts.
  - Use multimeter to check connection between gold SIM contacts and pins on back of connector.
  - Verify a 0V voltage on Pin “tray_det” (C5803) when card is removed.
  - Verify 1.8 Volts on Pin “tray_det” (C5803) when card is inserted.
  - Check for unexpected shorts to ground on M5801 and M5802 pins 1, 2, 3, 6 (factory cable, USB, and battery must be removed).
  - SIM1 - Verify R5502, R5503, and R5505 are placed
  - SIM2 - Verify R5510, R5512, and R5513 are placed

PROCESSOR AND MEMORY TROUBLESHOOTING

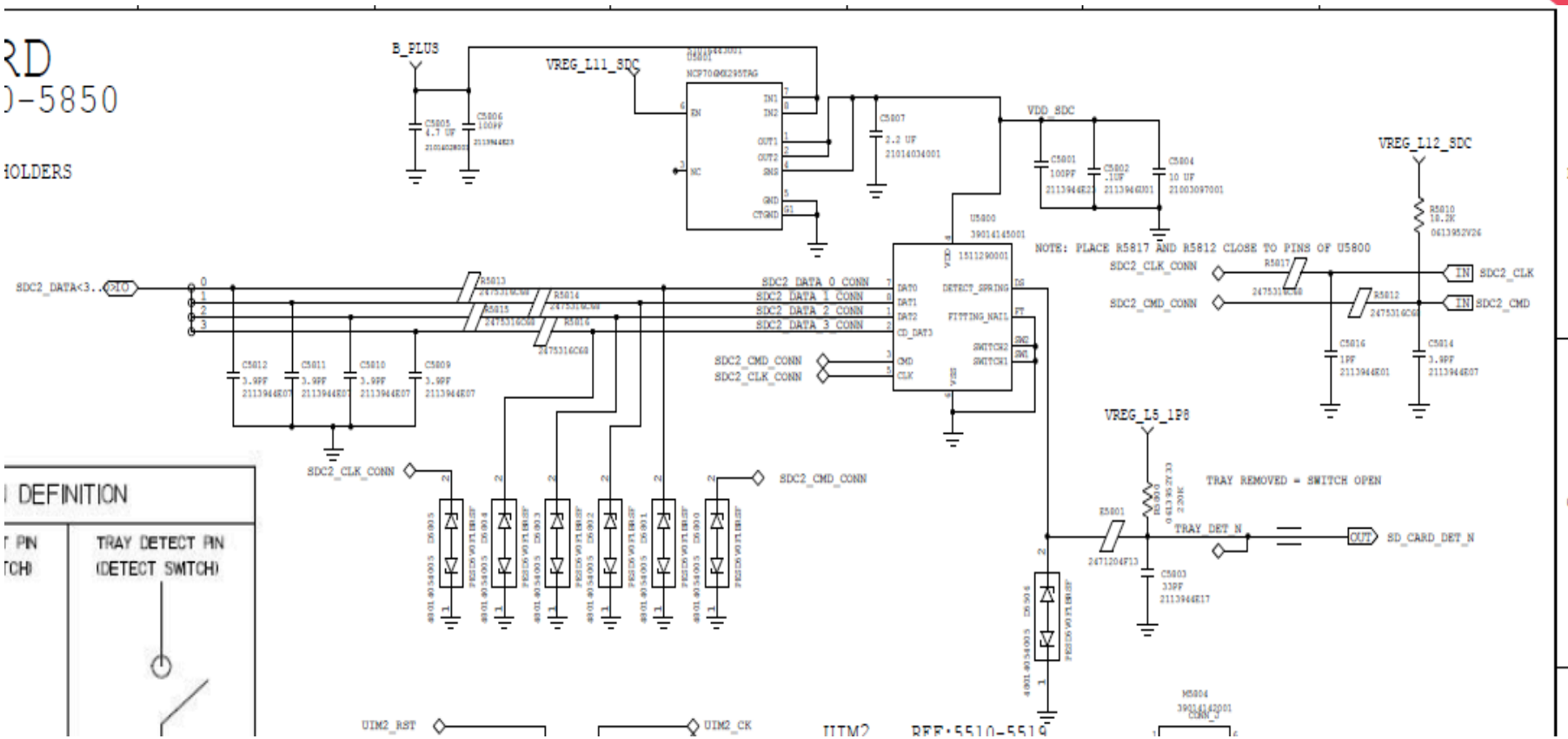
eMMC Schematic (Internal NAND) and Troubleshooting



If the phone is stuck at the logo screen or does not power up completely or keeps enumerating in blank flash mode then EMMC component could be suspected:

1. Check the 1.8V, 2.95V supplies
2. Probe the EMMC_CLK line to measure 400Khz first and then maximum of 177MHz.
3. Wire our command and data lines along with clock and put it on the scope. If the command does not output the command information then the EMMC controller inside the chip could be corrupted.
4. Note down lot code and date code.
5. Try user reset (hold power key for 10secs) and restart the procedure.
6. If it still fails X-ray the board and reflow the part.
7. If it still continues to fail, the part might need to go back to supplier.

Micro SDCARD Schematic (removable memory)



Micro SDCARD Troubleshooting (removable memory)

1. When you put a card in the tray you should see SD_Card_det_n line go high

2. Measure supplies VDD_SDC (3V), VREG_L5_1P8 (1.8V)

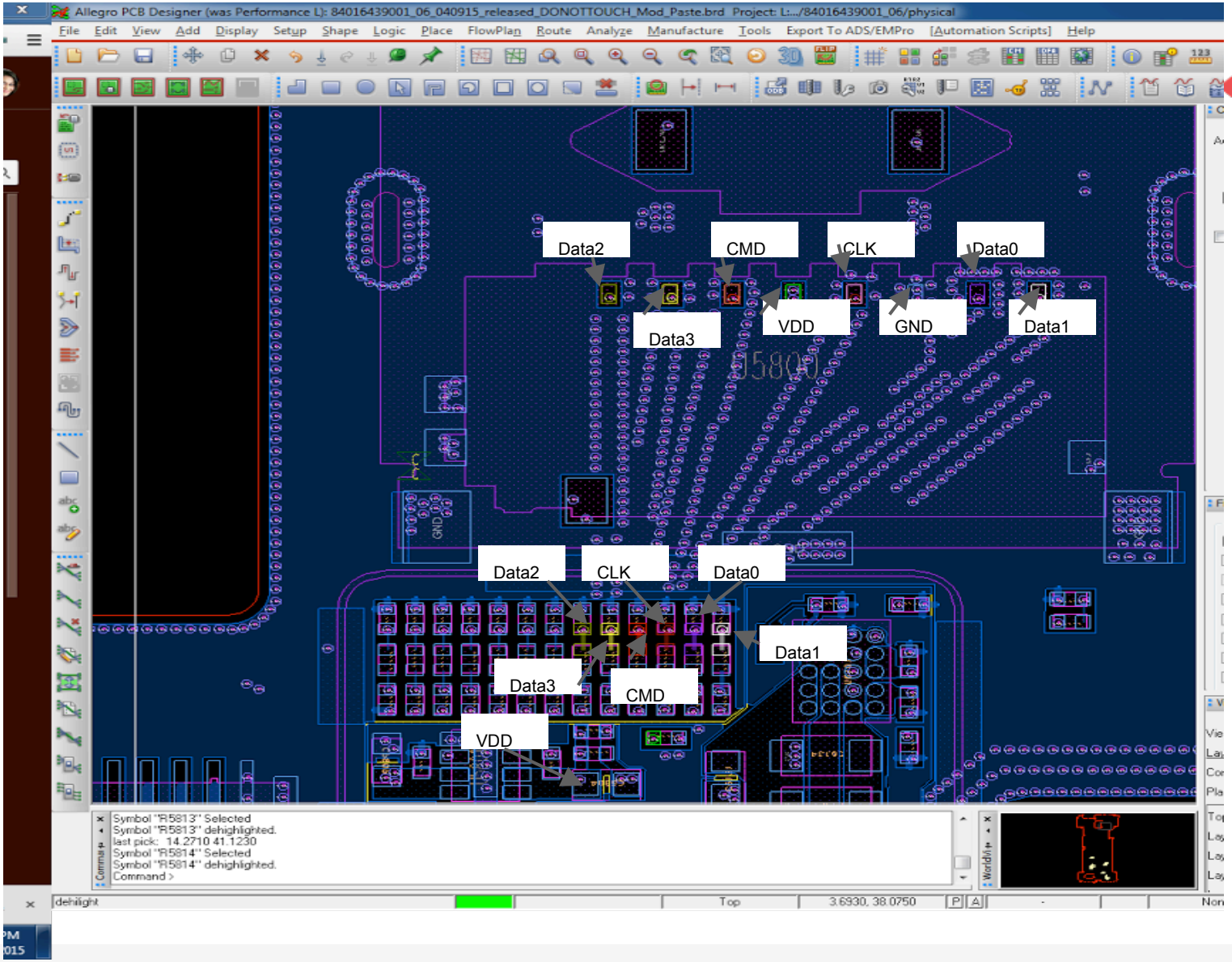
3. If you do not see the VDD_SDC supply come up measure the VREG_L11_SDC (1.8V) to ensure the LDO is turning on. B_PLUS can also be measured to see if its present.

4. Depending on the type of card placed in the slot you can measure sdc2_clk as 12.5MHz, 25MHz, 50MHz, 100MHz, 200MHz during a read or write operation

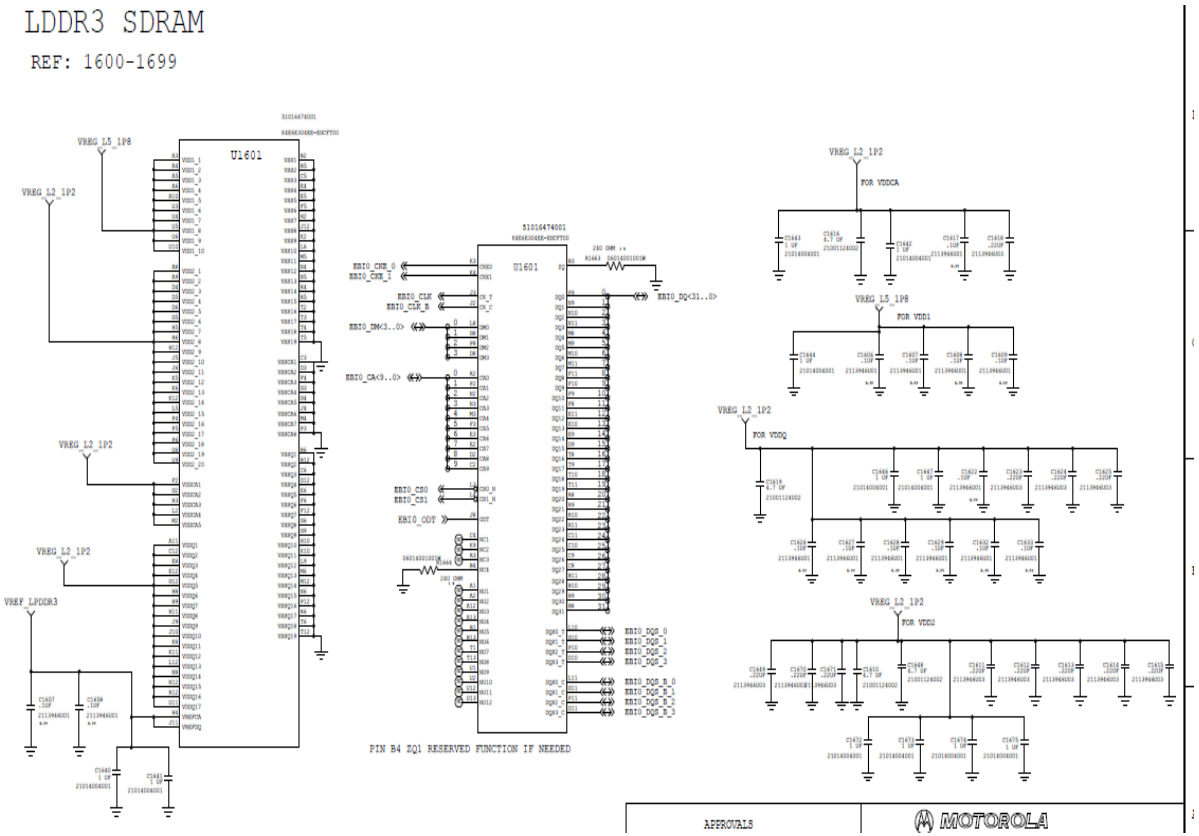
5. Probe SDC2_DATA<3..0>, SDC2_CMD to ensure there is activity on the bus. Start with Data0.

6. If any line is held low then measure the voltage across the ESD diodes placed on all data and detect line to ensure you read 0.7V confirming its not shorted to ground.

Micro SDCARD PCB Contacts



RAM Schematic and Troubleshooting

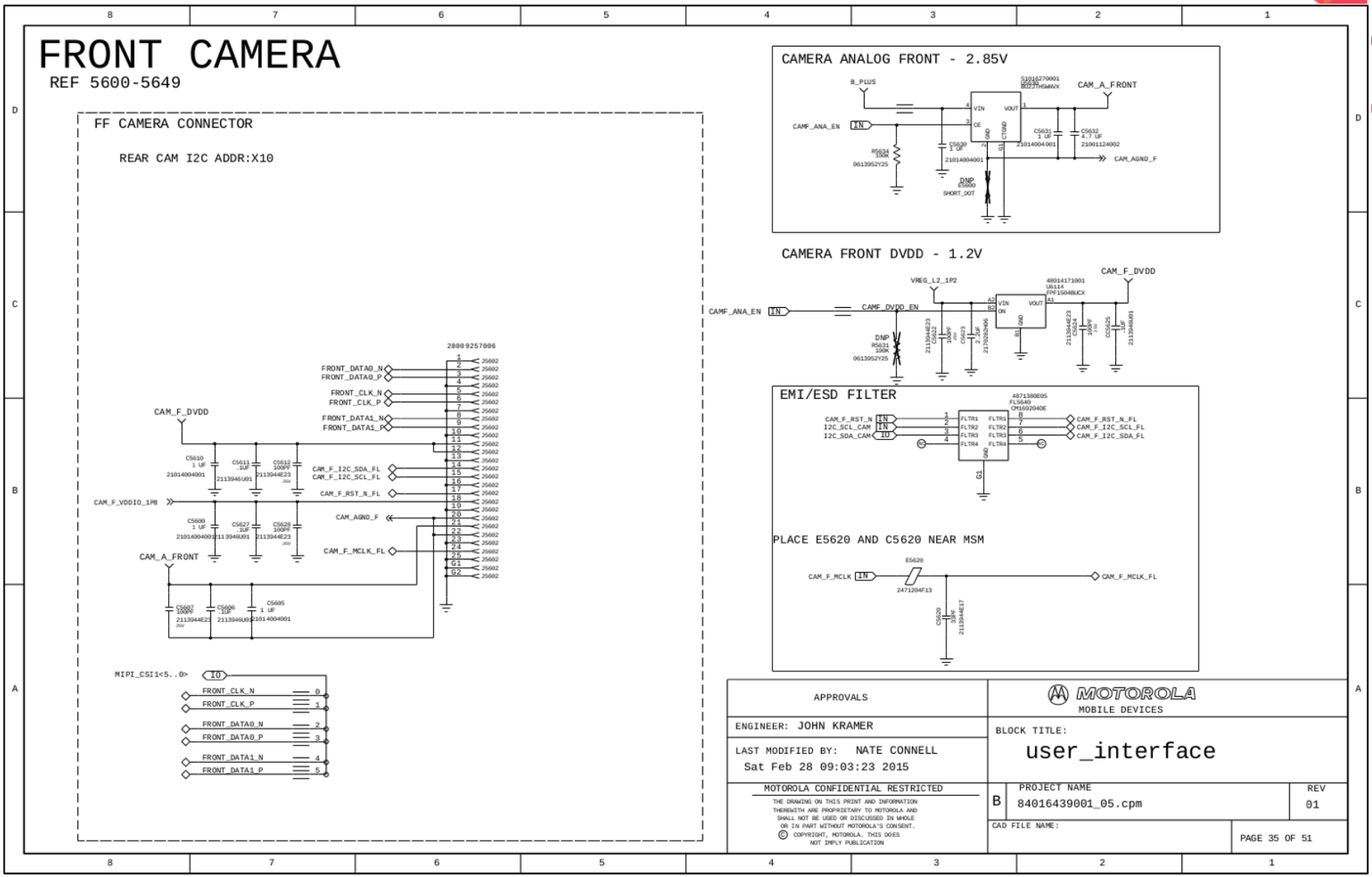


If the phone is stuck in blank flash mode then RAM component could be suspected:

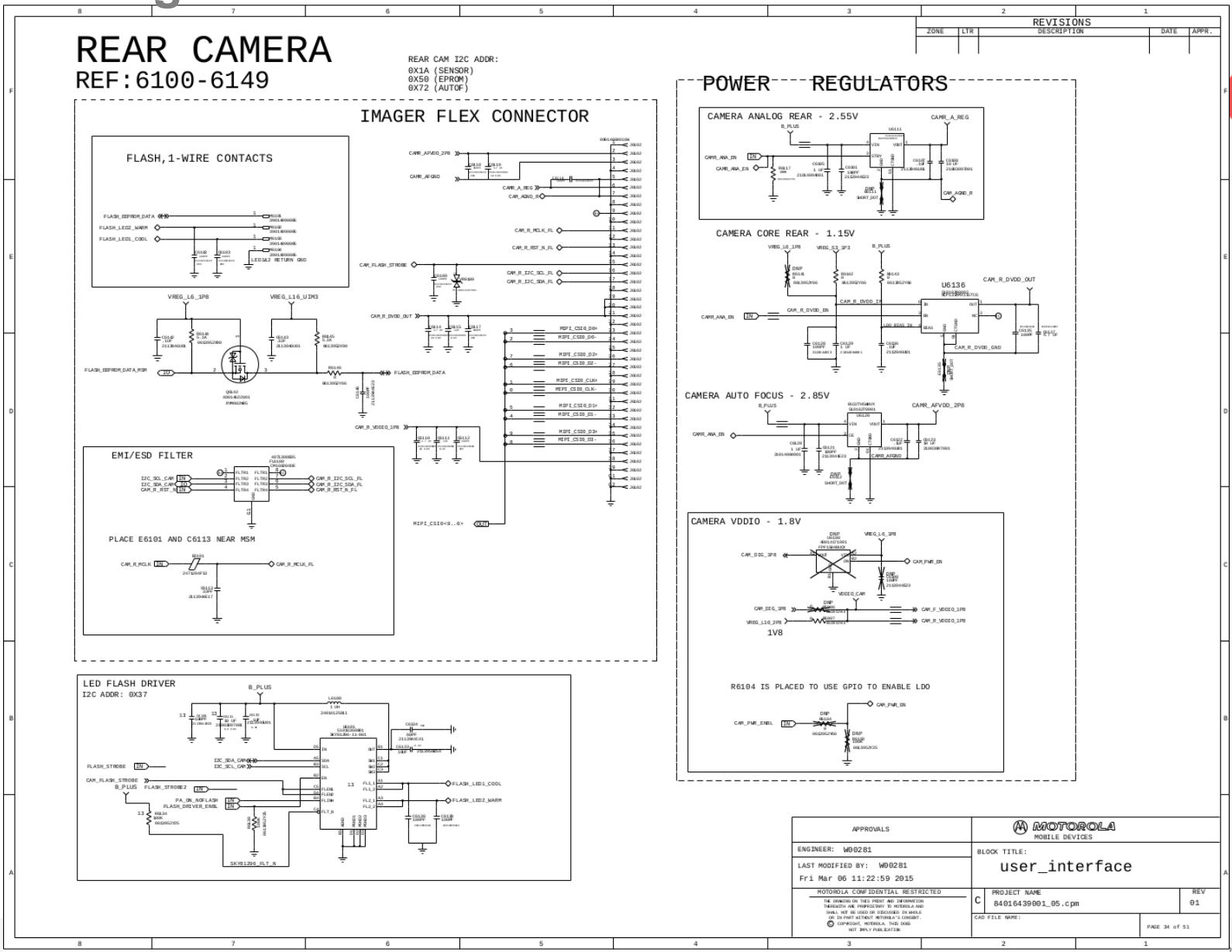
1. X-ray the board
2. Check the supplies as shown in schematic.
3. Note down component lot code and date code.

CAMERA TROUBLESHOOTING

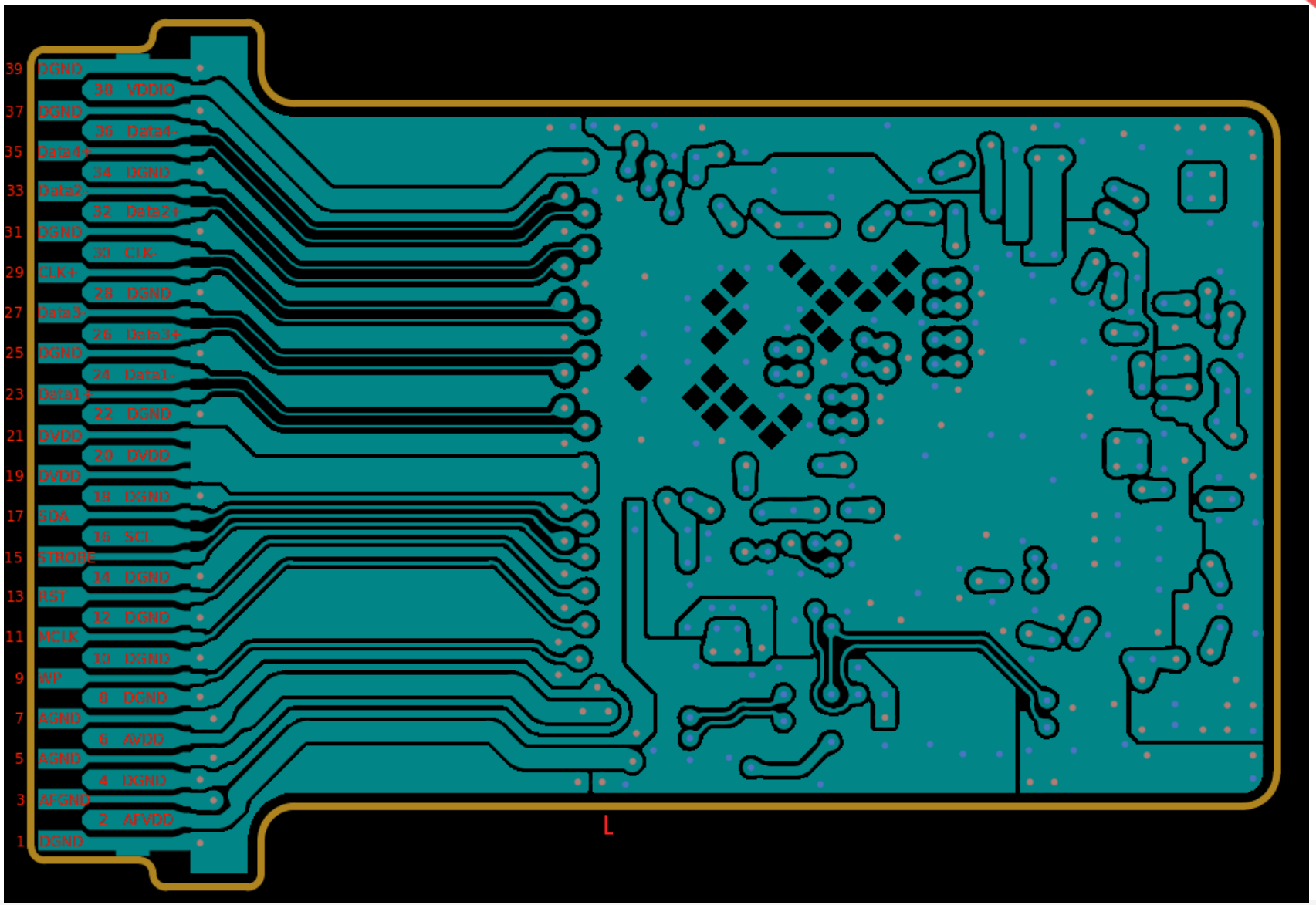
Front Imager Schematic



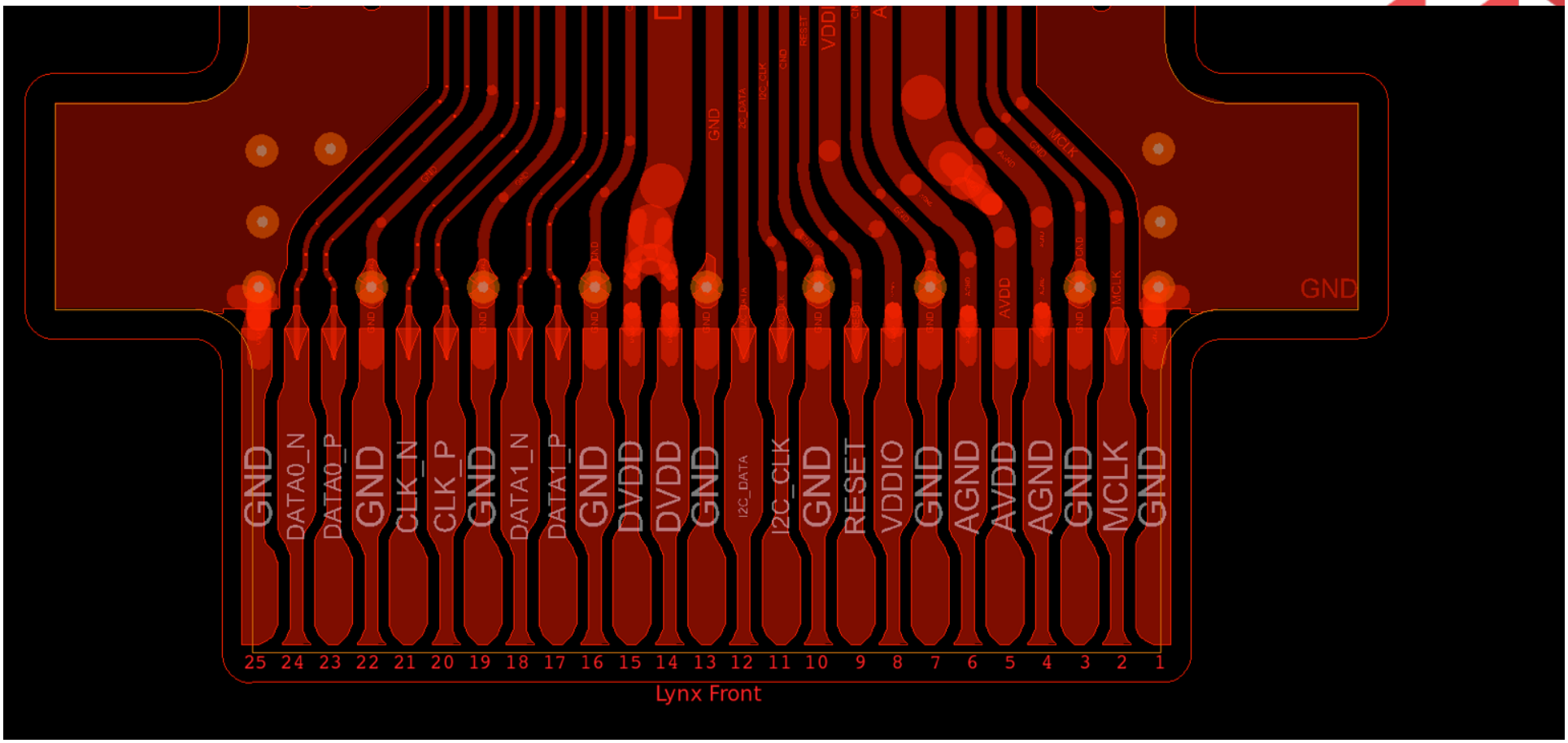
Rear Imager/LED Flash Schematic



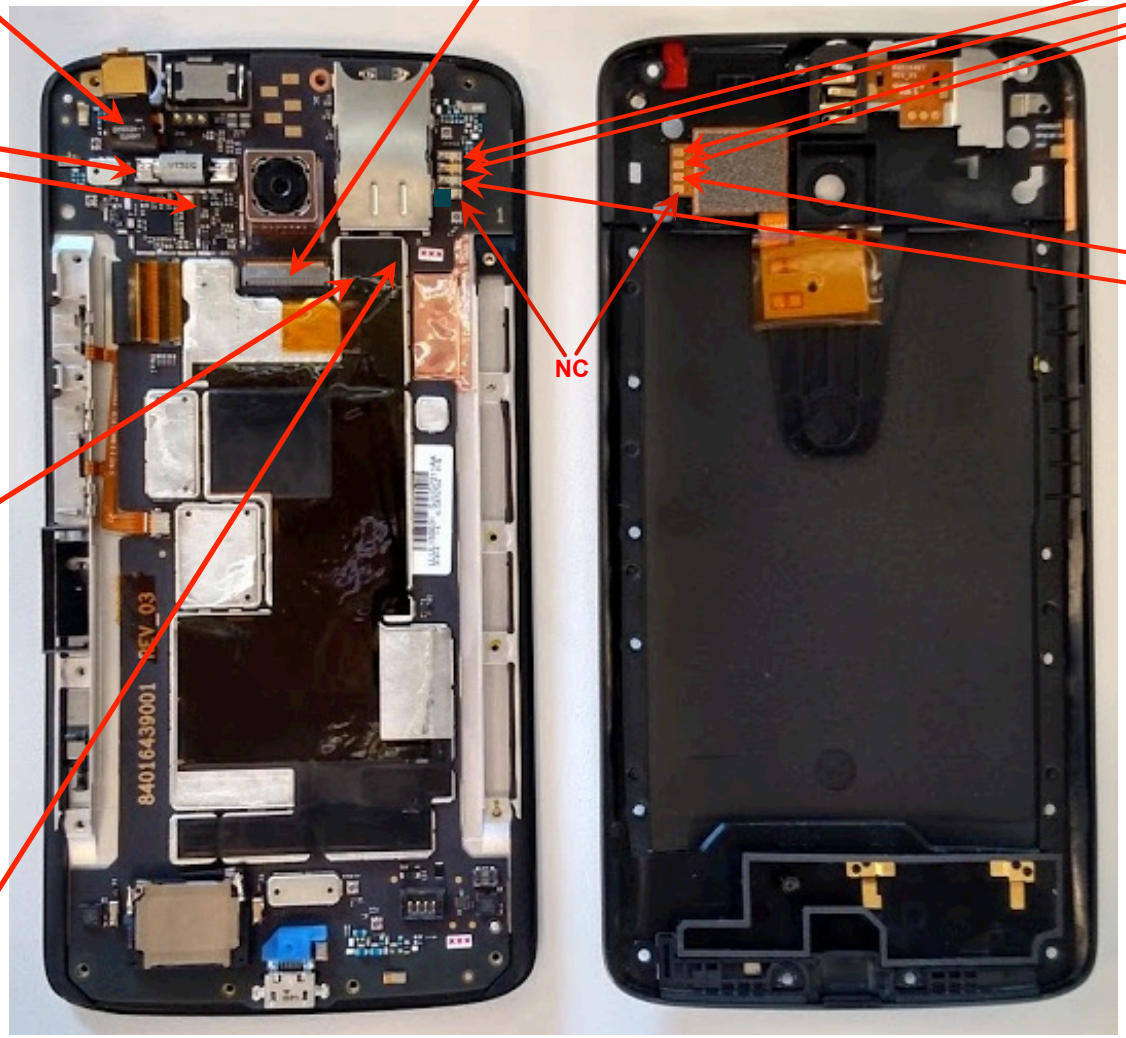
Camera Pinout – Rear (camera pointed at you)



Camera Pinout – Front (camera pointed at you)

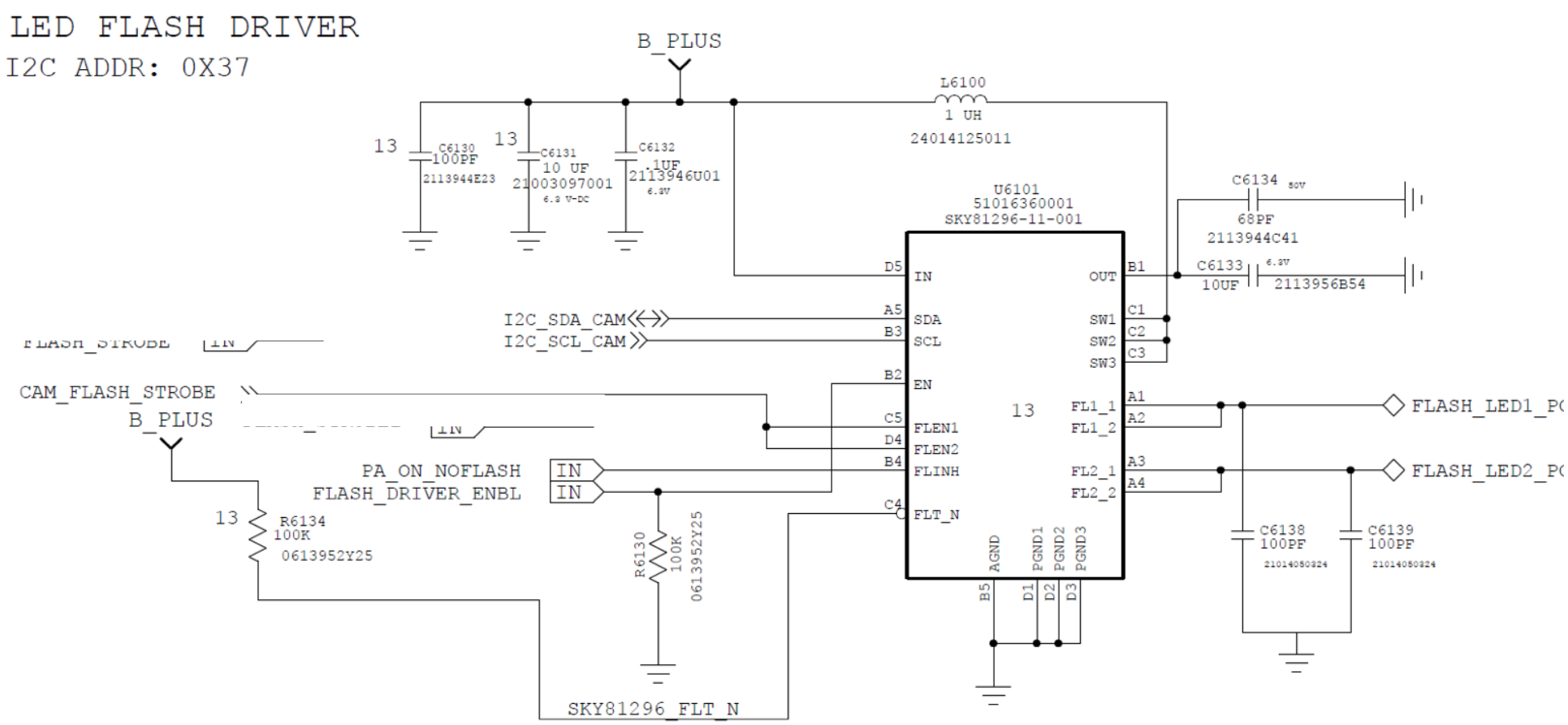


Camera Troubleshooting

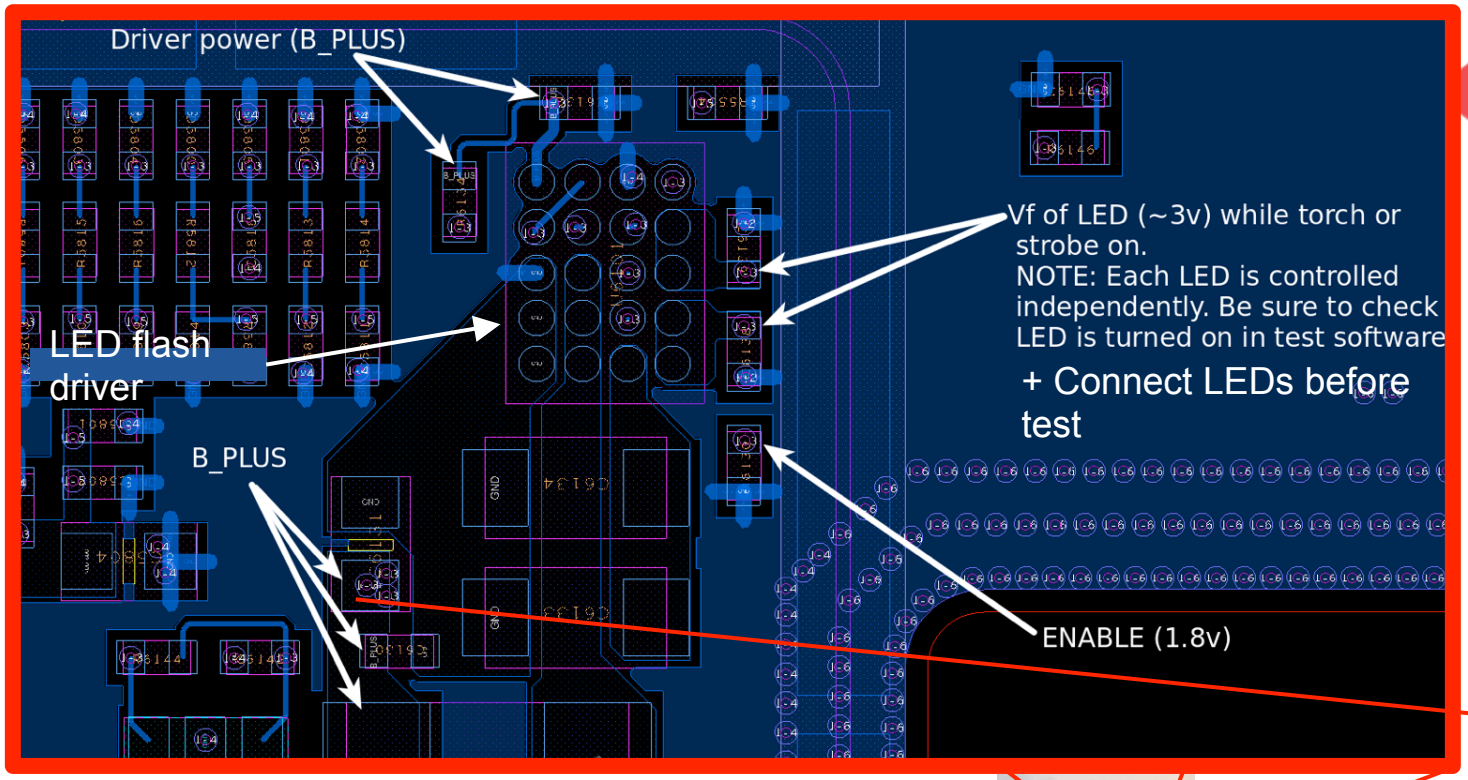


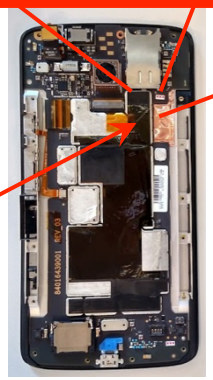
If the camera does not turn on, change the camera module. If the camera still does not power on, then it is likely an issue on the main PCB.

LED Flash Schematic Detail



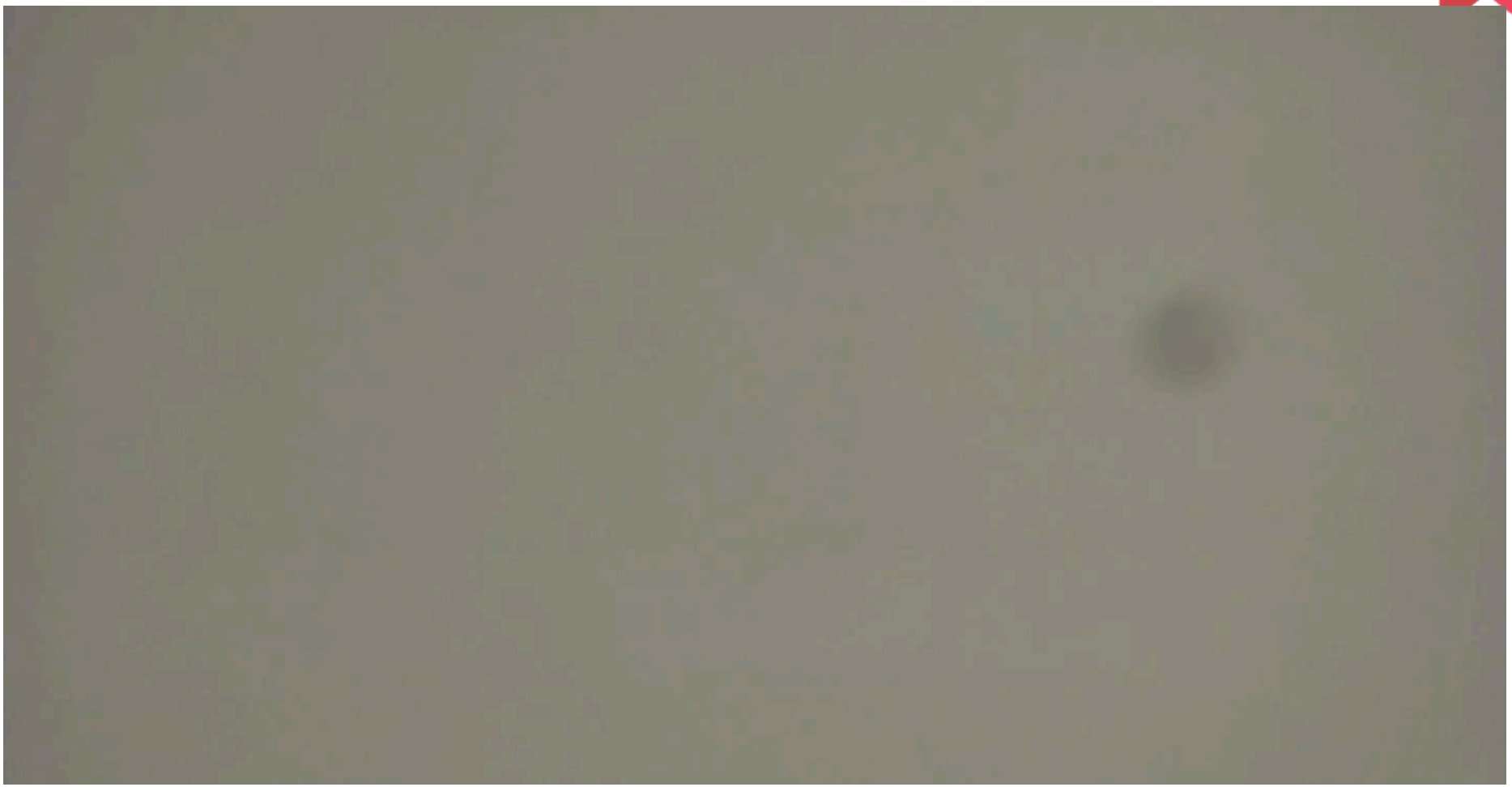
LED Flash Layout Detail





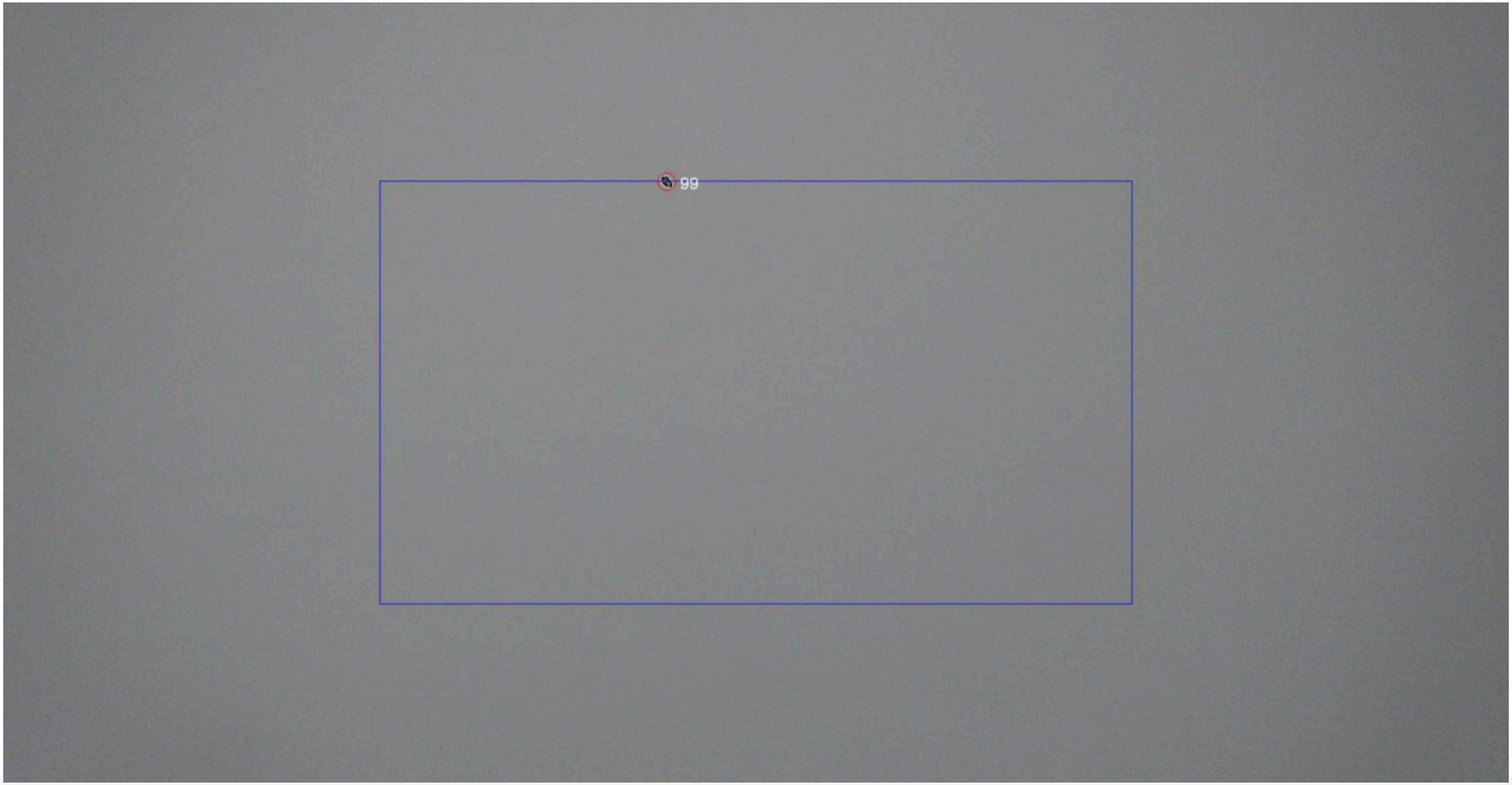
Blemish Example #1

Blemish failure due to FM. This FM is most likely beneath the lens.



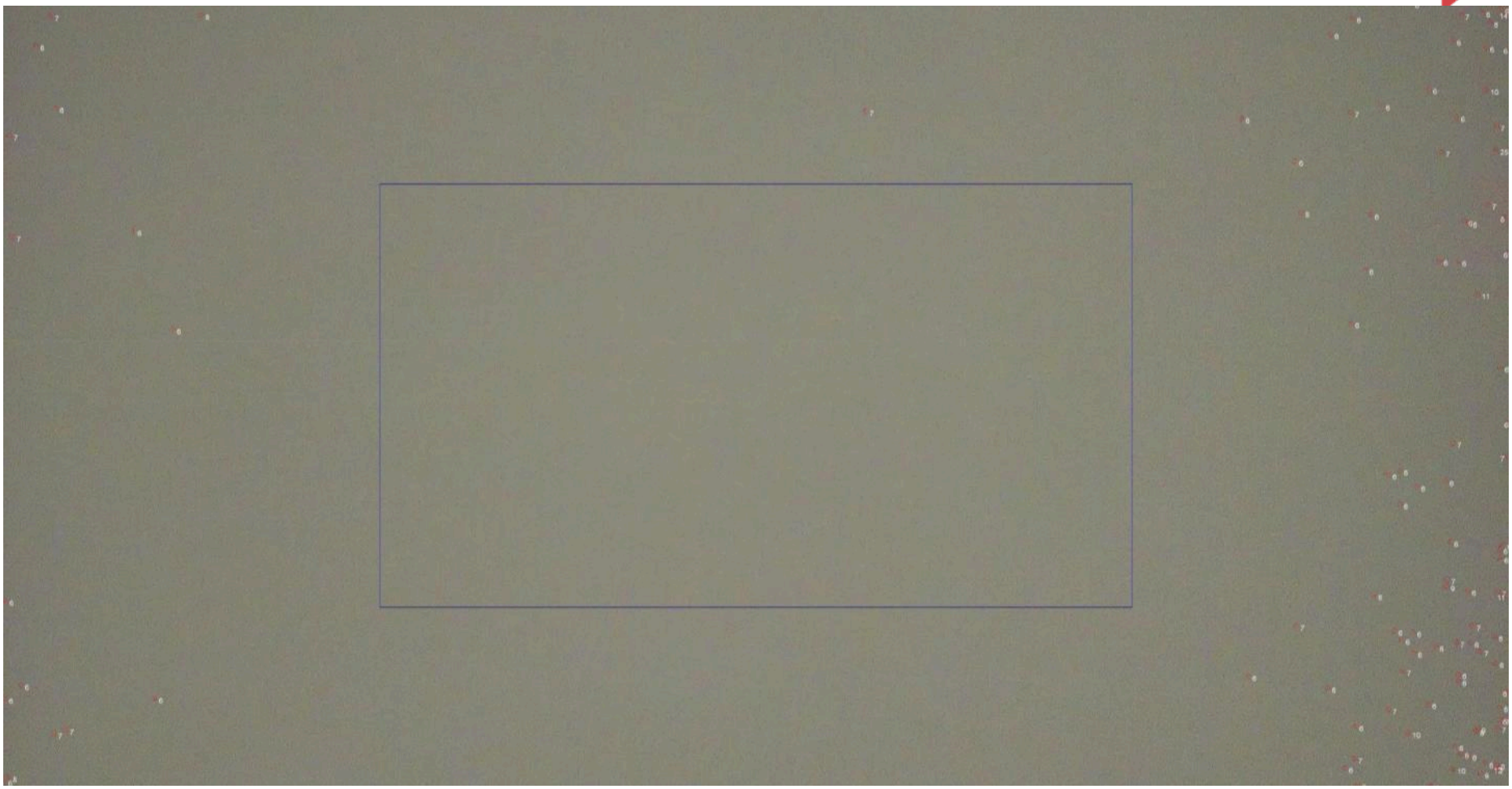
Blemish Example #2

Blemish failure due to FM. The blue box and red circle are part of the annotated image. Annotated images end with _BLEMISH in the file name. These annotations are drawn by the analysis software and not part of the real image. The blemish that is circled however is real and indicates FM or a defect in the lens.



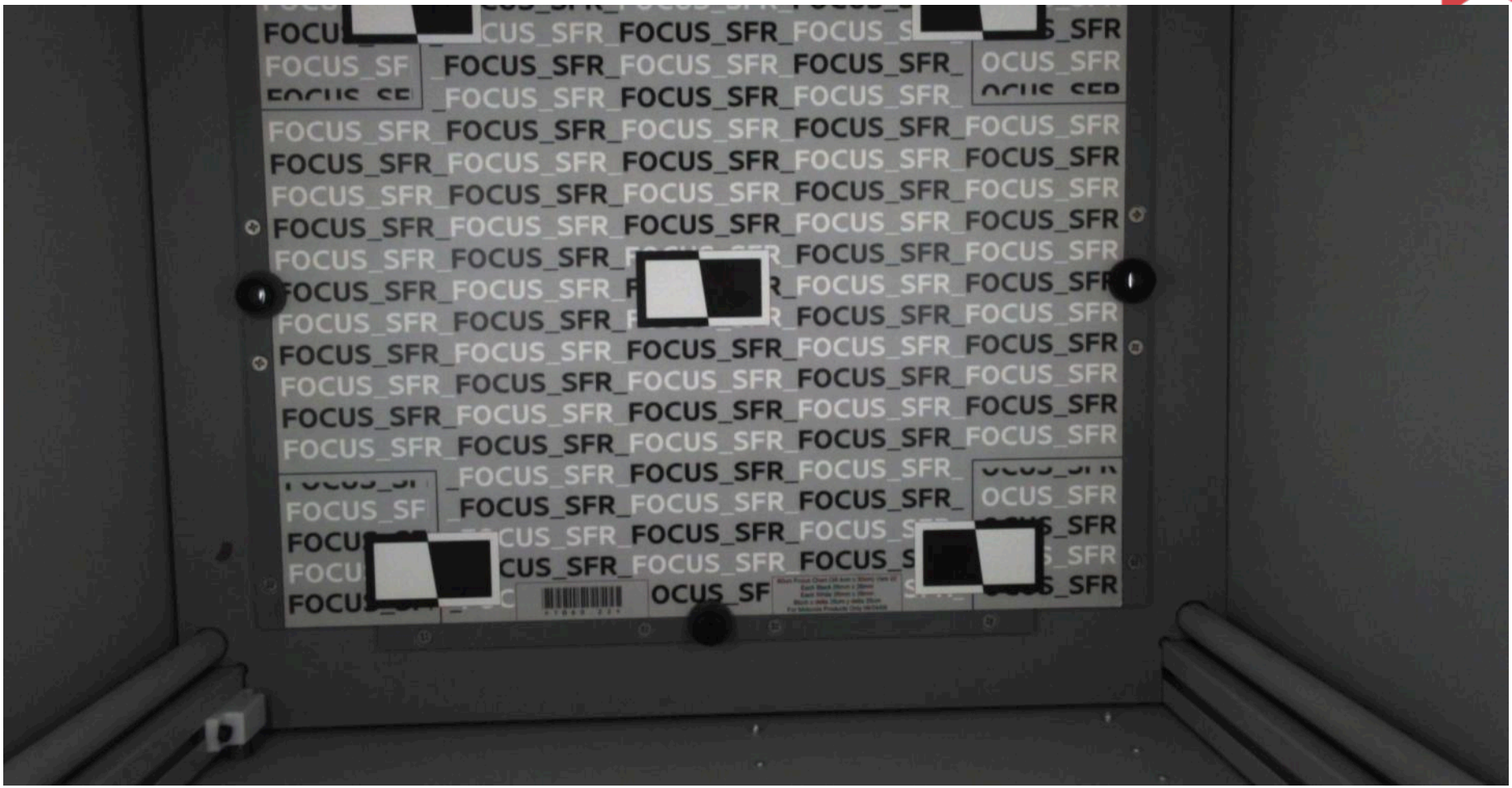
Blemish Example #3

Blemish failure due to noise. There are no particles or lens defects in this module, but the noise is so bad that it is getting mistaken for blemishes. This is most likely a problem with the sensor.



Placement Error Example

This picture shows a really severe case of the focus chart not being centered within the camera's view. This case is most likely caused by operator error when placing the phone into the test chamber.



Focus Error Example

The top side of this image is blurry. This will most likely be a problem with the lens placement inside the module.