

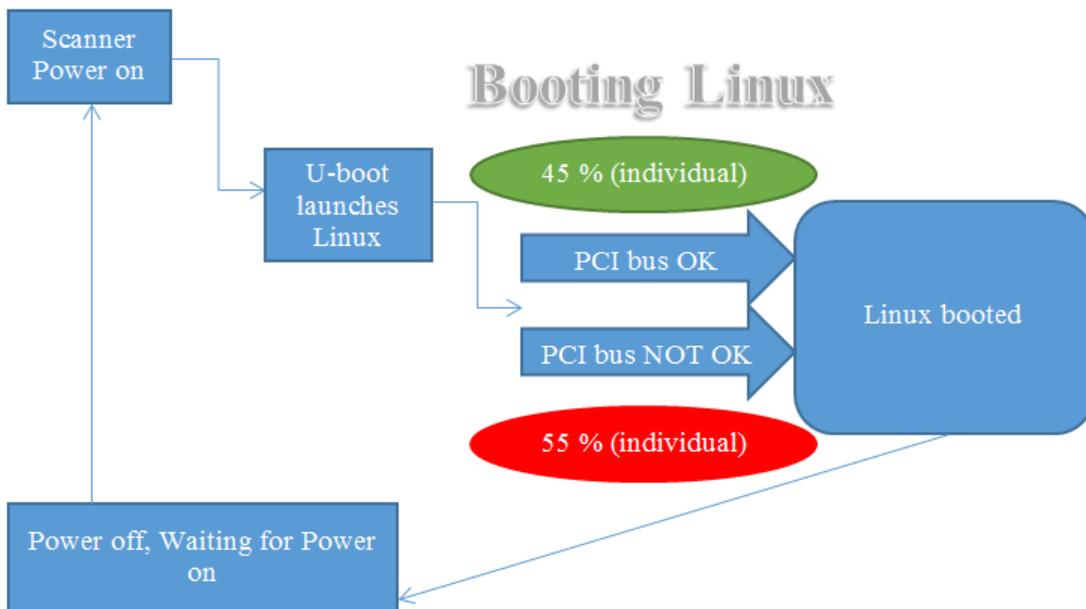
## I211 Start-up Failure

### Failure Description

Intel#I211 sometimes fails to come up after a cold reset. When this happens the chip is not detected at all and it is not possible to "reset it".

MPN: **WGI211ATSLJXZ**

- The failure rate for a failing PCB is individual and varies slightly with temperature.
- The issue has currently been found in almost 10% of the PCB's (6/63).
- The i211 chip is used together with a Freescale IMX6Q CPU.
- If the i211 was initialized OK during boot the functioning seems flawless (until next power-cycle)
- If the i211 was initialized OK during boot the i211 will always work when Linux is re-booted
- If the i211 was **NOT** initialized OK during boot Linux hangs when a re-boot is performed
- The issue has been re-produced with several Linux Kernel versions (**4.1.X**, **4.9.175**, **4.9.75**, **4.14.22**, etc.) and with "hundreds" of modifications to the original drivers. No driver fixes have been able to solve the issue.



Subject	Data
Mainboards tested in room-temperature	63
Boards with PCI issue	6
Percentage with PCI issue	9.5%
Failure rates for failing Mainboards (room t.)	55% 33% 32% 31% 9% 7%

Table 1: Data for 63 screened boards

The data in Table 1: Data for 63 screened boards were found by doing a power-cycle boot test with a serial port connected. The number of boots varied between a few hundred up to several thousands.

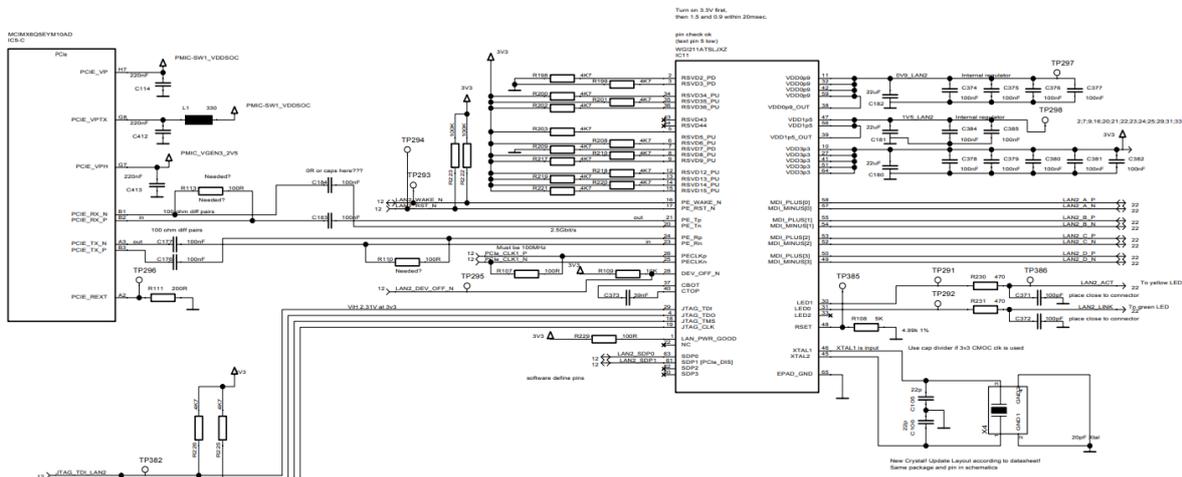
## Symptoms

Sometimes after a cold reset the i211 chip is not functioning/detected. When this occurs the Linux boot log shows the error message "phy never came up". The issue has been re-produced with several Linux Kernel versions (4.1.X, 4.9.175, 4.9.75, 4.14.22, etc.) and with "hundreds" of modifications to the original drivers. For example, the full initialization sequence has been attempted 10 times in case of a failure, without any help. This suggests that the failure must have happened before the initialization steps.

Boot OK	Boot Not OK
imx6q-pcie 1ffc000.pcie: PCI host bridge to bus 0000:00	imx6q-pcie 1ffc000.pcie: phy link never came up
--- other PCI information	imx6q-pcie 1ffc000.pcie: failed to initialize host
	imx6q-pcie: probe of 1ffc000.pcie failed with error -22

Table 2: Boot logs.

## Schematics



## Temperature Dependency

S/N ...760002

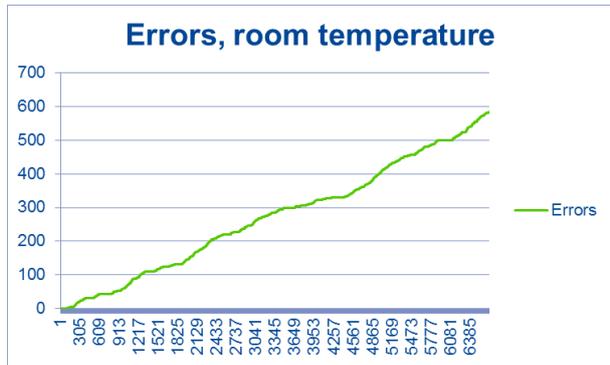
Temperature	Failure Rate
Cold temperature ~3C degrees	25.5% (2415 boots)
Room temperature ~25C degrees	27% (18800 boots)
Hot temperature ~55C degrees	9.5% (220 boots)

The Mainboard with S/N ...760002 was better in high temperature compared to lower temperatures.

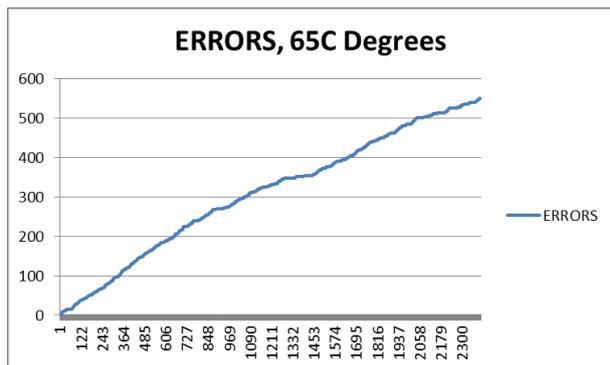
S/N ...2180074

Temperature	Failure Rate
Cold temperature ~25C degrees	8.8% (6680 boots)
Hot temperature ~60C degrees	22.3% (2407 boots)

The Mainboard with S/N ...2180074 was better in room temperature compared to higher temperatures.



PCI Boot test data for S/N ...2180074 in room temperature. The failure rate was 8.8%. The line is fairly linear, so the failure rate seems "constant".



## Component Swap Test

To check the soldering and to see if the error follows certain components, a soldering inspection and a set of replacements of suspected components were carried out at Dynamic Precision – a PCB manufacturer.

Suspected Component	Description	Comments
IC5	CPU	The "brain"
IC11	Ethernet controller	Ethernet controller chip Intel#i211. Connected between the NET2 port and the CPU. Communicates over PCIe protocol.
X4	Crystal	25 MHz crystal connected to IC11

S/N	Change	Failure Rate before fix	Failure rate after fix
0110040872180070CR0	Replaced CPU (IC5)	33.33% (388 boots)	37.7% (1327 boots)
0110039397270043CR0	Replaced i211 crystal (X4)	31.5% (117 boots)	100% (1327 boots)
0110039397270041CR0	Replaced i211 (IC11)	31.8% (55 boots)	0% (347 boots)
0110040872180085CR0	IC11 from ..0041CR0	0% (297 boots)	49.3% (347 boots)

The swap test showed that changing the CPU on a failing board (0110040872180070CR0) did not solve the issue. Replacing the crystal did not work either (0110039397270043CR0). After the replacement of the crystal the initialization of the PCI bus never worked. This was later found to be due to wrong usage of the replacement part. More crystals are to be tested later.

The most interesting data brought forward during the testing was the swapping of the Ethernet controller chip i211 (IC11). A board that previously failed 31.8% (0110039397270041CR0) worked 100% of the time after the replacement, and the component that was removed made a previously non-failing Mainboard to fail 49.3% of the time.

# Voltages

3V3 (C180)

Looks OK



1V5 (C181)

Looks OK



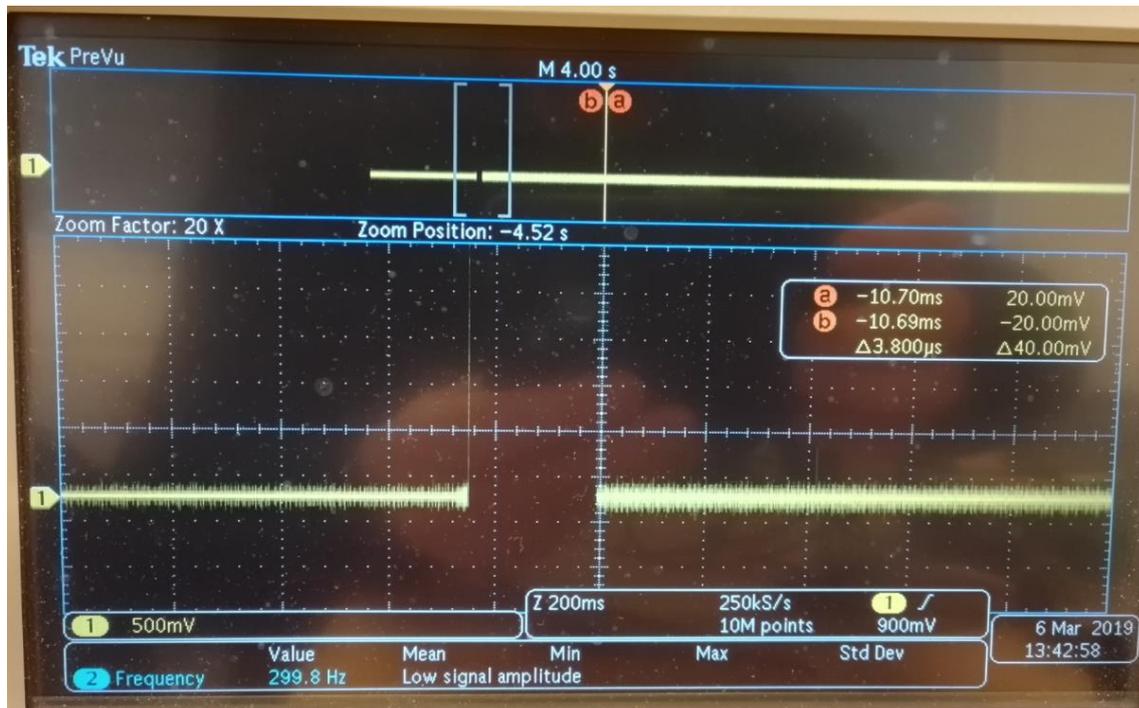
0V9 (C182)

Looks OK



DEV\_OFF\_N (R109)

Is turned high for ~220ms during power-up and then dragged down



**PE\_RST\_N (R223)**

Is high for quite a long while, until drivers touch it during Linux boot, then driven low for ~120ms and back



**LAN\_PWR\_GOOD (R222)**

Driven high by VDD during power-up

**3.3V to Xosc**

~10 ms

**Crystal X4 (C105)**

0-10 ms

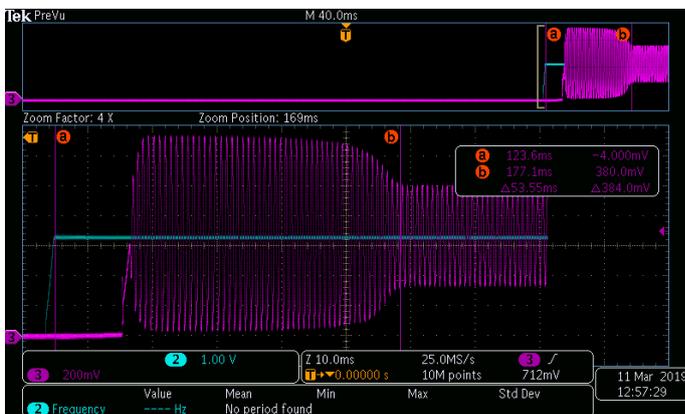
10ms – 50ms

50 ms -

0V

25 MHz 10 mV - 1.3V

25 MHz 350 mV - 0.9V



## Component Changes

Fix	Comments	Impact
Re-heatpads of I211 crystal	Ensure crystal was correctly soldered	Still fails
Set C105=106=27pF	Small change on crystal capacitors according to datasheet	Still fails
Set R222=100R	Set PE_WAKE_N = '1' according to datasheet. Now 100K.	Still fails
C183=C184=0R	Changing rx according to datasheet.	Still fails
R107= 82R	CLK diff resistor. Spec says 80-120R.	Still fails
R218 = not mounted	Remove iNVM security pin. Implemented on 0110040872180070CR0	Still fails
Set C105=106=27pF, 33pF	Match datasheet, same as fix #2, but now on 0110040872180070CR0	Still fails
C180 = 47uF	Same as reference design, for 3v3. Minimum 15uF in spec .... Implemented on 0110040872180070CR0	Still fails
Removed Rdiff R110 & R113 for TX/RX	Match PCI spec.... Implemented on 0110040872180070CR0	Still fails
Delayed LAN_PWR_GOOD with RC delay (220K+ 1uF)	Done on 0110040872180085CR0	Still fails