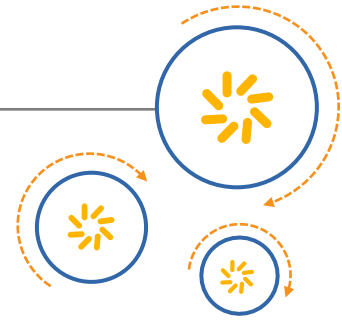




Qualcomm Technologies, Inc.



DragonBoard™ 410c based on Qualcomm® Snapdragon™ 410E processor

Interfacing Grove Digital Light I2C Sensor Application Note

September 2016

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Questions or comments: <https://www.96boards.org/DragonBoard410c/forum>

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Revision history

Revision	Date	Description
C	August 2016	Update for 'E' part
B	October 14, 2015	Instructions for making changes to Makefile and Kconfig, page 7.
A	August 4, 2015	Initial release.

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1 Introduction

1.1 Purpose

This application note describes how to integrate and test the Grove Digital Light I2C sensor on 3.10 kernel on DragonBoard™ 410c based on Qualcomm® Snapdragon™ 410E processor.

1.2 Acronyms, abbreviations, and terms

Table 1-1 provides definitions for the acronyms, abbreviations, and terms used in this document.

Table 1-1 Acronyms, abbreviations, and terms

Term	Definition
I2C	Inter-Integrated Circuit
GND	Ground
TTL	Transistor Transistor Logic
UART	Universal Asynchronous Receiver Transmitter
USB	Universal Serial Bus

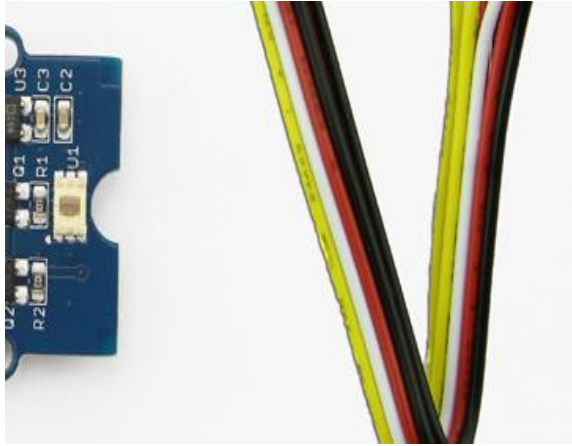
1.3 Components used

- DragonBoard 410c and power supply

<https://www.arrow.com/en/products/dragonboard410c/arrow-development-tools>

- Grove Digital Light Sensor

<http://www.seeedstudio.com/depot/Grove-Digital-Light-Sensor-p-1281.html>



- PCA9306 level shifter
<https://www.sparkfun.com/products/11955>



- Bread Board and connector cables
- TTL-232 RG 1.8V USB to UART cable

2 Configuring Kernel

2.1 Rebuilding kernel

The Android build dated 6/18/2015 on <https://www.96boards.org/products/ce/dragonboard410c/>

Android 5.1 (Lollipop)

Linux Kernel 3.10

Release: 15.06

does not have the kernel configured to detect the Grove Digital Light I2C sensor by default.

Download the Linux Android Board Support Package from:

<https://developer.qualcomm.com/hardware/dragonboard-410c/tools>

Clone the build and set up the environment as described in the “Linux Android Software Build and Installation Guide”.

2.2 Commands to modify and rebuild kernel

Change the directory to the source root:

- `cd $BUILDROOT`
- `source build/envsetup.sh`
- `lunch msm8916_64-userdebug`

To launch the kernel config, run the command:

- `make -j8 kernelconfig`

Where -j8 depends on the Linux machine cores; change accordingly.

You should see the configuration window as shown below:

```
.config - Linux/arm64 3.10.49 Kernel Configuration
Linux/arm64 3.10.49 Kernel Configuration
Arrow keys navigate the menu. <Enter> selects submenus ---. Highlighted letters are hotkeys. Pressing <Y> includes, <N> excludes, <M> modularizes features. Press
<Esc><Esc> to exit, <?> for Help, </> for Search. Legend: [*] built-in [ ] excluded <M> module <> module capable

[*] General setup ---
[*] Enable loadable module support ---
[*] Enable the block layer ---
Platform selection ---
Bus support ---
Kernel Features ---
Boot options ---
Userspace binary formats ---
Power management options ---
CPU Power Management ---
[*] Networking support ---
Device Drivers ---
Firmware Drivers ---
File systems ---
[ ] Virtualization ---
Kernel hacking ---
Security options ---
-- Cryptographic API ---
Library routines ---
[*] restrict kernel memory permissions as much as possible
```

- Select Device Drivers → Industrial I/O support → Light sensors → TSL2563.

```
config - Linux/arm64 3.10.49 Kernel Configuration
Device Drivers
Arrow keys navigate the menu. <Enter> selects submenus ---. Highlighted letters are hotkeys. Pressing <Y> includes, <N> excludes, <M> modularizes features. Press
<Esc><Esc> to exit, <?> for Help, </> for Search. Legend: [*] built-in [ ] excluded <M> module <> module capable

[*] Ultra Wideband devices ---
<*> MMC/SD/SDIO card support ---
<> Sony MemoryStick card support ---
-- LED Support ---
[*] Switch class support ---
[ ] Accessibility support ---
<> InfiniBand support ---
[ ] EDAC (Error Detection And Correction) reporting ---
[*] Real Time Clock ---
[ ] External SOCs Control ---
[*] IMA Engine support ---
[ ] Auxiliary Display support ---
<*> Userspace I/O drivers ---
<> VFIO Non-Privileged userspace driver framework ---
[ ] Virtualization drivers ---
Virtio drivers ---
Microsoft Hyper-V guest support ---
[*] Staging drivers ---
Qualcomm MSM specific device drivers ---
[ ] I2C clock driver
[*] MISS pll programming
Hardware Spinlock drivers ---
[*] Support for ARM architected timer event stream generation
[ ] Mailbox Hardware Support ---
[*] IOMMU Hardware Support ---
Remoteproc drivers ---
mpmsg drivers ---
-- generic Dynamic Voltage and Frequency Scaling (DVFS) support ---
<> External Connector Class (extcon) support ---
[ ] Memory Controller drivers ---
<*> Industrial I/O support ---
<> VME bridge support ---
```

```
.config - Linux/arm64 3.10.49 Kernel Configuration
> Device Drivers > Industrial I/O support > Light sensors
Light sensors
Arrow keys navigate the menu. <Enter> selects submenus ---. Highlighted letters are hotkeys. Pressing <Y> includes, <N> excludes, <M> modularizes features. Press
<Esc><Esc> to exit, <?> for Help, </> for Search. Legend: [*] built-in [ ] excluded <M> module <> module capable

<> <M> S311-CR999 digital color sensor
<*> TAOS TSL2560, TSL2561, TSL2562 and TSL2563 ambient light sensors
<> VCNL4000 combined ALS and proximity sensor
```

- Choose the kernel built option for:
 - <*> TAOS TSL2560, TSL2561, TSL2562, and TSL2563 ambient light sensors.
- Save and exit from the kernel config menu.
- If you are adding a new driver on your own you need to make changes to Makefile and Kconfig in kernel/drivers and add the right path in kernel/drivers/Kconfig which sources the new device driver Kconfig file. This adds the new entries in the kernel config screen that you can select, driver files need to be added in the same directory as your new Kconfig and Makefile as well.

Open kernel/arch/arm64/boot/dts/qcom/apq8016-sbc.dtsi and add the code shown below (highlighted in yellow):

```
&soc {
    i2c@78b6000 {
        tsl2561@29 { /* Grove digital light sensor */
            compatible = "taos,tsl2561";
            reg = <0x29>;
        };
    };
};
```

- Save the file and then run the command:

```
make -j8 bootimage
```

boot.img will be generated at **out/target/product/msm8916_64/boot.img**.

NOTE: 78b6000 is the BLSP address configured for I2C communication; we are connecting the light sensor to i2c-0.

2.3 Flashing the kernel to DragonBoard 410c

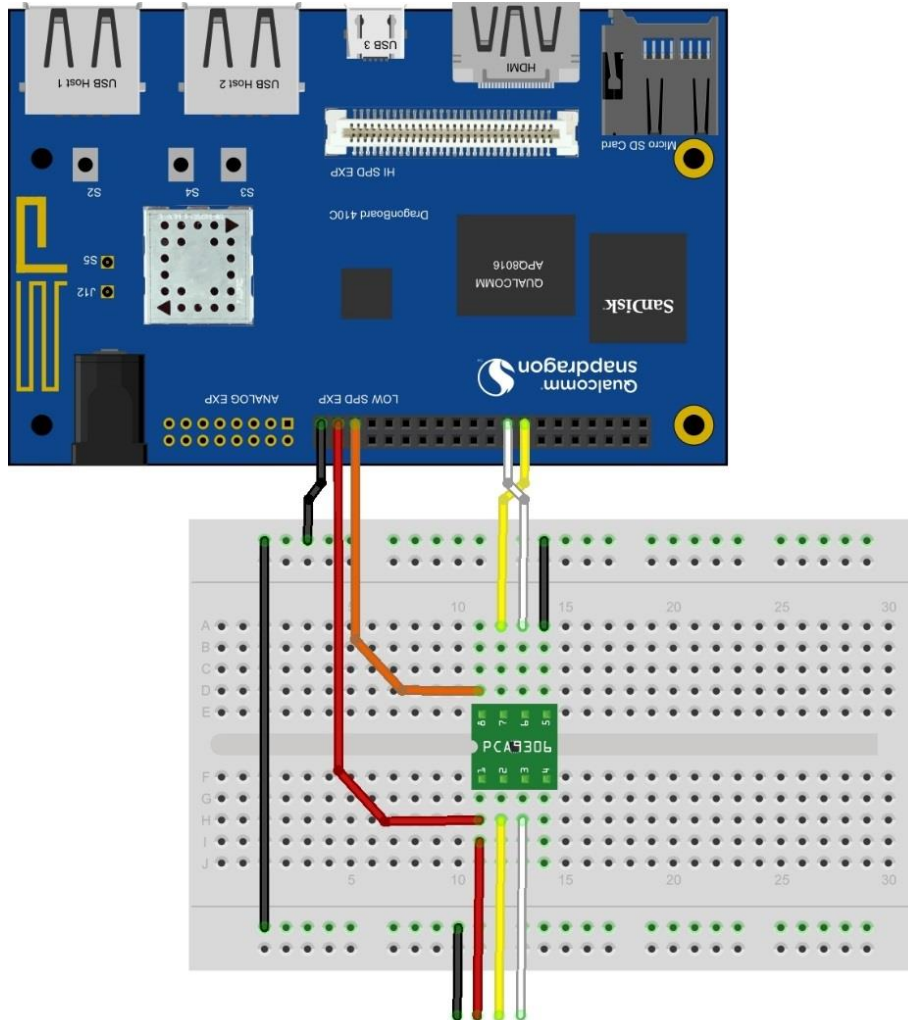
Bring the DragonBoard 410c into fastboot by holding VOL during power up. Once in fastboot, you can flash the boot.img using the command:

- fastboot flash boot boot.img

Connection Diagram for Grove Light Sensor and PCA9306 from J8 on DragonBoard 410c (DragonBoard 410c (J8) → PCA9306 → Grove light sensor):

```
PIN #37 → VREF2 of PCA9306 → VCC of grove light sensor
PIN #39 → "-" on Bread Board
```

```
PIN #35 → VREF1 of PCA9306
PIN #15 (I2C0_SCL) → SCL1 of PCA9306
PIN #17 (I2C0_SDA) → SDA1 of PCA9306
PCA9306 GND to "-" on Bread Board
VREF2 of PCA9306 → VCC of Digital Light Sensor
SCL2 of PCA9306 → SCL of Digital Light Sensor
SDA2 of PCA9306 → SDA of Digital Light Sensor
 "-" from Bread Board → GND of Digital Light Sensor
```

USB to UART cable (TTL-232 RG 1.8V) connection to see kernel boot traces. On J8 connector on DragonBoard 410c:

```
PIN #11 UART1_TX
PIN #13 UART1_RX
PIN #1 GND
```

Refer to *DragonBoard™ 410c based on Qualcomm® Snapdragon™ 410E processor Connecting the UART to USB Adapter Application Note* for details. DragonBoard 410c schematics are available at: <https://www.96boards.org/products/ce/dragonboard410c/>

- With the above connection setup, power ON the device.
- Check for kernel traces for the below message:

```
ts12563 0-0029: model 5, rev. 0
```

If you do not have a USB to UART cable you can check this via `dmesg` on adb shell as root:

```
adb shell
su
dmesg
```

- At the shell prompt, change the directory to:

```
cd /sys/bus/i2c/devices/i2c-0/
```

You should see 0-0029. 0x29 is the I2C address of the new sensor that we just added:

```
cd /sys/bus/i2c/devices/i2c-0/0-0029/iio:device0
```

```
cat in_illuminance0_input
```

- You will see an integer value as output. Keep trying the same command by using a cell phone flash light or other light source. The integer value increases or decreases depending on the light intensity.

NOTE: This application note provides basic instructions on validating the I2C sensor with kernel changes only. For full Android user space integration please refer to the “Sensors Porting Guide for DragonBoard 410c” on <https://developer.qualcomm.com/hardware/dragonboard-410c/tools>.

EXHIBIT 1

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