CHIPS.

Newsletter
January 2016

> **The most powerful factors in the world are clear ideas in the minds of energetic men of good will.**
>
> *Sir John Thomson*

CEO's Note

Dear Readers,

The ESPROS TOF technology is gaining huge momentum. The delivery start of the 3D-TOF QVGA imager was excellent. Customers immediately recognized the performance of our OHC15L technology. A QE of more than 80% at 850nm wavelength and pixels with 100% fill factor provide unmatched sensitivity with very low illumination power. A reference design of a camera engine with a horizontal FOV of 94° achieves a 10m range in the full field. Ok, this is on a white target. But the exposure time is a few milliseconds only.

However, 3D TOF is not the most simple things for engineers. Or, in other words, solid know-how is needed to implement an accurate, robust and reliable system. The purpose of this newsletter is to share know-how we gained in the past. Many successful implementations of our 3D TOF chips prove their performance and capability. Key for success was always a diligently implementation of the illumination, lens system, power supply, thermal concept, and efficient algorithms which are capable to deal with measurement imperfectness.

Beat De Coi

epc660 application information

Our 3D TOF imager epc660 is a real success story. Many engineers world wide are working on their implementation of the chip in their systems environment. We see a huge variety of applications and, in many cases, far out of simple daily expectations if we think about the Fourth Industrial Revolution (spheres of digital, connectivity, robotics and big data). This high interest in the product challenges us keeping you informed on products performance and product support.

Temperature Drift

Several components of a TOF system are temperature sensitive: On the 3D TOF chip e.g. pixel-field, LED driver and the phase detector (DLL), etc.; on camera level e.g. the illumination (e.g. LEDs, VCSELs), illumination driver, connectors, IR filters, lenses, etc.

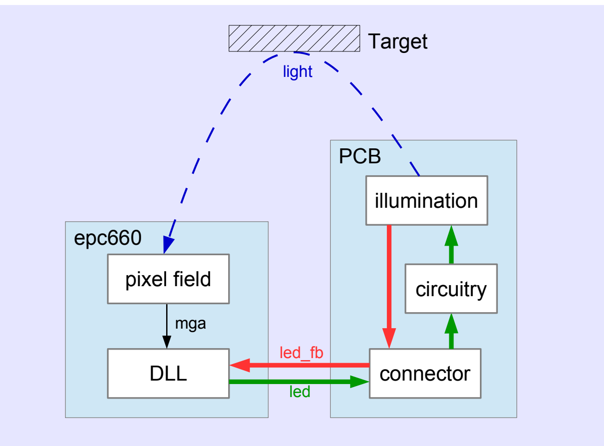

Figure 1: Temperature drift sources

Figure 1 shows the signal path with the contributors to temperature drift. The main contribution comes from the pixel-field which is approx. 85% of the total distance drift by temperature (Figure 2).

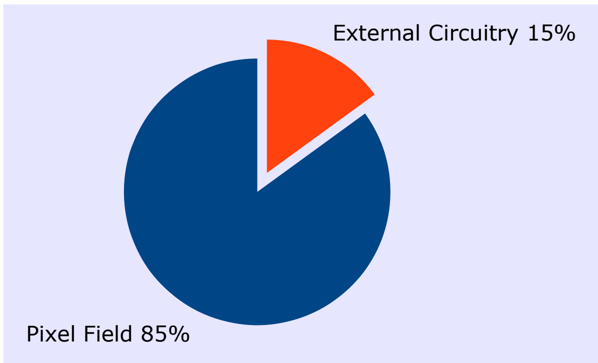

Figure 2: Contribution of the drift sources

The temperature drift in the pixel field is related on the one hand to the drift speed of electrons in solid which changes by temperature. It is a physical constant so it can be compensated by simple temperature measurement of the chip temperature. On the second hand, the drift speed is also related to the field strength in the photodetector. This field is generated by the the backside voltage VBS. A simple rule says the higher the voltage the faster the electrons (Figure 3). However, there is a voltage limit where other effects start to become dominant. It is to note that a variation of VBS varies the measured distance. Thus, an accurate and constant VBS voltage is mandatory for accurate measurement.

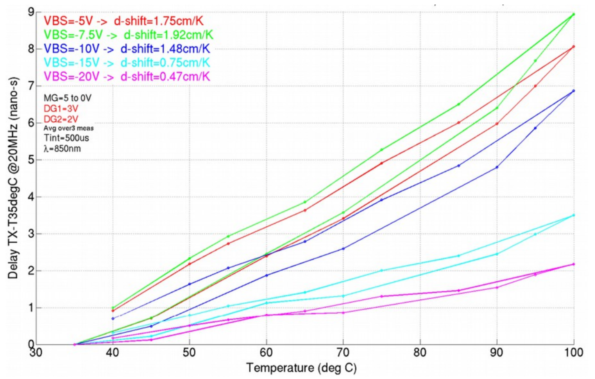

Figure 3: Delay drift versus temperature

Figure 4 shows a 2^{nd} order fit for the compensation of the temperature drift in the pixel field.

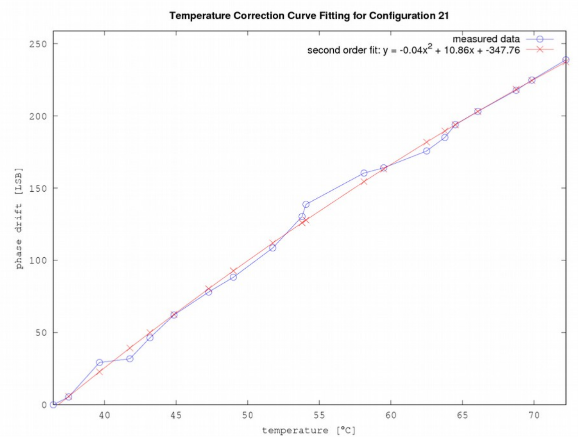

Figure 4: Temperature gradient approx. 1.7cm/°K

DLL

The delay lock loop (DLL) implemented in the epc660 is foreseen to compensate changing properties of the on-chip LED driver and the external illumination circuitry e.g. temperature, aging, etc. (refer to Figure 1, green signal path). The datasheet epc660 contains a detailed description thereof.

However, the current available silicon does not show the expected good performance of the DLL and should not be used (Note: It shall be corrected in the next chip version). However, the DLL functionality can be used as shown with the DME 660 hardware V1.2 or higher (marked on the TOF cape). We implemented a workaround with a software controlled DLL locking which can be activated by entering the following in the command line of the GUI (in the Commands section):

```
setCorrectionUpdateInterval x
```

Set x=1 for DLL control loop on with a refresh rate of 1 second. If x is set to 0, the DLL control loop is turned off. x can vary between 1 and 10.

Deviations to datasheet epc660

The available parts are the first series chips. Until today, the following most important deviations chip to datasheet epc660 are identified:

The saturation flag:
Cannot be used. It shows false values.

Temperature reading:
The chip shows false values. The DME 660 temperature readings are correct.

Integration time setting (register INTM_):
The register is not supported by the current chip versions. A download sequence is available for enabling this functionality. Please ask our support department.

Minimum data readout clock on TCMI:
The readout time must be shorter than the row conversion time to get not in conflict with the next data readout: Minimum DCLK: 20.5 MHz.

Some other minor bug fixes: Please ask our support department for sequencer code update.

We expect having next chip version with fixes and extended functions available mid of 2016. For more information or download sequence:
Contact your sales office or info@espros.com.

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