Fermi National Accelerator Laboratory

# PIXEL DETECTOR PROJECT

# HONEYWELL VCSEL HFE4080 TESTS

## Document # ESE-PIX-?????

-PRELIMINARY-

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# Test Results on the single VCSEL from Honeywell

| VCSEL Current i (mA) | VCSEL-1 | | VCSEL-2 | | VCSEL-3 | |
|---|---|---|---|---|---|---|
| | Voltage V (Volt) | Intensity I (uW) | Voltage V (Volt) | Intensity I (uW) | Voltage V (Volt) | Intensity I (uW) |
| 0.273 | 1.39 | 0.014 | 1.39 | 0.021 | 1.39 | 0.010 |
| 0.9 | 1.47 | 0.092 | 1.47 | 0.132 | 1.47 | 0.072 |
| 1.795 | 1.54 | 0.303 | 1.54 | 0.405 | 1.54 | 0.245 |
| 2 | 1.56 | 0.365 | 1.56 | 0.507 | 1.56 | 0.277 |
| 4 | 1.67 | 112.000 | 1.67 | 191.000 | 1.67 | 151.000 |
| 6 | 1.77 | 487.000 | 1.76 | 570.000 | 1.76 | 446.000 |
| 8 | 1.85 | 897.000 | 1.85 | 1,187.000 | 1.85 | 864.000 |
| 10 | 1.94 | 1,352.000 | 1.94 | 1,530.000 | 1.94 | 1,275.000 |
| 12 | 2.03 | 1,723.000 | 2.03 | 1,673.000 | 2.03 | 1,555.000 |
| 14 | 2.10 | 2,099.000 | 2.11 | 1,976.000 | 2.11 | 1,808.000 |
| 16 | 2.19 | 2,532.000 | 2.19 | 2,186.000 | 2.19 | 1,988.000 |
| 18 | 2.26 | 2,845.000 | 2.27 | 2,549.000 | 2.27 | 2,126.000 |
| 20 | 2.34 | 3,103.000 | 2.35 | 2,605.000 | 2.35 | 2,234.000 |
| 22 | 2.42 | 3,290.000 | 2.43 | 2,797.000 | 2.43 | 2,479.000 |
| 24 | 2.49 | 3,430.000 | 2.50 | 3,063.000 | 2.50 | 2,522.000 |
| 26 | 2.56 | 3,474.000 | 2.58 | 3,188.000 | 2.58 | 2,407.000 |
| 28 | 2.63 | 3,484.000 | 2.65 | 3,146.000 | 2.65 | 2,557.000 |

Table 1: Intensity, Voltage and current measurements of three single VCSEL (Honeywell, HFE4080-322/XBA). The test was done using a fiber optic (50um/125um, fiber-1). First test.

| VCSEL Current i (mA) | VCSEL-1 | | VCSEL-2 | | VCSEL-3 | |
|---|---|---|---|---|---|---|
| | Voltage V (Volt) | Intensity I (uW) | Voltage V (Volt) | Intensity I (uW) | Voltage V (Volt) | Intensity I (uW) |
| 0.276 | 1.39 | 0.009 | 1.39 | 0.018 | 1.39 | 0.008 |
| 0.904 | 1.47 | 0.082 | 1.47 | 0.129 | 1.47 | 0.054 |
| 1.8 | 1.54 | 0.287 | 1.54 | 0.406 | 1.54 | 0.184 |
| 2 | 1.56 | 0.327 | 1.56 | 0.510 | 1.56 | 0.222 |
| 4 | 1.67 | 122.000 | 1.67 | 205.000 | 1.67 | 121.500 |
| 6 | 1.76 | 451.000 | 1.76 | 568.000 | 1.77 | 337.000 |
| 8 | 1.84 | 807.000 | 1.84 | 1,020.000 | 1.85 | 630.000 |
| 10 | 1.94 | 1,235.000 | 1.94 | 1,540.000 | 1.94 | 983.000 |
| 12 | 2.03 | 1,871.000 | 2.03 | 1,858.000 | 2.03 | 1,247.000 |
| 14 | 2.10 | 1,943.000 | 2.10 | 1,963.000 | 2.11 | 1,500.000 |
| 16 | 2.18 | 2,514.000 | 2.19 | 2,219.000 | 2.20 | 1,573.000 |
| 18 | 2.26 | 2,850.000 | 2.26 | 2,552.000 | 2.27 | 1,811.000 |
| 20 | 2.34 | 2,835.000 | 2.35 | 2,630.000 | 2.35 | 1,881.000 |
| 22 | 2.42 | 3,171.000 | 2.43 | 2,800.000 | 2.44 | 1,793.000 |
| 24 | 2.49 | 3,083.000 | 2.50 | 2,920.000 | 2.51 | 1,801.000 |
| 26 | 2.56 | 3,186.000 | 2.58 | 3,201.000 | 2.59 | 1,798.000 |
| 28 | 2.63 | 3,171.000 | 2.64 | 3,133.000 | 2.65 | 1,801.000 |

Table 2: Intensity, Voltage and current measurements of three single VCSEL (Honeywell, HFE4080-322/XBA). The test was done using a fiber optic (50um/125um, fiber-1). Second test.

| VCSEL Current i (mA) | VCSEL-1 | | VCSEL-2 | | VCSEL-1 | |
|---|---|---|---|---|---|---|
| | Voltage V (Volt) | Intensity I (uW) | Voltage V (Volt) | Intensity I (uW) | Voltage V (Volt) | Intensity I (uW) |
| 0.276 | 1.39 | 0.010 | 1.39 | 0.020 | 1.39 | 0.009 |
| 0.903 | 1.47 | 0.089 | 1.47 | 0.124 | 1.47 | 0.064 |
| 1.801 | 1.54 | 0.289 | 1.54 | 0.383 | 1.54 | 0.196 |
| 2 | 1.56 | 0.347 | 1.56 | 0.465 | 1.56 | 0.255 |
| 4 | 1.67 | 101.000 | 1.67 | 187.000 | 1.67 | 133.000 |
| 6 | 1.77 | 470.000 | 1.76 | 551.000 | 1.76 | 380.000 |
| 8 | 1.85 | 861.000 | 1.84 | 976.000 | 1.85 | 733.000 |
| 10 | 1.94 | 1,270.000 | 1.93 | 1,317.000 | 1.94 | 1,255.000 |
| 12 | 2.03 | 1,655.000 | 2.02 | 1,603.000 | 2.03 | 1,355.000 |
| 14 | 2.10 | 2,056.000 | 2.10 | 1,901.000 | 2.11 | 1,548.000 |
| 16 | 2.19 | 2,474.000 | 2.19 | 2,139.000 | 2.20 | 1,863.000 |
| 18 | 2.26 | 2,772.000 | 2.26 | 2,447.000 | 2.27 | 1,791.000 |
| 20 | 2.34 | 3,025.000 | 2.34 | 2,509.000 | 2.36 | 1,906.000 |
| 22 | 2.42 | 3,202.000 | 2.43 | 2,825.000 | 2.44 | 1,968.000 |
| 24 | 2.49 | 3,351.000 | 2.50 | 2,805.000 | 2.50 | 2,001.000 |
| 26 | 2.56 | 3,408.000 | 2.57 | 3,063.000 | 2.58 | 2,029.000 |
| 28 | 2.63 | 3,411.000 | 2.64 | 3,168.000 | 2.65 | 2,029.000 |

Table 3: Intensity, Voltage and current measurements of three single VCSEL (Honeywell, HFE4080-322/XBA). The test was done using a fiber optic (50um/125um, fiber-2). First test.

| VCSEL Current i (mA) | VCSEL-1 | | VCSEL-2 | | VCSEL-1 | |
|---|---|---|---|---|---|---|
| | Voltage V (Volt) | Intensity I (uW) | Voltage V (Volt) | Intensity I (uW) | Voltage V (Volt) | Intensity I (uW) |
| 0.27 | 1.39 | 0.008 | 1.39 | 0.019 | 1.39 | 0.008 |
| 0.895 | 1.47 | 0.092 | 1.47 | 0.123 | 1.47 | 0.067 |
| 1.792 | 1.54 | 0.307 | 1.54 | 0.400 | 1.54 | 0.223 |
| 2 | 1.56 | 0.370 | 1.56 | 0.474 | 1.56 | 0.280 |
| 4 | 1.67 | 121.000 | 1.67 | 194.000 | 1.67 | 153.000 |
| 6 | 1.76 | 481.000 | 1.76 | 550.000 | 1.76 | 443.000 |
| 8 | 1.85 | 927.000 | 1.85 | 991.000 | 1.85 | 859.000 |
| 10 | 1.94 | 1,335.000 | 1.94 | 1,327.000 | 1.94 | 1,280.000 |
| 12 | 2.03 | 1,873.000 | 2.03 | 1,800.000 | 2.03 | 1,570.000 |
| 14 | 2.10 | 2,209.000 | 2.10 | 1,876.000 | 2.11 | 1,801.000 |
| 16 | 2.19 | 2,600.000 | 2.19 | 2,116.000 | 2.20 | 1,988.000 |
| 18 | 2.26 | 2,883.000 | 2.26 | 2,300.000 | 2.27 | 2,120.000 |
| 20 | 2.34 | 3,152.000 | 2.35 | 2,524.000 | 2.35 | 2,234.000 |
| 22 | 2.42 | 3,491.000 | 2.43 | 2,863.000 | 2.44 | 2,304.000 |
| 24 | 2.49 | 3,494.000 | 2.50 | 2,815.000 | 2.51 | 2,524.000 |
| 26 | 2.56 | 3,792.000 | 2.58 | 3,110.000 | 2.58 | 2,529.000 |
| 28 | 2.63 | 3,787.000 | 2.64 | 3,183.000 | 2.65 | 2,534.000 |

Table 4: Intensity, Voltage and current measurements of three single VCSEL (Honeywell, HFE4080-322/XBA). The test was done using a fiber optic (50um/125um, fiber-2). Second test.

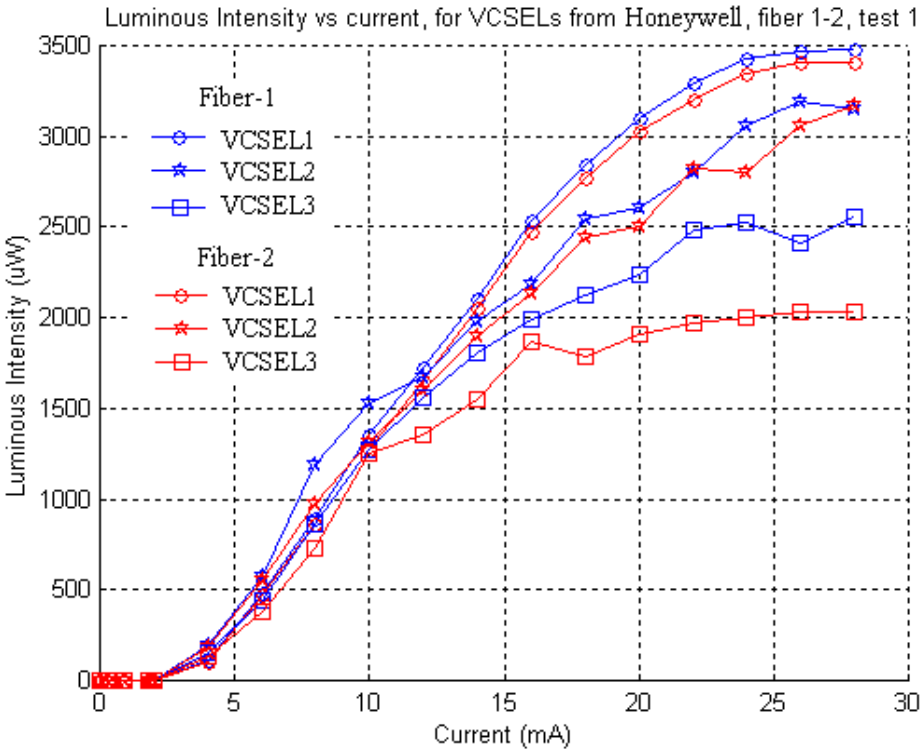


Figure 1: Graphic of Luminous Intensity versus Current for each single VCSEL (Honeywell, HFE4080-322/XBA). Using optical fiber 1 and 2 in the first test.

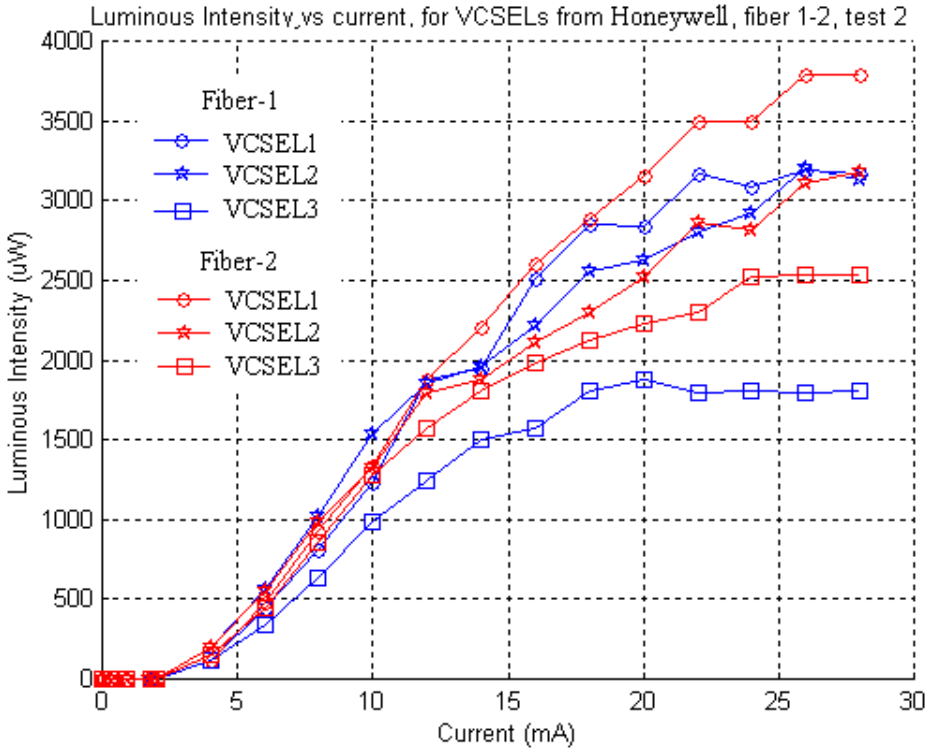


Figure 2: Graphic of Luminous Intensity versus Current for each single VCSEL (Honeywell, HFE4080-322/XBA). Using optical fiber 1 and 2 in the second test.

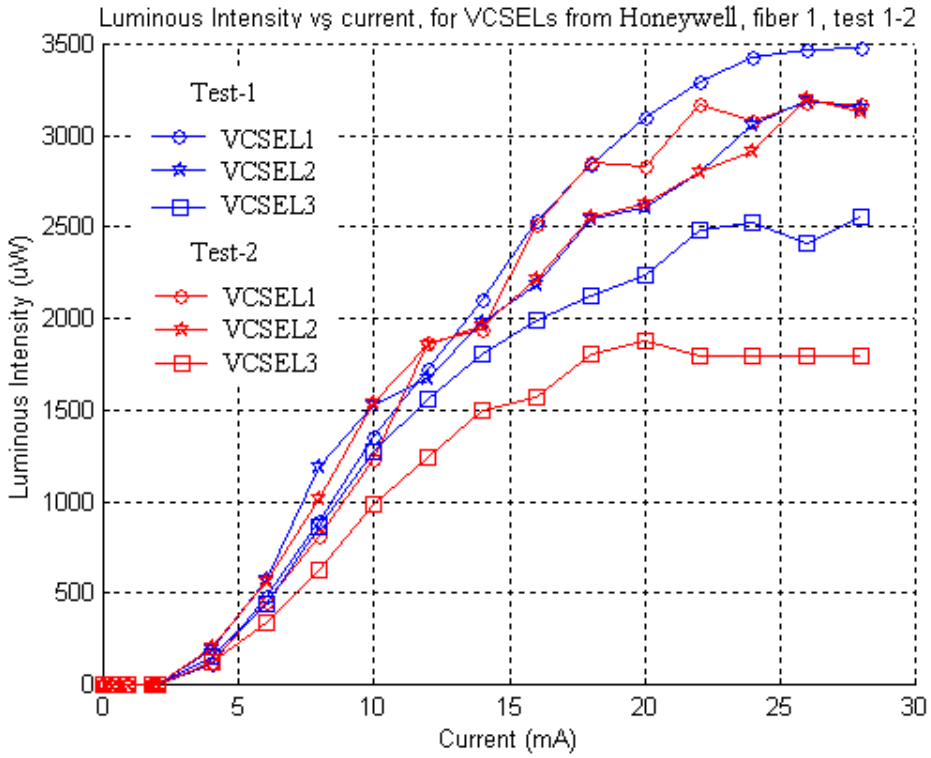


Figure 3: Graphic of Luminous Intensity versus Current for each single VCSEL (Honeywell, HFE4080-322/XBA). Using optical fiber 1 in the first and second test.

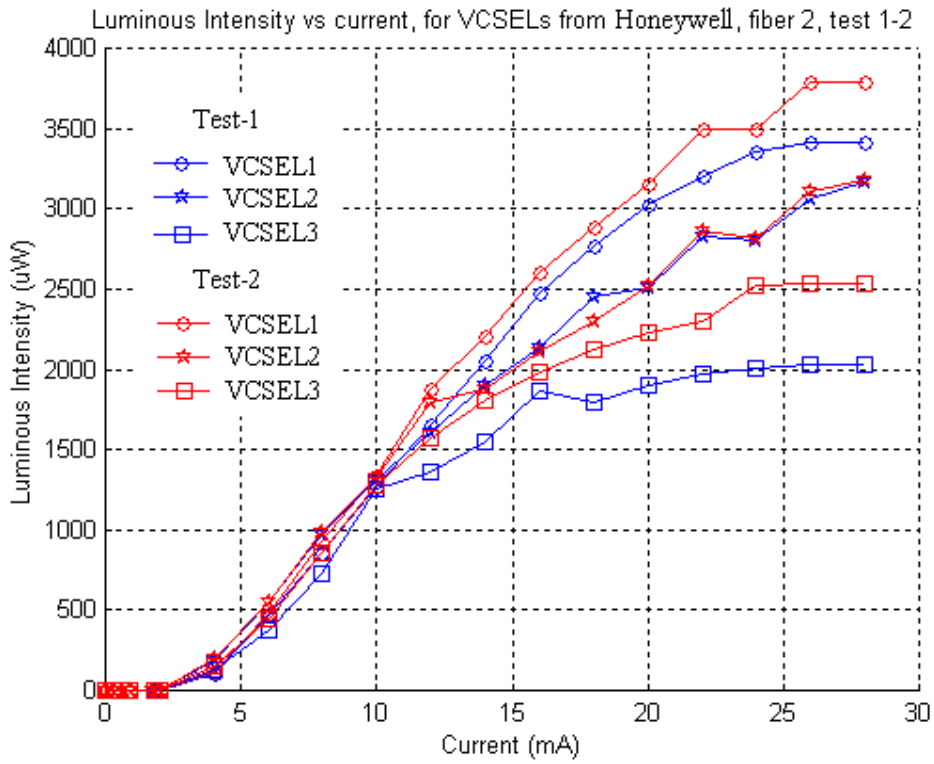


Figure 4: Graphic of Luminous Intensity versus Current for each single VCSEL (Honeywell, HFE4080-322/XBA). Using optical fiber 2 in the first and second test.

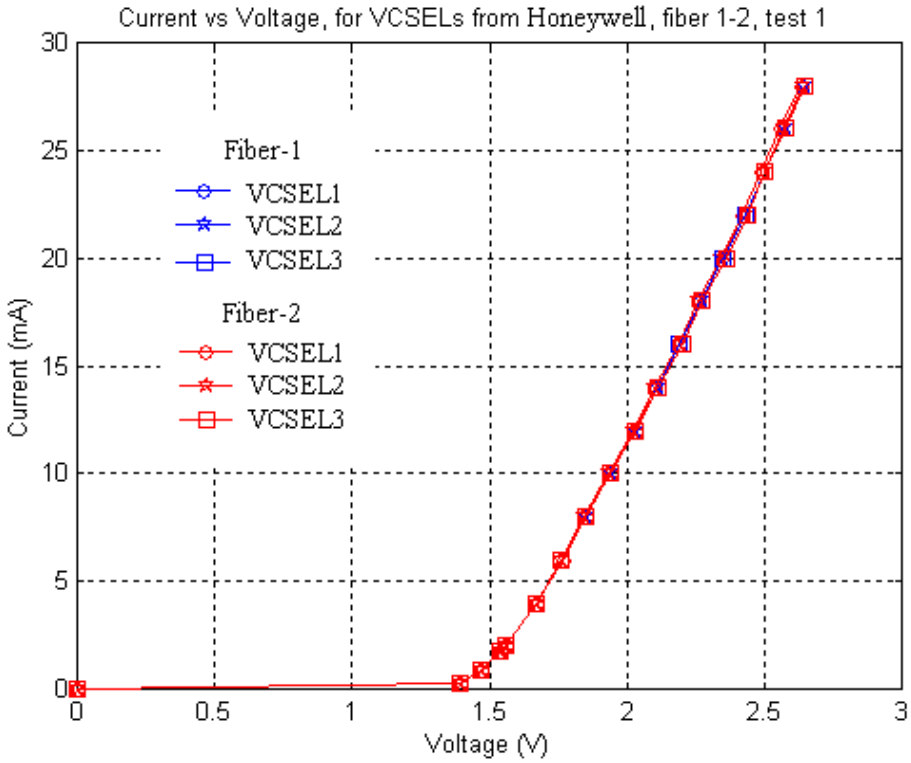


Figure 5: Graphic of the Current versus Voltage for each single VCSEL (Honeywell, HFE4080-322/XBA). Using optical fiber 1 and 2 in the first test.

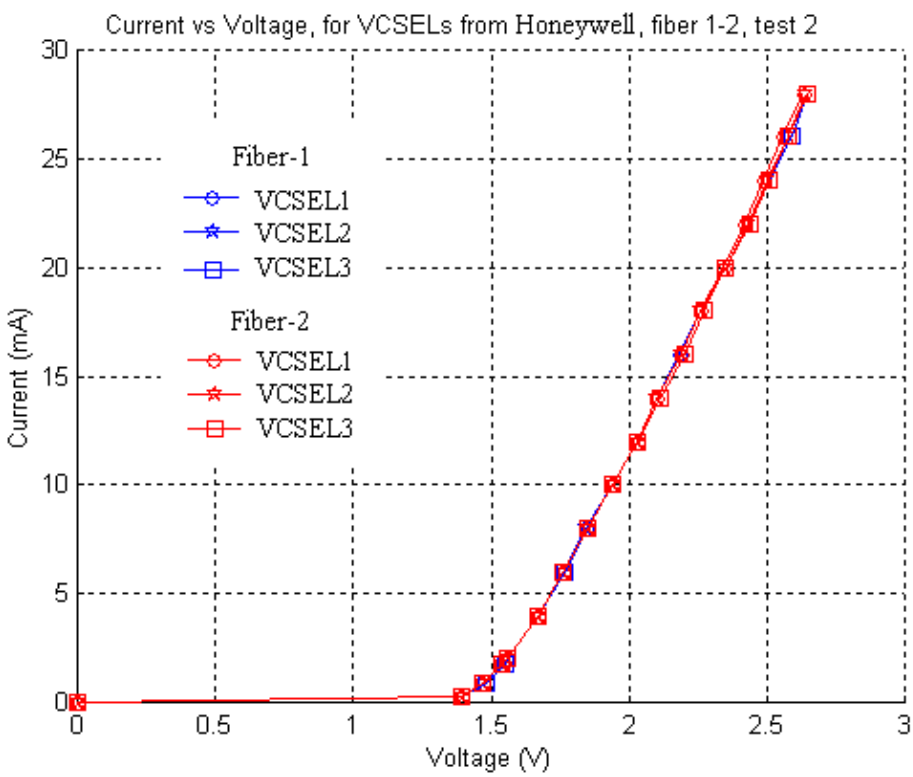


Figure 6: Graphic of the Current versus Voltage for each single VCSEL (Honeywell, HFE4080-322/XBA). Using optical fiber 1 and 2 in the second test.

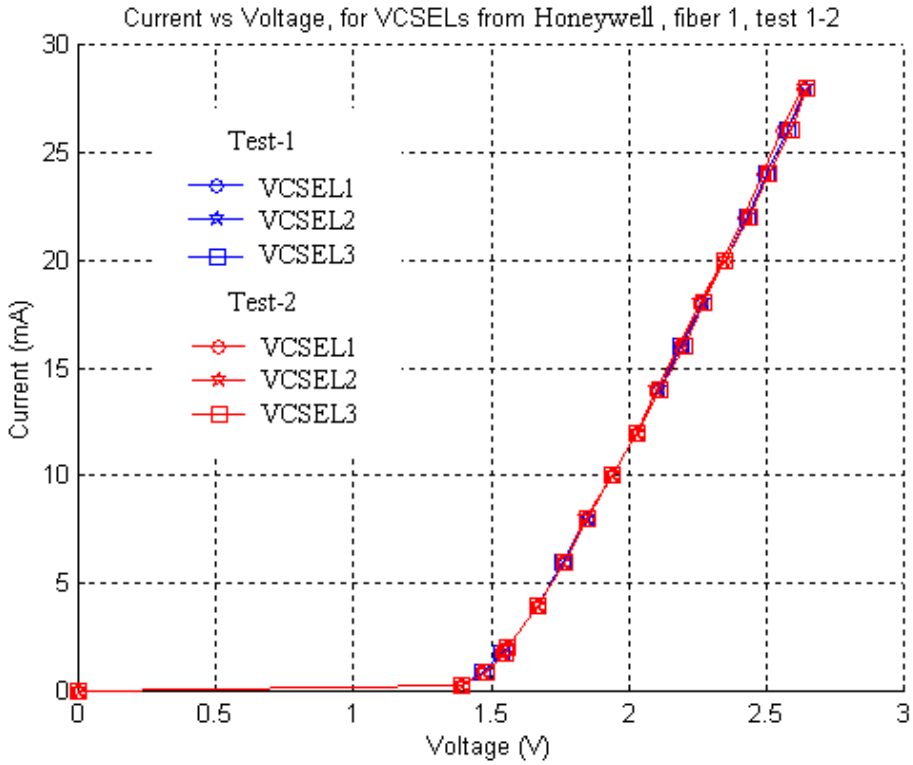


Figure 7: Graphic of the Current versus Voltage for each single VCSEL (Honeywell, HFE4080-322/XBA). Using optical fiber 1 in the first and second test.

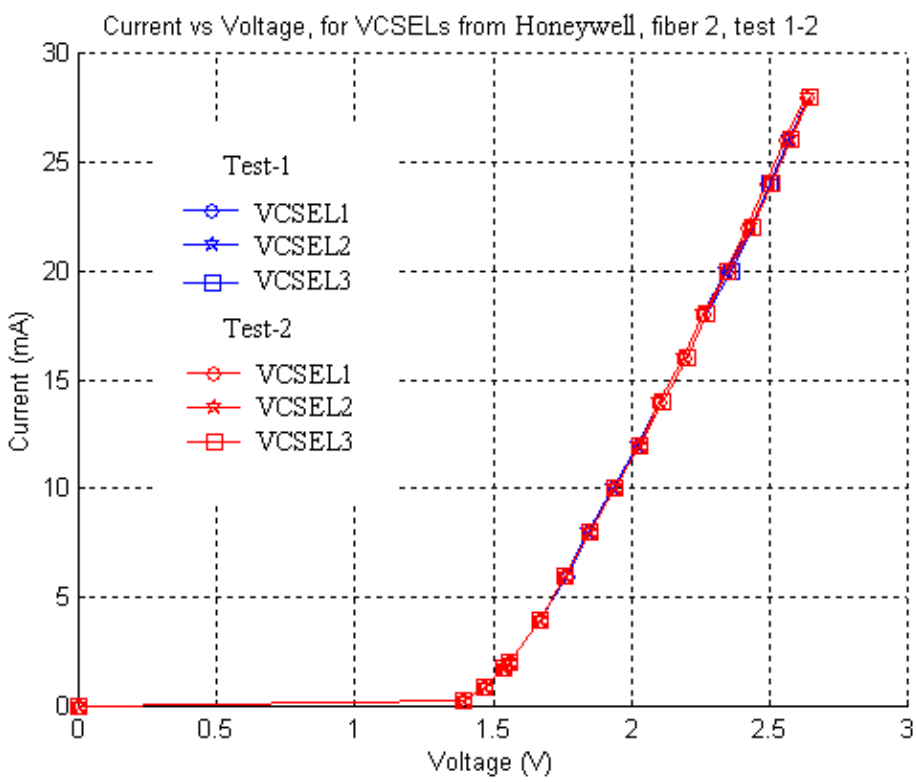


Figure 8: Graphic of the Current versus Voltage for each single VCSEL (Honeywell, HFE4080-322/XBA). Using optical fiber 2 in the first and second test.

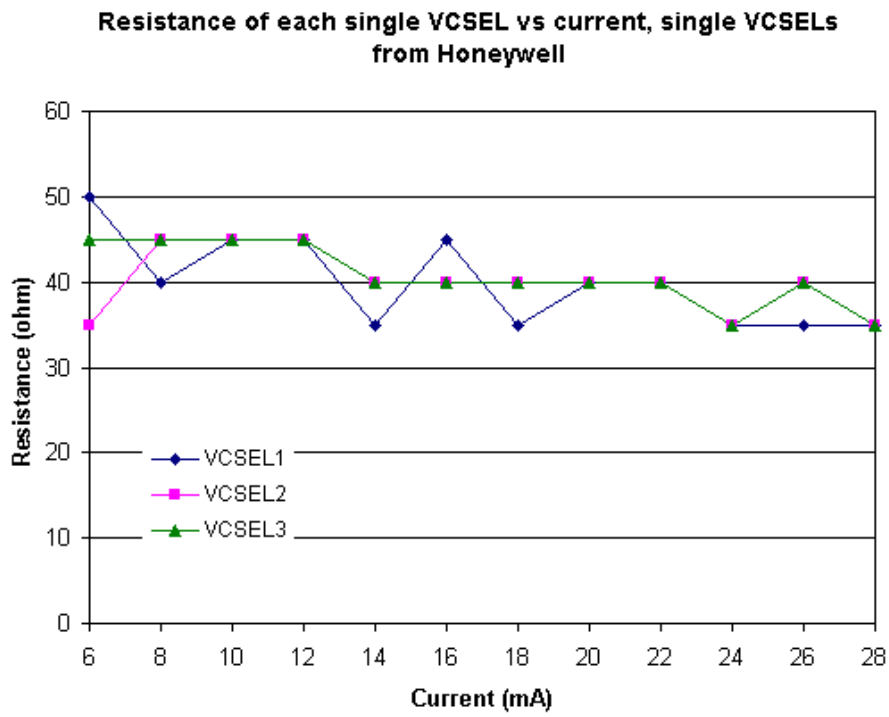


Figure 9: Graphic of the Resistance versus Current for each single VCSEL (Honeywell, HFE4080-322/XBA).

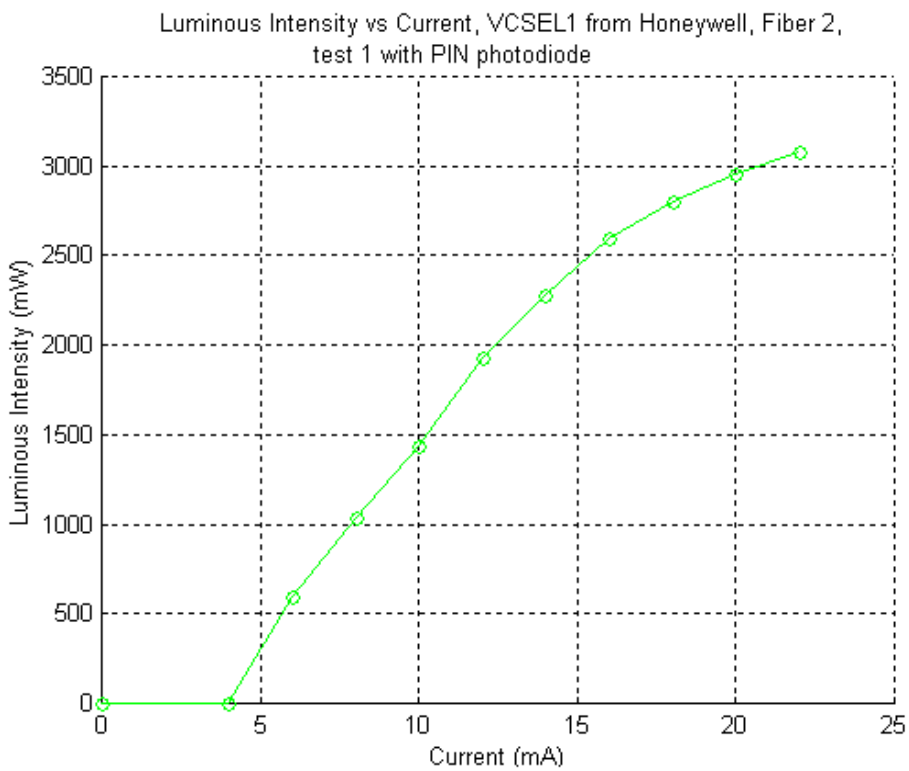


Figure 10: Graphic of Luminous Intensity versus Current for single VCSEL-1 (Honeywell, HFE4080-322/XBA). Using optical fiber 2 in a first test. Measuring the luminous intensity with a single PIN photodiode (Mitel, 1A354 ST-2A) as optical power meter.

## Conclusions

- Each single VCSEL from Honeywell shows a very stable current-voltage relationship.

- The resistance in the single Honeywell VCSELs averages $40\Omega$, with a current between 6mA and 28mA.

- The relationship between the optical power delivered for the VCSEL and its current is stable but the optical power delivered into the fiber optic depends strongly on the quality of the connectors.