Introduction

PerkinElmer's new Gigahertz Photon Detection module (GPDM) provides ultra-low-light level detection in DC mode. The DC mode of operation with single photon sensitivity makes the GPDM module superior to traditional counting circuits with their high light level performance limitation. The GPDM offers the world’s highest dynamic range between 1 cps and 1 Gcps in a single operating mode, coupled with extremely low noise performance.

The fully-equipped module includes the Channel Photomultiplier, the high voltage supply, analogue current amplifier, A to D conversion, and a microcontroller with USB/SPI interface, allowing for adapting to a wide range of applications. Additional features like the synchronization I/O offer the ability to synchronize the measurement with other devices, such as flash lamp trigger.

Features and Benefits

- World's highest dynamic counting range between 1 cps and 1 Gcps in a single operating mode
- Extremely low background noise
- High gain
- 4 different operating modes
- Variable interface options
- Best suited for multimodal analytical applications

Applications

- Multimodal analytical analysis
- Luminescence spectroscopy
- Time-resolved fluorescence
- High through-put screening
- DNA & cell analysis
- Microplate reading

Figure 1. Block Diagram

www.perkinelmer.com
### Preliminary Technical Data

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Condition</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply voltage</td>
<td></td>
<td>5.0</td>
<td>5.3</td>
<td>5.6</td>
<td>VDC</td>
</tr>
<tr>
<td>Supply current</td>
<td></td>
<td>300</td>
<td></td>
<td></td>
<td>mA</td>
</tr>
<tr>
<td>Detection range</td>
<td>Real counting mode</td>
<td>1</td>
<td>1</td>
<td>1e4</td>
<td>counts per second</td>
</tr>
<tr>
<td></td>
<td>Straight output mode</td>
<td>1</td>
<td>1</td>
<td>5e7</td>
<td>counts per second</td>
</tr>
<tr>
<td></td>
<td>Fast switching mode</td>
<td>3e5</td>
<td></td>
<td>1e9</td>
<td>counts per second</td>
</tr>
<tr>
<td></td>
<td>HV reduction mode</td>
<td></td>
<td></td>
<td>1e10</td>
<td>counts per second</td>
</tr>
<tr>
<td>Switching dead time</td>
<td>w/o offset calibration</td>
<td>1</td>
<td></td>
<td>20</td>
<td>ms</td>
</tr>
<tr>
<td>in fast switching mode</td>
<td>including offset calibration</td>
<td></td>
<td></td>
<td></td>
<td>ms</td>
</tr>
<tr>
<td>QE</td>
<td>λ peak</td>
<td>20%</td>
<td></td>
<td></td>
<td>photoelectrons / photons</td>
</tr>
<tr>
<td>CPM gain</td>
<td></td>
<td>1E3</td>
<td>adjustable</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sample time</td>
<td>Continuous data output</td>
<td>200</td>
<td></td>
<td>5 000</td>
<td>ms</td>
</tr>
<tr>
<td></td>
<td>(under development)</td>
<td>1</td>
<td></td>
<td>5 000</td>
<td>ms</td>
</tr>
<tr>
<td>Acquisition time</td>
<td>Width of measurement window</td>
<td>3</td>
<td></td>
<td>200</td>
<td>µs</td>
</tr>
<tr>
<td></td>
<td>for flash sequence measurements</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interface</td>
<td>USB 2.0</td>
<td>2</td>
<td></td>
<td>8</td>
<td>Mbit / second</td>
</tr>
<tr>
<td></td>
<td>SPI (under development)</td>
<td>-</td>
<td></td>
<td></td>
<td>MHz</td>
</tr>
</tbody>
</table>

### Operating Modes

To enable best performance characteristics for different application depending requirements, the GPDM offers different operating modes, which can either be selected manually or will be set automatically:

<table>
<thead>
<tr>
<th>Operating Mode</th>
<th>Range (Counts per second)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real Counting Mode</td>
<td>1 CPS – 10 k CPS</td>
</tr>
<tr>
<td>Straight Output Mode</td>
<td>1 CPS – 50 M CPS</td>
</tr>
<tr>
<td>Fast Switching Mode</td>
<td>1 CPS – 1 G CPS</td>
</tr>
<tr>
<td>HV Reduction Mode</td>
<td>– 10 G CPS</td>
</tr>
</tbody>
</table>

### Notes:

1) See below performance characteristics
2) CPM characteristics can be matched to the application’s requirements – see spectral response curve
3) Gain pre-set to optimal single photons sensitivity
4) Actual output information is RLU (relative light unit) – counts per second is the calculated value based on RLU
**GigaHertz Photon Detection Module**

**Measurement Bandwidth**

- **Real Counting Mode**
- **Straight Output Mode**
- **Fast Switching Mode**
- **HV Reduction Mode**

**Relative Intensity Of Light**

- CPS (Data ReadOut)

**Table: Model Comparison**

<table>
<thead>
<tr>
<th>Model * (also order no.)</th>
<th>Installed CPM Type</th>
<th>Photocathode Diameter/mm</th>
<th>Photocathode Material</th>
<th>Window Material</th>
<th>Spectral Response/hm</th>
<th>Typ. dark counts per second (cps)</th>
</tr>
</thead>
<tbody>
<tr>
<td>GPDM 943</td>
<td>C943 P</td>
<td>5, 9, 15</td>
<td>Bialkali</td>
<td>UV glass</td>
<td>185-650</td>
<td>10, 40, 100</td>
</tr>
<tr>
<td>GPDM1343</td>
<td>C1343 P</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GPDM1943</td>
<td>C1943 P</td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>GPDM 963</td>
<td>C963 P</td>
<td>5, 9, 15</td>
<td>Multialkali</td>
<td>UV glass</td>
<td>185-850</td>
<td>100, 400, 1000</td>
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<tr>
<td>GPDM1363</td>
<td>C1363 P</td>
<td></td>
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<td></td>
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<tr>
<td>GPDM1963</td>
<td>C1963 P</td>
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<tr>
<td>GPDM 973</td>
<td>C973 P</td>
<td>5, 9, 15</td>
<td>Extended red Multialkali</td>
<td>UV glass</td>
<td>185-900</td>
<td>500, 2000, 5000</td>
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<tr>
<td>GPDM1373</td>
<td>C1373 P</td>
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<td>GPDM1973</td>
<td>C1973 P</td>
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<tr>
<td>GPDM 983</td>
<td>C983 P</td>
<td>5, 9, 15</td>
<td>Low noise Bialkali</td>
<td>UV glass</td>
<td>185-650</td>
<td>3, 10, 25</td>
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<td>GPDM1383</td>
<td>C1383 P</td>
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<td>GPDM1983</td>
<td>C1983 P</td>
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<td>GPDM 993</td>
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<td>5, 9, 15</td>
<td>Extended Yellow Bialkali</td>
<td>UV glass</td>
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<td>10, 40, 100</td>
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<td>GPDM1393</td>
<td>C1393 P</td>
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</tr>
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<td>GPDM1993</td>
<td>C1993 P</td>
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<td></td>
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</tbody>
</table>

**Figure 6. Dynamic Range Comparison CPM vs. PMT**

- **Range of CPM electronics (DC):** 1e7
- **Range of PMT electronics:** 1e4
Figure 7. Typical spectral response of C9xx CPM types.
Identical characteristics for CPM types C13xx and C19xx

### Dimensions

<table>
<thead>
<tr>
<th>Module Type</th>
<th>Dimension/mm</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
<th>I</th>
<th>J</th>
<th>K</th>
<th>L</th>
<th>M</th>
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</thead>
<tbody>
<tr>
<td>GPDM 9xx</td>
<td></td>
<td>4.5</td>
<td>36</td>
<td>4.5</td>
<td>33</td>
<td>127</td>
<td>120</td>
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<td>19.5</td>
<td>10</td>
<td>18</td>
<td>45</td>
<td>45</td>
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<td>GPDM 13xx</td>
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<td>30</td>
<td>20</td>
<td>19</td>
<td>10</td>
<td>22.1</td>
<td>50</td>
<td>50</td>
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<td>GPDM 19xx</td>
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<td>4.5</td>
<td>36</td>
<td>7</td>
<td>33</td>
<td>137</td>
<td>130</td>
<td>30</td>
<td>20</td>
<td>19</td>
<td>10</td>
<td>22.1</td>
<td>50</td>
<td>50</td>
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