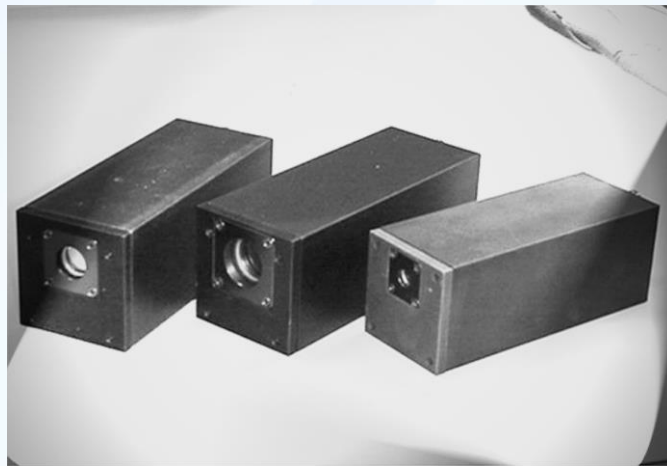


# Ultra High Sensitivity CPM Photon Counting Module CM 900 / CM 1300 / CM 1900 series

Preliminary Operating Instructions



## Operating Manual

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### Introduction

The Photon Counting Head CM series is designed for applications in all fields of single photon detection, e.g. chemo-luminescence, bioluminescence, in-vitro assay, environmental measurements or pure research. It is an easy to use module, containing the Channel Photomultiplier, a high voltage power supply, a discrimination amplifier and a pulse shaper for fast output pulses. An installed active quenching system avoids

over-illumination to the detector. It is also possible to apply an external gate function for time-correlated photon counting. Strong variations in light levels are possible due to the high dynamic range of the installed CPM. The exceptional low noise and high sensitivity facilitates detection of extremely weak light levels.

### Features and Benefits

- Extremely low background noise
- Best low light level detection limits
- High dynamic range & gain
- Low microphonic & magnetic sensitivity
- Compact size & rugged design
- Multiple photocathode and window selections
- Plug and play for shortest design-in and time-to-market
- Customizations and added features available

### Applications

- Photon counting
- Luminescence & fluorescence spectroscopy
- Microplate readers
- Clinical diagnostics
- DNA & cell analysis
- Particle measurements
- Industrial spectroscopy
- Nucleic acid amplification (PCR)

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Specification

Parameter (typ.)	Condition	CM	Unit
Linear Countrate		10	Mega Counts/sec
Max Countrate		20	Mega Counts/sec
Pulsewidth		15	ns
Overillumination Protection Reset		external TTL reset pulse	
Gating function  (electronic shutter)	Delay Gate on	320	ns
	Delay Gate off	160	ns
	Gate on	20	ns
	Gate off	20	ns
Kill function	Kill on	340	ms
	Kill off	550	ms

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Table 1: CM parameter

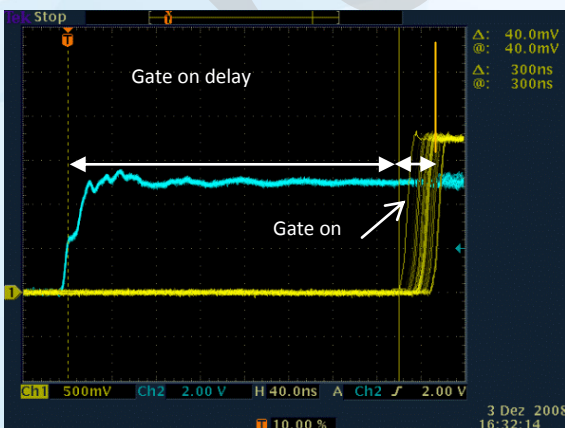


Figure 1: Gate on delay time characteristics

Blue: External Gate Input Pulse (TTL)

Yellow: Gate switch off (regular counting) to on (counting disabled) with typical jitter characteristics

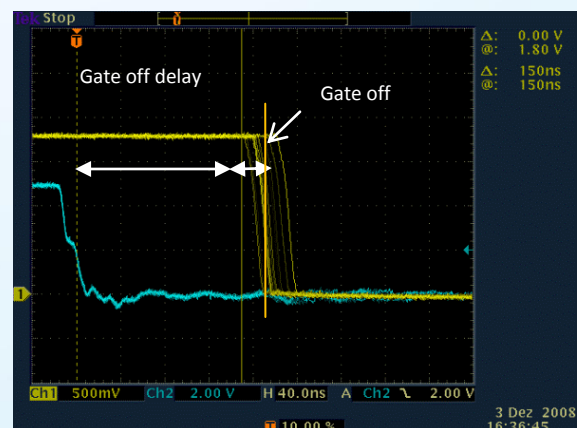


Figure 2: Gate off delay time characteristics

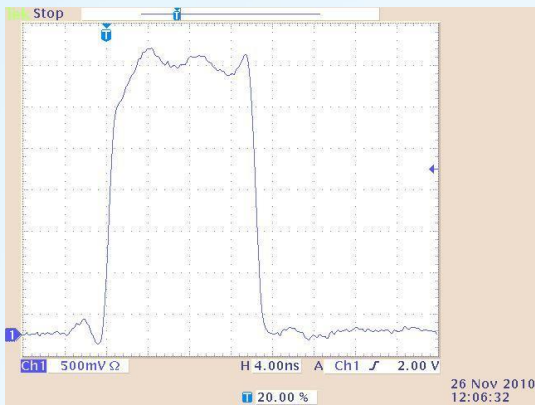


Figure 3: Single Output TTL Pulse (typ. 15ns)

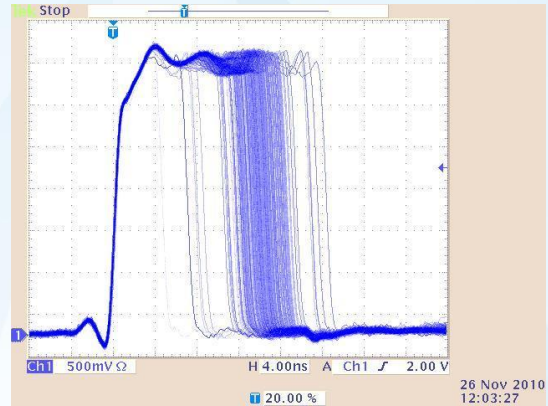


Figure 4: Multiple Output TTL Pulses (with typ. pulse width variation)

## Important Notes

- When not operating the CPM-module, always keep cathode covered or in darkness
- Turn off all power supplies immediately, if the module does not work properly
- Review all connections of the power supply and signal output

## Definitions

### Gating

In case of Gating, the following process happens:

A TTL high signal (internally generated) at the “Gate” input of the High voltage power supply (hvps) triggers an hvps internal circuit which immediately switches cathode potential more positive than Channel Entrance Voltage so the cathode cannot emit photoelectrons into the channel vacuum.

The Gate function fulfils two purposes:

- Over illumination protection  
When accidentally too high light intensities enter the window of the ChannelPhotomultiplier, which would cause count rates, exceeding the maximum specified count rate, the “Gate” function is activated and the Photocathode is blocked (avoiding damage of the detector). Re-operation only can be achieved by switching off and on power supply or by applying an external TTL high signal to the Gate Reset input pin (pin 9 of SUB D connector)
- Electronic shutter:  
If operator intends to use the gate function as an electronic shutter (e.g. to switch the cathode blind during illuminating the probe by excitation light) the “Gate” function can be enabled (and disabled) by applying a TTL high (low) to the external Gate input pin.

### Kill

In case of Kill – function is activated, the high voltage power supply switches to stand-by mode with main output voltage turning to 0 volts thus all related potentials turning to 0 volts, too (CPM disabled). This mode may be useful for repair-, maintenance- or safety purposes. It can either be enabled or disabled by applying a low (ground) or TTL high to the “kill” input pin (HV shutdown).

### Vmon

Voltage monitor output. The adjusted high voltage can be monitored / displayed by addressing this function. The value represents the high voltage value divided by 1000.

## Testing/Measurements

- Ensure that 5 Volts power supply is switched off
- Connect red wire (4) to 5 Volts power supply
- Connect black wire (8) to ground of 5 Volts power supply
- Connect yellow wire (6) to the voltage input of a voltmeter
- Connect ground input of voltmeter to common ground (black wire of module)
- Connect output signal of module via a 50 Ohms coaxial cable to an oscilloscope, a counter or your electronic system.
- Terminate output signal with a 50 Ohms resistor
- Optional (if installed): Connect external gate input to your gating signal source (see Table 1)  
For the time a TTL-high signal is applied to the input, the internal cathode voltage is switched 200 volts more positive (→ no electrons accelerated towards the anode, no anode current at the output)
- Using the optional Gating function, a TTL level of about 5 V is required. The cathode is switched off only for the time the input level is at high. With gate input open or ground, the module will be in regular operating mode
- Before switching on supply voltage, make sure the Channel Photomultiplier module is in total darkness (Turn off any light source).
- While switching on supply voltage, monitor output signal. In total darkness, count rate is max. about 20 to 30 typically (Please refer to your test report sheet of the module). It never can exceed 25.000.000 counts per second.
- Please note: Module is protected against over-exposure. When an anode current exceeds 20  $\mu$ A or 20Mcps, the cathode voltage is switched off automatically and will recover only after external “Gate Reset” pulse has been applied or after module’s power has been switched off and on again.
- If the CPM was exposed to high light levels before operating started, number of counts can exceed 1kcps. In that case, store CPM for one hour in darkness before re-operating.

## External Gain Control

- Since all CPM-Counting Modules are optimized to operate on the “Single Photoelectron Plateau”, no external Gain Control is needed and therefore, this option is not installed. However, if you wish to use this option for your application, please contact your local distributor or ProxiVision GmbH.

**SUB D Connector**

SUB D9- Connections				
Pin	Color	Function	In-/Output	Signal Level
1	blue	HV Shutdown (kill)	Input	>2.6 inactive, <2.4 V active
2	green	n.c.		
3	orange	ext. Gate-Input	Input	<2.7 V inactive, >2.9 V active
4	red	+5Vdc(Power supply)	Input	
5	white	Gate Indicator	Output	int. Gate active = 3.4 V, inactive<1.3V, active >1.5V
6	yellow	Vmon	Output	0 to 3 volts
7	brown	GND (Gate)	Input	
8	black	GND(power supply)	Input	
9	purple	ext. Gate Reset	Input	> 1.5 V Gate Reset > 1 $\mu$ s



Fig.5:  
Rear View CM-Module

Table 2: Input / Output Connections

Linear count rate:	10 Mega Counts (20 Mcps max. count rate*)
Output Signal:	TTL-Pulse, positive
Over-illumination protection**):	Active quenching control (Gate enabled, no output signal) Reset: Via external TTL high or power supply switch off – switch on
Output impedance:	50 Ohms
Supply voltage	+5 V to +5.5 V DC
Gating (electronic shutter function)	TTL-Pulse, active high,
Gate timing characteristics	Gate On (including Delay): 340 ns (typ.) Gate Off (including Delay): 180 ns (typ.)
Output pulse width	15 ns (typ), (optional: 130 ns, 300 ns)
Input current at max. count rate	< 250 mA

**Maximum ratings**

Input voltage	+5.5 V
Operating temperature	+5 to +40 °C
Storage temperature	-20 to +50 °C
Weight	~ 350g /420g / 450g (CM900/CM1300/CM1900)

\*) for long term operation: max. average output countrate of < 200 Kcps (anode current of <100 nA) is recommended

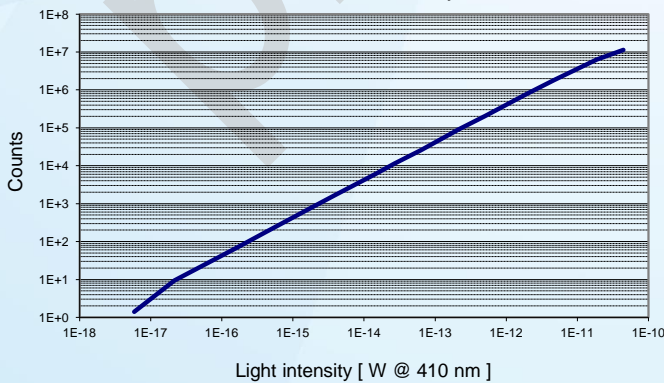
\*\*\*) Module will start counting only after external reset pulse or power off/on

List of Module Variations

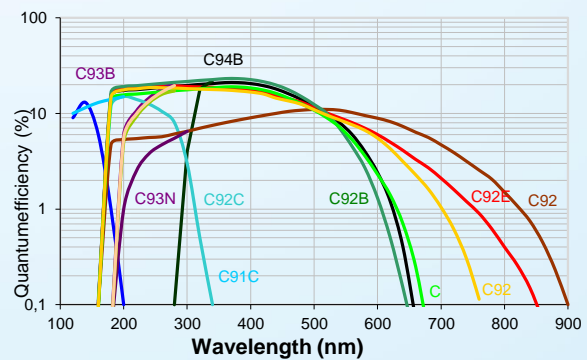
Model (also order no.)	Detector type	Photocathode diameter	Window material	Photocathode material	Spectral response / nm	Quantum efficiency	Typ. dark counts per second (cps)	
CM 91CI CM131CI CM191CI	Customized Photo Multiplier (CPM)	min. 5mm	MgF <sub>2</sub> (1)	CsI (CI)	115-200	Peak Value 20% typical (ext. red MA: 10% typ.)	0.1 0.4 1	
CM 92B CM132B CM192B			Quartz (2)	Bialkali (B)	165-650		10 40 100	
CM 93B CM133B CM193B			UV Glass (3)	Bialkali (B)	185-650		10 40 100	
CM 92E CM132E CM192E			Quartz	S20 (E)	165-850		100 400 1000	
CM 93E CM133E CM193E			UV Glass	S20 (E)	185-850		100 400 1000	
CM 92N CM132N CM192N			min. 9mm	Quartz	S25 (N)		165-900	500 2000 5000
CM 93N CM133N CM193N			UV Glass	S25 (N)	185-900		500 2000 5000	
CM 92LB CM132LB CM192LB			min. 15mm	Quartz	Low Noise Bialkali (LB)		165-650	3 10 25
CM 93LB CM133LB CM193LB			UV Glass	Low Noise Bialkali (LB)	185-650		3 10 25	
CM 92YE CM132YE CM192YE			Quartz	Yellow Enhanced (YE)	165-750		10 40 100	
CM 93YE CM133YE CM193YE			UV Glass	Yellow Enhanced (YE)	185-750		10 40 100	

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Count Rate Linearity

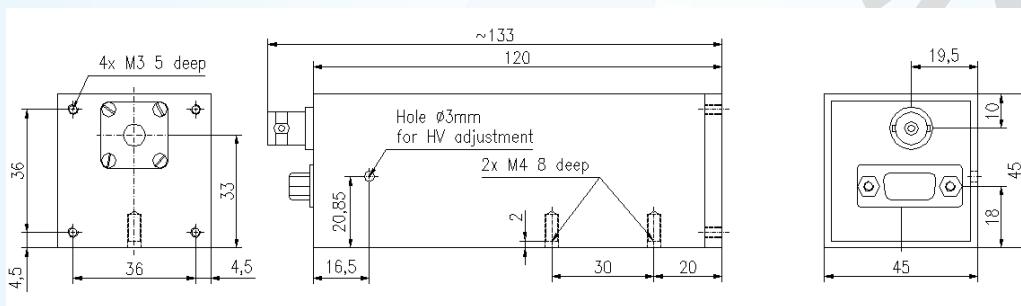


Spectral response of various CPM types

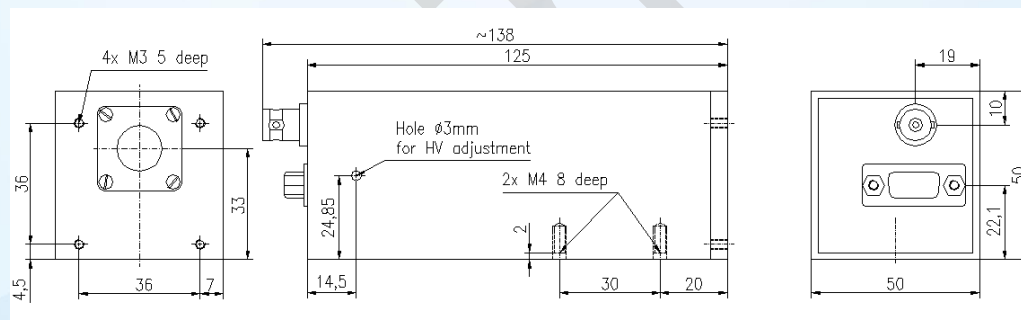


Window Material = X		Photocathode Type = Z	
MgF <sub>2</sub>	=1	Cesium Iodid	=CI
Quartz	=2	Cesium Tellurid	=C
UV Glass	=3	Bialkali	=B
Borosilicat	=4	LowNoise Bialkali	=LB
		S20	=E
		S25	=N
		YellowEnhanced	=YE

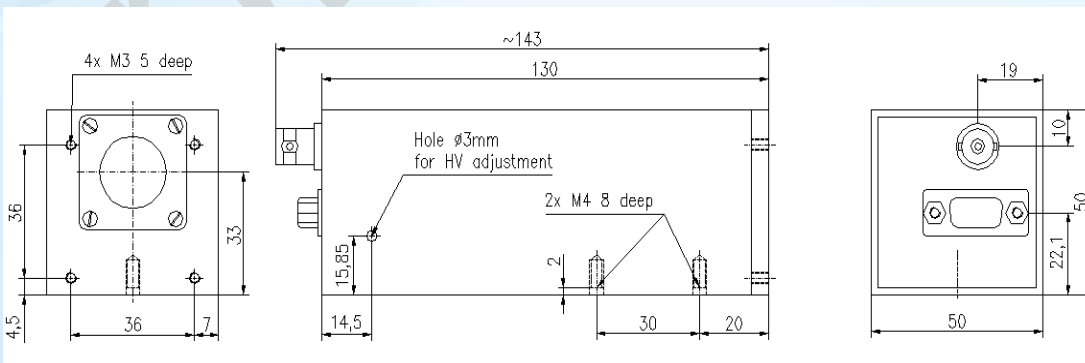
### Dimensions (mm)



CM 900



CM 1300



CM 1900

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- Warning: HIGH VOLTAGE
- This product operates at high voltage. Extreme care must be taken to ensure operator safety and to avoid damage to other instruments. Avoid direct contact with the CPM when high voltage is applied.
- If the photocathode is operated at negative high voltage, avoid to place any material close to the cathode. It is advantageous to keep any material 5 to 10 mm away from the biased cathode. If materials are used close to the cathode operated at high voltage electrical fields might create unwanted noise.
- Ensure that no light levels are applied, generating higher anode currents than specified.
- All given values are nominal/typical @ 20 °C ambient temperature; specification subject to change without notice

### ESD warning

CPM Modules should only be handled at an ESD-safe work station.

### Warranty

A standard 12-month warranty following shipment applies. Any warranty is null and void if the module case has been opened unauthorized