



Operating manual

Photon Counter
AD200

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Introduction

Redwave Labs' AD200 is a compact and affordable single-photon detector module based on a reliable silicon avalanche photodiode sensitive in the visible spectral range. The detector of the AD200 has high efficiency values in the near visible region (around 650 nm). The AD200 features active quenching and full digital temperature control. A separate power supply is provided as standard.



Key Features	70% quantum efficiency at 650 nm 55% quantum efficiency at 800 nm Tunable temperature of the diode Low dark and after pulsing rates Software included	
Applications	Time correlated single photon counting Single molecule detection Laser scanning microscopy Particle physics Spectrophotometry	
Specifications	Parameter	Value
Power	Single	+12 V
Photodiode	Wavelength	400 – 1000 nm
	Breakdown Voltage	125V@ 25C
	Active Area	500 μm
Single-Photon Detection Probability	At 650nm	70%
	At 800nm	55%
Dark Count Rate		25 @ -20C, typical
Deadtime		40 ns
Output pulse		40 ns
Connectors	Power	Molex 2 PIN
	Output	SMA
	USB	USB TYPEB
	Timing Gate	SMA
Dimensions (WxHxD)		120 x 92 x 30 mm
Weight		350 g
Storage Temp		-55 to 100 C
Operating Temp		-40 to 85 C

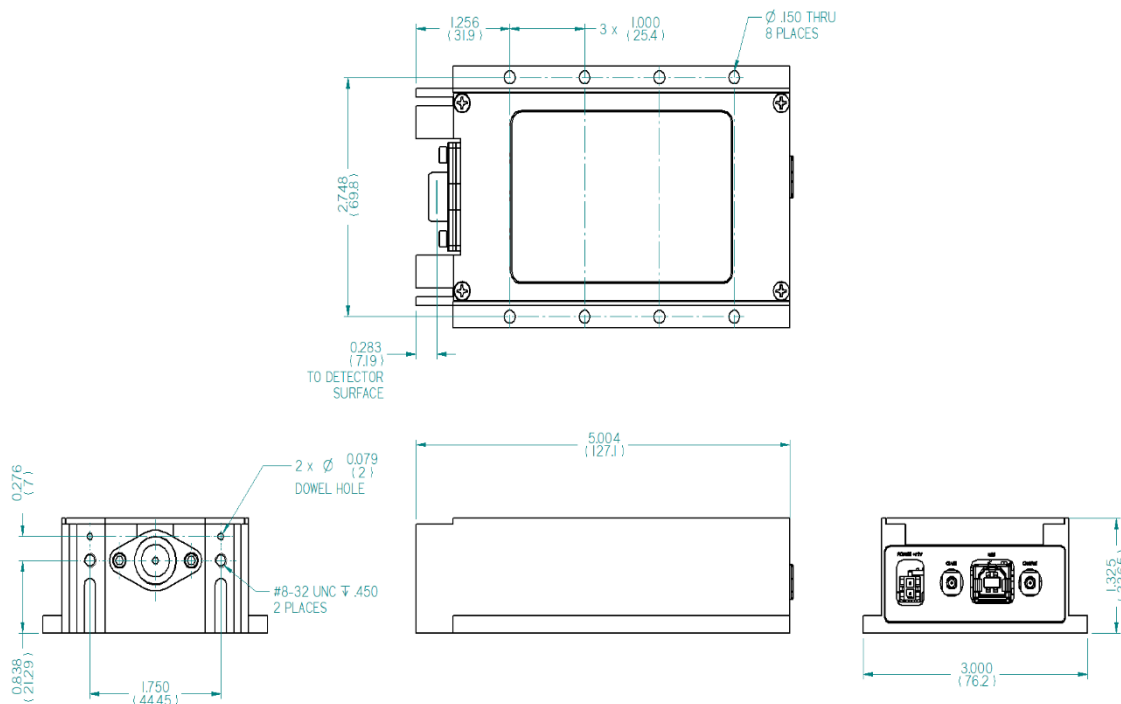
RedWave Labs Ltd keeps improving its products and therefore some specifications can vary.

Absolute Maximum Ratings

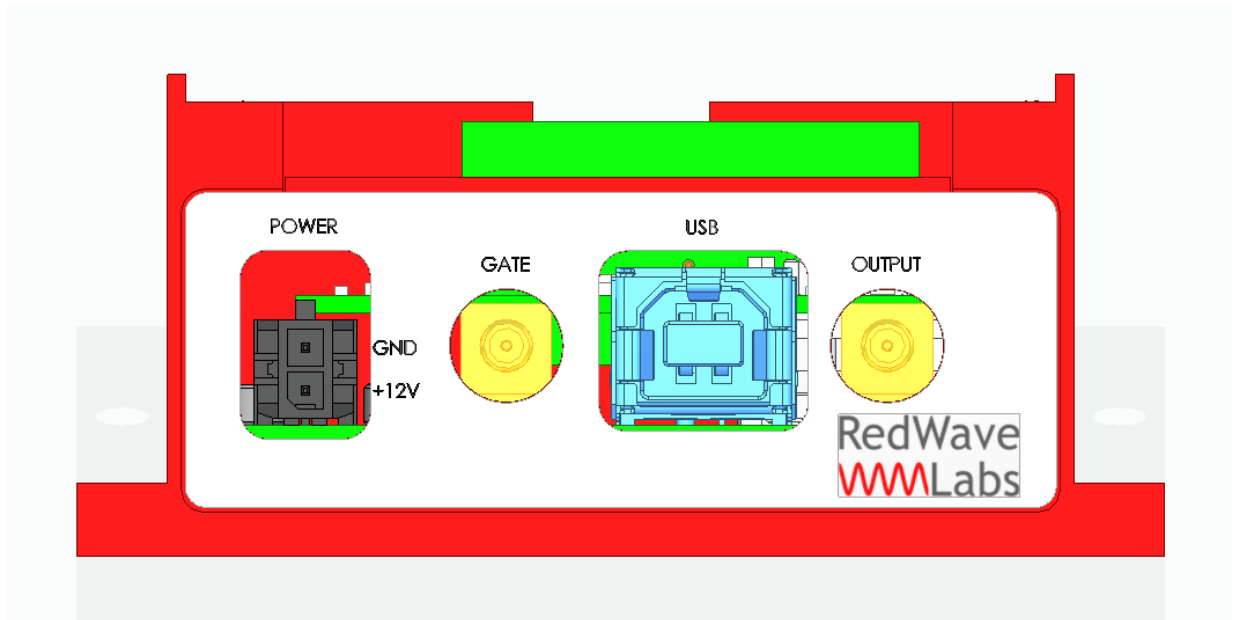
Symbol	Parameter	Ratings	Unit
V _{dd}	Supply Voltage	+12	Volt
T _{op}	Operational Temperature	-40 to 85	Deg C
T _{st}	Storage Temperature	-55 to 100	Deg C

Mechanical Information

Parameter	Value	Unit
Length	5.004 (127.1)	Inch (mm)
Width	3.000 (76.2)	Inch (mm)
Height	1.325 (33.65)	Inch (mm)
Weight	350	gram



Electrical Characteristics: Rear Panel 1

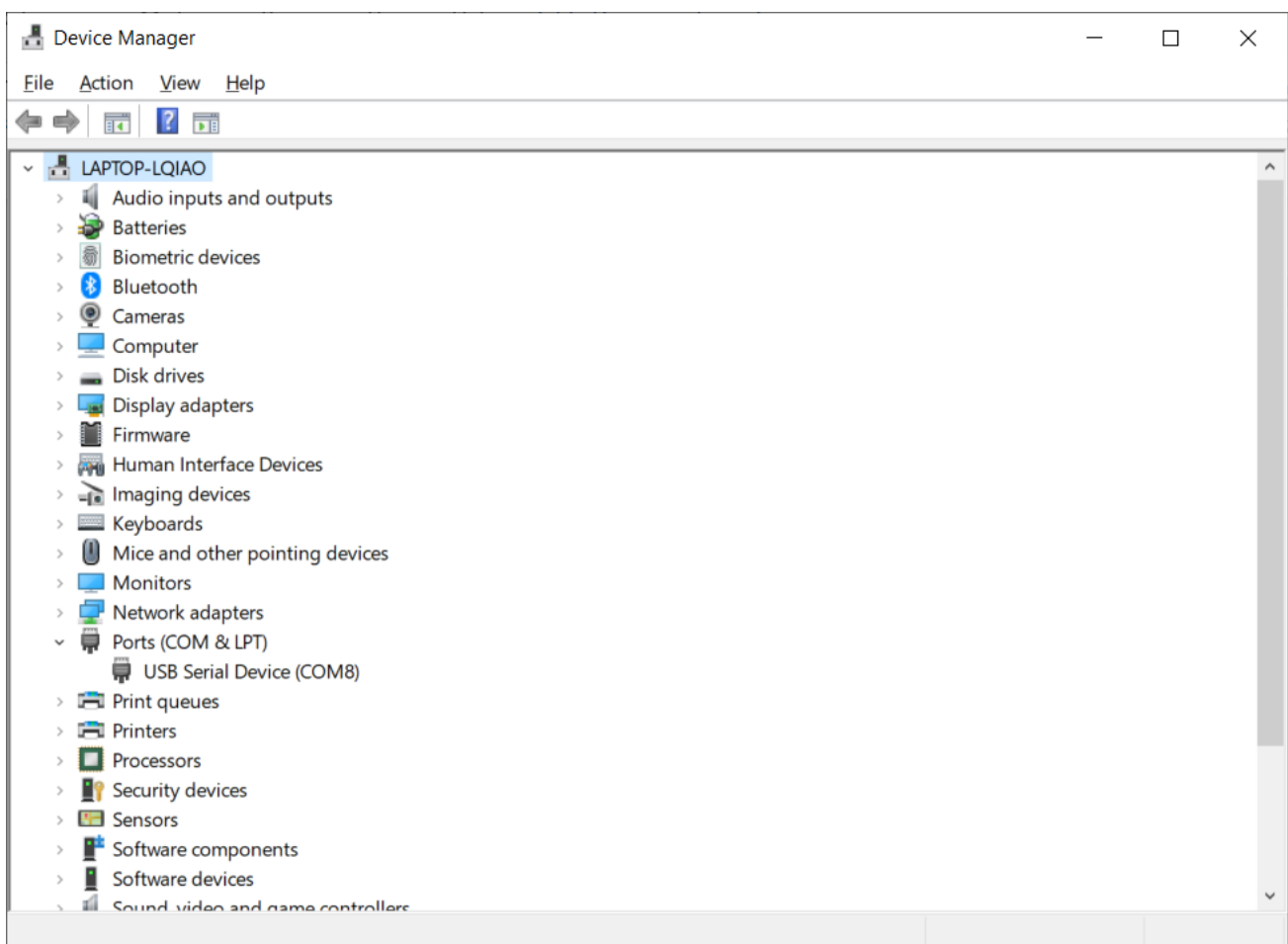


Connection	Name	Description
Power	Power	12V 5A
SMB	Gate	Gate Function
USB	USB	USB TYPE B; Digital Interference
SMB	Output	Photon Count Output

Setting Up

Step 1: Find USB Serial Device (COM)

The USB Serial Device (COM?) can be found in the Device Manager after the photon count connecting 12V power and Digital interference. As can be seen below, we know the USB serial Device is COM8 in my situation.



Step 2: Click "Connect" Button.

Your computer can talk to the photon counter through the USB after you enter the "COM?" found in step one and click the "Connect" button

The screenshot shows the GEN Term v6000.0.2 software interface. At the top, there is a 'TCP/IP Port' section with a 'Connect' button and a dropdown menu set to 'COM8'. To the right is the 'SCPI Status' section showing 'SYST:ERR:ALL?' as '0, "No error"' and two checked options: 'Auto check cmd success' and 'Auto clear err code'. Below this is a navigation bar with tabs for 'Scpi99', 'SYSTEM', 'Trgt Sys', 'Trgt Usr', 'Log', 'VT100', 'FILE LOG', 'TEC', 'TEC Graph', 'Sensor', 'Pid', 'LD', 'Photon', 'LinearEqu', and 'Pid Tune'. The 'LD' tab is selected, and a dropdown menu shows 'LD_0' with a 'Refresh' button to its right. The main area is divided into several sections: 'Current' (with fields for LD:I:MAX, LD:I:LIMIT, LD:I:[SET?], LD:I?, and (A) values), 'Current Slope' (with fields for LD:I:SLOPE:MAX, LD:I:SLOPE[:SET?], LD:I:SLOPE?, and (A/s) values), 'Voltage' (with fields for LD:V:MAX, LD:V:LIMIT, LD:V:[SET?], LD:V?, and (V) values), 'Voltage Slope' (with fields for LD:V:SLOPE:MAX, LD:V:SLOPE[:SET?], LD:V:SLOPE?, and (V/s) values), 'LD' (with fields for LD:MODE, LD:CONTROL, LD:OUTPUT, LD:FAULT?, and dropdowns for Mode, Bipolar, Output, and Mask), and 'Pulse' (with fields for LD:PULSE:MAX, LD:PULSE, (min Hz), (max Hz), (min Duty%), (max Duty%), (Repeat), and (Duty%) values).

Step 3: Set Temperature of the APD.

You can set the temperature of the APD in the sensor tab before you click "TEC:T[:SET?]" button.

The screenshot shows the GEN Term v6000.0.2 software interface. At the top, there is a window title bar and a menu bar with options: Scpi99, SYSTem, Trgt Sys, Trgt Usr, Log, VT100, FILE LOG, TEC, TEC Graph, Sensor, Pid, LD, Photon, LinearEqu, Pid Tune. The 'Sensor' tab is selected.

At the top of the interface, there is a 'TCP/IP Port' section with a 'Close' button and a dropdown menu set to 'COM8'. To the right is the 'SCPI Status' section with a text field containing '0,"No error"' and two checked checkboxes: 'Auto check cmd success' and 'Auto clear err code'.

The main configuration area is divided into several sections:

- TEC:** A dropdown menu is set to 'TEC_0' and a 'Refresh' button is present.
- Sensor:**
 - 'TEC:SENSOR:TYPE' is set to 'SENSOR_THERMISTOR'.
 - 'TEC:SENSOR:CONST' has fields for 'Ro' (0.0), 'A' (0.00107513), 'B' (0.000313205), and 'C' (1.64019e-007).
 - 'TEC:SENSOR:IEXC[:SET?]' has a field for '(uA)' (250.0) and a 'TEC:SENSOR:IEXC?' button.
 - 'TEC:SENSOR?' has fields for 'Res Ohm' (1343.77), 'uA' (250.0), 'V' (0.335941), and 'C' (21.6088).
- Temperature:**
 - 'TEC:T:MAX' has fields for '(min C)' (-30.0) and '(max C)' (35.0).
 - 'TEC:T[:SET?]' has a field for '(C)' (-20.0) and a 'TEC:T?' button.
 - 'TEC:T?' has a field for '(C)' (21.6144).
- Temperature History:**
 - 'Range' is set to 'RANGE_SEC'.
 - 'TEC:T:HISTORY?' has fields for 'Index' (191), 'time' (946684988), and 'C' (21.6144).
 - 'TEC:T:HISTORY:INDEX?' has a field for 'Index' (0).
 - 'TEC:T:HISTORY:INFO?' has fields for 'Rd' (144) and 'Wr' (192).

Step 4: Turn on the TEC.

Choose TEC_ON and click "TEC:OUTPUT" button if you would like to turn on the TEC.
 Choose TEC_OFF and click "TEC:OUTPUT" button if you choose to turn off the TEC.

The screenshot displays the GEN Term v6000.0.2 interface for controlling the TEC. At the top, the TCP/IP Port is set to COM8 and the SCPI Status is 0, "No error". The main menu includes options like Scpi99, SYSTEM, Trgt Sys, Trgt Usr, Log, VT100, FILE LOG, TEC, TEC Graph, Sensor, Pid, LD, Photon, LinearEqu, and Pid Tune. The TEC control panel is currently set to TEC_0. It features several sections: Current (with limits for TEC:I:MAX, TEC:I:LIMIT, and TEC:I[:SET?]), Current Slope (with limits for TEC:I:SLOPE:MAX and TEC:I:SLOPE[:SET?]), Voltage (with limits for TEC:V:MAX, TEC:V:LIMIT, and TEC:V[:SET?]), and a TEC control section. The TEC control section includes a Mode dropdown set to TEC_MODE_INT_TEMPC, an Output dropdown with TEC_ON selected, and buttons for TEC:MODE, TEC:OUTPUT, TEC:PID, TEC:PID:RATE, and TEC:FAULT?. The Kp value is 0.03 and the Kd value is 0.0.

Step 5: Set Bias Voltage of the APD.

You can set the bias voltage of the APD in the LD tab before you click "LD:V[:SET?]" button.

The screenshot shows the GEN Term v6000.0.2 software interface. At the top, there's a TCP/IP Port section with a 'Close' button and a dropdown menu set to 'COM8'. To the right is the SCPI Status section showing 'SYST:ERR:ALL?' and '0,"No error"' with checkboxes for 'Auto check cmd success' and 'Auto clear err code'. Below this is a menu bar with options: Scpi99, SYSTEM, Trgt Sys, Trgt Usr, Log, VT100, FILE LOG, TEC, TEC Graph, Sensor, Pid, LD (selected), Photon, LinearEqu, Pid Tune. The main area is titled 'LD' with a dropdown menu set to 'LD_0' and a 'Refresh' button. The interface is divided into several sections:

- Current:** Contains buttons for 'LD:I:MAX', 'LD:I:LIMIT', and 'LD:I[:SET?]' with input fields for '(max A)' (0.003), '(A)' (0.0), and 'LD:I?' (0.0).
- Current Slope:** Contains buttons for 'LD:I:SLOPE:MAX', 'LD:I:SLOPE[:SET?]', and 'LD:I:SLOPE?' with input fields for '(min A/s)' (0.0001), '(max A/s)' (0.003), and '(A/s)' (0.0001).
- Voltage:** Contains buttons for 'LD:V:MAX', 'LD:V:LIMIT', and 'LD:V[:SET?]' with input fields for '(max V)' (133.0), '(V)' (117.0), and 'LD:V?' (0.0).
- Voltage Slope:** Contains buttons for 'LD:V:SLOPE:MAX', 'LD:V:SLOPE[:SET?]', and 'LD:V:SLOPE?' with input fields for '(min V/s)' (10.0), '(max V/s)' (100.0), and '(V/s)' (10.0).
- LD:** A sub-section with buttons for 'LD:MODE', 'LD:CONTROL', 'LD:OUTPUT', and 'LD:FAULT?'. It includes dropdown menus for 'Mode' (PWR_CONTROLLER_VOLTAGE), 'Bipolar' (PWR_MODE_CONTINUOUS), and 'Output' (LD_OFF), along with a 'Mask' input field (0).
- Pulse:** A sub-section with buttons for 'LD:PULSE:MAX' and 'LD:PULSE'. It includes input fields for '(min Hz)', '(max Hz)', '(min Duty%)', '(max Duty%)', '(Repeat)', '(Hz)', and '(Duty%)', all currently set to 0.0.

Step 6: Turn on the APD's power supply.

Choose LD_ON and click "LD:OUTPUT" button if you would like to turn on the APD's power supply.
 Choose LD_OFF and click "LD:OUTPUT" button if you choose to turn off the APD's power supply.

The screenshot shows the 'GEN Term v6000.0.2' interface. At the top, there are fields for 'TCP/IP Port' (COM8) and 'SCPI Status' (0, "No error"). Below this is a menu bar with options like 'Scpi99', 'SYSTEM', 'Trgt Sys', 'Trgt Usr', 'Log', 'VT100', 'FILE LOG', 'TEC', 'TEC Graph', 'Sensor', 'Pid', 'LD', 'Photon', 'LinearEqu', and 'Pid Tune'. The 'LD' menu item is selected.

The main control area is divided into several sections:

- Current:** Includes fields for LD:I:MAX (0.003), LD:I:LIMIT (0.003), LD:I[:SET?] (0.0), and LD:I? (0.0).
- Current Slope:** Includes fields for LD:I:SLOPE:MAX (0.0001), LD:I:SLOPE[:SET?] (0.0001), LD:I:SLOPE? (0.0001), and LD:I:SLOPE? (0.0001).
- Voltage:** Includes fields for LD:V:MAX (133.0), LD:V:LIMIT (133.0), LD:V[:SET?] (117.0), and LD:V? (0.0).
- Voltage Slope:** Includes fields for LD:V:SLOPE:MAX (10.0), LD:V:SLOPE[:SET?] (10.0), LD:V:SLOPE? (10.0), and LD:V:SLOPE? (10.0).
- LD:** A sub-section with buttons for LD:MODE, LD:CONTROL, LD:OUTPUT, and LD:FAULT?. The 'LD:OUTPUT' button is circled in orange. To its right, there are dropdown menus for 'Mode' (PWR_CONTROLLER_VOLTAGE), 'Bipolar' (PWR_MODE_CONTINUOUS), 'Output' (LD_OFF), and 'Mask' (LD_OFF). The 'LD_OFF' option in the 'Output' dropdown is also circled in orange.
- Pulse:** A sub-section with buttons for LD:PULSE:MAX and LD:PULSE. It includes fields for (min Hz), (max Hz), (min Duty%), (max Duty%), (Repeat), (Hz), and (Duty%).

Step 7: Count photons.

In order to start count photons, firstly, click “Count:MEASure:START” button and then click “Start Polling” button.

GEN Term v6000.0.2

TCP/IP Port: Close, COM8

SCPI Status: SYST:ERR:ALL?, 0, "No error"

Auto check cmd success Auto clear err code

Scpi99 | SYSTem | Trgt Sys | Trgt Usr | Log | VT100 | FILE LOG | TEC | TEC Graph | Sensor | Pid | LD | Photon | LinearEqu | Pid Tune

Control: COUNT:MEASure:START, COUNT:MEASure:STOP, COUNT:MEASure:CLear, Refresh

Setup: COUNT:GATE:MODE, GATE_MODE_FREE, COUNT:GATE:APERTure (us) 1000000, COUNT:GATE:DELAY (us) 10, COUNT:ARRAy:NPOInts (us) 100, COUNT:ARRAy:STATe, SENS_COUNT_ARRAY_STATE_CONTINUOUS

Results: COUNT:DATA?, Counter 0, Status 0, Index 0, COUNT:MEASurement?, Status 0

COUNT:SATURation:VOLTage (V) 5.0, Start Polling

```
bin=0026 count=1422674
bin=0027 count=1445604
bin=0028 count=1483231
bin=0029 count=1461302
bin=0030 count=1502239
bin=0031 count=1506841
bin=0032 count=1266960
bin=0033 count=13372
bin=0034 count=346
bin=0000 count=0
```

Certification

RedWave Labs Ltd certifies that: i) the parts and/or materials were produced in conformance with all contractually applicable Government and/or Buyer's specification as referenced in, or furnished with, the above purchase order and ii) all processes required in the production of these parts and/or materials are listed and were performed by a facility or by personnel specifically approved or certified by the seller's cognizant government quality control agency when such approval or certification is required by an applicable specification. RedWave Labs products are not authorized for use in safety-critical applications (such as life support) where a failure of the product would reasonably be expected to cause severe personal injury or death, unless officers of the parties have executed an agreement specifically governing such use of the products.

Warranty and returns

RedWave Labs Ltd products are warranted against defects in materials and workmanship for a period of 180 days from date of shipment. During the warranty period RedWave Labs Ltd will replace or repair products which prove to be defective or damaged. Our warranty shall not apply to defects or damages resulting from: i) misuse of the product or ii) operation beyond specifications detailed in the current manual.

Return procedure

Customer must obtain a valid RMA number by contacting RedWave Labs prior to the return. In all cases the customer is responsible for duty fees incurred on all received shipments and on all international returns for both warranty and non-warranty items; the customer is responsible for any duties, brokers fees or freight charges deemed chargeable to RedWave Labs Ltd.

Revisions

Revision 1.0: First revision

Revision 2.0:

- Improved dark count rate to 25 cps
- Substantial electronics redesign.