光电探测器供电电路

8-PIN 光电探测器				
型号	管脚 1	管脚 2、4、5、7、8	管脚 3	管脚 6
DSC-R604APD （供电要参考说明文档中 K-connector 版本）	2.45	GND	3.3	37.0

注：以上电压都为典型值

电路设计要求

一、 供电

1、 上电顺序与断电顺序，以下要求的各管脚之间在上电及断电时有**延迟**，不能所有管脚同时进行供电，设计完成后要有：

上电顺序及注意事项：

1) 先接地，延迟>10ms

2) 使用限流电源进行供电并使用稳定的偏置

3) V_{bd} 电压加到+10V，延迟>10ms

4) V_{cc} 电压加到+3.3V

5) 光输入后，通过旋钮调整 V_{bd} 的电压（+10V~+37V）获取想要的增益

断电顺序：

1) 断开 bias 供电之前移除光信号输入

Single-Ended K-Connector Version:

Operating Procedure:

Always follow these steps:
1. Connect ground first
2. Use current-limited power supplies
3. Apply stabilized bias with proper polarities
4. Turn on APD bias voltage (V_{bd}) to +10V
5. Turn on Amplifier bias (V_{cc}) to +3.3V
6. Apply optical power.
7. Adjust APD bias voltage to achieve desired gain

Always shutdown with these steps:
1. Remove optical power before removing bias
2. Reduce APD bias voltage to +10V
3. Turn off the Amplifier bias voltage
4. Turn off the APD bias voltage
5. Disconnect the device

2) V_{bd}先降至+10V，延迟>10ms

3) 断开 V_{cc}的连接，延迟>10ms

4) 断开 V_{bd}，延迟>10ms

5) 断开设备连接

2、 电源反向输入保护；

3、 要求输入光电探测器的每一路的纹波电压不大于 30mV；

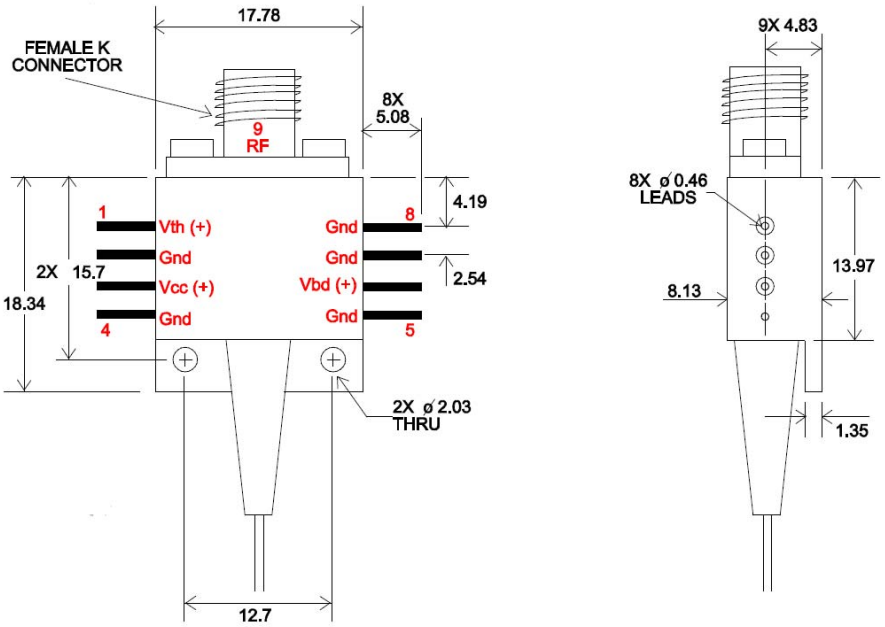
4、 提供一个电源开关键，并有绿色的工作指示灯；

5、 要考虑防静电；

二、 尺寸和标识

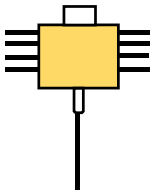
1、电路板尺寸在 7cm×7cm 以内；

2、 8-PIN 夹具形式的安装方式：



3、 在光电探测器底部要考虑散热；

4、 在电路板上画出光电探测器的安装方向，以避免用户安装反向，如下图所示：



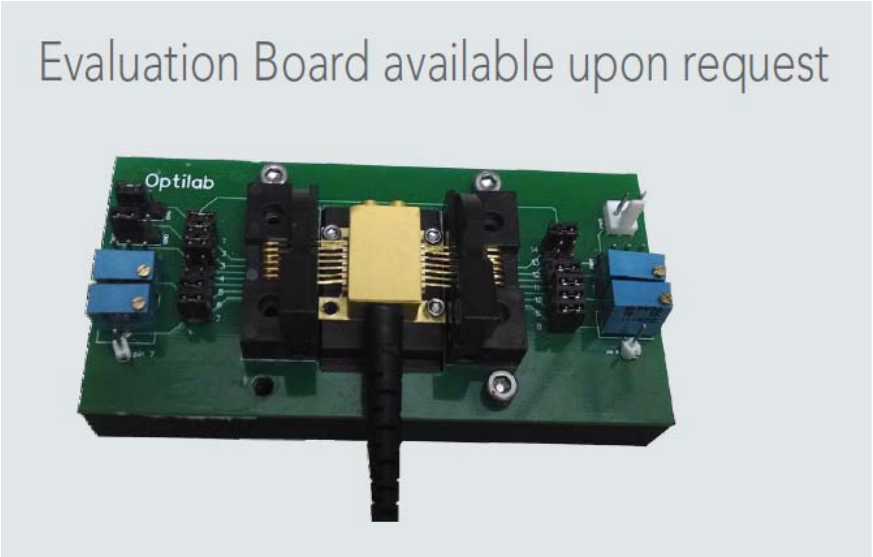
5、 电路板在 4 个角都需要 1 个安装孔（共 4 个）；

三、 其它

1、 提供电路设计原理图及对应的 PCB 图；

2、 提供使用说明书及注意事项；

附：参考电路板



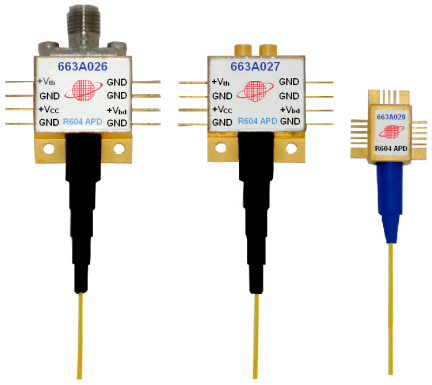
Data Sheet
March 2014

10 Gb/s High-Sensitivity High-Gain APD Optical Receiver with Optional CDR

Description:

The DSC-R604-APD is a high-gain APD (avalanche photodiode) + Transimpedance + Limiting amplifier ideally suited for digital applications up to 11 Gb/s. The R604-APD offers a high optical sensitivity of -27.5dBm, an optical dynamic range > 27dB, differential transimpedance gain of 12,000 Ω, a decision threshold adjustment function and very low power dissipation of 200mW.

The R604-APD is available in both module and Lab Buddy instrument forms. Three module package styles are available: differential GPPO, single-ended K-connector, and a miniature surface mount package with CPW (coplanar waveguide) RF outputs. In Lab Buddy instrument form, an optional clock and data recovery (CDR) unit is available which provides a 3R (receive, reshape, retime) solution with a jitter tolerance of 0.6 UIp-p and conveniently interfaces with bit error rate (BER) test stations.



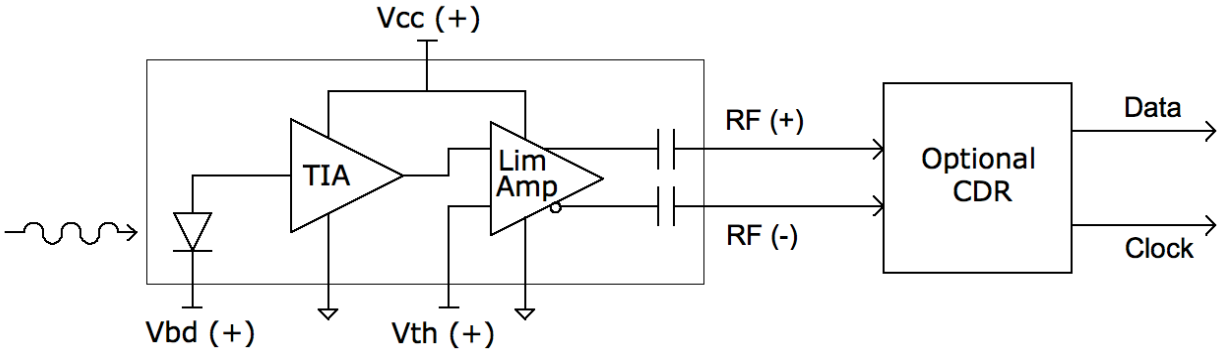
Salient Features:

- High Optical Sensitivity of -27.5 dBm at 10 Gb/s
- Wide Optical Dynamic Range > 27dB at 10 Gb/s
- High differential transimpedance gain of 12,000 Ω
- Decision threshold adjustment to minimize BER
- GPPO, K-connector or surface mount package options
- Very low power dissipation of 200mW
- Low optical PDL @ 1550nm (typically 0.05dB)
- High reliability InGaAs APD, transimpedance amplifier and packaging
- CDR option with 0.6UIp-p jitter tolerance

Applications:

- Metro and Long Haul 10 Gb/s
- DWDM systems
- Digital applications up to 11 Gb/s baud rate
- High sensitivity / wide dynamic range digital applications
- Free space optical communication links
- Test and Measurement

Block Diagram : R604-APD module and optional CDR



Electrical / Optical Specifications:

(Conditions unless otherwise noted: $T_{AMBIENT}$ = 25ºC, Vcc = +3.3V, 1550nm, R_{LOAD} = 50Ω)

Parameter		Min	Typical	Max	Units
Wavelength Response Range (>0.1 A/W)		950	-	1650	nm
APD Gain (M) Operating Range (1) (9)		2		11	A / A
Intrinsic Unity-Gain Responsivity (@ M=1)	@ 1550 nm	-	0.7	-	A / W
	@ 1310 nm	-	0.7	-	A / W
	@ 1630 nm	-	0.5	-	A / W
Differential Transimpedance (2)		8,000	12,000	-	Ohms
Optical Sensitivity (10Gb/s, 1550nm, 2^{31}-1 PRBS, BER=10^{-12}, 13dB Ext. Ratio, M = optimized) (3)		-26.0	-27.5	-	dBm
Optical NEP (Noise Equivalent Power) (3)		-	2.5	-	pW/√Hz
Optical Overload (10Gb/s, 1550nm, 2^{31}-1 PRBS, BER=10^{-12}, 13dB Ext. Ratio) (1) (4)		-	- 10	-	dBm
Maximum Differential Output Swing (5)		-	450	600	mV_{p-p}
Bandwidth (-3dB, small signal)		-	7	-	GHz
Low Frequency Cut-off (-3dB)		-	30	100	KHz
Electrical Return Loss		-	-10	-	dB
Decision Threshold Adjustment (Vth) (6)		+2.1	+2.45	+2.8	V
Decision Threshold Input Resistance		-	7,000	-	Ohms
Optical Return Loss @ 1550nm		27	35	-	dB
Optical PDL @ 1550nm (7)		-	0.05	-	dB
APD Breakdown Voltage (Vbd) (@ 10uA dark current) (8)		-	37	-	V
APD Breakdown Voltage Temperature Coefficient		-	0.15	-	% / °C
APD Dark Current @ M=10		-	50	-	nA
Amplifier Bias Voltage (Vcc)		+3.14	+3.3	+3.46	V
Amplifier Bias Current (Icc)		-	50	65	mA
Power Dissipation		-	200	260	mW

Absolute Maximum Ratings:

Operating Case Temperature Range	0 to +70	ºC
Storage Temperature Range	-40 to +85	ºC
APD Bias Voltage (Vbd) [8]	Maximum Operating Voltage + 1	V
APD DC Photo-current [1] [9]	1.5	mA
Optical Input Power [1] [9]	-6	dBm Peak
Amplifier Bias Voltage (Vcc)	+4	V
Decision Threshold Voltage (Vth)	+/- 4	V
Lead Soldering Temperature (10s)	250	ºC

Notes :

1.) A DC photo-current of 1.5mA must not be exceeded. Damage to the APD may occur if exceeded.
2.) Single-ended gain is 1/2 of Differential gain.
3.) Discovery tests Optical Sensitivity on all R604-APD receivers. Based on this Bit Error Rate (BER) measurement, the optimum APD gain setting is determined for each receiver and shall be specified on the receiver test report. A typical optimum gain setting is M=10. The optical NEP is also lowest at this optimal gain setting.
4.) At high optical input power, such as 0dBm, the APD gain should be reduced. A typical reduced gain would be M=2, for example.
5.) Under high optical power illumination when the R604-APD is in Limiting mode.
6.) A DC voltage applied to Vth can be used to adjust the decision threshold and the output eye crossing level from ~ 15% to ~ 85%. If it is left open, the decision threshold and output eye crossing level will be ~ 50%.
7.) Optical PDL is measured by scanning all states of polarization at 1550nm.
8.) The APD must never be biased near its Breakdown Voltage. On every receiver test report, Discovery shall specify the allowable maximum APD bias voltage, which will be 1 Volt higher than the optimum gain setting for best sensitivity.
9.) Assumes NRZ format with 50% duty cycle.

Single-Ended K-Connector Version:

Operating Procedure:

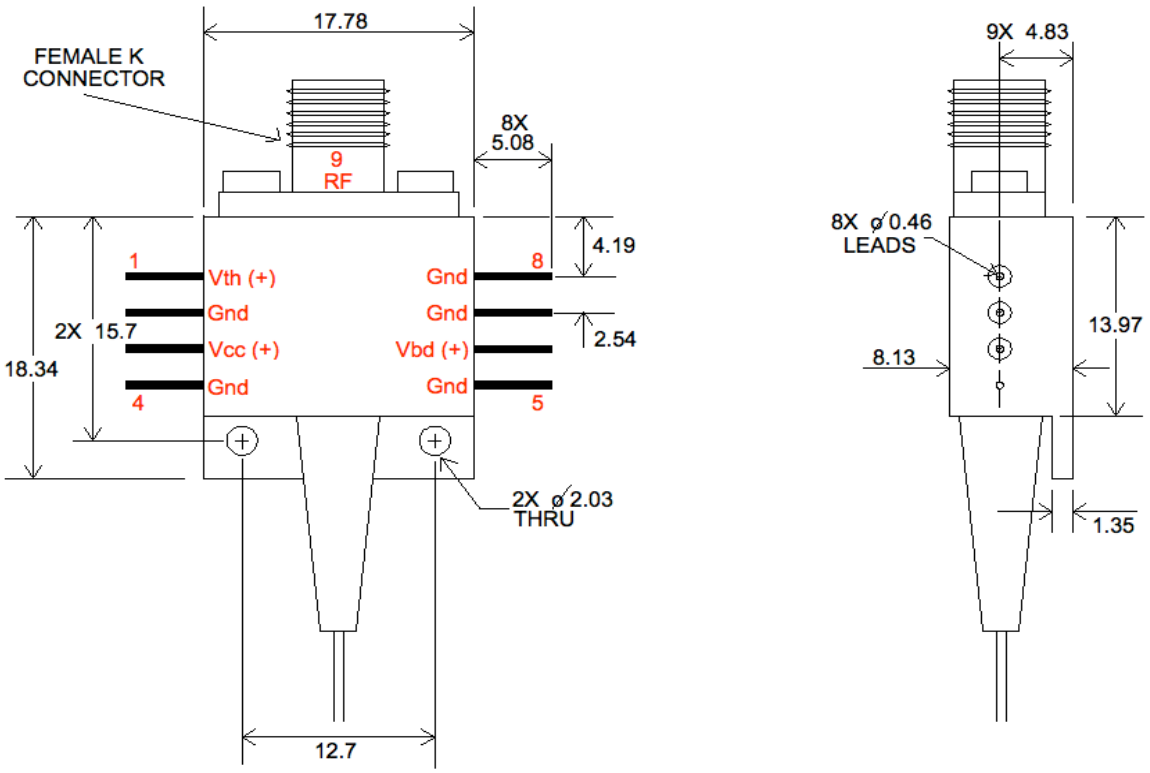
Always follow these steps:
1. Connect ground first
2. Use current-limited power supplies
3. Apply stabilized bias with proper polarities
4. Turn on APD bias voltage (V_{bd}) to +10V
5. Turn on Amplifier bias (V_{cc}) to +3.3V
6. Apply optical power.
7. Adjust APD bias voltage to achieve desired gain

Always shutdown with these steps:
1. Remove optical power before removing bias
2. Reduce APD bias voltage to +10V
3. Turn off the Amplifier bias voltage
4. Turn off the APD bias voltage
5. Disconnect the device

Pin Connections (Observe Polarities):

1.	Decision Threshold Voltage (V_{th})
2.	Case Ground - Gnd
3.	Bias Voltage Amplifier (V_{cc})
4.	Case Ground - Gnd
5.	Case Ground - Gnd
6.	Bias Voltage Photodiode (V_{bd})
7.	Case Ground - Gnd
8.	Case Ground - Gnd
9.	RF Signal Out (Non-Inverting, AC-Coupled)

Dimensioned Outline Drawing:
(Dimensions are in mm)



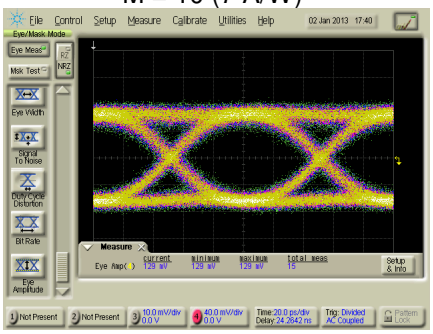
This drawing represents one set of options. Please consult with Discovery before doing board layout.

DISCOVERY SEMICONDUCTORS RESERVES THE RIGHT TO MAKE DESIGN CHANGES WITHOUT NOTICE

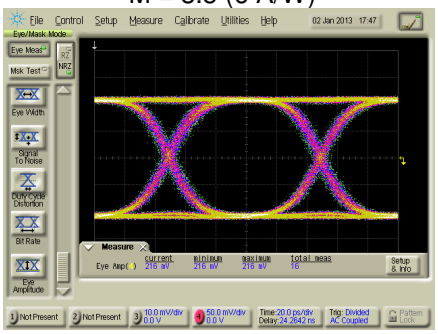
10 Gb/s 1550nm Eye Patterns

(single-ended output, Vth left open)

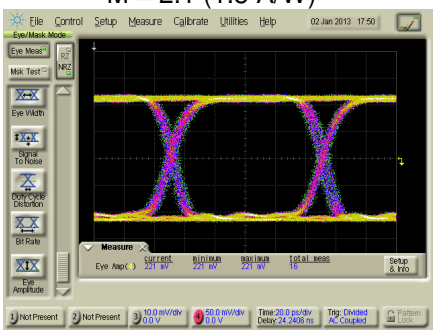
-27dBm Optical Input,
M = 10 (7 A/W)



-22dBm Optical Input
M = 8.5 (6 A/W)



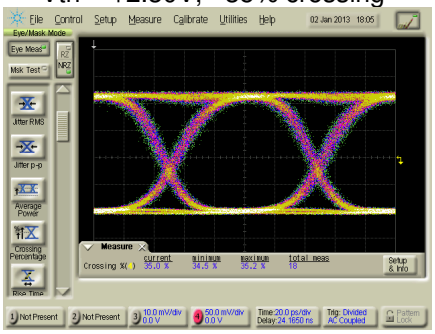
0dBm Optical Input
M = 2.1 (1.5 A/W)



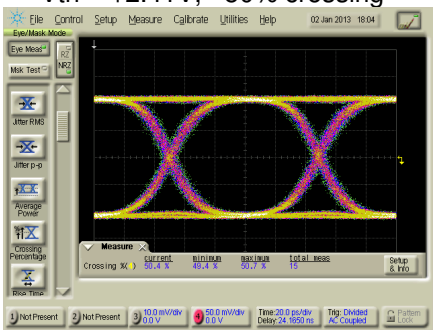
Decision Threshold (Vth) Adjustment

(10Gb/s, 1550nm, -22dBm input, M=8.5, Vth externally controlled)

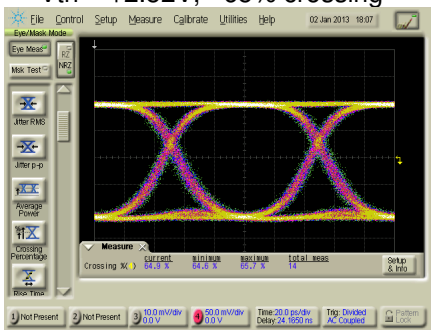
Vth = +2.30V, ~35% crossing



Vth = +2.41V, ~50% crossing

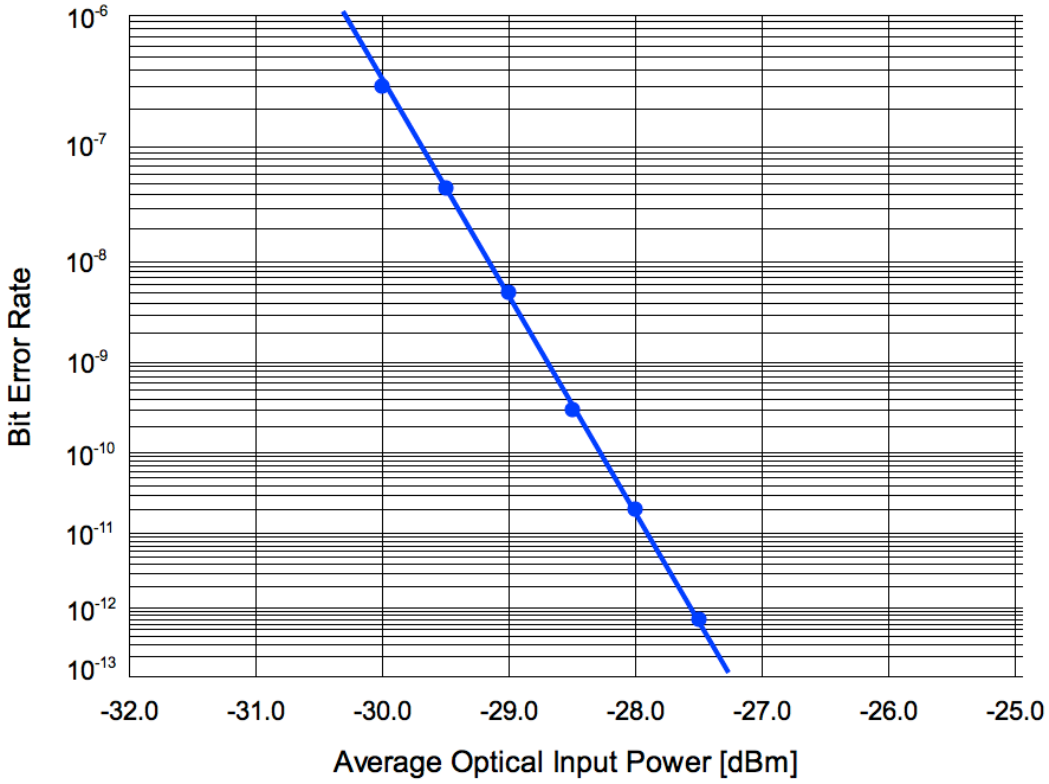


Vth = +2.52V, ~65% crossing



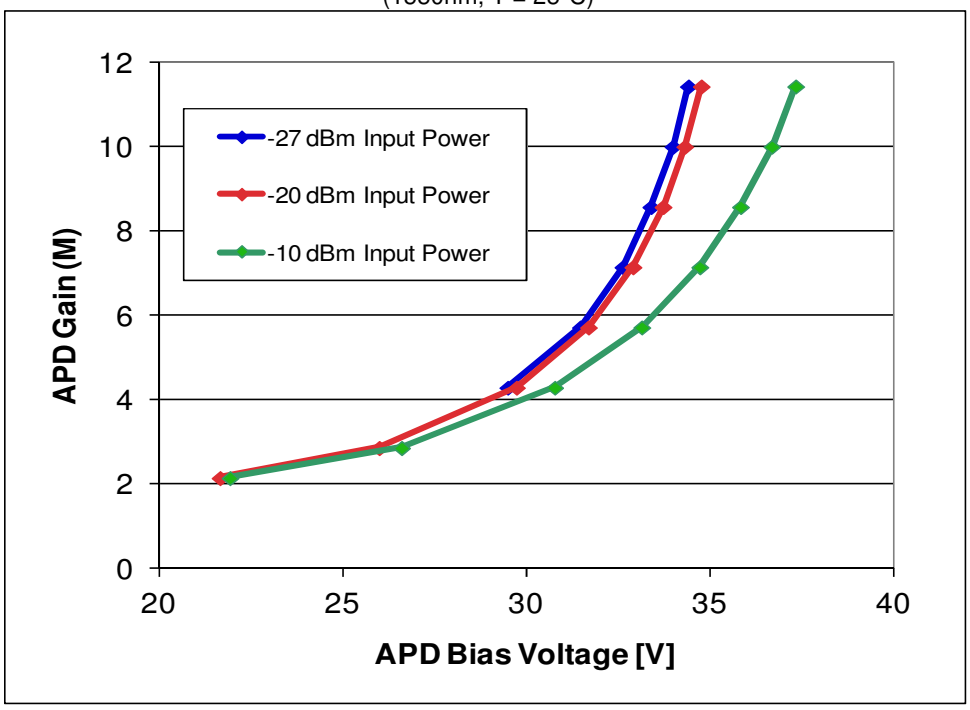
Typical 10Gb/s BER Curve

(1550nm, M = 10, 2^{31}-1 PRBS, 13 dB Ext. Ratio)

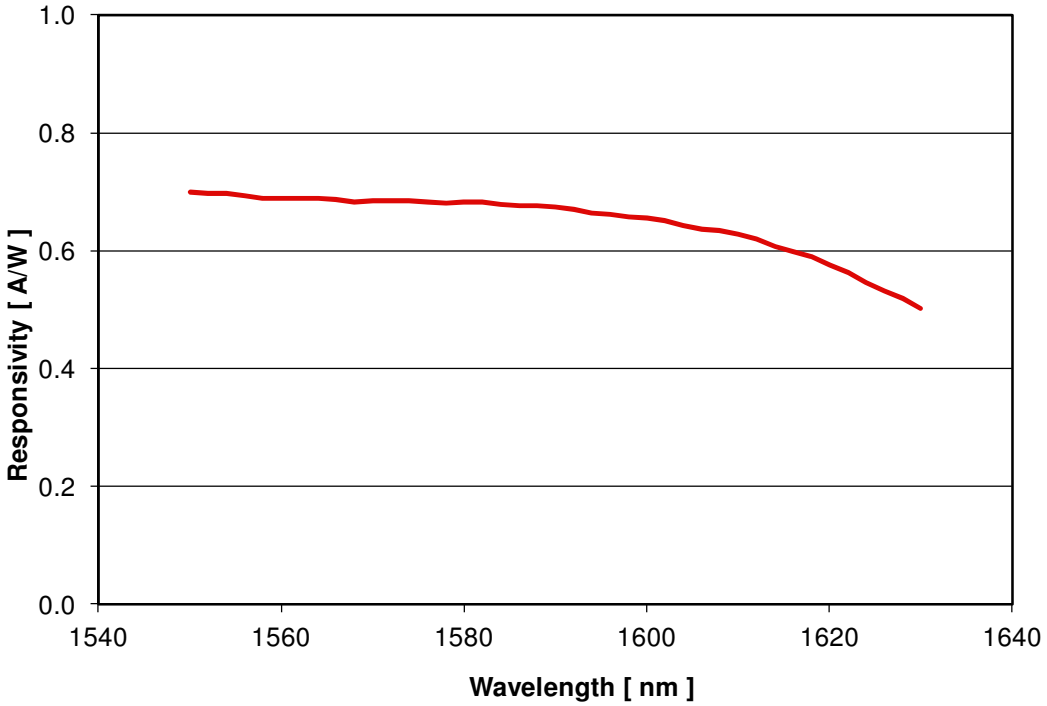


Typical APD Gain vs. Bias Voltage

(1550nm, T = 25°C)



Typical Unity-Gain Responsivity over C- and L-bands



Optical Input:

Connector	Polish	Fiber	Buffer	Length
FC, SC or LC	PC, UPC or APC	SMF28 or PM	900 µm (std)	1 meter typical
FC	PC, UPC	50/125 µm MM		
FC	PC, UPC	62.5/125 µm MM		

Electrical Output:

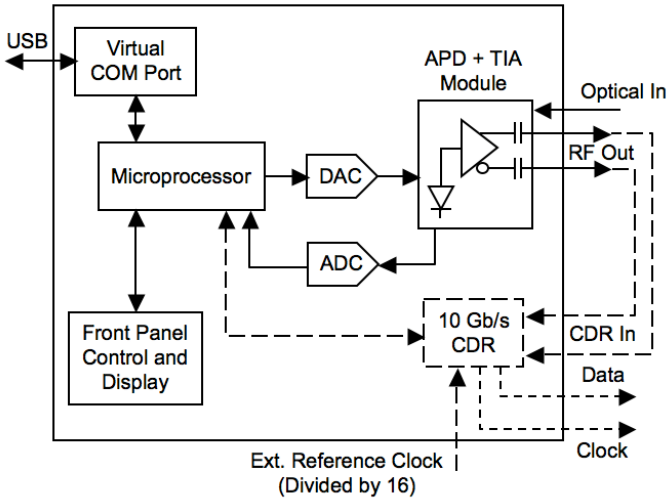
Model	Coupling	Standard	Options
DSC-R604-APD	AC	"CPW" Coplanar waveguide output in surface mount package. "G" Differential GPPO male full-detent. "K" * type female coaxial connector.	"KM" type male coaxial connector (extra cost)

* K connector is a trademark of Anritsu Company; K connectors are 2.92 mm coaxial (compatible with 3.5 mm SMA).

Lab Buddy Block Diagram:

The block diagram below shows the basic instrument functions as well as the clock and data recovery (CDR) option. The R604-APD Lab Buddy is a microprocessor-based instrument which can be operated either manually with front panel push-buttons, or remotely through an external PC with Discovery-supplied software. The R604-APD Lab Buddy allows for user-control of the APD bias voltage and the Decision Threshold Voltage, and also reads and displays the APD Photocurrent. Computer interface is serial (RS-232C via virtual COM port) and is provided through a Type B USB connector on the Lab Buddy. The virtual COM port driver software is included along with a USB Type A to Type B cable of ~ 1 meter in length.

Lab Buddy option 3 includes a 10G CDR unit. The differential RF outputs of the R604-APD module may be externally connected to the CDR inputs through phase-matched RF cables provided by Discovery. Single-ended connections may also be used, however all unused RF ports should be terminated with 50 ohms. The CDR requires a Reference Clock which must have a frequency of 1/16th the data rate. The R604-APD Lab Buddy does include two internal reference clocks for the specific data rates of 9.953 and 10.709 Gb/s. The user may also input an external reference clock for data rates ranging from 9.95 to 11.1 Gb/s.



Lab Buddy Mechanical Specifications:

- Height: 3.50 in. (8.9 cm)
- Width: 8.25 in. (20.95 cm)
- Length: 10.75 in. (27.3 cm)
- Weight: 5.0 lb (2.3 kg)

Lab Buddy Optical and Electrical Connections:

- The optical input is provided through a detachable DIAMOND optical connector which can be easily removed without tools to allow for quick and effortless cleaning of the input fiber endface.
- All RF inputs and outputs are provided through type K RF connectors.
- The Lab Buddy power supply input is through a LEMO connector which also has a special locking mechanism to prevent accidental removal of the power cord during operation. Included with the Lab Buddy is a power supply which operates from 100 to 240 VAC, 50/60 Hz, 0.4A without the need for switching line voltages.

R604-APD with CDR Lab Buddy Option

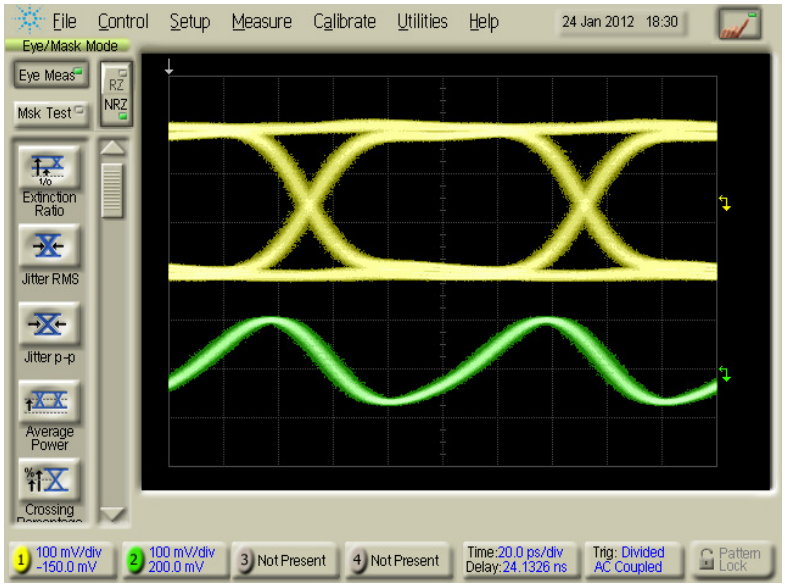
Additional Specifications for R604-APD with CDR Lab Buddy Option:

(Conditions unless otherwise noted: $T_{AMBIENT}$ = 25ºC)

Parameter		Min	Typical	Max	Units
Data Rate for CDR		9.95	-	11.1	Gb/s
Reference Clock [10] (Data Rate / 16)	Internal Clock 1	622.08			MHz
	Internal Clock 2	669.326			
	External Clock	622.08	-	693.48	
Recovered Data Output	Amplitude	285	320	365	mVp-p
	Rise / Fall Time	20	25	30	ps
Recovered Clock Amplitude		-	190	-	mVp-p
Low Frequency Cutoff at CDR Input		-	30	-	kHz
Total High-Frequency Jitter Tolerance		-	0.6	-	UIp-p

[10] The reference clock to the CDR can be selected by the user to be either of the two internal clocks, included in the Lab Buddy, or an external clock.

10 Gb/s Recovered Data and Recovered Clock at 1550 nm



Ordering information:

Parts should be ordered as DSC-R604APD-YT-ZZ/UUU-Ψ-W where the code characters:

- Y is '3' for standard optical return loss, '5' for >40 dB ORL, '6' for 50 um multimode fiber, '7' for 62.5 um multimode fiber, '8' for PM fiber,
- T is '9' for 0.9 mm diameter buffer (standard),
- ZZ specifies the fiber optic connector (FC, SC, LC),
- UUU specifies the ferrule finish (PC, UPC, APC),
- Ψ is 'K' for K coaxial output connector, 'G' for GPPO differential coaxial output connectors, or 'CPW' for coplanar waveguide output in surface mount package, (KM for male connector option)
- W is '1' for microwave package module option, '2' for Lab Buddy instrument, '3' for Lab Buddy with CDR (clock and data recovery)

Regulatory Compliance:
This product is EU directive 2002/95/EC (RoHS) compliant, with exemptions.
This product is subject to the International Traffic in Arms Regulations (ITAR) of the Export Administration Regulations (EAR). Export of these items to foreign persons or foreign entities inside or outside of the United States may require written authorization by the U.S. Department of Commerce or a valid export license by the U.S Department of State, Directorate of Defense Trade Controls. Violations of these export regulations may be subject to severe criminal penalties.

Discovery Semiconductors, Inc. is an ISO 9001:2008 and ISO 14001:2004 certified company.

For additional information, please contact the following:

INTERNET: www.discoverysemi.com
ADDRESS: Discovery Semiconductors, Inc.
119 Silvia Street, Ewing, NJ 08628, USA,
Tel: +(609) 434-1311, Fax: +(609) 434-1317