Data Sheet
January 2011

10 Gb/s High-Sensitivity Limiting PIN-TIA Optical Receiver

Description:

The DSC-R603 is a high-gain PIN + Transimpedance + Limiting amplifier ideally suited for digital applications up to 13 Gb/s. The R603 offers extremely high differential conversion gain of 9,000 V/W, high sensitivity of -20dBm, optical overload of +4dBm, and very low power dissipation of 170mW. The R603 is available in three package styles: single-ended K-connector, differential GPPO, and a miniature surface mount package with CPW (coplanar waveguide) RF outputs. The R603 utilizes Discovery's high-reliability InGaAs photodiode technology.

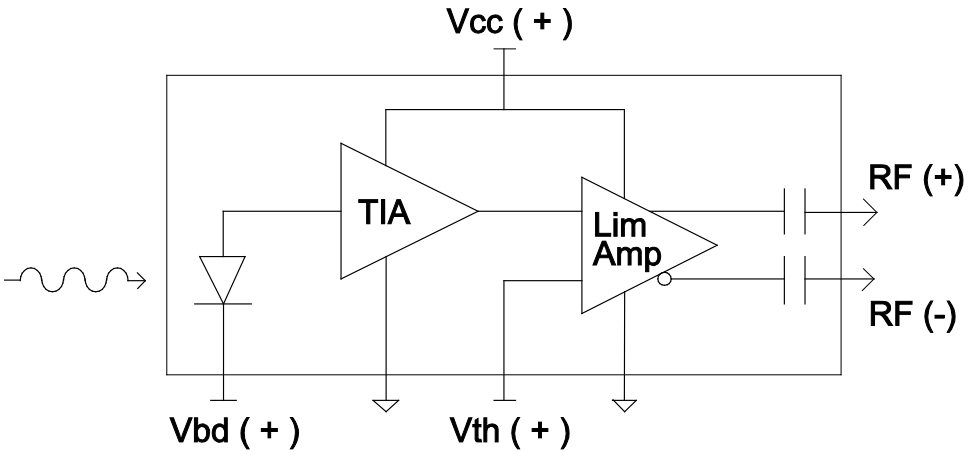
Salient Features:

- High differential conversion gain of 9,000 V/W
- High Responsivity at 1310nm, 1550nm & L-band
- 850nm MMF versions available
- Sensitivity of -20 dBm at 10 Gb/s, 1550nm.
- Optical overload of +4 dBm at 10 Gb/s
- External decision threshold adjustment
- K-connector, GPPO or surface mount package options
- Very low power dissipation of 170 mW
- Low optical PDL @ 1550nm (typically 0.05dB)
- Meets GR-468 reliability standard

Applications:

- 10 Gb/s SONET/SDH/Ethernet Intermediate Reach
- Digital applications up to 13 Gb/s baud rate
- High sensitivity / wide dynamic range digital applications

Block Diagram



Electrical / Optical Specifications:

(Conditions unless otherwise noted: $T_{AMBIENT}$=25ºC, Vbd =+5V, Vcc=+3.3V, 1550nm)

Parameter		Min	Typical	Max	Units
Wavelength Response Range		800	-	1650	nm
Responsivity	@ 1550 nm	0.7	0.8	-	A / W
	@ 1310 nm	0.7	0.8	-	A / W
	@ 850 nm*	0.3	0.4	-	A / W
Differential Transimpedance (1)		8,000	12,000	-	Ohms
Differential Conversion Gain (1) @1550nm		5,600	9,600	-	V / W
Maximum Differential Output Swing (2)		-	450	600	mV_{p-p}
Optical Sensitivity (10Gb/s, 1550nm, 2^{31}-1 PRBS, BER 10^{-12}, 13dB Ext. Ratio)		-18.5	-20	-	dBm
Optical Overload (BER < 10^{-12}) (3)		+2	+4	-	dBm
Bandwidth (-3dB, small signal)		-	8.5	-	GHz
Gain Flatness (relative to mean) (4)		-	+/- 1	-	dB
Low Frequency Cut-off (-3dB)		-	-	100	KHz
Electrical Return Loss		-	-10	-	dB
Decision Threshold Adjustment (V_{th}) (5)		+2.1	+2.45	+2.8	V
Decision Threshold Input Resistance		-	7,000	-	Ohms
Optical Return Loss @ 1550nm		27	35	-	dB
Optical PDL @ 1550nm (6)		-	0.05	0.12	dB
PD Dark Current		-	10	50	nA
V_{bd} Bias (Photodiode)		+4.5	+5	+5.5	V
V_{cc} Bias (Amplifier)		+3.14	+3.3	+3.46	V
I_{cc} Current (Amplifier)		-	50	65	mA
Power Dissipation		-	170	230	mW

*Note: For your 850nm needs, please contact factory for further information

Absolute Maximum Ratings:

Operating Case Temperature Range	-5 to +75	ºC
Storage Temperature Range	-40 to +85	ºC
Photodiode Bias (V_{bd})	+7	V
Amplifier Bias (V_{cc})	+4	V
Decision Threshold Voltage (V_{th})	+/- 4	V
Optical Input Power	8	dBm Peak
Lead Soldering Temperature (10s)	250	ºC

(1) Single-ended gain is 1/2 of Differential gain.
(2) Under high optical power illumination when the DSC-R603 is in Limiting mode.
(3) Assumes NRZ format with 50% duty cycle.
(4) Flatness is measured relative to the mean from DC to 70% of the -3dB bandwidth.
(5) A 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%.
(6) Optical PDL is measured by scanning all states of polarization.

Surface Mount Version:

Operating Procedure:

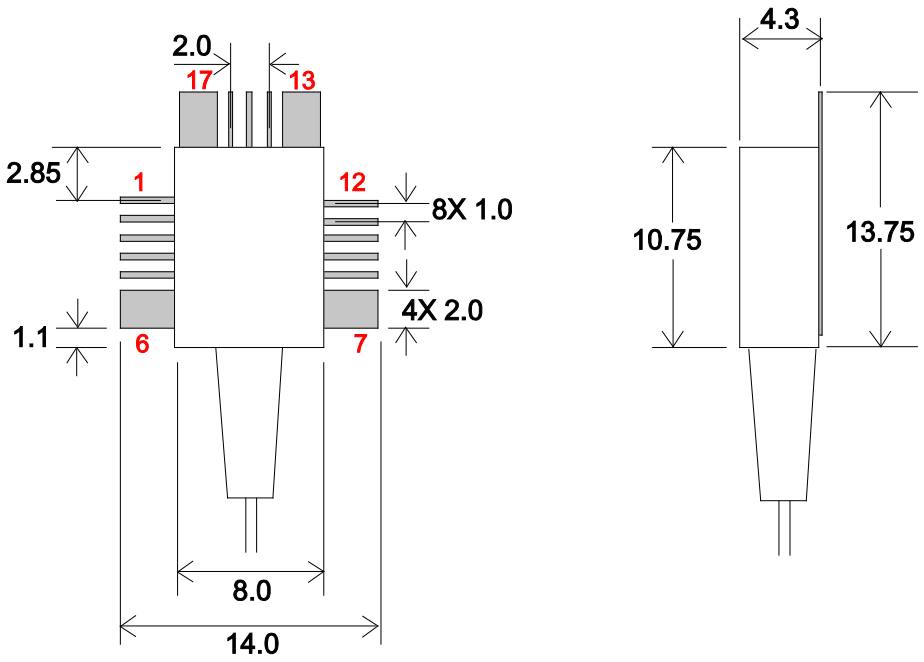
Always follow these steps:
1. Connect ground first
2. Use current-limited power supplies
3. Apply stabilized bias: V_{bd} then V_{cc}
4. Apply optical power.

Always shutdown with these steps:
1. Remove optical power before removing bias
2. Power down V_{cc} first and then V_{bd}
3. Disconnect device.

Pin Connections (Observe Polarities):

1.	Case Ground – Gnd
2.	Decision Threshold Voltage V_{th}
3.	No Connection
4.	No Connection
5.	Bias Voltage Amplifier V_{cc}
6.	Case Ground - Gnd
7.	Case Ground - Gnd
8.	Bias Voltage Photodiode V_{bd}
9.	No Connection
10.	No Connection
11.	No Connection
12.	Case Ground - Gnd
13.	Case Ground - Gnd
14.	RF Signal Out (Inverting, AC Coupled)
15.	Case Ground - Gnd
16.	RF Signal Out (Non-Inverting, AC Coupled)
17.	Case Ground - Gnd

Dimensioned Outline Drawing:
(Dimensions are in mm)



This drawing represents one set of options. Consult with factory before doing board layout.

Differential GPPO Version:

Operating Procedure:

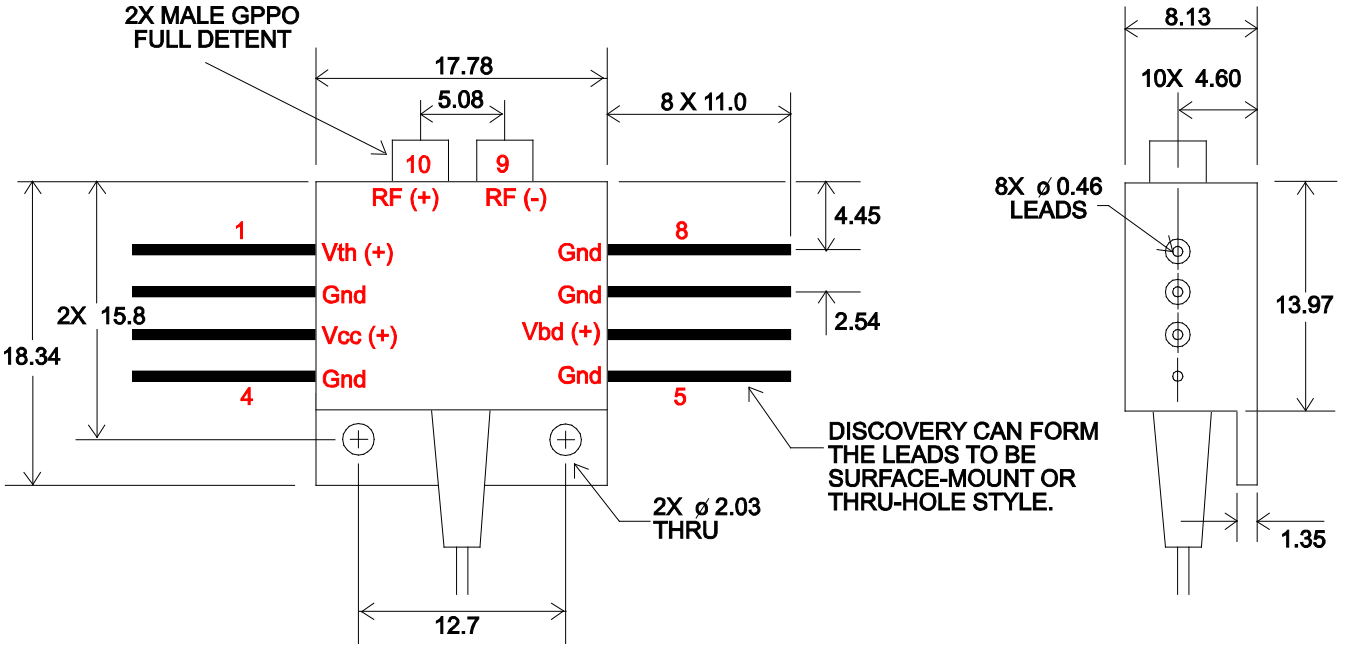
Always follow these steps:
1. Connect ground first
2. Use current-limited power supplies
3. Apply stabilized bias: V_{bd} then V_{cc}
4. Apply optical power.

Always shutdown with these steps:
1. Remove optical power before removing bias
2. Power down V_{cc} first and then V_{bd}
3. Disconnect 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 (Inverting, AC-Coupled)
10.	RF Signal Out (Non-Inverting, AC-Coupled)

Dimensioned Outline Drawing:
(Dimensions are in mm)



This drawing represents one set of options. Consult with factory before doing board layout.

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: V_{bd} then V_{cc}
4. Apply optical power.

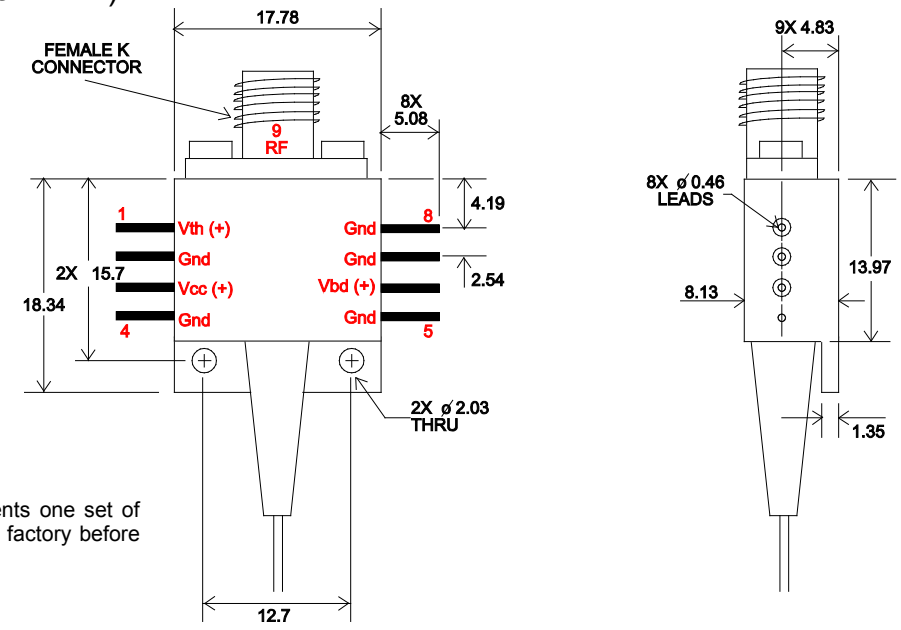
Always shutdown with these steps:
1. Remove optical power before removing bias
2. Power down V_{cc} first and then V_{bd}
3. Disconnect device.

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. Consult with factory before doing board layout.

DISCOVERY SEMICONDUCTORS RESERVES THE RIGHT TO MAKE DESGIN CHANGES WITHOUT NOTICE

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:

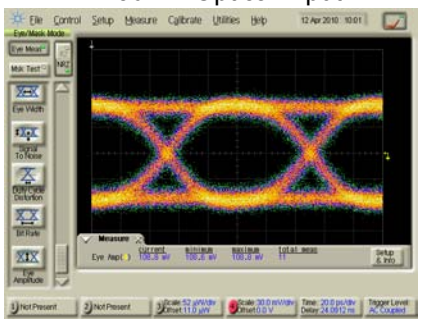
Model	Coupling	Standard	Options
DSC-R603	AC	"CPW" Coplanar waveguide output in surface mount package. "G" Differential GPPO male full-detent. "K" * type female coaxial connector.	"KM" type male coaxial connector (extra cost)

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

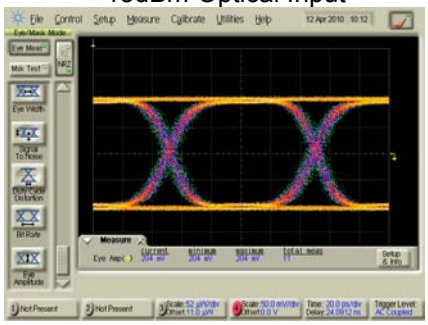
10 Gb/s 1550nm Eye Patterns

(single-ended output, Vth left open)

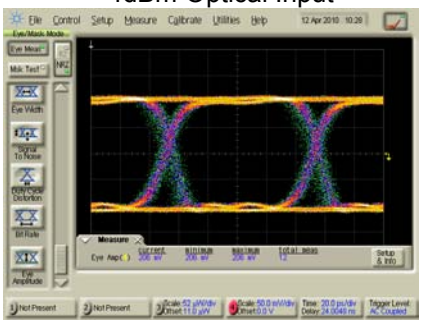
-19dBm Optical Input



-13dBm Optical Input



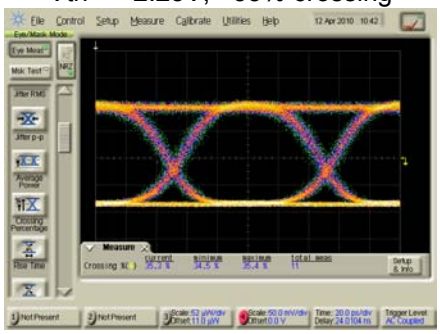
+4dBm Optical Input



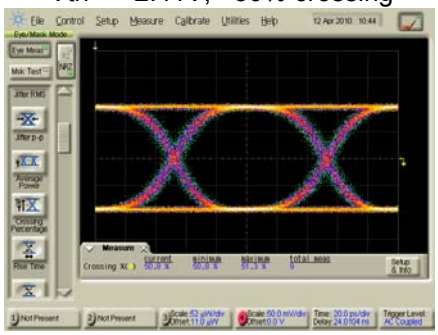
Decision Threshold (Vth) Adjustment

(10Gb/s, 1550nm, -15dBm input, Vth externally controlled)

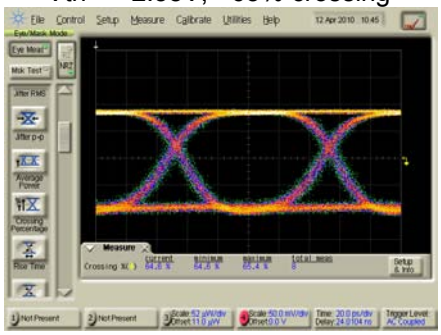
Vth = +2.25V, ~35% crossing



Vth = +2.41V, ~50% crossing



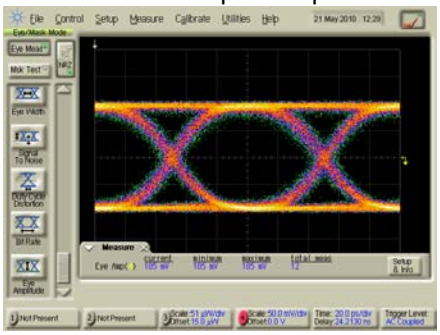
Vth = +2.58V, ~65% crossing



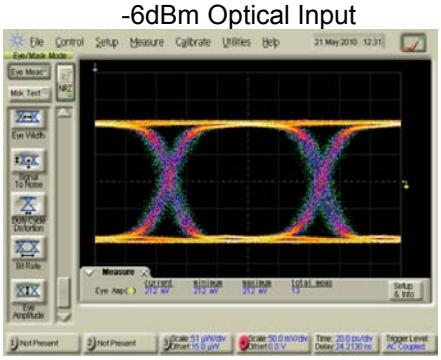
10 Gb/s 850nm Eye Patterns

(tested with 850nm VCSEL)

-11dBm Optical Input

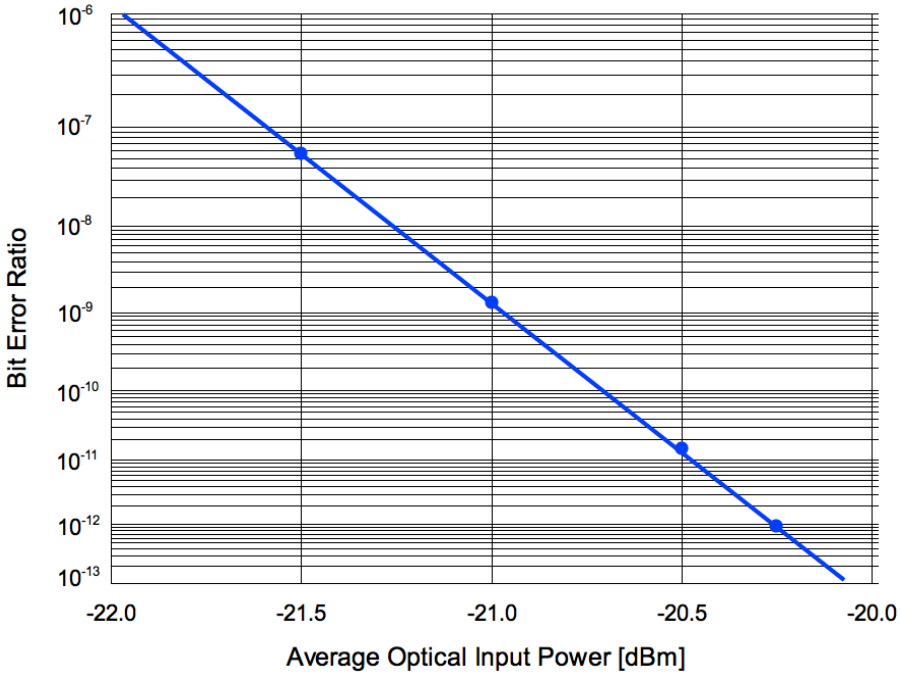


-6dBm Optical Input

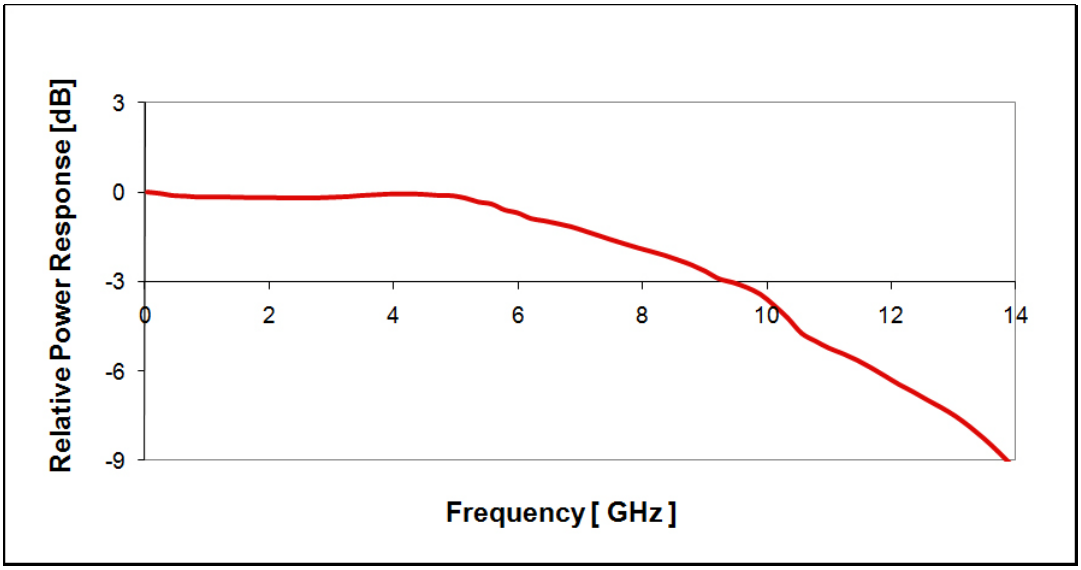


Typical 10Gb/s BER Curve

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

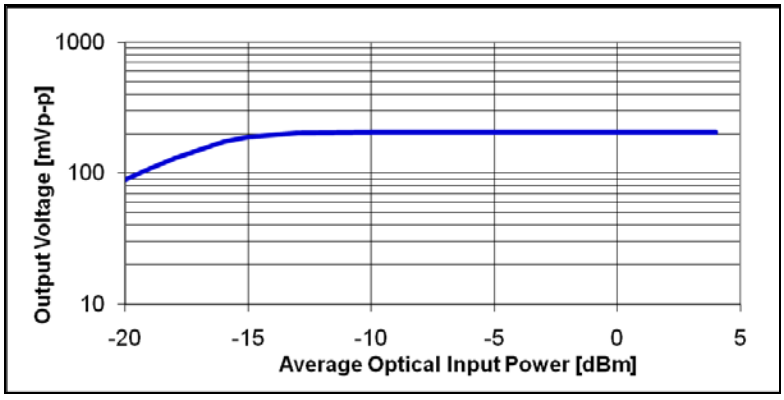


Typical Frequency Response

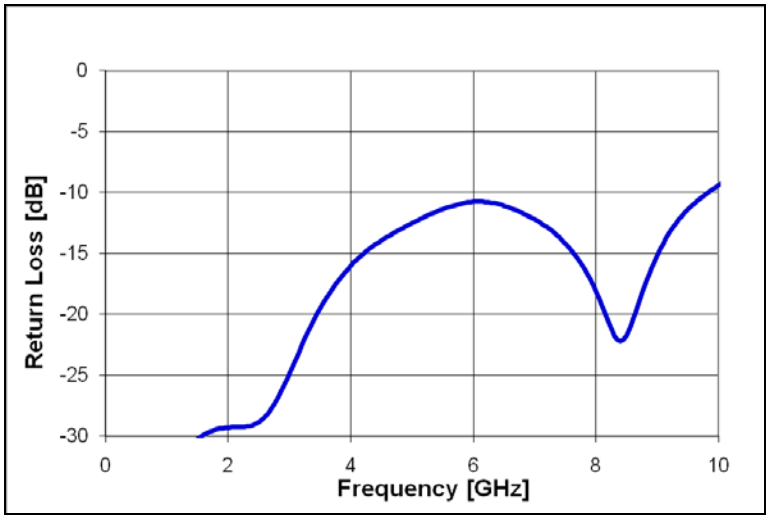


Output Voltage vs. Optical Input Power

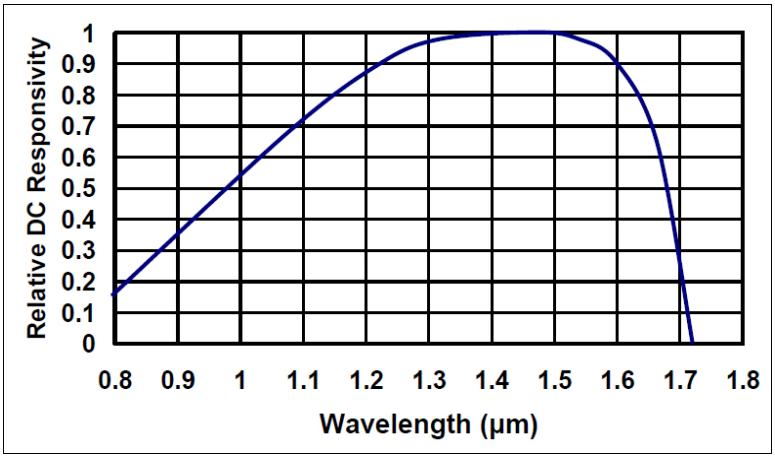
(Single-ended output, 10Gb/s)



Typical Single-Ended Electrical Return Loss



Typical Relative DC Responsivity



Ordering information:

Parts should be ordered as DSC-R603-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	'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	specifies 'K' for K coaxial output connector, "G" is for GPPO differential coaxial output connectors, or 'CPW' for coplanar waveguide output in surface mount package, (KM for male connector option)
W	'1' specifies microwave package module option, '2' specifies Lab Buddy as shown below.

Lab Buddy Options:

"Lab Buddy" is a versatile O/E Converter Instrument as shown.

Single-ended RF Output Version

- 110/220V Plug-in
- Eliminates accidental damage and biasing errors
- Saves up to 3 power supplies
- Robust and compact

- Height: 1.75 in.
- Width: 3.125 in.
- Length: 5.25 in.
- Weight: 0.6 lb.

Differential RF Output Version

- 110/220V Plug-in
- Eliminates accidental damage and biasing errors
- Saves up to 3 power supplies
- Robust and compact

- Height: 2.13 in. (5.41 cm)
- Width: 6.50 in. (16.51 cm)
- Length: 9.00 in. (22.86 cm)
- Weight: 2.20 lb (0.99 kg)

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.

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