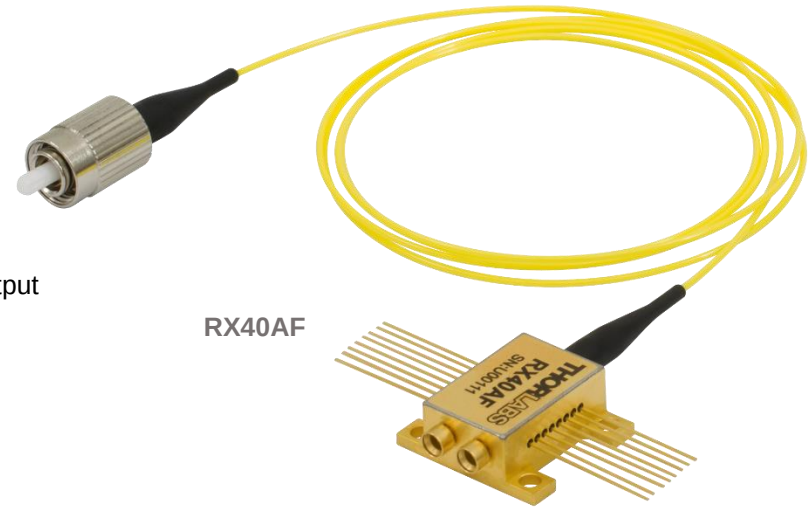
RX40AF: 40 GHz Amplified Photoreceiver

Features

- 40 GHz Bandwidth
- PIN/TIA/VGA Configuration
- 1250 - 1650 nm InGaAs Detector
- SMF-28 Input Fiber
- Manual or Auto Gain Control
- Dual GPPO® Output Connectors
- AC-Coupled, Current Mode Logic (CML) Output



Applications

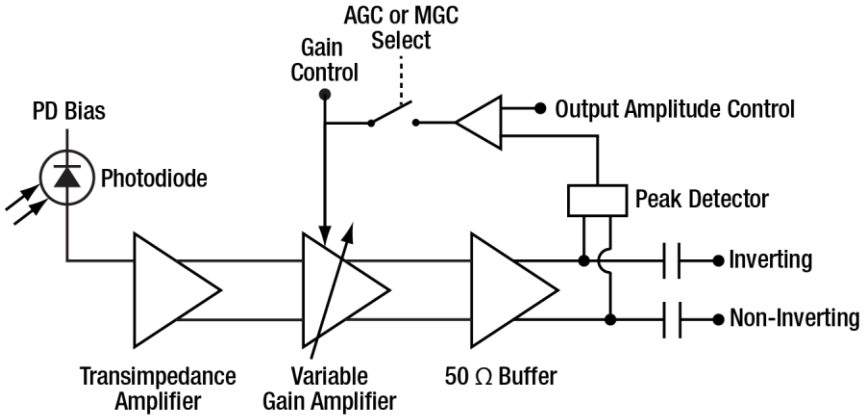
- Test and Measurement
- High-Speed Communications
- Instrumentation O-E Front End
- OEM Integration

Description of Models

The RX40AF is a variable-gain photoreceiver module with 40 GHz bandwidth and differential GPPO outputs. Optical input is coupled into the detector through an FC/PC connector and single mode (SMF-28) fiber. RF output is CML and AC coupled. Custom units with FC/APC connectors also available upon request.

- **RX40AF** Photoreceiver with SMF-28 Single Mode Input Fiber (Yellow Jacket) and FC/PC Connector

Block Diagram



Absolute Maximum Ratings

All ratings are specified at 25 °C and at 1550 nm unless noted. Exceeding these ratings may cause permanent damage or affect device reliability.

Parameter	Min	Max	Unit	Note
Optical Input Power	-	10	dBm	13 dBm Peak at 50% Duty Cycle
Amplifier Bias Voltage	-	4.5	V	For 5 s Maximum
Photodiode Bias Voltage	-	6	V	-
Digital Control Inputs	-	4.5	V	-
Fiber Bend Radius	15	-	mm	Breakage
Storage Temperature	-40	85	°C	-

Operating Conditions

Parameter	Min	Typ.	Max	Unit	Note
Operating Temperature	0	-	70	°C	-
Relative Humidity	-	-	85	%	Non-Condensing
PD Bias Voltage	3.0	3.3	4.0	V	-
Optical Input Power		-	3	dBm	6 dBm Peak at 50% Duty Cycle
Amplifier Bias Voltage	3.15	3.3	3.45	V	-
Amplifier Supply Current	-	185	-	mA	Sum Total on Pins 3 and 15

Specifications

All specifications are typical at 25 °C, at 1550 nm, and into 50 Ω unless noted.

Parameter	Min	Typ.	Max	Unit	Note
Wavelength Range	1250	-	1650	nm	-
-3 dB Bandwidth	35	40	-	GHz	-
Low Frequency Cutoff	-	300	-	kHz	AC Coupled
Responsivity	0.6	0.7	0.8	A/W	-
Conversion Gain	100	-	3500	V/W	Differential
Input Reference Noise (at Amplifier)	-	17	-	pA/√Hz	At Maximum Gain Setting
Noise-Equivalent Power	-	24	-	pW/√Hz	At Maximum Gain Setting
Optical Return Loss	-	-33	-28	dB	-
PD Dark Current	-	10	50	nA	-
Output Swing (AGC mode)	150	-	700	mV	Differential (1800 mV Max in MGC Mode) Linear to 700 mV, THD = 2%
Electrical Return Loss	-	-10	-	dB	To 35 GHz

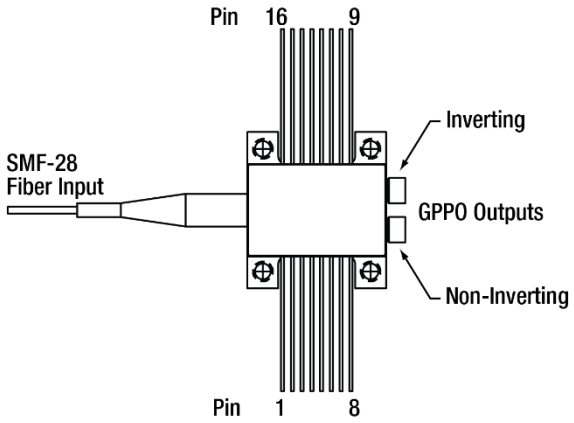
Qualification Testing

Parameter	Conditions
Mechanical Shock	500 g, Six Axes, 5 Times
Thermal Cycling	100 Cycles, 0 °C to 70 °C
Temperature Storage	100 Hours at -40 °C; 100 Hours at 85 °C
Fiber Pull	Straight Pull: 0.5 kg, 60 s Side Pull: 0.25 kg, 10 s, 4 Directions

PIN-OUT CONNECTIONS

Pin #	Name	Conditions
1	PD Bias	3.3 V, 10 mA Max
2	GND	GND and Case are Common
3	V_{cc}	3.3 V (180 mA Sum Total on Pins 3 and 15)
4	Peaking Adjust (PKH)	GND = Lower Peaking; Float or 2.7 V = Higher Peaking
5	Output Enable (OC)	GND = OFF; Float or 2.7 V = ON
6	NIC	No Internal Connection
7	NIC	No Internal Connection
8	GND	GND and Case are Common
9	NIC	No Internal Connection
10	Peaking Adjust (PKL)	GND = Lower Peaking; Float or 2.7 V = Higher Peaking
11	Peak Detect (PKD)	Output
12	Gain Control (GC)	0 V to 2.7 V (Higher Voltage = Higher Gain; Leave Floating in AGC Mode)
13	Output Amplitude Control (OA)	0 V to 2.7 V (Higher Voltage = Higher Output)
14	AGC or MGC Select (MC)	GND = MGC; Float or 2.7 V = AGC
15	V_{cc}	3.3 V (180 mA Sum Total on Pins 3 and 15)
16	NIC	No Internal Connection

Notes: Digital controls: Low = 0 V to 0.8 V, High = Float or 2.0 V to 2.7 V (Do not Apply More Than 2.7 V)
Power up sequence: PD Bias, Amp Bias, Control Signals
Power down sequence: Control Signals, Amp Bias, PD Bias



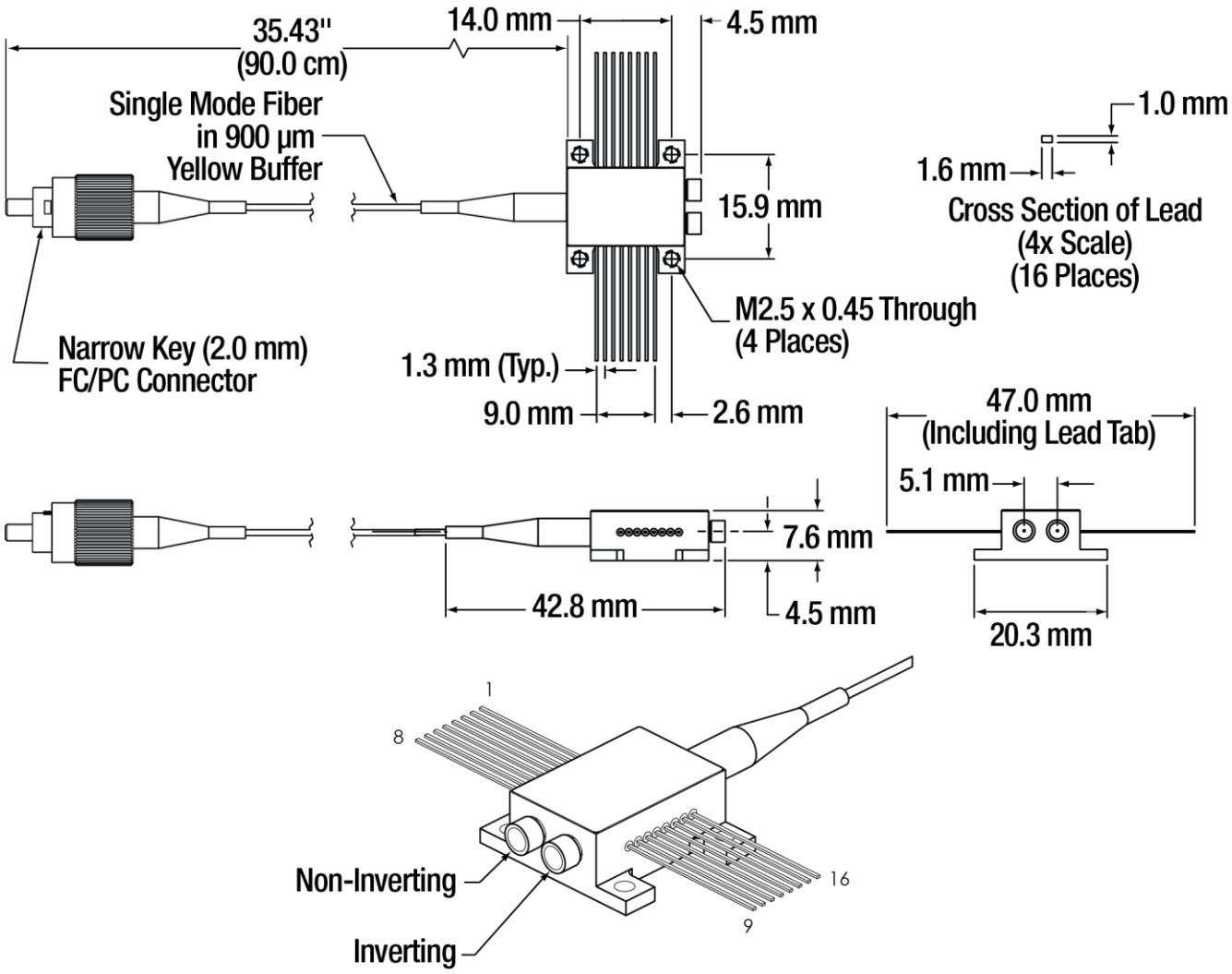
CONTROL VOLTAGES TO ADJUST PEAKING

Setting #	Peaking Adjust (PKH)	Peaking Adjust (PKL)	Peaking Condition
1	GND	GND	Minimum Peaking
2	GND	Float or 2.7 V	…
3	Float or 2.7 V	GND	…
4	Float or 2.7 V	Float or 2.7 V	Maximum Peaking

MECHANICAL SPECIFICATIONS

Parameter	Value
Fiber Connector	2.0 mm Narrow Key FC/PC (FC/APC Available Upon Request)
Fiber Type	SMF-28 Fiber with Ø900 µm Yellow Buffer
Fiber Length	90 cm ± 10 cm
RF Output Connector	Dual GPPO®*
Pin Soldering	Max 10 s at 250 °C per Pin

Notes: Use the proper tool to remove GPPO® connectors or damage can occur.
*GPPO is a registered trademark of Corning.



PRECAUTIONS



The components inside this module are ESD sensitive. Take all appropriate precautions to discharge personnel and equipment before making any electrical connections to the unit. This also applies to coaxial cables that easily accumulate capacitive change.



Be sure to observe all ESD precautions. The RX40AF is sensitive to ESD and can be damaged.

- **Mounting**: The unit has four M2.5 x 0.45 mounting holes. It is also possible to use the feet as through holes for M2 screws. The control pins should not be used for mechanical mounting.
- **Control Pins**: All control pins should be directly soldered to electrical traces. The pins can be bent as necessary to accommodate various mounting requirements. Avoid hard right angles and repetitive bending to avoid pin cracking. Note soldering time and temperature limits. Ensure all control pins are driven by clean, stable, and noise-free supplies limited so they do not exceed operating limits.
- **RF Output Connectors**: The RX40AF uses full-detent GPPO® RF connectors for output. Be sure to push the mating part straight in until it gives a solid click. To disconnect, be sure to use the proper GPPO removal tool (not included). The disconnecting action must be a straight pull, otherwise the GPPO connector can be damaged, which can severely affect performance. A damaged connector cannot be replaced. RF outputs should each be connected to a 50 Ω load via cables or adapters before powering up the device. If only one output is used the other output must be terminated with a high quality 50 Ω termination.
- **Photocurrent Monitor**: The DC photocurrent can be monitored using a small resistor in series with the bias pin and a voltmeter across the resistor. Make sure that the voltage drop across the resistor does not reduce the bias on the photodiode below its operating voltage. It is always a good idea to check the dark-current of the PD before applying an optical signal.
- **Optical Connector**: Clean the FC input connector before every connection. This is the number one source of reduced sensitivity. Keep the FC connector capped when not in use. Input fiber should be SMF-28 or equivalent. Ensure the average input optical power does not exceed the absolute maximum of 10 dBm.

Operational Sequence

1. Make sure device is mounted properly and the RF outputs are connected.
2. **Power-Up Sequence**: Photodiode First, Then Amplifier, Then Control Pins
3. Couple the optical input signal to the unit via the FC connector.
4. Select the type of gain control mode desired using the Automatic or Manual Gain Control (MC) pin.
    a. MGC is manual gain control. The gain is controlled by the Gain Control (GC) pin.
    b. AGC is automatic gain control. The output amplitude is set by the Output Amplitude Control (OA) pin, and the GC pin should be disconnected.
5. Enable the output signal using the Output Enable (OC) pin. If left open (floating), the output will be enabled.
6. It is recommended to start in MGC mode to have full control and explore the operating parameters.
7. Set the GC voltage in the middle of the range at about 1.3 V for nominal performance.
8. Set the peaking controls (PKH and PKL) both at 0 V for nominal performance.
9. Operate the device and adjust the input level and controls as necessary.
10. **Power-Down Sequence**: Control Pins First, Then Amplifier, Then Photodiode

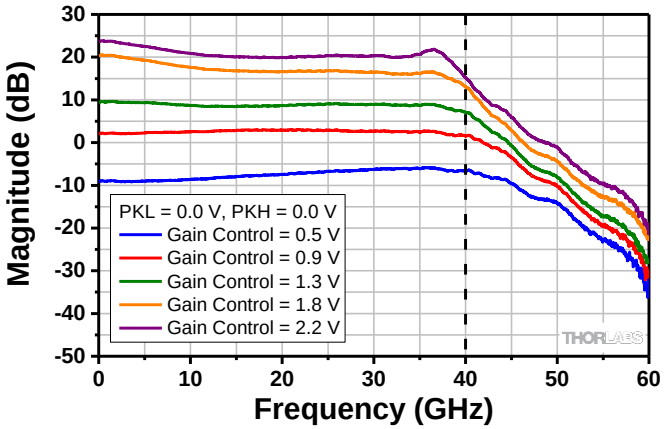
Additional Considerations

- See the graphs on the next page of this data sheet to see how the control pins affect output response.
- Peaking the frequency response of the photoreceiver can be useful if other components in the signal chain have excess high-frequency roll-off.
- Adjusting the gain allows the output swing to be matched to the next device in the signal chain and optimize the signal-to-noise ratio. Note that adjustment of the gain also affects the shape of the frequency response, so the peaking controls can be used in combination to optimize the signal.
- AGC mode can be used for those situations where a constant output level is required despite changing input levels.
- Peak Detect output (PKD) is a monitor signal that provides an indication of the output level. This is useful for external control loops that the user may desire to implement.

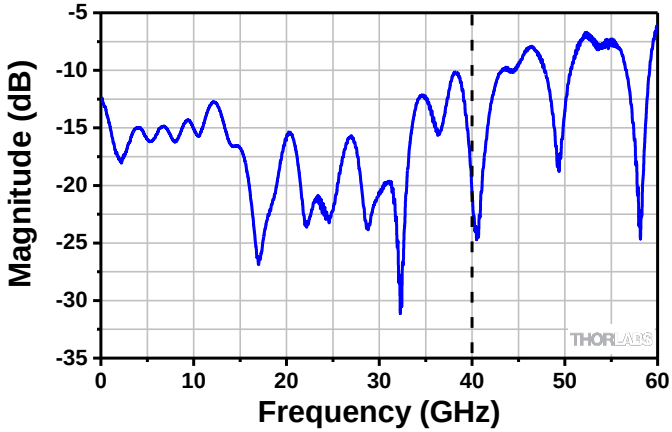
Typical Performance Graphs

The performance of each ultrafast detector is factory tested, and the individualized test results are provided with the detector. The dashed line in the frequency response graphs indicates the -3 dB bandwidth for the module. The amplifier gain graph shows the total gain of the combined internal stages.

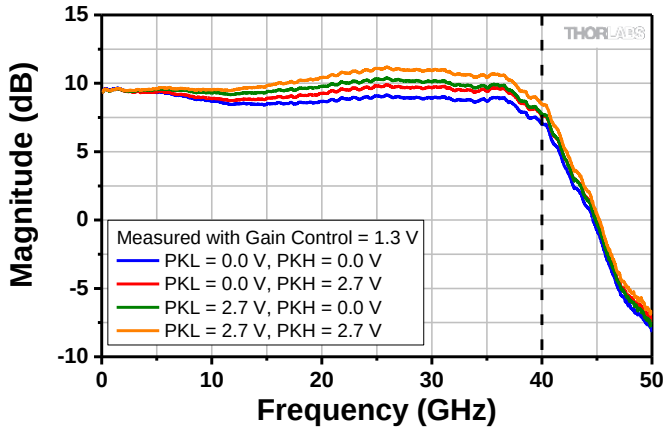
Response vs Gain Control



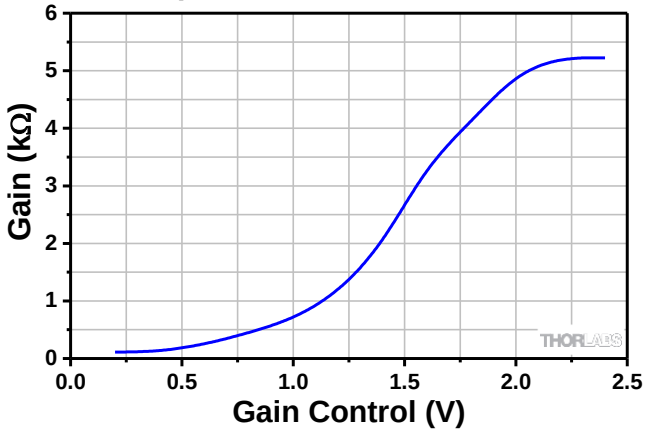
Electrical Return Loss



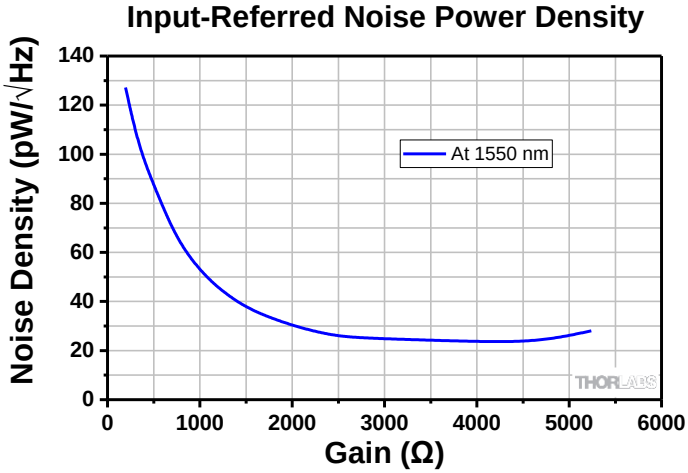
Response vs Peaking Control



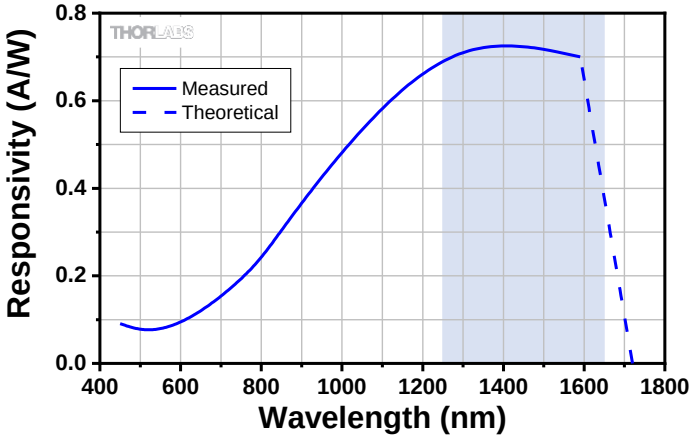
Amplifier Gain vs Gain Control



Input-Referred Noise Power Density



Spectral Response



MANUFACTURING AND COMPLIANCE

Manufactured by: Thorlabs Inc., Ann Arbor, MI 48103 USA

All specifications are subject to change without notice.

