RX38AF: 38 GHz Amplified Photoreceiver

Features

- 38 GHz Bandwidth
- PIN/TIA/VGA Configuration
- 800 - 1650 nm InGaAs Detector
- SMF-28 Fiber with FC/PC Input Connector
- Manual or Auto Gain Control
- Dual GPPO® Output Connectors
- AC-Coupled, Current Mode Logic (CML) Output
- Linear Response



RX38AF

Applications

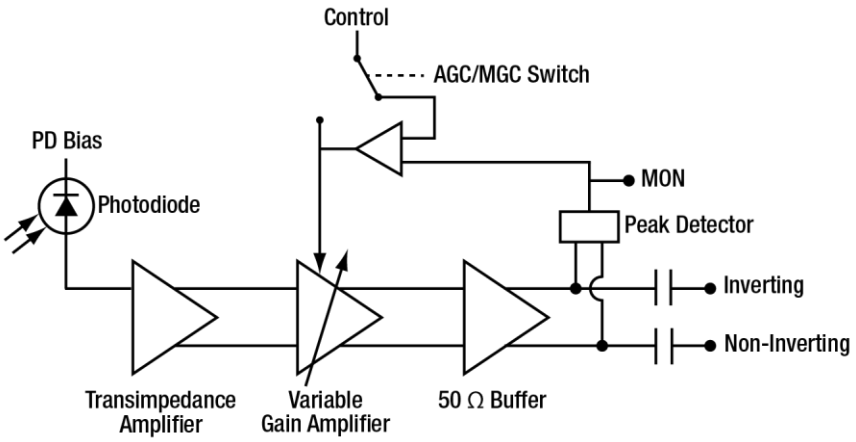
- Test and Measurement
- High-Speed Communications
- Instrumentation O-E Front End
- OEM Integration

Description of Models

The RX38AF is a hermetically-sealed, variable gain, photoreceiver module with 38 GHz bandwidth and differential GPPO® outputs (GPPO® is a registered trademark of Corning). Optical fiber input is coupled into the detector through an FC/PC narrow key (2.0 mm) connector. RF output is CML and AC coupled. The receiver has both linear and variable gain capabilities, making it suitable for both 4-level pulse amplitude modulation (PAM4) and non-return-to-zero (NRZ) modulation formats. Custom units with FC/APC connectors are also available upon request.

- **RX38AF** Photoreceiver with Single Mode Input Fiber, SMF-28, 800 - 1650 nm, Yellow Buffer, FC/PC

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 (Avg.)	-	7	dBm	10 dBm Peak at 50% Duty Cycle
Amplifier Bias Voltage	-	4.0	V	-
Photodiode Bias Voltage	-	4.0	V	-
Digital Control Inputs	-0.5	3.8	V	Max is Amp Bias +0.5 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 (Avg.)	-	-	7	dBm	10 dBm Peak at 50% Duty Cycle
Amplifier Bias Voltage	3.15	3.3	3.45	V	-
Amplifier Supply Current	-	65	-	mA	-

O-E Specifications

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

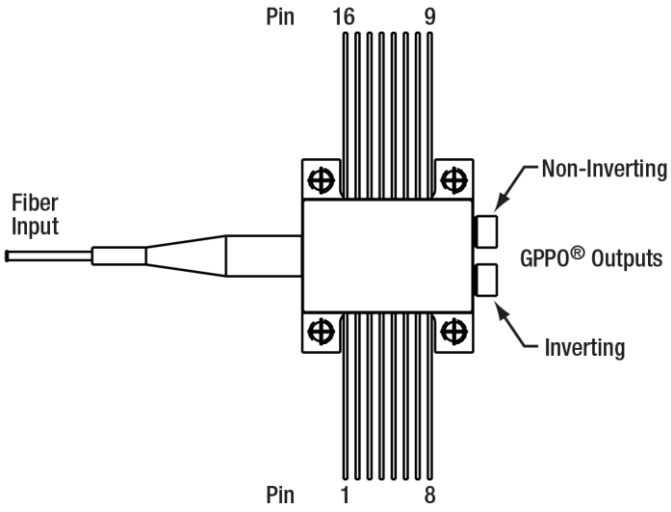
Parameter	Min	Typ.	Max	Unit	Note
Wavelength Range	800	-	1650	nm	-
-3 dB Bandwidth	-	38	-	GHz	Manual Gain, Control = 0.5 V, 1550 nm, Bandwidth May be Decreased for Short Wavelengths
Low Frequency Cutoff	-	45	-	kHz	AC Coupled
Responsivity	-	0.7	-	A/W	-
Differential Conversion Gain	75	-	3375	V/W	-
Input Ref. Noise (at Amplifier)	-	14	-	pA/√Hz	Into 40 GHz, At Maximum Gain Setting
Noise-Equivalent Power	-	19	-	pW/√Hz	At Maximum Gain Setting
Optical Return Loss	-	-25	-	dB	-
PD Dark Current	-	10	50	nA	-
Output Swing	-	-	600	mV	Differential Linear to 450 mV, THD = 3%
Electrical Return Loss	-	-10	-	dB	To 40 GHz

PIN-OUT CONNECTIONS

Pin #	Name	Conditions
1	NIC	No Internal Connection
2	NIC	No Internal Connection
3	NIC	No Internal Connection
4	AGC/MGC	Low = MGC; High = AGC (Floats High)
5	Control	Adjusts Gain in MGC Mode, Adjusts Swing in AGC Mode, See Below
6	GND	GND and Case are Common
7	MON	Output Swing Monitor
8	NIC	No Internal Connection
9	GND	GND and Case are Common
10	NIC	No Internal Connection
11	NIC	No Internal Connection
12	NIC	No Internal Connection
13	NIC	No Internal Connection
14	NIC	No Internal Connection
15	V_{cc}	3.3 V (60 mA Typ.)
16	PD Bias	3.3 V (10 mA Max)

Notes:

- AGC/MGC Binary Control Voltage (Pin 4): MGC = 0 V to 1.0 V, AGC = Float or 2.3 V to 3.3 V
- Control Pin (Pin 5)
    - In MGC Mode, Lower Voltage = Higher Gain, 0.1 V (Max Gain) to 1.0 V (Min Gain), See Chart Below for Gain vs Voltage
    - In AGC Mode, Higher Voltage = Higher Swing, 0.3 V to 0.7 V, Applied Voltage Corresponds to Output Peak-to-Peak Signal Swing for PAM4 Signal
- MON Output (Pin 7) provides DC voltage equal to output peak-to-peak voltage for output swings from 250 mV_{pp} to 800 mV_{pp}. Calibrated for PAM4 data, results higher with NRZ.



- Control Pin Voltages Should not Exceed V_{CC}
- Power Up Sequence: PD Bias, Amp Bias, Control Signals
- Power Down Sequence: Control Signals, Amp Bias, PD Bias

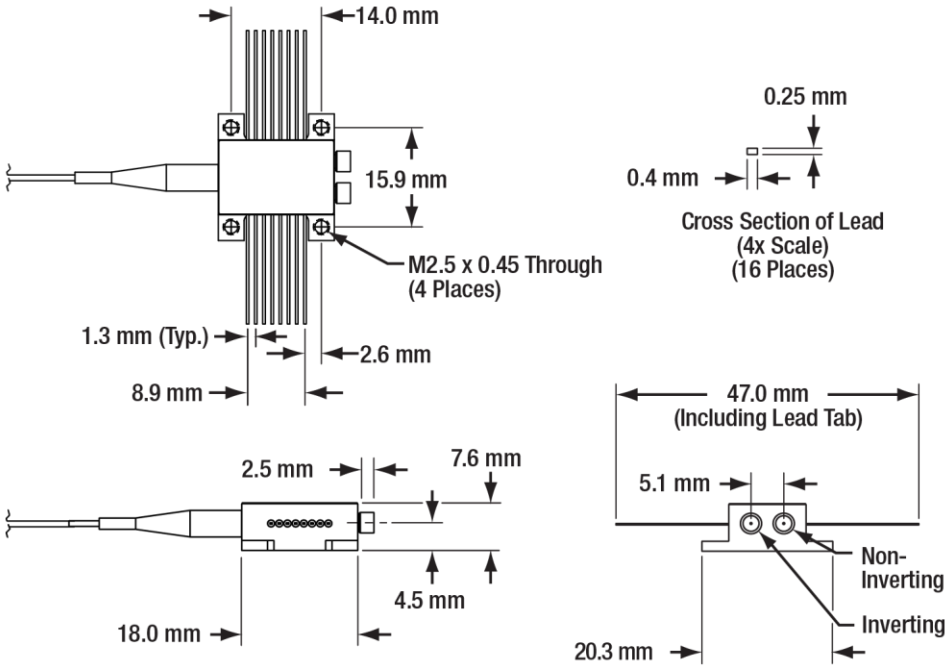
MECHANICAL SPECIFICATIONS

Parameter	Value
Fiber Connector	2.0 mm Narrow Key FC/PC
Fiber Type	Ø9 µm Core, 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

Note: Use a proper GPPO®* straight cable removal tool or damage can occur to the connectors.
*GPPO is a registered trademark of Corning.

MECHANICAL DRAWING

RX38AF



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



Be sure to observe all ESD precautions. These photoreceivers are 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**: Each receiver 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 identical or equivalent to the fiber in the photoreceiver. Ensure the average input optical power does not exceed the absolute maximum of 10 dBm.

*GPPO is a registered trademark of Corning.

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 AGC/MGC pin.
    a. MGC is manual gain control. The voltage on the Control pin controls the gain of the amplifier.
    b. AGC is automatic gain control. The voltage on the Control pin controls the output swing of the amplifier.
5. It is recommended to start in MGC mode to have full control and explore the operating parameters.
6. Set the control voltage in the middle of the range at about 0.5 V for nominal performance.
7. During operation, adjust the input level and controls as necessary.
8. **Power-Down Sequence**: Control Pins First, Then Amplifier, Then Photodiode

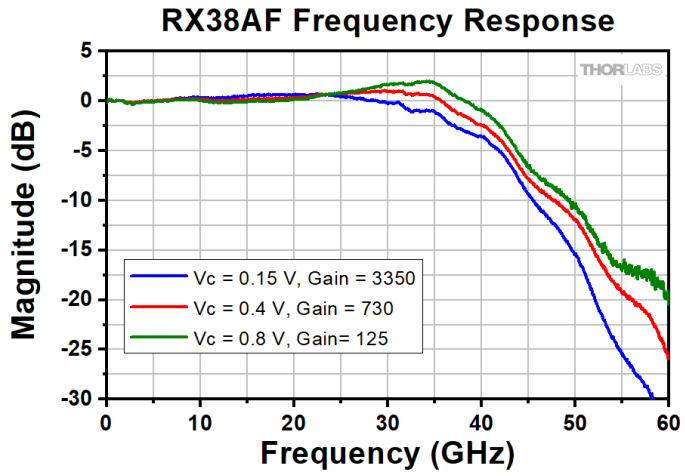
Additional Considerations

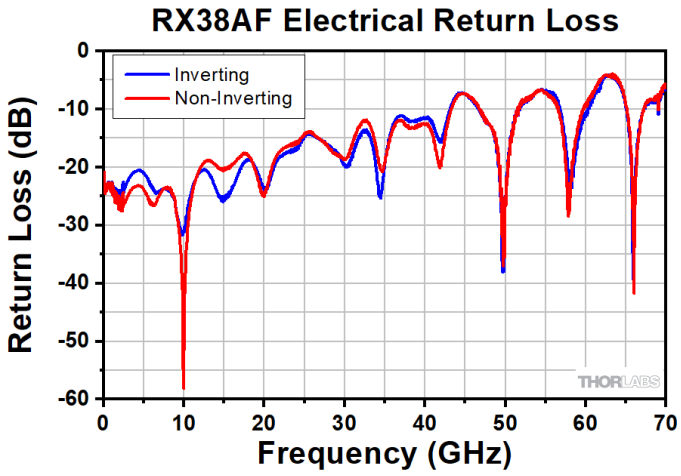
- See the graphs on the next page of this data sheet to see how the control pins affect output response.
- Adjusting the gain allows the output swing to be matched to the next device in the signal chain and optimize the signal-to-noise ratio.
- AGC mode can be used for those situations where a constant output level is required despite changing input levels.

TYPICAL PERFORMANCE GRAPHS

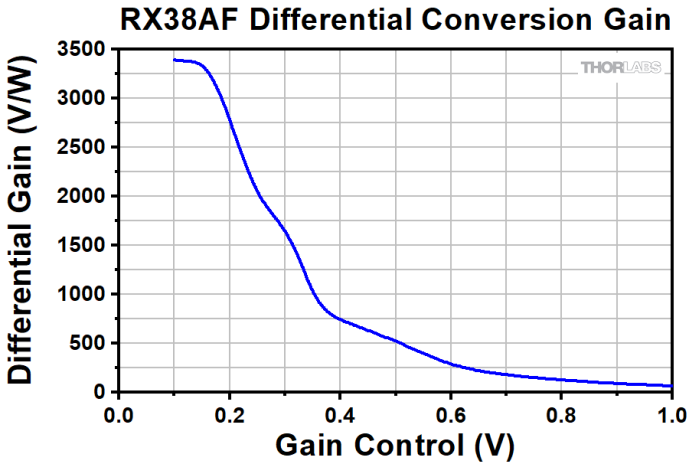
RX38AF Photoreceiver, Single Mode Input Fiber, 800 - 1650 nm

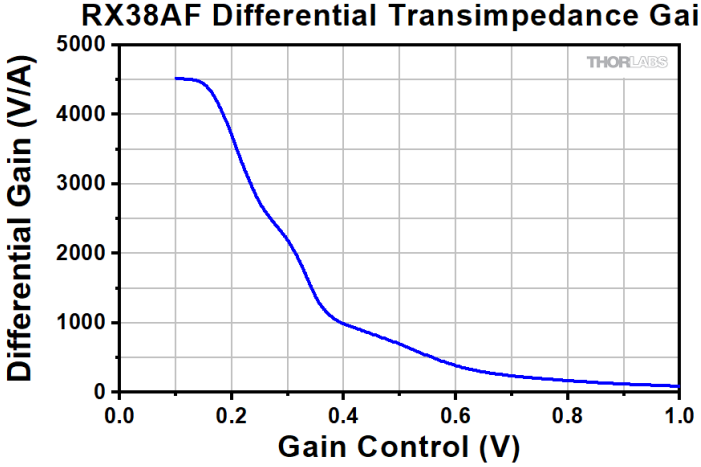
The performance of each ultrafast detector is factory tested, and the individualized test results are provided with the detector.

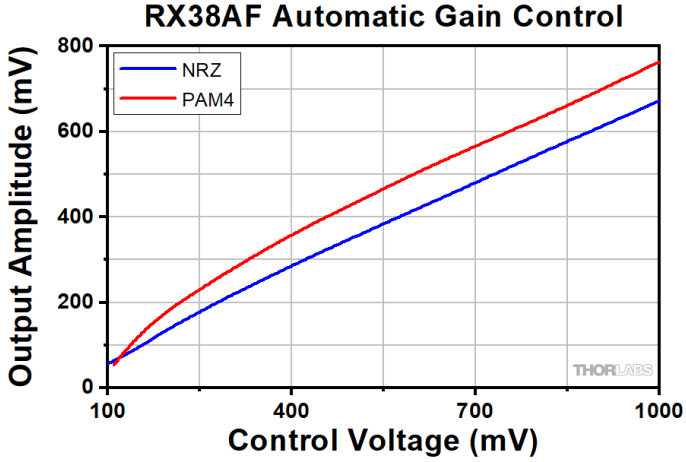


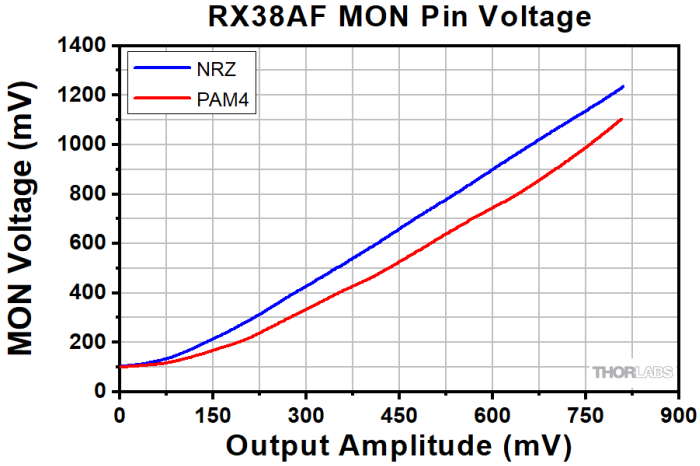


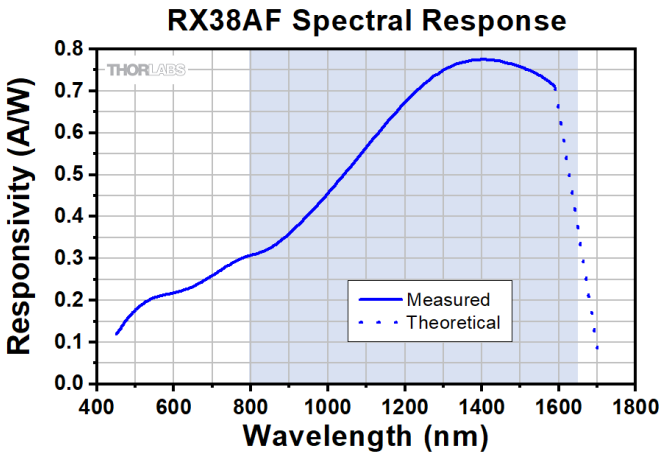
Frequency response data taken at 1550 nm.

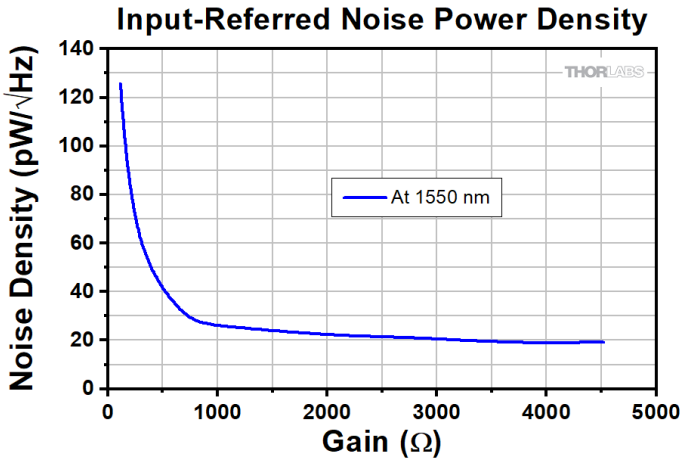












PRECAUTIONS



The components inside this instrument 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.

MANUFACTURING AND COMPLIANCE

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

All specifications are subject to change without notice.

