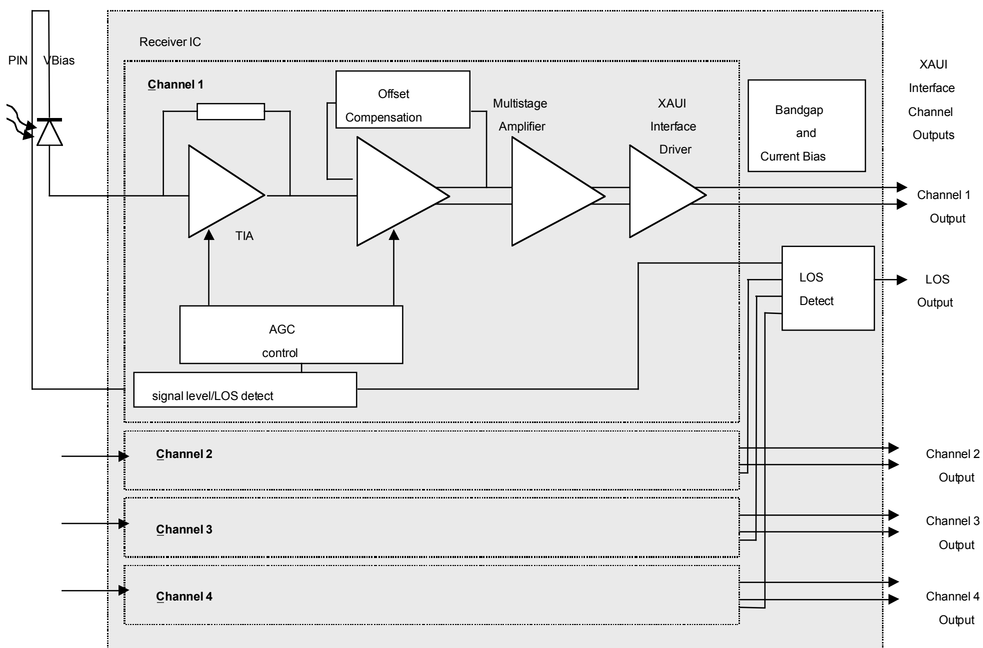
Quad 3.125Gb/s Integrated Photo Diode Receiver

Features

- Four Complete IEEE 802.3 Compatible Channels
  - Low Noise Transimpedance Amplifiers
  - Automatic Gain Control
  - Loss Of Signal Detection
  - XAUI Compatible Interface
- Single 3.3 V Power Supply
- Multiple Packaging Options

Functional Block Diagram



Product Description

The Honeywell HRF-RX1000 is designed for 10 GB/s Ethernet Fiber Optic applications (IEEE 802.3), using the XAUI standard interface. Implemented using Honeywell's patented Silicon On Insulator (SOI) manufacturing technology, the HRF-RX1000 integrates four channels of 3.125 Gb/s photo diode receiver, each channel containing trans-impedance amplifiers, AGC, limiting amplifiers, and XAUI drivers, all onto a single integrated circuit.

The HRF-RX1000 operates from a single 3.3V power supply, provides excellent sensitivity, extremely high channel to channel isolation, offset compensation, and supports a direct interface to XAUI-XAUI re-timers. Independent Loss Of Signal (LOS) and automatic channel power-down functions are internally implemented. A very high level of integration minimizes the need for external components.

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Product Architecture

The HRF-RX1000 product architecture, with four unique channels of photo diode receiver electronics and a common set of bias voltage and Loss OF Signal (LOS) detection circuitry, is shown above. The external components such as power supply de-coupling and RF chokes are not shown. Each channel of the HRF-RX1000 incorporates a separate Automatic Gain Control (AGC) with a number of discrete settings. The Loss Of Signal (LOS) function operates independently for each channel. When LOS is detected on a channel, most of the circuits associated with that channel are powered down and the differential output voltage goes to zero. The data outputs may not become valid until some time after the negation of the LOS.

Electrical Specifications

Symbol	Parameter	Conditions	Min	Typ	Max	Units
Junction Temp	Temperature (used for simulation corners)		0	30	115	°C
VDD (RX)	Supply Voltage	DC	3.135	3.3	3.465	V
IDD (RX)	Supply Current	DC	398	475	608	mA
Pdiss	Power Dissipation	DC	1.25	1.57	2.11	W

Photodiode Parameters

Symbol	Parameter	Conditions	Min	Typ	Max	Units
Cpdj	Zero Bias Junction Capacitance			0.25		pF
Rpdjs	Junction Series Resistance			4.5		Ω
Cpdsh	Photodiode Shunt Capacitance			0.2		pF
Rpdsh	Photodiode Shunt Resistance			230		Ω
Rpds	Photodiode Series Resistance			18		Ω
Spd	Photodiode Responsivity		0.75		1.05	A / W

The HRF-RX1000 is optimized for a photodiode with a high resistive component in the impedance. An increase in deterministic jitter will occur if the HRF-RX1000 is used with a photodiode with a low shunt resistance.

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Optical Specifications

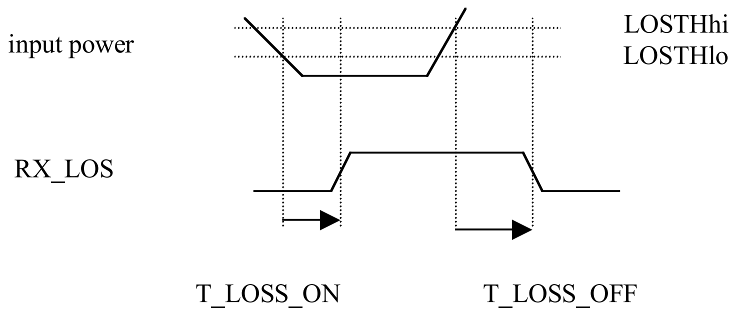
Symbol	Parameter	Conditions	Min	Typ	Max	Units
Brate	Bit Rate		2.45	3.125	3.20	Gb/s
Inoise	Input Noise Current (1MHz-3.125GHz) (Note 9)	Input Referred		415	540	nA rms
Pmin	Min Signal Level (Note 1,2)	Time Averaged	-19.5			dBm
Imax	Max Signal Current (Note 3)	Peak-To-Peak			1.2	mA
RXER	Source Extinction Ratio		7			dB
TX_Vo	Vertical Eye Opening At Receiver Output	Differential Peak-To-Peak	175	550	800	mV
PDRevBias	Photo Diode Reverse Bias Voltage		1.5	2.0		V
RX_DJ	Total Receiver DJ (P-P)	Min Input Signal		23	57	
RX_DJPD	Pattern Dependent DJ (P-P) (Note 4,5)	Min Input Signal		13	47	ps
RX_DJPD2		All Input Power Levels		24	56	ps
RX_DJPS	DJ Due To External Power Supply Noise (Note 8)				10	ps
RX_RJ	Receiver Random Jitter (Pk/Pk) For BER Of 10^{-12}			143	183	ps
RX_TJ	Receiver Total Jitter (Pk/Pk) For BER Of 10^{-12}	Pattern Dependant		166	234	ps
LowCO	Low Frequency Cut Off				1	MHz
RX_BW	3db Bandwidth		1.35	1.74	2	GHz
LOSTHlo	Loss Of Signal Threshold (Power Falling) (Note 6)		-30.9	-25.8	-24.7	dBm
LOSTHhi	Loss Of Signal Threshold (Power Rising) (Note 6)		-26.1	-23.3	-21.1	dBm
T_LOSS_ON	Loss Of Signal Assertion Time			60	100	µs
T_LOSS_OFF	Loss Of Signal Deassertion Time			0.5	100	µs
CPDiff	Channel Power Difference (Note 7)				4	dB

Note 1: Pmin Is The Minimum Input Signal That Will Be Amplified To Give A Vertical Eye Opening Of TX_Vo Measured At The Center Of The Eye.

Note 2: This Parameter Is Defined For A Source With Worst-Case Extinction Ratio And Photodiode Responsivity.

Note 3: Imax Is The Maximum Peak-To-Peak Current That The Circuit Will Handle. A Peak-To-Peak Current Of 1.2 Ma Is Produced By A -2.5 dBm Input Signal With 100% Extinction And Best Case Photodiode Responsivity.

Note 4:	RX_DJ, RX_RJ And RX_TJ Are Dependent On Input Signal Power. The Specified Values Are Achieved With An Input Power Of 0.5 dB Greater Than Pmin.
Note 5:	The Standard Repeated Pattern To Be Used For Determining Deterministic Jitter Is K28.5.Character /1100000101/0011111010/ At 3.125 Gbit/S.
Note 6:	Loss Of Signal Detect Is Based On The Low-Frequency Average Optical Power. Loss Of Signal Output Is Open Drain With A 4.7kΩ Pull-Up Active High Signal.
Note 7:	Required for crosstalk simulations.
Note 8:	This is dependent on system power supply environment and is conditional on power supply filtering.
Note 9:	Simulated performance.



HRF-RX1000 Loss Of Signal Timing Diagram

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Pin List and Pad Placement

Code: P =Power/Gnd, I =Input, O = Output, OD = Open Drain Output, NC = no connect

Pin Name	Type	Description
RXC1_OP/ RXC1_ON	O	XAUI Positive And Negative Outputs For Channels 1-4
RXC2_OP/ RXC2_ON	O	
RXC3_OP/ RXC3_ON	O	
RXC4_OP/ RXC4_ON	O	
RXCA1/RXAN1	I/O	Channel 1 Photodiode Cathode And Anode Connections
RXCA2/RXAN2	I/O	Channel 2 Photodiode Cathode And Anode Connections
RXCA3/RXAN3	I/O	Channel 3 Photodiode Cathode And Anode Connections
RXCA4/RXAN4	I/O	Channel 4 Photodiode Cathode And Anode Connections
VDDTIA1/GNDTIA1	P	Channel 1 Transimpedance Input Amp. Only
VDDTIA2/GNDTIA2	P	Channel 2 Transimpedance Input Amp. Only
VDDTIA3/GNDTIA3	P	Channel 3 Transimpedance Input Amp. Only
VDDTIA4/GNDTIA4	P	Channel 4 Transimpedance Input Amp. Only
AVDD1A/AGND1A	P	Post-Amplifier Supply, Channels 3/4
AVDD1B/AGND1B	P	Post-Amplifier Supply, Channels 1/2
AVDD2A/AGND2A	P	Limiting Amplifier Supply 1, Channels 3/4
AVDD2B/AGND2B	P	Limiting Amplifier Supply 1, Channels 1/2
AVDD3A/AGND3A	P	Limiting Amplifier Supply 2, Channels 3/4
AVDD3B/AGND3B	P	Limiting Amplifier Supply 2, Channels 1/2
XVDD1-4, XGND1-4	P	XAUI I/O Power And Ground Channels 1-4
LOS1	OD	Loss Of Signal Output (Ch1), Active High (AGCMON=0) AGC Down-Pulse Monitor, Active Low (AGCMON=1)
LOS2	OD	Loss Of Signal Output (Ch2), Active High (AGCMON=0) AGC Up-Pulse Monitor, Active Low (AGCMON=1)
LOS3	OD	Loss Of Signal Output (Ch3)
LOS4	OD	Loss Of Signal Output (Ch4)
TEST_AGC0	I	Override AGC Setting - Bit 0
TEST_AGC1	I	Override AGC Setting - Bit 1
TEST_AGCMON	I	Enable Monitoring Of AGC Output Pulses
TEST_PD	I	Test Mode Power Down
TEST_BG	O	Bandgap Monitor For Production Test Only
DUMMY	NC	Electrically Floating Pads Used To Meet Flip-Chip Mechanical Assembly Rules

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External Components

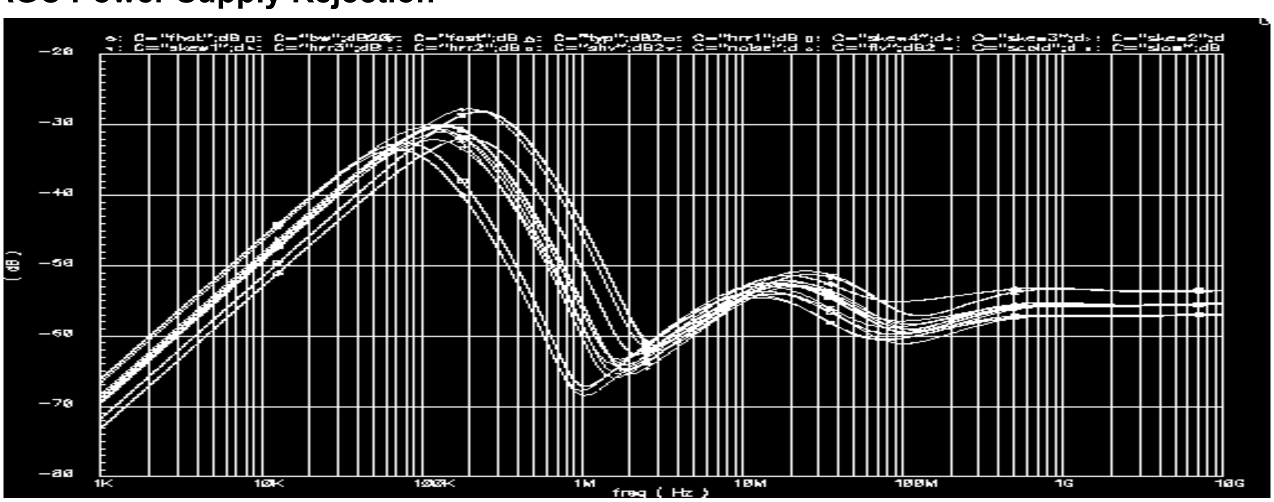
Name	Component	Description
L1-L2	33 nH	Front-End Supply Filter: High Self-Resonant Frequency Inductor Coilcraft 0603CS-33N DC Resistance=0.22 Ω Max Substitute 0402 Part: 0402CS-27N
C1-C2	1 µF	Front-End Supply Bypass Capacitor, Surface Mount Ceramic
L3	16 nH	High Self-Resonant Frequency Inductor Coilcraft 0603CS-16N DC Resistance=0.1 Ω Max Substitute 0402 Part: 0402CS-12N
C3-C4	Approx 100 nF	Post-Amp Supply Bypass Capacitor, Surface Mount Ceramic
C5-C8	Approx 100 nF	Limiting Amplifier Supply Bypass Capacitor, Surface Mount Ceramic
L4	470 nH	Optional Low-Frequency Filter: Inductor DC Resistance = 55 MΩ Max Murata LQH3CR47M24 Or Similar
C9-C16	47 nF	DC Blocking Capacitors On Rxcn_OP/Rxcn_ON For N=1,2,3,4

Capacitors C9-C16 allow the RF outputs to interface to an arbitrary common-mode level at the input of the retimer chip. DC coupled termination to VDD is permitted but DC coupled termination to GROUND is not.

The HRF-RX1000 requires external power supply filtering for correct operation. Contact Honeywell for technical insights on the best approaches. The front-end power supply requires completely independent filtering of channel groups 1/2 and 3/4. The post-amplifier supply AVDD1 uses a common filter but it is recommended that the power routing for AVDD1A and AVDD1B on the PCB from the inductor L3 to the bypass capacitor C3 and C4 is independent. Some form of low-frequency regulation is also assumed but the exact nature of this is not critical. Odd numbered bypass capacitors should be located at the 'B' side of the HRF-RX1000. Even numbered bypass capacitors should be located at the 'A' side of the HRF-RX1000. An allowance for the DC voltage drop across the inductors specified above has been included within the on-chip supply voltage budget below.

Inductor	Max DC Current (mA)	Max DC Resistance (Ω)	Voltage Budget (mV)
L3	126	0.1	13
L1/L2	82	0.22	18
L4	608	0.55	33

AGC Power Supply Rejection



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XAUI Interface Electrical Specifications

Symbol	Parameter	Conditions	Min	Typical	Maximum	Units
TX_IC	Tx Input Current			6.5		mA
TX_DS	Tx Differential Skew				15	ps
RX_Vcm	Rx Vin Common Mode Level (see note2)			0.75		V
RX_Vi	Rx Vin Diff	(TBR)	175		1000	mV
RX_DS	Rx Differential Skew				75	ps
Trise	Rise Time	20%-80%	60		131	ps
Tfall	Fall Time	20%-80%	60		131	ps
PCBZ	PCB Impedance	Tol.=±10%		100		Ω
ConnZ	Connector Impedance	Tol.=±30%		100		Ω
SourceZ	Source Impedance	Tol.=±20%		100		Ω
LoadZ	Load Termination	Tol.=±20%		100		Ω
Rloss	Return Loss (see note 3)			10		dB

Note: Logic Level 1 Corresponds to Positive I/O high voltage level, Negative I/O low voltage level.

Low Speed I/O Electrical Specifications

Symbol	Parameter	Conditions	Minimum	Typical	Maximum	Units
VIL	Input Logic Low To HRF-RX1000 (Note 10)		0		0.8	V
IIL	Input Logic Low To HRF-RX1000 (Note 10)		0		0.17	mA
VIH	Input Logic High To HRF-RX1000 (Note 10)	(VddT=3.3V)	2.0		VddT+0.3	V
IIH	Input Logic High To HRF-RX1000 (Note 10)		0.2		VddT+0.3 / 4.7K	mA
VOL	Output Logic Low From HRF-RX1000 (Note 10)		0		0.5	V
IOL	Output Logic Low From HRF-RX1000 (Note 10)		0		0.11	mA
VOH	Output Logic High From HRF-RX1000 (Note 10)		VddT-0.5		VddT+0.3	V
IOH	Output Logic High From HRF-RX1000 (Note 10)		0.28		0.77	mA
CLOAD	Load Capacitance				200	pF
RPULLUP	Pull-Up Resistor To VDD=3.3V		4.7		10	KΩ

Note 10: Only XAUI Interface electrical standards defined above are applicable to the HRF-TX1000 and HRF-RX1000.
Note 11: Allows potential for direct connection instead of AC decoupling.
Note 12: Measured from 125MHz to 3.125GHz.
Note 13: For Open Drain outputs the VIL and VOH specs are for a 4.7K to 10K ohms pull-up resistor to 3.3V measured at the pin of the HRF-RX1000.

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Typical Application Circuit

Call Honeywell for details

Evaluation Circuit Board

Call Honeywell for details

Ordering Information

Ordering Number	Product
HRF-RX1000-D	Delivered In Die Form(14)
HRF-RX1000-FC	Delivered In Flip Chip Form(14)
HRF-RX1000-E	Engineering Evaluation Board

Note 14: Call Honeywell for details

Honeywell reserves the right to make changes to improve reliability, function or design. Honeywell does not assume any liability arising out of the application or use of any product or circuit described herein; neither does it convey any license under its patent rights nor the rights of others.

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