Applications

- SONET/SDH-based transmission systems, test equipment and modules
- OC-48 fibre optic modules and line termination
- ATM optical receivers
- Gigabit Ethernet
- Fibre Channel

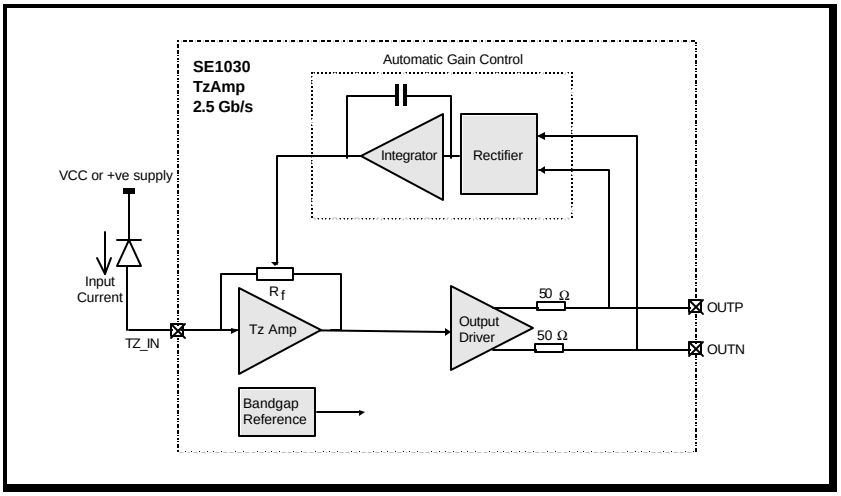
Features

- Single +3.3 V power supply
- Input noise current = 360 nA rms when used with a 0.5 pF detector
- Transimpedance gain = 2.3 kΩ into a 50 Ω load (differential)
- On-chip automatic gain control gives input current overload of 2.6 mA pk and max output voltage swing of 300 mV pk-pk
- Differential 50 Ω outputs
- Bandwidth (-3 dB) = 2.4 GHz
- Wide data rate range = 50 Mb/s to 2.5 Gb/s
- Constant photodiode reverse bias voltage = 1.5 V (anode to input, cathode to VCC)
- Minimal external components, supply decoupling only
- Operating junction temperature range = -40°C to +125°C
- Equivalent to Nortel Networks AB89-A2A

Ordering Information

Type	Package	Remark
SE1030W	Bare Die	Shipped in Waffle Pack

Functional Block Diagram



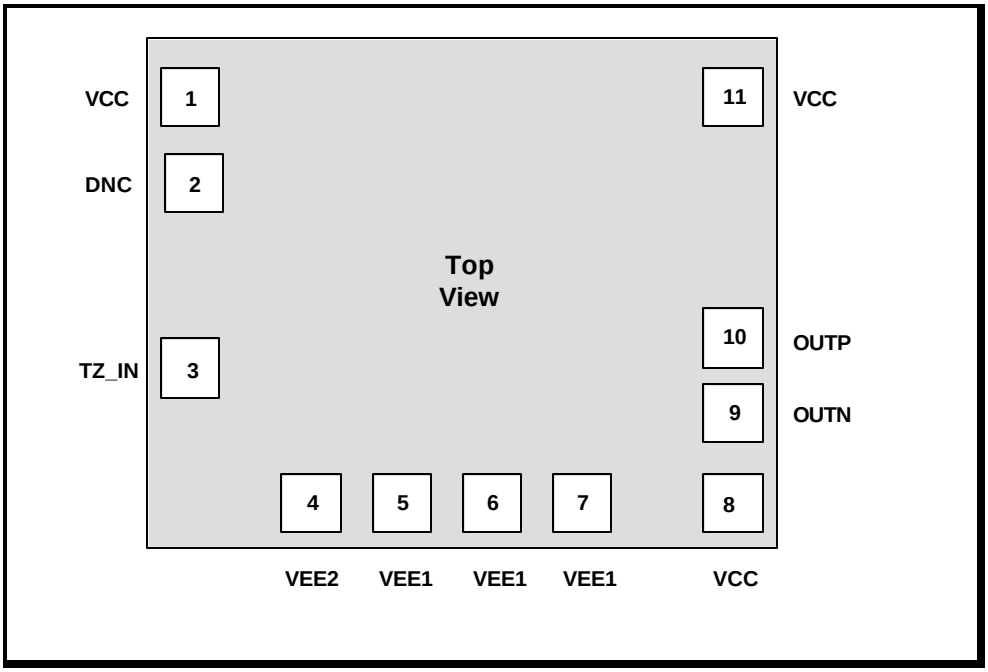
Product Description

SiGe Semiconductor offers a portfolio of optical networking ICs for use in high-performance optical transmitter and receiver functions, from 155 Mb/s up to 12.5 Gb/s.

SiGe Semiconductor's SE1030W is a fully integrated, silicon bipolar transimpedance amplifier; providing wideband, low noise preamplification of signal current from a photodetector. It features differential outputs, and incorporates an automatic gain control mechanism to increase dynamic range, allowing input signals up to 2.6 mA peak. A decoupling capacitor on the supply is the only external circuitry required. A system block diagram is shown after the functional description, on page 3.

Noise performance is optimized for 2.5 Gb/s operation, with a calculated rms noise based sensitivity of –26 dBm for 10^{-10} bit error rate, achieved using a detector with 0.5 pF capacitance and a responsivity of 0.9 A/W, with an infinite extinction ratio source.

Bondpad Diagram



Bondpad Description

Pad No.	Name	Description
1	VCC	Positive supply (+3.3 V), pads 1, 8 & 11 are connected on chip. Only one pad needs to be bonded.
2	DNC	Do not connect.
3	TZ_IN	Input pad (connect to photodetector anode).
4	VEE2	Negative supply (0V) – Note this is separate ground for the input stage, which is AC coupled on chip. There is no DC current through this pad.
5	VEE1	Negative supply (0V), pads 5, 6 & 7 are connected on chip. Only one pad needs to be bonded.
6	VEE1	Negative supply (0V), pads 5, 6 & 7 are connected on chip. Only one pad needs to be bonded.
7	VEE1	Negative supply (0V), pads 5, 6 & 7 are connected on chip. Only one pad needs to be bonded.
8	VCC	Positive supply (+3.3 V), pads 1, 8 & 11 are connected on chip. Only one pad needs to be bonded.
9	OUTN	Negative differential voltage output.
10	OUTP	Positive differential voltage output.
11	VCC	Positive supply (+3.3 V), pads 1, 8 & 11 are connected on chip. Only one pad needs to be bonded.

Functional Description

Amplifier Front-End

The transimpedance front-end amplifies an input current from a photodetector, at pin TZ_IN, to produce a differential output voltage with the feedback resistor Rf determining the level of amplification (see the functional block diagram on page 1). An automatic gain control loop varies this resistor, to ensure that the output from the front-end does not saturate the output driver stage that follows. This gain control allows input signals of up to 2.6 mA peak.

The input pin TZ_IN is biased at 1.5 V below the supply voltage VCC, allowing a photodetector to have a constant reverse bias by connecting the cathode to 3.3 V. This enables full single rail operation.

The front-end stage has its own supply ground connection (VEE2) to achieve optimum noise performance and maintain integrity of the high-speed signal path. The front-end shares the VCC (+3.3 V) connection with the remainder of the circuitry, which has a separate ground (VEE1).

Output driver stage

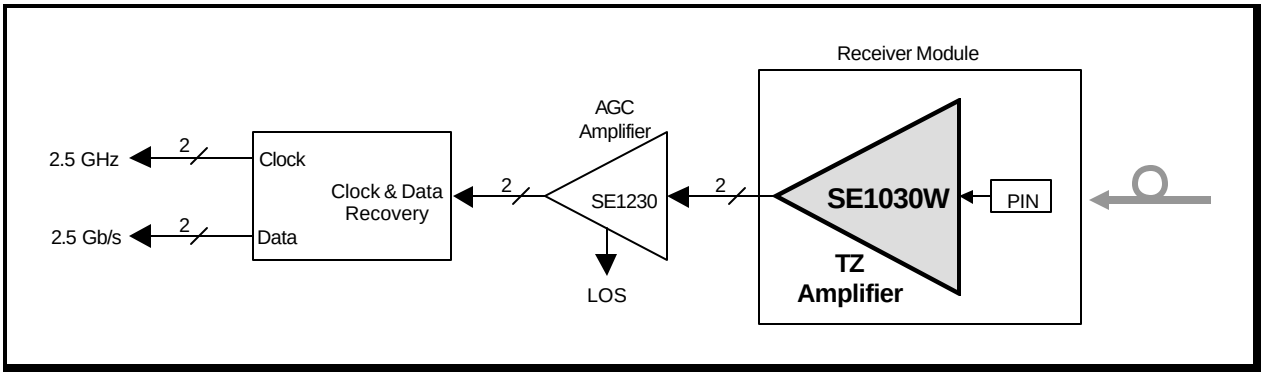
The output driver acts as a buffer stage, capable of swinging up to 300 mVpk-pk differential into a 100 Ω load. The small output swings allow ease of use with low voltage post amplifiers (e.g. 3.3 V parts). Increasing optical input level gives a positive-going output signal on the OUTP pin.

Automatic Gain Control (AGC)

The AGC circuit monitors the voltages from the output driver and compares them to an internal reference level produced via the on-chip bandgap reference circuit. When this level is exceeded, the gain of the front-end is reduced by controlling the feedback resistor Rf.

A long time-constant integrator is used within the control loop of the AGC with a typical low frequency cut-off of 5 kHz.

System Block Diagram



Absolute Maximum Ratings

These are stress ratings only. Exposure to stresses beyond these maximum ratings may cause permanent damage to, or affect the reliability of the device. Avoid operating the device outside the recommended operating conditions defined below.

Symbol	Parameter	Min	Max	Unit
VCC	Supply Voltage	–0.7	6.0	V
V_{IO}	Voltage at any input or output	–0.5	VCC+0.5	V
I_{IO}	Current sourced into any input or output except TZ_IN	–20	20	mA
I_{IO}	Current sourced into pin TZ_IN	–5	5	mA
V_{ESD}	Electrostatic Discharge (100 pF, 1.5 kΩ) except TZ_IN	–2	2	kV
V_{ESD}	Electrostatic Discharge (100 pF, 1.5 kΩ) pin TZ_IN	–0.25	0.25	kV
Tstg	Storage Temperature	–65	150	°C

Recommended Operating Conditions

Symbol	Parameter	Min	Typ	Max	Unit
VCC	Supply Voltage	3.1	3.3	3.5	V
Tj	Operating Junction Temperature	–40		125	°C

DC Electrical Characteristics

Symbol	Parameter	Min	Typ	Max	Unit
ICC max	Supply Current (max input current)		66	101	mA
ICC zero	Supply Current (zero input current)		52	85	mA
Iagc	AGC Threshold	42			µA pk-pk
Vin	Input Bias Voltage	VCC–1.57	VCC–1.52	VCC–1.47	V
Vout	Output Bias Voltage		VCC–0.30		V
Rout	Output Resistance	35	50	65	Ω

AC Electrical Characteristics

Symbol	Parameter	Min	Typ	Max	Unit
BW (3dB)	Small Signal Bandwidth at –3dB point	1.8	2.4		GHz
Tz	Differential Transimpedance (50 Ω on each output, f = 100 MHz)	1.6	2.3	3.1	kΩ
Dri	Input Data Rate	50		2500	Mb/s
Voutmax	Maximum Differential Output Voltage			300	mV pk-pk
Flf	Low Frequency Cut-off		5		kHz
I_{OL}	Input Current before overload (2.5 Gb/s NRZ data)	2600			µA pk-pk
Pol	Optical Overload	+1.6			dBm
Nrms	Input Noise Current (in 2 GHz)		360	500	nA rms

DC and AC electrical characteristics are specified under the following conditions:

Supply Voltage (VCC).....3.1 V to 3.5 V
Junction Temperature (Tj).....–40°C to 125°C
Load Resistor (R_L).....50 Ω AC coupled via 220 nF, for each output
Photodetector Capacitance (Cd).....0.5 pF
Input bond wire inductance.....1 nH
Photodetector responsivity.....0.9 A/W
Transimpedance (Tz) measured with 4 µA mean photocurrent

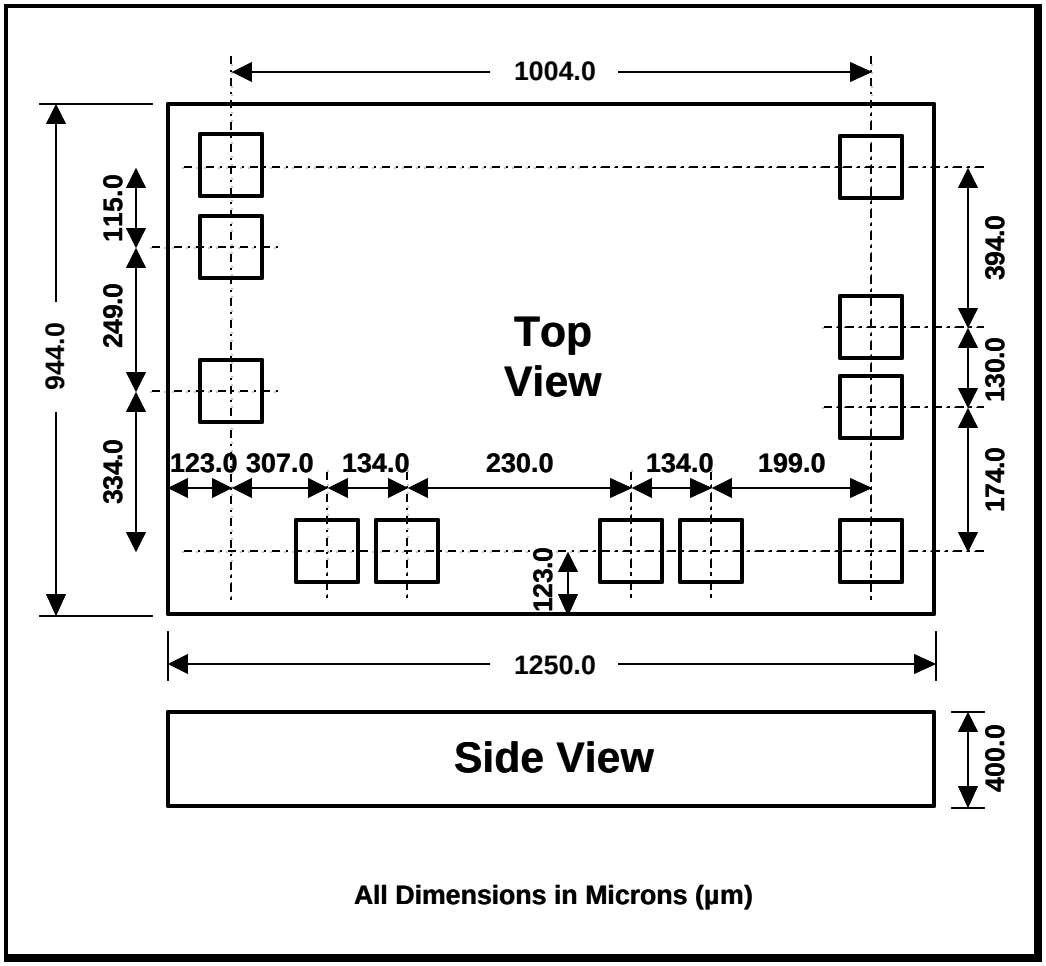
Bondpad Configuration

The bondpad center coordinates are referenced to the center of the lower left pad (pad 4). All dimensions are in microns (µm).

Pad No.	Name	X Coordinate (µm)	Y Coordinate (µm)
1	VCC	-307.0	698.0
2	DNC	-307.0	583.0
3	TZ_IN	-307.0	334.0
4	VEE2	0	0
5	VEE1	134.0	0
6	VEE1	364.0	0
7	VEE1	498.0	0
8	VCC	697.0	0
9	OUTN	697.0	174.0
10	OUTP	697.0	304.0
11	VCC	697.0	698.0

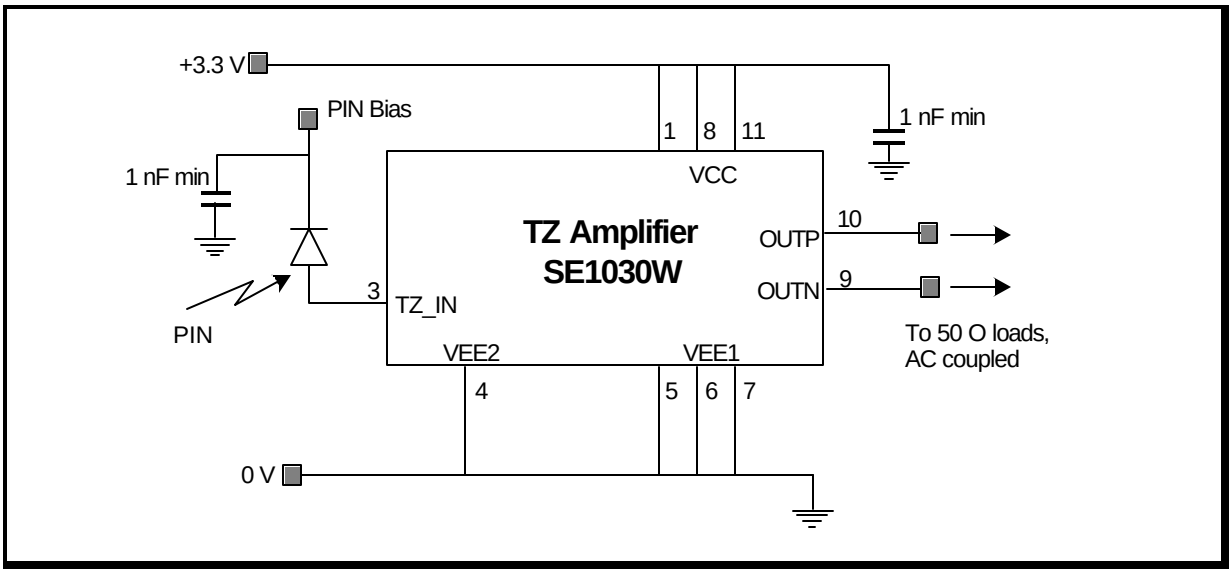
The diagram below shows the bondpad configuration of the SE1030W Transimpedance Amplifier. Note that the diagram is not to scale. All bondpads are 92 µm x 92 µm with a passivation opening of 82 µm x 82 µm. There are three VCC and three VEE1 pads for ease of wire bonding; the VCC and VEE1 pads respectively are connected on-chip and only one pad of each type is required to be bonded out.

Mechanical die visual inspection criteria per MIL-STD-883 Method 2010.10 Condition B Class Level B.



Applications Information

Note that all VCC pads (1, 8, 11) are connected on-chip, as are the VEE1 pads (5, 6, 7), and only one pad of each type is required to be bonded out. However, in order to minimize inductance for optimum high speed performance, it is recommended that all power pads are wire bonded. The VEE2 pad is not connected on chip to VEE1 and must be bonded out separately.



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Product Preview
The datasheet contains information from the product concept specification. SiGe Semiconductor reserves the right to change information at any time without notification.

Preliminary
The datasheet contains information from the design target specification. SiGe Semiconductor reserves the right to change information at any time without notification.

Final
The datasheet contains information from the final product specification. SiGe Semiconductor reserves the right to change information at any time without notification. Production testing may not include testing of all parameters.