02.08.06

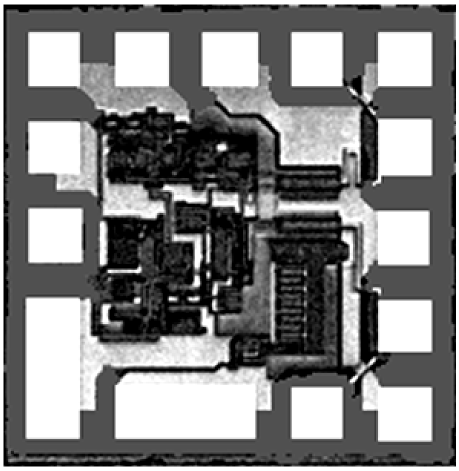
F0100404B

3.3V/5V 1.25 Gb/s Receiver

Transimpedance Amplifier

♦ *Features*

- +3.3V or +5.0 V single power supply
- transimpedance 600 Ω (50 Ω load)
- Typical 2200 MHz broad bandwidth
- 16 dB high gain
- Over 20 dB wide dynamic range
- Differential output
- Excellent equivalent input noise current of 9 pA/√Hz



♦ *Applications*

- G bit Ethernet (1.25 Gb/s)
- Preamplifier of an optical receiver circuit for fiber channel (1.0625 Gb/s)

♦ *Functional Description*

The F0100404B is a stable GaAs integrated transimpedance amplifier capable of 16 dB gain at a typical 1900 MHz 3 dB-cutoff-frequency, making it ideally suited for an optical receiver circuit for a Gbit Ethernet (1.25 Gb/s), instrumentation, and measurement applications. The integrated feedback loop design provides broad bandwidth and stable operation. The F0100404B typically specifies a high transimpedance of 600 Ω (RL=50 Ω) with a wide dynamic range of over 20 dB. Furthermore, it can operate with a supply voltage of single +3.3V or +5.0 V. It features a typical dissipation current of 43 mA.

Only chip-shipment is available for all product lineups of GaAs transimpedance amplifiers, because the packaged preamplifier can not operate with the maximum performance owing to parasitic capacitance of the package.

♦ *Absolute Maximum Ratings*

T_a=25 °C, unless specified

Parameter	Symbol	Value	Units
Supply Voltage	$V_{DD3.3}$	V_{SS}-0.5 to V_{SS}+4.0	V
	$V_{DD5.0}$	V_{SS}-0.5 to V_{SS}+7.0	V
Supply Current	I_{DD}	65	mA
Ambient Operating Temperature	T_a	-40 to +90	° C
Storage Temperature	T_{stg}	-55 to +125	° C

♦ *Recommended Operating Conditions*

T_a=25 °C, V_{SS}=GND, unless specified

Parameter	Symbol	Value		Units
		Min.	Max.	
Supply Voltage	$V_{DD3.3}$	2.8	3.6	V
	$V_{DD5.0}$	4.5	5.25	V
Ambient Operating Temperature	T_a	0	85	° C

♦ *Electrical Characteristics*

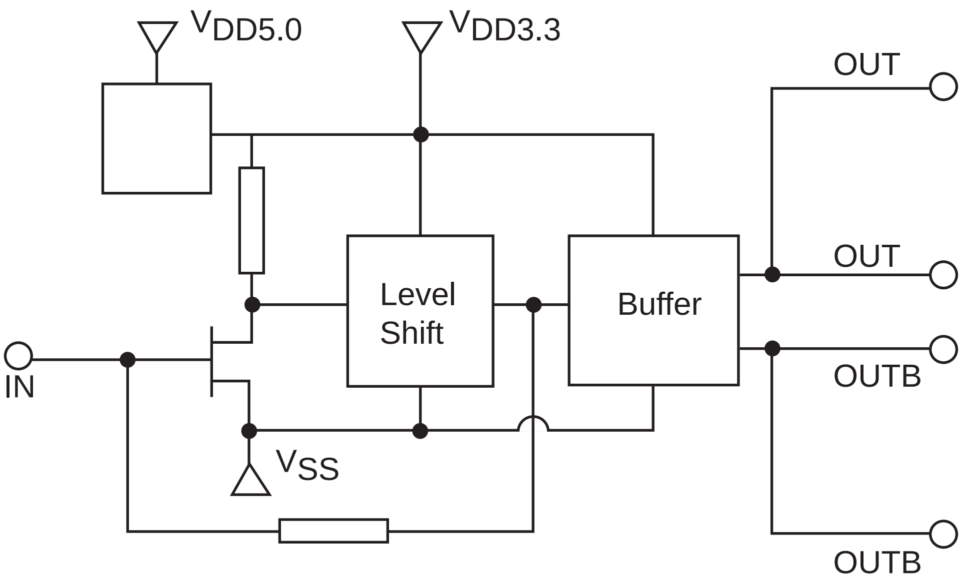
T_a=25 °C, V_{DD}=3.3V, V_{SS}=GND, unless specified

Parameter	Symbol	Test Conditions	Value			Units
			Min.	Typ.	Max.	
Supply Current	I_{DD}	DC	29	43	60	mA
Gain(Positive) *1	S_{21P}	P_{IN}=-50dBm f=1MHz, RL=50Ω	13.0	16.0	21.0	dB
Gain(negative) *1	S_{21N}	P_{IN}=-50dBm f=1MHz, RL=50Ω	13.0	16.0	21.0	dB
High Frequency Cut-off (positive) *1	F_{CP}	P_{IN}=-50dBm RL=50Ω	1.25	1.9	3	GHz
High Frequency Cut-off (negative) *1	F_{CN}	P_{IN}=-50dBm RL=50Ω	1.25	1.7	3	GHz
Input Impedance	R_I	f=1MHz	80	95	160	Ω
Trans-Impedance(positive) *1,*2	Z_{TP}	f=1MHz	450	600	-	Ω
Trans-Impedance(negative) *1,*2	Z_{TN}	f=1MHz	450	625	-	Ω
Output Voltage(positive) *1	V_{OP}	DC	1.4	1.7	2.4	V
Output Voltage(negative) *1	V_{ON}	DC	1.5	2.0	2.5	V
Input Voltage	V_{IN}	DC	0.75	0.9	1.15	V
3.3 V Terminal Voltage *3	V_{33}	DC	2.8	-	3.6	V

*1 Defined at OUT and $\overline{OUT}$ *2 ZTP,N= $\frac{RI+50}{2} \times 10^{\frac{S21P,N}{20}}$

*3 Voltage of $V_{DD3.3}$ pad when supplied the voltage(4.50~5.25 V) to $V_{DD5.0}$ pad

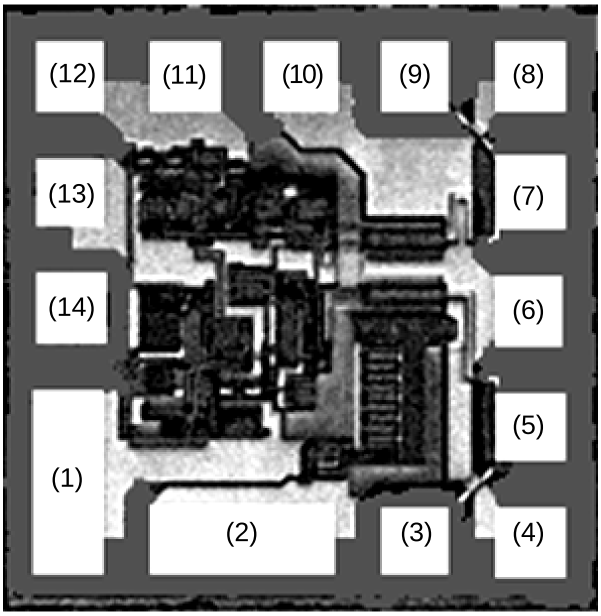
♦ *Block Diagram*



♦ *Die Pad Description*

$V_{DD3.3}$	Power Supply
$V_{DD5.0}$	Power Supply
V_{SS}	Power Supply
IN	Input
OUT	Output
OUTB	Output

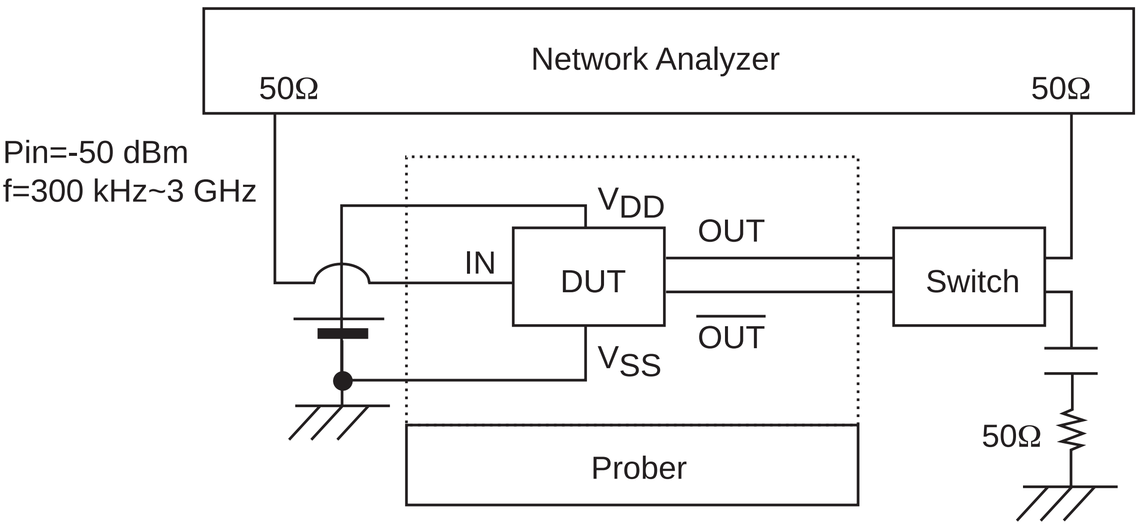
♦ *Die Pad Assignments*



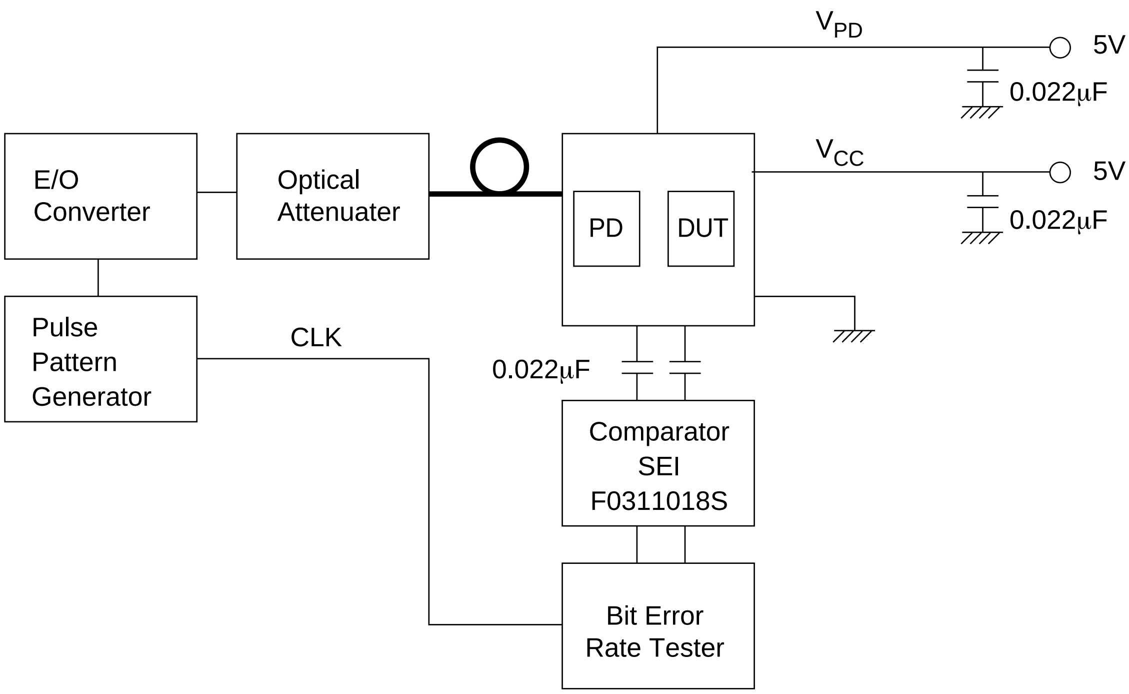
No.	Symbol	Center Coordinates(μm)	No.	Symbol	Center Coordinates(μm)
(1)	$V_{DD3.3}$	(75,155)	(10)	V_{SS}	(395,715)
(2)	$V_{DD5.0}$	(315,75)	(11)	$V_{DD3.3}$	(235,715)
(3)	OUTB	(555,75)	(12)	$V_{DD3.3}$	(75,715)
(4)	V_{SS}	(715,75)	(13)	V_{SS}	(75,555)
(5)	OUTB	(715,235)	(14)	IN	(75,395)
(6)	V_{SS}	(715,395)			
(7)	OUT	(715,555)			
(8)	V_{SS}	(715,715)	O		(0,0)
(9)	OUT	(555,715)	A		(790,790)

♦ *Test Circuits*

1) AC Characteristics



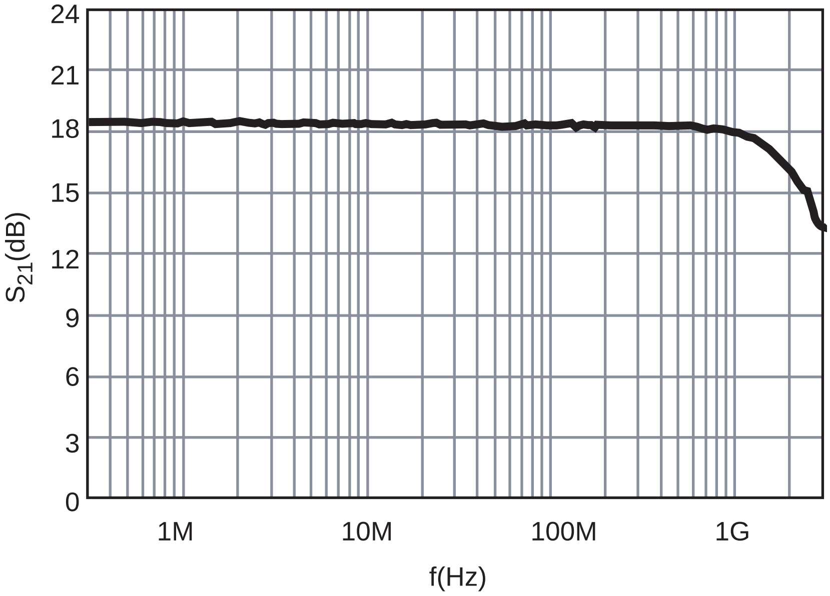
2) Sensitivity Characteristics



♦ *Examples of AC Characteristics*

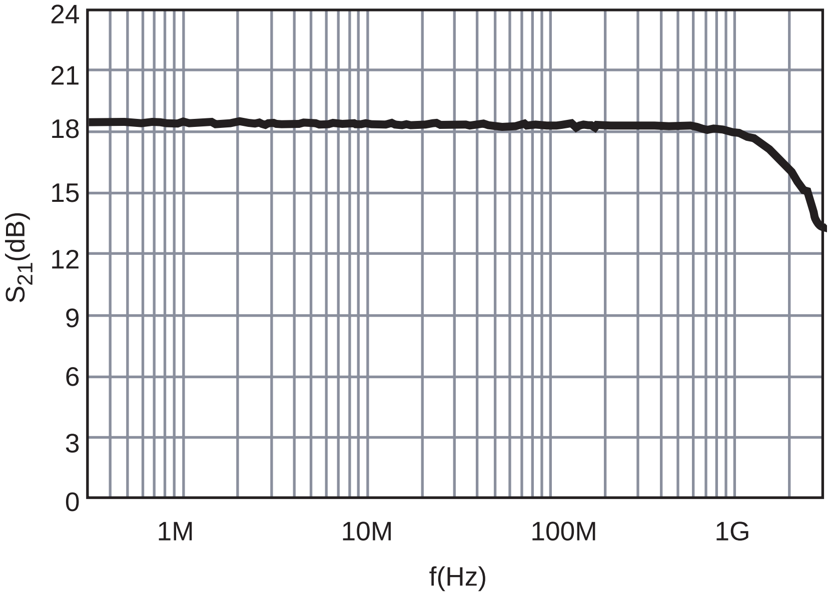
(1) Gain (S_{21P})

T_a=25 °C, V_{DD}=+5.0 V, V_{SS}=GND, Pin=-50 dBm, RL=50 Ω, 300 kHz-3 GHz



(2) Gain (S_{21N})

T_a=25 °C, V_{DD}=+5.0 V, V_{SS}=GND, Pin=-50 dBm, RL=50 Ω, 300 kHz-3 GHz



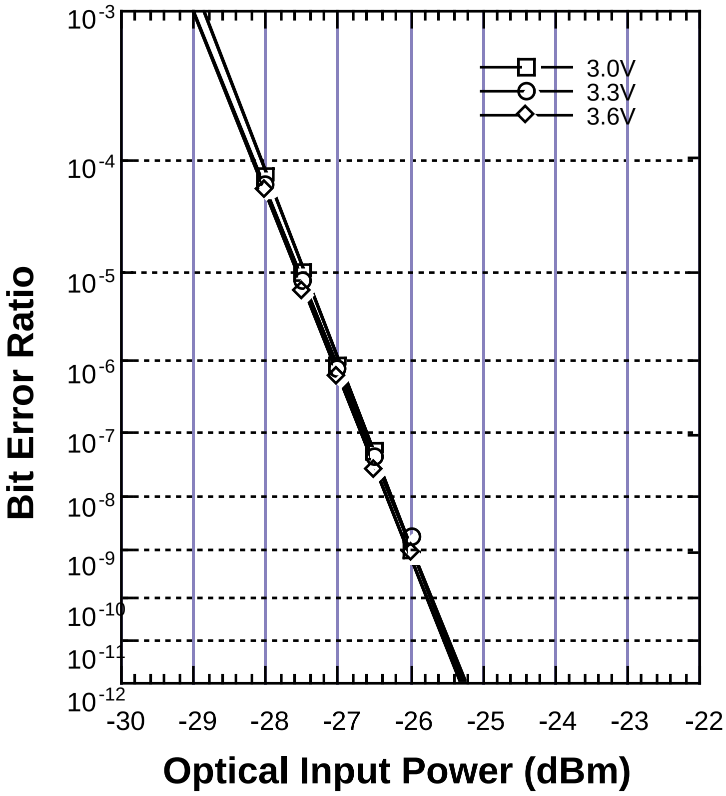
(3) Input Noise Current Density & Transimpedance

INPUT NOISE CURRENT DENSITY & TRANSIMPEDANCE(Typical Vaiues)		
Freq. (MHz)	Zt(Ω) (RF transimpedance)	Ini(pA/√Hz) (Equivalent input noise currentdensity)
10	683	9.68
20	682	8.96
30	679	9.29
50	663	8.08
80	656	8.72
100	649	8.60
200	652	9.07
300	642	8.54
400	649	8.25
500	641	8.68
600	662	8.90
700	663	10.80
800	670	10.60
900	685	10.30
1000	685	8.96

♦ *Typical Bit Error Rate*

DATA RATE: 1.25 Gb/s

PRBS 2^{23}-1, T_a=25 °C, V_{DD}=+5.0 V, V_{SS}=GND, RL=50 Ω



♦ *General Description*

A transimpedance amplifier is applied as a pre-amplifier which is an amplifier for a faint photo-current from a PIN photo diode (PD). The performance in terms of sensitivity, bandwidth, and so on, obtained by this transimpedance amplifier strongly depend on the capacitance brought at the input terminal; therefore, “typical”, “minimum”, or “maximum” parameter descriptions can not always be achieved according to the employed PD and package, the assembling design, and other technical experts. This is the major reason that there is no product lineup of packaged transimpedance amplifiers.

Thus, for optimum performance of the transimpedance amplifier, it is essential for customers to design the input capacitance carefully.

Hardness to electro-magnetic interference and fluctuation of a power supply voltage is also an important point of the design, because very faint photo-current flows into the transimpedance amplifier. Therefore, in the assembly design of the interconnection between a PD and a transimpedance, noise should be taken into consideration.

♦ *Recommendation*

SEI basically recommends the F08 series PINAMP modules for customers of the transimpedance amplifiers. In this module, a transimpedance amplifier, a PD, and a noise filter circuit are mounted on a TO-18-can package hermetically sealed by a lens cap, having typically a fiber pigtail. The F08 series lineups are the best choice for customers to using the F01 series transimpedance amplifiers. SEI’s F08 series allows the customers to resolve troublesome design issues and to shorten the development lead time.

♦ *Noise Performance*

The F0100404B based on GaAs FET’s shows excellent low-noise characteristics compared with IC’s based on the silicon bipolar process. Many transmission systems often demand superior signal-to-noise ratio, that is, high sensitivity; the F0100404B is the best choice for such applications.

The differential circuit configuration in the output enable a complete differential operation to reduce common mode noise: simple single ended output operation is also available.

♦ *Die-Chip Description*

The F0100404B is shipped like the die-chip described above. The die thickness is typically 280 μm ± 20 μm with the available pad size uncovered by a passivation film of 95 μm square. The material of the pads is TiW/Pt/Au and the backside is metalized by Ti/Au.

♦ *Assembling Condition*

SEI recommends the assembling process as shown below and affirms sufficient wire-pull and die-shear strength. The heating time of one minute at the temperature of 310 °C gave satisfactory results for die-bonding with AuSn performs. The heating and ultrasonic wire-bonding at the temperature of 150 °C by a ball-bonding machine is effective.

♦ *Quality Assurance*

For the F01 series products, there is only one technically inevitable drawback in terms of quality assurance which is to be impossible of the burn-in test for screening owing to die-shipment. SEI will not ship them if customers do not agree on this point. On the other hand, the lot assurance test is performed completely without any problems according to SEI's authorized rules. A microscope inspection is conducted in conformance with the MIL-STD-883C Method 2010.7.

♦ *Precautions*

Owing to their small dimensions, the GaAs FET's from which the F0100404B is designed are easily damaged or destroyed if subjected to large transient voltages. Such transients can be generated by power supplies when switched on if not properly decoupled. It is also possible to induce spikes from static-electricity-charged operations or ungrounded equipment.