FEATURES

- Single +5 Volt Supply
- Automatic Gain Control
- Excellent Sensitivity (- 34 dBm)
- 0 dBm Optical Overload

APPLICATIONS

- SONET OC-12/SDH STM-4 Receiver
- Low Noise RF Amplifier

AN14T

Vdd2 · Vdd1 · I in · GND · GND · GND · GND · CBY · CBY · GND · CAGC · GND · Vdd2 · GND · GND · V out

D1
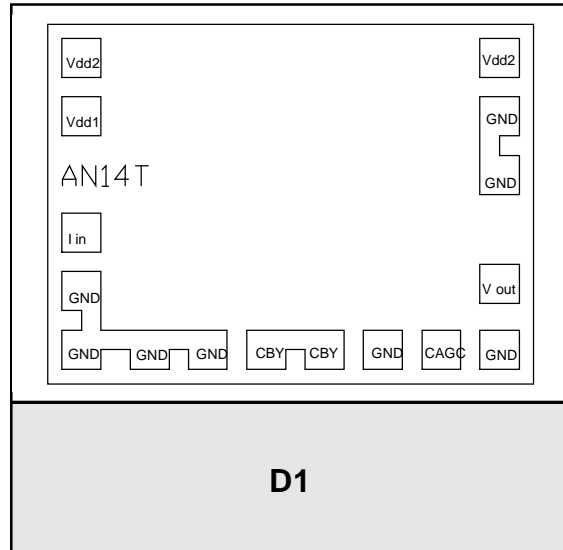
Electrical Characteristics (1)
(T_A= 25 °C, V_{DD} =+5.0V ± 10%, C_{DIODE} +C_{STRAY} = 0.7 pF, Detector Cathode to I_{IN})

PARAMETER	MIN	TYP	MAX	UNIT
Transresistance(R_L=¥,I_{DC} < 500 nA)	7	11		kΩ
Transresistance (R_L=50 W) (1)	3.5	5		kΩ
Bandwidth - 3dB	400	425		MHz
Input Resistance (2)		300		Ω
Output Resistance	30	43	60	Ω
Input Offset Voltage	1.0	1.3		Volts
Output Offset Voltage	1.0	1.4		Volts
AGC Threshold (I_{IN}) (3)		40		μA
AGC Time Constant (6)		4.2		μsec
Optical Overload (4)	0	+ 1		dBm
Optical Sensitivity (7)		- 34		dBm
Input Noise Current (RMS) (5)		40	50	nA
Supply Current		30	45	mA
Operating Voltage Range	+ 4.5	+ 5.0	+ 5.5	Volts
Operating Temperature Range	- 40		85	°C

NOTES
(1) f = 50 MHz
(2) Measured with I_{IN} below AGC Threshold. During AGC, input impedance will decrease proportionally to $I_{IN.}$
(3) Defined as the I_{IN} where Transresistance has decreased by 50%.
(4) See note on "Indirect Measurement of Optical Overload."
(5) See note on "Input Referred Noise Current."
(6) C_{AGC} = 56 pF
(7) Parameter is guaranteed (not tested) by design and characterization data @ 622 Mb/s, assuming detector responsively of 0.95.

ATA06212AD1C

Absolute Maximum Ratings

V_{DD1}	7.0 V
V_{DD2}	7.0 V
I_{IN}	5 mA
T_A	Operating Temp. -40 °C to 125 °C
T_S	Storage Temp. -65 °C to 150 °C

ATA06212AD1C Pad Description

PAD	Description	Comment
V_{DD1}	VDD1	Positive supply for input gain stage
V_{DD2}	VDD2	Positive supply for second gain stage
I_{IN}	TIA Input Current	Connect to detector cathode for proper operation
V_{OUT}	TIA Output Voltage	Requires external DC block
C_{AGC}	External AGC Capacitor	70kW x (4.5pF+ C_{AGC}) = AGC time constant
C_{BY}	Input gain stage bypass capacitor	>56 pF

ATA06212AD1C Equivalent Ciruit

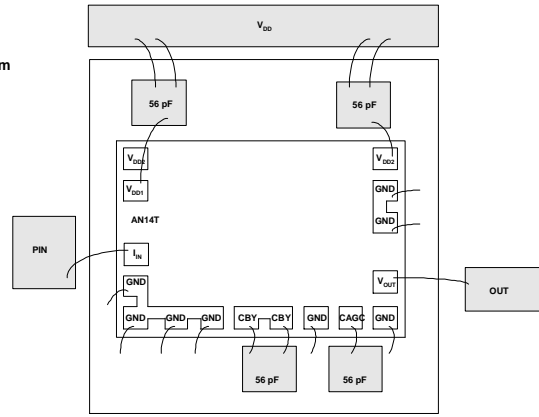Photodetector cathode must be connected to
I_{IN} for proper AGC operation
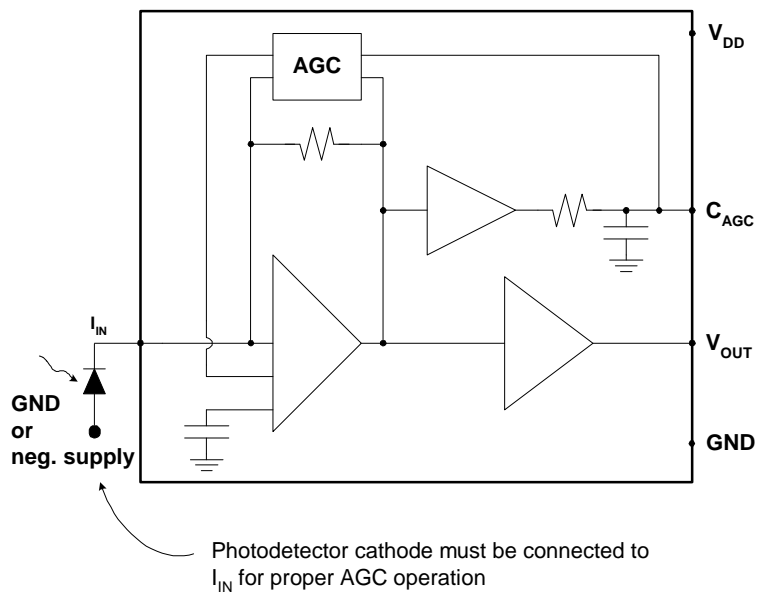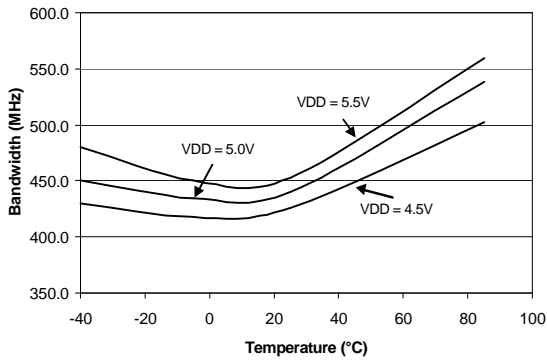
Bonding Pads
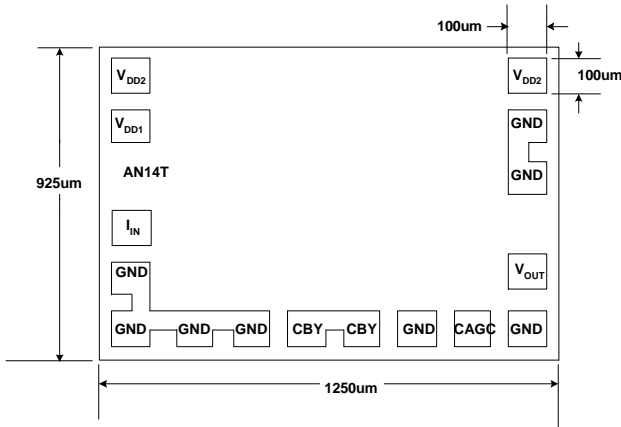
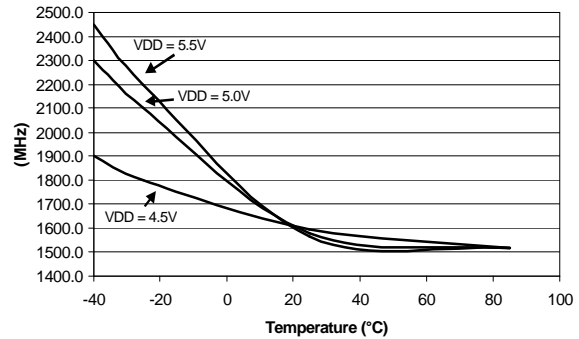**Typical Bonding Diagram**

Note: Bond to either V_{DD2} Bond Pad

TYPICAL CHARACTERISTICS (V_{DD} = +5V, T_A = +25°C, UNLESS OTHERWISE NOTED)
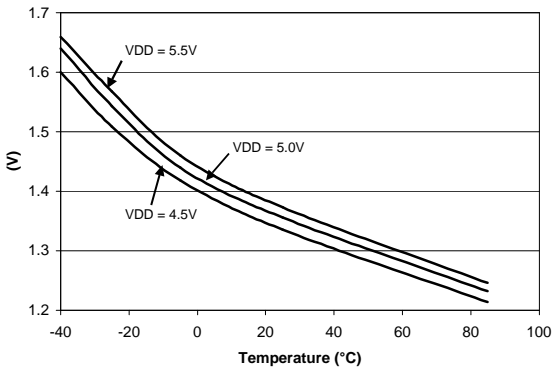
3dB Bandwidth vs. Temperature
C_T = 0.6 pF

AGC Bandwidth vs. Temperature
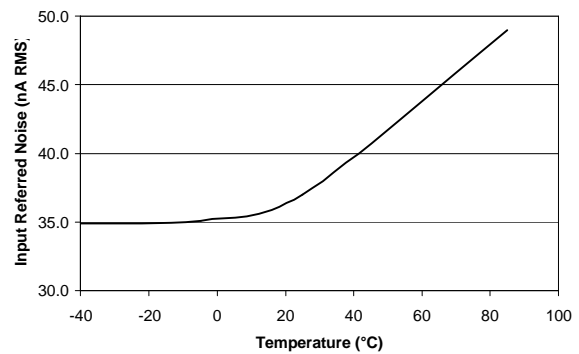C_T = 0.6 pF; I_{IN} = 1.5 mA (Average)

Input Offset Voltage vs. Temperature

Input Referred Noise vs. Temperature
CT = 0.5 pF; 467 MHz LPF

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POWER SUPPLIES AND GENERAL LAYOUT CONSIDERATIONS

The ATA06212AD1C may be operated from a positive supply as low as + 4.5 V and as high as + 6.0 V. Below + 4.5 V, bandwidth, overload and sensitivity will degrade, while at + 6.0 V, bandwidth, overload and sensitivity improve (see "Bandwidth vs. Temperature" curves). Use of surface mount (preferably MIM type capacitors), low inductance power supply bypass capacitors (>=56pF) are essential for good high frequency and low noise performance. The power supply bypass capacitors should be mounted on or connected to a good low inductance ground plane.

GENERAL LAYOUT CONSIDERATIONS

Since the gain stages of the transimpedance amplifier have an open loop bandwidth in excess of 1.0 GHz, it is essential to maintain good high frequency layout practices. To prevent oscillations, a low inductance RF ground plane should be made available for power supply bypassing. Traces that can be made short should be made short, and the utmost care should be taken to maintain very low capacitance at the photodiode-TIA interface (I_{IN}); excess capacitance at this node will cause a degradation in bandwidth and sensitivity.

I_{IN} CONNECTION

Bonding the detector cathode to I_{IN} (and thus drawing current from the ATA06212D1C) improves the dynamic range. Although the detector may be used in the reverse direction for input currents not exceeding 25 μA, the specifications for optical overload will not be met (refer to the equivalent circuit diagram).

V_{OUT} CONNECTION

The output pad should be connected via a coupling capacitor to the next stage of the receiver channel (filter or decision circuits), as the output buffers are not designed to drive a DC coupled 50 Ohm load (this would require an output bias current of approximately 36 mA to maintain a quiescent 1.8 Volts across the output load). If V_{OUT} is connected to a high input impedance decision circuit (>500 Ohms), then a coupling capacitor may not be required, although caution should be exercised since DC offsets of the photo detector/TIA combination may cause clipping of subsequent gain or decision circuits.

SENSITIVITY AND BANDWIDTH

In order to guarantee sensitivity, the TIA is subjected to a comprehensive series of tests at the die sort level (100% testing at 25 °C) to verify the DC and AC parametric performance (transimpedance and bandwidth).

INDIRECT MEASUREMENT OF OPTICAL OVERLOAD

Optical overload can be defined as the maximum optical power above which the BER (bit error rate) increases beyond 1 error in 10^{10} bits. The ATA06212AD1C is 100% tested at die sort by an AC measurement which has excellent correlation with a PRBS optical overload measurement.

INPUT REFERRED NOISE CURRENT

The "Input Noise Current" is directly related to sensitivity . It can be defined as the output noise voltage (V_{OUT}) with no input signal, (including a 400 MHz lowpass filter at the output of the TIA) divided by the AC transresistance.

AGC CAPACITOR

It is important to select an external AGC capacitor of high quality and appropriate size. The ATA06212AD1C has an on-chip 70 kΩ resistor with a shunt 4.5 pF capacitor to ground. Without external capacitance the chip will provide an AGC time constant of 315 ns. For the best performance in a typical 622Mb/s SONET receiver, a minimum AGC capacitor of 56pF is recommended. This will provide the minimum amount of protection against pattern sensitivity and pulse width distortion on repetitive data sequences during high average optical power conditions. The AGC function can be disabled by bonding C_{AGC} to ground. Conservative design practices should be followed when selecting an AGC capacitor, since unit to unit variability of the internal time constant and various data conditions can lead to data errors if the chosen value is too small.

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NOTES

ANADIGICS

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