1.25Gbps Fiber-Optic PIN Pre-Amplifier with AGC

GENERAL DESCRIPTION

The CS6704 is a first-generation transimpedance amplifier with AGC designed for STM8/OC-24 fiber optic systems. The AGC function allows 0dBm input overload.

The CS6704 amplifies the current generated by a PIN diode or avalanche photodiode and converts this to a differential output voltage.

The PINK output of the CS6704 is connected to V_{CC} through a 1.2kΩ on-chip resistor. By using a bypass capacitor at this pin, a filter function significantly reduces the amount of noise at the cathode of the photodiode.

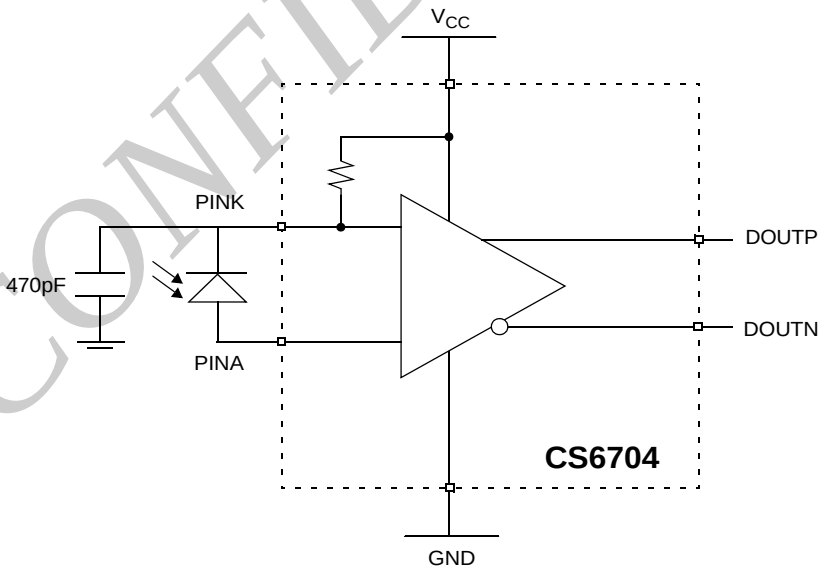
FEATURES

- 3.3V and 5V operation.
- 3kΩ differential transimpedance gain.
- 950MHz bandwidth
- On-chip Automatic Gain Control (AGC).
- Differential outputs.
- Available as die.
- 0 dBm overload.

APPLICATIONS

- Fiber Channel
- SDH/SONET
- Gigabit Ethernet

BLOCK DIAGRAM



PIN CONNECTION DIAGRAM

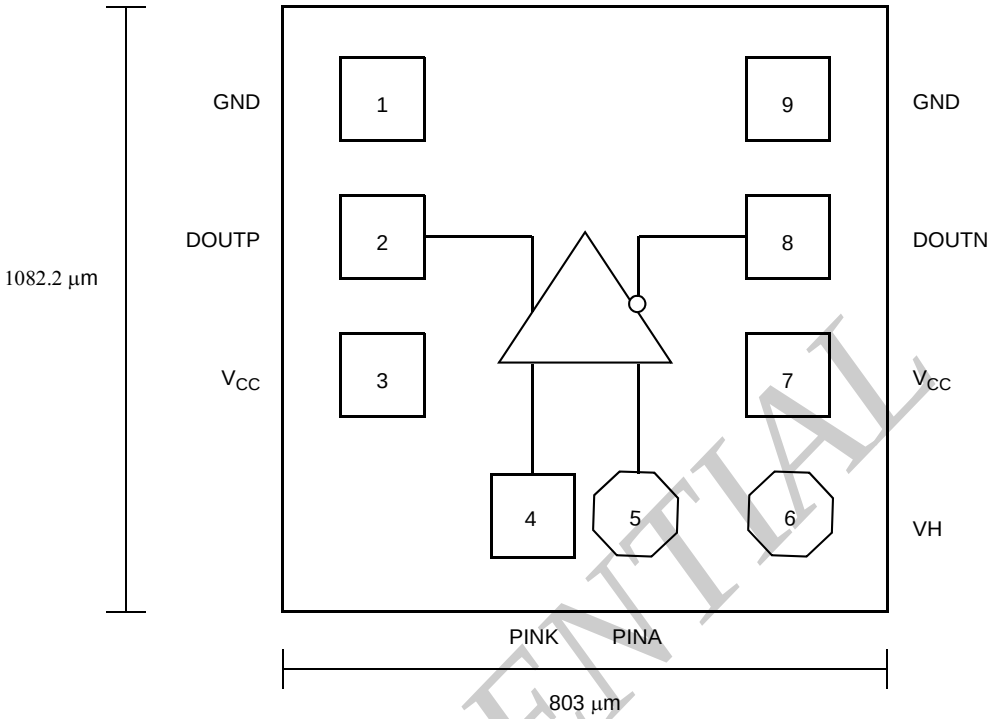


Figure-1

1	**GND**	X=0	Y=523.4
2	**DOUTP**	X=0	Y=373.4
3	**V_{CC}**	X=0	Y=0
4	**PINK**	X=216.05	Y=-90.3
5	**PINA**	X=505.95	Y=-98.3
6	**VH**	X=704	Y=-100.25
7	**V_{CC}**	X=704	Y=0
8	**DOUTN**	X=704	Y=373.4
9	**GND**	X=704	Y=523.4

Note: The coordinates start from the center of PAD PINK to the center of each PAD, and the total die size does not include seal ring and scribe line.

PIN DESCRIPTION

Name	Pin	Description
GND	1, 9	Ground pin. Connect to most negative supply voltage.
DOUTP	2	Data output pin. This pin goes high when current flows into pin PINA.
V_{CC}	3, 7	Power pin. Connect to most positive supply voltage.
PINK	4	PIN input pin. Connect the cathode of the photodiode between this pin and PINA. Connect a capacitor between this pin and ground. Tying this pin to ground to disable the DC Restore function.
PINA	5	PIN input pin. Connect the anode of the photodiode between this pin and PINK.
VH	6	Test pin. Measure the voltage of this pin can get the transimpedance gain. Leave this pin open in typical application circuits.
DOUTN	8	Inverting data output pin. Complementary to pin DOUTP.

Note: PINA is an ESD sensitive pin. Handle with care.

FUNCTIONAL DESCRIPTION

The CS6704 is a transimpedance pre-amplifier fabricated by BiCMOS process. The CS6704 consists of a transimpedance amplifier, an AGC control block, an output buffer, a DC restore block, and a voltage regulator.

Transimpedance Amplifier

The transimpedance amplifier in CS6704 is a high gain, single ended amplifier with a feedback resistor. The feedback resistor converts the input current to a voltage at the output node, and is controlled by the AGC control block. The minimum differential output swing is 10mV with 50Ω load at -27dBm input.

AGC Control Block

The AGC control block is to prevent the output voltage swing from saturation. When the input optic power is lower than -9.5dBm, the AGC function is disabled, and the transimpedance gain is 3.2kΩ.

Output Buffer

The single-ended output of transimpedance amplifier is converted to differential signal through output buffer. It is able to drive either a 50Ω load or a high impedance load. The output swing will be smaller when the CS6704 is terminated with a 50Ω load. For better noise rejection, the different output should be terminated symmetrically.

DC Restore Block

The DC restore block draws DC component of the input current, thus minimize the pulse width distortion of large input current.

Voltage Regulator

In order to minimize the influence of power supply on noise performance, a voltage regulator is incorporated in the CS6704.

FUNCTIONAL DIAGRAM

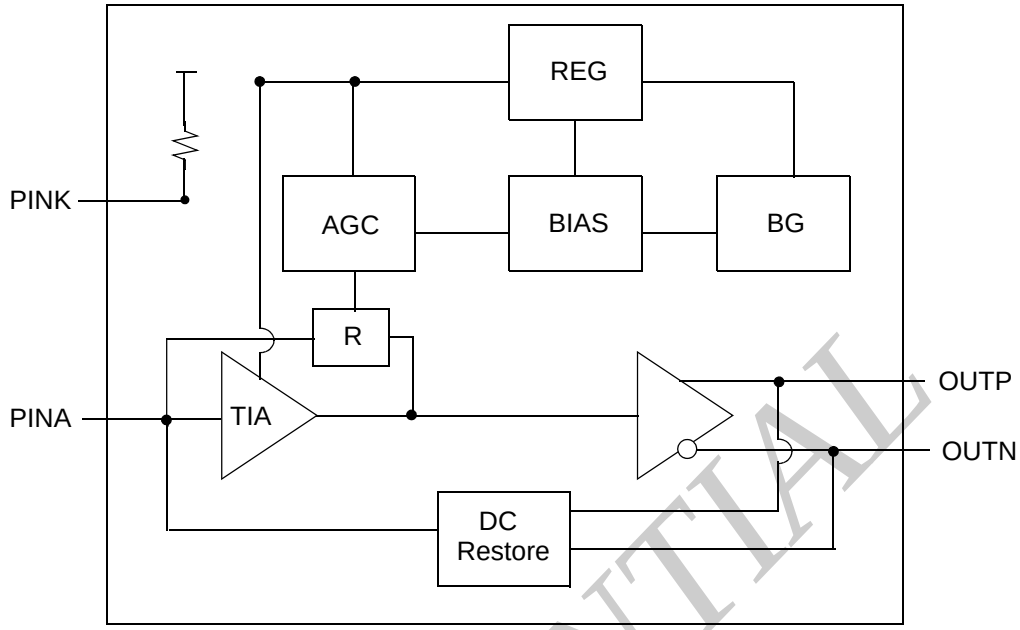
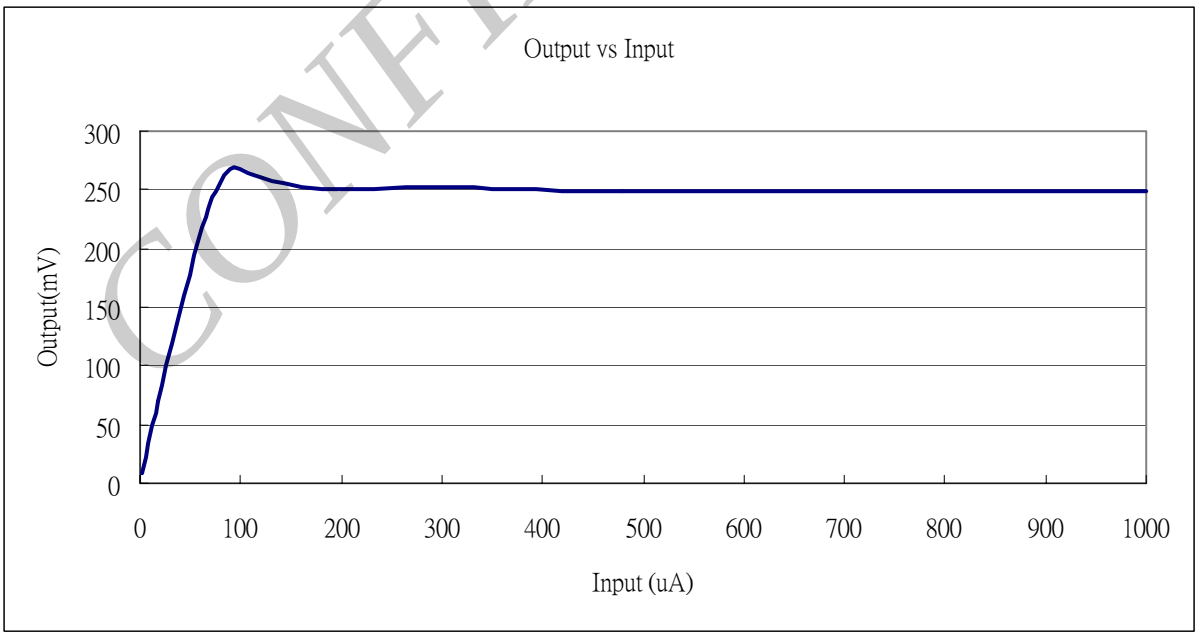


Figure-2

TYPICAL OPERATING CURVE

(T_A = 25°C, C_{IN} = 1pF, data is collected by differential output with 50Ω termination.)



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Rating	Unit
V_{CC}	Power Supply (V_{CC} - GND)	6	V
T_{stg}	Storage Temperature	-65 to +150	°C

RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Rating	Unit
V_{CC}	Power Supply (V_{CC} - GND)	3.0 to 5.5	V
T_A	Operating Ambient	-40 to 85	°C

ELECTRICAL CHARACTERISTICS

Symbol	Parameter	Condition	Min	Typ	Max	Unit
V_{IN}	Input bias voltage		0.75	0.85	0.95	V
I_{CC}	Supply current			27	36	mA
R_O	Output impedance	Single ended	-	50	-	Ω
G	Small signal transimpedance Input = 50 uA_{P-P} (Note 1)	Differential, R_L = 50Ω	2400	3300	3700	Ω
$I_{AC,MAX}$	Maximum AC input current		1	-	-	mA_{pp}
$I_{DC,MAX}$	Maximum DC input current		0.65	-	-	mA
V_{DF}	Maximum differential output voltage	Iinput = $1mA_{p-p}$, R_L = 50Ω	180	250	320	mV
BW	Small signal bandwidth		800	950	1050	MHz
BW_L	Cutoff frequency	-3dB	-	20	-	KHz
I_N	Input referred RMS noise	(Note 1)	-	233	256	nA
$PIN_{(min)}$	Optical sensitivity	(Note 1)	-	-26	-	dBm
$PIN_{(max)}$	Optical saturation		0	-	-	dBm
T_{PWD}	Pulse width distortion	(Note 2)	-	-	10	%
OS	Pulse overshoot	(Note 2)	-	-	10	%
PSRR	Power supply refection ratio	F < 4MHz (Note 2)	35	-	-	dB

Note 1. Assuming photodrobe responsivity of 0.9A/w, extinction ration of 10 dB and BER of 10^{-10}.
Note 2. The result is guarenteed by design simulation.