

# 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  $1.2k\Omega$  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.

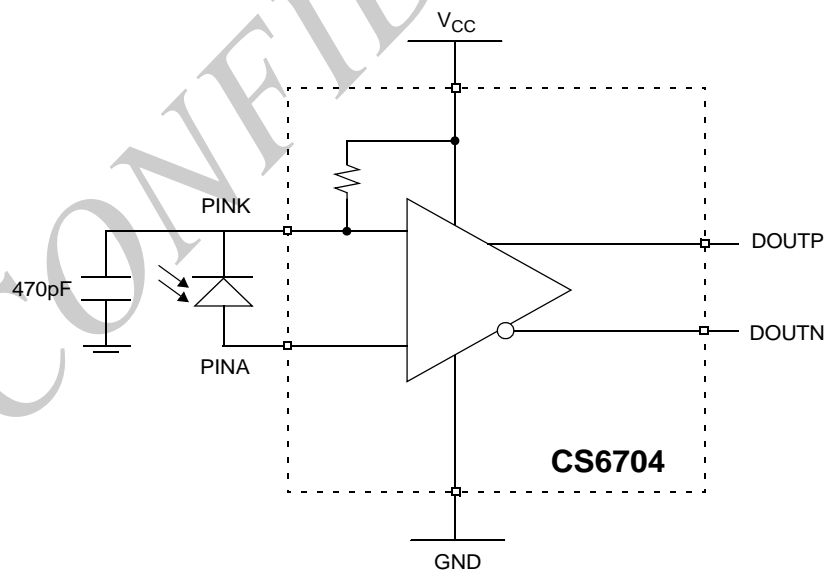
## FEATURES

- 3.3V and 5V operation.
- $3k\Omega$  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



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PIN CONNECTION DIAGRAM

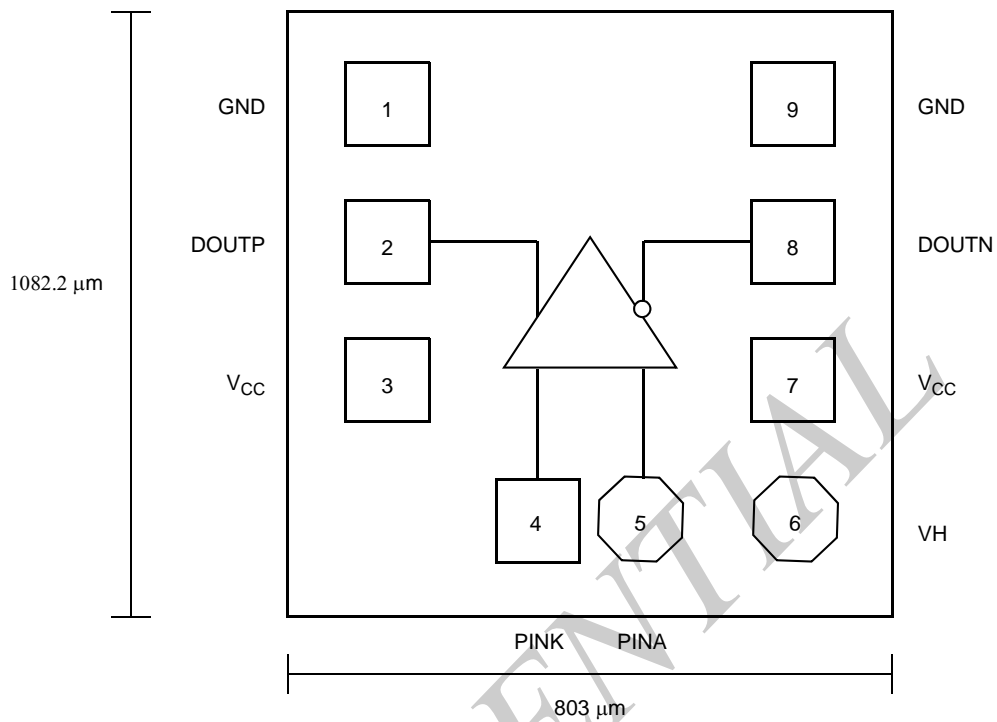


Figure-1

1	GND	X=0	Y=523.4
2	DOUTP	X=0	Y=373.4
3	V <sub>CC</sub>	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 <sub>CC</sub>	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 <sub>CC</sub>	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

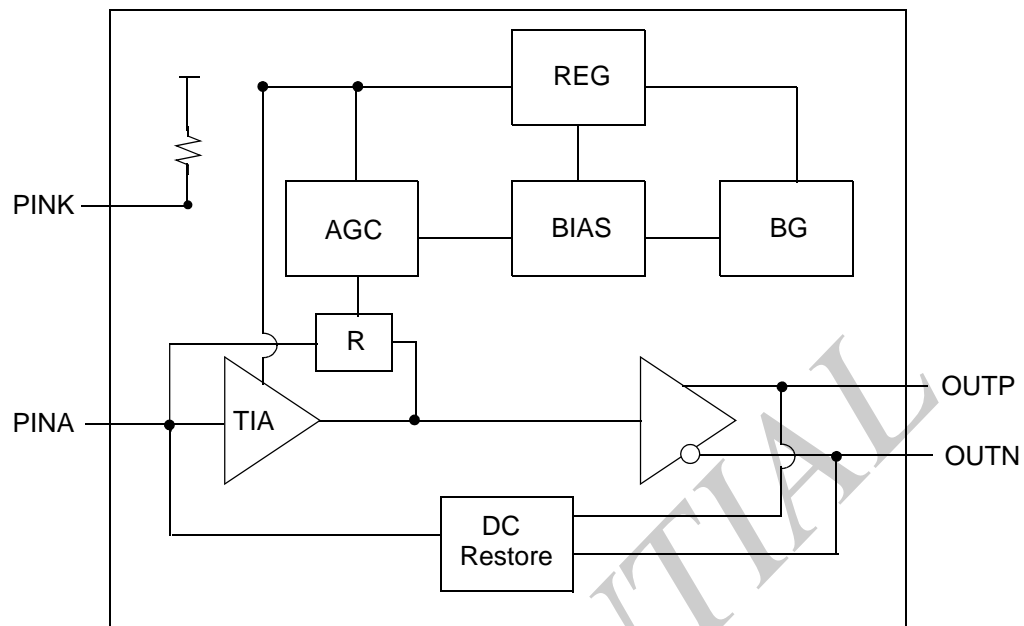
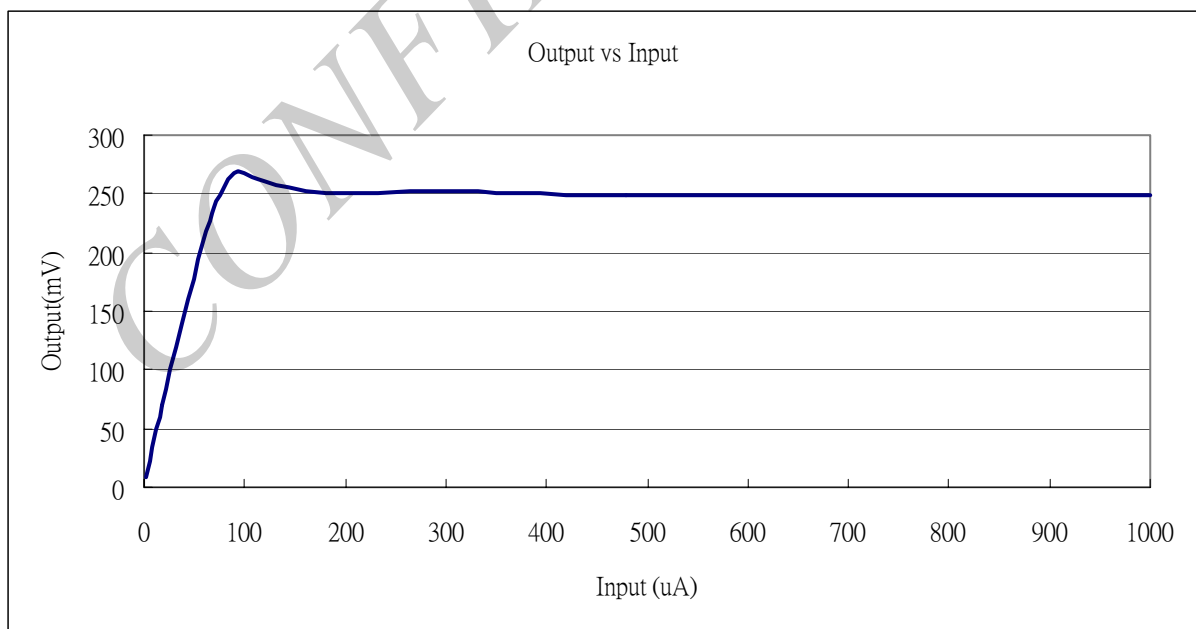


Figure-2

## TYPICAL OPERATING CURVE

( $T_A = 25^\circ\text{C}$ ,  $C_{IN} = 1\text{pF}$ , data is collected by differential output with  $50\Omega$  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	-	$\Omega$
G	Small signal transimpedance Input = 50 $\mu A_{P-P}$ (Note 1)	Differential, $R_L = 50\Omega$	2400	3300	3700	$\Omega$
$I_{AC,MAX}$	Maximum AC input current		1	-	-	$mA_{pp}$
$I_{DC,MAX}$	Maximum DC input current		0.65	-	-	mA
$V_{DF}$	Maximum differential output voltage	$I_{input} = 1mA_{P-P}$ , $R_L = 50\Omega$	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 rejection ratio	$F < 4MHz$ (Note 2)	35	-	-	dB

Note 1. Assuming photodiode responsivity of 0.9A/w, extinction ratio of 10 dB and BER of  $10^{-10}$ .

Note 2. The result is guaranteed by design simulation.