

DATA SHEET

SA5224 FDDI fiber optic postamplifier

Product specification

1998 Oct 07

Replaces datasheet NE/SA5224 of 1995 Apr 26

IC19 Data Handbook

FDDI fiber optic postamplifier**SA5224****DESCRIPTION**

The SA5224 is a high-gain limiting amplifier that is designed to process signals from fiber optic preamplifiers. Capable of operating at 125Mb/s, the chip is FDDI compatible and has input signal level-detection with a user-adjustable threshold. The DATA and LEVEL-DETECT outputs are differential for optimum noise margin and ease of use. Also available is the SA5225 which is an ECL 10K version of the SA5224.

FEATURES

- Wideband operation: 1.0kHz to 120MHz typical
- Applicable in 155Mb/s OC3/SONET receivers
- Operation with single +5V or -5.2V supply
- Differential 100k ECL outputs
- Programmable input signal level-detection
- Fully differential for excellent PSRR to 1GHz

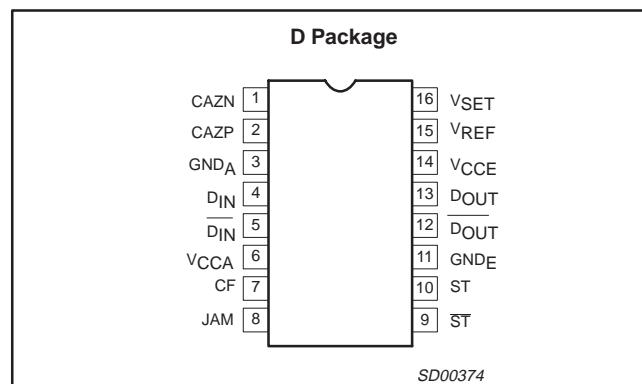
PIN DESCRIPTION

Figure 1. Pin Configuration

APPLICATIONS

- FDDI
- Data communication in noisy industrial environments
- LANs

ORDERING INFORMATION

DESCRIPTION	TEMPERATURE RANGE	ORDER CODE	DWG #
16-Pin Plastic Small Outline (SO) package	-40 to +85°C	SA5224D	SOT109-1

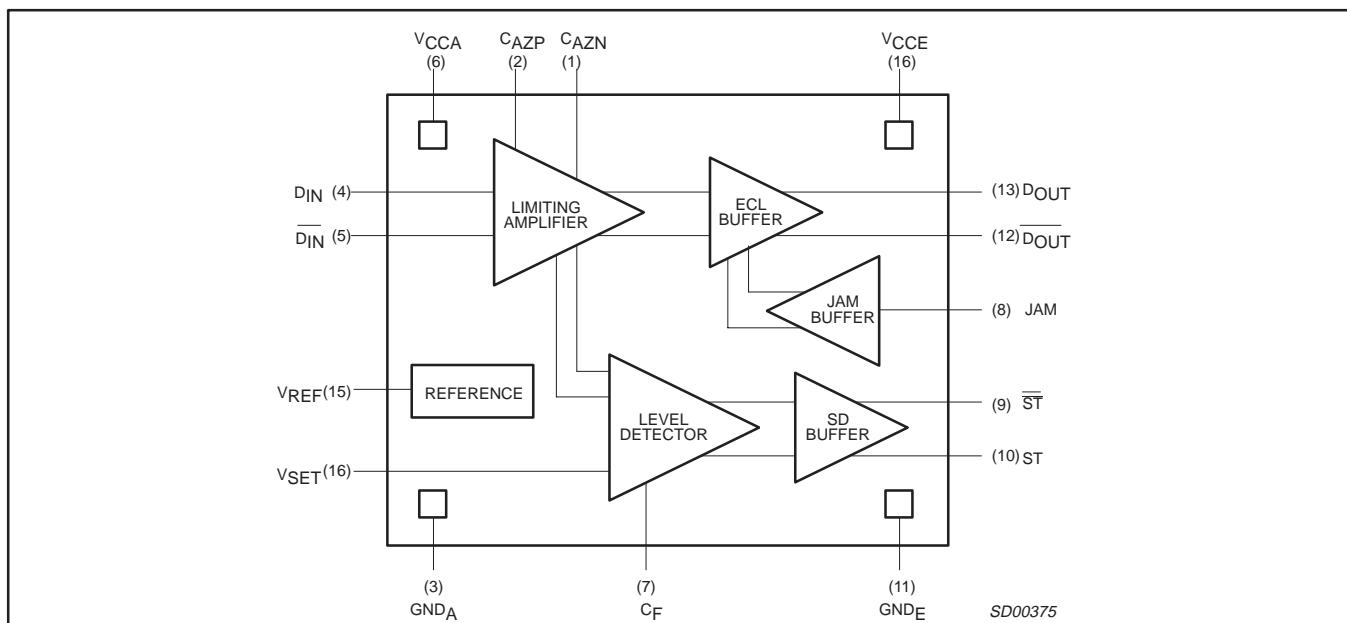
BLOCK DIAGRAM

Figure 2. Block Diagram

FDDI fiber optic postamplifier

SA5224

PIN DESCRIPTIONS

PIN NO.	NAME	FUNCTION
1	C_{AZN}	Auto-zero capacitor pin. Connecting a capacitor between this pin and C_{AZP} will cancel the offset voltage of the limiting amplifier.
2	C_{AZP}	Auto-zero capacitor pin. Connecting a capacitor between this pin and C_{AZN} will cancel the offset voltage of the limiting amplifier.
3	GND_A	Analog GND pin. Connect to ground for +5V upshifted ECL operation. Connect to -5.2V for standard ECL operation. Must be at same potential as GND_E (Pin 11).
4	D_{IN}	Differential input. DC bias level is set internally at approximately 2.9V. Complimentary to $\overline{D_{IN}}$ (Pin 5).
5	$\overline{D_{IN}}$	Differential input. DC bias level is set internally at approximately 2.9V. Complimentary to D_{IN} (Pin 4).
6	V_{CCA}	Analog power supply pin. Connect to a +5V supply for upshifted ECL operation. Connect to ground for standard ECL operation. Must be at same potential as V_{CCE} (Pin 14).
7	C_F	Filter capacitor for level detector. Capacitor should be connected between this pin and V_{CCA} .
8	JAM	This ECL-compatible input controls the output buffers $\overline{D_{OUT}}$ and D_{OUT} (Pins 12 and 13). When an ECL LOW signal is applied, the outputs will follow the input signal. When an ECL HIGH signal is applied, the $\overline{D_{OUT}}$ and D_{OUT} pins will latch into LOW and HIGH states, respectively. When left unconnected, this pin is actively pulled-low (JAM OFF).
9	\overline{ST}	Input signal level-detect \overline{STATUS} . This ECL output is high when the input signal is below the user programmable threshold level.
10	ST	ECL compliment of \overline{ST} (Pin 9).
11	GND_E	Digital GND pin. Connect to ground for +5V upshifted ECL operation. Connect to a negative supply for normal ECL operation. Must be at the same potential as GND_A (Pin 3).
12	$\overline{D_{OUT}}$	ECL-compatible output. Nominal level is $V_{CCE}-1.3V$. When JAM is HIGH, this pin will be forced into an ECL HIGH condition. Complimentary to D_{OUT} (Pin 13).
13	D_{OUT}	ECL-compatible output. Nominal level is $V_{CCE}-1.3V$. When JAM is HIGH, this pin will be forced into an ECL LOW condition. Complimentary to $\overline{D_{OUT}}$ (Pin 12).
14	V_{CCE}	Digital power supply pin. Connect to a +5V supply for upshifted ECL operation. Connect to ground during normal ECL operation. Must be at the same potential as V_{CCA} (Pin 6).
15	V_{REF}	Reference voltage for threshold level voltage divider. Nominal value is approximately 2.64V.
16	V_{SET}	Input threshold level setting circuit. This input can come from a voltage divider between V_{REF} and GND_A .

ABSOLUTE MAXIMUM RATINGS

SYMBOL	PARAMETER	RATING	UNITS
V_{CC}	Power supply (V_{CC} - GND)	6	V
T_A	Operating ambient	-45 to +85	°C
T_J	Operating junction	-55 to +150	°C
T_{STG}	Storage	-65 to +150	°C
P_D	Power dissipation, $T_A = 25^\circ\text{C}$ (still air) ¹ 16-pin Plastic SO	1100	mW

NOTE:

1. Maximum dissipation is determined by the ambient temperature and the thermal resistance, θ_{JA} : 16-pin SO: $\theta_{JA} = 110^\circ\text{C}/\text{W}$

RECOMMENDED OPERATING CONDITIONS

SYMBOL	PARAMETER	RATING	UNITS
V_{CC}	Supply voltage	4.5 to 5.5	V
T_A	Ambient temperature ranges	-40 to +85	°C
T_J	Junction temperature ranges	-40 to +110	°C

FDDI fiber optic postamplifier

SA5224

DC ELECTRICAL CHARACTERISTICS

Min and Max limits apply over operating temperature at $V_{CC} = 5V \pm 10\%$, unless otherwise specified. Typical data apply at $T_A = 25^\circ C$ and $V_{CC} = +5V$.

SYMBOL	PARAMETER	TEST CONDITIONS	SA5224			UNIT
			Min	Typ	Max	
V_{IN}	Input signal voltage single-ended differential		.002 .004		1.5 3.0	V_{P-P}
V_{OS}	Input offset voltage ²				50	μV
V_N	Input RMS noise ²				60	μV
V_{TH}	Input level-detect programmability single-ended	$V_{IN} = 200\text{kHz}$ square wave	2		12	mV_{P-P}
V_{HYS}	Level-detect hysteresis		4	5	6	dB
I_{CC}	$V_{CCA} + V_{CCE}$ supply current	No ECL loading		27	35	mA
I_{INL}	JAM input current	Pin 8 = 0V	-10		10	μA
V_{OHMAX}	Maximum logic high ¹				-0.880	V_{DC}
V_{OHMIN}	Minimum logic high ¹		-1.055			V_{DC}
V_{OLMAX}	Maximum logic low ¹				-1.620	V_{DC}
V_{OLMIN}	Minimum logic low ¹		-1.870			V_{DC}
V_{IH}	Minimum input for JAM = high ¹		-1.165			V_{DC}
V_{IL}	Maximum input for JAM = low ¹				-1.490	V_{DC}

NOTES:

1. These ECL specifications are referenced to the V_{CCE} rail and apply for $T_A = 0^\circ C$ to $85^\circ C$.
2. Guaranteed by design.

AC ELECTRICAL CHARACTERISTICS

Typical data apply at $T_A = 25^\circ C$ and $V_{CC} = +5V$. Min and Max limits apply for $4.5 \leq V_{CC} \leq 5.5V$.

SYMBOL	PARAMETER	TEST CONDITIONS	Min	Typ	Max	UNIT
BW_1	Lower -3dB bandwidth	$C_{AZ} = 0.1\mu F$	0.5	1.0	1.5	kHz
BW_2	Upper -3dB bandwidth		90	120	150	MHz
R_{IN}	Input resistance	Pin 4 or 5	2.9	4.5	7.6	$\text{k}\Omega$
C_{IN}	Input capacitance	Pin 4 or 5			2.5	pF
t_r, t_f	ECL output ³ risetime, falltime	$R_L = 50\Omega$ To $V_{CCE} - 2V$ 20-80%	1.2		2.2	ns
t_{PWD}	Pulsewidth distortion				0.3	ns_{P-P}
R_{AZ}	Auto zero output resistance	Pin 1 or 2	155	250	423	$\text{k}\Omega$
R_F	Level-detect filter resistance	Pin 7	14	24	41	$\text{k}\Omega$
t_{LD}	Level-detect time constant	$C_F = 0$	0.5	1.0	2.0	μs

NOTES:

1. Both outputs should be terminated identically to minimize differential feedback to the device inputs on a PC board or substrate.

FDDI fiber optic postamplifier

SA5224

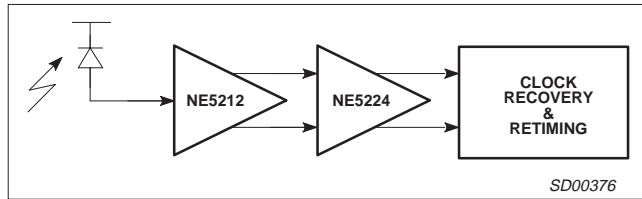


Figure 3. Typical Fiber Optic Receiving System

INPUT BIASING

The DATA INPUT pins (4 and 5) are DC biased at approximately 2.9V by an internal reference generator. The SA5224 can be DC coupled, but the driving source must operate within the allowable 1.4V to 4.4V input signal range (for $V_{CC} = 5V$). If AC coupling is used to remove any DC compatibility requirement, the coupling capacitors C1 and C2 must be large enough to pass the lowest input frequency of interest. For example, .001 μ F coupling capacitors react with the internal 4.5k input bias resistors to yield a lower -3dB frequency of 35kHz. This then sets a limit on the maximum number of consecutive "1"s or "0"s that can be sensed accurately at the system data rate. Capacitor tolerance and resistor variation (2.9k to 7.6k) must be included for an accurate calculation.

AUTO-ZERO CIRCUIT

Figure 5 also shows the essential details of the auto-zero circuit. A feedback amplifier (A4) is used to cancel the offset voltage of the forward signal path, so the input to the internal ECL comparator (A6) is at its toggle point in the absence of any input signal. The time constant of the cancelling circuitry is set by an external capacitor (C_{AZ}) connected between Pins 1 and 2. The formula for the lower -3dB frequency is:

$$f_{-3dB} = \frac{150}{2\pi \cdot R_{AZ} \cdot C_{AZ}}$$

where R_{AZ} is the internal driving impedance which can vary from 155k to 423k over temperature and device fabrication limits. The input coupling time constant must also be considered in determining the lower frequency response of the SA5224.

INPUT SIGNAL LEVEL-DETECTION

The SA5224 allows for user programmable input signal level-detection and can automatically disable the switching of its

ECL data outputs if the input is below a set threshold. This prevents the outputs from reacting to noise in the absence of a valid input signal, and insures that data will only be transmitted when the input signal-to-noise ratio is sufficient for low bit-error-rate system operation. Complimentary ECL flags (ST and STB) indicate whether the input signal is above or below the desired threshold level.

Figure 6 shows a simplified block diagram of the SA5224 level-detect system. The input signal is amplified and rectified before being compared to a programmable reference. A filter is included to prevent noise spikes from triggering the level-detector. This filter has a nominal 1 μ s time constant, and additional filtering can be achieved by using an external capacitor (CF) from Pin 7 to V_{CCA} (the internal driving impedance is nominally 24k). The resultant signal is then compared to a programmable level, V_{SET} , which is set by an internal voltage reference (2.64V) and an external resistor divider (R1 and R2). The value of $R1 + R2$ should be maintained at approximately 5k.

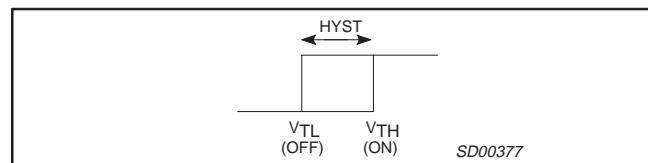


Figure 4.

The circuit is designed to operate accurately over a differential 2-12mV_{P-P} square-wave input level detect range. This level, $V_{SET}/100$, is the average of V_{TH} and V_{TL} .

Nominal hysteresis of 5dB is provided by the complimentary ECL output comparator yielding $V_{TL} = \frac{V_{SET}}{139}$ and $V_{TH} = \frac{V_{SET}}{78}$. For example, with $V_{SET} = 1.2V$, a 15.4mV_{P-P} square-wave differential input will drive the ST pin high, and an input level below 8.6mV_{P-P} will drive the ST pin low.

Since a "JAM" function is provided (Pin 8) and can force the data outputs to a predetermined state ($D_{OUT} = \text{LOW}$, $\overline{D}_{OUT} = \text{HIGH}$), the ST and JAM pins can be connected together to automatically disable signal transmission when the chip senses that the input signal is below the desired threshold. JAM (Pin 8) low enables the Data Outputs. ST will be in a high ECL state for input signals below threshold.

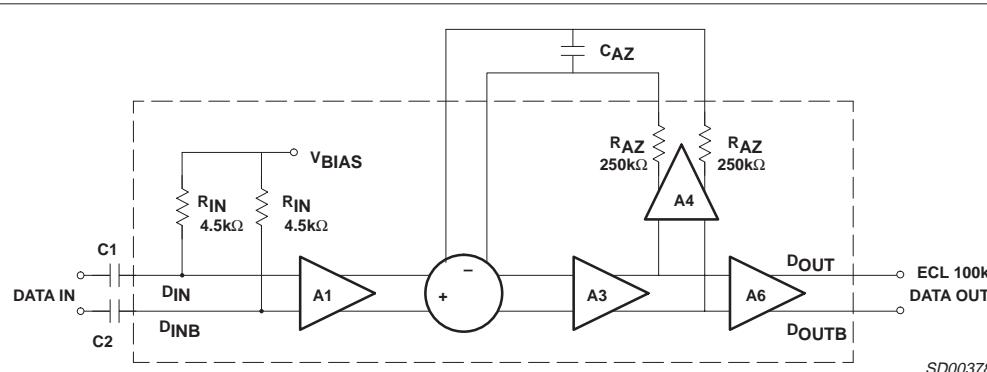


Figure 5. SA5224 Forward Gain Path Including Auto-Zero

FDDI fiber optic postamplifier

SA5224

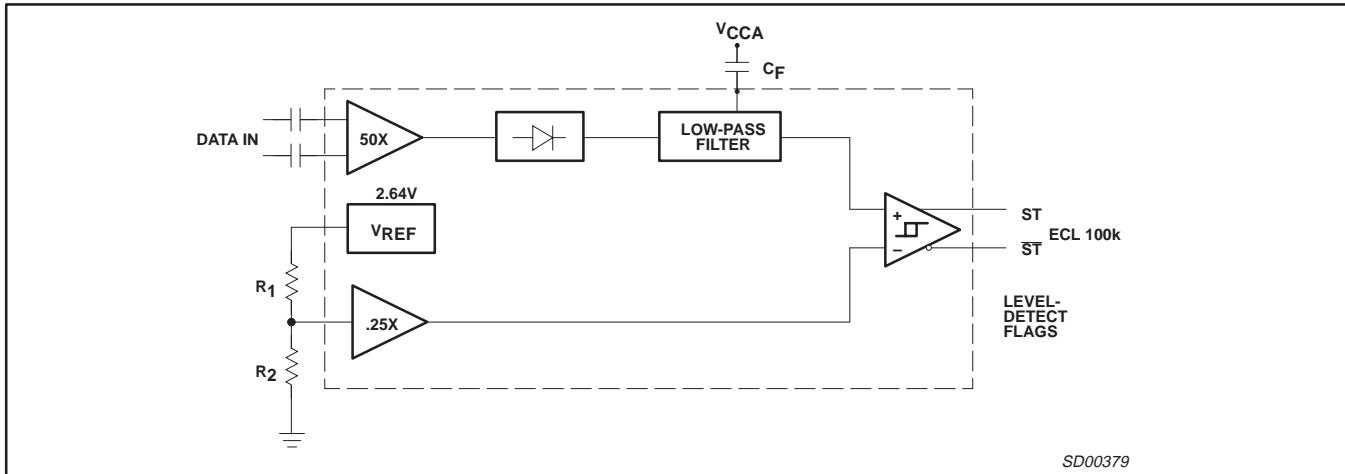


Figure 6. SA5224 Input Signal Level-Detect System

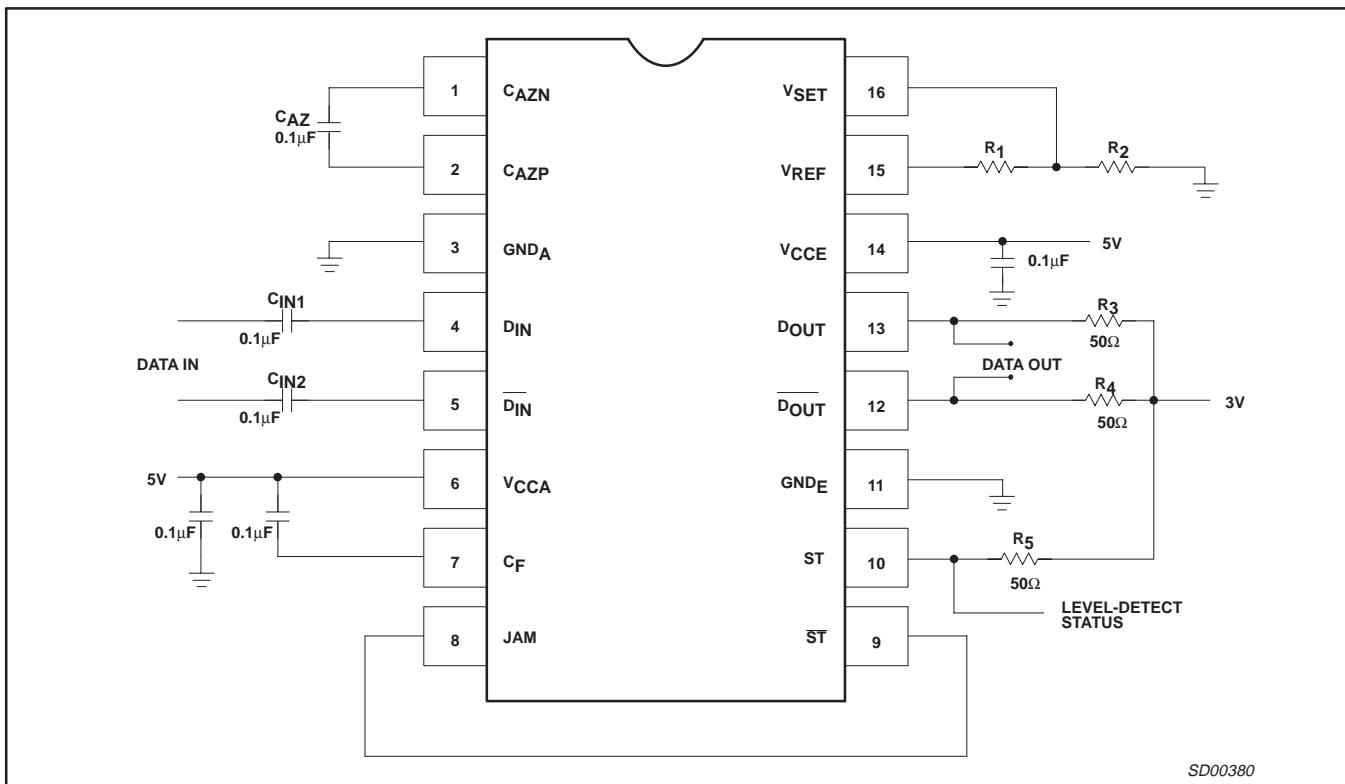


Figure 7. Application with $V_{CC} = 5.0V$

NOTE: A 50Ω resistor is required from Pin 9 to 3V only if the ST pin is required to meet 100k ECL specifications.

Die Sales Disclaimer

Due to the limitations in testing high frequency and other parameters at the die level, and the fact that die electrical characteristics may shift after packaging, die electrical parameters are not specified and die are not guaranteed to meet electrical characteristics (including temperature range) as noted in this data sheet which is intended only to specify electrical characteristics for a packaged device.

All die are 100% functional with various parametrics tested at the wafer level, at room temperature only (25°C), and are guaranteed to be 100% functional as a result of electrical testing to the point of wafer sawing only. Although the most modern processes are utilized for wafer sawing and die pick and place into waffle pack carriers, it is impossible to guarantee 100% functionality through this process. There is no post waffle pack testing performed on individual die.

FDDI fiber optic postamplifier

SA5224

Since Philips Semiconductors has no control of third party procedures in the handling or packaging of die, Philips Semiconductors assumes no liability for device functionality or performance of the die or systems on any die sales.

Although Philips Semiconductors typically realizes a yield of 85% after assembling die into their respective packages, with care customers should achieve a similar yield. However, for the reasons stated above, Philips Semiconductors cannot guarantee this or any other yield on any die sales.

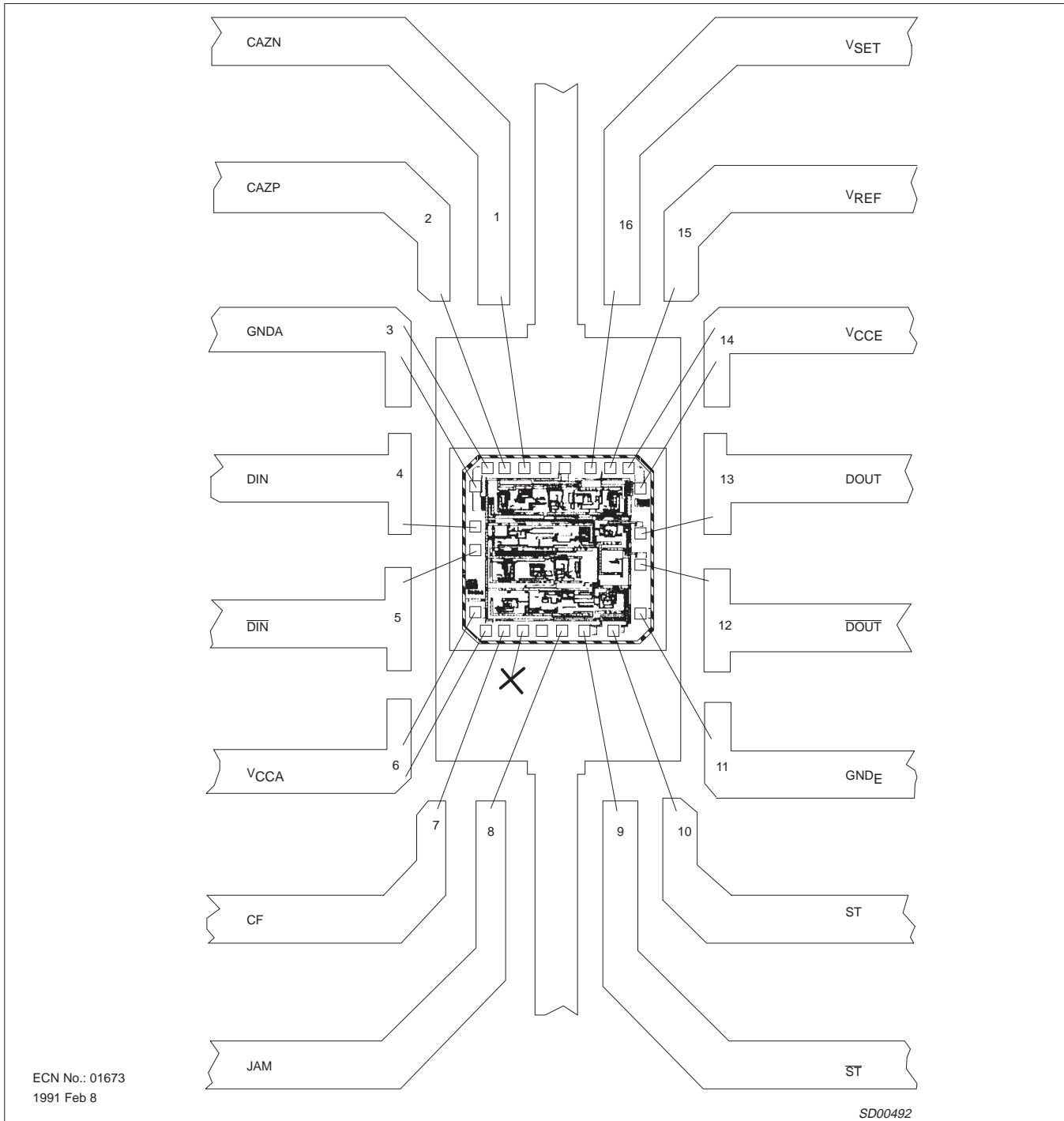


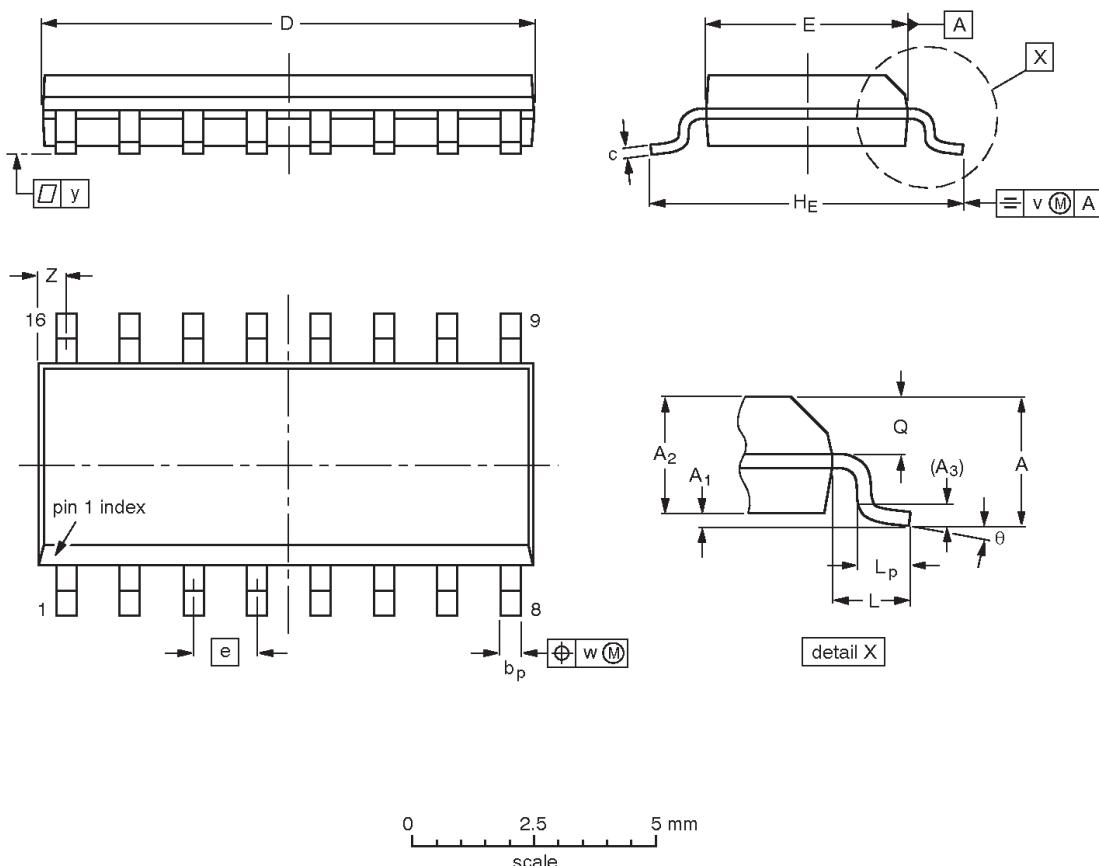
Figure 8. SA5224 Bonding Diagram

FDDI fiber optic postamplifier

SA5224

SO16: plastic small outline package; 16 leads; body width 3.9 mm

SOT109-1



DIMENSIONS (inch dimensions are derived from the original mm dimensions)

UNIT	A max.	A ₁	A ₂	A ₃	b _p	c	D ⁽¹⁾	E ⁽¹⁾	e	H _E	L	L _p	Q	v	w	y	Z ⁽¹⁾	θ
mm	1.75	0.25 0.10	1.45 1.25	0.25	0.49 0.36	0.25 0.19	10.0 9.8	4.0 3.8	1.27	6.2 5.8	1.05	1.0 0.4	0.7 0.6	0.25	0.25	0.1	0.7 0.3	8° 0°
inches	0.069	0.010 0.004	0.057 0.049	0.01	0.019 0.014	0.0100 0.0075	0.39 0.38	0.16 0.15	0.050	0.244 0.228	0.041	0.039 0.016	0.028 0.020	0.01	0.01	0.004	0.028 0.012	

Note

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT109-1	076E07S	MS-012AC				95-01-23 97-05-22

FDDI fiber optic postamplifier

SA5224

NOTES

FDDI fiber optic postamplifier

SA5224

Data sheet status

Data sheet status	Product status	Definition [1]
Objective specification	Development	This data sheet contains the design target or goal specifications for product development. Specification may change in any manner without notice.
Preliminary specification	Qualification	This data sheet contains preliminary data, and supplementary data will be published at a later date. Philips Semiconductors reserves the right to make changes at any time without notice in order to improve design and supply the best possible product.
Product specification	Production	This data sheet contains final specifications. Philips Semiconductors reserves the right to make changes at any time without notice in order to improve design and supply the best possible product.

[1] Please consult the most recently issued datasheet before initiating or completing a design.

Definitions

Short-form specification — The data in a short-form specification is extracted from a full data sheet with the same type number and title. For detailed information see the relevant data sheet or data handbook.

Limiting values definition — Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of the specification is not implied. Exposure to limiting values for extended periods may affect device reliability.

Application information — Applications that are described herein for any of these products are for illustrative purposes only. Philips Semiconductors make no representation or warranty that such applications will be suitable for the specified use without further testing or modification.

Disclaimers

Life support — These products are not designed for use in life support appliances, devices or systems where malfunction of these products can reasonably be expected to result in personal injury. Philips Semiconductors customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify Philips Semiconductors for any damages resulting from such application.

Right to make changes — Philips Semiconductors reserves the right to make changes, without notice, in the products, including circuits, standard cells, and/or software, described or contained herein in order to improve design and/or performance. Philips Semiconductors assumes no responsibility or liability for the use of any of these products, conveys no license or title under any patent, copyright, or mask work right to these products, and makes no representations or warranties that these products are free from patent, copyright, or mask work right infringement, unless otherwise specified.

Philips Semiconductors
811 East Arques Avenue
P.O. Box 3409
Sunnyvale, California 94088-3409
Telephone 800-234-7381

© Copyright Philips Electronics North America Corporation 1998
All rights reserved. Printed in U.S.A.

Date of release: 10-98
Document order number: 9397 750 04628

Let's make things better.