DATA SHEET

SA5222
Low-power FDDI transimpedance amp

Product specification

1995 Apr 26

IC19 Data Handbook

Philips
Semiconductors

PHILIPS

Low-power FDDI transimpedance amplifier SA5222

DESCRIPTION

The SA5222 is a low-power, wide-band, low noise transimpedance amplifier with differential outputs, optimized for signal recovery in FDDI fiber optic receivers. The part is also suited for many other RF and fiber optic applications as a general purpose gain block.

FEATURES

- Extremely low noise: $2.0pA/\sqrt{Hz}$
- Single 5V supply
- Low supply current: 9mA
- Large bandwidth: 165MHz
- Differential outputs
- Low output offset
- Low input/output impedances
- High power-supply-rejection ratio: 55dB
- Tight transresistance control
- High input overload: 115µA
- ESD protected

PIN DESCRIPTION

D Package

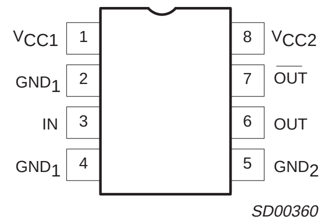


Figure 1. Pin Configuration

APPLICATIONS

- FDDI preamp
- Current-to-voltage converters
- Wide-band gain block
- Medical and scientific instrumentation
- Sensor preamplifiers
- Single-ended to differential conversion
- Low noise RF amplifiers
- RF signal processing

ORDERING INFORMATION

DESCRIPTION	TEMPERATURE RANGE	ORDER CODE	DWG #
8-Pin Plastic Small Outline (SO) package	-40 to +85°C	SA5222D	SOT96-1

ABSOLUTE MAXIMUM RATINGS

SYMBOL	PARAMETER	RATING	UNITS
$V_{CC1,2}$	Power supply voltage	6	V
T_A	Ambient temperature range	-40 to +85	°C
T_J	Junction temperature range	-55 to +150	°C
T_{STG}	Storage temperature range	-65 to +150	°C
P_D	Power dissipation T_A = 25°C (still air)[1]	0.78	W
I_{INMAX}	Maximum input current	5	mA

NOTE:
1. Maximum power dissipation is determined by the operating ambient temperature and the thermal resistance θ_{JA} = 158°C/W. Derate 6.2mW/°C above 25°C.

RECOMMENDED OPERATING CONDITIONS

SYMBOL	PARAMETER	RATING	UNITS
$V_{CC1,2}$	Power supply voltage	4.5 to 5.5	V
T_A	Ambient temperature range: SA grade	-40 to +85	°C
T_J	Junction temperature range: SA grade	-40 to +105	°C

DC ELECTRICAL CHARACTERISTICS

Typical data and Min and Max limits apply at T_A = 25°C, and V_{CC1} = V_{CC2} = +5V, unless otherwise specified.

SYMBOL	PARAMETER	TEST CONDITIONS	SA5222			UNIT
			Min	Typ	Max	
V_{IN}	Input bias voltage		1.3	1.55	1.8	V
$V_{O\pm}$	Output bias voltage		2.9	3.2	3.5	V
V_{OS}	Output offset voltage			0	±100	mV
I_{CC}	Supply current		6	9	12	mA
I_{OMAX}	Output sink/source current		1.5	2		mA
I_{IN}	Input current (2% linearity)	Test circuit 5, Procedure 2	±60	±90		µA
I_{INMAX}	Maximum input current overload threshold	Test circuit 5, Procedure 4	±80	±115		µA
V_{OMAX}	Maximum differential output voltage swing	$R_L = \infty$, Test Circuit 5, Procedure 3		3.6		V_{P-P}

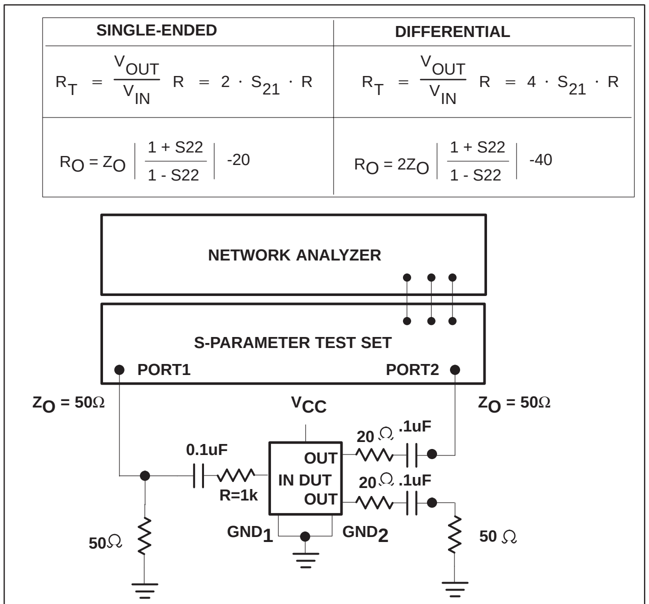
AC ELECTRICAL CHARACTERISTICS

Typical data and Min and Max limits apply at T_A = 25°C and V_{CC1} = V_{CC2} =+5V, unless otherwise specified.

SYMBOL	PARAMETER	TEST CONDITIONS	SA5222			UNIT
			Min	Typ	Max	
R_T	Transresistance (differential output)	DC tested, $R_L = \infty$, Test Circuit 5, Procedure 1	13.3	16.6	19.9	kΩ
R_O	Output resistance (differential output)	DC tested	30	60	90	Ω
R_T	Transresistance (single-ended output)	DC tested, $R_L = \infty$	6.65	8.3	9.95	kΩ
R_O	Output resistance (single-ended output)	DC tested	15	30	45	Ω
f_{3dB}	Bandwidth (-3dB)[1]	Test Circuit 1	110	140		MHz
R_{IN}	Input resistance			150		Ω
C_{IN}	Input capacitance[2]			1		pF
$\Delta R/\Delta V$	Transresistance power supply sensitivity	$V_{CC1} = V_{CC2} = 5 \pm 0.5V$		1.0		%/V
$\Delta R/\Delta T$	Transresistance ambient temperature sensitivity	$\Delta T_A = T_{A\,MAX} - T_{A\,MIN}$		0.07		%/°C
I_{IN}	RMS noise current spectral density (referred to input)	Test Circuit 2, f = 10MHz		2.0		$pA/\sqrt{Hz}$
I_T	Integrated RMS noise current over the bandwidth (referred to input) C_S = 0pF	Test circuit 2, Δf = 50MHz		15		nA
		Δf = 100MHz		25		
		Δf = 150MHz		36		
	C_S = 1pF	Δf = 50MHz		17		
		Δf = 100MHz		35		
		Δf = 150MHz		55		
PSRR	Power supply rejection ratio	DC Tested, $\Delta V_{CC} = \pm 0.5V$		–55		dB
PSRR	Power supply rejection ratio[3]	f = 1.0MHz, Test Circuit 3		–34		dB
I_{INMAX}	Maximum input amplitude for output duty cycle of 50 ±5%[4]	Test circuit 4		±120		µA
t_r, t_f	Rise and fall times	10 – 90%		2.2		ns
t_D	Group delay	f = 10MHz		2.2		ns

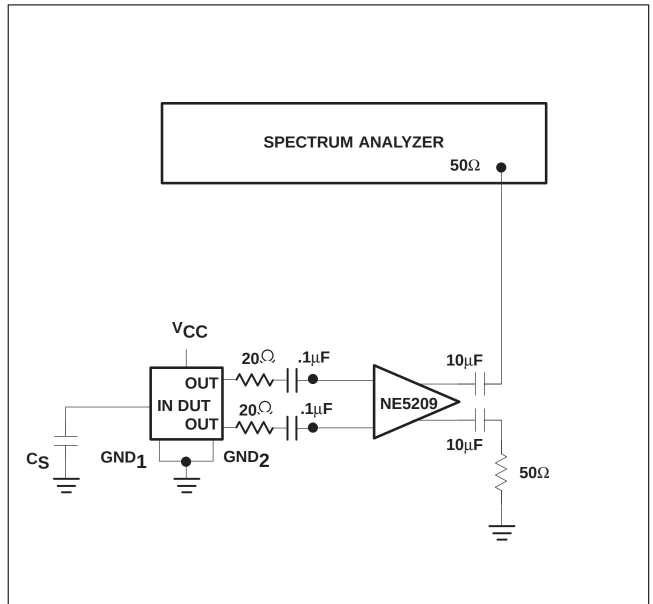
NOTES:
1. Bandwidth is tested into 50Ω load. Bandwidth into 1kΩ load is approximately 165MHz.
2. Does not include Miller-multiplied capacitance of input device.
3. PSRR is output referenced and is circuit board layout dependent at higher frequencies. For best performance use a RF filter in V_{CC} line.
4. Monitored in production via linearity and over load tests.

TEST CIRCUITS



Test Circuit 1: Bandwidth

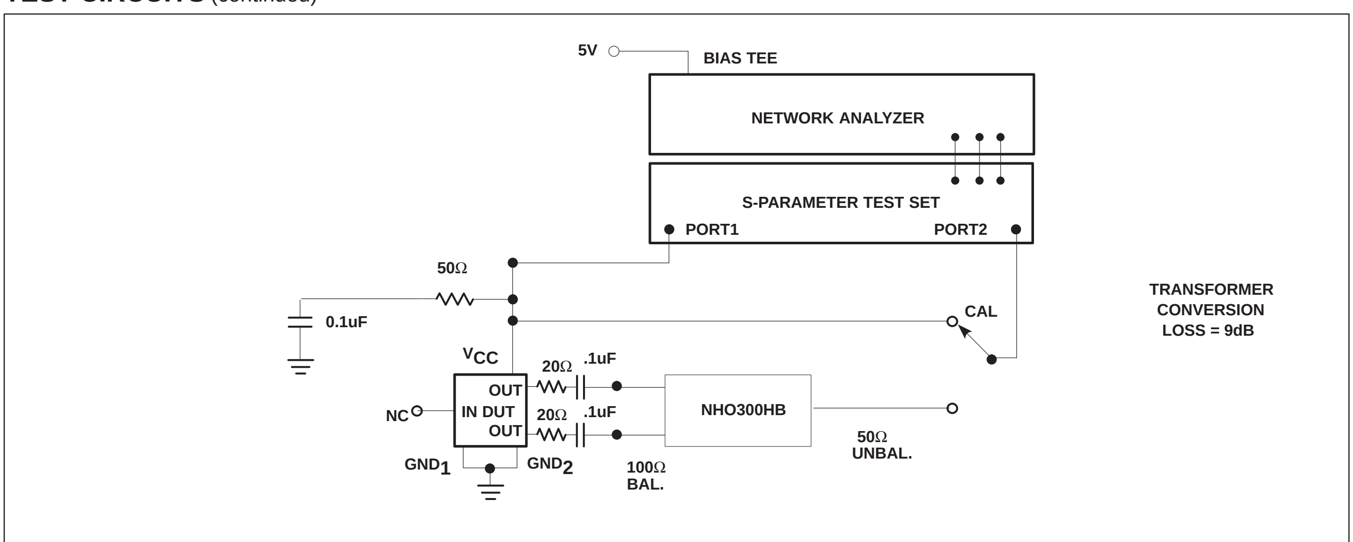
Figure 2. Test Circuit1



Test Circuit 2: Noise

Figure 3. Test Circuit2

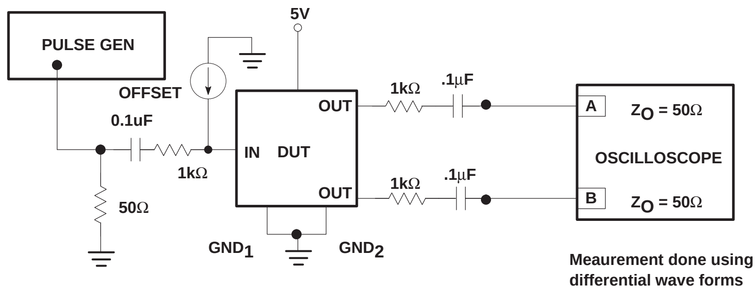
TEST CIRCUITS (continued)



Test Circuit 3: PSRR

Figure 4. Test Circuit4

TEST CIRCUITS (continued)

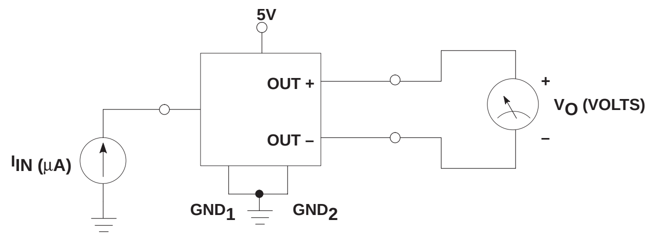


Test Circuit 4: Duty Cycle Distortion

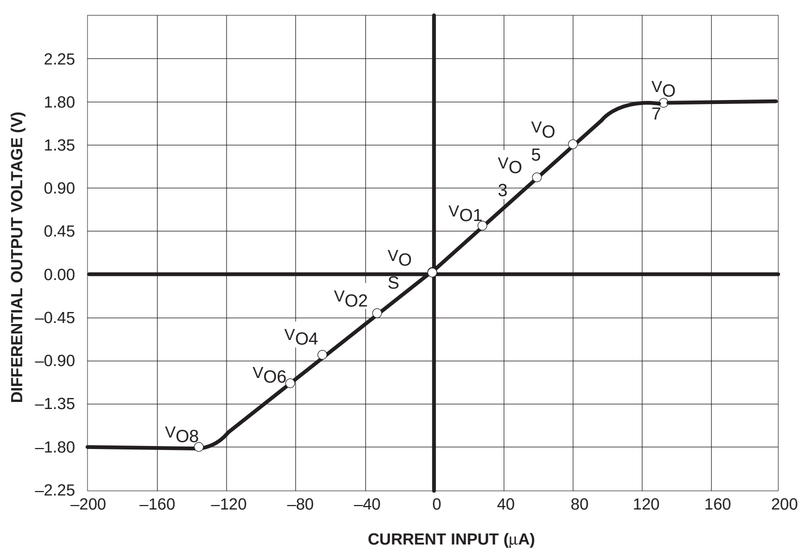
SD00364

Figure 5. Test Circuit4

TEST CIRCUITS (continued)



Typical V_O (Differential) vs I_{IN}



SA5222 TEST CONDITIONS

Procedure 1 R_T measured at 30µA
$R_T = (V_{O1} - V_{O2}) / (+30\mu A - (-30\mu A))$
Where: V_{O1} Measure at I_{IN} = +30µA
V_{O2} Measured at I_{IN} = -30µA

Procedure 2 Linearity = 1 - ABS(($V_{OA} - V_{OB}$ / ($V_{O3} - V_{O4}$))
Where: V_{O3} Measured at I_{IN} = +60µA
V_{O4} Measured at I_{IN} = -60µA
$V_{OA} = R_T \times (+60\mu A) + V_{OS}$
$V_{OB} = R_T \times (-60\mu A) + V_{OS}$

Procedure 3 $V_{OMAX} = V_{O7} - V_{O8}$
Where: V_{O7} Measured at I_{IN} = +130µA
V_{O8} Measured at I_{IN} = -130µA

Procedure 4 I_{INMAX} Test Pass Conditions:
$V_{O7} - V_{O5} > 50mV$ and $V_{O6} - V_{O8} < 50mV$
Where: V_{O5} Measured at I_{IN} = +80µA
V_{O6} Measured at I_{IN} = -80µA
V_{O7} Measured at I_{IN} = +130µA
V_{OB} Measured at I_{IN} = -130µA

Test Circuit 5: DC Tests

SD00365

Figure 6. Test Circuit5

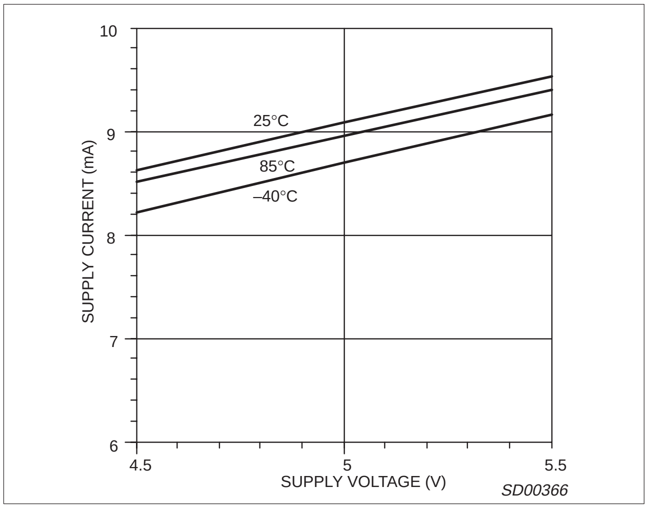


Figure 7. I_{CC} vs. V_{CC} and Temperature

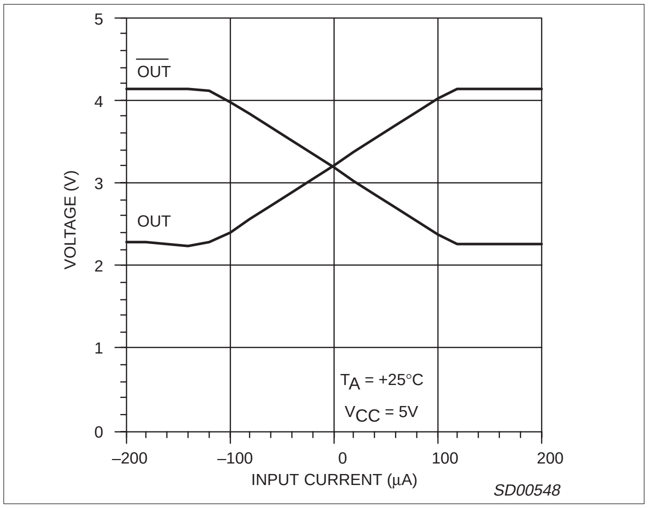


Figure 10. Differential Output Voltages vs. Input Current

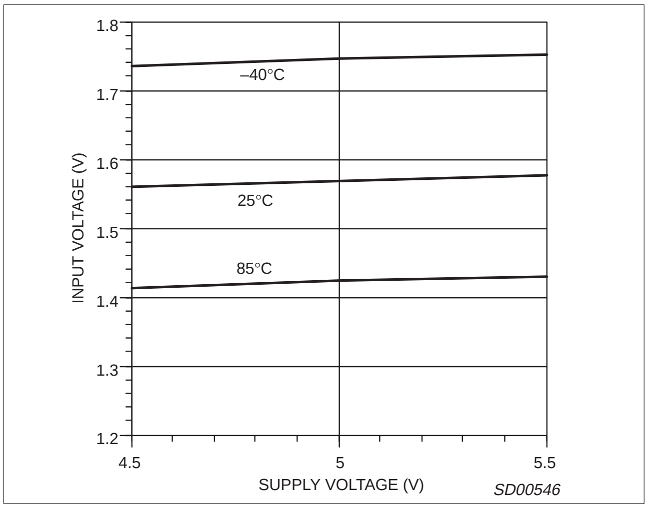


Figure 8. Input Voltage vs. V_{CC} and Temperature

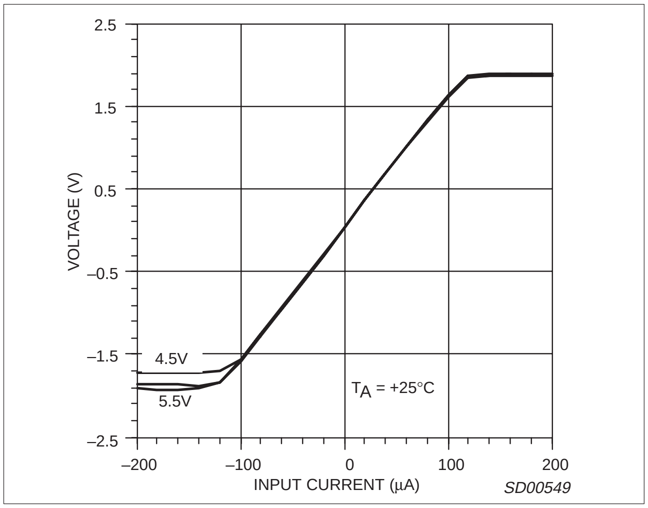


Figure 11. Differential Output Voltage vs Input Current and V_{CC}

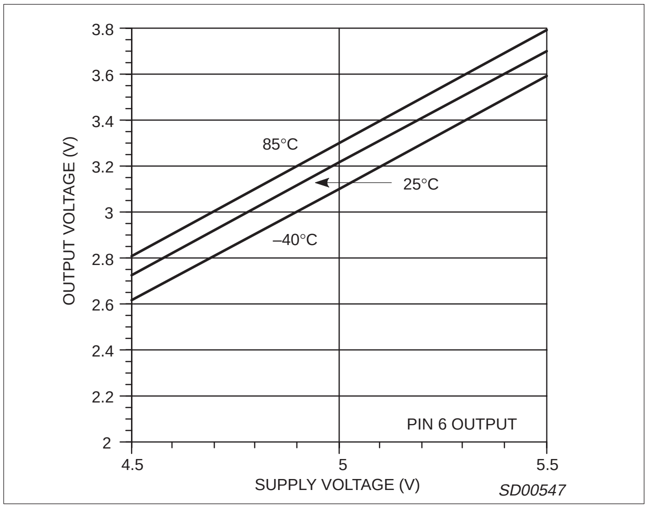


Figure 9. Output Voltage vs. V_{CC} and Temperature

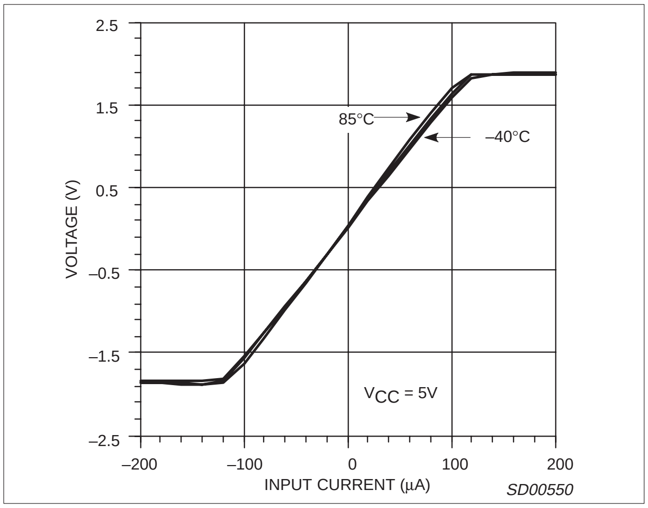


Figure 12. Diff. Output Voltage vs. Input Current and Temp.

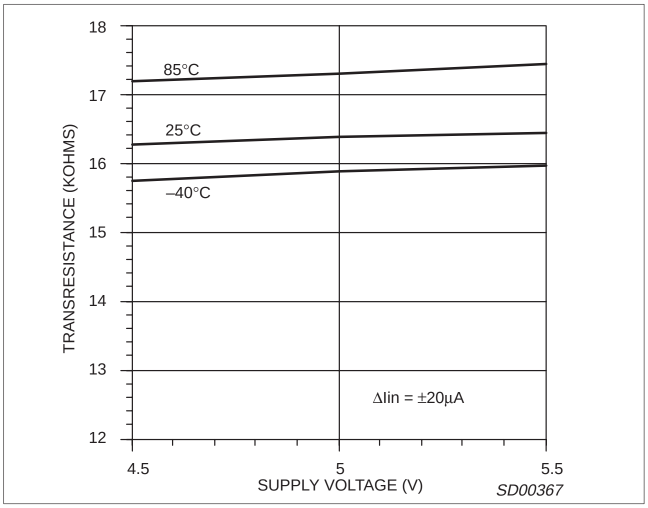


Figure 13. Differential Transresistance vs. V_{CC} and Temperature

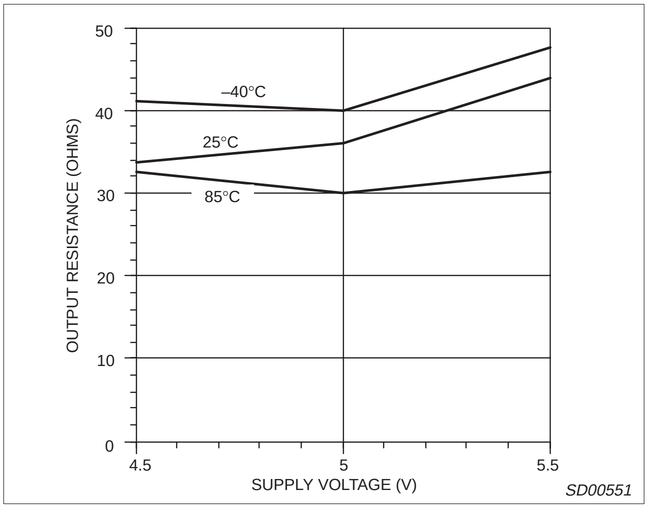


Figure 14. Output Resistance vs. V_{CC} and Temperature

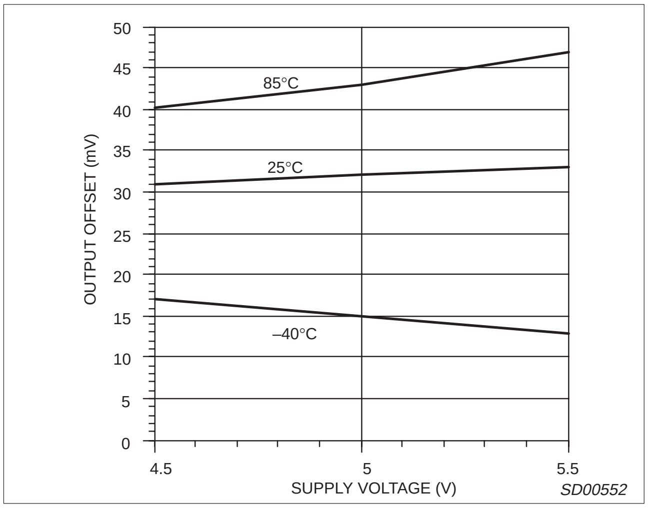


Figure 15. Output Offset Voltage vs. V_{CC} and Temperature

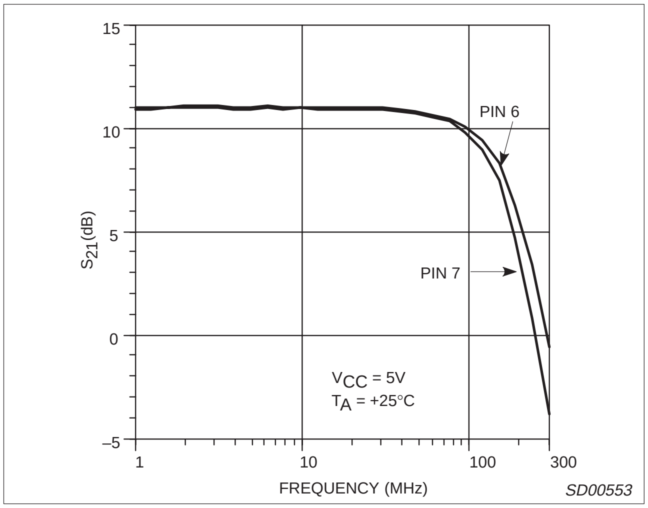


Figure 16. Insertion Gain vs. Frequency

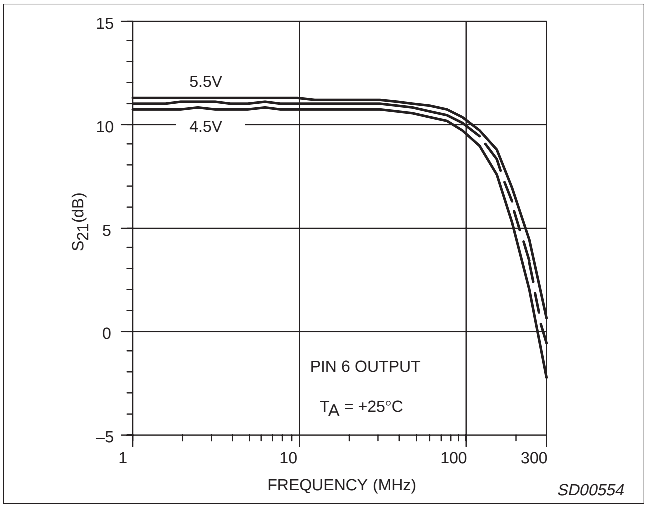


Figure 17. Insertion Gain vs. Frequency and V_{CC}

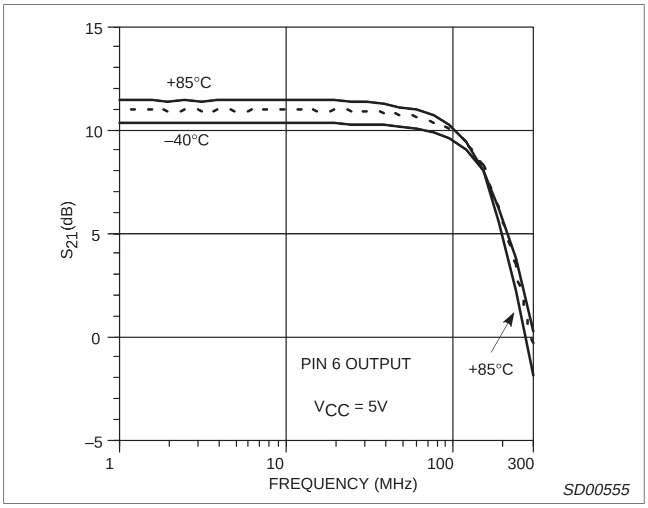


Figure 18. Insertion Gain vs. Frequency and Temperature

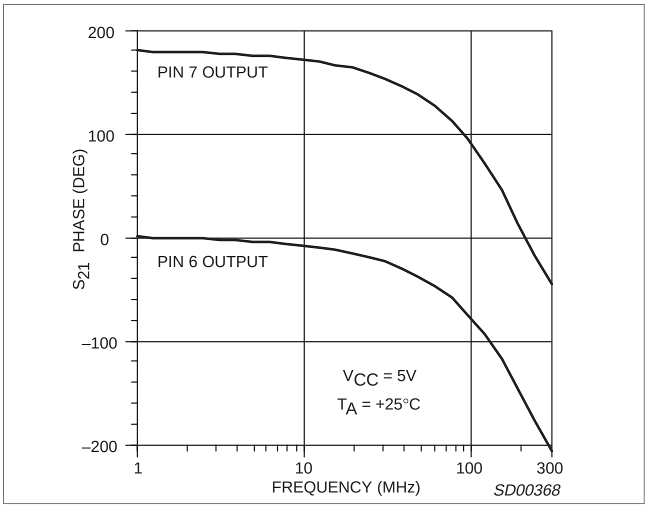


Figure 19. Phase vs. Frequency

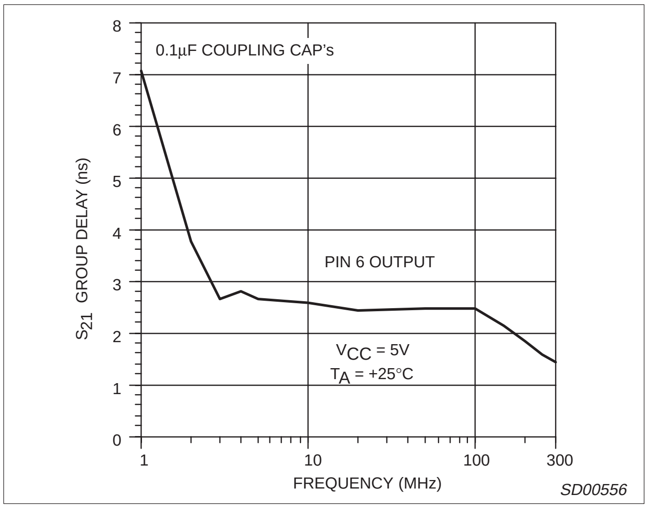


Figure 20. Group Delay vs. Frequency

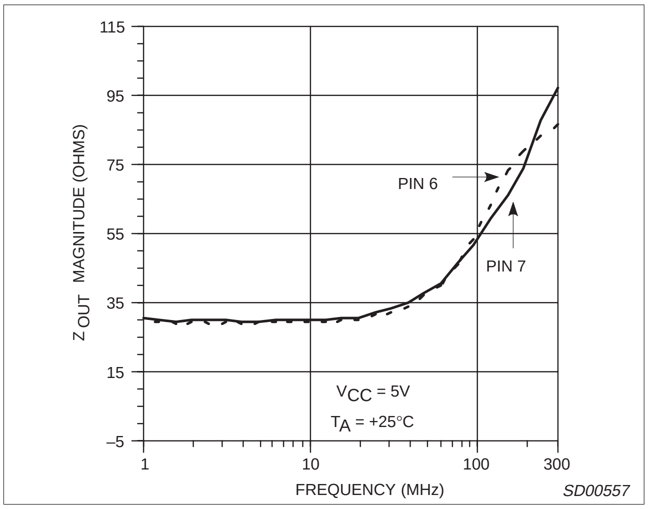


Figure 21. Output Impedance vs. Frequency

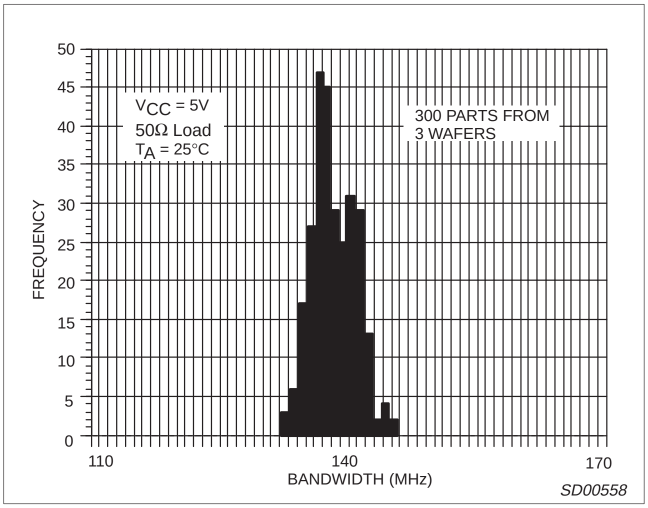


Figure 22. –3dB Bandwidth Distribution

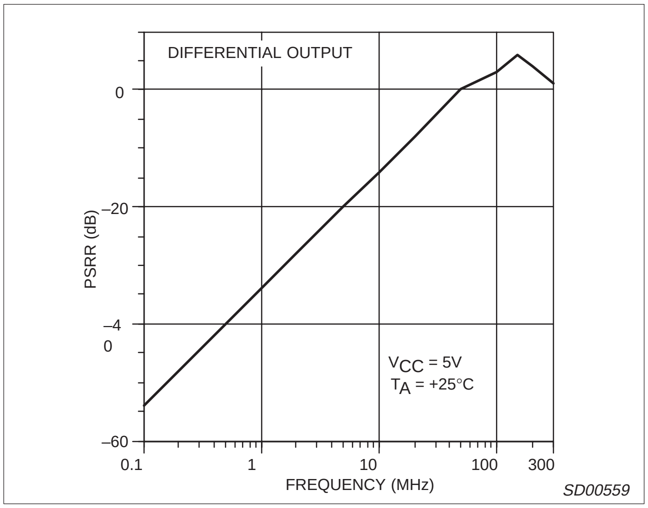


Figure 23. Power–Supply Rejection Ratio vs. Frequency

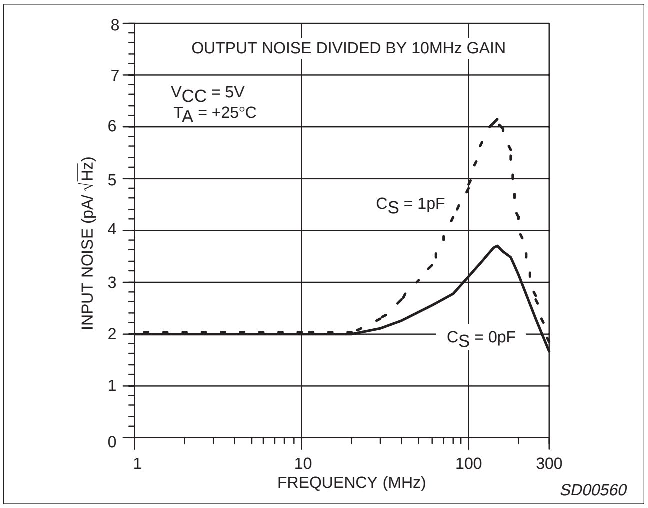


Figure 24. Input Noise Spectral Density vs. Frequency

Low-power FDDI transimpedance amplifier SA5222

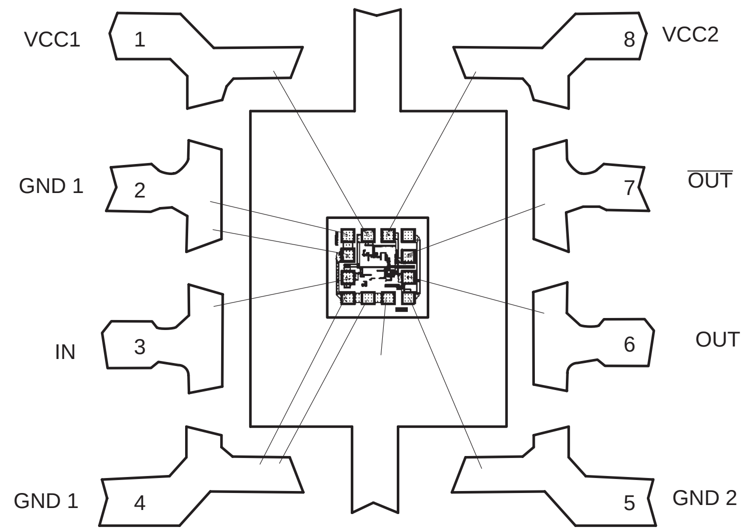


Figure 25. SA5222 Bonding Diagram

Die Sales Disclaimer

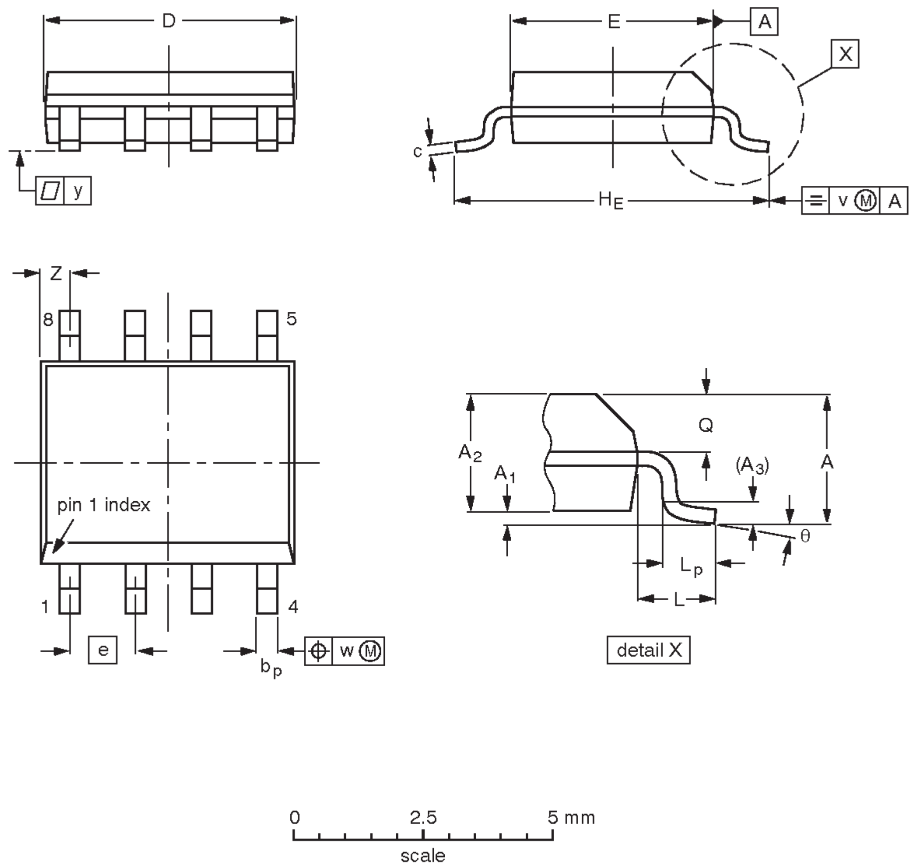
Due to the limitations in testing high frequency and other parameters at the die level, and the fact that die electrical characteristics may shift after packaging, die electrical parameters are not specified and die are not guaranteed to meet electrical characteristics (including temperature range) as 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.

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.

SO8: plastic small outline package; 8 leads; body width 3.9mm SOT96-1



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(2)	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	5.0 4.8	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	0.20 0.19	0.16 0.15	0.050	0.244 0.228	0.041	0.039 0.016	0.028 0.024	0.01	0.01	0.004	0.028 0.012	

Notes

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.
2. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT96-1	076E03S	MS-012AA				~~95-02-04~~ 97-05-22

NOTES

Low-power FDDI transimpedance amplifier SA5222

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 chages 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.

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