

DATA SHEET

CGY2105ATS

High dynamic range dual LNA
MMIC

Product specification
Supersedes data of 1999 December 23
File under Integrated Circuits, IC17

2000 Nov 22

High dynamic range dual LNA MMIC

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FEATURES

- Dual Low Noise Amplifier (LNA) Monolithic Microwave Integrated Circuit (MMIC)
- Typical noise figure of 0.57 dB
- Typical gain of 16.3 dB at 1810 MHz
- Input IP3 of 13.5 dBm at 1810 MHz
- Low current of 58 mA at 2.5 V for each channel
- Low cost SSOP16 plastic package.

APPLICATIONS

- DCS1800
- PCS1900.

GENERAL DESCRIPTION

The CGY2105 is a dual Gallium Arsenide (GaAs) MMIC amplifier designed for use in very low noise figure applications, where high linearity is also required.

Excellent tracking between the two amplifiers is obtained. Gain and noise figure variations with temperature are very small.

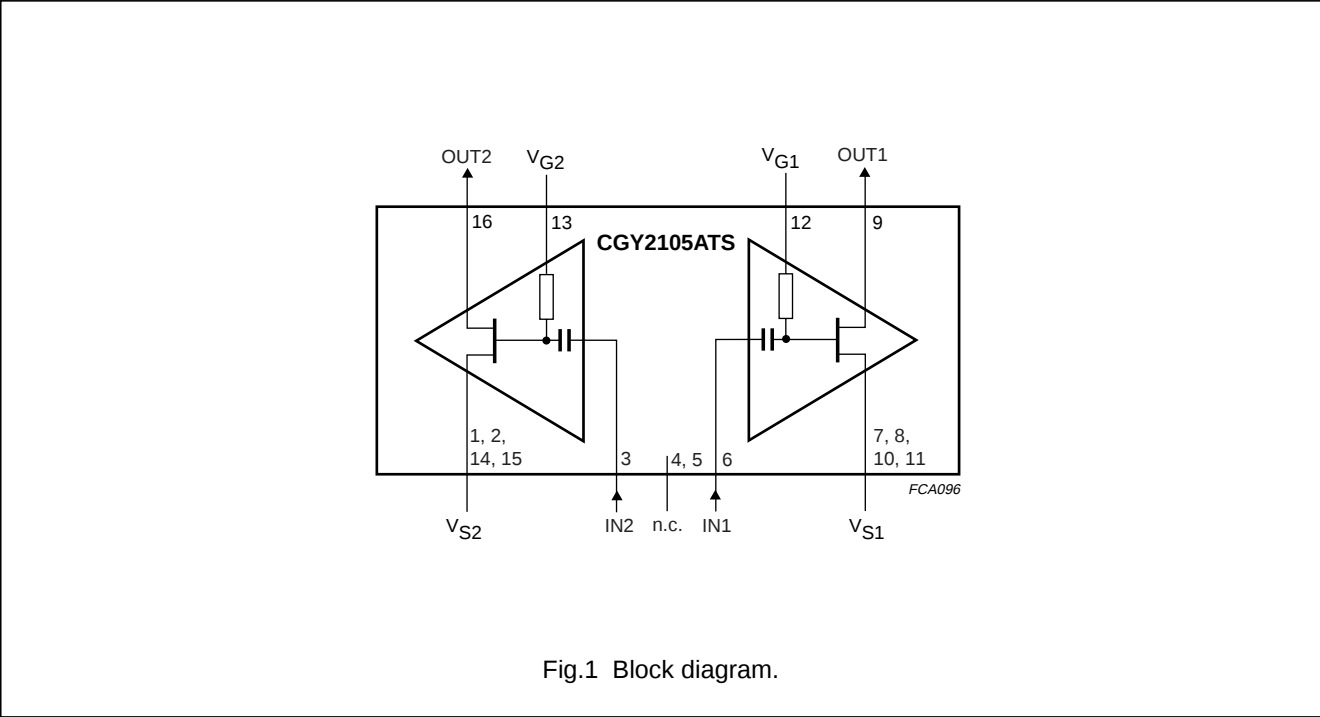
The device is suitable for use in DCS1800 and PCS1900 base station applications. It also provides high gain and very low noise performance at frequencies between 1.0 and 2.5 GHz, as used in Wireless Local Area Network (WLAN) applications.

A redesign of the application board might be necessary for optimum performance.

ORDERING INFORMATION

TYPE NUMBER	PACKAGE		
	NAME	DESCRIPTION	VERSION
CGY2105ATS	SSOP16	plastic shrink small outline package; 16 leads; body width 4.4 mm	SOT369-1

BLOCK DIAGRAM



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PINNING

SYMBOL	PIN	DESCRIPTION
V _{S2}	1, 2, 14 and 15	amplifier 2 source
IN2	3	amplifier 2 input
n.c.	4	not connected
n.c.	5	not connected
IN1	6	amplifier 1 input
V _{S1}	7, 8, 10 and 11	amplifier 1 source
OUT1	9	amplifier 1 drain output
V _{G1}	12	amplifier 1 gate bias
V _{G2}	13	amplifier 2 gate bias
OUT2	16	amplifier 2 drain output

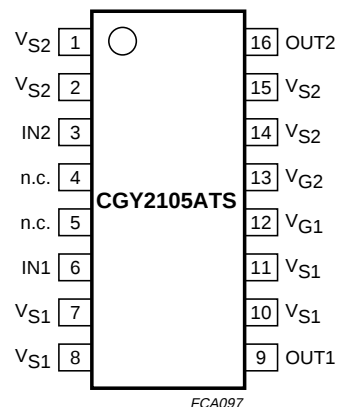


Fig.2 Pin configuration.

LIMITING VALUES

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V _{DS}	drain-source voltage	source connected to ground and gate open-circuit	–	5	V
V _{GS}	gate-source voltage	source connected to ground and drain open-circuit	–3	+1	V
V _{DG}	drain-gate voltage	gate connected to ground and source open-circuit	–	7	V
V _{supply}	positive supply voltage	see Chapter “Application and test information”	–	6	V
V _{neg}	negative supply voltage	see Chapter “Application and test information”	–6	–	V
T _{amb}	ambient temperature		–40	+85	°C
T _j	junction temperature		–	150	°C
T _{stg}	storage temperature		–	150	°C
P _{tot}	total power dissipation	T _{amb} < 85 °C	–	430	mW

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	VALUE	UNIT
R _{th(j-a)}	thermal resistance from junction to ambient	150	K/W

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CHARACTERISTICS

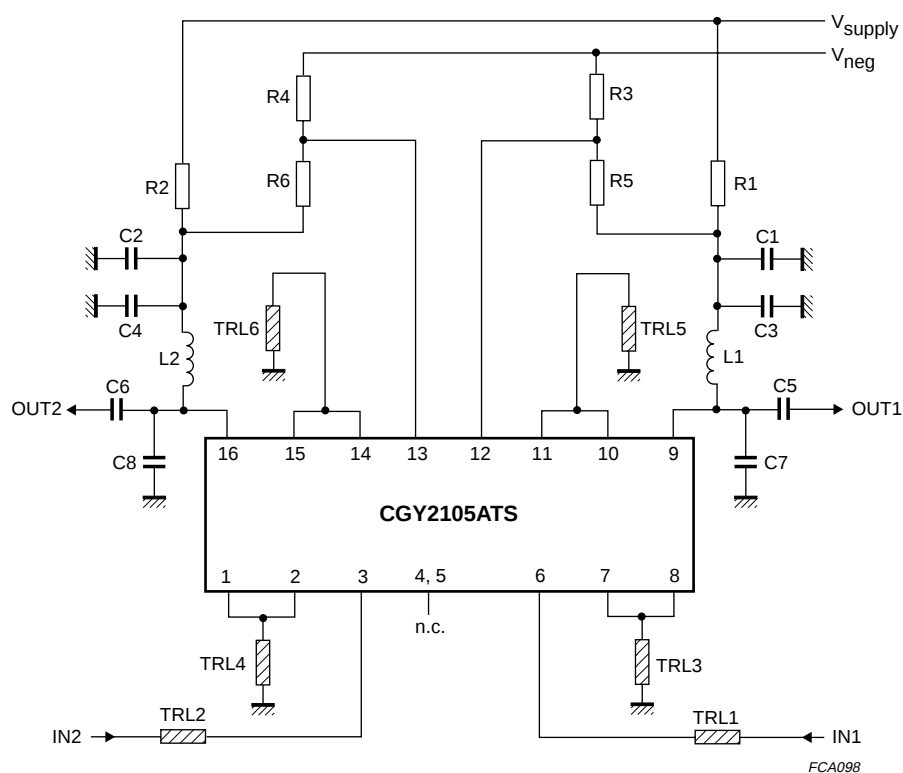
$T_{amb} = 25\text{ °C}$; measured and guaranteed only for the application shown in Chapter “Application and test information”; unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Supplies						
I_{supply}	positive supply current (for each LNA)	$V_{supply} = 5.0\text{ V}$; $V_{neg} = -5.0\text{ V}$	42	56	72	mA
I_{neg}	negative supply current (for each LNA)	$V_{supply} = 5.0\text{ V}$; $V_{neg} = -5.0\text{ V}$	–	0.3	0.4	mA
Amplifiers: $V_{supply} = 5.0\text{ V}$; $V_{neg} = -5.0\text{ V}$; $Z_0 = 50\text{ }\Omega$; both LNAs biased; duty cycle 100%						
f_i	input frequency		1710	–	1910	MHz
G	gain	$f_i = 1710\text{ MHz}$	15.8	16.7	17.6	dB
		$f_i = 1710\text{ to }1910\text{ MHz}$	14.6	16.1	17.6	dB
$\Delta G_{(T)}$	gain variation with temperature	$-40\text{ °C} < T_{amb} < +85\text{ °C}$	–	± 0.45	–	dB
NF	noise figure		–	0.64	0.8	dB
$\Delta NF_{(T)}$	noise figure variation with temperature	$-40\text{ °C} < T_{amb} < +85\text{ °C}$	–	± 0.25	–	dB
IP3 _i	input third-order intercept point	$\Delta f = \pm 0.5\text{ MHz}$	11	14	–	dBm
$\Delta IP3_{i(T)}$	input third-order intercept point variation with temperature	$-40\text{ °C} < T_{amb} < +85\text{ °C}$	–	± 0.45	–	dB
ISO _r	reverse isolation		18	20	–	dB
ISO _{i-i}	isolation between inputs		21	23	–	dB
S ₁₁	input reflection coefficient	50 Ω source	–	–8	–	dB
S ₂₂	output reflection coefficient	50 Ω load	–	–14	–	dB

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APPLICATION AND TEST INFORMATION

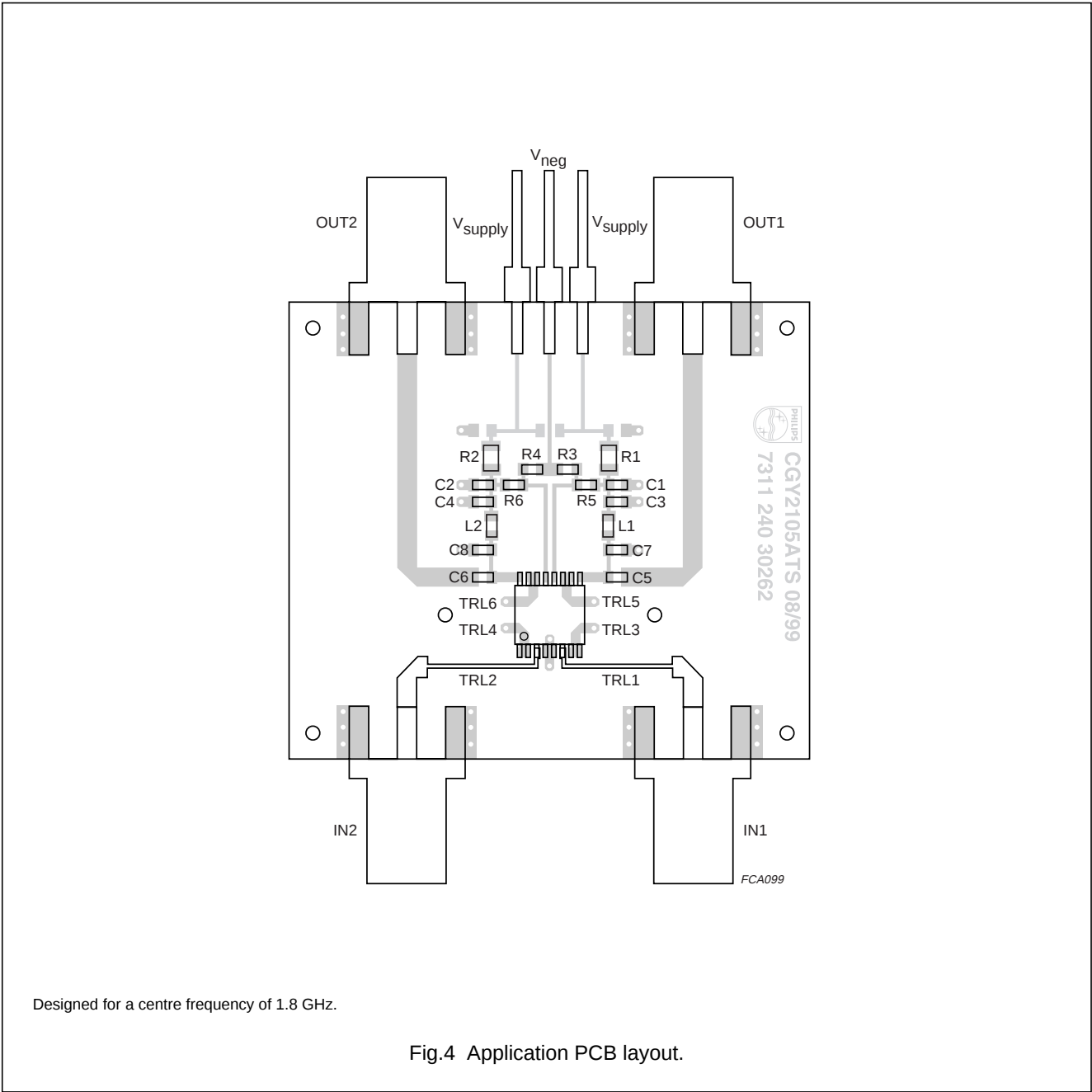


The demonstration board has been optimized for a centre frequency of 1.8 GHz.
The MMIC s-parameters (typical values) in a range from 0.1 to 6 GHz are available on request.

Fig.3 Application diagram.

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Table 1 List of components; see Figs 3 and 4

COMPONENT	DESCRIPTION	VALUE	REFERENCE
C1, C2	decoupling capacitor	1 nF	Philips; NPO, 0603
C3, C4	decoupling capacitor	47 pF	Philips; NPO, 0603
C5, C6	decoupling capacitor	47 pF	Philips; NPO, 0603
C7, C8	decoupling capacitor	0.56 pF	Philips; NPO, 0603
R1, R2	drain biasing resistor	39 Ω	Philips; XR7, 0805
R3, R4	gate biasing resistor	15 k Ω	Philips; 0603
R5, R6	gate biasing resistor	10 k Ω	Philips; 0603
L1, L2	drain biasing inductor	18 nH	Coilcraft; 0603

Table 2 Transmission lines; see Figs 3 and 4

COMPONENT	Z_0	LENGTH IN λ	LENGTH IN mm ⁽¹⁾	WIDTH IN mm ⁽¹⁾
TRL1, TRL2	100 Ω	0.101 λ at 1800 MHz	10 mm	0.25 mm
TRL3, TRL4	100 Ω	0.040 λ at 1800 MHz	4 mm	0.80 mm
TRL5, TRL6	100 Ω	0.034 λ at 1800 MHz	3.4 mm	0.80 mm

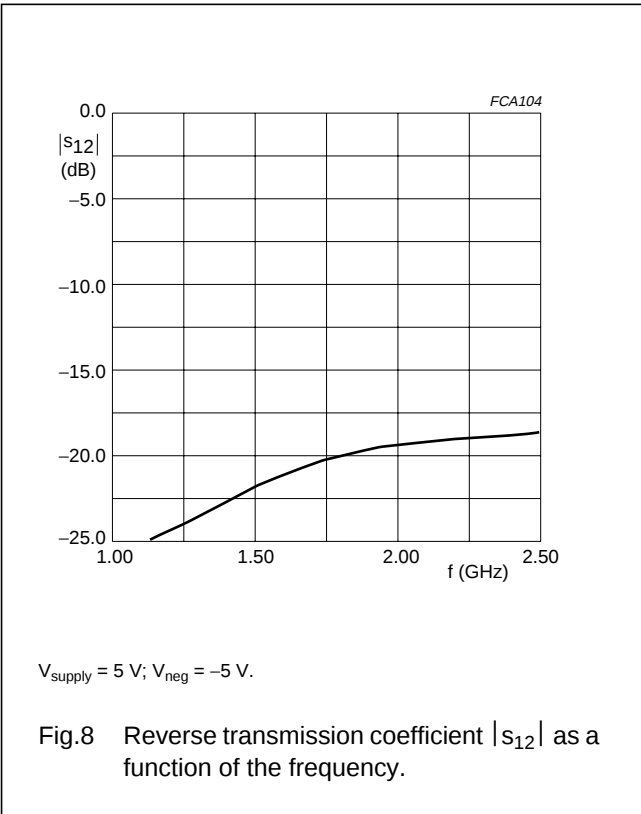
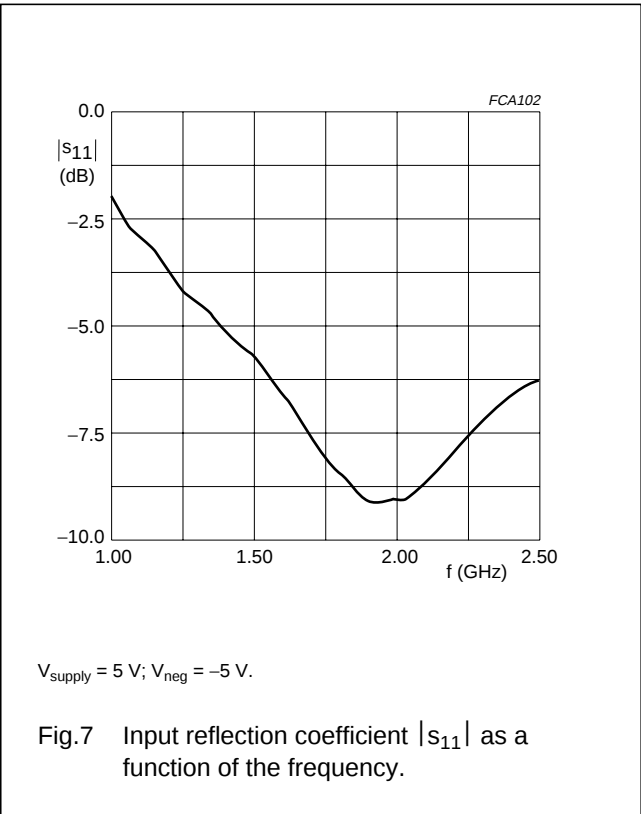
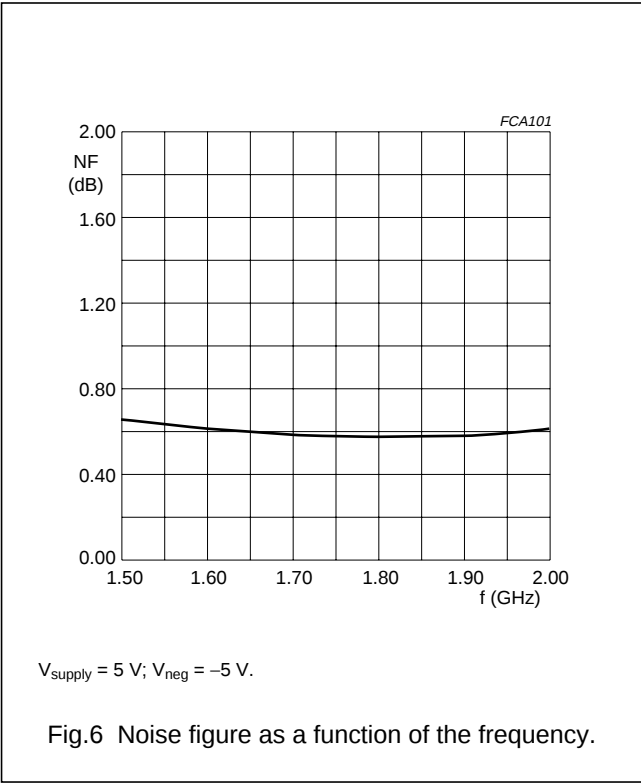
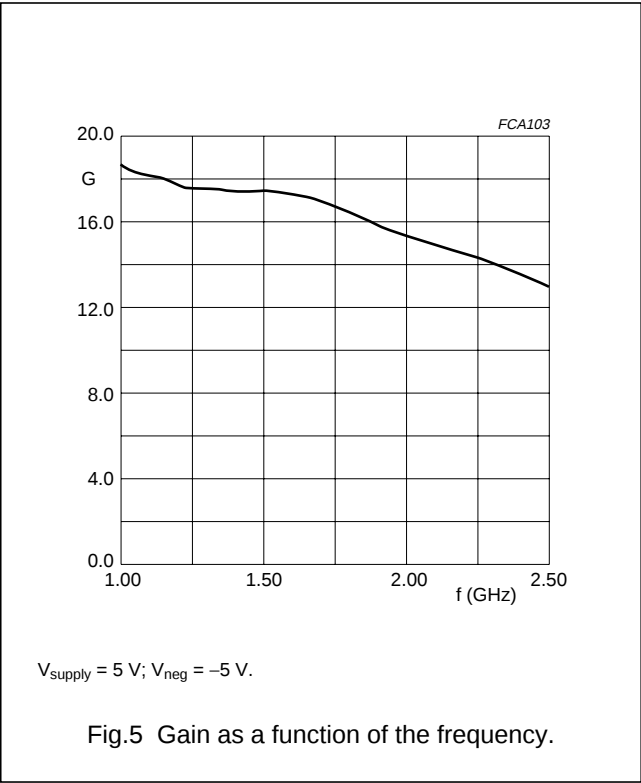
Note

1. Transmission line lengths and widths in mm are valid for a double sided PCB; thickness of 0.8 mm in FR4 material ($\epsilon = 4.7$).

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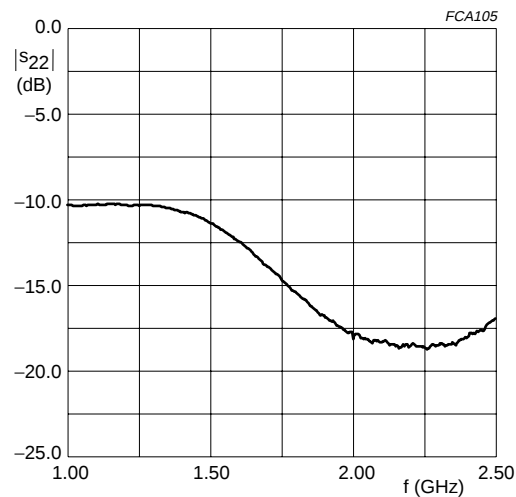
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Measured performance



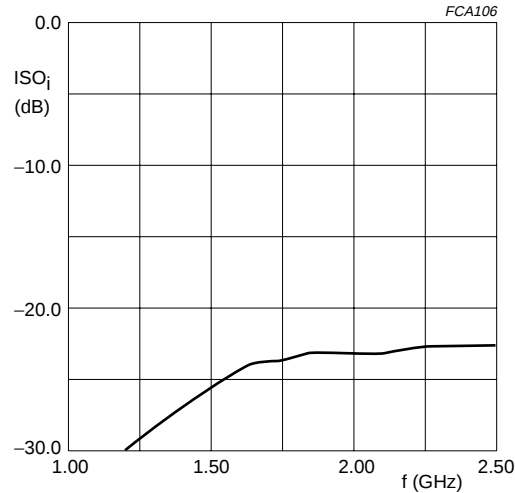
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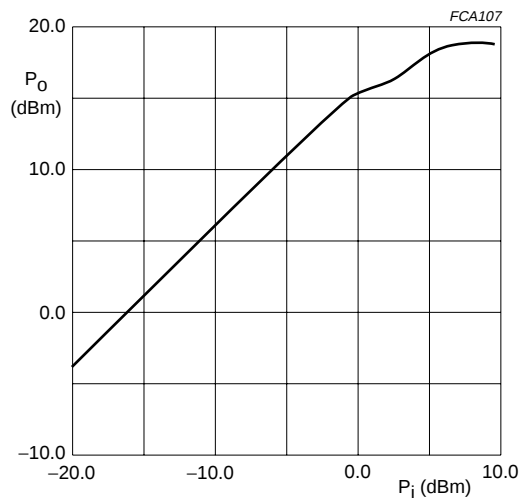
V_{supply} = 5 V; V_{neg} = -5 V.

Fig.9 Output reflection coefficient $|s_{22}|$ as a function of the frequency.



V_{supply} = 5 V; V_{neg} = -5 V.

Fig.10 Isolation between RF inputs as a function of the frequency.



V_{supply} = 5 V; V_{neg} = -5 V.

Fig.11 RF output power as a function of the RF input power.

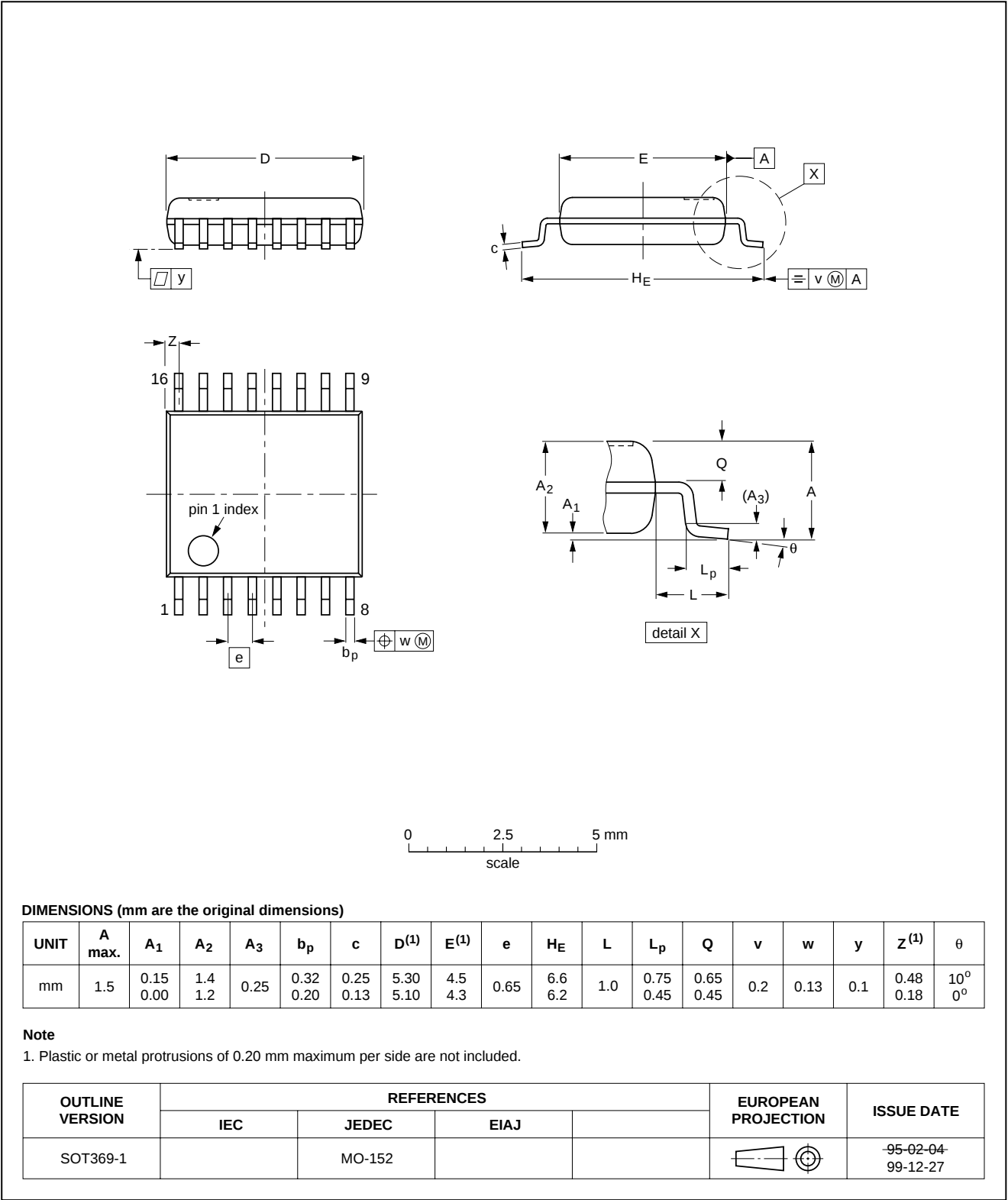
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PACKAGE OUTLINE

SSOP16: plastic shrink small outline package; 16 leads; body width 4.4 mm

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SOLDERING

Introduction to soldering surface mount packages

This text gives a very brief insight to a complex technology. A more in-depth account of soldering ICs can be found in our *"Data Handbook IC26; Integrated Circuit Packages"* (document order number 9398 652 90011).

There is no soldering method that is ideal for all surface mount IC packages. Wave soldering can still be used for certain surface mount ICs, but it is not suitable for fine pitch SMDs. In these situations reflow soldering is recommended.

Reflow soldering

Reflow soldering requires solder paste (a suspension of fine solder particles, flux and binding agent) to be applied to the printed-circuit board by screen printing, stencilling or pressure-syringe dispensing before package placement.

Several methods exist for reflowing; for example, convection or convection/infrared heating in a conveyor type oven. Throughput times (preheating, soldering and cooling) vary between 100 and 200 seconds depending on heating method.

Typical reflow peak temperatures range from 215 to 250 °C. The top-surface temperature of the packages should preferably be kept below 220 °C for thick/large packages, and below 235 °C for small/thin packages.

Wave soldering

Conventional single wave soldering is not recommended for surface mount devices (SMDs) or printed-circuit boards with a high component density, as solder bridging and non-wetting can present major problems.

To overcome these problems the double-wave soldering method was specifically developed.

If wave soldering is used the following conditions must be observed for optimal results:

- Use a double-wave soldering method comprising a turbulent wave with high upward pressure followed by a smooth laminar wave.
- For packages with leads on two sides and a pitch (e):
 - larger than or equal to 1.27 mm, the footprint longitudinal axis is **preferred** to be parallel to the transport direction of the printed-circuit board;
 - smaller than 1.27 mm, the footprint longitudinal axis **must** be parallel to the transport direction of the printed-circuit board.

The footprint must incorporate solder thieves at the downstream end.

- For packages with leads on four sides, the footprint must be placed at a 45° angle to the transport direction of the printed-circuit board. The footprint must incorporate solder thieves downstream and at the side corners.

During placement and before soldering, the package must be fixed with a droplet of adhesive. The adhesive can be applied by screen printing, pin transfer or syringe dispensing. The package can be soldered after the adhesive is cured.

Typical dwell time is 4 seconds at 250 °C.

A mildly-activated flux will eliminate the need for removal of corrosive residues in most applications.

Manual soldering

Fix the component by first soldering two diagonally-opposite end leads. Use a low voltage (24 V or less) soldering iron applied to the flat part of the lead. Contact time must be limited to 10 seconds at up to 300 °C.

When using a dedicated tool, all other leads can be soldered in one operation within 2 to 5 seconds between 270 and 320 °C.

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Suitability of surface mount IC packages for wave and reflow soldering methods

PACKAGE	SOLDERING METHOD	
	WAVE	REFLOW ⁽¹⁾
BGA, LFBGA, SQFP, TFBGA	not suitable	suitable
HBCC, HLQFP, HSQFP, HSOP, HTQFP, HTSSOP, SMS	not suitable ⁽²⁾	suitable
PLCC ⁽³⁾ , SO, SOJ	suitable	suitable
LQFP, QFP, TQFP	not recommended ⁽³⁾⁽⁴⁾	suitable
SSOP, TSSOP, VSO	not recommended ⁽⁵⁾	suitable

Notes

1. All surface mount (SMD) packages are moisture sensitive. Depending upon the moisture content, the maximum temperature (with respect to time) and body size of the package, there is a risk that internal or external package cracks may occur due to vaporization of the moisture in them (the so called popcorn effect). For details, refer to the Drypack information in the *"Data Handbook IC26; Integrated Circuit Packages; Section: Packing Methods"*.
2. These packages are not suitable for wave soldering as a solder joint between the printed-circuit board and heatsink (at bottom version) can not be achieved, and as solder may stick to the heatsink (on top version).
3. If wave soldering is considered, then the package must be placed at a 45° angle to the solder wave direction. The package footprint must incorporate solder thieves downstream and at the side corners.
4. Wave soldering is only suitable for LQFP, TQFP and QFP packages with a pitch (e) equal to or larger than 0.8 mm; it is definitely not suitable for packages with a pitch (e) equal to or smaller than 0.65 mm.
5. Wave soldering is only suitable for SSOP and TSSOP packages with a pitch (e) equal to or larger than 0.65 mm; it is definitely not suitable for packages with a pitch (e) equal to or smaller than 0.5 mm.

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DATA SHEET STATUS

DATA SHEET STATUS	PRODUCT STATUS	DEFINITIONS ⁽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.

Note

1. Please consult the most recently issued data sheet 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 60134). 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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