

NPN EPITAXIAL SILICON TRANSISTOR
FOR MICROWAVE LOW-NOISE AMPLIFICATION

The 2SC3604 is an NPN epitaxial transistor designed for low-noise amplification at 1.0 to 6.0 GHz. This transistor has low-noise and high-gain characteristics in a wide collector current region, and has a wide dynamic range.

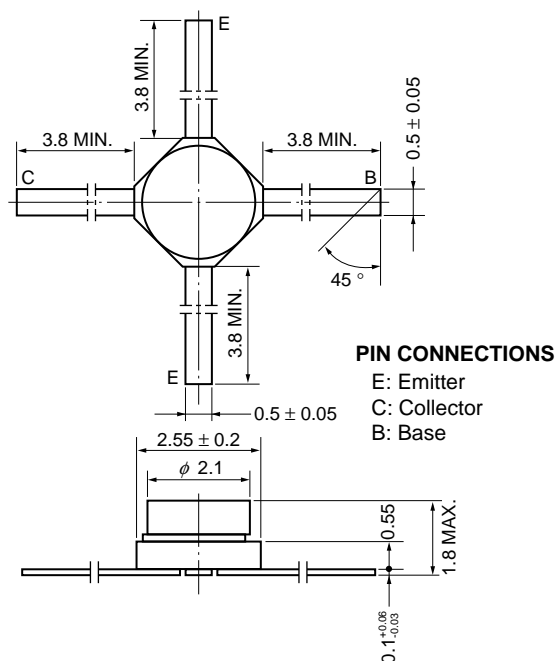
FEATURES

- Low noise : NF = 1.6 dB TYP. @ f = 2.0 GHz
- High power gain : $G_A = 12$ dB TYP. @ f = 2.0 GHz

ABSOLUTE MAXIMUM RATINGS ($T_A = 25\text{ }^\circ\text{C}$)

PARAMETER	SYMBOL	RATING	UNIT
Collector to Base Voltage	V_{CBO}	20	V
Collector to Emitter Voltage	V_{CEO}	10	V
Emitter to Base Voltage	V_{EBO}	1.5	V
Collector Current	I_C	65	mA
Total Power Dissipation	P_T ($T_C = 25\text{ }^\circ\text{C}$)	580	mW
Junction Temperature	T_j	200	$^\circ\text{C}$
Storage Temperature	T_{stg}	-65 to +150	$^\circ\text{C}$

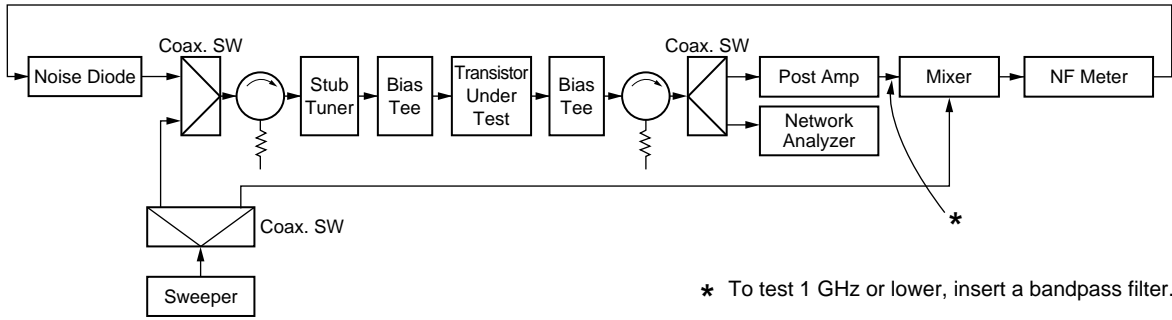
PACKAGE DIMENSIONS (in mm)



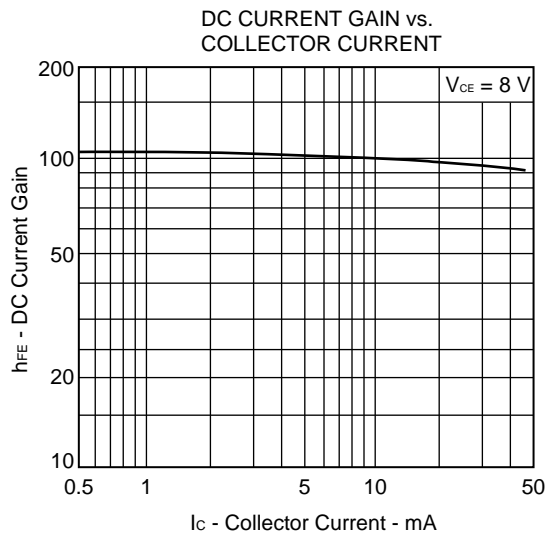
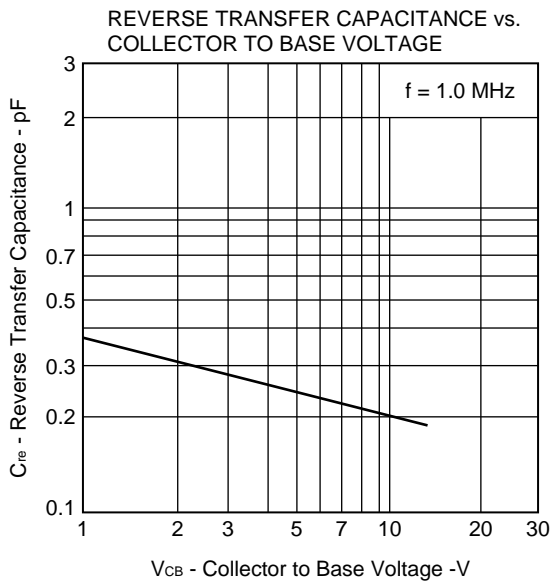
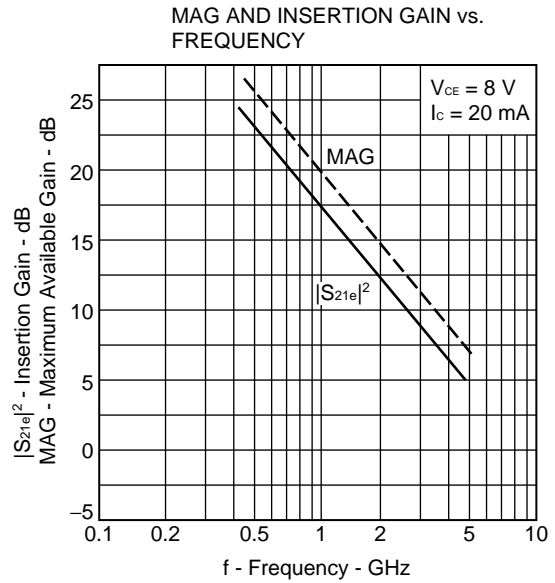
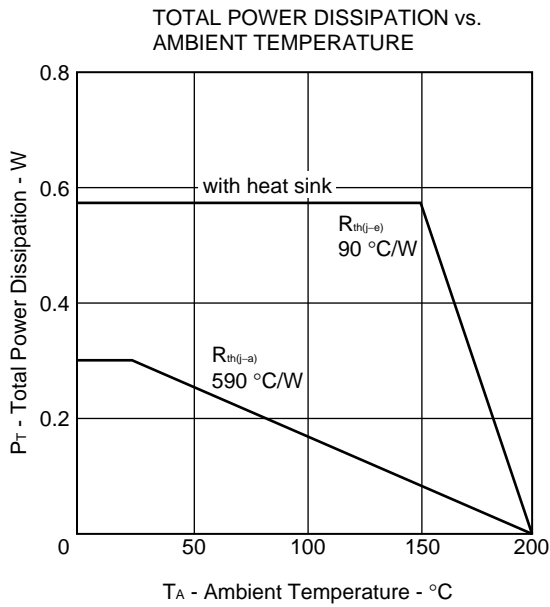
ELECTRICAL CHARACTERISTICS ($T_A = 25\text{ }^\circ\text{C}$)

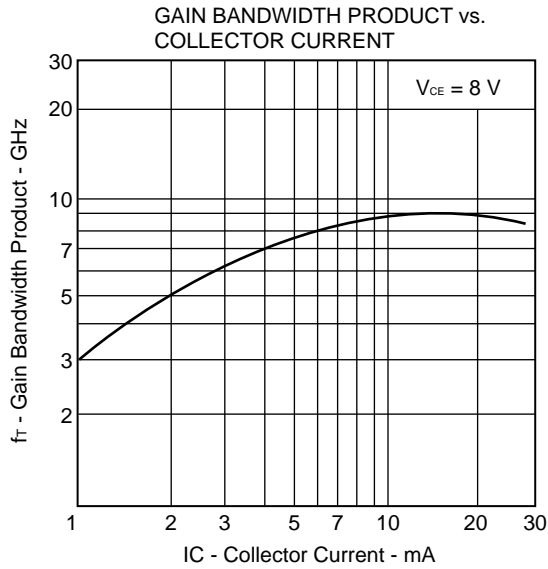
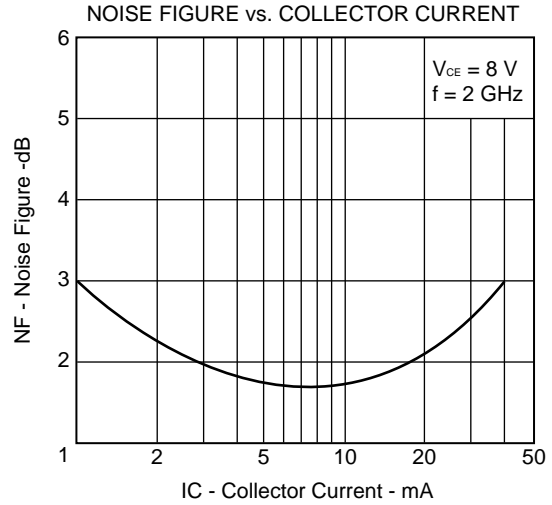
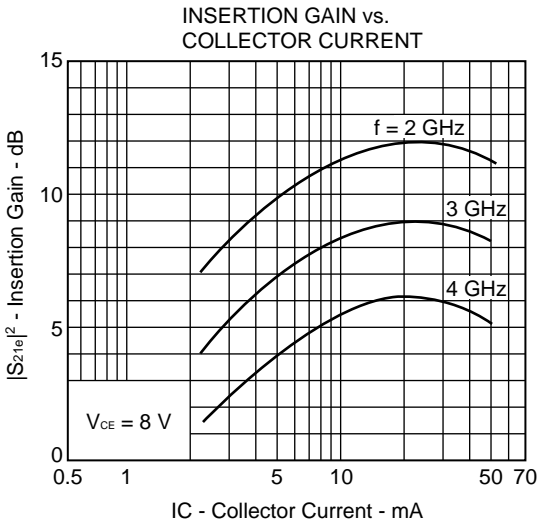
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current	I_{CBO}	$V_{CB} = 10\text{ V}, I_E = 0$			1.0	μA
Emitter Cut-off Current	I_{EBO}	$V_{EB} = 1\text{ V}, I_C = 0$			1.0	μA
DC Current Gain	h_{FE}	$V_{CE} = 8\text{ V}, I_C = 20\text{ mA Pulse}$	50	100	250	
Gain Bandwidth Product	f_T	$V_{CE} = 8\text{ V}, I_C = 20\text{ mA}$		8		GHz
Reverse Transfer Capacitance	C_{re}	$V_{CB} = 10\text{ V}, I_E = 0, f = 1\text{ MHz}$		0.2	0.7	pF
Noise Figure	NF ^{Note}	$V_{CE} = 8\text{ V}, I_C = 7\text{ mA}, f = 2.0\text{ GHz}$		1.6	2.3	dB
Insertion Gain	$ S_{21e} ^2$	$V_{CE} = 8\text{ V}, I_C = 20\text{ mA}, f = 2.0\text{ GHz}$	9.0	11		dB
Maximum Available Gain	MAG	$V_{CE} = 8\text{ V}, I_C = 20\text{ mA}, f = 2.0\text{ GHz}$		13		dB
Power Gain	G_A	$V_{CE} = 8\text{ V}, I_C = 7\text{ mA}, f = 2.0\text{ GHz}$		12		dB

Note Test block diagram



TYPICAL CHARACTERISTICS (T_A = 25 °C)





S PARAMETER

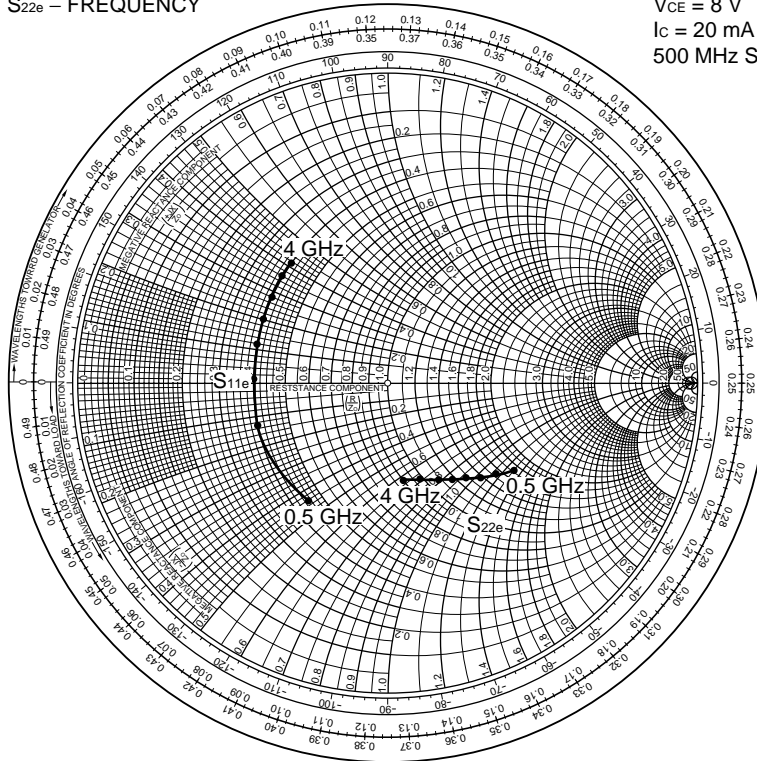
$V_{CE} = 6\text{ V}$, $I_C = 10\text{ mA}$, $Z_O = 50\ \Omega$

f (MHz)	$ S_{11} $	$\angle S_{11}$	$ S_{21} $	$\angle S_{21}$	$ S_{12} $	$\angle S_{12}$	$ S_{22} $	$\angle S_{22}$
500	.463	-125.3	13.822	106.8	.027	37.9	.516	-36.6
1000	.432	-162.7	7.901	86.2	.0424	48.2	.463	-40.7
1500	.416	178.7	5.250	71.1	.0606	53.1	.421	-46.2
2000	.439	165.0	3.949	59.7	.0758	52.0	.396	-50.9
2500	.451	153.6	3.151	51.7	.097	49.3	.372	-56.5
3000	.470	143.6	2.809	39.6	.111	45.1	.345	-63.7
3500	.482	135.2	2.337	28.6	.124	39.5	.320	-73.2
4000	.494	129.1	2.022	21.3	.132	35.5	.321	-82.0

S PARAMETER

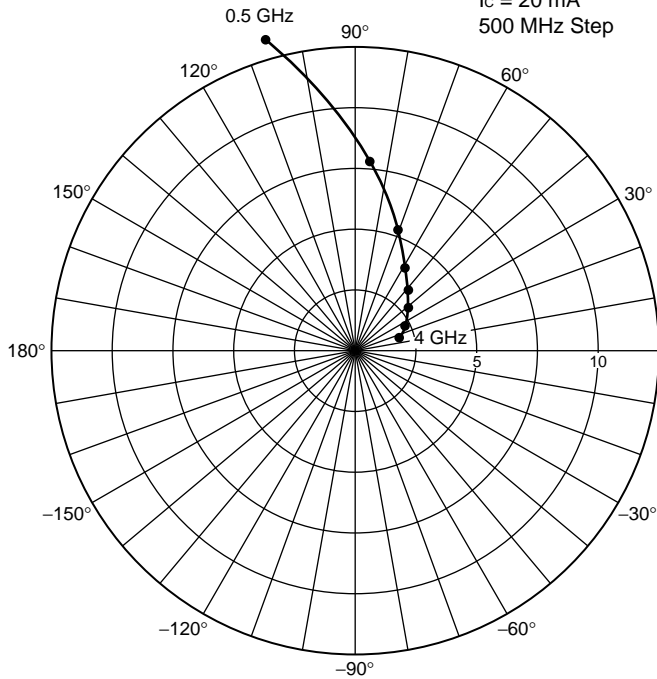
S_{11e}, S_{22e} - FREQUENCY

$V_{CE} = 8\text{ V}$
 $I_C = 20\text{ mA}$
 500 MHz Step



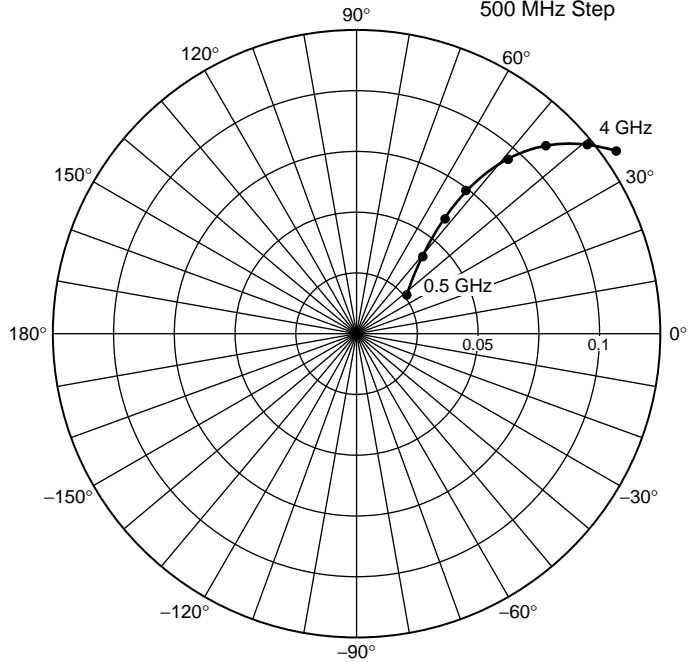
S_{21e} - FREQUENCY

$V_{CC} = 8\text{ V}$
 $I_C = 20\text{ mA}$
 500 MHz Step



S_{12e} - FREQUENCY

$V_{CE} = 8\text{ V}$
 $I_C = 20\text{ mA}$
 500 MHz Step

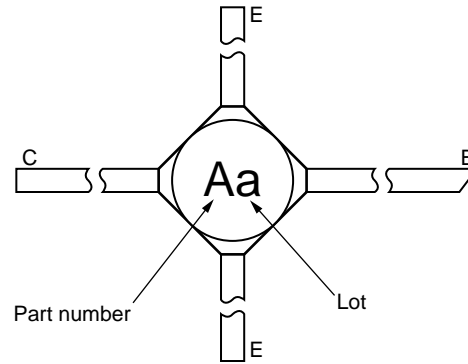


MARKING

Because the package of the micro X package transistor is too small to be marked, the following indication is employed.

Part Number

Part Number	Marking	Part Number	Marking
2SC2148	A	2SC3603	0
2SC2149	B	2SC3604	2
2SC2150	C	2SC3587	1
2SC2367	H		
2SC2585	K		
2SC1223	D		



Lot

Lot indication is colored as shown below.

The sequence black, brown, red, blue, and green, forms one cycle and this cycle is repeated.

Month \ Year	1988	1989	1990	1991	1992	1993	1994	1995	1996
1	j Black	v	h	t	f	r	d	p	b
2	k	w	i	u	g	s	e	q	c
3	l	x	j	v	h	t	f	r	d
4	m	y	k	w	i	u	g	s	e
5	n	z	l	x	j	v	h	t	f
6	o	a Brown	m	y	k	w	i	u	g
7	p	b	n	z	l	x	j	v	h
8	q	c	o	a Red	m	y	k	w	i
9	r	d	p	b	n	z	l	x	j
10	s	e	q	c	o	a Blue	m	y	k
11	t	f	r	d	p	b	n	z	l
12	u	g	s	e	q	c	o	a Green	m

[MEMO]

[MEMO]

The export of this product from Japan is prohibited without governmental license. To export or re-export this product from a country other than Japan may also be prohibited without a license from that country. Please call an NEC sales representative.

No part of this document may be copied or reproduced in any form or by any means without the prior written consent of NEC Corporation. NEC Corporation assumes no responsibility for any errors which may appear in this document.

NEC Corporation does not assume any liability for infringement of patents, copyrights or other intellectual property rights of third parties by or arising from use of a device described herein or any other liability arising from use of such device. No license, either express, implied or otherwise, is granted under any patents, copyrights or other intellectual property rights of NEC Corporation or others.

While NEC Corporation has been making continuous effort to enhance the reliability of its semiconductor devices, the possibility of defects cannot be eliminated entirely. To minimize risks of damage or injury to persons or property arising from a defect in an NEC semiconductor device, customer must incorporate sufficient safety measures in its design, such as redundancy, fire-containment, and anti-failure features.

NEC devices are classified into the following three quality grades:

"Standard", "Special", and "Specific". The Specific quality grade applies only to devices developed based on a customer designated "quality assurance program" for a specific application. The recommended applications of a device depend on its quality grade, as indicated below. Customers must check the quality grade of each device before using it in a particular application.

Standard: Computers, office equipment, communications equipment, test and measurement equipment, audio and visual equipment, home electronic appliances, machine tools, personal electronic equipment and industrial robots

Special: Transportation equipment (automobiles, trains, ships, etc.), traffic control systems, anti-disaster systems, anti-crime systems, safety equipment and medical equipment (not specifically designed for life support)

Specific: Aircrafts, aerospace equipment, submersible repeaters, nuclear reactor control systems, life support systems or medical equipment for life support, etc.

The quality grade of NEC devices in "Standard" unless otherwise specified in NEC's Data Sheets or Data Books. If customers intend to use NEC devices for applications other than those specified for Standard quality grade, they should contact NEC Sales Representative in advance.

Anti-radioactive design is not implemented in this product.