



# NEC's NPN SILICON TRANSISTOR

## NE687M03

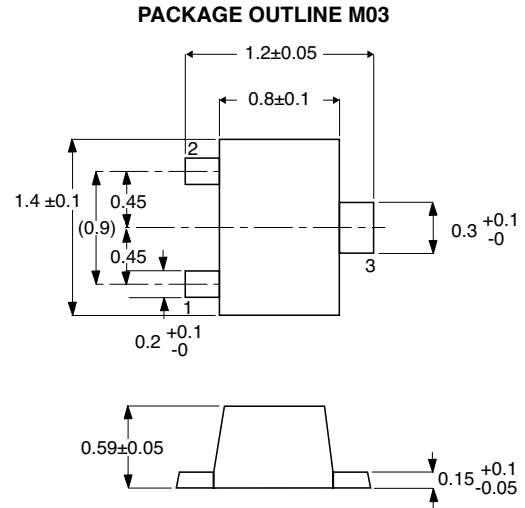
### FEATURES

- **NEW M03 PACKAGE:**
  - Smallest transistor outline package available
  - Low profile/0.59 mm package height
  - Flat lead style for better RF performance
- **HIGH GAIN BANDWIDTH PRODUCT:**  
 $f_T = 14 \text{ GHz}$
- **LOW NOISE FIGURE:**  
 $NF = 1.4 \text{ dB at } 2 \text{ GHz}$

### DESCRIPTION

NEC's NE687M03 transistor is designed for low noise, high gain, and low cost requirements. This high  $f_T$  part is well suited for very low voltage/low current designs for portable wireless communications and cellular radio applications. NEC's new low profile/flat lead style "M03" package is ideal for today's portable wireless applications. The NE687 is also available in six different low cost plastic surface mount package styles.

### OUTLINE DIMENSIONS (Units in mm)



#### PIN CONNECTIONS

1. Emitter
2. Base
3. Collector

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

PART NUMBER EIAJ <sup>1</sup> REGISTERED NUMBER PACKAGE OUTLINE		NE687M03 2SC5436 M03			
SYMBOLS	PARAMETERS AND CONDITIONS	UNITS	MIN	TYP	MAX
$f_T$	Gain Bandwidth at $V_{CE} = 2 \text{ V}$ , $I_C = 20 \text{ mA}$ , $f = 2 \text{ GHz}$ $V_{CE} = 1 \text{ V}$ , $I_C = 10 \text{ mA}$ , $f = 2 \text{ GHz}$	GHz	9	14	
		GHz	7	12	
NF	Noise Figure at $V_{CE} = 2 \text{ V}$ , $I_C = 3 \text{ mA}$ , $f = 2 \text{ GHz}$ $V_{CE} = 1 \text{ V}$ , $I_C = 3 \text{ mA}$ , $f = 2 \text{ GHz}$	dB		1.3	2
		dB		1.3	2
$IS_{21E}^2$	Insertion Power Gain at $V_{CE} = 2 \text{ V}$ , $I_C = 20 \text{ mA}$ , $f = 2 \text{ GHz}$ $V_{CE} = 1 \text{ V}$ , $I_C = 10 \text{ mA}$ , $f = 2 \text{ GHz}$	dB	8.5	10	
		dB	6	9.0	
$h_{FE}^2$	Forward Current Gain at $V_{CE} = 2 \text{ V}$ , $I_C = 20 \text{ mA}$		70		130
$I_{CBO}$	Collector Cutoff Current at $V_{CB} = 5 \text{ V}$ , $I_E = 0$	$\mu\text{A}$			0.1
$I_{EBO}$	Emitter Cutoff Current at $V_{EB} = 1 \text{ V}$ , $I_C = 0$	$\mu\text{A}$			0.1
$C_{RE}^3$	Feedback Capacitance at $V_{CB} = 2 \text{ V}$ , $I_E = 0$ , $f = 1 \text{ MHz}$	pF		0.4	0.8

#### Notes:

1. Electronic Industrial Association of Japan.
2. Pulsed measurement, pulse width  $\leq 350 \mu\text{s}$ , duty cycle  $\leq 2\%$ .
3. Capacitance is measured with emitter and case connected to the guard terminal at the bridge.

**ABSOLUTE MAXIMUM RATINGS<sup>1</sup>** (T<sub>A</sub> = 25°C)

SYMBOLS	PARAMETERS	UNITS	RATINGS
V <sub>CBO</sub>	Collector to Base Voltage	V	5
V <sub>CEO</sub>	Collector to Emitter Voltage	V	3
V <sub>EBO</sub>	Emitter to Base Voltage	V	2
I <sub>C</sub>	Collector Current	mA	30
P <sub>T</sub>	Total Power Dissipation	mW	90
T <sub>J</sub>	Junction Temperature	°C	150
T <sub>STG</sub>	Storage Temperature	°C	-65 to +150

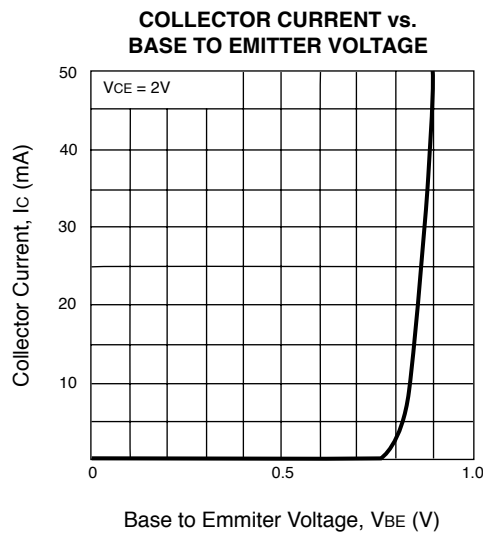
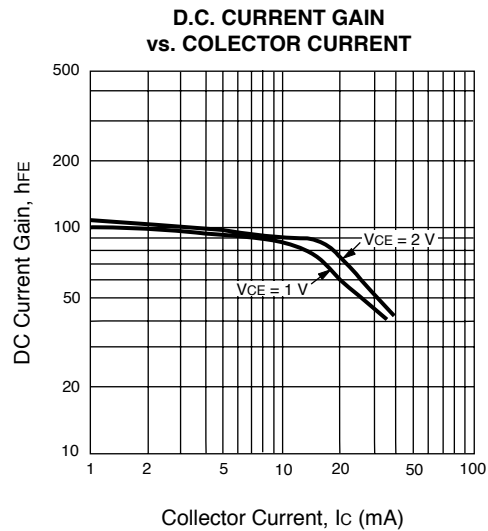
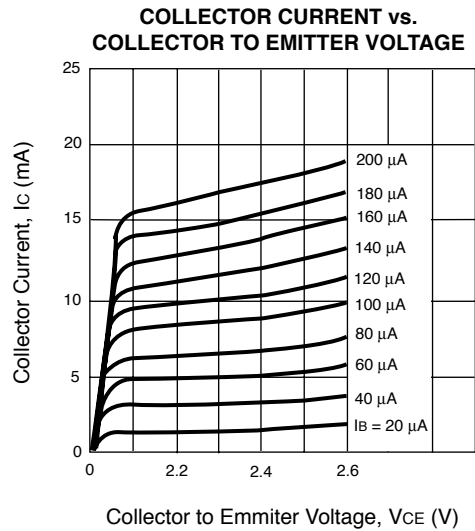
Note:

1. Operation in excess of any one of these parameters may result in permanent damage.

**ORDERING INFORMATION**

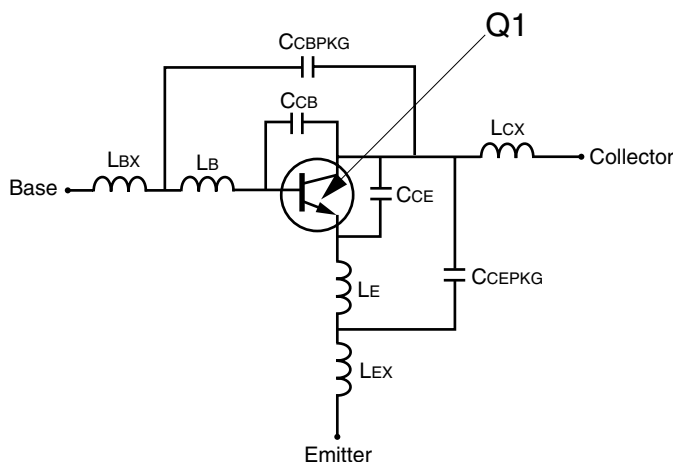
PART NUMBER	QUANTITY
NE687M03-A	
NE687M03-T1-A	

**TYPICAL PERFORMANCE CURVES** (T<sub>A</sub> = 25°C)



## NE687M03 NONLINEAR MODEL

### SCHEMATIC



### BJT NONLINEAR MODEL PARAMETERS<sup>(1)</sup>

Parameters	Q1	Parameters	Q1
IS	302.3e-18	MJC	0.53
BF	104	XCJC	0.27
NF	1.038	CJS	0
VAF	10	VJS	0.75
IKF	0.370	MJS	0
ISE	1e-6	FC	0.37
NE	31.19	TF	5e-12
BR	17.54	XTF	8
NR	1.023	VTF	0.06
VAR	30	ITF	1.0
IKR	8.369e-3	PTF	69.1
ISC	81.93e-12	TR	1.e-9
NC	4.986	EG	1.11
RE	0.80	XTB	0
RB	11.10	XTI	3
RBM	2.46	KF	0
IRB	17e-3	AF	1
RC	4.477		
CJE	0.415e-12		
VJE	0.68		
MJE	0.53		
CJC	0.102e-12		
VJC	0.8		

(1) Gummel-Poon Model

#### Life Support Applications

These NEC products are not intended for use in life support devices, appliances, or systems where the malfunction of these products can reasonably be expected to result in personal injury. The customers of CEL using or selling these products for use in such applications do so at their own risk and agree to fully indemnify CEL for all damages resulting from such improper use or sale.

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DATA SUBJECT TO CHANGE WITHOUT NOTICE

### UNITS

Parameter	Units
time	seconds
capacitance	farads
inductance	henries
resistance	ohms
voltage	volts
current	amps

### ADDITIONAL PARAMETERS

Parameters	687M03
CCB	0.26e-12
CCE	0.19e-12
LB	0.4e-9
LE	0.7e-9
CCBPKG	0.08e-12
CCEPKG	0.08e-12
LBX	0.12e-9
LCX	0.10e-9
LEX	0.12e-9

#### MODEL TEST CONDITIONS

Frequency: 0.1 to 5.0 GHz

Bias:  $V_{CE} = 0.5 \text{ V to } 2.5 \text{ V}$ ,  $I_C = 0.5 \text{ mA to } 30 \text{ mA}$

Date: 11/98

$h_{FE} = 108$  at 2 V, 20 mA

04/26/2004

**NEC**

A Business Partner of NEC Compound Semiconductor Devices, Ltd.

Subject: Compliance with EU Directives

CEL certifies, to its knowledge, that semiconductor and laser products detailed below are compliant with the requirements of European Union (EU) Directive 2002/95/EC Restriction on Use of Hazardous Substances in electrical and electronic equipment (RoHS) and the requirements of EU Directive 2003/11/EC Restriction on Penta and Octa BDE.

CEL Pb-free products have the same base part number with a suffix added. The suffix –A indicates that the device is Pb-free. The –AZ suffix is used to designate devices containing Pb which are exempted from the requirement of RoHS directive (\*). In all cases the devices have Pb-free terminals. All devices with these suffixes meet the requirements of the RoHS directive.

This status is based on CEL’s understanding of the EU Directives and knowledge of the materials that go into its products as of the date of disclosure of this information.

Restricted Substance per RoHS	Concentration Limit per RoHS (values are not yet fixed)	Concentration contained in CEL devices	
		-A	-AZ
Lead (Pb)	< 1000 PPM	Not Detected	(*)
Mercury	< 1000 PPM	Not Detected	
Cadmium	< 100 PPM	Not Detected	
Hexavalent Chromium	< 1000 PPM	Not Detected	
PBB	< 1000 PPM	Not Detected	
PBDE	< 1000 PPM	Not Detected	

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