CEL

# NPN SILICON TRANSISTOR | NE685M03

## FEATURES

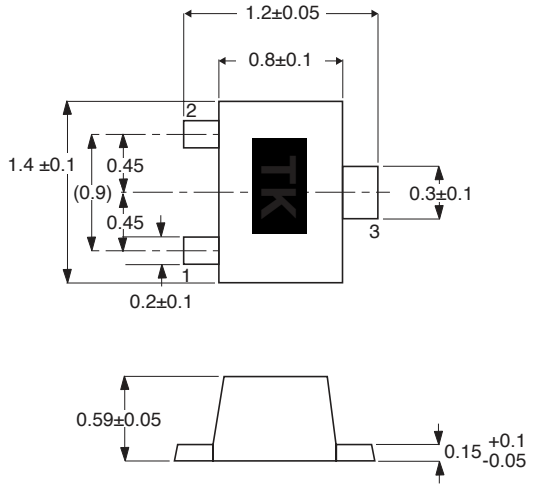
- **NEW M03 PACKAGE:**
  - Smallest transistor outline package available
  - Low profile/0.59 mm package height
  - Flat lead style for better RF performance
- **HIGH GAIN BANDWIDTH PRODUCT:**
  $f_T$ = 12 GHz
- **LOW NOISE FIGURE:**
  NF = 1.5 dB at 2 GHz

## DESCRIPTION

The NEC's NE685M03 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 NE685 is also available in six different low cost plastic surface mount package styles.

## OUTLINE DIMENSIONS (Units in mm)

**PACKAGE OUTLINE M03**




PIN CONNECTIONS
1. Emitter
2. Base
3. Collector

## ELECTRICAL CHARACTERISTICS ($T_A$ = 25°C)

| PART NUMBER<br>EIAJ[1] REGISTERED NUMBER<br>PACKAGE OUTLINE | | NE685M03<br>2SC5435<br>M03 | | | |
|---|---|---|---|---|---|
| **SYMBOLS** | **PARAMETERS AND CONDITIONS** | **UNITS** | **MIN** | **TYP** | **MAX** |
| $f_T$ | Gain Bandwidth at $V_{CE}$ = 3 V, $I_C$ = 10 mA, f = 2 GHz | GHz | | 12 | |
| NF | Noise Figure at $V_{CE}$ = 3 V, $I_C$ = 3 mA, f = 2 GHz | dB | | 1.5 | 2.5 |
| $\|S_{21E}\|^2$ | Insertion Power Gain at $V_{CE}$ = 3 V, $I_C$ = 10 mA, f = 2 GHz | dB | 7 | 9 | |
| $h_{FE}$[2] | Forward Current Gain at $V_{CE}$ = 3 V, $I_C$ = 10 mA | | 75 | | 140 |
| $I_{CBO}$ | Collector Cutoff Current at $V_{CB}$ = 5 V, $I_E$ = 0 | μA | | | 0.1 |
| $I_{EBO}$ | Emitter Cutoff Current at $V_{EB}$ = 1 V, $I_C$ = 0 | μA | | | 0.1 |
| $C_{RE}$[3] | Feedback Capacitance at $V_{CB}$ = 3 V, $I_E$ = 0, f = 1 MHz | pF | | 0.4 | 0.7 |

Notes:
1. Electronic Industrial Association of Japan.
2. Pulsed measurement, pulse width ≤ 350 μs, duty cycle ≤ 2 %.
3. Capacitance is measured with emitter and case connected to the guard terminal at the bridge.

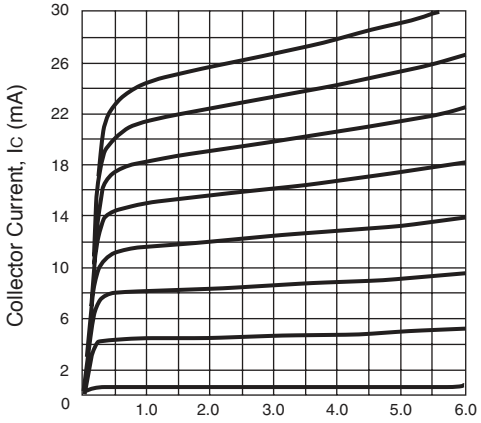
## ABSOLUTE MAXIMUM RATINGS[1] ($T_A$ = 25°C)

| SYMBOLS | PARAMETERS | UNITS | RATINGS |
|---|---|---|---|
| $V_{CBO}$ | Collector to Base Voltage | V | 9 |
| $V_{CEO}$ | Collector to Emitter Voltage | V | 5 |
| $V_{EBO}$ | Emitter to Base Voltage | V | 2 |
| $I_C$ | Collector Current | mA | 30 |
| $P_T$ | Total Power Dissipation | mW | 125 |
| $T_J$ | Junction Temperature | °C | 150 |
| $T_{STG}$ | Storage Temperature | °C | -65 to +150 |

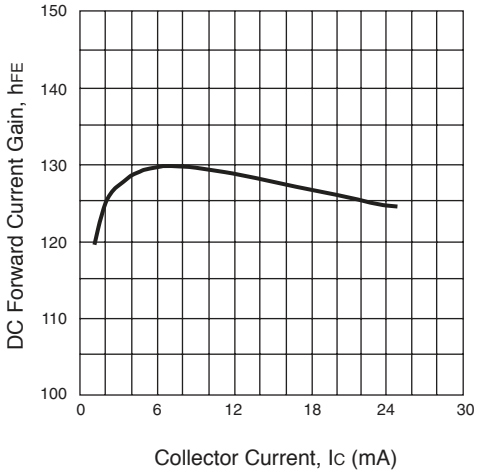
Note:
1. Operation in excess of any one of these parameters may result in permanent damage.

## TYPICAL PERFORMANCE CURVES ($T_A$ = 25°C)

**COLLECTOR CURRENT vs. COLLECTOR TO EMITTER VOLTAGE**



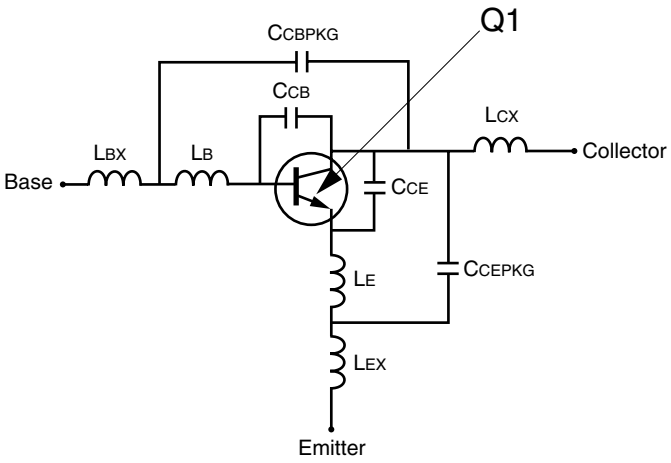

**D.C. FORWARD CURRENT GAIN vs. COLLECTOR CURRENT**




## ORDERING INFORMATION

| PART NUMBER | QUANTITY |
|---|---|
| NE685M03-A | |
| NE685M03-T1-A | |

## SCHEMATIC




## BJT NONLINEAR MODEL PARAMETERS (1)

| Parameters | Q1 | Parameters | Q1 |
|---|---|---|---|
| IS | 8.98e-17 | MJC | 0.19 |
| BF | 107.1 | XCJC | 0 |
| NF | 0.99 | CJS | 0 |
| VAF | 22 | VJS | 0.75 |
| IKF | 0.55 | MJS | 0 |
| ISE | 1e-6 | FC | 0.5 |
| NE | 31.10 | TF | 4e-12 |
| BR | 16.06 | XTF | 12 |
| NR | 0.98 | VTF | 1 |
| VAR | 6 | ITF | 0.04 |
| IKR | 8.02e-3 | PTF | 120 |
| ISC | 0 | TR | 1e-9 |
| NC | 2 | EG | 1.11 |
| RE | 0.6 | XTB | 0 |
| RB | 10 | XTI | 3 |
| RBM | 8.34 | KF | 0 |
| IRB | 0.009 | AF | 1 |
| RC | 5.07 | | |
| CJE | 0.50e-12 | | |
| VJE | 0.95 | | |
| MJE | 0.5 | | |
| CJC | 0.11e-12 | | |
| VJC | 0.56 | | |

(1) Gummel-Poon Model

## UNITS

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

## ADDITIONAL PARAMETERS

| Parameters | 68533 |
|---|---|
| CCB | 0.13e-12 |
| CCE | 0.14e-12 |
| LB | 0.3e-9 |
| LE | 0.8e-9 |
| CCBPKG | 0.08e-12 |
| CCEPKG | 0.08e-12 |
| LBX | 0.12e-9 |
| LCX | 0.10e-9 |
| LEX | 0.12e-9 |

MODEL RANGE

Frequency: 0.1 to 4.0 GHz
Bias: $V_{CE}$ = 0.5 V to 3 V, $I_C$ = 0.5 mA to 20 mA
Date: 11/98

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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 | |
|---|---|---|---|
| Lead (Pb) | < 1000 PPM | -A | -AZ |
| | | 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 | |

If you should have any additional questions regarding our devices and compliance to environmental standards, please do not hesitate to contact your local representative.