

CLASS C, 175 MHz, 7 VOLT POWER TRANSISTOR

NE020214-07
NE020620-07
NE020790-07
NE020791-07

FEATURES

- FOUR DIFFERENT LOW-COST PACKAGE STYLES AVAILABLE
- HIGH POWER
- HIGH GAIN
- SUPPLY VOLTAGE, $V_{CC} = 7.2$ V
- FOR 150 MHz BAND HAND-HELD RADIO APPLICATIONS
- SUPERIOR RF PERFORMANCE
- RUGGED VSWR $\infty : 1$
- HIGH RELIABILITY

DESCRIPTION AND APPLICATIONS

The NE0200-07 NPN series of VHF epitaxial silicon transistors is designed to provide from 2 to 7 watts output power in the 150 MHz radio band. The series is available in a variety of low cost, rugged packages designed to fulfill the requirements of most applications; specifically hand-held radio applications with a 7.2 volt, or less, supply voltage.

High performance, ruggedness and product uniformity are achieved in the series by combining the highest grade materials with carefully controlled production processes.

Reliability is assured by Si_3N_4 passivation and SiO_2 glassivation, and by using test procedures patterned after MIL-STD-750 and MIL-S-19500. High performance and ruggedness are achieved by a proprietary fabrication technique using arsenic doped polysilicon (As DOPOS) and by diffused ballast resistors.

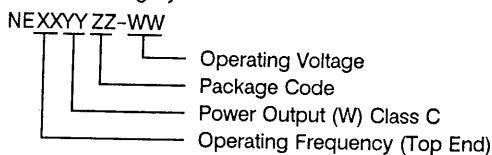
The NE0200-07 provides the designer with high gain, high power and high production volume in low-cost packages, making the series an ideal choice for low voltage VHF applications.

PERFORMANCE SPECIFICATIONS (T_A = 25°C)

| PART NUMBER ¹ EIAJ ² REGISTERED NUMBER PACKAGE OUTLINE | | | NE020214-07 2SC2221 14 | | | NE020620-07 2SC2222 20 | | | NE020790-07 2SC2289K 90 | | | NE020791-07 2SC2289M 91 | | |
|--|--|--------|------------------------------|-----|-----|------------------------------|-----|-----|-------------------------------|-----|-----|-------------------------------|-----|-----|
| SYMBOLS | PARAMETERS AND CONDITIONS | UNITS | MIN | TYP | MAX | MIN | TYP | MAX | MIN | TYP | MAX | MIN | TYP | MAX |
| P _{OUT} | Output Power at f = 175 MHz, V _{CC} = 7.2 V, P _{IN} = 200 mW P _{IN} = 700 mW | W W | 1.6 | 2 | | 5 | 6.3 | | 5 | 7.1 | | 5 | 7.1 | |
| η _c | Collector Efficiency at f = 175 MHz, V _{CC} = 7.2 V, P _{IN} = 200 mW P _{IN} = 700 mW | % % | 60 | 70 | | 60 | 70 | | 60 | 70 | | 60 | 70 | |
| VSWR | Voltage Standing Wave Ratio, Phase = λg/2, V _{CC} = 9 V, P _{OUT} = 2 W P _{OUT} = 6 W P _{OUT} = 7 W | | ∞ | | | ∞ | | | ∞ | | | ∞ | | |

Notes:

1. Power Numbering System:



2. Electronic Industrial Association of Japan.

ELECTRICAL CHARACTERISTICS (T_A = 25°C)

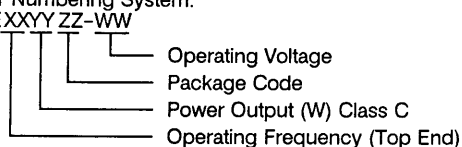
| PART NUMBER ¹ EIAJ ² REGISTERED NUMBER PACKAGE OUTLINE | | | NE020214-07 2SC2221 14 | | | NE020620-07 2SC2222 20 | | | NE020790-07 2SC2289K 90 | | | NE020791-07 2SC2289M 91 | | |
|--|--|--------|------------------------------|-----|------|------------------------------|-----|-----|-------------------------------|-----|-----|-------------------------------|-----|-----|
| SYMBOLS | PARAMETERS AND CONDITIONS | UNITS | MIN | TYP | MAX | MIN | TYP | MAX | MIN | TYP | MAX | MIN | TYP | MAX |
| BV _{CB0} | Collector to Base Breakdown Voltage at I _E = 0 I _C = 1 mA I _C = 2 mA | V V | 25 | | | 25 | | | 25 | | | 25 | | |
| BV _{EB0} | Emitter to Base Breakdown Voltage at I _E = 0 I _C = 1 mA I _C = 2 mA | V V | 2.5 | | | 2.5 | | | 2.5 | | | 2.5 | | |
| LV _{CE0} | Collector to Emitter Breakdown Voltage at I _B = 0 I _C = 10 mA I _C = 20 mA | V V | 12 | | | 12 | | | 12 | | | 12 | | |
| I _{CBO} | Collector Cutoff Current at V _{CB} = 20 V, I _E = 0 | mA | | | 0.25 | | | 0.5 | | | 0.5 | | | 0.5 |
| I _{EBO} | Emitter Cutoff Current at V _{EB} = 2 V, I _C = 0 | mA | | | 0.25 | | | 0.5 | | | 0.5 | | | 0.5 |
| h _{FE} | DC Forward Cutoff Gain at V _{CE} = 7 V I _C = 0.2 A (pulsed) I _C = 0.4 A (pulsed) | | 20 | 60 | 200 | 20 | 60 | 200 | 20 | 60 | 200 | 20 | 60 | 200 |
| C _{OB} | Output Capacitance ³ at V _{CB} = 10 V, I _E = 0, f = 1 MHz | pF | | 7 | 10 | | 12 | 18 | | 12 | 18 | | 12 | 18 |

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C)

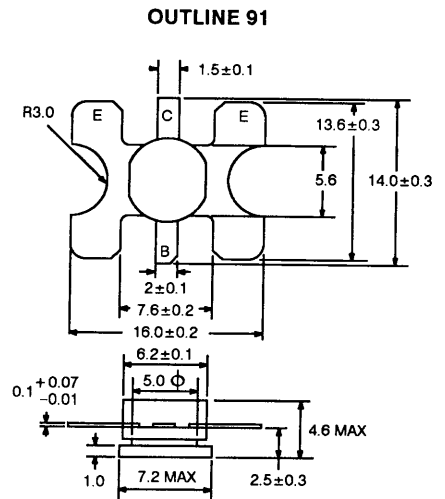
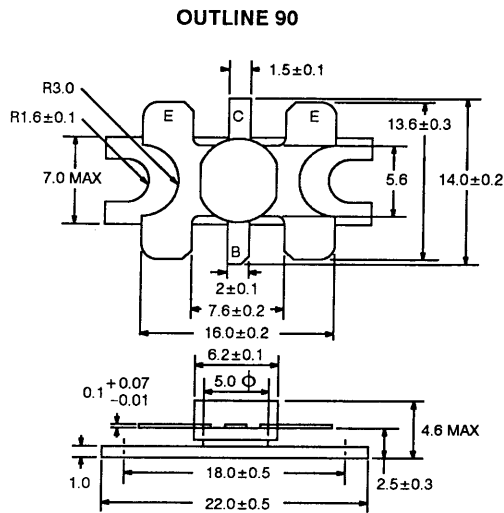
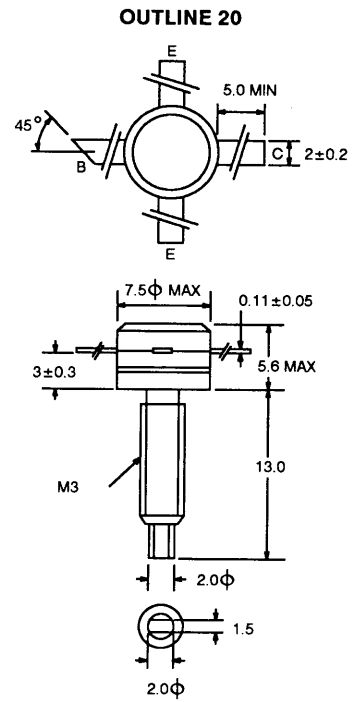
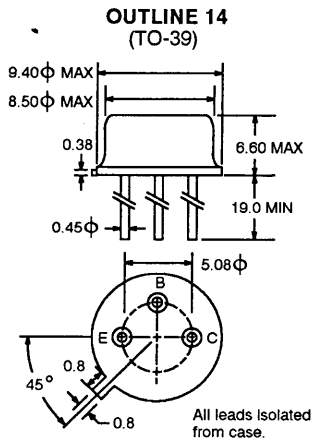
| PART NUMBER ¹ EIAJ ² REGISTERED NUMBER PACKAGE OUTLINE | | | NE020214-07 2SC2221 14 | NE020620-07 2SC2222 20 | NE020790-07 2SC2289K 90 | NE020791-07 2SC2289M 91 |
|--|---|-------|------------------------------|------------------------------|-------------------------------|-------------------------------|
| SYMBOLS | PARAMETERS | UNITS | RATINGS | RATINGS | RATINGS | RATINGS |
| V _{CB0} | Collector-to-Base Voltage | V | 25 | 25 | 25 | 25 |
| V _{EB0} | Collector-to-Emitter Voltage | V | 2.5 | 2.5 | 2.5 | 2.5 |
| V _{CE0} | Emitter-to-Base Voltage | V | 12 | 12 | 12 | 12 |
| I _C | Collector Current | A | 0.75 | 1.5 | 1.5 | 1.5 |
| R _{TH(J-C)} | Thermal Resistance (Junction-to-Case) | °C/W | 20 | 8.8 | 8.8 | 8.8 |
| P _T | Total Power Dissipation (T _c = 25°C) | W | 7.5 | 17 | 17 | 17 |
| T _J | Junction Temperature | °C | 175 | 175 | 175 | 175 |
| T _{STG} | Storage Temperature | °C | -65 to +175 | -65 to +175 | -65 to +150 | -65 to +150 |

Notes:

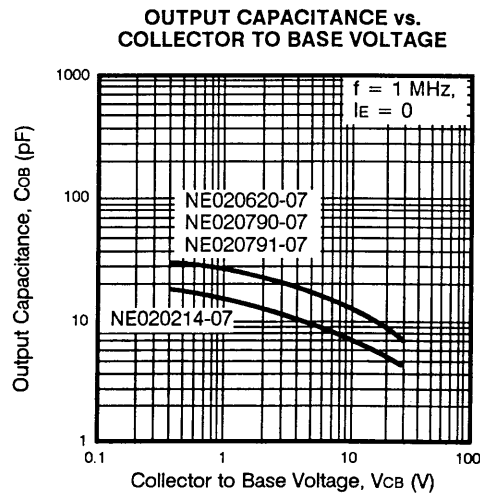
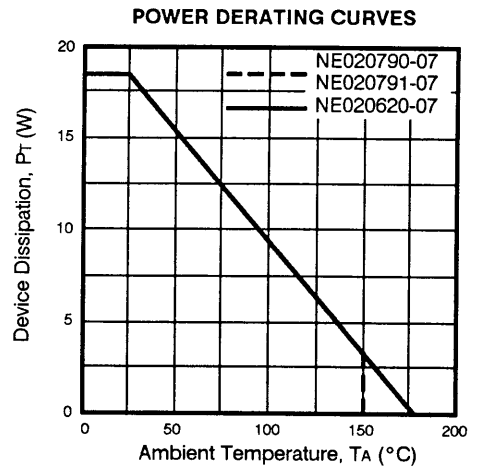
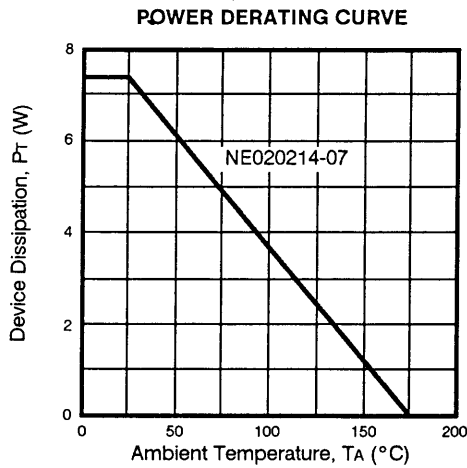
1. Power Numbering System:
2. Electronic Industrial Association of Japan.
3. Emitter and flange (stud) are grounded.



OUTLINE DIMENSIONS (Units in mm)

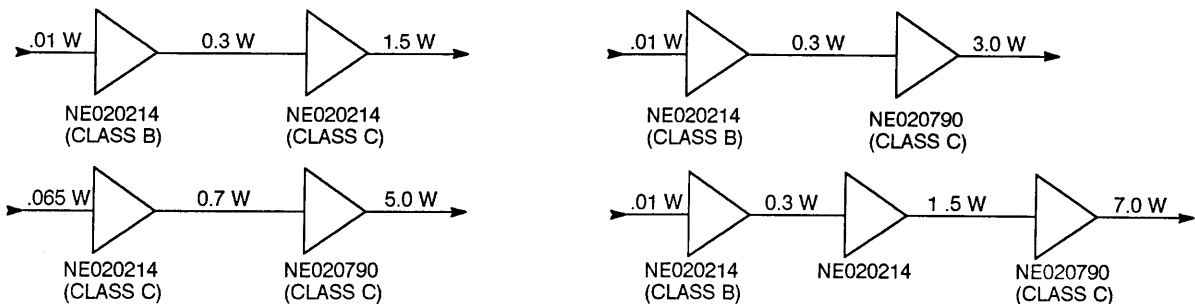


TYPICAL DEVICE CHARACTERISTICS (TA = 25°C)

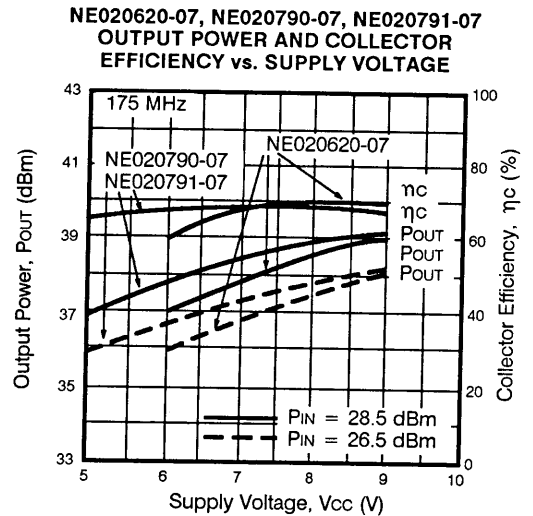
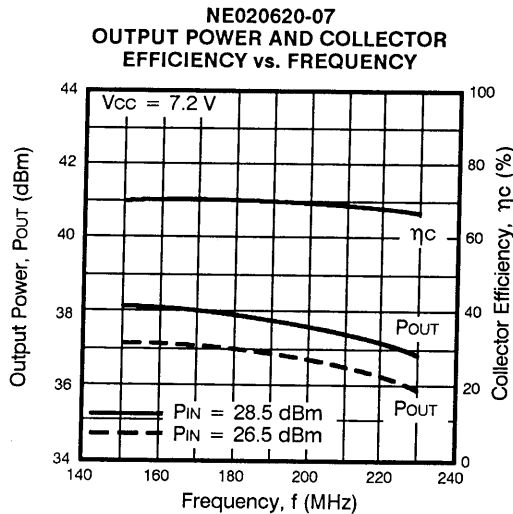
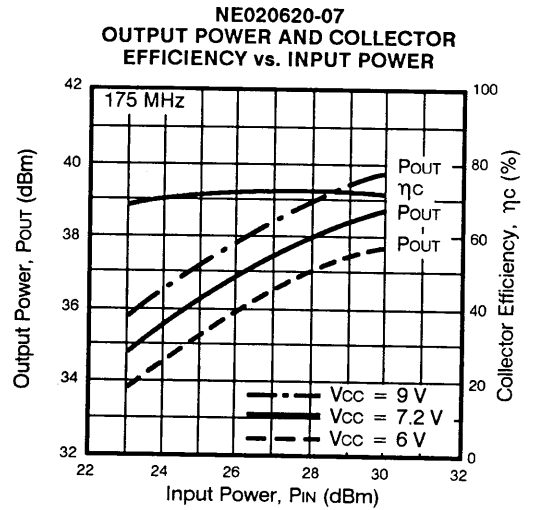
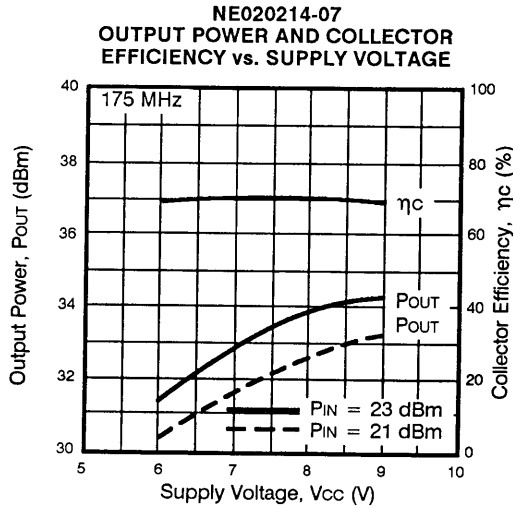
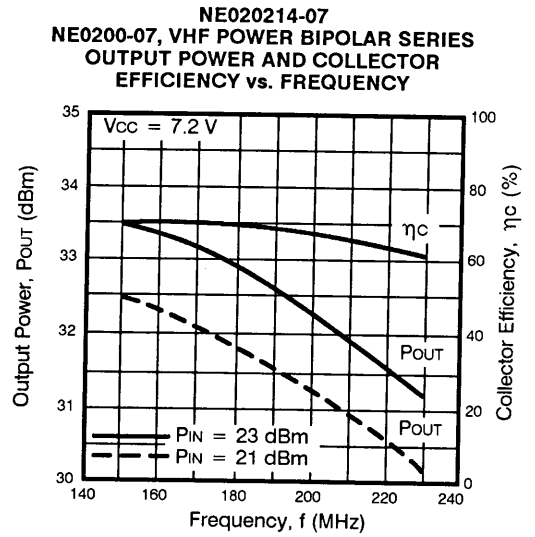
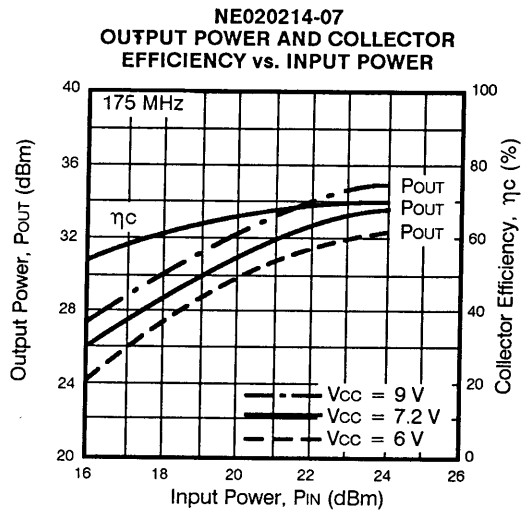


APPLICATIONS

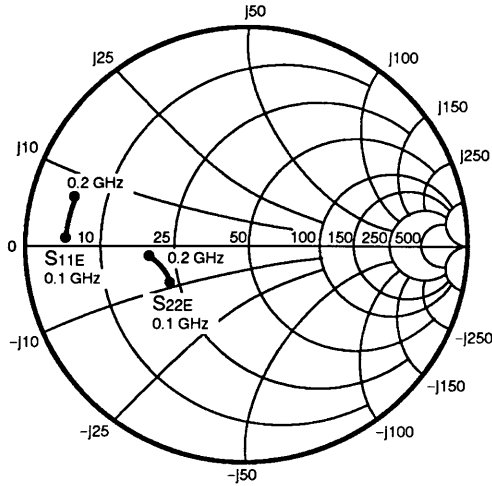
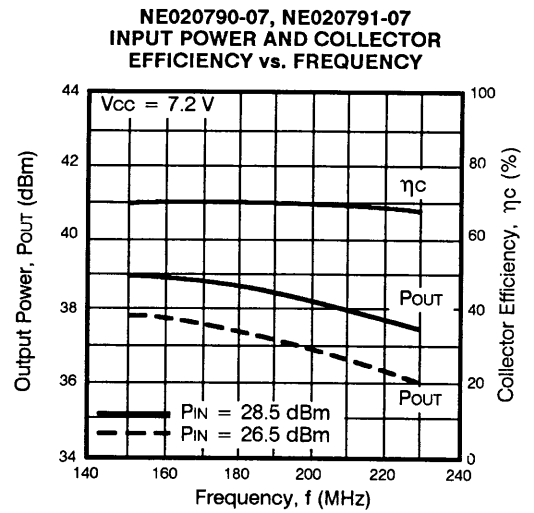
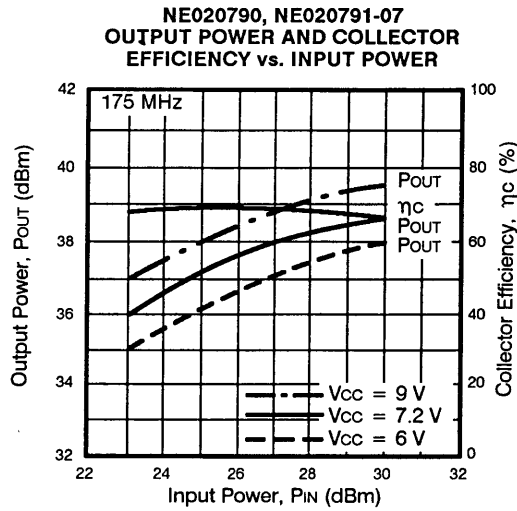
150 MHz HAND-HELD RADIO BAND (Vcc = 7.2 V)



TYPICAL PERFORMANCE CHARACTERISTICS ($T_A = 25^\circ\text{C}$, CLASS C, GROUNDING EMITTER)



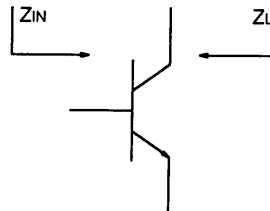
TYPICAL PERFORMANCE CHARACTERISTICS ($T_A = 25^\circ\text{C}$, CLASS C, GROUNDED EMITTER)



NE020214-07
S-Parameters
($V_{CE} = 10\text{ V}$, $I_C = 30\text{ mA}$, $Z_{OUT} = 50\ \Omega$)

TYPICAL IMPEDANCE

| PART NUMBER | FREQUENCY | Z_{IN} | | Z_L | |
|-----------------|-----------|----------|-------|-------|-------|
| NE020620-07 | 175 MHz | 2.5 | +j8.5 | 11.5 | +j7.5 |
| NE020790(91)-07 | 175 MHz | 3.5 | -j40 | 5.0 | +j0 |



Z_L is optimum load impedance at rated output power.

FEATURES

- SIX DIFFERENT LOW-COST PACKAGE STYLES AVAILABLE
- HIGH POWER
- HIGH GAIN
- SUPPLY VOLTAGE, $V_{CC} = 13.5\text{ V}$
- FOR 150 MHz BAND MOBILE RADIO APPLICATIONS
- SUPERIOR RF PERFORMANCE
- RUGGED VSWR $\infty : 1$
- HIGH RELIABILITY

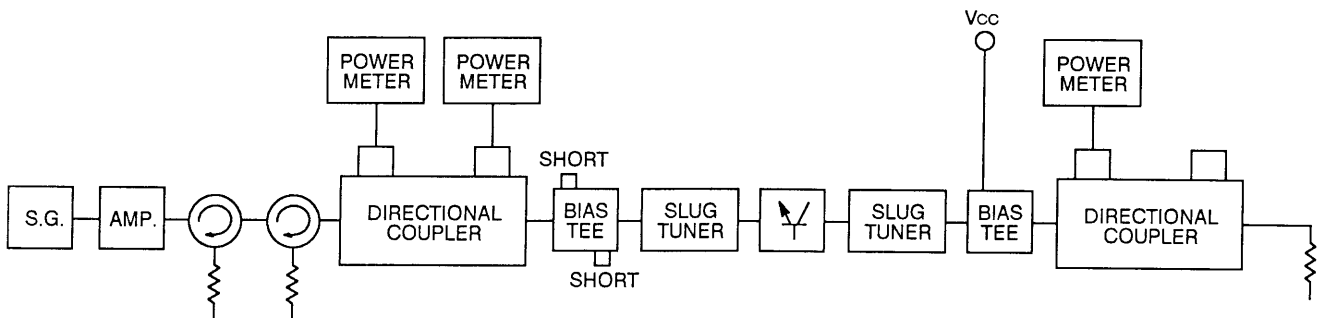
DESCRIPTION

The NE0200-12 series of VHF power transistors is NPN epitaxial silicon transistors designed to provide from 2.5 to 37.2 watts output power in the 150 MHz radio band. The Series is available in a variety of low cost, rugged packages designed to fulfill the requirements of most applications. All of the transistors are designed for a 13.5 supply voltage configuration for mobile radio applications.

High performance, ruggedness and reliability are achieved in the Series by combining the highest grade materials with carefully controlled production processes. Reliability is assured by passivation with Si_3N_4 and SiO_2 and by using test procedures patterned after MIL-STD-750 and MIL-S-19500. High performance and ruggedness are achieved by a proprietary fabrication technique using arsenic doped polysilicon (As DOPOS) and diffused ballast resistors.

The Series makes available to the designer high gain, high power and high production volume which are all combined in low-cost packages. The characteristics and features offered make NEC's NE0200-12 Series the ideal choice for mobile radio applications in the 150 MHz band.

TEST CIRCUIT (for Power Measurement)



PERFORMANCE SPECIFICATIONS (TA = 25°C)

| SYMBOLS | PARAMETERS AND CONDITIONS | UNITS | NE020214-12 2SC2339 14 (10-39) | | | NE020320-12 2SC2280 20 | | | NE020390(91)-12 2SC2286 90(91) | | | NE021020-12 2SC2281 20 | | | NE021090(91)-12 2287 90(91) | | | NE022025-12 2SC2282 25 | | | NE022090(91)-12 2288 90(91) | | | NE023592-12 2SC2330 92 | | |
|-------------------|--|-------|--------------------------------------|------|------|------------------------------|------|-----|--------------------------------------|-----|-----|------------------------------|-----|-----|-----------------------------------|-----|-----|------------------------------|-----|-----|-----------------------------------|-----|-----|------------------------------|-----|-----|
| | | | MIN | TYP | MAX | MIN | TYP | MAX | MIN | TYP | MAX | MIN | TYP | MAX | MIN | TYP | MAX | MIN | TYP | MAX | MIN | TYP | MAX | MIN | TYP | MAX |
| P _{OUT} | Output Power at f = 175 MHz, V _{CC} = 13.5 V | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Pin = 18 dBm | dBm | 33 | 34.5 | | 33 | 35.5 | | | | | | | | | | | | | | | | | | | |
| | Pin = 20 dBm | dBm | | | | | | | | | | | | | | | | | | | | | | | | |
| | Pin = 26 dBm | dBm | | | | | | | | | | | | | | | | | | | | | | | | |
| η _c | Collector Efficiency at f = 175 MHz, V _{CC} = 13.5 V | % | | | | | | | | | | | | | | | | | | | | | | | | |
| | Pin = 18 dBm | % | 55 | 70 | | 55 | 65 | | | | | | | | | | | | | | | | | | | |
| | Pin = 20 dBm | % | | | | | | | | | | | | | | | | | | | | | | | | |
| | Pin = 26 dBm | % | | | | | | | | | | | | | | | | | | | | | | | | |
| BV _{EBO} | Collector to Base Breakdown Voltage at I _E = 0 | V | 38 | | | 38 | | | | | | | | | | | | | | | | | | | | |
| | I _C = 1 mA | V | | | | | | | | | | | | | | | | | | | | | | | | |
| | I _C = 2 mA | V | | | | | | | | | | | | | | | | | | | | | | | | |
| | I _C = 4 mA | V | | | | | | | | | | | | | | | | | | | | | | | | |
| BV _{CEO} | Emitter to Base Breakdown Voltage at I _C = 0 | V | 3 | | | 3 | | | | | | | | | | | | | | | | | | | | |
| | I _E = 1 mA | V | | | | | | | | | | | | | | | | | | | | | | | | |
| | I _E = 2 mA | V | | | | | | | | | | | | | | | | | | | | | | | | |
| | I _E = 4 mA | V | | | | | | | | | | | | | | | | | | | | | | | | |
| LV _{CEO} | Collector to Base Breakdown Voltage at I _B = 0 | V | 18 | | | 18 | | | | | | | | | | | | | | | | | | | | |
| | I _C = 10 mA | V | | | | | | | | | | | | | | | | | | | | | | | | |
| | I _C = 20 mA | V | | | | | | | | | | | | | | | | | | | | | | | | |
| | I _C = 40 mA | V | | | | | | | | | | | | | | | | | | | | | | | | |
| I _{CBO} | Collector Cutoff Current at V _{CB} = 30 V, I _E = 0 | mA | | | 0.25 | | | | | | | | | | | | | | | | | | | | | |
| | Emitter Cutoff Current at V _{EB} = 2 V, I _C = 0 | mA | | | 0.25 | | | | | | | | | | | | | | | | | | | | | |
| h _{FE} | DC Forward Cutoff Gain at V _{CE} = 10 V | | 20 | 60 | 200 | 20 | 60 | 200 | | | | | | | | | | | | | | | | | | |
| | I _C = 0.2 A (Pulsed) | | | | | | | | | | | | | | | | | | | | | | | | | |
| | I _C = 0.4 A (Pulsed) | | | | | | | | | | | | | | | | | | | | | | | | | |
| | I _C = 0.8 A (Pulsed) | | | | | | | | | | | | | | | | | | | | | | | | | |
| C _{OB} | Output Capacitance at V _{CB} = 10 V, I _E = 0, f = 1 MHz ³ | pF | 7 | 10 | 7 | 10 | 7 | 10 | | | | | | | | | | | | | | | | | | |
| | Voltage Standing Wave Ratio Phase = λ g/2 | | | | | | | | | | | | | | | | | | | | | | | | | |
| V _{SWR} | V _{CC} = 16 V, P _o = 4 W | | | | | | | | | | | | | | | | | | | | | | | | | |
| | V _{CC} = 16 V, P _o = 10 W | | | | | | | | | | | | | | | | | | | | | | | | | |
| | V _{CC} = 16 V, P _o = 20 W | | | | | | | | | | | | | | | | | | | | | | | | | |
| | V _{CC} = 16 V, P _o = 35 W | | | | | | | | | | | | | | | | | | | | | | | | | |

See notes on page 3.

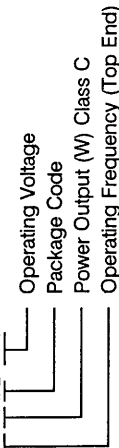


ABSOLUTE MAXIMUM RATINGS (T_A = 25°C)

| PART NUMBER ¹ EIAJ ² REGISTERED NUMBER PACKAGE OUTLINE | | NE02014-12 2SC2329 14 (TO-39) | NE020320-12 2SC2280 20 | NE020390(91)-12 2SC2286 90 (91) | NE021020-12 2SC2281 20 | NE021090(91)-12 2SC2287 90 (91) | NE022025-12 2SC2282 25 | NE022090(91)-12 2SC2288 90 (91) | NE023592-12 2SC2330 92 |
|--|---|-------------------------------------|------------------------------|---------------------------------------|------------------------------|---------------------------------------|------------------------------|---------------------------------------|------------------------------|
| SYMBOLS | CHARACTERISTICS | UNITS | | | | | | | |
| V _{ceo} | Collector to Base Voltage | V | 38 | 38 | 38 | 38 | 38 | 38 | 38 |
| V _{ebo} | Emitter to Base Voltage | V | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| V _{ceo} | Collector to Emitter Voltage | V | 18 | 18 | 18 | 18 | 18 | 18 | 18 |
| I _c | Collector Current | A | 0.75 | 0.75 | 0.75 | 1.5 | 3 | 3 | 6 |
| R _{th} | Thermal Resistance (Junction-to-Case) | °C/W | 20 | 15 | 15 | 8.8 | 4.4 | 4.4 | 2.5 |
| P _T | Total Power Dissipation (T _c = 25°C) | W | 7.5 | 10 | 10 | 17 | 34 | 34 | 70 |
| T _J | Junction Temperature | °C | 175 | 175 | 175 | 175 | 175 | 175 | 200 |
| T _{stg} | Storage Temperature | °C | -65 to +175 | -65 to +175 | -65 to +150 | -65 to +175 | -65 to +175 | -65 to +150 | -65 to +150 |

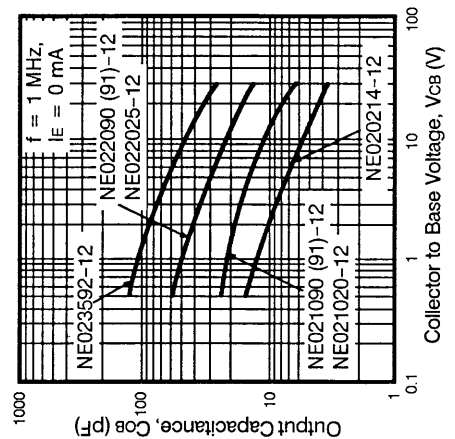
Notes:

1. Power Numbering System
NE¹XXYY ZZ-WW
 - NE: Electronic Industrial Association of Japan.
 - XXYY: Package Code
 - ZZ: Operating Voltage
 - WW: Operating Frequency (Top End)
2. Electronic Industrial Association of Japan.
3. Emitter and Case are grounded.

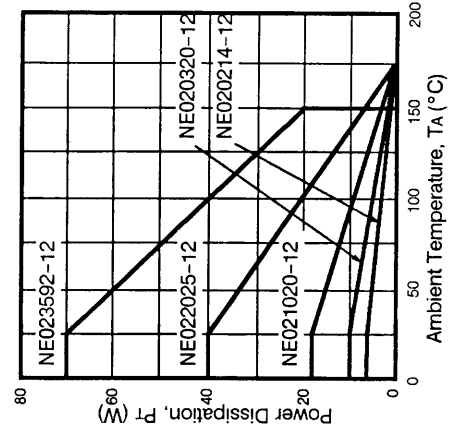


TYPICAL DEVICE CHARACTERISTICS (T_A = 25°C)

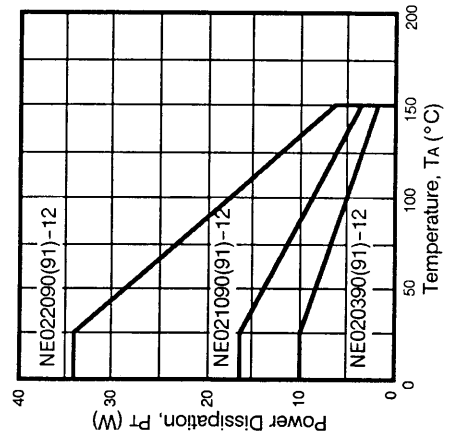
OUTPUT CAPACITANCE vs. COLLECTOR TO BASE VOLTAGE



POWER DERATING CURVES

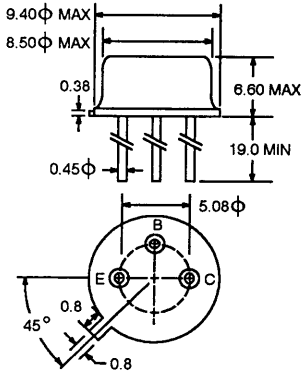


POWER DERATING CURVES



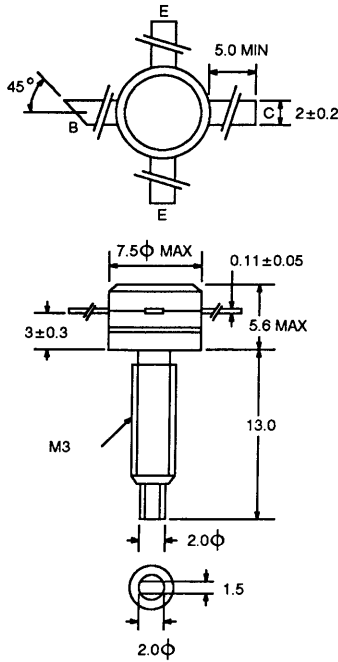
OUTLINE DIMENSIONS (Units in mm)

OUTLINE 14
(TO-39)

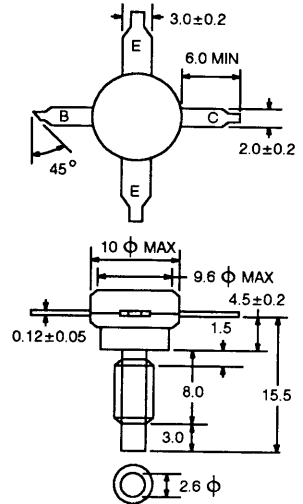


All leads isolated from case.

OUTLINE 20

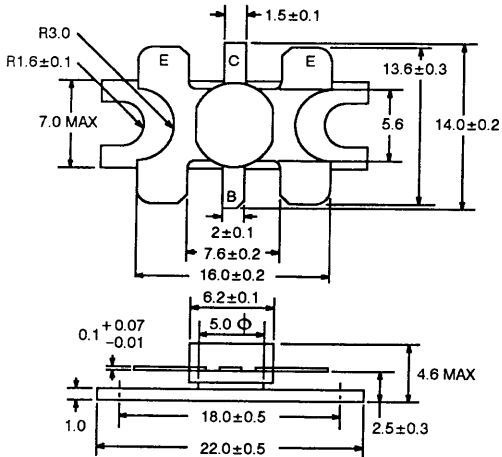


OUTLINE 25

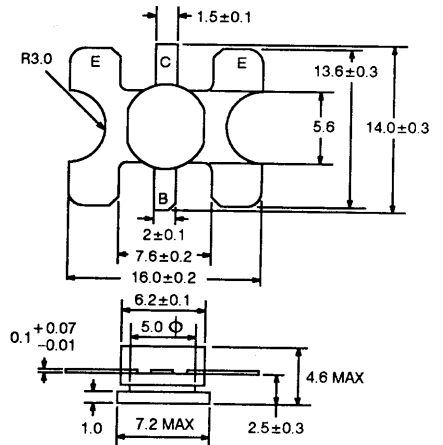


All leads insulated from stud.

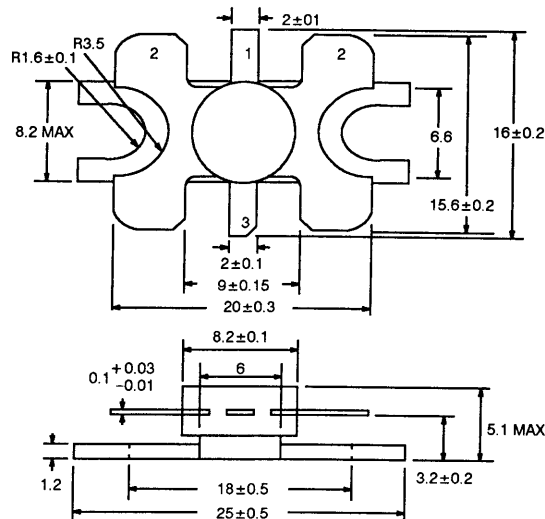
OUTLINE 90



OUTLINE 91

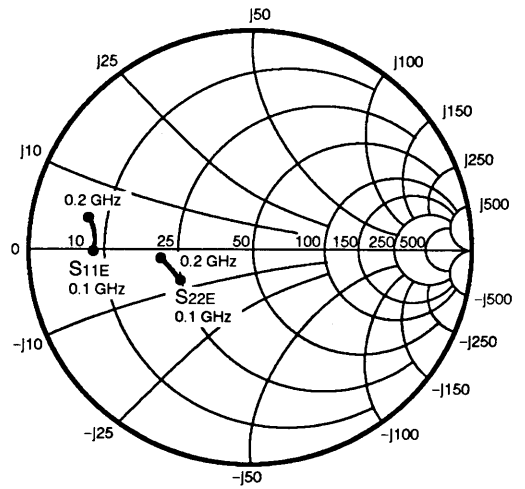
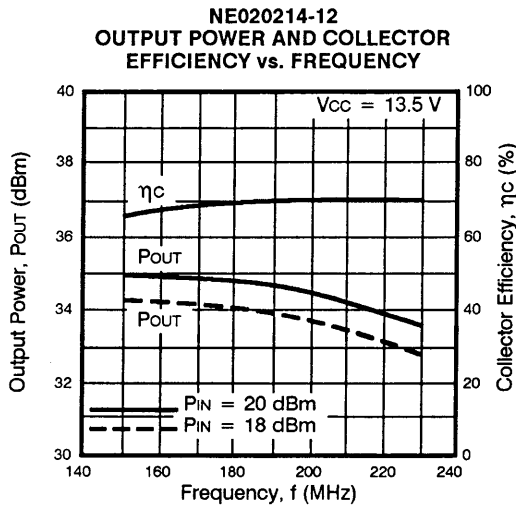
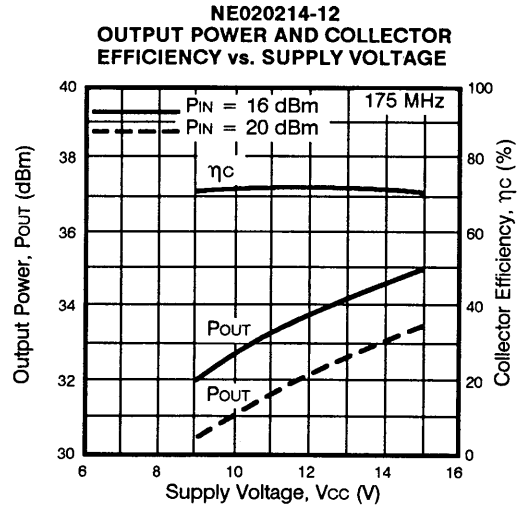
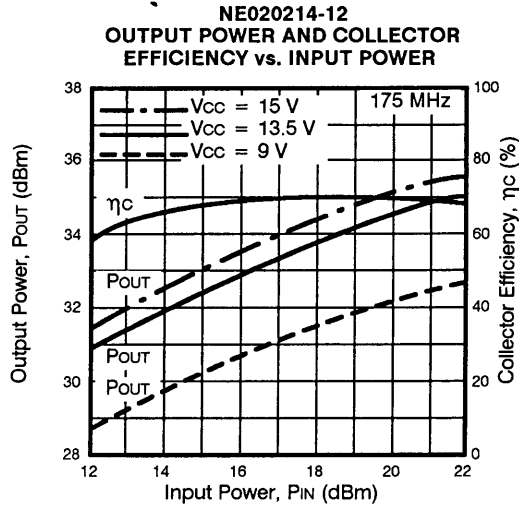


OUTLINE 92



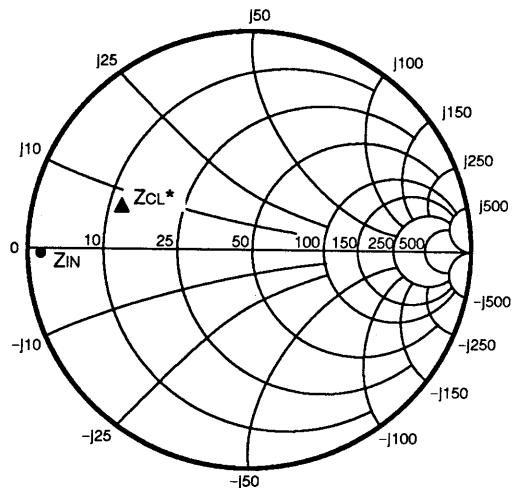
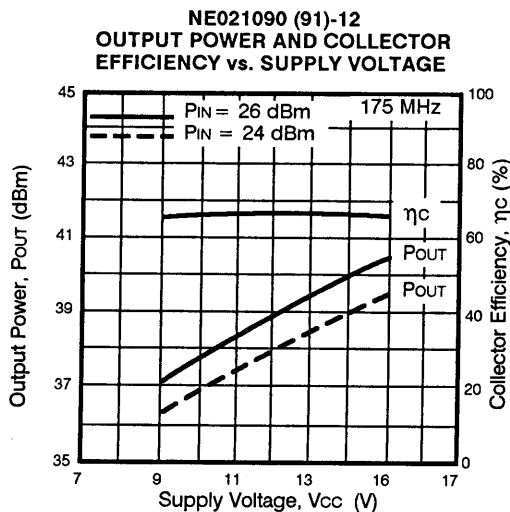
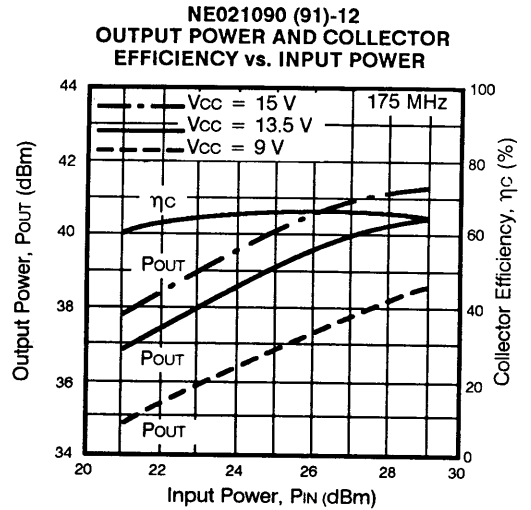
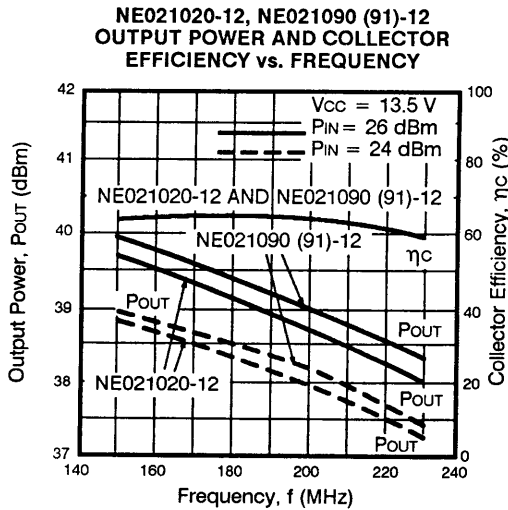
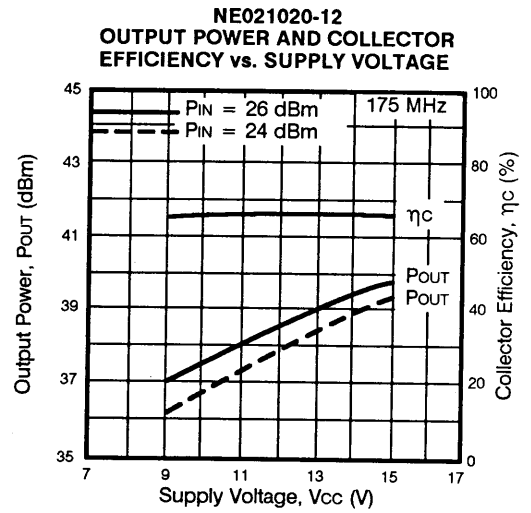
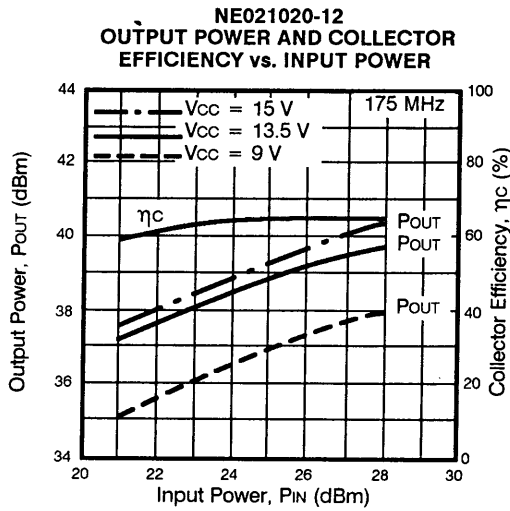
NE0200-12 SERIES

TYPICAL PERFORMANCE CHARACTERISTICS ($T_A = 25^\circ\text{C}$, CLASS C, GROUNDED EMITTER)



NE020214-12
S Parameters
 ($V_{CE} = 10\text{ V}$, $I_c = 30\text{ mA}$, $Z_o = 50\ \Omega$)

TYPICAL PERFORMANCE CHARACTERISTICS (T_A = 25°C, CLASS C, GROUNDED EMITTER)

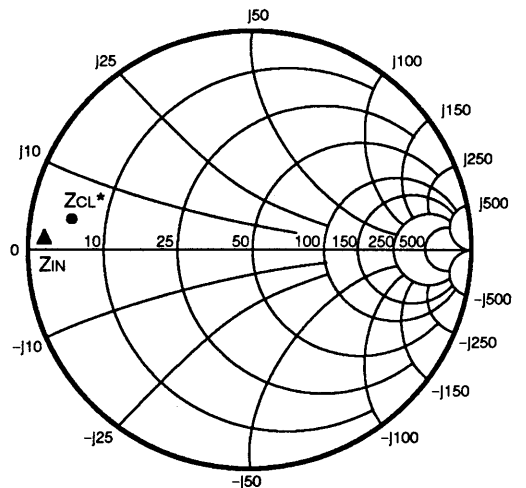
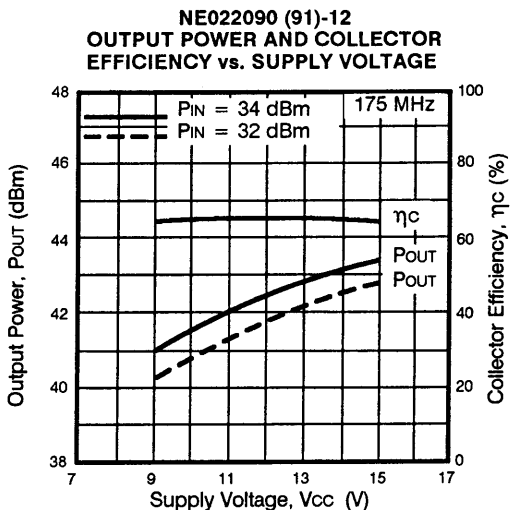
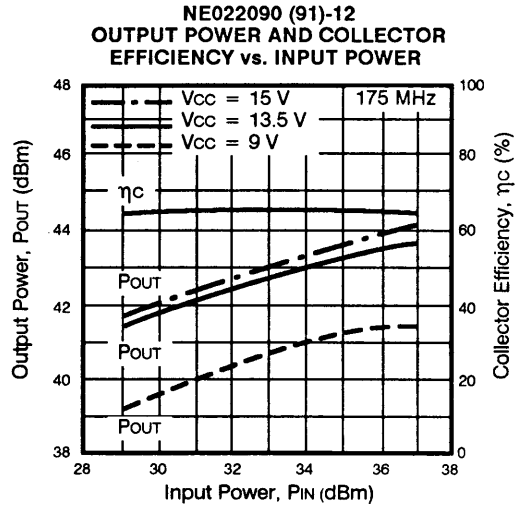
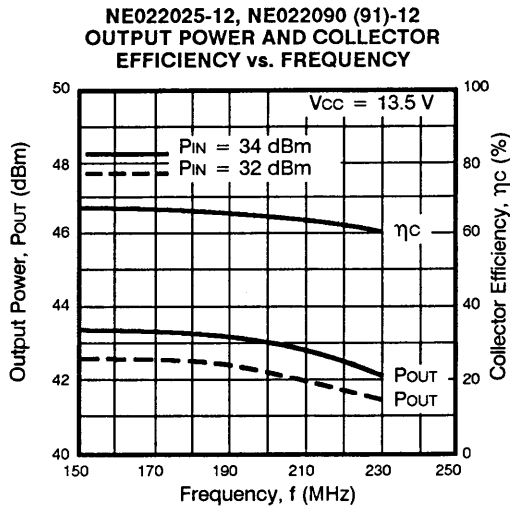
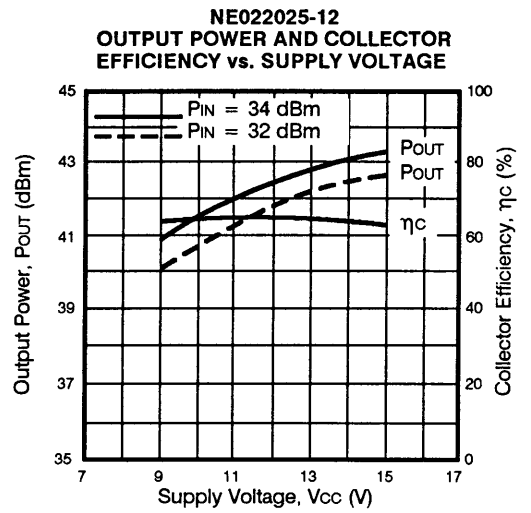
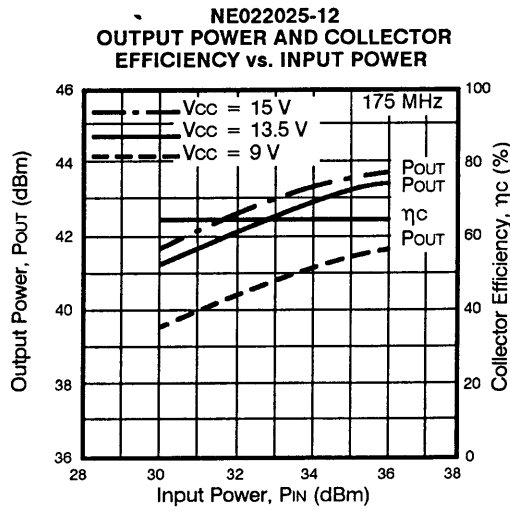


NE021090 (91)-12
Input and Output Impedances
(V_{cc} = 13.5 V, f = 175 MHz, P_{OUT} = 39.5 dBm, Z_{OUT} = 50 Ω)
*Z_{CL} is looking into the matching network

2

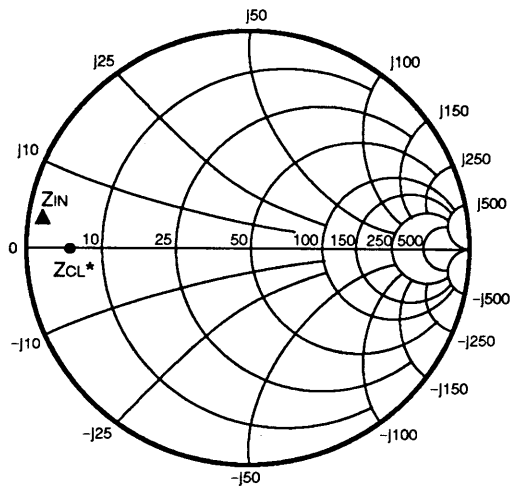
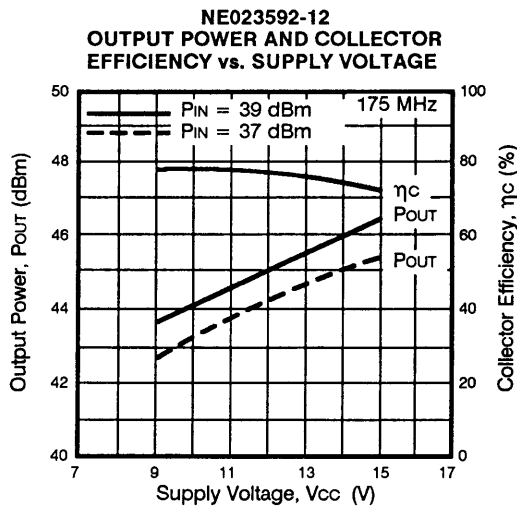
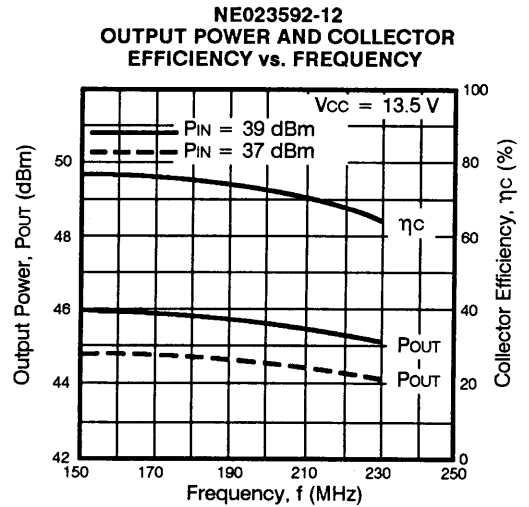
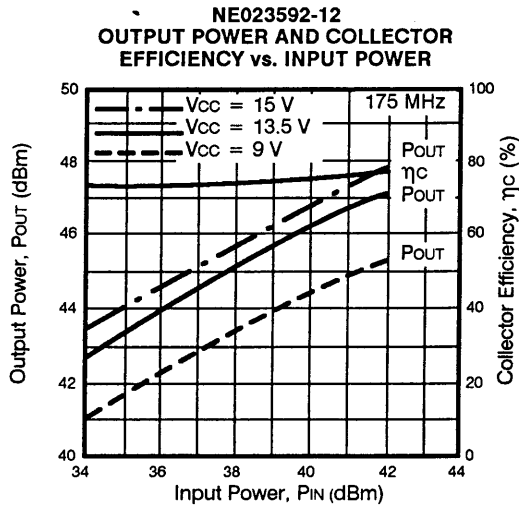
NE0200-12 SERIES

TYPICAL PERFORMANCE CHARACTERISTICS (T_A = 25°C, CLASS C, GROUNDED EMITTER)



**NE022090 (91)-12
Input and Output Impedances**
(V_{cc} = 13.5 V, f = 175 MHz, P_{OUT} = 43 dBm, Z_{OUT} = 50 Ω)
*Z_{CL} is looking into the matching network

TYPICAL PERFORMANCE CHARACTERISTICS (T_A = 25°C, CLASS C, GROUNDED EMITTER)



NE023592-12
Input and Output Impedances
 (V_{CC} = 13.5 V, f = 175 MHz, P_{OUT} = 45.7 dBm, Z_{OUT} = 50 Ω)
 *Z_{CL} is looking into the matching network

APPLICATIONS

150 MHz MOBILE RADIO BAND (V_{CC} = 12 V)

