



**NEC's POWER AMPLIFIER  
FOR BLUETOOTH™ CLASS 1**

**UPG2301TQ**

**FEATURES**

- **OPERATION FREQUENCY**  
f<sub>opt</sub> = 2,400 to 2,500 MHz (2 450 MHz TYP.)
- **SUPPLY VOLTAGE**  
V<sub>CC1,2</sub> = V<sub>bias</sub> = 2.7 to 3.6 V (3.3 V TYP.)
- **CONTROL VOLTAGE**  
V<sub>cont</sub> = 0 to 3.6 V (2.5 V TYP.)  
V<sub>enable</sub> = 0 to 3.1 V (2.9 V TYP.)
- **CIRCUIT CURRENT**  
I<sub>CC</sub> = 120 mA TYP.@ V<sub>CC1,2</sub> = V<sub>bias</sub> = 3.3 V, V<sub>cont</sub> = 2.5 V,  
V<sub>enable</sub> = 2.9 V, P<sub>in</sub> = +4 dBm
- **MAXIMUM POWER**  
P<sub>out(MAX.)</sub> = +23 dBm TYP.@ V<sub>CC1,2</sub> = V<sub>bias</sub> = 3.3 V,  
V<sub>cont</sub> = 2.5 V, V<sub>enable</sub> = 2.9 V, P<sub>in</sub> = +4 dBm
- **GAIN CONTROL RANGE**  
GCR = 23 dB TYP.@ V<sub>CC1,2</sub> = V<sub>bias</sub> = 3.3 V,  
V<sub>cont</sub> = 0 to 2.5 V, V<sub>enable</sub> = 2.9 V, P<sub>in</sub> = +4 dBm
- **POWER GAIN**  
G<sub>P</sub> = 23 dB TYP.(Reference value)
- **HIGH EFFICIENCY**  
PAE = 50% TYP.(Reference value)
- **SHUT DOWN FUNCTION**
- **HIGH-DENSITY SURFACE MOUNTING**  
10 pin plastic TSON package (2.4 × 2.55 × 0.6 mm)

**DESCRIPTION**

NEC's μPG2301TQ is a GaAs HBT MMIC for power amplifier for Bluetooth Class 1.

This device realizes high efficiency, high gain and high output power by using InGaP HBT. This device is housed in a low profile 10-pin plastic TSON package.

**APPLICATION**

- **POWER AMPLIFIER FOR BLUETOOTH CLASS 1**
- **WIRELESS LAN**

**ELECTRICAL CHARACTERISTICS**

(Unless otherwise specified, T<sub>A</sub> = +25°C, V<sub>CC1,2</sub> = V<sub>bias</sub> = 3.3 V, f = 2,450 MHz, External input and output matching)

| PARAMETER          | SYMBOL                 | TEST CONDITIONS  | MIN. | TYP. | MAX.  | UNIT |
|--------------------|------------------------|--|------|------|-------|------|
| Circuit Current    | I <sub>CC</sub>        | V <sub>cont</sub> = 2.5 V, V <sub>enable</sub> = 2.9 V,<br>P <sub>in</sub> = +4 dBm      | 110  | 120  | 130   | mA   |
| Shut Down Current  | I <sub>shut down</sub> | V <sub>cont</sub> = 2.5 V, V <sub>enable</sub> = 0 V,<br>P <sub>in</sub> = +4 dBm        | -    | 0.1  | 1.0   | μA   |
| Output Power 1     | P <sub>out1</sub>      | V <sub>cont</sub> = 2.5 V, V <sub>enable</sub> = 2.9 V,<br>P <sub>in</sub> = +4 dBm      | +21  | +23  | +24.5 | dBm  |
| Output Power 2     | P <sub>out2</sub>      | V <sub>cont</sub> = 0 V, V <sub>enable</sub> = 2.9 V,<br>P <sub>in</sub> = +4 dBm        | -    | 0    | +1    | dBm  |
| Gain Control Range | GCR                    | V <sub>cont</sub> = 0 to 2.5 V, V <sub>enable</sub> = 2.9 V,<br>P <sub>in</sub> = +4 dBm | 20   | 23   | -     | dB   |

**ELECTRICAL CHARACTERISTICS**

(Unless otherwise specified, T<sub>A</sub> = +25°C, V<sub>CC1,2</sub> = V<sub>bias</sub> = 3.3 V, f = 2,450 MHz, External input and output matching)

| PARAMETER  | SYMBOL         | TEST CONDITIONS   | MIN. | TYP. | MAX. | UNIT |
|------------|----------------|---|------|------|------|------|
| Efficiency | PAE            | V <sub>cont</sub> = 2.5 V, V <sub>enable</sub> = 2.9 V,<br>P <sub>in</sub> = +4 dBm | -    | 50   | -    | %    |
| Power Gain | G <sub>P</sub> | V <sub>cont</sub> = 2.5 V, V <sub>enable</sub> = 2.9 V,<br>P <sub>in</sub> = -5 dBm | -    | 23   | -    | dB   |

**ABSOLUTE MAXIMUM RATINGS**

| PARAMETER                     | SYMBOL       | RATINGS             | UNIT |
|-------------------------------|--------------|---------------------|------|
| Supply Voltage                | $V_{CC1,2}$  | 5.0                 | V    |
|                               | $V_{bias}$   |                     |      |
| Control Voltage               | $V_{cont}$   | 3.6                 | V    |
|                               | $V_{enable}$ |                     |      |
| Circuit Current               | $I_{cc}$     | 400                 | mA   |
| Control Current               | $I_{cont}$   | 0.5                 | mA   |
|                               | $I_{enable}$ |                     |      |
| Power Dissipation             | $P_D$        | 700 <sup>Note</sup> | mW   |
| Operating Ambient Temperature | $T_A$        | -40 to +85          | °C   |
| Storage Temperature           | $T_{stg}$    | -55 to +150         | °C   |
| Input Power                   | $P_{in}$     | +10                 | dBm  |

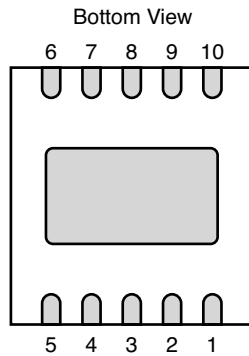
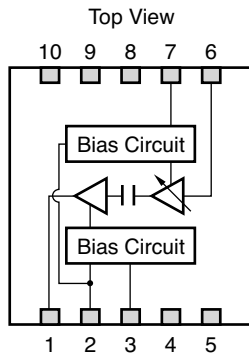
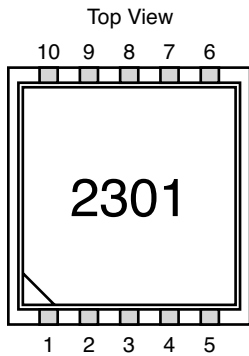
**Note** Mounted on double copper-clad 50 × 50 × 1.6 mm epoxy glass PWB,  $T_A = +85^\circ\text{C}$

**RECOMMENDED OPERATING RANGE**

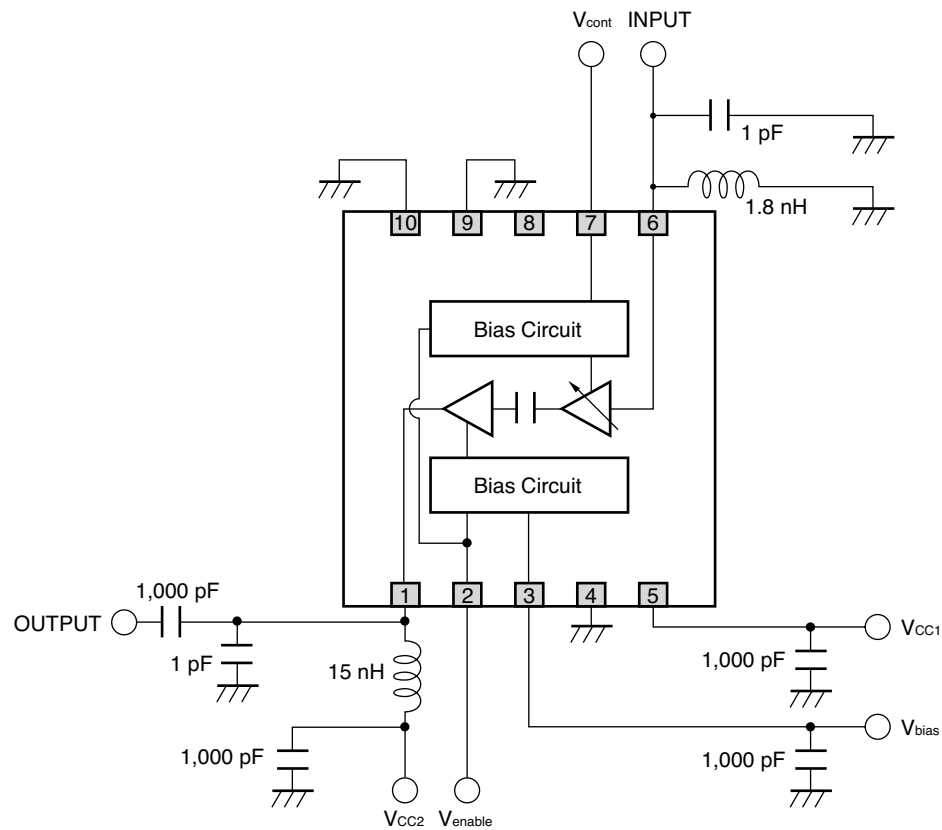
( $T_A = +25^\circ\text{C}$ )

| PARAMETER           | SYMBOL       | MIN.  | TYP.  | MAX.  | UNIT |
|---------------------|--------------|-------|-------|-------|------|
| Operating Frequency | $f_{opt}$    | 2,400 | 2,450 | 2,500 | MHz  |
| Supply Voltage      | $V_{CC1,2}$  | 2.7   | 3.3   | 3.6   | V    |
|                     | $V_{bias}$   |       |       |       |      |
| Control Voltage     | $V_{cont}$   | 0     | 2.5   | 3.6   | V    |
|                     | $V_{enable}$ | 0     | 2.9   | 3.1   |      |

**PIN CONNECTIONS AND INTERNAL BLOCK DIAGRAM**

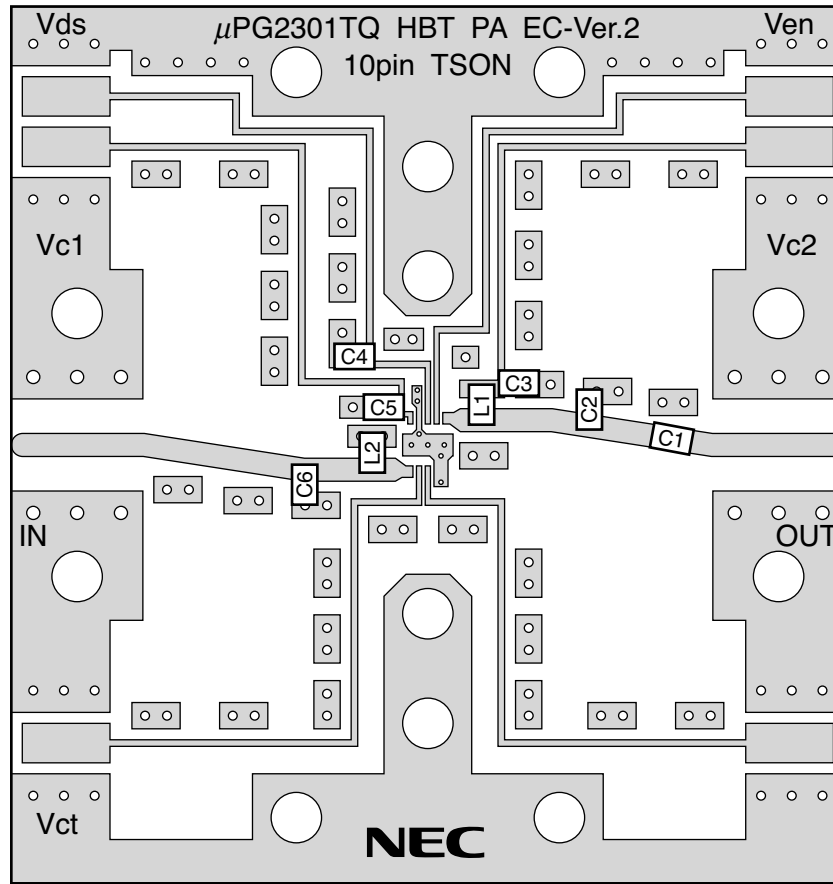


| PIN NO. | PIN NAME          |
|---------|-------------------|
| 1       | OUTPUT/ $V_{CC2}$ |
| 2       | $V_{enable}$      |
| 3       | $V_{bias}$        |
| 4       | GND               |
| 5       | $V_{CC1}$         |
| 6       | INPUT             |
| 7       | $V_{cont}$        |
| 8       | N.C.              |
| 9       | GND               |
| 10      | GND               |

**EVALUATION CIRCUIT** ( $V_{CC1,2} = V_{bias} = 3.3\text{ V}$ ,  $f = 2,450\text{ MHz}$ )

The application circuits and their parameters are for reference only and are not intended for use in actual design-ins.

ILLUSTRATION OF THE TEST CIRCUIT ASSEMBLED ON EVALUATION BOARD

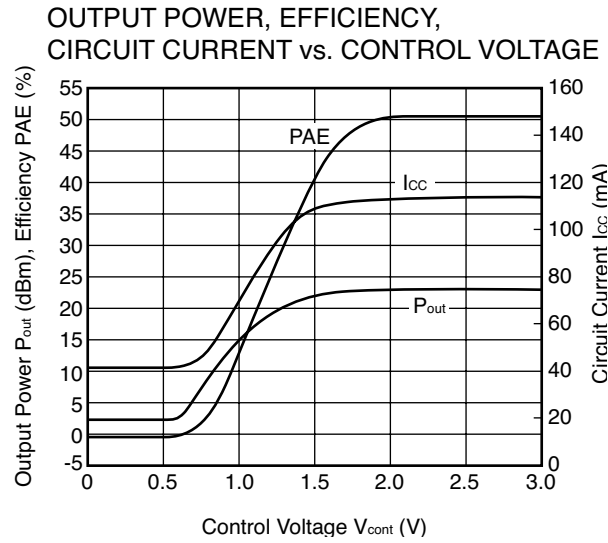


COMPONENT LIST

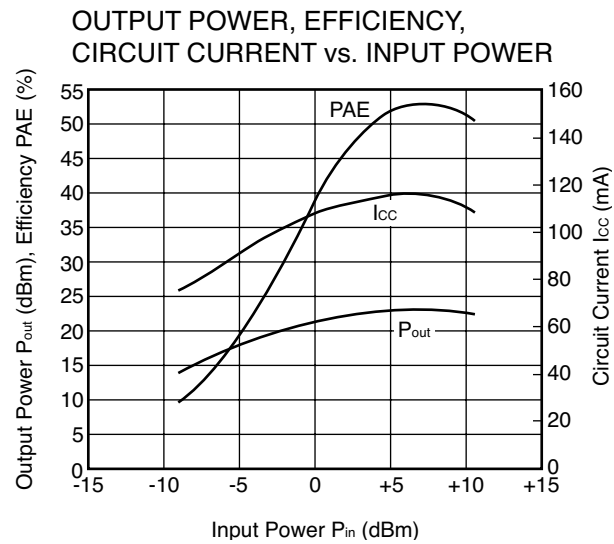
| SYMBOL         | RATING   | PART NUMBER   | MANUFACTURER |
|----------------|----------|---------------|--------------|
| C1, C3, C4, C5 | 1,000 pF | GRM39CH102J50 | muRata       |
| C2, C6         | 1 pF     | GRM39CH010C50 | muRata       |
| L1             | 15 nH    | TFL0816-15N   | Susumu       |
| L2             | 1.8 nH   | TFL0816-1N8   | Susumu       |

**TYPICAL CHARACTERISTICS**

Condition :  $f = 2,450 \text{ MHz}$ ,  $V_{CC1} = V_{CC2} = V_{bias} = 3.3 \text{ V}$ ,  $V_{enable} = 2.9 \text{ V}$ ,  $P_{in} = +4 \text{ dBm}$ , External input and output matching



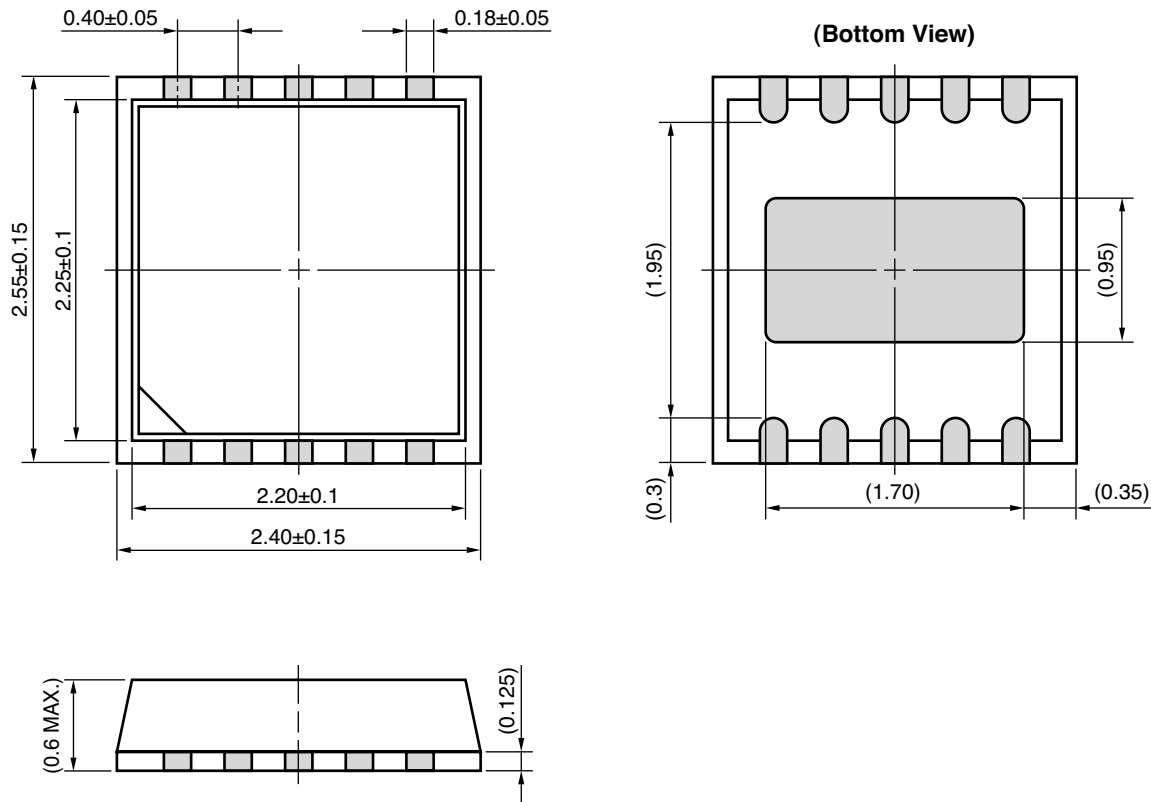
Condition :  $f = 2,450 \text{ MHz}$ ,  $V_{CC1} = V_{CC2} = V_{bias} = 3.3 \text{ V}$ ,  $V_{enable} = 2.9 \text{ V}$ ,  $V_{cont} = 2.5 \text{ V}$ , External input and output matching



**Remark** The graphs indicate nominal characteristics.

**PACKAGE DIMENSIONS**

**10-PIN PLASTIC TSON (UNIT: mm)**



**Note** ( ) : Reference value

**ORDERING INFORMATION**

| PART NUMBER         | PACKAGE             | MARKING | SUPPLYING FORM   |
|---------------------|---------------------|---------|--|
| $\mu$ PG2301TQ-E1-A | 10-pin plastic TSON | 2301    | <ul style="list-style-type: none"> <li>• Embossed tape 8 mm wide</li> <li>• Pin 5, 6 face the perforation side of the tape</li> <li>• Qty 3 kpcs/reel</li> </ul> |

**Remark** To order evaluation samples, contact your nearby sales office.  
Part number for sample order:  $\mu$ PG2301TQ

**Life Support Applications**

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02/04/2004

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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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