

3 V, 2.9 GHz SILICON MMIC MEDIUM OUTPUT POWER AMPLIFIER FOR MOBILE COMMUNICATIONS

DESCRIPTION

The μ PC8182TB is a silicon monolithic integrated circuit designed as amplifier for mobile communications. This IC is low current consumption and wide band than μ PC2771TB.

This IC is manufactured using NEC's 25 GHz fr UHS0 silicon bipolar process. This process uses direct silicon nitride passivation film and gold electrodes. These materials can protect the chip surface from pollution and prevent corrosion/migration. Thus, this IC has excellent performance, uniformity and reliability.

FEATURES

- High-density surface mounting : 6-pin super minimold package (2.0 × 1.25 × 0.9 mm)
- Supply voltage : $V_{CC} = 2.7$ to 3.3 V
- Circuit current : $I_{CC} = 30$ mA TYP. @ $V_{CC} = 3.0$ V
- Medium output power : $P_{O(1dB)} = +9.5$ dBm TYP. @ $f = 0.9$ GHz
 $P_{O(1dB)} = +9.0$ dBm TYP. @ $f = 1.9$ GHz
 $P_{O(1dB)} = +8.0$ dBm TYP. @ $f = 2.4$ GHz
- Power gain : $G_P = 21.5$ dB TYP. @ $f = 0.9$ GHz
 $G_P = 20.5$ dB TYP. @ $f = 1.9$ GHz
 $G_P = 20.5$ dB TYP. @ $f = 2.4$ GHz
- Upper limit operating frequency : $f_u = 2.9$ GHz TYP. @ 3 dB bandwidth

APPLICATION

- Buffer amplifiers on 1.9 GHz to 2.4 GHz mobile communications system.

ORDERING INFORMATION

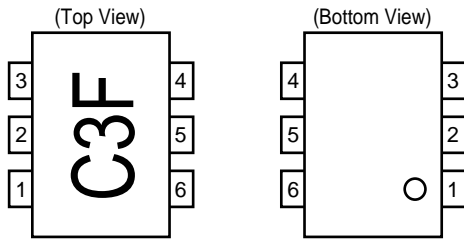
| Part Number | Package | Marking | Supplying Form |
|-------------------|----------------------|---------|--|
| μ PC8182TB-E3 | 6-pin super minimold | C3F | Embossed tape 8 mm wide. 1, 2, 3 pins face to perforation side of the tape. Qty 3 kp/reel. |

Remark To order evaluation samples, please contact your local NEC sales office.
(Part number for sample order: μ PC8182TB)

Caution Electro-static sensitive devices

The information in this document is subject to change without notice. Before using this document, please confirm that this is the latest version.
Not all devices/types available in every country. Please check with local NEC representative for availability and additional information.

PIN CONNECTIONS



| Pin No. | Pin Name |
|---------|-----------------|
| 1 | INPUT |
| 2 | GND |
| 3 | GND |
| 4 | OUTPUT |
| 5 | GND |
| 6 | V _{CC} |

PRODUCT LINE-UP (T_A = +25 °C, V_{CC} = V_{out} = 3.0 V, Z_s = Z_L = 50 Ω)

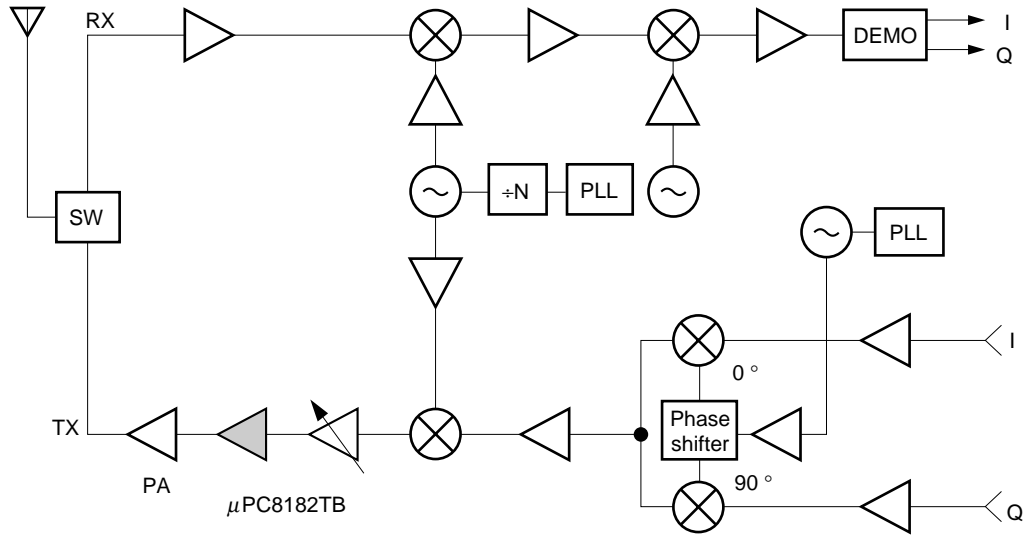
| Part No. | f _u (GHz) | P _O (1 dB) (dBm) | G _P (dB) | I _{CC} (mA) | Package | Marking |
|-----------|-------------------------|--------------------------------|------------------------|-------------------------|----------------------|---------|
| μPC2762T | 2.9 | +8.0 @ f = 0.9 GHz | 13.0 @ f = 0.9 GHz | 26.5 | 6-pin minimold | C1Z |
| μPC2762TB | | +7.0 @ f = 1.9 GHz | 15.5 @ f = 1.9 GHz | | 6-pin super minimold | |
| μPC2763T | 2.7 | +9.5 @ f = 0.9 GHz | 20.0 @ f = 0.9 GHz | 27.0 | 6-pin minimold | C2A |
| μPC2763TB | | +6.5 @ f = 1.9 GHz | 21.0 @ f = 1.9 GHz | | 6-pin super minimold | |
| μPC2771T | 2.2 | +11.5 @ f = 0.9 GHz | 21.0 @ f = 0.9 GHz | 36.0 | 6-pin minimold | C2H |
| μPC2771TB | | +9.5 @ f = 1.5 GHz | 21.0 @ f = 1.5 GHz | | 6-pin super minimold | |
| μPC8182TB | 2.9 | +9.0 @ f = 1.9 GHz | 20.5 @ f = 1.9 GHz | 30.0 | 6-pin super minimold | C3F |
| | | +8.0 @ f = 2.4 GHz | 20.5 @ f = 2.4 GHz | | | |

Remark Typical performance. Please refer to ELECTRICAL CHARACTERISTICS in detail.

Notice The package size distinguishes between minimold and super minimold.

SYSTEM APPLICATION EXAMPLE

Digital cellular telephone



PIN EXPLANATION

| Pin No. | Pin Name | Applied Voltage (V) | Pin Voltage (V) ^{Note} | Function and Applications | Internal Equivalent Circuit |
|-------------|-----------------|--|---------------------------------|---|-----------------------------|
| 1 | INPUT | – | – | Signal input pin. A internal matching circuit, configured with resistors, enables 50 Ω connection over a wide band. A multi-feedback circuit is designed to cancel the deviations of h _{FE} and resistance. This pin must be coupled to signal source with capacitor for DC cut. | |
| 4 | OUTPUT | Voltage as same as V _{CC} through external inductor | – | Signal output pin. The inductor must be attached between V _{CC} and output pins to supply current to the internal output transistors. | |
| 6 | V _{CC} | 2.7 to 3.3 | – | Power supply pin, which biases the internal input transistor. This pin should be externally equipped with bypass capacitor to minimize its impedance. | |
| 2 3 5 | GND | 0 | – | Ground pin. This pin should be connected to system ground with minimum inductance. Ground pattern on the board should be formed as wide as possible. All the ground pins must be connected together with wide ground pattern to decrease impedance difference. | |

Note Pin voltage is measured at V_{CC} = 3.0 V.

ABSOLUTE MAXIMUM RATINGS

| Parameter | Symbol | Conditions | Ratings | Unit |
|-------------------------------|------------------|--|-------------|------|
| Supply Voltage | V _{CC} | T _A = +25 °C, pin 4 and 6 | 3.6 | V |
| Total Circuit Current | I _{CC} | T _A = +25 °C | 60 | mA |
| Power Dissipation | P _D | Mounted on double copper clad 50 × 50 × 1.6 mm epoxy glass PWB (T _A = +85 °C) | 200 | mW |
| Operating Ambient Temperature | T _A | | -40 to +85 | °C |
| Storage Temperature | T _{stg} | | -55 to +150 | °C |
| Input Power | P _{in} | T _A = +25 °C | +10 | dBm |

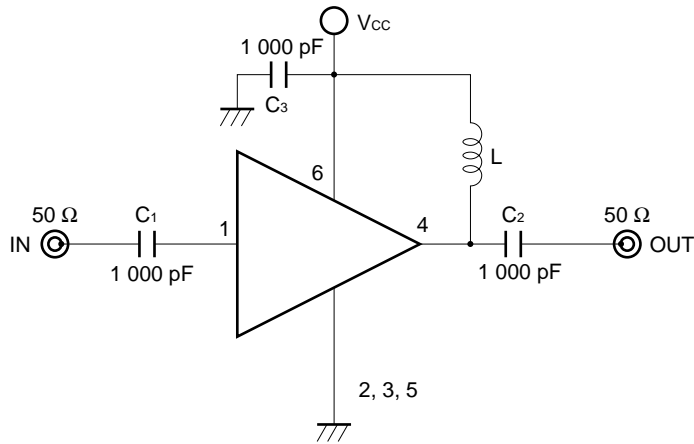
RECOMMENDED OPERATING CONDITIONS

| Parameter | Symbol | MIN. | TYP. | MAX. | Unit | Remark |
|-------------------------------|-----------------|------|------|------|------|--|
| Supply Voltage | V _{CC} | 2.7 | 3.0 | 3.3 | V | Same voltage should be applied to pin 4 and 6. |
| Operating Ambient Temperature | T _A | -40 | +25 | +85 | °C | - |

ELECTRICAL CHARACTERISTICS (T_A = +25 °C, V_{CC} = V_{out} = 3.0 V, Z_S = Z_L = 50 Ω)

| Parameter | Symbol | Test Conditions | MIN. | TYP. | MAX. | Unit |
|------------------------------------|----------------------|--|------|-------|------|------|
| Circuit Current | I _{CC} | No signal | 22.0 | 30.0 | 38.0 | mA |
| Power Gain | G _P | f = 0.9 GHz | 19.0 | 21.5 | 25.0 | dB |
| | | f = 1.9 GHz | 17.5 | 20.5 | 23.5 | |
| | | f = 2.4 GHz | 18.0 | 20.5 | 24.0 | |
| Noise Figure | NF | f = 0.9 GHz | – | 4.5 | 6.0 | dB |
| | | f = 1.9 GHz | – | 4.5 | 6.0 | |
| | | f = 2.4 GHz | – | 5.0 | 6.5 | |
| Upper Limit Operating Frequency | f _u | 3 dB down below from gain at f = 0.1 GHz | 2.8 | 2.9 | – | GHz |
| Isolation | ISL | f = 0.9 GHz | 30 | 33 | – | dB |
| | | f = 1.9 GHz | 27 | 32 | – | |
| | | f = 2.4 GHz | 28 | 31 | – | |
| Input Return Loss | RL _{in} | f = 0.9 GHz | 6 | 8 | – | dB |
| | | f = 1.9 GHz | 8 | 10 | – | |
| | | f = 2.4 GHz | 9 | 12 | – | |
| Output Return Loss | RL _{out} | f = 0.9 GHz | 8 | 10 | – | dB |
| | | f = 1.9 GHz | 9 | 11 | – | |
| | | f = 2.4 GHz | 11 | 14 | – | |
| 1 dB Gain Compression Output Level | P _O (1dB) | f = 0.9 GHz | +7.5 | +9.5 | – | dBm |
| | | f = 1.9 GHz | +7.0 | +9.0 | – | |
| | | f = 2.4 GHz | +5.5 | +8.0 | – | |
| Saturated Output Power Level | P _O (sat) | f = 0.9 GHz, P _{in} = –5 dBm | – | +10.5 | – | dBm |
| | | f = 1.9 GHz, P _{in} = –5 dBm | – | +10.0 | – | |
| | | f = 2.4 GHz, P _{in} = –5 dBm | – | +9.5 | – | |

TEST CIRCUIT



COMPONENTS OF TEST CIRCUIT FOR MEASURING ELECTRICAL CHARACTERISTICS

| | Type | Value |
|---------------------------------|-----------|----------|
| C ₁ , C ₂ | Bias Tee | 1 000 pF |
| C ₃ | Capacitor | 1 000 pF |
| L | Bias Tee | 1 000 nH |

EXAMPLE OF ACTUAL APPLICATION COMPONENTS

| | Type | Value | Operating Frequency |
|----------------------------------|----------------|----------|---------------------|
| C ₁ to C ₃ | Chip capacitor | 1 000 pF | 100 MHz or higher |
| L | Chip inductor | 100 nH | 100 MHz or higher |
| | | 10 nH | 2.0 GHz or higher |

INDUCTOR FOR THE OUTPUT PIN

The internal output transistor of this IC consumes 20 mA, to output medium power. To supply current for output transistor, connect an inductor between the Vcc pin (pin 6) and output pin (pin 4). Select large value inductance, as listed above.

The inductor has both DC and AC effects. In terms of DC, the inductor biases the output transistor with minimum voltage drop to output enable high level. In terms of AC, the inductor make output-port-impedance higher to get enough gain. In this case, large inductance and Q is suitable.

For above reason, select an inductance of 100 Ω or over impedance in the operating frequency. The gain is a peak in the operating frequency band, and suppressed at lower frequencies.

The recommendable inductance can be chosen from example of actual application components list as shown above.

CAPACITORS FOR THE Vcc, INPUT, AND OUTPUT PINS

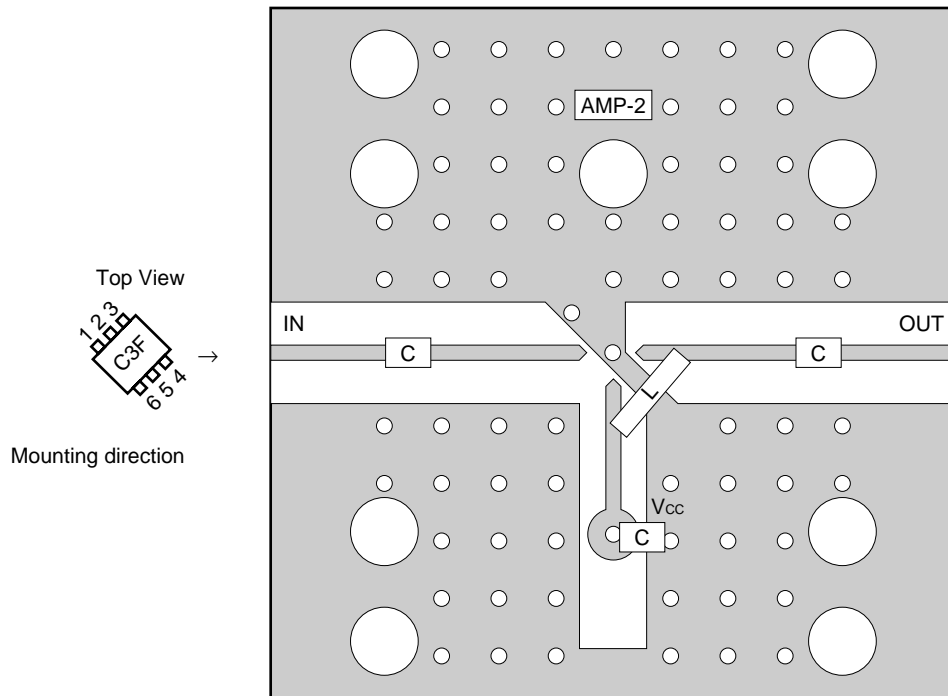
Capacitors of 1 000 pF are recommendable as the bypass capacitor for the Vcc pin and the coupling capacitors for the input and output pins.

The bypass capacitor connected to the Vcc pin is used to minimize ground impedance of Vcc pin. So, stable bias can be supplied against Vcc fluctuation.

The coupling capacitors, connected to the input and output pins, are used to cut the DC and minimize RF serial impedance. Their capacitance are therefore selected as lower impedance against a 50 Ω load. The capacitors thus perform as high pass filters, suppressing low frequencies to DC.

To obtain a flat gain from 100 MHz upwards, 1 000 pF capacitors are used in the test circuit. In the case of under 10 MHz operation, increase the value of coupling capacitor such as 10 000 pF. Because the coupling capacitors are determined by equation, $C = 1/(2\pi Rfc)$.

ILLUSTRATION OF THE TEST CIRCUIT ASSEMBLED ON EVALUATION BOARD



COMPONENT LIST

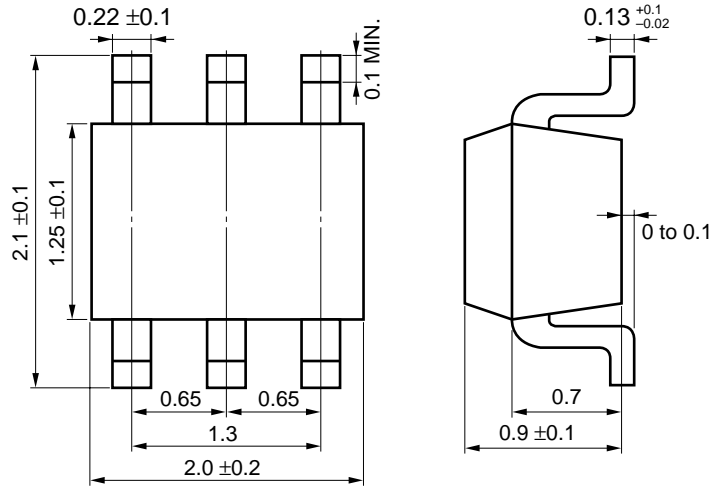
| | Value |
|---|----------------|
| C | 1 000 pF |
| L | Example: 10 nH |

Notes

1. 30 × 30 × 0.4 mm double sided copper clad polyimide board.
2. Back side: GND pattern
3. Solder plated on pattern
4. ○ ○ : Through holes

PACKAGE DIMENSIONS

6 PIN SUPER MINIMOLD (UNIT: mm)



NOTES ON CORRECT USE

- (1) Observe precautions for handling because of electro-static sensitive devices.
- (2) Form a ground pattern as widely as possible to minimize ground impedance (to prevent undesired oscillation).
All the ground pins must be connected together with wide ground pattern to decrease impedance difference.
- (3) The bypass capacitor should be attached to the Vcc pin.
- (4) The inductor must be attached between Vcc and output pins. The inductance value should be determined in accordance with desired frequency.
- (5) The DC cut capacitor must be attached to input pin.

RECOMMENDED SOLDERING CONDITIONS

This product should be soldered under the following recommended conditions. For soldering methods and conditions other than those recommended below, contact your NEC sales representative.

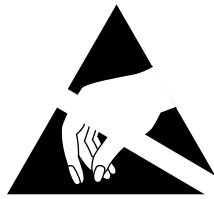
| Soldering Method | Soldering Conditions | Recommended Condition Symbol |
|------------------|---|------------------------------|
| Infrared Reflow | Package peak temperature: 235 °C or below Time: 30 seconds or less (at 210 °C) Count: 3, Exposure limit: None ^{Note} | IR35-00-3 |
| VPS | Package peak temperature: 215 °C or below Time: 40 seconds or less (at 200 °C) Count: 3, Exposure limit: None ^{Note} | VP15-00-3 |
| Wave Soldering | Soldering bath temperature: 260 °C or below Time: 10 seconds or less Count: 1, Exposure limit: None ^{Note} | WS60-00-1 |
| Partial Heating | Pin temperature: 300 °C Time: 3 seconds or less (per side of device) Exposure limit: None ^{Note} | — |

Note After opening the dry pack, keep it in a place below 25 °C and 65 % RH for the allowable storage period.

Caution Do not use different soldering methods together (except for partial heating).

For details of recommended soldering conditions for surface mounting, refer to information document **SEMICONDUCTOR DEVICE MOUNTING TECHNOLOGY MANUAL (C10535E)**.

[MEMO]



ATTENTION

OBSERVE PRECAUTIONS
FOR HANDLING
ELECTROSTATIC
SENSITIVE
DEVICES

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