PF0031

MOS FET Power Amplifier Module for Mobile Phone

HITACHI

ADE-208-461 (Z)
1st Edition
July 1, 1996

Application

PF0031: For NMT900 890 to 925 MHz

Features

- High stability: Load VSWR = 20:1
- Low power control current: 400 μA
- Thin package: 5 mm t

Pin Arrangement

- 1: Pin
- 2: V_{APC}
- 3: V_{DD}
- 4: Pout
- 5: GND

• RF-B2
PF0031

Internal Diagram and External Circuit

![Diagram](image)

C1 = C2 = 0.01 µF (Ceramic chip capacitor)
C3 = 10 µF (Aluminum Electrolyte Capacitor)
FB = Ferrite bead BL01RN1-A62-001 (Manufacture: MURATA) or equivalent
Z1 = Z2 = 50 Ω (Microstrip line)

Absolute Maximum Ratings (Tc = 25°C)

<table>
<thead>
<tr>
<th>Item</th>
<th>Symbol</th>
<th>Rating</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply voltage</td>
<td>V DD</td>
<td>17</td>
<td>V</td>
</tr>
<tr>
<td>Supply current</td>
<td>I DD</td>
<td>3</td>
<td>A</td>
</tr>
<tr>
<td>APC voltage</td>
<td>V APC</td>
<td>8</td>
<td>V</td>
</tr>
<tr>
<td>Input power</td>
<td>Pin</td>
<td>20</td>
<td>mW</td>
</tr>
<tr>
<td>Operating case temperature</td>
<td>Tc (op)</td>
<td>–30 to +100</td>
<td>°C</td>
</tr>
<tr>
<td>Storage temperature</td>
<td>Tstg</td>
<td>–40 to +110</td>
<td>°C</td>
</tr>
</tbody>
</table>
**Electrical Characteristics (Tc = 25°C)**

<table>
<thead>
<tr>
<th>Item</th>
<th>Symbol</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
<th>Test Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drain cutoff current</td>
<td>$I_{DS}$</td>
<td>—</td>
<td>—</td>
<td>500</td>
<td>μA</td>
<td>$V_{DD} = 17,V$, $V_{APC} = 0,V$, $R_g = R_L = 50,\Omega$</td>
</tr>
<tr>
<td>Total efficiency</td>
<td>$\eta_T$</td>
<td>35</td>
<td>40</td>
<td>—</td>
<td>%</td>
<td>$Pin = 2,mW$, $V_{DD} = 12.5,V$, $P_{out} = 6,W$ (at APC controlled)</td>
</tr>
<tr>
<td>2nd harmonic distortion</td>
<td>2nd H.D.</td>
<td>—</td>
<td>—50</td>
<td>—30</td>
<td>dB</td>
<td>$R_L = R_g = 50,\Omega$</td>
</tr>
<tr>
<td>3rd harmonic distortion</td>
<td>3rd H.D.</td>
<td>—</td>
<td>—50</td>
<td>—30</td>
<td>dB</td>
<td></td>
</tr>
<tr>
<td>Input VSWR</td>
<td>VSWR (in)</td>
<td>—</td>
<td>1.5</td>
<td>3</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>Output VSWR</td>
<td>VSWR (out)</td>
<td>—</td>
<td>1.5</td>
<td>—</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>Stability</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>$Pin = 2,mW$, $V_{DD} = 12.5,V$, $P_{out} = 6,W$ (at APC controlled), $R_L = R_g = 50,\Omega$, Output VSWR = 20:1 All phases, t = 20 sec</td>
</tr>
</tbody>
</table>

**Test System Diagram**

![Test System Diagram](image-url)
Test Fixture Pattern

Unit: mm

Grass Epoxy Double sided PCB
(t = 1.6 mm, $\varepsilon_r = 4.8$)

Mechanical Characteristics

<table>
<thead>
<tr>
<th>Item</th>
<th>Conditions</th>
<th>Spec</th>
</tr>
</thead>
<tbody>
<tr>
<td>Torque for screw up the heatsink flange</td>
<td>M3 Screw Bolts</td>
<td>4 to 6 kg•cm</td>
</tr>
<tr>
<td>Warp size of the heatsink flange: S</td>
<td>S = 0</td>
<td>+0.3/− 0 mm</td>
</tr>
</tbody>
</table>
Note for Use

- Unevenness and distortion at the surface of the heatsink attached module should be less than 0.05 mm.
- It should not be existed any dust between module and heatsink.
- MODULE should be separated from PCB less than 1.5 mm.
- Soldering temperature and soldering time should be less than 230°C, 10 sec.
  (Soldering position spaced from the root point of the lead frame: 2 mm)
- Recommendation of thermal joint compounds is TYPE G746.
  (Manufacturer: Shin-Etsu Chemical, Co., Ltd.)
- To protect devices from electro-static damage, soldering iron, measuring-equipment and human body etc. should be grounded.
- Torque for screw up the heatsink flange should be 4 to 6 kg · cm with M3 screw bolts.
- Don't solder the flange directly.
- It should make the lead frame as straight as possible.
- The module should be screwed up before lead soldering.
- It should not be given mechanical and thermal stress to lead and flange of the module.
- When the external parts (Isolator, Duplexer, etc.) of the module are changed, the electrical characteristics should be evaluated enough.
- Don't washing the module except lead pins.
- To get good stability, ground impedance between the module GND flange and PCB GND pattern should be designed as low as possible.
Characteristics Curve

**Pout, $\eta_T$ vs. $V_{DD}$ (1)**

- $f = 890$ MHz
- $P_{in} = 2$ mW
- $V_{APC} = 4$ V
- $T_c = 25$ °C

**Pout, $\eta_T$ vs. $V_{DD}$ (2)**

- $f = 915$ MHz
- $P_{in} = 2$ mW
- $V_{APC} = 4$ V
- $T_c = 25$ °C
Pin = 2 mW
V_DD = 12.5 V
Pout = 6 W
T_c = 25°C
Pout, $\eta_T$ vs. Pin (1)

- $f = 890$ MHz
- $V_{DD} = 12.5$ V
- $V_{APC} = 4$ V
- $T_c = 25^\circ$C

Pout, $\eta_T$ vs. Pin (2)

- $f = 915$ MHz
- $V_{DD} = 12.5$ V
- $V_{APC} = 4$ V
- $T_c = 25^\circ$C
**Pout, η_T vs. V_{APC} (1)**

- **f** = 890 MHz
- **Pin** = 2 mW
- **V_DD** = 12.5 V
- **Tc** = 25°C

**Pout, η_T vs. V_{APC} (2)**

- **f** = 915 MHz
- **Pin** = 2 mW
- **V_DD** = 12.5 V
- **Tc** = 25°C
$f = 890 \text{ MHz}$  
$V_{DD} = 12.5 \text{ V}$  
$P_{in} = 2 \text{ mW}$  
$P_{out} = 6 \text{ W}$

Efficiency $\eta_T$ vs. $T_C$ (1)

$\eta_T$ vs. $T_C$ (2)

$f = 915 \text{ MHz}$  
$V_{DD} = 12.5 \text{ V}$  
$P_{in} = 2 \text{ mW}$  
$P_{out} = 6 \text{ W}$
Pout vs. TC (1)

Case Temperature TC (°C)
Output Power Pout (W)

f = 890 MHz
V_{DD} = 12.5 V
P_{in} = 2 mW
V_{APC} = 7.0 V

Pout vs. TC (2)

Case Temperature TC (°C)
Output Power Pout (W)

f = 915 MHz
V_{DD} = 12.5 V
P_{in} = 2 mW
V_{APC} = 7.0 V
Package Dimensions

Unit: mm

<table>
<thead>
<tr>
<th>Hitachi Code</th>
<th>RF-B2</th>
</tr>
</thead>
<tbody>
<tr>
<td>JEDEC</td>
<td>—</td>
</tr>
<tr>
<td>EIAJ</td>
<td>—</td>
</tr>
<tr>
<td>Weight (reference value)</td>
<td>16 g</td>
</tr>
</tbody>
</table>
When using this document, keep the following in mind:

1. This document may, wholly or partially, be subject to change without notice.
2. All rights are reserved: No one is permitted to reproduce or duplicate, in any form, the whole or part of this document without Hitachi’s permission.
3. Hitachi will not be held responsible for any damage to the user that may result from accidents or any other reasons during operation of the user’s unit according to this document.
4. Circuitry and other examples described herein are meant merely to indicate the characteristics and performance of Hitachi’s semiconductor products. Hitachi assumes no responsibility for any intellectual property claims or other problems that may result from applications based on the examples described herein.
5. No license is granted by implication or otherwise under any patents or other rights of any third party or Hitachi, Ltd.
6. MEDICAL APPLICATIONS: Hitachi’s products are not authorized for use in MEDICAL APPLICATIONS without the written consent of the appropriate officer of Hitachi’s sales company. Such use includes, but is not limited to, use in life support systems. Buyers of Hitachi’s products are requested to notify the relevant Hitachi sales offices when planning to use the products in MEDICAL APPLICATIONS.