# STPAC01F2

## IPAD™ RF DETECTOR FOR POWER AMPLIFIER CONTROL

### MAIN PRODUCT CHARACTERISTICS

The STPAC01F2 has two outputs, one for the signal detection and another one for the temperature compensation:

- $V_{DCout}$ = 0.88 V at 0.85 GHz at 10 dBm
- $V_{DCout}$ = 1.07 V at 1.85 GHz at 10 dBm
- Vsupply = 5 V max
- Lead free package

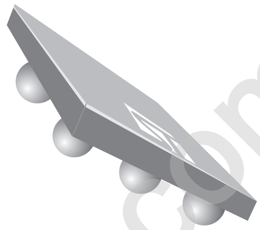
### DESCRIPTION

The STPAC01F2 is an integrated RF detector for the power control stage. It converts RF signal coming from the coupler into a DC signal usable by the digital stage. It is based on the use of two similar diodes, one providing the signal detection while the second one is used to provide a temperature information to thermal compensation stage. A biasing stage suppresses the detection diode drop voltage effect.

Target applications are cellular phones and PDA using GSM, DCS, PCS, AMPS, TDMA, CDMA and 800 MHz to 1900 MHz frequency ranges.

### BENEFITS

- The use of IPAD technology allows the RF front-end designer to save PCB area and to drastically suppress parasitic inductances.



Flip-Chip (8 Bumps)

**Table 1: Order Code**

| Part Number | Marking |
|---|---|
| STPAC01F2 | RA |

**Figure 1: Pin Configuration (Ball side)**

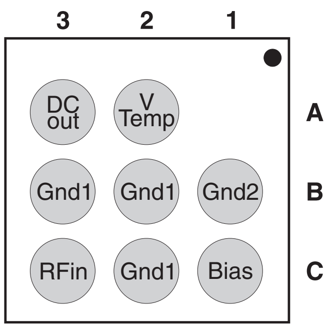



**Figure 2: Functional diagram**

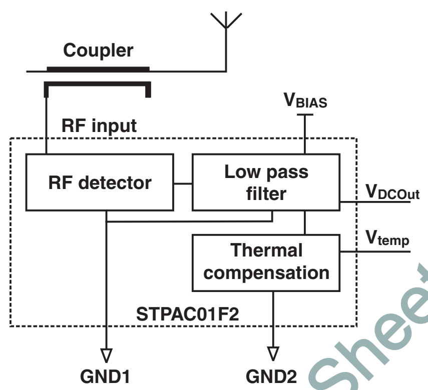


**Table 2: Absolute Retings** ($T_{amb}$ = 25°C)

| Symbol | Parameter and test conditions | Value | Unit |
|---|---|---|---|
| $V_{BIAS}$ | Bias voltage | 5 | V |
| $P_{RF}$ | RF power at the RF input | 20 | dBm |
| $F_{OP}$ | Operating frequency range | 0.8 to 2 | GHz |
| $V_{PP}$ | ESD level as per MIL-STD 883E method 3015.7 notice 8 (HBM) | 250 | V |
| $T_{OP}$ | Operating temperature range | - 30 to + 85 | °C |
| $T_{STG}$ | Storage temperature range | - 55 to + 150 | °C |

**ELECTRICAL CHARACTERISTICS** ($T_{amb}$ = 25°C)

**Table 3: Parameters related to BIAS voltage**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $V_{BIAS}$ | Operating bias voltage | | 2.2 | | 3.2 | V |
| $I_{BIAS}$ | Bias current | $V_{BIAS}$ = 3.2 V | | | 0.5 | mA |

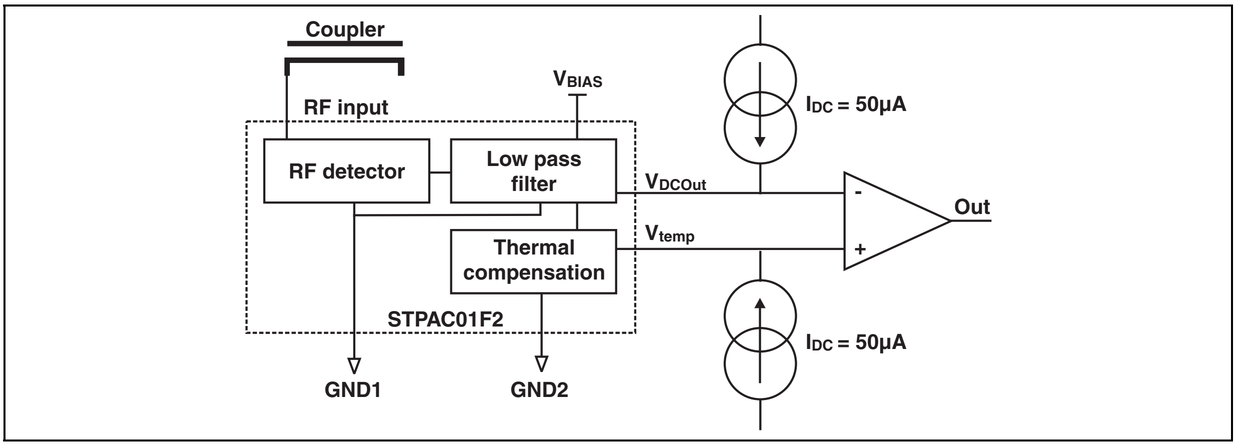
**Table 4: Parameters related detection function** ($V_{BIAS}$ + 2.7 V, DC output load = 100kΩ)

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $V_{DCout}$ | DC output voltage (see fig. 1, $I_{DC}$ = 50 µA) | F = 1.85 GHz, $P_{RF}$ = 10 dBm | 0.97 | 1.07 | 1.17 | V |
| | | F = 1.85 GHz, $P_{RF}$ = - 20 dBm | 1.83 | 1.93 | 2.03 | |
| | | F = 0.85 GHz, $P_{RF}$ = 10 dBm | 0.78 | 0.88 | 0.98 | |
| | | F = 0.85 GHz, $P_{RF}$ = - 20 dBm | 1.83 | 1.93 | 2.03 | |
| $\Delta V_{DCout}$ | DC output voltage variation (see fig. 8, $I_{DC}$ = 50µA) | 0 < $T_{amb}$ < 70°C<br>F = 1.85 GHz, $P_{RF}$ = 10 dBm | | 0.09 | | V |
| | | 2.2 < $V_{BIAS}$ < 3.2 V<br>F = 1.85 GHz, $P_{RF}$ = 10 dBm | | 0.44 | | |

**Table 5: Parameters related to detection function**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $V_{Temp}$ | Temperature output voltage (see fig. 9) | $I_{DC}$ = 50µA | 1.83 | 1.93 | 2.03 | V |
| $\Delta V_{Temp}$ | Temperature output voltage variation (see fig. 9) | $I_{DC}$ = 50µA, 0 < $T_{amb}$ < 70°C | | 0.09 | | V |
| | | $I_{DC}$ = 50µA, 2.2 < $V_{BIAS}$ < 3.2V | | 0.44 | | |

**Figure 3: Application diagram**




The STPAC01 is the first part of the power amplifier stage and provides both RF power and die temperature measurements. The above figure gives the basic circuit of RF detector.

A coupler located on the line between RF amplifier output and the antenna takes a part of the available power and applies it to STPAC01 RF input.

The RF detector and the low pass filter provide a DC voltage depending on the input power. Thermal compensation provides a DC voltage depending on the ambient temperature. As the detection system and the thermal compensation are based on the same topology, VDCout will have the same temperature variation as Vtemp. Connected to a differential amplifier, the output will be a voltage directly linked to the RF input power. VDCout and Vtemp must be bias with 50µA DC current.

This topology offers the most accurate output value as it is 100% compensated.

**Figure 4: $V_{DCout}$ measurement circuit**

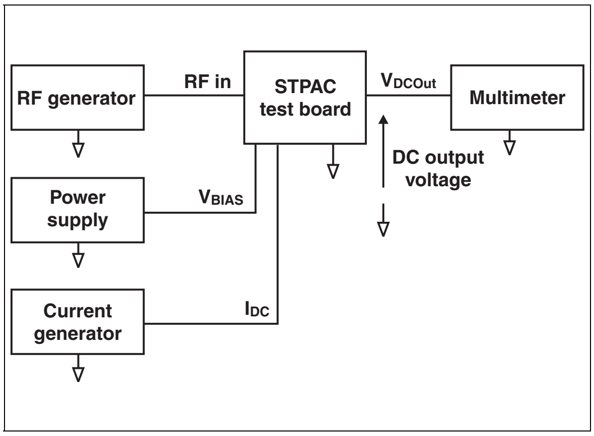



**Figure 5: $V_{DCout}$ versus RF input power**

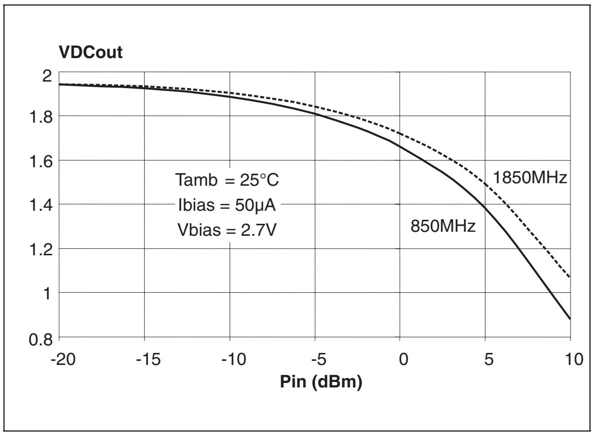


**Figure 6: Relative variation of $V_{DCout}$ versus frequency (from 800 to 900 MHz)**

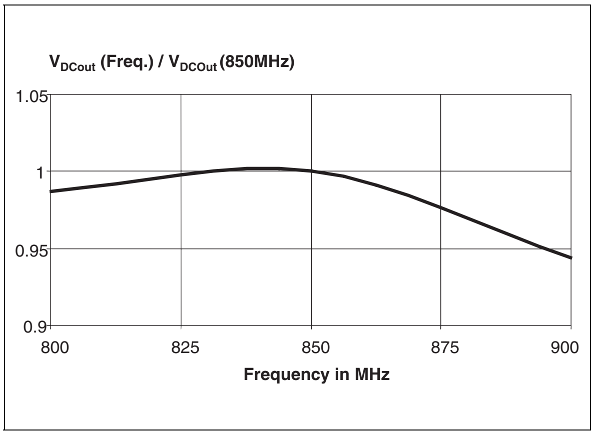



**Figure 7: Relative variation of $V_{DCout}$ versus frequency (from 1800 to 1900 MHz)**

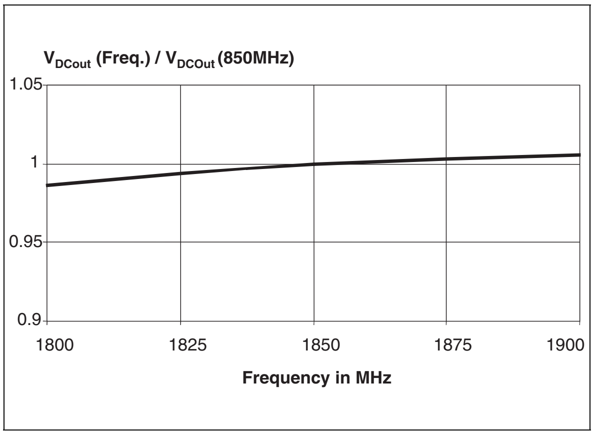



**Figure 8: Temperature effect measurement circuit on $V_{DCout}$**

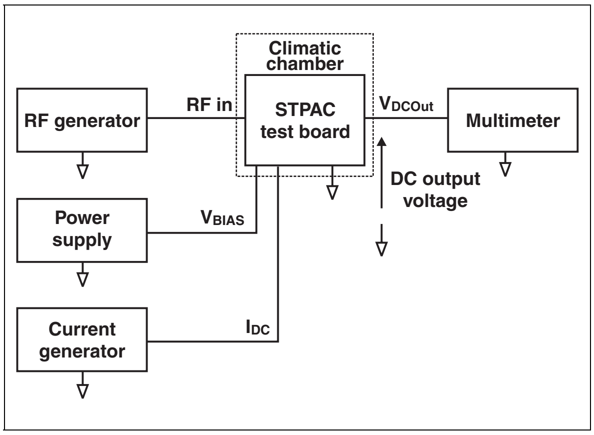



**Figure 9: $V_{temp}$ measurement circuit**

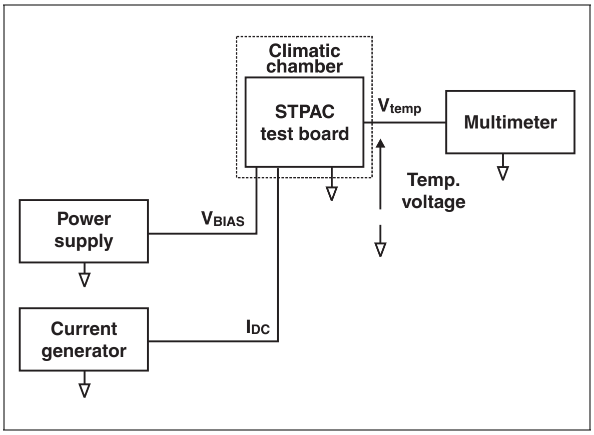



**Figure 10: $V_{temp}$ output voltage versus ambient temperature**

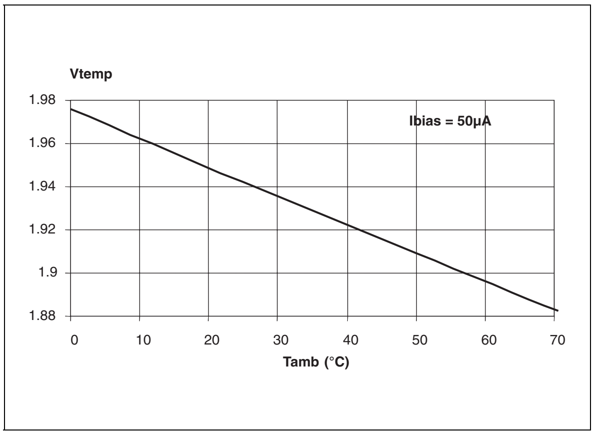


**Figure 11: FLIP-CHIP Package Mechanical Data**

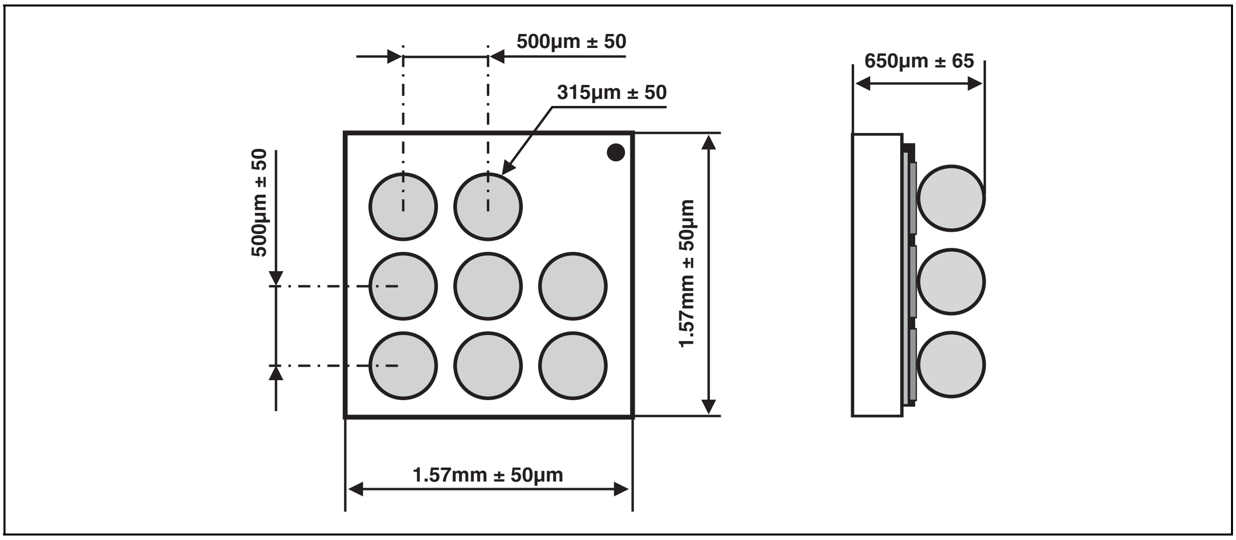



**Figure 12: Foot print recommendations**

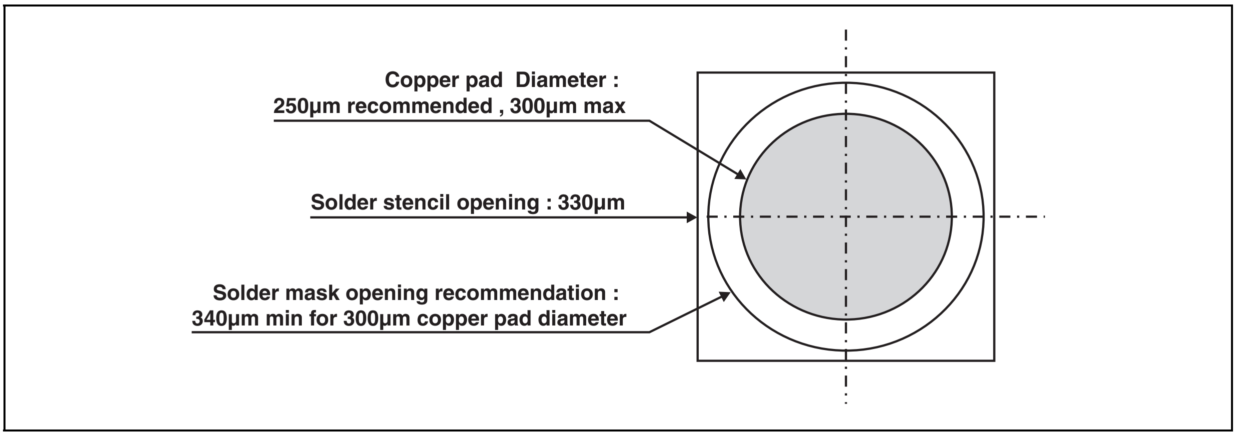
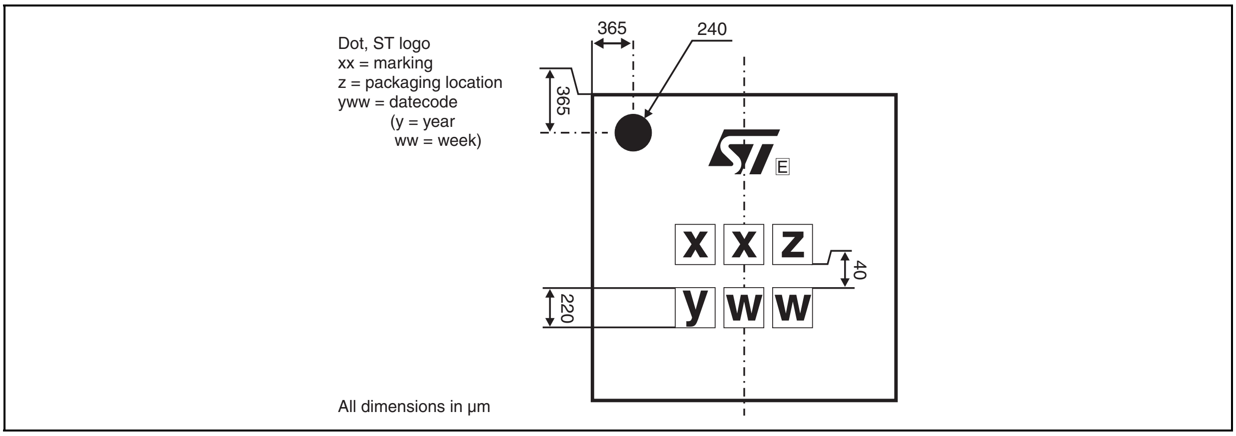
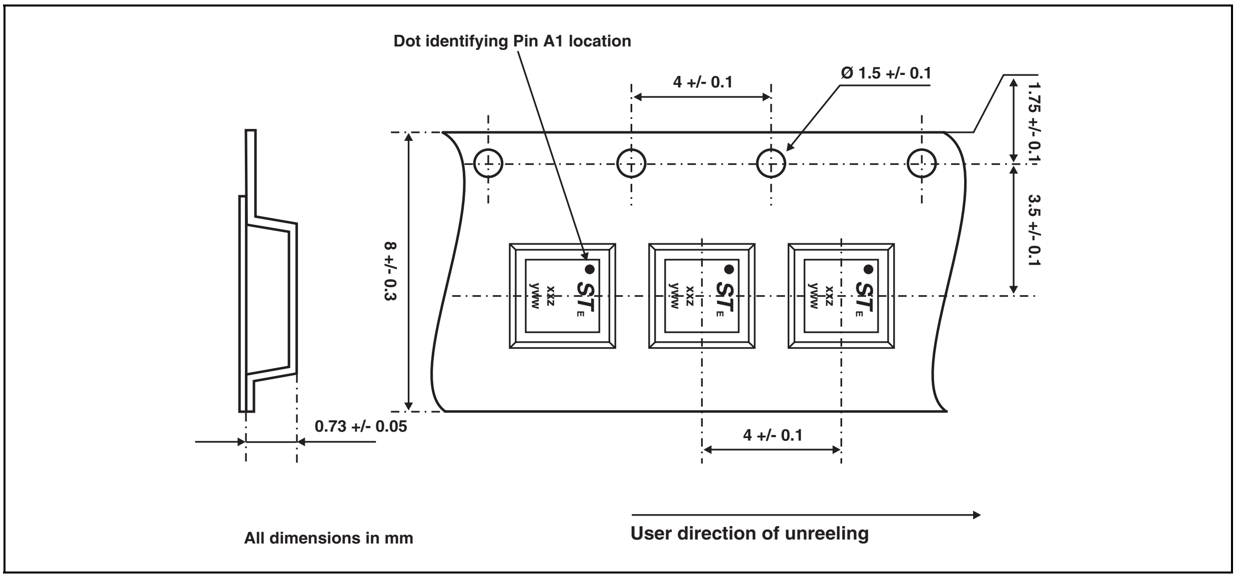



**Figure 13: Marking**



## Figure 14: FLIP-CHIP Tape and Reel Specification




## Table 6: Ordering Information

| Ordering code | Marking | Package | Weight | Base qty | Delivery mode |
|---|---|---|---|---|---|
| STPAC01F2 | RA | Flip-Chip | 3.3 mg | 5000 | Tape & reel 7” |

**Note:** More informations are available in the application notes:
AN1235: “Flip-Chip: Package description and recommendations for use”
AN1751: "EMI Filters: Recommendations and measurements"

## Table 7: Revision History

| Date | Revision | Description of Changes |
|---|---|---|
| 21-Oct-2004 | 1 | First issue |