

# SIEMENS

## ICs for Communication

Prescaler Circuit 1.1 GHz  
PMB 2313T

V1.5

|                               |  |
|-------------------------------|--|
| <b>PMB 2313T</b>              |  |
| <b>Revision History: 7.96</b> |  |
| Previous Releases:            | none                                   |
| Page                          | Subjects (changes since last revision) |
|                               |  |

### Data Classification

### Maximum Ratings

Maximum ratings are absolute ratings; exceeding only one of these values may cause irreversible damage to the integrated circuit.

### Characteristics

The listed characteristics are ensured over the operating range of the integrated circuit. Typical characteristics specify mean values expected over the production spread. If not otherwise specified, typical characteristics apply at TA = 25 °C and the given supply voltage.

### Operating Range

In the operating range the functions given in the circuit description are fulfilled.

For detailed technical information about "Processing Guidelines" and "Quality Assurance" for ICs, see our Product Overview "ICs for Communications"

### Edition 7.96

This edition was realized using the software system FrameMaker®.

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Preliminary Data

Bipolar IC

### Functional Description, Application

The IC is designed for use in mobile radio communication devices up to 1100 MHz.

Due to its low power consumption and low phase noise generation it is suitable for the use in battery powered handheld systems, e.g. GSM, cordless telephone and wireless LANs.

Low supply voltage down to 2.7V.

It can be switched to a low-power standby mode.

Internal current source at the emitter follower output. No external resistor needed in typical applications.

The divide ratio is 1:64/65 or 1:128/129 depending on the external circuit configuration.

The IC is board level compatible to the PMB 2312 prescaler.

## Circuit Description

The differential inputs of the IC may be connected either balanced or single ended. In the latter case the unused input must be RF-grounded with a capacitor (about 1.5 nF) with a low serial inductance.

Depending on the logic level at SW input the basic divide ratio of the ECL-stages is fixed to 1:64/65 or 1:128/129. The MOD input determines whether modulus 1:n or 1:n+1 (n=64 or 128 according to SW-level) is active.

The IC can be switched to a low-power standby mode (input STB).

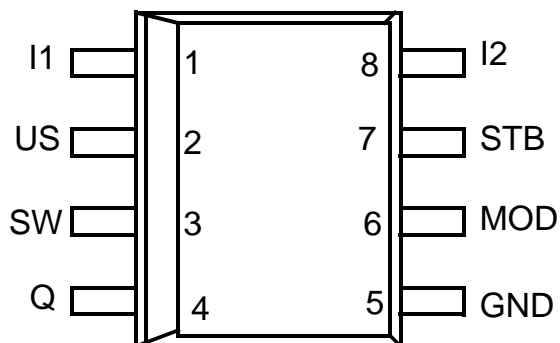
The MOD input is TTL/CMOS compatible.

The emitter follower output is CMOS compatible according to the application circuit on page 11. The minimum logic swing is  $0.8 V_{pp}$ .

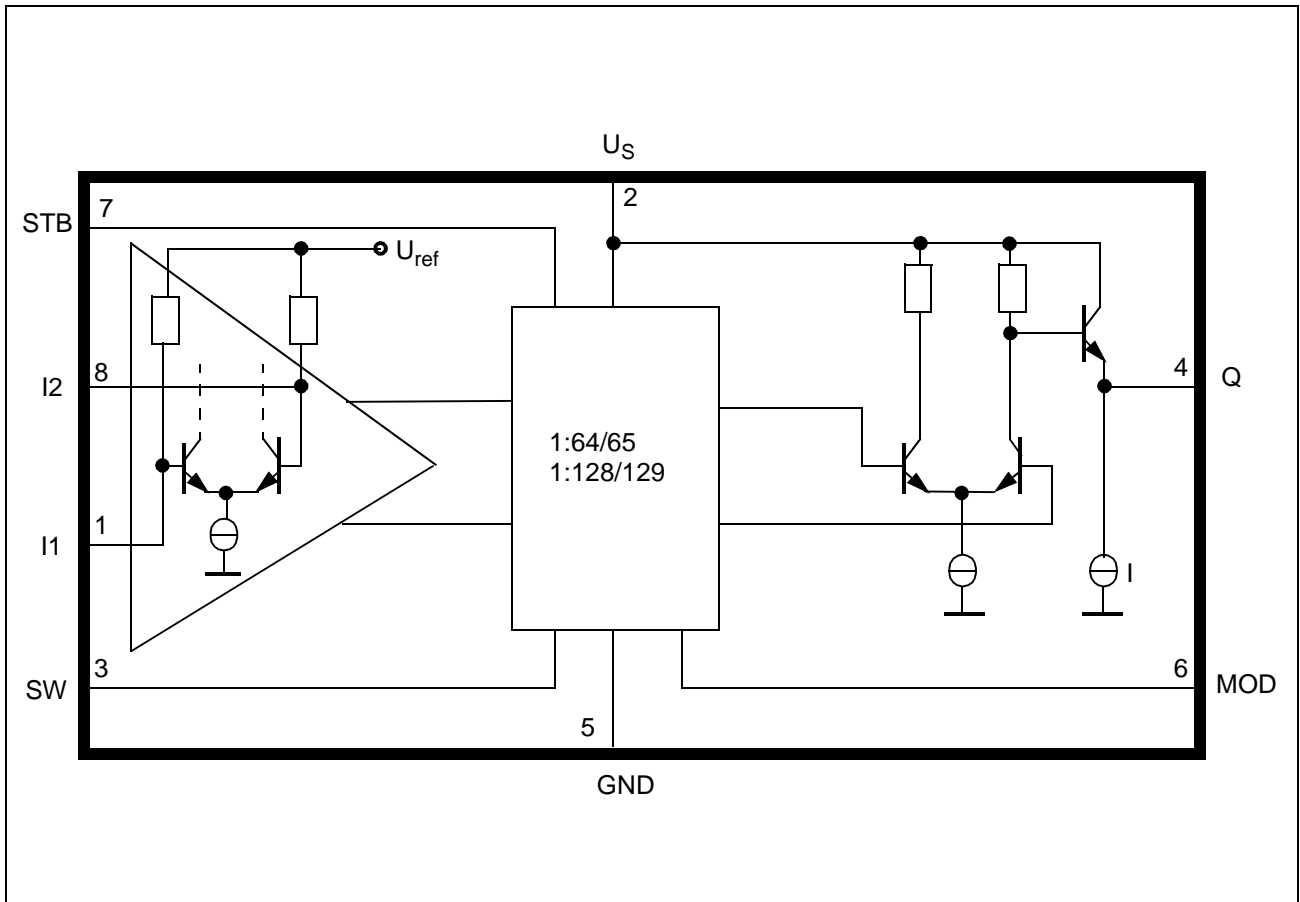
## Function table

| Input pin  | Logic level   | Prescaler function              |
|------------|---|---------------------------------|
| <b>SW</b>  | HIGH = $U_S - 0.1 V$ to $U_S$<br>LOW = GND to 0.8 V or open | 1:64/65<br>1:128/129            |
| <b>MOD</b> | HIGH = 2.0 V to $U_S$ or open<br>LOW = GND to 0.8 V         | 1:64/1:128<br>1:65/1:129        |
| <b>STB</b> | HIGH = $U_S - 0.1 V$ to $U_S$<br>LOW = GND to 0.8 V         | Divider<br>Q=HIGH, STANDBY-mode |

## Pin Assignment



- Pin 1 RF-input I1
- Pin 2 supply voltage  $U_S$
- Pin 3 divide ratio 1:64/65 - 1:128/129 control input (SW)
- Pin 4 output Q
- Pin 5 GND
- Pin 6 modulus 1:n/n+1 (n=64 or 128) control input (MOD)
- Pin 7 standby mode control input (STB)
- Pin 8 RF-input I2



**Block Diagram**

## Absolute Maximum Ratings

$T_A = -40$  to  $85$  °C

| Parameter                            | Symbol                                | Limit Values |  | Unit | Remarks          |
|--------------------------------------|---------------------------------------|--------------|--|------|------------------|
|                                      |                                       | min.         | max.   |      |                  |
| Supply voltage                       | $U_S$                                 | -0.3         | 6  | V    |                  |
| Input level<br>(Pin 1; Pin 8)        | $U_I$                                 |              | 2  | V    | $U_S=0V$         |
| Voltage swing<br>(Pin 1 to 8)        | $U_{I18}$                             | -2           | 2  | V    |                  |
| Input level<br>(Pin 3; Pin 6; Pin 7) | $U_{SW},$<br>$U_{MOD},$<br>$U_{STB},$ | -0.3         | $U_S+0.7V$<br>or 5.5V if<br>$U_S+0.7V >$<br>5.5V | V    | $U_S=2.7...5.5V$ |
| Output level<br>(Pin 4)              | $U_Q$                                 |              | $U_S$  | V    |                  |
| Output current<br>(Pin 4)            | $-I_Q$                                |              | 5  | mA   |                  |
| Junction temperature                 | $T_j$                                 |              | 125  | °C   |                  |
| Storage temperature                  | $T_S$                                 | -65          | 125  | °C   |                  |
| Thermal resistance<br>system-ambient | $R_{thsa}$                            |              | 185  | K/W  |                  |

The maximum ratings may not be exceeded under any circumstances, not even momentarily and individually, as permanent damage to the IC will result.

**ESD-integrity ( according MIL-STD 883D, Meth. 3015.7): 500V**

## Operating Range

| Parameter           | Symbol | Limit Values |      | Unit | Remarks |
|---------------------|--------|--------------|------|------|---------|
|                     |        | min.         | max. |      |         |
| Supply Voltage      | $U_S$  | 2.7          | 5.5  | V    |         |
| Input frequency     | $f$    | 50           | 1400 | MHz  |         |
| Ambient temperature | $T_A$  | -40          | 85   | °C   |         |

Within the operational range the IC operates as described in the circuit description. The AC / DC characteristic limits are not guaranteed.

## AC/DC Characteristics

$T_A = -20$  to  $85\text{ °C}$

| Parameter | Symbol | Limit Values |      |      | Unit | Test Condition |
|-----------|--------|--------------|------|------|------|----------------|
|           |        | min.         | typ. | max. |      |                |

**Supply voltage**  $U_S=2.7$  to  $5.5V$

**Ambient temperature**  $T_A = -20$  to  $85\text{ °C}$  (referred to the test circuit)

|                                   |            |            |      |       |                   |   |
|-----------------------------------|------------|------------|------|-------|-------------------|---|
| Supply current                    | $I_S$      |            | 1.9  | 2.4   | mA                | inputs RF-grounded,<br>$U_S=2.7$ , $T_A = 25\text{ °C}$ ,<br>STB= $U_S$ output open |
|                                   | $I_S$      |            | 1.95 | 2.45  | mA                | inputs RF-grounded,<br>$U_S=4.0$ , $T_A = 25\text{ °C}$ ,<br>STB= $U_S$ output open |
|                                   | $I_S$      |            | 2.00 | 2.5   | mA                | inputs RF-grounded,<br>$U_S=5.5$ , $T_A = 25\text{ °C}$ ,<br>STB= $U_S$ output open |
| Supply current<br>in standby-mode | $I_{STB}$  |            |      | 0.1   | mA                | inputs RF-grounded,<br>output open, STB = GND                                       |
| Input level                       | $U_{in}$   | 25         |      | 400   | mV <sub>rms</sub> | 100-1000MHz (sine wave)   |
| dynamicrange                      | $P_{in}$   | -19        |      | 5     | dBm               | 100-1000MHz (sine wave)   |
| (see diagram 2)                   | $U_{in}$   | 25         |      | 280   | mV <sub>rms</sub> | 1000-1100MHz (sine wave)  |
|                                   | $P_{in}$   | -19        |      | 2     | dBm               | 1000-1100MHz (sine wave)  |
| Output logic swing                | $U_Q$      | 1          | 1.1  |       | V <sub>PP</sub>   | $C_L \leq 12\text{pF}$ , $R_L=2\text{k}\Omega$                                      |
|                                   | $U_Q$      | 0.8        | 1.1  |       | V <sub>PP</sub>   | $C_L \leq 8\text{pF}$   |
| SW voltage High                   | $U_{SWH}$  | $U_S-0.1V$ |      | $U_S$ | V                 |   |
| SW voltage Low                    | $U_{SWL}$  | GND        |      | 0.8   | V                 |   |
| SW input current                  | $I_{SWH}$  |            |      | 60    | $\mu A$           | SW= $U_S$   |
| High                              |            |            |      |       |                   |   |
| SW input current                  | $-I_{SWL}$ |            |      | 30    | $\mu A$           | SW=GND  |
| Low                               |            |            |      |       |                   |   |
| MOD voltage High                  | $U_{MODH}$ | 2.3        |      | $U_S$ | V                 |   |
| MOD voltage Low                   | $U_{MODL}$ | GND        |      | 0.8   | V                 |   |
| MOD input current                 |            |            |      | 50    | $\mu A$           | MOD= $U_S$  |
| High                              | $I_{MODH}$ |            |      |       |                   |   |
| MOD input current                 |            |            |      | 120   | $\mu A$           | MOD=GND   |
| Low                               | $I_{MODL}$ |            |      |       |                   |   |

AC /DC characteristics involve the spread of values guaranteed within the specified supply voltage and ambient temperature range. Typical characteristics are the median of the production.



## AC/DC Characteristics

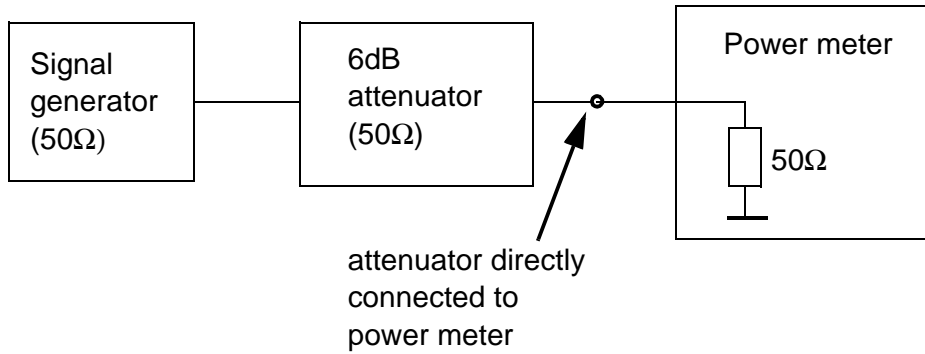
$T_A = -20$  to  $85$  °C

| Parameter                                   | Symbol      | Limit Values |      |       | Unit    | Test Condition |
|---|-------------|--------------|------|-------|---------|----------------|
|   |             | min.         | typ. | max.  |         |                |
| STB voltage High                            | $U_{STBH}$  | $U_S - 0.1$  |      | $U_S$ | V       | STB = $U_S$    |
| STB voltage Low                             | $U_{STBL}$  | GND          |      | 0.8   | V       |                |
| STB input current High                      | $I_{STBH}$  |              |      | 30    | $\mu A$ |                |
| STB input current Low                       | $-I_{STBL}$ |              |      | 60    | $\mu A$ | STB = GND      |
| Internal current source (see block diagram) | $I$         |              | 400  |       | $\mu A$ |                |
| <b>Delay times</b>                          |             |              |      |       |         |                |
| MOD setup time (diagram 1)                  | $t_{set}$   |              |      | 29    | ns      |                |

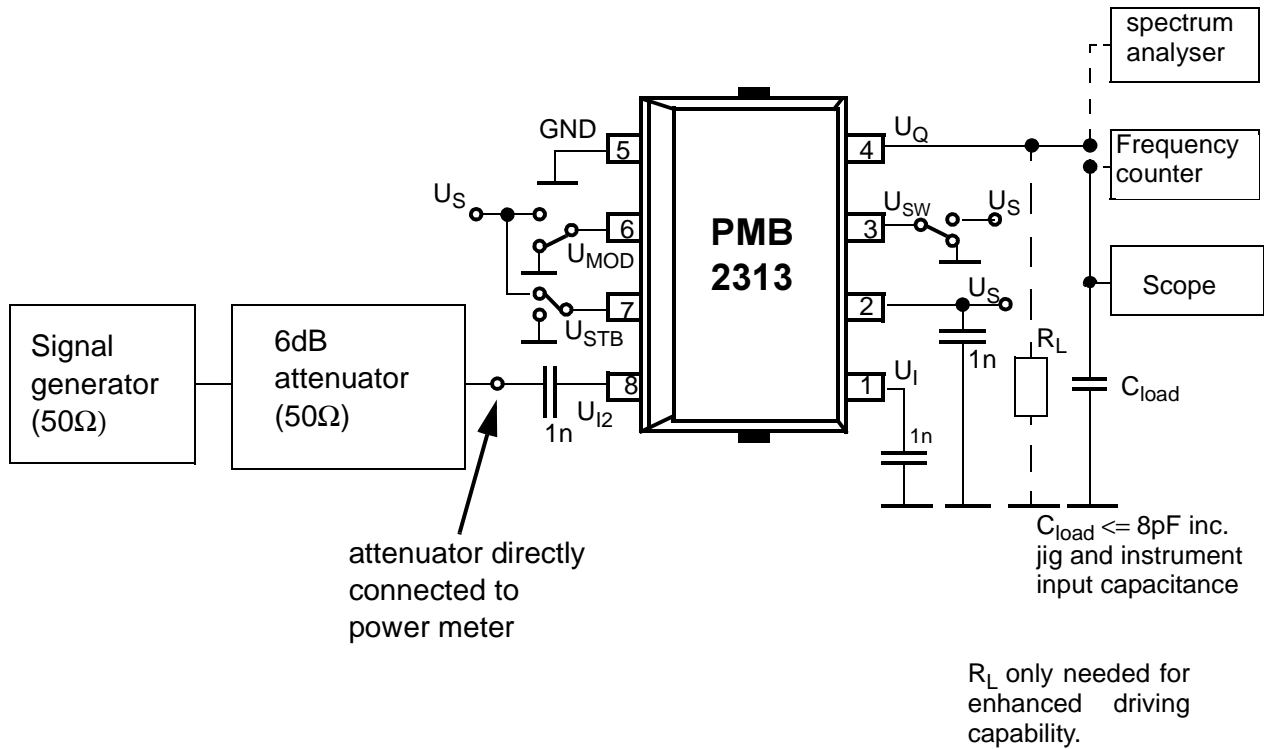
AC /DC characteristics involve the spread of values guaranteed within the specified supply voltage and ambient temperature range. Typical characteristics are the median of the production.

Test circuit

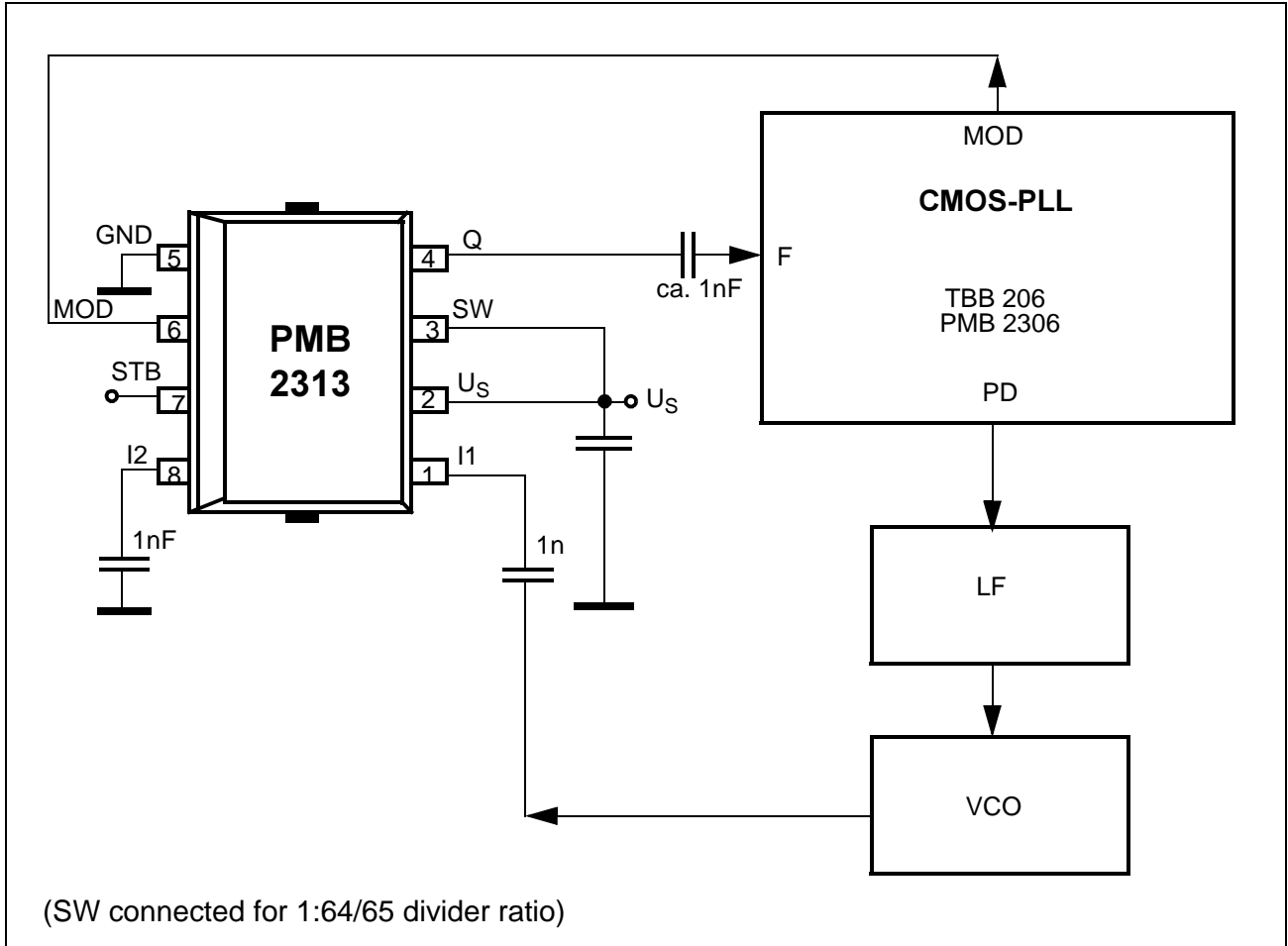
Calibration of the signal generator



Input sensitivity and output logic swing measurement



Application Circuit



## Definition of Modulus Setup Time

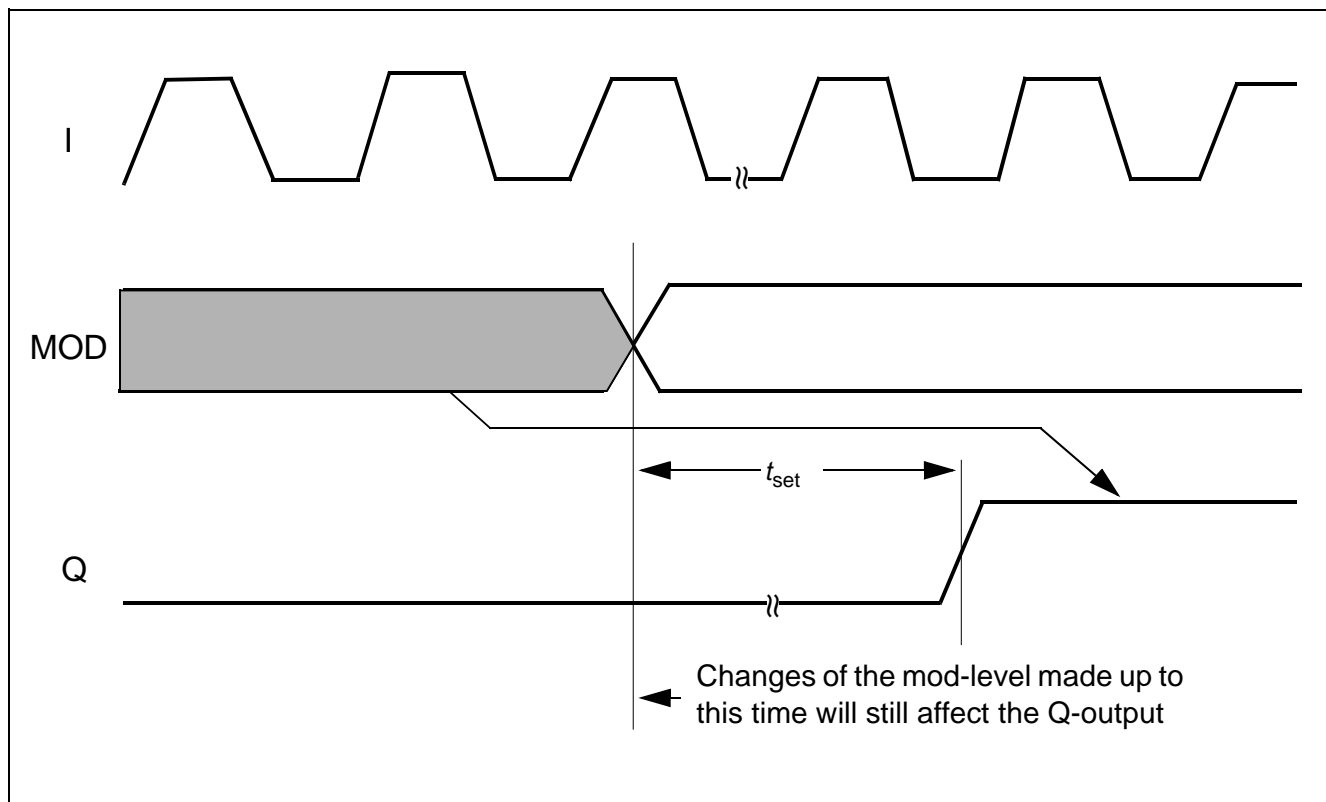
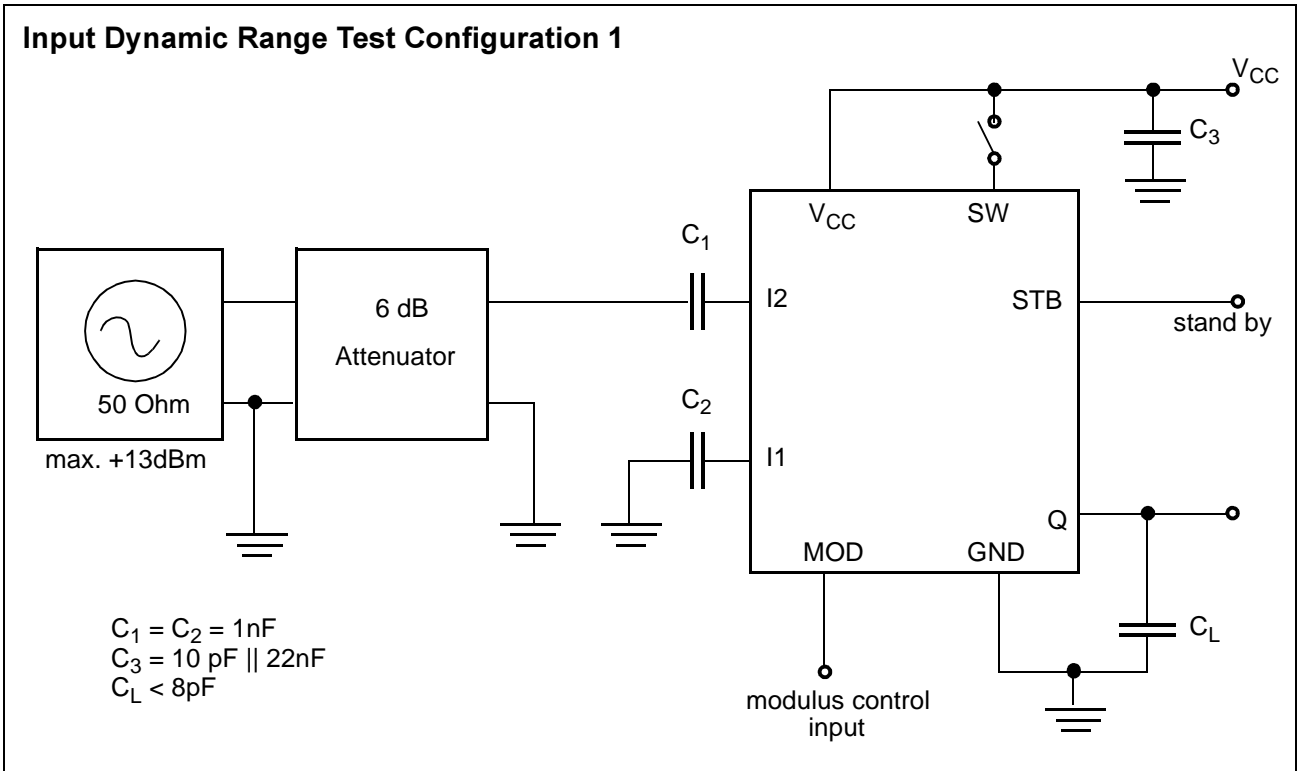


Diagram 1

Diagram 2



**PMB 2313 Dynamic Range 4V Ratio 65 Test Configuration 1**

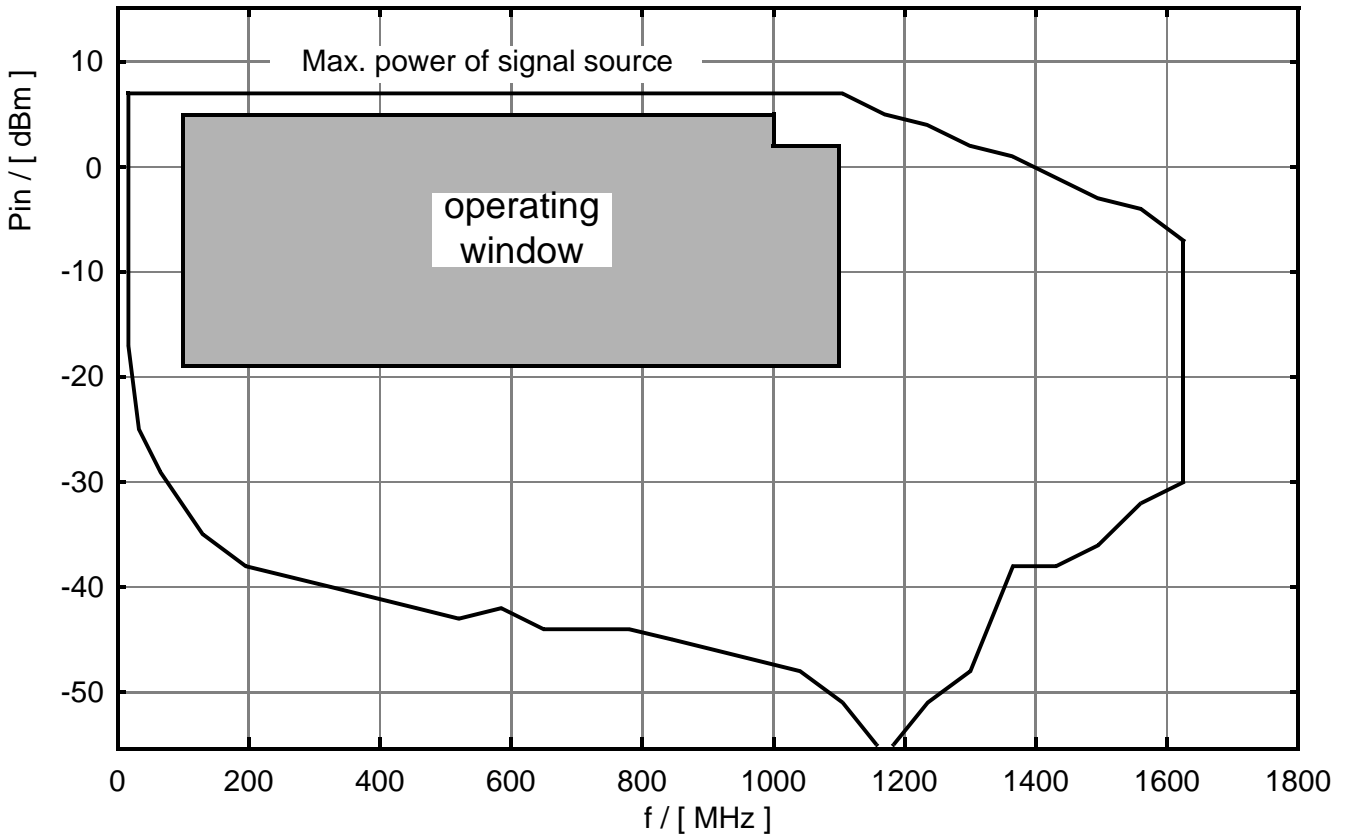
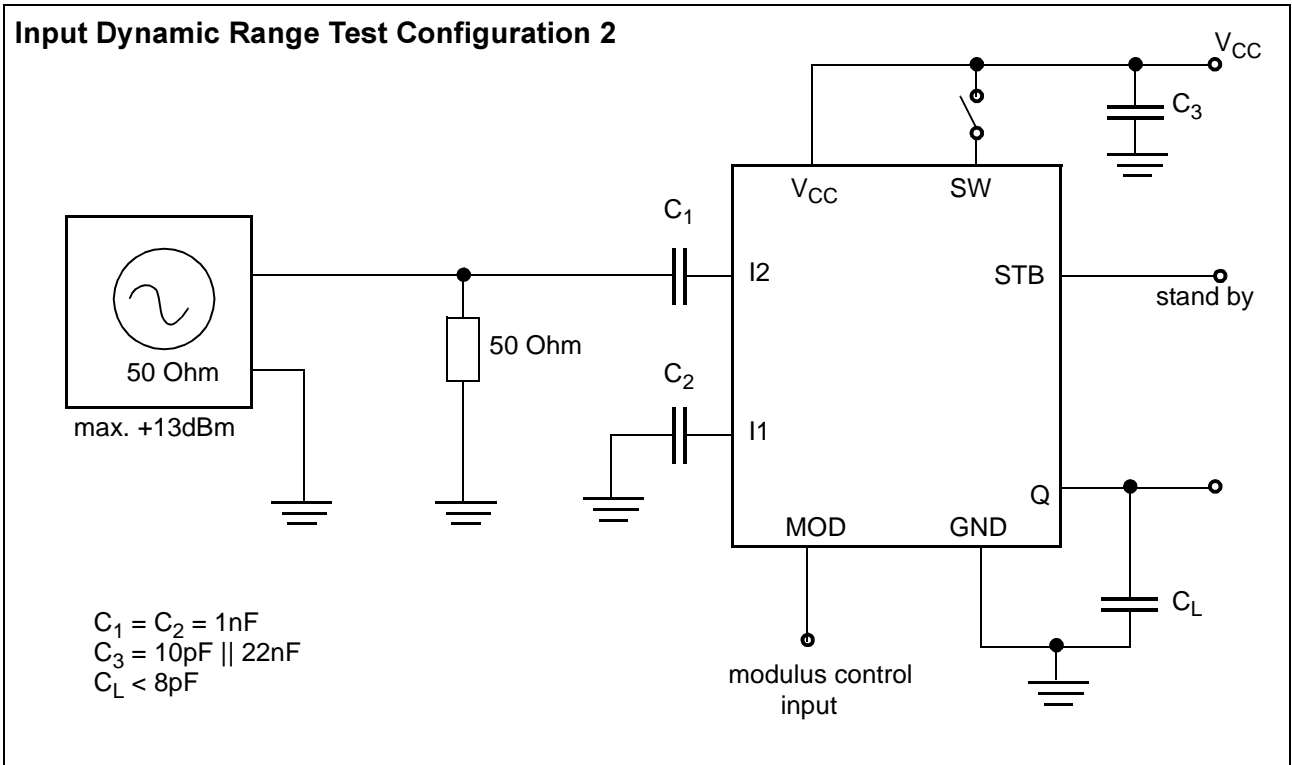
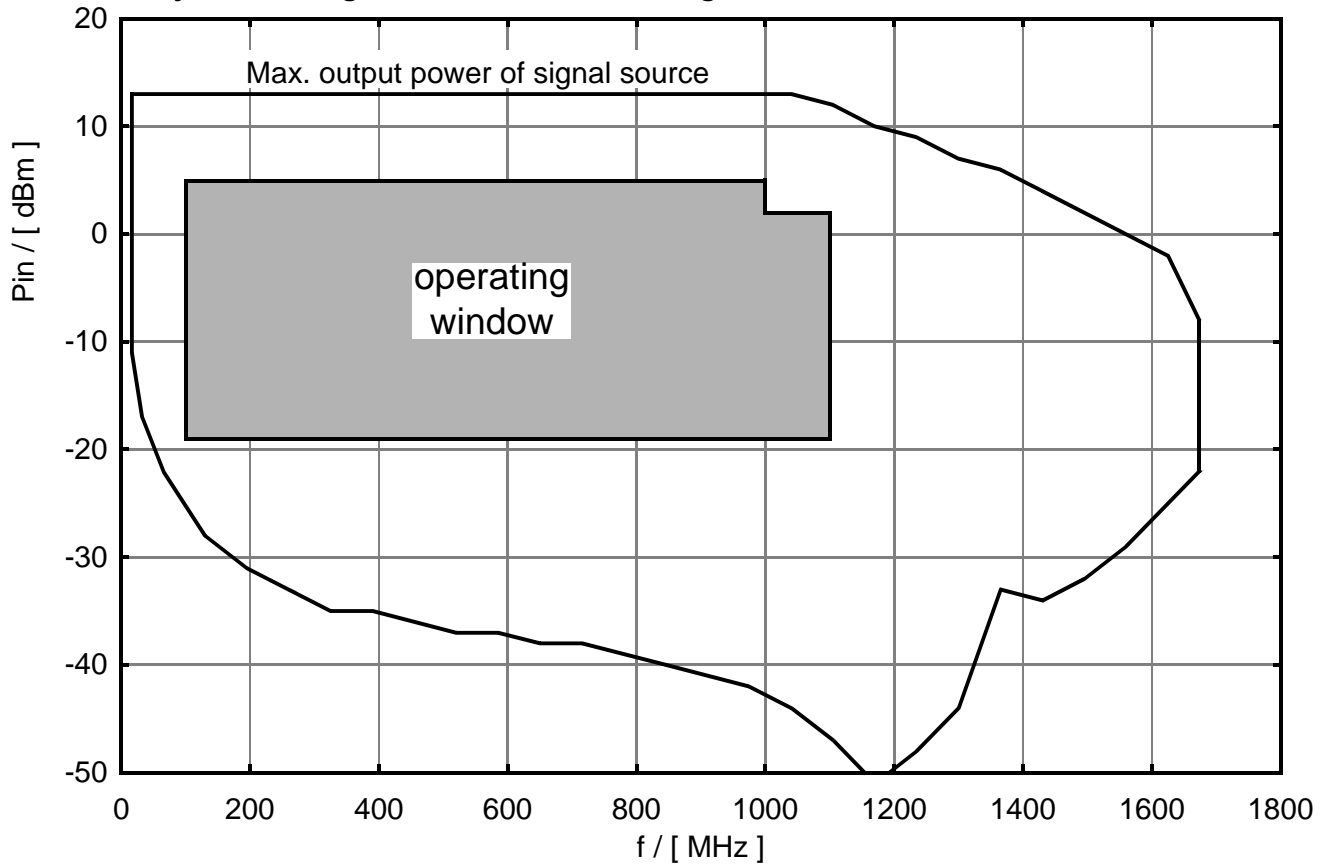


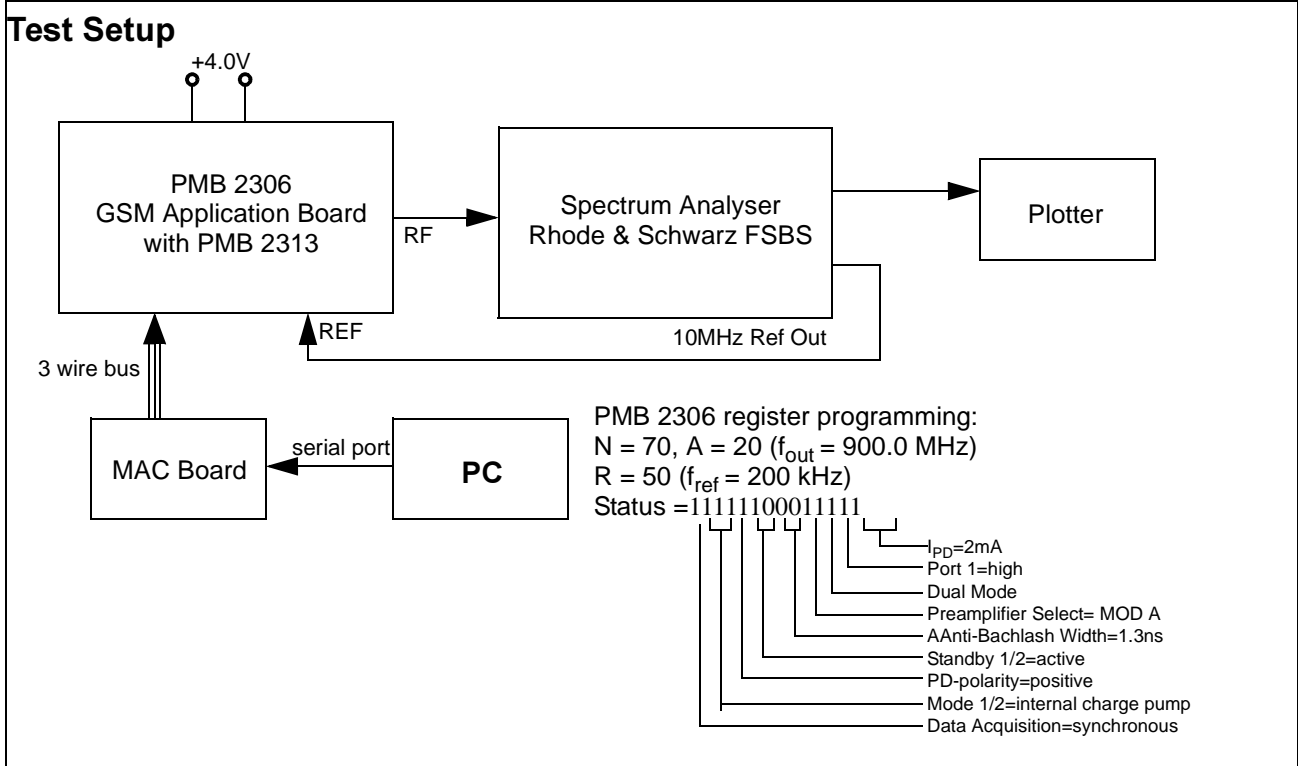
Diagram 3



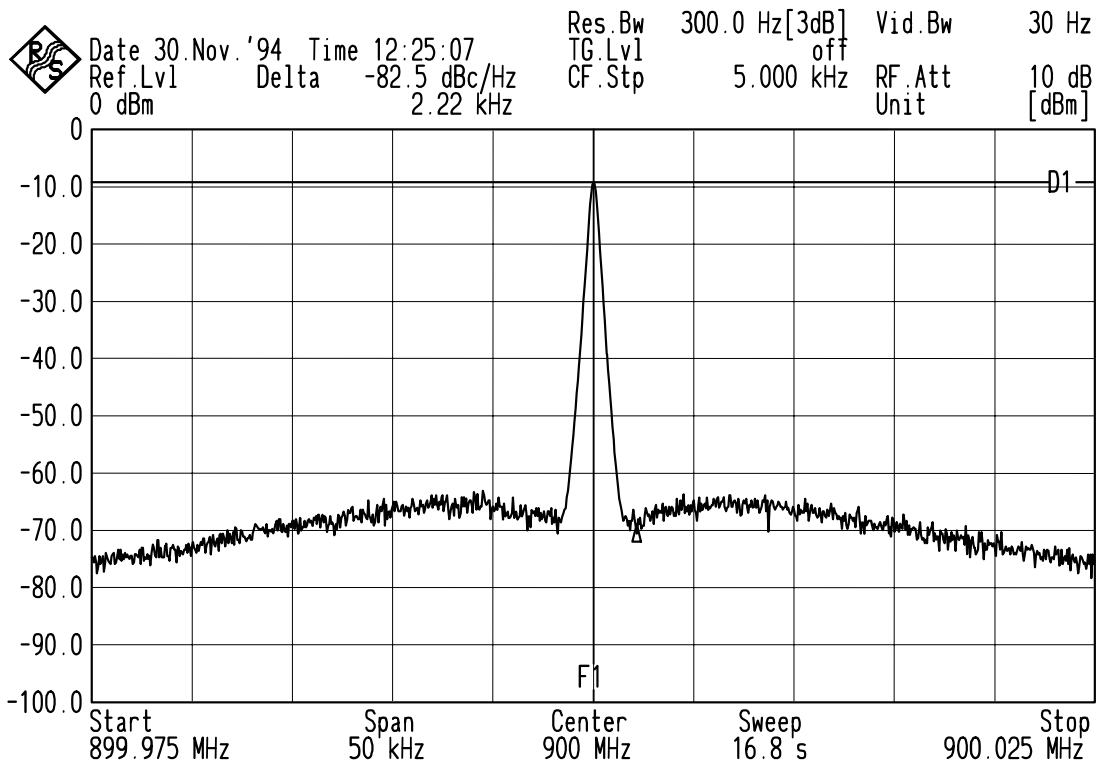
PMB 2313 Dynamic Range 4V Ratio 65 Test Configuration 2



## Phase Noise Measurement



## Measured Spectrum







## PMB 2306 GSM Application Board

### List of Components

| Item | Quantity | Reference                      |                     | Part     |                     |
|------|----------|--------------------------------|---------------------|----------|---------------------|
| 1    | 1        | R7                             | 100Ω                | SMD/0805 | B54102-A1101-X60    |
| 2    | 2        | R13, R14                       | 150Ω                | SMD/0805 | B54102-A1151-J60    |
| 3    | 1        | R6                             | 220Ω                | SMD/0805 | B54102-A1221-J60    |
| 4    | 1        | R8                             | 330Ω                | SMD/0805 | B54102-A1331-J60    |
| 5    | 1        | R15                            | 2.2kΩ               | SMD/0805 | B54102-A1222-J60    |
| 6    | 1        | R10                            | 3.3kΩ               | SMD/0805 | B54102-A1332-J60    |
| 7    | 1        | RA                             | 4.7kΩ               | SMD/0805 | B54102-A1472-J60    |
| 8    | 1        | R12                            | 6.8kΩ               | SMD/0805 | B54102-A1682-J60    |
| 9    | 4        | R3, R5, R9, R11                | 8.2kΩ               | SMD/0805 | B54102-A1822-J60    |
| 10   | 1        | R4                             | 18kΩ                | SMD/0805 | B54102-A1183-J60    |
| 11   | 1        | R2                             | 22kΩ                | SMD/0805 | B54102-A1223-J60    |
| 12   | 1        | R1                             | 39kΩ                | SMD/0805 | B54102-A1393-J60    |
| 13   | 1        | L1                             | 22nH                | SIMID 01 | B82412-A3220-M      |
| 14   | 1        | C11                            | 1.2pF               | COG/0805 | B37940-K5010-C262   |
| 15   | 1        | C13                            | 2.2pF               | COG/0805 | B37940-K5020-C262   |
| 16   | 1        | C8                             | 10pF                | COG/0805 | B37940-K5100-J62    |
| 17   | 6        | C10, C12, C14<br>C15, C16, C30 | 22pF                | COG/0805 | B37940-K5220-J62    |
| 18   | 3        | C1, C2, C17                    | 33pF                | COG/0805 | B37940-K5330-J62    |
| 19   | 1        | C9                             | 100pF               | COG/0805 | B37940-K5101-J62    |
| 20   | 1        | C3                             | 330pF               | COG/0805 | B37940-K5331-J62    |
| 21   | 1        | C5                             | 560pF               | COG/0805 | B37940-K5561-J62    |
| 22   | 1        | C4                             | 1.0nF               |          |                     |
| 23   | 1        | C7                             | 5.6nF               | COG/1210 |                     |
| 24   | 1        | C6                             | 100nF               | X7R/1210 | B37950-K5104-K62    |
| 25   | 1        | C19                            | 22μF                |          |                     |
| 26   | 1        | D1                             | BBY51               |          | Q62702-B631         |
| 27   | 2        | T2, T3                         | BFR280              |          | Q62702-F1298        |
| 28   | 1        | T1                             | BFT92               |          | Q62702-F1062        |
| 29   | 2        | X1, X2                         | SMA                 |          | Connector           |
| 30   | 1        | RX                             | 1.3GHz              |          | B69620-G1307-A410   |
| 31   | 1        | IC1                            | PMB 2306T P-DSO-14  |          | Q67100-H6423 (TUBE) |
|      |          | or                             | PMB 2306T P-DSO-14  |          | Q67106-H6423 (T+R)  |
| 32   | 1        | IC2                            | PMB 2313T P-DSO-8-1 |          | Q ?? (TUBE)         |
|      |          | or                             | PMB 2313T P-DSO-8-1 |          | Q 67006-A6116 (T+R) |

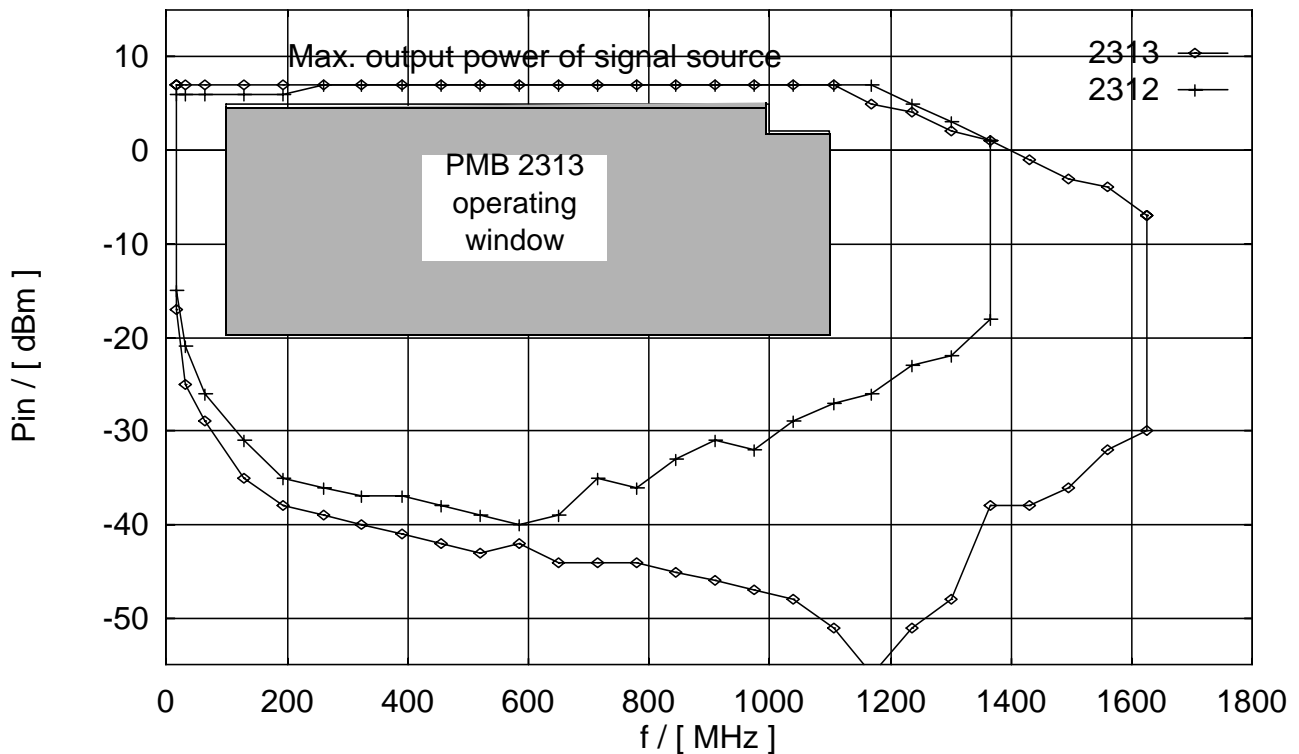
## Replacing the PMB 2312 by the PMB 2313

|                         | PMB 2312  | PMB 2313  | Test Condition   |
|-------------------------|---|---|--|
| Supply current (typ.):  | 5.7mA   | 1.95 mA   | inputs RF-grounded,<br>$U_S = 4.0\text{ V}$ , $T_{\text{amb}} = 25\text{ °C}$<br>STB open, output open   |
| Input frequency         | 200 - 1000 MHz  | 100 - 1100 MHz                                    |  |
| Supply voltage          | 4.0 - 5.5V  | 2.7 - 5.5 V                                       |  |
| Output stage load:      | internal load resistor                                  | internal current source                           |  |
| Phase noise:            | same performance, see section "Phase Noise Measurement" |   |  |
| Input impedance (typ.): | 40 $\Omega$    1.3 pF<br>66 $\Omega$    1.4 pF          | 750 $\Omega$    560 fF<br>1150 $\Omega$    350 fF | $f = 900\text{ MHz}$ , $C_1 = C_2 = 1\text{ nF}$<br>$U_S = 4.0\text{ V}$ , $T_{\text{amb}} = 25\text{ °C}$<br>$f = 450\text{ MHz}$ , $C_1 = C_2 = 1\text{ nF}$<br>$U_S = 4.0\text{ V}$ , $T_{\text{amb}} = 25\text{ °C}$ |
| Input sensitivity:      | see following diagram                                   |   |  |

Due to the internal output current source of the PMB 2313, an external load resistor may be omitted in most cases.

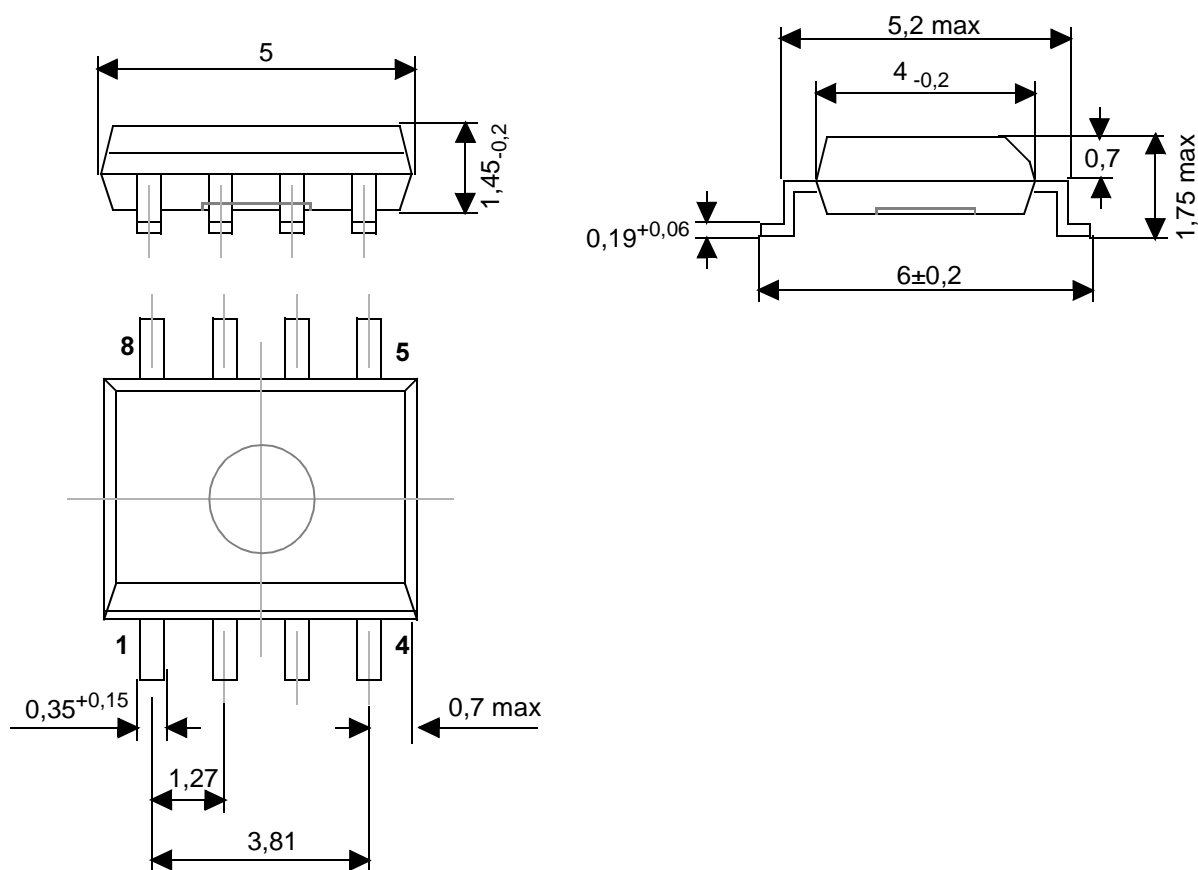
Input Sensitivity of PMB 2313 versus PMB 2312  
Measurement according to Test Configuration 1

PMB 2313 vers. PMB 2312 Dynamic Range 4V Ratio 65 Test Circuit 1



Package Outlines

Plastic-Package, P-DSO-8



(Dual-in-Line-Package, Small-Outline)  
20 A 8 DIN 41870 T16 (SMD)