# U2891B

# 2.5-GHz Quadrature Up-Converter

## Description

The U2891B is a silicon monolithic IC made with Atmel Wireless & Microcontrollers' advanced UHF process. The IC consists of a 500-MHz I/Q quadrature modulator and a 2.5-GHz mixer. Both parts can be connected via an external filter in order to suppress harmonics and spurious products. The device features 3-V operation, low-current consumption and furthermore two separate power-down functions for modulator and mixer. The RF ports are single-ended and the device can be operated adjustment free. These features and the double-conversion concept of U2891B make this device perfectly suited for all digital radio applications from 900 MHz up to 2.5 GHz (e.g., GSM, DCS 1800, JDC, PHP and WLAN).

Electrostatic sensitive device.
Observe precautions for handling.

## Features

- Low power consumption: 25 mA / 3 V
  (typical at –8 dBm output level)

- 2.5 GHz output frequency

- Excellent sideband suppression by means of duty cycle regeneration and 90° phase control

- Separate power-down mode for modulator and mixer

- Low LO input level: –10 dBm (typical)

- LO and RF port 50-Ω single-ended

## Benefits

- Extended talk time due to increased battery life

- Few external components results in cost and board space saving

- Adjustment free, hence saves time and cost

- One TX platform for different systems

- Reduced costs and space for battery (3-V operation)
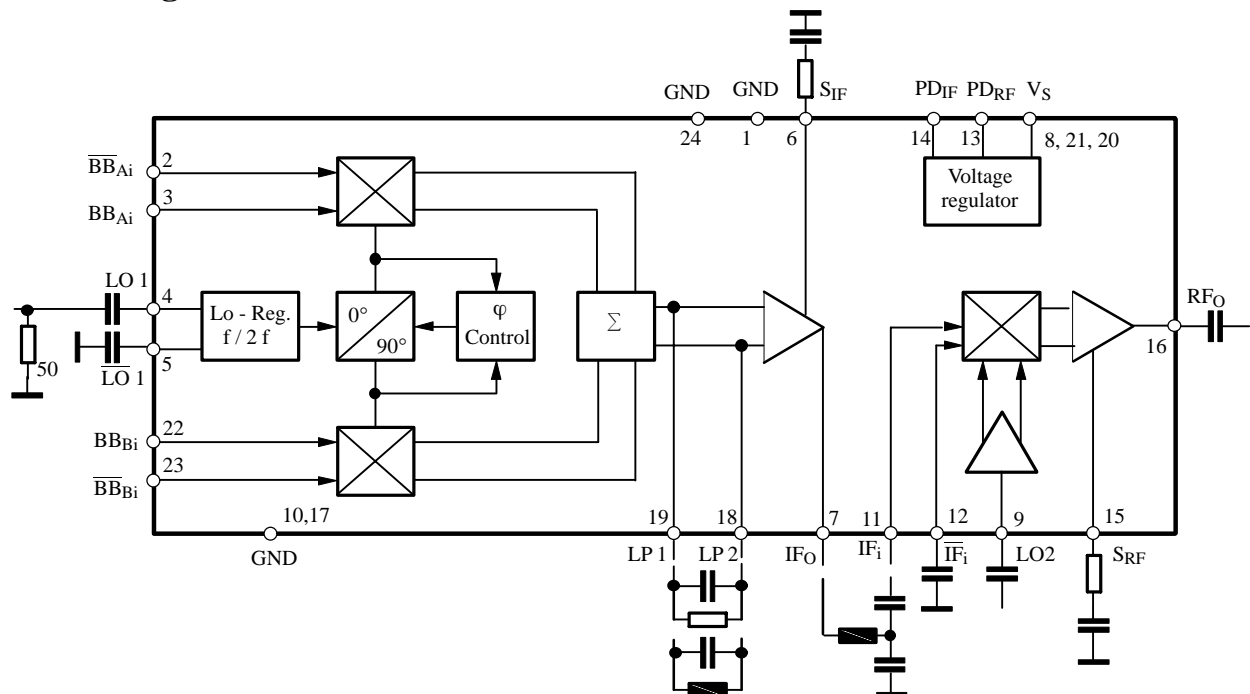
## Block Diagram



Figure 1.  Block diagram

# U2891B

## Ordering Information

| Extended Type Number | Package | Remarks |
|---|---|---|
| U2891B-MFS | SSO24 | Tube, MOQ 690 pcs. |
| U2891B-MFSG3 | SSO24 | Taped and reeled, MOQ 4000 pcs. |

## Pin Description

```
GND     [1]          [24]  GND
BB_Ai   [2]          [23]  BB_Bi
BB_Ai   [3]          [22]  BB_Bi
LO 1    [4]          [21]  V_S
LO 1    [5]          [20]  V_S
S_IF    [6]          [19]  LP 1
IF_O    [7]          [18]  LP 2
V_S     [8]          [17]  GND
LO 2    [9]          [16]  RF_O
GND     [10]         [15]  S_RF
IF_i    [11]         [14]  PD_IF
IF_i    [12]         [13]  PD_RF

          94 8581 e
```

| Pin | Symbol | Function |
|---|---|---|
| 1, 10, 17, 24 | GND | Ground |
| 2 | $\overline{BB}_{Ai}$ | Baseband input A inverse |
| 3 | $BB_{Ai}$ | Baseband input A |
| 4 | LO 1 | LO 1 input |
| 5 | $\overline{LO}$ 1 | LO 1 input inverse |
| 6 | $S_{IF}$ | Output symmetry IF |
| 7 | $IF_O$ | IF output |
| 8 | $V_S$ | Supply voltage |
| 9 | LO 2 | LO 2 input |
| 11 | $IF_i$ | IF input |
| 12 | $\overline{IF}_i$ | IF input inverse |
| 13 | $PD_{RF}$ | Power-down RF |
| 14 | $PD_{IF}$ | Power-down IF |
| 15 | $S_{RF}$ | Output symmetry RF |
| 16 | $RF_O$ | RF output |
| 18 | LP 2 | Filter and IF level adjustment |
| 19 | LP 1 | Filter and IF level adjustment |
| 20 | $V_S$ | Supply voltage |
| 21 | $V_S$ | Supply voltage |
| 22 | $BB_{Bi}$ | Baseband input B |
| 23 | $\overline{BB}_{Bi}$ | Baseband input B inverse |

## Absolute Maximum Ratings

| Parameters | | Symbol | Value | Unit |
|---|---|---|---|---|
| Supply voltage | Pins 8, 20 and 21 | $V_S$, $V_{SRF}$ | 6 | V |
| Input voltage | Pins 2, 3, 4, 5, 9, 11, 12, 22 and 23 | $V_i$ | 0 to $V_S$ | V |
| Junction temperature | | $T_j$ | 125 | °C |
| Storage temperature range | | $T_{stg}$ | −40 to +125 | °C |

## Operating Range

| Parameters | | Symbol | Value | Unit |
|---|---|---|---|---|
| Supply voltage | Pins 8, 20 and 21 | $V_S$, $V_{SRF}$ | 2.7 to 5.5 | V |
| Ambient temperature range | | $T_{amb}$ | −40 to +85 | °C |

## Thermal Resistance

| Parameters | | Symbol | Value | Unit |
|---|---|---|---|---|
| Junction ambient | SSO24 | $R_{thJA}$ | 140 | K/W |

## Electrical Characteristics: General Data

| Parameters | Test Conditions / Pin | Symbol | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| **Power supply** | | | | | | |
| Supply voltage range | Pin 8, 20 and 21 | $V_S$, $V_{SRF}$ | 2.7 | | 5.5 | V |
| Supply current | Pin 8, 20 and 21, $V_S = 3$ V | $I_S$, $I_{SRF}$ | | 25 | | mA |

## Electrical Characteristics: I/Q Modulator

Test conditions (unless otherwise specified): $V_S = 3$ V, $T_{amb} = 25°C$, referred to test circuit.
System impedance Zo = 50 Ω, $f_{LO1} = 100$ MHz, $P_{LO1} = -10$ dBm.

| Parameters | Test Conditions / Pin | Symbol | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| **IF output**      **Pin 7** | | | | | | |
| Output level | $R_{LP} = \infty$ | $P_{IFo}$ | | − 8 | | dBm |
| LO1 suppression | | $LO_{RFo}$ | | 40 | | dB |
| Voltage standing wave ratio | | $VSWR_{IFo}$ | | 1.4 | 2 | |
| Sideband suppression | | $SBS_{IFo}$ | | 45 | | dB |
| **Baseband inputs**      **Pins 2, 3, 22 and 23** | | | | | | |
| Input voltage range (diff.) | | $V_{BBi}$ | | 500 | 900 | mVpp |
| Input impedance | | $Z_{BBi}$ | | 150 | | kΩ |
| Input frequency | | $f_{BBi}$ | | | 200 | MHz |
| **LO1 input**      **Pins 4 and 5** | | | | | | |
| Frequency range | | $f_{LOi}$ | 30 | | 500 | MHz |
| Input level [1] | | $P_{LOi}$ | | −10 | −2 | dBm |
| Input impedance | | $Z_{iLO}$ | | tbd. | | Ω |
| Duty cycle range | | $DCR_{LO1}$ | 0.4 | | 0.6 | |
| **Power-down mode** | | | | | | |
| Supply current | $V_{PD} \leq 0.5$ V Pin 14 | $I_{PD}$ | | <5 | | µA |
| Settling time | $C_{SPD}$ 100 pF, $C_{LO} = 100$ pF, $C_{RFo} = 1$ nF | $t_S$ | | 10 | | µs |
| **Power down voltage**      **Pin 14** | | | | | | |
| "Power on" | $V_S = 3.5$ to 5.5 V <br> $V_S = 2.7$ to 3.5 V | $V_{PON}$ | $V_S - 0.5$ <br> $V_S$ | | $V_S + 0.5$ <br> $V_S + 0.5$ | V <br> V |
| "Power down" | | $V_{PDN}$ | | | 1 | V |
| Power down current | Power on <br> Power down | $I_{PON}$ <br> $I_{PDN}$ | | 0.15 <br> < 1 | | mA <br> µA |

Note: [1]      Required LO level is a function of the LO frequency

## Electrical Characteristics: Mixer

$V_S$ = 3 V, $f_{LO2}$ = 800 MHz, $f_{IF}$ = 100 MHz, $P_{LO2}$ = – 10dBm, system impedance Zo = 50 Ω, $T_{amb}$ = 25 °C, reference point Pin 10, unless otherwise specified

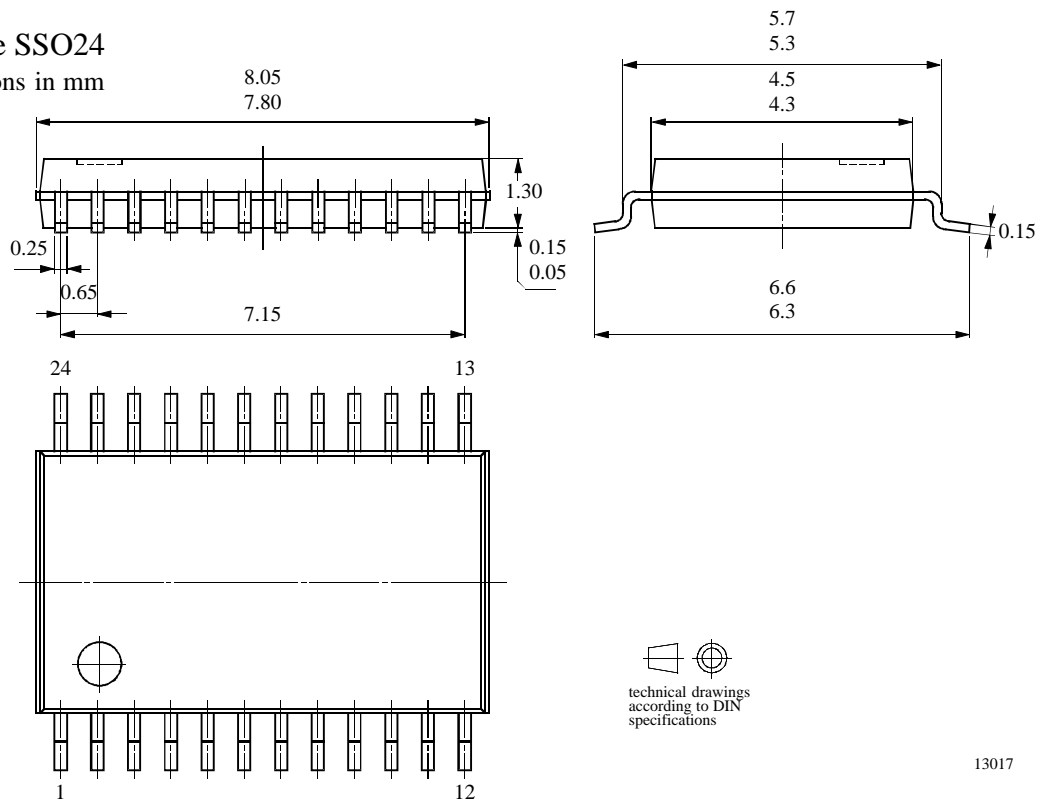| Parameters | Test Conditions / Pin | Symbol | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| **Operating frequencies** | | | | | | |
| RF$_O$ frequency | Pin 16 | RF$_O$ | 50 | | 2500 | MHz |
| LO2 frequency | Pin 9 | $f_{LO2}$ | 50 | | 2500 | MHz |
| **Isolation** | | | | | | |
| LO2 spurious at RF$_o$ | Pin 9–16 $P_{iLO}$ = –10 to 0 dBm | IS$_{LO2\text{-}RFo}$ | | –30 | | dBm |
| RF$_o$ to LO2 | Pin 16–9 | IS$_{RFo\text{-}LO2}$ | | tbd. | | dB |
| **Output level** | | | | | | |
| Output compression point | Pin 16 $R_{Po}$ = ∞ | CP$_o$ – 1 dB | | –7 | | dBm |
| **Input level** | | | | | | |
| Input compression point [1] | Pins 11 and 12 | CP$_i$ – 1dB | | –15 | | dBm |
| Input LO2 | Pin 9 | $P_{LO2}$ | | –10 | | dBm |
| Third order input intercept point [1] | Pins 11 and 12 | $P_{iIIP3}$ | | –6 | | dBm |
| **Voltage standing wave ratio (VSWR)** | | | | | | |
| Input IF | Pins 11 and 12 | VSWR$_{IFi}$ | | tbd. | | |
| Input LO2 | Pin 9 | VSWR$_{LO2}$ | | tbd. | | |
| Output RF | Pin 16 | VSWR$_{RF}$ | | tbd. | | |
| Conversion power gain | $R_L$ = 50 Ω | PG$_C$ | | 9 | | dB |
| Noise Figure (SSB) [2] | $P_{iLO}$ = – 6 dBm | NF50 | | 13 | | dB |
| **Power-down mode** | | | | | | |
| Supply current | $V_{PD}$ ≤ 0.5 V Pin 13 | $I_{PD}$ | | <5 | | µA |
| Settling time | C$_{SPD}$ 100 pF, C$_{LO}$ = 100 pF, C$_{RFo}$ = 1 nF | $t_S$ | | 10 | | µs |
| **Power down voltage** **Pin 13** | | | | | | |
| "Power on" | $V_S$ = 3.5 to 5.5 V $V_S$ = 2.7 to 3.5 V | $V_{PON}$ | $V_S$ – 0.5 $V_S$ | | $V_S$ +0.5 $V_S$ +0.5 | V V |
| "Power down" | | $V_{PDN}$ | | | 1 | V |
| Power down current | Power on Power down | $I_{PON}$ $I_{PDN}$ | | 0.15 < 1 | | mA µA |

Note:
[1]     with 50 Ω termination resistor at Pin 11
[2]     without termination resistor

# Packing Information

## Package SSO24
Dimensions in mm



8.05
7.80

1.30

0.25

0.15
0.05

0.65

7.15

5.7
5.3

4.5
4.3

0.15

6.6
6.3

24          13

1          12

technical drawings
according to DIN
specifications

13017

## Ozone Depleting Substances Policy Statement

It is the policy of **Atmel Germany GmbH** to

1. Meet all present and future national and international statutory requirements.

2. Regularly and continuously improve the performance of our products, processes, distribution and operating systems with respect to their impact on the health and safety of our employees and the public, as well as their impact on the environment.

It is particular concern to control or eliminate releases of those substances into the atmosphere which are known as ozone depleting substances (ODSs).

The Montreal Protocol (1987) and its London Amendments (1990) intend to severely restrict the use of ODSs and forbid their use within the next ten years. Various national and international initiatives are pressing for an earlier ban on these substances.

**Atmel Germany GmbH** has been able to use its policy of continuous improvements to eliminate the use of ODSs listed in the following documents.

1. Annex A, B and list of transitional substances of the Montreal Protocol and the London Amendments respectively

2. Class I and II ozone depleting substances in the Clean Air Act Amendments of 1990 by the Environmental Protection Agency (EPA) in the USA

3. Council Decision 88/540/EEC and 91/690/EEC Annex A, B and C (transitional substances) respectively.

**Atmel Germany GmbH** can certify that our semiconductors are not manufactured with ozone depleting substances and do not contain such substances.

**Data sheets can also be retrieved from the Internet:** **http://www.atmel–wm.com**

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