

## Features

- Supply Voltage: 5 V
- Low Power Consumption: 15 mA/5 V
- Output Level and Spurious Products Adjustable (Optional)
- Excellent Sideband Suppression by Means of Duty Cycle Regeneration of the LO Input Signal
- Phase-control Loop for Precise 90° Phase Shifting
- Power-down Mode
- Low LO Input Level: -15 dBm
- 50-Ω Single-ended LO and RF Port
- LO Frequency Range of 30 MHz to 300 MHz

## Benefits

- Low Current Consumption
- Few External Components Result in Cost and Board Space Saving
- Adjustment Free Hence Saves Time

Electrostatic sensitive device.

Observe precautions for handling.



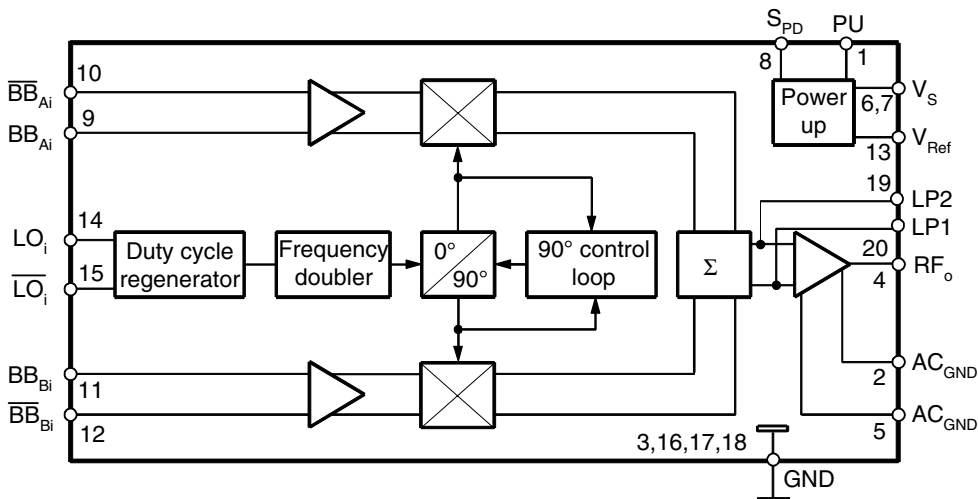
## 300-MHz Quadrature Modulator

### U2793B

## Description

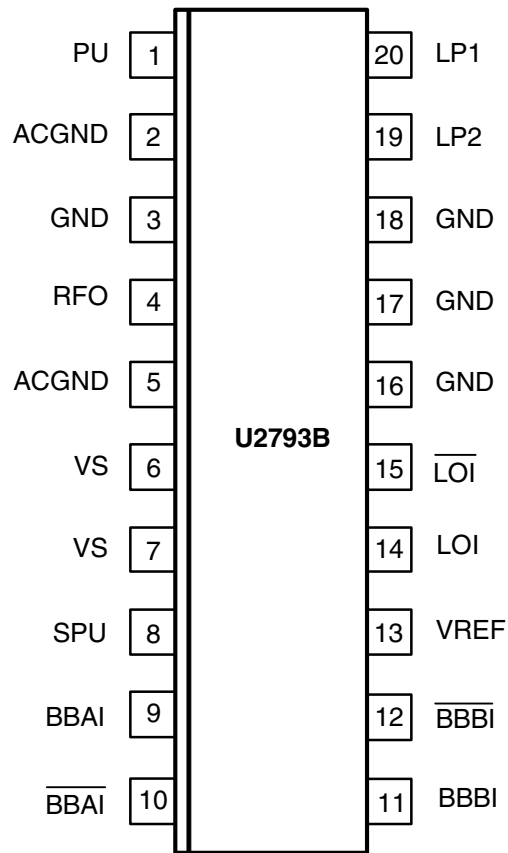
The IC U2793B is a 300-MHz quadrature modulator that uses Atmel's advanced UHF process. It features low current consumption, single-ended RF ports and adjustment-free application, which makes the device suitable for all digital radio systems, e.g., GSM, PCN, JDC and WLAN. As an option, output level and spurious products are adjustable at pins 19 and 20. In conjunction with Atmel's U2795B mixer, an up-converter up to 2 GHz can be realized.

Figure 0-1. Block Diagram



# 1. Pin Configuration

Figure 1-1. Pinning SSO20



**Table 1-1.** Pin Description

Pin	Symbol	Function
1	PU	Power-up input
2	ACGND	AC ground
3	GND	Ground
4	RFO	RF output
5	ACGND	AC ground
6	VS	Supply voltage
7	VS	Supply voltage
8	SPU	Settling time power-up
9	BBAI	Baseband input A
10	BBAI	Baseband input A inverse
11	BBBI	Baseband input B
12	BBBI	Baseband input B inverse
13	VREF	Reference voltage (2.5 V)
14	LOI	Input LO
15	LOI	Input LO inverse, typically grounded
16	GND	Ground
17	GND	Ground
18	GND	Ground
19	LP2	Output low pass and power control
20	LP1	Output low pass and power control

## 2. Absolute Maximum Ratings

Stresses beyond those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Parameters	Symbol	Value	Unit
Supply voltage	$V_S$	6	V
Input voltage	$V_i$	0 to $V_S$	V
Junction temperature	$T_j$	125	°C
Storage temperature range	$T_{Stg}$	-40 to +125	°C

## 3. Thermal Resistance

Parameters	Symbol	Value	Unit
Junction ambient SSO20	$R_{thJA}$	140	K/W

## 4. Operating Range

Parameters	Symbol	Value	Unit
Supply voltage	$V_S$	4.5 to 5.5	V
Ambient temperature range	$T_{amb}$	-40 to +85	°C

## 5. Electrical Characteristics

Test conditions (unless otherwise specified);  $V_S = 5\text{ V}$ ,  $T_{amb} = 25^\circ\text{C}$ , referred to test circuit.

System impedance  $Z_o = 50\ \Omega$ ,  $f_{LO} = 150\text{ MHz}$ ,  $P_{LO} = -15\text{ dBm}$ ,  $V_{BBI} = 1.0\text{ V}_{pp}$ , differential

No.	Parameters	Test Conditions	Pin	Symbol	Min.	Typ.	Max.	Unit	Type*
1.1	Supply voltage range		6, 7	$V_S$	4.5	5	5.5	V	A
1.2	Supply current		6, 7	$I_S$		15		mA	A
<b>2</b>	<b>Baseband Inputs, Pin 9-10, 11-12</b>								
2.1	Input-voltage range (differential)			$V_{BBI}$		1000	1500	mVpp	D
2.2	Input impedance			$Z_{BBI}$		30		k $\Omega$	D
2.3	Input-frequency range			$f_{BBI}$	0		50	MHz	D
2.4	Input voltage, common mode					2.5		V	
<b>3</b>	<b>LO Input, Pins 14 and 15</b>								
3.1	Frequency range			$f_{LOi}$	30		300	MHz	D
3.2	Input level <sup>(1)</sup>			$P_{LOi}$		-15	-5	dBm	D
3.3	Input impedance			$Z_{ILO}$		(2)		$\Omega$	D
3.4	Voltage standing wave ratio			$VSWR_{LO}$		3.5			D
3.5	Duty-cycle range			$DCR_{LO}$	0.4		0.6		D

Notes: 1. Required LO level is a function of the LO frequency.

2. The LO input impedance is consisting of a 50  $\Omega$  resistor in series with a 15 pF capacitor.

3. With the pins 19 and 20 spurious performance especially for low frequency application can be improved by adding a chip capacitor between LP1 and LP2. In conjunction with a parallel resistor the output level can be adjusted to the following mixer stage without degradation of LO suppression and noise performance which would decrease if the I/Q input level is reduced.

4. For  $T_{amb} = -40^\circ\text{C}$  to  $+85^\circ\text{C}$  and  $V_S = 4.5\text{ V}$  to  $5.5\text{ V}$

## 5. Electrical Characteristics (Continued)

Test conditions (unless otherwise specified);  $V_S = 5\text{ V}$ ,  $T_{\text{amb}} = 25^\circ\text{C}$ , referred to test circuit.

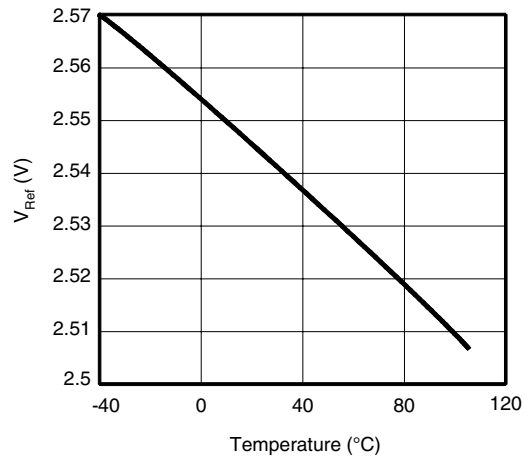
System impedance  $Z_0 = 50\ \Omega$ ,  $f_{\text{LO}} = 150\text{ MHz}$ ,  $P_{\text{LO}} = -15\text{ dBm}$ ,  $V_{\text{BBi}} = 1.0\text{ V}_{\text{pp}}$ , differential (Continued)

No.	Parameters	Test Conditions	Pin	Symbol	Min.	Typ.	Max.	Unit	Type*
<b>4</b>	<b>RF Output, Pin 4</b>								
4.1	Output level	$f_{\text{LO}} = 150\text{ MHz}$ , $V_{\text{BBi}} = 1\text{ V}_{\text{pp}}$ , differential $f_{\text{LO}} = 50\text{ MHz}$ , $V_{\text{BBi}} = 0.3\text{ V}_{\text{pp}}$ , differential		$P_{\text{RFo}}$	-3	-1	+2	dBm	A/B
4.2	LO suppression	$P_{\text{LO}} = -20\text{ dBm}$		$\text{LO}_{\text{RFo}}$	32	45		dB	A
4.3	Voltage standing wave ratio			$\text{VSWR}_{\text{RF}}$		1.4	2		D
4.4	Sideband suppression <sup>(3)</sup>			$\text{SBS}_{\text{RFo}}$	35	45		dB	A
4.5	Phase error <sup>(4)</sup>			$P_e$		< 1		deg	D
4.6	Amplitude error			$A_e$		< $\pm 0.25$		dB	D
4.7	Noise floor	$V_{\text{BBi}} = 2\text{ V}$ , $V_{\text{BBi}} = 3\text{ V}$ $V_{\text{BBi}} = V_{\text{BBi}} = 2.5\text{ V}$		$N_{\text{FL}}$		-137 -143		dBm/Hz	D
<b>5</b>	<b>Power-up Mode</b>								
5.1	Supply current	$V_{\text{PU}} \leq 0.5\text{ V}$ , pins 6, 7 $V_{\text{PU}} = 1\text{ V}$		$I_{\text{PU}}$		10	1	$\mu\text{A}$	D
5.2	Settling time	Pins 1 to 4, $C_{\text{SPU}} = 100\text{ pF}$ $C_{\text{LO}} = 100\text{ pF}$ , $C_{\text{RFo}} = 1\text{ nF}$		$t_{\text{SPU}}$		10		$\mu\text{s}$	D
<b>6</b>	<b>Switching Voltage, Pin 1</b>								
6.1	Power on			$V_{\text{PUON}}$	4			V	D
<b>7</b>	<b>Reference Voltage, Pin 13</b>								
7.1	Voltage range			$V_{\text{Ref}}$	2.375	2.5	2.625	V	A
7.2	Output impedance			$Z_{\text{ORef}}$		30		$\Omega$	D

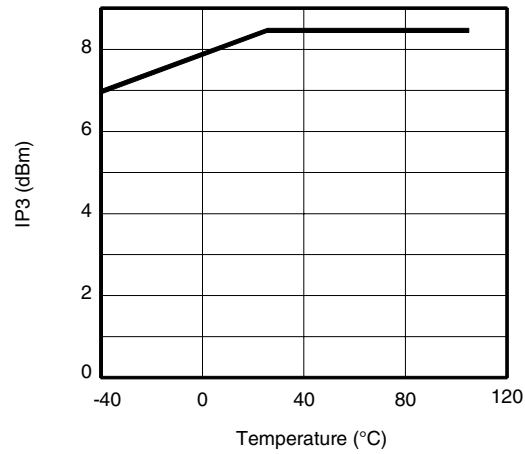
- Notes:
1. Required LO level is a function of the LO frequency.
  2. The LO input impedance is consisting of a  $50\ \Omega$  resistor in series with a  $15\text{ pF}$  capacitor.
  3. With the pins 19 and 20 spurious performance especially for low frequency application can be improved by adding a chip capacitor between LP1 and LP2. In conjunction with a parallel resistor the output level can be adjusted to the following mixer stage without degradation of LO suppression and noise performance which would decrease if the I/Q input level is reduced.
  4. For  $T_{\text{amb}} = -40^\circ\text{C}$  to  $+85^\circ\text{C}$  and  $V_S = 4.5\text{ V}$  to  $5.5\text{ V}$

## 6. Diagrams

**Figure 6-1.** Reference Voltage versus  $T_{amb}$



**Figure 6-2.** OIP3 versus  $T_{amb}$ , LO = 150 MHz, Level -10 dBm



**Figure 6-3.** Supply Current versus  $T_{amb}$

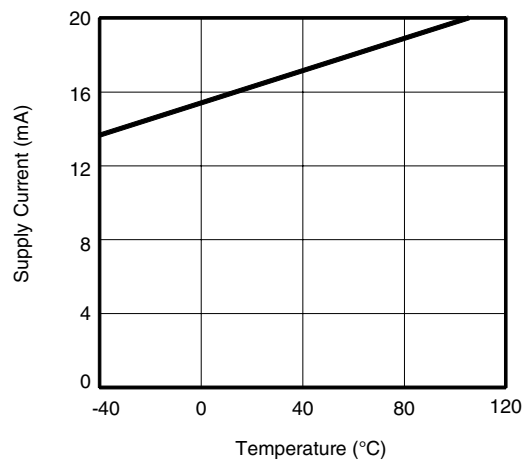


Figure 6-4. Recommended LO Power Range versus LO Frequency at  $T_{amb} = 25^{\circ}C$

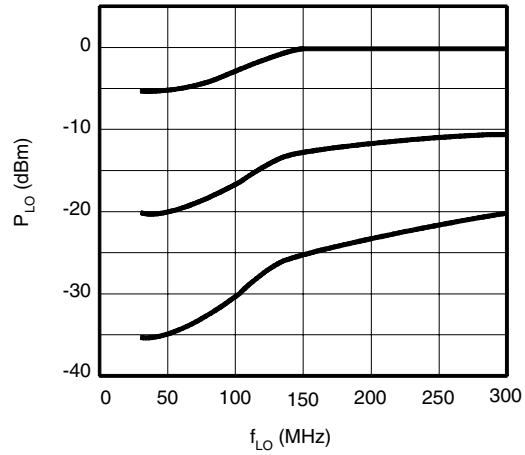


Figure 6-5. Output Power versus  $T_{amb}$

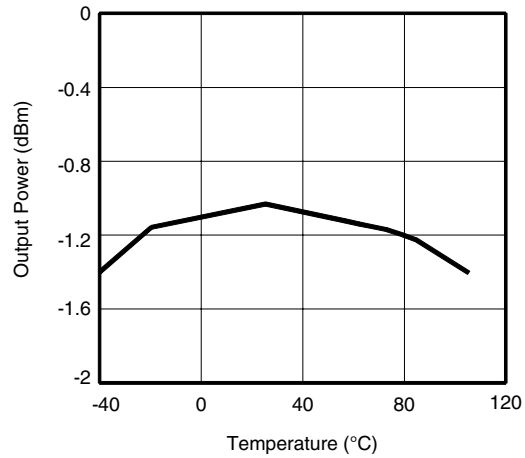
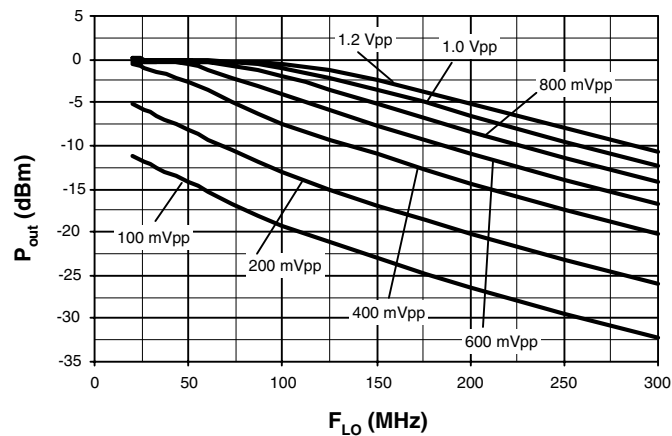
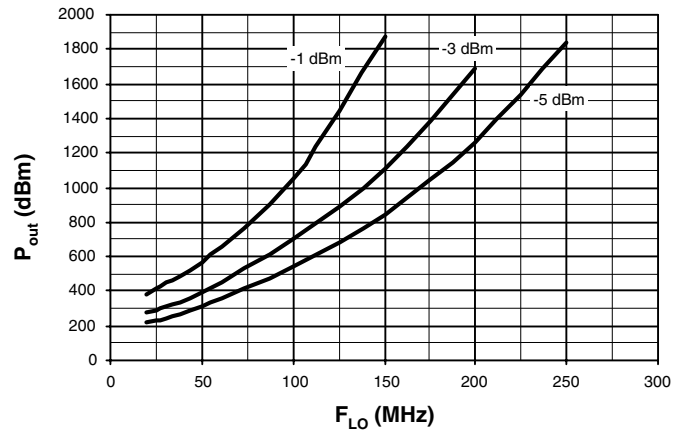


Figure 6-6. Typical Output Power versus LO Frequency at  $T_{amb} = 25^{\circ}C$ ,  $V_{BBI} = 250$  mV (Differential)



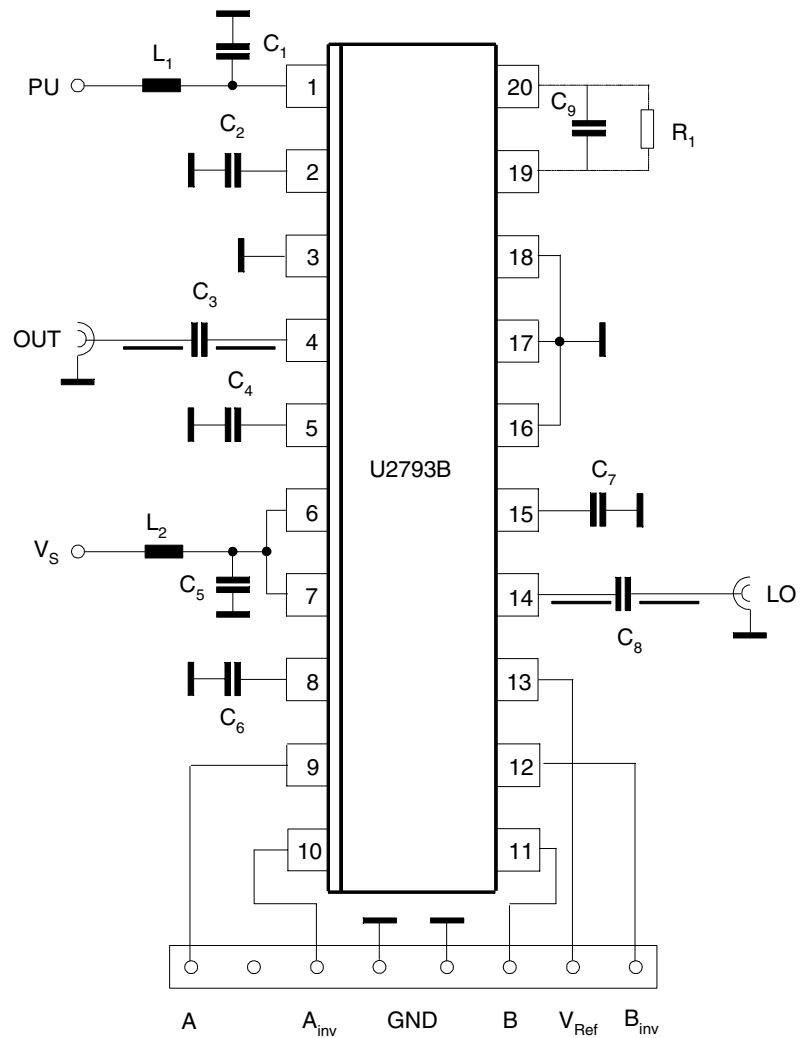
**Figure 6-7.** Typical Required  $V_{\text{BBI}}$  Input Signal (Differential) versus LO Frequency for  $P_{\text{O}} = 1 \text{ dBm}$  and  $P_{\text{O}} = -3 \text{ dBm}$





## 7. Evaluation Board Drawings

Figure 7-1. Evaluation Board Circuitry

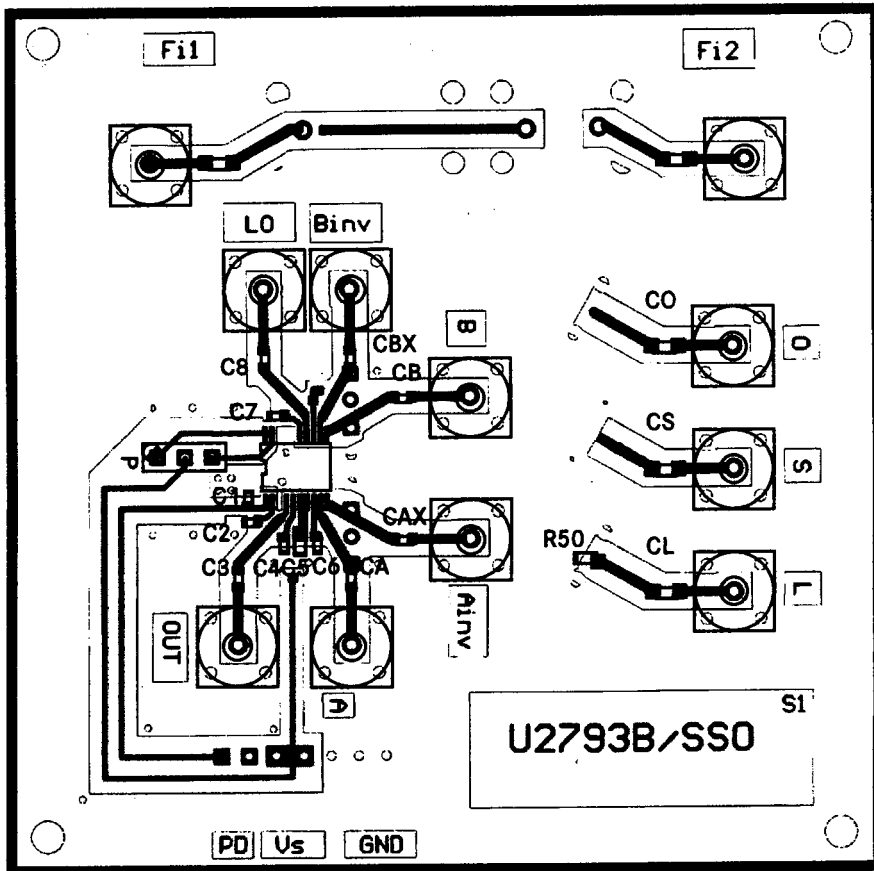


### Part List

$C_1, C_2, C_3, C_4, C_6$	=	1 nF
$C_7, C_8$	=	100 pF
$C_5$	=	100 nF
$C_9, R_1$	=	1 pF to 10 pF
	=	50-Ω Microstrip
	=	optional

The above listed components result in a PD settling time of <math><20 \mu\text{s}</math>. The use of other component values will require consideration for time requirements in burst-mode applications.

Figure 7-2. PCB Layout Evaluation Board



## 8. Application Circuits

Bias network for AC-coupled baseband inputs ( $V_{BA}$ ,  $V_{BB}$ ).

$R_1 = 2.5 \text{ k}\Omega$ ,  $R_2 \leq 10 \text{ k}\Omega$  for  $\geq 35 \text{ dB}$  LO suppression which is in reference to  $< 2 \text{ mV}$  input offset.

Figure 8-1. Application Circuit with AC-coupled Baseband Inputs

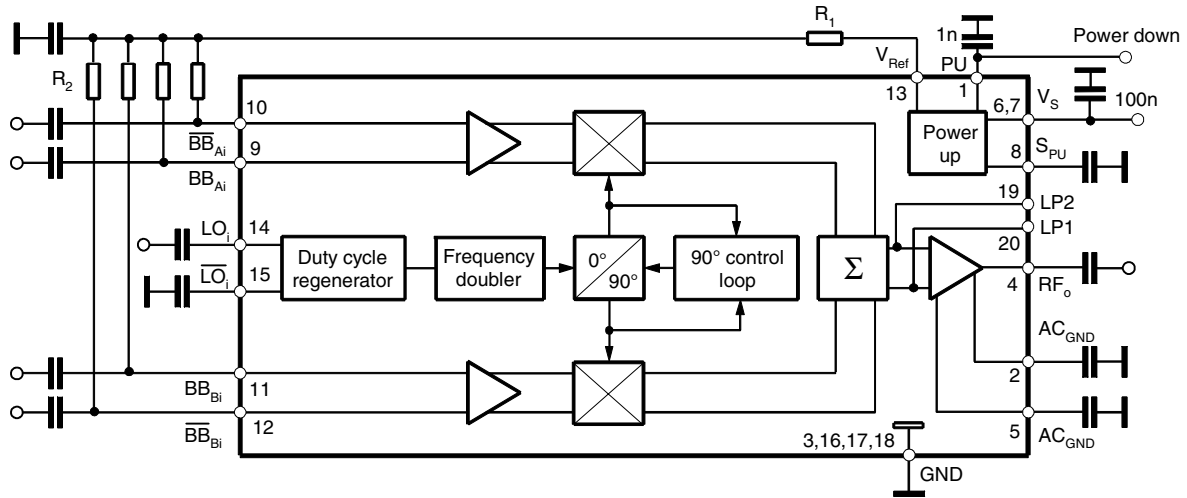
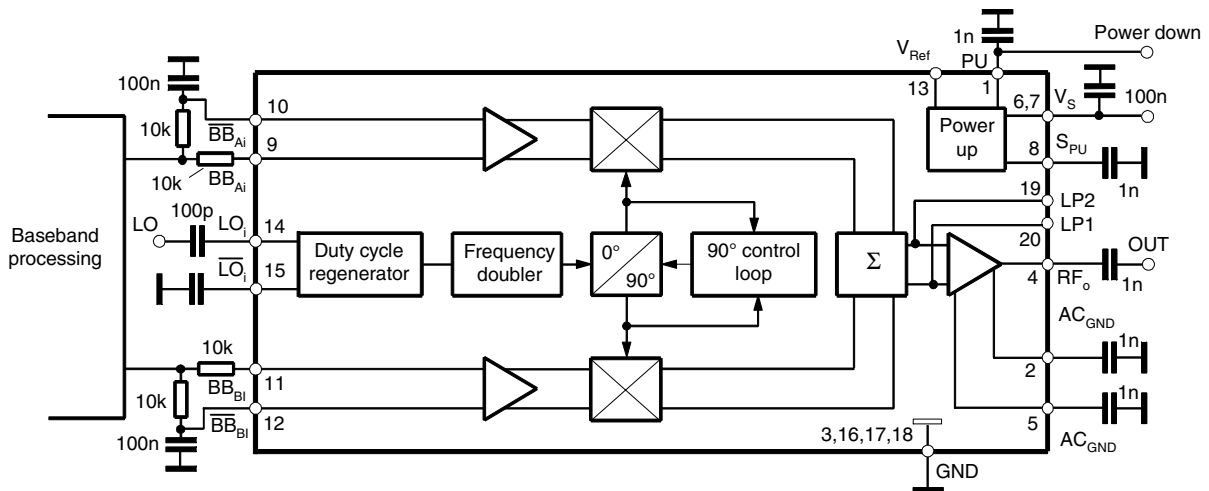


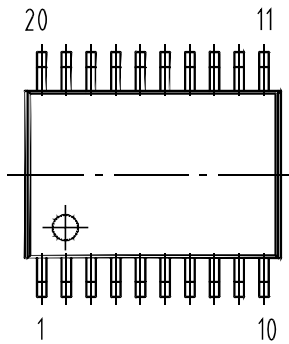
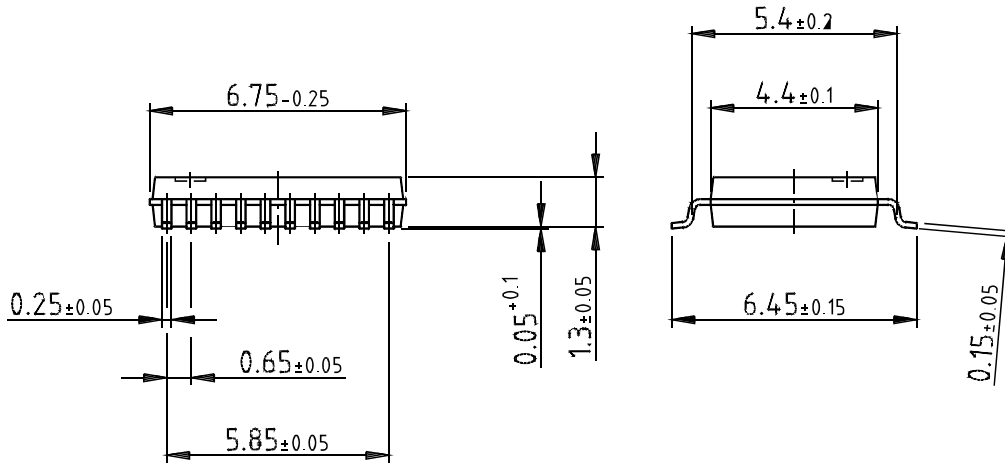
Figure 8-2. Application Circuit with DC-coupled Baseband Inputs



## 9. Ordering Information

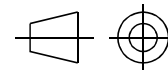
Extended Type Number	Package	Remarks
U2793B-NFSH	SSO20	Tube, lead free
U2793B-NFSG3H	SSO20	Taped and reeled, lead free

## 10. Package Information



Package: SSO 20

Dimensions in mm



technical drawings  
according to DIN  
specifications

Drawing-No.: 6.543-5056.01-4

Issue: 1; 10.03.04



## Atmel Corporation

2325 Orchard Parkway  
San Jose, CA 95131, USA  
Tel: 1(408) 441-0311  
Fax: 1(408) 487-2600

## Regional Headquarters

### Europe

Atmel Sarl  
Route des Arsenalux 41  
Case Postale 80  
CH-1705 Fribourg  
Switzerland  
Tel: (41) 26-426-5555  
Fax: (41) 26-426-5500

### Asia

Room 1219  
Chinachem Golden Plaza  
77 Mody Road Tsimshatsui  
East Kowloon  
Hong Kong  
Tel: (852) 2721-9778  
Fax: (852) 2722-1369

### Japan

9F, Tonetsu Shinkawa Bldg.  
1-24-8 Shinkawa  
Chuo-ku, Tokyo 104-0033  
Japan  
Tel: (81) 3-3523-3551  
Fax: (81) 3-3523-7581

## Atmel Operations

### Memory

2325 Orchard Parkway  
San Jose, CA 95131, USA  
Tel: 1(408) 441-0311  
Fax: 1(408) 436-4314

### Microcontrollers

2325 Orchard Parkway  
San Jose, CA 95131, USA  
Tel: 1(408) 441-0311  
Fax: 1(408) 436-4314

La Chantrerie  
BP 70602  
44306 Nantes Cedex 3, France  
Tel: (33) 2-40-18-18-18  
Fax: (33) 2-40-18-19-60

### ASIC/ASSP/Smart Cards

Zone Industrielle  
13106 Rousset Cedex, France  
Tel: (33) 4-42-53-60-00  
Fax: (33) 4-42-53-60-01

1150 East Cheyenne Mtn. Blvd.  
Colorado Springs, CO 80906, USA  
Tel: 1(719) 576-3300  
Fax: 1(719) 540-1759

Scottish Enterprise Technology Park  
Maxwell Building  
East Kilbride G75 0QR, Scotland  
Tel: (44) 1355-803-000  
Fax: (44) 1355-242-743

### RF/Automotive

Theresienstrasse 2  
Postfach 3535  
74025 Heilbronn, Germany  
Tel: (49) 71-31-67-0  
Fax: (49) 71-31-67-2340

1150 East Cheyenne Mtn. Blvd.  
Colorado Springs, CO 80906, USA  
Tel: 1(719) 576-3300  
Fax: 1(719) 540-1759

### Biometrics/Imaging/Hi-Rel MPU/ High Speed Converters/RF Datacom

Avenue de Rochepleine  
BP 123  
38521 Saint-Egreve Cedex, France  
Tel: (33) 4-76-58-30-00  
Fax: (33) 4-76-58-34-80

---

### Literature Requests

[www.atmel.com/literature](http://www.atmel.com/literature)

**Disclaimer:** The information in this document is provided in connection with Atmel products. No license, express or implied, by estoppel or otherwise, to any intellectual property right is granted by this document or in connection with the sale of Atmel products. **EXCEPT AS SET FORTH IN ATMEL'S TERMS AND CONDITIONS OF SALE LOCATED ON ATMEL'S WEB SITE, ATMEL ASSUMES NO LIABILITY WHATSOEVER AND DISCLAIMS ANY EXPRESS, IMPLIED OR STATUTORY WARRANTY RELATING TO ITS PRODUCTS INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTY OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, OR NON-INFRINGEMENT. IN NO EVENT SHALL ATMEL BE LIABLE FOR ANY DIRECT, INDIRECT, CONSEQUENTIAL, PUNITIVE, SPECIAL OR INCIDENTAL DAMAGES (INCLUDING, WITHOUT LIMITATION, DAMAGES FOR LOSS OF PROFITS, BUSINESS INTERRUPTION, OR LOSS OF INFORMATION) ARISING OUT OF THE USE OR INABILITY TO USE THIS DOCUMENT, EVEN IF ATMEL HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.** Atmel makes no representations or warranties with respect to the accuracy or completeness of the contents of this document and reserves the right to make changes to specifications and product descriptions at any time without notice. Atmel does not make any commitment to update the information contained herein. Atmel's products are not intended, authorized, or warranted for use as components in applications intended to support or sustain life.

© Atmel Corporation 2005. All rights reserved. Atmel®, logo and combinations thereof, and other, are registered trademarks, and Everywhere You Are<sup>SM</sup> and others are the trademarks of Atmel Corporation or its subsidiaries. Other terms and product names may be trademarks of others.



Printed on recycled paper.

4651D-CELL-03/05