Features

- **Supply Voltage Range: 2.7 V to 5.5 V**
- **Excellent Isolation Characteristics**
- **Low Current Consumption: 3.2 mA without R_{IP3}**
- **IIP3 Programmable**
- **Input Frequency Operating Range Up to 2 GHz**
- **RF Characteristics Nearly Independent of Supply Voltage**

Benefits

- **Low Current Consumption**
- **Small Package**
- **Easy to Implement**

Electrostatic sensitive device.
Observe precautions for handling.

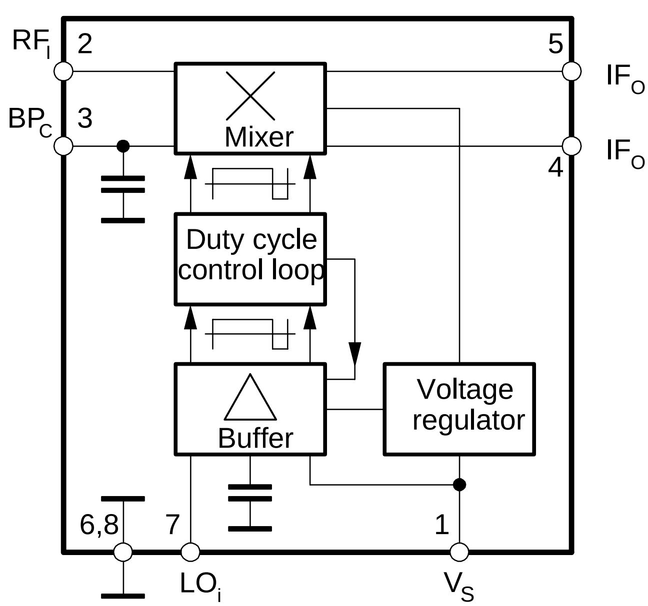
2-GHz Single-balanced Mixer

U2796B

Description

The U2796B is a 2-GHz down-conversion mixer for telecommunication systems, e.g., cellular radio, CT1, CT2, DECT, PCN, using Atmel's advanced bipolar UHF technology. The U2796B is well suited for the receiver portion of the RF circuit. Single-balanced structure has been chosen for best noise performance and low current consumption. The IIP3 is programmable.

Figure 1. Block Diagram



Rev. 4652A–CELL–01/03

Pin Configuration

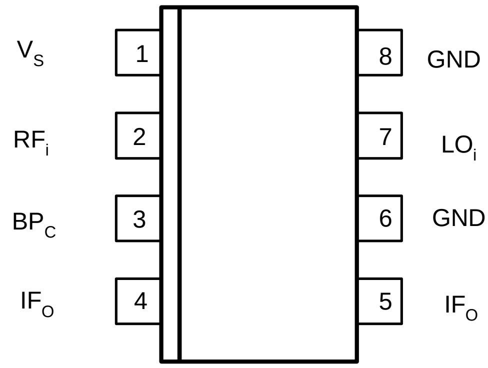


Figure 2. Pinning

Pin Description

Pin	Symbol	Function
1	V_S	Supply voltage
2	RF	RF input and IIP3 programming port
3	BP_C	Bypass capacitor
4	IFo	IF output
5	IFo	IF output
6	GND	Ground
7	LO_i	Local oscillator input
8	GND	Ground

Absolute Maximum Ratings

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	T_{stg}	-40 to +125	°C

Thermal Resistance

Parameters	Symbol	Value	Unit
Junction ambient SO8	R_{thJA}	175	K/W

Operating Range

Parameters	Symbol	Value	Unit
Supply-voltage range	V_S	2.7 to 5.5	V
Ambient temperature	T_{amb}	-40 to +85	°C

Electrical Characteristics

Test conditions (unless otherwise specified):
V_S = 3 V, f_{LO} = 900 MHz; I_M = 1.2 mA(1), T_{amb} = 25°C. System impedance Z_O = 50 Ω

No.	Parameters	Test Conditions	Pin	Symbol	Min.	Typ.	Max.	Unit	Type*
1.1	Supply voltage		1	V_S	2.7		5.5	V	D
1.2	Supply current	$R_{IP3} = \infty$	1	I_S	2.8	3.2	3.7	mA	A
1.3	Conversion gain Figure 4	RL = 3 kΩ, $R_{IP3} = \infty$ f_{LO} = 900 MHz		PG_C		9		dB	B
1.4	Conversion gain Figure 4	f_{LO} = 1700 MHz f_{IF} = 45 MHz		PG_C		9		dB	B
2	**Isolation**								
2.1	LO spurious at RF_{in}	Pi_{LO} = -10 dBm Figure 5	2, 7	IS_{LORF}			-35	dBm	D
2.2	RF to LO Figure 6	Pi_{RF} = -25 dBm f_{LO} = 900 MHz	2, 7	IS_{RFLO}	30	40		dB	D
2.3	RF to LO Figure 6	f_{LO} = 1700 MHz	2, 7	IS_{RFLO}		20		dB	D
3	**Operating Frequencies**								
3.1	RF frequency		2	RF_i			2000	MHz	D
3.2	LO_{in} frequency		7	LO_i			2000	MHz	D
3.3	IF_{out} frequency		4, 5	IF_o			300	MHz	D
4	**Input Level**								
4.1	RF input (-1 dB comp.)	RL = 50 Ω,	2	Pi_{RF}		-15		dBm	D
4.2	3rd-order intercept point	Pi_{LO} = -10 dBm, $R_{IP3} = \infty$ Figure 2	2	IIP3		-4		dBm	B
4.3	LO input		7	P_{iLO}		-6	0	dBm	D
5	**Impedances**								
5.1	RF input		2	Z_{iRF}		25		Ω	D
5.2	LO input		7	Zi_{LO}		50		Ω	D
5.3	IF output		4, 5	Z_{oIF}		> 10 kΩ|| 0.9 pF			D
5.4	Noise figure (DSB) Figure 7	Pi_{LO} = 0 dBm, RL > 3 kΩ f_{LO} = 900 MHz		NF_{50}		9	10	dB	B
5.5	Noise figure (DSB) Figure 7	f_{LO} = 1700 MHz		NF_{50}		12		dB	B
5.6	Voltage standing wave ratio LO		7	$VSWR_{LO}$		1.3	2		B

Note: 1. I_M : Internal mixer current, set by R_{IP3} at pin 2 (see Figure 3, Figure 4, Figure 5 and Figure 6)

Figure 3. Mixer Current (I_M) versus RE

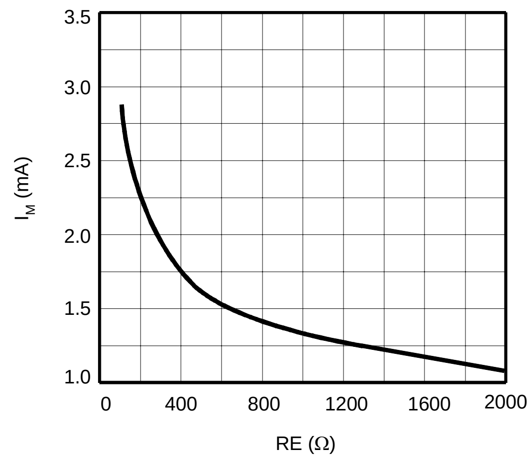


Figure 4. Third-order Input Intercept IIP3 Point versus I_M

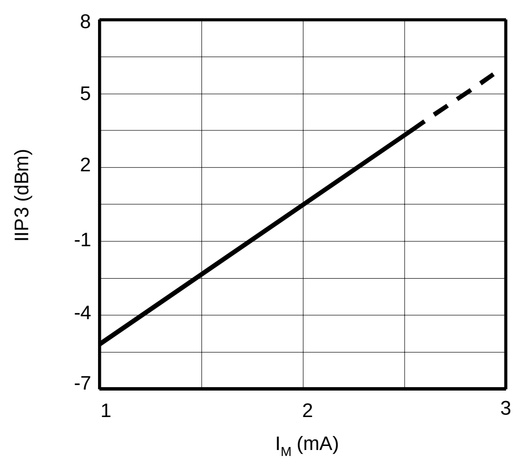


Figure 5. Mixer Circuitry

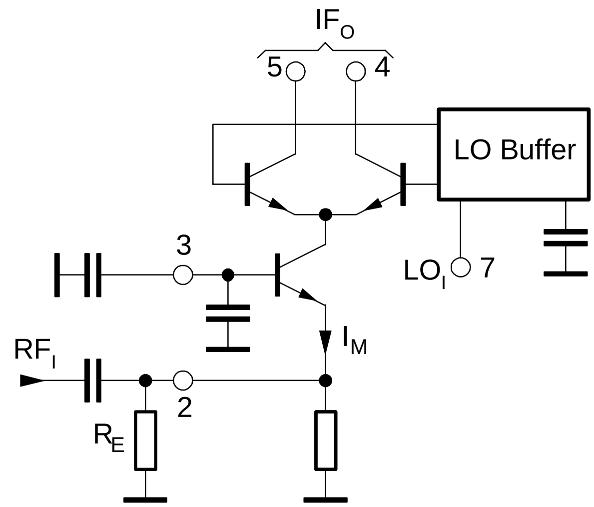


Figure 6. Test Circuit Conversion Power Gain (PG_C) and 3rd-order Input Intercept Point (IIP3)

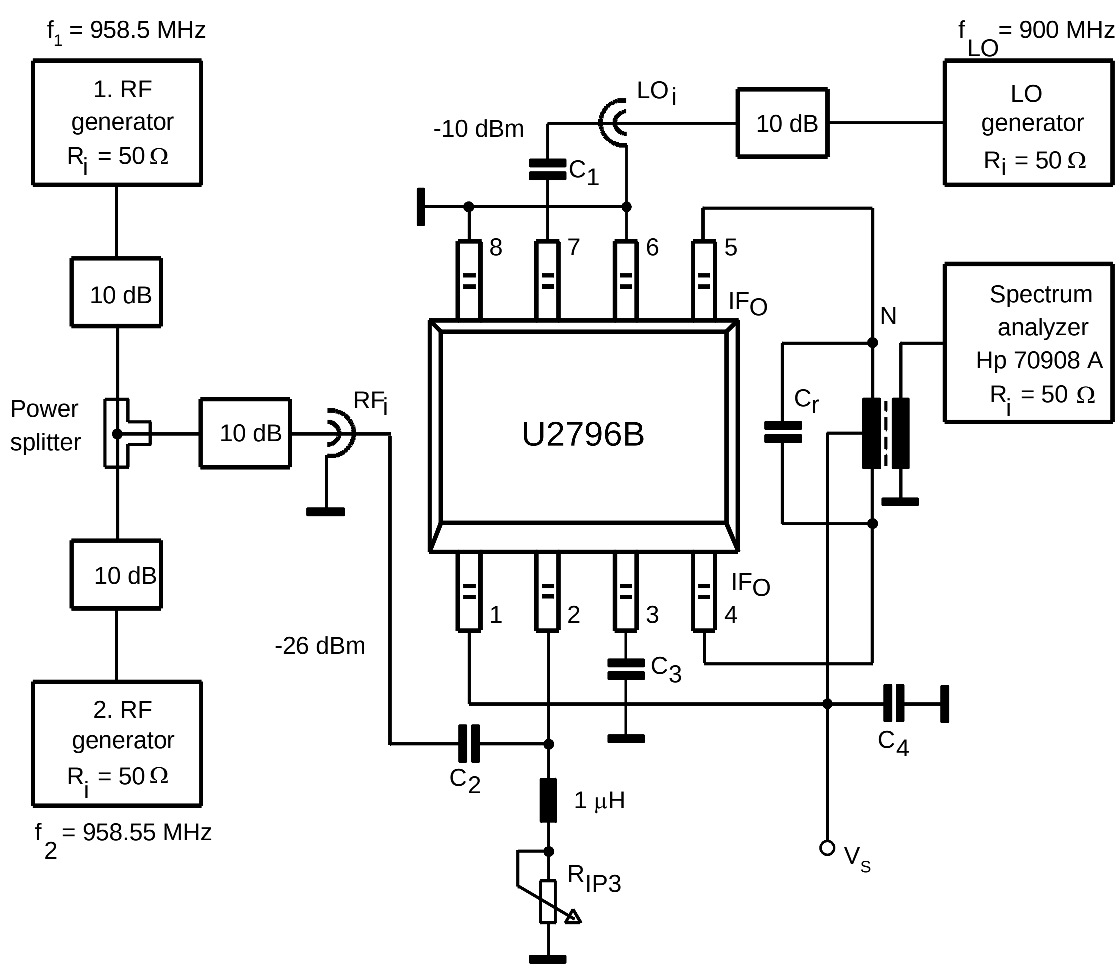


Figure 7. Test Circuit Isolation LO to RF

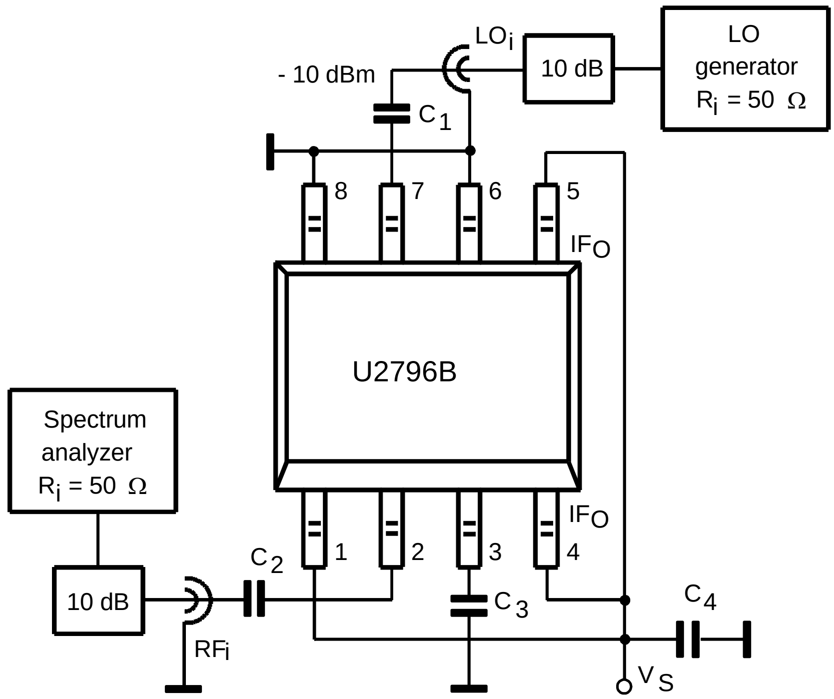


Figure 8. Test Circuit Isolation RF to LO

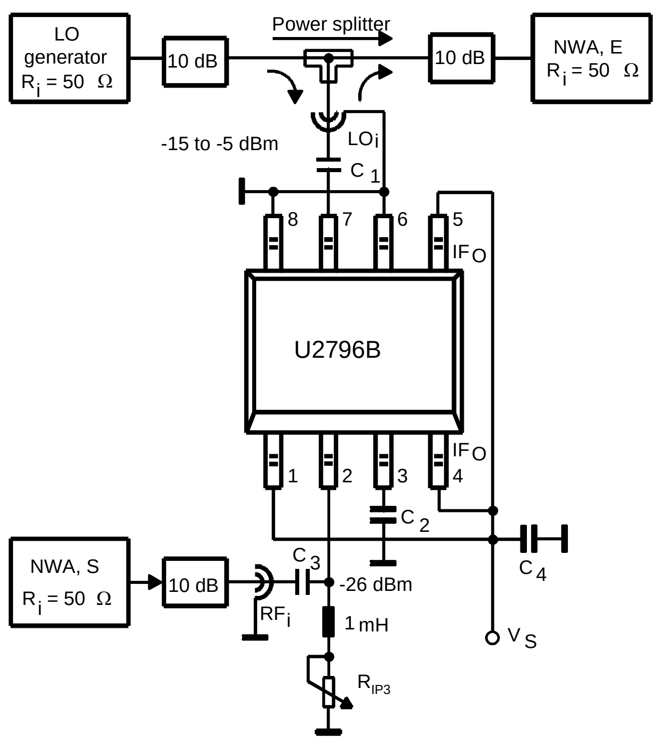
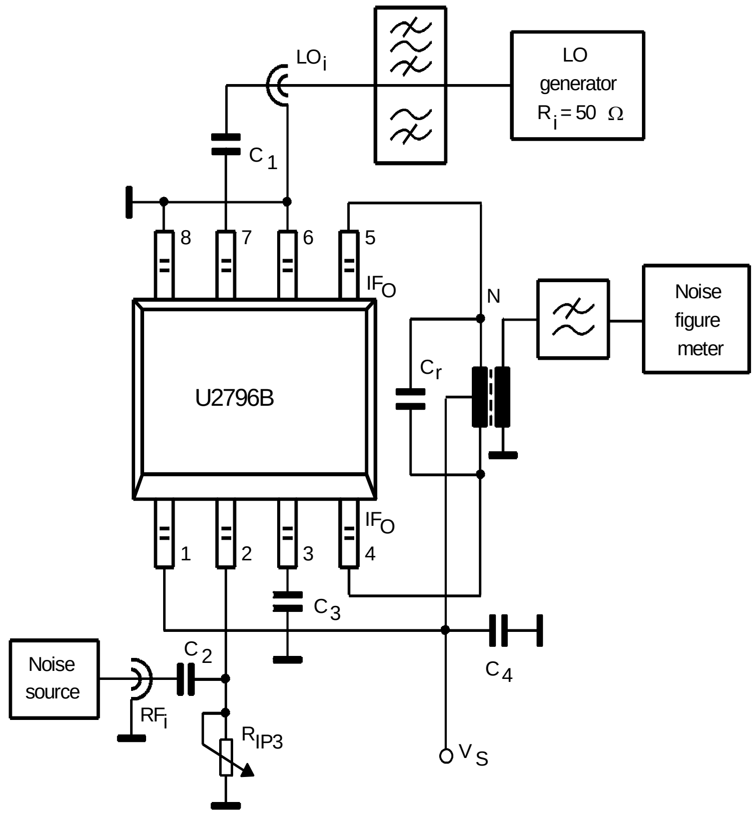


Figure 9. Test Circuit Noise Figure



Note:
1. The noise floor of the LO generator might influence the noise figure test result. In order to avoid this, either a bandpass or a highpass filter with fc > f_{IF} should be implemented.
2. If IF output network does not provide sufficient suppression of the LO component,a lowpass filter should be inserted to avoid overdriving the noise figure meter.
3. For best noise performance 0 dBm LO power level is required.

Figure 10. S11 RF Input Impedance

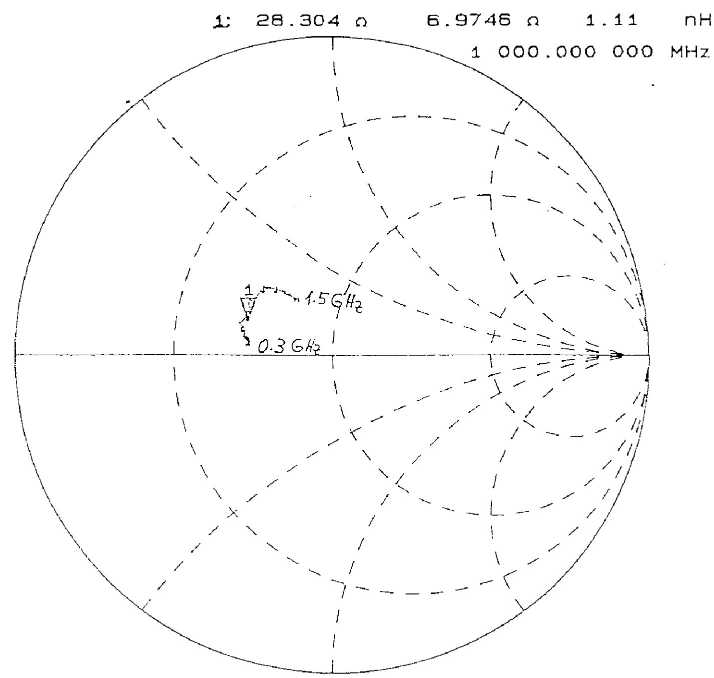
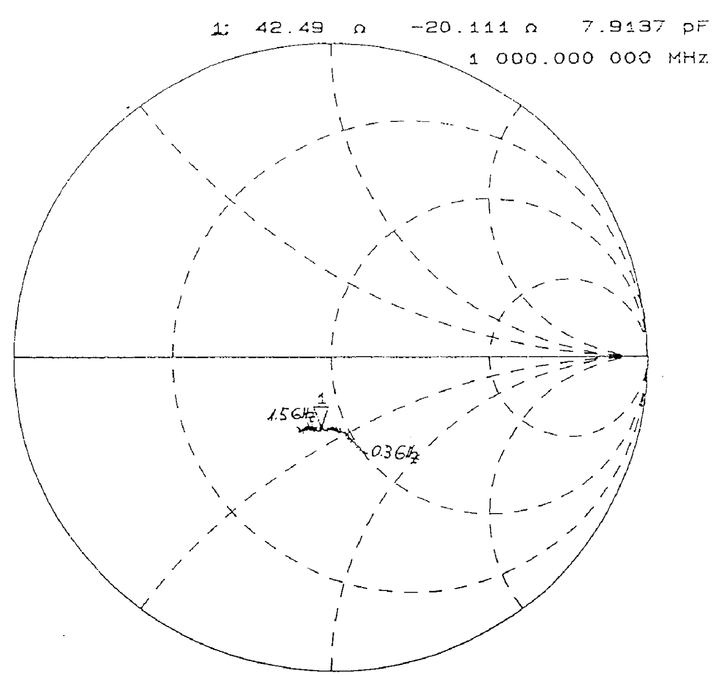
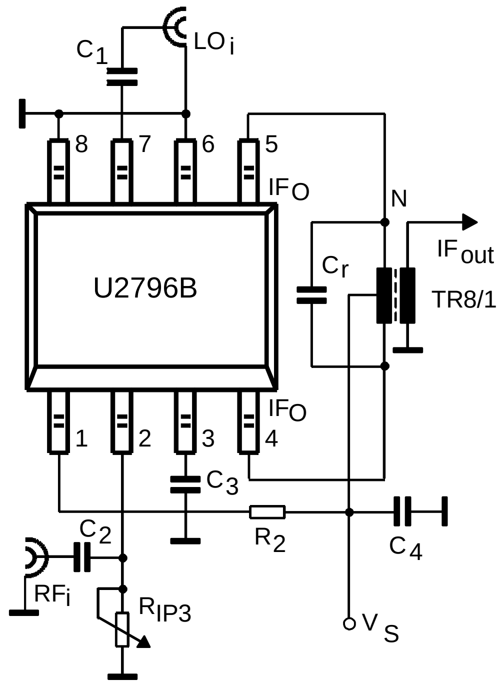


Figure 11. S11 LO Input Impedance



Application Circuit



Recommended Values for the Evaluator

C_1 and C_2 = 150 pF, C_3 and C_4 = 100 nF. C_r is calculated for resonance with the balun at f_{IF}, or as a highpass filter for f_{LO}. The output balun transformer ratio ≥ 8:1 for Z_O = 50 Ω. R_2 increases the IF output level and is calculated from:

$$R_2 = \frac{V_S(4, \text{MinimalMinimal5}) - V_S(1)}{I_S(1)}$$

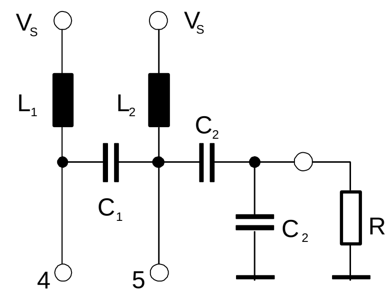
For example ,$V_S(4, 5)$ = 4 V, $V_S(1)$ = 3 V, $I_S(1)$ = 2.2 mA, $R_2 \approx 470\ \Omega$, where $I_S(1)$ is the current consumption without the mixer stage.

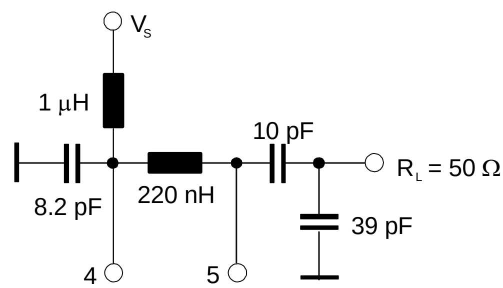
Application Hint

The output transformer at the Pins 4 and 5 can be replaced by LC circuits as shown in Figure 12. Compared to transformer, LC circuits save space and are suitable for higher IF frequencies. When applying one of these solutions, it has to be checked whether the requirements on noise figure and gain can be achieved.

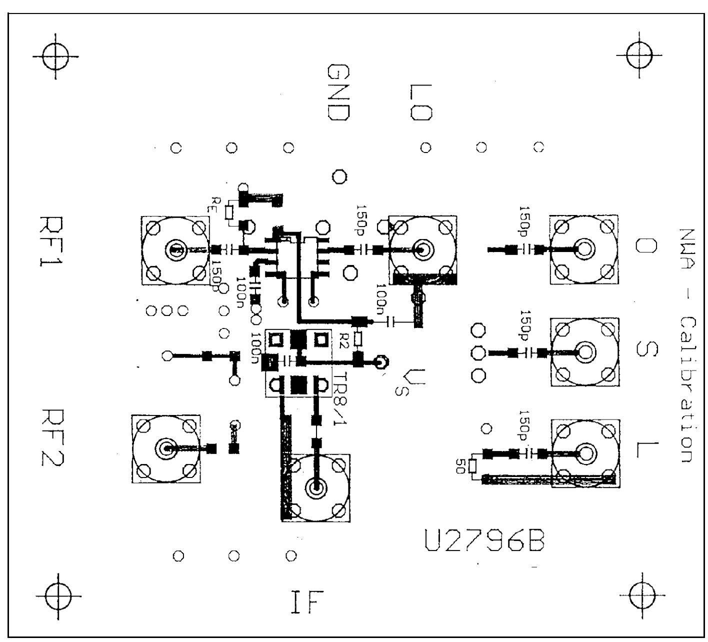
The second circuit was dimensioned for approximately 130 MHz and a load resistance of 50 Ω. If, for instance, the impedance of a subsequent filter is 1 kΩ, the capacitive voltage divider may be left out.

Figure 12. Application Hint





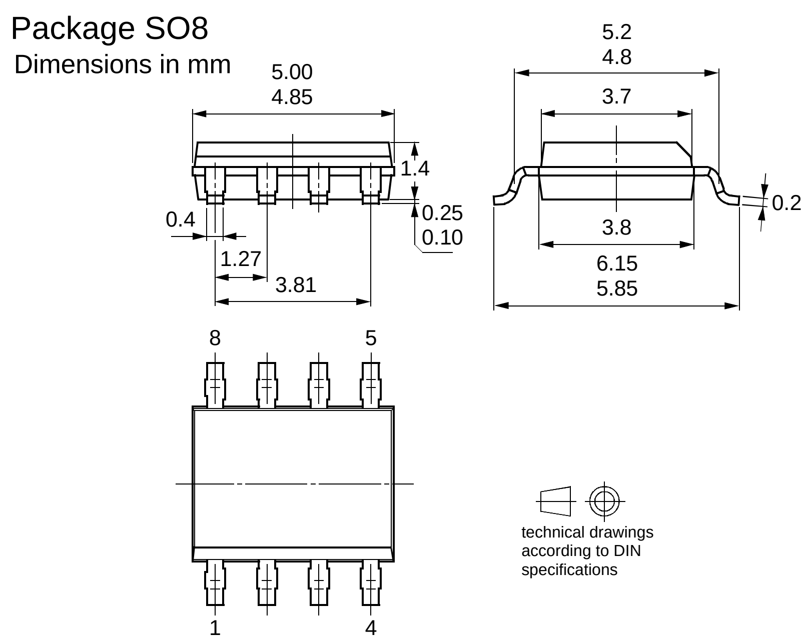
Evaluation Board



Ordering Information

Extended Type Number	Package	Remarks
U2796B-MFP	SO8	Tube
U2796B-MFPG3	SO8	Taped and reeled

Package Information



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