1000-MHz Quadrature Modulator

Description

U2790B is a 1000-MHz quadrature modulator that uses TELEFUNKEN's advanced UHF process. It features a frequency range from 100 MHz up to 1000 MHz, low current consumption, and single-ended RF and LO ports. Adjustment free application makes the direct converter suitable for all digital radio systems up to 1000 MHz, e.g., GSM, ADC, JDC.

Features

- Supply voltage 5 V (typical)
- Very low power consumption: 150 mW (typical) for –1 dBm output level
- Very good 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: –10 dBm (typical)
- 50-Ω single-ended LO and RF port
- LO- frequency from 100 MHz to 1 GHz
- SO 16 package

Benefits

- No external components required for phase shifting
- Adjustment free, hence saves time
- Only three external components result in cost and board space saving

Block Diagram

U2790B-FP

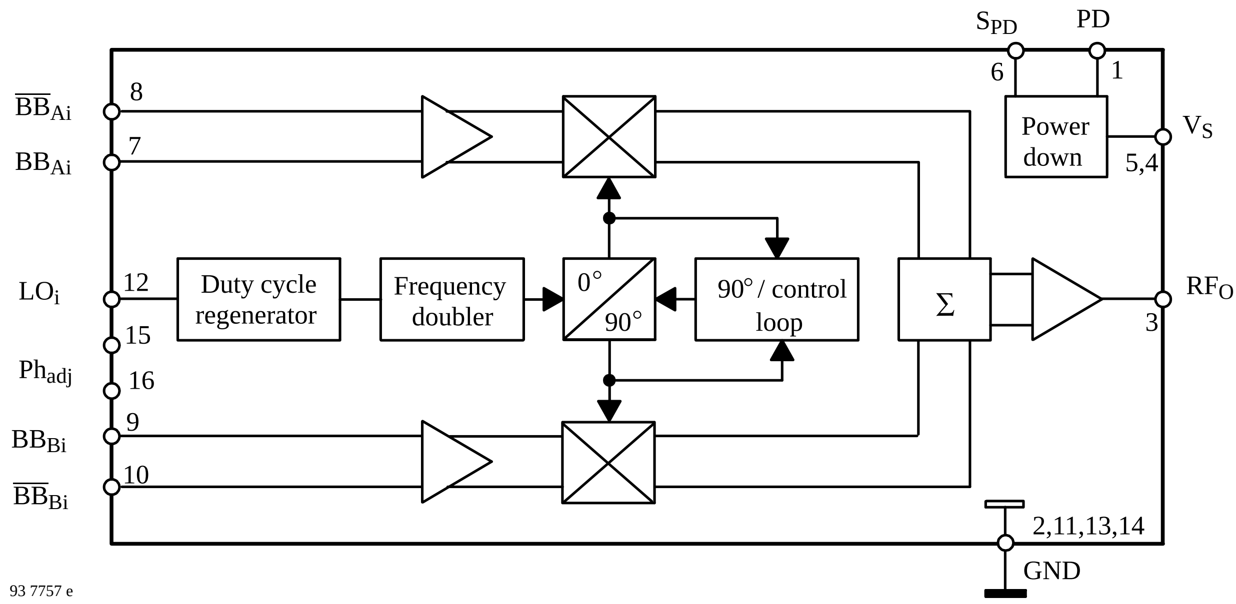
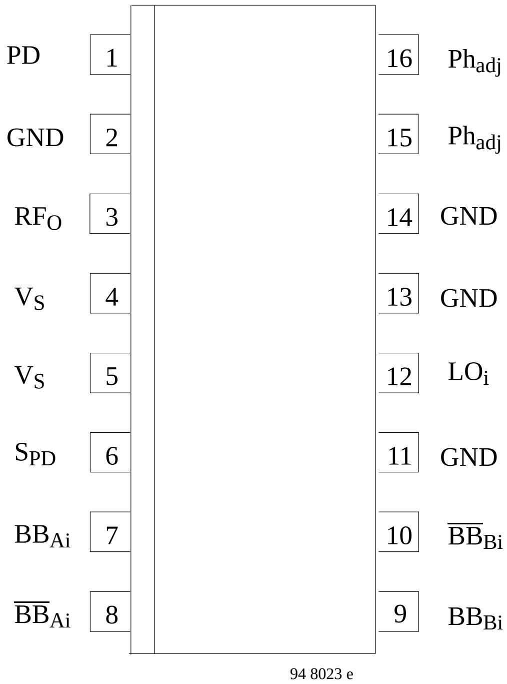


Figure 1.

Pin Description

SO 16



U2790B–FP (SO 16)

Pin	Symbol	Function
1	PD	Power down port
2, 11, 13, 14	GND	Ground
3	RF_o	RF output
4, 5	V_S	Supply voltage
6	S_{PD}	Settling time power down
7	BB_{Ai}	Baseband input A
8	$\overline{BB}_{Ai}$	Baseband input A inverse
9	BB_{Bi}	Baseband input B
10	$\overline{BB}_{Bi}$	Baseband input B inverse
12	LO_i	LO input
15/16	Ph_{adj}	Phase adjustment (not necessary for regular applications)

Absolute Maximum Ratings

Parameters		Symbol	Value	Unit
Supply voltage	Pins 4 and 5	V_S	6	V
Input voltage	Pins 7, 8, 9, 10 and 12	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 range	Pins 4 and 5	V_S	4.5 to 5.5	V
Ambient temperature range		T_{amb}	–40 to +85	°C

Thermal Resistance

Parameters		Symbol	Value	Unit
Junction ambient	SO 16	R_{thJA}	110	K/W

Electrical Characteristics

Test conditions (unless otherwise specified): V_S = 5 V, T_{amb} = 25°C, referred to test circuit,
system impedance Z_O = 50 Ω, f_{LO} = 900 MHz, P_{LO} = –10 dBm, V_{BBi} = 1 V_{pp} diff

Parameters	Test Conditions / Pin	Symbol	Min.	Typ.	Max.	Unit
Supply voltage range	Pins 4 and 5	V_S	4.5		5.5	V
Supply current	Pins 4 and 5	I_S		30		mA
Baseband inputs	Pins 7-8, 9-10					
Input voltage range (differential)		V_{BBi}		1000	1500	mV_{pp}
Input impedance (single ended)		Z_{BBi}		3.2		kΩ
Input frequency range		f_{BBi}	0		200	MHz
Internal bias voltage		V_{BBb}	2.35	2.5	2.65	V
Temperature coefficient		TC_{BB}		0.1	< 1	mV/°C
LO input	Pin 12					
Frequency range		f_{LOi}	100		1000	MHz
Input level [1]		P_{LOi}	–12	–10	–5	dBm
Input impedance		Z_{iLO}		50		Ω
Voltage standing wave ratio		$VSWR_{LO}$		1.4	2	–
Duty cycle range		DCR_{LO}	0.4		0.6	–
RF output	Pin 3					
Output level		P_{RFo}	–5	–1		dBm
LO suppression [2]	$f_{LO:}$ = 900 MHz $f_{LO:}$ = 150 MHz	LO_{RFo}	30 32	35 35		dB
Sideband suppression [2,3]	$f_{LO:}$ = 900 MHz $f_{LO:}$ = 150 MHz	SBS_{RFo}	35 30	40 35		dB
Phase error [4]		P_e		< 1		deg.
Amplitude error		A_e		< ± 0.25		dB
Noise floor	V_{BBi} = 2 V, $\overline{V}_{BBi}$ = 3 V V_{BBi} = $\overline{V}_{BBi}$ = 2.5 V	N_{FL}		– 132 – 144		dBm/Hz
VSWR		$VSWR_{RF}$		1.6	2	
3rd order baseband harmonic suppression		S_{BBH}	35	45		dB
RF harmonic suppression		S_{RFH}		35		dB
Power down mode						
Supply current	V_{PD} ≦ 0.5 V Pins 4, 5 V_{PD} = 1 V	I_{PD}		 10	1	µA
Settling time	C_{SPD} = 100 pF C_{LO} = 100 pF C_{RFo} = 1 nF Pin 6 to 3	t_{sPD}		10		µs
Switching voltage	Pin 1					
Power on		V_{PDon}	4			V
Power down		V_{PDdown}			1	V

Note: 1 The required LO level is a function of the LO frequency.
Note: 2 In reference to a RF output level ≤ –1 dBm and I/Q input level of 400 mV_{pp} diff
Note: 3 Sideband suppression is tested without connection at Pins 15 and 16.
For higher requirements a potentiometer can be connected at these pins.
Note: 4 For T_{amb} = – 30 to + 85°C and V_S = 4.5 to 5.5 V

Typical Single Sideband Output Spectrum at V_S =4.5 V and V_S = 5.5 V f_{LO} = 900 MHz, P_{LO} = – 10 dBm, V_{BBi} = 1 V_{PP} (differential) T_{amb} = 25°C

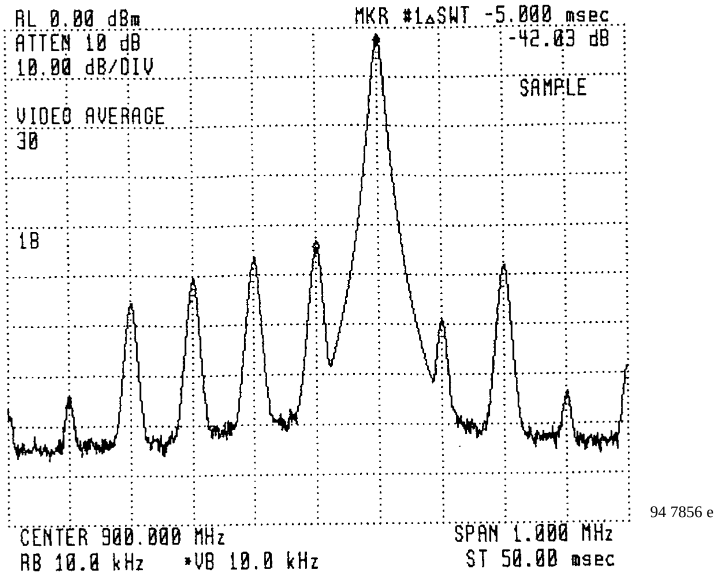


Figure 2.

Typical GMSK Output Spectrum

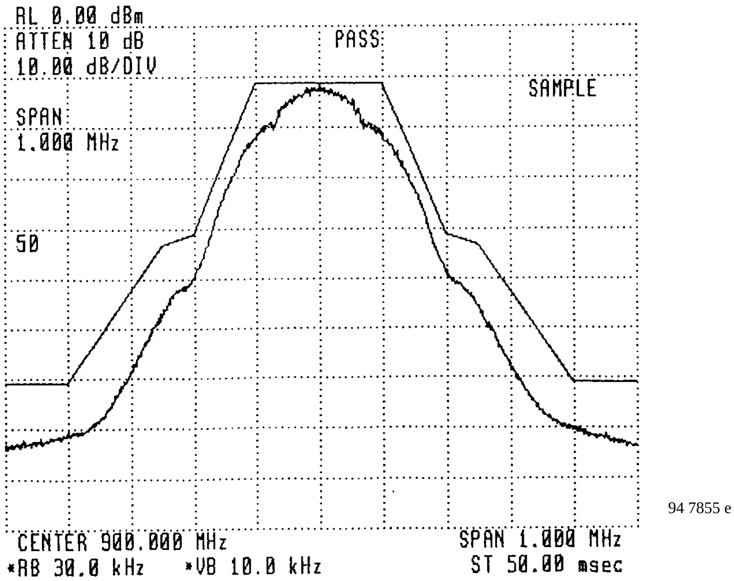


Figure 3.

Typical RF-Harmonic Output Spectrum

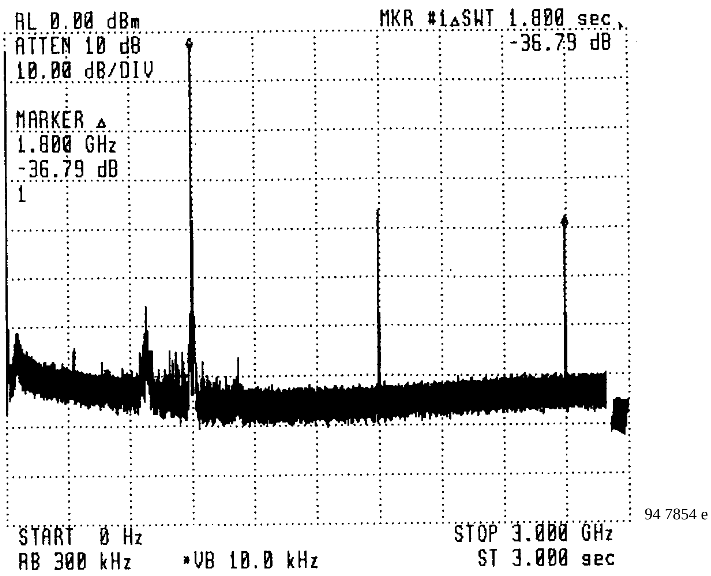


Figure 4.

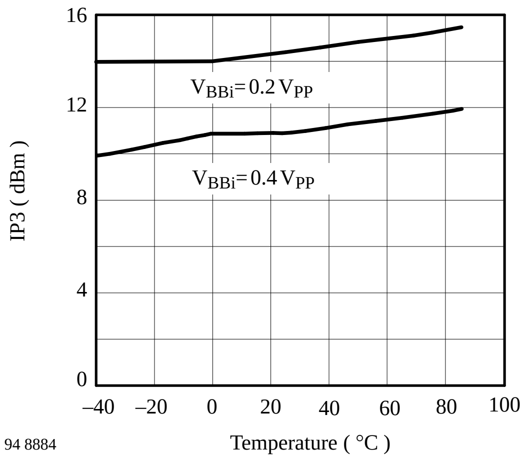


Figure 5. OIP3 vs. T_{amb}, LO = 150 MHz, level – 20 dBm

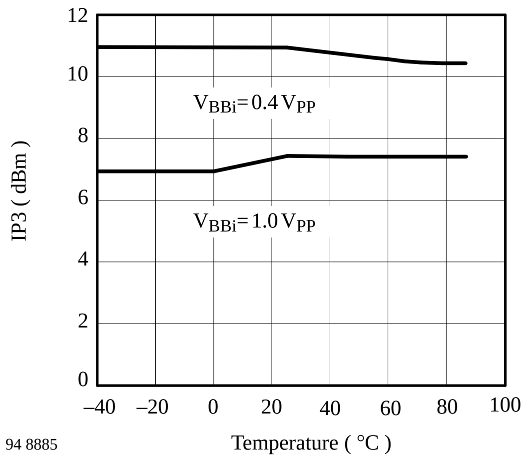


Figure 6. OIP3 vs. T_{amb}, LO = 900 MHz, level – 10 dBm

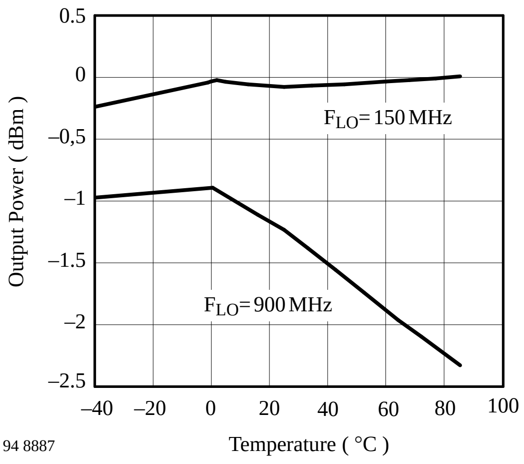


Figure 7. Output power vs. T_{amb}

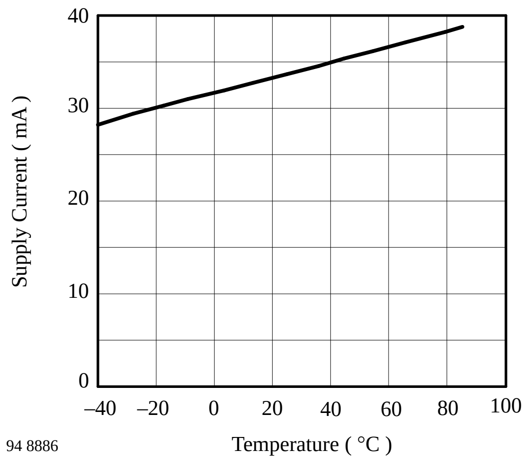


Figure 8. Supply current vs. T_{amb}

Typical S11 Frequency Response of the RF Output

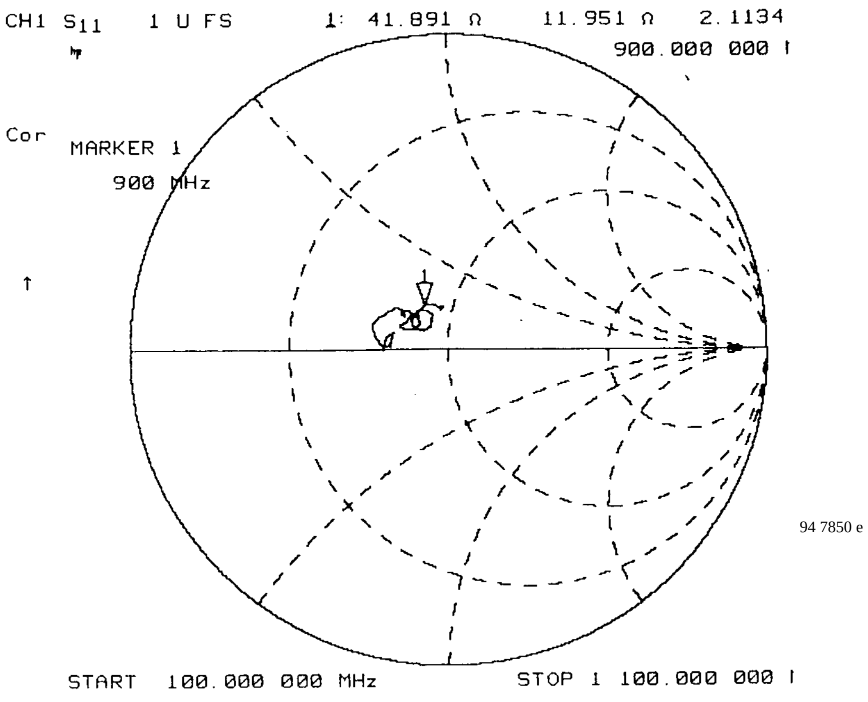


Figure 9.

Typical VSWR Frequency Response of the RF Output

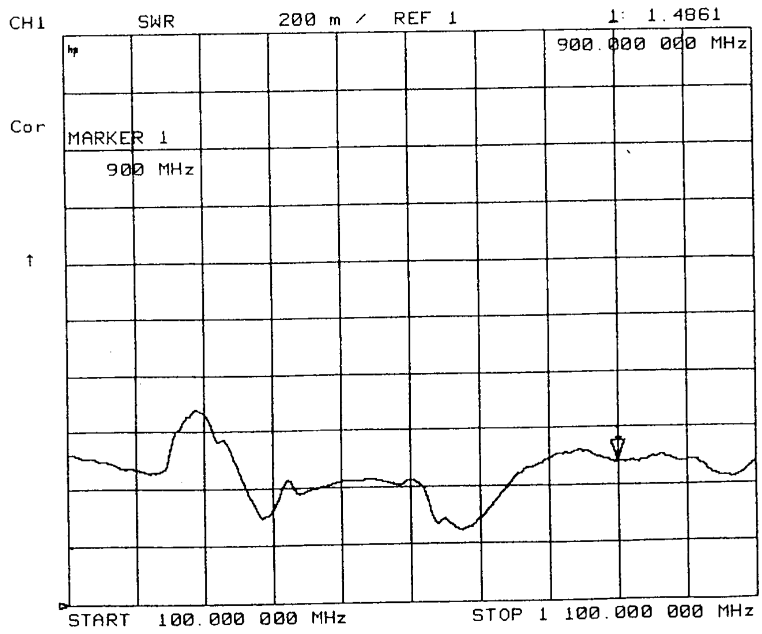


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Figure 10.

Typical S11 Frequency Response of the LO Input

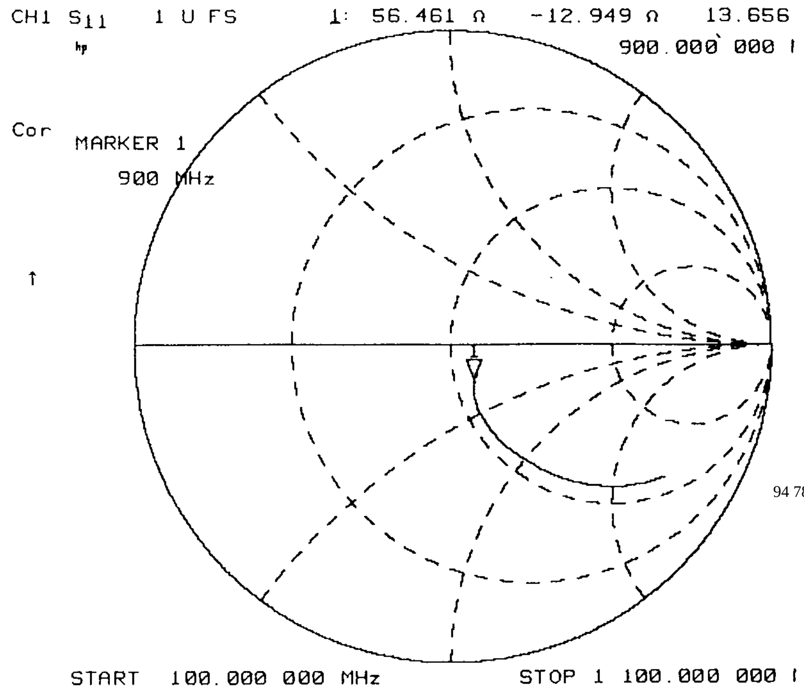

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Figure 11.

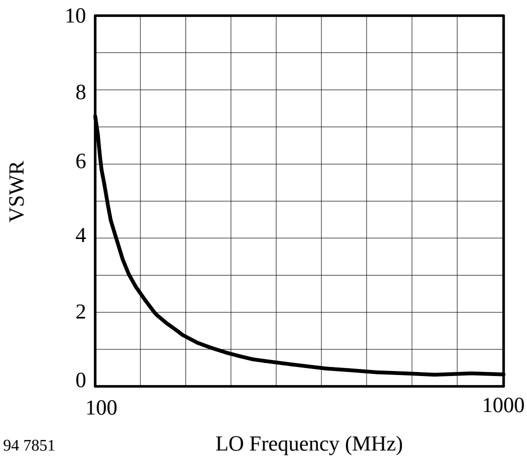


Figure 12. Typical VSWR frequency response of the LO input

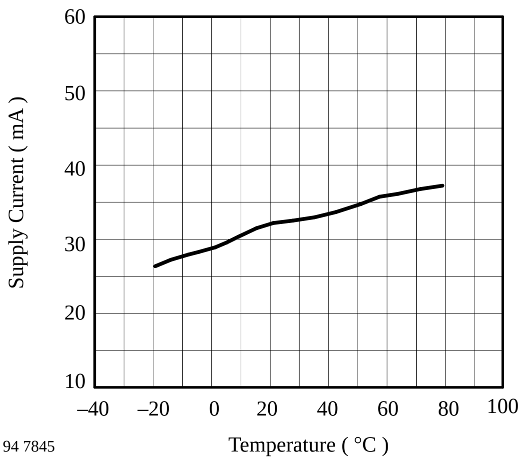


Figure 13. Typical supply current vs. temperature at V_S = 5 V

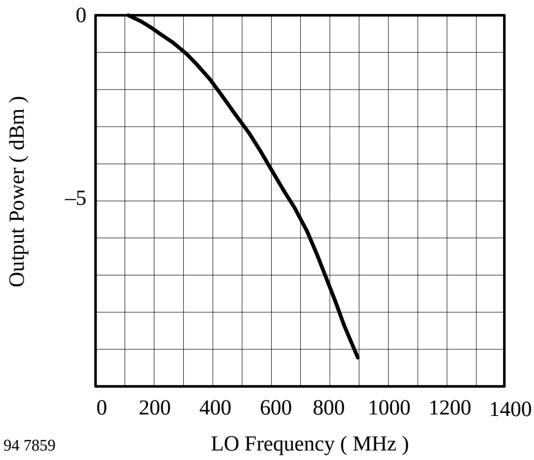


Figure 14. Typical output power vs. LO-frequency at T_{amb} = 25°C, V_{BBi} = 230 mV_{PP} (differential)

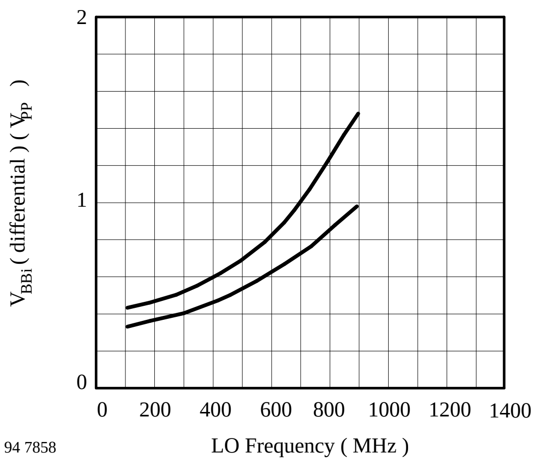


Figure 15. Typical required V_{BBi} input signal (differential) vs. LO frequency for P_O = 0 dBm and P_O = – 2 dBm

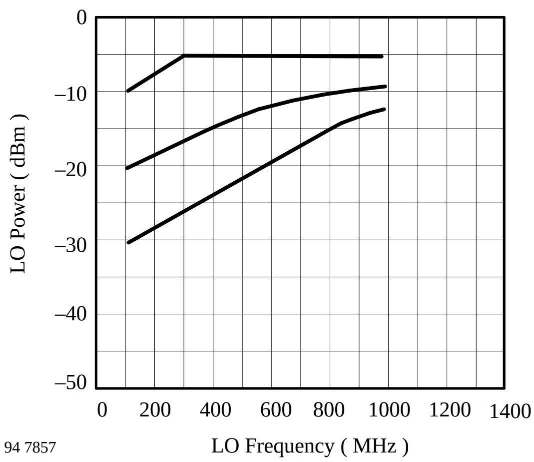


Figure 16. Typical useful LO power range vs. LO frequency at T_{amb} = 25 °C

Application Circuit

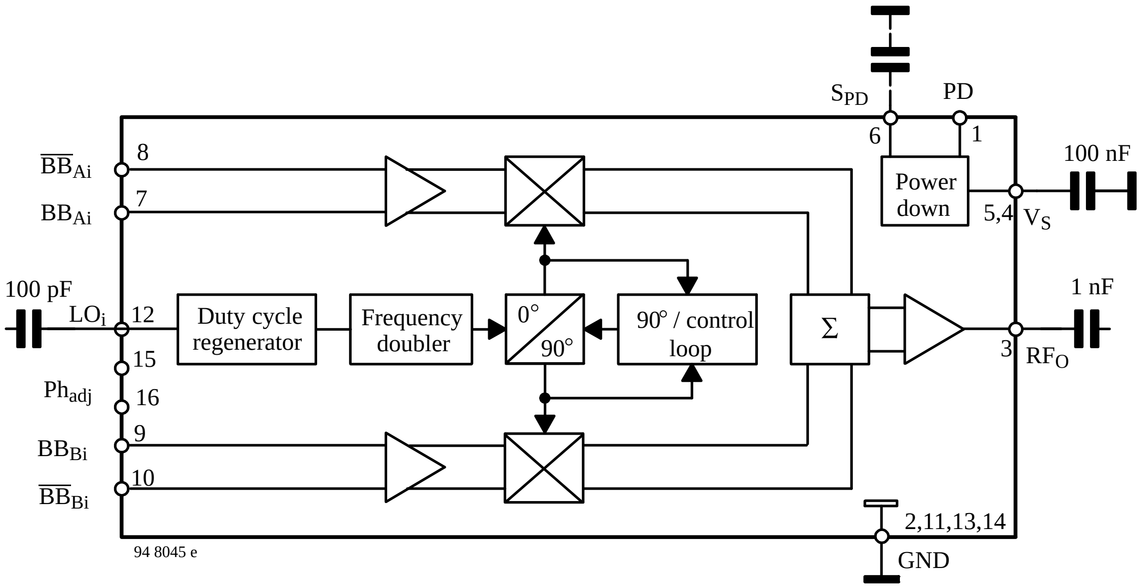


Figure 17.

PCB Layout

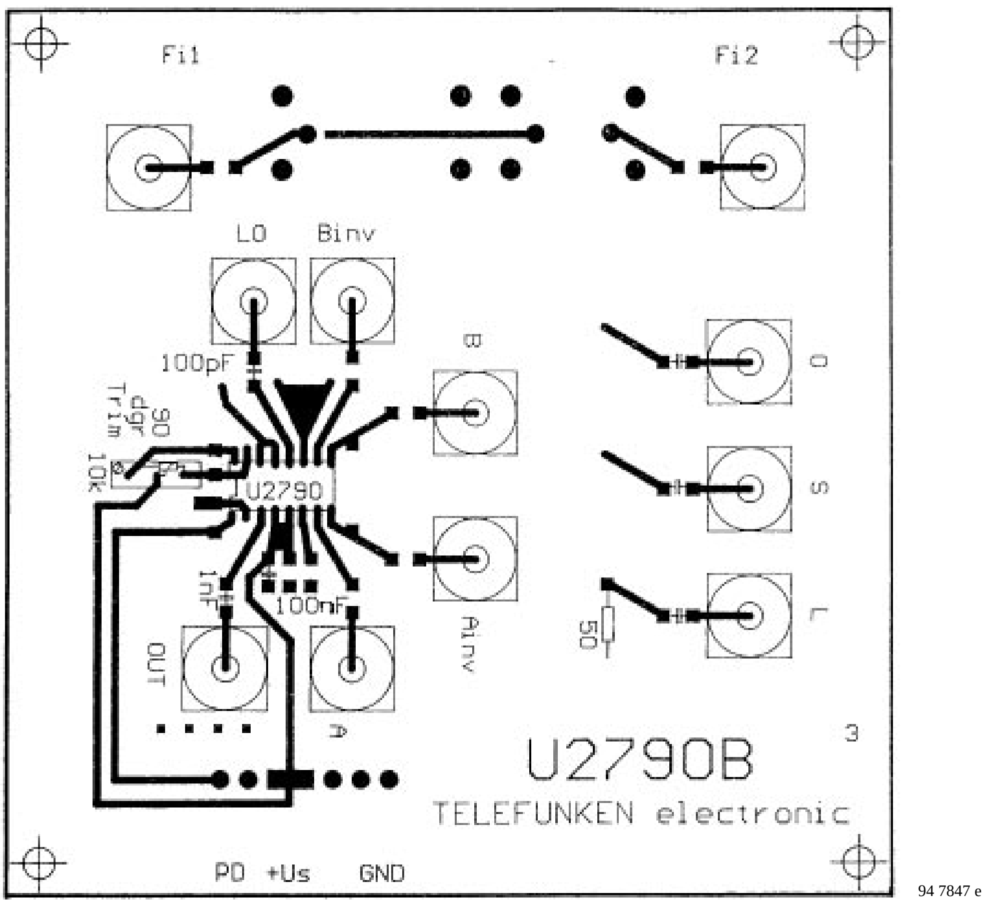


Figure 18. U2790B-FP (SO 16)

Application Notes

1. Noise floor and settling time

In order to reduce noise on the power down control input and improve the wide-off noise floor of the 900-MHz RF output signal, capacitor C_{PD} should be connected from Pin 6 to ground in the shortest possible way.

The settling time has to be considered for the system under design. For GSM applications a value of C_{PD} = 1 nF defines a settling time, t_{sPD}, equal or less than 3 µs. This capacitance does not have any influence on the noise floor within the relevant GSM mask. For mobile application the mask requirements can be achieved very easily without C_{PD}.

A significant improvement of the wide-off noise floor is obtainable with C_{PD} greater than 100 nF. Such values are recommended for applications where the settling time is not critical, such as in base stations. Coupling capacitors for LO_i and RF_O also have a certain impact on the settling time. The values used for the measurements are C_{LOi} = 100 pF and C_{RFo} = 1 nF

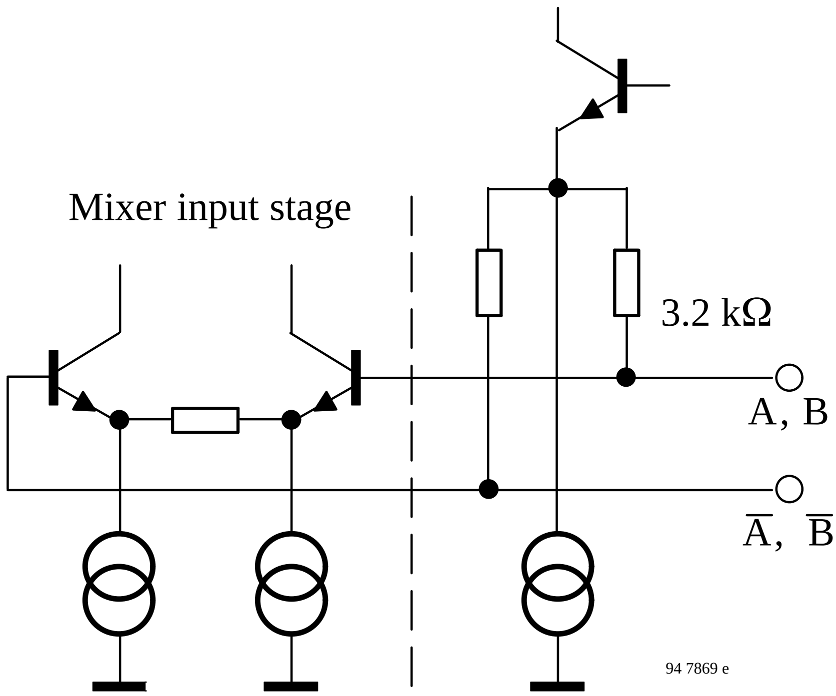


Figure 19. Baseband input circuitry

2. Baseband coupling

U2790B-FP (SO 16) has an integrated biasing network which allows ac coupling of the baseband signal at a low count of external components. The bias voltage is 2.5 V ± 0.15 V.

Figure 1 shows the baseband input circuitry with a resistance of 3.2 kΩ for each asymmetric input. The internal dc offset between A and $\overline{A}$, and B and $\overline{B}$ is typically < ± 1 mV with a maximum of ± 3 mV. DC coupling is also possible with an external dc voltage of 2.5 ± 0.15 V.

3. Circuitries

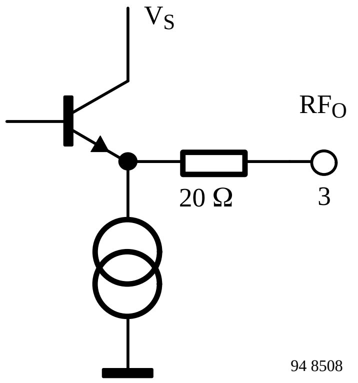


Figure 20. RF output circuitry

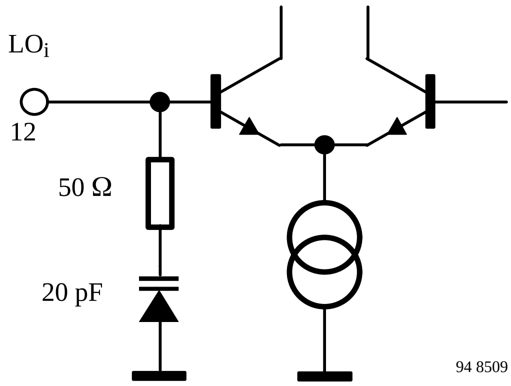


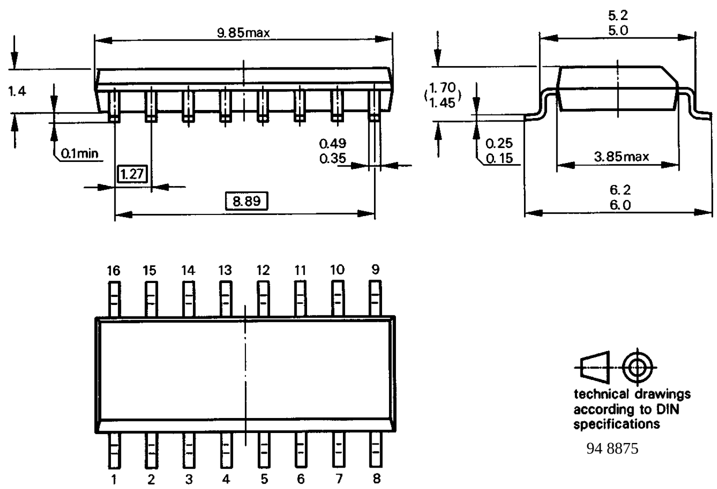
Figure 21. L_O input circuitry

Ordering Information

Package	Part number
SO 16	U2790B-FP

Dimensions in mm

Package: SO 16



Ozone Depleting Substances Policy Statement

It is the policy of **TEMIC TELEFUNKEN microelectronic 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.

TEMIC TELEFUNKEN microelectronic GmbH semiconductor division 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.

TEMIC can certify that our semiconductors are not manufactured with ozone depleting substances and do not contain such substances.

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