

Wireless Components

ASK Transmitter 315 MHz

TDA 5101A V 0.2

Specification May 1999

Preliminary

For questions on technology, delivery and prices please contact the Infineon Technologies Offices in Germany or the Infineon Technologies Companies and Representatives worldwide:
see our webpage at http://www.infineon.com

ABM®, AOP®, ARCOFI®, ARCOFI®-BA, ARCOFI®-SP, DigiTape®, EPIC®-1, EPIC®-S, ELIC®, FALC®54, FALC®56, FALC®-E1, FALC®-LH, IDEC®, IOM®, IOM®-1, IOM®-2, IPAT®-2, ISAC®-P, ISAC®-S, ISAC®-S TE, ISAC®-P TE, ITAC®, IWE®, MUSAC®-A, OCTAT®-P, QUAT®-S, SICAT®, SICOFI®, SICOFI®-2, SICOFI®-4, SICOFI®-4µC, SLICOFI® are registered trademarks of Infineon Technologies AG.

ACE™, ASM™, ASP™, POTSWIRE™, QuadFALC™, SCOUT™ are trademarks of Infineon Technologies AG.

Edition 03.99

Published by Infineon Technologies AG i. Gr.,
SC,
Balanstraße 73,
81541 München

© Infineon Technologies AG i. Gr. 12.05.99.
All Rights Reserved.

Attention please!

As far as patents or other rights of third parties are concerned, liability is only assumed for components, not for applications, processes and circuits implemented within components or assemblies.

The information describes the type of component and shall not be considered as assured characteristics.

Terms of delivery and rights to change design reserved.

Due to technical requirements components may contain dangerous substances. For information on the types in question please contact your nearest Infineon Technologies Office.

Infineon Technologies AG is an approved CECC manufacturer.

Packing

Please use the recycling operators known to you. We can also help you – get in touch with your nearest sales office. By agreement we will take packing material back, if it is sorted. You must bear the costs of transport.

For packing material that is returned to us unsorted or which we are not obliged to accept, we shall have to invoice you for any costs incurred.

Components used in life-support devices or systems must be expressly authorized for such purpose!

Critical components[1] of the Infineon Technologies AG, may only be used in life-support devices or systems[2] with the express written approval of the Infineon Technologies AG.

1 A critical component is a component used in a life-support device or system whose failure can reasonably be expected to cause the failure of that life-support device or system, or to affect its safety or effectiveness of that device or system.

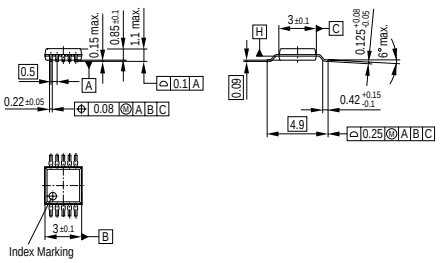
2Life support devices or systems are intended (a) to be implanted in the human body, or (b) to support and/or maintain and sustain human life. If they fail, it is reasonable to assume that the health of the user may be endangered.

Productinfo

General Description

The TDA5101A is a single chip ASK transmitter for the frequency band 315 MHz. The IC offers a high level of integration and needs only a few external components. The device contains a fully integrated PLL synthesizer and a high efficiency power amplifier to drive a loop antenna. A special circuit design and an unique power amplifier design are used to save current consumption and therefore to save battery live. Additionally features like a power down mode, a low power detect and a divided clock output are implemented.

Package



Features

- fully integrated frequency synthesizer
- VCO without external components
- high efficiency power amplifier
- frequency range 315 MHz
- ASK modulation
- low supply current (typically < 7mA)
- voltage supply range 2.1 - 4 V
- power down mode
- low voltage sensor
- low external component count

Applications

- Keyless entry systems
- Remote control systems
- Alarm systems
- Communication systems

Ordering Information

Type	Ordering Code	Package
TDA 5101A		P-TSSOP-10

1 Table of Contents

1 Table of Contents 1-1

2 Product Description 2-1
- 2.1 Overview 2-2
- 2.2 Applications 2-2
- 2.3 Features 2-2
- 2.4 Package Outlines 2-3

3 Functional Description 3-1
- 3.1 Pin Configuration 3-2
- 3.2 Pin Definition and Function 3-3
- 3.3 Block diagram 3-4
- 3.4 Functional Blocks 3-5

4 Applications 4-1
- 4.1 Circuits 4-2
- 4.3 Bill of Materials 4-2

5 Reference 5-1
- 5.1 Electrical Data 5-2
- 5.2 Test Circuit 5-4

2 Product Description

Contents of this Chapter

2.1 Overview 2-2
2.2 Applications 2-2
2.3 Features 2-2
2.4 Package Outlines 2-3

2.1 Overview

The TDA5101A is a single chip ASK transmitter for the frequency band 315 MHz. The IC offers a high level of integration and needs only a few external components. The device contains a fully integrated PLL synthesizer and a high efficiency power amplifier to drive a loop antenna. A special circuit design and an unique power amplifier design are used to save current consumption and therefore to save battery live. Additionally features like a power down mode, a low power detect and a divided clock output are implemented.

2.2 Applications

- Keyless entry systems
- Remote control systems
- Alarm systems
- Communication systems

2.3 Features

- fully integrated frequency synthesizer
- VCO without external components
- high efficiency power amplifier
- frequency range 315 MHz
- ASK modulation
- low supply current (typically < 7mA)
- voltage supply range 2.1 - 4 V
- power down mode
- low voltage sensor
- low external component count

2.4 Package Outlines

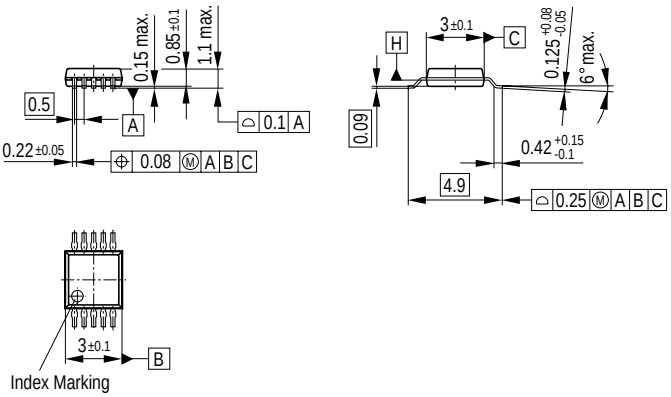


Figure 2-1 P-TSSOP-10

3 Functional Description

Contents of this Chapter

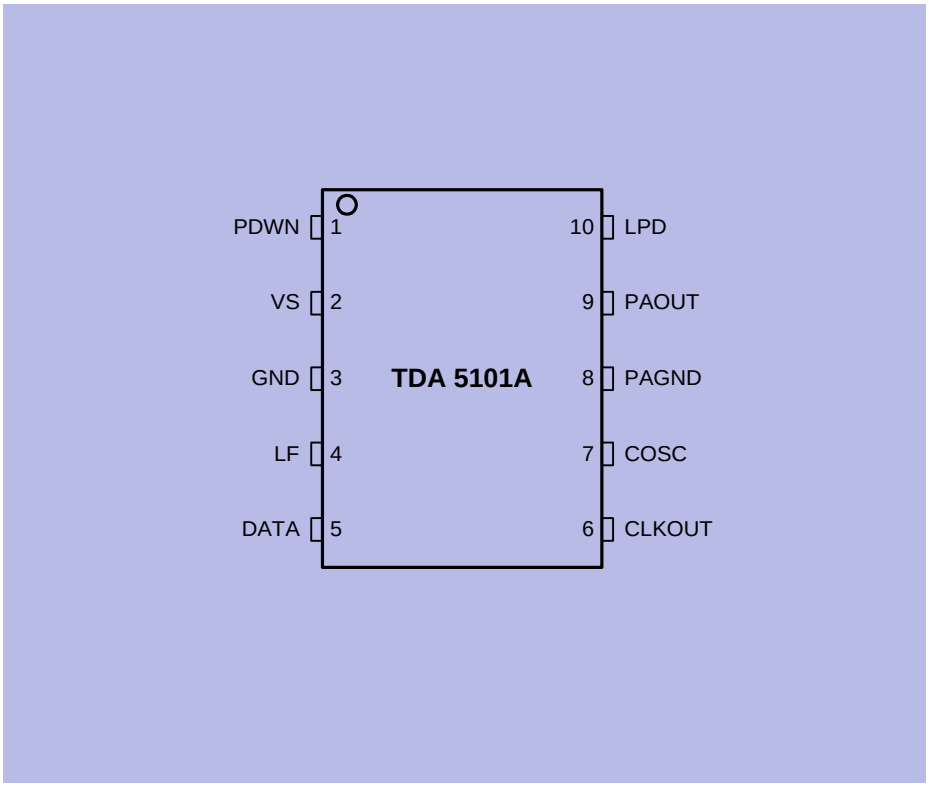
3.1 Pin Configuration 3-2

3.2 Pin Definition and Function 3-3

3.3 Block diagram 3-4

3.4 Functional Blocks 3-5
1 PLL Synthesizer 3-5
2 Crystal Oscillator 3-5
3 Power Amplifier 3-6
4 Low Power Detect 3-6
5 Power Modes 3-6
6 Power Down Mode 3-7
7 PLL Enable Mode 3-7
8 Transmit Enable Mode 3-7

3.1 Pin Configuration



Pin_config.wmf

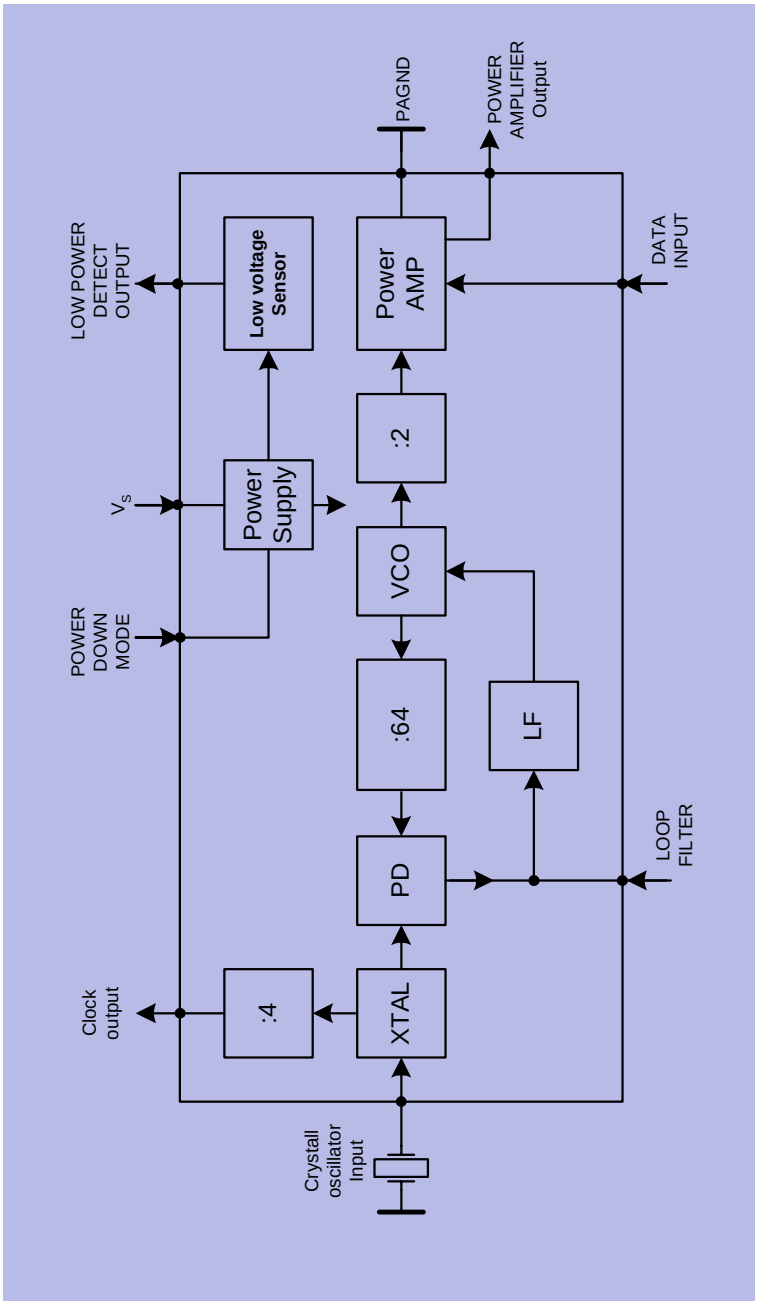
Figure 3-1 IC Pin Configuration

3.2 Pin Definition and Function

Table 3-1 Pin Configuration

Pin No.	Symbol	Equivalent I/O-Schematic	Function
1	PDWN		Power down mode
2	VS		Voltage supply
3	GND		Ground
4	LF		Loop filter
5	DATA		Amplitude Shift Keying data input
6	CLKOUT		Clock output
7	COSC		Crystal oscillator input
8	PAGND		Power amplifier ground
9	PAOUT		Power amplifier output
10	LPD		Low power detect output

3.3 Block diagram



Block_diagram.wmf

Figure 3-2 Main Block Diagram

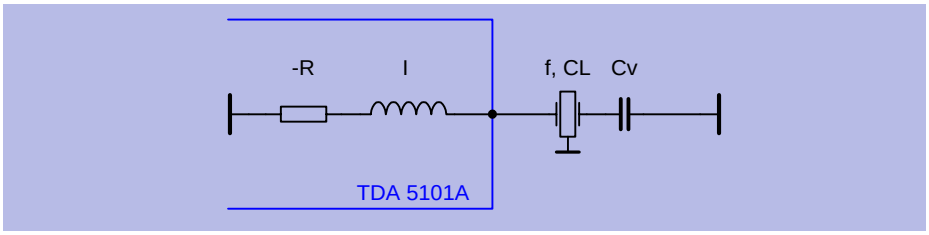
3.4 Functional Blocks

1. PLL Synthesizer

The Phase Locked Loop synthesizer consists of a voltage controlled oscillator (VCO), an asynchronous divider chain, a phase detector, a charge pump and a loop filter and is fully implemented on chip. The tuning circuit of the VCO consisting of spiral inductors and varactor diodes is on chip, too. Therefore no additional external components are necessary. The nominal center frequency of the VCO is 630 MHz. The oscillator signal is fed both to the synthesizer divider chain and to the power amplifier. The overall division ratio of the asynchronous divider chain is 64. The phase detector is a Typ IV PD with charge pump. The passive loop filter is realized on chip.

2. Crystal Oscillator

The crystal oscillator operates at a frequency of 9.84 MHz. It achieves a turn on time of typically less than 1ms. To attend this, a NIC oscillator type is implemented in the TDA 5101A.
The oscillator type has the property, that the input impedance is a negative resistance in series to an inductance. Therefore the load capacitance of the crystal CL (specified by the crystal supplier) is transformed to the capacitance Cv.



$$Cv = \frac{1}{\frac{1}{CL} + \omega^2 l}$$

CL: crystal load capacitance for nominal frequency
ω: angular frequency
l: inductivity of the crystal oscillator (typically 11µH)

The crystal oscillator signal is divided in the frequency by 4 and guided to the open collector output CLKOUT to drive the clock input of a micro controller.

An external pull up resistor (RL) is to connect between this pin and the supply voltage. The value of RL is dependent on the clock frequency and the load capacitance CLD (PCB board plus input capacitance of the microcontroller). RL can be calculated to :

$$R_L = \frac{1}{2 \times f_{CLKOUT} \times C_{LD}} = \frac{1}{20 \times 10^6 \times C_{LD}}$$

Remark: Because to the reason of a low current consumption an a low spurious radiation the largest possible RL should be choosen.

3. Power Amplifier

In ASK transmission the power amplifier can be switched on with pin 5 (DTA). In this case the same pin is used as the data input.
The PAOUT pin is an open collector output and requires an external pull up coil to provide bias. The coil is part of the tuning and matching LC cuircit to get best performance with the external loop antenna. To achieve the best power amplifier efficiency the high frequency voltage swing at the PAOUT pin should be two times the supply voltage.
The power amplifier has its own ground pin (PAGND) in order to reduce the amount of coupling to the other circuit blocks.

4. Low Power Detect

The supply voltage is sensed by a low power detector. If the supply voltage drops below 2.15 V, the LPD pin (pin10) switches to low. The minimum sink current is 1 mA. To spare at most cases the external pull up resistor, an internal pull up current of 30µA is implemented.
A simple application of this feature is the switching off of the power amplifier via pin 5.

5. Power Modes

The IC provides three power modes, the POWER DOWN MODE, the PLL ENABLE MODE and the TRANSMIT MODE. How to get in this modes is described in the table below.

Table 3-2

PDWN	DTA	
L	L	POWER DOWN MODE
H	L	PLL ENABLE MODE
H	H	TRANSMIT MODE

6. Power Down Mode

In the POWER DOWN MODE the current consumption is less than 100nA. To switch the IC in this mode, the input pin PDWN (pin1) has to be in the low state.

7. PLL Enable Mode

The turn on time of the circuit is determined by the turn on time of the crystal oscillator and is typically less than 1 msec (dependent on the crystal itself). To save current consumption and to avoid undesired power radiation during this time, the power amplifier is turned off. The current consumption at this mode is typically 3.5 mA.

8. Transmit Enable Mode

In the TRANSMIT ENABLE MODE the power amplifier is turned on too, and the current consumption of the IC is about 7 mA. To get in this state, the DTA input is to switch to a high level.

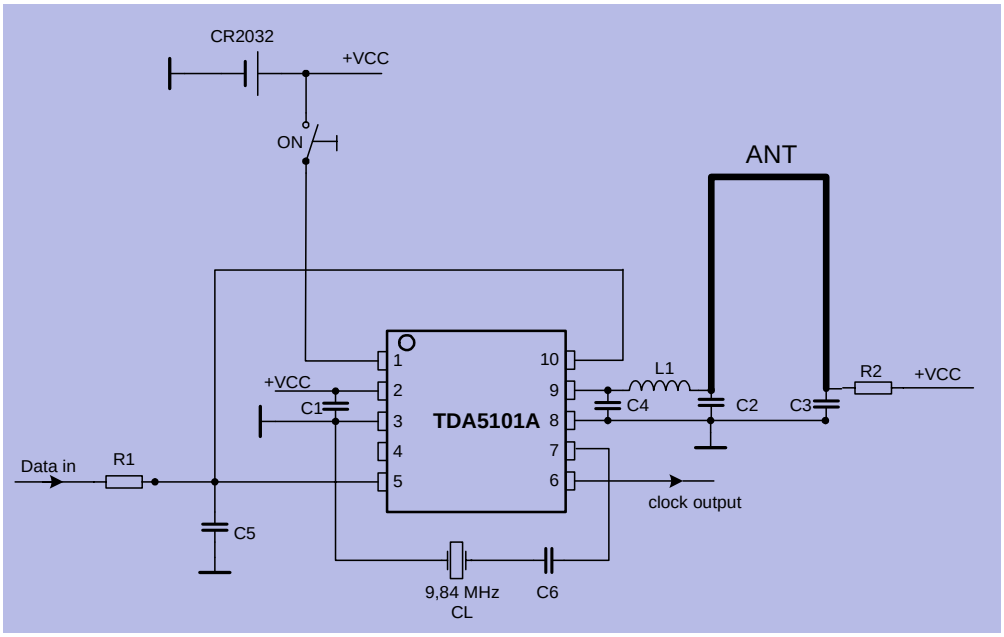
4 Applications

Contents of this Chapter

4.1 Circuits 4-2

4.2 Bill of Materials 4-2

4.1 Circuits



Application_Circuit.wmf

Figure 4-1 Application Circuit

4.2 Bill of Materials

Table 4-1 315 Mhz

Part	Value	
R1[1)]	4.7 k	
R2	1 k	
C1	47 nF	
C2[2)]	18 pF	COG, ± 0.1 pF
C3	330 pF	
C4[2)]	10 pF	COG, ± 0.1 pF
C5[1]	1 nF	
C6[3)]	15 pF	
L1[2)]	39 nH	

1) Dependent on the data rate.

2) Dependent on the antenna and the PCB layout.

3) The value depends on the used crystal and its nominal load capacitance (CL)

5 Reference

Contents of this Chapter

5.1 Electrical Data. 5-2
5.1.1 Absolute Maximum Range 5-2
5.1.2 Operating Ratings. 5-2

5.2 Test Circuit 5-4

5.1 Electrical Data

5.1.1 Absolute Maximum Range

The AC / DC characteristic limits are not guaranteed. The maximal ratings may not be exceeded under any circumstances, not even momentary and individual, as permanent damage to the IC will result.

Table 5-1

Parameter	Symbol	Limit Values		Unit	Remarks
		Min	Max		
Junction Temperature	T_J	-40	150	°C	
Storage Temperature	T_s	-40	125	°C	
Thermal Resistance	R_{thSA}		tbd.	K/W	
ESD integrity, all pins	V_{ESD}	-1	+1	kV	100pF, 1500 Ω

Ambient Temperature under bias: T_A=-25 to +85°C

5.1.2 Operating Ratings

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

Table 5-2

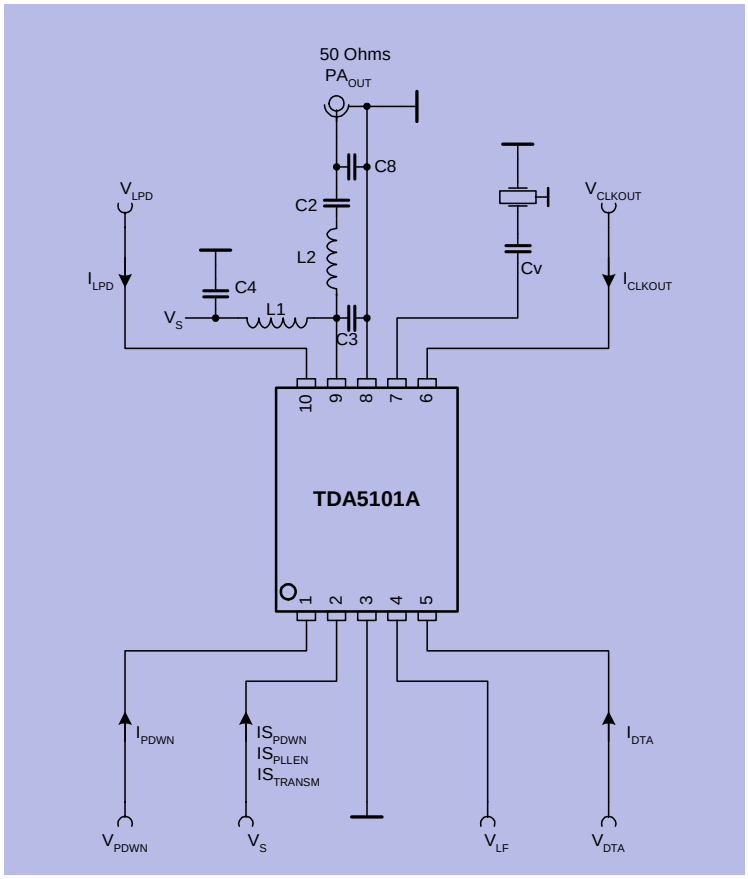
Parameter	Symbol	Limit Values		Unit	Test Conditions
		Min	Max		
Supply voltage	V_S	2.1	4.0	V	
Ambient temperature	T_A	-25	85	°C	

5.1.3 AC/DC Characteristics

Table 5-3 Supply Voltage V_S = 3V, Ambient temperature T_{amb} = 25 °C

Parameter	Symbol	Limit Values			Unit	Test Conditions
		Min	Typ	Max		
Current consumption						
Stand by mode	$I_{S\ PDWN}$			100	nA	Pins 5=0V or N.C.
PLL enable	$I_{S\ PLL_EN}$		3.3	4	mA	
Transmit enable	$I_{S\ TRANSM}$		7	9	mA	see Test circuit
Power Down Modeswitch						
Stand by mode	V_{PDWN}	0		0.2	V	
PLL enable	V_{PDWN}	1.5		Vs	V	V_{DTA} < 0.5V
Transmit enable	V_{PDWN}	1.5		Vs	V	V_{DTA} > 1.4V
Input bias current PDWN	I_{PDWN}			30	µA	V_S = 4V
Low Power Detect						
Internal pull up current	I_{LPD1}	-30			µA	V_S = 2.25 ... 4V
Input current low voltage	I_{LPD2}	1			mA	V_S = 1.9 ... 2.05V
VCO tuning voltage	V_{LF}	Vs-1.6		Vs-0.6	V	PLL locked
ASK Modulation						
ASK Transmit disable	V_{DTA}	0		0.5	V	PLLEN-MODE
ASK Transmit enable	V_{DTA}	1.5		Vs	V	PLLEN-MODE
Input bias current DTA	I_{DTA}			30	µA	V_{DTA} =Vs
Input bias current DTA	I_{DTA}	-20			µA	V_{KDTA} = 0V
ASK data rate	f_{DTA}			20	kHz	
CLOCK driver output						
Output current	I_{CLKOUT}	1			mA	
Crystal oscillator input						
Load capacitance	$C_{COSC-max}$			5	pF	
Serioues Resistance of the crystal				100	Ohm	f=9.84 MHz
Input inductance of the COSC pin			11		µH	f=9.84 MHz
Power amplifier output, transformed to 50 Ohm (see test circuit)						
Output Power	P_{PAOUT}		5		dBm	f=315 MHz

5.2 Test Circuit



Test_circuit.wmf

Figure 5-1 Test_Circuit

Table 5-4 Transforming schematic to 50 Ohms

f=315 MHz	
L1	220 nH
L2	56 nH
C2	56 pF
C3	5.6 pF
C4	330 pF
C8	22 pF