



Chipsmall Limited consists of a professional team with an average of over 10 year of expertise in the distribution of electronic components. Based in Hongkong, we have already established firm and mutual-benefit business relationships with customers from,Europe,America and south Asia,supplying obsolete and hard-to-find components to meet their specific needs.

With the principle of “Quality Parts,Customers Priority,Honest Operation,and Considerate Service”,our business mainly focus on the distribution of electronic components. Line cards we deal with include Microchip,ALPS,ROHM,Xilinx,Pulse,ON,Everlight and Freescale. Main products comprise IC,Modules,Potentiometer,IC Socket,Relay,Connector.Our parts cover such applications as commercial,industrial, and automotives areas.

We are looking forward to setting up business relationship with you and hope to provide you with the best service and solution. Let us make a better world for our industry!



## Contact us

Tel: +86-755-8981 8866 Fax: +86-755-8427 6832

Email & Skype: info@chipsmall.com Web: www.chipsmall.com

Address: A1208, Overseas Decoration Building, #122 Zhenhua RD., Futian, Shenzhen, China





## Wireless Components


ASK/FSK Transmitter 868/433 MHz

TDA7110 Version 1.0

Data Sheet December 2008

<b>Revision History</b>		
Current Version: Version 1.0 as of 10.12.2008		
Previous Version: none		
Page (in previous Version)	Page (in current Version)	Subjects (major changes since last revision)

**We Listen to Your Comments**  
 Is there any information in this document that you feel is wrong, unclear or missing?  
 Your feedback will help us to continuously improve the quality of this document.  
 Please send your proposal (including a reference to this document) to:  
[wirelesscontrol@infineon.com](mailto:wirelesscontrol@infineon.com)



**Edition 2008**  
**Published by Infineon Technologies AG,**  
**Am Campeon 1 - 12**  
**85579 Neubiberg, Germany**  
**© 2008 Infineon Technologies AG**  
**All Rights Reserved.**

**Attention please!**  
 The information herein is given to describe certain components and shall not be considered as a guarantee of characteristics.  
 Terms of delivery and rights to technical change reserved.  
 We hereby disclaim any and all warranties, including but not limited to warranties of non-infringement, regarding circuits, descriptions and charts stated herein.

**Information**  
 For further information on technology, delivery terms and conditions, and prices, please contact the nearest Infineon Technologies Office in Germany or the Infineon Technologies Companies and Infineon Technologies Representatives worldwide ([www.infineon.com](http://www.infineon.com)).

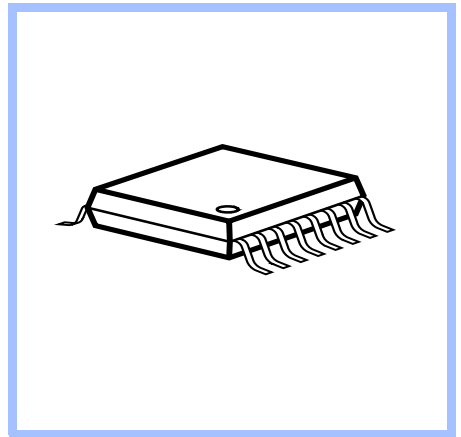
**Warnings**  
 Due to technical requirements, components may contain dangerous substances. For information on the types in question, please contact the nearest Infineon Technologies Office.  
 Infineon Technologies Components may be used in life-support devices or systems only with the express written approval of Infineon Technologies, if a failure of such components can reasonably be expected to cause the failure of that life-support device or system, or to affect the safety or effectiveness of that device or system. Life support devices or systems are intended to be implanted in the human body, or to support and/or maintain and sustain and/or protect human life. If they fail, it is reasonable to assume that the health of the user or other persons may be endangered.

## Product Info

### General Description

The TDA7110 is a single chip ASK/FSK transmitter for the frequency bands 868-870 MHz and 433-435 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 life. Additionally features like a power down mode, a low power detect, a selectable crystal oscillator frequency and a divided clock output are implemented. The IC can be used for both ASK and FSK modulation.

### Package



### Features

- fully integrated frequency synthesizer
- VCO without external components
- high efficiency power amplifier typically 10 dBm @ 3 V
- switchable frequency range 868-870/433-435 MHz
- ASK/FSK modulation
- low supply current typ. 13 mA@3V
- voltage supply range 2.1 - 4 V
- power down mode
- low voltage sensor
- selectable crystal oscillator 6.78 MHz/13.56 MHz
- programmable divided clock output for  $\mu$ C
- low external component count

### Applications

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

### Ordering Information

Type	Ordering Code	Package
TDA7110	SP000524278	PG-TSSOP-16
available on tape and reel		

# 1 Product Description

## Contents of this Chapter

1.1	Overview . . . . .	1-2
1.2	Applications . . . . .	1-2
1.3	Features . . . . .	1-2
1.4	Package Outlines . . . . .	1-3

## 1.1 Overview

The TDA7110 is a single chip ASK/FSK transmitter for the frequency bands 868-870 MHz and 433-435 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 life. Additional features like a power down mode, a low power detect, a selectable crystal oscillator frequency and a divided clock output are implemented. The IC can be used for both ASK and FSK modulation.

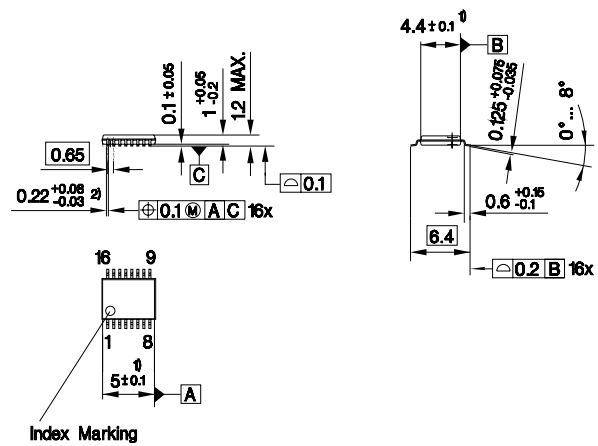
## 1.2 Applications

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

## 1.3 Features

- fully integrated frequency synthesizer
- VCO without external components
- high efficiency power amplifier typ. 10 dBm @ 3 V
- switchable frequency range 868-870/433-435 MHz
- ASK/FSK modulation
- low supply current typ. 13 mA @ 3 V
- voltage supply range 2.1 - 4 V
- power down mode
- low voltage sensor
- selectable crystal oscillator 6.78 MHz/13.56 MHz
- programmable divided clock output for  $\mu$ C
- low external component count

## 1.4 Package Outlines



- 1) Does not include plastic or metal protrusion of 0.15 max. per side
- 2) Does not include dambar protrusion

Figure 1-1 PG-TSSOP-16

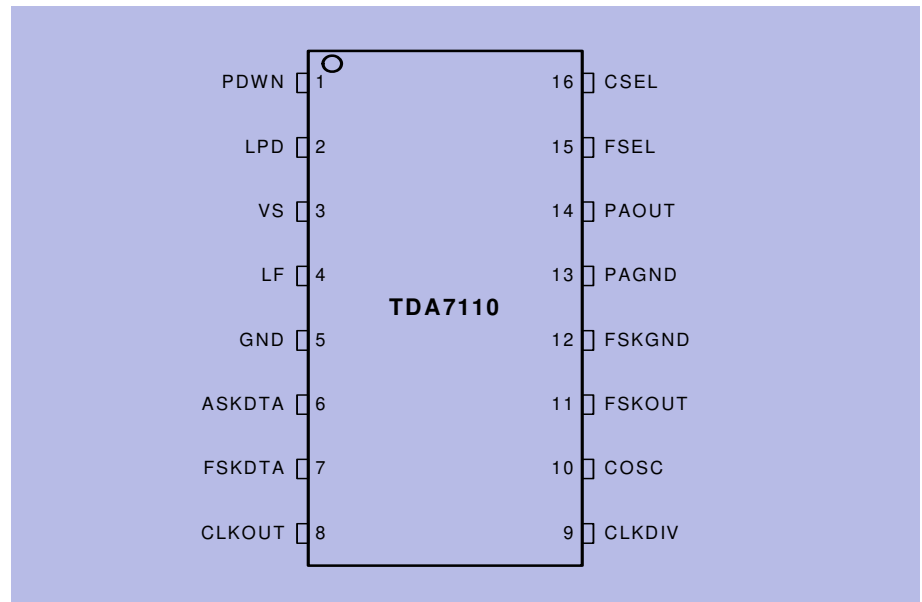
# 2 Functional Description

## Contents of this Chapter

2.1	Pin Configuration . . . . .	2-2
2.2	Pin Definitions and Functions . . . . .	2-3
2.3	Functional Block diagram . . . . .	2-7
2.4	Functional Blocks. . . . .	2-8
2.4.1	PLL Synthesizer. . . . .	2-8
2.4.2	Crystal Oscillator . . . . .	2-8
2.4.3	Power Amplifier . . . . .	2-9
2.4.4	Low Power Detect . . . . .	2-10
2.4.5	Power Modes. . . . .	2-10
2.4.5.1	Power Down Mode . . . . .	2-10
2.4.5.2	PLL Enable Mode . . . . .	2-10
2.4.5.3	Transmit Mode. . . . .	2-10
2.4.6	Recommended timing diagrams for ASK- and FSK-Modulation . .	2-12



## 2.1 Pin Configuration



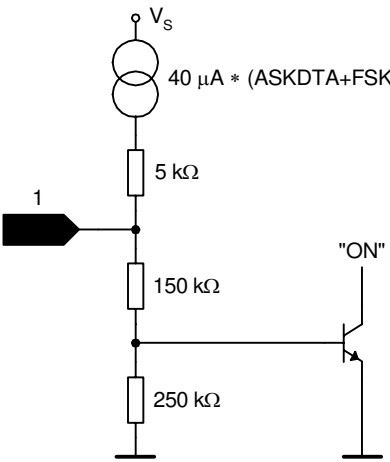
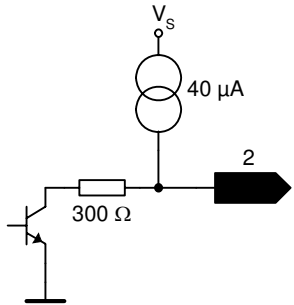
Pin\_config.wmf

Figure 2-1 IC Pin Configuration

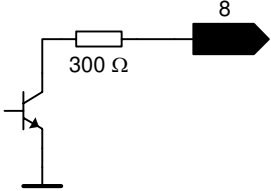
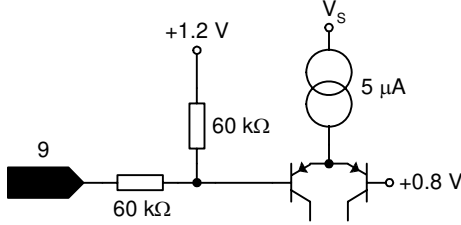
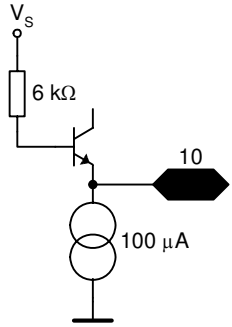
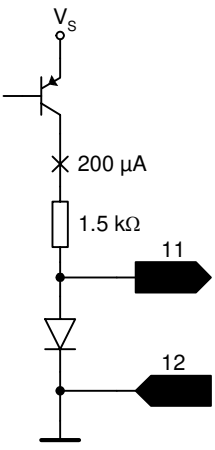
Table 2-1		
Pin No.	Symbol	Function
1	PDWN	Power Down Mode Control
2	LPD	Low Power Detect Output
3	VS	Voltage Supply
4	LF	Loop Filter
5	GND	Ground
6	ASKDTA	Amplitude Shift Keying Data Input
7	FSKDTA	Frequency Shift Keying Data Input
8	CLKOUT	Clock Driver Output
9	CLKDIV	Clock Divider Control
10	COSC	Crystal Oscillator Input
11	FSKOUT	Frequency Shift Keying Switch Output
12	FSKGND	Frequency Shift Keying Ground
13	PAGND	Power Amplifier Ground
14	PAOUT	Power Amplifier Output
15	FSEL	Frequency Range Selection (433 or 868 MHz)
16	CSEL	Crystal Frequency Selection (6.78 or 13.56 MHz)

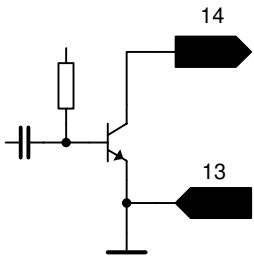
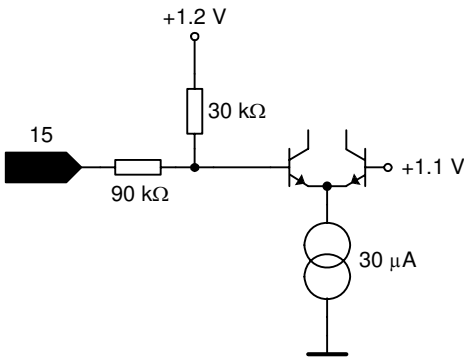
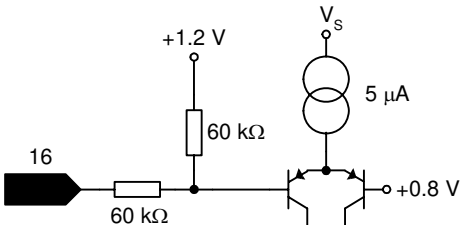
## 2.2 Pin Definitions and Functions

Table 2-2

Pin No.	Symbol	Interface Schematic <sup>1)</sup>	Function
1	PDWN		<p>Disable pin for the complete transmitter circuit.</p> <p>A logic low (PDWN &lt; 0.7 V) turns off all transmitter functions.</p> <p>A logic high (PDWN &gt; 1.5 V) gives access to all transmitter functions.</p> <p>PDWN input will be pulled up by 40 μA internally by either setting FSKDTA or ASKDTA to a logic high-state.</p>
2	LPD		<p>This pin provides an output indicating the low-voltage state of the supply voltage VS.</p> <p>VS &lt; 2.15 V will set LPD to the low-state.</p> <p>An internal pull-up current of 40 μA gives the output a high-state at supply voltages above 2.15 V.</p>
3	VS		<p>This pin is the positive supply of the transmitter electronics.</p> <p>An RF bypass capacitor should be connected directly to this pin and returned to GND (pin 5) as short as possible.</p>

4	LF		<p>Output of the charge pump and input of the VCO control voltage.</p> <p>The loop bandwidth of the PLL is 150 kHz when only the internal loop filter is used. The loop bandwidth may be reduced by applying an external RC network referencing to the positive supply VS (pin 3).</p>
5	GND		<p>General ground connection.</p>
6	ASKDTA		<p>Digital amplitude modulation can be imparted to the Power Amplifier through this pin.</p> <p>A logic high (ASKDTA &gt; 1.5 V or open) enables the Power Amplifier.</p> <p>A logic low (ASKDTA &lt; 0.5 V) disables the Power Amplifier.</p>
7	FSKDTA		<p>Digital frequency modulation can be imparted to the Xtal Oscillator by this pin. The VCO-frequency varies in accordance to the frequency of the reference oscillator.</p> <p>A logic high (FSKDTA &gt; 1.5V or open) sets the FSK switch to a high impedance state.</p> <p>A logic low (FSKDTA &lt; 0.5 V) closes the FSK switch from FSKOUT (pin 11) to FSKGND (pin 12).</p> <p>A capacitor can be switched to the reference crystal network this way. The Xtal Oscillator frequency will be shifted giving the designed FSK frequency deviation.</p>

8	CLKOUT		<p>Clock output to supply an external device. An external pull-up resistor has to be added in accordance to the driving requirements of the external device.</p> <p>A clock frequency of 3.39 MHz is selected by a logic low at CLKDIV input (pin 9). A clock frequency of 847.5 kHz is selected by a logic high at CLKDIV input (pin 9).</p>
9	CLKDIV		<p>This pin is used to select the desired clock division rate for the CLKOUT signal.</p> <p>A logic low (CLKDIV &lt; 0.2 V) applied to this pin selects the 3.39 MHz output signal at CLKOUT (pin 8).</p> <p>A logic high (CLKDIV open) applied to this pin selects the 847.5 kHz output signal at CLKOUT (pin 8).</p>
10	COSC		<p>This pin is connected to the reference oscillator circuit.</p> <p>The reference oscillator is working as a negative impedance converter. It presents a negative resistance in series to an inductance at the COSC pin.</p>
11	FSKOUT		<p>This pin is connected to a switch to FSKGND (pin 12).</p> <p>The switch is closed when the signal at FSKDTA (pin 7) is in a logic low state.</p> <p>The switch is open when the signal at FSKDTA (pin 7) is in a logic high state.</p> <p>FSKOUT can switch an additional capacitor to the reference crystal network to pull the crystal frequency by an amount resulting in the desired FSK frequency shift of the transmitter output frequency.</p>
12	FSKGND		<p>Ground connection for FSK modulation output FSKOUT.</p>

13	PAGND	<p>Ground connection of the power amplifier.</p> <p>The RF ground return path of the power amplifier output PAOUT (pin 14) has to be concentrated to this pin.</p>
14	<p>PAOUT</p> 	<p>RF output pin of the transmitter.</p> <p>A DC path to the positive supply VS has to be supplied by the antenna matching network.</p>
15	<p>FSEL</p> 	<p>This pin is used to select the desired transmitter frequency.</p> <p>A logic low (FSEL &lt; 0.5 V) applied to this pin sets the transmitter to the 433 MHz frequency range.</p> <p>A logic high (FSEL open) applied to this pin sets the transmitter to the 868 MHz frequency range.</p>
16	<p>CSEL</p> 	<p>This pin is used to select the desired reference frequency.</p> <p>A logic low (CSEL &lt; 0.2 V) applied to this pin sets the internal frequency divider to accept a reference frequency of 6.78 MHz.</p> <p>A logic high (CSEL open) applied to this pin sets the internal frequency divider to accept a reference frequency of 13.56 MHz.</p>

- 1) Indicated voltages and currents apply for PLL Enable Mode and Transmit Mode. In Power Down Mode, the values are zero or high-ohmic.

### 2.3 Functional Block diagram

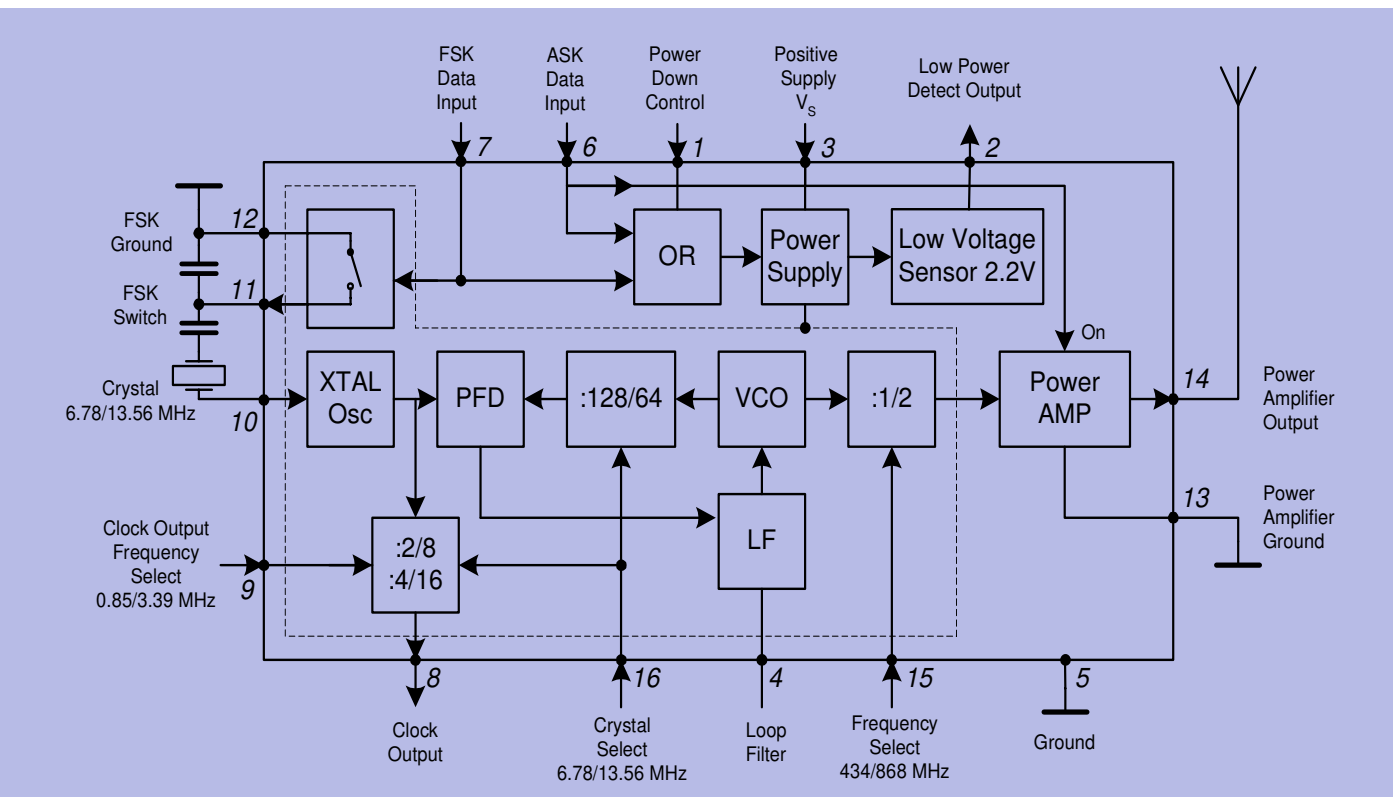


Figure 2-2 Functional Block diagram

Block\_diagram.wmf

## 2.4 Functional Blocks

### 2.4.1 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. It 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 869 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 128 in case of a 6.78 MHz crystal or 64 in case of a 13.56 MHz crystal and can be selected via CSEL (pin 16). The phase detector is a Type IV PD with charge pump. The passive loop filter is realized on chip.

### 2.4.2 Crystal Oscillator

The crystal oscillator operates either at 6.78 MHz or at 13.56 MHz.

The reference frequency can be chosen by the signal at CSEL (pin 16).

**Table 2-3**

CSEL (pin 16)	Crystal Frequency
Low <sup>1)</sup>	6.78 MHz
Open <sup>2)</sup>	13.56 MHz

- 1) Low: Voltage at pin < 0.2 V
- 2) Open: Pin open

For both quartz frequency options, 847.5 kHz or 3.39 MHz are available as output frequencies of the clock output CLKOUT (pin 8) to drive the clock input of a micro controller.

The frequency at CLKOUT (pin 8) is controlled by the signal at CLKDIV (pin 9)

**Table 2-4**

CLKDIV (pin 9)	CLKOUT Frequency
Low <sup>1)</sup>	3.39 MHz
Open <sup>2)</sup>	847.5 kHz

- 1) Low: Voltage at pin < 0.2 V
- 2) Open: Pin open

To achieve FSK transmission, the oscillator frequency can be detuned by a fixed amount by switching an external capacitor via FSKOUT (pin 11).

The condition of the switch is controlled by the signal at FSKDTA (pin 7).

Table 2-5	
FSKDTA (pin7)	FSK Switch
Low <sup>1)</sup>	CLOSED
Open <sup>2)</sup> , High <sup>3)</sup>	OPEN

- 1) Low: Voltage at pin < 0.5 V
- 2) Open: Pin open
- 3) High: Voltage at pin > 1.5 V

### 2.4.3 Power Amplifier

In case of operation in the 868-870 MHz band, the power amplifier is fed directly from the voltage controlled oscillator. In case of operation in the 433-435 MHz band, the VCO frequency is divided by 2. This is controlled by FSEL (pin 15) as described in the table below.

Table 2-6	
FSEL (pin 15)	Radiated Frequency Band
Low <sup>1)</sup>	433 MHz
Open <sup>2)</sup>	868 MHz

- 1) Low: Voltage at pin < 0.5 V
- 2) Open: Pin open

The Power Amplifier can be switched on and off by the signal at ASKDTA (pin 6).

Table 2-7	
ASKDTA (pin 6)	Power Amplifier
Low <sup>1)</sup>	OFF
Open <sup>2)</sup> , High <sup>3)</sup>	ON

- 1) Low: Voltage at pin < 0.5 V
- 2) Open: Pin open
- 3) High: Voltage at pin > 1.5 V

The Power Amplifier has an Open Collector output at PAOUT (pin 14) and requires an external pull-up coil to provide bias. The coil is part of the tuning and matching LC circuitry to get best performance with the external loop antenna. To achieve the best power amplifier efficiency, the high frequency voltage swing at PAOUT (pin 14) should be twice the supply voltage.

The power amplifier has its own ground pin PAGND (pin 13) in order to reduce the amount of coupling to the other circuits.



#### 2.4.4 Low Power Detect

The supply voltage is sensed by a low power detector. When the supply voltage drops below 2.15 V, the output LPD (pin 2) switches to the low-state. To minimize the external component count, an internal pull-up current of 40  $\mu$ A gives the output a high-state at supply voltages above 2.15 V.

The output LPD (pin 2) can either be connected to ASKDTA (pin 6) to switch off the PA as soon as the supply voltage drops below 2.15 V or it can be used to inform a micro-controller to stop the transmission after the current data packet.

#### 2.4.5 Power Modes

The IC provides three power modes, the POWER DOWN MODE, the PLL ENABLE MODE and the TRANSMIT MODE.

##### 2.4.5.1 Power Down Mode

In the POWER DOWN MODE the complete chip is switched off.

The current consumption is typically 0.25 nA at 3 V 25°C.

This current doubles every 8°C. The value at +85°C is typically 14 nA.

##### 2.4.5.2 PLL Enable Mode

In the PLL ENABLE MODE the PLL is switched on but the power amplifier is turned off to avoid undesired power radiation during the time the PLL needs to settle. The turn on time of the PLL is determined mainly by the turn on time of the crystal oscillator and is less than 1 msec when the specified crystal is used.

The current consumption is typically 4 mA.

##### 2.4.5.3 Transmit Mode

In the TRANSMIT MODE the PLL is switched on and the power amplifier is turned on too.

The current consumption of the IC is typically 13 mA when using a proper transforming network at PAOUT, see Figure 3-1.

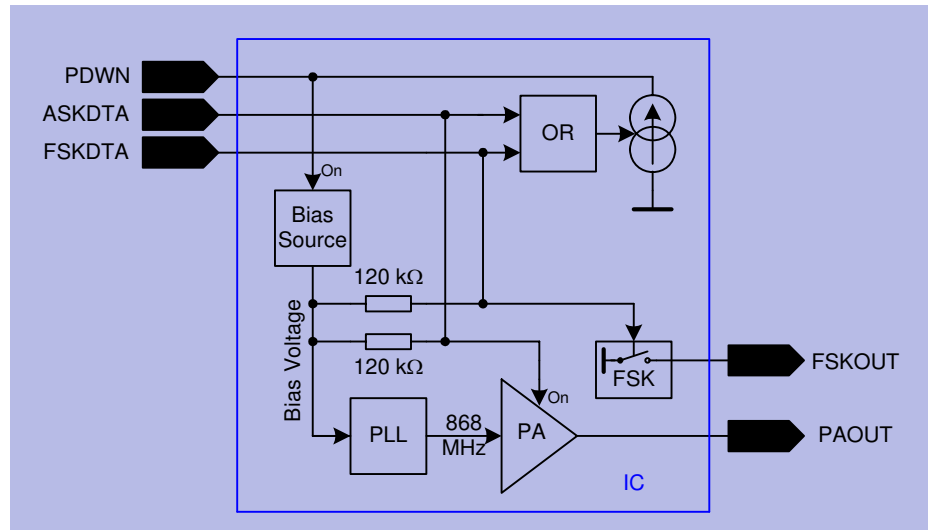
##### 2.4.5.4 Power mode control

The bias circuitry is powered up via a voltage  $V > 1.5$  V at the pin PDWN (pin 1). When the bias circuitry is powered up, the pins ASKDTA and FSKDTA are pulled up internally.

Forcing the voltage at the pins low overrides the internally set state.

Alternatively, if the voltage at ASKDTA or FSKDTA is forced high externally, the PDWN pin is pulled up internally via a current source. In this case, it is not necessary to connect the PDWN pin, it is recommended to leave it open.

The principle schematic of the power mode control circuitry is shown in Figure 2-5.



Power\_Mode.wmf

Figure 2-5 Power mode control circuitry

Table 3-8 provides a listing of how to get into the different power modes

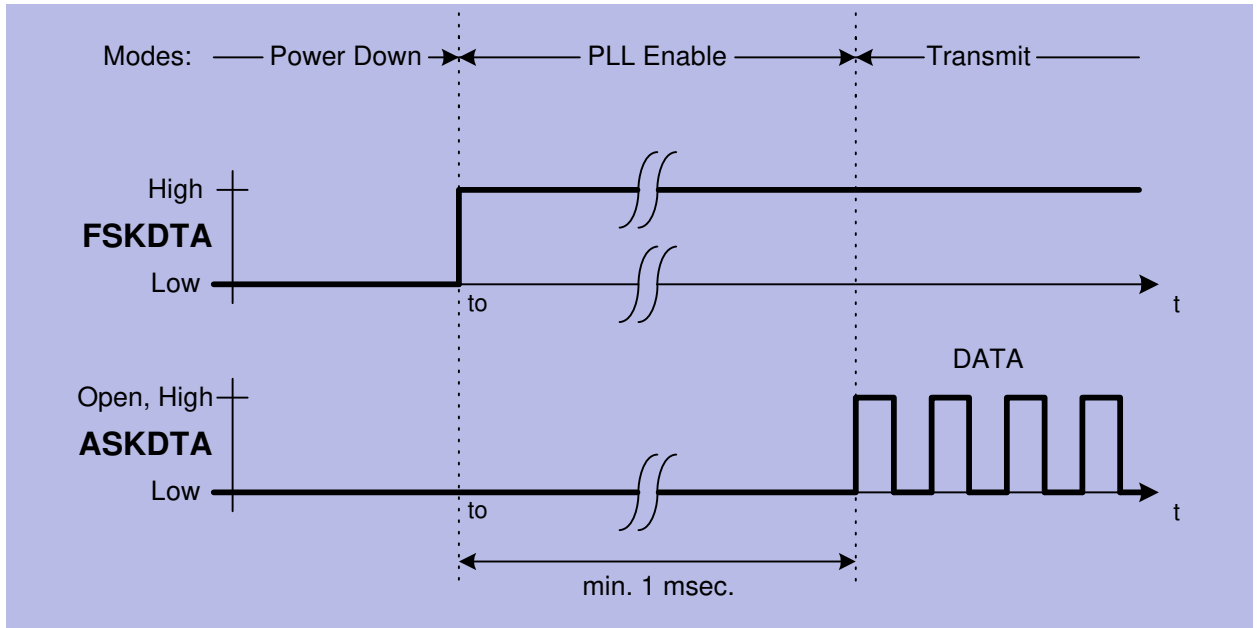
Table 2-8			
PDWN	FSKDTA	ASKDTA	MODE
Low <sup>1)</sup>	Low, Open	Low, Open	POWER DOWN
Open <sup>2)</sup>	Low	Low	
High <sup>3)</sup>	Low, Open, High	Low	PLL ENABLE
Open	High	Low	
High	Low, Open, High	Open, High	TRANSMIT
Open	High	Open, High	
Open	Low, Open, High	High	

- 1) Low: Voltage at pin < 0.7 V (PDWN)  
Voltage at pin < 0.5 V (FSKDTA, ASKDTA)
- 2) Open: Pin open
- 3) High: Voltage at pin > 1.5 V

Other combinations of the control pins PDWN, FSKDTA and ASKDTA are not recommended.

**2.4.6 Recommended timing diagrams for ASK- and FSK-Modulation**

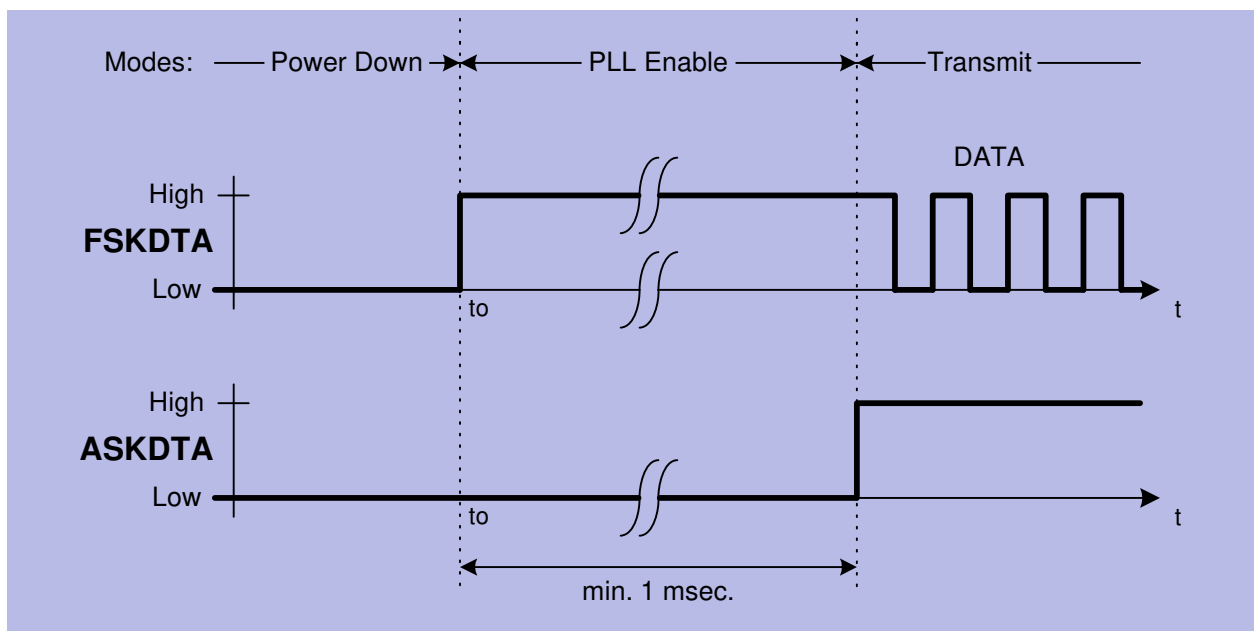
ASK Modulation using FSKDTA and ASKDTA, PDWN not connected



ASK\_mod.wmf

Figure 2-6 ASK Modulation

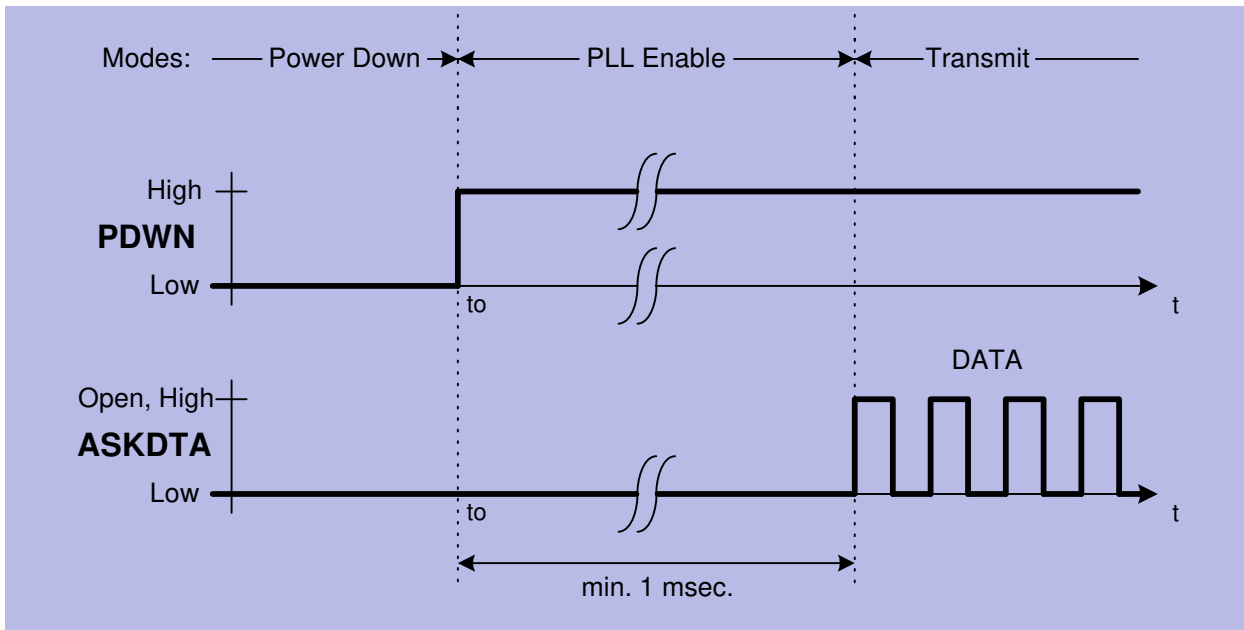
FSK Modulation using FSKDTA and ASKDTA, PDWN not connected



FSK\_mod.wmf

Figure 2-7 FSK Modulation

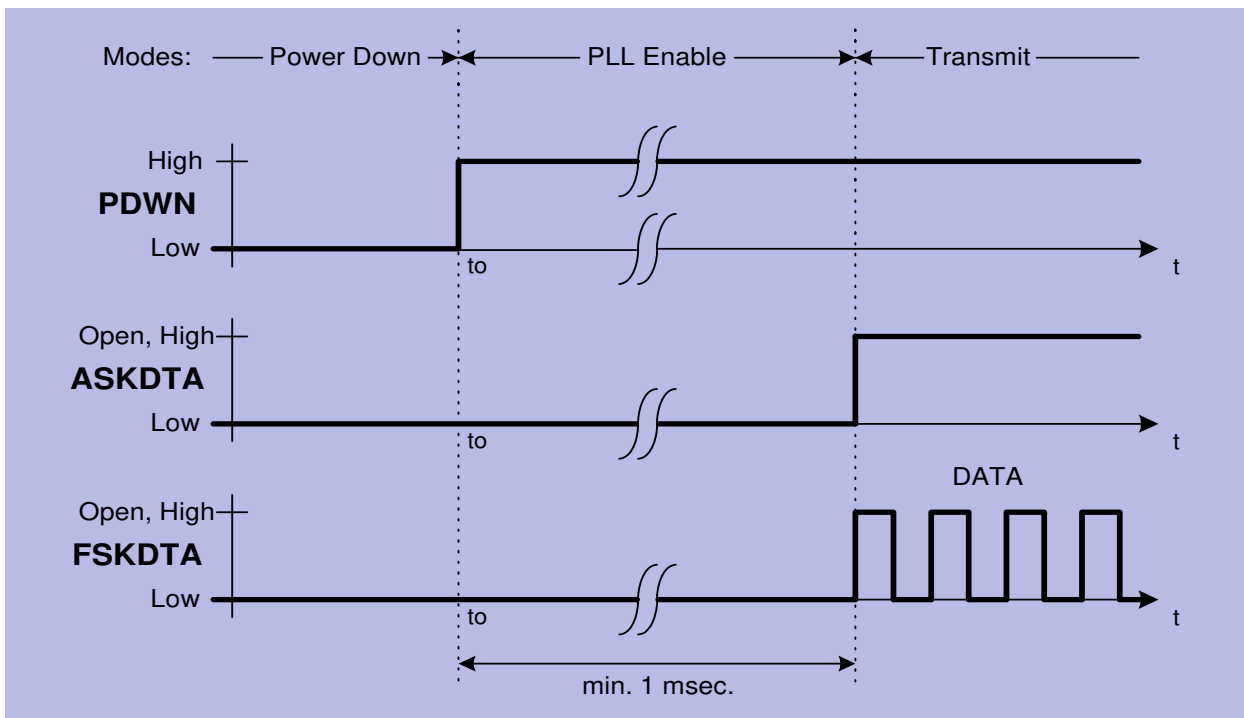
Alternative ASK Modulation, FSKDTA not connected.



Alt\_ASK\_mod.wmf

Figure 2-8 Alternative ASK Modulation

Alternative FSK Modulation



Alt\_FSK\_mod.wmf

Figure 2-9 Alternative FSK Modulation

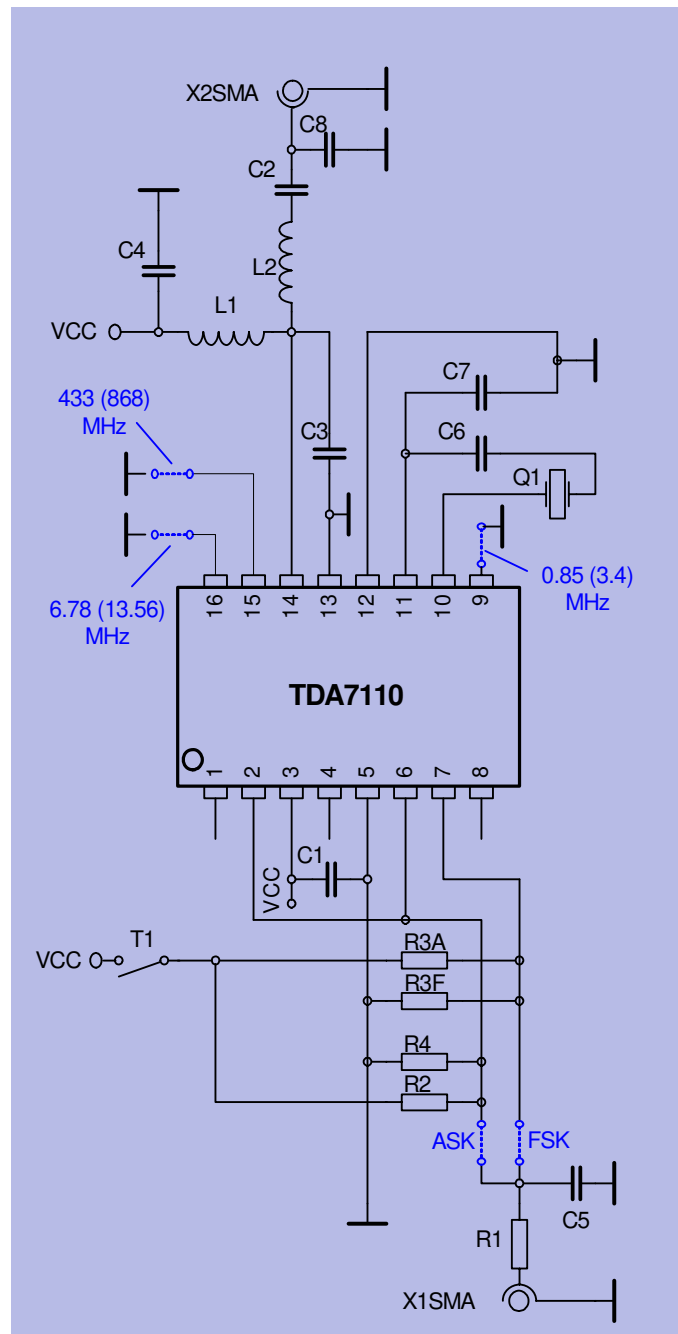


# 3 Applications

## Contents of this Chapter

3.1	50 Ohm-Output Testboard: Schematic . . . . .	3-2
3.2	50 Ohm-Output Testboard: Layout . . . . .	3-3
3.3	50 Ohm-Output Testboard: Bill of material . . . . .	3-4
3.4	Application Hints on the Crystal Oscillator . . . . .	3-5
3.5	Design hints on the buffered clock output (CLKOUT). . . . .	3-7
3.6	Application Hints on the Power-Amplifier . . . . .	3-8

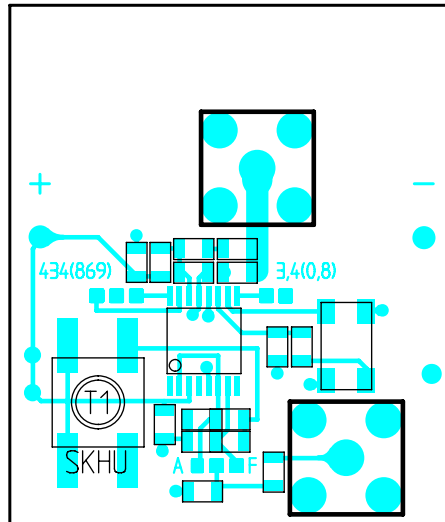
### 3.1 50 Ohm-Output Testboard: Schematic



50ohm\_test\_v5.wmf

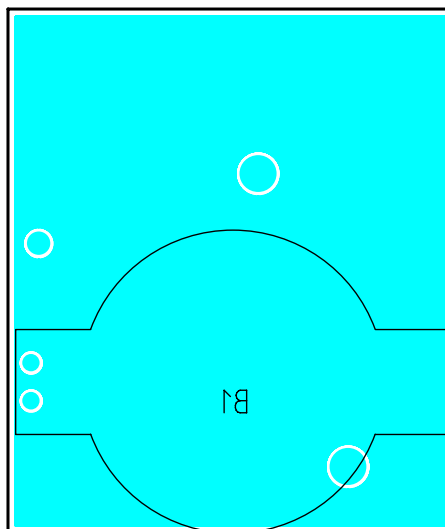
Figure 3-1 50Ω-output testboard schematic

### 3.2 50 Ohm-Output Testboard: Layout



pcboben.pdf

Figure 3-2 Top Side of TDA7110-Testboard with 50  $\Omega$ -Output



pcbunten.pdf

Figure 3-3 Bottom Side of TDA7110-Testboard with 50  $\Omega$ -Output



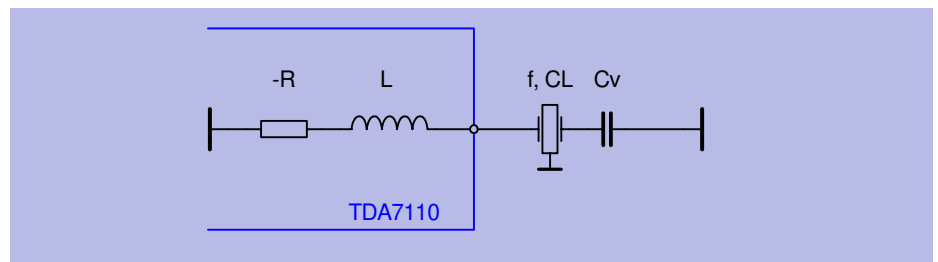
### 3.3 50 Ohm-Output Testboard: Bill of material

Table 3-1 Bill of material

Part	Value	434 MHz	869 MHz	ASK	FSK	Specification
R1	4.7k					0805, ± 5%
R2					12k	0805, ± 5%
R3A				15k		0805, ± 5%
R3F					15k	0805, ± 5%
R4	open					0805, ± 5%
C1	47nF					0805, X7R, ± 10%
C2		27pF	27pF			0805, COG, ± 5%
C3		6.8pF	2.7pF			0805, COG, ± 0.1 pF
C4		330pF	100pF			0805, COG, ± 5%
C5	1nF					0805, X7R, ± 10%
C6				6.8pF	434MHz: 10pF 868MHz: 8.2pF	0805, COG, ± 0.1 pF
C7				0Ω Jumper	434MHz: 6.8pF 868MHz: 15pF	6.8pF: 0805, COG, ± 0.1pF 15pF: 0805, COG, ± 1% 0805, 0Ω Jumper
C8		12pF	5.6pF			5.6pF: 0805, COG, ± 0.1pF 12pF: 0805, COG, ± 1%
L1		68nH	68nH			TOKO LL2012-J
L2		27nH	10nH			27nH: TOKO LL1608-J 10nH: TOKO PTL2012-J
Q1	13.56875 MHz, CL=20pF					Tokyo Denpa TSS-3B 13568.75 kHz Spec.No. 10-50205
IC1	TDA7110					
T1	Push-button					replaced by a short
X1	SMA-S					SMA standing
X2	SMA-S					SMA standing

### 3.4 Application Hints on the Crystal Oscillator

The crystal oscillator achieves a turn on time less than 1 msec when the specified crystal is used. To achieve this, a NIC oscillator type is implemented in the TDA7110. The input impedance of this oscillator 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.



$$C_v = \frac{1}{\frac{1}{CL} + \omega^2 L} \quad (1)$$

CL: crystal load capacitance for nominal frequency

$\omega$ : angular frequency

L: inductance of the crystal oscillator

#### Example for the ASK-Mode:

Referring to the application circuit, in ASK-Mode the capacitance C7 is replaced by a short to ground. Assume a crystal frequency of 13.56 MHz and a crystal load capacitance of CL = 12 pF. The inductance L at 13.5 MHz is about 4.6  $\mu$ H. Therefore C6 is calculated to 8.567 pF, but due to parasitic capacitors of the board C6 usually has to be smaller (e.g. 6.8 pF in the ASK evalboard)

$$C_v = \frac{1}{\frac{1}{CL} + \omega^2 L} = C6$$