

ON Semiconductor®



APPLICATION NOTE AND9312/D

AX5043

**0 dBm / 8 mA TX and
9.5 mA RX Configuration for
the 868 MHz Band**

Revision 2



Table of Contents

1. Introduction.....	3
2. Hardware Configuration.....	4
2.1. Summary of Changes vs. standard DVK-2 add-on Modules	4
2.2. RF Reference Clock	4
2.3. Antenna Interface	5
3. Software Configuration	6
4. Performance	7



1. Introduction

This application note describes how to use **AX5043** to design a 0 dBm / 8 mA transmit and 9.5 mA receive configuration for the 868 MHz band. Both hardware and software configurations are discussed.

The configuration targets wide band and category 2 or 3 receiver usage as regulated by ETSI EN 300 220-1 V2.4.1 (2012-05). Performance is given for 50 kbps FSK operation in the 868.0 – 868.6 MHz band.

AX5043 has a differential and a single ended power amplifier (PA). To get the highest possible output power the differential PA must be used. 0 dBm output power which is far below the maximum possible output power can be achieved with both PAs. However, using the single ended power amplifier allows 0 dBm output power to be achieved with less power consumption.

The differential PA is internally multiplexed with the receive path. The single ended PA is output on a dedicated pin and must be externally connected to the receiver if a single antenna configuration is to be used. A low component count, purely passive configuration to achieve this goal is presented in this application note.



2. Hardware Configuration

2.1. Summary of Changes vs. standard DVK-2 add-on Modules

Module	AX5043 DVK-2b V1.4
Antenna Interface	Use configuration shown in Figure 2
RF Reference Clock	16 MHz XTAL instead of 48 MHz TCXO Direct connection of the XTAL to the device pins CLK16P and CLK16N without TCXO network as shown in Figure 1 Disconnect VAUX (TCXO supply) from J2 to avoid shorting it to GND across the XTAL

Table 1 Module changes

2.2. RF Reference Clock

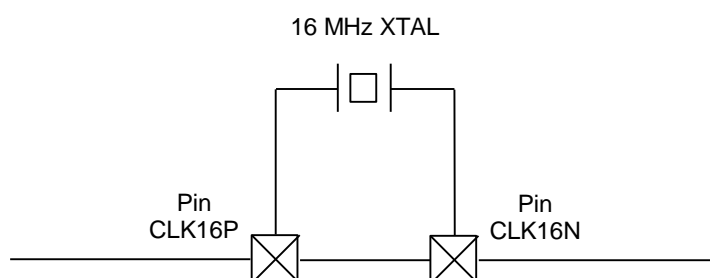


Figure 1 XTAL configuration

2.3. Antenna Interface

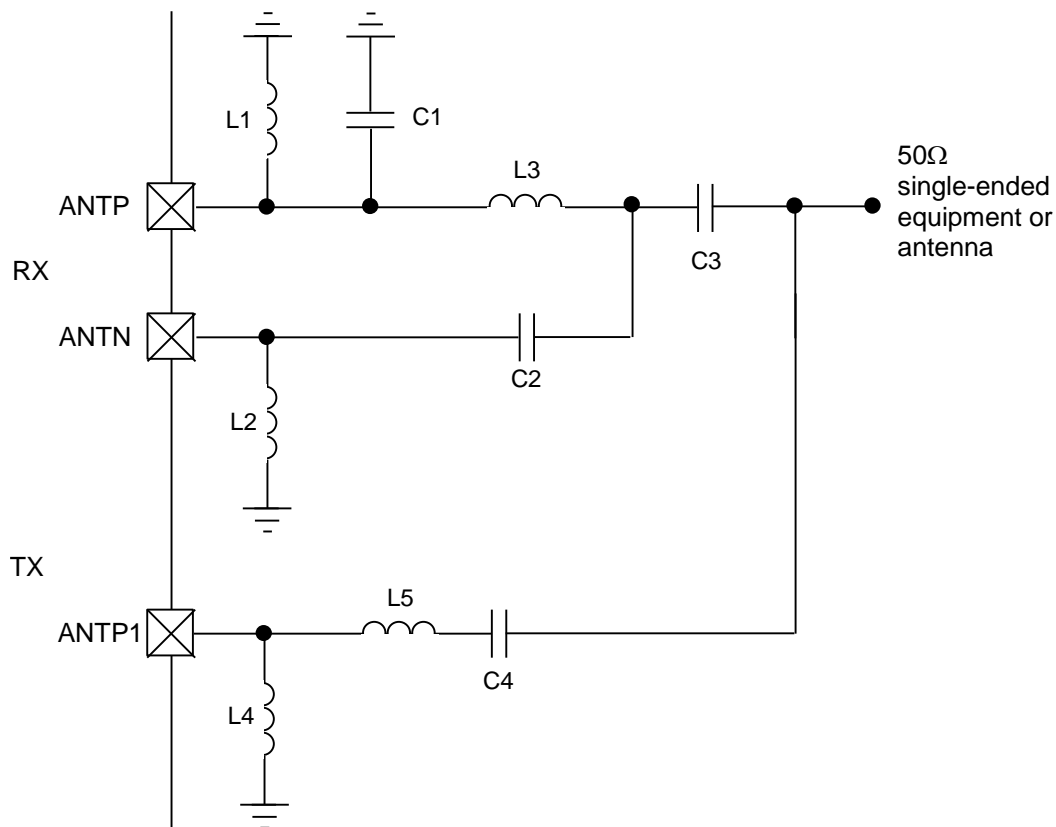


Figure 2 Structure of the antenna interface for a single-ended antenna and single ended internal PA, without RX/TX switch

Frequency Band	L1 [nH]	L2 [nH]	L3 [nH]	L4 [nH]	L5 [nH]	C1 [pF]	C2 [pF]	C3 [pF]	C4 [pF]
868 MHz	18	7.2	12	12	27	2.7	2.7	10	2.7

Table 2 Component values



3. Software Configuration

For software setup AX-RadioLab for AX5043 V2.2 is used. Table 3 gives the register values that were changed vs. the RadioLab generated configuration.

It is recommended to use FSK as modulation, not GFSK, as the shaping logic for the GFSK output consumes additional current and ETSI EN 300 220-1 V2.4.1 (2012-05) wide band regulatory requirements can easily be met with FSK.

Register	Register Address	Parameter	Value TX	Value RX
AX5043_TXPWRCOEFFB1	0x16A	Output Power	0x02	
AX5043_TXPWRCOEFFB0	0x16B		0x80	
AX5043_F11	0xF11	XTAL config.	0x84	
AX5043_POWCTRL1	0xF08	VDD_ANA	0x02	0x03
AX5043_POWCTRL0	0xF09	VDD_MODEM	0x01	

Table 3 Register Settings



4. Performance


Measurement equipment TX	0.5 m RG-58 cable from SMA to R&S FSEB spectrum analyzer (note 1)
Measurement equipment RX	Pair of AX5043 modules with variable attenuation chain and shielding box
Mainboard and debug adapter	DVK-2b
Carrier Frequency	868.3 MHz
Bit rate	50 kbps
Modulation	FSK
FSK deviation ($f_{\text{mark}} - f_{\text{space}})/2$	$h=0.667$, 16.667 kHz
IDD for TX $P_{\text{out}} = 0$ dBm random data	7.8 mA (note 2)
IDD for RX	9.5 mA
VDD_IO range with $P_{\text{out}} = 0$ dBm	1.6 V – 3.6 V
RX sensitivity Input sensitivity at PER = 1% for 868 MHz operation, 144 bit packet data, without FEC	-105 dBm (note 3)
ETSI EN 300 220-1 V2.4.1 (2012-05)	TX : wide band operation 868.0 – 868.6 pass RX : class 2 or 3

Table 4 Performance

Notes :

1. 0 dBm is the spectrum analyzer reading. Cable losses are not compensated
2. Without RX/TX combination $P_{\text{out}} = 0$ dBm is achieved with 300 μA less current with the same TX network
3. Without RX/TX combination the sensitivity is 3 dB better



ON Semiconductor and the  are registered trademarks of Semiconductor Components Industries, LLC (SCILLC) or its subsidiaries in the United States and/or other countries. SCILLC owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of SCILLC's product/patent coverage may be accessed at www.onsemi.com/site/pdf/Patent-Marking.pdf. SCILLC reserves the right to make changes without further notice to any products herein. SCILLC makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does SCILLC assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. "Typical" parameters which may be provided in SCILLC data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. SCILLC does not convey any license under its patent rights nor the rights of others. SCILLC products are not designed, intended, or authorized for use as components in systems intended for surgical implant into the body, or other applications intended to support or sustain life, or for any other application in which the failure of the SCILLC product could create a situation where personal injury or death may occur. Should Buyer purchase or use SCILLC products for any such unintended or unauthorized application, Buyer shall indemnify and hold SCILLC and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that SCILLC was negligent regarding the design or manufacture of the part. SCILLC is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

PUBLICATION ORDERING INFORMATION

LITERATURE FULFILLMENT:

Literature Distribution Center for ON Semiconductor
19521 E. 32nd Pkwy, Aurora, Colorado 80011 USA
Phone: 303-675-2175 or 800-344-3860 Toll Free USA/Canada
Fax: 303-675-2176 or 800-344-3867 Toll Free USA/Canada
Email: orderlit@onsemi.com

N. American Technical Support: 800-282-9855 Toll Free
USA/Canada

Europe, Middle East and Africa Technical Support:
Phone: 421 33 790 2910

Japan Customer Focus Center
Phone: 81-3-5817-1050

ON Semiconductor Website: www.onsemi.com

Order Literature: <http://www.onsemi.com/orderlit>

For additional information, please contact your local
Sales Representative