Application Note AN_A7125_HW_00

General Information

Document Title

Application Note AN_A7125_HW_00

Revision History

Rev.	History	Issue Date	Remark
0.0	Initial issue	September, 2008	Preliminary
0.1	Add Temperature vs. thermal reading Add RSSI curve Add Tx power control setting Add Rx sensitivity in different channels	January, 2009	Preliminary
0.2	Add Prohibited channels	July, 2010	Preliminary

Table of Contents

1. Crystal Selection Guide

Specification for selecting appropriate crystal in A7125 application is given in the following table 1. Customers can adjust frequency by tuning the external capacitors at A7125 XI and XO pins.

Quartz Crystal Specification	1	2	3	4	5
Center Frequency	16 MHz	16 MHz	8 MHz	12 MHz	6 MHz
Frequency tolerance at room temperature	20 ppm	20 ppm	20 ppm	20 ppm	20 ppm
Frequency stability over operation temperature	30 ppm	30 ppm	30 ppm	30 ppm	30 ppm
Load Capacitance	18 pF	20 pF	20 pF	20 pF	20 pF
Equivalent Series Resistor (ESR)	<= 50 ohm	<= 50 ohm	<= 50 ohm	<= 50 ohm	<= 50 ohm
Shunt Capacitance	<= 7 pF	<= 7 pF	<= 7 pF	<= 7 pF	<= 7 pF
External Capacitor at A7125 XI pin	33 pF	33 pF	33 pF	33 pF	33 pF
External Capacitor at A7125 XO pin	27 pF	33 pF	33 pF	33 pF	33 pF

Table 1 Quartz Crystal Specification

2. Application Circuit and Layout Guide

2.1 Application Circuit

MD7125-A06-01 is a reference design for wireless data transmission application (please see module spec. for the last update). The schematic is as Fig. 2.1a and the layout is as Fig. 2.1b. This document mainly shows some key points which should be paid attention when doing layout.

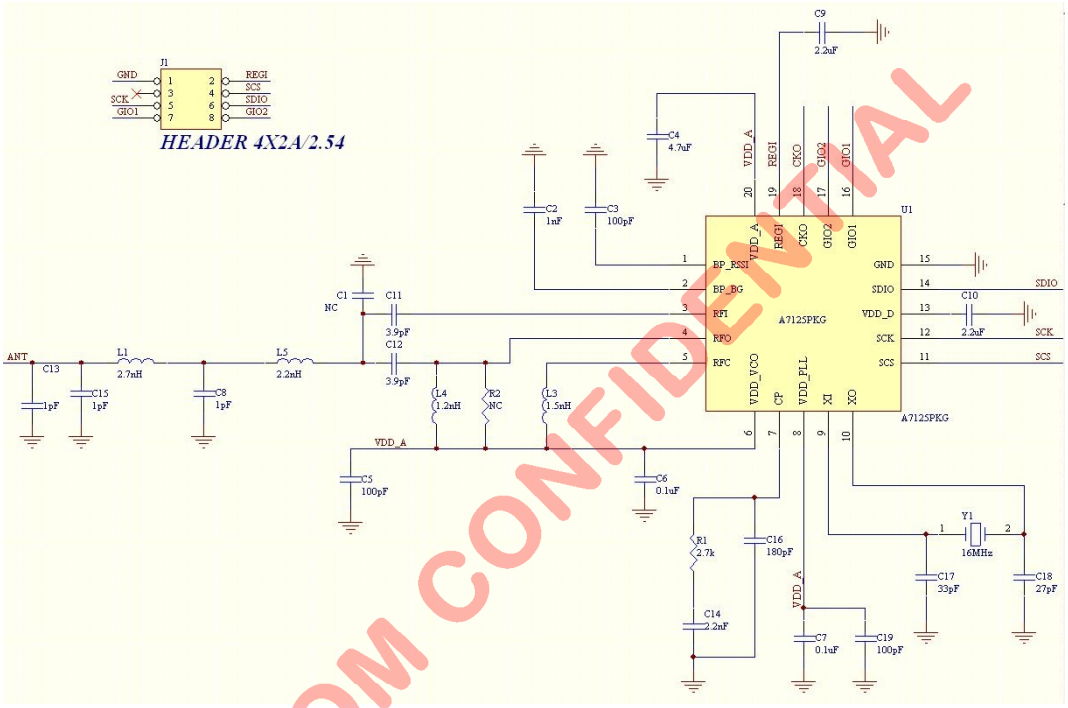


Fig. 2.1a Schematic of MD7125-A06-01

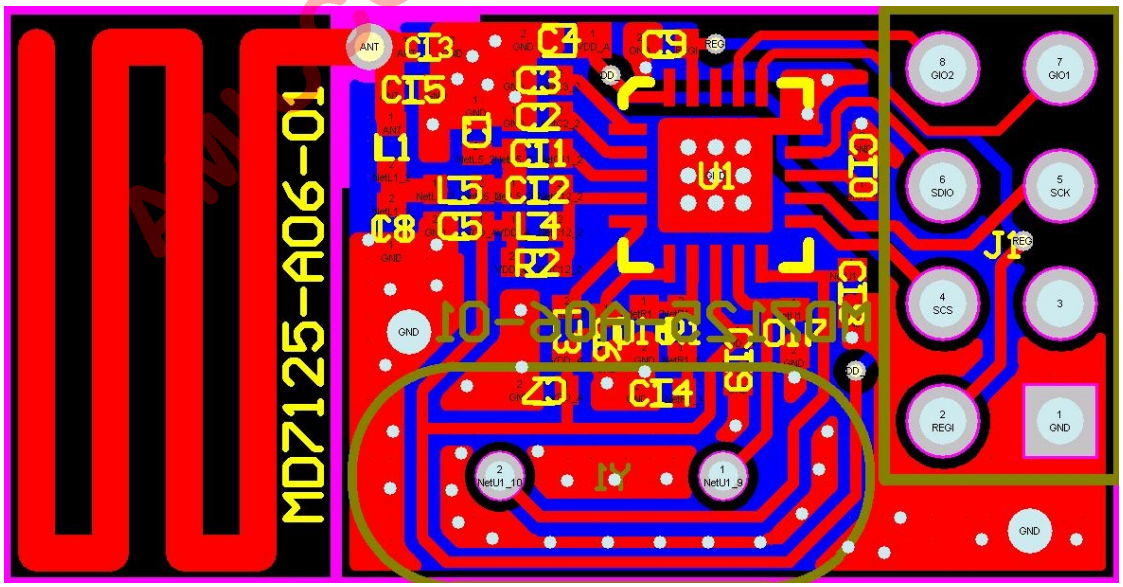


Fig. 2.1b Layout of MD7125-A06-01

2.2 Layout Guide

1. A7125 IC should have very solid ground. The ground plane under the IC should be intact, and not fragmentary. Please refer to Fig. 2.1b.
2. The impedance of RF path should as close to 50 ohm as possible, and the length also should be as short as possible. The ground plane below the RF traces should be intact and not fragmentary. The matching components (C1, C5, C11, C12, L4, L3, R2) should be close to A7125 IC. Because the matching circuit affects the performance (power, current, and sensitivity) heavily, we strongly recommend customers follow our layout in RF matching part without any change. Please refer to the green traces in Fig. 2.2a.

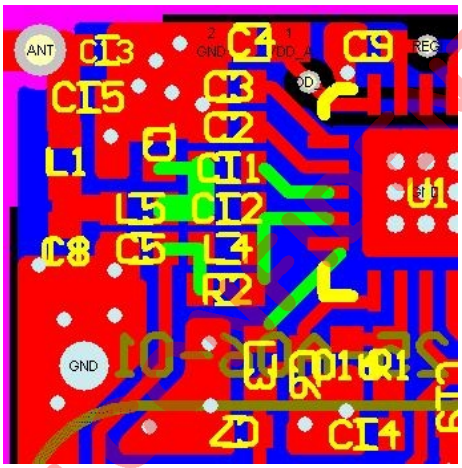


Fig. 2.2a RF matching trace (green)

3. The bypass capacitors (C2, C4, C6, C7, C9, C10, C19) should be very close the IC pins, and the ground via also should be very close the ground pad. Please refer to Fig. 2.1b.
4. The loop filter (C14, C16, R1) should be close to pin 7 of A7105 IC. Please refer to Fig. 2.1b.

5. The X’tal traces should be as short as possible and are better to be isolated by ground via. Please refer to the green traces in Fig. 2.2b.

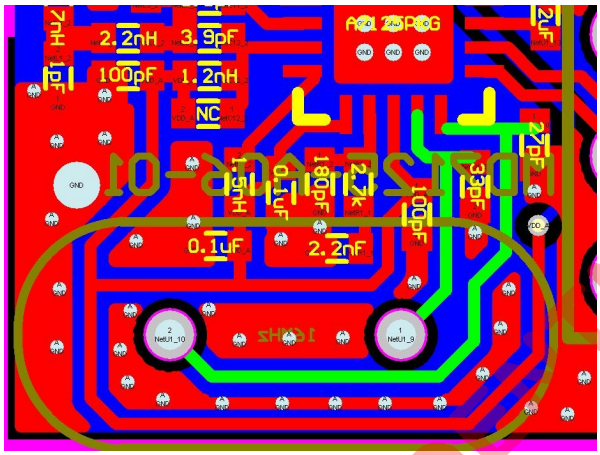


Fig. 2.2b X’tal trace (green)

6. There is no GND plane below the antenna. Please refer to Fig. 2.1b.

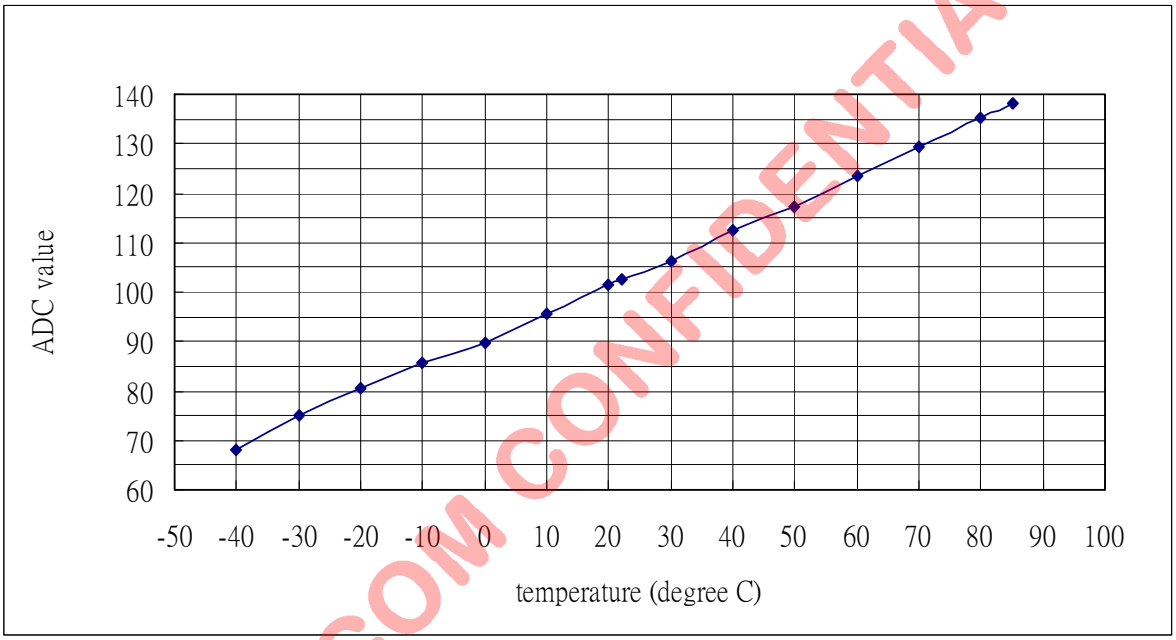
3. Temperature vs. Thermal Sensor Reading

A7125 has a thermal sensor inside and users can know the temperature of the IC from reading the value of ADC.

Register setting is as below:

Reg[01] b[0]: ADCM enable (set to 1)
Reg[1F] b[1]: RSS disable (set to 0)
Reg[35] b[2:0]: RFT set to 1
Read Reg[1E] at Standby Mode

Measurement data is as below:



Users can use the formula below to get the temperature of IC.

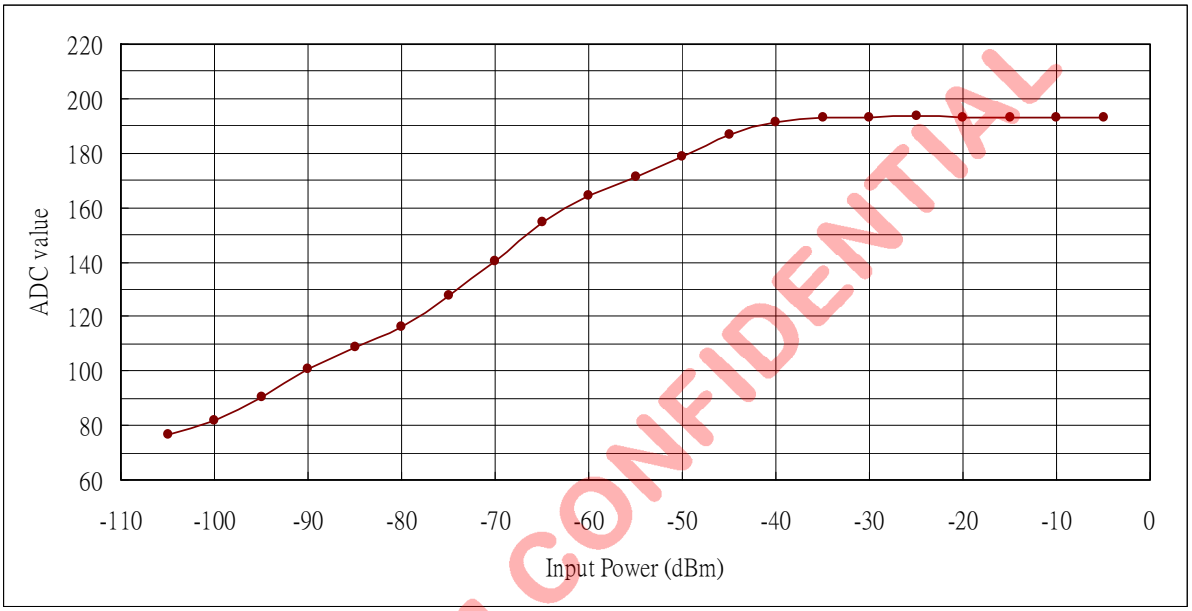
Temperature (C) = 1.786 * (ADC value) – 161.429

4. RSSI Curve

Users can read the RSSI value of A7125 by setting the registers as below:

Reg[01] b[0]: ADCM enable (set to 1)
Reg[1F] b[1]: RSS enable (set to 1)
Read Reg[1E] at Rx Mode

Measurement data of Input Power V.S. RSSI is as below:



In the linear range (Input Power: -105 dBm ~ -40 dBm), users can use the formula below to get the Input Power of the module.

Input Power = 0.564 * (ADC value) – 148.108

5. Tx Power Control Setting

Users can get different Tx power by setting TBG (Tx Buffer Gain) and PAC (PA Current) in register [2Dh] as the tables below. The default setting of register [2Dh] is 0x2F. The power variation is about +-2dB between modules.

Tx Power and Current		PAC							
		0		1		2		3	
		power (dBm)	current (mA)	power (dBm)	current (mA)	power (dBm)	current (mA)	power (dBm)	current (mA)
TBG	0	-21.16	13.08	-19.04	14.78	-17.59	17.83	-16.86	22.08
	1	-18.19	13.12	-16.06	14.81	-14.61	17.86	-13.87	22.11
	2	-15.20	13.18	-13.08	14.87	-11.63	17.91	-10.89	22.16
	3	-11.73	13.30	-9.62	14.98	-8.16	18.00	-7.41	22.24
	4	-8.32	13.51	-6.20	15.16	-4.72	18.15	-3.97	22.38
	5	-4.82	13.92	-2.73	15.52	-1.25	18.43	-0.53	22.62
	6	-1.70	14.61	0.19	16.16	1.45	18.97	1.99	23.08
	7	0.74	15.63	2.02	17.23	2.89	19.94	3.34	23.65

6. Rx Sensitivity in different channels and the prohibited channels

When Tx frequency is set to the times of 16MHz (frequency of X'tal) +- 1MHz, the Rx sensitivity will degrade a little (maybe up to 10 dB). To get the best performance, users should avoid use the channels which equal to the times of 16MHz +- 1MHz. The table below shows Rx sensitivity in different channels and the prohibited channels.

Tx Frequency (MHz)	Rx Sensitivity (dBm)	Tx Frequency (MHz)	Rx Sensitivity (dBm)	Tx Frequency (MHz)	Rx Sensitivity (dBm)	Tx Frequency (MHz)	Rx Sensitivity (dBm)
2403	-90	2423	-90	2443	-90	2463	Prohibited
2404	-90	2424	-90	2444	-90	2464	Prohibited
2405	-90	2425	-90	2445	-90	2465	Prohibited
2406	-90	2426	-90	2446	-90	2466	-90
2407	-90	2427	-90	2447	Prohibited	2467	-90
2408	-90	2428	-90	2448	Prohibited	2468	-90
2409	-90	2429	-89	2449	Prohibited	2469	-90
2410	-90	2430	-89	2450	-90	2470	-90
2411	-90	2431	Prohibited	2451	-90	2471	-89
2412	-90	2432	Prohibited	2452	-90	2472	-90
2413	-90	2433	Prohibited	2453	-90	2473	-89
2414	-90	2434	-89	2454	-90	2474	-90
2415	Prohibited	2435	-89	2455	-89	2475	-90
2416	Prohibited	2436	-90	2456	-90	2476	-90
2417	Prohibited	2437	-90	2457	-90	2477	-90
2418	-90	2438	-90	2458	-90	2478	-90
2419	-90	2439	-89	2459	-90	2479	Prohibited
2420	-90	2440	-89	2460	-90	2480	Prohibited
2421	-90	2441	-89	2461	-90	2481	Prohibited
2422	-90	2442	-90	2462	-90	2482	-90