Application Note AN_A7139_HW_D00

General Information

Document Title

Application Note AN_A7139_HW_D00

Revision History

Rev.	History	Issue Date	Remark
0.1	Initial issue.	2022, May	Preliminary
0.2	Update TX power vs current table	2023, Oct.	

Table of Contents

1. Crystal Selection Guide

To select an appropriate crystal for A7139 is important for good RF performance. If users are not familiar with how to choose the X'tal, we suggest them to use the one in BOM of MD7139 module spec. The X'tal spec. shown in table 1~5 are some suitable examples for different applications. Users can also get more information in "*FQA_0001_Xtal Selection*". Users can adjust frequency by enable INTXC to setting XCL in register [08] page 9. Please read A7139 datasheet or contact our FAE for detail.

X'tal Type: 49S
X'tal Load Capacitance: 20pF
X'tal Shunt Capacitance: 7pF
X'tal Drive Level: 100uW typ.
X'tal Eqiuvalent Series Resistor (ESR): ≦100Ω [*1]

Table 1 : 315 MHz Band

IFBW (KHz)	DR (Kbps)	Deviation (Kbps)	X'tal Frequency (MHz)	TRx are both in the same temperature		One of TRx is in room temperature		One of TRx is above room temperature and the other one is below room temperature	
				Tolerance (ppm)	Stability (ppm)	Tolerance (ppm)	Stability (ppm)	Tolerance (ppm)	Stability (ppm)
50	10	18.75	12.8	20	20	x	x	x	x
100	10	37.5	12.8	20	20	20	20	20	20
100	100	37.5	12.8	20	20	20	20	10	15
150	150	56.25	12.8	20	20	20	20	20	20
250	250	93.75	16	20	20	20	20	20	20

Table 2 : 433 MHz Band

IFBW (KHz)	DR (Kbps)	Deviation (Kbps)	X'tal Frequency (MHz)	TRx are both in the same temperature		One of TRx is in room temperature		One of TRx is above room temperature and the other one is below room temperature	
				Tolerance (ppm)	Stability (ppm)	Tolerance (ppm)	Stability (ppm)	Tolerance (ppm)	Stability (ppm)
50	10	18.75	12.8	15	20	x	x	x	x
100	10	37.5	12.8	20	20	20	20	10	15
100	100	37.5	12.8	20	20	10	20	10	10
150	150	56.25	12.8	20	20	20	20	10	20
250	250	93.75	16	20	20	20	20	20	20

Annotation 1：

A7139 can works well with an X'tal with ESR < 100 Ω. However, the X'tal settling time will get longer with higher ESR. The X'tal shown in BOM of MD7139 module spec. is fully tested. If users have problems with X'tal selection, please contact your X'tal supplier or AMICCOM's FAE.

Table 3 : 470 ~ 510 MHz Band

IFBW (KHz)	DR (Kbps)	Deviation (Kbps)	X'tal Frequency (MHz)	TRx are both in the same temperature		One of TRx is in room temperature		One of TRx is above room temperature and the other one is below room temperature	
				Tolerance (ppm)	Stability (ppm)	Tolerance (ppm)	Stability (ppm)	Tolerance (ppm)	Stability (ppm)
50	10	18.75	12.8	10	20	x	x	x	x
100	10	37.5	12.8	20	20	20	20	10	15
100	100	37.5	12.8	20	20	10	15	10	10
150	150	56.25	12.8	20	20	20	20	10	15
250	250	93.75	16	20	20	20	20	20	20

Table 4 : 868 MHz Band

IFBW (KHz)	DR (Kbps)	Deviation (Kbps)	X'tal Frequency (MHz)	TRx are both in the same temperature		One of TRx is in room temperature		One of TRx is above room temperature and the other one is below room temperature	
				Tolerance (ppm)	Stability (ppm)	Tolerance (ppm)	Stability (ppm)	Tolerance (ppm)	Stability (ppm)
50	10	18.75	12.8	x	x	x	x	x	x
100	10	37.5	12.8	20	20	10	10	x	x
100	100	37.5	12.8	15	20	x	x	x	x
150	150	56.25	12.8	20	20	10	15	x	x
250	250	93.75	16	20	20	20	20	10	15

Table 5 : 915 MHz Band

IFBW (KHz)	DR (Kbps)	Deviation (Kbps)	X'tal Frequency (MHz)	TRx are both in the same temperature		One of TRx is in room temperature		One of TRx is above room temperature and the other one is below room temperature	
				Tolerance (ppm)	Stability (ppm)	Tolerance (ppm)	Stability (ppm)	Tolerance (ppm)	Stability (ppm)
50	10	18.75	12.8	x	x	x	x	x	x
100	10	37.5	12.8	20	20	10	10	x	x
100	100	37.5	12.8	15	20	x	x	x	x
150	150	56.25	12.8	20	20	10	10	x	x
250	250	93.75	16	20	20	20	20	10	15

Annotation 2：

"x" means not suggestion.

2. Application Circuit and Layout Guide

2.1 Application Circuit

MD7139 is AMICCOM's reference design for sub 1GHz application (please see module spec. for the last update). The schematic is as Fig. 2.1a~2.1d and the layout is as Fig. 2.1e~2.1h. This document mainly notifies some key points which should be paid attention while doing PCB layout.

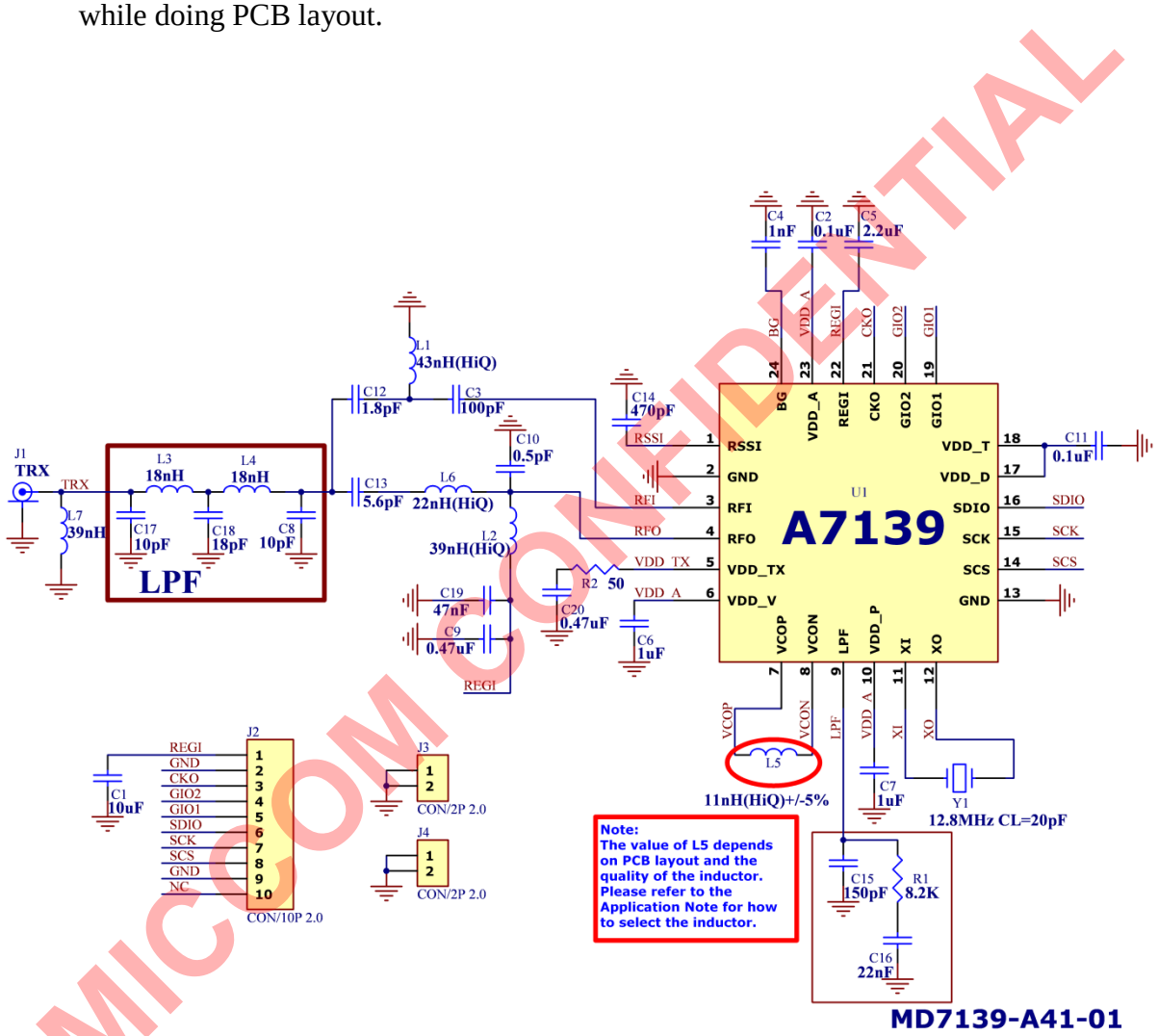


Fig. 2.1a Schematic of MD7139-A41

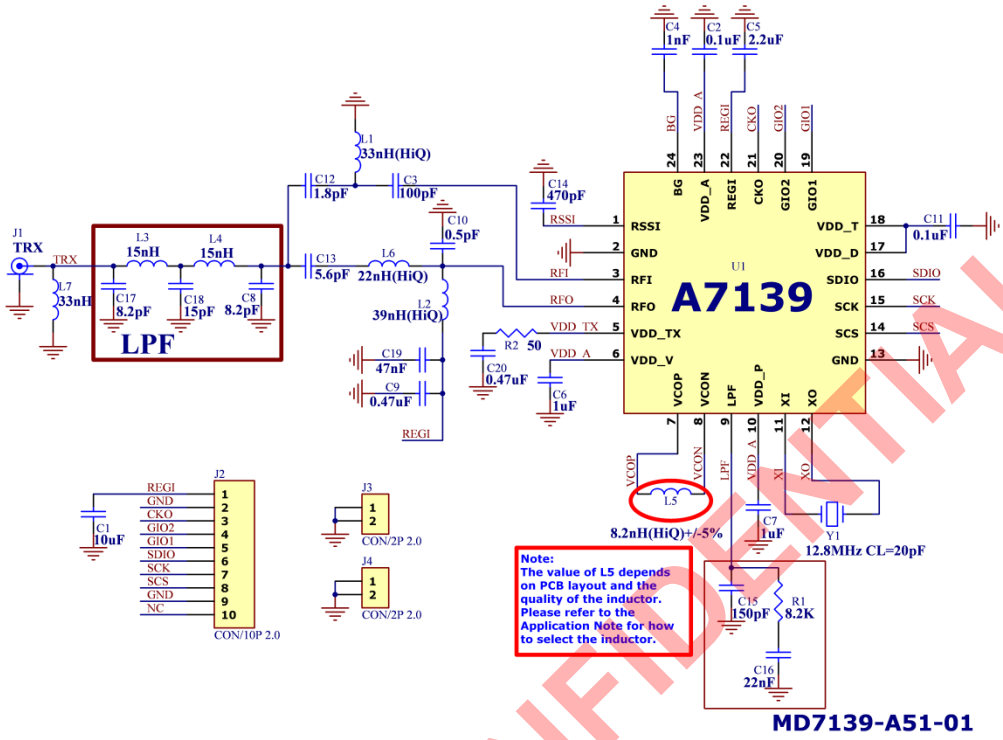


Fig. 2.1b Schematic of MD7139-A51

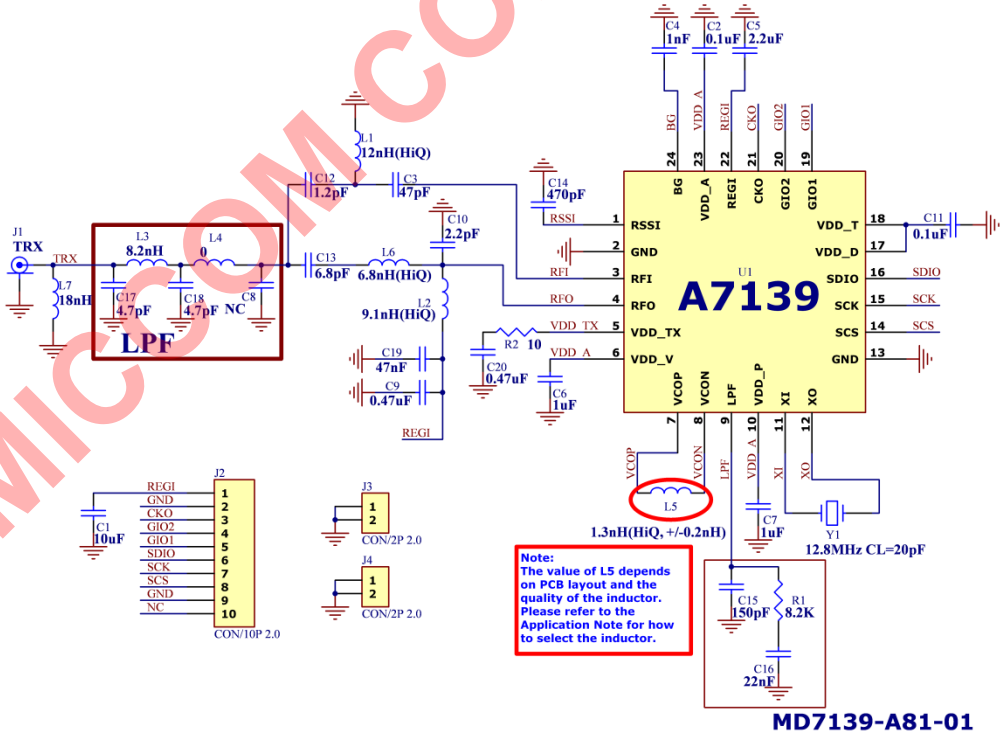


Fig. 2.1c Schematic of MD7139-A81

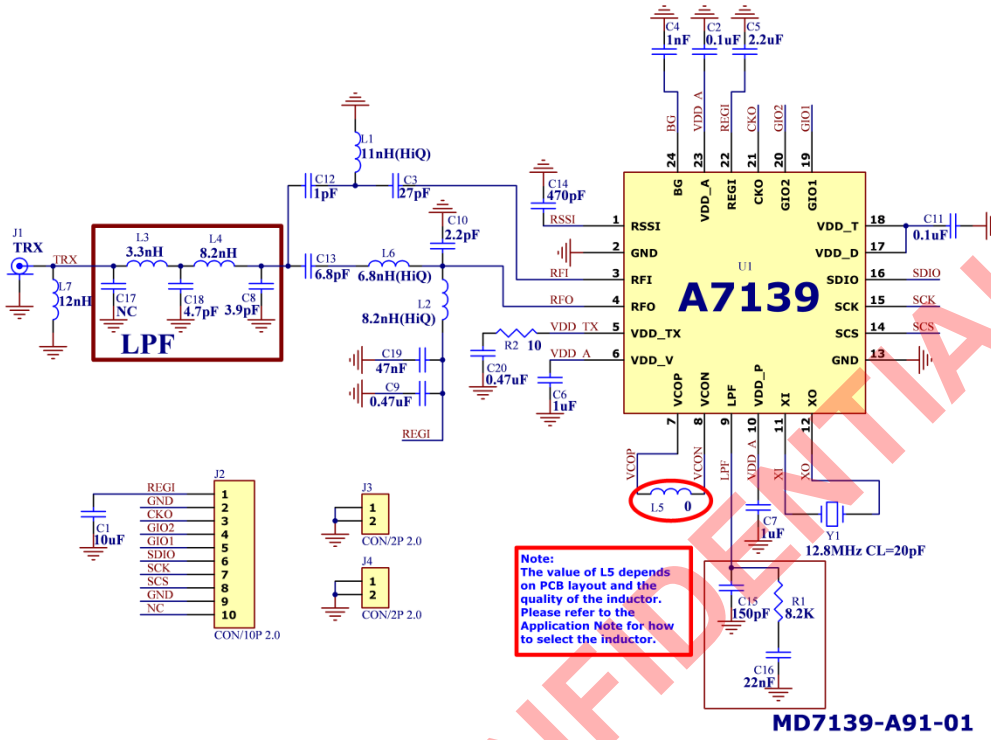


Fig. 2.1d Schematic of MD7139-A91

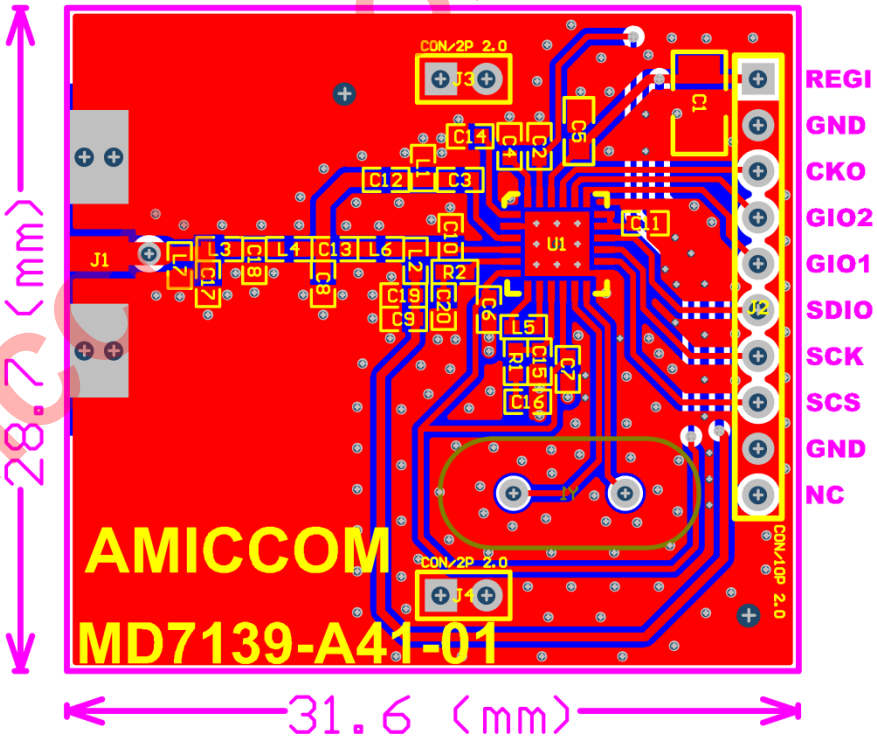


Fig. 2.1e Layout of MD7139-A41

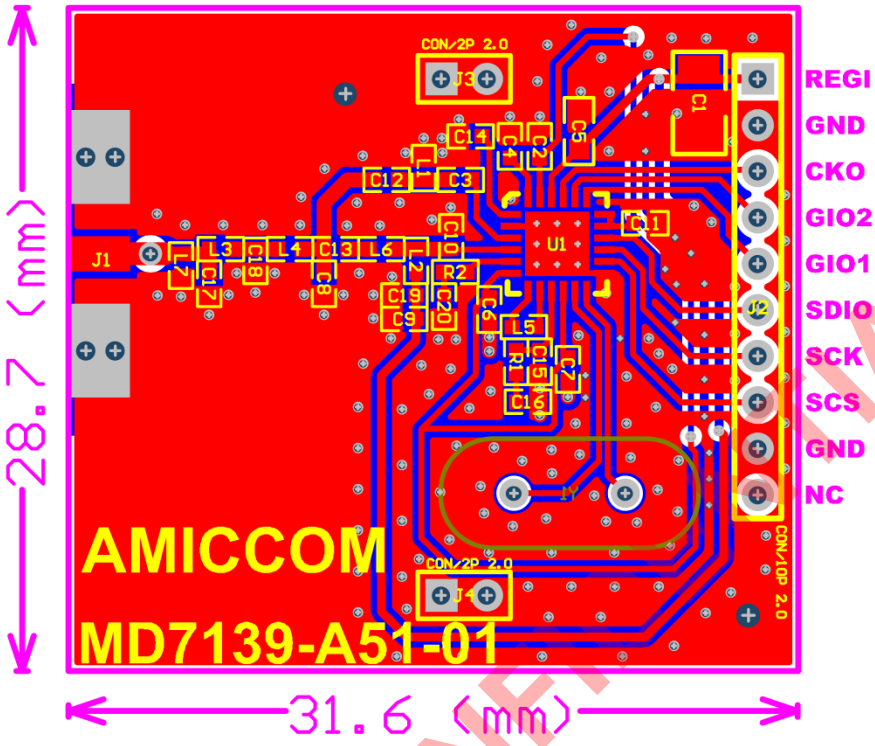


Fig. 2.1f Layout of MD7139-A51

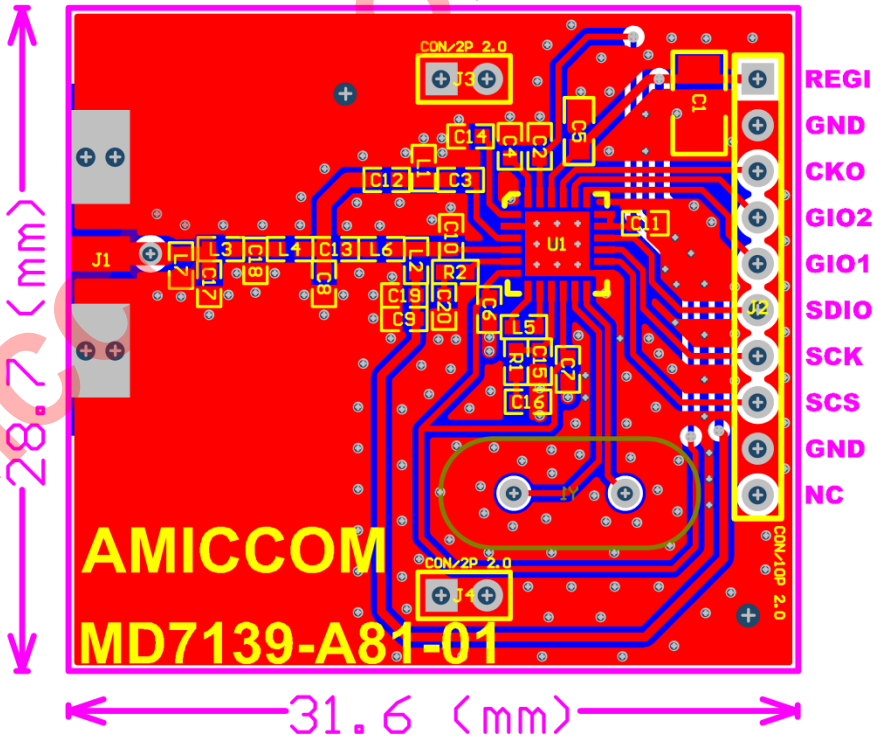


Fig. 2.1g Layout of MD7139-A81

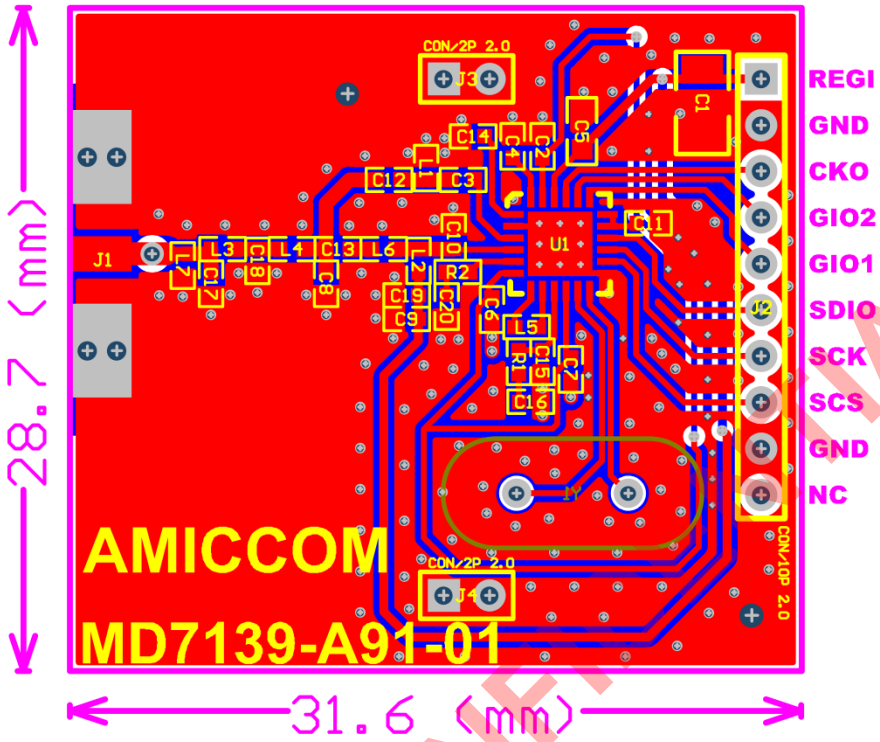


Fig. 2.1h Layout of MD7139-A91

2.2 Layout Guide

1. Bad ground plane always induce poor RF performance. Hence, a solid ground where it under the IC should be intact and not fragmentary can make the best RF performance of A7139. Please refer to Fig. 2.2a.

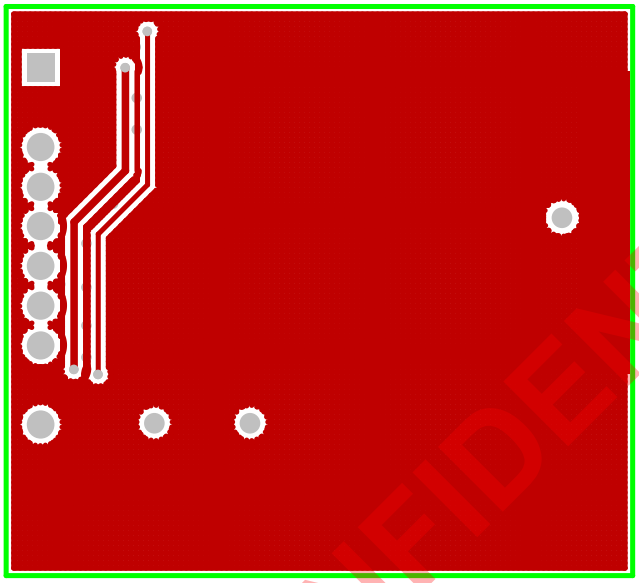


Fig. 2.2a solid ground for Bottom-layer (2L PCB)

2. The impedance of RF path should be as close to 50 ohm as possible, and the RF trace should also be as short as possible. The ground plane below all RF traces must be intact and not fragmentary. The matching network (C3, L1, C12, C10, L2, L6, C13, R2) and LPF (C8, L4, C18, L3 and C17), should be placed close to A7139 IC because the matching network affects RF performance (power, and current) heavily. Therefore, we strongly recommend user to follow components placement and layout where shown in Fig. 2.2b without any change.

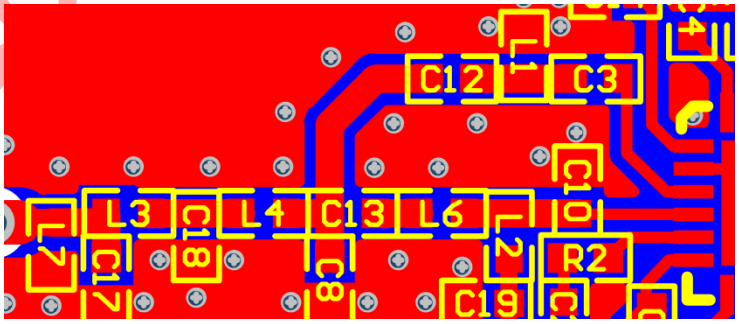


Fig. 2.2b RF matching

3. In addition to ground plane, the clean and stable VDD source is also a key factor to impact RF performance. The bypass capacitor (C2, C4, C5, C6, C7, C11 and C20) on this reference design is used for this purpose. To have the clean VDD source to A7139, those capacitors should be placed as close to the IC pins as possible and its ground via should be just nearby the components ground pad. Please refer to Fig. 2.1f.

4. C15, C16 are PLL loop filter capacity. These capacitors (C15 and C16) should be correct and be close to IC pin 9 to for good PLL performance. Please refer to Fig. 2.1f.

5. The X'tal traces should be as short as possible and are better to be isolated by ground via. In addition, to minimize cross talk issue, components placement shall be as far away to X'tal trace as possible. Please refer to the white traces in Fig. 2.2c.

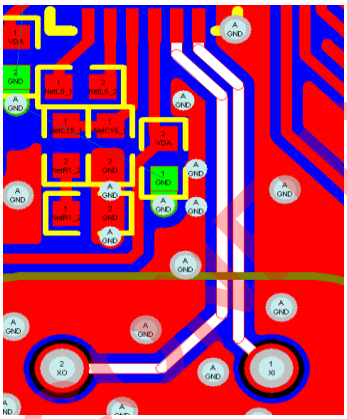


Fig. 2.2c X'tal trace

6. To get better performance, the ground pins of C6 (bypass capacitor of VDD_VCO), C7 (bypass capacitor of VDD_PLL), C15 and C16 (capacitors of the loop filter) should connect to the ground plane on bottom layer and be isolated to the ground plane on top layer. Please refer to the green pads in Fig. 2.2d.

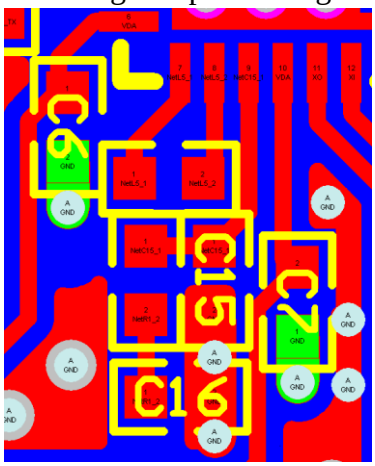


Fig. 2.2d

3. Tx Power Control Setting

Users can get different TX power by setting TBG (Tx Buffer Gain), TDC (TX Current Select) and PAC (PA Current Select) in register [07] as the tables below. The default setting of register [09] page 0. The power maybe change between different modules because the variation of components.

MD7139-A41 power control setting (433MHz)

AVG		PAC=0		PAC=1		PAC=2		PAC=3	
TBG	TDC	Power (dBm)	Current (mA)	Power (dBm)	Current (mA)	Power (dBm)	Current (mA)	Power (dBm)	Current (mA)
0	0	-13.9	8.5	-13.9	8.5	-14.0	8.4	-13.9	8.4
1		3.7	16.9	7.7	24.0	9.2	28.0	10.6	33.1
2		6.3	20.2	9.9	28.5	11.3	33.1	12.5	39.0
3		9.2	25.3	12.4	35.4	13.6	41.0	14.6	48.5
4		11.6	31.1	14.5	42.8	15.5	49.6	16.5	59.0
5		14.6	41.3	17.3	57.3	18.3	67.9	18.9	84.7
6		16.5	50.5	19.0	71.6	19.8	89.4	19.8	120.6
7		17.3	55.2	19.7	79.2	20.1	102.5	19.9	143.0

AVG		PAC=0		PAC=1		PAC=2		PAC=3	
TBG	TDC	Power (dBm)	Current (mA)	Power (dBm)	Current (mA)	Power (dBm)	Current (mA)	Power (dBm)	Current (mA)
0	1	-13.9	8.4	-13.9	8.4	-14.0	8.4	-14.0	8.4
1		6.7	23.7	10.1	31.3	11.3	35.3	12.4	40.1
2		9.4	28.5	12.4	37.2	13.4	41.6	14.4	47.1
3		12.3	35.4	14.8	45.7	15.7	51.1	16.6	57.7
4		14.6	42.8	16.7	54.3	17.5	60.3	18.3	67.7
5		16.9	53.0	18.6	65.6	19.3	72.7	20.0	82.5
6		18.2	61.0	19.7	74.8	20.4	83.8	20.9	101.7
7		18.8	65.4	20.2	80.2	20.8	90.6	21.1	116.9

AVG		PAC=0		PAC=1		PAC=2		PAC=3	
TBG	TDC	Power (dBm)	Current (mA)	Power (dBm)	Current (mA)	Power (dBm)	Current (mA)	Power (dBm)	Current (mA)
0	2	-13.9	8.5	-13.9	8.4	-14.0	8.4	-14.0	8.4
1		8.1	28.2	11.3	36.1	12.4	40.1	13.5	44.9
2		10.7	33.4	13.4	42.4	14.4	46.1	15.4	52.2
3		13.4	40.8	15.7	51.2	16.5	56.7	17.4	62.7
4		15.5	48.2	17.3	59.0	18.0	64.3	18.7	70.7
5		17.5	57.3	18.9	68.1	19.5	74.0	20.1	81.5
6		18.7	64.8	19.9	76.3	20.4	83.1	21.0	94.5
7		19.2	69.3	20.4	81.5	20.8	88.9	21.3	106.8

AVG		PAC=0		PAC=1		PAC=2		PAC=3	
TBG	TDC	Power (dBm)	Current (mA)	Power (dBm)	Current (mA)	Power (dBm)	Current (mA)	Power (dBm)	Current (mA)
0	3	-13.9	8.4	-13.9	8.4	-14.0	8.4	-13.9	8.4
1		8.9	31.3	11.9	39.3	12.9	43.3	14.0	48.1
2		11.3	36.6	13.9	45.6	14.8	50.2	15.8	55.5
3		13.9	43.9	16.0	54.2	16.8	59.3	17.6	65.2
4		15.8	50.9	17.5	61.2	18.1	66.2	18.8	72.2
5		17.7	59.5	19.0	69.6	19.5	75.0	20.1	81.8
6		18.9	67.1	20.0	77.6	20.4	83.8	21.0	93.2
7		19.5	71.7	20.5	82.8	20.8	89.4	21.3	103.5

MD7139-A51 power control setting (490MHz)

AVG		PAC=0		PAC=1		PAC=2		PAC=3	
TBG	TDC	Power (dBm)	Current (mA)	Power (dBm)	Current (mA)	Power (dBm)	Current (mA)	Power (dBm)	Current (mA)
0	0	-17.1	8.3	-17.2	8.3	-17.2	13.2	-17.2	8.3
1		3.6	16.0	7.4	23.0	8.8	29.7	10.0	32.4
2		6.3	19.3	9.7	27.4	10.9	35.4	12.1	38.1
3		9.3	24.3	12.3	34.1	13.4	45.4	14.4	47.6
4		11.9	30.0	14.5	41.6	15.5	56.9	16.4	58.4
5		15.1	40.4	17.5	56.3	18.3	74.9	19.0	85.0
6		17.0	49.5	19.4	71.4	20.0	74.3	20.0	124.7
7		17.7	53.8	20.0	79.7	20.3	91.5	20.1	149.7

AVG		PAC=0		PAC=1		PAC=2		PAC=3	
TBG	TDC	Power (dBm)	Current (mA)	Power (dBm)	Current (mA)	Power (dBm)	Current (mA)	Power (dBm)	Current (mA)
0	1	-17.2	8.3	-17.2	8.3	-17.3	14.8	-17.3	8.3
1		6.6	22.6	9.8	30.0	10.9	37.1	12.0	38.9
2		9.3	27.1	12.1	35.5	13.1	43.9	14.0	45.6
3		12.4	34.0	14.7	44.1	15.6	54.1	16.4	56.3
4		14.9	41.8	16.9	53.2	17.6	64.2	18.3	67.2
5		17.5	53.2	19.1	66.1	19.7	77.0	20.3	83.8
6		18.8	61.0	20.3	75.4	20.8	69.8	21.2	105.5
7		19.3	64.9	20.7	80.2	21.2	81.7	21.3	123.5

AVG		PAC=0		PAC=1		PAC=2		PAC=3	
TBG	TDC	Power (dBm)	Current (mA)	Power (dBm)	Current (mA)	Power (dBm)	Current (mA)	Power (dBm)	Current (mA)
0	2	-17.1	8.3	-17.2	8.3	-17.2	15.8	-17.3	8.3
1		8.0	27.1	11.0	34.7	12.0	42.0	13.0	43.6
2		10.7	32.1	13.2	40.8	14.1	49.1	15.0	50.8
3		13.5	39.6	15.7	49.8	16.5	59.0	17.2	61.7
4		15.9	47.7	17.6	58.9	18.3	68.2	18.9	71.3
5		18.2	58.3	19.5	69.3	20.0	78.0	20.5	83.3
6		19.3	65.3	20.4	77.1	20.9	69.1	21.3	97.0
7		19.8	69.0	20.8	81.4	21.2	80.3	21.5	111.5

AVG		PAC=0		PAC=1		PAC=2		PAC=3	
TBG	TDC	Power (dBm)	Current (mA)	Power (dBm)	Current (mA)	Power (dBm)	Current (mA)	Power (dBm)	Current (mA)
0	3	-17.2	8.3	-17.2	8.3	-17.2	16.5	-18.0	8.3
1		8.9	30.3	11.7	38.0	12.6	45.3	13.4	46.9
2		11.4	35.4	13.8	44.2	14.7	52.3	15.4	54.2
3		14.1	42.9	16.1	53.3	16.9	62.1	17.5	65.0
4		16.3	51.0	18.0	61.8	18.5	70.5	19.0	73.4
5		18.4	60.8	19.6	71.1	20.1	79.2	20.5	83.8
6		19.5	67.6	20.5	78.5	20.9	84.8	21.3	95.2
7		20.0	71.3	20.9	82.7	21.3	89.9	21.6	107.4

MD7139-A81 power control setting (868MHz)

AVG		PAC=0		PAC=1		PAC=2		PAC=3	
TBG	TDC	Power (dBm)	Current (mA)	Power (dBm)	Current (mA)	Power (dBm)	Current (mA)	Power (dBm)	Current (mA)
0	0	-30.3	8.8	-30.4	8.8	-30.4	8.8	-30.5	8.8
1		-10.3	11.1	-4.0	17.1	-2.3	21.2	-0.8	26.7
2		-7.3	11.9	-1.3	18.6	0.4	23.1	1.7	29.1
3		-3.5	13.6	2.0	21.5	3.5	26.9	4.8	34.1
4		1.1	16.7	5.8	27.0	7.1	34.0	8.2	43.6
5		5.2	21.0	9.2	33.7	10.4	42.5	11.4	54.9
6		8.5	26.6	12.0	42.9	13.0	54.6	13.8	71.6
7		12.4	36.7	15.3	60.5	16.1	79.5	16.7	108.1

AVG		PAC=0		PAC=1		PAC=2		PAC=3	
TBG	TDC	Power (dBm)	Current (mA)	Power (dBm)	Current (mA)	Power (dBm)	Current (mA)	Power (dBm)	Current (mA)
0	1	-30.4	8.8	-30.4	8.8	-30.5	8.8	-30.5	8.8
1		-7.7	15.1	-1.7	21.3	0.0	25.4	1.4	30.9
2		-4.5	16.2	1.1	23.0	2.7	27.5	4.0	33.5
3		-0.4	18.5	4.4	26.6	5.8	31.8	7.0	38.9
4		4.2	22.7	8.2	33.0	9.5	39.7	10.5	48.9
5		8.5	28.9	11.6	41.2	12.6	49.2	13.4	60.6
6		11.8	36.7	14.2	51.7	15.1	61.9	15.8	77.4
7		15.2	49.3	17.4	70.4	18.2	86.4	18.8	112.2

AVG		PAC=0		PAC=1		PAC=2		PAC=3	
TBG	TDC	Power (dBm)	Current (mA)	Power (dBm)	Current (mA)	Power (dBm)	Current (mA)	Power (dBm)	Current (mA)
0	2	-30.3	8.8	-30.4	8.8	-30.4	8.8	-30.5	8.8
1		-6.1	18.2	-0.3	24.5	1.4	28.7	2.7	34.2
2		-2.9	19.6	2.4	26.5	4.0	31.0	5.2	37.0
3		1.3	22.3	5.7	30.5	7.1	35.7	8.3	42.7
4		5.9	27.2	9.5	37.6	10.7	44.0	11.6	53.0
5		10.1	34.4	12.7	46.6	13.6	54.1	14.4	65.0
6		13.1	43.0	15.2	57.6	16.0	67.2	16.8	81.8
7		16.2	56.6	18.2	76.7	19.0	91.3	19.7	115.3

AVG		PAC=0		PAC=1		PAC=2		PAC=3	
TBG	TDC	Power (dBm)	Current (mA)	Power (dBm)	Current (mA)	Power (dBm)	Current (mA)	Power (dBm)	Current (mA)
0	3	-30.4	8.8	-30.4	8.8	-30.5	8.8	-30.5	8.8
1		-5.0	20.5	0.6	26.9	2.3	31.1	3.6	36.6
2		-1.7	22.0	3.4	29.1	4.9	33.6	6.1	39.5
3		2.5	25.0	6.7	33.4	8.0	38.5	9.2	45.5
4		7.1	30.6	10.4	41.0	11.5	47.3	12.4	56.0
5		11.1	38.4	13.5	50.4	14.3	57.7	15.1	68.2
6		13.9	47.3	15.8	61.8	16.6	71.1	17.4	85.0
7		16.8	61.2	18.7	80.7	19.5	94.7	20.2	117.3

MD7139-A91 power control setting (915MHz)

AVG		PAC=0		PAC=1		PAC=2		PAC=3	
TBG	TDC	Power (dBm)	Current (mA)	Power (dBm)	Current (mA)	Power (dBm)	Current (mA)	Power (dBm)	Current (mA)
0	0	-33.1	8.4	-33.2	8.4	-33.2	8.4	-33.2	8.4
1		-12.3	10.3	-5.2	15.8	-3.5	19.6	-2.0	24.7
2		-9.1	11.0	-2.6	17.1	-0.7	21.2	0.7	26.9
3		-5.1	12.4	0.8	19.7	2.5	24.8	3.8	31.6
4		-0.4	15.1	4.8	24.7	6.3	31.3	7.4	40.5
5		4.0	18.8	8.4	30.8	9.7	39.2	10.6	51.1
6		7.6	23.8	11.3	39.3	12.3	50.6	13.0	67.1
7		11.7	32.9	14.6	55.6	15.3	74.1	15.8	101.8

AVG		PAC=0		PAC=1		PAC=2		PAC=3	
TBG	TDC	Power (dBm)	Current (mA)	Power (dBm)	Current (mA)	Power (dBm)	Current (mA)	Power (dBm)	Current (mA)
0	1	-33.1	8.4	-33.2	8.4	-33.2	8.4	-33.3	8.4
1		-9.6	14.0	-3.1	19.6	-1.2	23.4	0.3	28.6
2		-6.3	14.9	-0.2	21.2	1.5	25.4	2.9	31.0
3		-2.2	16.8	3.3	24.3	4.8	29.3	6.1	36.1
4		2.9	20.4	7.3	30.1	8.6	36.5	9.7	45.4
5		7.4	25.8	10.9	37.5	11.9	45.1	12.7	56.2
6		10.9	32.7	13.6	46.9	14.4	56.8	15.1	72.1
7		14.6	44.2	16.8	64.0	17.5	79.8	18.0	105.2

AVG		PAC=0		PAC=1		PAC=2		PAC=3	
TBG	TDC	Power (dBm)	Current (mA)	Power (dBm)	Current (mA)	Power (dBm)	Current (mA)	Power (dBm)	Current (mA)
0	2	-33.1	8.4	-33.2	8.4	-33.2	8.4	-33.3	8.4
1		-8.0	16.9	-1.7	22.6	0.2	26.5	1.6	31.7
2		-4.6	18.0	1.2	24.4	2.9	28.6	4.2	34.2
3		-0.4	20.2	4.6	27.9	6.1	32.8	7.4	39.5
4		4.6	24.5	8.6	34.2	9.9	40.5	10.9	49.1
5		9.1	30.8	12.1	42.3	13.0	49.5	13.8	60.1
6		12.4	38.5	14.7	52.2	15.4	61.5	16.1	75.9
7		15.8	50.8	17.8	69.9	18.5	84.3	18.9	107.9

AVG		PAC=0		PAC=1		PAC=2		PAC=3	
TBG	TDC	Power (dBm)	Current (mA)	Power (dBm)	Current (mA)	Power (dBm)	Current (mA)	Power (dBm)	Current (mA)
0	3	-33.2	8.4	-33.2	8.4	-33.3	8.4	-33.3	8.4
1		-6.8	19.0	-0.7	24.9	1.1	28.7	2.6	33.9
2		-3.5	20.3	2.2	26.8	3.8	31.0	5.2	36.6
3		0.9	22.8	5.6	30.5	7.1	35.4	8.3	42.1
4		5.8	27.5	9.6	37.3	10.7	43.4	11.7	51.9
5		10.1	34.4	12.8	45.8	13.7	52.8	14.4	63.0
6		13.2	42.5	15.3	56.0	16.1	65.0	16.7	78.8
7		16.4	55.1	18.3	73.9	19.0	87.6	19.5	109.6

4. RSSI

A7139 has a built-in digital RSSI (Received Signal Strength Indicator) which measures the strength of the incoming RF signal. The digital RSSI can be read from **RXⅡ register** and its range is from 0 to 511 (9 bits). Typical RSSI characteristic is shown in Figure 4a.

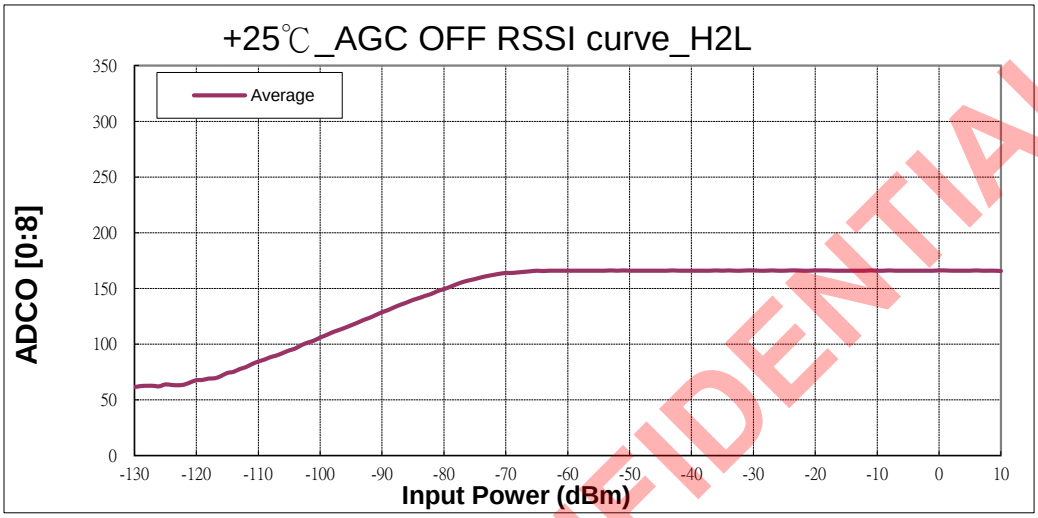


Fig. 4a Typical RSSI characteristic

AGC off (Formulas are for reference only.)		
315MHz	:	Input power = -70dBm + ((0.48 * ADC[7:0]) -85)
433MHz 490MHz	:	Input power = -70dBm + ((0.48 * ADC[7:0]) -80)
868MHz	:	Input power = -70dBm + ((0.48 * ADC[7:0]) -71)
915MHz	:	Input power = -70dBm + ((0.48 * ADC[7:0]) -66)
AGC on (Formulas are for reference only.)		
315MHz	:	Input power = -40dBm + ((0.48 * ADCO[8:0]) -119)
433MHz 490MHz	:	Input power = -40dBm + ((0.48 * ADCO[8:0]) -110)
868MHz	:	Input power = -40dBm + ((0.48 * ADCO[8:0]) -103)
915MHz	:	Input power = -40dBm + ((0.48 * ADCO[8:0]) -100)

5. VCO Band Selection

There are 8 VCO Bands in A7139 IC. The VCO Band is used to design the frequency we want. At 433MHz / 470MHz~510MHz / 868MHz / 915MHz, we can use different inductor to find out the VCO Band we want. We want the VCO Band located at Band 3 or Band 4, because they are in the center of VCO Bands. Therefore, the module can perform well, no matter how the temperature changes.

Please follow the steps below to make the VCO Band at Band 3 or Band 4.

Step1. You should choose which frequency you want to use.

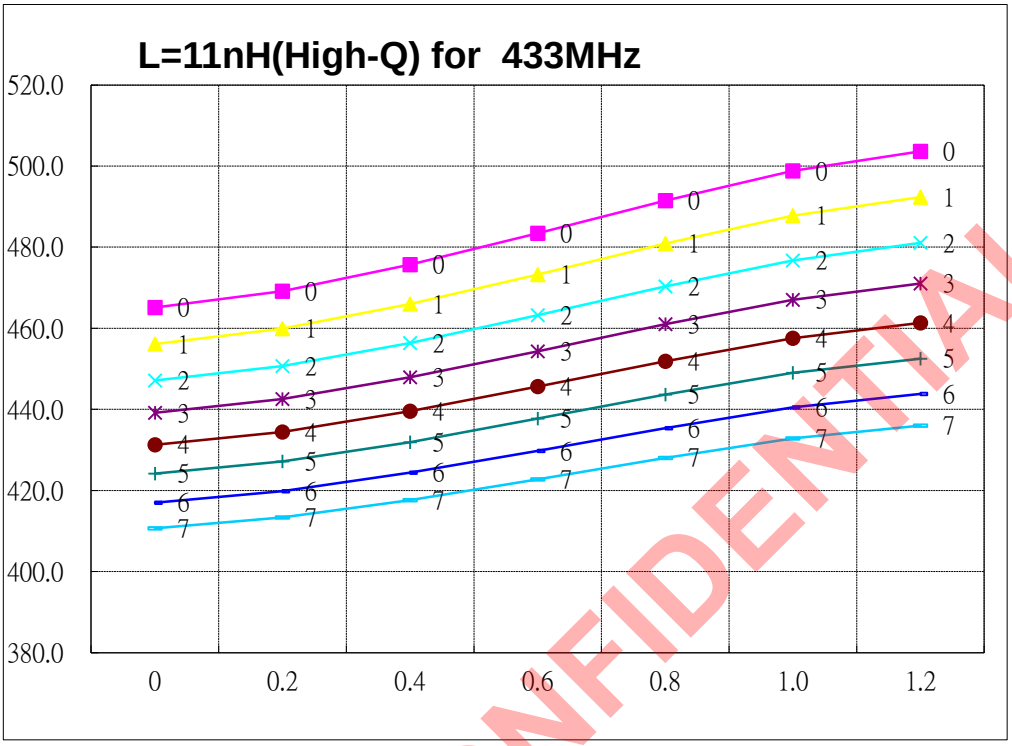
Step2. Set the register [0E] “Calibration” as following.
At 433MHz / 470~510MHz / 868MHz / 915MHz, The VT High Threshold is **"vdd-0.42V"**, and VT Low Threshold is **"0.3V"**.

Step3. Use control register “VCO auto calibration”.

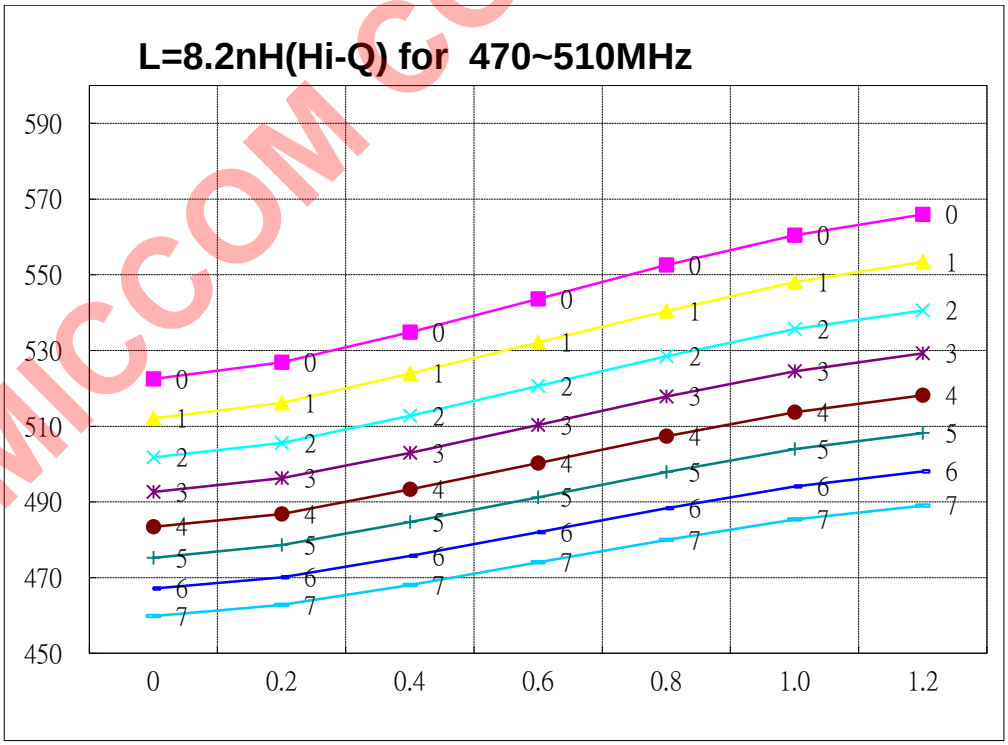
Step4. Read the VCO Band Value, and then check if it is Band 3 or Band 4.

Step5. You can use this formula f=1/[2*π*(LC)^1/2] to fine tune the inductance. For example, if you get the VCO Band = 7, you must increase the inductance. On the other hand, if you get the VCO Band = 0, you must decrease the inductance.

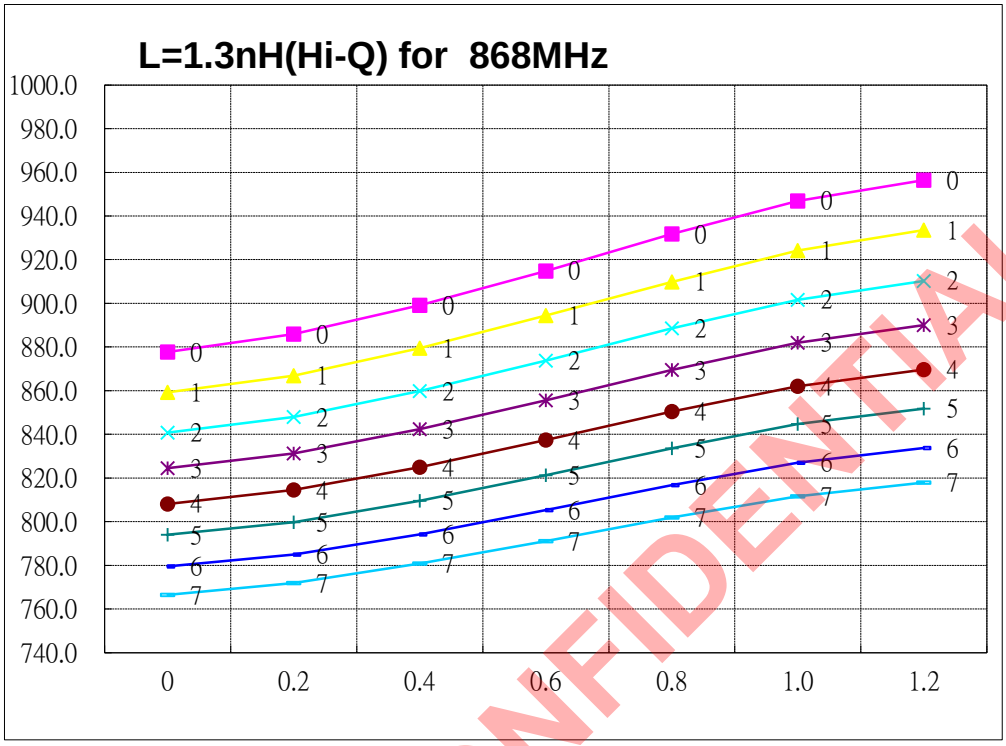
Step6. Repeat step 1 ~ 5 to make VCO Band located at Band 3 or Band 4.



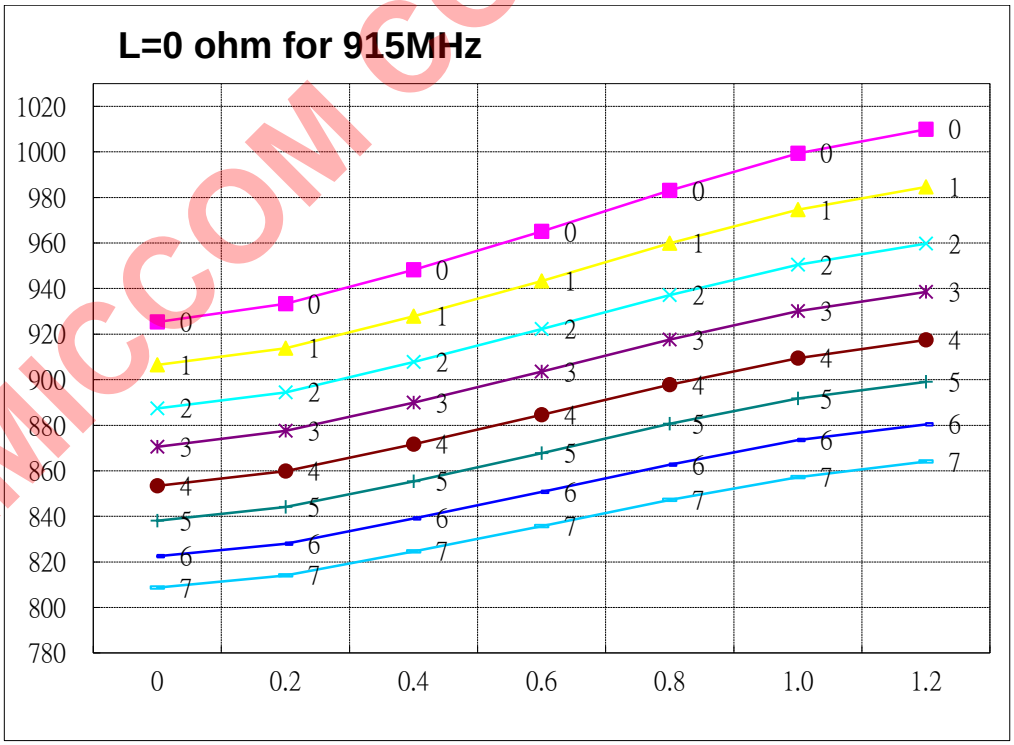
433MHz Band



470MHz~510MHz Band



868MHz Band



915MHz Band

6. The restriction of VCO Band Range when RF module is tested in Pilot Run or Mass Production

In Pilot Run or Mass Production, the VCO Band Range should be between Band 1 and Band 6 when customer tests RF module at room temperature. Band 0 and Band 7 should not be used. It is a very important rule for Pilot Run or Mass Production.
However, for the application software in product, the VCO Band Range can be between Band 0 and Band 7.

Customers can refer to Amiccom's document "FQA_0003_VCO Application Note V0.0" for detail.

7. The Prohibition of Frequency

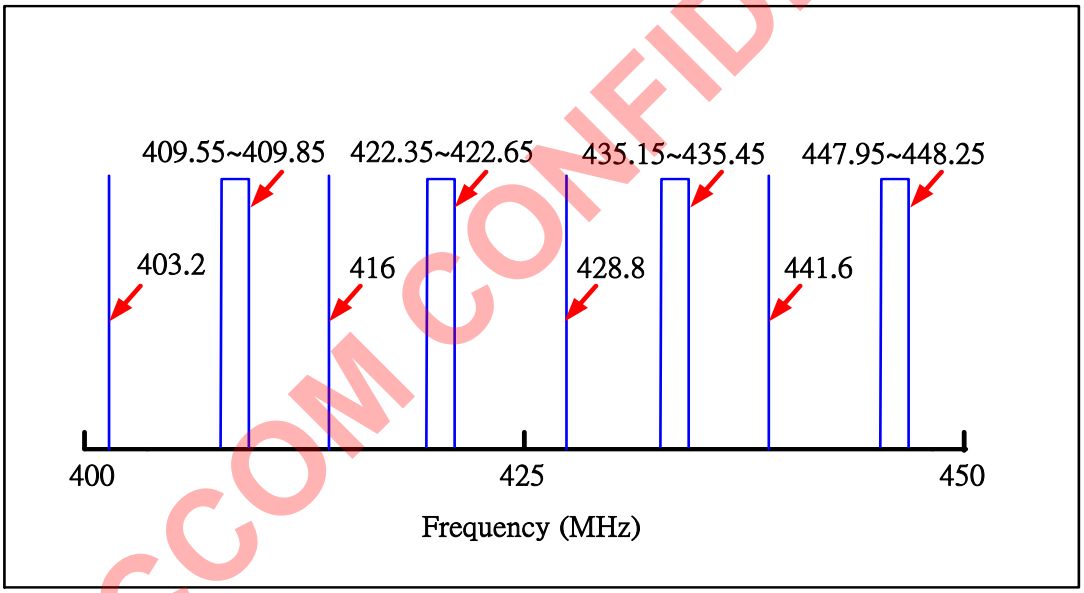


Figure 7a. Crystal=12.8 MHz；IF=100 kHz ；Frequency= 400~450 MHz

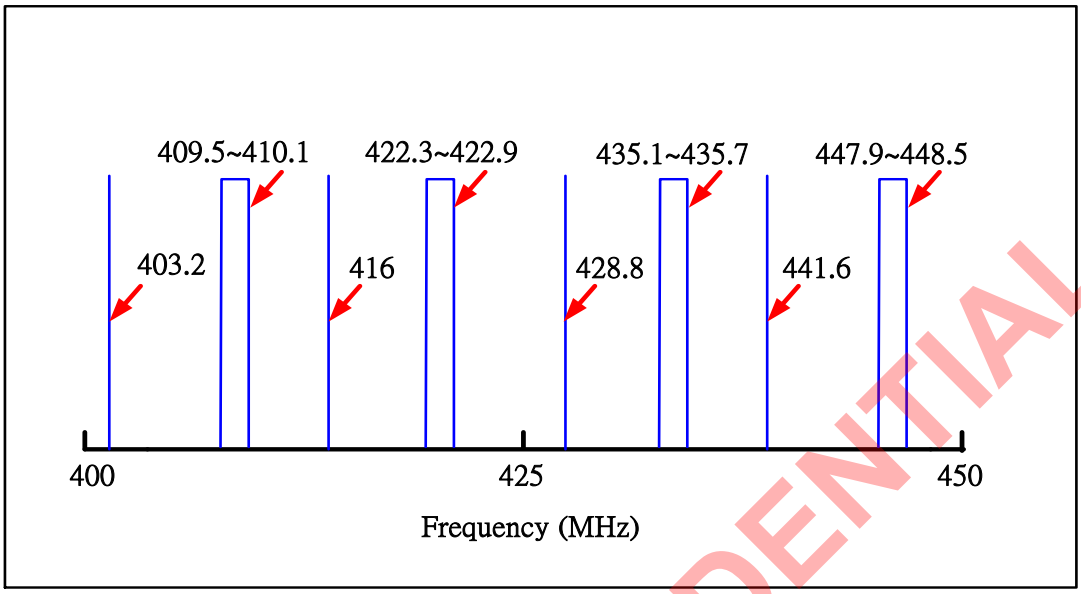


Figure 7b. Crystal=12.8 MHz；IF=200 kHz ；Frequency= 400~450 MHz

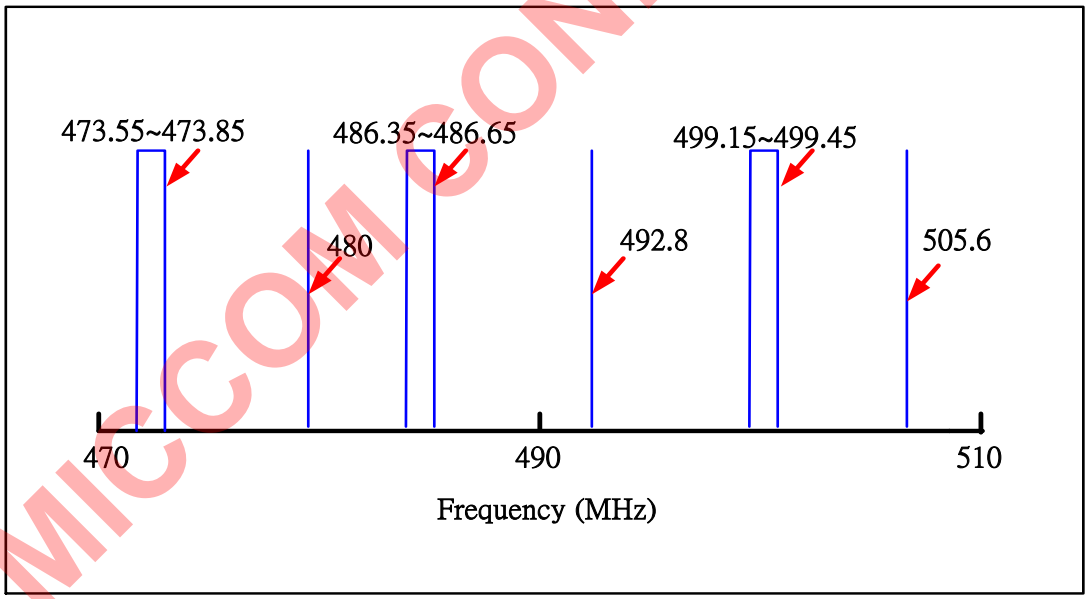


Figure 7c. Crystal=12.8 MHz；IF=100 kHz ；Frequency= 470~510 MHz

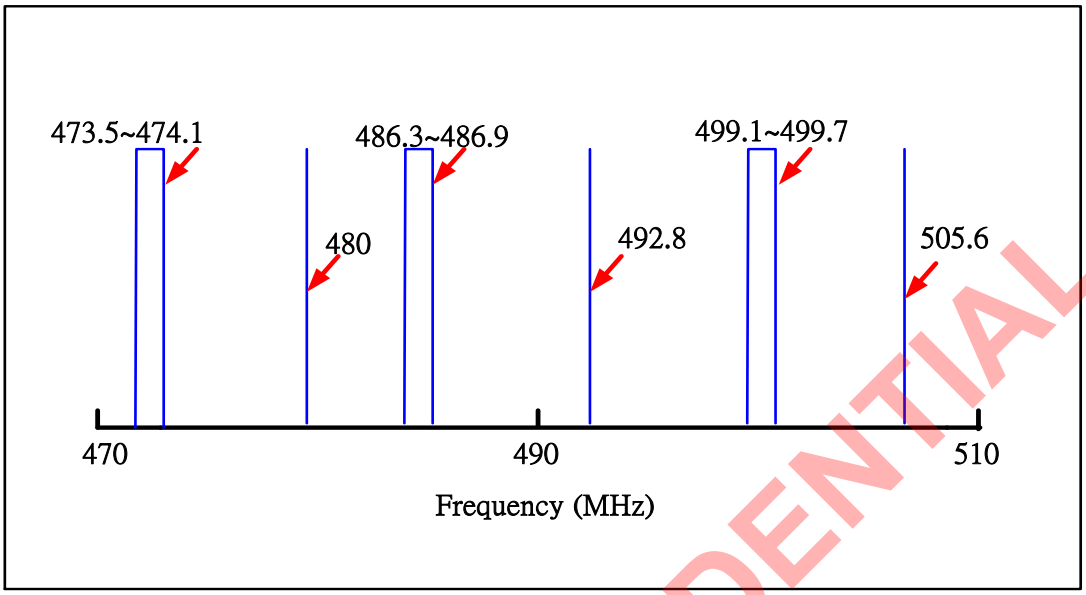


Figure 7d. Crystal=12.8 MHz；IF=200 kHz ；Frequency= 470~510 MHz

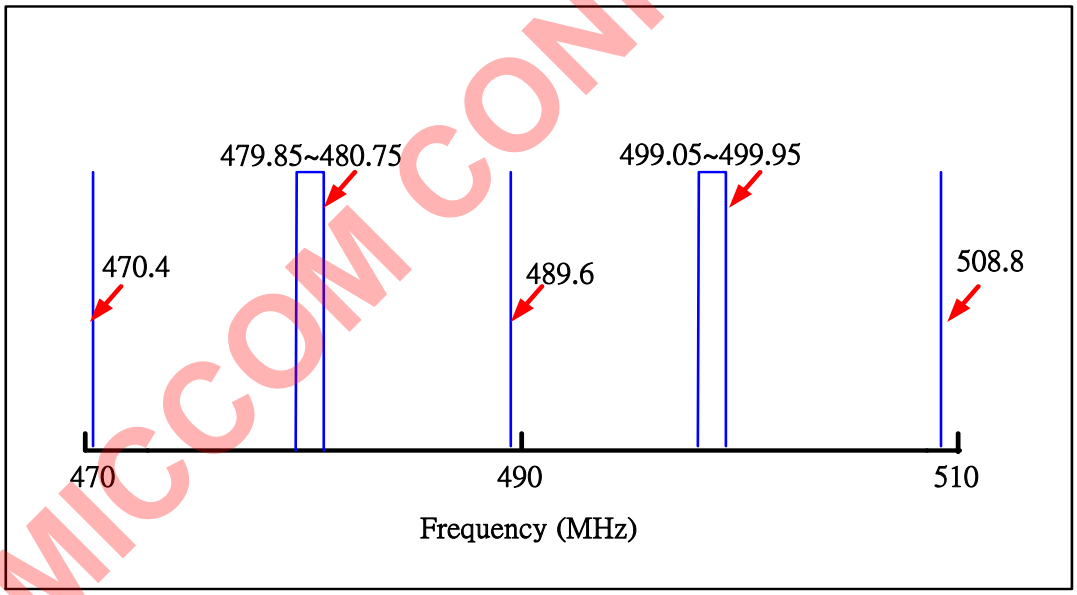


Figure 7e. Crystal=19.2 MHz；IF=300 kHz ；Frequency= 470~510 MHz

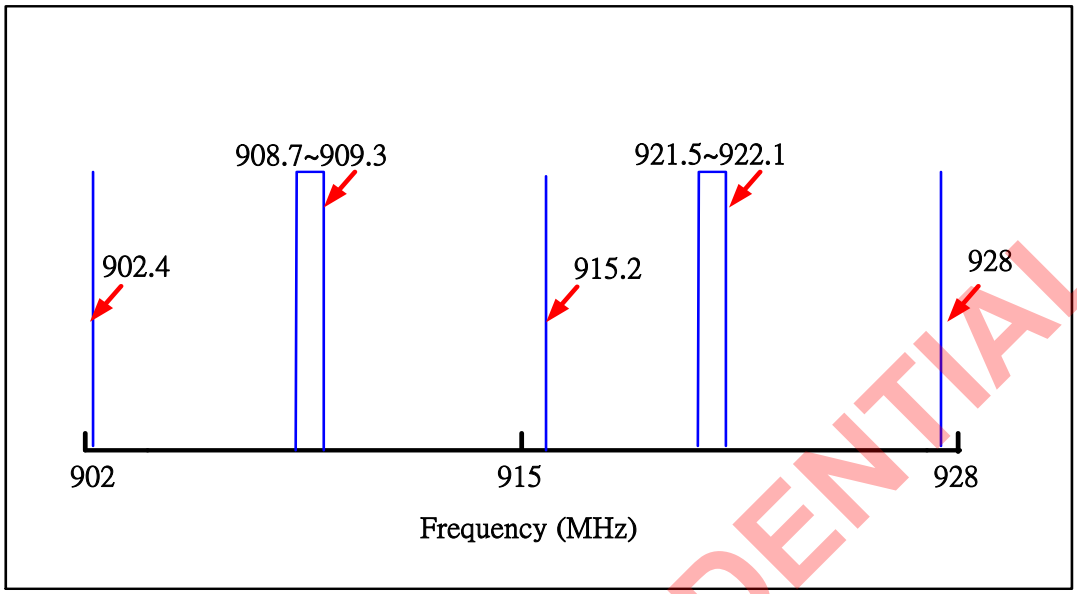


Figure 7f. Crystal=12.8 MHz；IF=200 kHz ；Frequency= 902~928 MHz

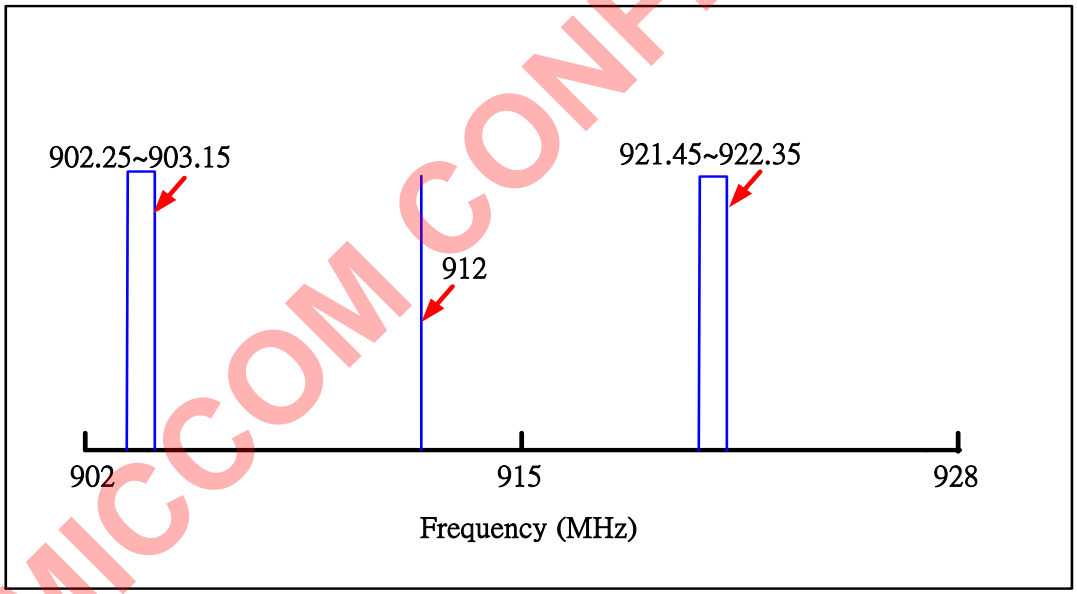


Figure 7g. Crystal=19.2 MHz；IF=300kHz；Frequency= 902~928 MHz

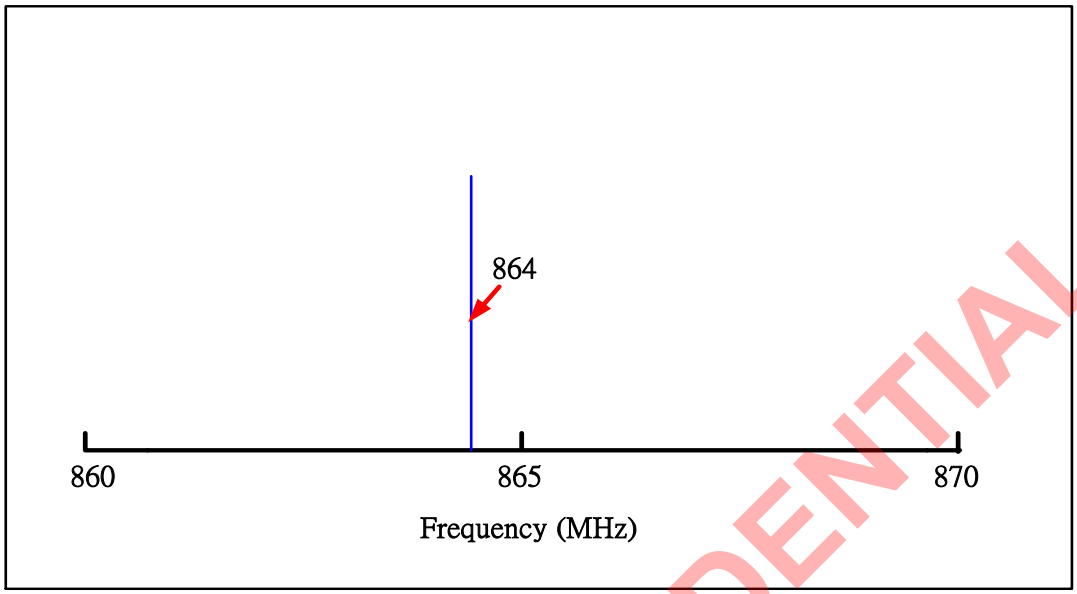


Figure 7h. Crystal=12.8 MHz；IF=200k；Frequency= 860 ~ 870 MHz

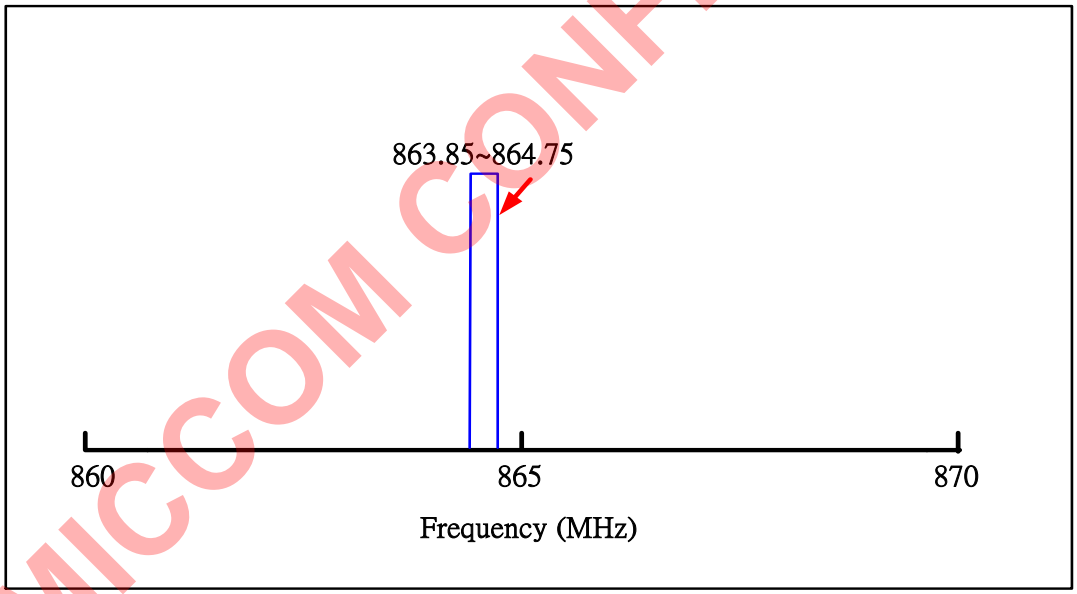


Figure 7i. Crystal=19.2 MHz；IF=300kHz；Frequency= 860~870 MHz

8. Frequency Setting Rule

Please set 1 KHz more than the frequency you want to reduce spurious. For example, if you want to operate at 433MHz, please set the frequency at 433.001 MHz.