九齊科技股份有限公司
Nyquest Technology Co., Ltd.

User Manual

QFID_Demo_Kit

Quick Format Identification Demo Kit

Version 1.1

Aug. 28, 2018

Revision History

Version	Date	Description	Modified Page
1.0	2017/07/28	Formal release.	-
1.1	2018/08/28	1. Remove zener diode in Tag Circuit. 2. Modify QFID Paragraph in Q-Code. 3. Add Fundamental Power Test Result.	12 14 23

Table of Contents

1 Introduction

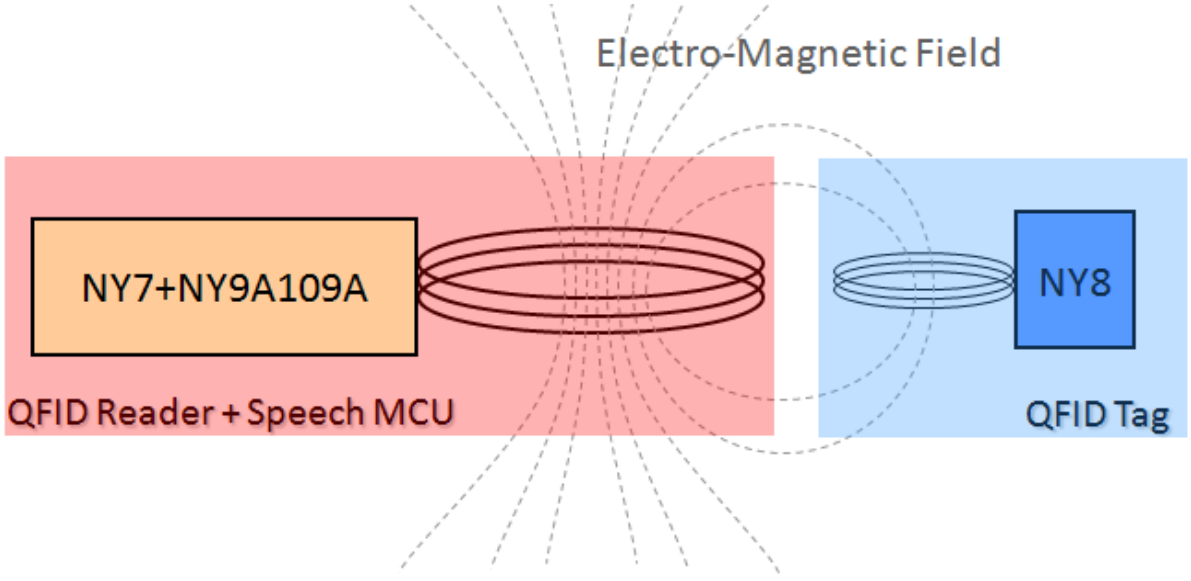
QFID_Demo_Kit is the product of Nyquest for multiple object recognition applications, and it's features are low frequency, easy to pass certification, low cost, high stability and easy to production. User can quickly develop wireless identification related applications with the Q-Code software provided by Nyquest and the corresponding Tag.

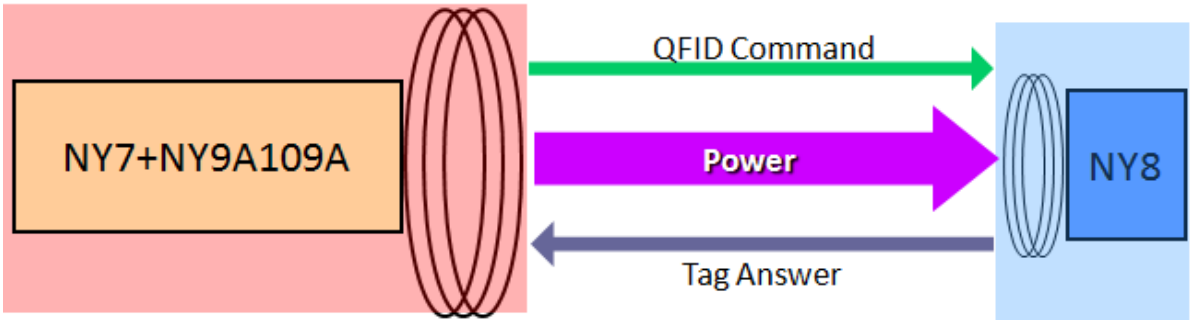
The QFID solution can support 8 Groups, and each Group has 16 ID Tags or 8 Input/output Tags. The maximum number of simultaneous readable IDs is 128 (8 Group x 16 Tag = 128). Users can also define 9-bit Vendor ID and 10-bit Project ID, the maximum number is 524,288 (VID+PID = 19-bit = 524,288).

The QFID_Demo_Kit hardware may also support Reader-to-Reader and wireless power supply, please contact Nyquest for advanced information.

1.1 Basic Theory

QFID_Demo_Kit uses the electromagnetic induction between Reader and Tag to achieve the purpose of communication. The action principle is shown below. The NY7+NY9A109A in the Reader circuit make the coil area to generate an electromagnetic field. The coil in the Tag senses the electromagnetic field change to a power source and drives the NY8 in the Tag to communicate with the Reader to classify the Tag data.





1.2 Features

(1) Scenario

- Input: 16 Input Tags, Tag ID = 0x0~0xF and Group 0.
- Output: 16 LEDs and speaker.

(2) Trigger Mode

The trigger mode is to place the Tag on the coil induction zone. If the Tag is completely vertical to the coil induction zone, it will not be triggered.

(3) VDD

- FDB: 2.3V ~ 5.5V (No Speaker, No LED), 2.4V ~ 5.5V (Speaker, LED).
- OTP: 2.1V ~ 5.5V (No Speaker, No LED), 2.2V ~ 5.5V (Speaker, LED).

(4) Overall Scanning Current

- 24.8mA@3.0V (FDB).
- 13.7mA@3.0V (OTP).
- 47mA@4.5V (FDB).
- 17.2mA@4.5V (OTP).

(5) QFID Frequency

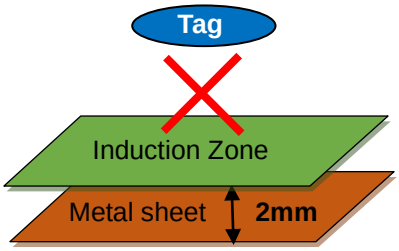
125 KHz.

(6) Coil Inductance

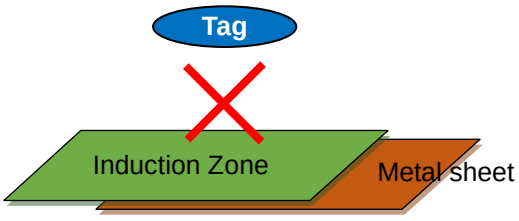
0.705mH (Resonance Formula: $2\pi f = \frac{1}{\sqrt{LC}}$, f=QFID Frequency, L= Coil Inductance, C=2300pF).

(7) Electro-Magnetic Field

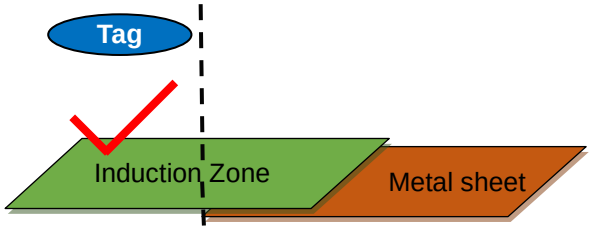
When the metal sheet completely shields the entire induction zone from the upper or lower 2mm, the Tag's induction will be completely disabled. When the metal sheet shields the induction zone more than about 2/3 area (the metal sheet is close to the induction zone), the Tag's induction will be disabled. When the metal sheet shields the induction zone is less than about 2/3 area (the metal sheet is close to the induction zone), the induction zone without shielding by the metal sheet can induce the Tag. The schematic diagram is as follows.



Fully shielded Induction Zone



Shielded induction zone is more than 2/3 area



Shielded induction zone is less than 2/3 area

(8) Induction distance

- The induction distance in the middle area is about 4 cm.
- The induction distance in the edge area is about 2 cm.

(9) The time to begin operation after NY8A051B QFID Tag received carrier wave.

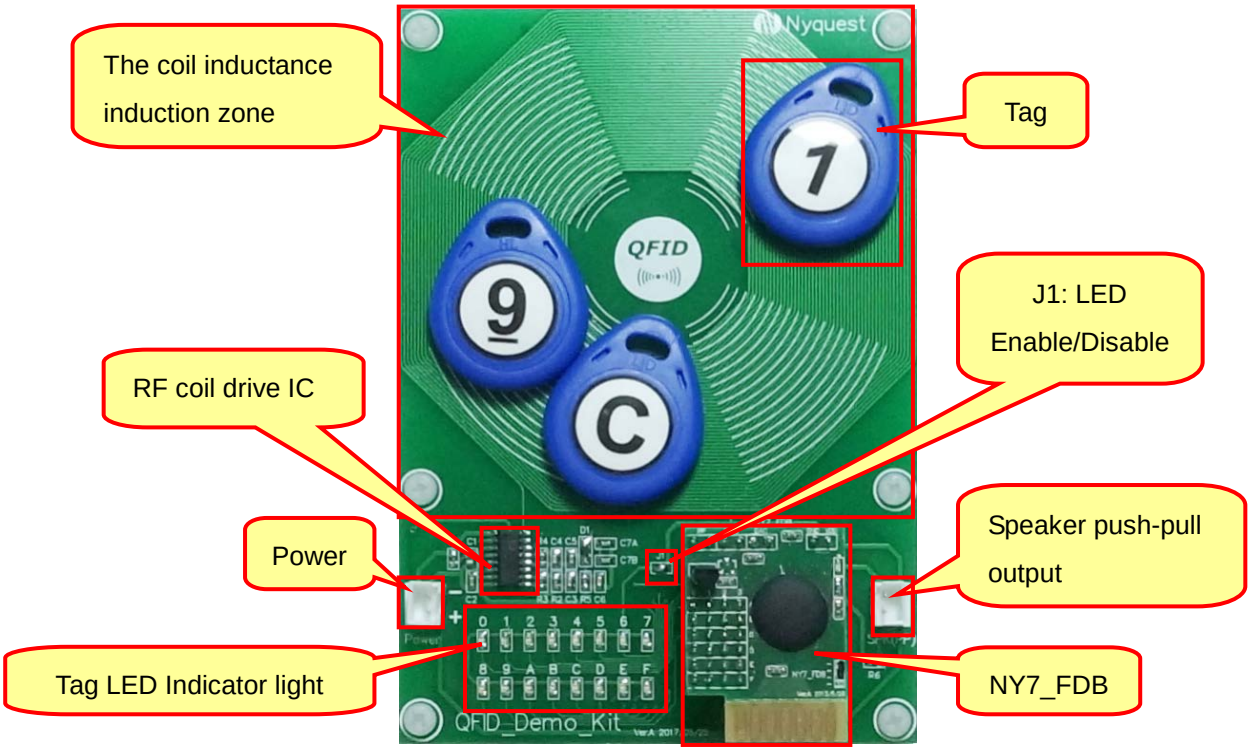
- 7.86 ms@3.0V (Tag is placed in the center of the Reader and close to the coil)
- 9.26 ms@3.0V (Tag is placed in the edge of the Reader and close to the coil)
- 9.78 ms@3.0V (Tag is placed in the center of the Reader from the coil 4 cm)
- 7.70 ms@4.5V (Tag is placed in the center of the Reader and close to the coil)
- 8.42 ms@4.5V (Tag is placed in the edge of the Reader and close to the coil)
- 8.46 ms@4.5V (Tag is placed in the center of the Reader from the coil 4 cm)

(10) Feature Introduction (The original program of QFID_Demo_Kit Reader)

When the power supply is connected, the NY7_FDB power indicator light is always on, the Tag LED indicator light will light and extinguish after 50ms, and the speaker will sound the background sound. When the Tag is placed on the QFID inducting zone, the LED will light in accordance with corresponding Tag ID, and the speaker will sound in accordance with the corresponding Tag ID. When the Tag is picked up to leave the QFID inducting zone, the LED will extinguish in accordance with the corresponding Tag ID.

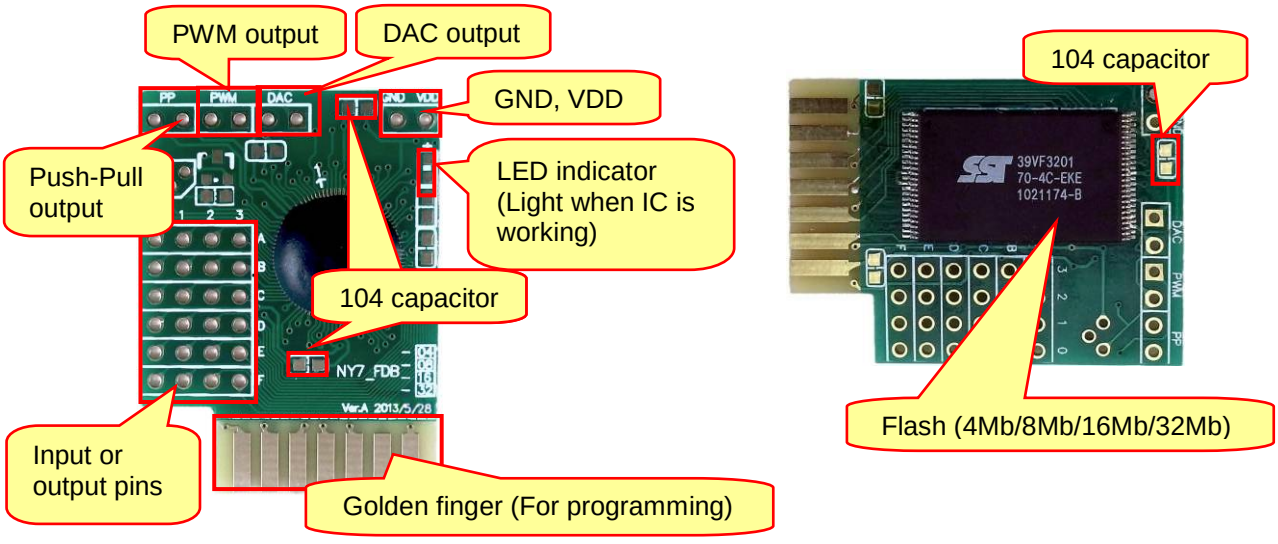
1.3 Reader

QFID_Demo_Kit Reader is a reader for inducting Tag. *Q-Code* can be used to program as needed. After compiling, the generated .bin files are burned into the NY7_FDB, and then the function of inducting Tag can be developed. The appearance of Reader is shown below.



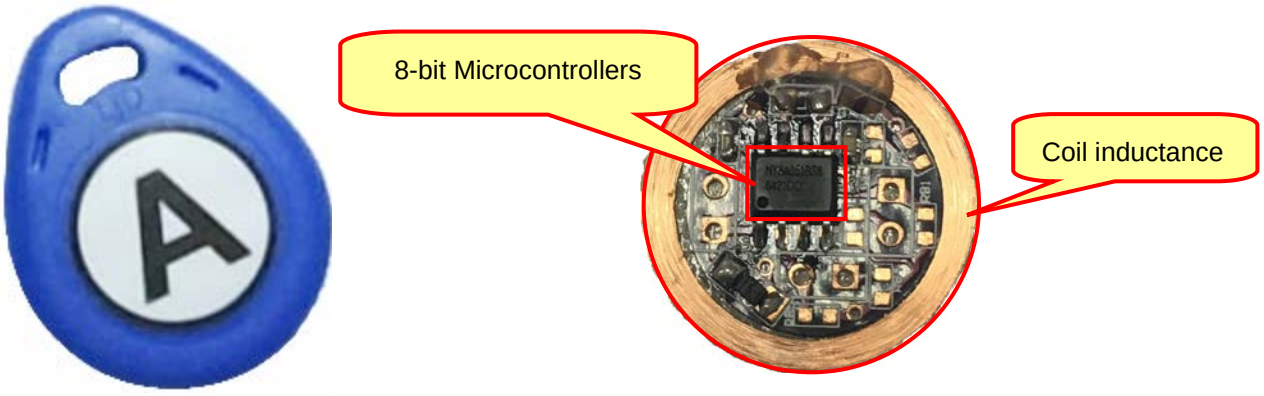
1.4 NY7_FDB

NY7_FDB is the flash demo board for NY7 demonstration. User can make .bin files by *NYIDE* or *Q-Code* software and download it to NY7_FDB to verify functions. The appearance of NY7_FDB is shown below.



1.5 Tag

Tag is an induction circuit composed of NY8A051B which demonstrates the results by inducting with the coil induction zone. The internal circuit and appearance of Tag are shown below.

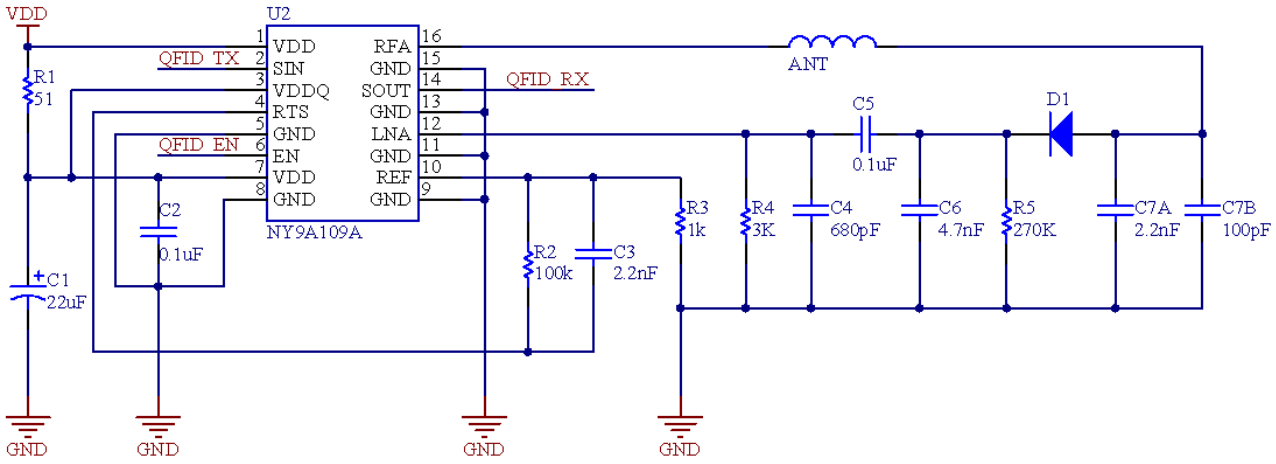


2 Circuit Description

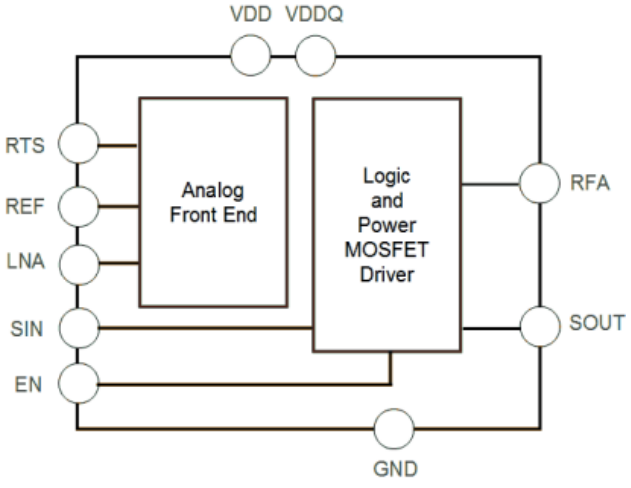
The QFID_Demo_Kit is divided into Reader circuit and Tag circuit.

2.1 Reader Circuit

In the following Reader circuit, the resistor R1 and the capacitor C1 are low-pass filter, and filter capacitor C2 improves the voltage stability. The 125KHz square wave generated by the NY7_FDB is input to NY9A109A Pin 2 SIN, and through the NY9A109A internal buffer to generate electromagnetic fields from the Pin 16 RFA to the coil. If the coils produce large energy electromagnetic fields, they need to match the resonances of the C7 (C7A+C7B) capacitor. Please refer to 4.1 The Resonant Capacitor Selection for adjusting the resonant capacitance of the coil. When the Tag is close to the Reader coil, the return data from Tag will return with amplitude modulation (AM) type. After the AM demodulating circuit, The NY9A109A pin 4, 10, 12, the resistor R2, R3 and capacitor C3 constitute a non inverting closed loop amplifier, which amplifies the signal returned by the Tag. The resistance R2 and capacitor C3 in layout must be close to NY9A109A pin 10, otherwise the signal is easily interfered by noise, and finally the signal outputs from the NY9A109A pin 14 SOUT.

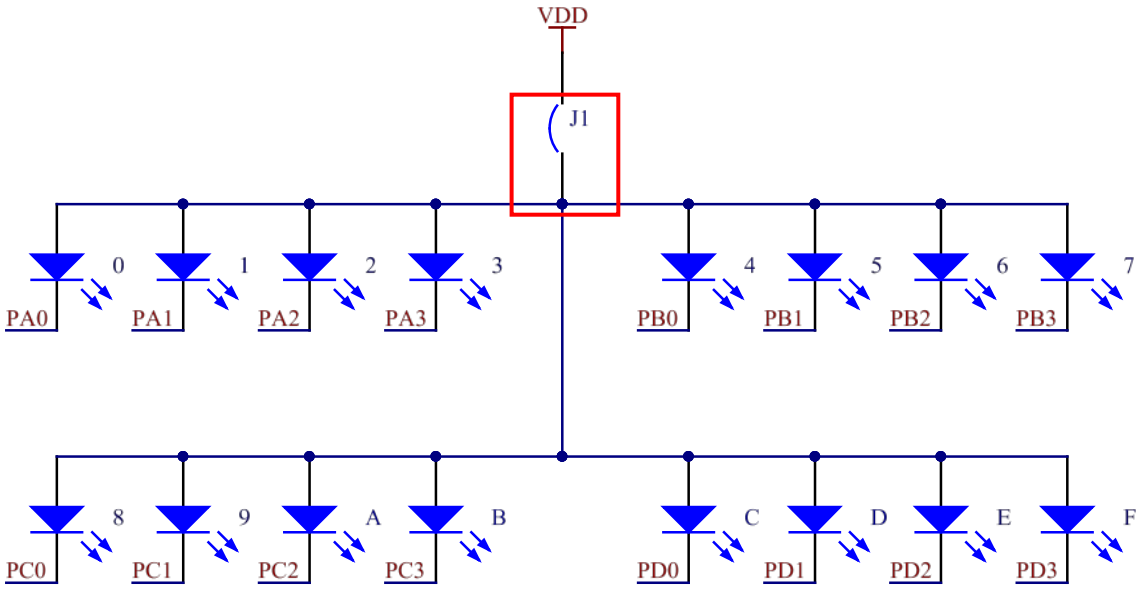


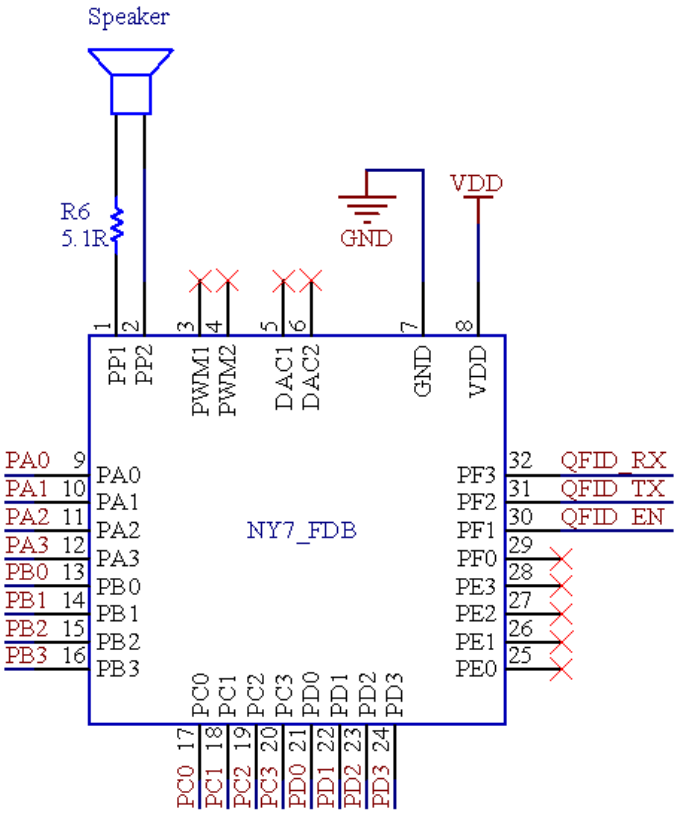
In the Reader circuit, the block diagram and pin description of NY9A109A is shown below.



Pin Name	Pin No.	ATTR.	Description
VDD	1	Power	Digital power.
SIN	2	I	Carrier Signal from MCU.
VDDQ	3	Power	Coil Driving power.
RTS	4	O	Reference output.
GND	5	Power	Negative power.
EN	6	I	NY9A109A enable input. High to enable, Low to disable/standby.
VDD	7	Power	Positive power of logic control circuit.
GND	8	Power	Negative power.
GND	9	Power	Negative power.
REF	10	I	Reference input.
GND	11	Power	Negative power.
LNA	12	I	Coil Feedback input.
GND	13	Power	Negative power.
SOUT	14	O	Signal output to MCU.
GND	15	Power	Negative power.
RFA	16	O	Coil Driving output.

Tag LED indicator light is low potential drive. When the NY7_FDB transmits and receives signals from the NY9A109A to know the Tag value, the Tag outputs low potential to light up or outputs high potential to extinguishe the LED, and drives the speaker to sound according to the corresponding Tag value. J1 is the LED power supply, if users do not use the LED on the board, please disconnect J1 and use PA / PB / PC / PD as shown below.





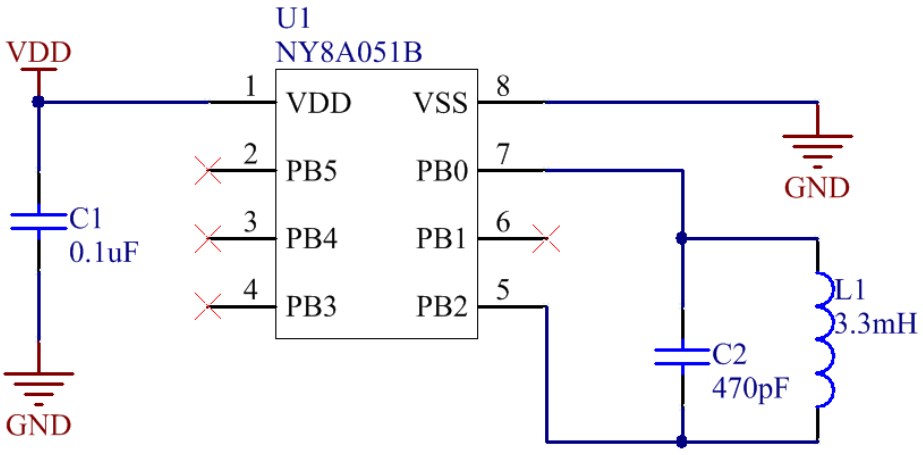
About NY7_FDB driving speaker, resistor R6 must aaply the appropriate resistance value in series speaker output, in order to avoid malfunction due to power supply interference. The table below shows that 4Ω speaker has to apply 8Ω resistor in series to have normal action in Push-Pull 100%, 8Ω speaker has to apply 4Ω resistor in series to have normal action in Push-Pull 100%, 16Ω speaker doesn't need resistor in Push-Pull 100% to have a normal action.

The resistor R6 in normal action (Unit: Ω)			
Speaker (Ω) / PP(%)	4	8	16
50	4	0	0
66	6	2	0
83	7	3	0
100	8	4	0

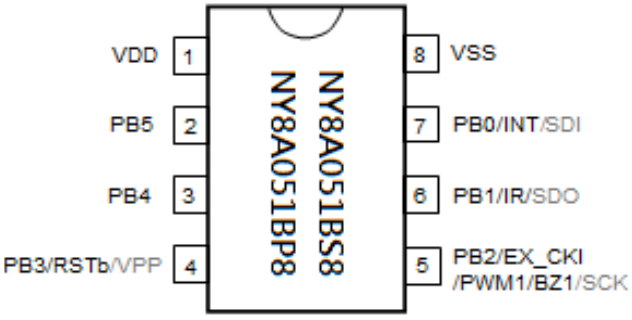
If users do not want the speaker series resistor to reduce the volume, in the circuit design, the low-pass filter composed of the resistor R1 and capacitor C1 muest be adjusted. The louder the volume, the larger the capacitance C1 in need, and it can effectively avoid the power being interfered by the speaker noise, then reading the Tag will not be error.

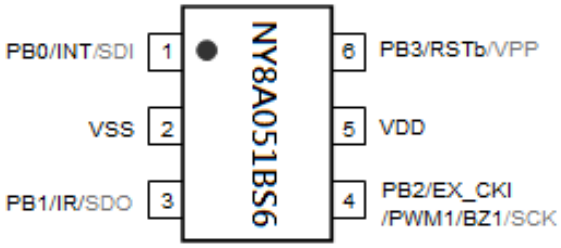
2.2 Tag Circuit

In the Tag circuit below, the capacitor C2 resonates with the coil L1. The capacitor C1 stores the voltage from LC resonance. NY8A051B were programmed into 16 different codes to make NY7_FDB identify Tag 0x0 ~ 0xF.



In the Tag circuit, the pin description of NY8A051B is shown below.





Pin Name	I/O	Description
PB0/ INT/ SDI	I/O	PB0 is a bidirectional I/O pin. PB0 is input pin of external interrupt when EIS=1 & INTIE=1. PB0 can be programming pad SDI.
PB1/ IR/ SDO	I/O	PB1 is a bidirectional I/O pin. If IR mode is enabled, this pin is IR carrier output. PB1 can be programming pad SDO.
PB2 / EX_CKI / PWM1 / BZ1 / SCK	I/O	PB2 is a bidirectional I/O pin. It can also be timer clock source EX_CKI. It can also be PWM output. It can also be BUZZER output. PB2 can be programming pad SCK.

Pin Name	I/O	Description
PB3/ RSTb/ VPP	I/O	PB3 is an input pin or open-drain output pin. It can be reset pin RSTb. If RSTb pin is low, it will reset NY8A051B. It can be programming pad VPP.
PB4	I/O	PB4 is a bidirectional I/O pin. PB4 also can be output of instruction clock.
PB5	I/O	PB5 is a bidirectional I/O pin.
VDD	-	Positive power supply.
VSS	-	Ground.

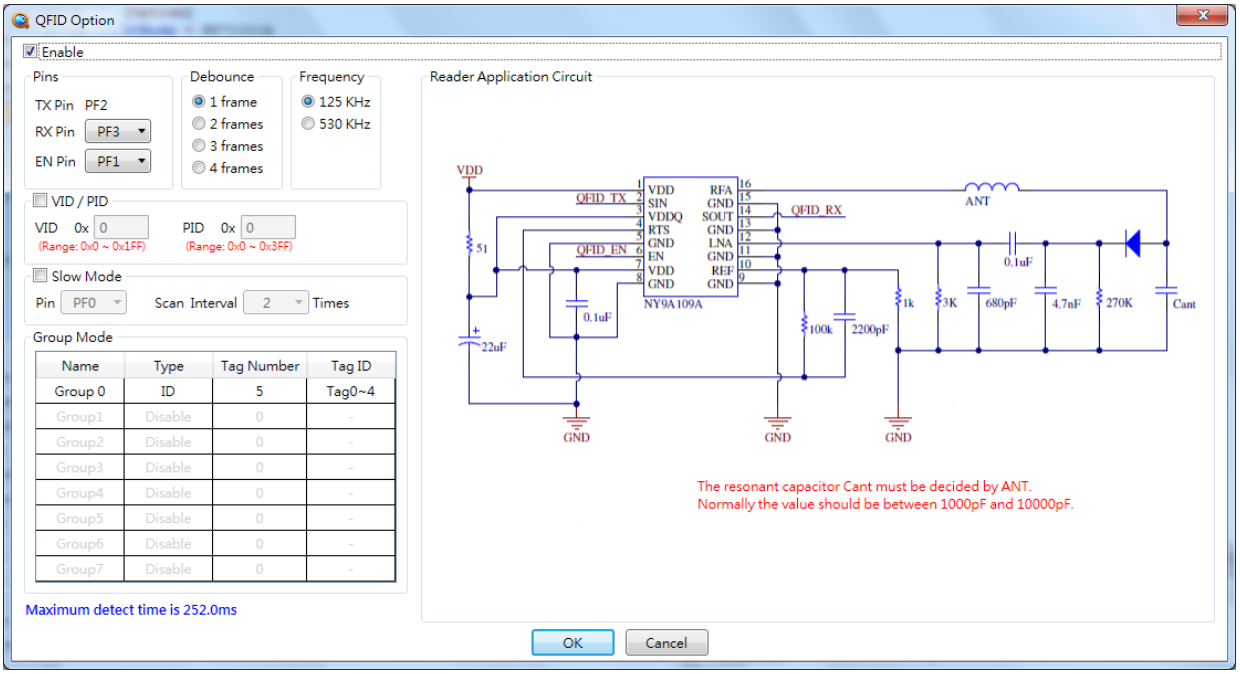
3 QFID *Q-Code*

Q-Code is an application development tool for NY4 / NY5 / NY6 / NY7 / NY9T / NX1 series IC of Nyquest Technology Co., Ltd. It provides a simple graphical user interface to complete the development of application program. Engineers will be able to utilize the powerful features to complete the development of application program even without the understanding of hardware structure and assembly language. So the product development process is simplified and the product development efficiency is enhanced.

3.1 QFID Paragraph

Note: NY4 / NY5 / NY6 / NY9T do not support the QFID Paragraph.

Step: QFID → QFID Option



TX Pin: Pin for generating QFID carrier. QFID_TX is fixed to particular pin, where TX pin is assigned to PB.2 of NY7A, PD.2 of NY7B and PF.2 of NY7C.

RX Pin: Pin to receive data from Tag. RX pin should be connected to the SOUT pin of NY9A109A

En Pin: Pin to enable the function of NY9A109A. *Q-Code* will control NY9A109A automatically, En pin should be connected to the EN pin of NY9A109A.

Slow Pin: The rest time of Slow Mode is counted by RC charging / discharging of specified I/O. To enable Slow Mode, it is necessary to connect a 100KΩ resistor and 0.1uF capacitor in parallel to the specified I/O.

Scan Interval: QFID Slow Mode will scan for tags once and rest several times, the rest times is determined by the value of Scan Interval. For example, when Scan Interval is selected as 2, it means to scan once and rest twice. If the scan time is 200ms, the rest time is about 400ms. The scan time is determined by tag number. The user can also change the resistance and capacitance to adjust the Interval unit time. The calculated unit time after the change is as follows. Please note that the rest time is an approximate value and may deviate.

$Interval_{(new)} = (Interval_{(original)} \times R \times C) / 0.01$

Frequency: QFID frequency has two options: 125KHz and 530KHz. When the user chooses 530KHz, although needs to add a NY8A051D, the tag can be made as PCB antenna. After setting project, An additional CarrierGen-530KHz.bin for programming to NY8A051D will be automatically generated by *Q-Code*.

QFID_Debounce: Set the debounce time when QFID is scanning, there are 4 options: 1 / 2 / 3 / 4 frames.

QFID_Group0_Mode: QFID mode. ID means to recognize Tag only. ID+Input is to recognize Tag and read the I/O state on Tag.

QFID_Group0_Tags: The available numbers of tag. 1 to 16 tags are applicable if QFID_Group0_Mode is ID, and the corresponding tags are Tag0 ~ Tag15. 1 to 8 tags are applicable if QFID_Group0_Mode is ID+input, and the corresponding tags are Tag0 ~ Tag7.

QFID_VID: Set the Vender ID of product, the range is 0x0~0x1FF. If the Vender ID of Tag is different from the reader's setting, the Tag won't be recognized.

QFID_PID: Set the Project ID of product, the range is 0x0~0x3FF. If the Project ID of Tag is different from the reader's setting, the Tag won't be recognized.

QFID_VID / QFID_PID is used to avoid the interference between different products' Tags. The VID / PID of Tag and reader must be exactly the same in order to be recognized. User can also disable the VID / PID function.

User has to define the corresponding trigger state in **[QFID]** paragraph, NY7 series only supports one set of state. The entry in [QFID] state specifies the action to perform when Tag is detected by reader or left reader. The entry number cannot exceed the number of QFID_Group0_Tags, and the entries have to be separated by blank (TAB or Space).

The allowed entries are as follows.

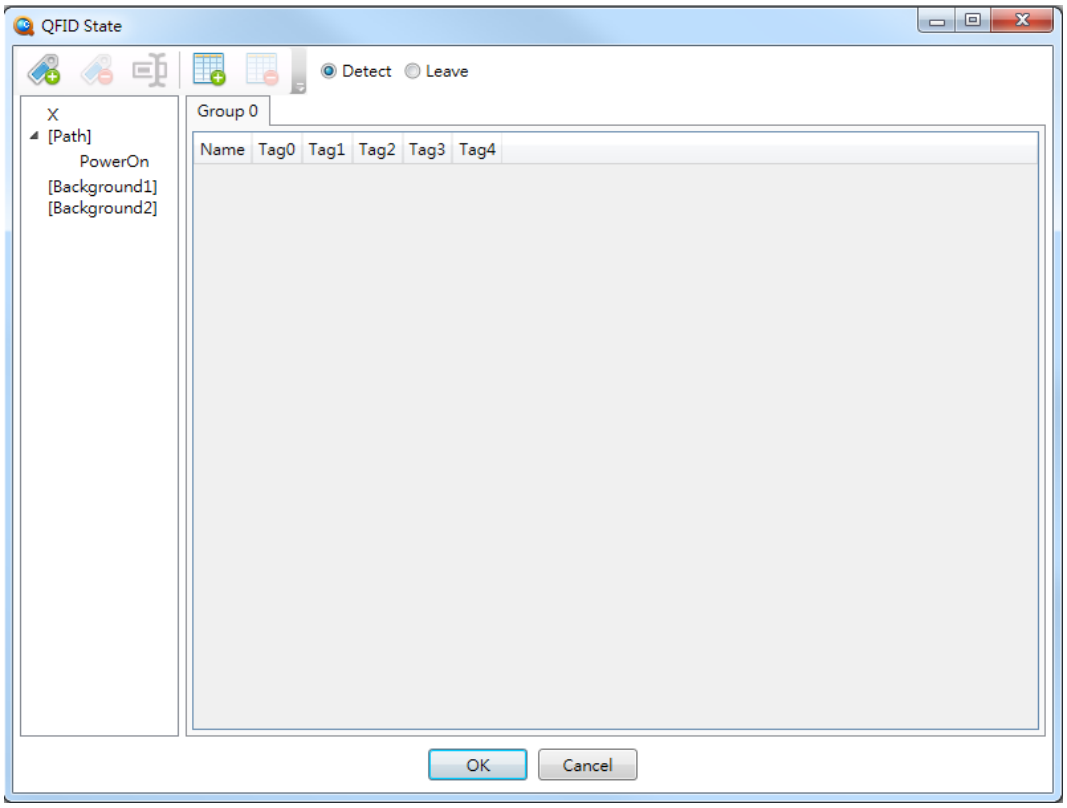
Fomat	Tag Trigger Type	Descriptions
X	Ignore	No action.
Path1	Detect	When Tag is detected by reader, execute Path1.
/Path2	Leave	When Tag leaves reader, execute Path2.
Path1/Path2	Detect & Leave	When Tag is detected, execute Path1. When Tag is left, execute Path2.

Ex. [QFID]

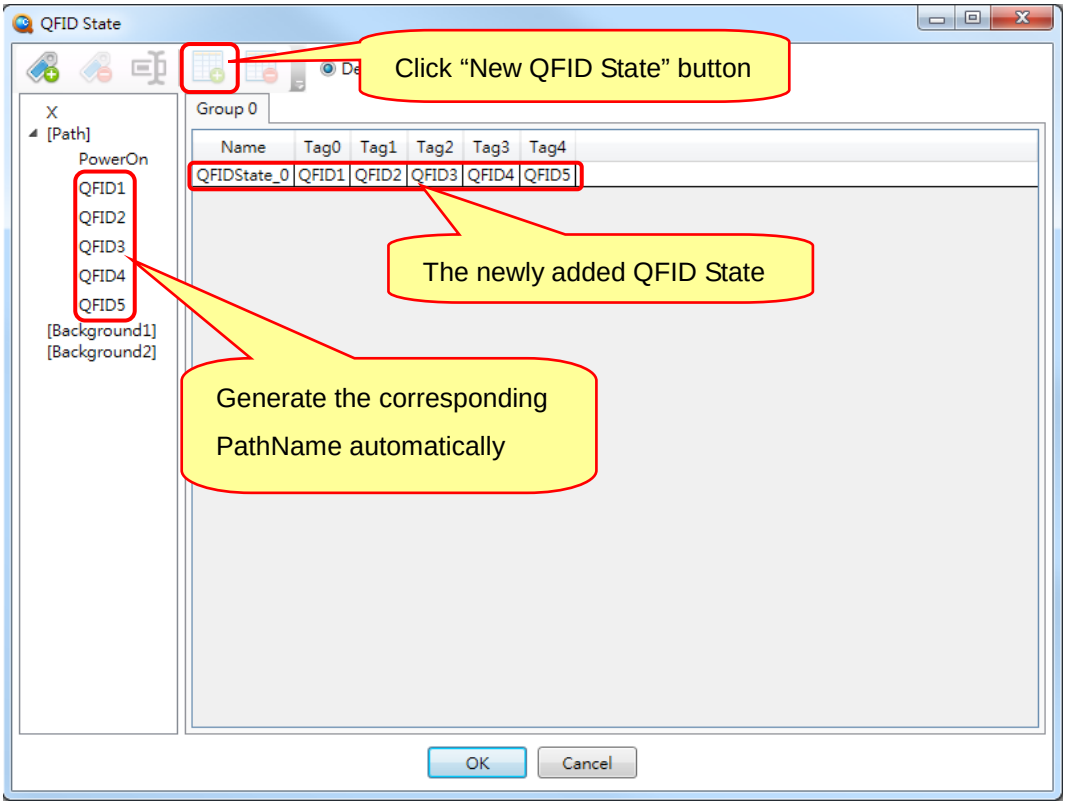
Group0: TR1R X /TR3F TR4R/TR4F

Step: QFID → QFID State → Add State Name → Add PathName → OK, the operations are below.

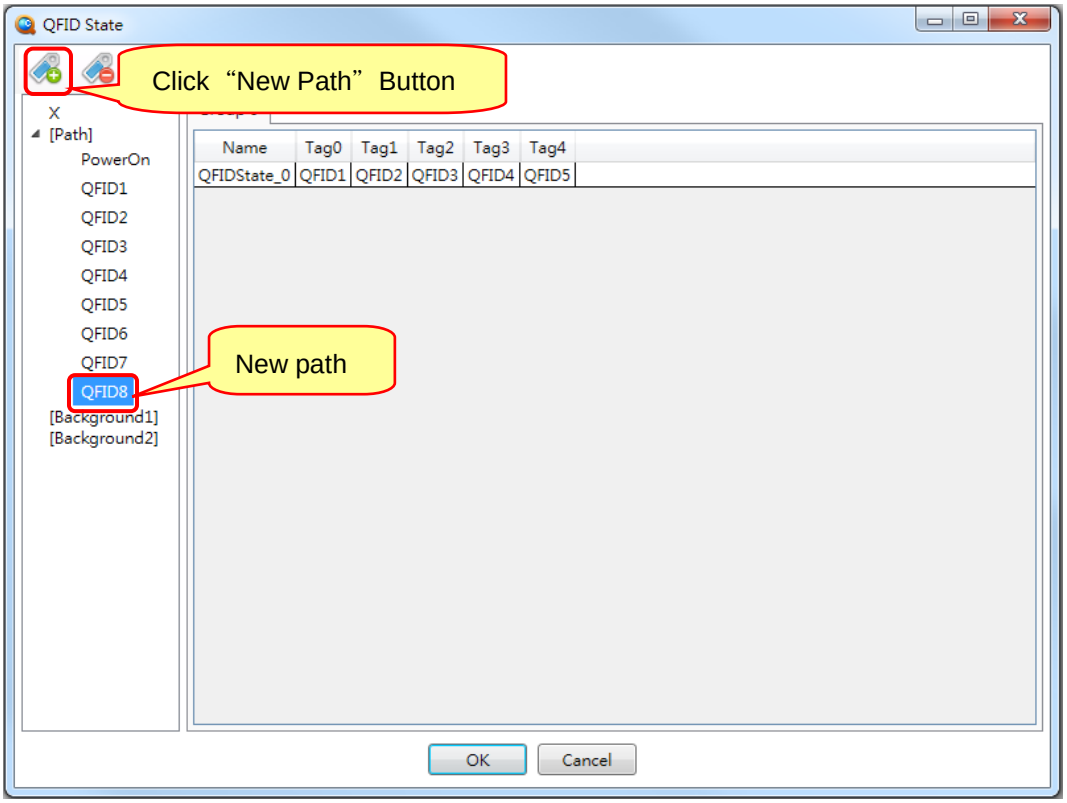
Click **QFID State** and the following dialog box will appear:

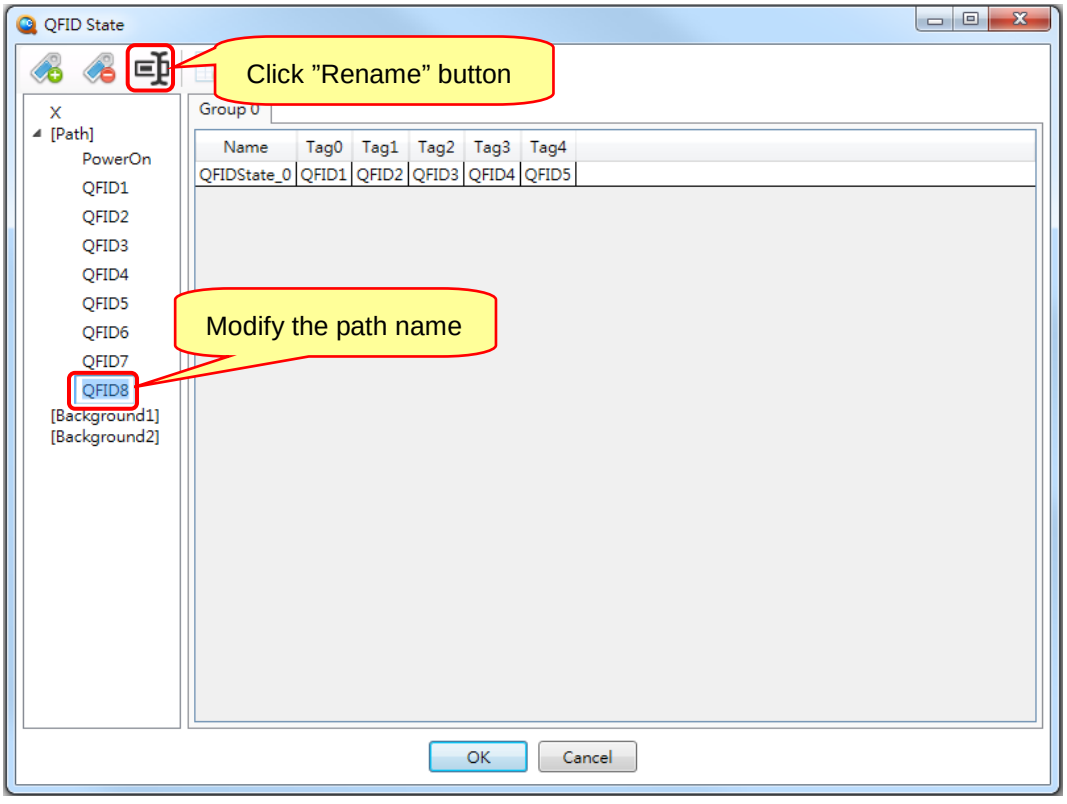


Step1:Click  to add **QFID State**.

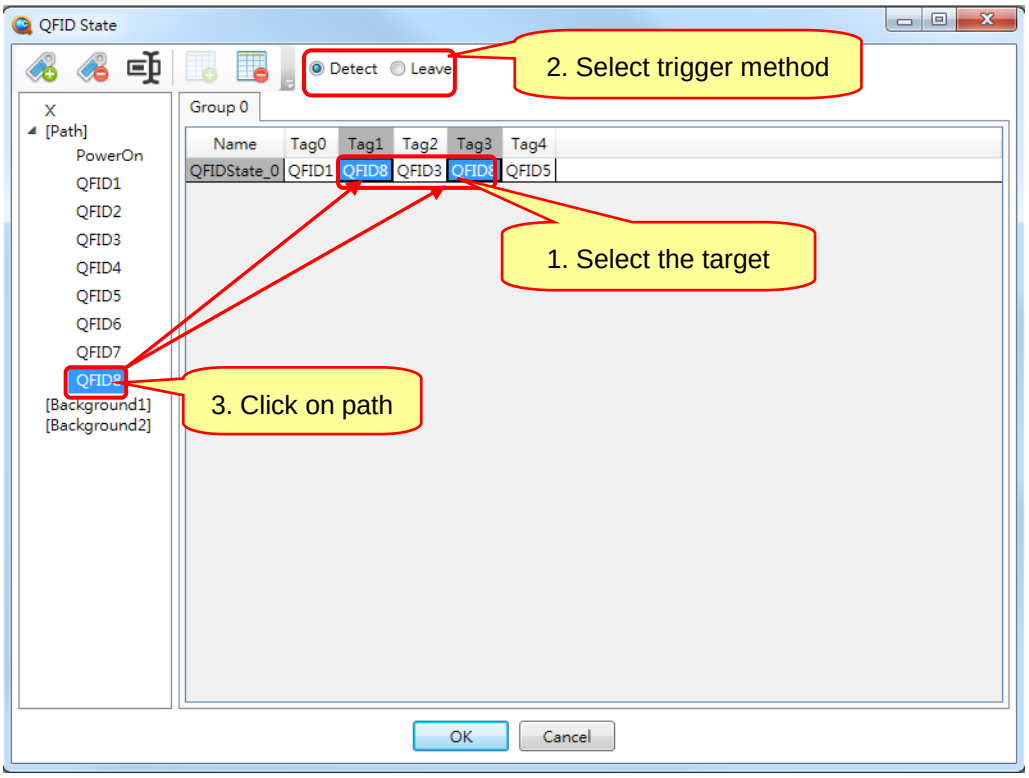


Step2: Add path or modify the path name.

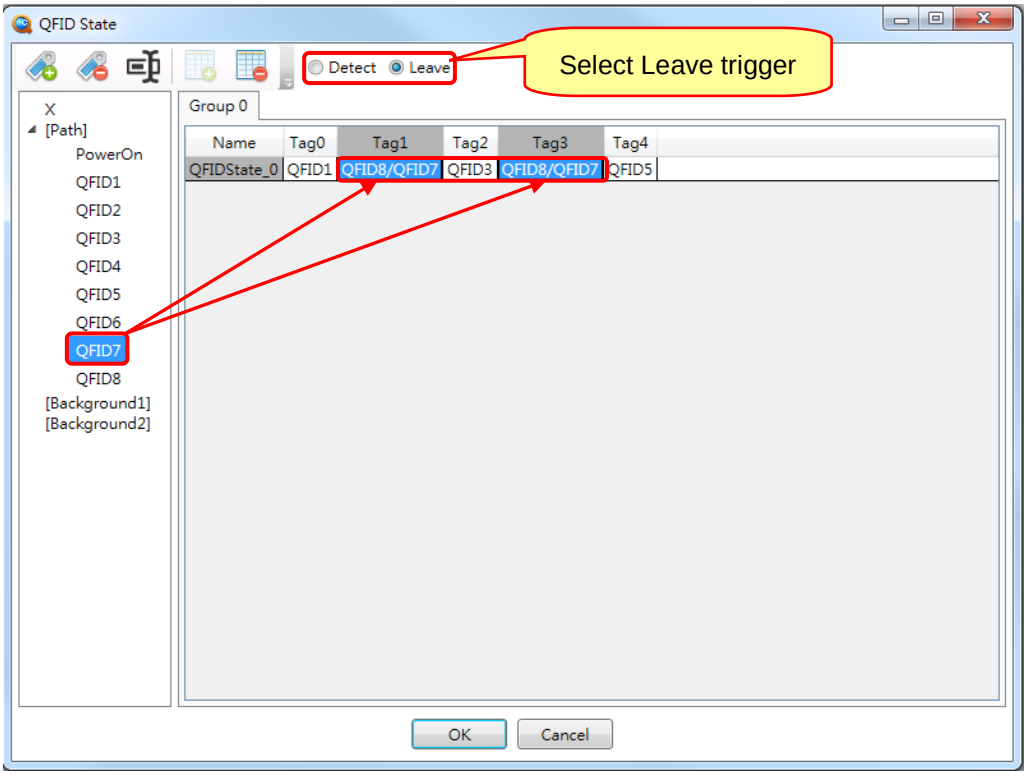




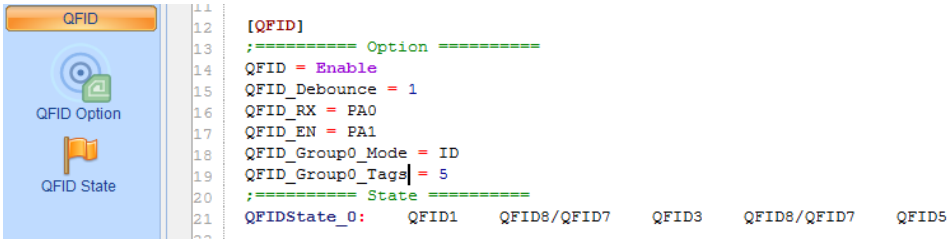
Step3: Modify the corresponding path. Although *Q-Code* fills the entries by default, user can modify the corresponding path if necessary.



If user wants to set the entry when Tag is left, just select the Leave button on the 2nd action as the picture shown below.

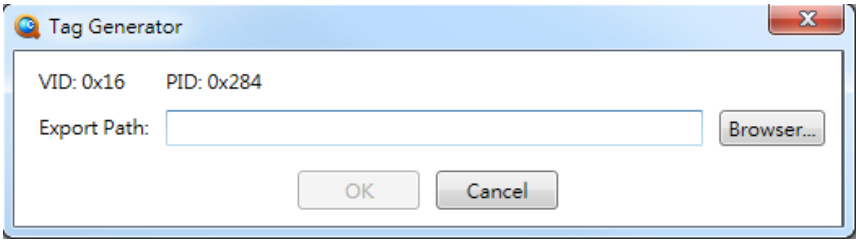


After setting then click OK.



The QFID function can only coordinate with the .bin file of Tag generated by *Q-Code*. *Q-Code* provides Tag Generator tool to generate the Tag .bin file. User can program the file to Tag IC through *Q-Writer*.

Usage: Tools → QFID Tag Generator



VID: The corresponding QFID Vender ID.

PID: The corresponding QFID Project ID.

Export Path: Set the location of the generated .bin file.

After setting, click the OK button, the Tag .bin file will be generated in the path that specified by user. Filename format: {VID_}{PID_}{TagID}.bin.

3.2 QFID_Demo_Kit Data

Users can download QFID_Demo_Kit data from the Nyquest website: http://www.nyquest.com.tw.

QFID_Demo_Kit Information:

- There are programmed files of Tag0x0~Tag0xF and Tag circuit in Tag folder.
- Reader_Code.bin is the demo programmed file of QFID_Demo_Kit Reader, which directly programming the bin file to NY7_FDB, will perform simple action.
- The programmed file of Tag and Reader do not have VID and PID functions.
- Reader_Schematic.pdf is the file about all circuits for QFID_Demo_Kit Reader.

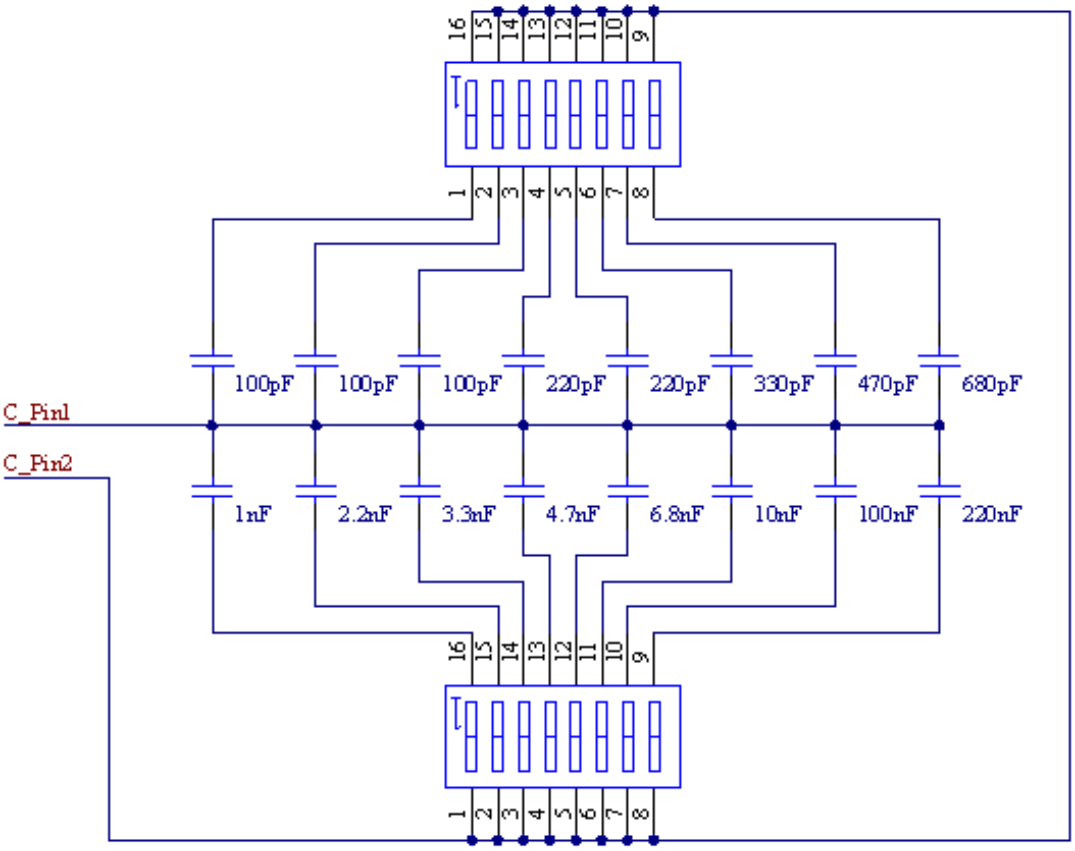
4 Appendix

4.1 The Resonant Capacitor Selection

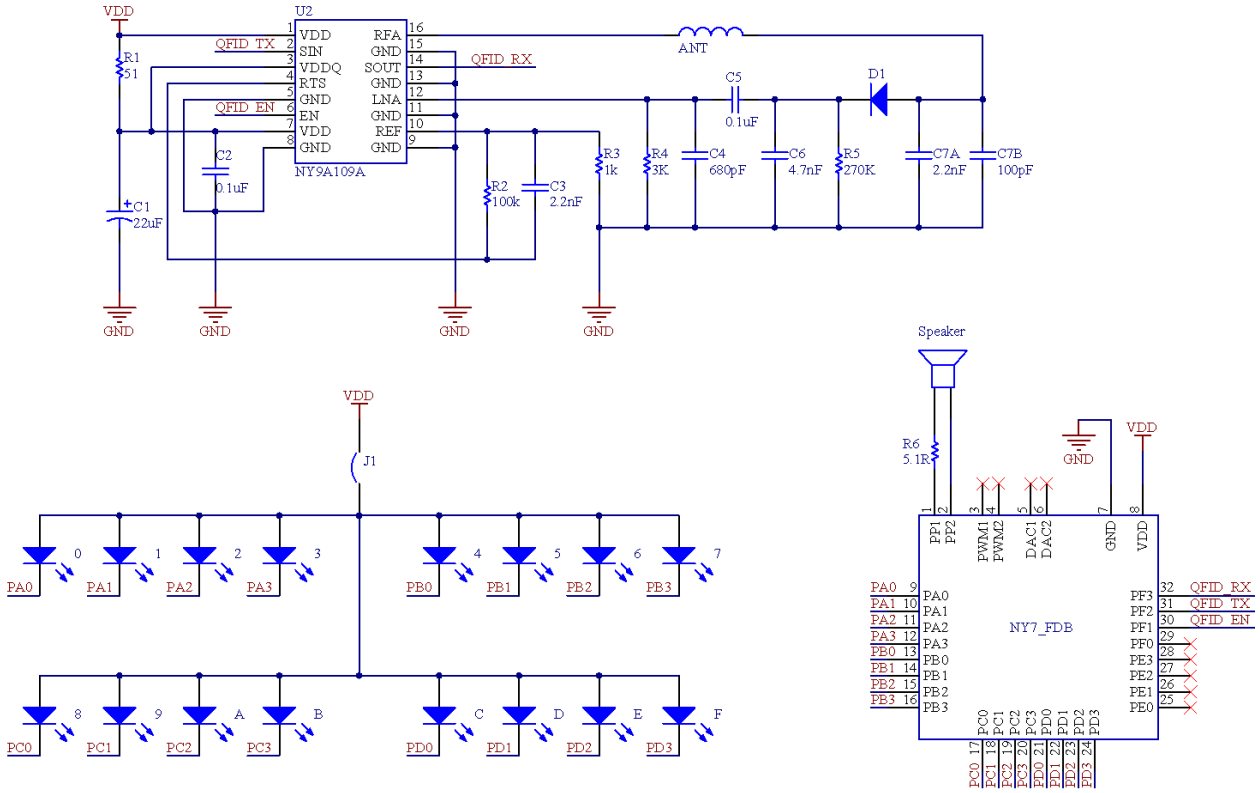
When the Reader coil finished, user must find the capacitance of the resonant capacitor. User can use the capacitor box or self-made simple capacitor board to match. Connect the resonant capacitor both ends of Reader circuit to the capacitor box or self-made simple capacitor board. Through the NY7_FDB or signal generator to generate 125KHZ square wave, input this signal into the pin2 SIN in NY9A109A, and use the oscilloscope to observe the coil and the resonant capacitor connection point voltage to adjust the capacitor box or self-made simple capacitor board to make capacitor value bigger. At this time the oscilloscope measurement signal amplitude will be more and more, if the capacitor value will continue to increase, the signal amplitude will begin to become smaller. The previous capacitor value before signal becomes smaller is the capacitor value of coil resonant.

4.1.1 Simple Capacitor Board

Through the DIP switch short circuit capacitance of different capacitance, to form a different capacitance value, user can quickly find the matching capacitor value of coil .



4.2 Reader Circuit



4.3 Fundamental Power Test Result

Fundamental Power Test Result

Dekra Corporation

Application:	九齊	**Project Number**	客戶到場
E U T :	QFID_Demo_Kit	**Test Date:**	2018/07/26
Input Voltage:	1.5V*2	**Temperature:**	25.3 C
Test Mode:	Transmit	**Humidity:**	58.6 %

Fundamental Power at 3m

Loop Antenna X

Frequency: 125kHz					
Test Conditions	Frequency (MHz)	Reading Level (dBuV)	Factor(AFE) (dB/m)	Emission Level (dBuV/m)	Limit (dBuV/m) @3m
X-axis	0.125	49.5	20	69.5	105.666
Y-axis	0.125	52.37	20	72.37	105.666

Loop Antenna Y

Frequency: 125kHz					
Test Conditions	Frequency (MHz)	Reading Level (dBuV)	Factor(AFE) (dB/m)	Emission Level (dBuV/m)	Limit (dBuV/m) @3m
X-axis	0.125	52.37	20	72.37	105.666
Y-axis	0.125	63.16	20	83.16	105.666

Loop Antenna Z

Frequency: 125kHz					
Test Conditions	Frequency (MHz)	Reading Level (dBuV)	Factor(AFE) (dB/m)	Emission Level (dBuV/m)	Limit (dBuV/m) @3m
X-axis	0.125	55.6	20	75.6	105.666
Y-axis	0.125	56.59	20	76.59	105.666

$E(dB\mu V/m)=R(dB\mu V)+ AF_E$

Remark: Pass	**Engineer Signature:**

Radiated Emission Test Result

Dekra Corporation

Application:	九齊	**Project Number**	客戶到場
E U T :	**QFID_Demo_Kit**	**Test Date:**	**2018/07/26**
Input Voltage:	**1.5V*2**	**Temperature:**	**25.3 C**
Test Mode:	**Transmit**	**Humidity:**	**58.6 %**

Loop Antenna X

Transmit Mode

Test Conditions	Frequency (MHz)	Reading Level (dBuV)	Emission Level (dBuV/m)	Limit (dBuV/m) @3m	Margin (dB)
X-axis	0.25	31.48	51.48	99.645	-48.165
	0.375	22.5	42.5	96.124	-53.624
	0.5	30.56	50.56	73.625	-23.065
	0.625	12.28	32.28	71.687	-39.407
Y-axis	0.25	37.2	57.2	99.645	-42.445
	0.375	24.1	44.1	96.124	-52.024
	0.5	40.2	60.2	73.625	-13.425
	0.625	14.52	34.52	71.687	-37.167

Loop Antenna Y

Transmit Mode

Test Conditions	Frequency (MHz)	Reading Level (dBuV)	Emission Level (dBuV/m)	Limit (dBuV/m) @3m	Margin (dB)
X-axis	0.25	31.2	51.2	99.645	-48.445
	0.375	22.5	42.5	96.124	-53.624
	0.5	29.3	49.3	73.625	-24.325
	0.625	13.8	33.8	71.687	-37.887
Y-axis	0.25	35.2	55.2	99.645	-44.445
	0.375	32.6	52.6	96.124	-43.524
	0.5	31.1	51.1	73.625	-22.525
	0.625	30.1	50.1	71.687	-21.587

Loop Antenna Z

Transmit Mode					
Test Conditions	Frequency (MHz)	Reading Level (dBuV)	Emission Level (dBuV/m)	Limit (dBuV/m) @3m	Margin (dB)
X-axis	0.25	35.8	55.8	99.645	-43.845
	0.375	23.1	43.1	96.124	-53.024
	0.5	40.1	60.1	73.625	-13.525
	0.625	15.1	35.1	71.687	-36.587
Y-axis	0.25	28.43	48.43	99.645	-51.215
	0.375	30.5	50.5	96.124	-45.624
	0.5	29.51	49.51	73.625	-24.115
	0.625	28.57	48.57	71.687	-23.117

E(dBμV/m)=R(dBμV)+ AFE

Remark:	**Engineer Signature:**
Pass	