Tel: 0086-755-82706913
Fax: 0086-755-82706900
E-mail: sales@sysiot.cn
Http://www.sysiot.cn

Add: Room 716, Yiben E-Commerce and Industrial Park, Chaguang Road Nanshan District, Shenzhen, China
Post Code：518055

SYS-IoT UHF Reader & Module

How to Implement Efficient Multi-tag Inventory

V1.2.0

2018-06-18

Shenzhen SYS IoT Co., Ltd

Tel: 0086-755-82706913
Fax: 0086-755-82706900
E-mail: sales@sysiot.cn
Http://www.sysiot.cn

Add: Room 716, Yiben E-Commerce and Industrial Park, Chaguang Road Nanshan District, Shenzhen, China
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Version Information

Date	Version	Comments
2018-06-18	V1.2	First draft

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CONTENTS

Foreword

This document is intended to be used in conjunction with the "Sys-IoT UHF Reader & Module Demo User Manual V1.2" to further describe the related operations of the reader related to multi-tag inventory. Users can achieve more efficient use of our readers for tag inventory. Therefore, users are advised to read the "Sys-IoT UHF Reader & Module Demo User Manual V1.2" before read the instructions in this document.

1. Software Interface

1.1 Start Interface

Start running “ModuleReaderV4.1A.exe”DEMO, Software interface runs as below picture

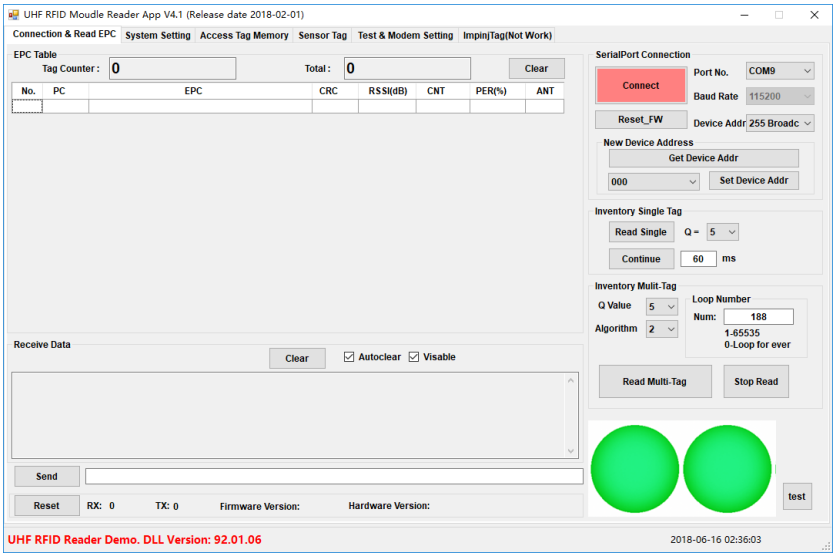


Figure 1

After connecting the reader and reading the label, the software interface is as follows

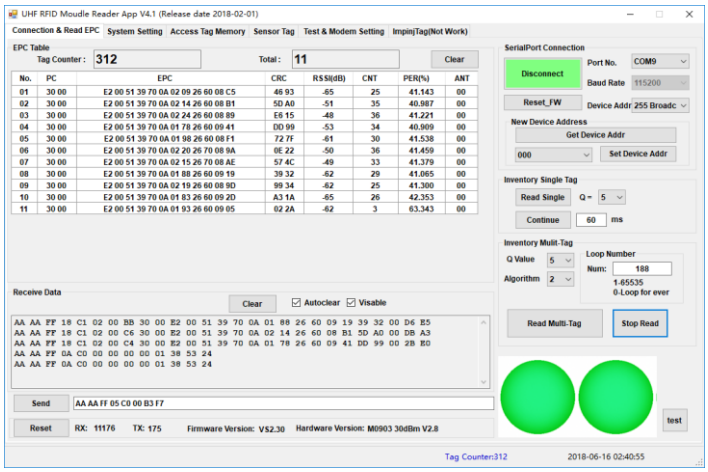


Figure 2

2. Multi-label Inventory Operation

2.1 Start Interface of Multi-Tag inventory

Multi-tag inventory read interface as Figure 3:

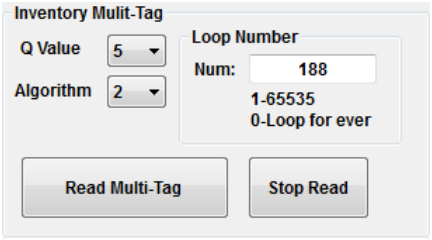


Figure 3

Click “Read Multi-Tag” button, then reader performs multi-tag inventory reading according to the set Q value, the algorithm of the inventory tag, the number of cycles, and the number of independent inventory of the antenna port (refer to "System Settings"). The reader automatically turns on the power amplifier to carry out the inventory label. According to the set number of cycles, decide whether to automatically turn off the power amplifier or manually turn off the power amplifier.

2.1.1 Q Value

The Q value represents the approximate number of reader tags accessed by the reader module: 2^Q tags. For example, if Q=5, then 25=32 sheets; the larger the Q value, the longer the reading time.

The user should set a reasonable Q value according to the actual number of inventory labels per time. Generally, the setting of Q value is generally 25%~40% more than the actual label, and the number of inventory labels is the most efficient.

2.1.2 Algorithm

The inventory algorithm, the algorithm of the tag inventory used when reader is working under multi-tag inventory.

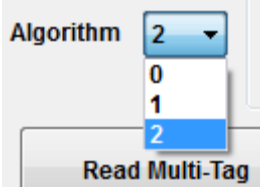


Figure 4

Inventory Rate: Inventory a specific number of tags, read different EPC ID tags, the number of tags that is read successfully. For instance: 98 tags are read amount 100 tags within 1 second, the inventory rate is 90%.

Success Read Rate: Within a specific period of time, the total times that EPC ID tags (same and

different tag) are read successfully, scilicet the total times of all tags been read. For instance: Within 1 second, the total times of all tags been read.

1. Algorithm 0: Inventory Rate high, Success Read Rate low;
2. Algorithm 1: Inventory Rate and Success Read Rate compromised;
3. Algorithm 2: Inventory Rate low, Success Read Rate high.

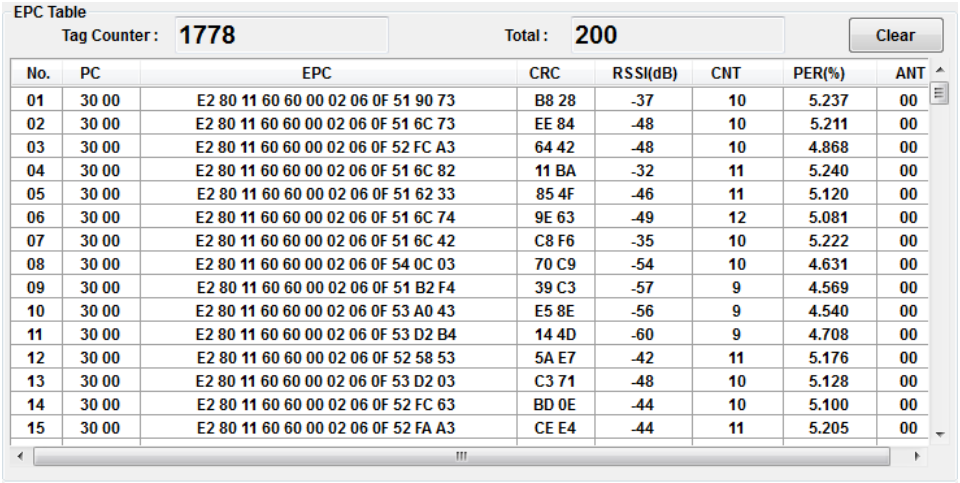
		Inventory Rate	Success Read Rate
1	Algorithm 0	High	Low
2	Algorithm 1	Middle	Middle
3	Algorithm 2	Low	Low

2.1.3 Loop Number

Loop number, set the loop number of reader module inventory tag, each time the reader module sent an inventory instruction for one loop. **If the user enable the "Antenna Auto Polling" function, then an inventory round of all enabled antenna ports as one loop.**

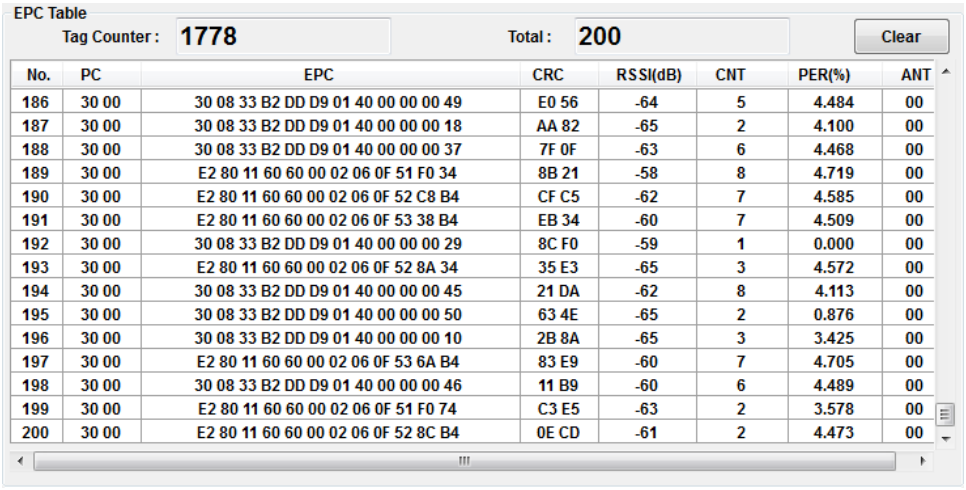
If the loop number is set to 0, the reader module will inventory multi-tag until the user clicks the "Stop Read" button. If the loop number is set to non-zero, 1~65535, the reader module will inventory tag until the set loop number reached, then stop the RF transmit.

The result of inventory multi-tag shown as Figure 5 and Figure 6:



No.	PC	EPC	CRC	RSSI(dB)	CNT	PER(%)	ANT
01	30 00	E2 80 11 60 60 00 02 06 0F 51 90 73	B8 28	-37	10	5.237	00
02	30 00	E2 80 11 60 60 00 02 06 0F 51 6C 73	EE 84	-48	10	5.211	00
03	30 00	E2 80 11 60 60 00 02 06 0F 52 FC A3	64 42	-48	10	4.868	00
04	30 00	E2 80 11 60 60 00 02 06 0F 51 6C 82	11 BA	-32	11	5.240	00
05	30 00	E2 80 11 60 60 00 02 06 0F 51 62 33	85 4F	-46	11	5.120	00
06	30 00	E2 80 11 60 60 00 02 06 0F 51 6C 74	9E 63	-49	12	5.081	00
07	30 00	E2 80 11 60 60 00 02 06 0F 51 6C 42	C8 F6	-35	10	5.222	00
08	30 00	E2 80 11 60 60 00 02 06 0F 54 0C 03	70 C9	-54	10	4.631	00
09	30 00	E2 80 11 60 60 00 02 06 0F 51 B2 F4	39 C3	-57	9	4.569	00
10	30 00	E2 80 11 60 60 00 02 06 0F 53 A0 43	E5 8E	-56	9	4.540	00
11	30 00	E2 80 11 60 60 00 02 06 0F 53 D2 B4	14 4D	-60	9	4.708	00
12	30 00	E2 80 11 60 60 00 02 06 0F 52 58 53	5A E7	-42	11	5.176	00
13	30 00	E2 80 11 60 60 00 02 06 0F 53 D2 03	C3 71	-48	10	5.128	00
14	30 00	E2 80 11 60 60 00 02 06 0F 52 FC 63	BD 0E	-44	10	5.100	00
15	30 00	E2 80 11 60 60 00 02 06 0F 52 FA A3	CE E4	-44	11	5.205	00

Figure 5



No.	PC	EPC	CRC	RSSI(dB)	CNT	PER(%)	ANT
186	30 00	30 08 33 B2 DD D9 01 40 00 00 00 49	E0 56	-64	5	4.484	00
187	30 00	30 08 33 B2 DD D9 01 40 00 00 00 18	AA 82	-65	2	4.100	00
188	30 00	30 08 33 B2 DD D9 01 40 00 00 00 37	7F 0F	-63	6	4.468	00
189	30 00	E2 80 11 60 60 00 02 06 0F 51 F0 34	8B 21	-58	8	4.719	00
190	30 00	E2 80 11 60 60 00 02 06 0F 52 C8 B4	CF C5	-62	7	4.585	00
191	30 00	E2 80 11 60 60 00 02 06 0F 53 38 B4	EB 34	-60	7	4.509	00
192	30 00	30 08 33 B2 DD D9 01 40 00 00 00 29	8C F0	-59	1	0.000	00
193	30 00	E2 80 11 60 60 00 02 06 0F 52 8A 34	35 E3	-65	3	4.572	00
194	30 00	30 08 33 B2 DD D9 01 40 00 00 00 45	21 DA	-62	8	4.113	00
195	30 00	30 08 33 B2 DD D9 01 40 00 00 00 50	63 4E	-65	2	0.876	00
196	30 00	30 08 33 B2 DD D9 01 40 00 00 00 10	2B 8A	-65	3	3.425	00
197	30 00	E2 80 11 60 60 00 02 06 0F 53 6A B4	83 E9	-60	7	4.705	00
198	30 00	30 08 33 B2 DD D9 01 40 00 00 00 46	11 B9	-60	6	4.489	00
199	30 00	E2 80 11 60 60 00 02 06 0F 51 F0 74	C3 E5	-63	2	3.578	00
200	30 00	E2 80 11 60 60 00 02 06 0F 52 8C B4	0E CD	-61	2	4.473	00

Figure 6

2.2 Ant Setting

Ant Setting, set the relevant parameter settings of the reader module when accessing the antenna port.

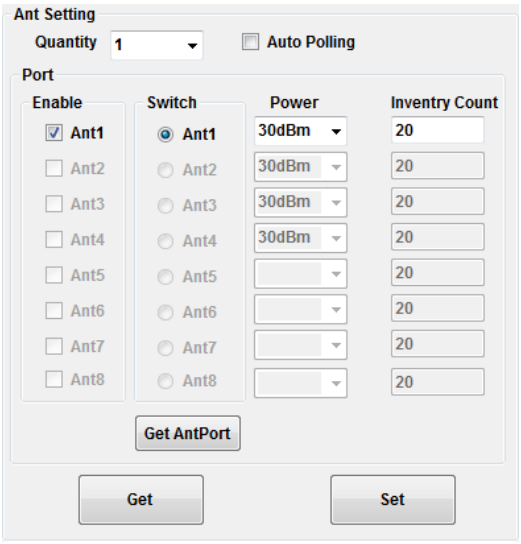


Figure 7

After setting the parameter, click “Set” button to set all the antenna parameters, click ”Get” to query all the current set antenna parameters.

Noted: after the “Set” setting, it is necessary to reset or repower the reader’s so that the newly set antenna parameters take effect.

2.2.1 Quantity

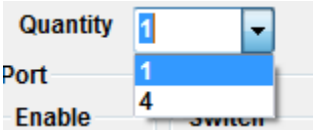


Figure 8

The antenna quantity corresponds to the actual reader's (module) antenna ports number. For single-port module, the antenna quantity is 1, and the four ports module, antenna quantity is 4.

2.2.2 Antenna Auto Polling

Antenna Auto Polling, when there are multiple antenna ports, the user enables this option, and when the multi-tag inventory command is activated (reference to 3.3.2), the reader module will access the enabled antenna ports according to the antenna control parameters automatically and successively without any antenna port switch command. **Note: the enabled antenna port must be connected to an antenna with a matching impedance of 50Ω and a standing wave of less than 1.3.**

Figure 9

If "Auto Polling" is not enabled, as shown in Figure 9, the reader(module) antenna port needs to send a Switch antenna command to switch to the corresponding antenna port. Please refer to the subsequent antenna switching contents.

"Auto Polling" function, **only valid for multi-tag inventory**!

2.2.3 Antenna Enable

Antenna Enable, the antenna is enable to work, do not turn off the antenna while it's working. As shown in Figure 10, the enabled antenna ports are: Ant1, Ant3 and Ant4, Ant 2 is forbidden. **It is important to note that the Ant1, Ant3 and Ant4 antenna ports must be connected with a 50Ω antenna or a 50Ω load; Otherwise, the antenna port is idling, enables work for a long time, it's easily damage the internal amplifier chip of the reader module.**

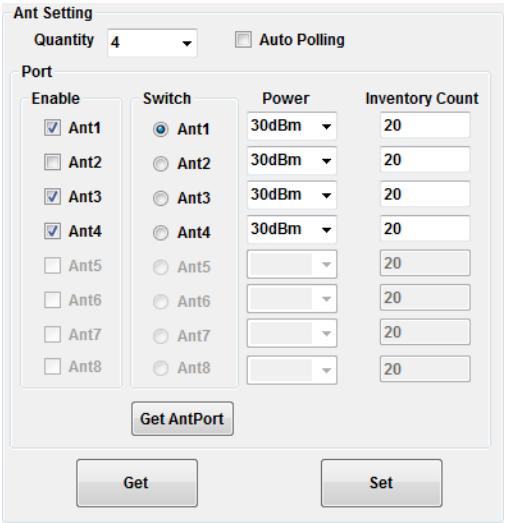


Figure 10

When the Multi-tag inventory reading (Read Multi-Tag) is started, the reader module sequentially accesses each enabled antenna port: Ant1-> Ant3-> Ant4-> Ant1-> Ant3-> Ant4-> Ant1-> ....., until the end of the multi-tag inventory.

2.2.4 Antenna Switch

This function is applied when reader is not working under "antenna automatic polling". For example, manually switch antenna ports to read, write, erase, and lock labels.

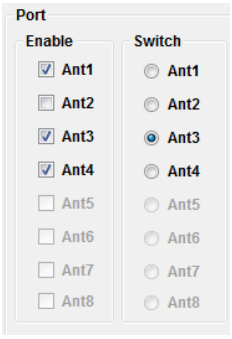


Figure 11

As Figure 11 shown, enable round button Ant3, switch to Antenna 3, the bottom status bar shows success message shown as Figure 12.

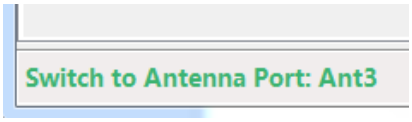


Figure 12

If try to switch to an antenna which is no enabled, status bar will show failed message as Figure 13.

Figure 13

2.2.5 Power of Antenna Port

Means the RF transmit power of each antenna port can be adjusted. Shown as Figure 29:

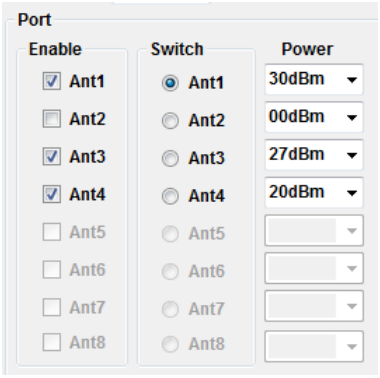


Figure 14

When the reader module accesses the antenna port, the set RF power is transmitted according to different antenna power settings. Ant1->30dBm， Ant3->27dBm， Ant4->20dBm。

30dBm=1W (Watt), 27dBm=500mW, 24dBm=250mW, 21dBm=125mW.

Calculated as follows:

$$P_{dBm}=10\log(P_{mW});$$

Note: The parameters of the antenna port power are valid only under “Multi-tags Reading” mode

and "Antenna Auto Polling" is enabled. If "a Antenna Auto Polling" is not enabled, and module (reader) working under "Multi-tags Reading", the power transmitted of the module (reader) is determined by the power set by "RF Power Setting".

2.2.6 Antenna Auto Polling Times

"Inventory Count", When working under "Multi-tags Reading" inventory, the number of times the module (reader) sends the inventory instruction when accesses each antenna port, and when the number of inventory times is completed, the module (reader) continues to access the next enabled antenna. So reciprocating access circularly. The greater the number of antenna inventory, the longer the module (reader) resides on this antenna port.

Note: This parameter is valid only for multi-tags inventory read commands.

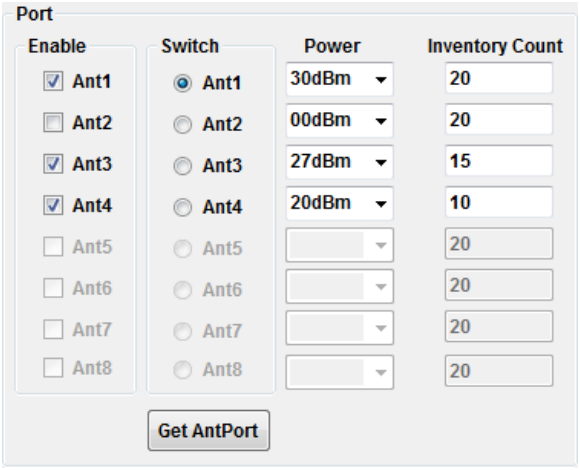


Figure 15

Shown as Figure 15, ANT1(20) ->ANT3(15) ->ANT4(10) ->ANT1(20) ->ANT3(15) ->ANT4(10) ->.....

3. Detail Description

3.1 Factors Affecting Multi-tags Inventory

Including:

1. Algorithm for inventory;
2. Q value;
3. Antenna inventory times;
4. RF transmit power.

The above four factors affect each other's inventory efficiency. Only by cooperating with each other by setting appropriate parameters, can the tag inventory efficiency be effectively improved.

3.1.1 Algorithm for Inventory

Algorithm for inventory determines the efficiency of the inventory. ISO18000-6C protocol provides anti-collision mechanism for multi-tags inventory. Our module (reader) advanced optimize the anti-collision algorithm, and improve the efficiency of inventory massively:

Algorithm 0, Algorithm that take identifying the number of different tags with high speed as priority, scilicet the highest inventory rate for different EPC ID tags;

Algorithm 1, Compromise algorithm that pursue both on inventorying different EPC ID tags with high speed and the times of read EPC ID tag;

Algorithm 2, Algorithm that pursue on EPC ID tag read times, not take identifying the number of different tags with high speed as priority.

Inventory Rate: Inventory a specific number of tags, read different EPC ID tags, the number of tags that is read successfully. For instance: 98 tags are read amount 100 tags within 1 second, the inventory rate is 90%.

Success Read Rate: Within a specific period of time, the total times that EPC ID tags(same and different tag) are read successfully, scilicet the total times of all tags been read. For instance: Within 1 second, the total times of all tags been read.

1. Algorithm 0: Inventory Rate high, Success Read Rate low;
2. Algorithm 1: Inventory Rate and Success Read Rate compromised;
3. Algorithm 2: Inventory Rate low, Success Read Rate high.

		Inventory Rate	Success Read Rate
1	Algorithm 0	High	Low
2	Algorithm 1	Middle	Middle
3	Algorithm 2	Low	Low

3.1.2 Inventory Q Value

Q Value is an anti-collision mechanism provided by ISO18000-6C protocol for establishing a synchronous time slot channel for communication interaction between module (reader) and tags. Module (reader) notify tags the number of time slot channel of each inventory with Q value during inventory. Number of time slot channel is 2^Q.

Q	Number of channel
0	1
1	2
2	4
3	8
4	16
5	32
6	64

7	128
8	256

The tag group randomly selects the time slot channel, and return EPC to reader, and when tag collision occurs, reader will quit inventory. If there is no tag collision, the tag will be identified. Therefore, the Q Value affects the efficiency of inventory greatly. Then, the larger the Q value, the larger the number of time slots channel, and the longer each time the inventory needs, and this will affect the inventory efficiency at some point. The user needs to set an appropriate Q value for inventory based on the number of tags.

Anti-collision mechanism of tag inventory shown as Figure 16:

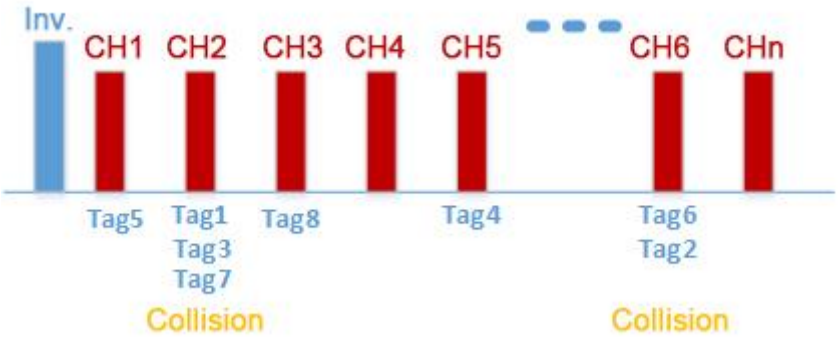


Figure 16

In this round of inventory, tags identified successfully: Tag5, Tag8 and Tag4, collision occurs and tags not identified: Tag1, Tag2, Tag7, Tag6 and Tag2.

3.1.3 Antenna Inventory Times

The times the antenna port inventory will affect the inventory time length of the current working antenna port that reader reside on, which is automatically controlled by reader. It also affects the inventory completion rate of the current working antenna port.

The larger the number of an antenna port inventory, the longer time the reader will stay in the current working antenna port for tag inventory, and vice versa.

The larger the number of an antenna port inventory, the lower the probability of missing tag, and vice versa.

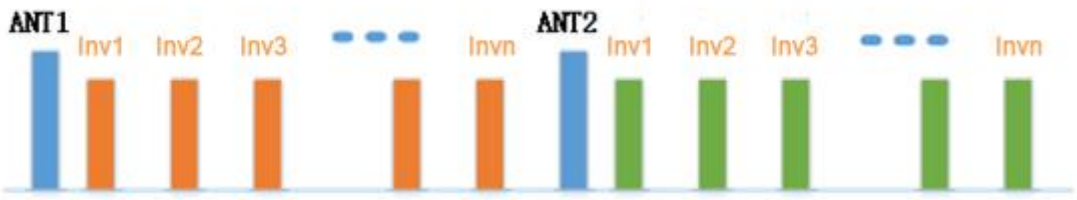


Figure 17