BIXOLON

RFID Programming manual

SLP-TX40xR/ XT5-4xNR/ XD5-4xtR Series

Ver. 2.00

http://www.bixolon.com

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1. Manual Introduction

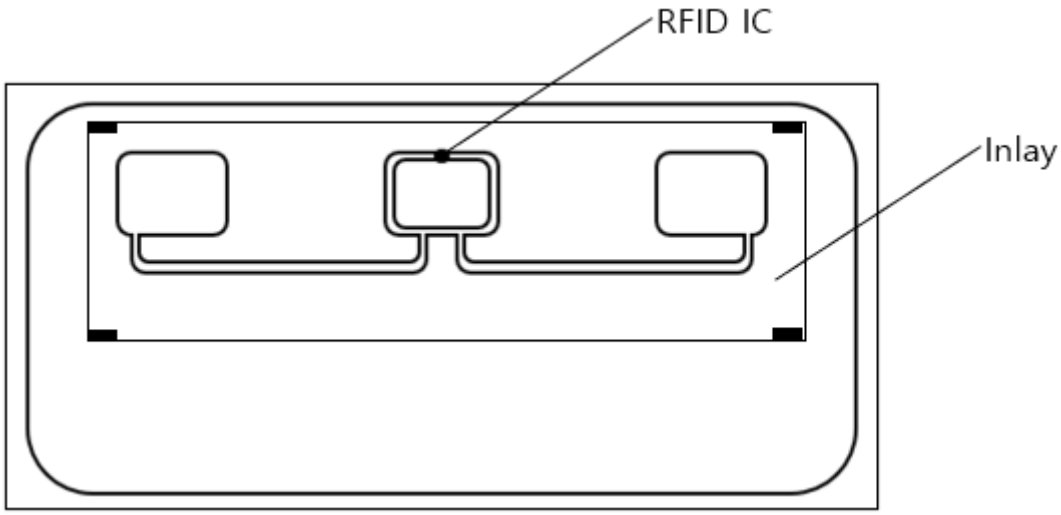
This manual provides instructions on the encoding of information into an RFID tag and its control commands.

2. Basic Theory

2-1RFID Printer

• An RFID printer is a device that can encode and print information on labels or tickets equipped with RFID transponders in the HF and UHF frequency bands.

2-2 RFID Transponder



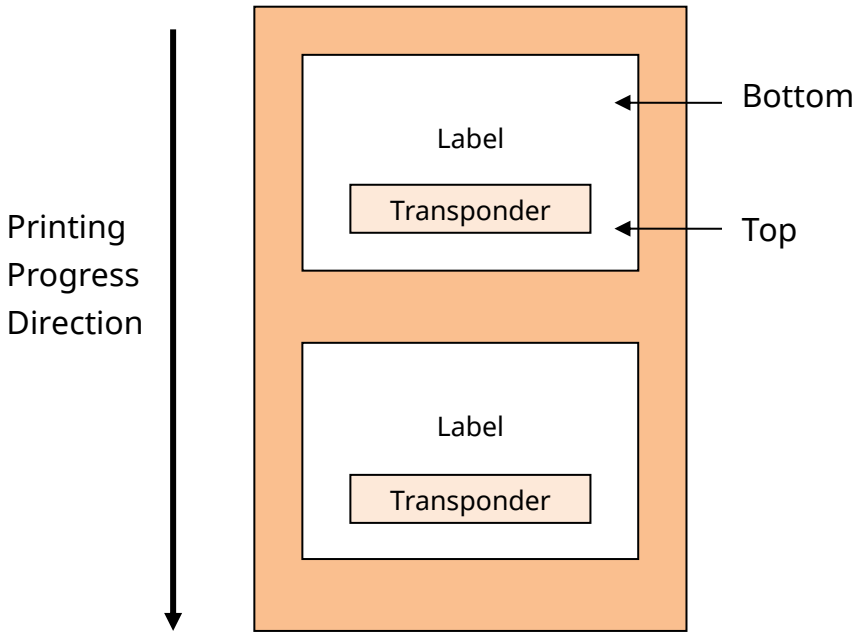
An RFID transponder, also known as an RFID tag or Inlay, is made by bonding an RFID chip (IC) to an antenna. Internally, the RFID chip (IC) consists of RF circuits, an encoder, a decoder, and memory, etc.

2-3 RFID Label Selection

• When selecting an RFID label, it is important to consider the type of RFID transponder and the bonding position of the RFID transponder for effective encoding.

1) Selection of the Type of RFID Transponder
Select an RFID transponder equipped with an EPC GEN2 chip operating on the UHF frequency band.

2) Transponder Boding Position
The RFID transponder must be designed to be positioned at the top of the RFID label for stable operation.



For the XD5-40tR model, it is recommended to use RFID inlays with a size of 87mm or smaller.

2-4 EPC GEN2 Chip Memory Structure

• The memory structure of an EPC GEN2 Chip is as follows:

GEN2 (EPC Class 1 Generation 2) Tag Memory Allocation

MEM BANK	MEM BANK NAME	MEM BANK BIT ADDRESS	BIT NUMBER																R/W ADDRESS (Byte)
			15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
11	USER	…	…																…
		0x00 – 0x0F	USER[15:0]																0,1
10	TID (ROM)	0x10 – 0x1F	0	0	0	1	MODEL NUMBER												2,3
		0x00 – 0x0F	1	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0,1
01	EPC (NVM)	0x70 – 0x7F	EPC[15:0]																14,15
		0x60 – 0x6F	EPC[31:16]																12,13
		0x50 – 0x5F	EPC[47:32]																10,11
		0x40 – 0x4F	EPC[63:48]																8,9
		0x30 – 0x3F	EPC[79:64]																6,7
		0x20 – 0x2F	EPC[95:80]																4,5
		0x10 – 0x1F	PROTOCOL-CONTROL BITS (PC)																2,3
		0x00 – 0x0F	CRC-16																0,1
00	RESERVED (NVM)	0x30 – 0x3F	ACCESS PASSWORD[15:0]																6,7
		0x20 – 0x2F	ACCESS PASSWORD[31:16]																4,5
		0x10 – 0x1F	KILL PASSWORD[15:0]																2,3
		0x00 – 0x0F	KILL PASSWORD[31:16]																0,1

1) The MEM BANK is structured as 00 (Reserved), 01 (EPC), and 10 (TID). For chips that have a User memory area, the MEM BANK is configured as 11.

2) The RESERVED Field area is used to store Security-related Access Passwords (4 bytes) and Kill Passwords (4 bytes). The initial values for the Access and Kill Passwords are stored as 00 00 00 00 and 00 00 00 00, respectively.

3) The TID Field area is where the tag manufacturer inputs their unique ID Data during production and it is shipped with this information. This area is not typically used by general users.

4) The EPC field area consists of 16 bytes ranging from 0 to 15. Among these, bytes 2 to 15 (14 bytes in total) are the user-assignable data area where users can input their desired data. Bytes 0 and 1 (2 bytes in total) are the CRC-16 area, and users must not change these bytes arbitrarily. Bytes 2 and 3 (2 bytes in total) are the PC (Protocol Control) area, which defines the data length of the memory area.

5) “>RFW command” can be used to Read/Write data in the EPC Address field.



If the First Byte number is 4 and the Number of Bytes is 12, user can Read/Write data in the EPC Address field from 4 to 15.

2-5 EPC/USER Field length and PC value

• The Protocol-Control (PC) area is a memory section that defines the length of the EPC data.

In general, the default configuration for an EPC Gen2 RFID tag sets the PC to a fixed 96-bit EPC memory length. However, by adjusting the Protocol-Control (PC) bits, you can modify the length of both the EPC and User memory.

Higgs 3 EPC/User Length and PC Values

Protocol-Control(PC)		EPC Memory Length	User Memory Length
Bits setting	Hex Value		
0011 0xxx	0x3000	96bit	512bit
0011 1xxx	0x3800	112bit	448bit
0100 0xxx	0x4000	128bit	448bit
0100 1xxx	0x4800	144bit	448bit
0101 0xxx	0x5000	160bit	448bit
0101 1xxx	0x5800	176bit	384bit
0110 0xxx	0x6000	192bit	384bit
0110 1xxx	0x6800	208bit	384bit
0111 0xxx	0x7000	224bit	384bit
0111 1xxx	0x7800	240bit	320bit
1000 0xxx	0x8000	256bit	320bit
1000 1xxx	0x8800	272bit	320bit
1001 0xxx	0x9000	288bit	320bit
1001 1xxx	0x9800	304bit	256bit
1010 0xxx	0xA000	320bit	256bit
1010 1xxx	0xA800	336bit	256bit
1011 0xxx	0xB000	352bit	256bit
1011 1xxx	0xB800	368bit	192bit
1100 0xxx	0xC000	384bit	192bit
1100 1xxx	0xC800	400bit	192bit
1101 0xxx	0xD000	416bit	192bit
1101 1xxx	0xD800	432bit	128bit
1110 0xxx	0xE000	448bit	128bit
1110 1xxx	0xE800	464bit	128bit
1111 0xxx	0xF000	480bit	128bit

Higgs 9 EPC/User Length and PC Values

Protocol-Control(PC)		EPC Memory Length	User Memory Length
Bits setting	Hex Value		
0011 0xxx	0x3000	96bit	688bit
0011 1xxx	0x3800	112bit	624bit
0100 0xxx	0x4000	128bit	624bit
0100 1xxx	0x4800	144bit	624bit
0101 0xxx	0x5000	160bit	624bit
0101 1xxx	0x5800	176bit	560bit
0110 0xxx	0x6000	192bit	560bit
0110 1xxx	0x6800	208bit	560bit
0111 0xxx	0x7000	224bit	560bit
0111 1xxx	0x7800	240bit	496bit
1000 0xxx	0x8000	256bit	496bit
1000 1xxx	0x8800	272bit	496bit
1001 0xxx	0x9000	288bit	496bit
1001 1xxx	0x9800	304bit	432bit
1010 0xxx	0xA000	320bit	432bit
1010 1xxx	0xA800	336bit	432bit
1011 0xxx	0xB000	352bit	432bit
1011 1xxx	0xB800	368bit	368bit
1100 0xxx	0xC000	384bit	368bit
1100 1xxx	0xC800	400bit	368bit
1101 0xxx	0xD000	416bit	368bit
1101 1xxx	0xD800	432bit	304bit
1110 0xxx	0xE000	448bit	304bit
1110 1xxx	0xE800	464bit	304bit
1111 0xxx	0xF000	480bit	304bit
1111 1xxx	0xF800	496bit	240bit

- This document is based on the higgs-3 and higgs-9 standards.
- When the EPC memory length is changed, the user memory length is automatically adjusted accordingly.
- The memory length is changed only in word units.
- For detailed information, refer to the EPC Gen2 Specification.
- A customer who wants to encode data of 240 bits (30 bytes) in the EPC area can set the Protocol-Control (PC) to '0x7800' and use it as follows.

>RFW,H,2,32,'**7800**11223344556677889900112233445566778899001122334455667788990011223344556677889900'

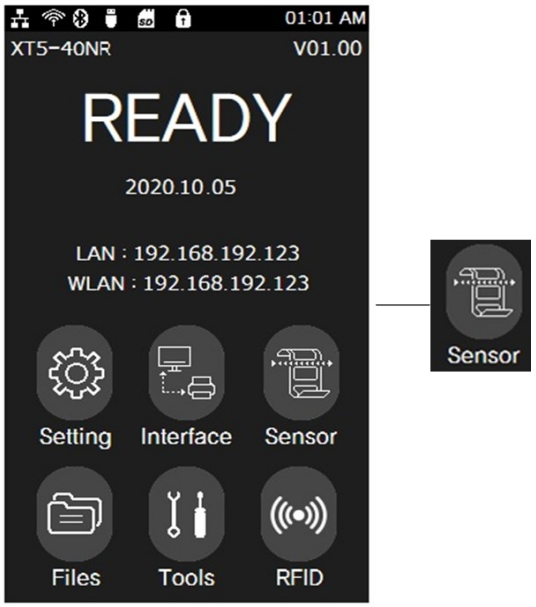
3. RFID Printer Setting

To use an RFID printer, the following configuration steps are required:

3-1 Media Installation and Auto Calibration

• To ensure accurate RFID operation, it is important to first install the media correctly. You must run the sensor auto-calibration mode according to the type of media installed. For detailed media installation instructions, refer to the User's Manual specific to your model. After installing the media, execute the auto-calibration mode that corresponds to the media type.

No	Model	Operating Status
1	SLP-TX40xR	* Gap Sensor Auto-Calibration Mode In the standalone configuration mode, when the 4th LED status (LED 1: orange / LED 2: green - blinking 4 times) is displayed, pressing the Feed button activates the Gap Sensor Auto-Calibration Mode. * Black Mark Sensor Auto-Calibration Mode In the standalone configuration mode, when the 5th LED status (LED 1: orange / LED 2: orange - blinking 4 times) is displayed, pressing the Feed button activates the Black Mark Sensor Auto-Calibration Mode.

<table>
<tr>
<td>2</td>
<td>XT5-4xNR</td>
<td>


* Gap Sensor Auto-Calibration Mode
In the print-ready mode, press the Sensor → Gap Calibration menu initiates the Gap Sensor Auto-Calibration Mode.

* Black Mark Sensor Auto-Calibration Mode
In the print-ready mode, press the Sensor → Black Mark Calibration menu activates Black Mark Sensor Auto-Calibration Mode.
</td>
</tr>
<tr>
<td>3</td>
<td>XD5-4xtR</td>
<td>


* Gap Sensor Auto-Calibration Mode
In the print-ready mode, navigate to Sensor → Gap Cal (Gap Calibration), and then press Function Button 1 ( ) to activate the Gap Sensor Auto-Calibration Mode.

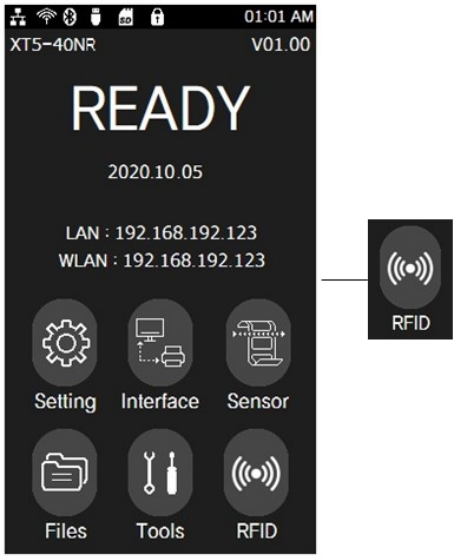
* Black Mark Sensor Auto-Calibration Mode
In the print-ready mode, navigate to Sensor → Black Mark Cal (Black Mark Calibration), and then press Function Button 1 ( ) to activate the Black Mark Sensor Auto-Calibration Mode.
</td>
</tr>
</table>

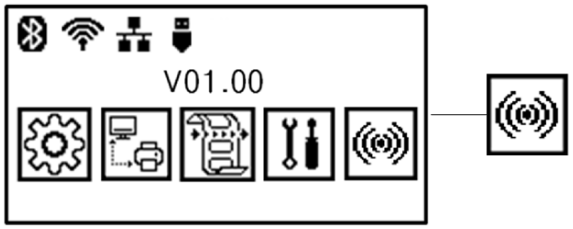
3-2 RFID Transponder (Encoding) Location and Transmission Power Calculation

• When the RFID transponder's (encoding) location and transmission power are incorrectly set, it can result in improper RFID encoding. To calculate the optimal coding position (read/write position of the transponder) and transmission power of the RFID label, this method is used.

Before determining the RFID Transponder (Encoding) position and Strength, the “3-1 Media Installation and Auto Calibration” process must be normally completed.

1) LCD Menu

No	Model	Operating Status
1	XT5-4xNR	 When using RFID → RFID Calibration menu is pressed, the RFID Transponder (Encoding) position and transmission power are automatically calculated and stored. ※ Depending on the tag type and tag length, the calibration process may take a few minutes. ※ During the calibration process, approximately 2 to 5 media sheets may be ejected, depending on the tag type and length.

2	XD5-4xtR	 When using RFID → RFID Calibration menu is pressed, the RFID Transponder (Encoding) position and transmission power are automatically calculated and stored. ※ Depending on the tag type and tag length, the calibration process may take a few minutes. ※ During the calibration process, approximately 2 to 5 media sheets may be ejected, depending on the tag type and length.

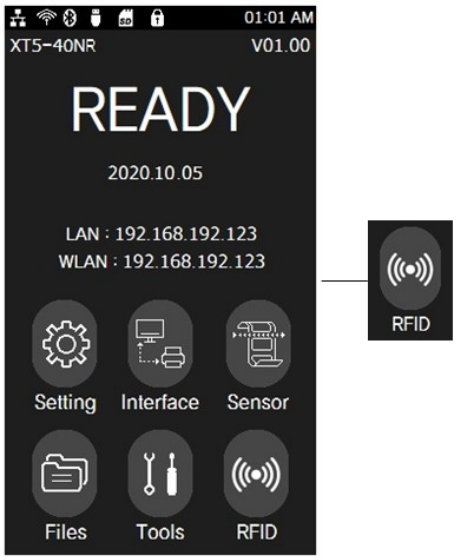
2) Using Commands

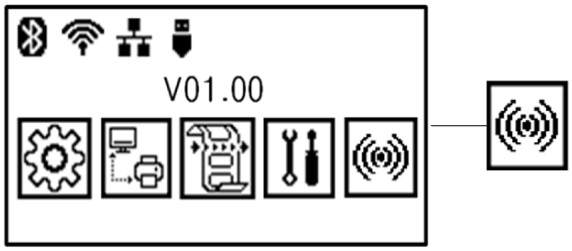
Send the command ">RFCP" to the printer.
When the printer receives the command ">RFCP", it automatically calculates the optimal coding position value and transmission power, and stores them in the printer. The stored values remain intact and permanently stored even when the printer is turned off.

3-3 Manual Setting of RFID Transponder (Encoding) Location and Transmission power

• When the RFID transponder's (encoding) position and transmission power are incorrectly set through RFID calibration, and RFID coding does not function properly, the optimal coding position (read/write position of the transponder) and transmission power of the RFID label can be manually adjusted.

1) LCD Menu

No	Model	Operating Status
1	XT5-4xNR	 * Setting Transponder Coding Position Navigating RFID → RFID Setup → Pressing Transponder Coding Position menu, the RFID write position can be configured. * Setting Transmission power Navigating RFID → RFID Setup → Pressing Transmission Power menu, the read/write transmission power of the RFID module can be configured.

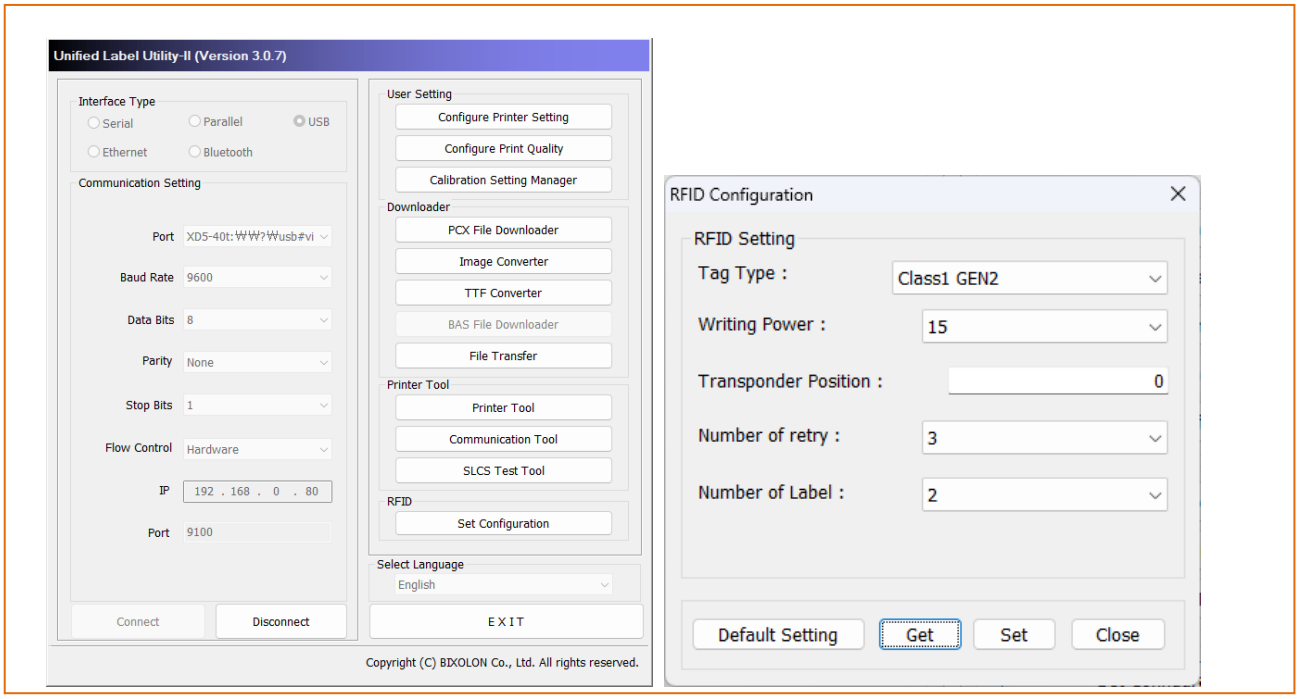
2	XD5-4xtR	 * Setting Transponder Coding Position Navigating RFID → Settings → Pressing Position menu, the coding position for RFID transponders can be configured. * Setting Transmission power Navigating RFID → Settings → Pressing Power menu, the transmission power for the RFID module can be adjusted.

2) Utility Program (Unified Label Utility-II)

To configure the RFID Transponder position and transmission/receive strength, the Unified Label Utility-II software can be used.

The utility program, Unified Label Utility-II, can be downloaded from the BIXOLON website (www.bixolon.com).

Ensure that the printer is connected, then run the utility program and configure the communication settings. Once done, click the "Set configuration" button on the RFID BOX.



(1) When the "Get" button is pressed, the RFID settings stored in the printer will be displayed.

(2) After verifying the RFID settings, manually enter the values for Writing Power and Transponder Position.

(3) Press the "Set" button to store the RFID Transponder position and transmission power values in the printer.

3) Use of Commands

* Transponder Coding Positing Setting
  By sending ">RFTP" command, the transponder coding position can be set.

Example
>RFTP, 200

※ Once the printer receives the command, it will store the coding position value.
※ The stored value will remain intact and permanently stored even when the printer is turned off.

* Transmission power Setting
  By sending ">RFTP" command, the transponder coding position can be set.

Example
>RFP,18

※ Once the printer receives the command, it will store the transmission strength value.
※ The stored value will remain intact and permanently stored even when the printer is turned off.

4. RFID Printer Operation Sequence

The basic operation sequence of an RFID printer is as follows.

4-1 RFID Printer Operation Sequence

No	Model	Operating Status
1	SLP-TX40xR	Start Printing → Feed → RFID Transponder Coding Stop when (Write/Read) Position is reached → (RFID Transponder Unlock) → (RFID Data Write) → (RFID Transponder Lock) → Printing → Printing Completion
2	XT5-4xNR XD5-4xtR	* If the RFID transponder coding position is less than 0. Start printing → Feed → RFID Transponder Coding Stop when (Write/Read) position is reached → (RFID Transponder Unlock) → (RFID Data Write) → (RFID Transponder Lock) Printing → Print Completion * When the RFID transponder coding position is greater than 0 Start printing → Print → Stop when RFID transponder coding (Write/Read) position is reached → (RFID Transponder Unlock) → (RFID Data Write) → (RFID Transponder Lock) Resume printing → Printing completion

4-2 Write/Read Operating Status

No	Model	Operating Status
1	SLP-TX40xR	- Write/Read Success: Green LED blinking - Write/Read Failure: Red LED blinking and black lines printing (If number of write failures exceeds the set value of “Number of retry”) - Write/Read Error: Red LED continuous blinking (If number of write failures exceeds the set value of “Number of label”)
2	XT5-4xNR XD5-4xtR	Write/Read Failure: Black lines printing (If number of write failures exceeds the set value of “Number of retry”)

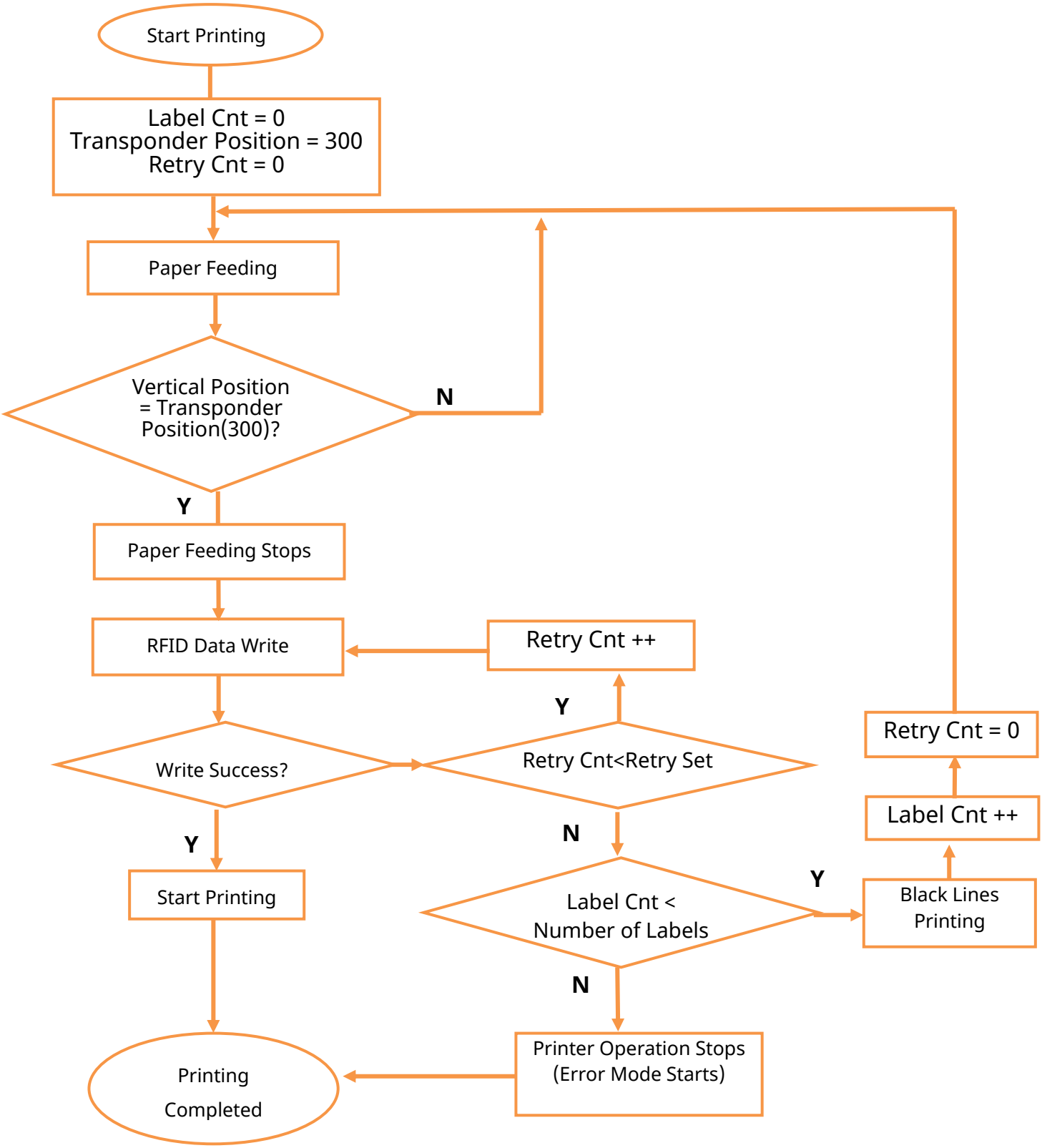
4-3 RFID Data Write Examples

1) Basic Set Value
- Retry Set = 3
- Number of label =2

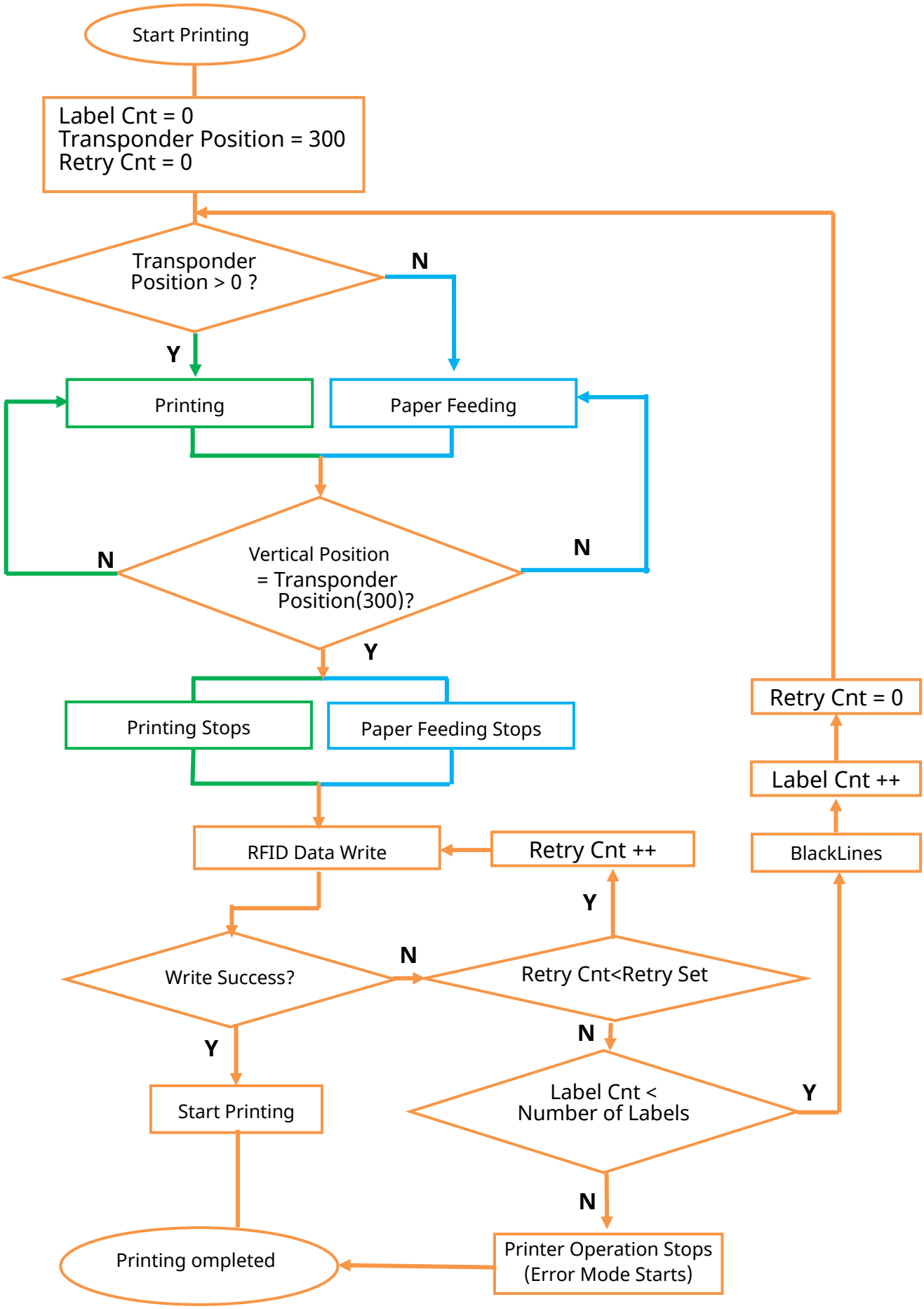
2) Command Coding Value

```
>RFS,5,3,2,15
T50,50,3,1,1,0,0,N,N,'Label Printer Test 1'
>RFW,A,4,12,’ABCDEFABCDEF’
P1
```

3) Flow chart (TX40xR)



4) Flow chart (XT5-4xNR, XD5-4xtR)

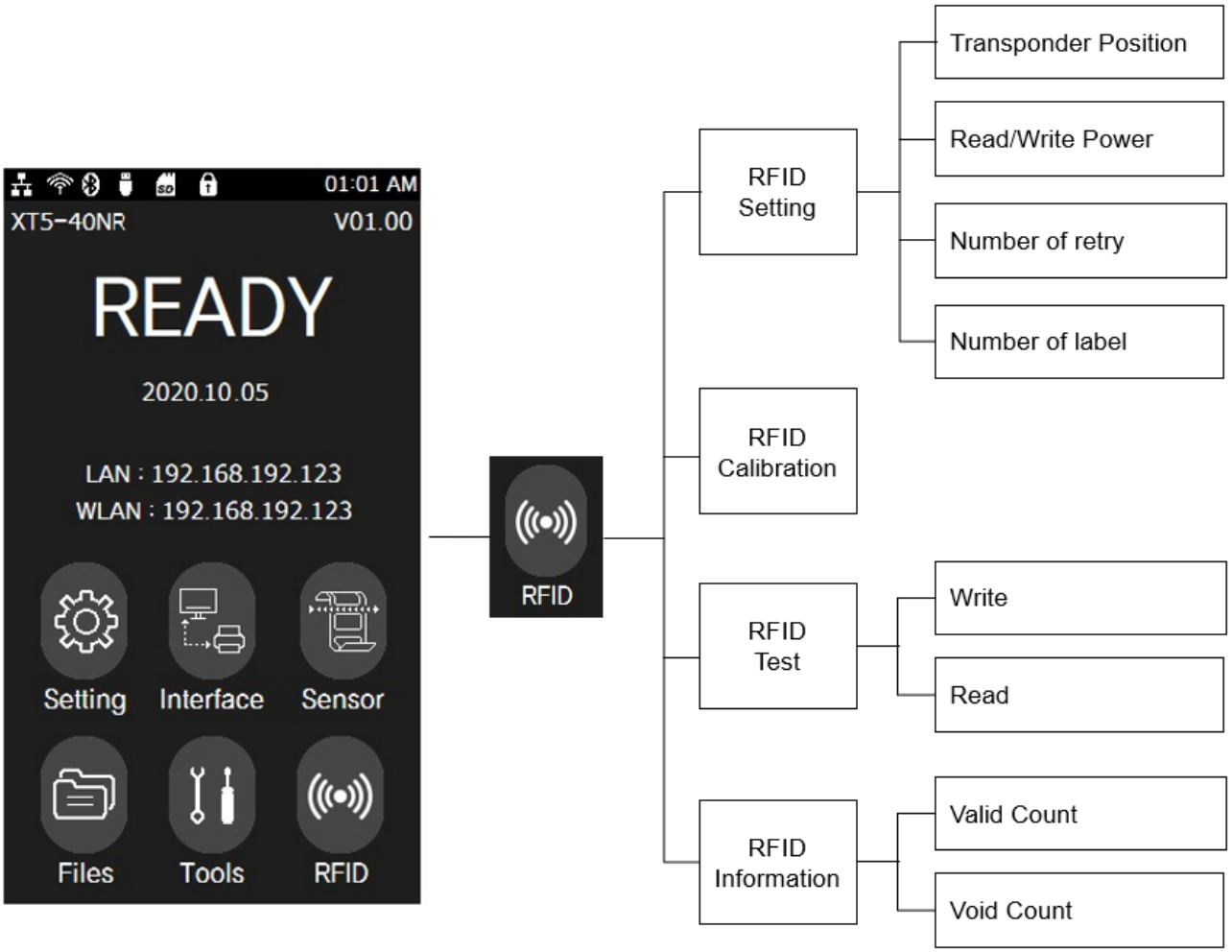


5. RFID Menu

For LCD models, the RFID menu is structured as follows.

5-1 XT5-4xNR Menu

• For XT5-4xNR models, main screen and RFID menu are structured as follows.



5-1-1 XT5-4xNR Menu Instructions

1. Transponder Coding Position

Path	RFID→ RFID Setting→ Transponder Coding Position
Explanation	RFID write position setting suitable for RFID paper characteristics The value can be set by user or by automatic RFID calibration.
Default value	0(dot)
Variable Value	-300 ~ +32000 (203dpi) -450 ~ +30000 (300dpi) -900 ~ +24000 (600dpi)

2. Transmission power

Path	RFID→ RFID Setting→ Transmission power
Explanation	RFID module read/write transmission power setting The value can be set by user or by automatic RFID calibration.
Default value	15(*10dbm)
Variable Value	0 ~ 30

3. Number of Retry Coding

Path	RFID→ RFID Setting→ Number of Retry Coding
Explanation	Number of retry setting in case of RFID coding failures If the RFID transponder is unstable and the write attempt fails, increase the value and try again. Use the same value as configured for subsequent write attempts to the same transponder.
Default value	3
Variable Value	0 ~ 10

4. Retry Label Counts

Path	RFID→ RFID Setting→ Retry Label Counts
Explanation	Number of retry labels in case of RFID label write failures If the RFID transponder is unstable and the write attempt fails, increase the value and try again. Use the same content for subsequent write attempts on the next label.
Default value	2
Variable Value	0 ~ 10

5. RFID Calibration

Path	RFID→ RFID Calibration
Explanation	The function automatically calibrates the coding position and transmission power of RFID labels. - Calibration is performed for the installed transponder. The printer moves the media while determining the optimal transponder position and strength. - After installing the RFID media and performing gap or black mark calibration, feed one piece of media to align the tear-off position, and then start the RFID calibration.

6. RFID Test

Path	RFID→ RFID Test
Explanation	Write and Read Test function, using the configured RFID position and transmission power - After moving to the configured RFID position, try to write and read data to the transponder, using the configured transmission power. - Perform data writing from the 4th Byte to the 12th Byte of the EPC area. If write succeeds, a success message will be displayed on the screen. - Perform data reading from the 4th Byte to the 12th Byte of the EPC area. If read succeeds, hex value will be displayed on the screen.

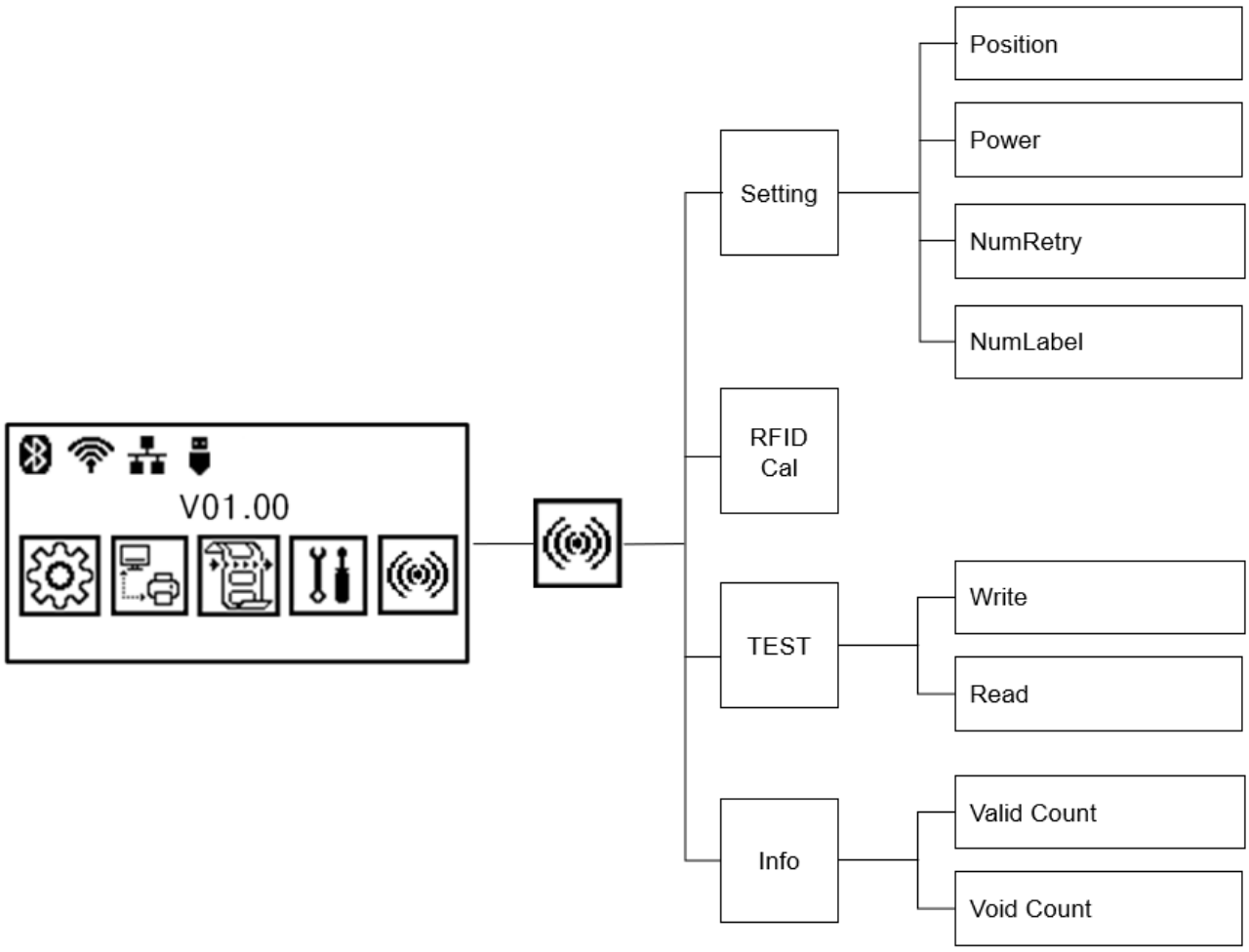
7. RFID Data

Path	RFID→ RFID Data
Explanation	The function to check or initialize the stored RFID success/failure values  This function displays the number of successful and failed read/write commands executed on the transponder so far. This function can also be used to initialize success/failure counts.

5-2 XD5-4xtR Menu

• For the XD5-4xtR model, the main screen and RFID menu are structured as follows.

This model supports LCD display in English only.



5-2-1 XD5-4xtR Menu Instructions

1. Transponder Coding Position

Path	RFID→ Setting(RFID Setting)→ Position(Transponder Coding Position)
Explanation	RFID write position setting suitable for RFID paper characteristics This function displays the number of successful and failed read/write commands executed on the transponder so far. This function can also be used to initialize success/failure counts.
Default value	0(dot)
Variable Value	-300 ~ +8000 (203dpi) -450 ~ +12000 (300dpi)

2. Transmission Power

Path	RFID→ Setting(RFID Setting)→ Power(Transmission Power)
Explanation	Setting for RFID module read/write transmission power The value can be set by user or by automatic RFID calibration.
Default value	15(*10dbm)
Variable Value	0 ~ 30

3. Number of retry coding

Path	RFID→ Setting(RFID Setting) → NumRetry(Number of retry coding)
Explanation	Setting the number of retry in case of RFID coding failures If the RFID transponder is unstable and the write attempt fails, increase the value and try again. Use the same value as configured for subsequent write attempts to the same transponder.
Default value	3
Variable Value	0 ~ 10

4. Number of retry labels

Path	RFID→ RFID Setting→ Number of retry labels
Explanation	Number of retry labels in case of RFID label write failures If the RFID transponder is unstable and the write attempt fails, increase the value and try again. Use the same content for subsequent write attempts on the next label.
Default value	2
Variable Value	0 ~ 10

5. RFID Calibration

Path	RFID→ RFID Calibration
Explanation	Automatic calibration function for RFID label coding position and transmission power The function calibrates the installed transponder. By moving the media and printer, the optimal position and strength of transponder are calibrated. - After installing the RFID media and performing gap or black mark calibration, feed one piece of media to align the tear-off position, and then start the RFID calibration.

6. RFID Test

Path	RFID→ RFID Test
Explanation	Write and Read Test function, using the configured RFID position and transmission power - After moving to the configured RFID position, attempt to write and read data to the transponder, using the configured transmission power. - Perform data writing from the 4th Byte to the 12th Byte of the EPC area. If write succeeds, a success message will be displayed on the screen. - Perform data reading from the 4th Byte to the 12th Byte of the EPC area. If read succeeds, hex value will be displayed on the screen.

7. RFID Data

Path	RFID→ RFID Data
Explanation	The function to check or initialize the stored RFID success/failure values This function displays the number of successful and failed read/write commands executed on the transponder so far. This function can also be used to initialize success/failure counts.

6. RFID Label Design

For RFID Label design, the following values need to be set first.
(Refer to “3. RFID Printer Setting”)

- RFID Transponder Type (Tag type)
- Number of Retry Label
- Number of Retry Coding
- Transmission power
- Coding position of RFID label

6-1 Write to labels in ASCII Type

• Gen2 96-bit data to be written to labels in ASCII Type

1) Command

Line	SLCS Command	Description
1	T100,100,3,1,1,0,0,N,N,'Wirte example'	Print "Write example" at the (100, 100) position on the label
2	>RFW,A,4,12,'ABCDEFABCDEF'	W,A: Write ASCII 4,12: from 4th Byte to 12th Byte in the EPC Write Data: ABCDEFABCDEF
3	P1	Start Printing

2) Label Output



(RFID transponder input value: ABCDEFABCDEF)

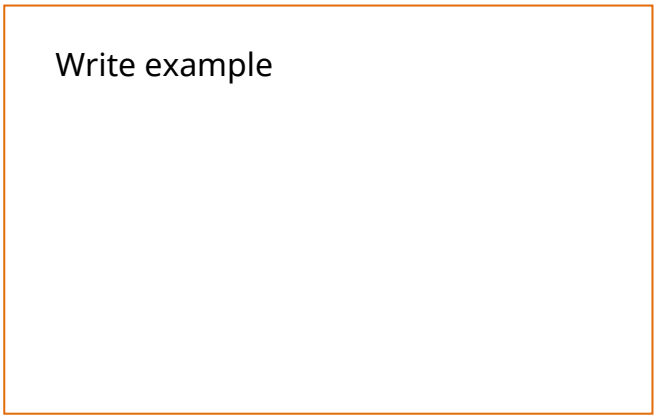
6-2 To write in hexadecimal format on a label

• To write Gen2 96-bit data in hexadecimal format on a label

1) Command

Line	SLCS Command	Description
1	T100,100,3,1,1,0,0,N,N,'Wirte example'	Print "Write example" at the (100, 100) position on the label
2	>RFW,H,4,12,'112233445566778899001122'	W,H: Write Hex 4,12: from 4th Byte to 12th Byte in the EPC Write Data: 112233445566778899001122
3	P1	Start Printing

2) Label Output



(RFID transponder input value: ABCDEFABCDEF)

6-3 To read in ASCII format and transmit to the Host

• To read in ASCII format and transmit to the host.

1) Command

Line	SLCS Command	Description
1	>RFR,A,4,12,S P1	R,A: Read ASCII 4,12: from 4th Byte to 12th Byte in the EPC S: Transmit data to the Host

2) Results after action

- Stored data in RFID transponder: ABCDEFABCDEF
- Data transmitted to the Host: ABCDEFABCDEF

6-4 To read in Hexadecimal format and transmit to the Host

• To read the data stored in RFID transponder in Hexadecimal format and transmit to the Host

1) Command

Line	SLCS Command	Description
1	>RFR,H,4,12,S P1	R,H: Read Hex 4,12: from 4th Byte to 12th Byte in the EPC S: Transmit data to the Host

2) Results after action

- Stored data in RFID transponder: 11223344556677889900 1122
- Data transmitted to the Host: 11223344556677889900 1122

7. RFID Commands

>RFS - RFID Setup

Description

To set up the RFID transponder type, number of retry coding (Write/Read Retries), number of labels, transmission power

Syntax

>RFS, p1, p2, p3, p4

Parameter

p1 : RFID Transponder Type

0 = none
1 = ISO 18000-6 Type A
2 = ISO 18000-6 Type B
3 = EPC Class 0
4 = EPC Class 1
5 = EPC Class 1 Generation 2

p2 : To set the number of retry coding (Write/Read Retries) if coding fails
Can be set to between 0 ~ 10 times.
Default value : 3 times

p3: To set the number of labels if RFID label write fails
0 ~ 10 times
Default value : 2 times

p4: To adjust the transmission power (0~30)
0 : minimum power output
30: maximum power output



When installing RFID labels on a printer for the first time or when changing labels, it is essential to perform these steps..

Example

GEN2 Tag, Write/Read Retries =4, Number of label=2, Transmission power =15,
>RFS,5,4,2,15

>RFCP - RFID Calibration of Transponder Position

Description

After calculating the optimal coding position (read/write position of the transponder) for RFID labels, store the result in the printer for printing.

Syntax

>RFCP

Example

After calculating the optimal coding position, store the result in the printer.

>RFCP

Instruction

1) Install RFID label and turn on the power
2) Execute Media Calibration and recognize the RFID Label (Tag)
3) Transmit command “>RFCP” to printer.
4) When the printer receives the command ">RFCP," it automatically calculates the optimal coding position and stores the value in its memory. This stored value remains intact and permanently stored even when the printer is turned off.

- Position values can be transmitted to the host using the “>RFI” command.
- The “>RFS” command must be executed before use.
- The steps must be performed whenever RFID label type changes.

>RFP - Read /Write Power Control

Description

To set transmission power (Read/Write Power)

Syntax

>RFP, p1

Parameter

p1: Adjustment of transmission power (0~30)
0: minimum power output
30: maximum power output
Default value: 15

Example

>RFP,18
Adjust the transmission power to 18

>RR - Set Write/Read Retries & Number of Label

Description

Setting the number of retry coding and retry label if Read/Write fails

Syntax

>RR, p1, p2

Parameter

p1: If coding fails, number of retry to be set (Number of retry)
Default value: 3

P2: If RFID label Write fails, number of labels to be set (Number of label)
Default value: 2

Example

> (5 Times Retry, Label 3 sheets retried)

>RFTP - Trans Position

Description

To set coding position (Read/Write Position of transponder) manually on RFID label

Syntax

>RFTP, p1

Parameter

p1: Coding position (y axis value) on RFID label
Default value: 0(dot)

- The ">RFTP" command is used to change the optimal coding position calculated by the previous ">RFCP" command. Therefore, extra caution is required when using it.
- When the coding position of the RFID label is not precisely known, it is recommended to use the ">RFCP" command.

Example

Coding position of an RFID label is to be set to 400.
> RFTP,400

>RFES - define EPC data Structure

Description

To define EPC data structure to write EPC Data

Syntax

>RFESn,'p1,p2,p3,.....p15'

Parameter

n : total bit of a field

p1,....p15: bits of each field (using decimal notation)

Example

If total bit: 64bit,
field1 bit: 2bit,
field2 bit: 3bit,
field3 bit: 14bit,
field4 bit: 20bit,
field5 bit: 25bit,

```
>RFES64,'2,3,14,20,25'
>RFW,E,'0,3,12345,454332,22111221'
P1
```

- The configured EPC data structure is deleted when the printer's power is turned off.
- The EPC data structure needs to be reconfigured after each power reset.

>RF - RFID Read / Write

Description

To Read or Write an RFID label.

Syntax

>RFn, p1, (p2), (p3), (p4), ('DATA')

Parameter

n: Select functions
W = RFID Label Write
R = RFID Label Read

p1: Data type
A =EPC Area (ASCII)
H =EPC Area (Hexadecimal)
E =EPC Area (bits per field)
U =User Area (Hexadecimal)

p2: Starting Byte number
Default: 4 (To be set in units of 2 bytes)

p3: Number of Bytes to Read or Write
Default: 12 (To be set in units of 2 bytes)

p4: Data processing method after Read (No need for Write)
S = Transmit the Reading Value to Host

DATA: A(ASCII) = Data input in ASCII Type
H(Hexadecimal) = Data input in Hex Type
E(EPC) =
Data input in EPC type (Not to be higher than set number of bits per field)



- For the Write command, it is not executed immediately upon receiving the command. Instead, it is activated when P command starts print work and the printing reaches the RFID coding position.
- For the Read command, it is executed immediately after being received by the printer. It moves to the RFID coding position and performs the Read operation.

Example

Writing

A(EPC ASCII)	>RFW,A,4,12,'123456789ABC' P1
H(EPC Hexadecimal)	>RFW,H,4,12,'313233343536373839414243' P1
E(EPC bit per each field)	>RFES96,'8,8,8,8,8,8,8,8,8,8,8,8' >RFW,E,'49,50,51,52,53,54,55,56,57,65,66,67' P1

Reading

>RFR,A,4,12,S (Transmit Reading value to Host)
Value stored in RFID transponder: 123456789ABC
Host transmitted Data: 123456789ABC

>RFZ - RF Password

Description

To set the RFID Access Password and Kill Password.

Syntax

>RFZ,'p1, p2, p3, p4'

Parameter

p1: Old Access Password 4Byte (Access Password currently in use)
p2: Old Kill Password 4Byte (Kill Password currently in use)
p3: New Access Password 4Byte (Access Password to be corrected)
p4: New Kill Password 4Byte (Kill Password to be corrected)



- When using the Lock command, the desired password must be set each time.
- When using the Unlock command, the password that already configured on the tag must be used.
  (The initial setting value is all zero, i.e., 00 00 00 00)

Example

>RFZ,'00000000, 00000000, 33333333, 33333333'

>RFLK - RF Lock

Description

Access Password can lock Kill/Access/EPC Data.

- Kill Password Read/Write Lock
- Access Password Read/Write Lock
- EPC Memory Write Lock

Syntax

>RFLK

Example

To lock Tag's Kill/Access/EPC Data.

```
>RFZ,'00000000, 00000000, 33333333, 33333333'
>RFLK
P1
```

- It is essential to execute the ">RFZ" command before use.
- To lock TID/User Data in addition to Kill/Access/EPC Data, use the ">RFLP" command.
- When printing labels or using the P command, the commands are executed at the RFID coding position.

>RFUL - RF UnLock

Description

Access Password can lock Kill/Access/EPC Data.

Syntax

>RFUL

Example

To lock Tag's Kill/Access/EPC Data.

```
>RFZ,'00000000, 00000000, 33333333, 33333333'
>RFUL
P1
```



- It is essential to execute the ">RFZ" command before use.
- To lock TID/User Data in addition to Kill/Access/EPC Data, use the ">RFLP" command.
- When printing labels or using the P command, the commands are executed at the RFID coding position.

>RFLP - RF Lock Payload

Description

The Lock Payload of Tag can be changed by the Access Password.
Lock Payload can be changed by calculating the 3-byte value with reference to below table.

Lock-Command Payload

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	-	-	-	-	20	21	22	23
Access Action		EPC Action		TID Action		User Action		EPC Mask		TID Mask		User Mask		Kill Action						Kill Mask		Access Mask	

Masks and Associated Action Fields

Kill pwd		Access pwd		EPC memory		TID memory		User memory	
0	1	2	3	4	5	6	7	8	9
Skip/ write	Skip/ write	Skip/ write	Skip/ write	Skip/ write	Skip/ write	Skip/ write	Skip/ write	Skip/ write	Skip/ write
10	11	12	13	14	15	16	17	18	19
Pwd Read/ write	Perma Lock	Pwd Read/ write	Perma Lock	Pwd Write	Perma Lock	Pwd Write	Perma Lock	Pwd Write	Perma Lock

Lock action-field functionality

Pwd-write	Perma lock	Description
0	0	Associated memory bank is writeable from either the open or secured states
0	1	Associated memory bank is permanently writeable from either the open or Secured states and may never be locked
1	0	Associated memory bank is writeable from the secured state but not form the open state.
1	1	Associated memory bank is not writeable from any state.
Pwd read/write	**Perma lock**	**Description**
0	0	Associated password location is readable and writeable from either the open or secured states.
0	1	Associated password location is permanently readable and writeable from either the open or secured states and my never be locked
1	0	Associated password location is readable and writeable from the secured but not from the open states.
1	1	Associated password location is not readable writeable from any state.

Syntax

>RFLP,n,’p1,p2,p3’

Parameter

n: Select functions

L: Lock

U: Unlock

p1								p2								p3							
MSB							LSB	MSB							LSB	MSB				LSB			
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	-	-	-	-	20	21	22	23
Access Action		EPC Action		TID Action		User Action		EPC Mask		TID Mask		User Mask		Kill Action						Kill Mask		Access Mask	

Example

1. Kill Password Read/Write Lock
   Access Password Read/Write Lock
   EPC Memory Write Lock

   >RFZ,'00000000,00000000,33333333,33333333'
   >RFLP,L,’A0,82,0A’
   P1

2. Kill Password Read/Write Unlock
   Access Password Read/Write Unlock
   EPC Memory Write Unlock

   >RFZ,'00000000,00000000,33333333,33333333'
   >RFLP,U,’00,08,0A’
   P1

- It is essential to execute the ">RFZ" command before use.
- When using the P command, the commands are executed at the RFID coding position.

>RFI - RF Information

Description

To transmit the current RFID setting data and history data to Host.

Syntax

>RFI, p1

Parameter

p1: Item

1: Tag Type
2: Transmission Power (Read/Write power)
3: Coding Position (Read/Write Position of transponder)
4: Number of Retry
5: Number of Label

Return Value Format

Characters +0x0d +0x0a

Example

>RFI,1	Return Value:GEN2 + 0x0d +0x0a
>RFI,2	Return Value:20 + 0x0d +0x0a

8. RFID Programming example

8-1 RFID Setting

1) After installing the RFID label, turn on the power.

2) Set the RFID Transponder Type, Transponder R/W position, error handling or transmission power by using the **“>RFS” Command.**

Example
>RFS, 5, 3, 2, 15

3) Calculate the optimal RFID transponder coding position (Read/Write Position of Transponder)

- Instructions

(1) Install RFID label and turn on the power.
(2) Execute Media Calibration and recognize RFID Label(Tag).
(3) Send the command ">RFCP" to the printer.
(4) When the printer receives the command ">RFCP", it automatically calculates the optimal coding position value and transmission power, and stores them in the printer. The stored value will remain intact and will be permanently stored even though the printer is turned off.



When installing RFID labels on a printer for the first time or when changing labels, it is essential to perform these steps.

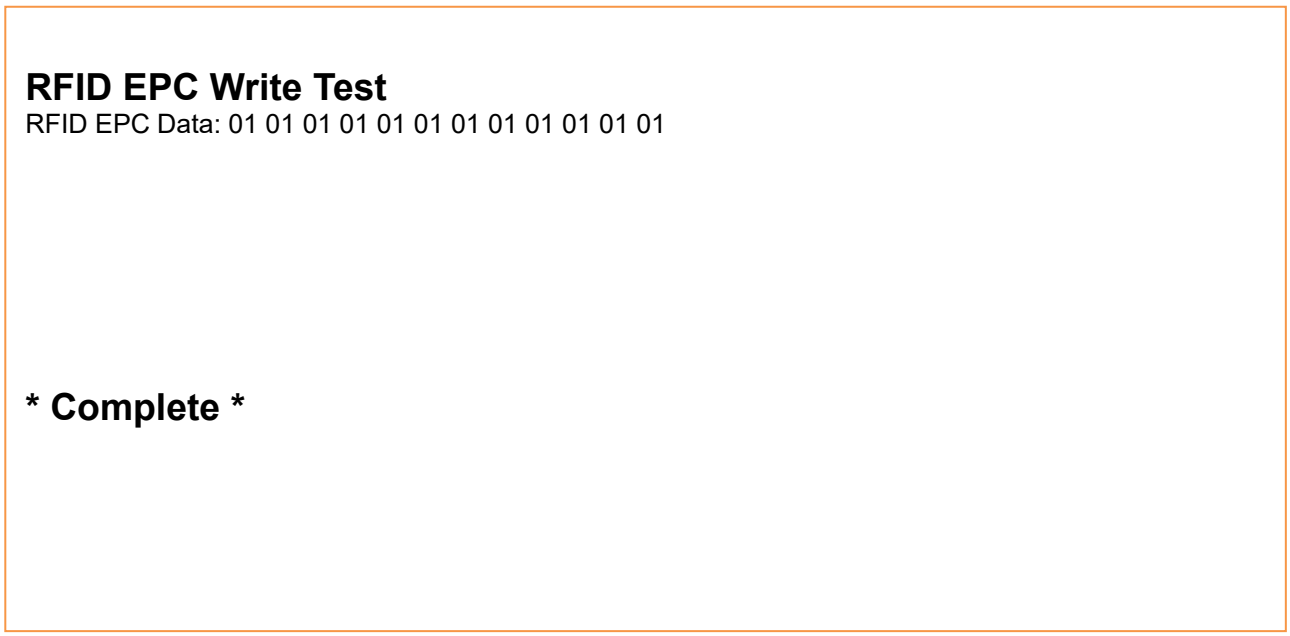
8-2 EPC Data Write (bits per field)

• ">RFW" command is used to write 8 bits per field starting from the 4th byte in the EPC area.

1) Command

```
T56, 32, 4, 1, 1, 0, 0, N, B, 'RFID EPC Write Test'
T57,81,2,1,1,0,0,N,N,'RFID EPC Data: 01 01 01 01 01 01 01 01 01 01 01 01'
>RFES96,'8,8,8,8,8,8,8,8,8,8,8,8'
>RFW,E,'1,1,1,1,1,1,1,1,1,1,1,1'                    → EPC Data Write
T59,351,4,1,1,0,0,N,B,'* Complete *'
P1
```

2) Label Output



3) RFID Transponder Data
: 0x01 0x01 0x01 0x01 0x01 0x01 0x01 0x01 0x01 0x01 0x01 0x01
(EPC: Hexadecimal 12Byte)

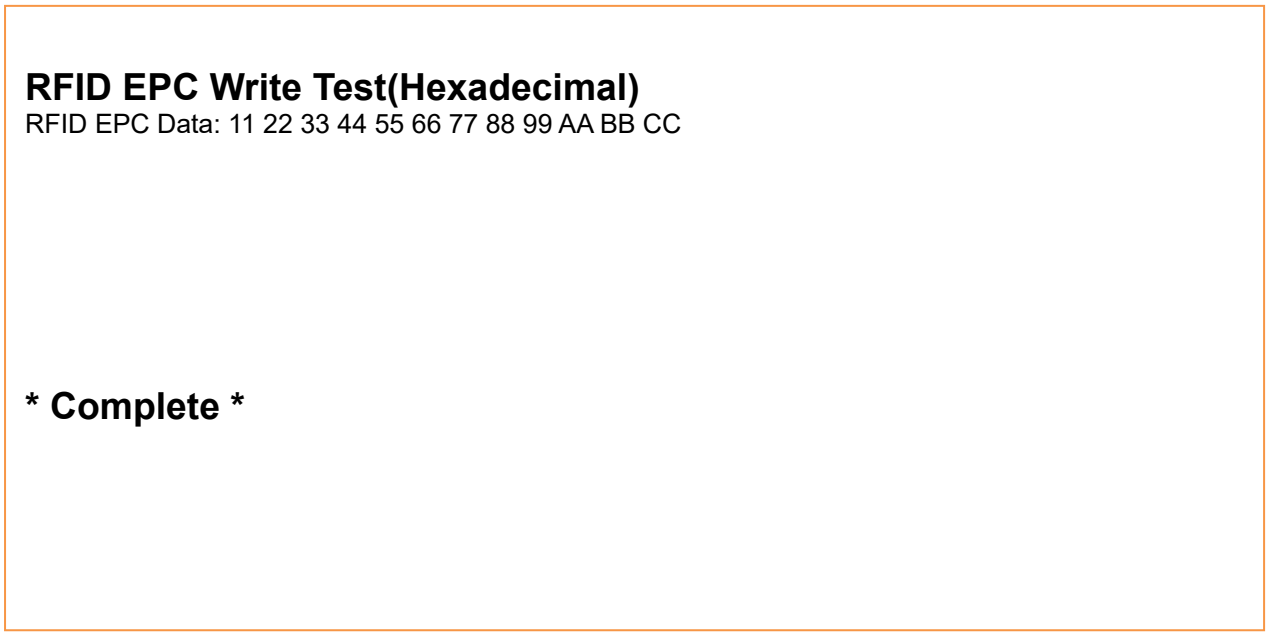
8-3 EPC Data write(Hexadecimal)

• ">RFW" command is used to write a 12-byte hexadecimal data starting from the 4th byte in the EPC area.

1) Command

```
T56,32,4,1,1,0,0,N,B,'RFID EPC Write Test(Hexadecimal)'
T57,81,2,1,1,0,0,N,N,'RFID EPC Data: 11 22 33 44 55 66 77 88 99 AA BB CC'
>RFW,H,4,12,'112233445566778899AABBCC'          → Hexadecimal Data Write
T59,351,4,1,1,0,0,N,B,'* Complete *'
P1
```

2) Label Output



3) RFID Transponder Data
: 0x11 0x22 x33 0x44 0x55 0x66 0x77 0x88 0x99 0xAA 0xBB 0xCC
(EPC: Hexadecimal 12Byte)

8-4 EPC Data write(ASCII)

• ">RFW" command is used to write a 12-byte ASCII data starting from the 4th byte in the EPC area.

1) Command

```
T56,32,4,1,1,0,0,N,B,'RFID EPC Write Test(ASCII)'
T57,81,2,1,1,0,0,N,N,'RFID EPC Data: A B C D E F G H I J K L'
>RFW,A,4,12,'ABCDEFGHIJKL'          → ASCII Data Write
T59,351,4,1,1,0,0,N,B,'* Complete *'
P1
```

2) Label Output



3) RFID Transponder Data
: 0x41 0x42 0x43 0x44 0x45 0x46 0x47 0x48 0x49 0x4A 0x4B 0x4C
(EPC: Hexadecimal 12Byte)

8-5 Secured Write (Write & Lock)

• The ">RFLK" command is used to lock the Access/Kill password/EPC area.

1) Command

>RFZ, '00000000, 00000000, 33333333, 33333333' → **Access/Kill password Change**
T56,32,4,1,1,0,0,N,B,'RFID Write and Lock Test '
T57,81,2,1,1,0,0,N,N,'RFID EPC Data: 01 01 01 01 01 01 01 01 01 01 01 01'
>RFES96,'8,8,8,8,8,8,8,8,8,8,8,8'
>RFW,E,'1,1,1,1,1,1,1,1,1,1,1,1' → EPC Data Write
>RFLK → Lock Kill / Access / EPC Data to Normal
T59,351,4,1,1,0,0,N,B,'* Complete *'
P1

2) Label Output

RFID Write and Lock Test
RFID EPC Data: 01 01 01 01 01 01 01 01 01 01 01 01

*** Complete ***

3) RFID Transponder Data
: 0x01 0x01 0x01 0x01 0x01 0x01 0x01 0x01 0x01 0x01 0x01 0x01
(EPC : Hexadecimal 12Byte)
Kill / Access / EPC Data Lock
(Data cannot be changed unless unlocked.)

8-6 Secured Write (Unlock & Write)

• The ">RFUL" command is used to unlock the Access/Kill password/EPC area.

1) Command

>RFZ, '00000000, 00000000, 33333333, 33333333' → Access/Kill password Change
>RFUL → Unlock locked Kill/Access/EPC Data to enable writing
T56,32,4,1,1,0,0,N,B,'RFID Unlock and Write Test '
T57,81,2,1,1,0,0,N,N,'RFID EPC Data: 01 01 01 01 01 01 01 01 01 01 01 01'
>RFES96,'8,8,8,8,8,8,8,8,8,8,8,8'
>RFW,E,'1,1,1,1,1,1,1,1,1,1,1,1' → EPC Data Write
T59,351,4,1,1,0,0,N,B,'* Complete *'
P1

2) Label Output

RFID Unlock and Write Test
RFID EPC Data: 01 01 01 01 01 01 01 01 01 01 01 01

*** Complete ***

3) RFID Transponder Data
: 0x01 0x01 0x01 0x01 0x01 0x01 0x01 0x01 0x01 0x01 0x01 0x01
(EPC : Hexadecimal 12Byte)

8-7 EPC(PC+Data) & USER 12 Byte Write

The ">RFW" command is used to write 2 bytes of PC data starting from the 2nd byte in the EPC area.
The ">RFW" command is used to write 12 bytes of hexadecimal data starting from the 4th byte in the EPC area.
The ">RFW" command is used to write 12 bytes of hexadecimal data starting from the 0th byte in the USER area.

1) Command

T56,32,4,1,1,0,0,N,B,'RFID EPC(PC+Data) & USER 12Byte Write Test '
T57,81,2,1,1,0,0,N,N,'RFID EPC Data: 31 31 31 31 31 31 31 31 31 31 31 31'
T57,130,2,1,1,0,0,N,N,'RFID USER Data: 32 32 32 32 32 32 32 32 32 32 32 32'
>RFW,H,2,14,'3000313131313131313131313131' → **EPC Data Write(PC= 0x3000)**
>RFW,U,0,12,'323232323232323232323232' → **USER Data Write**
T59,351,4,1,1,0,0,N,B,'* Complete *'
P1

2) Label Output

RFID EPC(PC+Data) & USER 12Byte Write Test
RFID EPC Data: 31 31 31 31 31 31 31 31 31 31 31 31
RFID USER Data: 32 32 32 32 32 32 32 32 32 32 32 32

*** Complete ***

3) RFID Transponder Data
: 0x31 0x31 0x31 0x31 0x31 0x31 0x31 0x31 0x31 0x31 0x31 0x31
(EPC : Hexadecimal 12Byte)
: 0x32 0x32 0x32 0x32 0x32 0x32 0x32 0x32 0x32 0x32 0x32 0x32
(USER : Hexadecimal 12Byte)

8-8 EPC(PC+Data) & USER 14 Byte Write

The ">RFW" command is used to write 2 bytes of PC data starting from the 2nd byte in the EPC area.
The ">RFW" command is used to write 14 bytes of hexadecimal data starting from the 4th byte in the EPC area.
The ">RFW" command is used to write 14 bytes of hexadecimal data starting from the 0th byte in the USER area.

1) Command

```
T56,32,4,1,1,0,0,N,B,'RFID EPC(PC+Data) & USER 14Byte Write Test '
T57,81,2,1,1,0,0,N,N,'RFID EPC Data: 31 31 31 31 31 31 31 31 31 31 31 31'
T57,130,2,1,1,0,0,N,N,'RFID USER Data: 32 32 32 32 32 32 32 32 32 32 32 32'
>RFW,H,2,16,'380031313131313131313131313131'
                                        → EPC Data Write(PC= 0x3800)
>RFW,U,0,14,'32323232323232323232323232'   → USER Data Write
T59,351,4,1,1,0,0,N,B,'* Complete *'
P1
```

2) Label Output

RFID EPC(PC+Data) & USER 14Byte Write Test
RFID EPC Data: 31 31 31 31 31 31 31 31 31 31 31 31 31 31
RFID USER Data: 32 32 32 32 32 32 32 32 32 32 32 32 32 32

*** Complete ***

3) RFID Transponder Data
: 0x31 0x31 0x31 0x31 0x31 0x31 0x31 0x31 0x31 0x31 0x31 0x31 0x31 0x31
(EPC : Hexadecimal 14Byte)
: 0x32 0x32 0x32 0x32 0x32 0x32 0x32 0x32 0x32 0x32 0x32 0x32 0x32 0x32
(USER : Hexadecimal 14Byte)

8-9 EPC(PC+Data) & USER 16 Byte Write

The ">RFW" command is used to write 2 bytes of PC data starting from the 2nd byte in the EPC area.
The ">RFW" command is used to write 16 bytes of hexadecimal data starting from the 4th byte in the EPC area.
The ">RFW" command is used to write 16 bytes of hexadecimal data starting from the 0th byte in the USER area.

1) Command

```
T56,32,4,1,1,0,0,N,B,'RFID EPC(PC+Data) & USER 16Byte Write Test '
T57,81,2,1,1,0,0,N,N,'RFID EPC Data: 31 31 31 31 31 31 31 31 31 31 31 31 31 31'
T57,130,2,1,1,0,0,N,N,'RFID USER Data: 32 32 32 32 32 32 32 32 32 32 32 32 32 32'
>RFW,H,2,18,'4000313131313131313131313131313131'
                                                    → EPC Data Write(PC= 0x4000)
>RFW,U,0,16,'32323232323232323232323232323232'   → USER Data Write
T59,351,4,1,1,0,0,N,B,'* Complete *'
P1
```

2) Label Output

RFID EPC(PC+Data) & USER 16Byte Write Test
RFID EPC Data: 31 31 31 31 31 31 31 31 31 31 31 31 31 31 31 31
RFID USER Data: 32 32 32 32 32 32 32 32 32 32 32 32 32 32 32 32

*** Complete ***

3) RFID Transponder Data
: 0x31 0x31 0x31 0x31 0x31 0x31 0x31 0x31 0x31 0x31 0x31 0x31 0x31 0x31 0x31 0x31
(EPC : Hexadecimal 16Byte)
: 0x32 0x32 0x32 0x32 0x32 0x32 0x32 0x32 0x32 0x32 0x32 0x32 0x32 0x32 0x32 0x32
(USER : Hexadecimal 16Byte)

9. RFID Module Spec

Item		Description
RFID	Frequency	Minimum 860MHz ~ Maximum 960MHz - KC (Korea): 917MHz~923.5MHz - FCC (US): 902MHz~928MHz - CE (Europe): 865MHz~868MHz
	Protocol	ISO 18000-6C / EPC Gen2

Revision History

Ver.	Date	Description
1.00	-	New
1.10	-	Flow chart added
2.00	23.06.14	Addition of EPC/USER Field length and PC value Addition of detailed description of printer setting Addition of RFID menu tree Addition of RFID programming examples Addition of module specification