Specification for Proposal

Model Name : NC-900

TTCNC Co., Ltd.

AF05-0072,AF05-0073, 202, Dasanjigeum-ro, Namyangju-si, Gyeonggi-do, Republic of Korea
Tel : +82-70-8226-1006 Fax : +82-031-560-9956 URL: www.ttcnc.co.kr

SUBJECT Specification for Proposal

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EDIT DATE 2023년 4 월 14 일 Editor KHOON CHO

Revision History

Date	Version	Editor	Revision History
2022-07-05	1.0	DY Yang	Initial release
2023-02-17	1.1	DY Yang	Addition of OTA function
2023-02-17	1.2	DY Yang	Added GET_AUTOMODE, GET_MIFAREKEY, RESTART
2023-03-20	1.3	KHOON Cho	415KCU7-4 MCU, EXT. RESET
2023-04-14	1.4	KHOON CHO	Translation in English

PURSOE

Approval sheet of (NC-900)Model (Support Smartphone NFC[Androide /iphone] , ISO1443A CARD , Mifare Classic , T-Money , Cash-Bee , card by Ministry of Environment)

STATE

COMPLETED

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INDEX

1. GENERAL DESCRIPTION 6

1.1. GENERAL DESCRIPTION 6

1.2. GENERAL SPECIFICATION 6

1.3. RF SPECIFICATION 7

2. HARDWARE COMPOSITION 8

2.1. OUTLINE DIMENSIONS 8

*2.1.1. SIZE 50*40MM 8*

2.2. SERIAL INTERFACE (CN1) / (CONNECTOR : 12505-05 PIN) 9

3. ELECTRO-OPTICAL CHARACTERISTIC 10

3.1. ELECTRICAL CHARACTERISTICS 10

3.2. ENVIRONMENTAL CHARACTERISTICS 10

4. BOARD APPEARANCE 11

4.1. BOARD APPEARANCE 11

4.2. BOARD SPECIFICATION 11

4.3. BOARD VERSION INFORMATION 11

4.5. ARTWORK PCB SIZE 50*40MM 14

4.5.1. Top Side 14

4.5.2. Middle Side 14

4.5.3. Bottom Side 15

4.5.4. Assembly Top 16

4.5.5. Assembly Bottom 16

5. CIRCUITRY 17

5.8. ANTENNA INFORMATION 22

6. PROTOCOL 23

6.1. OPERATING MODE 23
6.2. HOST COMMAND 23
6.3. OPERATION DESCRIPTION 24
6.3.1. UART TTL I/O communication specification 24
6.3.2. Command frame format 25
6.3.3. RESPONSE FRAME FORMAT 26
6.3.4. EXAMPLE of HOST COMMAND and RESPONSE 27
6.3.5. RF ON 28
6.3.6. REQUEST 28
6.3.7. SET_MIFARE_KEY 28
6.3.8. GET_MIFARE_KEY 29
6.3.9. CARD ID 30
6.3.10. AUTOMODE ON 32
6.3.11. AUTOMODE OFF 32
6.3.12. GET AUTOMODE 33
6.3.13. RF OFF 33
6.3.14. RESTART 34
6.4. NC-900'S FACTORY DEFAULT MODE 34

7. OTA FUNCTION 36

7.1. CONCEPT 36
7.2. DOWNLOAD START PROTOCOL 36
7.3. FIRMWARE IMAGE DOWNLOAD PROTOCOL 36

8. OPERATING METHOD 37

8.1. CONCEPT 37
8.2. INITIALIZATION OF READER MODULE 37
8.3. H/W RESET OF READER MODULE 37
8.4. READER MODULE OPERATION 37
8.5. MESSAGE RECEPTION INTERVAL OF READER MODULE 38
8.6. OPERATION METHOD OF READER MODULE 38
8.6.1. Operating process of Passive method(AUTOMODE OFF) 38
8.6.2. Operating process of AUTOMODE ON 39

9. WARRANTY 41

10. OTHERS 43

11. MANUFACTURING PROCESS 44

12. RELIABILITY TEST 45

13. WARNING 46

14. PACKING 47

14.1. PACKING QUANTITY 47
14.2. PACKING METHOD 47
14.3. OUTER BOX LABEL SPECIFICATION 48
14.3.1. Outer Box Label 48
14.3.2. OUTBOX Outer / Safety Letter 49

15. REVISION HISTORY 50

1. General description

1.1. General Description

NC-900 is a module to be embedded a RFID/NFC wireless communication function with 13.56MHz frequency.

NC-900 can support RFID/Mifare/NFC and UID/T-Money/CashBee/new Transportation card/Android/iPhone as RF Reader Module. If Mifare Key value is set, it can check its specified block's information. In case of Android and iPhone, it needs SDK for Smartphone's application development. It supports communication method with RS232 or UART TTL. Antenna is made integral with module. Antenna matching is tunned with 50 ohm direct matching.

1.2. General Specification

ITEM	SPECIFICATION	REMARK
Main MCU	AT32F415 Cortex-M4, 150MHz	
Program memory	256KByte Flash	
Data memory	32KByte SRAM	
LED	Status LED 2 EA (Power , operation)	
Interface	UART(RS232C,TTL Level) * 1 (CONNECTOR : 12505-05PIN)	Default RS232C
Available Card	RFID/Mifare/NFC CARD - UID - T-Money/CashBee SNO - New Transportation card - Mifare Classic Data Blocks(3 block) Android/iPhone NFC Data - 16 Byte ID (Encrytion transmission) - 256 Byte Message (unencryted)	

Input Power	DC5Volt / 500mA	

1.3. RF Specification

ITEM	Specification	Remark
Frequency	13.560Mhz	
Sub carrier	847 KHz	
Antenna	50ohm pattern Antenna	

2. Hardware Composition

2.1. Outline Dimensions

2.1.1. SIZE 50*40MM

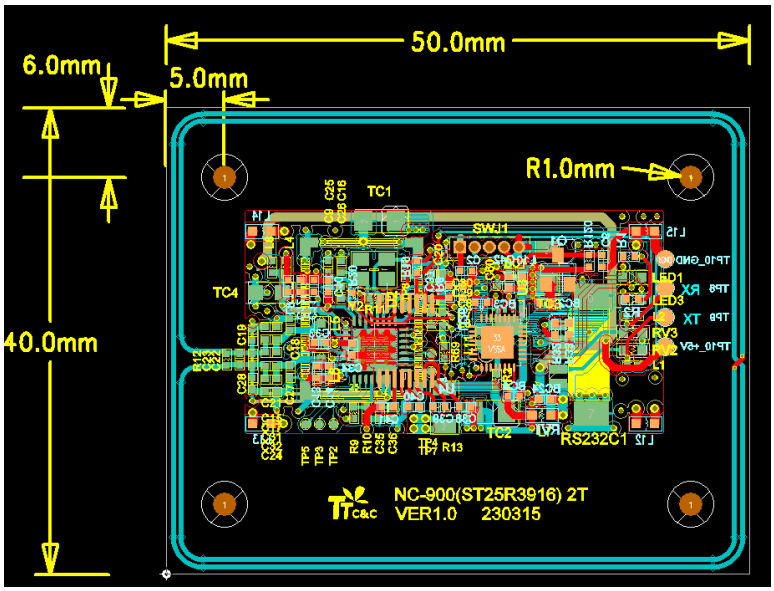


그림 1-2. NC-900 CAD Drawing 50*40mm(+/-2mm)

3. Electro-Optical Characteristic

3.1. Electrical Characteristics

Parameter	Min	Typical	Max	Units
Input Voltage	4.5	5.0	5.5	[v]
Operating current	150	200	350	[mA]

3.2. Environmental Characteristics

Parameter	Min	Typical	Max	Units
Operating Temperature	-40		105	℃
Storage Temperature	-60		150	℃
Operating Humidity	30		90	%
Storage Humidity	30		90	%

4. Board Appearance

4.1. Board appearance

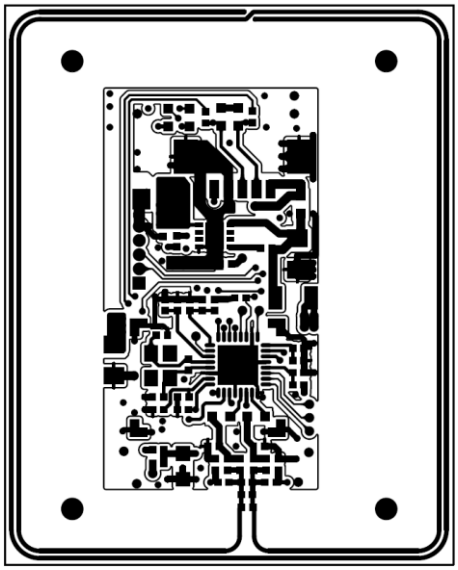
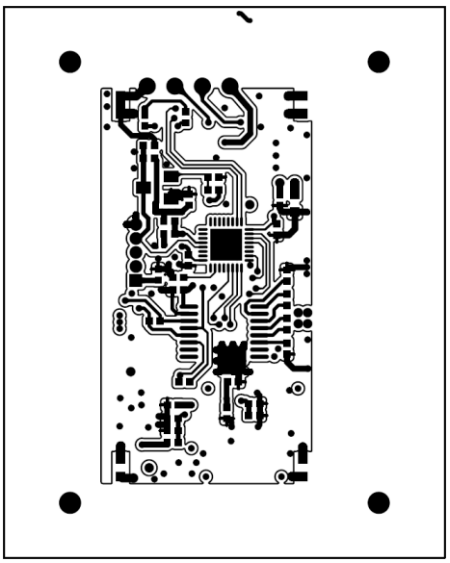
	
TOP Side	**BOTTOM Side**

Fig 2-2. NC-900 Board 50*40mm

4.2. Board Specification

- W : 50.0mm * L : 40.0mm * 1.6T
- 4 Layer PCB

4.3. Board Version Information

Board version with Model name and firmware version production date on the center of the lower of PCB Top side.

NC-900(ST25R3916)

VER1.0 230315 YYWW

"NC-900" : H/W Model name

"(ST25R3916)" : NFC IC Model Name

"VER1.0" : Firmware Build Information

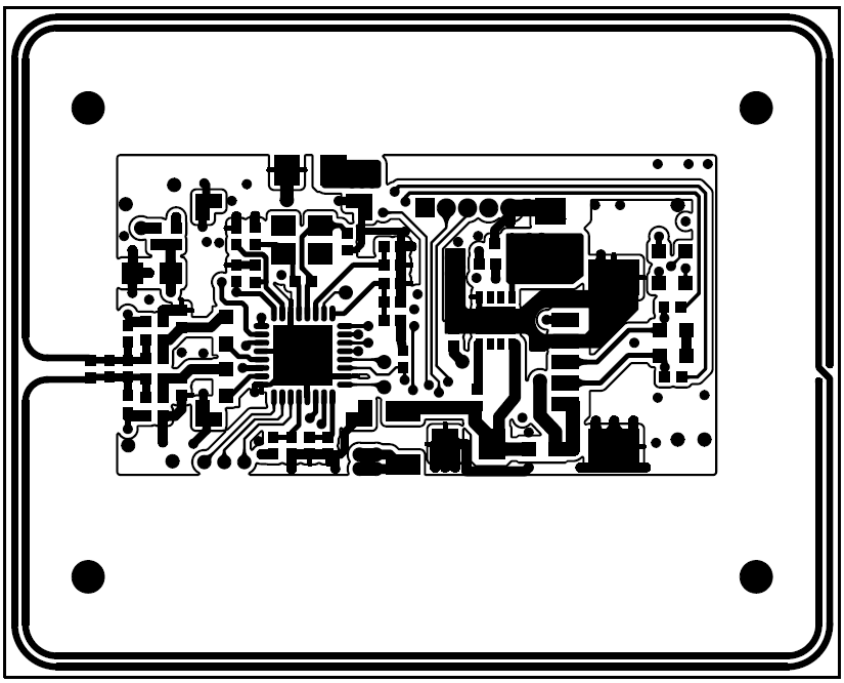
Refer to "6. PROTOCOL_INTERFACE" for firmware version and Build information.

" 230315" : First Design Date

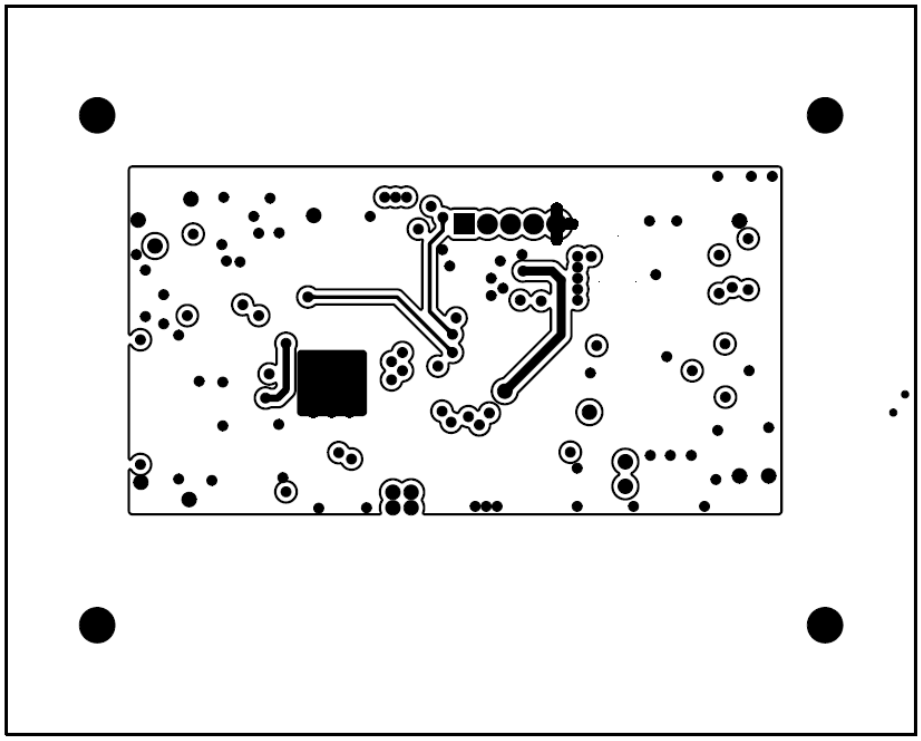
"2314" :Periodic Production Date(LOT) YYWW(Year Week)

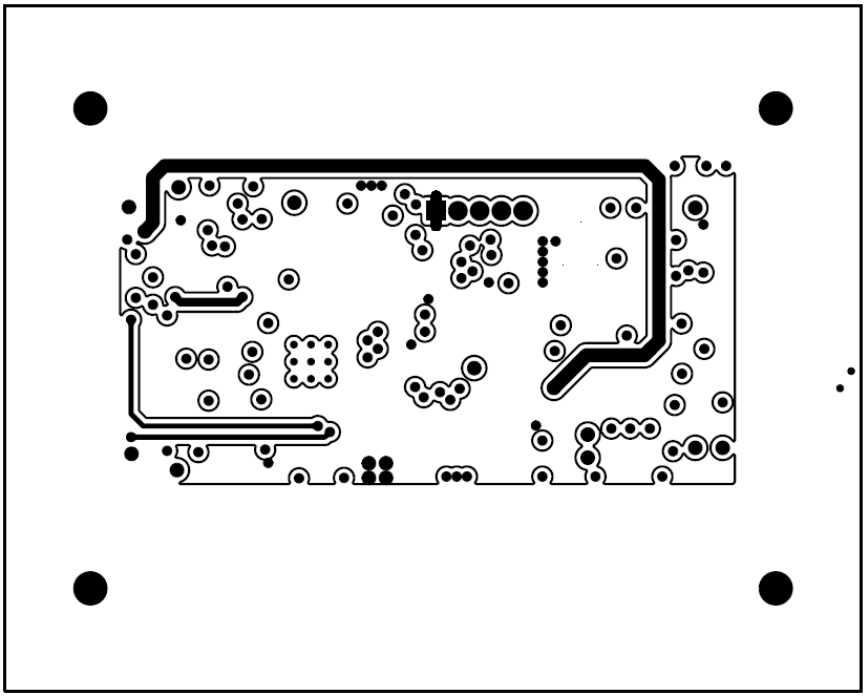
4.5. ARTWORK PCB Size 50*40mm

4.5.1. Top Side

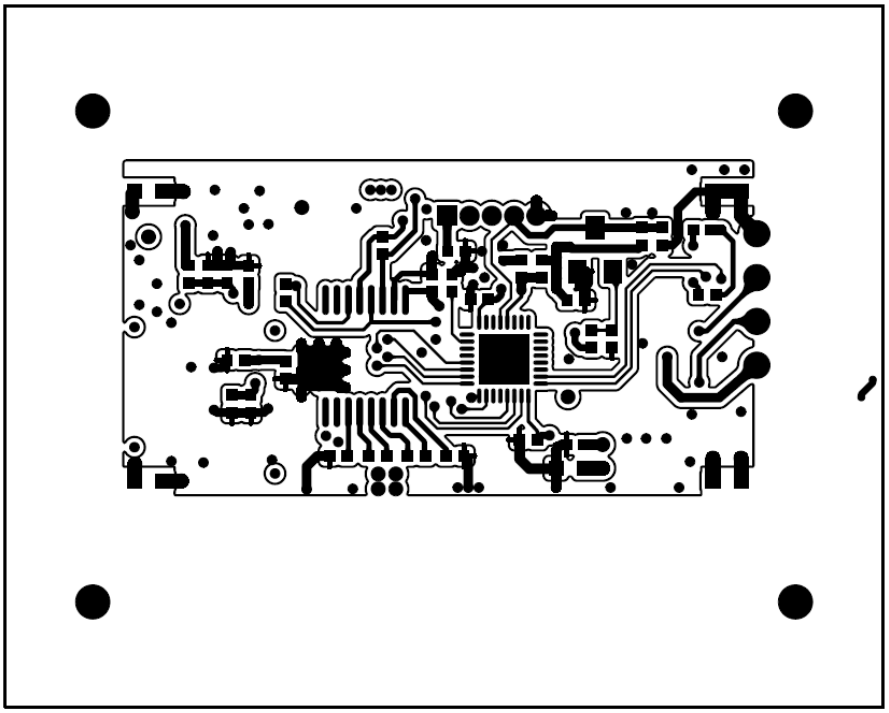


4.5.2. Middle Side





4.5.3. Bottom Side



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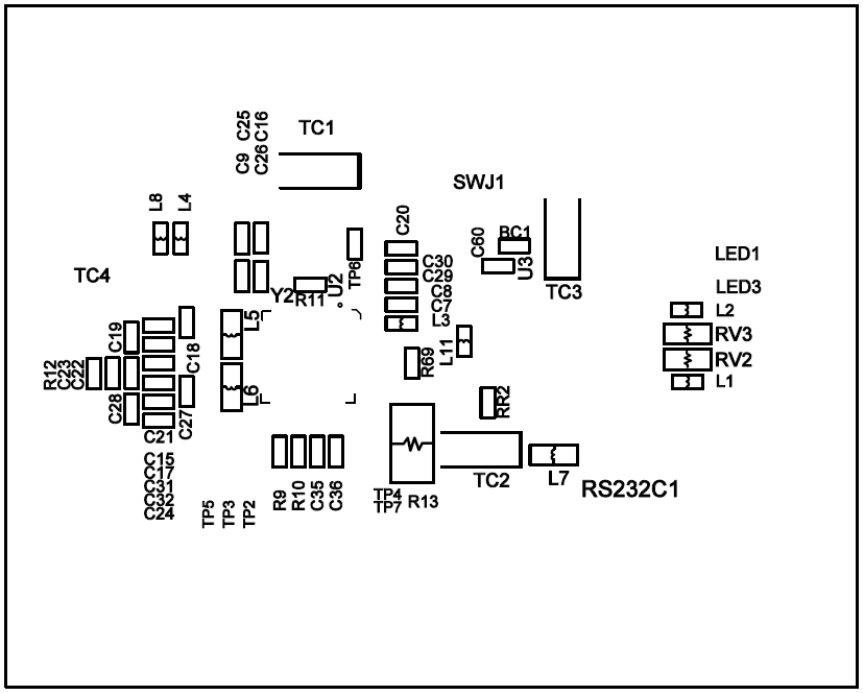
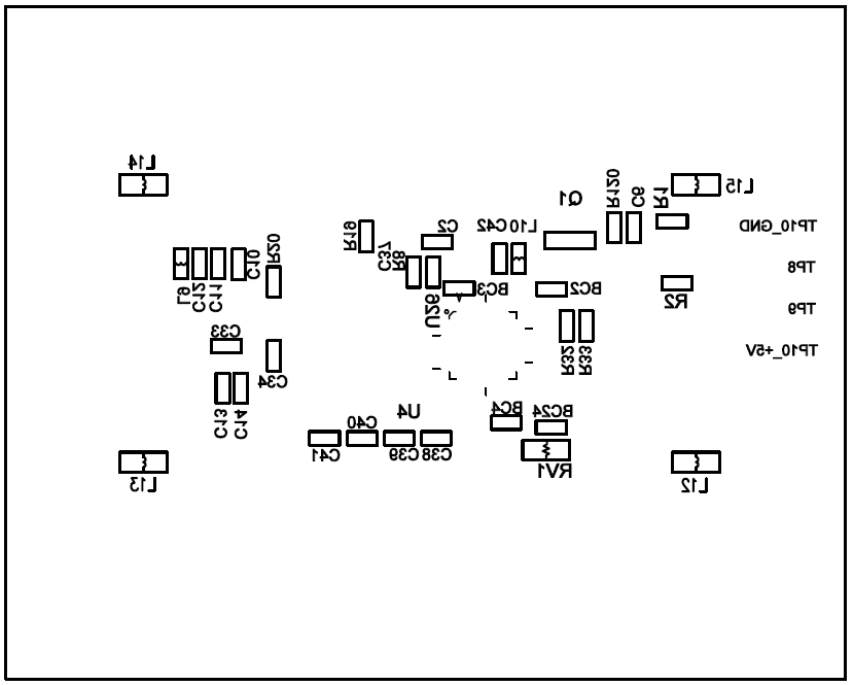
4.5.4. Assembly Top



4.5.5. Assembly Bottom



5.8. Antenna Information

1) Antenna turns : 2
2) Antenna Length : 50mm
3) Antenna Width : 40mm
4) Thickness : 35um
5) Segment Mode: veritical, 8 segments
6) Matching OHM : 50 OHM

6. Protocol

6.1. Operating Mode

On Power-on, it enters into AUTOMODE after initializing the system and it standbys to detect cards to be available RFID card , NFC card , T-money card, cashbee card, Mifare Classic DATA check, android phone, Iphone NFC). LED3 turns on when it enters AUTOMODE. LED1 turns on and off when certification card is detected and disappeared.

And when a certification card is detected, a response format message is transmitted through RS232C/UART TTL communication interface.

On Power-on, it waits for Host's command after an initialization of system. And it operates related responses by host's following command. The following is NC-900's flow chart.

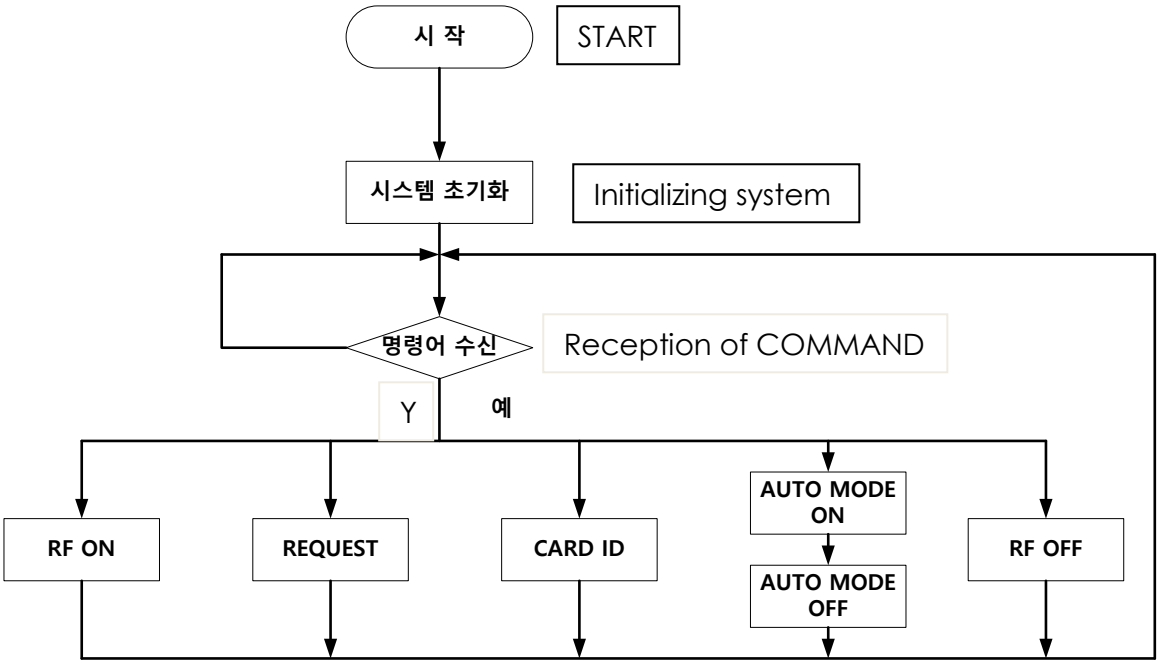


Fig 3 NC-900 OPERATION FLOW

6.2. HOST COMMAND

COMMAND	FUNCTION DESCRIPTION	REMARK

RF ON	NC-900 RF ON OPERATION	
GET VERSION	NC-900 READER FIRMWARE VERSION CHECK	
REQUEST	CHECK A CARD ON ANTENNA	
CARD ID	CARD ID (RFID/Mifare/NFC UID T-Money SNO) DETECTION OPERATION - READ data from Mifare Card's first block to the end of Block / one sector unit (Available to read up to three blocks) - Read Block information for only Mifare Classic card	
SET_MIFARE_KEY	Key setting for reading a data of Mifare Classic Card	
GET_MIFARE_KEY	Read a Key value to be set	
AUTOMODE	Continuous card detection operation if a card is present or not (RFID/Mifare/NFC UID T-Money SNO) and read card's ID	
GET_AUTOMODE	Read an AUTOMODE value to be set	
RF OFF	Operation of RF OFF	
RESTART	Restart RF Reader Module's program	

6.3. Operation Description

6.3.1. UART TTL I/O communication specification

NC-900 has one channel of RS232C/ UART TTL communication interface.

The following is for a data communication setting.

Parameter	Values	Units
Baud rate	115,200	bps
Data bits	8	bit
Number of stop bits	1	bit
Parity	Non Parity	bit

6.3.2. Command frame format

STX	LENGTH	COMMAND	DATA [n]	LRC	ETX(optional)
0x02	0xHH 0xHH	0xHH	0xHH.....	0xHH	0x03

➢STX : 0x02

➢LENGTH : 2byte length, indicates COMMAND and DATA'S length.

➢COMMAND : operation command

■Operation Command

Command	HEX value
GET VERSION	0xC3
RF ON	0x10
REQUEST	0x21
CARD ID	0x3D
SET_MIFARE_KEY	0x22
GET_MIFARE_KEY	0x32
AUTOMODE(ON/OFF)	0x3E/0x3F
GET_AUTOMODE	0x40
RF OFF	0x11
RESTART	0xD0

➢DATA[n] : data byte

➢LRC : data XOR value for LENGTH and DATA

➢ETX : 0x03 (Optional, if ETX is not sent, no ETX in response data)

6.3.3. RESPONSE FRAME FORMAT

STX	LENGTH	RESPONSE	DATA [n]	LRC	ETX
0x02	0xHH 0xHH	0xHH	0xHH.....	0xHH	0x03

➢STX : 0x02

➢LENGTH : 2byte, indicates a length from COMMAND to DATA.

➢RESPONSE : it indicates a response by a command.

■RESPONSE TYPE

RESPONSE TYPE		HEX VALUE
SUCCESS	PRO_SUCCESS	0x00
ERROR	PRO_CONTINUE	0x01
	PRO_FAILURE	0xFF
	PRO_TIMEOUT	0xF0
	PRO_NOT_FOUND_CMD	0xF1
	PRO_LCR_NOT_MATCH	0xF2
	PRO_UNAVAILABLE_CONDITION	0xF3
	PRO_NEED_MIFARE_2BLOCKNO	0xF4
	PRO_RECEIVE_DATA_OVERFLOW	0xF5
	PRO_RF_IS_OFF	0xF6
	PRO_CARD_NOT_FOUND	0xF7
	PRO_ERROR_FOR_FLASH_LIMIT	0xFA

■DATA[n] : DATA BYTE

➢LRC : data XOR value for LENGTH and DATA

➢ETX : 0x03 (Optional, if ETX is not sent, no ETX in response data)

6.3.4. EXAMPLE of HOST COMMAND and RESPONSE

HOST COMMAND	HOST DATA	FLOW	NC-900 RESPONSE DATA
RF ON	02 00 01 10 11 03	<=>	02 00 01 00 01 03
REQUEST	02 00 01 21 20 03	<=>	02 00 01 F6 F7 03 (No card) 02 00 03 00 04 00 07 03 (card)
CARD ID	02 00 03 3D 04 04 3E 03 (setting one block "04th" setting-setting only once) 02 00 03 3D 04 06 3C 03 (setting multi-block"04th~06th" setting-setting only once) **02 00 01 3D 3C 03 (Verify block data to be set – use repeatedly)**	<=>	02 00 01 F6 F7 03 (success of setting/no card) 02 00 12 00 08 12 34 12 34 12 34 12 34 12 34 12 34 12 34 12 34 1A 03 (BLOCK 16 Byte)
SET_MIFARE_KEY	02 00 07 22 45 41 32 AE 7A CC 0B 03	<=>	02 00 01 00 01 03 (success) 02 00 01 02 03 03 (failure)
GET_MIFARE_KEY	02 00 01 32 33 03	<=>	02 00 07 00 [redacted] 29 03
AUTOMODE ON	02 00 01 3E 3F 03	<=>	02 00 01 00 01 03
AUTOMODE OFF	02 00 01 3F 3E 03	<=>	02 00 01 00 01 03
GET AUTOMODE	02 00 01 40 41 03		02 00 02 00 02 00 03 (02:OFF, 01: ON)
RF OFF	02 00 01 11 10 03	<=>	02 00 01 00 01 03
RESTART	02 00 01 D0 D1 03	<=>	02 00 01 00 01 03

6.3.5. RF ON

A command to be activated a RF field

■ **RF ON Command**

STX	LENGTH	COMMAND	LRC	ETX
0x02	0x00 0x01	0x10	0x11	0x03

■ **RF ON Response**

STX	LENGTH	RESPONSE	LRC	ETX
0x02	0x00 0x01	0x00	0x01	0x03

6.3.6. REQUEST

A COMMAND to transmit a REQUEST command to card

■ **REQUEST Command**

STX	LENGTH	COMMAND	LRC	ETX
0x02	0x00 0x01	0x21	0x20	0x03

■ **REQUEST Response (No Card)**

STX	LENGTH	RESPONSE	LRC	ETX
0x02	0x00 0x01	0xF6	0xF7	0x03

■ **REQUEST Response (Card Presense)**

STX	LENGTH	RESPONSE	DATA [2]	LRC	ETX
0x02	0x00 0x03	0x00	ATQA	0xHH	0x03

6.3.7. SET_MIFARE_KEY

A Command to set Mifare Key value in order to be able to check a data of indicated block of Mifare card

Default mode is a state not to be set a Mifare Key value. This mode is only available to check card's UID value. when Mifae Key value is set, the setting

value is stored into RF READER module and and Mifare Key value is managed continuously after a re-boot.

In order to check UID value again, Mifare Key value should be cleared. The method is to send data "0x0" all for Mifare key value.

■ **SET_MIFARE_KEY Command**

STX	LENGTH	COMMAND	DATA [6]	LRC	ETX
0x02	0x00 0x07	0x22	0xHH.....	0xHH	0x03

■ **SET_MIFARE_KEY Response (SUCCESS)**

STX	LENGTH	RESPONSE	LRC	ETX
0x02	0x00 0x01	0x00	0x01	0x03

■ **SET_MIFARE_KEY Response (Failure)**

STX	LENGTH	RESPONSE	LRC	ETX
0x02	0x00 0x01	0x01	0x00	0x03

6.3.8. GET_MIFARE_KEY

COMMAND to check Mifare Key value to be set in NC900 Reader Module

■ **GET_MIFARE_KEY Command**

STX	LENGTH	COMMAND	DATA [6]	LRC	ETX
0x02	0x00 0x07	0x32	0xHH.....	0xHH	0x03

■ **SET_MIFARE_KEY Response (Success)**

STX	LENGTH	RESPONSE	DATA [6]	LRC	ETX
0x02	0x00 0x07	0x00	KEY Datas	0xHH	0x03

6.3.9. CARD ID

COMMAND to request a card's ID

Block setting command for card check is used only once and after that, it is used to check card without setting a block (if it's used to set and check blocks continuously, it can bring into writency limitaton in memory. so It is set to be " PRO_ERROR_FOR_FLASH_LIMIT" if it has 5 times calls of setting block of card ID COMMAND)

- If a command is sent without a block number
  - Check UID if Mifare Key is not set
  - Check Mifare Data if Mifare Key is set
- If a command is sent with a block number, it can check a block data using Mifare Key value. No key value certification, check UID.
- Checking a block is available to read blocks up to three in the same sector
- Available to check one block information from xx to xx
- It can receive 16 bytes of block data to be set according to block number value to be requested.

The key value to be applied to % card"is set to [redacted]"
Pls ask to TTCNC Co., Ltd for a Key value specially.

1) UID/SMARTPHOE check

■ **CARD ID Command**

STX	LENGTH	COMMAND	LRC	ETX
0x02	0x00 0x01	0x3D	0x3C	0x03

■ **CARD ID Response (No CARD)**

STX	LENGTH	RESPONSE	LRC	ETX
0x02	0x00 0x01	0xF6	0xF7	0x03

■ **CARD ID Response (Card Presence)**

STX	LENGTH	RESPONSE	DATA [n]	LRC	ETX
0x02	0xHH 0xHH	0x00	SAK(1Byte) + CARD ID OR 'T'+	0xHH	0x03

			TMONEY SNO		

■ **SMARTPHONE Datas Response (Data presence)**

STX	LENGTH	RESPONSE	DATA [n]	LRC	ETX
0x02	0xHH 0xHH	0x00	'N' + Block Datas	0xHH	0x03

When Android and Iphone's datra is acknowleded, the following formatted message is transmitted.

DATA[n] = '{smartphone CODE}' + Block Datas(Max 256)

- Android {smartphone Code} : 'N' / 0x4E
- iPhone {smartphone Code} : 'I' / 0x 49
- Block Datas are transmitted with the following two formats.
  1. ID
     - ◆ 16 Byte ID value (the encrypted method is transmitted)
     - ◆ Tmobilepass SDK transmits encrypted message
  2. Plain Text Message
     - ◆ Max 256 Byte
     - ◆ Tmobilepass SDK transmits unencrypted message
     - ◆ User can apply data's encryption and format

2) Mifare Bank Data check

■ **Mifare Data Command**

STX	LENGTH	COMMAND	BLOCK NO	LRC	ETX
0x02	0x00 0x03	0x3D	0x04 0x04	0x3E	0x03

DATA[0] : First inspection of Block No.
DATA[1] : Last inspection of Block No.
It's essential to be the first and last block No. at the same sector in order to avoid a key value error under read operation.

■ **CARD ID Response (No card)**

STX	LENGTH	RESPONSE	LRC	ETX
0x02	0x00 0x01	0xF6	0xF7	0x03

■ **CARD ID 응답 (Card presense)**

STX	LENGTH	RESPONSE	DATA [n]	LRC	ETX
0x02	0xHH 0xHH	0x00	SAK + Block Datas (Minimum 16 Bytes, Max 48 bytes)	0xHH	0x03

6.3.10.AUTOMODE ON

When an acceptable card is detected, this is a command to operate a response of "CARD UID response(card presense) message"
(an only message on card detection)

■ AUTOMODE **ON Command**

STX	LENGTH	COMMAND	LRC	STX
0x02	0x00 0x01	0x3E	0x3F	0x03

■ AUTOMODE **ON Response**

STX	LENGTH	RESPONSE	LRC	STX
0x02	0x00 0x01	0x00	0x01	0x03

6.3.11.AUTOMODE OFF

Command to finish an AUTOMODE mode

■ AUTOMODE **OFF Command**

STX	LENGTH	COMMAND	LRC	ETX
0x02	0x00 0x01	0x3F	0x3E	0x03

■ AUTOMODE **OFF Response**

STX	LENGTH	RESPONSE	LRC	ETX
0x02	0x00 0x01	0x00	0x01	0x03

6.3.12.GET AUTOMODE

Command to finish AUTOMODE

■ AUTOMODE **OFF Command**

STX	LENGTH	COMMAND	LRC	ETX
0x02	0x00 0x01	0x40	0x41	0x03

■ AUTOMODE **OFF Response응답**

STX	LENGTH	RESPONSE	DATA [1]	LRC	ETX
0x02	0x00 0x02	0x00	02 : OFF, 01:ON	0xHH	0x03

6.3.13.RF OFF

Command to deactivate a RF Field

■ **RF OFF Command**

STX	LENGTH	COMMAND	LRC	ETX
0x02	0x00 0x01	0x11	0x10	0x03

■ **RF OFF Response**

STX	LENGTH	RESPONSE	LRC	ETX
0x02	0x00 0x01	0x00	0x01	0x03

6.3.14.RESTART

Command to restart Reader module's program

■ **RESTART Command**

STX	LENGTH	COMMAND	LRC	ETX
0x02	0x00 0x01	0xD0	0xD1	0x03

■ **RESTART Response**

STX	LENGTH	RESPONSE	LRC	ETX
0x02	0x00 0x01	0x00	0x01	0x03

6.4. NC-900's Factory Default mode

1) AutoMode , No Mifare Classic

⇨ After auto-detection of RFID card, the function to transmit a card's UID value or T-Money SNO information, Android/iPhone's data to HOST.

⇨ Inherent 'HOLD' function to be able to protect a duplicate recognition under a card or smart phone's detection process

2) Setting to be able to detect Mifare Classic card

⇨ Mifare Classic card can be selected one of both that detecting an UID information or output a data of card's specific area.

⇨ Method to be able to detect Mifare Classic card.

"SET_MIFARE_KEY" command can set a Mifare Key value to Reader. If it's set once, its information is saved into FLASH memory. So its key value is available on re-boot.

⇨ In order to set "Program", it needs a following process at system initialization process. When a command transmits normally, it receives a related response. After it receives a return value, pls transmit a following command.

[if UID Value or T-Money/CashBee/SSCharger ID or Smart phone's data]

Use AUTOMODE of Factory Default Mode

[if Mifare Data Block Read]

1) AutoMode OFF (Command mode needs to unlock AUTO MODE first of all)
   "0200013F3E"
2) SET_MIFARE_KEY (setting of Mifare Key value)
   "02 00 07 22 45 41 32 AE 7A CC 0B"
3) CARD ID (setting of Mifare card's block check (From block , To block))
   "02 00 03 3D 04 06 3C" (from block 4th , to block 6th)
4) AutoMode On
   "0200013E3F"

After pls refer to the additional NDA contract for "key value and Data block number value" to be input on card detection from Reader module

7. OTA Function

7.1. Concept

When it's received a message of "DN_START_MESSAGE" from HOST, it responses a message of "SUCCESS". And according to YMODEM communication protocol, NC900 downloads a NC900 firmware image from HOST. If it is downloaded successfully, after a rebooting, it installs an application and executes normally.

LED3 toggles very fast under downloading a firmware with YMODEM communication and when it is installed and executed normally, LED1 operates ON state normally.

Pls ask TTCNC for a supply of HOST's(Linux/Windows/MCU) program source

7.2. DOWNLOAD START PROTOCOL

■ **DOWNLOAD START COMMAND**

STX	LENGTH	COMMAND	LRC	ETX
0x02	0x00 0x01	0xC5	0xC4	0x03

■ **DOWNLOAD START REPONSE**

STX	LENGTH	RESPONSE	LRC	ETX
0x02	0x00 0x01	0x00	0x01	0x03

7.3. FIRMWARE IMAGE DOWNLOAD PROTOCOL

FIRMWARE IMAGE DOWNLOAD PROTOCOL uses YMODEM standard protocol

8. Operating method

8.1. Concept

NC-900 manages a method to control a transmission and reception of protocol(refer to chapter 6 'protocol') between HOST and NC900.

When Reader detects a card on AUTOMODE, it transmits a corresponding card's UID or T-Money, CashBee, SsCharger SNO, smartphone's data or MifareClassic Block datas.

HOST is enough to have a CARD information on AUTOMODE and Reader module supports inherent HOLD function to protect a duplicate recognition of card under a card detection and presense process.

8.2. Initialization of Reader Module

If it's powered on to NC-900, Power Indicator LED(LED3) and state indicator LED(LED1) are initialized and two LEDs turn on ' ON'.

After that, when all Reader module's interface peripherals are initialized, state indicator LED1 turns on 'ON' and Power indicator LED3 turns off 'OFF'.

8.3. H/W Reset of Reader Module

It's available to reset Reader module with hardware externally using Serial interface connector(CN1)'s Pin number '5'.

H/W RESET method

CN1 5th pin state is low state on default mode. at this time, when High state is given a more time than 10ms and turn to low state again, it resets externally.

8.4. Reader Module operation

When Reader module is initialized, it's a standby mode to receive data from HOST. When Reader module receives a message, the next process is a card detection and reponses card's information or no card information.

If there is no detection with no card, the state indicator LED(LED3) keeps 'OFF' state. If a card is detected, the state indicator LED(LED3) keeps 'ON' state for a while and

turns off.

8.5. Message reception interval of Reader Module

Reader Module can support a message reception interval time up to 300ms for card detection and response from HOST.

When AUTOMODE is off, it can transmit and receive "HOST message".

If a card is already under a detection process, it can't process "HOST Message".

So, after removing a card on antenna field, it can transmit a HOST message.

8.6. Operation method of Reader module

Reader Module has two methods AUTOMODE OFF and AUTOMODE ON.

AUTOMODE OFF is a passive method to get a response to a command transmission from HOST and AUTOMODE ON is an automatic method to get a response to a command to be already set when a card is detected in RF field.

% Smartphone data communication is only available on "AUTOMOE ON" .

Reader's AUTOMODE ON/OFF state can be set using "AUTOMODE ON/OFF command [0x3E/0x3F]".

8.6.1. Operating process of Passive method(AUTOMODE OFF)

Even though RF Reader module is RF ON state on default mode, HOST can control 'RF ON' or 'OFF' by HOST command.
When RF off and executes a command to be related to card check function, it responds a message "PRO_RF_ISOFF(0xF6)".

HOST transmits a command to Reader like a following order.
[Mifare Classic card data check function]

1) <6.3.10. AUTOMODE OFF> command(0x3E) transmission
2) <6.3.7. SET_MIFARE_KEY>Key value setting through command(0x22) transmission
3) <6.3.8. CARD ID> command(0x3D) transmission including block information -> Mifare Classic corresponding block data check (Block information is stored into Reader even a card is not detected)
4) Card is detected and checked through below command repetation
   A. 6.3.6. REQUEST command (0x21) transmission
      i. If it receives a message of "no card", after 300ms, it retries a command of 'REQUEST' transmission
      ii. Receives a message of 'card presense"
   B. If card is detected with "card presense" it checks card's data with **6.3.8**

CARD ID COMMAND(0x3D) transmission without block information.

Example of % COMMAND transmission

1) AUTOMODE OFF COMMAND "0200013F3E03"
2) SET_MIFARE_KEY COMMAND " 02 00 07 22 [redacted] B903"
3) CARD ID COMMAND with block information " 02 00 03 3D 04 06 3C03"
4) REQUEST COMMAND "020001212003"
5) **CARD ID** COMMAND without block information "0200013D3C03"

[Functions except Mifare Classic card data check]

RFID/NFC UID check , T-MONEY/CASH-BEE/new transportation card(SSCHARGER) SNO check

1) 6.3.10. AUTOMODE OFF command(0x3E) transmission
2) Card is detected and checked through below command repetition
   A. 6.3.6. REQUEST COMMAND (0x21) Transmission
      i. If it receives a message of "no card", after 300ms, it retries a command of 6.3.6 'REQUEST' transmission
      ii. Receives a message of 'card presense"
   B. If card is detected with "card presense" it checks card's data with **6.3.8 CARD ID COMMAND(0x3D)** transmission without block information.

      So, checks RFID/NFC UID and T-MONEY/CASH-BEE/new transportation card(SSCHARGER) SNO **(0x3D command BLOCK information is not included.)**

Example of % COMMAND transmission

1) AUTOMODE OFF COMMAND "0200013F3E03"
2) REQUEST COMMAND "020001212003"
3) **CARD ID COMMAND** without a block information "0200013D3C03"

8.6.2. Operating process of AUTOMODE ON

Reader's initial mode is RF ON state. HOST can also control RF ON/OFF by HOS's command. When RF off and executes a command to be related to card check function, it responds a message "PRO_RF_ISOFF(0xF6)".

HOST transmits a command to Reader like a following order

% Smartphone data communication is only available on "AUTOMOE ON" .

[Mifare Classic card/smartphone data check function]

1) <6.3.10. AUTOMODE OFF> command(0x3E) transmission
2) <6.3.7. SET_MIFARE_KEY>Key value setting through command(0x22) transmission
3) <6.3.8. CARD ID> command(0x3D) transmission including block information
   -> Mifare Classic corresponding block data check (Block

information is stored into Reader even a card is not detected)

4) 6.3.9. AUTOMODE ON command(0x3F) transmission
5) When card is detected, card's data is delivered to HOST automatically.

According to % scenario, at the time of card detection, it's set "AUTOMODE ON" and timeout. And when customer's card is detected in timeout, it receives card data, if not, after timeout it's set "AUTOMODE OFF" and can disable NFC function..

Example of % COMMAND transmission

1) AUTOMODE OFF COMMAND "0200013F3E03"
2) SET_MIFARE_KEY COMMAND " 02 00 07 22 [redacted] B903"
3) CARD ID COMMAND with block information " 02 00 03 3D 04 06 3C03"
4) AUTOMODE ON COMMAND "0200013F3F03" (at the time of need 4) ~ '6)' process repetition or after once execution of 4)'s AUTOMOE ON, there's a method to get card data continuously)
5) Reception of card data or TIMEOUT

   % smartphone data reception ('Setup' function is available with Plain Text transmission mode)

   In Application, Using PlainText (setToken()) mode, if data is transmitted with JSON Format Message constructure, HOST can parse them and is able to use a Setup Configuration function.

6) AUTOMODE OFF COMMAND "0200013F3E03"

[Functions except Mifare Classic card data check]

Can check RFID/NFC UID and T-MONEY/CASH-BEE/new transportation card(SSCHARGER) SNO

1) 6.3.10. AUTOMODE OFF COMMAND(0x3F) transmission
2) 6.3.9. AUTOMODE ON COMMAND "0200013F3F03" (At the time of need, 2) ~ 4)'s process repetition or after once execution of 2)'s AUTOMOE ON, there's a method to get card data continuously)
3) CARD data reception or timeout
4) 6.3.10. AUTOMODE OFF COMMAND "0200013F3E03"

Example of % COMMAND transmission

1) AUTOMODE OFF COMMAND "0200013F3E03"
2) AUTOMODE ON COMMAND "0200013F3F03" (At the time of need, 2) ~ 4)'s process repetition or after once execution of 2)'s AUTOMOE ON, there's a method to get card data continuously)
3) CARD data reception or timeout
4) AUTOMODE OFF COMMAND "0200013F3E03"

9. Warranty

A. TTC&C warrants that its module conforms to the foregoing specifications and TTc&c will test "QC" to all NFC Antenna modules sold.

B. TTc&c disclaims all other warranties including the implied warranties of merchantability and fitness for a particular purpose.

C. TTc&c will not take responsibility for any trouble that is caused by using the NFC module at conditions exceeding our specifications.

D. These specifications are applied only when a NFC module stands alone and it is strongly recommended that the User of the NFC module confirms the properties upon assembly. TTc&c is not responsible for failures caused during and after assembling. It will be excepted from the rule if the failure would cause undoubtedly by TTC&C.

E. A claim report stating details about the defect shall be made when returning defective NFC module. TTc&c will investigate the report immediately and inform the user of the results.

F. The module described in this brochure is intended to be used for ordinary electronic equipment (Such as office equipment, communications equipment) on the applications in which exceptional quality and reliability are required, particularly when the failure or malfunction of the NFC module may directly jeopardize life or health (such as for airplanes, aerospace, submersible repeaters, nuclear reactor control systems, automobiles, traffic control equipment, life support systems and safety devices)

G. TTC&C liability for defective devices shall be limited to replacement and in no event shall TTC&C be liable for consequential damage or lost profits.

H. Warranty on the harmful material to circumstances

I. Our company warranties our information on the harmful material to circumstances related to all products supplied to your company by us is a correct source.

J. We warranty to be responsible for any damage or loss taking place due to the case of that your company and the third party have a dispute or sue because of the observance of circumstances standard, or the discordance, error of the information of material to circumstances supplied by us.

AF05-0072,AF05-0073, 202, Dasanjigeum-ro, Namyangju-si, Gyeonggi-do, Republic of Korea
Tel : +82-70-8226-1006 Fax : +82-031-560-9956 URL: www.ttcnc.co.kr

10. Others

A. The warranties of quality set forth herein are exclusive. All previous negotiations and agreements not specifically incorporated herein are superseded and rendered null and void.

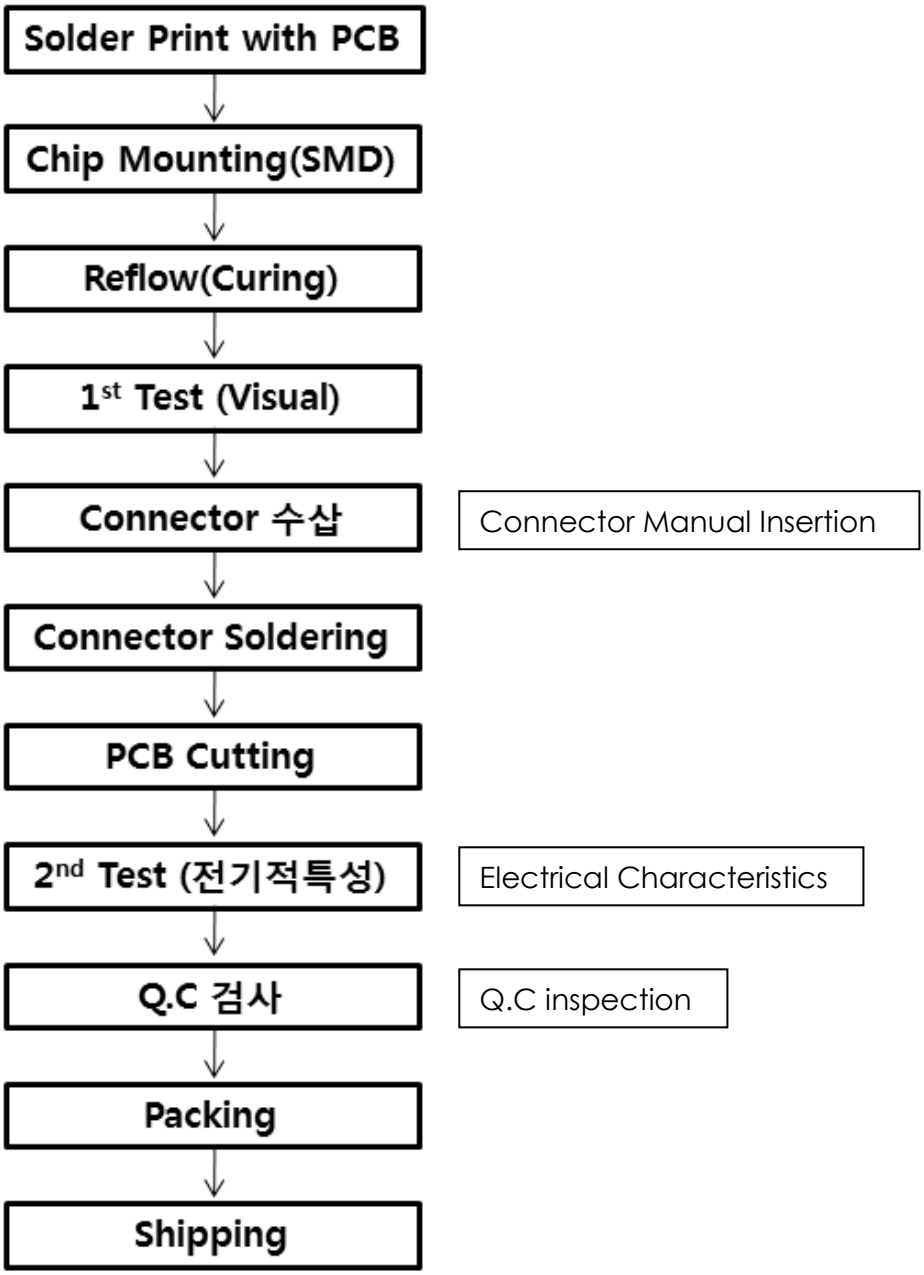
B. Both parties shall sincerely try to find a solution when any disagreement occurs regarding these specifications.

C. User shall not reverse engineer by disassembling or analysis of the NFC modules without having prior written consent from TTc&c. When defective NFC modules are found, the User shall inform TTc&c directly before disassembling or analysis.

D. These specifications can be revised upon mutual agreement.

E. TTc&c understands that the User accepts the content of these specifications, if the User does not return these specifications with signatures within 3 weeks after receipt.

11. Manufacturing Process



AF05-0072,AF05-0073, 202, Dasanjigeum-ro, Namyangju-si, Gyeonggi-do, Republic of Korea
Tel : +82-70-8226-1006 Fax : +82-031-560-9956 URL: www.ttcnc.co.kr

12. Reliability Test

Test item	Condition	Criteria
Room Temperature Lifetime Test	Operating Temp. 25 °C Apply rated current, 1,00hr	Frequency change rate compared to initial value < 20%
High Temperature Operating Lifetime Test	Operating Temp. 50 °C Apply rated current, 1,00 hr	Frequency change rate compared to initial value < 20%
High Temperature Operating Lifetime Test	Operating Temp. 50 °C, Relative Humidity 90% Apply rated current, 1,00 hr	Frequency change rate compared to initial value < 20%
Temperature Cycle	-10°C ~25°C~85°C~25°C (30Min on~5Min on~30Min on~5Min Cycle 5times repetition)	Frequency change rate compared to initial value < 20%

13. Warning

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:
(1) This device may not cause harmful interference.
(2) This device must accept any interference received, including interference that may cause undesired operation.

CAUTION: Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

FCC Radiation Exposure Statement:
This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator & your body.

OEM INTEGRATION INSTRUCTIONS:

This device is intended only for OEM integrators under the following conditions:

The module must be installed in the host equipment such that 20 cm is maintained between the antenna and users, and the transmitter module may not be co-located with any other transmitter or antenna. The module shall be only used with the internal on-board antenna that has been originally tested and certified with this module. External antennas are not supported. As long as these 3 conditions above are met, further transmitter test will not be required.

However, the OEM integrator is still responsible for testing their end-product for any additional compliance requirements required with this module installed (for example, digital device emissions, PC peripheral requirements, etc.). The end-product may need Verification testing, Declaration of Conformity testing, a Permissive Class II Change or new Certification. Please involve a FCC certification specialist in order to determine what will be exactly applicable for the end-product.

Validity of using the module certification:

In the event that these conditions cannot be met (for example certain laptop configurations or co-location with another transmitter), then the FCC authorization for this module in combination with the host equipment is no longer considered valid and the FCC ID of the module cannot be used on the final product. In these circumstances, the OEM integrator will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate FCC authorization. In such cases, please involve a FCC certification specialist in order to determine if a Permissive Class II Change or new Certification is required.

Upgrade Firmware:

The software provided for firmware upgrade will not be capable to affect any RF parameters as certified for the FCC for this module, in order to prevent compliance issues.

End product labeling:

This transmitter module is authorized only for use in device where the antenna may be installed such that 20 cm may be maintained between the antenna and users. The final end product must be labeled in a visible area with the following: “Contains FCC ID: 2BAYV-NC-900”.

Information that must be placed in the end user manual:

The OEM integrator has to be aware not to provide information to the end user regarding how to install or remove this RF module in the user's manual of the end product which integrates this module. The end user manual shall include all required regulatory information/warning as show in this manual.

WARNING
Changes or modifications not expressly approved by the manufacturer could void the user’s authority to operate the equipment.

“CAUTION : Exposure to Radio Frequency Radiation.

Antenna shall be mounted in such a manner to minimize the potential for human contact during normal operation. The antenna should not be contacted during operation to avoid the possibility of exceeding the FCC radio frequency exposure limit.

Information for OEM Integrator

This device is intended only for OEM integrators under the following conditions:
1) The antenna must be installed such that 20 cm is maintained between the antenna and users, and
2) The transmitter module may not be co-located with any other transmitter or antenna.

End product labelling
The label for end product must include
"Contains FCC ID: 2BAYV-NC-900".

" CAUTION: Exposure to Radio Frequency Radiation.
This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance of 20cm between the radiator and your body. This transmitter module is authorized only for use in device where the antenna may be installed such that 20 cm may be maintained between the antenna and users."

Requirement per KDB996369 D03

2.2 List of applicable FCC rules

List the FCC rules that are applicable to the modular transmitter. These are the rules that specifically establish the bands of operation, the power, spurious emissions, and operating fundamental frequencies. DO NOT list compliance to unintentional-radiator rules (Part 15 Subpart B) since that is not a condition of a module grant that is extended to a host manufacturer. See also Section 2.10 below concerning the need to notify host manufacturers that further testing is required.3
Explanation: This module meets the requirements of FCC part 15C(15.247)

2.3 Summarize the specific operational use conditions

Describe use conditions that are applicable to the modular transmitter, including for example any limits on antennas, etc. For example, if point-to-point antennas are used that require reduction in power or compensation for cable loss, then this information must be in the instructions. If the use condition limitations extend to professional users, then instructions must state that this information also extends to the host manufacturer's instruction manual. In addition, certain information may also be needed, such as peak gain per frequency band and minimum gain, specifically for master devices in
5 GHz DFS bands.
Explanation: The EUT has a PCB Antenna, and the antenna use a permanently attached antenna which is not replaceable.

2.4 Limited module procedures

If a modular transmitter is approved as a "limited module," then the module manufacturer is responsible for approving the host environment that the limited module is used with. The manufacturer of a limited module must describe, both in the filing and in the installation instructions, the alternative means that the limited module manufacturer uses to verify that the host meets the necessary requirements to satisfy the module limiting conditions.
A limited module manufacturer has the flexibility to define its alternative method to address the conditions that limit the initial approval, such as: shielding, minimum signaling amplitude, buffered modulation/data inputs, or power supply regulation. The alternative method could include that the limited module manufacturer reviews detailed test data or host designs prior to giving the host manufacturer approval.
This limited module procedure is also applicable for RF exposure evaluation when it is necessary to demonstrate compliance in a specific host. The module manufacturer must state how control of the product into which the modular transmitter will be installed will be maintained such that full compliance of the product is always ensured. For additional hosts other than the specific host originally granted with a limited module, a Class II permissive change is required on the module grant to register the additional host as a specific host also approved with the module.
Explanation: The Module is not a limited module.

2.5 Trace antenna designs

For a modular transmitter with trace antenna designs, see the guidance in Question 11 of KDB Publication 996369 D02 FAQ – Modules for Micro-Strip Antennas and traces. The integration information shall include for the TCB review the integration instructions for the following aspects:
layout of trace design, parts list (BOM), antenna, connectors, and isolation requirements.
a) Information that includes permitted variances (e.g., trace boundary limits, thickness, length, width, shape(s), dielectric constant, and impedance as applicable for each type of antenna);
b) Each design shall be considered a different type (e.g., antenna length in multiple(s) of frequency, the wavelength, and antenna shape (traces in phase) can affect antenna gain and must be considered);
c) The parameters shall be provided in a manner permitting host manufacturers to design the printed circuit (PC) board layout;
d) Appropriate parts by manufacturer and specifications;
e) Test procedures for design verification; and
f) Production test procedures for ensuring compliance.
The module grantee shall provide a notice that any deviation(s) from the defined parameters of the antenna trace, as described by the instructions, require that the host product manufacturer must notify the module grantee that they wish to change the antenna trace design. In this case, a Class II permissive change application is required to be filed by the grantee, or the host manufacturer can take responsibility through the change in FCC ID (new application) procedure followed by a Class II permissive change application.
Explanation: Yes, The module with trace antenna designs, and This manual has been shown the layout of trace design, antenna, connectors, and isolation requirements.

2.6 RF exposure considerations

It is essential for module grantees to clearly and explicitly state the RF exposure conditions that permit a host product manufacturer to use the module. Two types of instructions are required for RF exposure information: (1) to the host product manufacturer, to define the application conditions (mobile, portable – xx cm from a person’s body); and (2) additional text needed for the host product manufacturer to provide to end users in their end-product manuals. If RF exposure statements and use conditions are not provided, then the host product manufacturer is required to take responsibility of the module through a change in FCC ID (new application).

Explanation: This module complies with FCC RF radiation exposure limits set forth for an uncontrolled

environment, This equipment should be installed and operated with a minimum distance of 20

centimeters between the radiator and your body." This module is designed to comply with the FCC

statement, FCC ID is: 2BAYV-NC-900.

2.7 Antennas

A list of antennas included in the application for certification must be provided in the instructions. For modular transmitters approved as limited modules, all applicable professional installer instructions must be included as part of the information to the host product manufacturer. The antenna list shall also identify the antenna types (monopole, PIFA, dipole, etc. (note that for example an “omni-directional antenna” is not considered to be a specific “antenna type”)).

For situations where the host product manufacturer is responsible for an external connector, for example with an RF pin and antenna trace design, the integration instructions shall inform the installer that unique antenna connector must be used on the Part 15 authorized transmitters used in the host product. The module manufacturers shall provide a list of acceptable unique connectors.

Explanation: The EUT has a PCB Antenna, and the antenna use a permanently attached antenna which is unique.

2.8 Label and compliance information

Grantees are responsible for the continued compliance of their modules to the FCC rules. This includes advising host product manufacturers that they need to provide a physical or e-label stating “Contains FCC ID” with their finished product. See Guidelines for Labeling and User Information for RF Devices – KDB Publication 784748.

Explanation: The host system using this module, should have label in a visible area indicated the following texts: "Contains FCC ID: 2BAYV-NC-900”

2.9 Information on test modes and additional testing requirements5

Additional guidance for testing host products is given in KDB Publication 996369 D04 Module Integration Guide. Test modes should take into consideration different operational conditions for a stand-alone modular transmitter in a host, as well as for multiple simultaneously transmitting modules or other transmitters in a host product.

The grantee should provide information on how to configure test modes for host product evaluation for different operational conditions for a stand-alone modular transmitter in a host, versus with multiple, simultaneously transmitting modules or other transmitters in a host.

Grantees can increase the utility of their modular transmitters by providing special means, modes, or instructions that simulates or characterizes a connection by enabling a transmitter. This can greatly simplify a host manufacturer’s determination that a module as installed in a host complies with FCC requirements.

Explanation: Top band can increase the utility of our modular transmitters by providing instructions that simulates or characterizes a connection by enabling a transmitter.

2.10 Additional testing, Part 15 Subpart B disclaimer

The grantee should include a statement that the modular transmitter is only FCC authorized for the specific rule parts (i.e., FCC transmitter rules) listed on the grant, and that the host product manufacturer is responsible for compliance to any other FCC rules that apply to the host not covered by the modular transmitter grant of certification. If the grantee markets their product as being Part 15 Subpart B compliant (when it also contains unintentional-radiator digital circuity), then the grantee shall provide a notice stating that the final host product still requires Part 15 Subpart B compliance testing with the modular transmitter installed.

Explanation: The module without unintentional-radiator digital circuity, so the module does not

require an evaluation by FCC Part 15 Subpart B. The host should be evaluated by the FCC Subpart B.

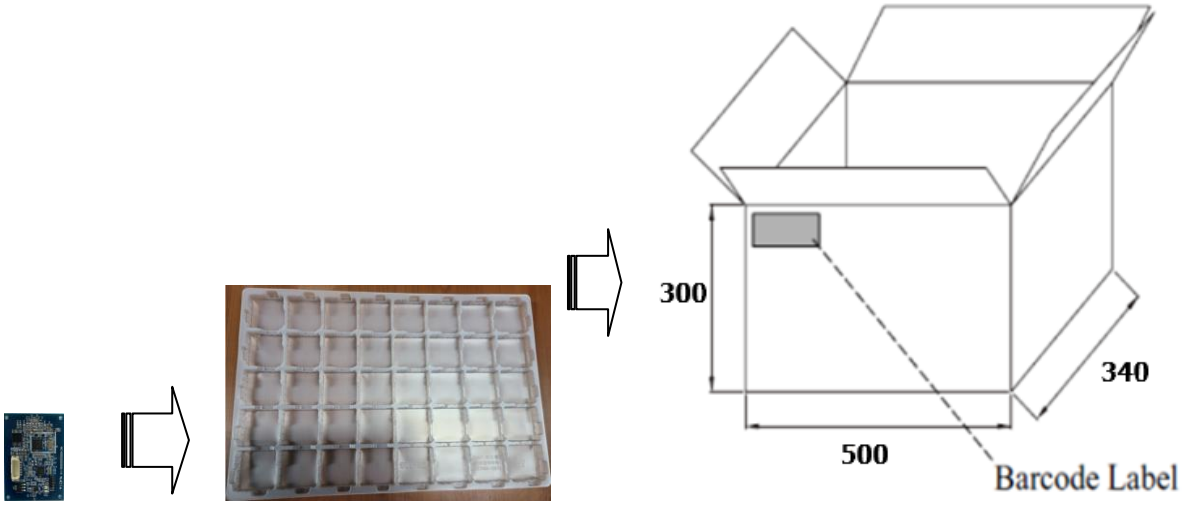
14. Packing

14.1. Packing Quantity

Unit:pcs

Packing Method	1 Tray	Carton Box	N.B.
NC-900 Module	40	1,000	laminated 25 Trays

14.2. Packing Method



Inner Antistatic Tray

Tray Size 483 x 320 x 15(H)mm

One Square Size : 53x53x15(H)

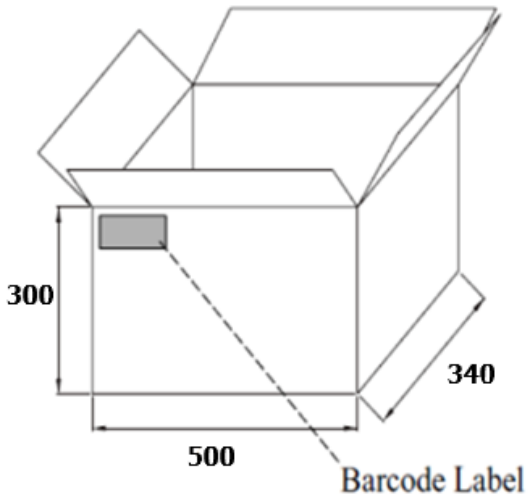
1 Tray Squares : 40 Squares

Carton Box

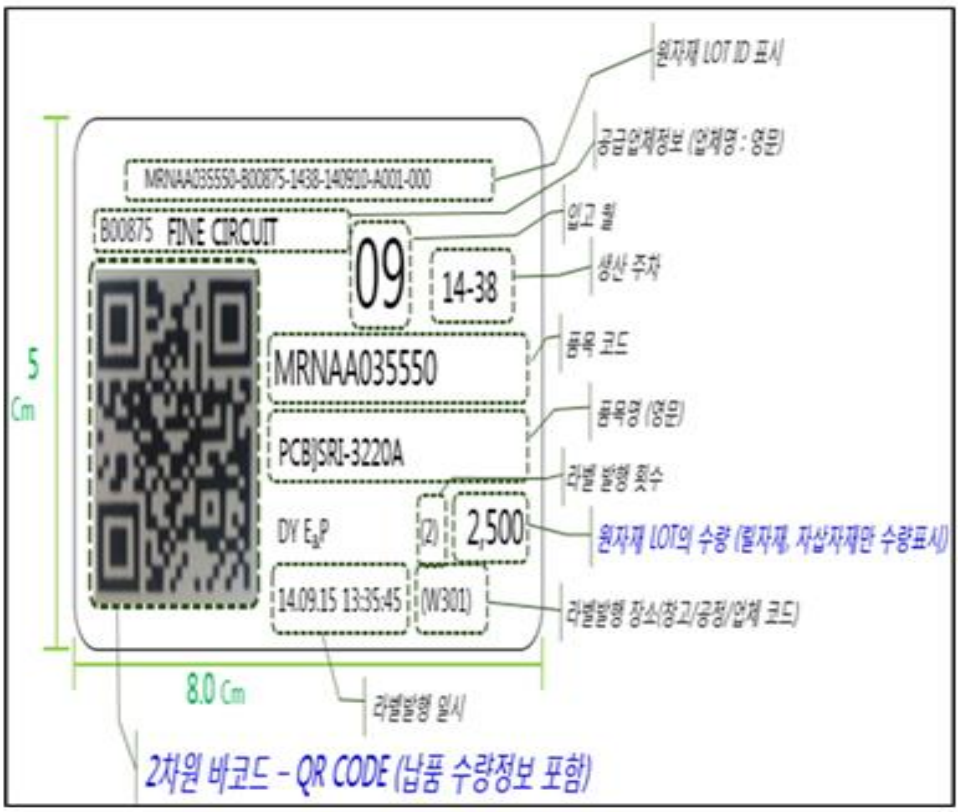
Box Size 500 x 340 x 300 (H)mm

14.3. Outer Box Label specification

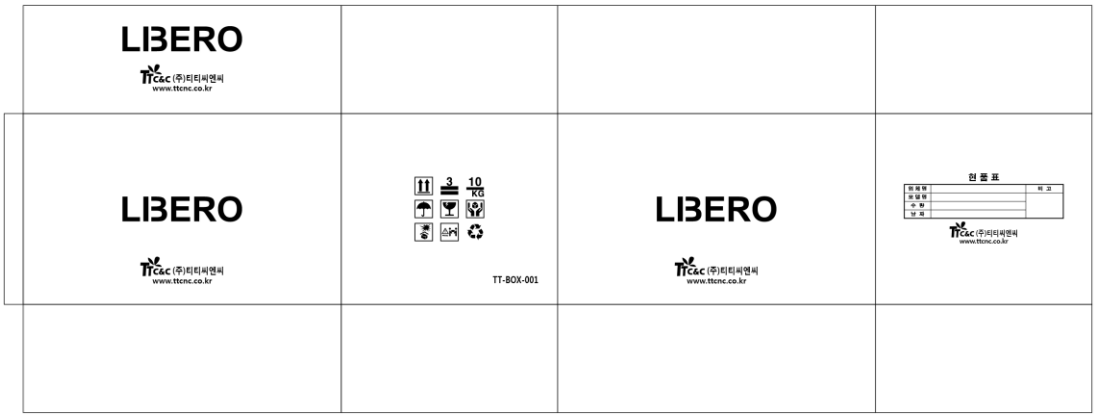
14.3.1.Outer Box Label



Label 사양



14.3.2.OUTBOX Outer / Safety Letter



현 품 표

업 체 명		비 고
모 델 명		
수 량		
날 짜		

15. Revision History

Part No	TT-NC-900		
Title	Specification For Approval		
Rev. No	Date	Summary of Revision	Remarks

AF05-0072,AF05-0073, 202, Dasanjigeum-ro, Namyangju-si, Gyeonggi-do, Republic of Korea
Tel : +82-70-8226-1006 Fax : +82-031-560-9956 URL: www.ttcnc.co.kr