

NFC OEM Read/Write Module: DTNFCxx

The **DTNFCxx OEM NFC** module combines in a single package both NFC controller and secure smart card controller. This Module supports Mifare family (ISO 14443A), FeliCa, Ultra light and Near Field Communication (ISO 18092) standards.



SPECIFICATION

Supported Standards	-	Mifare® family (ISO 14443A), NFC protocol ISO18092
Baud Rate (to host)	-	9.6, 19.2, 38.4, 57.6, 115.2, 230.4, 460.8 k Baud, 8, N, 1
Baud rate (tag / NFC peer)	-	106 kBaud, 212 kBaud, up to 424 kBaud.
Interface	-	USB 2.0 (cable 1.80m) / UART (TTL).
Power Supply	-	USB bus powered / +5V (non USB module).
Power consumption	-	~ 120mA.
Antenna	-	Integrated.
Size (L X B X H) in mm	-	56 X 37 X 11 (L X B X H)
Reading Range	-	60 m m
Operating Voltage	-	+5.0V
Operating Temperature	-	-10 C to +65 C
Tag Types supported	-	Mifare, Ultra light, FeliCa contactless smart cards.
Package	-	ABS Plastic, 6x Pin out / 1.80m USB cable (Pigtail).
Color	-	Black

Variants of DTNFCxx Module

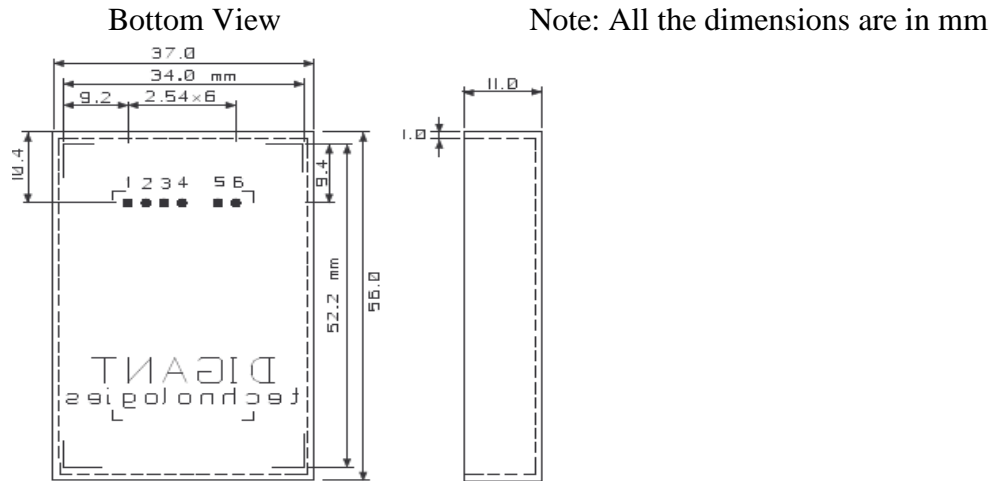
Part Number/ Ordering code	Interface	Security Engine	Antenna
DTNFCSS	UART	YES	Internal
DTNFCUS	USB	YES	Internal

Pin out Details for DTNFCSS

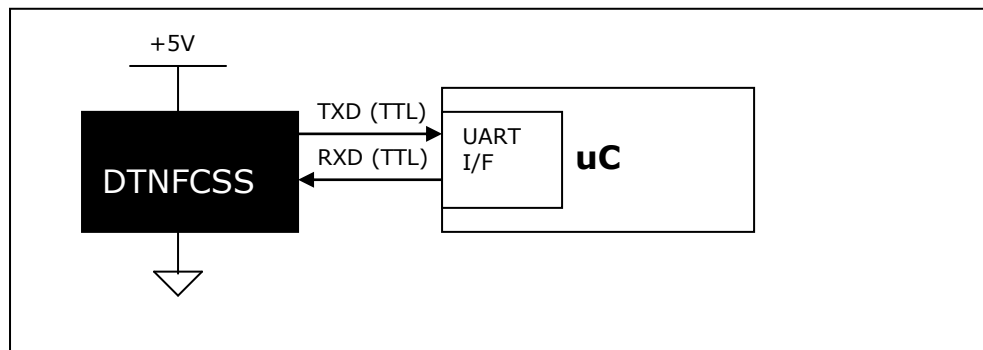
Pin#	Signal Name	Description
1	VCC (+5V)	+5V DC +/- 5%.
2	TXD	Output from the module
3	RXD	Input to the module
4	GND	Ground
5	Reset	Input, a high pulse on this pin resets the module.
6	NC	No connection



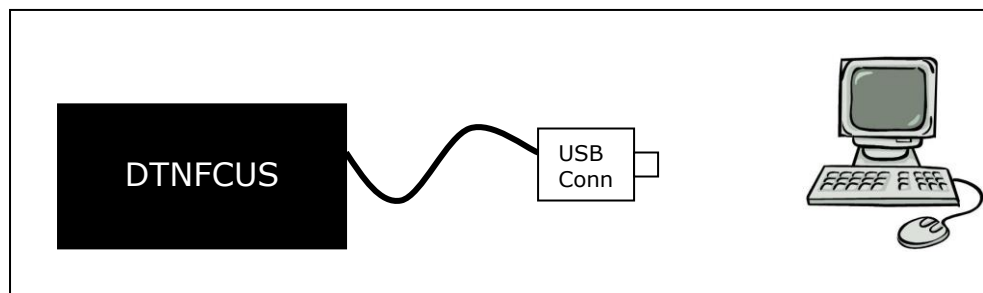
Mechanical drawing



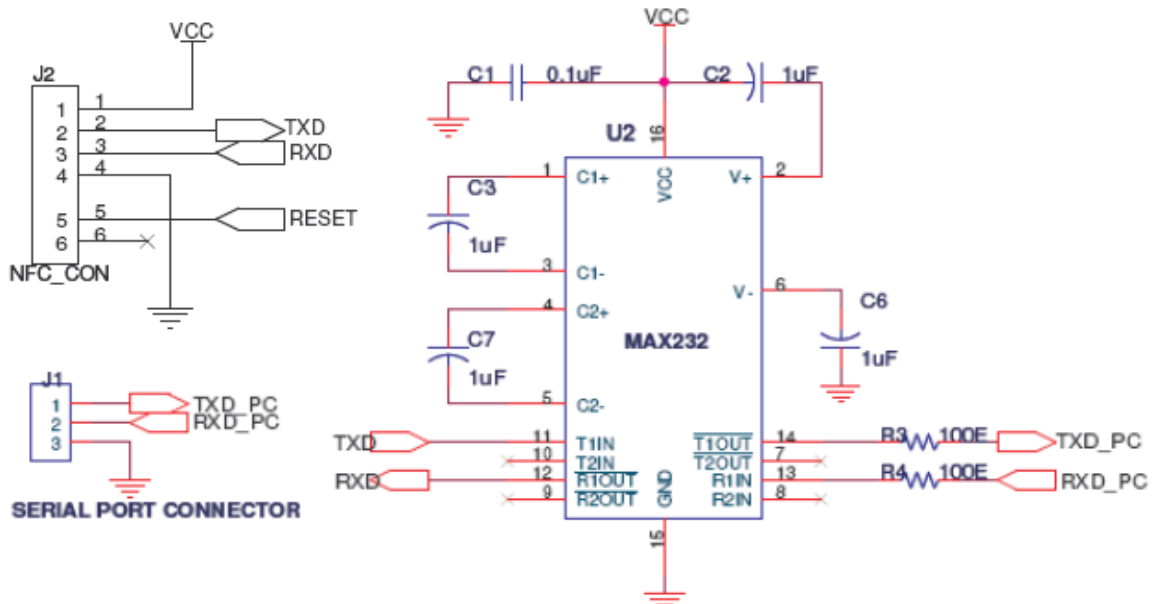
Reference Schematics



DTNFCSS Reference connection to a microcontroller



DTNFCUS Reference connection to a PC



Reference Schematics

Features

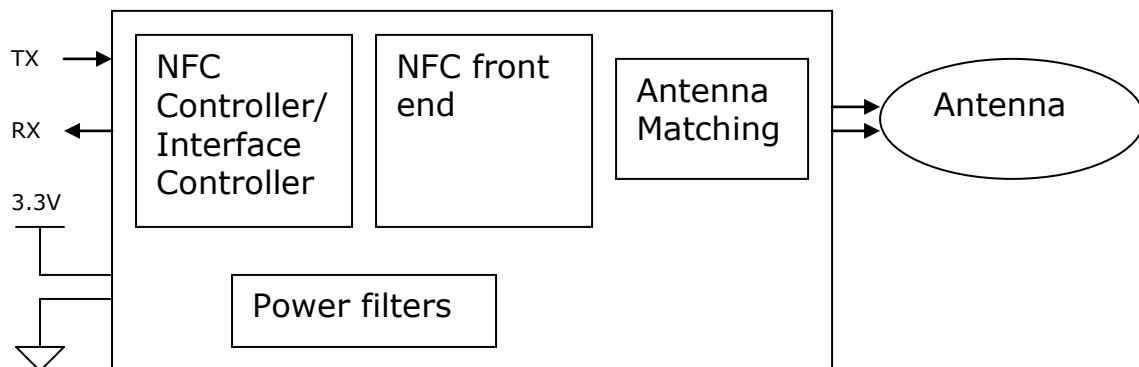
General

NFC module integrates NFC controller and SmartMX secure smart card controller in a single package.

Module is fully integrated which does not need any external circuitry except +5V power input to make it work.

Module is fully NFC IP-1 (ISO18092) compliant.

Block Diagram





NFC - Mifare Command Set.

The basic operations can be performed on MIFARE tag using Near Field Communication Modules (NFC) are

- ✓ Select Tag
- ✓ Authentication
- ✓ Read data
- ✓ Write data
- ✓ Value block
- ✓ Increment block data
- ✓ Decrement block value
- ✓ Transfer block data
- ✓ Restore data
- ✓ Anti-Collision
- ✓ Halt Tag

Input Frame Format:

0x00	0x00	0xFF	LEN	LCS	TFI	PD	DCS	0x00
preamble	Start of packet code		Packet length	Packet length check sum	DTNFCUS frame identifier	Packet Data	Packet data check sum	Postamble

Acknowledgement Frame Format:

The acknowledgement frame sent by DTNFCUS to host controller to indicate the result of the previous operation.

ACK Frame:

00	00 FF	00 FF	00
preamble	Start of packet code	Ack packet code	Postamble

NACK Frame:

This acknowledgement indicates that the previous frame has not been successfully received.

00	00 FF	FF 00	00
preamble	Start of packet code	Ack packet code	Postamble



Error Frame:

This acknowledgement indicates that DTNFCUS has detected an error at application level.

00	00	FF	01	FF	7F	81	00
----	----	----	----	----	----	----	----

Error Codes:

Error Cause	Error Code
Timeout	0x01
CRC	0x02
Parity	0x03
Bit count	0x04
Framing	0x05
Collision	0x06
Buffer too small	0x07
RF buffer overflow	0x09
RF	0x0A
Protocol	0x0B
Temperature	0x0D
Internal buffer overflow	0x0E
Invalid parameters	0x10
Unsupported command	0x12
Invalid format	0x13
AE	0x14
UID check byte	0x23
Invalid device state	0x25
Operation not allowed	0x26
Unknown target	0x27

Select Tag:

This command is used to initiate the targets. DTNFCUS is capable of handling 2 targets at a time.

The input frame format is:

Example:

Bit 0	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7	Bit 8	Bit 9	Bit 10
0x00	0x00	0xFF	0x04	0x00	0xD4	0x4A	0x01	0x00	0x00 – sum of data	0x00

1. 0x00 – Preamble.
2. 0x00 and 0xFF – Start of packet code.
3. 0x04 – packet length.

4. 0x00 – packet length check sum.
Bit 4 = 0x00 – bit 3
5. 0x01 – Number of targets wanted to initialize.
This field value should not exceed 2.
6. 0x00 – Baud rate
0x00 - 106 kbps
0x01 – 212 kbps
0x02 – 424 kbps.
7. 0x00 – packet data check sum.
Bit 9 = 0x00 – (bit 5 + bit6 + bit7+bit8);
8. 0x00 – postamble.

The Output frame format is:

Example: 00 00 FF 00 FF 00 00 00 FF 0C F4 D5 4B 01 01 04 00 08 04 4A 3C 93 34 81 00

D5 4B	01	01	04 08	08	04	4A 3C 93 34	81 00
Output parameters	No .of targets	Logical number of tag	SENS_RES	SEL_RES	TagID length	Tag ID	ATS

Here the Tag ID of the MIFARE card is: 4A 3C 93 34

Authentication:

The command code for authentication is: 0x60

The input frame format is:

Example:

0x00	0x00	0xFF	0x0F	0x00 - Length	0xD4	0x40	0x01	0x60	0x02
preamble	Start of packet code	Start of packet code	Length of data	LCS	Input parameter	Input parameter	Tag Number	CMD	Block NO

0xFF	0xFF	0xFF	0xFF	0xFF	0xFF	0x4A	0x3C	0x93	0x34	0x00 – sum of data	0x00
key	key	key	key	key	key	Tag id	Tag id	Tag id	Tag id	Check sum	poatamble

In the above frame we are authenticating using the keys 0xFF 0xFF 0xFF 0xFF 0xFF 0xFF to the address 0x02 of a MIFARE card whose ID number is 0x4A 0x3C 0x93 0x34.



The Output frame format is:

Example: 0000FF00FF000000FF03FDD54100EA00

D5 41	00	EA 00
Output parameters	Error code	ATS

Read Data:

The command code for Read data is: 0x30

The input frame format is:

0x00	0x00	0xFF	0x0F	0x00 - Length	0xD4	0x40	0x01	0x30	0x02
preamble	Start of packet code	Start of packet code	Length of data	LCS	Input parameter	Input parameter	Logical number assigned to tag by DTNFCUS	Command code	Block number

0x00 – sum of data	0x00
Check sum	poatamble

Here we are reading 16 – bytes data from the address 0x02.

The Output frame format is:

Example: 0000FF00FF000000FF13EDD541007068616E696B726973686E61303030312900

D5 41	00	70 68 61 6E 69 6B 72 69 73 68 6E 61 30 30 30 31	29 00
Output parameters	Error code	16-Bytes of data	ATS

Write Data:

The command code for Write data is: 0xA0. Here we are writing 16 – bytes data 0x00... ..0x1A to the address 0x02.

The input frame format is:

0x00	0x00	0xFF	0x0F	0x00 - Length	0xD4	0x40	0x01	0x30	0x02
preamble	Start of packet code	Start of packet code	Length of data	LCS	Input parameter	Input parameter	Logical number assigned to tag by DTNFCUS	Command code	Block number

0x01	0x02	0x03	0x04	0x05	0x06	0x07	0x08	0x09	0x0A	0x0B	0x0C	0x0D	0x0E	0x0F	0x1A
data	data	data	data	data	data	data	data	data	data	data	data	data	data	data	data

0x00 – sum of data	0x00
Check sum	poatamble

The Output frame format is:

Example: 0000FF00FF000000FF03FDD54100EA00

D5 41	00	EA 00
Output parameters	Error code	ATS

Value Block:

Before doing the Increment block data or decrement the block data operations we have to make the block as value block. This can be done by writing the value to the block by using normal write command.

The value must be 4-byte. The maximum value is 9999.

The input frame format is:

0xD4	0x40	0x01	0x30	0x02
Input parameter	Input parameter	Logical number assigned to tag by DTNFCUS	Command code	Block number

value	<u>value</u>	value	addr	<u>addr</u>	addr	<u>addr</u>	0x00- sum of data	0x00
0... .. 3	4... .. 7	8... .. 11	12	13	14	15	Check sum	postamble

The Output frame format is: value

Example: 0000FF00FF000000FF03FDD54100EA00

D5 41	00	EA 00
Output parameters	Error code	ATS

Increment Block Data:

The command code for Increment Block data is: 0xC1.

The input frame format is:

0x00	0x00	0xFF	0x09	0x00 - Length	0xD4	0x40	0x01	0xC1	0x02
preamble	Start of packet code	Start of packet code	Length of data	LCS	Input parameter	Input parameter	Tag Number	CMD	Block NO

0x01	0x02	0x03	0x04	0x00 – sum of data	0x00
value	value	value	value	Check sum	poatamble

Here we are incrementing the data of block 0x02 by 0x01 0x02 0x03 0x04

The Output frame format is:

Example: 0000FF00FF000000FF03FDD54100EA00

D5 41	00	EA 00
Output parameters	Error code	ATS

Decrement Block Data:

The command code for Increment Block data is: 0xC0.

The input frame format is:

0x00	0x00	0xFF	0x09	0x00 - Length	0xD4	0x40	0x01	0xC0	0x02
preamble	Start of packet code	Start of packet code	Length of data	LCS	Input parameter	Input parameter	Tag Number	CMD	Block NO

0x01	0x02	0x03	0x04	0x00 – sum of data	0x00
value	value	value	value	Check sum	poatamble

Here we are decrementing the data of block 0x02 by 0x01 0x02 0x03 0x04

The Output frame format is:

Example: 0000FF00FF000000FF03FDD54100EA00

D5 41	00	EA 00
Output parameters	Error code	ATS



Transfer Block Data:

The command code for Transfer Block data is: 0xB0.

This operation should perform immediately after incrementing or decrementing the block data.

The input frame format is:

0x00	0x00	0xFF	0x09	0x00 - Length	0xD4	0x40	0x01	0xB0	0x01
preamble	Start of packet code	Start of packet code	Length of data	LCS	Input parameter	Input parameter	Tag Number	CMD	Block NO

Here we are transferring the incremented or decremented block data to other block in the same sector.

The Output frame format is:

Example: 0000FF00FF000000FF03FDD54100EA00

D5 41	00	EA 00
Output parameters	Error code	ATS

0x00 – sum of data	0x00
Check sum	poatamble

Restore Block Data:

The command code for Transfer Block data is: 0xC2.

This operation should be performed after performing the transfer operation.

The input frame format is:

0x00	0x00	0xFF	0x09	0x00 - Length	0xD4	0x40	0x01	0xC2	0x01
preamble	Start of packet code	Start of packet code	Length of data	LCS	Input parameter	Input parameter	Tag Number	CMD	Block NO

The Output frame format is:

Example: 0000FF00FF000000FF03FDD54100EA00

D5 41	00	EA 00
Output parameters	Error code	ATS

0x00 – sum of data	0x00
Check sum	poatamble

Anti-collision:

This command is used to initiate the targets. DTNFCUS is capable of handling 2 targets at a time.

The input frame format is:

Example:

Bit 0	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7	Bit 8	Bit 9	Bit 10
0x00	0x00	0xFF	0x04	0x00	0xD4	0x4A	0x01	0x00	0x00	0x00

0x00 – Preamble.

0x00 and 0xFF – Start of packet code.

0x04 – packet length.

0x00 – packet length check sum.

Bit 4 = 0x00 – bit3

0xD4 – Input Parameters

0x01 – Number of targets wanted to initialize.

This field value should not exceed 2.

0x00 – Baud rate

0x00 - 106 kbps

0x01 – 212 kbps

0x02 – 424 kbps.

0x00 – packet data check sum.

Bit 9 = 0x00 – (bit5+bit6 ++bit9)

0x00 – postamble.

The Output frame format is:

Example:

0000FF00FF000000FF15EBD54B0201040008044A3C93340204000804CAF49334E900

This command detects maximum of 2 targets.

D5 4B	02	01	04 00	08	04	4A 3C 93 34
Output parameters	No .of targets	Logical number of tag	SENS_RES	SEL_RES	Tag ID 1 length	Tag ID 1

02	04 00	08	04	CA F4 93 34	E9 00
Logical number of tag	SENS_RES	SEL_RES	Tag ID 2 length	Tag ID 2	ATR

Halt Tag:

The command code for Halt Tag is: 0x44

The input frame format is:

Example:

0x00	0x00	0xFF	0x04	0x00	0xD4	0x44	0x01	0x00 – sum of data	0x00
preamble	Start of packet code	Start of packet code	Length of data	LCS	Input parameter	CMD	Tag Num ber	checks um	postam ble

Here we are forcing the card whose logical number assigned by DTNFCUS is 01 to halt mode or we are deselecting the tag.

The Output frame format is:

Example: 0000FF00FF000000FF03FDD54500E600

D5 45	00	EA 00
Output parameters	Error code	ATS

NFC - Peer To Peer Communication

The goal of Peer To Peer communication is exchange of data between two NFC devices. One NFC device acts as Initiator and the other NFC device acts as Target.

The sequence of operations can be performed in Peer To Peer communications are...

Initiator Side:

- ✓ Configure NFC as initiator and scan for the targets in the field.
- ✓ Send data to the target.
- ✓ Release target.

Target Side:

- ✓ Configure NFC as target.
- ✓ Receive data from initiator.
- ✓ Send acknowledgement to initiator.

Input Frame Format:

0x00	0x00	0xFF	LEN	LCS	TFI	PD	DCS	0x00
preamble	Start of packet code		Packet length	Packet length check sum	DIGANT frame identifier	Packet Data	Packet data check sum	Post amble

Acknowledgement Frame Format:

The acknowledgement frame sent by Digant to host controller to indicate the result of the previous operation.

ACK Frame:

00	00 FF	00 FF	00
preamble	Start of packet code	Ack packet code	Postamble

NACK Frame:

This acknowledgement indicates that the previous frame has not been successfully received.

00	00 FF	FF 00	00
preamble	Start of packet code	Ack packet code	Postamble

Error Frame:

This acknowledgement indicates that Digant has detected an error at application level.

00	00	FF	01	FF	7F	81	00
----	----	----	----	----	----	----	----

Error Codes:

Error Cause	Error Code
Timeout	0x01
CRC	0x02
Parity	0x03
Bit count	0x04
Framing	0x05

Collision	0x06
Buffer too small	0x07
RF buffer overflow	0x09
RF	0x0A
Protocol	0x0B
Temperature	0x0D
Internal buffer overflow	0x0E
Invalid parameters	0x10
Unsupported command	0x12
Invalid format	0x13
AE	0x14
UID check byte	0x23
Invalid device state	0x25
Operation not allowed	0x26
Unknown target	0x27

The user must follow the following sequence for the NFC Peer To Peer communication.

Configure NFC as target:

This command is used to configure one NFC module as target.

Input frame format is:

Example:

0x00	0x00	0xFF	25	0x00 – bit 3	0xD4	8C	02
Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7	Bit 8

0x04	0x03	0x12	0x34	0x56	0x40
Bit 9	Bit 10	Bit 11	Bit 12	Bit 13	Bit 14

0x01	0xFE	0xA2	0xA3	0xA4	0xA5	0xA6	0xA7
Bit 15	Bit 16	Bit 17	Bit 18	Bit 19	Bit 20	Bit 21	Bit 22

0xC0	0xC1	0xC2	0xC3	0xC4	0xC5	0xC6	0xC7
Bit 23	Bit 24	Bit 25	Bit 26	Bit 27	Bit 28	Bit 29	Bit 30

0xFF	0xFF
Bit 31	Bit 32

0xAA	0x99	0x88	0x77	0x66	0x55	0x44	0x33	0x22	0x11
Bit 33	Bit 34	Bit 35	Bit 36	Bit 37	Bit 38	Bit 39	Bit 40	Bit 41	Bit 42

0x00 – sum of data	0x00
Bit 43	Bit 44



1. 0x00 – Preamble.
2. 0x00 and 0xFF – Start of packet code.
3. 0x25 – packet length.
4. 0x00 – packet length check sum.
Bit 4 = 0x00 – bit 3
5. Bit 6 and Bit 7 are the input command code.
6. Bit 8 represents the mode (active/passive)
7. Bit 9 to Bit 14 represents MIFARE parameters.
Bit 9 and Bit 10 are SENS_RES bits.
Bit 11 to Bit 13 represents NFCID1t
Bit 14 is SEL_RES bit.
8. Bit 15 to Bit 32 represents Felica parameters
Bit 15 to Bit 22 represents NFCID2t.
Bit 23 to Bit 30 represents Padding.
Bit 31 and Bit 32 represents the system code.
9. Bit 33 to Bit 42 represents NFCID3t.
10. Bit 43 = 0x00 - (Bit 6 + Bit 7 + Bit 42)
It is the packet data check sum.
11. Bit 44 represents the postamble.

The Output frame format is:

Example: 0000FF00FF00

D5 41	00	EA 00
Output parameters	Error code	ATS

Configure NFC as Initiator:

This command is used to configure NFC module as initiator and also to scan for the targets in the field.

Input frame format is:

0x00	0x00	0xFF	0x0A	0x00 – bit 3	0xD4	0x56	0x01
Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7	Bit 8

0x02	0x01	0x00	0xFF	0xFF	0x00	0x00	0x00 - sum	0x00
Bit 9	Bit 10	Bit 11	Bit 12	Bit 13	Bit 14	Bit 15	Bit 16	Bit 17

- Bit 7 is the command code.
- Bit 8 is the mode (active/passive)
- Bit 9 is the baud rate.
- Bit 10 is the payload.
- Bit 11 to bit 15 is the payload field of polling request.

The Output frame format is:

0000FF00FF000000FF00FF000000FF13EDD55700010102030405060708090A000000009019200

0x57	0x00	0x01	01 02 03 04 05 06 07 08 09 0A 00 00 00 09 01 92
Response command code	Status (0 – no error)	Target number 1	ATR_RES received

Now one of the NFC module is configured as Initiator. And it activates the target in the field. When the target is identified by the initiator it sends the following response.

0000FF14ECD58D2111D400D8ABCD41A5011615AE9600000000F200

0x8D	0x21	11 D4 00 D8 AB CD 41 A5 01 16 15 AE 96 00 00 00 00
Response command code	mode	Initiator command received (ATR_REQ)

Send Data To Target:

Input frame format is:

0x00	0x00	0xFF	0x13	0x00 – bit3	0xD4	0x40	0x01
Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit7	Bit 8

-----252 bits data-----
Bit 9 to Bit 260

0x00 – sum	0x00
Bit 261	Bit 262

Bit 7 is the command code.

Bit 8 is the target number 1.

The Output frame format is:

0x41	0x00	99 88 77 -----
Response command code	Status(0 = no error)	data

Receive Data From Initiator:

Input frame format is:

0x00	0x00	0xFF	0x02	0x00 – bit 3	0xD4	0x86	0x00 - sum	0x00
preamble	Start of packet code	Start of packet code	Packet length	Packet length checksum	Input params	Command code	Packet data checksum	postamble

The Output frame format is:

Example:

Example:

0000FF00FF000000FF13EDD58700515151515151515151515151515151... .. .41419400

Send Acknowledgement To The Initiator:

0x87	0x00	51 51 51 51 51 51 51 51 51 51 51 51 51 51 51 51... ..4141
Response command code	Status (0 = no error)	----- data -----

When the data received by the target it can send acknowledgement to the initiator.

Input frame format is:

0x00	0x00	0xFF	0x02	0x00 – bit 3	0xD4	0x8E	0x00 – sum	0x00
preamble	Start of packet code	Start of packet code	Packet length	Packet length checksum	Input parameter	Command code	Packet data checksum	postamble

The Output frame format is:

Example:

0000FF03FDD54100EA000000FF00FF000000FF03FDD58F009C00

0x8F	0x00
Response command code	Status (0 = no error)

Release Target:

This command used at the initiator side to release the target.

Input frame format is:

0x00	0x00	0xFF	0x03	0x00 – bit 3	0xD4	0x52	0x01	0x00 – sum	0x00
preamble	Start	Start	Packet	Packet	Input	Command	Target	Packet	postamb



	of packet code	of packet code	length	length checksum	parameter	code	number	data checksu m	le
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The Output frame format is:

Example:

0000FF00FF000000FF03FDD55300D800

0x53	0x00
Response command code	Status (0 = no error)

Application

- | | |
|------------------------|---------------------|
| ■ e-money | ■ POS |
| ■ Access control | ■ Ticketing |
| ■ Card Personalization | ■ Time & Attendance |

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