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China financial integrated circuit card specifications - Part 11: Contactless integrated circuit card communication specification

中国金融集成电路（IC）卡规范

第 11 部分：非接触式 IC 卡通讯规范

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Foreword

JR/T 0025 consists of the parts as follows in the general name of “China financial integrated circuit card specifications”.

- Part 1: Electronic Purse/Electronic Deposit Card Specification (abolished);
- Part 2: Electronic Purse/Electronic Deposit Application Specification (abolished);
- Part 3: Application Independent ICC to Terminal Interface Requirements;
- Part 4: Debit/credit Application Specifications;
- Part 5: Debit/Credit Application Card Specifications;
- Part 6: Debit/Credit Application Terminal Specifications;
- Part 7: Debit/Credit Application Card Security Specifications;
- Part 8: Contactless Specification Independent of Application
- Part 9: Electronic Purse Extended Application Guide (abolished);
- Part 10: Debit/Credit card Personalization Guide;
- Part 11: Contactless Integrated Circuit Card Communication Specifications;
- Part 12: Contactless Integrated Circuit Card Payment Specification;
- Part 13: Low-value Payment Specifications Based on Debit/Credit Application;
- Part 14: Comprehensive Application Specification Based on Contactless Low-value Payment Application;
- Part 15: Electronic Cash Dual-currency Payment Specifications;
- Part 16: IC Card Internet Terminal Specifications;
- Part 17: Enhanced Debit/Credit Application Security Specifications.

This Part is Part 11 of JR/T 0025.

This Part was drafted according to the rules specified in GB/T 1.1-2009.

This Part replaces JR/T 0025.11-2010 “China financial integrated circuit card specifications - Part 11: Contactless integrated circuit card communication specification”.

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China financial integrated circuit card specifications - Part 11: Contactless integrated circuit card communication specification

1 Scope

This Part mainly includes the following contents:

- specifies the symbolic coding technique used by the contactless communication and defines the different logical values according to the symbols and their sequences, and also defines the Type A and Type B respectively according to bit encoding of PCD→PICC and PICC→PCD communication;
- specifies the data frame format used by Type A and Type B. The data bits are transmitted between PCD and PICC as the frame type;
- specifies the Composition mode of Type A and Type B data frames, frame size, frame time sequence, etc.;
- specifies valid command format of PCD in polling, collision detection and PICC activation;
- specifies contents of Type A and Type B PICC at initialization, polling, collision detection and state machine;
- specifies PCD processing flow at the initialization, poll and collision detection of PICC as well as its activation and shifting out.

The half-duplex block transmission protocol defined in this Part is applicable to Type A and Type B and it is used to transmit information (C-APDU and R-APDU) defined by the application layer. The requirements for application layer are not defined in this Part.

This Part is applicable to the financial contactless integrated circuit card issued or received by the banks. The using objects are mainly the relevant departments for such card design, manufacture, management, issuance and acceptance and those for the development, integration and maintenance of the application system.

2 Normative references

The following referenced documents are indispensable for the application of this

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3.5

Proximity coupling device (PCD)

The read-write equipment which provides energy to PICC with inductance coupling and controls the data exchange with PICC.

3.6

Bit duration

The time during which a logic state is determined and at the end of this time, a new bit will start.

3.7

Binary phase shift keying (BPSK)

Phase shift keying of 180 ° phase shift, making two phase states possible.

3.8

Modulation index

Defined as [a - b]/[a + b], in which, a and b are peak value and minimum value of signal amplitude.

3.9

Non-return to zero (NRZ-L)

The bit encoding mode; the logic state in bit duration may be expressed by either of two defined physical states of the telecommunication media.

3.10

Subcarrier

RF signal generated by modulation of carrier frequency f_c at the frequency f_s.

3.11

Anticollision loop

In PCD exciting field, algorithm used when the PCD makes dialogues with one or more PICCs.

3.12

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Time slot protocol

A method by which PCD establishes logical channel with one or more PICC and this method responds and uses time slot locating, similar to slotted-Aloha method.

3.19

Unique identifier (UID)

A number required by Type A anticollision algorithm.

3.20

Block

A special frame, containing efficient protocol data format.

NOTE: Efficient protocol data format includes I-block, R-block or S-block.

3.21

Prologue field

The first part of the block, containing the protocol control byte (PCB) (unused in CID and NAD defined in JR/T 0025.8).

3.22

Epilogue field

The last part of block, including error detection code (EDC).

4 Symbols and Abbreviations

For the purposes of this document, the following symbols and abbreviations apply.

AC	AntiCollision
ACK	Positive ACKnowledgement
ADC	Application Data Coding, Type B
AFI	Application Family Identifier, Type B
AM	Amplitude Modulation
ASK	Amplitude Shift Keying

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FSDI	Frame Size for proximity coupling Device Integer
FWI	Frame Waiting time Integer
FWT	Frame Waiting Time
HLTA	HaLT command, Type A
HLTB	HaLT command, Type B
IEC	International Electrotechnical Commission
INF	INFormation field
ISO	International Organization for Standardization
LSB	Least Significant Bit
max	Index to define a maximum value
MBL	Maximum Buffer Length
MBLI	Maximum Buffer Length Index
min	Index to define a minimum value
MSB	Most Significant Bit
N/A	Not Applicable
NAD	Node ADdress
NAK	Negative AcKnowledgement
NRZ-L	Non-Return to Zero, (L for level)
OOK	On/Off Keying
P	Odd Parity bit, Type A
PCB	Protocol Control Byte
PCD	Proximity Coupling Device (reader)
PICC	Proximity IC Card
PM	Phase Modulation

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Figure 16 -- $FDT_{B,PICC}$

The $FDT_{B,PICC,MIN}$ (= $TR0_{MIN}$ + $TR1_{MIN}$) is defined as the least time to wait for PICC, from the end of PCD to the start of SoS of the PICC response. After the command's EoS, the PCD shall be able to receive the SoS of the PICC response after the $FDT_{B,PICC,MIN}$ at least; the PICC sends the SoS of the response only after the $FDT_{B,PICC,MIN}$.

7.2.1.3 $FDT_{PICC,MAX}$

The longest waiting time ($FDT_{PICC,MAX}$) after the PCD command is defined as the Frame Waiting Time (FWT).

As for Type A and Type B, the definitions of FWT is general, which are respectively the maximum values (except for WUPA, SELECT, ANTICOLLISIO, RATS and WUPB commands) of $FDT_{A,PICC}$ and $FDT_{B,PICC}$. The FWT is calculated according to the following formula:

$$FWT = (256 \times 16/f_c) \times 2^{FWI}$$

Where, the value range of FWI is from 0 to 14. The FWI of Type B is in ATQB, and the FWI of Type A is in interface byte TB (1) of ATS. For example, if the FWI = 0, the FWT ≈ 302 μs; if the FWI = 7, the FWT ≈ 39 ms.

The PCD and PICC shall comply with the following requirements:

- Except for the WUPA, SELECT, ANTICOLLISION, RATS and WUPB commands, the PCD's waiting time for the PICC response shall be at least FWT + ΔFWT. If the response of PICC is not received within this time, the time-out error happens.

  Refer to Annex A for values of ΔFWT;

- Except for WUPA, SELECT, ANTICOLLISION, RATS and WUPB commands, the PICC shall send the response within the FWT after the end of the PCD command;

- The PCD shall support PICC whose FWT is less than or equal to FWT_{MAX}; refer to Annex A for values of FWT_{MAX};

- The FWT maximum value of PICC shall be the FWT_{MAX}.

As for the RATS command of Type A, the PICC shall start to response within the Frame Waiting Time of activation ($FWT_{ACTIVATION}$). The PCD shall receive the PICC response within the $FWT_{ACTIVATION}$. If the response is not received, the time-out error happens. Refer to Annex A for values of $FWT_{ACTIVATION}$.

As for the WUPB command of Type B, the PICC shall start to response within the FWT_{ATQB}. The PCD shall receive the PICC response within the FWT_{ATQB}. If the response is not received, the time-out error happens. Refer to Annex A for values of

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As for Type A, the SFGT is the required guard time from the end of transmitting ATS to being ready for receiving the next command; as for Type B, the SFGT is the required guard time from the end of transmitting ATTRIB response to being ready for receiving the next command.

Calculate SFGT with the following formula:

$$SFGT = (256 \times 16/f_c) \times 2^{SFGI}$$

Where, the range of SFGI is from 1 to 14. If the SFGI returned by PICC is 0 or is not returned, do not use the SFGT and use the $FDT_{PCD,MIN}$ only. As for Type A, the SFGI is returned by the PICC in the interface byte TB (1); as for Type, the SFGI is returned by the PICC in ATQB.

The PCD and PICC shall comply with the following rules:

- If the non-zero SFGI is returned by the PICC, the PCD shall wait for the SFGT + ΔSFGT and then send the next command after the PICC transmits the ATS (Type A) or the ATTRIB response (Type B);

- If the non-zero SFGI is returned by the PICC, the PICC shall be able to receive the new command of PCD after the SFGT after the PICC transmits the ATS (Type A) or the ATTRIB response (Type B). If the PICC receives the new PCD command within the SFGT, it may be regarded as the transmission error. Refer to Annex A for values of ΔSFGT;

- If the SFGI returned by the PICC is 0 or it is not returned, the PCD shall at least wait for the $FDT_{PCD,MIN}$ and then send the new command after the PICC transmits the ATS (Type A) or ATTRIB response (Type B);

- If the SFGI returned by the PICC is 0 or is not returned, the PICC shall be able to receive the new PCD command after the $FDT_{PCD,MIN}$ after the PICC transmits the ATS (Type A) or the ATTRIB response (Type B). If the PICC receives the new PCD command within the $FDT_{PCD,MIN}$, it may be regarded as the transmission error.

7.2.3 Brief summary

This Chapter gives out the minimum value and maximum value of Frame Delay Time (FDT). Refer to Table 4 for details.

Table 4 -- FDT

	Minimum value	Maximum value
$FDT_{A,PCD}$	$FDT_{PCD,MIN}$	N/A
$FDT_{A,PICC}$	$FDT_{A,PICC}$ (n = 9)	As for the WUPA, ANTICOLLISION and SELECT commands, it is $FDT_{A,PICC}$ (n = 9) As for the RATS command, it is $FWT_{ACTIVATION}$

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HLTA command is received	HLTA command

8.7 Request for Answer To Select (RATS)

PCD uses RATS command in the activation procedure of agreement and PICC negotiates the maximum frame size (FSD and FSC), frame waiting time (FWT) and start-up frame guard time (SFGT) of communication.

8.7.1 RATS command

RATS command carries out transmission by using the standard frame with CRC_A and its format is detailed in Table 16.

Table 16 -- Coding of RATS

Byte 1	Byte 2
'E0'	PARAM

PARAM (parameter byte) includes two parts, which is detailed in Table 17.

Table 17 -- Format of PARAM

b8	b7	b6	b5	b4	b3	b2	b1	Description
x	x	x	x					FSDI
				x	x	x	x	CID

b8 to b5, the most significant nibbles of PARAM which is used for the coding proximity coupling equipment frame size (FSD), are proximity coupling device frame size integer (FSDI). Corresponding relationship of FSD and FSDI coding is detailed in Table 18.

Table 18 -- Conversion from FSDI to FSD

FSDI	'0'	'1'	'2'	'3'	'4'	'5'	'6'	'7'	'8'	'9' ~ 'F'
FSD (bytes)	16	24	32	40	48	64	96	128	256	RFU

Requirement: $FSDI_{MIN}$

PCD
8.7.1.1 PCD shall set FSDI to be $FSDI_{MIN}$. See Annex A for the value of $FSDI_{MIN}$.

Requirement: processing of FSDI reserve value by PICC

PICC
8.7.1.2 When the receiving value of FSDI is '9' ~ 'F', PICC shall process FSDI by regarding FSDI as '8'

b4 to b1, the least significant nibbles of PARAM, is named Card identifier (CID), which

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and start-up frame guard time (SFGT). See Table 23 for its code format.

Table 23 -- Coding of TB (1)

b8	b7	b6	b5	b4	b3	b2	b1	Description
x	x	x	x					FWI
				x	x	x	x	SFGI

The most significant nibbles b8 ~ b5 is referred to as FWI (frame waiting time), which is used for FWT coding. If default Value of FWI is 4, then the value of FWT is 4.8 ms.

Requirement: interfacing byte TB (1) of ATS

PICC
8.7.2.4.1 PICC shall set that FWI is not larger than FWI_{MAX}, See Annex A for the value of FWI_{MAX}

The least significant nibble b4 ~ b1 of TB (1) is SFGI, which is used for SFGT coding. The default Value of SFGI is 0.

Requirements: interfacing byte TB (1) of ATS

PCD	**PICC**
8.7.2.4.2 PCD shall support the PICC with SFGI less than or equal to $SFGI_{MAX}$ PCD may support PICC with SFGI greater than $SFGI_{MAX}$	**8.7.2.4.3** PICC shall set that SFGI is less than or equal to $SFGI_{MAX}$ and see Annex A for the value of $SFGI_{MAX}$

8.7.2.5 Interfacing byte TC (1)

Interfacing byte TC (1) indicates whether PICC supports NAD and CID or not. The code format of TC (1) is detailed in Table 24.

Table 24 -- Coding of TC (1)

b8	b7	b6	b5	b4	b3	b2	b1	Description
0	0	0	0	0	0			RFU
						x		If b2 = 1, then TC (1) supports CID
							x	If b1 = 1, then TC (1) supports NAD

Bits b2 and b1 are used by PICC to define the optional field supported in prologue field.

Requirement: interfacing byte TC (1) of ATS

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that the extended ATQB is not supported)	command with b5 = 0, PICC shall not include the ATQB extension byte into its ATQB response PICC shall accept the WUPB command with b5 = 1 (i.e., supporting the extended ATQB) While responding to a WUPB command with b5 = 1, PICC may include the ATQB extension byte into its ATQB response or not to

9.3.2 WUPB response (ATQB)

See Table 28 for the format of ATQB.

Table 28 -- Format of ATQB

Byte 1	Byte 2 - 5	Byte 6 ~ 9	Byte 10 ~ 13
'50'	PUPI	Application Data	Protocol Info

The 13th byte of ATQB is optional. ATQB is required to consist of 13 bytes even if the 13th one is not used.

9.3.2.1 PUPI (Pseudo-Unique PICC Identifier)

PUPI is used to distinguish the PICCs in the anti-collision period.

Requirement: PUPI in ATQB

PICC
9.3.2.1.1 The length of PUPI shall be 4 bytes, and the value of PUPI shall be a fixed one or and random number generated dynamically by PICC
9.3.2.1.2 The random PUPI shall be generated only during the state switching of PICC from POWER-OFF to IDLE

9.3.2.2 Application Data

PCD reads out what applications are installed on PICC via the application data.

Requirement: application data

PCD
9.3.2.2.1 PCD shall omit any value of the application data returned by PICC

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9.3.2.3.5.1 PCD shall omit the value of b3 returned in ADC by PICC

9.3.2.3.6 FO (Frame Option)

The Frame Option supported by PICC is as shown in Table 36.

Table 36 -- Frame Option supported by PICC

b2	b1	Description
x		b2 = 1: support NAD
	x	b1 = 1: support CID

Requirement: FO

PCD	PICC
9.3.2.3.6.1 PCD shall not use CID and NAD and omit the FO returned by PICC	PICC may support CID and NAD

9.3.2.3.7 SFGI (Start-up Frame Guard Time Integer)

The most significant half bytes b8 to b5 of the optional ATQB extension byte are used for the coding of SFGI, which is used by PICC to define the SFGT. The default value of SFGI is 0.

Requirement: SFGI

PICC
9.3.2.3.7.1 PICC shall set the SFGI to be less than or equal to SFGIMAX. See Annex A for the values of SFGIMAX

9.4 ATTRIB

The ATTRIB command sent by PCD contains the information required for the PICC selection. After receiving a valid ATTRIB command and sending the ATTRIB response, PICC shall only respond according to the requirements specified in Chapter 13.

9.4.1 ATTRIB command

See Table 37 for the format of ATTRIB command.

Table 37 -- Format of ATTRIB command

Byte 1	Byte 2 ~ 5	Byte 6	Byte 7	Byte 8	Byte 9	Byte 10 ~ (10+k-1)
'ID'	PUPI	Param 1	Param 2	Param 3	Param 4	Higher-layer information field

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the PICC conforming to Chapter 8 of JR/T 0025.8

9.4.1.5 Coding of Param 4

See Table 44 for the coding of Param 4.

Table 44 -- Coding of Param 4 in ATTRIB command

b8	b7	b6	b5	b4	b3	b2	b1	Description
0	0	0	0					RFU
				x	x	x	x	CID

Requirement: coding of Param 4 in ATTRIB command

PCD	PICC
9.4.1.5.1 PCD shall not use CID. The least significant half bytes, b4 ~ b1, of Param 4 shall be set to (0000)b	**9.4.1.5.2** PICC shall accept the PCD not using CID PICC may support CID

9.4.1.6 Higher layer - INF (Higher layer information field)

The higher layer information field may contain any higher layer command which can be transmitted in the information field (INF); see 13.1 for the definition of information field.

Requirement: higher layer information field.

PCD	PICC
9.4.1.6.1 PCD shall not include higher layer command into the higher layer information field In the personalization of card, PCD may include higher layer command into the higher layer information field	**9.4.1.6.2** PICC shall accept the ATTRIB command regardless of the existence of higher layer information field

9.4.2 ATTRIB response

PICC shall respond to any valid ATTRIB command according to the format defined in Table 45, and valid response to the ATTRIB command means the PICC selection of PCD is successful.

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Table 45 -- ATTRIB Response Format

Byte 1	Byte 2 - (2 + n - 1)	
MBLI	CID	Higher layer response field

The least significant half bytes, b4 ~ b1, of Byte 1 contain the returned CID.

Requirement: CID in ATTRIB response

PICC
9.4.2.1 When the CID value in the ATTRIB command is (0000)b, the value of CID in the ATTRIB response shall be (0000)b

The most significant half bytes, b8 ~ b5, encodes the Maximum Buffer Length Index (MBLI), with which the PICC notifies the PCD its Maximum Buffer Length (MBL). MBL shall be calculated according to the following formula:

$$MBL = FSC \times 2^{MBLI-1}$$

Where, MBLI is an integral greater than zero. If the MBLI returned by PICC equals to 0, it means that PICC does not provide its MBL information.

Requirement: MBLI in ATTRIB response

PCD	**PICC**
9.4.2.2 PCD shall omit any value in the returned MBLI field	**9.4.2.3** The MBLI returned in the ATTRIB response is always (0000)b

The higher layer response field contains the responses to the higher layer commands in the higher layer information field of ATTRIB command.

Requirement: higher layer response field

PCD	**PICC**
9.4.2.4 PCD shall accept an ATTRIB response with the higher layer response field being blank	**9.4.2.5** As for an ATTRIB command with the higher layer information field being blank, PICC shall return an ATTRIB response with the higher layer response field being blank As for an ATTRIB command with higher layer information field, PICC may return an ATTRIB response with higher layer response field

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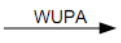
PROTOCOL state
10.1.1.2 PICC shall not send response if a transmission error is detected PICC may return (0001)b or (0101)b when it detects a transmission error at ACTIVE state
10.1.1.3 PICC shall respond to only the commands specified in this Part and it shall not send any response if a protocol error is detected
10.1.1.4 PICC shall not respond to any Type B command

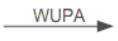
The following symbols are applied to the state diagram given in Figure 23:

- AC — Any anti-collision command defined in 8.4;
- AC CLn — The anti-collision command of n in the UID cascade level;
- SELECT — Any selection command defined in 8.5;
- SELECT CLn — The selection command for n in the UID cascade level;
- ERROR — A detected transmission or protocol error;
- 

A PICC state defined in this Part, which always exists and is irrelevant to the length of UID;
- 

A PICC state defined in this Part, whose existence is relevant to the length of UID;
- 

A PICC state defined in Chapter 7 of JR/T 0025.8 but not used in this Part;
- 

A PICC state switching defined and used in this Part;
- 

A PICC state switching defined in Chapter 7 of JR/T 0025.8 but not used in this Part.

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Requirement: Type A - READY' state

PICC
10.2.4.1 PICC shall maintain the READY' state when receiving effective ANTICOLLISION CL command and sending its UID CL2
10.2.4.2 PICC with Class 2 UID shall enter into ACTIVE state after receiving the effective SELECT CL 2 command matching with its UID CL2 and sending its SAK. PICC shall indicate that UID is complete in the SAK response. PICC with Class 2 UID has no READY" state
10.2.4.3 PICC with Class 3 UID shall maintain the READY" state when receiving effective SELECT CL 2 command matching with its UID CL2and sending its SAK
10.2.4.4 At all other conditions, PICC shall go back to IDLE state and transmit no response to PCD

10.2.5 READY” state

The requirement of this article is applicable to PICC at the READY” state. READY” state is an intermediate state, and only PICC with Class 3 UID has this state. In the READY" state, the cascade levels and 2 of UID has been selected.

Requirement: Type A - READY” state

PICC
10.2.5.1 PICC shall maintain the READY” state when receiving effective ANTICOLLISIOIN CL 3 command and sending its UID CL3
10.2.5.2 PICC with Class 3 UID shall enter into the ACTIVE state after receiving the effective SELECT CL 3 command matching with its UID CL3 and sending its SAK.PICC shall indicate that UID is complete in the SAK response
10.2.5.3 At all other conditions, PICC shall go back to IDLE state and transmit no response to PCD

10.2.6 ACTIVE state

The requirement of this article is applicable to PICC at the ACTIVE state. In the ACTIVE state, PICC monitors RATS command.

Requirement: Type A - ACTIVE state

PICC

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11.2.2.1 PICC shall enter into the READY state when receiving effective WUPB command and sending its ATQB PICC shall enter into the READY state when receiving effective REQB command defined as JR/T 0025.8, Chapter 7 and sending its ATQB
11.2.2.2 PICC shall remain the IDLE state and be able to give response to the WUPB command within the unmodulated carrier time t_P after receiving any Type A command
11.2.2.3 PICC shall neglect all other command and error and maintain the IDLE state

11.2.3 READY state

The requirement of this article is applicable to PICC in the READY state; in the READY state, PICC identifies ATTRIB command. PICC enters into the ACTIVE state after receiving ATTRIB command.

Requirement: Type B - READY state

PICC
11.2.3.1 If the PUPI in the effective ATTRIB command received matches with the PUPI of PICC, PICC shall enter into ACTIVE state after sending its ATTRIB response
11.2.3.2 If the PUPI in the effective ATTRIB command received doesn't match with the PUPI of PICC, PICC shall maintain READY state and send no response
11.2.3.3 PICC shall maintain the READY state after receiving effective WUPB command and sending its ATQB PICC may remain the READY state after receiving effective REQB command defined in JR/T 0025.8, Chapter 7 and sending its ATQB
11.2.3.4 PICC shall enter into the HALT state after receiving effective HLTB command and sending its HLTB response
11.2.3.5 PICC shall remain the READY state or return to the IDLE state and be able to give response to the WUPB command within the unmodulated carrier time t_P after receiving any Type A command
11.2.3.6 PICC shall neglect all other command and error and maintain the READY state

11.2.4 ACTIVE state

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12.1 Primary cycle

This article describes a complete primary cycle of a terminal. The terminal uses the primary cycle of function execution in PCD. This article covers two parts: different process in PCD execution; and the requirements on the primary cycle.

12.1.1 Primary cycle - Description

The terminal and PCD handling are as follows (see Figure 25):

1. To detect the PICCs in the working range, PCD polls different communication signal interfaces (Type A and Type B are compulsory, and other techniques are optional) supported by it. The polling procedure is stated in Article 12.2 in detail;

2. In the collision detection procedure, PCD ensures only one PICC in the working range. If PCD receives responses from multiple PICCs, it will report a collision to the terminal, reset the working range and restart a poll. The collision detection procedure stated in Article 12.3 in detail;

3. If only one PICC exist in the working range, PCD activates this PICC, and the activation procedure is stated in Article 12.4 in detail;

4. After PICC is activated, PCD uses the half-duplex transmission protocol defined in Chapter 13 and the terminal application executes the transaction. The transaction handling is located in the application layer, which is beyond the category of this Part;

5. When completing a transaction, PCD waits till the PICC is shifted out from the working range. The shifting out procedure is stated in Article 12.5 in detail. When the PICC is shifted out from the working range, PCD resets the working range and waits the unmodulated carrier time t_{PAUSE} (optional), and then restarts poll and collision detection (optional). Value t_{PAUSE} is a value related to the realization.

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command) If only one polling tag is set to be 1, PCD shall continue procedures in 12.3.1.2
12.3.1.2 If TYPE_A is set to be 1, PCD shall enter the collision detection procedure for Type A (see 12.3.2). If TYPE_B is set to be 1, PCD shall enter the collision detection procedure for Type B (see 12.3.3). If TYPE_OX is set to be 1, PCD shall enter the collision detection procedure for technique X

12.3.2 Collision detection for Type A

This Article describes, in detail, how PCD verifies only one Type A PICC is in the working range.

If Type A PICC responds to one WUPA command synchronously by using Manchester code, PCD shall be able to detect the bit-level collision of Type A PICC (i.e. at least two Type A PICCs simultaneously send complemental bit patterns on one or more bit levels). In such case, bit patterns are merged, and the carrier is modulated in the manner to modulate the subcarrier within the entire (100 %) bit duration.

In order to verify whether only one Type A PICC is in the working range and detect the UID of PICC, PCD shall carry out processing below (see Figure 27).

Requirement: collision detection for Type A

PCD
12.3.2.1 PCD shall wait the unmodulated carrier time t_P (tag 0) before sending WUPA command (tag 1). If PCD detects one transmission error in the response to WUPA command, it shall continue procedures in 12.3.2.8 within the time $t_{RESETDELAY}$ (metering from the response) Otherwise, PCD shall continue procedures in 12.3.2.2
12.3.2.2 PCD shall send one ANTICOLLISION command (SEL = '93') (tag 3). If PCD detects one transmission error in the response to ANTICOLLISION command, it shall thus continue procedures in 12.3.2.8 within the time $t_{RESETDELAY}$ (metering from the response), otherwise, procedures in 12.3.2.3
12.3.2.3 If ATQA indicates one Level-1 UID, PCD shall thus retrieve one complete UID (= UID CL1: uid0 uid1 uid2 uid3 BCC). PCD shall set the PICC to be in ACTIVE state through sending one SELECT command (SEL = '93', UID CL1) (tag 8). PCD shall, through the collision detection for Type A, conclude that only one Type A PICC is in the working range and then enter the activation procedure for Type A

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12.5.1.4 PCD shall send at most two WUPA commands. After the longest allowable response time, PCD shall re-send the WUPA command within the time $t_{RETRANSMISSION}$. If receiving any response (right or not) to WUPA command, PCD shall continue procedures in 12.5.1.3; if not receiving the response to the third WUPA command, PCD shall report one time-out error to the terminal and terminate the shifting out procedure

Requirement: shifting out of Type B

PCD
12.5.1.5 PCD shall reset the working range and wait the unmodulated carrier time t_P
12.5.1.6 PCD shall, through sending the WUPB command, poll one Type B PICC. If receiving any response (right or not) to WUPB command, PCD shall continue procedures in 12.5.1.7; if not, PCD shall continue procedures in 12.5.1.8
12.5.1.7 PCD shall wait the unmodulated carrier time t_P and then continue procedures in 12.5.1.6
12.5.1.8 PCD shall send at most two WUPB commands. After the longest allowable response time, PCD shall re-send the WUPB command within the time $t_{RETRANSMISSION}$. If receiving any response (right or not) to WUPB command, PCD shall continue procedures in 12.5.1.7; if not receiving the response to the third WUPB command, PCD shall report one time-out error to the terminal and terminate the shifting out procedure

12.6 Exception handling

This Article specifies how PCD handles correspondingly when PICC is subjected to exception in non PROTOCOL state (Type A) or non ACTIVE state (Type B). See Chapter 13 for error handling by PCD.

Requirement: exception handling

PCD
12.6.1.1 In activation procedure, if the response to transmission error is detected and conditions below are met, PCD shall report the transmission error to the terminal, reset the working range and return to polling procedure. - The response is encapsulated in the frame which is at least 4-byte long - The response is encapsulated in one frame without redundant bit (i.e. the data bit is the integral multiple to 8)

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block.

Requirement: total length of the half-duplex block format

PCD	PICC
13.1.1.1 The total length of block sent by PCD shall be less than or equal to FSC (FSC is designated by PICC in protocol installation)	**13.1.1.2** The total length of block sent by PCD shall be less than or equal to FSD (FSD is designated by PCD in protocol installation)
13.1.1.3 PCD shall be able to accept the block with the length less than or equal to FSD bytes. The block with the byte exceeding that of the FSD shall be regarded by PCD as the protocol error block	**13.1.1.4** PICC shall be able to accept the block with the length less than or equal to FSC bytes. The block with the byte exceeding that of the FSC shall be regarded by PICC as the protocol error block

13.1.2 Prologue field

The prologue field is mandatory and contains the protocol control byte (PCB) (CID and NAD defined in Chapter 8 of JR/T 0025.8 are not used). The protocol control byte (PCB) is used to transmit the information required for the control of data transmission. The protocol defines three fundamental transmission block types:

- Block I, used for the transmission of information on the application layer;

- Block R, used for the transmission of Positive or Negative Acknowledgement which is relative to the final receiving block and excluding INF field;

- Block S, used for the switching of control information between PCD and PICC. Two types of the block S are defined as follows:

  1) Waiting time extension (WTX), including INF field which is 1-bye long;

  2) DESELECT, excluding INF field (not used in this Part).

PCB coding depends on PCB type. Codes for block I, block R and block S are respectively shown in Table 49, Table 50 and Table 51.

Table 49 -- PCB Coding of Block I

b8	b7	b6	b5	b4	b3	b2	b1	Description
0	0							Block I
		0						Reserved for future use
			X					b5 = 1: linking
				0				b4 = 1: following CID

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those specified in this Part (e.g. PCB doesn't conform to those specified in this Part), it is regarded as a protocol error

13.2 Waiting Time Extension (WTX) for frame

If longer time is required by PICC than that by FWT to handle the received block, one S (WTX) request shall be sent. S (WTX) request includes the information field which is 1-byte long and as shown in Table 52.

Table 52 -- Coding for the Information Field under S (WTX) Request

b8	b7	b6	b5	b4	b3	b2	b1	Description
x	x							Power level indication
		x	X	x	x	x	x	WTXM

13.2.1 Power level indication

Two most significant bits, b8 and b7, encode the power level indication.

Requirement: power level indication

PCD	PICC
PCD may support the power level indication that the code is not (00)b	**13.2.1.1** The power level indication is not used. b8 and b7 shall be set to be (00)b

13.2.2 WTXM

The low 6 bits, b6 ~ b1, encode the WTXM of which the range is 1 ~ 59.

PCD acknowledges, through sending S (WTX) response, S (WTX) request of PICC. The response also includes the information field which is 1-byte long, and such information field consists of two parts (see Table 53), including therein WTXM same to that in request information.

Table 53 Coding for the Information Field under S (WTX) response

b8	b7	b6	b5	b4	b3	b2	b1	Description
0	0							RFU
		x	X	x	x	x	x	WTXM

FWT_{TEMP} shall be calculated according to the formula below:

$$FWT_{TEMP} = FWT \times WTXM.$$

The FWT_{TEMP} time under PICC request shall be from when PCD starts to send S (WTX) response.

Requirement: Waiting Time Extension (WTX) for Frame

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PCD	PICC
13.3.1.1 After sending one block, PCD shall switch to the receiving mode to wait the receiving block before turning back to the transmission mode	**13.3.1.2** After PICC is activated, PICC shall wait the block sent by PCD
13.3.1.3 Before the completion of current Command/Response pair or before the waiting time for frame has exceeded limit (the response is not received within such waiting time), PCD shall not initialize one new Command/Response pair	**13.3.1.4** Only after having received one active block sent by PCD, PICC shall be able to send the block. After response, PICC shall return to the receiving mode

13.3.2 Linking

If data required to be transmitted are unsuitable to be placed in the single data block respectively defined by FSC or FSD, the linking function shall thus allow PCD or PICC to split the information into several blocks for transmission.

Requirement: linking rule

PCD and PICC
13.3.2.1 The block linking is under the control of PCB link bit in block I. Each block I set with link bit must be acknowledged by block R (ACK)

Requirement: size of link block

PCD
13.3.2.2 When PCD sends a group of linked block I, the size of each block indicating the link shall be equal to FSC

One example for linking function is as shown in Figure 30, which describes the case that the character string which is 16-byte long is divided into three blocks for transmission, during which, symbols below are used:

- I (1) x the block I set with link bit and equipped block number x;
- I (0) x the block I (the last block linked) set with link bit and equipped with block number x;
- R (ACK) x the block R indicating one Positive Acknowledgement.

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13.3.4.7 PICC is permitted to send Block S(WTX) instead of Block I or Block R(ACK). (in such cases other than those resending Block I or Block R(ACK))
13.3.4.8 When a Block I not indicating link is received, PICC shall confirm it with Block I
13.3.4.9 Where a Block R(ACK) or Block R(NAK) is received and its No. is equal to No. of current PICC block, then - The last block shall be resent if it is sent by PICC (i.e. the last block sent by PICC is not confirmed by PCD) - The next block shall be sent if the last block is sent by PCD (i.e. the last block sent by PICC is confirmed by PCD)
13.3.4.10 Where one Block R(NAK) is received, if its No. is unequal to the No. of current PICC block, PICC shall send one Block R(ACK)
13.3.4.11 Where one Block R(ACK) is received, if its No. is unequal to the No. of current PICC block and the last Block I sent by PICC indicates a link, the link shall continue If the last Block I sent by PICC fails to indicate a link, PICC may deem reception of Block R(ACK) as a protocol error

13.3.5 Exception handling

The following exception handling can be carried out in the case of error detected.

Requirement: PICC exception handling

PICC
13.3.5.1 PICC shall detect transmission error (frame error or EDC error) and protocol error (in violation of agreement rules)
13.3.5.2 PICC shall not attempt error recovery. PICC can always keep receiving state in the case of one transmission error or one protocol error appearing. PICC shall not send Block R (NAK)

PCD exception handling aims at distinguishing any perceptible disturbance in the working range prior to PICC response and actual response with transmission error given off by PICC. Annex B gives a flow diagram describing PCD exception handling.

Requirement: PCD exception handling

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- Block is encapsulated in the frame which is at least 4-character long

- Block is encapsulated in one frame without redundant bit (i.e. the data bit is the integral multiple to 8)

- False CRC or odd-even check error in the frame

After completion of the blocks with above-mentioned transmission error, PCD shall neglect any other transmission errors and be ready to, within the time $t_{RECOVERY}$, handle correct frame

PCD shall, within the time $t_{RETRANSMISSION}$ (metering from the block with transmission error), send Block R (ACK)

PCD shall at most send Block R (ACK) twice continuously for requesting transmission again. If the correct response to the second Block R (ACK) is not received, PCD shall report transmission error to the terminal and continue handling, within the time $t_{RESETDELAY}$ (metering from the final ineffective response), according to the requirements of 13.3.5.9

13.3.5.7 If one block with protocol error is received following one block indicating a link, PCD shall report protocol error to the terminal and continue handling, within the time $t_{RESETDELAY}$ (metering from the protocol error response block), according to the requirements of 13.3.5.9

13.3.5.8 If a time-out error appears when receiving one block indicating a link, PCD shall resend the last Block R (ACK) again at most twice continuously for requesting transmission again. PCD shall send Block R (ACK) between $t_{TIMEOUT}$ and $t_{TIMEOUT}$ + $t_{RETRANSMISSION}$. If the active block responding to the second R (ACK) is not received or PCD detects one timeout after three continuous S (WTX) response blocks (i.e. PCD fails to detect the correct Block I or Block R of PICC after each S (WTX) response), PCD shall report time-out error to the terminal and continue handling between $t_{TIMEOUT}$ and $t_{TIMEOUT}$ + $t_{RESETDELAY}$ according to the requirements of 13.3.5.9. If PICC fails to request Frame Waiting Time Extension (WTX), $t_{TIMEOUT}$ is equal to FWT + ΔFWT; otherwise, $t_{TIMEOUT}$ is equal to (FWT + ΔFWT) × WTXM

13.3.5.9 If it is impossible to appear error recovery, PCD shall reset the working range

At this stage, continued handling of the terminal and PCD shall be defined, as follows (including but not limited to):

- Wait the unmodulated carrier time t_{PAUSE} and restart the polling procedure according to the requirements of 12.2

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