Advanced Card Systems Ltd.
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ACOSJ-P (Combi)

Functional Specifications V1.01

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Table of Contents

1.0. Overview 4

1.1. Reference Documents 4
1.2. Symbols and Abbreviations 5

2.0. Product Overview 7

2.1. Features 7
2.2. Technical Parameters 7
2.2.1. Electrical Parameters 7
2.2.2. EEPROM Parameters 7
2.2.3. Environmental Parameters 7
2.3. Application Installation Parameters 8
2.4. ATR (Contact Cards) 8

3.0. Card Life Cycle States 10

4.0. Personalization Data Management 11

5.0. Safety Management Mechanism 12

5.1. Session Key Calculation Method 12

6.0. Personalization Command 13

6.1. PBOC3.0 Debit/Credit Application Personalization Commands 13
6.2. INITIALIZE UPDATE 13
6.3. EXTERNAL AUTHENTICATE 13
6.4. STORE DATA 13

7.0. PBOC 3.0 Debit/Credit Application Dedicated Commands 14

7.1. SELECT 14
7.2. READ RECORD 14
7.3. GET DATA 14
7.4. GET RESPONSE 14
7.5. GET PROCESSING OPTIONS 14
7.6. INTERNAL AUTHENTICATE 14
7.7. VERIFY 15
7.8. GENERATE AC 15
7.9. EXTERNAL AUTHENTICATE 15
7.10. APPLICATION BLOCK 15
7.11. APPLICATION UNBLOCK 15
7.12. CARD BLOCK 15
7.13. PUT DATA 16
7.14. PIN CHANGE/UNBLOCK 16
7.15. UPDATE RECORD 16

8.0. Transaction Process 17

8.1. QPBOC Transaction Process 17
8.2. Debit/Credit (EC) Transaction Process 18

9.0. Life Support Application 20

10.0. Contact Information 21

List of Figures

Figure 1 : Card Life Cycle 10
Figure 2 : ACOSJ-P Support QPBOC Transaction Process 17
Figure 3 : ACOSJ-P Support Standard PBOC3.0 Debit/Credit Transaction Process 19

List of Tables

Table 1 : Symbols and Abbreviations 6
Table 2 : Application Installation Parameters 8
Table 3 : ATR Protocol Bytes 8
Table 4 : ATR Historical Bytes 9

1.0. Overview

This document describes features and functions of ACOSJ-P independently developed by Advanced Card Systems Ltd. It aims to provide readers an overview of the product.

1.1. Reference Documents

- China Financial Integrated Circuit Card Specifications--Part 4: Debit/credit Application Specifications JR/T 0025.4—2013
- China Financial Integrated Circuit Card Specifications--Part 5: Debit/Credit Application Card Specification JR/T 0025.4—2013
- China Financial Integrated Circuit Card Specifications--Part 6: Debit/Credit Application Terminal Specifications JR/T 0025.4—2013
- China Financial Integrated Circuit Card Specifications--Part 7: Debit/Credit Application Card Security Specifications JR/T 0025.4—2013
- China Financial Integrated Circuit Card Specifications--Part 10: Debit/Credit card Personalization Guide JR/T 0025.4—2013
- China Financial Integrated Circuit Card Specifications--Part 12: Contactless Integrated Circuit Card Payment Specification JR/T 0025.4—2013
- China Financial Integrated Circuit Card Specifications--Part 13: Low-value Payment Specifications Based on Debit/Credit Application JR/T 0025.4—2013
- China Financial Integrated Circuit Card Specifications--Part 17: Enhanced Debit/Credit Application Security Specifications JR/T 0025.4—2013
- Java Card 3 API, Classic Edition Version 3.0.4
- Global Platform Card Specification Version 2.2.1

1.2. Symbols and Abbreviations

Abbreviation	Description
3DES	Triple DES
AAC	Application Authentication Cryptogram
AAR	Application Authorization Referral
AC	Application Cryptogram
AFL	Application File Locator
ARPC	Authorization Response Cryptogram
ARQC	Authorization Request Cryptogram
AID	Application/Account Identifier
AIP	Application Interchange Profile
APDU	Application Protocol Data Unit
ATC	Application Transaction Counter
ATR	Answer To Reset
CA	Certificate Authority
CDA	Combined DDA/AC Generation
CDOL	Card Risk Management Data Object List
CID	Cryptogram Information Data
CKV	Check Key Value
CLA	Class byte of APDU commands
CM	Card Manager
CVM	Cardholder Verification Method
CVR	Card Verification Result
COS	Card Operating System
DDA	Dynamic Data Authentication
DOL	Data Object List
DDOL	Dynamic Data Authentication Data Object List
DES	Data Encryption Standard
DF	Dedicated File
DGI	Data Group Index
DEC(C, K)	Decryption of data C with key K using DES or 3DES
ENC(P, K)	Encryption of data P with key K using DES or 3DES
EF	Elementary File
FCI	File Control Information
GPO	Get Processing Option
IC	Integrated Circuit
INS	Instruction byte of APDU commands

Abbreviation	Description
M	Mandatory
O	Optional
MAC	Message Authentication Code
MSB	Most Significant Byte
PBOC	People's Bank of China specifications
PSE	Payment System Environment
P1	Parameter1
P2	Parameter2
P3	Parameter3
PDOL	Process Option Data Object List
PIN	Personal Identification Number
RFU	Reserved For Future Use
SAD	Signed Static Application Data
SDA	Static Data Authentication
SW1	Status Word 1
SW2	Status Word 2
SK	Session Key
TC	Transaction Certification
TDOL	Transaction Certification Data Object List
TLV	Tag-Length-Value
UDK	Unique DEA Key
EC	Low-value Payment Specifications Based on Debit/Credit Application (Electronic Cash Application)
QPBOC	Contactless Integrated Circuit Card Payment Specification

Table 1: Symbols and Abbreviations

2.0. Product Overview

ACOSJ-P is a smart card operating system independently developed by Advanced Card Systems Ltd. (ACS). With conformity to PBOC 3.0, ACOSJ-P is applicable to PBOC 3.0 debit/credit application and QPBOC applications.

2.1. Features

ACOSJ-P card conforms to/supports:

- ISO 7816 Parts 1 2, 3, and 4
- ISO 14443
- T=0 and Type A protocols
- Global Platform 2.2.1
- Java Card 3.0.4 standard
- DES/3DES and SM4 algorithms
- RSA algorithm, up to 2048-bit RSA key
- SM2 algorithm, 256-bit SM2 key
- SHA1 and SM3 algorithms

2.2. Technical Parameters

The following are technical parameters of the ACOSJ-P card:

2.2.1. Electrical Parameters

- Operating voltage: 1.62 V – 5.5 V DC+/-10% (Contact) and 2.7 V – 5.5 V DC +/-10% (Contactless)
- Maximum supply current: < 10 mA
- ESD protection: ≤ 5 KV

2.2.2. EEPROM Parameters

- Capacity: 12 KB
- EEPROM endurance: 500,000 erase/write cycles
- Data retention: 30 years

2.2.3. Environmental Parameters

- Operating temperature: -25 °C to 85 °C
- Storage temperature: -40 °C to 100 °C

2.3. Application Installation Parameters

ACOSJ-P adopts the following parameter definitions:

Program Package AID	Application AID	Privilege	Description
A000000333A1	A000000333A101 (application)	Below are installation parameters	PBOC 3.0 application
	A000000333A102 (PSE,PPSE)	Null	

Table 2: Application Installation Parameters

When installing the A000000333A101 (application), you can use a 1-byte parameter to indicate the application supported by the card.

	b8	b7	b6	b5	b4	b3	b2	b1	Description
C9	1	0	0	0	0	0	0	0	Supports state secret algorithms.
	0	0	0	0	0	0	0	0	
	0	0	0	0	0	0	0	1	Contact debit/credit application
	0	0	0	0	0	0	1	0	E-cash (EC) application
	0	0	0	0	0	1	0	0	QPBOC
	0	0	0	0	1	0	0	0	Support contactless debit/credit
	Other values								Reserved

2.4. ATR (Contact Cards)

After a hardware reset (e.g. power up) is performed, the card transmits an Answer-to-Reset (ATR) in compliance with ISO 7816 Part 3. ACOSJ-P supports the protocol type T=0 in direct convention.

The default ATR is as follows:

Parameter	ATR	Description
TS	3Bh	Direct convention. The least significant bit is sent first.
T0	BEh	TA1, TB1, and TD1 follow with 14 historical characters
TA1	95h	Capable of high-speed communication
TB1	00h	No programming voltage required
TD1	00h	No further interface bytes followed
14 historical characters		

Table 3: ATR Protocol Bytes

The 14 historical characters are composed as the following:

Historical Characters	ATR	Description
T1	41h	Indicates that the card is an ACOS card.
T2	11h	Major version
T3	00h	Minor version
T4	00h	
T5	00h	
T6	00h	
T7	00h	
T8	00h	
T9	00h	
T10	00h	
T11	00h	
T12	00h	
T13	90h	
T14	00h	

Table 4: ATR Historical Bytes

3.0. Card Life Cycle States

ACOSJ-P has three card states: initial state, user state, and card block state, as shown in the following figure.

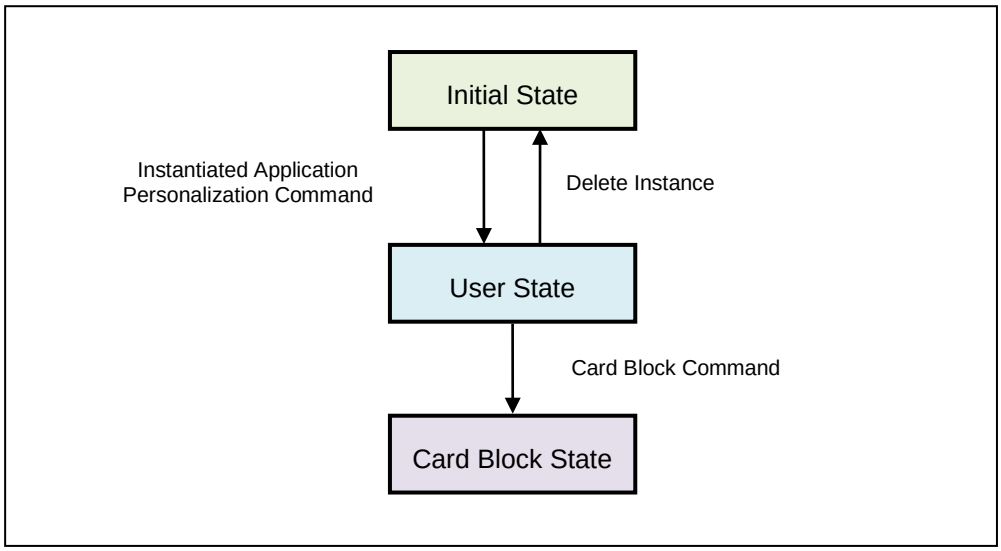


Figure 1: Card Life Cycle

1. **Initial State –** When ACOSJ-P leaves the factory, the card is in the initial state.
2. **User State –** When the card is in the initial state, the user instantiates the PSE, PPSE, and PBOC 3.0 application Applet, and sends the personalization command to load user data so that the card will go to the user state. When the card is in the user state, the Delete Instance command can be sent to delete PSE, PPSE, and PBOC instances, so that the card will return to the initial state. Before deleting instances, you need to use the master key to initiate the secure channel session to successfully initiate the authentication secure channel.
3. **Card Block State –** When the card is in the user state, the user can send the Card Block command to make the card go to the card block state. After the card is blocked, all data in the card cannot be accessed, and Applet of all applications will become invalid.

4.0. Personalization Data Management

PBOC 3.0 application personalization means to organize data in the form of data grouping and add data to the ICC. The data grouping identifier (DGI) is a 2-byte hex value. The first byte of the DGI is 01h – 1Eh, indicating the data stored SFI. The second byte indicates the record number of the SFI. All the other DGIs whose first byte is out of the range are used to index data not stored in the SFI.

- Magnetic Track Data
- Cardholder Information Data
- Authentication Data and Issuer Public Key Certificate
- Authentication Data: Issuer Public Key Index, Reminder, and CA Public Key Index
- Authentication Data, SAD
- Authentication Data: ICC Public Key Certificate
- ICC Public Key Index and Reminder
- Static Application Data
- Card Risk Management Data
- Card Risk Management Data
- Static Application Data
- Terminal Velocity Checking Data
- Card Risk Management Data
- Card Authentication Related Data (QPBOC)
- Card Internal Risk Management Data
- Card Private Risk Management Data
- DES Key
- SM4 Key
- DES Check Key Value
- SM4 Check Key Value
- ICC Private Key (CRT)
- SM2 Public Key and Private Key
- Offline PIN Value
- PIN Attempt Count and Maximum Attempt Limit
- GPO Response Data of the Standard Debit/Credit Transaction
- GPO Response Data of the Standard Debit/Credit Transaction (State Secret)
- EC Transaction GPO Response Data
- EC Transaction GPO Response Data (State Secret)
- QPBOC Transaction GPO Response Data
- QPBOC Transaction GPO Response Data (State Secret)
- Issuer Application Data
- Select Application Response Data for Debit/Credit Transaction (Contact)
- Select Application Response Data (Contactless)
- Select PSE Response Data
- Select PPSE Response Data

5.0. Safety Management Mechanism

ACOSJ-P card is a Java card of an open platform. Its security channel features conforms to GP2.2.1.

Note: *For details about the security management methods, please refer to* ***Global Platform Card Specification Version 2.2.1****.*

ACOSJ-P card is also a PBOC 3.0 debit/credit application that meets all security requirements listed in PBOC 3.0 – Part 7: Debit/Credit Application Card Security Specifications. This chapter only describes security features of ACOSJ-P card personalization and application transactions.

Security Management Parts:

- Card personalization security management.
- Security management of PBOC 3.0 debit/credit application.

5.1. Session Key Calculation Method

ACOSJ-P card adheres to security management of Secure Channel Protocol 02 (SCP02). This section mainly describes how to calculate SCP02 session keys.

Note: *For details about security management, please refer to* ***Global Platform Card Specification Version 2.2.1****.*

Personalization keys KENC, KMAC, and KDEK diversify their dispersing factors to generate personalization session keys SKUENC, SKUMAC, and SKUDEK. The diversification encryption algorithm is 3DES (CBC) and the initial vector.

6.0. Personalization Command

Card personalization indicates card operations required by a specific application. The main tasks of card personalization involve creating the application required file structure and writing data required by the application.

ACOSJ-P personalization includes Payment System Environment (PSE) personalization and debit/credit application personalization. PSE personalization does not need to initiate a session. After selecting a PSE application, directly send the personalization command. Debit/credit application personalization needs to send a successful session to the secure channel. All subsequent personalization commands are performed in this session.

The PSE and PBOC 3.0 debit/credit application instances must be installed before personalization of the ACOSJ-P card.

6.1. PBOC3.0 Debit/Credit Application Personalization Commands

6.2. INITIALIZE UPDATE

The INITIALIZE UPDATE command is used to initiate an ICC secure channel session while the personalized device authenticates card effectiveness. If the secure channel is corrupted or was not created, subsequent personalization commands will not precede.

The command is prohibited after packet data are completely stored (personalization is complete).

6.3. EXTERNAL AUTHENTICATE

During the secure channel session, the EXTERNAL AUTHENTICATE command is used by the card to authenticate the host and determine the security level required by all subsequent commands. The EXTERNAL AUTHENTICATE command can only be executed after the INTIALIZE UPATE command is successfully executed.

The command is prohibited after packet data are completely stored (personalization is complete).

Note: *The EXTERNAL AUTHENTICATE command is used in personalization. Its CLA is 84h, which is different from the* ***EXTERNAL AUTHENTICATE*** *command (CLA=00h) in* ***Section 7.9****.*

6.4. STORE DATA

The STORE DATA command is used to download personalization packet data from the personalization device to an ICC. This command can be executed after the EXTERNAL AUTHENTICATE command is successfully executed. The data protection level of the STORE DATA command is determined by the EXTERNAL AUTHENTICATE command.

The command is prohibited after packet data are completely stored (personalization is complete).

7.0. PBOC 3.0 Debit/Credit Application Dedicated Commands

7.1. SELECT

The SELECT command is used to select ICC supported applications and obtain card supported application information including the directory name of the payment system environment (PSE) and PBOC 3.0 debit/credit applications supported by the card. After the commands are successfully executed, the PSE and debit/credit application are set. Subsequent commands are applicable to this application.

7.2. READ RECORD

The READ RECORD command is used to read a file record from a linear record file, or reads records included in the response returned by the ICC. JR/T 0025 describes SFIs in the range of 1-10, and the record structure is a BER-TLV structure data object. JR/T 0025 does not describe SFIs out of the range 1-10.

The READ RECORD command is not restricted by application temporary blocking, but restricted by the application permanent blocking and card blocking.

7.3. GET DATA

The GET DATA command is used to obtain an elementary data object, which is not encapsulated in a record, from the current application. The response data field contains the elementary data object specified by the command packet P1P2.

The GET DATA command is not restricted by the application temporary blocking, but restricted by the application permanent blocking and card blocking.

7.4. GET RESPONSE

The GET RESPONSE command is used to transmit part of APDU data from a card to an interface device.

Some commands return the status 61xx, with the xx value indicates the actual length of the returned response bytes.

7.5. GET PROCESSING OPTIONS

The GET PROCESSING OPTIONS (GPO) command is used to start transactions inside the ICC. GPO informs the ICC of starting the transaction. Every time the GPO command runs successfully, the ATC increases by 1. When the ATC increases to FF FFh, the application will be permanently blocked and 6283 is returned for all subsequent commands.

The GPO command can be executed only one time during each transaction.

The GPO command is not restricted by the application temporary blocking, but is restricted by the application permanent blocking and card blocking.

7.6. INTERNAL AUTHENTICATE

The INTERNAL AUTHENTICATE command triggers the card to use the random number and data received from the terminal and the private key stored in the card to compute the signed dynamic application data. This command is used in dynamic data authentication (DDA) of PBOC 3.0 debit/credit transactions. The INTERNAL AUTHENTICATE command can be executed only when a card application supports DDA.

The INTERNAL AUTHENTICATE command is not restricted by the application temporary blocking, but restricted by the application permanent blocking and card blocking.

7.7. VERIFY

The VERIFY command is used by the ICC to compare the PIN stored in the card with the PIN provided by the terminal. This command is used when offline PIN verification is selected from the cardholder verification method (CVM) list.

The VERIFY command can only be ran when the card supports the CVM. The PIN will be blocked if the number of consecutive failures reaches the maximum value set in the error counter.

7.8. GENERATE AC

The GENERATE AC command is used to transmit the transaction related data from a terminal to a card. After behavior analysis, the card calculates and returns an application cryptogram (AC) defined by JR/T 0025 to the terminal. Contents of the AC may be Application Authentication Cryptogram (AAC), Authorization Request Cryptogram (ARQC), or Transaction Certificate (TC).

Before the GENERATE AC command, the card should have received the GPO command notifying that the transaction is started. 6985 is returned for the GENERATE AC command over two times.

If an application is temporarily blocked, the GENERATE AC command always returns the AAC response.

7.9. EXTERNAL AUTHENTICATE

The EXTERNAL AUTHENTICATE command requests the card application to authenticate a cryptogram for issuer authentication.

Before the EXTERNAL AUTHENTICATE command, the card should have received the GPO command. The EXTERNAL AUTHENTICATE command can be executed only once during one debit/credit transaction. If external authentication fails, the card will record the issuer authentication failure.

Note: *This EXTERNAL AUTHENTICATE command is used in debit/credit transactions. In this command, CLA=00h is used, which is different from the* ***INITIALIZE UPDATE*** *command in* ***Section 6.2*** *(CLA=84h, used in personalization).*

7.10. APPLICATION BLOCK

The APPLICATION BLOCK command is an issuer script command. It is used to block the current application making the application invalid.

After the application is blocked, the response code 62 83h is returned for the SELECT command, and the application always returns AAC instead of AC as a response for the GENERATE AC command.

7.11. APPLICATION UNBLOCK

The APPLICATION UNBLOCK command is an issuer script command. It is used to restore an application currently blocked. After the APPLICATION UNBLOCK command is successfully executed, application restrictions caused by blocking will be removed.

7.12. CARD BLOCK

The CARD BLOCK command is an issuer script command. It is used to permanently terminate all applications in the ICC.

When the CARD BLOCK command is executed successfully, the status code 6A 81h is returned for all subsequent SELECT commands, and all other commands are prohibited.

7.13. PUT DATA

The PUT DATA command is an issuer script command. It is used to modify values of some basic data objects in a card. It is effective only for tagged data. After successful personalization, this command can be used to modify a data object only if the data object is allowed to be updated according to PBOC 3.0 or self-defined rules.

7.14. PIN CHANGE/UNBLOCK

The PIN CHANGE/UNBLOCK command is an issuer script command. It is used by the issuer to unblock the PIN, or unblock and change the PIN at the same time. After the command is successfully executed, the value of the PIN attempt counter will be reset to the maximum value.

If the command contains PIN data, the data should be encrypted for confidentiality.

7.15. UPDATE RECORD

The UPDATE RECORD command is an issuer script command. It is used to modify the content of a record in the record file. The modified content is in the command data field.

8.0. Transaction Process

8.1. QPBOC Transaction Process

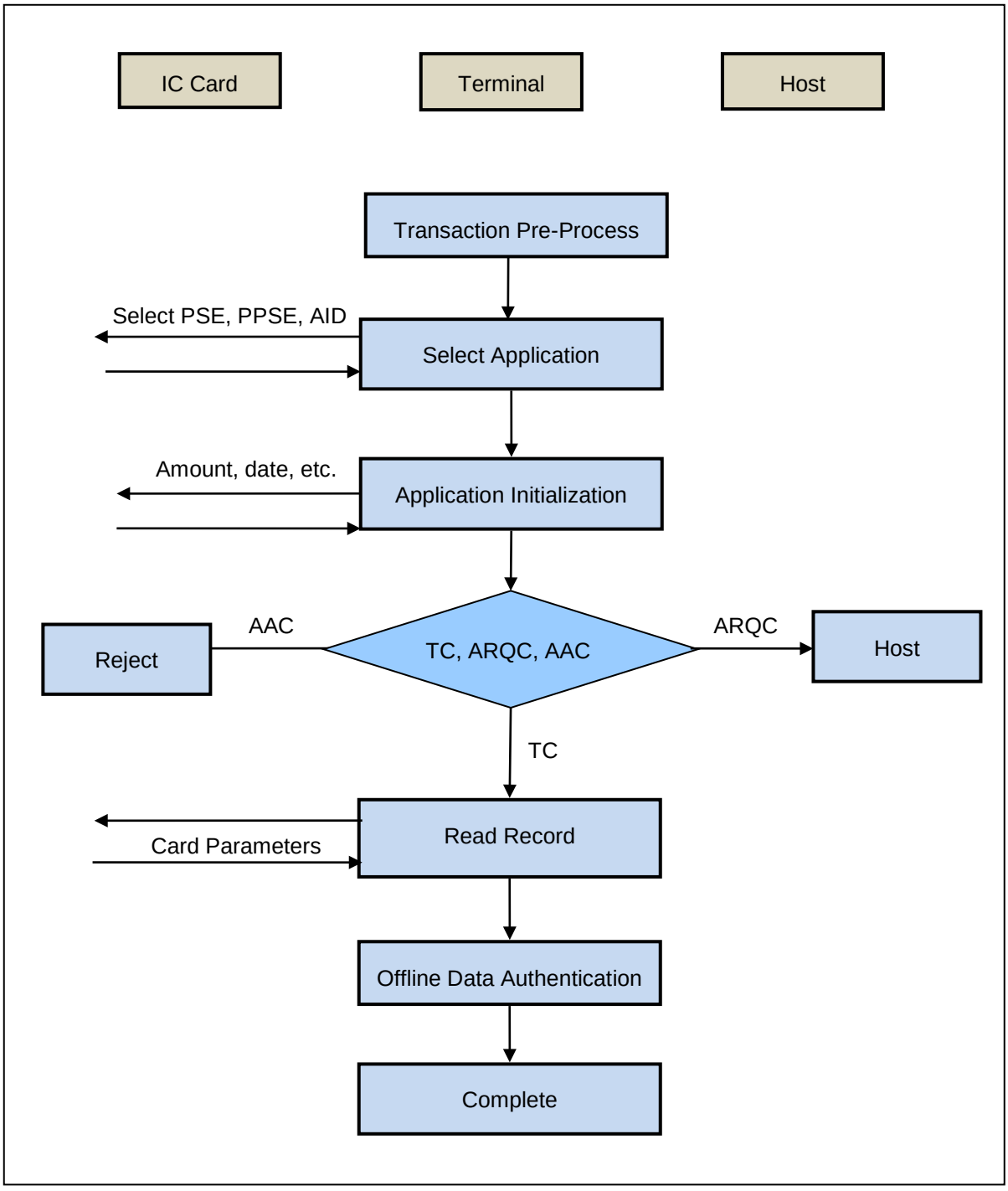
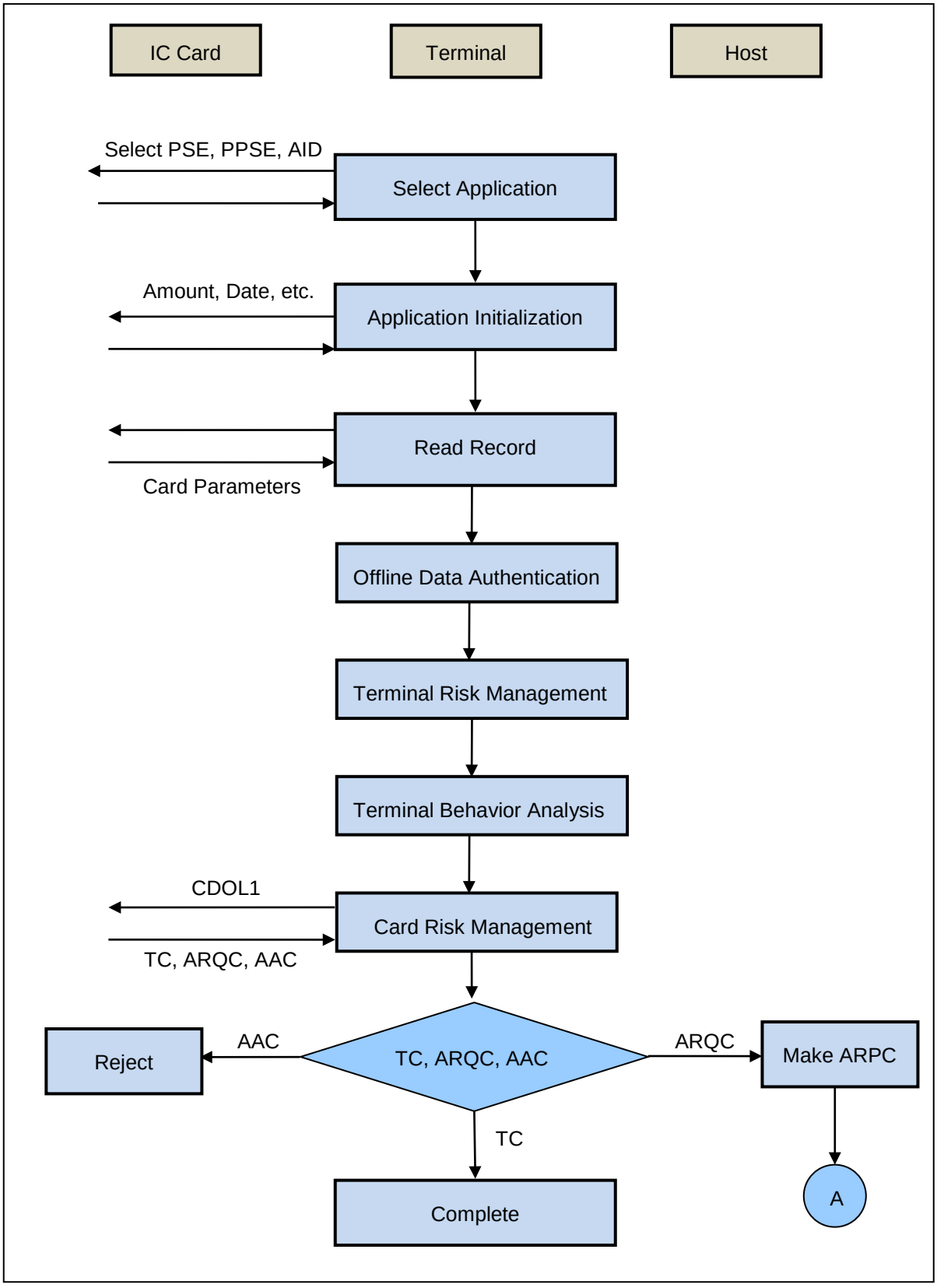


Figure 2: ACOSJ-P Support QPBOC Transaction Process

8.2. Debit/Credit (EC) Transaction Process



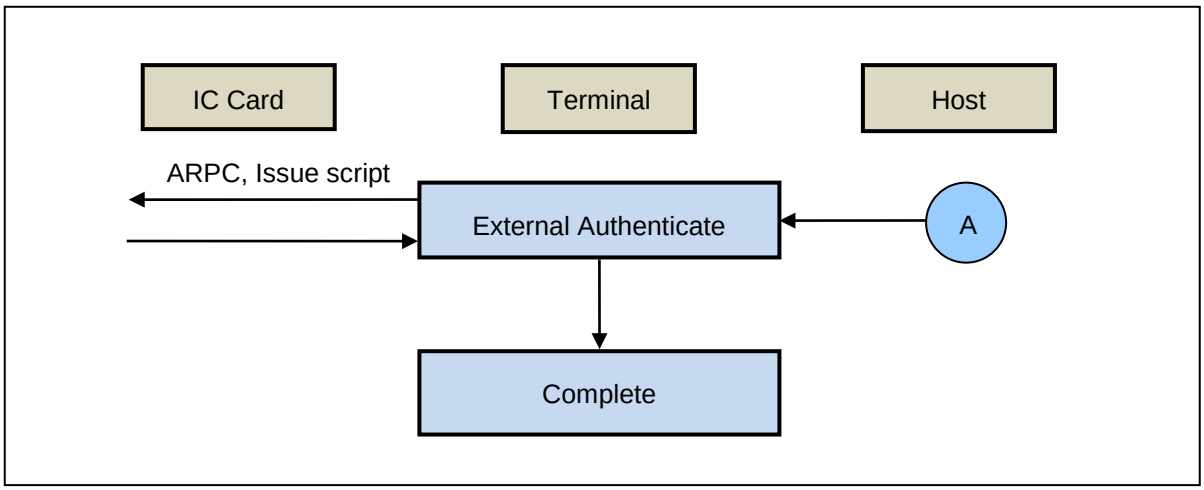


Figure 3: ACOSJ-P Support Standard PBOC3.0 Debit/Credit Transaction Process

9.0. Life Support Application

These products are not designed for use in life support appliances, devices, or systems where malfunction of these products can reasonably be expected to result in personal injury. ACS customers using or selling these products for use in such applications do so on their own risk and agree to fully indemnify ACS for any damages resulting from such improper use or sale.

10.0. Contact Information

For additional information please visit http://www.acs.com.hk.

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