EMV® Specification Bulletin No. 245
First Edition May 2020

Contactless – IQ Modulation

This Specification Bulletin introduces a new PCD requirement to ensure PCDs have IQ demodulation capabilities.

Applicability

This Specification Bulletin applies to:

- *EMV Level 1 Specifications for Payment Systems, EMV Contactless Interface Specification, Version 3.0 – February 2018.*

Related Documents

- *None*

Description

This Specification Bulletin introduces a new requirement to ensure PCDs are able to process load modulation signals that are comprised of a mixture of amplitude and phase modulation components (e.g. using IQ demodulation methods).

Proposed Specification Changes

Add the following new definition to section 1.5:

IQ TEST PICC	A PICC simulator used for EMV testing. It is used for testing IQ demodulation capabilities of a PCD.

Add the following new paragraph to the end of section 2.2:

Specific test equipment is used to ensure PCDs are able to receive load modulation signals that are comprised of a mixture of amplitude and phase modulation components (e.g. using IQ demodulation methods). Unlike the EMV – TEST PCD, EMV – TEST PICCs and EMV – TEST CMR, the detailed specification of the IQ demodulation test equipment is not in the scope of this specification. However, EMVCo will qualify that the equipment and processes used by accredited laboratories meet the standard required to achieve consistent results.

Include new section 2.2.4:

2.2.4 IQ Demodulation Test Equipment

The test equipment consists of:

- An IQ TEST PICC using the principle of active load modulation whereby the PICC actively transmits carrier sideband signals to the PCD under test. The load modulation generated in this way is synchronised to the carrier of the PCD under test and is configurable in the amplitudes and phases of the modulation components that are created.
- Associated equipment to detect sequences of commands from the PCD when the IQ TEST PICC is placed in the Operating Volume to ensure responses are transmitted with the correct timing and content and to verify if the PCD functions properly.

Include new section 3.5:

3.5 IQ Demodulation

3.5.1 Introduction

Requirements in section 3.4 consider load modulation on a purely amplitude basis. In reality the load modulation produced by a PICC has a mixture of amplitude and phase modulation components and consequently, for successful operation, PCDs must be able to receive load modulation signals that are comprised of a mixture of amplitude and phase modulation components, e.g. by using IQ demodulation methods.

3.5.2 PCD Requirements for IQ Demodulation

This section lists the requirements for the reception capabilities of a PCD to interpret IQ modulated load modulation applied by the PICC. Table 3.20 describes the measurement procedure that verifies whether a PCD functions properly with the IQ TEST PICC that applies load modulation comprised of a mixture of amplitude and phase modulation components.

The modulation angle defined by the phase relationship between the carrier frequency f_c and the lower and upper sideband frequencies (f_c - f_s) and (f_c + f_s) for the subcarrier frequency f_s is designated Φ_{LM}. Upon synchronization the modulation angle of the phase relationship at the start of a frame is designated $\Phi_{LM,INIT}$.

Table 3.20: Measurement of IQ Modulation PICC to PCD (PCD Reception)

Step #	Action
Step 1	Place the EMV – TEST PICC 1 in position (r=0, φ=0, z=2, θ=0) of the Operating Volume of the EMV – TEST PCD. Apply no modulation to J2 of the EMV – TEST PICC 1. Configure the EMV – TEST PICC 1 with NLZ. Connect input J1 of the EMV – TEST PCD with a signal generator V generating a carrier signal with frequency $\mathbf{f_{S,c}}$ within the range specified in Annex A.3. Regulate the signal generator V in such a way that it generates a mean voltage $\mathbf{V_{S,OV,LM}}$ at J1 of the EMV – TEST PICC 1. Refer to Annex A.3 for the value of $\mathbf{V_{S,OV,LM}}$.

Step #	Action
Step 2	Place the IQ TEST PICC in position (r=0, φ=0, z=2, θ=0) of the Operating Volume of the EMV – TEST PCD. Adjust the load modulation such that when measured at J2 of the EMV – TEST PCD: • The sidebands (f_c - f_s) and (f_c + f_s) have amplitudes such that the difference in amplitude is not more than 20% • Φ_{LM} is set to $\Phi_{LM,INIT}$ optimised to maximise the amplitude V_{pp} of the load modulation when measured on a purely amplitude basis • The amplitude of V_{pp} is **$V_{S2,pp,IQ}$** (peak to peak) Refer to Annex A.3 for the value of **$V_{S2,pp,IQ}$**
Step 3	Place the IQ TEST PICC in the Operating Volume of the PCD in a position with 2 < z ≤ 4 cm.
Step 4	Request the PCD to send a valid command to the IQ TEST PICC by means of the PCD Test Environment. Return a correct response by means of the IQ TEST PICC with Φ_{LM} in the range between 0° and 360° and verify if the PCD functions properly.
Step 5	Repeat steps 2 to 4 for Type A and Type B.

Requirements 3.18: IQ Modulation PICC to PCD (PCD Reception)

PCD	
3.5.2.1	The PCD shall function properly with the IQ TEST PICC provided the IQ TEST PICC has been set up as described in Table 3.20.

Add a new entry in Table A.4:

Table A.4: Set-up Values for EMV Contactless Level 1 Test Equipment

Topic	Parameter	EMV – TEST PICC	Min	Max	Unit
Load Modulation	$V_{S1,pp}$	1	5.5	85.0	mV
		2	5.5	85.0	mV
		3	6.0	85.0	mV
	$V_{S2,pp}$	1	3.5	40.0	mV
		2	3.5	40.0	mV
		3	4.5	33.0	mV
	$V_{S2,pp,IQ}$	IQ	4.0		mV

Legal Notice

The EMV® Specifications are provided “AS IS” without warranties of any kind, and EMVCo neither assumes nor accepts any liability for any errors or omissions contained in these Specifications. EMVCO DISCLAIMS ALL REPRESENTATIONS AND WARRANTIES, EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, TITLE AND NON-INFRINGEMENT, AS TO THESE SPECIFICATIONS.

EMVCo makes no representations or warranties with respect to intellectual property rights of any third parties in or in relation to the Specifications. EMVCo undertakes no responsibility to determine whether any implementation of the EMV® Specifications may violate, infringe, or otherwise exercise the patent, copyright, trademark, trade secret, know-how, or other intellectual property rights of third parties, and thus any person who implements any part of the EMV® Specifications should consult an intellectual property attorney before any such implementation.

Without limiting the foregoing, the Specifications may provide for the use of public key encryption and other technology, which may be the subject matter of patents in several countries. Any party seeking to implement these Specifications is solely responsible for determining whether its activities require a license to any such technology, including for patents on public key encryption technology. EMVCo shall not be liable under any theory for any party’s infringement of any intellectual property rights in connection with the EMV® Specifications