Test Report
No E-22-I-047-JG

PRIME Certification Tests Cases for Service Nodes

EQUIPMENT UNDER TEST	Single phase service node (Electricity meter)
MODEL	MA109H
PRIME FIRMWARE VERSION / COMMUNICATION MODULE FW VERSION	00-4158c20026253 / V5002
CERTIFICATION SCOPE	Profile 3 – Electricity Meter with PRIME chipset

Author: Javier Gómez
Reviewer: Fernando Lobo

NOTE: This test report shows the detailed information associated with the Test Report Summary no. No E-22-I-046-JG

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EQUIPMENT UNDER TEST IDENTIFICATION

Unit:	Single phase service node (Electricity meter)
Model:	MA109H
Trademark:	Kaifa
Serial Number:	2200350004
Manufacturer:	Shenzhen Kaifa Technology (Chengdu) Co., Ltd.

The samples were selected and delivered by the applicant.

Equipment characteristics declared by the applicant:

Device type	Single phase service node (Electricity meter)
BaudRate	9600 bps
MAC	10:E7:7A:AF:1C:63
PRIME Firmware version / Communication module FW version	00-4158c20026253 / V5002
Applicable Optional tests	3.4.23
Recertification	NA

1.- SUMMARY OF TEST RESULTS

In this chapter gives an overview of the inspection test results for each group of test cases. For detailed review regarding what is tested and all observations (i.e.: comments and remarks that apply to each test case and general exceptions and notes) please check Appendix A.

Major defects are a certain cause for operational risks: these MUST be corrected before going into an operational situation! They imply the test is **Fail**.

A remark introduces additional observations about the test case results, like limitations or minor deviations in the implementation. It implies that the test is **Pass with Remark**.

And finally, a comment refers to the additional observations about the test case results that are not directly addressed by the objectives of the subjected test case, so the test is **Pass**.

PHY LAYER		
	2.2 PHY Test Cases: Functional Category	
2.2.1	Verify error free communication (0.2% FER) checking the complete frame payload when communicating directly over the LISN stated in the PRIME PHY Spec and output level 120 dBuV, PPDU length 256 bytes. D8PSK	PASS
2.2.2	Verify error free communication (0.2% FER) checking the complete frame payload when communicating directly over the LISN stated in the PRIME PHY Spec and output level 120 dBuV,PPDU length 256 bytes. D8PSK+CC	PASS
2.2.3	Verify error free communication (0.2% FER) checking the complete frame payload when communicating directly over the LISN stated in the PRIME PHY Spec and output level 120 dBuV, PPDU length 256 bytes. DBPSK	PASS
2.2.4	Verify error free communication (0.2% FER) checking the complete frame payload when communicating directly over the LISN stated in the PRIME PHY Spec and output level 120dBuV, PPDU length 256 bytes. DBPSK+CC	PASS
2.2.5	Verify error free communication (0.2% FER) checking the complete frame payload when communicating directly over the LISN stated in the PRIME PHY Spec and output level 120 dBuV, PPDU length 256 bytes. Modulation type: DQPSK	PASS
2.2.6	Verify error free communication (0.2% FER) checking the complete frame payload when communicating directly over the LISN stated in the PRIME PHY Spec and output level 120 dBuV, PPDU length 256 bytes. QPSK+CC	PASS
2.2.7	Verify error free communication (0.2% FER) checking the complete frame payload when communicating directly over the LISN stated in the PRIME PHY Spec (2Ohm) and output level 120 dBuV, PPDU length 256 bytes.DBPSK	PASS
2.2.8	Verify error free communication (0.2% FER) checking the complete frame payload when communicating directly over the LISN stated in the PRIME PHY Spec (2Ohm) and output level 120 dBuV, PPDU length 256 bytes. D8PSK+CC	PASS
2.2.9	Verify error free communication (0.2% FER) (checking the complete frame payload) when receiving input signal of 122 dBuV. (DUT is in reception state). Modulation type: D8PSK	PASS
	2.4 PHY Test Cases: Signal Quality category	
2.4.1	Verify that the EVM of the received signal at output level is above 17dB.	PASS
2.4.2	Verify that the EVM of the transmitted signal output level is above 17dB.	PASS
	2.5 PHY Test Cases: Regulatory category	
2.5.1	PHY Test Cases: Regulatory category	PASS
MAC LAYER		
	3.2 MAC Test Cases: Service Node Start-up	
3.2.1	Service node start-up (forcing the reception of beacons).	PASS

3.2.2	Service node start-up (No PNPDUs are transmit when DUT receives BPDUs).	PASS
3.2.3	Service node start-up (Tx rate of PNPDUs reduced by factor of received PNPDUs).	PASS
3.2.4	Service node start-up (PNPDU generation latency and transmission parameters).	PASS
3.2.5	Service Node start-up (RANDOMness in the transmission of PNPDUs)	PASS
3.2.6	Service Node start-up (seeking promotion of DUT).	PASS
	3.3 MAC Test Cases: Channel Access	
3.3.1	Channel access- Shared Contention Period. Channel is idle	PASS
3.3.2	Channel access- Shared Contention Period. Channel is occupied.	PASS
3.3.3	Channel access- Contention Free Period.	PASS
3.3.4	Channel access- Adaptation to frame structure change (FRA)	PASS
	3.4 MAC Test Cases: Service Node MAC specific procedures	
3.4.1	Registration accepted (Base Node available when DUT powers up).	PASS
3.4.2	Registration accepted (Base Node not available when DUT powers up).	PASS
3.4.3	Registration accepted (DUT connected to a Switch node and the Switch node is connected to the Base Node).	PASS
3.4.4	Unregistering process initiated by a terminal node.	PASS
3.4.5	Unregistering process initiated by the Base node.	PASS
3.4.6	Promotion process initiated by the base node.	PASS
3.4.7	Promotion process initiated by the service node DUT.	PASS
3.4.8	Switching process: 2 levels of switching (DUT1 as a level 1 switch).	PASS
3.4.9	Switching process: 2 levels of switching (DUT as a level 2 switch).	PASS
3.4.10	Switching functions: BPDU transmission	PASS
3.4.11	Switching functions: BPDU updates from FRA control packet	PASS
3.4.12	Promotion rejected by the base node.	PASS
3.4.13	Demotion process initiated by the base node.	PASS
3.4.14	Keep-Alive process (response from DUT).	PASS
3.4.15	Keep-Alive process (timeout and disconnect).	PASS
3.4.16	Keep-Alive process (changes in Keep Alive timeout).	PASS
3.4.17	Connection establishment initiated by the Base node.	PASS
3.4.18	Connection establishment initiated by the Service node.	PASS
3.4.19	Connection establishment rejected by the Base node.	PASS
3.4.20	Connection closing initiated by the Base node.	PASS
3.4.21	Connection closing initiated by the Service node.	PASS
3.4.22	File transfer process (unicast).	PASS
3.4.23	File transfer process (multicast).	PASS
3.4.24	Error in the firmware upgrade process.	PASS
	CONVERGENCE LAYER	
	4.2 CL Test Cases: 4-32 Connection establishment	
4.2.1	Correct establishment and disconnection of 4-32 link	PASS
	4.3 CL Test Cases: DLMS traffic over 4-32 connection	
4.3.1	CS4-32 is able to pass valid DLMS payload between the meter and the test system.	PASS

For more detailed information about the test results see Annex I

2.- APPLICANT

Name: Li Ping Qin

Company Name: Shenzhen Kaifa Technology (Chengdu) Co., Ltd.

Address: No. 99 Tianquan Rd., Hi-Tech Development Zone (West),Chengdu, P.R.C. (PC: 611730)

3.- PLACE OF RECEPTION AND EXECUTION OF THE TESTS

Laboratory: DNV

Address: C/ Santa María Magdalena 14, Planta 3, 28016 Madrid, Spain

4.- STANDARDS AND TEST PROCEDURES EMPLOYED

Standards:

- Draft Specification for PoweRline Intelligent Metering Evolution. PRIME-Specification v.1.3.6.
- UNE EN 50065-1:2012: Signalling on low-voltage electrical installations in the frequency range 3 kHz to 148.5 kHz - Part 1: General requirements, frequency bands and electromagnetic disturbances.
- UNE EN 50065-2-3:2004 + A1:2006: Signalling on low-voltage electrical installations in the frequency range 3 kHz to 148.5 kHz - Part 2-3: Immunity requirements for mains communications equipment and systems operating in the range of frequencies of 3 kHz to 95 kHz and intended for use by electricity suppliers and distributors.
- UNE EN 50065-7:2002: Signalling on low-voltage electrical installations in the frequency range 3 kHz to 148.5 kHz - Part 7: Equipment impedance.

Testing procedures:

- PRIME Certification. Test Cases version R1.3

5.- CONCLUSIONS

In view of the results and in the test conditions expressed in the present report, the tested sample of:

Unit:	Single phase service node
Model:	MA109H
Trade Mark:	Kaifa
Serial Number:	2200350004
Manufacturer:	Shenzhen Kaifa Technology (Chengdu) Co., Ltd.

✓ **COMPLIES** with the tests cases defined by PRIME Alliance in its PRIME Certification. Test Cases version R1.3 based on PRIME-Specification v.1.3.6.

- This test report is granted on account of tests made at location of DNV in Madrid, Spain.
- The results of the present report apply only to the samples tested and the moment and conditions under which the measurements were performed.
- The complete results, including remarks and limitations, are laid down in ANNEX I of this report.

ANNEX I. TEST RESULTS

Place:

DNV Smart Grid Lab

C/ Santa María Magdalena 14, Planta 3, 28016 Madrid, Spain

Climatic conditions:

Temperature (ºC)	Min: 15ºC Max: 35ºC
Relative humidity (%)	Max: 75%

Responsible:

Fernando Lobo

Used instruments:

Measurement instruments	
X	*SW* ✓ *SW CURRENT PRIME audition v1.2.3ct* ✓ *SW PRIME Service Node MAC layer application* ✓ *SW DLMS Simulator 2.2.5 Beta 8 (DNV GL Software)*
X	*HW* ✓ *HW CURRET Base Node* ✓ *HW CURRET Service Node 1* ✓ *HW CURRET Service Node 2* ✓ *HW CURRET Sniffer*
Data registers storage place	
PBNCTT laptop	

Results:

1. PHY layer

1.1. Test setup

The network setup for these tests consists on the following modules:

- PRIME sniffer module, connected in the first level of the network

- Conformance Tester, a laptop with software to control sniffer, the auxiliary service nodes and reference base node with functionality to report the result

- Isolation transformer: Class 1 Construction, 3.0 KVA

- PRIME LISN: Output impedance 0.5 Ω

1.2. Test results

CODE	DESCRIPTION	RESULT	EXPECTED	STAT.	COMMENTS
2.2 PHY Test Cases: Functional Category					
2.2.1	Verify error free communication (0.2% FER) checking the complete frame payload when communicating directly over the LISN stated in the PRIME PHY Spec and output level 120 dBuV, PPDU length 256 bytes. D8PSK	2000	1996-2000	PASS	1, 2, 3, 4
2.2.2	Verify error free communication (0.2% FER) checking the complete frame payload when communicating directly over the LISN stated in the PRIME PHY Spec and output level 120 dBuV,PPDU length 256 bytes. D8PSK+CC	2000	1996-2000	PASS	1, 2, 3, 4
2.2.3	Verify error free communication (0.2% FER) checking the complete frame payload when communicating directly over the LISN stated in the PRIME PHY Spec and output level 120 dBuV, PPDU length 256 bytes. DBPSK	2000	1996-2000	PASS	1, 2, 3, 4
2.2.4	Verify error free communication (0.2% FER) checking the complete frame payload when communicating directly over the LISN stated in the PRIME PHY Spec and output level 120dBuV, PPDU length 256 bytes. DBPSK+CC	2000	1996-2000	PASS	1, 2, 3, 4
2.2.5	Verify error free communication (0.2% FER) checking the complete frame payload when communicating directly over the LISN stated in the PRIME PHY Spec and output level 120 dBuV, PPDU length 256 bytes. Modulation type: DQPSK	2000	1996-2000	PASS	1, 2, 3, 4

2.2.6	Verify error free communication (0.2% FER) checking the complete frame payload when communicating directly over the LISN stated in the PRIME PHY Spec and output level 120 dBuV, PPDU length 256 bytes. DQPSK+CC	2000	1996-2000	PASS	1, 2, 3, 4
2.2.7	Verify error free communication (0.2% FER) checking the complete frame payload when communicating directly over the LISN stated in the PRIME PHY Spec (2Ohm) and output level 120 dBuV, PPDU length 256 bytes.DBPSK	2000	1996-2000	PASS	1, 2, 3, 4
2.2.8	Verify error free communication (0.2% FER) checking the complete frame payload when communicating directly over the LISN stated in the PRIME PHY Spec (2Ohm) and output level 120 dBuV, PPDU length 256 bytes. D8PSK+CC	2000	1996-2000	PASS	1, 2, 3, 4
2.2.9	Verify error free communication (0.2% FER) (checking the complete frame payload) when receiving input signal of 122 dBuV. (DUT is in reception state). Modulation type: D8PSK	2000	1996-2000	PASS	1, 2, 3, 4
2.4 PHY Test Cases: Signal Quality category					
2.4.1	Verify that the EVM of the received signal at output level of 120 dBuV is above 17dB.	18,00 dB	>17 dB	PASS	1, 2, 3, 4
2.4.2	Verify that the EVM of the transmitted signal output level of 120 dBuV is above 17dB.	18,00 dB	>17 dB	PASS	1, 2, 3, 4

PHY Test Cases: Regulatory category

- Test report identification

  MA109H Service Node Meter is conformant to EN 50065-1, EN 50065-2-3 and EN 50065-7 according verification tests No. 21E040C-01 issued by Lacecal (04/11/2021).

- DUT identification

  Model Tested MA109H Service Node Meter with Serial Number:

- 2140000001
- 2140000002
- 2140000003

2. MAC layer

2.1. Test setup

The network setup for these tests consists on the following modules:

- PRIME sniffer module, connected in level 0 of the network **(*)**

- Conformance Tester, a laptop with software to control sniffer, the auxiliary service nodes and reference base node with functionality to report the result

- Isolation transformer: Class 1 Construction, 3.0 KVA

- Attenuators

(*) Especial test cases:

- Test cases 3.4.3: PRIME sniffer module is connected in level 1 of the network

- Test cases 3.4.8: PRIME sniffer module is connected in level 2 of the network

- Test cases 3.4.9: PRIME sniffer module is connected in level 3 of the network

2.2. Test results

CODE	DESCRIPTION	RESULT	EXPECTED	STAT.	COMMENTS
	3.2 MAC Test cases: Service Node Start-up				
3.2.1	Service node start-up (forcing the reception of beacons).			PASS	
3.2.2	Service node start-up (No PNPDUs are transmit when DUT receives BPDUs).			PASS	
3.2.3	Service node start-up (Tx rate of PNPDUs reduced by factor of received PNPDUs).			PASS	5
3.2.4	Service node start-up (PNPDU generation latency and transmission parameters).			PASS	5
3.2.5	Service Node start-up (RANDOMness in the transmission of PNPDUs)			PASS	
3.2.6	Service Node start-up (seeking promotion of DUT).			PASS	
	3.3 MAC Test Cases: Channel Access				
3.3.1	Channel access- Shared Contention Period. Channel is idle			PASS	6
3.3.2	Channel access- Shared Contention Period. Channel is occupied.	MacCSMAChBusyCount = 74 MacCSMAFailCount = 0	MacCSMAFailCount < MacCSMAChBusyCount	PASS	5, 6

3.3.3	Channel access- Contention Free Period.	PASS	6
3.3.4	Channel access- Adaptation to frame structure change (FRA)	PASS	6
3.4 MAC Test Cases: Service Node MAC specific procedures			
3.4.1	Registration accepted (Base Node available when DUT powers up).	PASS	
3.4.2	Registration accepted (Base Node not available when DUT powers up).	PASS	
3.4.3	Registration accepted (DUT connected to a Switch node and the Switch node is connected to the Base Node).	PASS	
3.4.4	Unregistering process initiated by a terminal node.	PASS	7
3.4.5	Unregistering process initiated by the Base node.	PASS	
3.4.6	Promotion process initiated by the base node.	PASS	
3.4.7	Promotion process initiated by the service node DUT.	PASS	
3.4.8	Switching process: 2 levels of switching (DUT1 as a level 1 switch).	PASS	
3.4.9	Switching process: 2 levels of switching (DUT as a level 2 switch).	PASS	
3.4.10	Switching functions: BPDU transmission	PASS	
3.4.11	Switching functions: BPDU updates from FRA control packet	PASS	
3.4.12	Promotion rejected by the base node.	PASS	
3.4.13	Demotion process initiated by the base node.	PASS	

3.4.14	Keep-Alive process (response from DUT).	PASS	
3.4.15	Keep-Alive process (timeout and disconnect).	PASS	
3.4.16	Keep-Alive process (changes in Keep Alive timeout).	PASS	
3.4.17	Connection establishment initiated by the Base node.	PASS	
3.4.18	Connection establishment initiated by the Service node.	PASS	
3.4.19	Connection establishment rejected by the Base node.	PASS	
3.4.20	Connection closing initiated by the Base node.	PASS	
3.4.21	Connection closing initiated by the Service node.	PASS	7
3.4.22	File transfer process (unicast).	PASS	
3.4.23	File transfer process (multicast).	PASS	
3.4.24	Error in the firmware upgrade process.	PASS	

3. CL layer

3.1. Test setup

The network setup for these tests consists on the following modules:

- PRIME sniffer module, connected in the first level of the network

- Conformance Tester, a laptop with software to control sniffer, the auxiliary service nodes and reference base node with functionality to report the result

- Isolation transformer: Class 1 Construction, 3.0 KVA

3.2. Test results

CODE	DESCRIPTION	RESULT	EXPECTED	STAT.	COMMENTS
4.2 CS Test Cases: 4-32 Connection establishment					
4.2.1	Correct establishment and disconnection of 4-32 link			PASS	
4.3 CS Test Cases: DLMS traffic over 4-32 connection					
4.3.1	CS4-32 is able to pass valid DLMS payload between the meter and the test system.			PASS	8

COMMENTS ON TEST RESULTS

1. All Physical tests were done with AUX1 as transmitting device; except in the test 2.4.2, where the device was configured as receiving. Additionally, the extended power range capability required for test case 2.2.9 is only available in this hardware module.

   The bit-to-bit check on the content of the bursts was verified by starting the sniffer via *CURRENT PRIME audition Test Tool* and by means of visual inspection. Only bursts with the content "PRIME IS A WONDERFUL TECHNOLOGY" were sniffed.

2. PrimeGUI 1.3.6 Rev 3736 was used for configuring the DUT in *PHY v1.3.6* mode for transmitting or receiving frames with different modulation type in PHY test cases.

3. PrimeGUI 1.3.6 Rev 3736 was used for reading the PIB attributes *phyStatsRxTotalCount* (0x00A4) and *phyStatsBlkAvgEvm* (0x00A5) from the DUT. The EVM was calculated according to the arithmetic average method based on the value of *phyStatsBlkAvgEvm*.

4. The client indicates that this is a single-phase meter with PRIME signal. Therefore, only the results obtained in the R phase are included.

5. PrimeGUI 1.3.6 Rev 3736 was used for reading the following PIB attributes from the DUT: *macMaxPromotionPdu* (0x0011), *macPromotionPduTxPeriod* (0x0012), *MacMinSwitchSearchTime* (0x0010), *MacCSMAFailCount* (0x0044) and *MacCSMAChBusyCount* (0x0045).

6. For executing MAC test cases related to Channel Access, it was necessary to configure the DUT in ‘AppEmu mode’ (AppEmu is activated to simulate a real DLMS/COSEM situation and the associated PRIME packets). This configuration was done via PrimeGUI 1.3.6 Rev 3736.

7. To force DUT unregistering process initiated by the DUT, PrimeGUI 1.3.6 Rev 3736 was used for setting PIB attribute *MACActionUnregister* (0x0064). Likewise, PrimeGUI 1.3.6 Rev 3736 was used to force DUT disconnection process initiated by the DUT by setting PIB attribute *MACActionConnClose* (0x0061).

8. The CS test case 4.3.1 related to DLMS traffic over 4-32 connection was performed with DNV GL DLMS Simulator 2.2.5 Beta 8 to force DLMS requests over PRIME PLC for reading some parameters.