

CA8737A Protocol Conformance Test Suite for China C-V2X

Protocol Conformance Test Solution for China C-V2X

Introduction

The Keysight CA8737A Protocol Conformance Test Suite for China C-V2X is TAP based solution implementing upper-layer testing of messages BSM, MAP, SPAT, RSI and RSM and verifying correct encoding and decoding of messages, based on YDT3710-2020.

The screenshot displays the Keysight Test Automation software interface. The main window shows a test plan titled "V2X OmniAir CV2X CAICT OBU*" with a status of "Completed in 494 s". Below the title bar is a table of test results.

Name	Verdict	Duration	Flow	Type
Sidelink Setup	Fail	477 s		OpenTap.Plugins.C8700200A_Instrument \ Sidelink Setup
PC5 Scheduler Setup Tx	Pass	375 ms		OpenTap.Plugins.C8700200A_Instrument \ PC5 Scheduler Setup
PC5 Scheduler Setup Rx	Pass	158 ms		OpenTap.Plugins.C8700200A_Instrument \ PC5 Scheduler Setup
MXG Scenario Setup	Pass	142 s		OpenTap.Plugins.C8700200A_Instrument \ MXG Scenario Setup
TC_ML_BSM_MST_BV_01	Pass	19.9 s		V2X \ YDT3710 \ TC_ML_BSM_MST_BV_01
TC_ML_BSM_MST_BV_02	Pass	16.0 s		V2X \ YDT3710 \ TC_ML_BSM_MST_BV_02
TC_ML_BSM_MST_BV_03	Pass	16.0 s		V2X \ YDT3710 \ TC_ML_BSM_MST_BV_03
TC_ML_BSM_MST_BV_04	Pass	16.1 s		V2X \ YDT3710 \ TC_ML_BSM_MST_BV_04
TC_ML_BSM_MST_BV_05	Pass	16.1 s		V2X \ YDT3710 \ TC_ML_BSM_MST_BV_05
TC_ML_BSM_MST_BV_06	Pass	16.1 s		V2X \ YDT3710 \ TC_ML_BSM_MST_BV_06
TC_ML_BSM_MST_BV_08	Pass	16.1 s		V2X \ YDT3710 \ TC_ML_BSM_MST_BV_08
TC_ML_BSM_MST_BV_09	Pass	16.1 s		V2X \ YDT3710 \ TC_ML_BSM_MST_BV_09
TC_ML_BSM_MST_BV_10	Pass	16.1 s		V2X \ YDT3710 \ TC_ML_BSM_MST_BV_10
TC_ML_BSM_MST_BV_11	Pass	16.7 s		V2X \ YDT3710 \ TC_ML_BSM_MST_BV_11
TC_ML_BSM_MST_BV_12	Pass	16.1 s		V2X \ YDT3710 \ TC_ML_BSM_MST_BV_12
TC_ML_BSM_PP_BV_01	Pass	16.6 s		V2X \ YDT3710 \ TC_ML_BSM_PP_BV_01
TC_ML_BSM_PP_BV_02	Pass	16.8 s		V2X \ YDT3710 \ TC_ML_BSM_PP_BV_02
TC_ML_BSM_PP_BV_03	Pass	16.8 s		V2X \ YDT3710 \ TC_ML_BSM_PP_BV_03
TC_ML_BSM_PP_BV_04	Pass	16.8 s		V2X \ YDT3710 \ TC_ML_BSM_PP_BV_04
TC_ML_BSM_PP_BV_05	Fail	16.8 s		V2X \ YDT3710 \ TC_ML_BSM_PP_BV_05
TC_ML_BSM_PP_BV_06	Fail	16.8 s		V2X \ YDT3710 \ TC_ML_BSM_PP_BV_06
TC_ML_BSM_PP_BV_07	Fail	16.8 s		V2X \ YDT3710 \ TC_ML_BSM_PP_BV_07
TC_ML_BSM_PP_BV_08	Fail	16.8 s		V2X \ YDT3710 \ TC_ML_BSM_PP_BV_08
TC_ML_BSM_PP_BV_09	Fail	16.8 s		V2X \ YDT3710 \ TC_ML_BSM_PP_BV_09

Below the table is a "Log" window showing various messages, including "Resource 'CAICT DUT' closed. [200 ms]", "WDS license check looks ok", "Error: DSNP Appears to be unlicensed.", "Stopping sending WSM messages", "Stopping sending BSM messages", "Stopping ITS Stack on Host VM", "ITS Stack stopped", "UXMSG Instrument close complete", "Resource 'UXMSG' closed. [2.99 s]", and "Resource 'CV2X TestApp (TCP/IP@:146.208.174.229::hislip2::INSTN)' closed. [11.5 ms]".

C-V2X Roll Out in China

C-V2X (Cellular Vehicle-to-Everything) technology is progressively being deployed across China. This technology is essential for enabling communication between vehicles and infrastructure, enhancing road safety, and improving traffic efficiency.

Certification Status: Currently, there is no national certification body for C-V2X in China. However, ensuring that devices comply with the C-V2X standard is crucial for successful interoperability and widespread adoption.

CA8737A Protocol Conformance Test Suite for China C-V2X: This solution aims to streamline the testing process through the development of automated test software for the CAICT (China Academy of Information and Communications Technology) C-V2X Protocol Conformance Test. This software will:

- Enable fast and repeatable testing.
- Provide comprehensive reporting capabilities.

Benefits:

- Increased efficiency in testing processes.
- Enhanced accuracy and consistency in test results.
- Accelerated rollout and adoption of C-V2X technology in China.

Features

- **Existing plugins:** OmniAir Framework and Instruments plugins.
- **Report generation:** Comprehensive report generation for all test cases.
- **Default test plan:**
 - Includes each supported test case.
 - Test cases grouped by direction (Tx vs Rx) and by message type (BSM, MAP, SPAT, etc).

DUT control interfaces

- **Supported interface:** Only TCI will be supported.
- **China TCI interface:**
 - Implemented as a separate TAP plugin to the existing OmniAir TCIv3 interface.
 - Specific to the China standard as defined in the LTE-based Internet of Vehicles wireless communication technology message layer Protocol conformance test control interface specification.

Supported YDT 3710-2020 Test Cases

The following features form a prioritized list of test cases. Only those indicated test cases are included in the initial release. All others may be included in future releases. Follow-on releases will be created under the software support subscription.

Test cases – DUT sending BSM

Test #	Identifier	Description
6.1.1	TC_ML_BSM_MST_BV_01	MsgCnt check
6.1.2	TC_ML_BSM_MST_BV_02	Vehicle ID check
6.1.3	TC_ML_BSM_MST_BV_03	Position 3D check
6.1.4	TC_ML_BSM_MST_BV_04	Transmission state check
6.1.5	TC_ML_BSM_MST_BV_05	Speed check
6.1.6	TC_ML_BSM_MST_BV_06	Heading check
6.1.8	TC_ML_BSM_MST_BV_08	Brake system status check
6.1.9	TC_ML_BSM_MST_BV_09	Vehicle size check
6.1.10	TC_ML_BSM_MST_BV_10	Vehicle classification check
6.1.11	TC_ML_BSM_MST_BV_11	Vehicle event flag check
6.1.12	TC_ML_BSM_MST_BV_12	Vehicle emergency extension check

Test cases – DUT receiving BSM

Test #	Identifier	Description
6.2.1	TC_ML_BSM_PP_BV_01	Position 3D check
6.2.2	TC_ML_BSM_PP_BV_02	Transmission state check
6.2.3	TC_ML_BSM_PP_BV_03	Speed check
6.2.4	TC_ML_BSM_PP_BV_04	Heading check
6.2.5	TC_ML_BSM_PP_BV_05	Brake system status check
6.2.6	TC_ML_BSM_PP_BV_06	Vehicle size check
6.2.7	TC_ML_BSM_PP_BV_07	Vehicle classification check
6.2.8	TC_ML_BSM_PP_BV_08	Vehicle safety extension check
6.2.9	TC_ML_BSM_PP_BV_09	Vehicle emergency extension check

Test cases – RSU DUT sending MAP

Test #	Identifier	Description
7.1.1	TC_ML_MAP_MST_BV_01	MsgCnt check
7.1.2	TC_ML_MAP_MST_BV_02	Node information check
7.1.3	TC_ML_MAP_MST_BV_03	Link information check
7.1.4	TC_ML_MAP_MST_BV_04	Lane Information check
7.1.5	TC_ML_MAP_MST_BV_05	Lane Attributes check
7.1.6	TC_ML_MAP_MST_BV_06	Allowed Manoeuvres check
7.1.7	TC_ML_MAP_MST_BV_07	The turning connection relationship between the downstream intersection at the lane and the downstream segment lane.
7.1.8	TC_ML_MAP_MST_BV_08	The relative position of the midpoint of the lane check
7.1.9	TC_ML_MAP_MST_BV_09	The actual latitude and longitude of the midpoint of the lane.

Test cases – OBU DUT receiving MAP

Test #	Identifier	Description
7.2.1	TC_ML_MAP_PP_BV_01	Decode Node information check
7.2.2	TC_ML_MAP_PP_BV_02	Decode Link information check
7.2.3	TC_ML_MAP_PP_BV_03	Decode Lane information check
7.2.4	TC_ML_MAP_PP_BV_04	Decode Allowed Manoeuvres check
7.2.5	TC_ML_MAP_PP_BV_05	Decode the turning connection relationship between the downstream intersection at the lane and the downstream segment lane.

Test cases – RSU DUT sending SPAT

Test #	Identifier	Description
8.1.1	TC_ML_SPAT_MST_BV_01	MsgCnt check
8.1.2	TC_ML_SPAT_MST_BV_02	Intersection ID check
8.1.3	TC_ML_SPAT_MST_BV_03	Status check
8.1.4	TC_ML_SPAT_MST_BV_04	Time Stamp check
8.1.5	TC_ML_SPAT_MST_BV_05	Phase count check
8.1.6	TC_ML_SPAT_MST_BV_06	Phase ID check
8.1.7	TC_ML_SPAT_MST_BV_07	Traffic light information check
8.1.8	TC_ML_SPAT_MST_BV_08	Traffic light countdown format check
8.1.9	TC_ML_SPAT_MST_BV_09	Traffic light UTC time format check

Test cases – OBU DUT receiving SPAT

Test #	Identifier	Description
8.2.1	TC_ML_SPAT_PP_BV_01	Intersection ID , status, time Stamp, timeConfidence check
8.2.2	TC_ML_SPAT_PP_BV_02	Traffic light countdown format check
8.2.3	TC_ML_SPAT_PP_BV_03	Traffic light UTC time format check

Test cases – RSU DUT sending RSI

Test #	Identifier	Description
9.1.1	TC_ML_RSI_MST_BV_01	MsgCnt check
9.1.2	TC_ML_RSI_MST_BV_02	RSU ID check
9.1.3	TC_ML_RSI_MST_BV_03	Position 3D check
9.1.4	TC_ML_RSI_MST_BV_04	RTE list check
9.1.5	TC_ML_RSI_MST_BV_05	RTS list check

Test cases – OBU DUT receiving RSI

Test #	Identifier	Description
9.2.1	TC_ML_RSI_PP_BV_01	RSU ID, refPos, countRTE, countRTS check
9.2.2	TC_ML_RSI_PP_BV_02	pRteData check
9.2.3	TC_ML_RSI_PP_BV_03	pRtsData check

Test cases – RSU DUT sending RSM

Test #	Identifier	Description
10.1.1	TC_ML_RSM_MST_BV_01	MsgCnt check
10.1.2	TC_ML_RSM_MST_BV_02	RSU ID check
10.1.3	TC_ML_RSM_MST_BV_03	Position 3D check
10.1.4	TC_ML_RSM_MST_BV_04	Participant list check

Test cases – OBU DUT receiving RSM

Test #	Identifier	Description
10.2.1	TC_ML_RSM_PP_BV_01	RSU ID, refPos, countRTE, countParticipants check
10.2.2	TC_ML_RSM_PP_BV_02	pPtcData check

Keysight enables innovators to push the boundaries of engineering by quickly solving design, emulation, and test challenges to create the best product experiences. Start your innovation journey at www.keysight.com.