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## COMPATIBILITY CHECK FOR SERIAL COMMUNICATION PROTOCOLS

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**Abstract:** Serial communication is the most well-known approach to send the data the slightest bit at a time over a communication Bus. There are many serial communication protocols such as SPI, CAN, LIN and I2C protocol. CAN and LIN protocols specifications are used for the conformance testing. Conformance testing checks that a product performs as indicated by its predetermined norms. CAN protocols provides with high speed of communication between ECU and modules which are present in autonomous vehicles. CAN protocol serves as a main bus while LIN protocol serves as a sub-bus for the CAN protocol. LIN protocol provides low- cost features. Connecting gateways in between CAN and LIN protocols which exchanges the data between two protocols. For autonomous industry, CAN and LIN protocols are more important along with other protocols such as ethernet, flex-Ray and MOST.

**Index Terms – Serial Communication, Autonomous industry, Modules, BCM and communication protocols.**

### I. INTRODUCTION

Firstly, Serial communications are utilized for all long stretch correspondence and most of the computer network organizations, where the link cost and the synchronization troubles make the communication of parallel unrealistic. Sequential correspondence transports are turning out to be more normal even at more limited distances, as worked on signal honesty and transmission speeds in fresher sequential advancements have started to offset the equal transport's benefit of straight forwardness. A serial communication needs fewer interconnection links like wires/filaments and it consumes small space. Extra room considers good seclusion of the channel from the environmental factors. The 2 types of serial communications are synchronous serial communication and an asynchronous serial communication. Synchronous serial communication allows more data to be disregarded a circuit for every unit time. Whereas asynchronous serial communication is determining endpoints and points of interaction are not synchronized from the clock signal. Conformance testing is a product testing strategy used to confirm that the product framework consents to the norms and guidelines as characterized by IEEE, W3C or ETSI. The motivation behind conformance testing is to decide the way that a framework under test affirms to meet the singular necessities of a specific norm. Conformance Testing Process is important to guarantee effectiveness, execution and to keep away from future dangers for a product application. Conformance Testing is utilized for testing the framework that offers full help to given guidelines.

CAN represents Controller Area Network and is a correspondence convention utilized by different electronic gadgets. CAN is frequently used to give correspondences between gadgets in vehicles. CAN is a high speed serial information communication transport ideal for continuous applications. The transport can work at information paces of up to 1 Mbps and has superb mistake location and rectification capacities. CAN was created by Robert-Bosh with its essential application being for car applications, yet it is presently likewise in numerous modern computerization and control applications. CAN is a multi-master, message-based convention. This implies that all the CAN gadgets can communicate information, and a few CAN gadgets can demand the utilization of the transport at the same time. CAN organize has no tending to framework and on second thought utilizes a focused on message framework. Every one of the messages are separated into a scope of needs. LIN represents Local Interconnect Network and is an electronic correspondence convention fundamentally utilized in vehicles like CAN. The LIN convention's need emerged since transports utilizing the CAN convention become too costly when each gadget in a vehicle is expected to convey through the transport. Hence, European vehicle makers started to utilize an alternate sequential interchanges framework, where the issues are similar. LIN was made by five automakers: BMW, Volkswagen Group, Audi, Volvo Cars, and Mercedes-Benz, with the assistance of Volcano Automotive Group and Motorola. LIN might be utilized as a sub-transport associated with a CAN transport. The CAN transport conveys a message to one of its hubs, which might itself at any point be a LIN master. At the point when the LIN actual layer transmitter gets the message, it changes over it at a rationale level to the LIN convention utilizing the CAN battery voltage level (normally 12 V). The LIN transmitter likewise incorporates a flow restricted wave-molding driver, which decreases electromagnetic discharges.

## A. LITERATURE REVIEW

A. B.V.P. Prasad, et al.[1].

This study use Controller Area Network (CAN) BUSES to accomplish Vehicle electronic control devices can communicate with one another thanks to easy, useful, and dependable functionalities. The foundation of the development of autonomous vehicles is CAN BUS' dependability and safety. Based on the demands of the car manufacturer, the semiconductor manufacturer created the CAN Bus system test specification. It is additionally broadly utilized in many fields like modern robotization, marine, clinical and different fields. Extra experiments are characterized in ISO 11898-2 and ISO 16845-2. These 2 norms intended to assess the exhibition of Controller Area Network actual layer, information interface layer data. Conformance test checks that CAN handsets communicate accurately with complex CAN networks utilizing gadgets from various merchants. These tests run in reference climate utilizing predefined settings to guarantee the most significant level of repeatability and likeness of experimental outcomes.

B. Haichun Zhang, et al.[2].

The In-Vehicle Network of wise vehicles perceived as key jobs in the shrewd the vehicle is presently the Controller Area Network. CAN transport convention has a few weaknesses with practically no encryption, verification, or honesty checking, which seriously undermines the wellbeing of drivers and travelers. Assailants hack the vehicular door and acquire the entrance right of the CAN, they can control the vehicle in view of the weaknesses of the CAN transport convention. Given the extreme protecting hazard of CAN, it has been proposed the CANsec, a pragmatic In-Vehicle CAN security assessment device that mimics malignant assaults as per significant assault models to assess the security chance of the In-Vehicle CAN. In this paper, it has been propose a vehicle CAN organize security evaluation device, CANsec, which is planned considering evaluation strategy determined. CANsec develops assessment vector as per the assault vector and destination resources of IVNs.

C. Nicolas Termer, et al.[4].

In vehicles, the essential specialized technique is the CAN transport. Be that as it may, it tends to be restrictively costly to put each electronic part onto the CAN transport. What's more, such an arrangement could cause transmission capacity issues given the huge number of parts on the cutting edge vehicle. In that capacity, the LIN convention was created as a correlative correspondences convention. The Local Interconnect Network (LIN) convention is a car standard that interfaces gadgets inside vehicles in a less difficult and more affordable way when CAN isn't needed for explicit applications. Micro processor's UART module has added convention support includes that work on LIN. Module equipment consequently creates ace cycles, synchronizes captives to the expert, sends and gets information bytes, and computes checksums expected by the LIN convention.

## II. PROBLEM STATEMENT

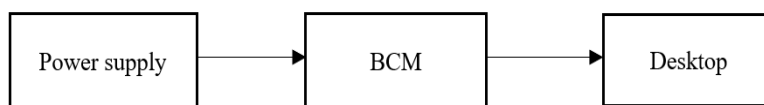
CAN and LIN protocols were designed for automotive industry. CAN was planned as a high unwavering quality and speed convention (up to 1 Mbit/s) for the unforgiving climate of the vehicle electrical transport. The CAN convention is a standard intended to permit the microcontroller and different gadgets to speak with one another with no host PC.

All parts in autonomous vehicles are associated through wire with single wire or numerous wires contingent on the need of the utilization CAN and LIN correspondence. Without the CAN and LIN protocols, designing the autonomous vehicles would be difficult.

## III. PROPOSED SYSTEM

The proposed system consists of power supply, BCM and Desktop. The conformance testing is carrying out by using this equipment to check the product or the process whether it is meeting the requirements of the specifications. In the proposed system, testing of the BCM with the specification requirements has been carried out. And the proposed system must provide the result whether the BCM is meeting the requirements of the specification of CAN and LIN protocol provided by ISO 11898-2.

## IV. METHODOLOGY



**Figure 1: Block Diagram**

In Figure 1, it consists of power supply, Body Control Module(BCM) and the Desktop. Power Supply is used to supply the voltage and current to the BCM to make the BCM awake by providing voltage of 12V and current of around 250-300mA.

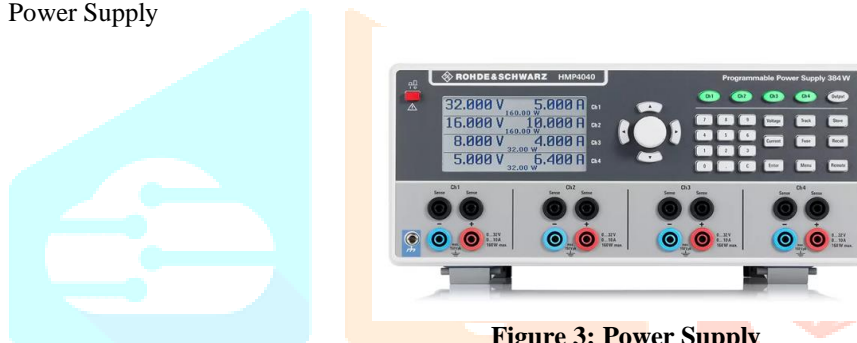
a. BCM(Body Control Module)



**Figure 2: Body Control Module(BCM)**

A thorough framework conveys and incorporates crafted by all electronic modules through the vehicle transport. Stringently talking, body control module capability is to control the drivers and directions enactment of gadget units. The controllers and connectors incorporated into a Body Control Module comprise focal underlying unit of the framework liable for the control part. Working information has been communicated to the BCM through the input gadgets. These may incorporate sensors, vehicle execution pointers, and variable reactors. A BCM in car can play out many capabilities. Yield gadgets are overseen in view of information got from input gadgets through Controller Area Network (CAN), LIN (Local Interconnect Network) or Ethernet as the method for correspondence with the modules and frameworks.

b. Power Supply



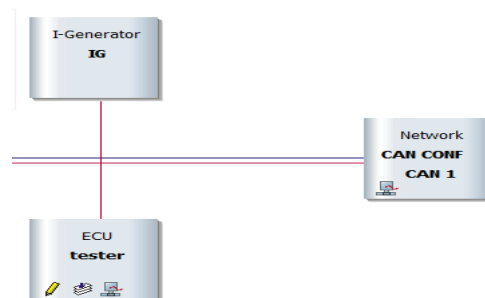
**Figure 3: Power Supply**

This power supply is mainly designed for an industrial use. It is having 4 channels with up to 10A output current. Depending on the model, the total active power is 188W or 384W, providing 80W or 160W per channel. In parallel operation mode, it can be possible to group of channels to obtain more currents. Integrated power system has the function which ensures power distribution to each channel in the operating mode. In daisy chain mode, you can combine channels up to 120 volts. The device's V/I monitoring function is also available in this operating mode.

c. Desktop

To execute the test cases, desktop has been used with the Canoe Simulation and CAPL. Test modules and the test environment has been updated in the desktop according to the project specific requirement. Desktop has to be connected with the setup using USB cable from the VN.

## V. RESULTS



**Figure 4: CANoe Simulation**

Figure 4 represents the CANoe simulation which must built first before executing the test cases. Canoe Simulation consists of the main ECU with other supporting ECUs as sub-buses. After that measurement setup window must be created.

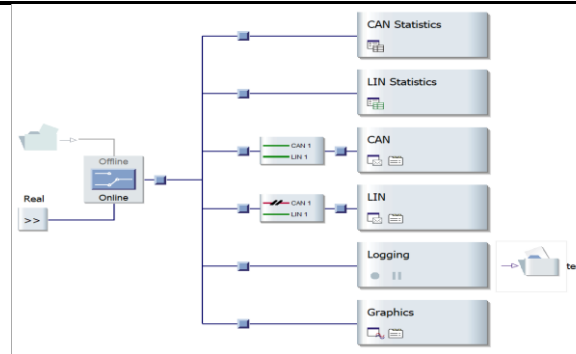


Figure 6: Measurement Setup

Figure 6 helps to measure the graphical representation of the traces and helps to record the logs. It also records the statistics. Compatibility check is the test to check the process or product to meet the requirement of the specification of serial communication protocols.

**2.1 Shortcut Between CANH and CANL: Passed**

Test case begin: 2022-05-30 10:44:13 (logging timestamp 3.403968)  
 Test case end: 2022-05-30 10:48:42 (logging timestamp 152.645968)

Main Part of Test Case			
Timestamp	Test Step	Description	Result
3.403968	PRE	Set Ubatt to 12V	-
3.403968	PRE	Set KL30 ON	-
4.035968	ACT	Start sending NM message	-
9.038968	PRE	ECU is in Normal Mode. Test will continue.	Pass
9.038968	ACT1	Create Shortcut between CAN-H and CAN-L	-
128.685968		Tester confirmation with 'Yes'.	-
128.685968	INFO	Wait for 4 seconds	-
132.725968	INFO	Record whether the CAN communication is disturbed or not.	-
132.725968	MEAS	Communication on CAN bus is not disturbed during fault condition.	-
132.725968	ACT2	Remove the shortcut between CANH and CANL.	-
137.849968		Tester confirmation with 'Yes'.	-
147.843968	INFO	ECU started communication after removing the Shortcut.	-
147.843968	REQ1	ECU shall send NM and application messages with correct cycle after removing the Shortcut.	Pass
147.843968	MEAS	CT for message 0x508 is as expected. CT was measured for 37 messages. Minimum CT is 272.584ms, Maximum CT is 272.877ms, average CT = 272.718ms	Pass
152.645968	INFO	Test Execution Completed	-

Figure 7: CAN Conformance Result

Figure 7 represents that example for CAN conformance test, where CAN-L and CAN-H should be shorted for few seconds and later it must be released. When they are shorted, there will be no communication and no messages traces. After release the shorting, there will be proper communication.

## VI. CONCLUSION

CAN and LIN protocols are the examples for serial communication protocols. Serial communication is the process of supplying data serially, one bit over a time, over a communication bus. Many communication buses are typically designed to connect 2 integrated circuits on a single circuit board, connected by signal traces on that board. CAN protocol provides 1 Mbps data rate, whereas LIN protocol provides 20 kbps data rate. Gateways are the one where the messages can be interchanged between CAN and LIN. Conformance testing of the CAN and LIN protocol is the process of testing the product to meet the requirements of the specifications of these protocols.

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