Development Of End-Of-Line Testing For Power Net Guardian Products

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Abstract: Testing a factory-made unit at the tip of the line could be a vital step within the production method. Defective product or perhaps those not matching specification limits closely enough should be separated from the useful units shipped to the client. End-of-Line (EoL) testing assesses not solely the standard of the merchandise, however conjointly the soundness and yield of the assembly method. Reliable detection of non-functional units is that the primary objective of the take a look at, however reducing the rejection rate and increasing the output is that the final result. Automatic testing replaces additional and additional subjective testing by human operators to shorten the assembly cycle and to enhance the reliability and likeness of the results. However, objective measurements have need to give a comprehensive assessment as sensitive as a personality's tester victimization his visual and aural senses. To completely vie with associate older operator, the target mensuration instrument must even have learning capabilities to accumulate information concerning physical causes of the mistake. Moreover, it should to be capable of being integrated in machine-driven lines, strong in an exceedingly harsh and shrie atmosphere, price effective and easy to use.

Keywords: Defective products, reliable detection, assembly cycle, tester victimization, machine driven lines.

1. INTRODUCTION

End-of-line (EOL) testers square measure answerable for testing the practicality of the merchandise throughout the producing method. Underneath the tough conditions of the producing atmosphere, check systems should simulate all the relevant conditions, while at identical activity the responses of the instrumentation being tested. In series production, a high testing outturn rate is crucial. For this reason, the check procedures developed in model testing square measure optimized so as to realize a brief cycle time. A stable mechanical device style is equally as necessary here as superior hardware and computer code design. Examples of applications for end-of-line check include: electrical window, HVAC (Heating, Ventilation and Air Conditioning), tailgates, car seats, remote management keys, seat occupancy sensors, ESL (Electronic Steering Lock), battery Management Systems for electrical vehicles. End-of-line check is vital to reduce risks for any automotive company and guarantee rider safety and satisfaction within the era of smarter vehicles. A versatile check resolution to ensure the passengers check coverage at the best attainable outturn. End-of-line Tester (EOL) systems will live and check the practicality of automotive electronic management units, mechanical elements and connected systems. Key factors thought of square measure high check amount, check completion and low system with upgrade prices. These days it is very necessary to take over a versatile check platform with the growing elaborateness of automotive physical science. Smart vehicles square measure making AN inflection purpose in automatic check as once disparate technologies still converge, and check organizations have to be forced to make sure the quality of those vehicles and their elements at lower prices. Organizations square measure abandoning their rack-and-stack box instruments and closed architectures to take a position in smarter check systems and automatic equipment (ATE) that scale with their needs. This helps them frequently shorten time to promote and drive down value and readying times. Designed on an open platform of standard hardware and versatile computer code, NT's approach to automatic check empowers organizations to make smarter automotive production check systems for electronic management units (ECUs), property and telematics, ADAS, docudrama, powertrain, and body physical science. Advanced Driver help Systems/Autonomous Driving (ADAS/AD) functions need in depth validation and testing before WE will be discharged to the market. Throughout each the purposeful development and therefore the production part, ADAS/AD functions have to be compelled to bear standardization, yet as hardiness, integrity and integration checks. [7] A unique methodology for standardization, purposeful checking and designation of specific ADAS/AD connected failures of camera-based ADAS/AD systems utilizing a vehicle-in-the-loop test simulation setup with real time stimulation of the camera detector on a unique manageable chassis ergometer testbed. During this setup, the driving Date and therefore the purposeful testing atmosphere is simulated whereas the $64000 vehicle, equipped with SAE level three category ADAS functions, is tested with realistic rolling conditions on the testbench. victimization this methodology, varied error conditions may be emulated and any potential issues may be diagnosed throughout testing with or while not access to the vehicle's ECUs. This diagnostic interface is crucial to perform testing in a very consistent and consistent manner and conjointly to re-use and compare results between totally different testing environments. End-of-line testers square measure answerable for testing the practicality of the merchandise throughout the producing method. Underneath the tough conditions of the producing atmosphere, check systems should simulate all the relevant conditions, while at identical activity the responses of the instrumentation being tested. A propensity to already appreciate that PCB (printed circuit board) is main half in any of the cars. But also, we must always understand that PCB contains several of

peripherals, resistors, capacitors, etc. So, if one in every of the connections is ignored in PCB which will be a significant complication that too in cars it's a significant quandary. So, to envision the physical connections on board we have a tendency to use EOL computer code.

Objectives

Following are the objectives of the work considered,

1. End of Line (EOL) software is used for testing physical connections on the board
2. Motivation is to identify the short circuit/open circuit in the PCB tracks
3. Used for flashing the calibration data, HSM activation, Variant coding
4. To retrieve and save Flash contents of the field return ECUs

Project Outcome and Mode of Demonstration

As stated in the objectives above, this project deals with the testing of the printed circuit boards that to be used in the automobiles which is very important for the automobiles. Through this implementation, one can check the printed circuit boards using the end of line testing for power net guardian products. Project outcome are a drag free PCB that's prepared for victimization in cars. Therefore, with the addition of this features the development cycle of automobile is increased. [9] Wolfgang Klippel Dresden et al., tested that can be done for the mechanical system could be an essential step within the production method. The PCBs shipped to the client from the helpful units ought to be separated if their particular specifications are not matching. End- of-line testing evaluate not solely the standard of the merchandise, however conjointly the steadiness and capitulate of the assembly method. [9] Constancy perception of ineffective units is that the foremost intent, however decreasing the rate of rejection and increasing the final output is that the final goal. The total percentage of motorized trial restore additional and additional internal trial by mechanist to shorten the assembly cycle and to enhance the duplicability and compare of the results. [9] Nevertheless, target computation ought to give a thorough testing as sensitive as somebody's tester victimization his visual and aural senses. [9] To completely vie with an old mechanist, the target mensuration device ought to even have ability to learn and to gather information concerning somatic conviction of the fault. Moreover, it ought to be capable of being integrated in machine-driven lines, strong in an exceedingly harsh and noisy setting, price effective and straightforward to use. [8] Integrated directly into production lines, end-of-line-test stands from Kistler provide an economical resolution to make sure the standard of electrical motors and alternative powertrain elements. These take a look at stands area unit made exactly in line with customers' needs in order that they are integrated seamlessly into the precise production setting. And although area is restricted, large numbers of tests is performed and documented due to totally machine-driven solutions from Kistler. Electrical motors area unit continued to evolve at an unbeatable pace a trend that's driven not solely by e- mobility however conjointly by steady progress towards the objectives of trade four. As regards vehicle motors, the main focus is on performance and efficiency; industrial applications, on the opposite hand, get pleasure from speed regulated drives that may be controlled with high preciseness for several totally different applications. E-bikes and e-scooters are gaining in quality as time goes on, and their current technological development are going to be a serious consider the approaching years. Integrated quality assurance generates extra price electrical powertrains have become additional complicated and additional economical, with improved performance and ever-increasing production quantities – therefore quality assurance contains an essential half to play here. Particularly at production level, there's growing demand for integrated systems that give totally machine-driven testing and qualification of every single product, with the likelihood of separation if needed. These end-of-line (or EOL) take a look at stands area unit more and more seen as an important element of production lines. Their role is to ensure prime quality and transparency for all powertrain elements – as well as motors, transmissions and inverters – and conjointly for complete powertrains. There are many other methods for testing a Printed Circuit Board (PCB) functionality in circuit testing, flying probe testing, automated optical inspection (AOI), Burn in, X-ray, functional testing. But have some disadvantages like there may be loss in some connection in in-circuit testing and in flying probe testing and there will be some functional problem too.

2. Methodology

In complex automotive electronic network, usage of standard communication protocol is gaining momentum. Added to this is the evolving vehicle architecture, which is presenting developers with higher uncertainty and possible nature of obsoleteness over work. Even technological upgradation in other domain, is pushing customer demand for more similar comfort features in vehicle. This can be noticed in OEMs and automotive service providers competing for higher feature with effective price. This can be achieved by reducing part of the cost that these companies incur during the course of development cycle. And the same can be implemented from very early days of project acquisition by automotive service provider from OEMs. This doesn't mean to compromise on effective utilization of available resources in hand to cater the customer needs.

2.1 Proposed Block Diagram

Figure 2.1 depicts the proposed block diagram of EOL development and testing for PNG products. This block diagram consists of mainly 3 blocks those are,

1. PCB manufacturing block
2. Software (SW), flashing station
3. EOL test and calibration

Figure 2.1: Project flow diagram

In PCB manufacturing block the PCBs are manufactured from different process such as Kitting, Baking, screen printing, pick and place, reflow soldering, AOI, X-ray inspection etc. In software flashing station, the process of installing the software to the PCB is carried out. Finally, in EOL test and calibration. the main block of testing the PCBs by using EOL software is implemented. Figure 2.2 shows the proposed block diagram of the work carried out that is EOL

development and testing for PNG products. It consists of mainly 3 blocks. They are,

1. Computer core segment (CCS) tester
2. Load
3. Electronic circuit unit (ECU)

In this method of approach there are commands such as activation command, read, read status, stimulus, output activation and report status. First the CCS tester gives the activation to the ECU that is electronic circuit unit using the controller area network (CAN) cables. Now the ECU performs operation and gives output activation command to the load block. Load block reads the activation command and gives the status of that reading back to the CCS tester. The CCS tester tests it and checks whether all the parameters are correct or wrong by comparing it with the already preloaded demands of the customer and matches the results with it.

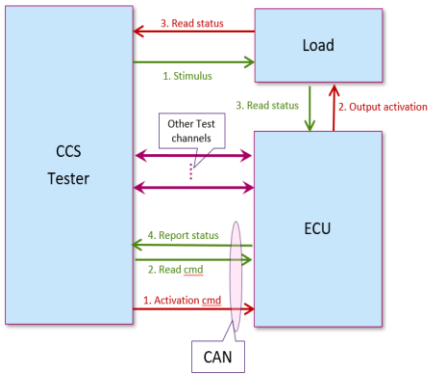


Figure 2.2: Proposed block diagram

These all operations are marked using the red arrow line as shown in Figure 2.2. Once all the parameter are passed and matched then the CCS tester gives the stimulus testing command to the load. At the same time CCS tester also gives the read command to the ECU, then the load reads it and gives back the status of that reading to the ECU. Finally, the ECU gives the report on the status of all the testing done viz., the resistor testing, capacitor testing, microcontroller testing, DBIO testing, compiler testing, power supply testing, memory testing such as RAM testing, ROM testing, flash memory testing etc.

2.2Architecture

Figure 2.3 shows the architecture developed for the EOL development and testing for PNG products.

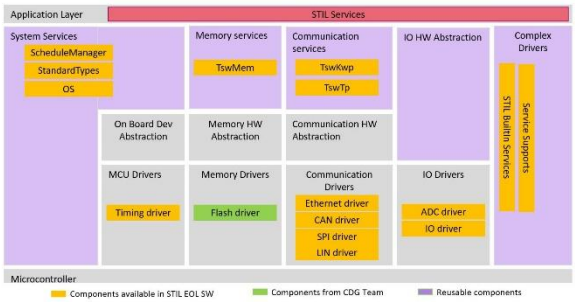


Figure 2.3: Self-test interpreter and loader architecture

The architecture consists of Application layer, STIL services, System services such as Schedule manager, standard types, OS Memory services, Communication services, input-output hardware (IO HW) abstractions, Complex drivers such as service supports, STIL Built in services, On board dev abstractions, Memory HW abstractions, Communication HW abstraction , MCU drivers such as timing driver, Memory drivers like flash driver, Communication drivers like ethernet driver, CAN driver, serial peripheral interface (SPI) driver, local interconnect network (LIN) driver, IO drivers like analog to digital converter (ADC) driver and input output (IO) driver.

The STIL software consists of two different components

1. STIL kernel and
2. Test routines/ services

Unique selling proposition (USP) of STIL software is downloadable services which can be compiled and generated independent of the software in microcontroller. The Standard communication protocols are used to download, execute tests and return the test results. It provides greater elasticity and adjustability. If downloadable services are used, code footprint is found to be very less. The test services offered are,

1. Digital out set/ clear service
2. Analog input read service
3. CAN channel test service
4. LIN channel test service
5. Ethernet channel test service
6. Generic SPI service
7. ECU sleep and wake up (used for quiescent current measurement)
8. Emergency microcontroller interface service
9. Flash read and write service
10. HSM key store service

Current code memory usage is about 60-80 kB depending on the features.

2.3 Keyword protocol

This protocol is utilized for on-board movement of vehicle diagnostics system. It covers the layer called application layer and session layer. This is standardized by ISO 14230. It helps in initiating, carrying, and ending a communication session. This keyword protocol has serial communication on an individual line known as the k-line. Along with this, there is a choice L-line for wakeup. The data rate of KWP protocol is in middle of 1.2 and 10.4 kilo baud. The message can have up to 255 bytes in the field of data. By then this is executed on a k-line physical layer KWP2000 wants a special wake-up sequence. They are,

1. 5-baud wakeup sequence
2. Fast initialization sequence

Each of the above-mentioned wakeup methods need critical manipulation of time to the k-line signal. It is either suitable on ISO 11898 that is controller area network (CAN) supporting larger data rates for up to 1 Mbit/sec. Now a days CAN is an extensively desired alternative to k-line this is due to the CAN bus is always present in now a-day vehicle and nevertheless deleting the use to install an extra physical cable. By the help of this KWP2000 on controller area network with ISO 15765 transfer and network layers is common. Even using this KWP2000 on CAN will not use the special wakeup functionalists. This KWP2000 may be executed on CAN only by utilizing the session layer and

service layer (that is none of the header specifying length, source and target address is utilized and none of the checksum is used) or by use of all layer (checksum and header are present inside a controller area network frame). Nevertheless, utilizing all the layers is damaging, as ISO15765 gives its own network or transport layers.

3. Results and Discussions

The system level bus development tool CANoe is used for this implementation and network analysis. The literature survey, which is carried out through systematic view signifies the need of generic platform and also lack of implementation with the actual loads. In the present work, it is intended to fill the existing gap and to reduce observed limitations.

3.1 IMPLEMENTATION

Figure 3.1 shows the setup and implementation of EOL that is end of line where it consists of two main blocks, they are test strategies of testing and STIL EOL development blocks. Test strategies of BE testing team block consists of DB explorer that is the data server block, CCS tester block and PAV test list generation block. Using the KWP 2000 protocol and CAN protocol the program is dumped into the (MCU) microcontroller unit and there the testing of different parts of the PCB is done. This testing includes resistor testing, capacitor testing, microcontroller testing, DBIO testing, compiler testing, power supply testing, memory testing such as RAM testing, ROM testing, flash memory testability etc. The obtained results are moved to the tester block and compared with the preprogrammed values and corresponding output is displayed.

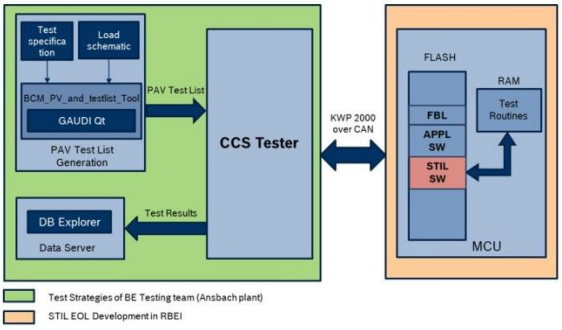


Figure 3.1: EOL setup

Figure 3.2 shows the switching of application software to the EOL software. (Explain)

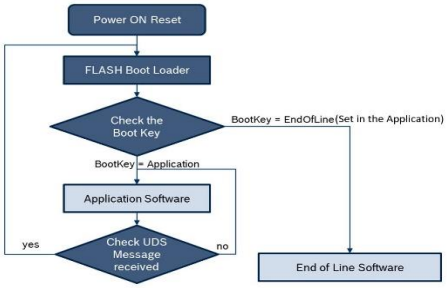


Figure 3.2: Switching from App SW to EOL SW

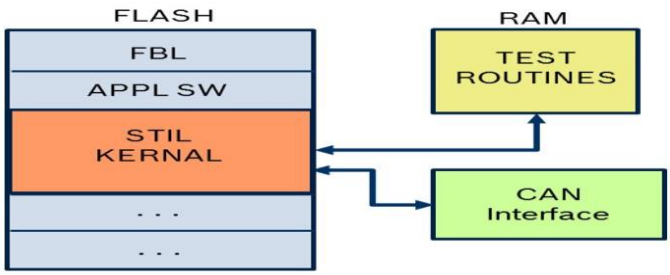


Figure 3.3: Self-test Interpreter and Loade

Initially, the power is ON then the flash boot loader loads the data. Next the command checks for the Boot key. If the Boot key is same as the EoL, then it will end. If Boot key is same as the application, it moves further for the application software there it checks for the suitable software and again check the unified diagnostic service (UDS) message is received or not. If it is received it again go back to the stage where the flash boot loader loads the data else if UDS message is not received it again go back to the stage of application software.

3.2 RESULTS

Result of this project are going to be just like the tested PCB is tested OK or not. Figure 3.4 shows the check result like it's passed or unsuccessful and conjointly offers data relating to the check setup and check hardware. Figure 3.4 offers the data of check begin date and time and conjointly the check finish date and time. It conjointly offers check module data like legal action details like ADC is passes which begin and finish date and time. Figure 3.4 gives the details of the preparation of the test case and the description of DIO passed and ADC passed or failed and that is the end of the report of this result. In result of EOL testing result clearly shows the version of the Canoe used, test module used, test file used, and also gives information regarding the test module library used. Using EOL testing the person can get the information regarding the CAN channels used to test the PCB along with the serial number so the EOL testing is the best method to test the PCB. This is best because it will give test staring time and date along with test ending time and date and it clearly gives information regarding the ADC and DIO testing. Also gives the return value for all the parameters. This is clearly shown in figure 3.4. The result will be passed or failed will be clearly shown. This is very helpful for the automobiles because the PCB plays the very important role in automobiles. So, this EOL testing is considered as the best in the best method of all the PCB methods. First the PCB design is given by the customer to the company. Then according to that design, the peripherals and the components are mounted on the PCB accordingly by various mounting methods like surface mounting, pick and place, through hole etc. The PCB's components are accordingly soldered by wave soldering, hand soldering based on the components used. After all these mounting and soldering once again the PCBs are checked whether the components are perfectly soldered and whether the components are perfectly placed in their desired places and with their desired values. Even this testing is important for the components which can be seen through eyes and some components that can be seen through the microscopes. But the functioning of the ICs, peripherals that cannot be seen through the eyes for that kind of testing this End of line testing is used which is very important. After

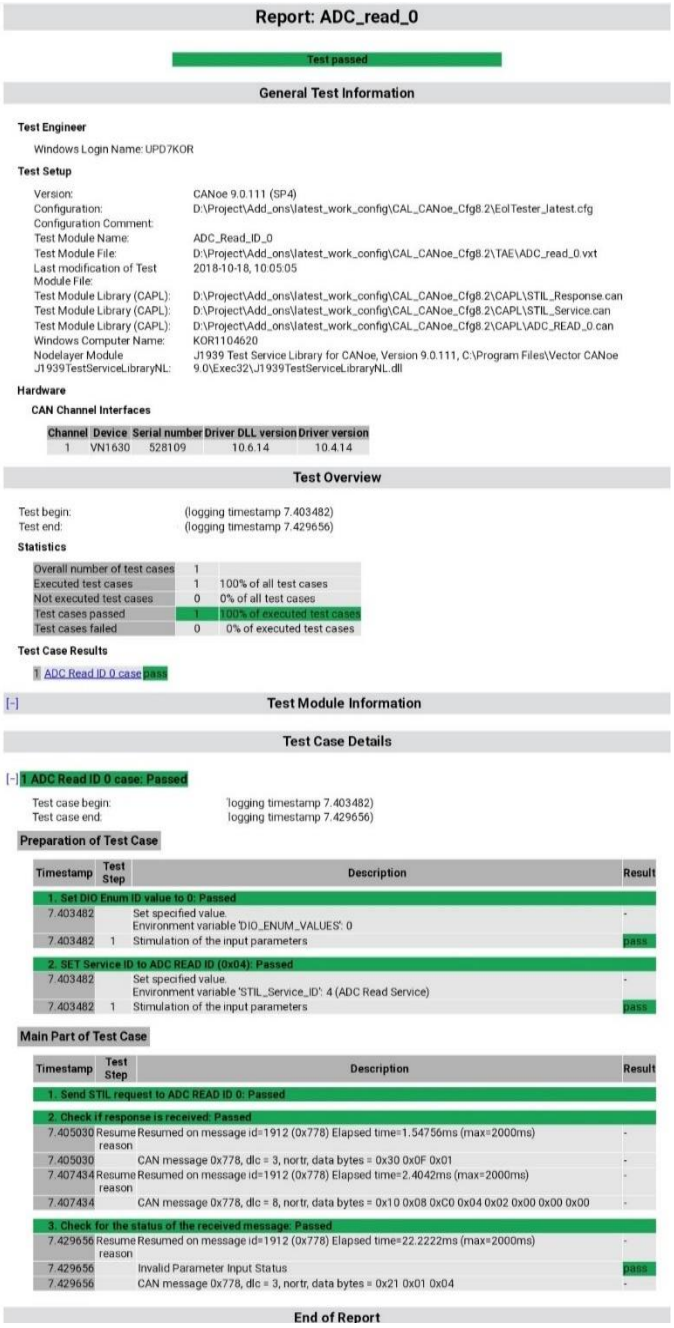
all the hand testing is done then the final printed circuit board is sent to the end of line testing. There the printed circuit board is connected to the laptops or personal computers where the end of line software is present through the LAN connections and using the vector CANoe cable, vector Vn1611 cable, power supply etc. Then the testing of the connected printed circuit board is started using the end of line software as the switching process is done from application software to the end of line software. The testing is done for analog to digital converter that is used in that particular printed circuit board and the result came out as shown in the figure 3.4. There it completely gives information like whether the test is passed or failed, who is doing the test, at what time it is started and at what time the test is ended, its configurations, its module name and description etc. as shown in figure 3.4. Here this particular result also gives the testing result of the digital input and output pins whether it is working or not and the result is passed or failed. It also gives information of the STIL architecture's result.

CONCLUSIONS

By exploitation this project, the PCB boards that are vital in automotive these days are often simply tested exploitation the package and might get the correct results for that PCBs. End of Line (EoL) southwest is employed for testing physical connections on the board has been tested. Short circuit/open circuit within the PCB tracks are known. This can be conjointly used for flashing the standardization knowledge, HSM activation, Variant writing and conjointly to retrieve and save Flash contents of the sphere come ECUs has been done.

FUTURE SCOPE

1. HCP 4/MLBevo3 (Infineon Aurix microcontroller)
2. Standardization of requirement template
3. User interface creation for testing instead of CMD prompt



Report: ADC_read_0

Test passed

General Test Information

Test Engineer

Windows Login Name: UPD7KOR

Test Setup

Version:	CANoe 9.0.111 (SP4)
Configuration:	D:\Project\Add_ons\latest_work_config\CAL_CANoe_Cfg8.2\EolTester_latest.cfg
Configuration Comment:	
Test Module Name:	ADC_Read_ID_0
Test Module File:	D:\Project\Add_ons\latest_work_config\CAL_CANoe_Cfg8.2\TAE\ADC_read_0.vxt
Last modification of Test Module File:	2018-10-18, 10:05:05
Test Module Library (CAPL):	D:\Project\Add_ons\latest_work_config\CAL_CANoe_Cfg8.2\CAPL\STIL_Response.can
Test Module Library (CAPL):	D:\Project\Add_ons\latest_work_config\CAL_CANoe_Cfg8.2\CAPL\STIL_Service.can
Test Module Library (CAPL):	D:\Project\Add_ons\latest_work_config\CAL_CANoe_Cfg8.2\CAPL\ADC_READ_0.can
Windows Computer Name:	KOR1104620
Nodelayer Module J1939TestServiceLibraryNL:	J1939 Test Service Library for CANoe, Version 9.0.111, C:\Program Files\Vector CANoe 9.0\Exec32\J1939TestServiceLibraryNL.dll

Hardware

CAN Channel Interfaces

Channel	Device	Serial number	Driver DLL version	Driver version
1	VN1630	528109	10.6.14	10.4.14

Test Overview

Test begin: (logging timestamp 7.403482)
Test end: (logging timestamp 7.429656)

Statistics

Overall number of test cases	1	
Executed test cases	1	100% of all test cases
Not executed test cases	0	0% of all test cases
Test cases passed	1	100% of executed test cases
Test cases failed	0	0% of executed test cases

Test Case Results

1 ADC Read ID 0 case pass

[-] Test Module Information

Test Case Details

[-] 1 ADC Read ID 0 case: Passed

Test case begin: logging timestamp 7.403482)
Test case end: logging timestamp 7.429656)

Preparation of Test Case

Timestamp	Test Step	Description	Result
1. Set DIO Enum ID value to 0: Passed			
7.403482		Set specified value. Environment variable 'DIO_ENUM_VALUES': 0	-
7.403482	1	Stimulation of the input parameters	pass
2. SET Service ID to ADC READ ID (0x04): Passed			
7.403482		Set specified value. Environment variable 'STIL_Service_ID': 4 (ADC Read Service)	-
7.403482	1	Stimulation of the input parameters	pass

Main Part of Test Case

Timestamp	Test Step	Description	Result
1. Send STIL request to ADC READ ID 0: Passed			
2. Check if response is received: Passed			
7.405030	Resume reason	Resumed on message id=1912 (0x778) Elapsed time=1.54756ms (max=2000ms)	-
7.405030		CAN message 0x778, dlc = 3, nortr, data bytes = 0x30 0x0F 0x01	-
7.407434	Resume reason	Resumed on message id=1912 (0x778) Elapsed time=2.4042ms (max=2000ms)	-
7.407434		CAN message 0x778, dlc = 8, nortr, data bytes = 0x10 0x08 0xC0 0x04 0x02 0x00 0x00 0x00	-
3. Check for the status of the received message: Passed			
7.429656	Resume reason	Resumed on message id=1912 (0x778) Elapsed time=22.2222ms (max=2000ms)	-
7.429656		Invalid Parameter Input Status	pass
7.429656		CAN message 0x778, dlc = 3, nortr, data bytes = 0x21 0x01 0x04	-

End of Report

Figure 3.4: Test report

References

[1]. Infineon-AURIX TC3xx Part1-UserManual-v01 00-EN.

[2]. Document Number: FS6500-FS4500 Rev. 6.0, 10/2017 NXP Semiconductors Data sheet: Advance Information

[3]. "Research of Distributed Optical Fiber Temperature Sensor (DTS) System with Optical Switch" by Jianfeng Wang; Yongxing Jin; Zaixuan Zhang; Changyu Shen; Yanqing Qiu.

[4]. "Designing with Cypress Quad SPI (QSPI) F-RAM™" by Shivendra Singh Associated Part Family: CY15x102QSx, CY15x104QSx, CY15x108QSx Document No. 002-18375 Rev.

[5]. "Selecting the Right Microcontroller Unit", by Takawira F., Dawoud D.S., Zimb. J. Sci. Technol., Vol. 4, no. 1, p 39-46

[6]. "Understanding the Key Architectural Features of a Microcontroller", by Gonzales D.R., Available at: http://www.dedicatedsystem.com

[7]. "Principles of Digital Design." by Gajski, Daniel D., Englewood Cliffs, NJ: Prentice Hall, 1997.

[8]. "End-of-line test stands for electrical drive systems Enhanced customer satisfaction and improved production efficiency": the benefits of EOL solutions from Kistler

[9]. "End-Of-Line Testing" Wolfgang Klippel Dresden University of Technology Germany

[10]. "Quad Serial Peripheral Interface (QuadSPI) Module Updates Implemented on Vybrid MCU" by David Paterson Document Number:AN4512 Application Note Rev. 0, May 2012

[11]. Xilinx, "Zynq-7000 EPP Technical Reference Manual", Version I.I, June 25, 2012.

[12]. ARM, "AMBA® AXFM and ACFM Protocol Specification·", Issued, October 28, 2011.

[13]. Spansion, "S25FL512S SPI with Multi-I/O flash memory data sheer·", Revision OS, May 24, 2012.

[14]. Xilinx, "7 Series FPGAs SelectiO Resources User Guide", Version I I, May 31, 2011