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TECHNICAL SPECIFICATION

SIGNAL_HIL_2 Test System

NEXTEER AUTOMOTIVE POLAND

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1. SCOPE:

- 1.1 This document outlines the requirements for the design, build, acceptance and installation of one (1), SIGNAL_HIL_2 Test System for Nexteer European Technical Center located in Tychy, Poland. Nexteer intent is to receive complete system with all wiring, build as cabinet or rack, together with software and necessary interface to control HIL system from a PC computer.
- 1.2 SIGNAL_HIL_2 Test System is intended to allow testing of embedded system core functionalities of EPS product line. Test System includes hardware platform with interfaces necessary to simulate CAN, CAN FD or FlexRay bus traffic, EPS sensors and electrical motor. Test System shall include software for controlling hardware platform and for creating and executing tests for EPS product.
- 1.3 This equipment shall be available for acceptance at the supplier's site not later than **December 8th 2023**.
- 1.4 The intent of this specification is to communicate the general requirements of the contract, and in no way does it relieve the vendor of their responsibility to provide rugged, accurate, and safe equipment.

2. HIL SYSTEM SPECIFICATION:

2.1 Hardware Requirements:

- 2.1.1 The system should allow to simulate load on car networks in real time.
- 2.1.2 System should have interface for CAN bus with at least two channels.
- 2.1.3 System should have interface for CAN FD bus with at least one channel.
- 2.1.4 System should have interface for FlexRay bus with at least one channel.
- 2.1.5 System should have the possibility to control and read status of input/output lines of device under test, both digital and analogue of voltages up to 5V. Minimum number of available analogue inputs is 30. Minimum number of available analogue outputs is 30. Minimum number of available digital inputs/outputs is 80. Minimum sampling time shall be 10kHz.
- 2.1.6 System should allow to simulate car ignition signal which is 0-48V. System should also provide and allow to change power supply voltage (simulating car battery 0-48V). System should be able to measure both voltages.
- 2.1.7 System should allow to simulate two sensors with SPI, SENT, I2C interface in real time.
- 2.1.8 System should have enough computational power to simulate electrical motor in real time. By this requirement it should be understood that there is computational unit, that can be programmed to read PWM signal, generated by device under tests, and provide data related to motor position and other values, that maybe necessary in testing. Computational unit should be programmable, so Nexteer would be able to update electrical motor model in house. Basic motor model of three phase BLDC motor should be provided, that takes PWM signals as inputs and calculate motor torque, rotational speed and motor position. Model's clock should be not slower than 1 MHz.
- 2.1.9 Necessary interfaces should be included in test system that allow to simulate position sensors signals both digital and analogue. Mandatory are: resolver simulation and digital incremental encoder simulation. There must be possibility to simulate at least two same type position sensors at a time. Update rate should be not slower than 1MHz.
- 2.1.10 Necessary interfaces for capturing at least 6 PWM signals should be available for measuring electrical motor control signals. Those data should be use by electrical motor simulation in real time. PWM frequency is in range 14kHz-18kHz.
- 2.1.11 System should contain means for failure injection on IO lines. Possible failures should include at least open circuit and short circuit to ground.
- 2.1.12 Connectors set should allow to easily plug and unplug test harness for different devices.
- 2.1.13 All elements of system should be put together into one cabinet. There should be enough space foreseen for further extension of the system like doubling number of input/output lines or doubling number of simulated sensors.
- 2.1.14 System should be modular. There should be possibility for doubling computational power of the system (adding another processor card mentioned in 2.1.9), extending number of IO lines or adding interfaces for other serial protocols like SENT.
- 2.1.15 The hardware platform shall not return energy to the external power grid in case of generator operation of the simulated BLDC engine.

2.2 Software Requirements:

- 2.2.1 The test system should provide software that allows to control hardware through GUI. Controlling should include at least: changing values of signals on CAN/CAN FD/FlexRay and changing parameters of simulated electrical motor.
- 2.2.2 Software provided together with test system should also provide means to read data back from simulated system and device under test. It should be possible to read data from hardware platform no slower than each 100us. Software provided with test system should allow to visualize measurement data with use of GUI.
- 2.2.3 Software should allow to build new GUIs and modify existing ones by Nexteer engineers.
- 2.2.4 Software included in test system should be able to read files that describes CAN, CAN FD or FlexRay communication. It should be able to process at least DBC, FIBEX and ARXML files.
- 2.2.5 Software supporting test automation should use Python programming language as one of the ways to create automated test sequences. Python interpreter and editor should be integrated within test development environment.
- 2.2.6 Software package should include tools for configuration and monitoring communication bus CAN/CAN FD/FlexRay traffic.
- 2.2.7 The test system should provide tools for running test cases directly on the hardware in real time with synchronization to simulated electrical motor and communication bus simulation. Although main way of executing tests should be to run them on PC, that communicates with hardware platform.
- 2.2.8 Software provided for controlling hardware platform should be conform to ASAM XIL and ASAM AE MCD-3 API standard.

2.3 Other Requirements:

- 2.3.1 For every software product delivered there should be maintenance and support provided for at least one year. Maintenance should include software upgrades during this period and support of supplier technical stuff. Response time should be less than 2 working days.
- 2.3.2 Supplier must have available trainings related to the hardware and software of the test system components. Trainings are optional, doesn't have to be a part of offer.
- 2.3.3 The supplier should prepare the acceptance process of the test system. The acceptance process shall be agreed with Nexteer before the acceptance activities will take a place.

2.4 Additional Instructions:

- 2.4.1 Project Management: Monthly status reports and a "project timeline" must be provided.
- 2.4.2 Mechanical Drawing Approval: Concept and detail drawings must be approved for build by Nexteer Engineer in Charge prior to construction.
- 2.4.3 Schematics Drawing Approval: Electrical controls drawings must be approved for build by Nexteer Engineer in Charge prior to design implementation.
- 2.4.4 Electronic Files: *NOTICE: the final payment cannot be made until all the files are approved by Nexteer Engineer in Charge.*
- 2.4.5 Deviations: Any deviations, requested after a purchase order is issued, must be approved in writing by the Nexteer Engineer in Charge.
- 2.4.6 Final Approval: The Nexteer Engineer in Charge must provide written approval that the equipment supplier has permission to ship the equipment. Equipment received without that document signed in will be returned at supplier's charge.
- 2.4.7 Service: Machine start up service is required at Nexteer European Technical Centre in Tychy, Poland. It is presumed that the supplier and Nexteer are mutually prepared to run HIL test system qualification process immediately after start-up.

3. QUOTATION:

- 3.1** Please fulfil the “Supplier Format/Buyer Format” cost breakdown, provided by our purchasing department employee responsible for the process of SIGNAL_HIL_2 purchasing.
- 3.2** Identify any subcontractors in your proposal.
- 3.3** Your main proposal must include the statement: ”We agree to conform to Nexteer Specifications including, T-SPEC SIGNAL_HIL_2 Test System”.
- 3.4** Any recommendations if they are not in agreement to this specification shall be attached to the offer.
- 3.5** Any and all deviations to these specifications must be approved prior to issuance of our purchase order.
- 3.6** All deviations to these specifications shall be itemized in the proposal attachment.

4. ABBREVIATIONS:

- 4.1** CAN – Controller Area Network
- 4.2** CAN FD – Controller Area Network Flexible Data-Rate
- 4.3** DBC – CAN Database file
- 4.4** EPS – Electric Power Steering
- 4.5** FIBEX – Field Bus Exchange Format
- 4.6** GUI – Graphical User Interface
- 4.7** HIL – Hardware In the Loop
- 4.8** I2C – Inter-Integrated Circuit
- 4.9** SPI – Serial Peripheral Interface
- 4.10** ASAM – Association for Standardization of Automation and Measuring Systems
- 4.11** API – Application Programming Interfaces

5. REVISIONS:

- 5.1** 1.0 – As released.