

**LOW-COST HARDWARE IN THE LOOP (HIL) TEST TOOL**

**User Manual**

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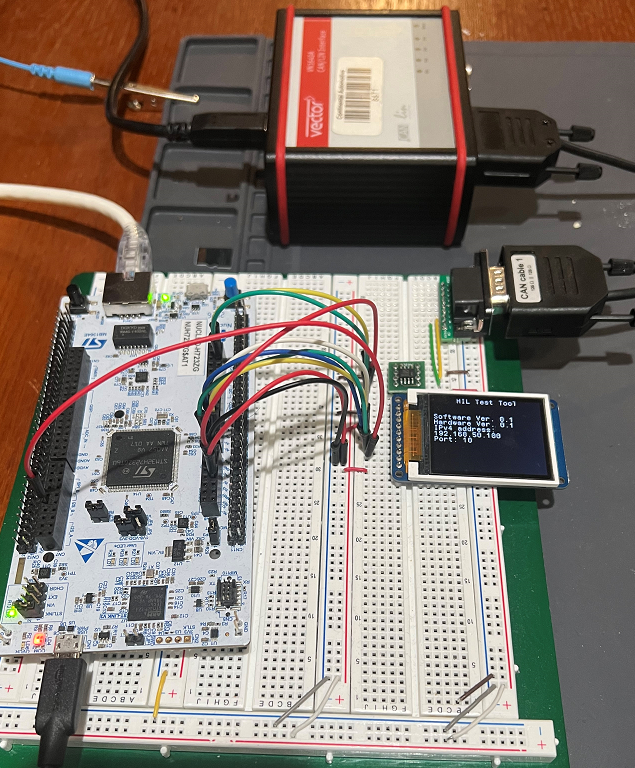
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# Introduction

Test and Validation teams across several automotive companies use COTS (Commercial Off-the-Shelf) technology for the design and development of Automated Test Equipment (ATE). System development programs budget high costs for professional development tools like Vector CANoe/CANalyzer, Vehicle Spy from ICS, etc.

While these tools are excellent to design and develop large simulations and tests scenarios, sometimes startup companies do not require or cannot afford these tools with high-cost licenses. On the other hand, when the test development team has finished the test automation and the rest of the R&D teams just need a simple tool to execute predefined test cases, they need to borrow at least a Runtime license of one of these expensive tools in order to run the test scenarios again to keep with OEM requirements for product maintenance.



## 

## Concept

The purpose of this project is to emulate the functionality of an Automated Test Equipment (ATE) capable of running pre-defined test scenarios via CAN communication to special types of ECUs. For this academic project, a basic simulated Body Control Module has been simulated using Vector CANoe. The simulation includes Vehicle Engine Status, Speed Engine and Head & Hazard lights control.

## Scope

The HIL Test Tool provides the ability to run predefined test scenarios to any ECU that has a CAN communication layer. The following table shows the pre-defined test modes available in the HIL Test Tool.

| **Test Name** | **Type** | **Description** |
| --- | --- | --- |
| Speed Engine | Functional | Verifies the speed set to the ECU. |
| Lights | Functional | Verifies the lights turn ON/OFF. |
| Hazards | Functional | Verifies the hazard lights turn ON/OFF |
| Engine status | Functional | Verifies the ignition status of the engine. |

Table 1. Test Modes.

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# Hardware

This section shows the guide to connect the hardware parts of the HIL Test Tool.



## HIL Test Tool Connection Tables

|  |  |  |  |
| --- | --- | --- | --- |
| **Connector** | **Board PIN #** | **Description** | **TFT Screen PIN #** |
| D | 68 | SPI1\_SCLK | SCK |
| D | 25 | SPI1\_MOSI | MOSI |
| D | 9 | Chip Select | TFT\_CS |
| NC | NC | Card Chip Select | CARD\_CS |
| D | 8 | SPI1 Data | D/C |
| D | 10 | SPI1 Reset | RST |
| NC | NC | VCC | VCC |
| NC | NC | GND | GND |

Table 2. PIN connections for TFT screen.

|  |  |  |  |
| --- | --- | --- | --- |
| **Connector** | **Board PIN #** | **Description** | **CAN Transceiver PIN** |
| D | 66 | CAN Tx | 1 (txD) |
| D | 67 | CAN Rx | 4 (rxD) |
| 5v | 5v | VCC | 3 (VCC 5v) |

Table 3. PIN connections for CAN transceiver.

|  |  |  |
| --- | --- | --- |
| **CAN Transceiver Connector PIN** | **Description** | **DB9 Connector** |
| 7 | CANH | 2 |
| 6 | CANL | 7 |

Table 4. PIN connections for DB9 connector.

NOTE: 120Ohm resistor between pin 2 and 7 of DB9 connector.

|  |  |
| --- | --- |
| **Port Name** | **Description** |
| USB | PWR to development board |
| Ethernet | LAN connection |

Table 5. Board Connections

Once connections are established you should see the welcome information in the tool screen.

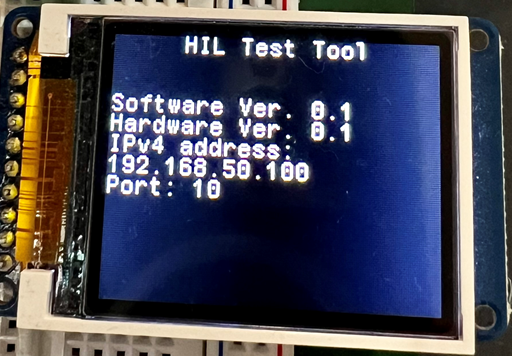


Figure 1. Welcome Information

## Interface with Simulated CAN Network

The project uses a VN1640 CAN interface but any CAN interface model from Vector can be used. As seen in *Figure 3*. Channel #2 of the interface tool was selected and configured for the project.

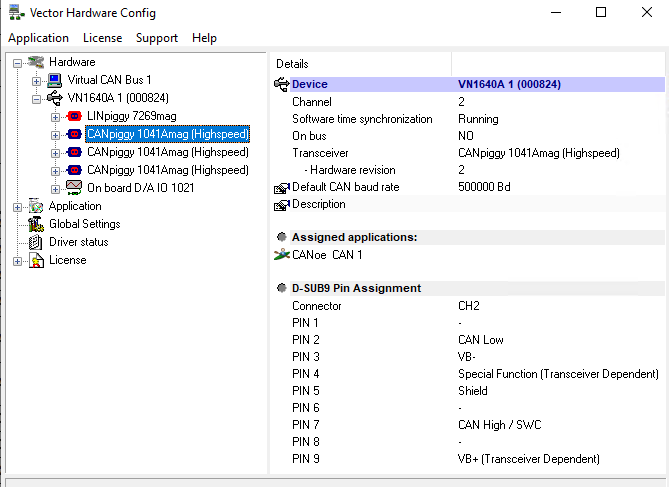


Figure 3. CAN Interface configuration.

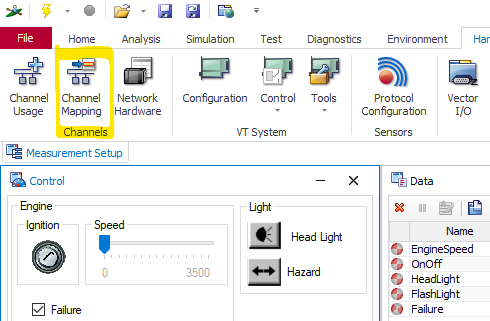
# Software

This section shows the instructions to operate the HIL Test Tool



## CANoe

1. Open the CANoe configuration (DEMO\_v11) located in <project\_directory>\002 CANoe\DEMO\_v11.cfg
2. Make sure the CAN interface is detected and appears in the Vector Hardware Configuration tool (see Figure 3).
3. Open Channel Mapping and verify that CAN1 points to the desired physical CAN channel. In this case CAN Ch2 was selected.



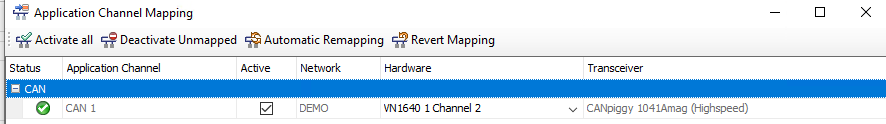


Figure 3. Channel Mapping configurations.

1. Open Network Hardware options and set the baud rate and sampling points to 500k to match the speed with the HIL Test Tool as seen on *Figure* *4*.

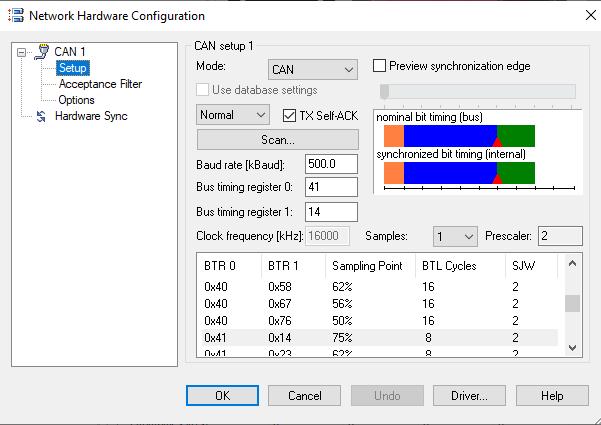


Figure 4. CAN interface speed configuration.

1. Start the CANoe configuration by clicking on the yellow thunderbolt icon located in the top left corner or by selecting the home tab and clicking the START button.

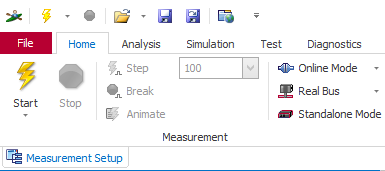


Figure 5. Home tab menu

## TCP Client

1. Download the Hercules utility tool from [www.hw-group.com/software/hercules-setup-utility](http://www.hw-group.com/software/hercules-setup-utility).
2. Select the TCP Client tab and connect to *192.168.50.100* using port *10*.
3. Once the connection has been established, in the Send section you can use any of the available test modes: Test\_Mode\_1. Test\_Mode\_2, Test\_Mode\_3 or Test\_Mode\_4.

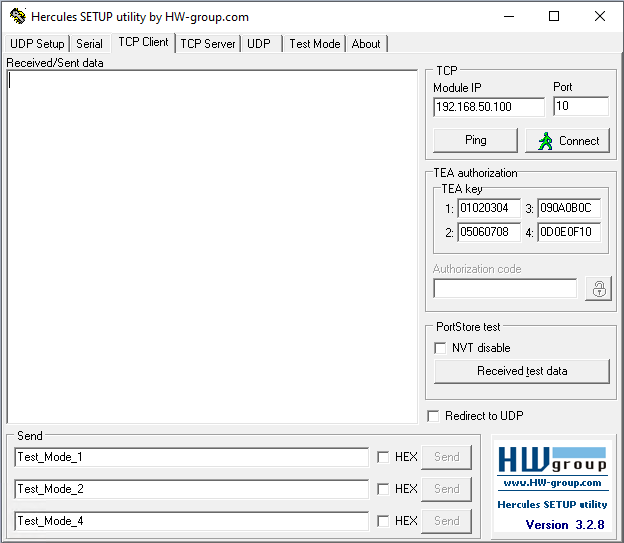


Figure 6. Hercules TCP Client tool.

NOTE: The HIL Test Tool uses static IP addressing. For demo purposes IP address *192.168.50.100* was used.

## CANoe Panels

Data Window

Graph Window

Trace Window

Figure 7. Overview of CANoe panels.

1. **Trace Window**: Displays the received and transmitted CAN messages.
2. **Graph Window**: Displays the data behavior once a Test Mode is being executed.
3. **Data Window**: Displays the same information as the Graph Window in numeric value.

## Test Results

Once a Test Mode finishes the HIL Test Tool will display the test result like the ones in *Figure 8*.

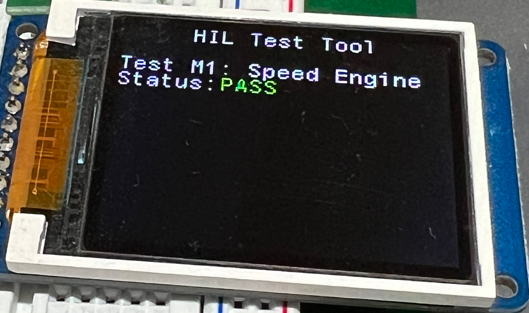
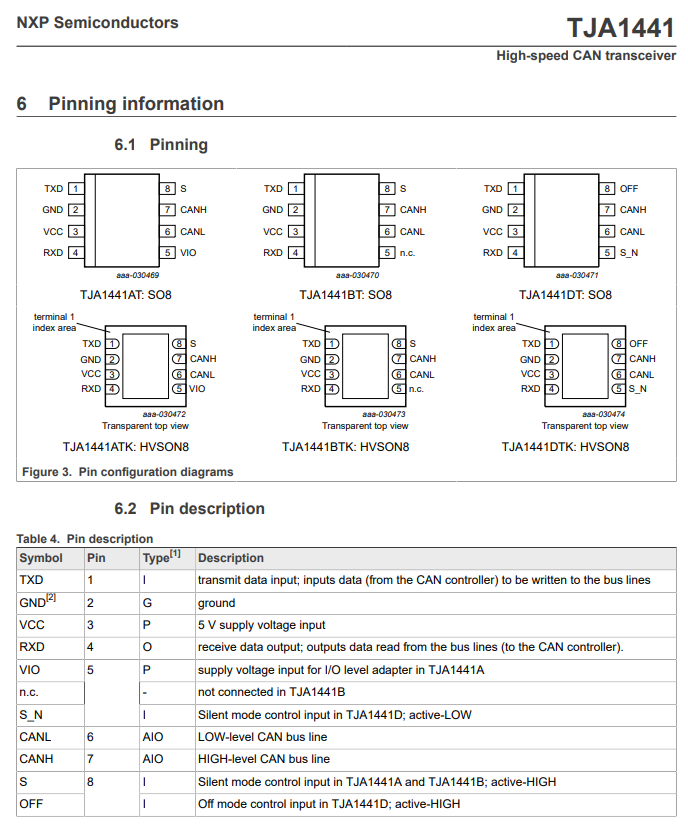
 

Figure 8. Test Results for TM1: Speed Engine

# Appendix A

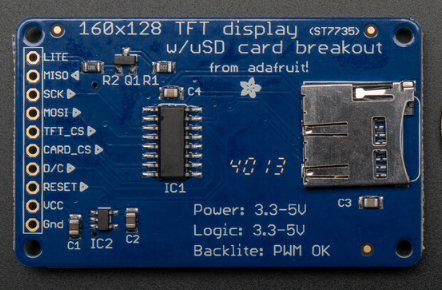
Pin information for CAN transceiver.



Source: NXP Semiconductors

# Appendix B

TFT screen information.



This color display uses SPI to receive image data.

* **Lite** - PWM input for the backlight control. Connect to 3-5VDC to turn on the backlight.
* **MISO**- this is the SPI Microcontroller In Serial Out pin, its used for the SD card.
* **SCLK** - this is the SPI clock input pin.
* **MOSI**- this is the SPI Microcontroller Out Serial In pin, it is used to send data from the microcontroller to the SD card and/or TFT.
* **TFT\_CS** - this is the TFT SPI chip select pin.
* **Card CS -**this is the SD card chip select, used if you want to read from the SD card.
* **D/C** - this is the TFT SPI data or command selector pin.
* **RST** - this is the TFT reset pin.
* **Vcc** - this is the power pin, connect to 3-5VDC.
* **GND**- this is the power and signal ground pin.

Source: https://learn.adafruit.com/1-8-tft-display/breakout-pinouts