USER GUIDE

NI CAN Demo Box

This document discusses the architecture and use of the CAN Demo Box, and gives examples for software.

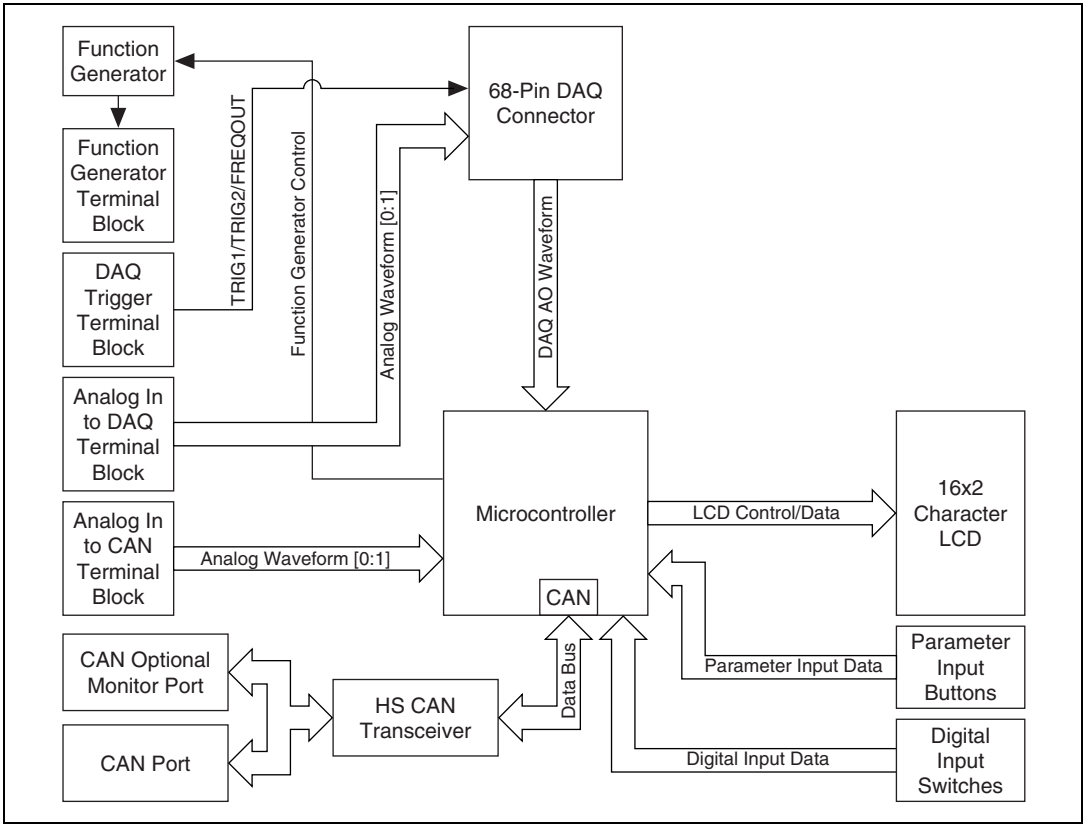
Overview

The CAN Demo Box, when communicating with NI-CAN and NI-DAQ hardware on a PC, provides a tool to demonstrate concepts of CAN communication, DAQ, and CAN/DAQ synchronization.

For a copy of the latest version of this User Guide and a copy of the `CAN Demo Box.ncd` file, refer to KnowledgeBase **3B8DEVHR**.

NATIONAL INSTRUMENTS

Block Diagram Overview



The Function Generator provides a sine, square, or triangle output waveform. The waveform type and frequency are user-adjustable through the parameter input buttons or CAN messages. The negative and positive peak values of the sine and triangle waveforms are 0.2 V and 3.6 V, respectively, on the function generator terminal block output. The output voltage range of the square waveform is 0 to 5 V.

The Function Generator Terminal Block provides a way to connect to the function generator output.

The 68-Pin DAQ Connector connects the DAQ interface analog in, analog out, and trigger pins to the box.

The DAQ Trigger Terminal Block provides a way to connect to the DAQ interface TRIG1, TRIG2, and FREQ_OUT pins.

The Analog In To DAQ Terminal Block provides a way to connect to the DAQ interface ACH0 and ACH1 pins.

The Analog In To CAN Terminal Block provides a way to connect to the CAN CH0 and CH1 pins of the micro controller. A signal may be sampled and have its waveform transmitted via CAN messages from the box.

The CAN Port connects the CAN interface card in the PC to the box.

The CAN (Optional Monitor) Port is wired in parallel with the CAN Port. It allows a second port of a CAN interface card in the PC to monitor box CAN bus activity.

The Parameter Input Buttons are used to input various operating parameters.

The states of the Digital Input Switches can be transmitted through CAN messages from the box.

Getting Started

Software Requirements

- LabVIEW 6.1 or newer
- NI-CAN 2.2 or newer
- NI-DAQ 7.0 or newer (required for CAN/DAQ examples)

Hardware Requirements

- 1 port (minimum) High-Speed CAN board (2 port optional for monitoring)
- 1 single termination CAN cable (second single termination cable optional for monitoring)
- 68-pin Multifunction Data Acquisition board
- 68-pin Data Acquisition cable

Hardware Setup

1. Connect one single termination CAN cable between the box CAN port and CAN card Port 1.
2. For optional monitoring, connect a second single termination CAN cable between the box CAN (Optional Monitor) port and CAN card Port 2.
3. Connect the 68-pin DAQ cable between the box 68-pin Device port and DAQ card 68-pin port.
4. Connect a jumper wire between the Function Generator Gen terminal and the Analog In To DAQ Ch0 terminal.

5. Connect a second jumper wire between the Function Generator Gen terminal and the Analog In To DAQ Ch1 terminal.
6. Connect a third jumper wire between the Function Generator Gen terminal and the Analog In To CAN Ch0 terminal.
7. Connect a fourth jumper wire between the Function Generator Gen terminal and the Analog In To CAN Ch1 terminal.
8. Connect the DC power supply to the box. At power up, the box will begin transmitting the `WAVEFORM0_SAW0_SWITCHES_FROM_CDB` and `WAVEFORM1_SAW1_FROM_CDB` messages at the NI-CAN default baud rate of 125 K. For more information on these messages, refer to the *CAN Communication* section.
9. Verify that the CAN messages are transmitting by running the Bus Monitor in the Measurement & Automation Explorer (MAX).
10. Load the `CAN Demo Box.ncd` file into the CAN Channels in MAX.

Demo Box Menus

The **LCD**, **Menu Select**, and **+/-** push buttons provide an intuitive interface for controlling box parameters. The box powers up with the CAN/DAQ menu active.

To cycle through the menus, click the **Menu Select** button. The **+/-** push buttons allow adjustment of the associated parameter within each menu. The **Menu Select** and **+/-** push buttons may be clicked, or held to adjust menus or parameters at a slow, then increased, rate. The menus and parameters for each are as follows:

- **CAN/DAQ** (power up default)
  - No parameters adjustable via **+/-** push buttons
- **Function Generator Output**
  - **Sine** (power up default)
  - **Square**
  - **Triangle**
- **Function Generator Frequency**
  - 0.1 Hz–1 KHz (power up default is 0.5 Hz)
- **LCD Contrast**
  - **–** Lower
  - **+** Higher
- **CAN Baud Rate**
  - **125 K** (power up default)
  - **250 K**

  - **500 K**
  - **1 M**
- **CAN Transmit**
  - **Disable All**
  - **Ch0/Saw0/Sw Only**
  - **Ch1/Saw1 Only**
  - **Enable All** (power up default)

CAN Communication

Refer to Figure 1, *NI CAN Demo Box Messages and Channels*, for the Messages and Channels provided by the `CAN Demo Box.ncd` file to communicate with the CAN Demo Box.

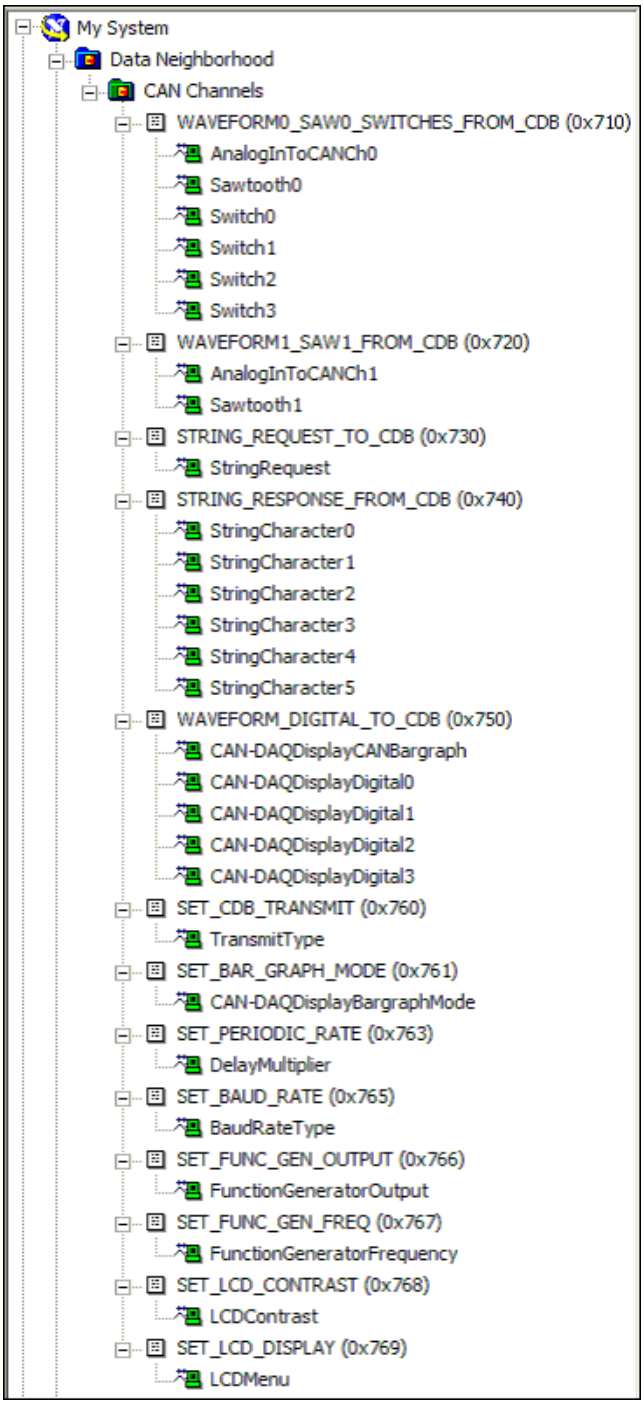


Figure 1. NI CAN Demo Box Messages and Channels

Message and Channel Descriptions

Table 1. WAVEFORM0_SAW0_SWITCHES_FROM_CDB

Channel Names	Description
AnalogInToCANCh0	A 10-bit sample of the signal on the Analog In To CAN terminal block Ch0 input.
Sawtooth0	An 8-bit value of a sawtooth waveform generated by the box microprocessor.
Switch0..3	A 1-bit sample of each of the Digital Input 3 2 1 0 switch states.

Table 2. WAVEFORM1_SAW1_FROM_CDB

Channel Names	Description
AnalogInToCANCh1	A 10-bit sample of the signal on the Analog In To CAN terminal block Ch1 input.
Sawtooth1	An 8-bit value of a second sawtooth waveform generated by the box microprocessor.

Table 3. STRING_REQUEST_TO_CDB

Channel Names	Description
StringRequest	Queries the box to return a message containing the string "NI-CAN" as 6 ASCII characters in 6 byte-wide channels. The box ignores the data and data length code. It simply responds with `STRING_RESPONSE_FROM_CDB` when it receives this message.

Table 4. STRING_RESPONSE_FROM_CDB

Channel Names	Description
StringCharacter0..5	Response to `STRING_REQUEST_TO_CDB`. The string "NI-CAN" is returned as 6 ASCII characters in 6 byte-wide channels.

Table 5. WAVEFORM_DIGITAL_TO_CDB

Channel Names	Description
CAN-DAQDisplayCANBargraph	A 10-bit sample of waveform data to display on the CAN bar graph in the **CAN/DAQ** menu.
CAN-DAQDisplayDigital0..3	A 1-bit sample of digital data to be displayed for each of the 3 2 1 0 indicators in the **CAN/DAQ** menu.

Table 6. SET_CDB_TRANSMIT

Channel Names	Description
TransmitType	Control transmission of the `WAVEFORM0_SAW0_SWITCHES_FROM_CDB` and `WAVEFORM1_SAW1_FROM_CDB` messages. Values: 0 - Disable all 1 - Waveform0-Sawtooth0-Switches only 2 - Waveform1-Sawtooth1 only 3 - Enable all Default = 3

Table 7. SET_BAR_GRAPH_MODE

Channel Names	Description
CAN-DAQDisplayBargraphMode	Set the display mode for the CAN and DAQ bar graphs in the **CAN/DAQ** menu. Values: 0 - Dot mode 1 - Bar mode Default = 1

Table 8. SET_PERIODIC_RATE

Channel Names	Description
DelayMultiplier	The periodic transmission rate of `WAVEFORM0_SAW0_SWITCHES_FROM_CDB` equals `DelayMultiplier * 200 nanoseconds`. Since the Analog In To CAN terminal block Ch0 input is sampled at each transmission of the `WAVEFORM0_SAW0_SWITCHES_FROM_CDB` message, the sample rate for the **AnalogInToCANCh0** channel is equal to the periodic transmission rate of `WAVEFORM0_SAW0_SWITCHES_FROM_CDB`. **DelayMultiplier** does not affect the periodic transmission rate of `WAVEFORM1_SAW1_FROM_CDB`. Values: Range is 0 to 65,535 Default = 50,000 (10 milliseconds)

Table 9. SET_BAUD_RATE

Channel Names	Description
BaudRateType	Set the baud rate of the CAN controller. Values: 2 - 125 Kbps 3 - 250 Kbps 4 - 500 Kbps 5 - 1 Mbps Default = 2

Table 10. SET_FUNC_GEN_OUTPUT

Channel Names	Description
FunctionGeneratorOutput	Set the output waveform type of the function generator. Values: 0 - Sine 1 - Square 2 - Triangle Default = 0

Table 11. SET_FUNC_GEN_FREQ

Channel Names	Description
FunctionGeneratorFrequency	Set the frequency of the function generator. Values: 0 to 9 - 0.1 Hz to 1 Hz in 0.1 Hz increments 9 to 18 - 1 Hz to 10 Hz in 1 Hz increments 18 to 117 - 10 Hz to 1,000 Hz in 10 Hz increments Default = 4 (0.5Hz)

Table 12. SET_LCD_CONTRAST

Channel Names	Description
LCDContrast	Adjust the contrast of the LCD. Values: 0 - Contrast decrease 1 - Contrast increase

Table 13. SET_LCD_DISPLAY

Channel Names	Description
LCDMenu	Select the menu to be displayed on the LCD. Values: 0 - CAN baud rate 1 - CAN transmit status 2 - CAN/DAQ 3 - Function generator output 4 - Function generator frequency 5 - LCD contrast Default = 2

Examples with CAN Demo Box

NI-CAN Examples

Example Name	Waveform Input.vi
Description	Read the Analog In To CAN Ch0 terminal block input and internally generated sawtooth waveform via CAN.
Instructions	1. Open the **Waveform Input.vi** example. 2. In the channel list, change **TransmissionOilPressure** to **AnalogInToCANCh0**, and **TransmissionFilterPressure** to **Sawtooth0**. 3. Change the sample rate to `250.0`. 4. Right click on the **Waveform Chart**, select **Y Scale**, and check **Autoscale Y**. 5. Run the VI.
Notes	The waveform chart will display white sine (**AnalogInToCANCh0**) and red sawtooth (**Sawtooth0**) waveforms. The frequency of the sawtooth waveform is fixed, but the sine waveform frequency may be adjusted via the box push buttons. The sine waveform may also be changed to triangle or square via the push buttons.

Example Name	Waveform Input.vi
Description	Read the states of switches 0 and 1 via CAN.
Instructions	1. Open the **Waveform Input.vi** example. 2. In the channel list, change **TransmissionOilPressure** to **Switch0**, and **TransmissionFilterPressure** to **Switch1**. 3. Change the sample rate to `250.0`. 4. Run the VI.
Notes	The waveform chart provides a logic analyzer type display. The white waveform represents the state of switch 0 (scaled such that ON = 40 and OFF = 35). The red waveform represents the state of switch 1 (scaled such that ON = 30 and OFF = 25). Observe the waveform changes as you toggle switches 0 and 1 on the box.

Example Name	Single Sample Periodic Output.vi
Description	Write the CAN bar graph and digital 0 indicator in the **LCD CAN/DAQ** menu via CAN.
Instructions	1. Open the **Single Sample Periodic Output.vi** example. 2. In the channel list, change **TransmissionOilPressure** to **CAN-DAQDisplayCANBargraph**, and **TransmissionFilterPressure** to **CAN-DAQDisplayDigital0**. 3. Right click on the **Channel 0** knob, and select **Data Range**. Click the **Scale** tab and change the **Scale Range Maximum** value to `5.5`. 4. Use the **Menu Select** push button to select the **LCD CAN/DAQ** menu. 5. Run the VI.
Notes	Turn the **Channel 0** knob and notice the LCD CAN bar graph change. Move the **Channel 1** slider from 0 to 40 and notice the LCD digital 0 indicator change. The **CAN-DAQDisplayDigital0** channel is scaled such that 0 = Off (no asterisk) and 40 = On (asterisk).

Example Name	CAN Waveform Input and AI Waveform Input.vi
Description	Read the Analog In To DAQ and Analog In To CAN Ch0 and Ch1 terminal block inputs via CAN and DAQ.
Instructions	1. Open the **CAN Waveform Input and AI Waveform Input.vi** example. 2. In the channel list, change **TransmissionOilPressure** to **AnalogInToCANCh0**, and **TransmissionFilterPressure** to **AnalogInToCANCh1**. 3. Change the sample rate to `250.0`. 4. Right click on the **Waveform Chart**, select **Y Scale**, and check **Autoscale Y**. 5. Run the VI.
Notes	The waveform chart will display red (**AnalogInToCANCh1**), white (**AnalogInToCANCh0**) and green overlapping blue sine waveforms (Analog In To DAQ Ch0 and Analog In To DAQ Ch1 are connected to the same signal, with no scaling). Notice how the white and red (Analog In To CAN channel), and green and blue (Analog In To DAQ channel) waveforms remain synchronized via RTSI. Note that the red waveform shows more stair stepping than the white waveform, since the **AnalogInToCANCh1** channel message is transmitted at a 50 ms periodic rate, while the **AnalogInToCANCh0** channel message is transmitted at a 10 ms rate. The sine waveform frequency may be adjusted via the box push buttons. The sine waveform may also be changed to triangle or square via the push buttons.

Example Name	CAN Waveform Output and AO Waveform Output.vi
Description	Write the CAN bar graph in the **LCD CAN/DAQ** menu via CAN. Write the DAQ bar graph in the **LCD CAN/DAQ** menu via DAQ.
Instructions	1. Open the **CAN Waveform Output and AO Waveform Output.vi** example. 2. In the channel list, change **TransmissionOilPressure** to **CAN-DAQDisplayCANBargraph** and delete **TransmissionFilterPressure**. Right-click on the entry, go to data operations, and select **Delete Element**. 3. Open the **CAN Waveform Output and AO Waveform Output.vi** diagram and change the amplitude and offset constants in the sinewave generator For Loop, from `5.0` to `2.75`. 4. Use the **Menu Select** push button to select the **LCD CAN/DAQ** menu. 5. Run the VI. Notice the behavior of the LCD CAN and DAQ bar graphs. Note that the waveforms are synchronized with a 90-degree phase shift relative to one another.
Notes	—

Example Name	Single Sample Periodic Output.vi (Uses MAX)
Description	Adjust the function generator frequency and output via CAN, and observe the resulting waveform changes via DAQ using a MAX test panel.
Instructions	1. Open the **Single Sample Periodic Output.vi** example. 2. In the channel list, change **TransmissionOilPressure** to **FunctionGeneratorFrequency**, and **TransmissionFilterPressure** to **FunctionGeneratorOutput**. 3. Right click on the **Channel 0** knob, and select **Data Range**. Click the **Scale** tab and change the **Scale Range Maximum** value to `117`. 4. Right click on the **Channel 1** slider, and select **Data Range**. Click the **Scale** tab and change the **Scale Range Maximum** value to `2`. 5. Open the MAX Test Panel for your DAQ device. Click the **Analog Input** tab and set the following: Channel = 0 Input Limits High = 5 Input Limits Low = 0 Data Mode = Continuous Sample Rate = 4000.0 Hz Click the **Start** button. 6. Run the VI.
Notes	Position the Test Panel and VI such that both are visible on the desktop. Turn the **Channel 0** knob and notice the Test Panel Analog Input waveform display reflect the frequency change. Move the **Channel 1** slider slowly from 0 to 1 then 2, and notice the Test Panel Analog Input waveform display reflect the change from sine to square, then triangle waveforms.

Where to Go for Support

The National Instruments Web site is your complete resource for technical support. At `ni.com/support` you have access to everything from troubleshooting and application development self-help resources to email and phone assistance from NI Application Engineers.

A Declaration of Conformity (DoC) is our claim of compliance with the Council of the European Communities using the manufacturer's declaration of conformity. This system affords the user protection for electronic compatibility (EMC) and product safety. You can obtain the DoC for your product by visiting ni.com/certification. If your product supports calibration, you can obtain the calibration certificate for your product at ni.com/calibration.

National Instruments corporate headquarters is located at 11500 North Mopac Expressway, Austin, Texas, 78759-3504. National Instruments also has offices located around the world to help address your support needs. For telephone support in the United States, create your service request at `ni.com/support` and follow the calling instructions or dial 512 795 8248. For telephone support outside the United States, contact your local branch office:

Australia 1800 300 800, Austria 43 0 662 45 79 90 0,
Belgium 32 0 2 757 00 20, Brazil 55 11 3262 3599,
Canada (Calgary) 403 274 9391, Canada (Ottawa) 613 233 5949,
Canada (Québec) 450 510 3055, Canada (Toronto) 905 785 0085,
Canada (Vancouver) 604 685 7530, China 86 21 6555 7838,
Czech Republic 420 224 235 774, Denmark 45 45 76 26 00,
Finland 385 0 9 725 725 11, France 33 0 1 48 14 24 24,
Germany 49 0 89 741 31 30, India 91 80 51190000,
Israel 972 0 3 6393737, Italy 39 02 413091, Japan 81 3 5472 2970,
Korea 82 02 3451 3400, Malaysia 603 9131 0918,
Mexico 01 800 010 0793, Netherlands 31 0 348 433 466,
New Zealand 0800 553 322, Norway 47 0 66 90 76 60,
Poland 48 22 3390150, Portugal 351 210 311 210,
Russia 7 095 783 68 51, Singapore 65 6226 5886,
Slovenia 386 3 425 4200, South Africa 27 0 11 805 8197,
Spain 34 91 640 0085, Sweden 46 0 8 587 895 00,
Switzerland 41 56 200 51 51, Taiwan 886 2 2528 7227,
Thailand 662 992 7519, United Kingdom 44 0 1635 523545

371409A-01 Jan05