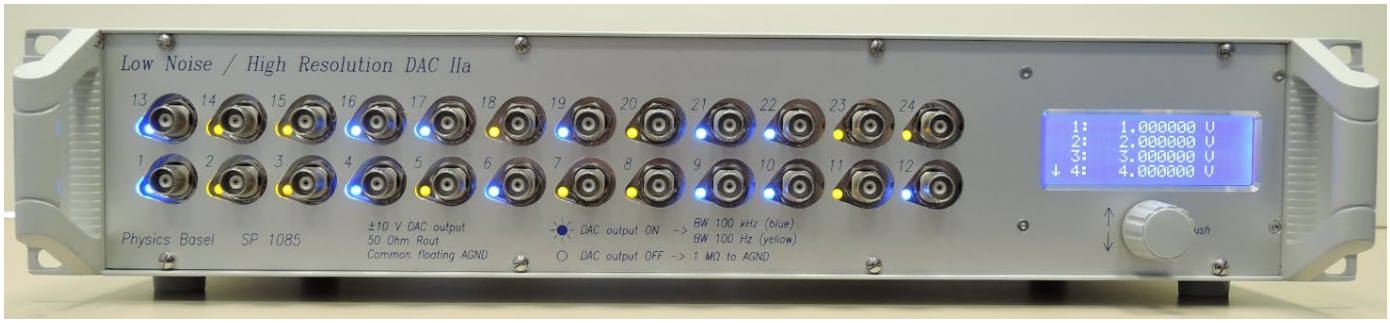
Low Noise / High Resolution DAC IIa

Physics Basel SP 1085

LabVIEW Drivers Description | Revision 1.2a

For Software Release 3.5.xy



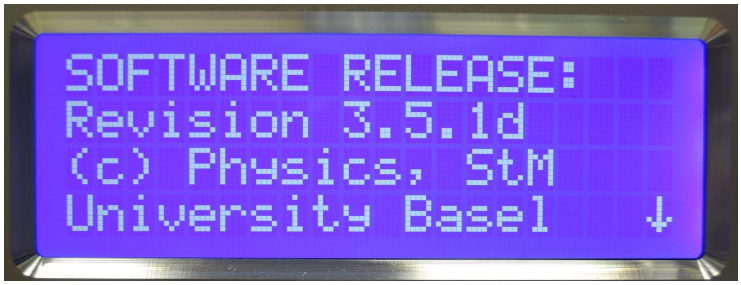
Michael Steinacher | February 2026

University of Basel

1 Table of Content

2 Overview

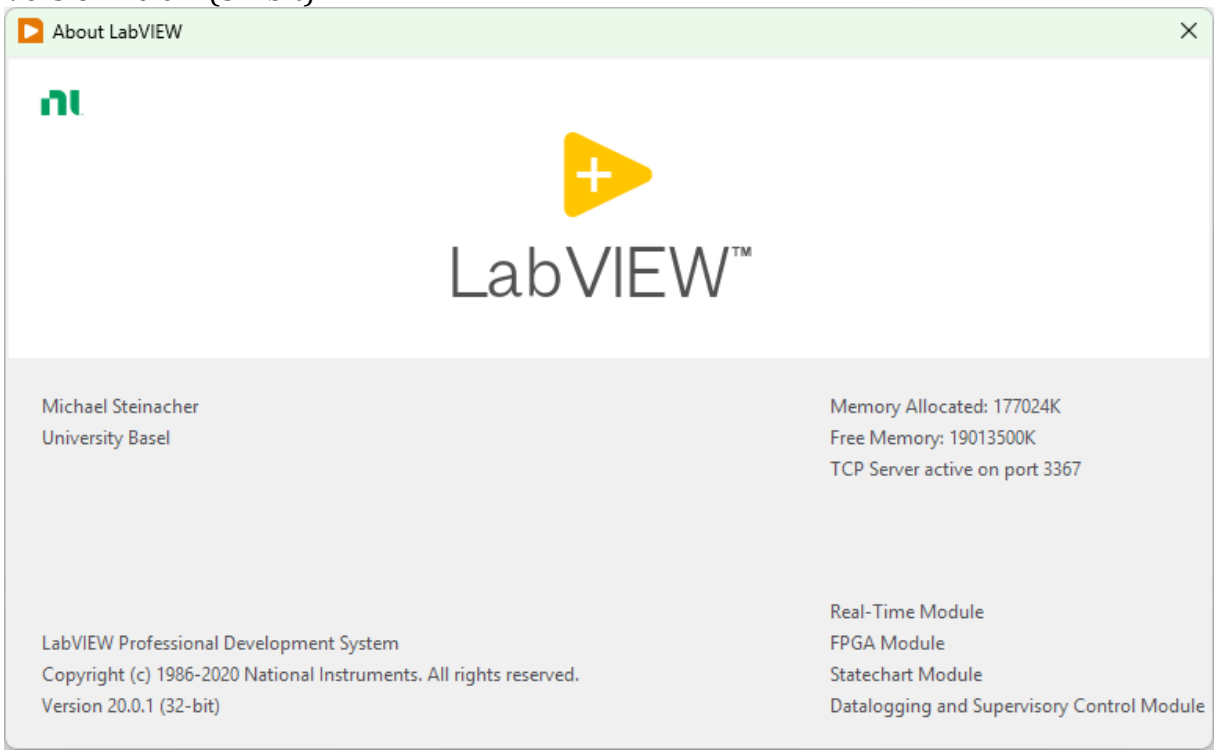
These LabVIEW drivers allow the remote control of the LNHR DAC IIa either via TCP/IP-Telnet or via the RS-232 serial port. They are designed to work with the LNHR DAC IIa with a Software Release 3.5.xy (x is a number from 0 to 9 and y a character from "a" to "z"). You can easily check the installed release on the local LCD under the menu item "Software Release":



Several sample programs are included that allow users to quickly create their own LabVIEW application to remotely control the LNHR DAC IIa.

2.1 LabVIEW Version

The drivers and sample programs are written with the 32-bit version of LabVIEW 2020 Version 20.0.1 (32-bit):

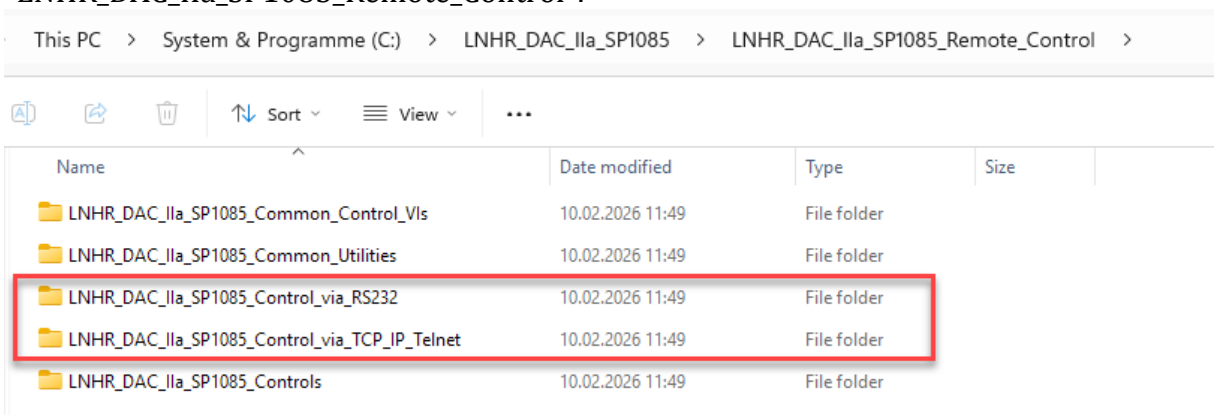


The LabVIEW drivers and sample programs are available in the sub-directory "LNHR_DAC_IIa_SP1085_Remote_Control" on the USB memory-stick which was delivered with the LNHR DAC IIa.

It is recommended to copy the content of this sub-directory from the memory-stick to the root of the PC-drive (normally C:\) under the directory "LNHR_DAC_IIa_SP1085". Doing so, the path to the LNHR DAC IIa drivers and sample programs is: C:\LNHR_DAC_IIa_SP1085\LNHR_DAC_IIa_SP1085_Remote_Control\

3 Selecting the Communication Port

Two separate LabVIEW projects, one for communication via TCP/IP-Telnet and one for the serial communication via RS-232 are available under the directory "LNHR_DAC_IIa_SP1085_Remote_Control":



It is recommended to use the TCP/IP-Telnet communication with the LNHR DAC IIa as it is much faster and less prone to interference. Additionally, an Ethernet connection can have a cable length of up to 100 meters.

Nevertheless, it is still possible to perform the communication with the LNHR DAC IIa by the old RS-232 serial connection.

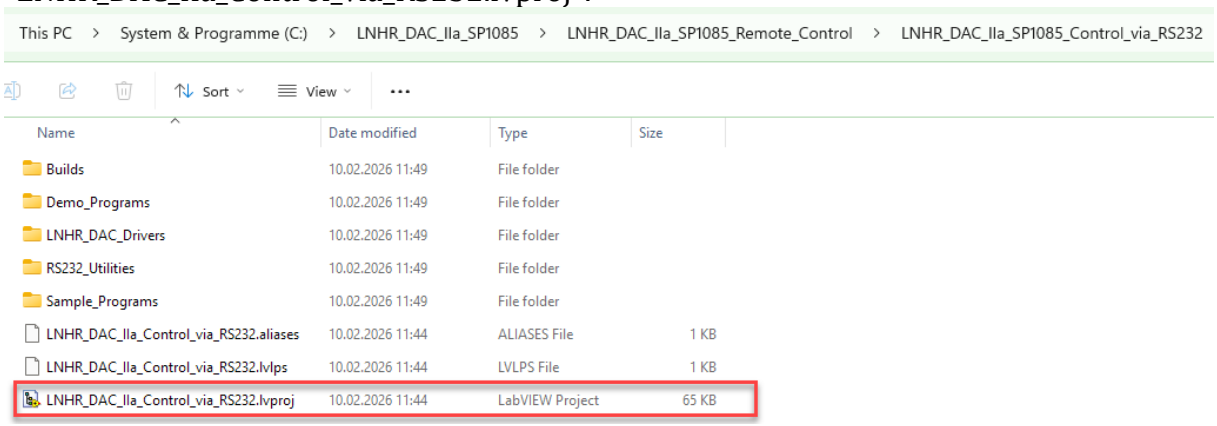
Note: At the highest RS-232 communication speed of 115.2 kbit/s the cable length shouldn't exceed three meters – otherwise, erroneous communication may occur.
Use a Null-modem RS-232 cable between your computer and the LNHR DAC IIa.

In principle, both the serial port and the Ethernet connection can be used simultaneously. The most recently received command, whether via RS-232 or TCP/IP-Telnet, is processed and activated.

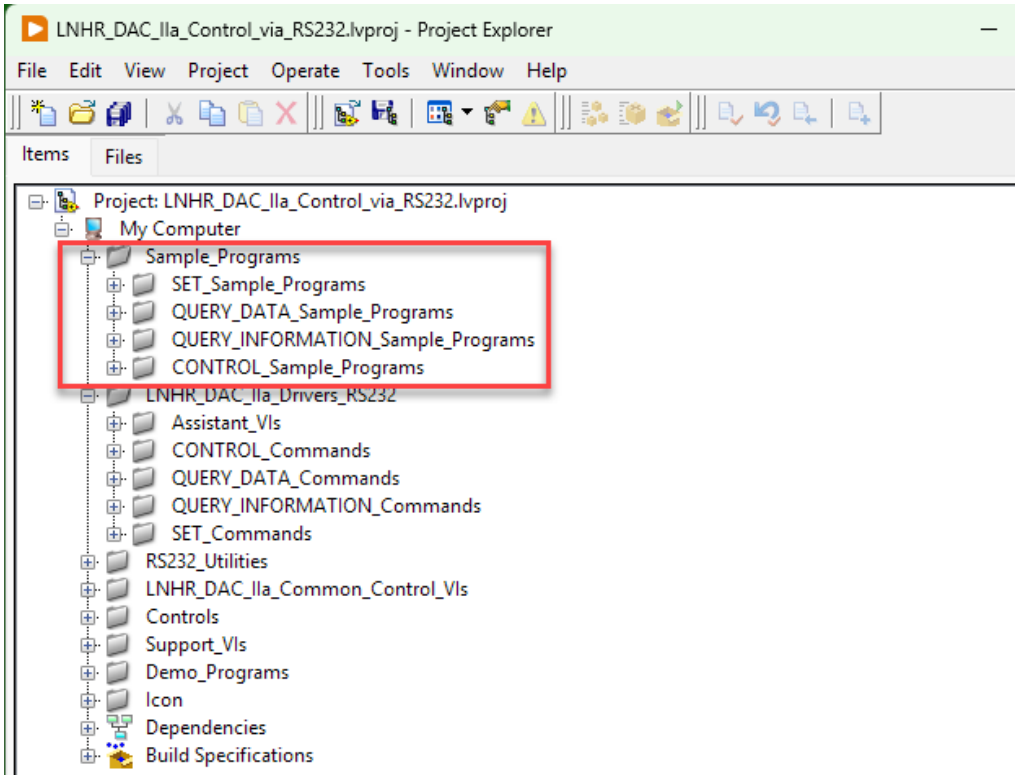
Proper handshaking must be implemented in the drivers for both communication channels. This ensures that the device processes the data before the next command is released. These LabVIEW drivers have a proper handshaking implementation.

3.1 Serial Communication via RS-232

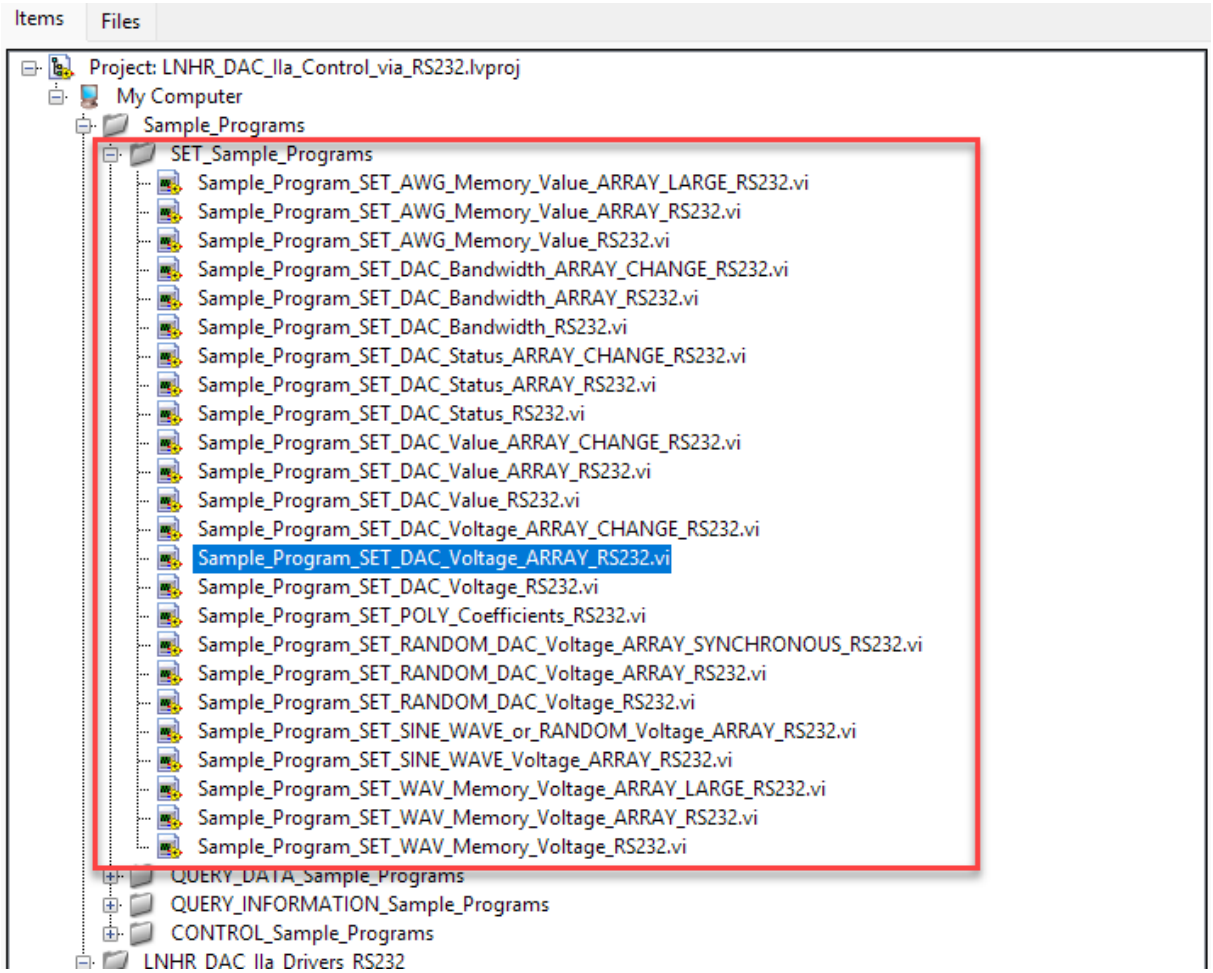
If you plan to communicate via RS-232 serial port, navigate to the folder "LNHR_DAC_IIa_SP1085_Control_via_RS23" and open the LabVIEW project "LNHR_DAC_IIa_Control_via_RS232.lvproj":



The LabVIEW project structure for controlling the LNHR DAC IIa via the serial port is as follows:

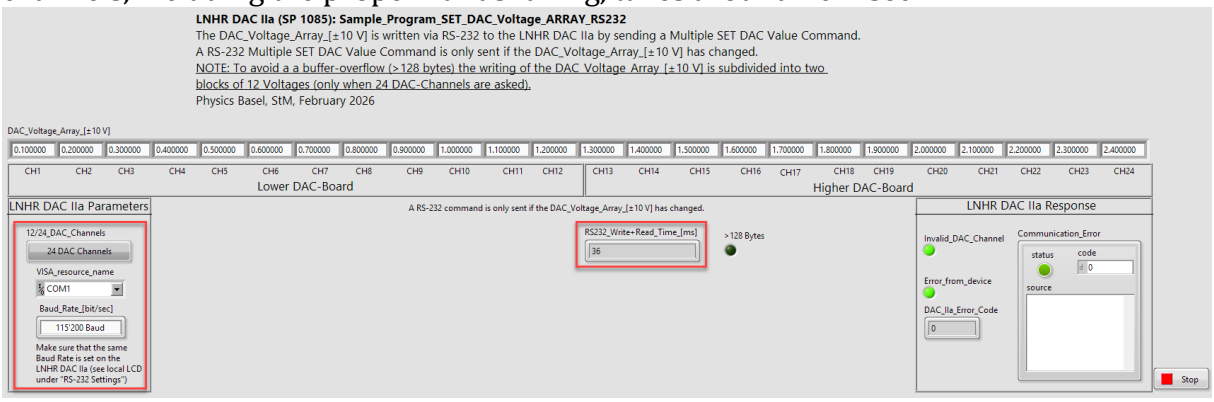


The folder "Sample_Programs" is structured in SET, QUERY_DATA, QUERY_INFORMATION and CONTROL Sample Programs. After unfolding the "SET_Sample_Programs" one can open the desired SET sample program (e.g. the "Sample_Program_SET_DAC_Voltage_ARRAY_RS232.vi"):



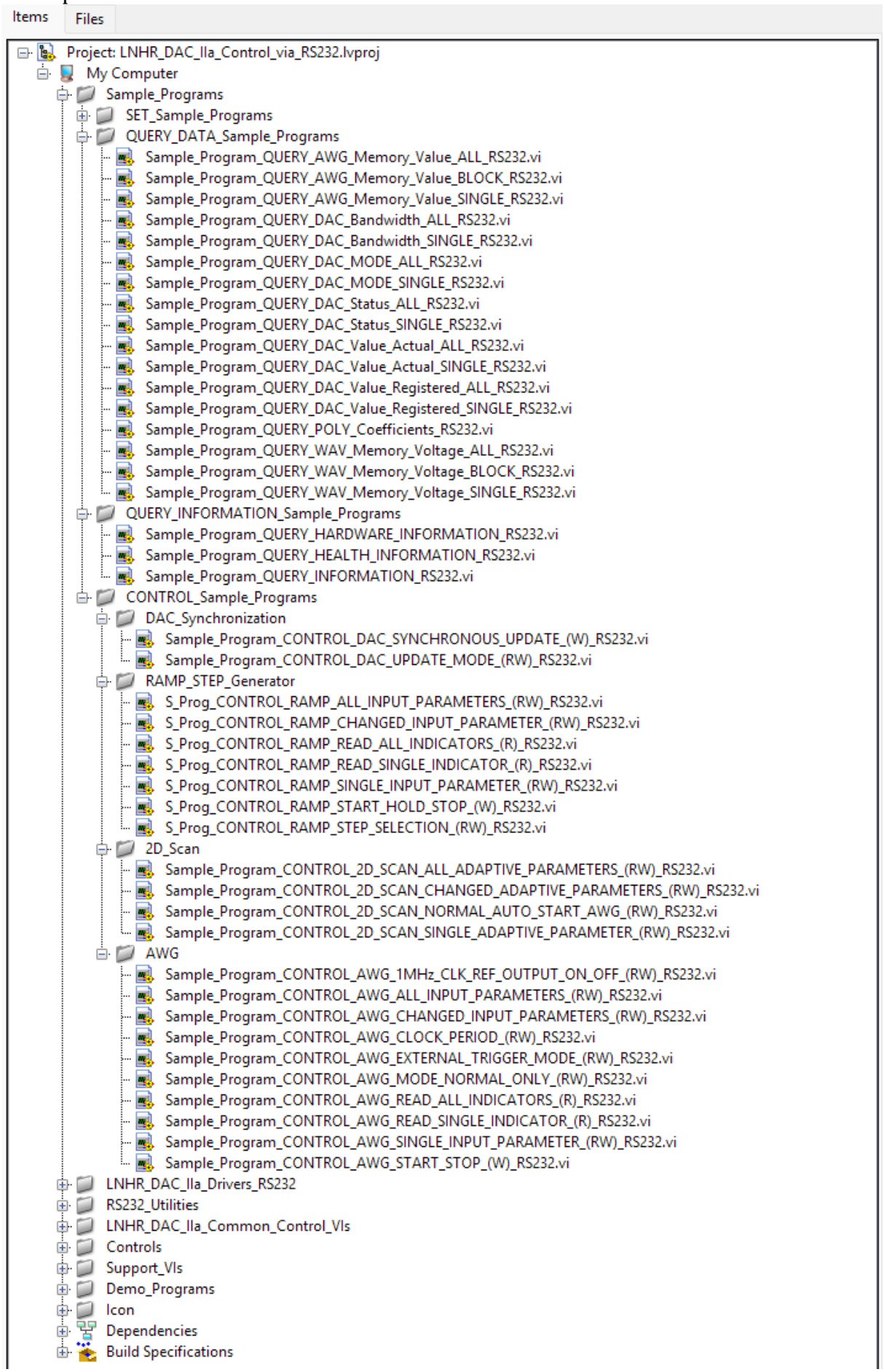
Before you start this Sample Program select the number of DAC-channels (12 or 24), the communication port in "VISA_resource_name" (e.g. COM1) and choose the same "Baud_Rate_[bit/sec]" as set on the LNHR DAC IIa (see local LCD under "RS-232 Settings"). Connect the serial port (e.g. COM1) of your computer to the serial port connector on the back-panel of the LNHR DAC IIa by using a Null-modem serial cable. For details see the chapter "Communication via Serial-Port (RS-232)" in the documentation "LNHR_DAC_IIa_Programmers_Manual".

After pressing START this program writes the "DAC_Voltage_Array_[±10 V]" (when changed) to the device and its response (error-code) is evaluated; a correct handshaking is implemented. At a Baud rate of 115'200 bit/sec the data transfer for the 24 DAC-channels, including the proper handshaking, takes around 40 msec:



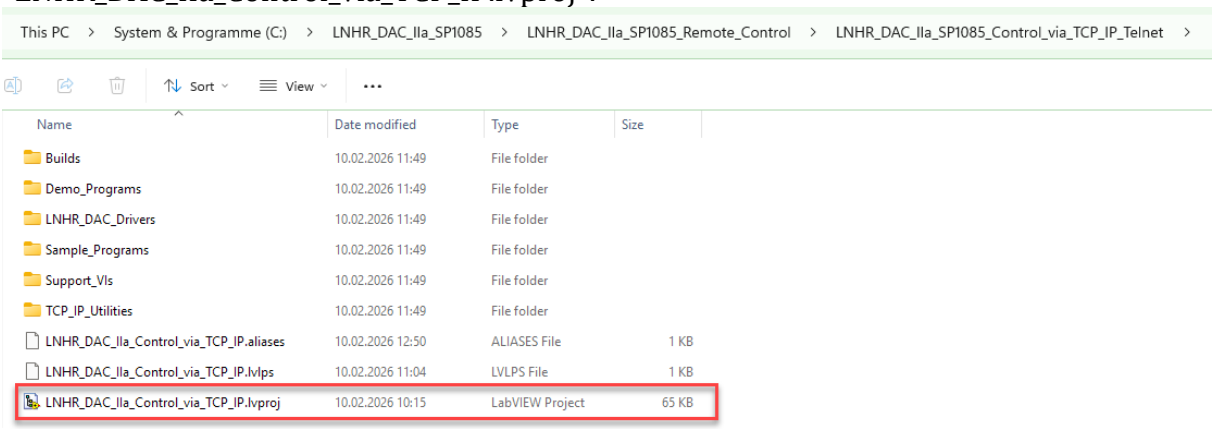
Press "Stop" to terminate this Sample Program.

There are numerous other Sample Programs for controlling the LNHR DAC IIa by the serial port:

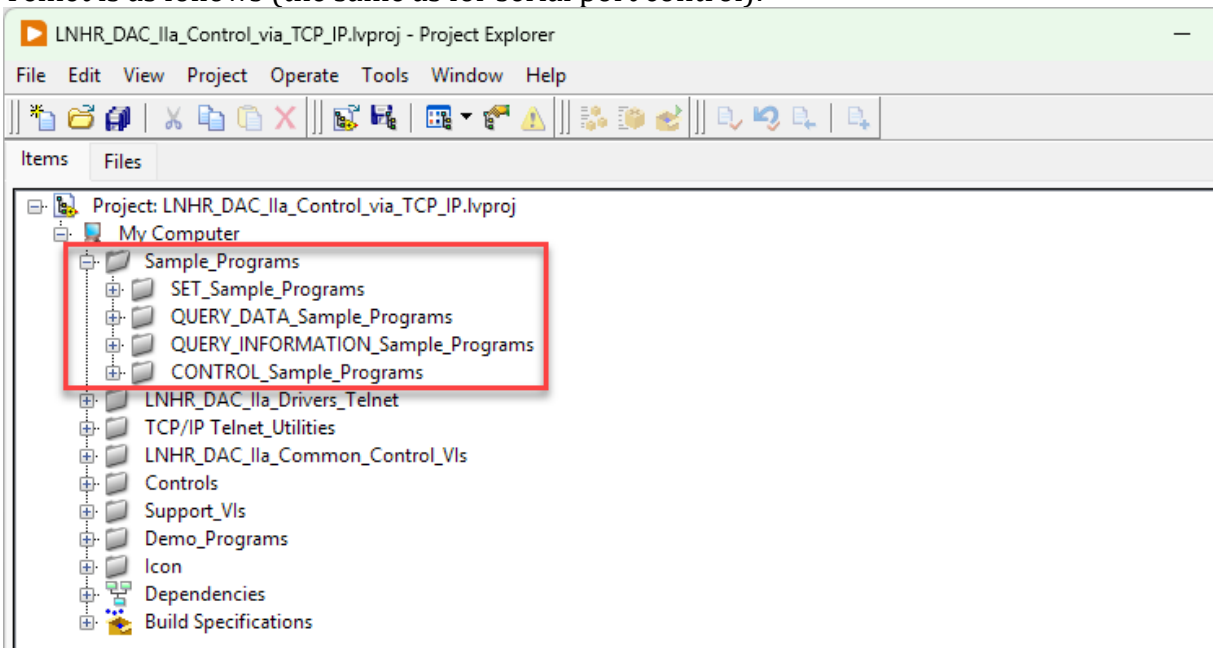


3.2 Ethernet Communication via TCP/IP-Telnet

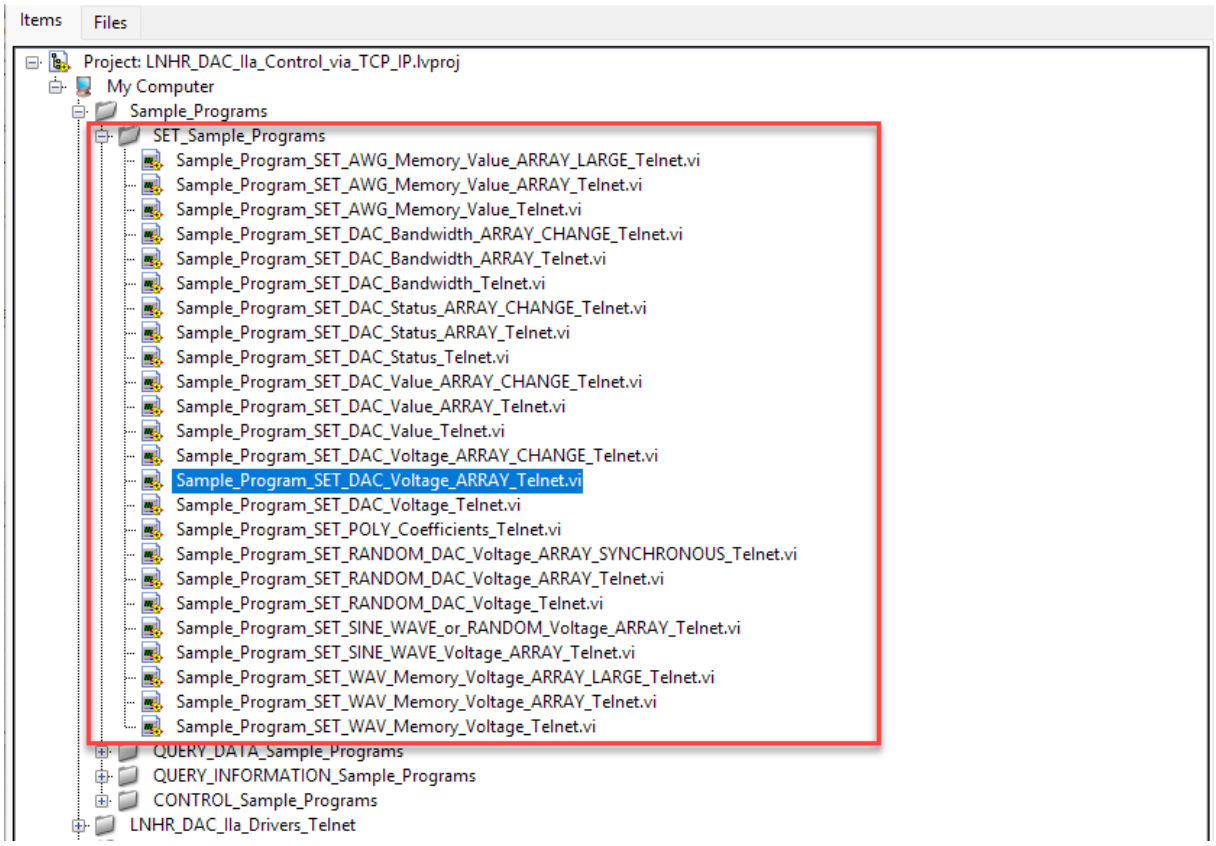
If you plan to communicate via Ethernet TCP/IP-Telnet, navigate to the folder "LNHR_DAC_IIa_SP1085_Control_via_TCP_IP_Telnet" and open the LabVIEW project "LNHR_DAC_IIa_Control_via_TCP_IP.lvproj":



The LabVIEW project structure for controlling the LNHR DAC IIa via Ethernet TCP/IP-Telnet is as follows (the same as for serial port control):

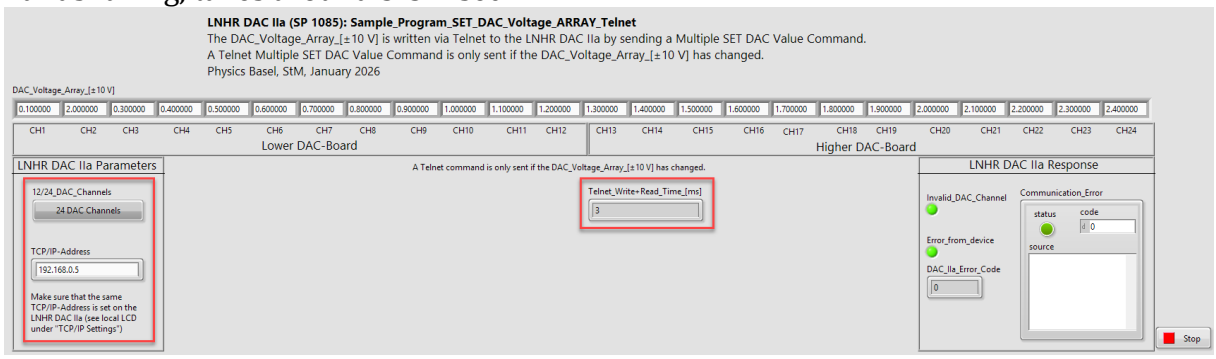


The folder "Sample_Programs" is structured in SET, QUERY_DATA, QUERY_INFORMATION and CONTROL Sample Programs. After unfolding the "SET_Sample_Programs" one can open the desired SET sample program (e.g. the "Sample_Program_SET_DAC_Voltage_ARRAY_Telnet.vi"):



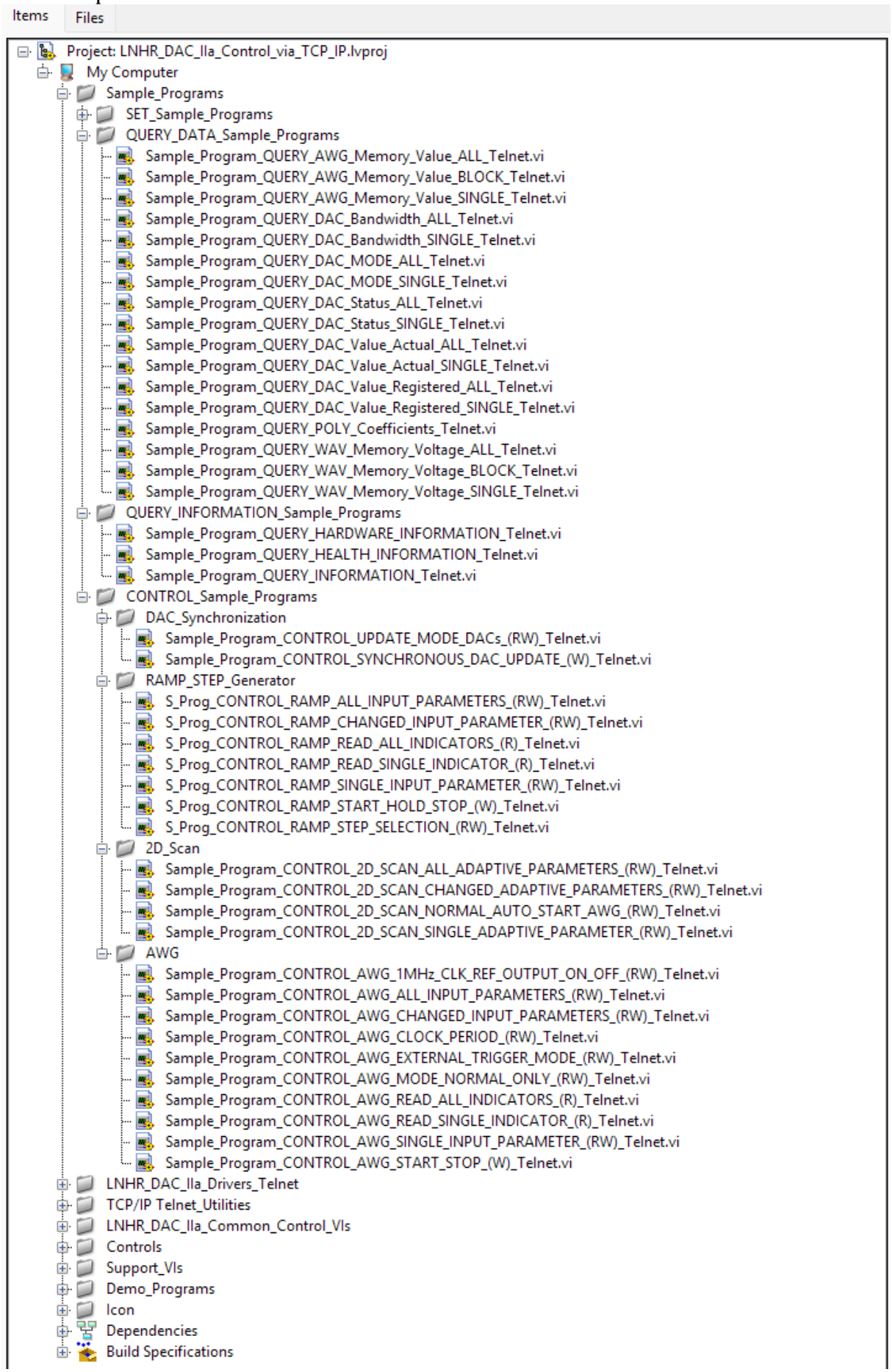
Before you start this sample program select the number of DAC-channels (12 or 24) and choose the same "TCP/IP-Address" as set on the LNHR DAC IIa (see local LCD under "TCP/IP Settings"). Connect the LAN Ethernet port (configured as private network) of your computer to the LAN Ethernet port on the back-panel of the LNHR DAC IIa by using a LAN cable (minimum Cat 5e). For details see the chapter "Communication via TCP/IP-Telnet Port" in the documentation "LNHR_DAC_IIa_Programmers_Manual".

After pressing START this program writes the "DAC_Voltage_Array_[±10 V]" (when changed) to the device and its response (error-code) is evaluated; a correct handshaking is implemented. The data transfer for the 24 DAC-channels, including the proper handshaking, takes around 3-5 msec:



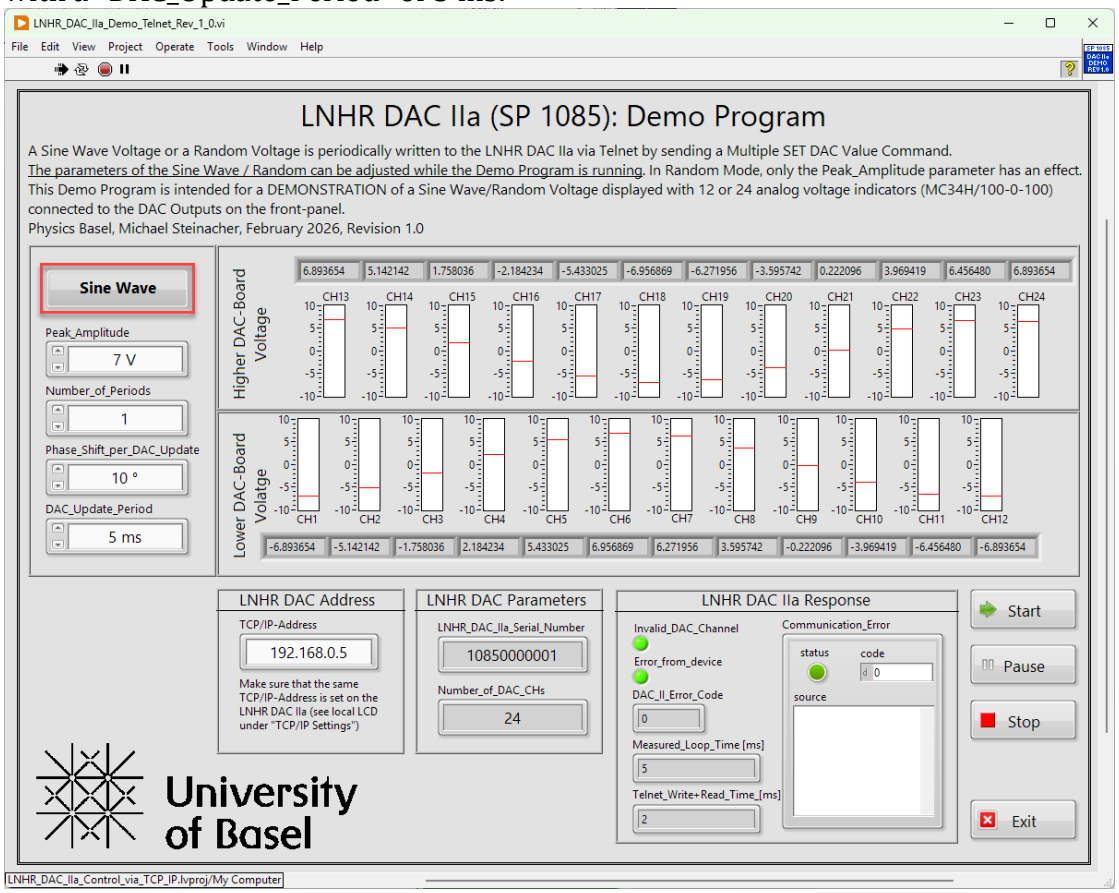
Press "Stop" to terminate this Sample Program.

There are numerous other Sample Programs for controlling the LNHR DAC IIa by the Ethernet port:

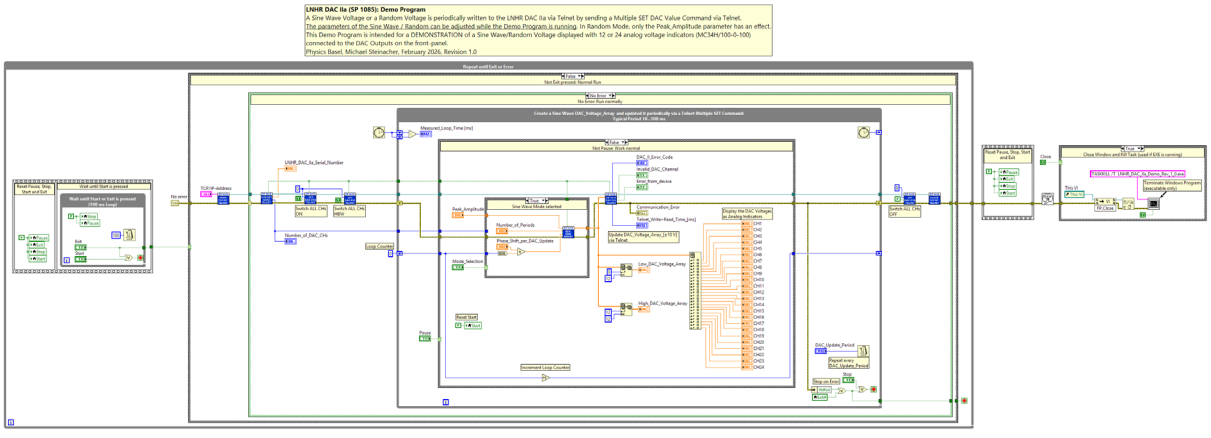


3.3 Demo Program

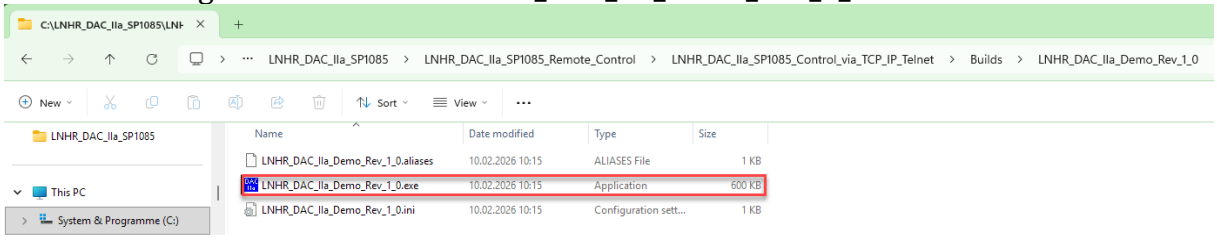
The Demo Program “LNHR_DAC_IIa_Demo_Telnet_Rev_1_0.vi” shows the performance of the “Multiple SET DAC Command” which allows a 24-channel DAC voltage update within less than 5 ms. Below a traveling sinusoidal wave is generated on the 24 DAC-Channels with a “DAC_Update_Period” of 5 ms:



The waveform can be switched between “Sine Wave” and “Random Voltage”. The structure of this LabVIEW Demo Program is the following:



In the sub-directory “Builds” you can also find the compiled version (as an EXE-file) of this Demo Program. It is named “LNHR_DAC_IIa_Demo_Rev_1_0.exe”:



4 Converting DAC-Voltage to DAC-Value

A DAC-Value is a 24-bit number in the decimal range from 0 to 16'777'215 (2^{24}-1); this corresponds to a hexadecimal range from 0x000000 to 0xFFFFFF.

The DAC-Voltage has a fixed range from -10 V to +10 V with a step-size of 1.192093 µV (20 V / 16'777'215).

For a given DAC output voltage (Vout [-10 V ...+10 V]) the 24-bit decimal DAC-Value (DACval [0…16'777'215]=[0x000000…0xFFFFFF]) is given by (rounded to the next integer value):

$$DACval\_dec = (Vout + 10) \cdot 838'860.74$$

To get a DAC-Value (HEX), which is needed for remote programming the DAC output voltage, the decimal number has to be converted to a hexadecimal number. All higher program languages have already included such a conversion-function.

For a given decimal DAC-Value (DACval_dec [0...16'777'215]=[0x000000…0xFFFFFF]) the DAC output voltage (Vout [-10 V...+10 V]) can be determined by:

$$Vout = (DACval\_dec / 838'860.74) - 10$$

The table below shows the DAC-Voltage [±10 V] in 1 V steps and the calculated DAC-Value (decimal) and the corresponding DAC-Value (HEX):

DAC-Voltage	DAC-Value (decimal)	DAC-Value (HEX)
+10 V	16'777'215	0xFFFFFF
+9 V	15'938'354	0xF33332
+8 V	15'099'493	0xE66665
+7 V	14'260'633	0xD99999
+6 V	13'421'772	0xCCCCCC
+5 V	12'582'911	0xBFFFFF
+4 V	11'744'050	0xB33332
+3 V	10'905'190	0xA66666
+2 V	10'066'329	0x999999
+1 V	9'227'468	0x8CCCCC
0 V	8'388'607	0x7FFFFF
-1 V	7'549'747	0x733333
-2 V	6'710'886	0x666666
-3 V	5'872'025	0x599999
-4 V	5'033'164	0x4CCCCC
-5 V	4'194'304	0x400000
-6 V	3'355'443	0x333333
-7 V	2'516'582	0x266666
-8 V	1'677'721	0x199999
-9 V	838'861	0x0CCCCD
-10 V	0	0x000000