RS485, GPIB

Theory: serial communication, RS485, parallel communication, GPIB, SCPI, operating an oscilloscope

Exercises :

1. Familiarize yourself with Terminal v1.93b application. Try out serial communication with RS485.
2. Examine physical signals on the RS485 interface using an oscilloscope. Try decoding the transmitted symbol out of a displayed waveform. Store selected representative waveforms on a flash drive.
3. Interconnect PC and Agilent 33220A function generator using GPIB interface and familiarize yourself with remote control of the connected instrument.
4. Operate the generator using GPIB remote control. Generate basic types of waveforms and vary their attributes.

Measurement guide:

1. Run the Terminal application and familiarize yourself with its settings and functions. The application allows to set baudrate, number of data bits, parity and number of stop bits. Connect oscilloscope probes to A (+) and B (-) lines of the RS485 interface. Select the connected COM Port a click [Connect]. Try sending symbols or messages via RS485 and display physical signals on an oscilloscope in order to check for a proper function of the interface. What can you say about A and B signals? What voltage levels represent a logic 1 (mark) and logic 0 (space)?
2. Change the parity and number of stop bits and send a symbol. How has the waveform changed? Turn the parity off, change the number of data bits (5) and send a symbol. Can it be sent/received properly? Change the number of data bits back to 8. Turn a periodic macro on in the terminal application: [Set Macros] -> write a character -> write a repeating interval (200ms) -> check [Auto Repeat]. Display the transmitted waveforms and store them (a USB flash drive with FAT32 file system is necessary). Try changing the baudrate and assess how the waveform is changing. Display the difference of A and B waveforms ([math] -> [A-B]). Send binary codes of numbers 0 to 10 (macro prefix $, e. g. $7 sends 0x00000111b) and compare them. Where are start bit and stop bit located? On which positions are the LSB and MSB transmitted? Send an ASCII character and read its binary code from the waveform. Compare the transmitted code with ASCII table ([ASCII table] button in Terminal). How does the waveform change when a smaller number of data bits (5) is set? Why is the character sent incorrectly? Set parity to even and send various characters. Where is the parity bit located and what is its value? How does this value change with odd parity? What is the change in waveform when a different number of stop bits is set? Store selected waveforms to prove your conclusions.
3. Interconnect PC and Agilent 33220A function generator using GPIB. Connect the generator output to the oscilloscope and turn both instruments on. Run NI MAX program, select [My Sytem] -> [Devices and Interfaces] -> [PCI-GPIB] -> [Scan for Instruments]. The program should find the connected instrument. Select its designation and click [Communicate with

Instrument] on the right. A new window opens with text box [Send String] for sending commands. Under this text box there are three buttons, [Query] for commands that an instrument replies to, [Write] for unidirectional commands, and [Read] for reading data from the instrument. Received data are displayed in text box [String Received]. Agilent 33220A function generator uses a standard SCPI command protocol. You can validate a proper connection by sending the „*IDN?“ querying command, which requests the instrument to identificate itself.

4. If we want to display the generated waveforms on an oscilloscope, we need to tune the generator output for high imoedance load. Remotely find out what output load is set on the generator by sending „OUTP:LOAD?“ [query]. High impedance output load is set by „OUTP:LOAD INF“ [write]. Now try to generate a sine, triangle, ramp, square waveforms and noise, with varying attributes – frequency, amplitude, offset. Look for commands you need in the 33220A generator manual (example: „APPL:SIN 5 khz, 3.0 vpp, -1 v“ sets 5kHz sinewave with $3V_{pp}$ amplitude and -1V offset). Verify that you are actually generating a waveform you want with an oscilloscope. Also request the instrument self-report to check for its status remotely.