

RS485 PicoScope

Remote Lab Instructions V3

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Remote Lab Instructions RS485 PicoScope

Getting Started

- Logon to Electromeet
- The software is installed on the remote labs search for "picoscope" or "RS485" using ctrl+f

Hardware:

As you will be doing this exercise by way of a remote lab please note that all the hardware is already set up and connected to the relevant remote labs. Other remote labs will not have the correct hardware setup.

Software & Hardware used:

The lab was set up with the following hardware:

- Laptop with at two USB ports
- 1x MOXA UPort 1150 USB-to-serial (RS-485) adapter
- 1x PicoScope 2204 USB oscilloscope with probes

The following software has been installed:

- RealTerm: Serial Capture Program (for sending characters via the COM port)
- PicoScope 6 software



RS485

This exercise will build upon the previous (RS-232) exercise, and will introduce the use of RS-485.

1.0 Implementation

1.1 Basic port setup

As you will be doing this exercise by way of a remote lab, all of the equipment will already be set up, but please read the instructions below to familiarize yourself with the procedure.



The Port setup is exactly the same as the RS232 lab, except the comm port may vary – ensure that you select the appropriate port, found in Device Manager.

And instead of using a Moxa1110 as in the last exercise we are using a Moxa1150 this time.

The UPort 1150 is identical in appearance to the 1110, though the outputs are different. The outputs are accessed through a screw terminal with the following configuration.

		UPort 1110	UPort	1130
DB9 (male)	Pin	RS-232	RS-422 4-wire RS-485	2-wire RS-485
	1	DCD (in)	TxD-(A)	- -
	2	RxD (in)	TxD+(B)	
	3	TxD (out)	RxD+(B)	Data+(B)
	4	DTR (out)	RxD-(A)	Data-(A)
	5	GND	GND	GND
	6	DSR (in)	6 .5 7	
0 9	7	RTS (out)	1 O	
	8	CTS (in)	1 	

The UPort 1150 has been set up (via Device manager) to operate in RS-485 'two wire' (2W) mode. The PicoScope probes have been attached to pins 3 and 4 on the screw connector: oscilloscope Channel A to RS-485 line 'A' (Data-) and oscilloscope Channel B to RS-485 line'B' (Data+).

UPort 1150 Properties	× Port 1	×
General Ports Configuration Driver Details Events	Port Number	COM2 (current)
	Fast Flush	Enable Disable the change to all ports
Port Setting	s s	et the change to all ports OK Cancel
0K Cancel		

The oscilloscope ground clips have not been attached, as grounding in this case takes place via the USB cable.

Note: Never attach a ground clip to either line A or line B, as this will short the line to ground and render it inoperative.

1.2 Prepare to send characters

1. Run RealTerm: Serial Capture Program by clicking on the desktop icon or on the taskbar at the bottom of the screen.



The software will open up:

角 RealTerm: Serial Capture Program 2.0.0.70			_		×
					~
Display Port Capture Pins Send Echo Port 12C 120 Display As	-2 I2CMisc Misc	<u>\n</u>	Clear	Freeze Conne RXD (TXD (TXD (CTS (DCD (DSR (BREA) Error	? cted 2) 3) 3) 1) 5) 9) 4
	Char Count:0	CPS:0	Port: 1 576	600 8N1 No	one //

- 2. Click the "Port" tab.
- 3. Then set the UART parameters for the appropriate COM port (2 in this case). Set the parameters exactly as per the following figure: Baud = 9600, Parity = Odd, Data Bits = 7, Stop Bits = 1, Hardware Flow Control = None.

Display Port	Capture Pins Send Echo Po	nt 120
<u>B</u> aud 9600	Port 2 = \msuport0	•
Parity O None	Data Bits Bits Bits C 8 bits C 1 bit C 2 bits	
C Even C Mark C Space	7 bits 6 bits 5 bits 5 bits 0 DTR/DSR O RS48	CTS 5-rts

4. Next, start the port monitoring process by clicking "Open" and "Change":



RealTerm is now running and the UART on the Moxa device is configured correctly. Now you must confirm the idle voltage.

1.3 Confirmation of idle voltages

We are doing this remotely thus we can measure the TxD line idle voltage with the PicoScope.

To do this you must:

5. Run the Picosope6 software. Double-click the PicoScope6 icon on the desktop of the remote computer.



6. We can add a measurement function to the PicoScope, which will allow us to obtain a DC voltage reading. Firstly click "Measurements" at the top of the PicoScope window.

Horas PicoScope 6					-
<u>File E</u> dit <u>V</u> iews	<u>M</u> e	asurements	<u>T</u> ools	<u>H</u> elp	
/ 🕂 🔟 🖉 (<u>A</u> dd Measu	rement		8.001 kS 😌 📢 32 of 32 📦 🧭
A. ±10 V ∨ DC		<u>E</u> dit Measu	rement		
■ 10.0 ₅		<u>D</u> elete Mea	surement		
V		Grid <u>F</u> ont Siz	ze 7	~	
8.0	\checkmark	<u>C</u> olumn Au	to-width		
0.0					

- 7. Click "Add Measurement"
- 8. This will bring up the "Add Measure Window"

Add Measurement		×
Select the channel to measure		ОК
A	\sim	Cancel
Select the type of measurement		
AC RMS	\checkmark	Help
Choose which section of the graph will be measured		
Whole trace	\sim	Advanced

9. From the Type of measurement selection field select "DC Average"

Av PicoScope 6 🐡 🖃	8
<u>File Edit V</u> iews <u>M</u> easurements <u>T</u> ools <u>H</u> elp	
🔽 Л Ш Ц 🤣 🥕 🚹 20 µs/div 🖂 x 1 🕀 8.001 kS 🕀 📢 32 of 32 🕪	0
■ 10.0	1
V	
8.0;;;;;;	1.1
6.0	-
Add Measurement	
4.0 Select the channel to measure OK	-
2.0 Select the type of measurement	
AC RMS	
0.0 AC RMS	
DC Average Advanced	
-2.0 Duty Cycle	
-4.0 Fall Time	
Low Pulse Width	-
-6.0 Maximum	-
Peak To Peak	
-8.0 Rise Time	
True RMS	
	000
x1.0 µs	
🙆 🤩 Trigger None 🔽 🗚 🔽 🗶 🛛 V 😌 20 % 🕀 🥀	

10. Then Click OK. This will add the measuring function to the bottom of the PicoScope

-6.0				ſļ,						
-10.0 0.0 ×1.0 μs	20.0	40.0	60.0	30.0	100.0	120.0	140.0	160.0	180.0	200.0
Channel A	Name DC Avera	Span Ige Whole	۱ trace -!	/alue 5.325 V	Min -5.331 V	Max -5.323 V	Average -5.327 V	σ 1.71 mV	Capture 20	Co- 🗆
🙆 🤩 Trig	ger None	~	rt [/	A		× 0v	×	20 %		>

11. You can then read the average DC voltage level.

Question: What is the average DC voltage on the A wire when it is idling? State the answer in your assignment (rounded to 2 decimal places).

Instruction: Take a screenshot of this and paste it into your assignment.

12. Temporarily enable Channel B on the PicoScope and repeat the DC measurement, but this time for the B wire:



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Off)C	V E	8 = 10	V 💌] DC	~	₩.	an marana a		
10.0 V	-							1	100		
heres		and less					172350				
6.0											
				-				100			
4.0								1			
2.0											
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20							F	1			
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-4.0								1			
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-8.0		ered for					1	1	1		
10.0	-						1	1		2	
0.0	0.2	0.4	0.6	0.8	1.0	1	.2	4	1.6	1.8	2.
TO ms	2000000	1	1252	NAME AND	in the second	10000		-	Beer	l e se	41.00

Question: What is the average DC voltage on the B wire when it is idling? State the answer in your assignment (rounded to 2 decimal places).

Instruction: Take a screenshot of this and paste it into your assignment.

Note:

- Due to a bug in the Picoscope software, it may prove difficult to capture the waveform on ChB.
- **The software may not trigger properly on ChB** so it is not necessary to provide a screen shot of just ChB on its own.
- ChA is triggering normally, so you must still submit screen shots of ChA waveform, as well as ChA + ChB waveform.
- To capture the ChA + ChB waveform together, the trigger must be set for ChA.

1.4 Transmitting a single character and then capturing it on the PicoScope

The PicoScope must be configured as before, but this time we are using both Channel A and Channel B. We will first check the waveform on the A wire, then on the B wire, and finally combine the two traces.

Note: This Is A Trap For The Unwary. The Start/Stop buttons on the PicoScope complement every time you click on them. So, if the PicoScope has stopped capturing, and you click twice on the Start button, you are still in 'stop' mode. However, if you observe the backgrounds of the Stop and Start

buttons you will notice that they change to a blue selection highlight when active.

1.4.1 Capturing the signal on the 'A' wire

We will set up **Channel A** first. The PicoScope settings should be as follows:

- Trigger: Single trigger, Channel A, rising edge
- Trigger level 2V. This is necessary because, unlike with RS-232, we are operating with positive voltages only. In theory the 'A' wire will be at '0' when no data is being sent. However, you have already ascertained that it is not. So, should the trigger level be set to 0V, the oscilloscope will not detect the low-to-high transition. If you cannot push the trigger level up high enough, check that the X-axis scale is on +/- 10V, and not on 'auto'.
- X-axis: 200 microseconds per division
- Magnification: X1
- Y-axis full scale: +/-10V
- Coupling: DC

Here is how we change to settings

13. First we will set the Y axis. At the top of the PicoScope under the "Input Range" field for ChA select +/-10V:



14. On the PicoScope under the trigger Field (at the bottom of the screen) select "Single":



15. Set the pre-trigger to 20%:





16. The other trigger settings (slope and level) are shown below:



17. At the top of the PicoScope interface under the Time/div field select 200µS/div:

Av PicoScope 6	
<u>F</u> ile <u>E</u> dit <u>V</u> iews <u>N</u>	<u>l</u> easurements <u>T</u> ools <u>H</u>
🚾 🞵 🔟 📠 🔗 🟠	20 µs/div 🔽 🛛 🗙 1
A Auto 🔽 DC	10 µs/div 20 µs/div ff ✓
■ 50.0	50 μs/div 100 μs/div
40.0	200 µs/div 500 µs/div
-10.0	1 ms/div 2 ms/div
30.0	- 5 ms/div
20.0	20 ms/div ≡ 50 ms/div
20.0	100 ms/div
10.0	500 ms/div
	2 s/div
	10 s/div
-10.0	20 s/div

18. Now click the green "Start Capturing" icon (green Icon at the bottom left of the PicoScope window)

-5	00.0 -1.0	-0.8	-0.6	-0.4	-0.2	0.0
C) () T	rigger S	ingle	✓ 1 ⁴	A	[
i Pic	Go Start ca	pturing				

The Picoscope is now ready to capture the character we are about to transmit on Channel A, which is the A line or Data- of the RS-485.

19. We already have RealTerm running (it will be in the tool bar at the bottom of the screen if the

window is not already on screen). Open the RealTerm window and click the "Display" tab, and select "Half Duplex" – this will output sent values to the black terminal window:

Display Port	Capture Pins Send Echo Port I2C I2C-2 I2CMisc Misc
Display As	Half Duplex newLine mode Invert
C int8 C int16 C unt16 C Ascii C Binary C Ribble C Float4 C Hex CSV	Data Frames Bytes 2 ♀ Single Gub Terminal Font 16 ♀ 80 ♀ □ Scrollback

20. On the RealTerm window click on the "Send" tab, enter a value in the field (i.e. "F") and click "Send ASCII" – note, the value appears in the black terminal above:

👕 RealTerm: Serial Capture Program 2.0.0.70	-	\Box \times
16		^
		~
Display Port Capture Pins Send Echo Port 12C 12C-2 12DMisc Misc	In Class	Erennel 2
and the second s		
16 ▼ Send Numbers Send ASOI +CR +LF +LF 0 ^C Literal Strip Spaces +crc	lefore lifter	Status Disconnect RXD (2) TXD (3) CTS (8) DCD (1)
16 ▼ Send Numbers Send ASCI +CR +CR 0 ^C LF Rgpeats 1 Send Numbers Send ASCI +LF 0 ^C LF Rgpeats 1 Literal Strip Spaces +crc SMBL Dump File to Port C:\Users\Student\Desktop\capture.txt ✓ Send File X Stop Delays Stopped Repeats 1 0 0		Status Disconnect RXD (2) TXD (3) CTS (8) DCD (1) DSR (6) Ring (9) BREAK Error

21. The transmission should be captured on the PicoScope now (and the PicoScope capture changed from Running to Stopped), select the PicoScope and observe the waveform (similar to the one below):





Note that the shape of the waveform is identical to that of RS-232, but instead of alternating between -5V and +5V it now only alternates between 0V and +5V.

Instruction: Take a screenshot of this waveform (trace A), and paste it into your assignment.

1.4.2 Capturing the signal on the 'B' wire

The steps are similar to those for the A wire, but there are a few minor differences. 27. First turn off Channel A in the Input range field:

🎝 PicoScope 6					-~		• ×
<u>Eile E</u> dit <u>V</u> i	iews <u>M</u>	easurements <u>I</u> oc	ols <u>H</u> elp		1.5		
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A Off 🗸	AC	💽 🗟 off	V AC	\mathbf{x}	AN/		
Auto ±50 mV							

22. Now turn on Channel B in the input range field, and select +/-10V:

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As Off 🖌 AC	B Off	AC 🗸	AA4		
■ 10.0 V	Auto				
8.0	±100 mV				
60	±200 mV ±500 mV				
0.0	±2 V ±5 V				
4.0	±10 V				
	±20 V	_			

- 23. Set the trigger for channel B. Keep in mind that the captured signal is expected to be a mirror image of what we saw on Channel A. Setting the trigger will involves the same steps as for Channel A, **BUT**:
- We have to trigger on channel **B**, and on the **falling** edge. See below:



- 24. Select RealTerm again send a value (Send ASCII) as we did for Channel A.
- 25. Bring up the PicoScope window again and you should have a waveform that looks similar to this:



Note that this signal is a mirror image of that on the Channel A wire. What is important is the difference between A and B

Instruction: Take a screenshot of this waveform (trace B), and paste it into your assignment.

1.4.3 Capturing A and B simultaneously

- 26. We now must enable Channel A again in order to capture both A and B. So leave Channel B enabled and re-enable Channel A by again selecting +/-10V under the "Input Range" field.
- 27. Reset the trigger again as above (Single) then click the green "Go" button (Running).
- 28. Again, select RealTerm and send a value (Send ASCII).
- 29. Bring up the PicoScope window and you should have a waveform that looks similar to this:



	14 3 6	200 µs/k		1	7 8.001	ks 🖨		1 of 1	100
±10 V	DC		B ±10 V	V D	c	~ 1			
10.0 V						1			10.0 V
8.0						÷			8.0
6.0									6.0
4.0		-				1			-
4.0									4.0
2.0									2.0
0.0	-	-				-	-	_	-0.0
-2.0									-2.0
10									
-4.0									-4.6
-6.0									-6.0
-8.0					- <u> </u>		- [-8.0
10.0									-10
-0.4	-0.2 0.0	0.2	0.4	0.6	0.8	1.0	1.2	1.4	1.6

At first glance it might seem like a string of rectangles, but this is because the low-to-high transition of the one signal coincides with the high-to-low transition of the other.

Question: Take a screenshow of this waveform (traces A and B) and paste it into your assignment.

END OF INSTRUCTIONS