



Application Note IC-2-RS485

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Serial Control of Iconyx RHAON Series Arrays

Abstract: The Iconyx RHAON models have an RS-485 connection for serial control via third-party controllers such as Crestron, AMX or any custom RS-485 control interface. This document details the available commands and necessary programming to execute them in the loudspeaker arrays.

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Renkus-Heinz Iconyx RHAON RS-485 Commands

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Background

Products in the Renkus-Heinz Iconyx line (this includes the Iconyx R and all iterations of the IC-Live R) are arrays made up of 1 or more individual powered loudspeaker columns. While in Renkus-Heinz's RHAON software arrays are communicated with as an entire array, communication via RS-485 requires addressing and communicating with each column individually instead.

In a multi-column array, the "master" column (designated using on-unit DIP switches) feeds audio directly to the other columns, bypassing the "slave" columns' RHAON input card. For this reason, some commands are master-only, while others must be sent to all columns in an array. The difference is noted in the command list document.

Communication Protocol

The communication protocol is RS-485, 57,600/8-N-1

Basic Command Structure

Once RS-485 Communication Mode has been activated on a column (done through RH software), all commands to (and responses from) a column follow the same basic structure:

<Header byte> <Address bytes> <Command Payload bytes> <Footer byte>

Which are assigned as (assume hexadecimal values unless otherwise noted):

Header byte: AA (i.e. 0xAA)

Footer byte: CC

Address bytes: the last 3 octets of the column's MAC address (as the first 3 octets of any RHAON loudspeaker will always be 00:1B:DE).

For example, the command to turn the "wink" LED on for unit with MAC address 00:1B:DE:00:07:C4 would be:

AA 00 07 C4 02 07 CC

Enabling / Disabling the ADC

Some commands require the undivided attention of the microcontroller. These commands have been designated in the commands listing. For these operations:

1. Issue "Disable ADC" command and wait 100ms.

2. Run command.
3. Issue “Enable ADC” command and wait 200ms.

Delay

RHAON input cards contain a stereo delay chip whose two channels are routed in series. Each channel can have unique delay settings, with a maximum of 170ms per channel in 48 kHz sample rate mode, 85ms in 96 kHz mode. To send the delay settings to the unit, each channel is converted to a 16-bit integer:

$$\text{channel} = \text{delay_ms} * (\text{sample_rate_Hz} / 1000)$$

The command payload for sending the delay is then as follows:

07 <R high byte> <R low byte> <L high byte> <L low byte>

For example, to send a delay of 243ms in 48kHz mode (thus 170ms to the right channel, 73ms to the left channel), the command payload is:

07 1F E0 0D B0

Microcontroller Firmware Version / Hardware Assembly Revision

Upon receiving the request command for the Microcontroller Firmware Version and RHAON board Hardware Assembly Revision, the column sends a response of the form:

<Header> <Address> <5 bytes FW Ver> <32 bytes Hardware Rev> <32 bytes Password> <Footer>

Note: All payload bytes are ASCII characters. Hardware Rev and Password strings are terminated with 0xFF.

Preset Beam Steering Metadata

There are two sets of metadata for a column’s beam steering. Of importance to the Crestron panels is the second set. Upon receipt of the command to retrieve this data, the column sends back a response of the form:

<Header> <Address> <128 bytes metadata> <Footer>

The metadata is of the form:

Audience Areas – between 1 and 3 (1 byte)

Audience Area dimensions – floats of (x, y)_{beginning} and (x, y)_{end} (48 bytes)

Array Position x-dimension – float (4 bytes)

Array Position y-dimension – float (4 bytes)

Array Position angle – float (4 bytes)

Preset Name – ASCII characters (63 bytes)

Note: the Preset Name is terminated with 0xFF or ends after 63 bytes. Unused bytes for Audience Area dimensions are filled with 0xFF bytes.

Status Message

When the column receives a status request, it returns a series of messages that report the status of various items that the microcontroller is controlling / tracking:
(bit order is assumed as right-to-left)

Message 1 - <Header> <Address> 2C xx yy <Footer>

xx is the gain value.

yy is of the form:

- bit 1 – mute status
- bit 2 – input pad status
- bit 3 – remote power status
- bit 4 – fault relay status
- bit 5 – front LED status
- bit 6 – alarm pin high/low status
- bit 7 – alarm pin connected
- bit 8 – button lock status

Message 2 - <Header> <Address> <Delay R high> <Delay R low> <Delay L high>
<Delay L low> <Footer>

Message 3 - <Header> <Address> 2D <speaker open coil> xx <Footer>

Speaker open coil – each speaker's coil status is each bit in this byte.

- 0 – speaker OK
- 1 – open coil
- bit 1 = top speaker
- ...
- bit 8 = bottom speaker

xx is of the form:

- bit 1 – external RH-switch attached
- bit 2 – 7-segment display status
- bit 3 – AES/EBU input status
- bit 4 – Ethernet connected
- bit 5 – fault relay default behavior
- bit 6 – signal present
- bit 7 – signal clip
- bit 8 – phase inversion (used with gain)

Message 4 - <Header> <Address> 29 <Current 7-segment Digits> xx <Footer>

xx is of the form:

- bit 1 – +5V supply status
- bit 2 – +12V supply status
- bit 3 – +1.8V supply status
- bit 4 – -12V supply status
- bit 5 – +3.3V supply status

bit 6 – unassigned
bit 7 – unassigned
bit 8 – 0: D2Audio amp OK
1: nerror occurred D2Audio amp BAD. Call vendor.

Message 5 - <Header> <Address> 2F <temp. high> <temp. low> <Footer>
After combining high byte and low byte into temperature_{encoded},
Temperature = (((t_{enc} * 2.4) / 1024) * 1000) + 500) / 10
Temperature is always reported in Fahrenheit.

Message 6 - <Header> <Address> 31 <P/S temp. high> <P/S temp. low> <Footer>
Power Supply temperature (for diagnostic purposes). Follows same calculation as
column temperature above.

Message 7 - <Header> <Address> 32 <Last Loaded Preset> xx <Footer>
Last Loaded Preset will resolve to FF if no preset has been loaded.
xx is of the form:
bit 1 – RS-485 mode status
bit 2 – 7-segment display default status
bit 3 – 7-segment display decimal point status
bit 4-8 - unassigned

Unless otherwise noted, a status bit set to 0 is “off” or “disabled”, 1 is “on” or “enabled”.

“Test” Tones

Occasionally a user will need to use sine tones of a known frequency and amplitude for testing speaker open coil status. As there are 2 D2Audio amplifiers per column, each command must be sent twice, with the D2Audio address byte changed for each command. The various setting command payloads are:

2A 54 B2 00 00 3F 01 2C 60 – sets frequency of 440Hz
2A 54 B4 00 00 3F 01 2C 60

2A 54 B2 00 00 3F 0D 55 57 – sets frequency of 5kHz
2A 54 B4 00 00 3F 0D 55 57

2A 54 B2 00 00 42 DF D9 0D – sets level of -12dB
2A 54 B4 00 00 42 DF D9 0D

2A 54 B2 00 00 40 80 00 00 – engages sine tone generator
2A 54 B4 00 00 40 80 00 00

2A 54 B2 00 00 40 00 00 00 – disengages sine tone generator
2A 54 B4 00 00 40 00 00 00

440Hz is the frequency used for testing low frequency drivers and 5kHz is for the high frequency drivers.

The order-of-operations for testing drivers is:

1. Stop requesting status messages
2. Issue Mute command to Master column. (if necessary)
3. Send “Start Scanning” command.
4. Send frequency and level commands.
5. Engage generator.
6. Wait 10 seconds.
7. Request the status of the column (open coil data encoded within).
8. Disengage generator.
9. Send “Stop Scanning” command
10. Unmute Master column (if necessary).

Wiring Details; Iconyx-R All Models

6 Pin 3.5mm Phoenix connector; J4 (Located bottom left on the User Interface Panel)

1	Vdd+	
2	RS485 Y	Used for RS485 Comms
3	RS485 X	Used for RS485 Comms
4	DGND	Used for RS485 Comms/Remote Controller
5	Remote LED Out	Used for Remote Controller
6	Program	Used for Remote Controller

Command List/Notes:

Command	Type	Byte 1	Byte 2+	Note
Status	A	01	02	See explanatory document for response.
LED ON	A	02	07	
LED OFF	A	02	08	
Board Reset	A	02	09	
Micro Version / Hardware Ass'y Rev	A	02	0A	See explanatory document for response.
Disable ADC	A	02	98	
Enable ADC	A	02	99	
Set 7-segment to digit x	A	02	8x	
Turn decimal points ON	A	02	94	
Turn decimal points OFF	A	02	95	
Save decimal points default status	A	02	AE	
Enable 7-segment display	A	02	9E	
Disable 7-segment display	A	02	9F	
Save 7-segment default status	A	02	A7	
Disable Crestron Comms (saved)	A	02	10	
Disable Crestron Comms (not saved)	A	02	AC	
Read 2nd set of metadata for Preset x	A, D	09	x	See explanatory document for response.
Begin test tone channel scan	A	02	A8	
End test tone channel scan	A	02	A9	
"Enter" button press	A, D	02	90	Wait 15 seconds after issuing command for preset to load.
Remote Power ON	M	02	12	
Remote Power OFF	M	02	13	
Toggle Mute	M	02	16	
Toggle Analog Pad	M	02	17	
Lock buttons	M	02	0B	
Unlock buttons	M	02	0C	
Send delay	M	07	ww xx yy zz	See delay calculator in explanatory document
Save delay	M	02	1A	
Turn AES OFF	M	02	96	
Turn AES ON	M	02	97	
Turn Phase Inversion OFF	M	02	A5	
Turn Phase Inversion ON	M	02	A6	
Send volume	M	06	xx yy	See "Gain encodings" tab for values.
Save volume	M	02	18	
M - Command only necessary for Master Unit				
A - Command necessary for All Units				
D - Command requires disabling ADC before, enabling ADC after				

Suggested Command Layout						
Button/Function(s)	Action	Suggested Display Graphic	Source	Notes:	Command Ref. (see sheet "Command List")	
Preset UP	Increment 7 Segment up	Two Digit Numeric	7 Segment Value		Set 7-segment to digit x	
Preset Down	Increment 7 Segment down				Set 7-segment to digit x	
Enter	"Enter" button press	Warning Box "Displayed Preset Not Loaded"	decimal point ON	Blanks out for decimal point OFF	"Enter" button press	
Volume UP	Increment volume up	Bar Meter	Volume Value (Gain)		Send volume	Save volume
Volume Down	Increment volume down				Send volume	Save volume
		Green "LED"	Signal Present		refer to Status Messages in "Crestron Command Document.doc"	
		Red "LED"	Signal Clip			
Delay UP	Increment delay up	Numeric Value (mS)	Delay Value		Send delay	Save delay
Delay Down	Increment delay down				Send delay	Save delay
Pad	Selects PAD	Button color change	PAD Status		Toggle Analog Pad	
Mute	Selects MUTE	Button color change	MUTE status		Toggle Mute	
AES/EBU	Selects AES/EBU	Button color change	AES Status		Turn AES ON	Turn AES OFF
Polarity	Selects Polarity	Button color change	Polarity Status (Phase)		Turn Phase Inversion ON	Turn Phase Inversion OFF
Column Panel Buttons Locked	Selects Column Panel Buttons Locked	Button color change			Lock buttons	Unlock buttons
Column Panel LEDs OFF	Selects Column Panel LEDs OFF	Button color change			LED OFF	LED ON
Column Panel 7 Segment Display OFF	Selects Column Panel 7 Segment Display OFF	Button color change			Disable 7-segment display	Enable 7-segment display
Power	Selects Power ON/OFF	Button color change	Remote Power Status		Remote Power ON	Remote Power OFF
Test Open Coils	Initiates Open Coil Test	8 x "Traffic Lights"; Green=Okay, Red= Open; labelled 1 thru' 8			Begin test tone channel scan	End test tone channel scan
Other Data						
		Versions Text Box	Firmware, DSP versions			

BEAM DATA						
		Numeric Display	Audience Areas (from Preset Beam Steering Metadata)			
		Text Display	Audience Area dimensions (from Preset Beam Steering Metadata)			
		Text Display	Array position x data (from Preset Beam Steering Metadata)			
		Text Display	Array position y data (from Preset Beam Steering Metadata)			
		Text Display	Array position angle (from Preset Beam Steering Metadata)			
FAULT/STATUS DATA						
		Status Indicator okay/Fault	Ethernet Connected			
		Status Indicator okay/Fault	External Fault Input	?		
		Status Indicator okay/Fault	+5V Power Supply			
		Status Indicator okay/Fault	+12V Power Supply			
		Status Indicator okay/Fault	+1.8V Power Supply			
		Status Indicator okay/Fault	-12V Power Supply			
		Status Indicator okay/Fault	+3.3V Power Supply			
		Status Indicator okay/Fault	D2 Amp Status			
		Numeric Value Display	Amp Temperature			
		Numeric Value Display	PSU Temperature			

Gain Encoding

Gain in dB	Gain byte in hex	Gain counter in hex
0.0	C8	C9
-0.5	C7	C5
-1.0	C6	C1
-1.5	C5	BD
-2.0	C4	B9
-2.5	C3	B5
-3.0	C2	B1
-3.5	C1	AD
-4.0	C0	A9
-4.5	BF	A5
-5.0	BE	A1
-5.5	BD	9D
-6.0	BC	99
-6.5	BB	95
-7.0	BA	91
-7.5	B9	8D
-8.0	B8	89
-8.5	B7	85
-9.0	B6	81
-9.5	B5	7D
-10.0	B4	79
-10.5	B3	75
-11.0	B2	71
-11.5	B1	6D
-12.0	B0	69
-12.5	AF	65
-13.0	AE	61
-13.5	AD	5D
-14.0	AC	59
-14.5	AB	55
-15.0	AA	51
-15.5	A9	4D
-16.0	A8	49
-16.5	A7	45
-17.0	A6	41
-17.5	A5	3D
-18.0	A4	39

-18.5	A3	35
-19.0	A2	31
-19.5	A1	2D
-20.0	A0	29
-20.5	9F	25
-21.0	9E	21
-21.5	9D	1D
-22.0	9C	19
-22.5	9B	15
-23.0	9A	11
-23.5	99	D
-24.0	98	9
-24.5	97	5
-25.0	96	5
-25.5	95	C5
-26.0	94	C1
-26.5	93	BD
-27.0	92	B9
-27.5	91	B5
-28.0	90	B1
-28.5	8F	AD
-29.0	8E	A9
-29.5	8D	A5
-30.0	8C	A1
-30.5	8B	9D
-31.0	8A	99
-31.5	89	95
-32.0	88	91
-32.5	87	8D
-33.0	86	89
-33.5	85	85
-34.0	84	81
-34.5	83	7D
-35.0	82	79
-35.5	81	75
-36.0	80	71
-36.5	7F	6D
-37.0	7E	69
-37.5	7D	65
-38.0	7C	61
-38.5	7B	5D
-39.0	7A	59
-39.5	79	55

-40.0	78	51
-40.5	77	4D
-41.0	76	49
-41.5	75	45
-42.0	74	41
-42.5	73	3D
-43.0	72	39
-43.5	71	35
-44.0	70	31
-44.5	6F	2D
-45.0	6E	29
-45.5	6D	25
-46.0	6C	21
-46.5	6B	1D
-47.0	6A	19
-47.5	69	15
-48.0	68	11
-48.5	67	D
-49.0	66	9
-49.5	65	5
-50.0	64	5
-50.5	63	C5
-51.0	62	C1
-51.5	61	BD
-52.0	60	B9
-52.5	5F	B5
-53.0	5E	B1
-53.5	5D	AD
-54.0	5C	A9
-54.5	5B	A5
-55.0	5A	A1
-55.5	59	9D
-56.0	58	99
-56.5	57	95
-57.0	56	91
-57.5	55	8D
-58.0	54	89
-58.5	53	85
-59.0	52	81
-59.5	51	7D
-60.0	50	79
-60.5	4F	75
-61.0	4E	71

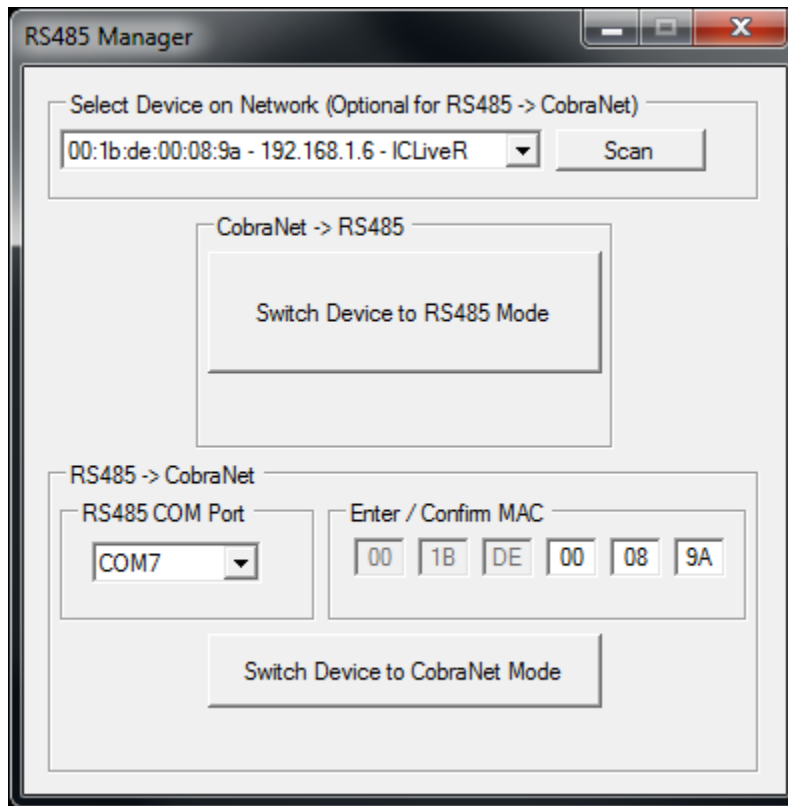
-61.5	4D	6D
-62.0	4C	69
-62.5	4B	65
-63.0	4A	61
-63.5	49	5D
-64.0	48	59
-64.5	47	55
-65.0	46	51
-65.5	45	4D
-66.0	44	49
-66.5	43	45
-67.0	42	41
-67.5	41	3D
-68.0	40	39
-68.5	3F	35
-69.0	3E	31
-69.5	3D	2D
-70.0	3C	29
-70.5	3B	25
-71.0	3A	21
-71.5	39	1D
-72.0	38	19
-72.5	37	15
-73.0	36	11
-73.5	35	D
-74.0	34	9
-74.5	33	5
-75.0	32	5
-75.5	31	C1
-76.0	30	BD
-76.5	2F	B9
-77.0	2E	B5
-77.5	2D	B1
-78.0	2C	AD
-78.5	2B	A9
-79.0	2A	A5
-79.5	29	A1
-80.0	28	9D
-80.5	27	99
-81.0	26	95
-81.5	25	91
-82.0	24	8D
-82.5	23	89

-83.0	22	85
-83.5	21	81
-84.0	20	7D
-84.5	1F	79
-85.0	1E	75
-85.5	1D	71
-86.0	1C	6D
-86.5	1B	69
-87.0	1A	65
-87.5	19	61
-88.0	18	5D
-88.5	17	59
-89.0	16	55
-89.5	15	51
-90.0	14	4D
-90.5	13	49
-91.0	12	45
-91.5	11	41
-92.0	10	3D
-92.5	F	39
-93.0	E	35
-93.5	D	31
-94.0	C	2D
-94.5	B	29
-95.0	A	25
-95.5	9	21
-96.0	8	1D
-96.5	7	19
-97.0	6	15
-97.5	5	11
-98.0	4	D
-98.5	3	9
-99.0	2	5
-99.5	1	1
-100.0	0	0

Operating IC-line Devices with External Controllers

Devices in the Iconyx line (ICR, ICLiveR, etc.) of powered loudspeakers are built with an RS485 port for communication to and from external control devices. The external devices can be used for a basic operating interface for your RHAON IC devices, including such features system monitoring, preset recall control, and power or level control. The RHAON software contains a module for enabling and disabling the RS485-control mode on your loudspeaker.

To begin, open the RS485 Manager window by clicking 'Help' -> 'RS485 Manager' in RHAON. Here is an example screenshot of the menu:



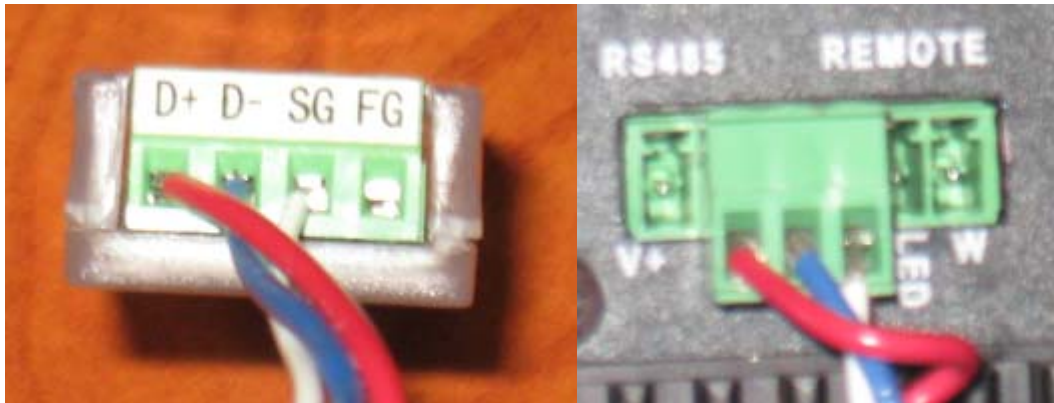
To enable:

Clicking 'Scan' will scan your CobraNet network for IC-line devices. If found, they will be listed in the ListBox and available for selection. To switch your array to RS485 mode, select the master unit and click 'Switch Device to RS485 mode'. This will send the command to every column in an IC array (for instance, both ICR units in an IC16R).

You are now done with the steps that would be done in RHAON. While some basic commands can still be done via the RHAON GUI, most commands and system monitoring are now unavailable to the PC until you disable this mode on your columns.

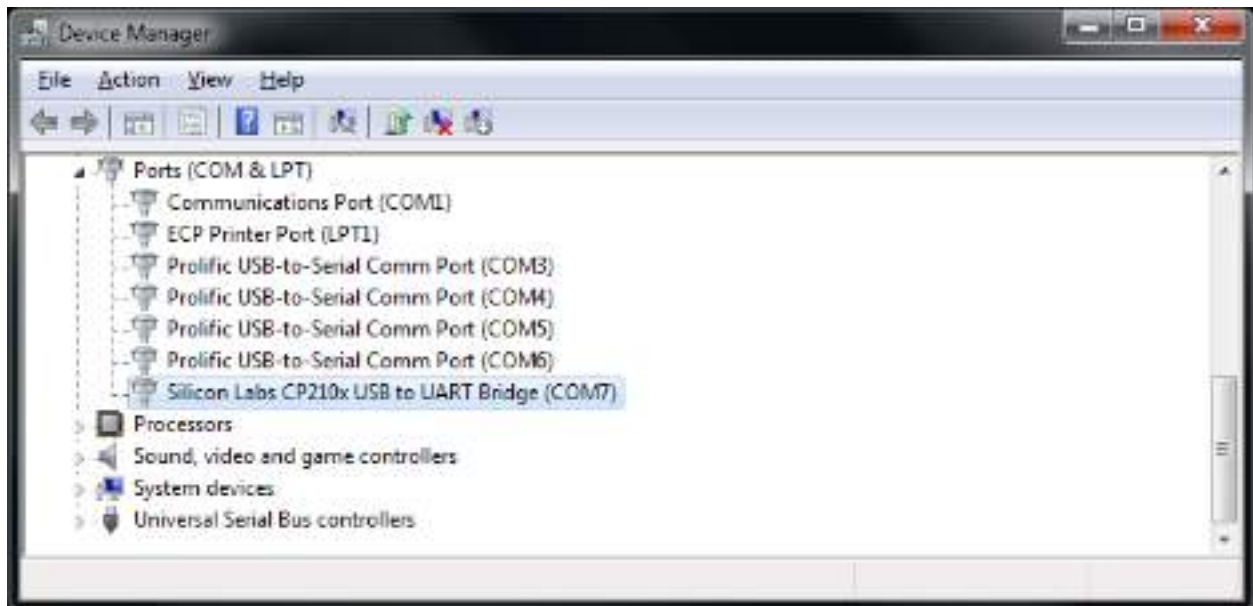
To disable:

Disabling the RS485 mode can be done directly from your external control device or from RHAON. To do so from RHAON, you will need a USB-to-RS485 adapter such as RH Part# JJJ-RS485-ADAPT, which is what will be described here. Once you have set the adapter up on your PC, connect the D+, D-, and SG ports on the adapter to the X, Y, and G ports respectively on your device:



If your column is on the network, you can scan-and-select as you did for Enabling, only you will notice that the MAC address of your column will fill in the 'Enter / Confirm MAC' text boxes.

Alternatively, you can manually enter in the MAC address of your device in the text boxes. Select the COM Port of your adapter from the drop-down menu. If you are unsure of the correct port, this can be found in Device Manager on your PC:



Once everything is set, clicking 'Switch Device to CobraNet Mode' will send the command to disable RS485 mode and return control back to your PC. This process must be repeated for each individual column in an array, for instance both ICR columns in an IC16R array.