User Guide

USB/Ethernet RF Switch Matrices

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Figure 1: MINI-CIRCUITS RC-2MTS-18 Transfer Switch

Chapter 1 – General Information

1.1 Scope of the User Guide

This user guide provides general introduction, installation instructions and operating information for Mini-Circuits USB and Ethernet control RF electro-mechanical switch matrices.

1.2 Warranty

See Mini-Circuits website http://www.minicircuits.com/support/ordering.html for warranty information.

1.3 Definitions

Note: A note advises on important information you may need to ensure proper operation of the equipment. There is no risk to either the equipment or the user.

CAUTION	**A caution advises about a condition or procedure which can cause damage to the equipment (no danger to users).**

WARNING	**A warning alerts to a possible risk to the user and steps to avoid it. DO NOT proceed until you are sure you understand the warning.**

1.4 General safety precautions

Please observe the following safety precautions at all times when using Mini-Circuits USB RF switch matrices.

WARNING	**Ensure that all instruments using mains power supply are properly grounded to prevent risk of electrical shock.**

CAUTION	**1. Ensure the switch matrix air vents are clear** **2. Do not attempt to switch signals of greater power than the switch is rated for in its datasheet.**

1.5 Introduction

Mini-Circuits has developed the RC series of RF switch matrices, capable of USB and Ethernet (HTTP and Telnet protocols) control. The series has a variety of switches, from SPDT and up to SP6T switches as well as Transfer Switches (as seen in Figure 1)*.* The SPDT switches operate from DC and up to 50 GHz (see section *1.8.2 Model Selection Guide* for details); all are available in a variety of different configurations with low insertion loss and high isolation.

All models are USB HID devices and are "plug & play," with no driver installation needed. Ethernet control in the RC series allows for both dynamic (DHCP) and static IP. Using the Ethernet interface the switch matrices can be controlled from any computer with an internet connection, or even your smartphone from almost anywhere!

Using the supplied GUI software or most common lab test software you can easily set complex, timed switching sequences using multiple switches with only a single power supply and USB, or Ethernet control line. You can even synchronize other software with the switching sequence.

These USB/Ethernet RF switches are light, compact and greatly simplify setting up complex switching sequences.

1.6 *Service and Calibration*

The USB/Ethernet switch matrix models do not require any periodic service or calibration. The only user service possible for the switch matrix models is external cleaning of the case and connectors as needed. Do not use any detergents or spray cleaning solutions to clean the Switch Matrix. To clean the connectors use an alcohol solution, and to clean the case a soft, damp cloth.

1.7 *Contact Information*

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Phone: 1-718-934-4500
General Fax: 1-718-332-4661
Sales / Customer Service Fax: 1-718-934-7092
sales@minicircuits.com
For regional offices and tech support see http://www.minicircuits.com/contact/offices.html

1.8 *Technical description*

1.8.1 **Features of Mini-Circuits Switch Matrices**

• Capable of 10 million switching cycles

• Absorptive failsafe RF switches in break-before-make configuration;

• Wide frequency range (DC up to 50GHz – see section *1.8.2 Model Selection Guide* for details)

• Electromechanical switching; High isolation

• High power handling models

• All RF ports SMA(F)

• Easy GUI installation and operation, simplifies complex switching and timing setups

• USB HID "plug & play" device

• For RC series Telnet and HTTP "plug & play" device

• ActiveX com object and .Net class library for use with other software: C++, C#, CVI®, Delphi®, LabVIEW® 8 or newer, MATLAB® 7 or newer, Python, Agilent VEE®, Visual Basic®, Visual Studio® 6 or newer, and more

• User friendly Graphical User Interface for any Windows® 32 or 64 bit computer. Command line support for Linux® computers

• For RC series command line support for any computer with a network connection (HTTP and Telnet protocols)

• 24VDC power adapter included

• Protected by US Patents 5,272,458; 6,414,577; 6,650,210; 7,633,361 and 7,843,289

For specific model features, performance data and graphs, outline drawing, ordering information and environmental specifications, see our catalog at:
https://www.minicircuits.com/WebStore/Switches.html

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1.8.2 **Model Selection Guide**

Model Name	Switch Type	Frequency	Switch Count	Connectors	Connectors
RC-1SPDT-A18	SPDT	DC - 18 GHz	1	Absorptive	SMA
RC-2SPDT-A18			2		
RC-4SPDT-A18			4		
RC-8SPDT-A18			8		
RC-1SPDT-A26		DC - 26.5 GHz	1	Absorptive	SMA
RC-2SPDT-A26			2		
RC-4SPDT-A26			4		
RC-2SPDT-40		DC - 40 GHz	2	Reflective	2.92 mm
RC-4SPDT-40			4		
RC-2SPDT-50		DC - 50 GHz	2	Reflective	2.4 mm
RC-4SPDT-50			4		
RC-1SP4T-A18	SP4T	DC - 18 GHz	1	Absorptive	SMA
RC-2SP4T-A18			2		
RC-1SP4T-26		DC - 26.5 GHz	1	Absorptive	SMA
RC-2SP4T-26			2		
RC-1SP4T-40		DC-40 GHz	1	Absorptive	2.92 mm
RC-2SP4T-40			2		
RC-1SP4T-50		DC - 50 GHz	1	Absorptive	2.4 mm
RC-1SP6T-A12	SP6T	DC - 12 GHz	1	Absorptive	SMA
RC-2SP6T-A12			2		
RC-2SP6T-A18		DC - 18 GHz	2	Absorptive	SMA
RC-1SP6T-26		DC - 26.5 GHz	1	Absorptive	SMA
RC-2SP6T-26			2		
RC-1SP6T-40		DC-40 GHz	1	Absorptive	2.92 mm
RC-2SP6T-40			2		
RC-1SP6T-50		DC - 50 GHz	1	Absorptive	2.4 mm
RC-2MTS-18	Transfer switch	DC - 18 GHz	2	Transfer	SMA
RC-3MTS-18			3		
RC-2MTS-26		DC - 26.5 GHz	2	Transfer	SMA
RC-3MTS-26			3		
RC-2MTS-40		DC-40 GHz	2	Transfer	2.92 mm
RC-3MTS-40			3		

1.8.3 Intended Applications

Mini-Circuits RC series switch matrices are intended for indoor use in:
- Lab and test equipment setups for both manual and automated measurements
- Control systems
- Automated switching of signal paths in a complex system

The models can be used by anyone familiar with the basics of electronics measurements or electronic control systems.

1.8.4 Conformity

Mini-Circuits RC series switch matrices conform to all requirements for the following international standards**:**

        RoHS – The models comply with EU directive for Restriction of Hazardous Substances for 6 substances.

        USB 2.0 – The models meet the specifications of the Universal Serial Bus Ver. 2.0 communication standard as described by USB-IF.

        USB HID – The models meet the requirements for Universal Serial Bus Human Interface Devices according to USB-IF's Device Class Definition for Human Interface Devices firmware rev. 1.11.

        TCP/IP – The RC series models' Ethernet communication complies with the specifications of the Transmission Control Protocol (TCP) and Internet Protocol (IP) as defined in RFC 791 and RFC 793.

        HTTP – The RC series models' support all requirements for communicating with the Hypertext Transfer Protocol (HTTP) as defined in RFC 1945.

        Telnet – The RC series models' support all requirements for communicating with the Telnet protocol, as defined in RFC 854.

1.8.5 Supported Software environments

Mini-Circuits RC series switch matrices have been tested in the following operating systems:
32 bit systems: Windows 10, Windows 8, Windows 7, Windows Vista
64 bit systems: Windows 10, Windows 8, Windows 7, Windows Vista, Linux
The switch matrices will work with almost any software environment that supports ActiveX or .Net including: C++, C#, CVI®, Delphi®, LabVIEW® 8 or newer, MATLAB® 7 or newer, Python, Agilent VEE®, Visual Basic®, AutoIT, Visual Studio® 6 or newer, and more

Additionally, the HTTP and Telnet protocols can operate from almost any computer with a network connection.
For more information see Mini-Circuits Switch Matrix programming handbook on our website.

1.8.6 Included Accessories and Options

1.8.6.1   All RC series switch matrices are supplied with the following accessories:
- 2.7 ft. USB cable
- 24V power adaptor
- Power cord, selected when ordering the switch matrix from US, UK, AUS/China or IL standard power cords.

1.8.6.2   Additionally, the following optional accessories are available:
- 6.8 ft USB cable
- 11 ft USB cable
- 4 inch coaxial, SMA(M) RF semiflex cable (other lengths are also available)
- Mounting bracket (set of two each)

For additional details and ordering information, see model specs and ordering information at:
https://www.minicircuits.com/WebStore/Switches.html

Chapter 2 – Installation and Setup

System requirements for the switch matrix models are a computer (Pentium II or better) with either support for USB HID or an Ethernet connection, and a power source of 110-220V$_{AC}$ (with socket matching the plug of the power cord selected when ordering the switch matrix). To run the GUI program a Windows operating system for either 32 or 64 bits is also required.

2.1 Software Setup

> ✔ **If you have had any problems installing the software, we're here to help.**
> Try following these complete step-by-step instructions. If you still experience problems, give us a call at Mini-Circuits Worldwide Technical support. It's (718) 934-4500 or e-mail apps@minicircuits.com for North America, or go to minicircuits.com/contact/worldwide_tech_support.html for other regional numbers and addresses.

2.1.1 *First,* save all work in progress and close any other programs that may be running.

2.1.2 *Next,* download the full CD software from https://www.minicircuits.com/softwaredownload/RFSwitchController_CD.zip. Unzip the downloaded files to a suitable folder on your computer, then open the file folder you created and double-click the "Install" icon.
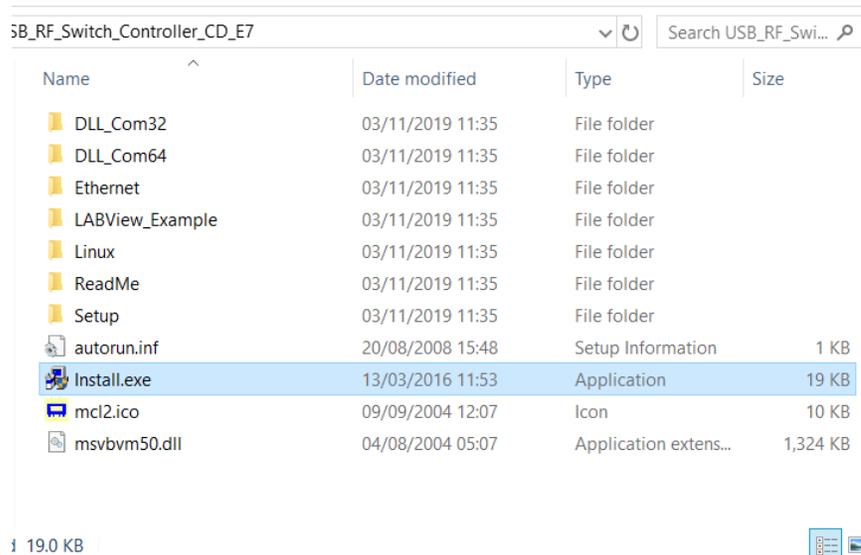
Name	Date modified	Type	Size
DLL_Com32	03/11/2019 11:35	File folder	
DLL_Com64	03/11/2019 11:35	File folder	
Ethernet	03/11/2019 11:35	File folder	
LABView_Example	03/11/2019 11:35	File folder	
Linux	03/11/2019 11:35	File folder	
ReadMe	03/11/2019 11:35	File folder	
Setup	03/11/2019 11:35	File folder	
autorun.inf	20/08/2008 15:48	Setup Information	1 KB
Install.exe	13/03/2016 11:53	Application	19 KB
mcl2.ico	09/09/2004 12:07	Icon	10 KB
msvbvm50.dll	04/08/2004 05:07	Application extens...	1,324 KB

Figure 2.1.2 *CD file listing window*

2.1.3 *Alternatively,* you may wish to just download and open without saving the setup files, from https://www.minicircuits.com/softwaredownload/RFSwitchController_Setup.zip . Then double click on the setup.exe icon.

2.2 Installation

2.2.1 **The installer window** should now appear. Click the "Install Now" button (if you downloaded only the setup files skip to 2.2.2).

Figure 2.2.1 *Installation program window*

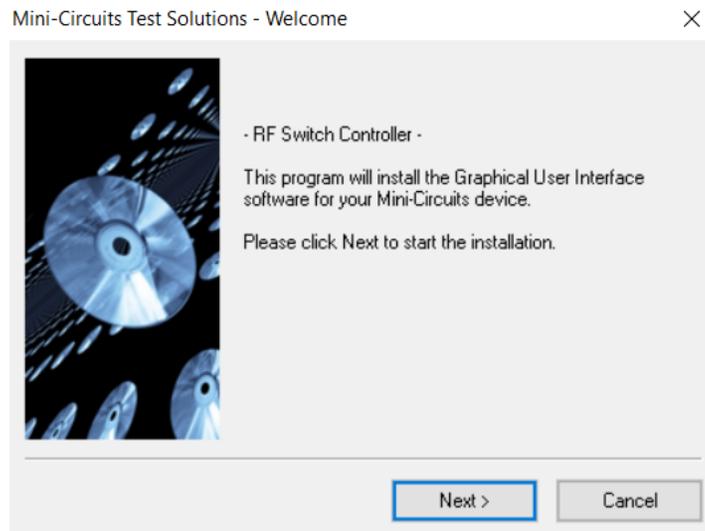2.2.2 **The GUI installer window** should now open. Click the "Next" button to begin with the installation process.

Figure 2.2.2 *Installation window*

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2.2.3 **The license agreement** should now appear. To proceed, click "Yes" to accept the agreement.
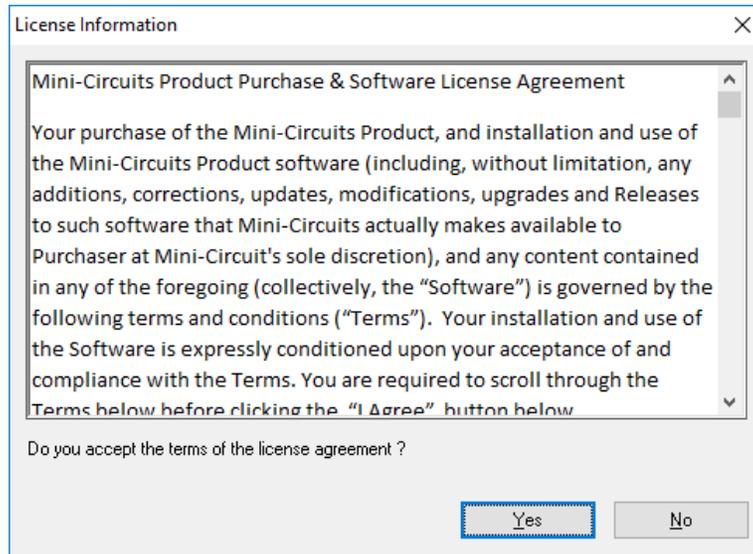
Figure 2.2.3 License agreement

2.2.4 **The installation program will install (will take a few seconds)**. Click the "Exit" button to close the installer.
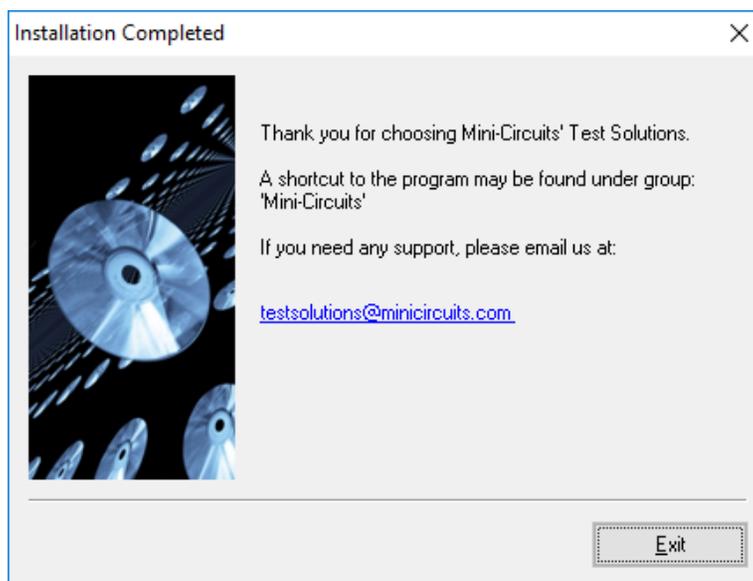
Figure 2.2.4 Installation program window

2.2.5 **The "RF Switch Controller" program will be in** "*C:\Program Files (x86)\Mini-Circuits\RF_Switch_Controller*" with links on the desktop and in the Start menu under *Mini-Circuits -> RF Switch Controller*.

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2.3 USB/Ethernet Switch Matrix Physical Setup

2.3.1 **Before** connecting the switch matrix, ensure the power switch is in the OFF position and the control software (either the supplied GUI software or a customer written application) is shut down.

WARNING	**Ensure the wall socket you use to power the switch matrix is intact and connected to a proper ground.**

2.3.2 **Connecting** the switch matrix for USB control:
-Connect supplied power adapter AC/DC-24-3W1 to mains power supply using the supplied power cord.
-Connect AC/DC-24-3W1 24V connector to the switch matrix unit 24V power socket.
-Connect USB cable between switch matrix unit USB port and computer USB port.
-Note the USB indicator lights up.
-Turn on the RC switch matrix unit.
-Note that power indicator lights up after turning on the unit.
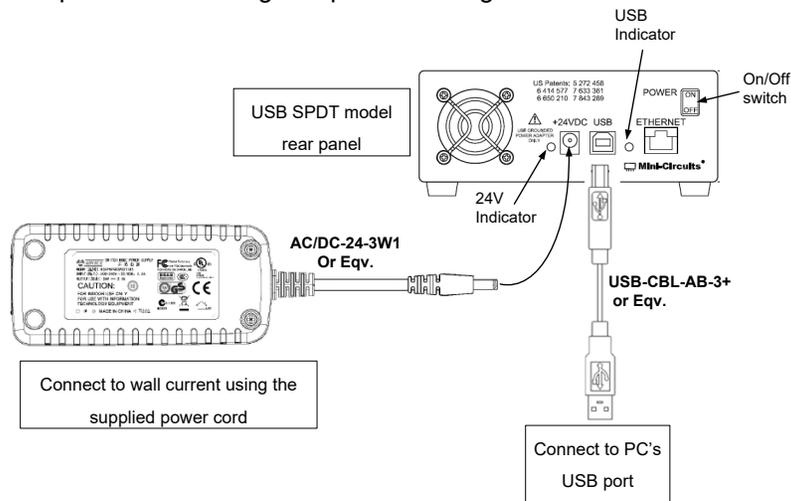
Figure 2.3.2a: Switch matrix USB control power up setup
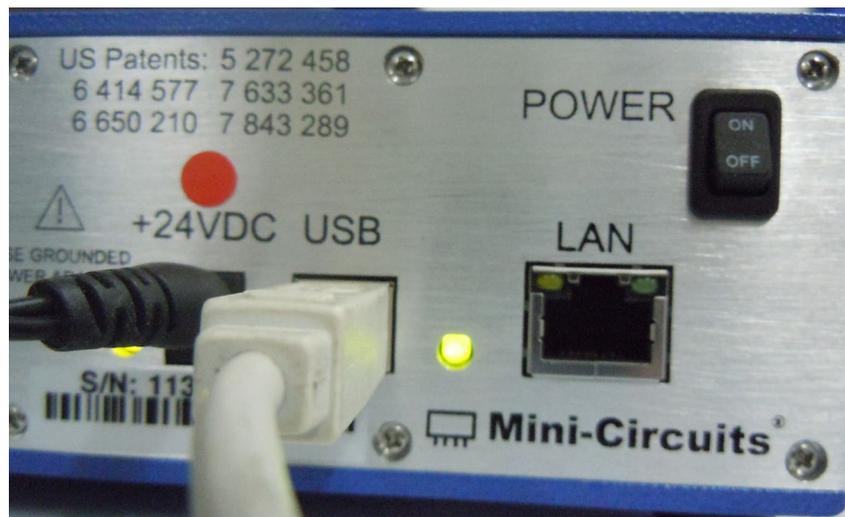
Figure 2.3.2b: Switch matrix power & USB control connections

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2.3.3 *Connecting* the switch matrix for Ethernet control:

-Connect supplied power adapter AC/DC-24-3W1 to mains power supply using the supplied power cord
-Connect AC/DC-24-3W1 24V connector to USB/Ethernet switch matrix unit and 24V power socket.
-Connect shielded network cable between switch matrix unit RJ45 socket and suitable network port.
-Turn on the USB/Ethernet switch matrix unit.
-Note that both the power indicator and the right-hand network indicator light up in green.
-Once a network connection is established the left-hand network indicator will light up intermittently, indicating data transmission.
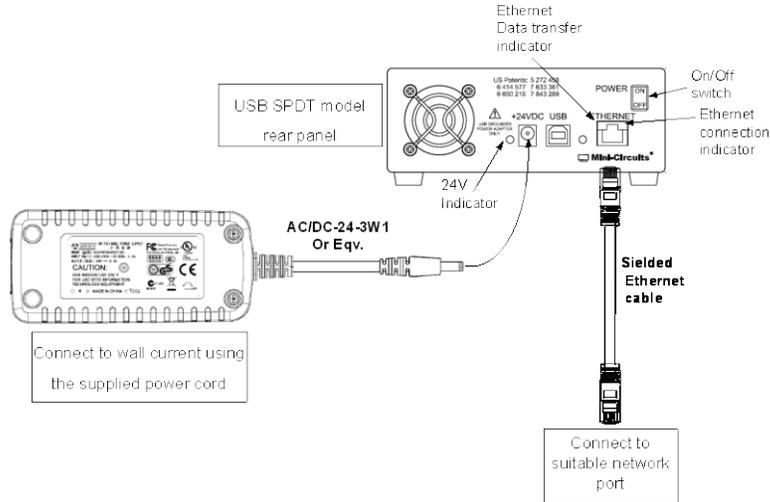
Figure 2.3.3a: switch matrix Ethernet control power up setup

Figure 2.3.3b: switch matrix power & Ethernet control connections

CAUTION	1. **Note the maximum rating power input in the datasheet and the conditions specified for it. Exceeding these values may damage the switch matrix.** 2. **Hot switching with power greater than 0.1W may result in reduced switch life.**

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Notes:
- ❖ Shielded Ethernet cable is recommended to ensure EMC/EMI compliance

2.3.4 ***After the power setup is assembled,*** connect the RF switches in the desired configuration (several preset configuration options are shown in chapter 3), and start the switch controller. Please note that for the SPDT models the RF switches will all initially be in COM->1 state while SP4T and SP6T models will initially be in DISCONNECT state.

Note: Keep USB/Ethernet switch matrix air vents unobstructed to ensure proper operation of the unit.

2.4 *Controlling the Mini-Circuits Switch Matrix*

Mini-Circuits offers multiple methods of controlling our switch matrices. You can:
- Use the supplied windows program to control the switch matrix via USB (see section 3.1.2).
- Use the supplied windows program to control the switch matrix via Ethernet (HTTP or Telnet protocols) (see section 3.1.4).
- Access the switch matrix internal GUI using common web browser software (see section 3.1.4).
- Use the supplied DLL files to create your own control interface (see Mini-Circuits Programming Handbook for details).
- Use the supplied USB interrupt codes to create your own control interface (See Mini-Circuits Programming Handbook section 2.2 for details).
- Use the commands described in the help file and Mini-Circuits Programming Handbook to control the switch matrix remotely via HTTP or Telnet.

Chapter 3 – Using Mini-Circuits GUI

Mini-Circuits' GUI Switch controller interface allows you to test a wide variety of preset configurations while showing the current state of all switches or running timed sequences of any configuration you can imagine. The switch controller even allows you to run other programs at any point in the timed sequence you select.

To start the program go to the Start menu and select All Programs>Mini-Circuits>RF Switch Controller (default), or go to the other destination address you selected earlier. The Mini-Circuits' "RF Switch Controller" icon should be waiting there for you. Click on it and get started!

3.1 *Starting the GUI Program*

3.1.1 ***When started the GUI will*** show the control selection screen allowing you to choose USB, HTTP, Telnet, or SSH control.
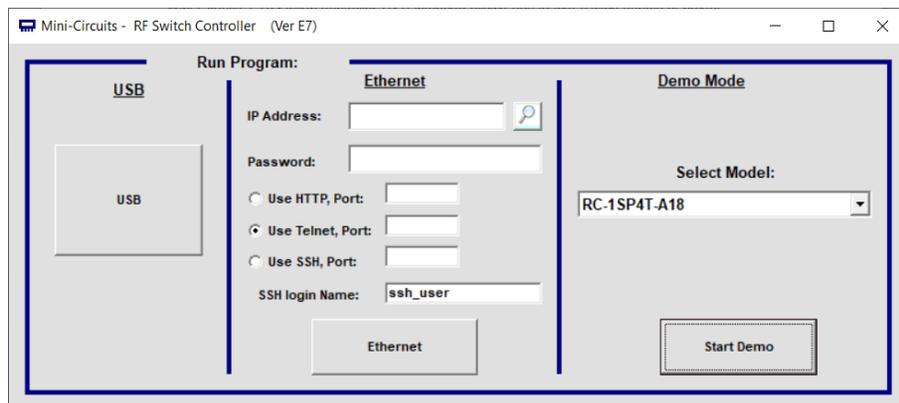
Figure 3.1.1: Switch Controller Startup screen

3.1.2 ***For USB control*** click on the USB button in the center. If no unit is connected via USB, or there is a problem with the power or USB connection of the unit an alert will pop up, an alert will pop up. Click OK, then check the power and USB connections of the unit before trying again.
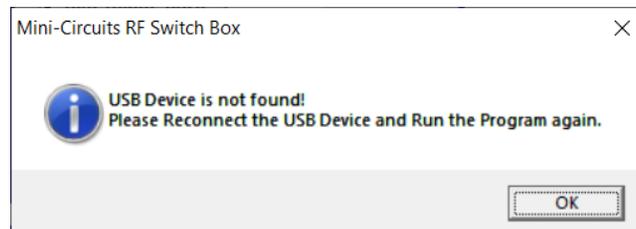
Figure 3.1.2: No USB unit found

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3.1.3 ***If multiple units are connected via USB***, the unit selection screen will appear with a list of serial numbers and model names for connected units. Select the unit you wish to start with and click "OK", or click "Cancel" to exit the program. The program can handle up to 24 units connected simultaneously. If only one unit is connected via USB, the program will go directly to the control screen.
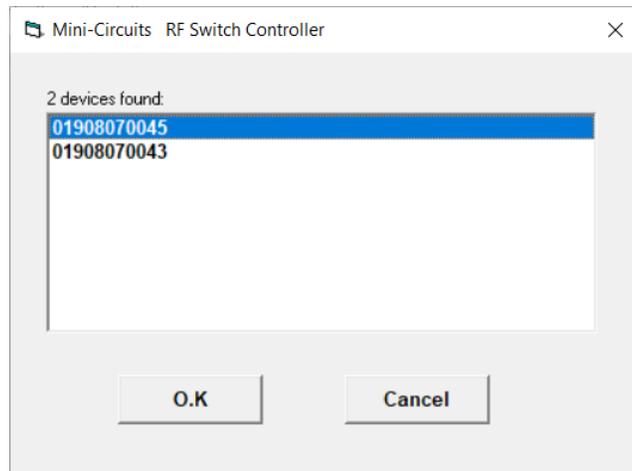

Figure 3.1.3: Unit selection screen

3.1.4 ***For Ethernet control,*** either enter the IP address of the unit in the "IP address" and the port in the relevant "port" field for the communication protocol selected, or click on the search icon next to it to find all Mini-Circuits unit connected to the network.

Note:
1. Default ports for Mini-Circuits models are: HTTP – port 80, Telnet – port 23, SSH – port 22.
2. In order to control the switch matrix over the internet you will first need to set up a Virtual Private Network (VPN).
3. When connecting to the unit with Ethernet control for the first time you may need to change the factory default Ethernet configuration to match your network configuration. See **section 3.2**.

3.1.5 ***A basic GUI interface is programmed*** into each switch matrix, and can be accessed simply by typing the switch matrix' IP address followed by "/home" into the address window of most common browsers (see Figure 3.1.5 for an example). This interface is usable from almost any Windows, Mac or Linux computer.
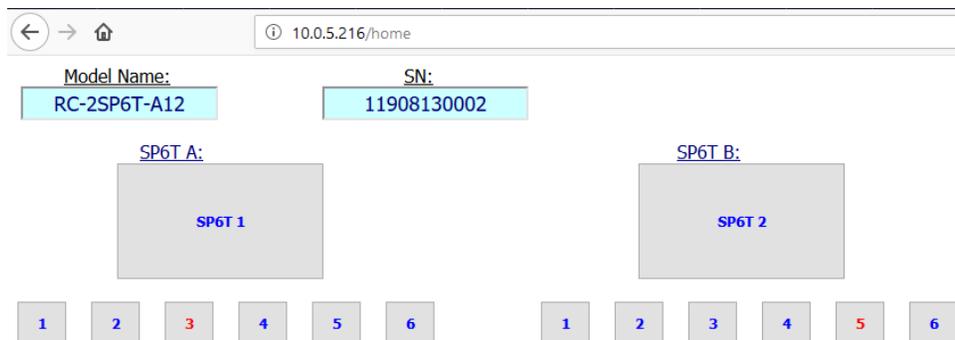
Figure 3.1.5: Web-browser GUI Interface

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3.1.6 **_After clicking on the search icon_** The IP search will pop up with a list of switch matrix IP addresses found and their HTTP ports on the left side of the screen, and full details of each unit on the right. Mark the IP address you wish to use and click select. The search window will close and the IP address will be entered in the IP address field of the initial screen automatically.
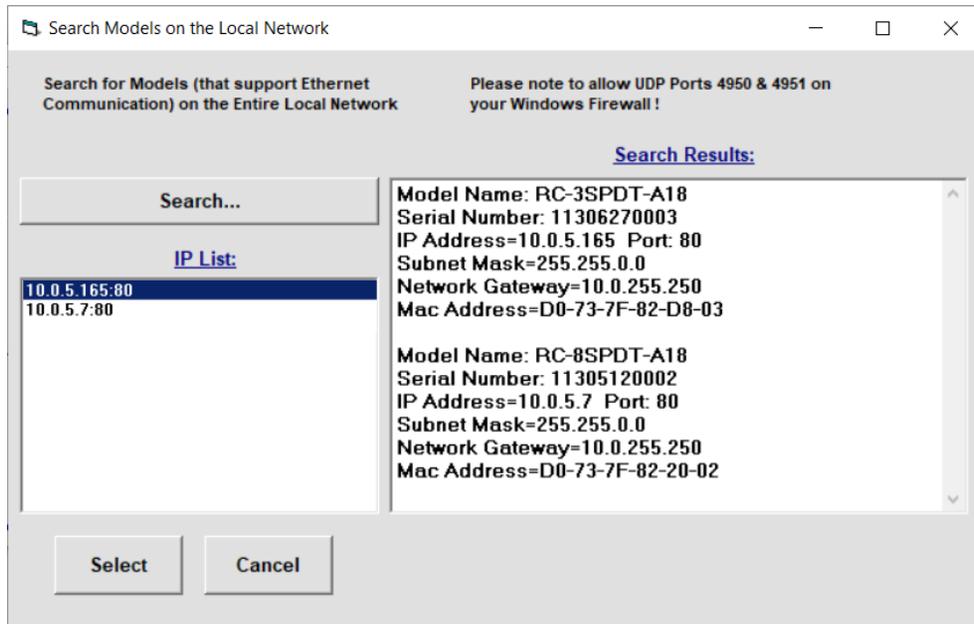

Figure 3.1.6: Ethernet IP search window

Notes:
1) To refresh the list of units found click on the Search button.
2) The search function uses ports UDP 4950 and UDP 4951 for communication, ensure your firewall allows access to these ports.

3.1.7 **_After entering the IP address_** enter your password if you set one (see **section 3.2.5**), select the communication protocol you wish to use (HTTP or Telnet) and click start, the unit's main screen will open.
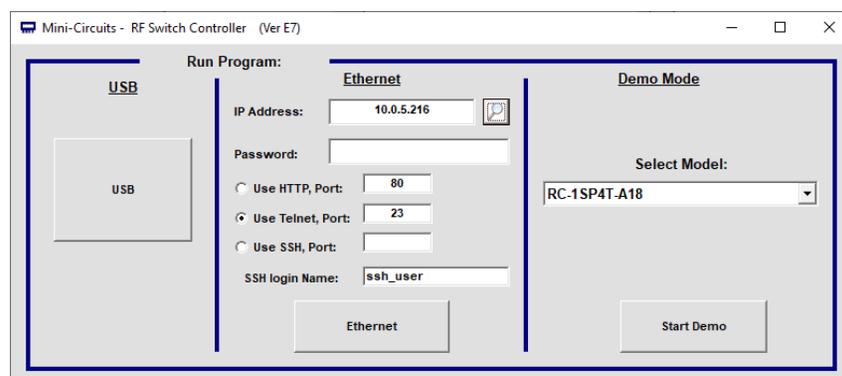
Figure 3.1.7: Ethernet startup screen

Note: Changing Ethernet settings is only possible via USB control, see section 3.2.5 for details.

3.1.8 ***Telnet or HTTP text commands*** can also be used to control the switch matrix. Just type in the command in the address field of your internet browser or implement a Get/Post HTTP function in your selected application (for HTTP) or establish a telnet connection (for Telnet). A full list of the commands available and their syntax is available in Mini-Circuits programming handbook chapter 2, and in a text file on the CD software provided on the Mini-Circuits website (see section 2.1 for details).

3.2 Ethernet Configuration

3.2.1 Default IP Configuration

Mini-Circuits' switch matrices ship from the factory with DHCP enabled by default so in most cases an IP address will be assigned automatically when the device is connected to the network. Once a valid IP address has been assigned and identified it can be re-configured via the Ethernet connection (for example, to set a static IP configuration) using our GUI, Ethernet configuration tool, or the programming API.

3.2.2 Default Static / "Link-Local" IP Address

A default "link-local" IP address will be assumed when DHCP is enabled if the device does not receive a valid response from a DHCP server. This also applies when a unit with DHCP enabled is connected directly via an Ethernet cable to a PC (instead of via a network). The default static / link-local IP address for all Mini-Circuits devices with the relevant firmware is 169.254.10.10.

This can be used as a method to configure a specific static IP address for a new device straight out of the box, without resorting to a USB connection or even Mini-Circuits' GUI. Just connect the unit directly to the PC, open the HTML Ethernet configuration tool (see **section 3.2.7**), connect to the unit using the 169.254.10.10 default IP and proceed to set the new configuration as needed.

Notes:
❖ Firmware F0 or later is required to support this feature.

3.2.3 Recovery of IP Configuration via USB

If at any time an Ethernet connection cannot be established (for example, if the current IP address is not valid on the network) then the settings can always be reset by connecting to the device using USB and the GUI or programming API.

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3.2.4 *Default factory settings* for switch matrix models are Dynamic IP (DHCP) using port 80 for HTTP or port 23 for Telnet (see **Figure 3.2.6**). To change these settings, click on the "Ethernet Config" button In the GUI (see **section 3.2.4**), or use Mini-Circuits Ethernet configuration tool (see **section 3.2.7**).

Figure 3.2.4: Ethernet-Config button on USB main screen

3.2.5 *The Ethernet Settings screen* will open showing the current configuration. **Figure 3.2.6** shows the factory default of the units.

If these settings are appropriate for your local network then you do not need to access the setup before connecting the unit to the network and can connect to the unit via Ethernet as described in **section 3.1.4**.

After making the changes you want, click on "Store" and the changes will be saved to the unit's memory.

Notes:
❖ If no DHCP server is available user may need to change Ethernet configuration via USB control to match their network setup.
❖ It is not advised to set the HTTP, Telnet, and SSH ports to use the same port.
❖ If you are using a proxy server for your LAN connections you may need to define a name for the switch matrix IP address, or disable the proxy server to connect to the switch matrix via Ethernet.

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3.2.6 *Ethernet settings descriptions:*
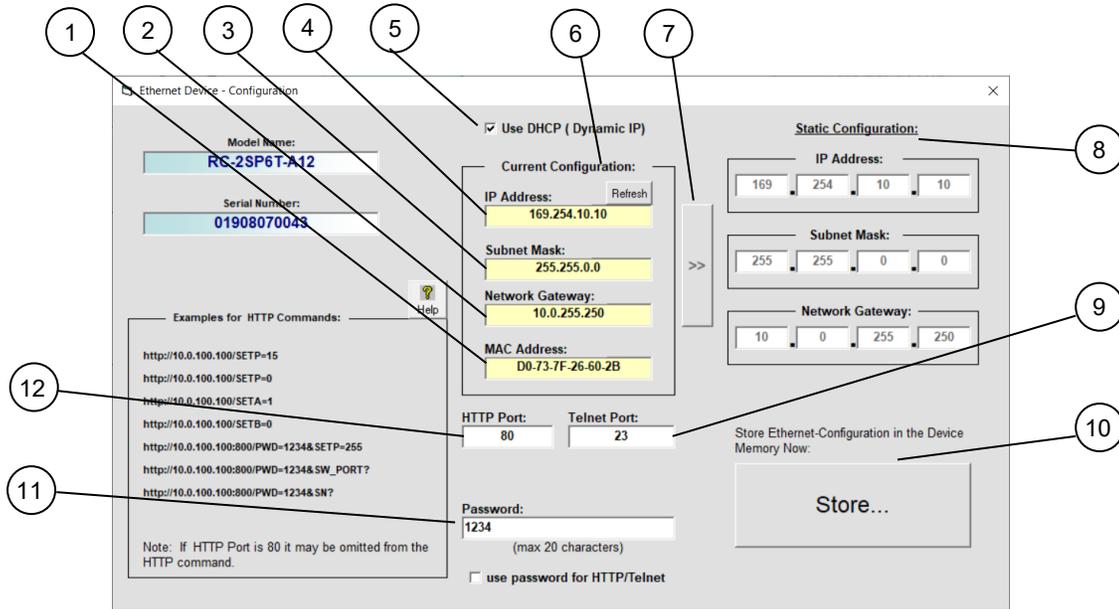
***Figure 3.2.6:** Ethernet Settings screen (showing factory default state)*

#	Name	Description
1	MAC Address	Media Access Control Address – a unique, unchanging identifier for the switch matrix unit.
2	Network gateway	IP address of the network gateway. When DHCP is selected this is assigned by the server and will change according to the server.
3	Subnet Mask	The Network's Subnet Mask. When DHCP is selected this is assigned by the server and will change according to the server.
4	IP Address	The IP address of the unit in your Network. When DHCP is selected this is assigned by the server and will change according to the server.
5	Use DHCP	When selected the Switch matrix will query the server for appropriate parameters with no input from the user and will disregard IP Address, Subnet Mask and Network gateway entered manually.
6	Refresh	Request IP address, Gateway and Subnet mask from Server.
7	Copy state	Copies current state of dynamic IP to static IP, not available when DHCP is selected.
8	Static Configuration	When DHCP is not selected the User must specify the values below and will not be changed by the server.
9	Telnet Port	Port to be used for telnet communication. Cannot be changed by User
10	Store	After you've made all changes you want to click on this button to save the settings.
11	Password	If you want to limit the users able to access the Switch box select "Use Password" and enter the desired password (up to 20 characters).
12	HTTP Port	Specify the port to use for communications with the Network (default 80). Note Port address does not get assigned by the Server when DHCP is selected. Port 23 is reserved for Telnet communication and cannot be used.

3.2.7 *Ethernet Configuration Tool*

The Ethernet configuration can also be changed via Ethernet control. To make changing the Ethernet configuration easier for users operating in a non-Windows environment or otherwise can't use the provided GUI, Mini-Circuits created the ethernet configuration tool (requires firmware F0 or newer)
https://www.minicircuits.com/softwaredownload/MCL_PTE_Ethernet_Config.zip
Note: Javascript must be enabled in your browser to use the configuration tool.

To use the configuration tool, type the IP address in the field in step 1 (if you assigned a password for the unit type is as well), if you set the device to some port other than 80, enter the port as well in the same field, then click 'Read current configuration'. The fields in step 2 will be populated with the current state of the device, entered the updated information in the relevant fields in step 2, and click 'Set New Configuration' and you're done.

Figure 3.2.7: Ethernet Configuration Tool

3.3 Switch Configurations

Several different preset configurations are available in the Mini-Circuits GUI switch controller and are described below. Where external RF cables are required for the configuration this is noted and the placement of the RF cables shown in the configuration screen. These preset configurations are currently available only via USB control for complex configurations with timing considerations or setting configurations via Ethernet control (see section 3.4).

3.3.1 *RC-1SPDT-A18*

This model has only a single absorptive SPDT switch, and thus there are no additional configurations beyond that of an SPDT switch. The switch state can be changed either by clicking on the button above the switch drawing circled in **Fig. 3.3.1** (the button will change between 'COM->2' and 'COM->1' to indicate the current switch state) or in the user sequence window, opened by clicking on the user sequence button (see section 3.4).
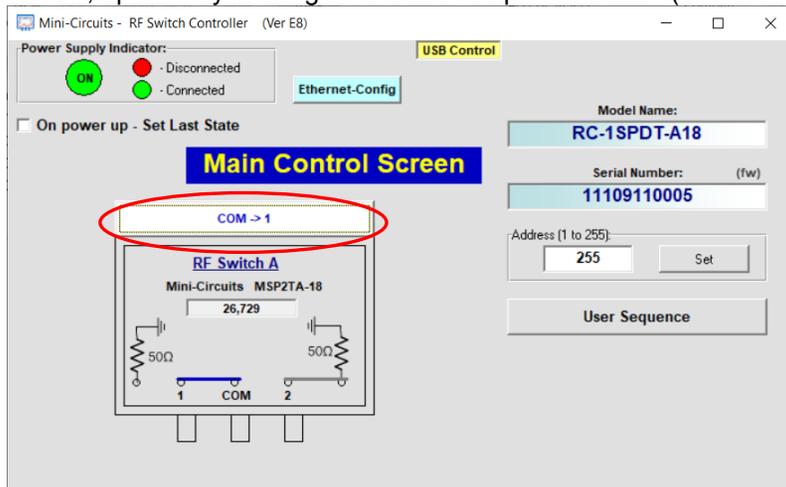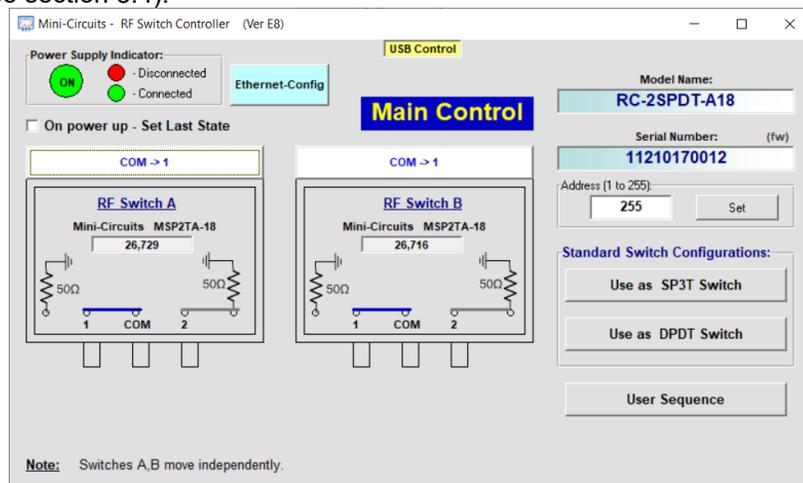

Figure 3.3.1: RC-1SPDT-A18 main window

3.3.2 *RC-2SPDT-A18*

This model has two absorptive SPDT switches and can be configured as a DPDT or SP3T switch in addition to two SPDT switches. In the default configuration each switch state can be changed independently by either clicking on the button above the corresponding switch drawing (the button will change between 'COM->2' and 'COM->1' to indicate the current switch state) or in the user sequence window, opened by clicking on the user sequence button (see section 3.4).

Figure 3.3.2: RC-2SPDT-A18 main window

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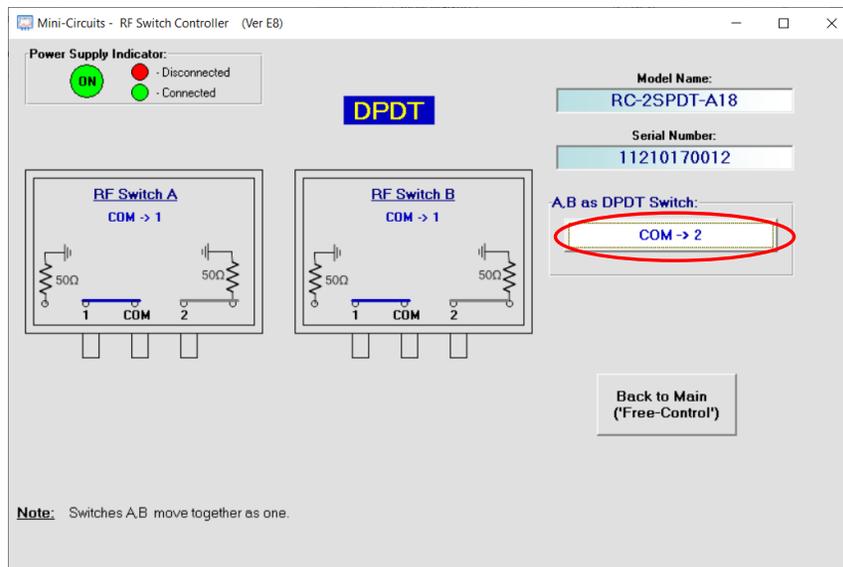
3.3.2.1 *RC-2SPDT-A18 as a SP3T switch*

Clicking on the 'Use as SP3T switch' button in the main window will transfer you to a new window - the SP3T configuration screen. In order to use the switch box in this configuration the user needs to connect external RF cable A as shown in **Fig. 3.3.2.1.** Clicking on the switch state buttons on the right side of the screen will change the state of the switches accordingly and the signal path and current state will be highlighted in green. In order to return to the main window, click on the 'Back to Main' button.
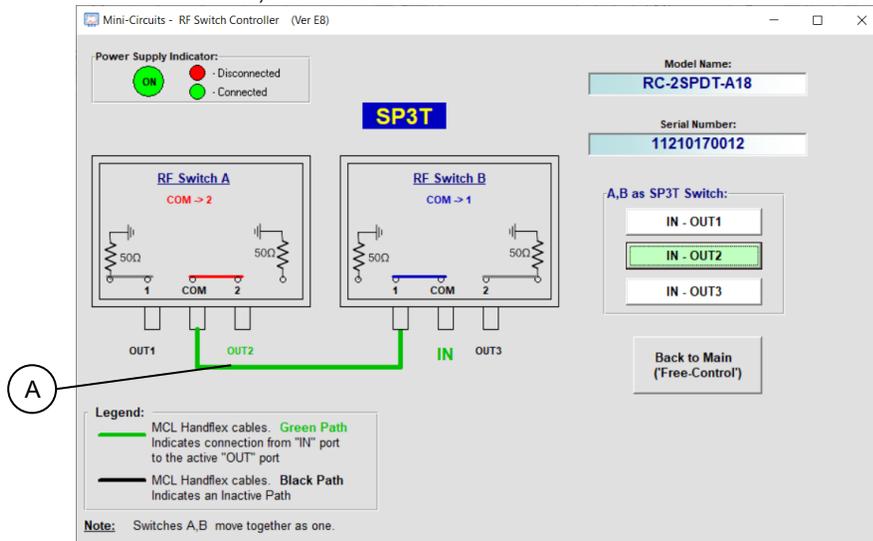
Figure 3.3.2.1: RC-2SPDT-A18 SP3T configuration window

3.3.2.2 *RC-2SPDT-A18 as a DPDT switch*

Clicking on the 'Use as DPDT switch' button in the initial screen will transfer you to a new window - the DPDT configuration screen. This configuration does not require any external RF cables to work**.** Clicking on the circled button will toggle both switches simultaneously as a single DPDT switch. In order to return to the main window, click on the 'Back to Main' button.

Figure 3.3.2.2: RC-2SPDT-A18 DPDT configuration window

3.3.3 **RC-3SPDT-A18**

This model has three absorptive SPDT switches and can be configured as a DPDT and a SPDT or a 3PDT with no external RF cables needed (same procedure as **section 3.3.2.2**) or as a SP3T and SPDT or SP4T switch with external RF cables as shown in the relevant screen (same procedure as **section 3.3.2.1**) in addition to the base configuration as three independent SPDT switches. In the default configuration each switch state can be changed independently by either clicking on the button above the corresponding switch drawing (the button will change between 'COM->2' and 'COM->1' to indicate the current switch state) or in the user sequence window, opened by clicking on the user sequence button (see section 3.4).
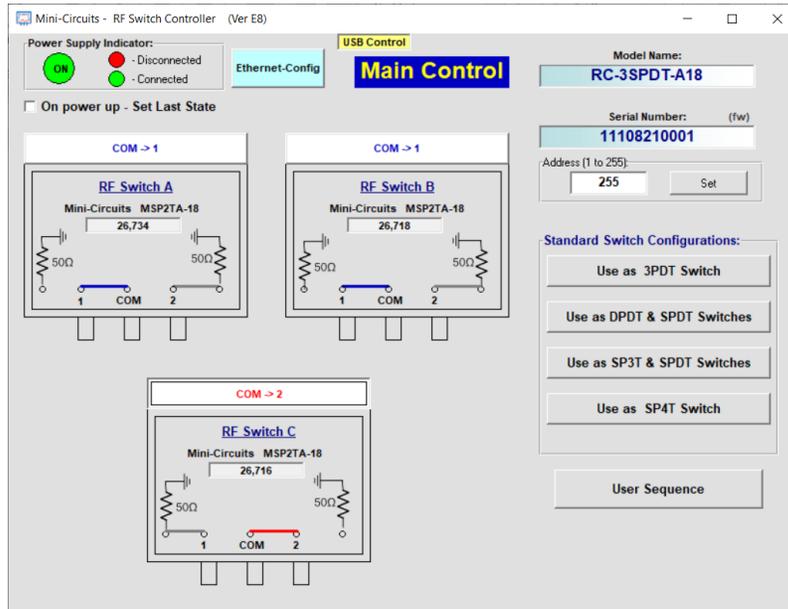
Figure 3.3.3: RC-3SPDT-A18 main window

3.3.3.1 **RC-3SPDT-A18 as a SP3T, and an SPDT switch**

Connect RF cable A as shown in **Fig. 3.3.3.1.** Clicking on the buttons on the right will change the state of the switches accordingly and the signal path and will be highlighted in green. In order to return to the main window, click on the 'Back to Main' button.
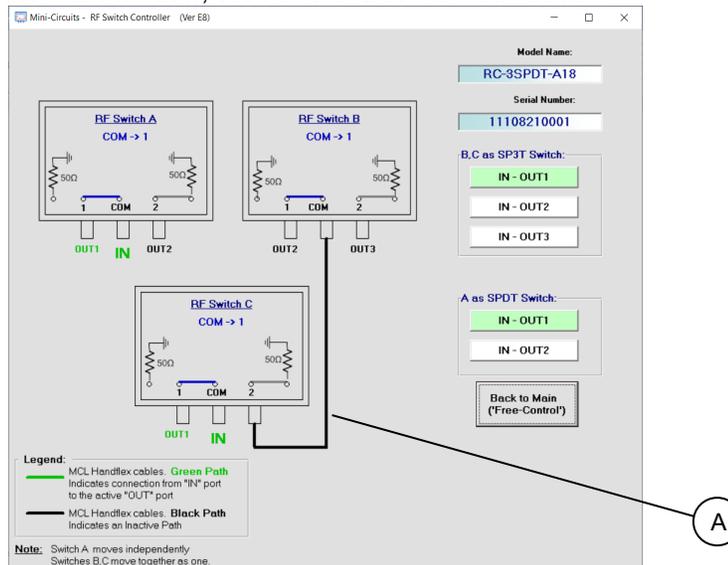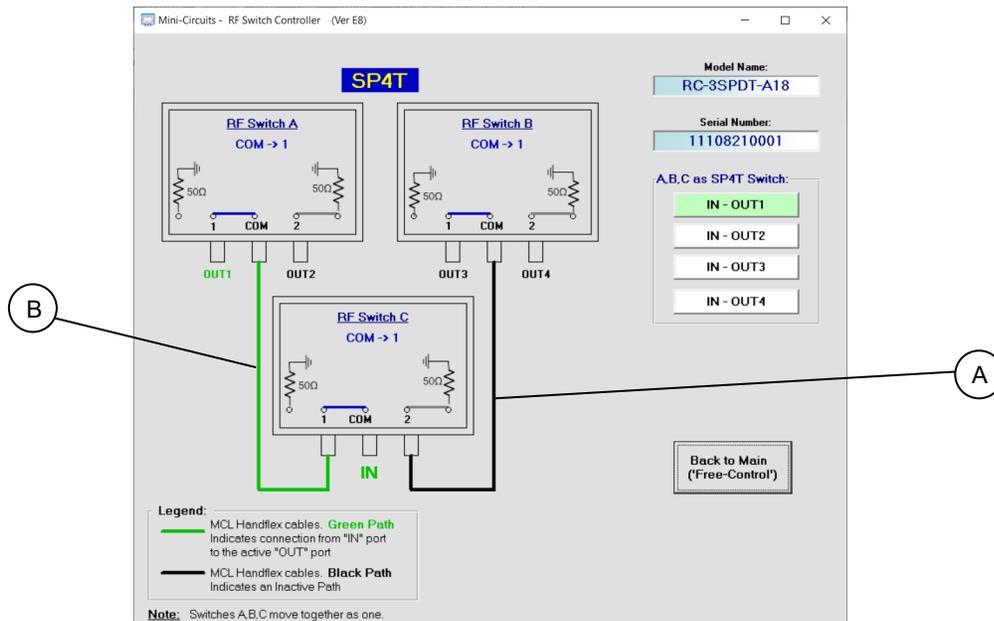

Figure 3.3.3.1: RC-3SPDT-A18 as a SP3T and SPDT

3.3.3.2 *RC-3SPDT-A18 as a SP4T switch*

Connect RF cables A and B as shown in **Fig. 3.3.3.2.** Clicking on the buttons on the right will change the state of the switches accordingly and the signal path and will be highlighted in green. In order to return to the main window, click on the 'Back to Main' button.

Figure 3.3.3.2: *RC-3SPDT-A18 as SP4T*

3.3.4 *RC-4SPDT-A18*

This model has four absorptive SPDT switches and can be configured as two DPDT, a 3PDT and a SPDT, or a 4PDT with no external RF cables needed (same procedure as **section 3.3.2.2**) or as two SP3T, a SP4T and a SPDT, a SP5T, or a transfer switch with external RF cables as shown in he relevant screen (same procedure as **section 3.3.2.1**) in addition to the default configuration of four independent SPDT switches. In the default configuration each switch state can be changed independently by either clicking on the button above the corresponding switch drawing (the button will change between 'COM->2' and 'COM->1' to indicate the current switch state) or in the user sequence window, opened by clicking on the user sequence button (see **section 3.4**).
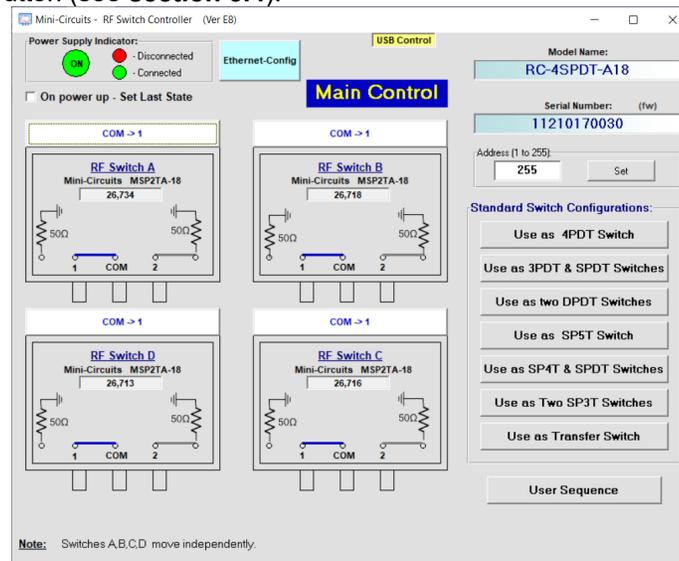

Figure 3.3.4: *RC-4SPDT-A18 main window*

3.3.4.1 *RC-4SPDT-A18 as a SP5T switch*

Connect RF cables A, B and C as shown in **Fig. 3.3.4.1.** Clicking on the buttons on the right will change the state of the switches accordingly and the signal path and will be highlighted in green. In order to return to the main window, click on the 'Back to Main' button.
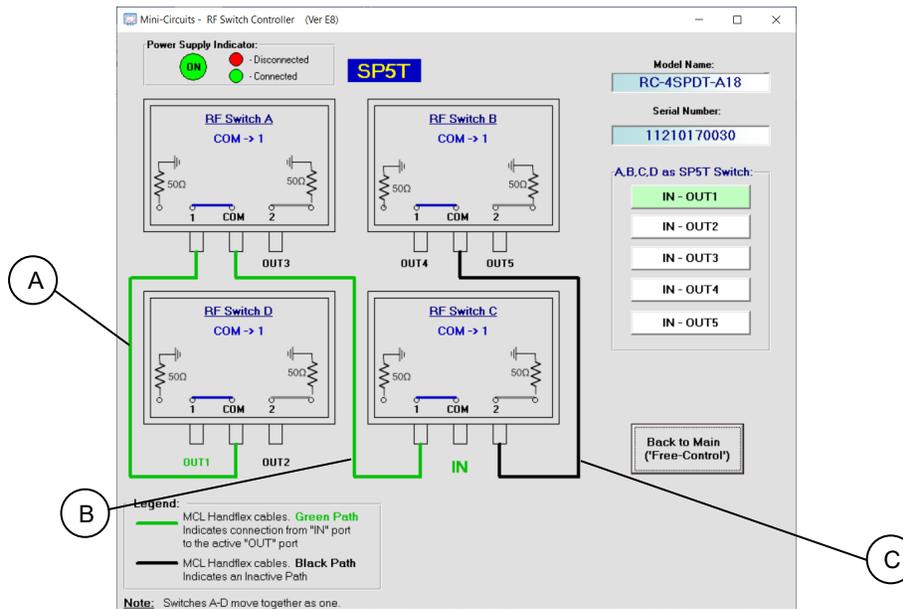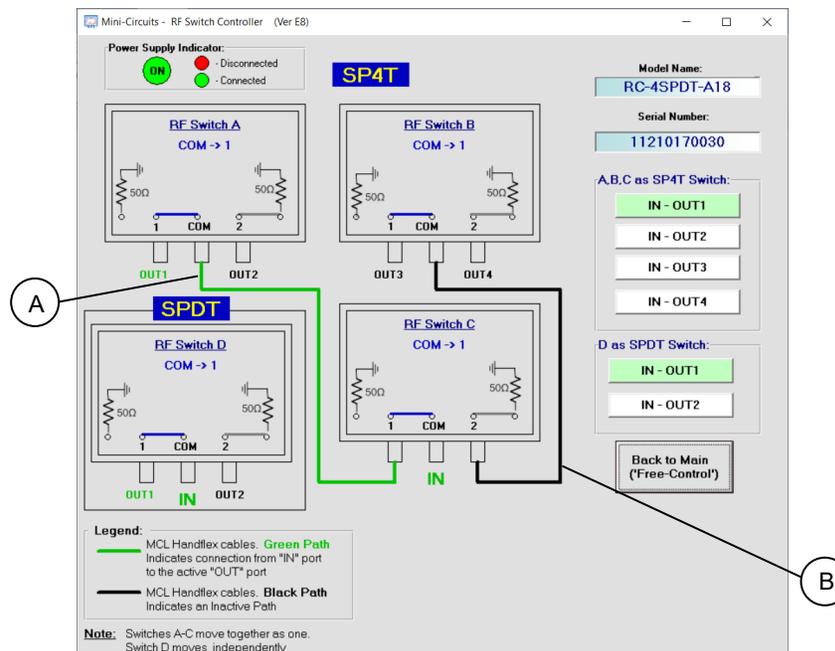

Figure 3.3.4.1: *RC-4SPDT-A18 as SP5T*

3.3.4.2 *RC-4SPDT-A18 as a SP4T, and a SPDT switch*

Connect RF cables A and B as shown in **Fig. 3.3.4.2.** Clicking on the buttons on the right will change the state of the switches accordingly and the signal path and will be highlighted in green. In order to return to the main window, click on the 'Back to Main' button.


Figure 3.3.4.2: *RC-4SPDT-A18 as a SP4T and SPDT*

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3.3.4.3 *RC-4SPDT-A18 as two SP3T switches*

Connect RF cables A and B as shown in **Fig. 3.3.4.3.** Clicking on the buttons on the right will change the state of the switches accordingly and the signal path and will be highlighted in green. In order to return to the main window, click on the 'Back to Main' button.
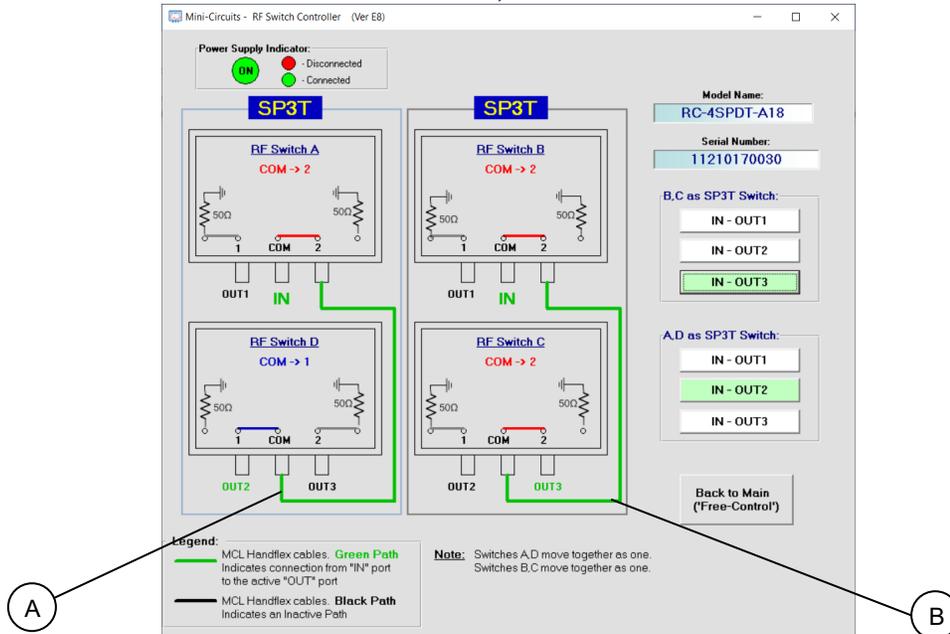
Figure 3.3.4.3: *RC-4SPDT-A18 as two SP3T*

3.3.5 *RC-8SPDT-A18*

This model has eight absorptive SPDT switches and can be configured in many different configurations in similar fashion to those shown in previous sections in addition to the default configuration of eight independent SPDT switches. In the default configuration each switch state can be changed independently by either clicking on the button above the corresponding switch drawing (the button will change between 'COM->2' and 'COM->1' to indicate the current switch state) or in the user sequence window, opened by clicking on the user sequence button (see **section 3.4**).
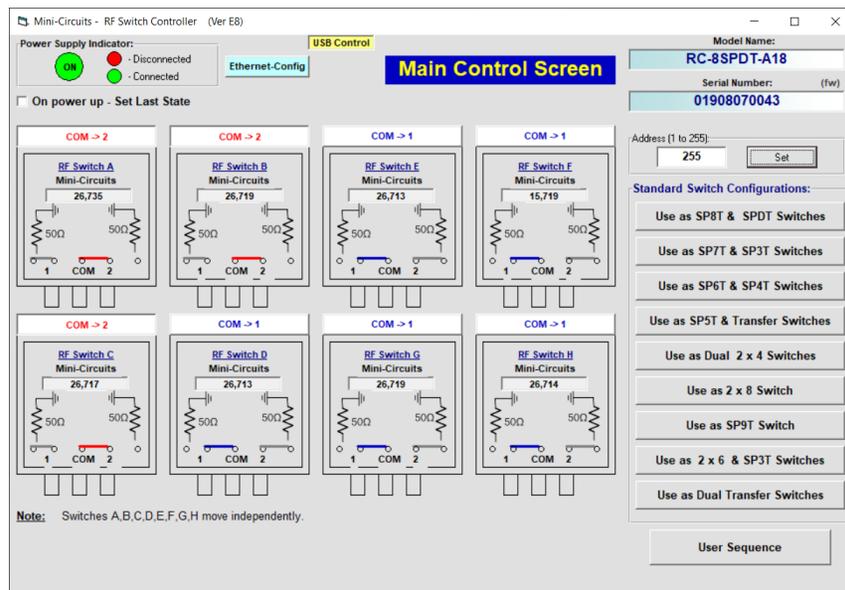

Figure 3.3.5: *RC-8SPDT-A18 main window*

3.3.6 *RC-1SP4T-A18*

This model has only a single absorptive SP4T switch and thus there are no additional configurations beyond that of an SP4T switch. The switch state can be changed either by clicking on the buttons on the right side of the screen in **Fig. 3.3.6**(the button will change color to indicate the current switch state) or in the user sequence window, opened by clicking on the 'User Sequence' button (see **section 3.4**).
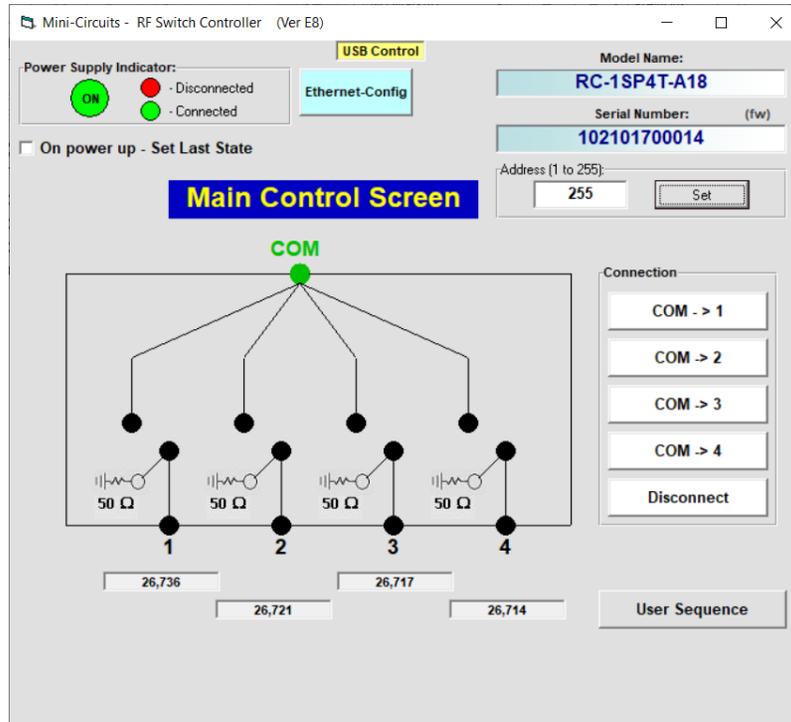

Figure 3.3.6: *RC-1SP4T-A18 main window*

3.3.7 *Re-starting the unit from last used state*

By checking the "On power up – Set Last State" option the unit will save the current state every 3 minutes and whenever the GUI is closed properly. When restarting the switch will assume the last stored state automatically.

Figure 3.3.7: *"Set last state on power-up" on USB main screen*

3.3.8 *Additional configurations not shown here*

For additional configurations not mentioned here of all models, or for configurations via Ethernet control, click on the 'User Sequence' button to open the user sequence window.

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3.4 *User Sequence*

Clicking on the 'User Sequence' button in the main window of any model will open a new window – the User Switching sequence window (see **Fig. 3.4.1**). This screen allows the user to run timed sequences of switching any of the switches in the model either individually or together, and run external programs synchronized with the switching sequence.

3.4.1 *User sequence screen buttons and indicators*

| #	Name	Description
1	Switching Set Name	Shows the name of the sequence displayed. If the sequence is not saved this indicator will be blank.
2	Switching Sequence	The list of commands in the sequence with an arrow pointing to the current command. Double clicking on the state of a switch in a command will change its state.
3	Switch states	Shows the state of each switch in the command. Double click on a state to change it.
4	Insert	Add the command above the current command
5	Add	Add a command to end of sequence
6	Count Limit	Enables setting a maximum number of cycles for the 'run continuously' option – Need to enter a number or uncheck option before clicking on 'run continuously'
7	Time Limit	Enables setting a maximum duration for the 'run continuously' option – Need to enter a value (in minutes) or uncheck option before clicking on 'run continuously'
8	Current Step	Run current command and remain on the same step
9	Continuously	Run all commands in the sequence, in a continuous loop until stopped by user or reach specified limit (if limit is set)
10	Stop	Stop the continuous run loop of all commands in sequence
11	Back to Main	Return to the initial screen of the model
12	View Switches	When selected opens a graphical presentation window beside the user sequence window (**Fig 3.4.2**)
13	Remove	Delete current command
14	Dwell time	The delay (in mSec) after toggling the switches to their new state before going to the next step (in 'run continuously'). If no value is entered the program will proceed immediately to the next step
15	Exec Program	If you wish to run an external program after changing the switches to their current state enter the file name here. File must be placed in C:\MCL_SwitchBox
16	Clear List	Delete all commands in sequence
17	Recall	Recall a previously saved sequence
18	Save	Save the sequence in one of 99 sequence registers. Unless specifically named sequence will be saved as Seq-XX where XX is the register number.
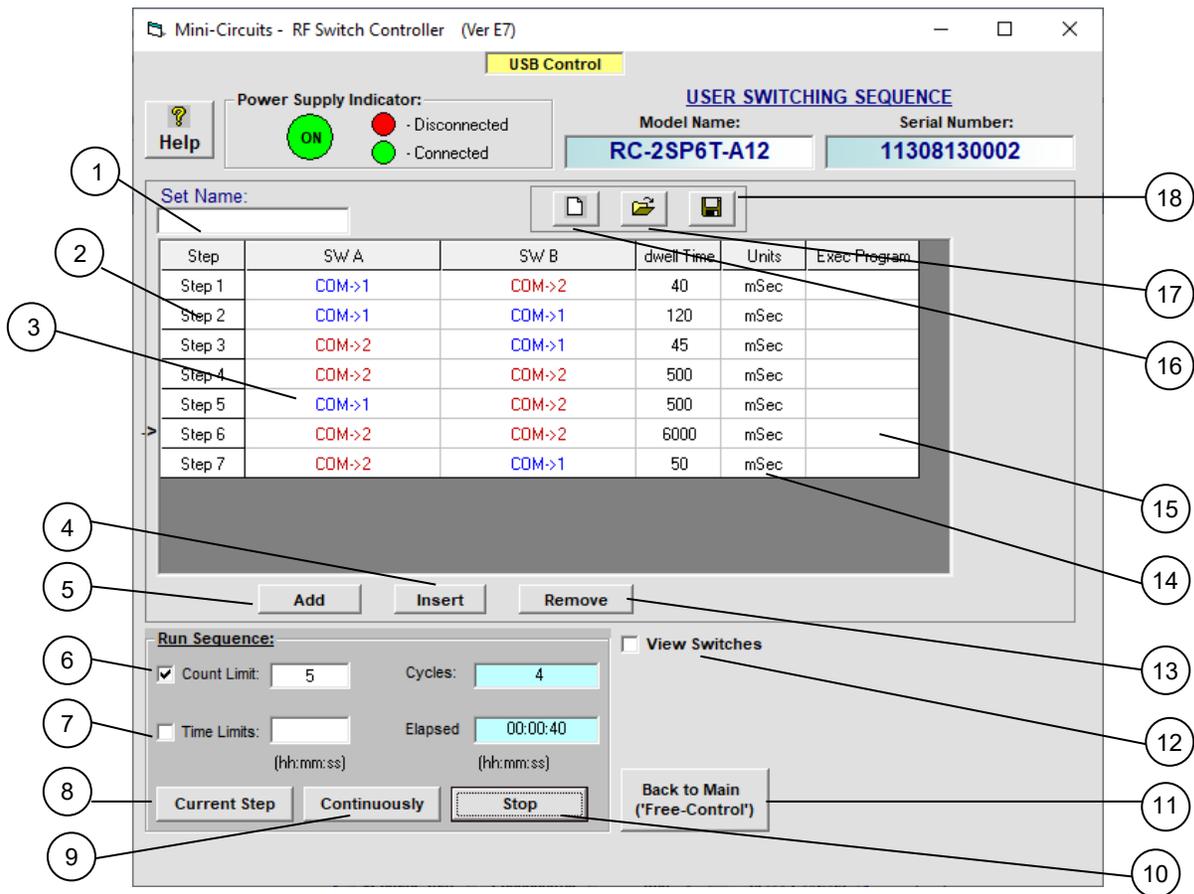
Figure 3.4.1: *User Switching Sequence screen*

Notes:
1. Typical switching time is 25 mSec, attempting to toggle a given switch twice with too short a delay between the commands may produce errors.
2. If time limit is set to a value which is not a multiple of sequence run time it will be rounded up to nearest multiple.

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3.4.2 *User sequence graphical switch presentation*

This window is opened beside the user sequence window by selecting the 'View Switches' option. This window shows the current state of all switches and allows you to illustrate multi switch setups by 'dragging' one of the connector circles to another switch's connector for example 2(A) to COM(B) (see **Fig. 3.4.2a**).

Each connector can be connected to only one other connector and cannot be connected to another connector in the same switch. Adding a second line between switches to a connector will erase the previous line and replace it with the new one.
Start and end of active signal paths are highlighted in the same color, with each signal path using a different color while the inactive connectors will remain white.
Clicking on the tab of a connector allows you to type in a new name for the connector instead of the default '1', 'COM' or '2'.
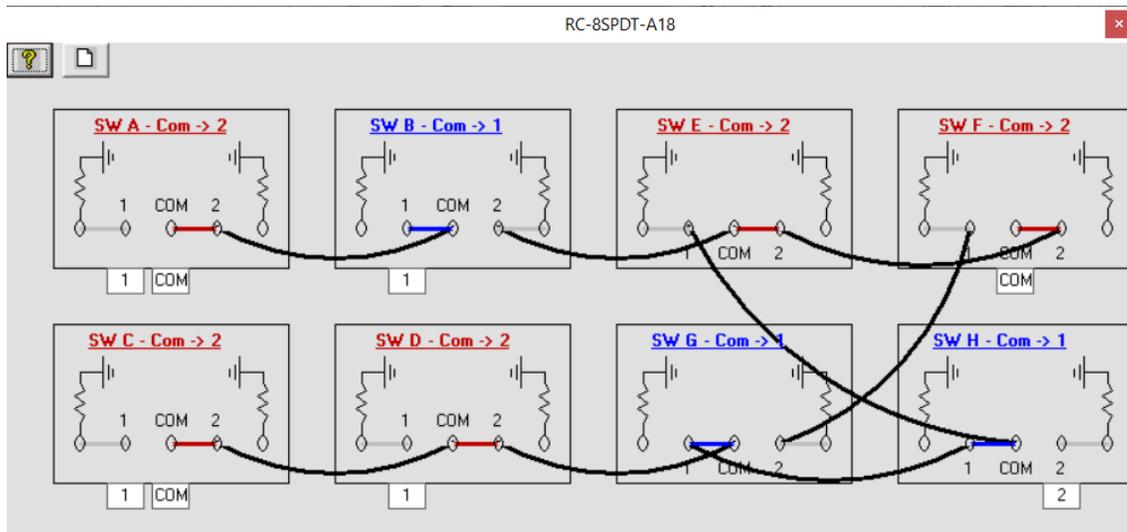
Figure 3.4.2a: User Switching graphical switch view window (8SPDT)
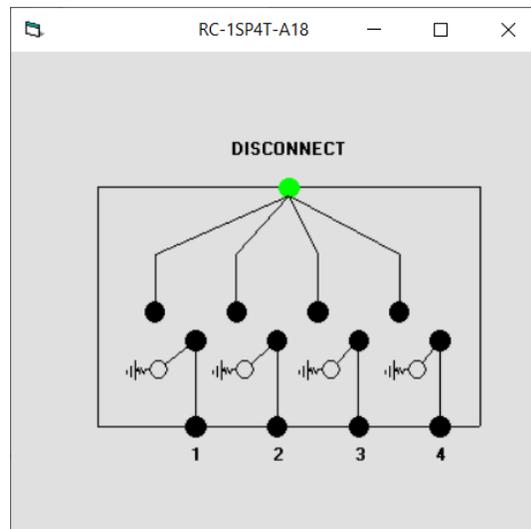
Figure 3.4.2b: User Switching graphical switch view window (1SP4T)

Note: Connections shown between switches need to be added by the user using external RF cables.

3.5 *Firmware update*

3.5.1 ***All Switch matrices are shipped with*** the latest available firmware and an update is usually not required. Mini-Circuits occasionally makes firmware update files available as a courtesy to add additional features or correct known issues. Please contact *testsolutions@minicircuits.com* for details.

3.5.2 ***Once the switch controller GUI*** *i*s installed and started (see chapter 2) you will note an **(fw)** indicator in the upper right corner of the main screen.
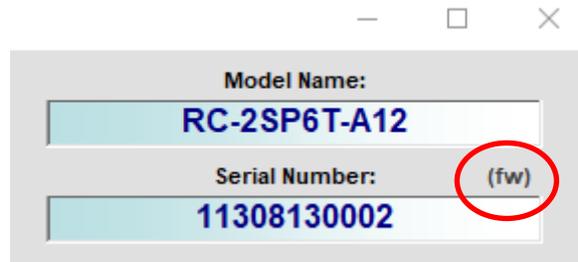

Figure 3.5.2 Firmware indicator on main screen

3.5.3 ***In order to update your switch matrix firmware,*** you must have a switch matrix unit with firmware revision B3 or later and a Windows computer with Mini-Circuits' Switch Controller software installed.

CAUTION	A power interrupt, to either the computer or the switch matrix while the firmware is being updated may cause the firmware to be corrupted. It is therefore recommended to only update the firmware while both the switch matrix and the computer are connected to an Uninterruptable Power Supply (UPS).

3.5.4 ***Click on the '(fw)' indicator,*** this will cause the firmware - info window to open (See **Fig. 3.5.4**). The 'Firmware' listed is the version of the firmware installed in your switch matrix. Click on "Update Firmware" to select a new firmware version to install or click 'Exit' to close the firmware – info window.
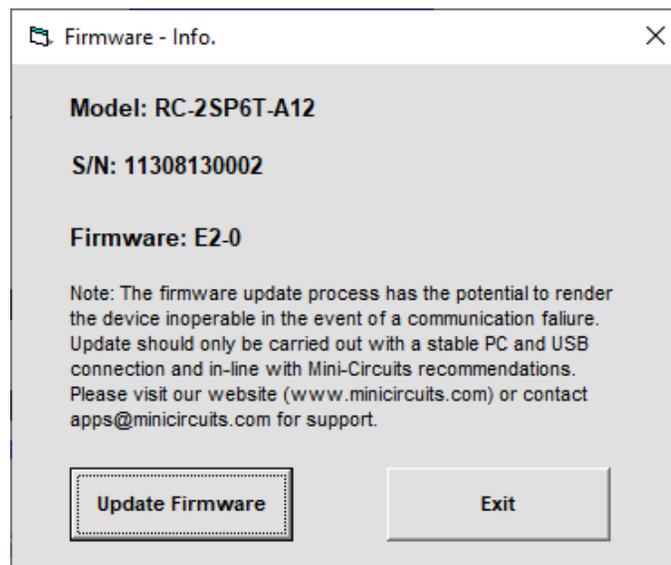

Figure 3.5.4: Firmware Information Window

3.5.5 ***A browse window will open to the firmware directory*** under the path you selected when installing the GUI program (See **Fig. 3.5.5**). Navigate to where you saved your firmware file, Select the firmware version you wish to install and click 'O.K'.
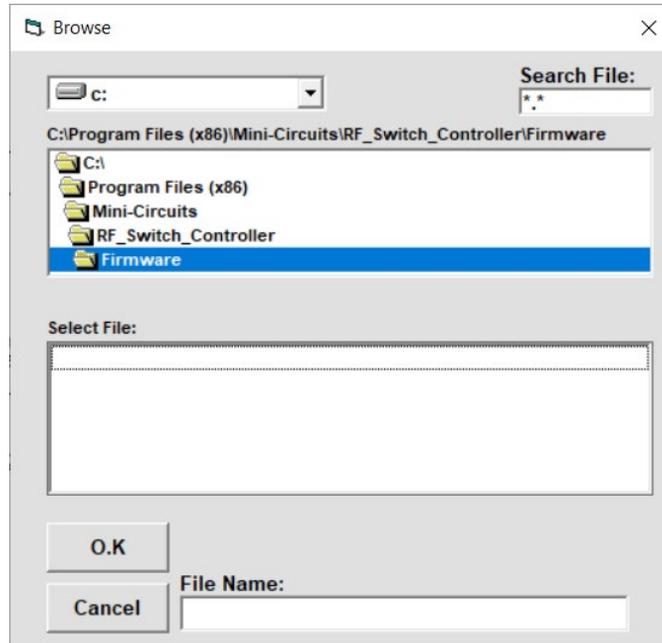

Figure 3.5.5: *Firmware - Browse Window*

3.5.6 ***The selected file will be installed in the switch matrix*** **the process** will take up to a minute.
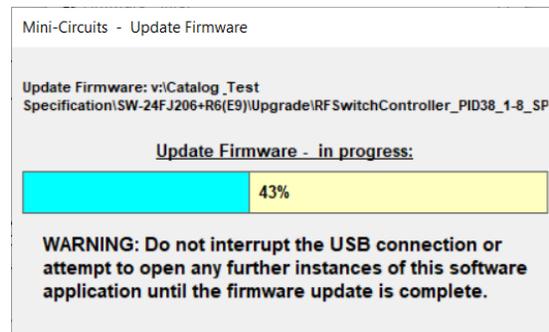

Figure 3.5.6: *Firmware - Progress Bar Window*

3.5.7 ***After the firmware has updated*** an alert will appear. Click 'OK' to shut down the Switch Controller program and then restart it normally.
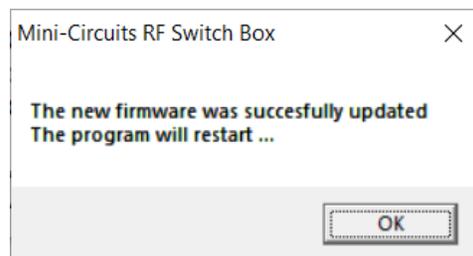

Figure 3.5.7: *Firmware - Successful Update*

3.6 Demo Mode

3.6.1 *This mode allows you to see all the* GUI functions of all switch matrix models available in the catalog.

3.6.2 *To start the Demo mode,* select the model requested from the drop box in the right side of the initial screen of the switch controller software and press "Start Demo" button. The default option of the demo mode is RC-1SP4T-A18.
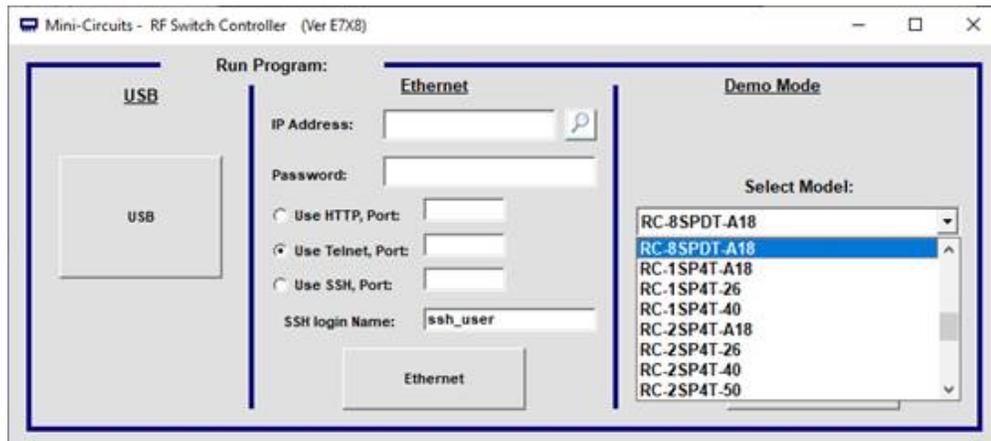

Figure 3.6.2: *Demo mode selection screen*

3.6.3 *The main screen of the model selected* will appear with all options available for the model selected, however they are simulated, with no communication to any unit connected to the computer. When in demo mode the unit S/N will show "not exist" instead of the unit's S/N and control method will be noted as "Demo control".
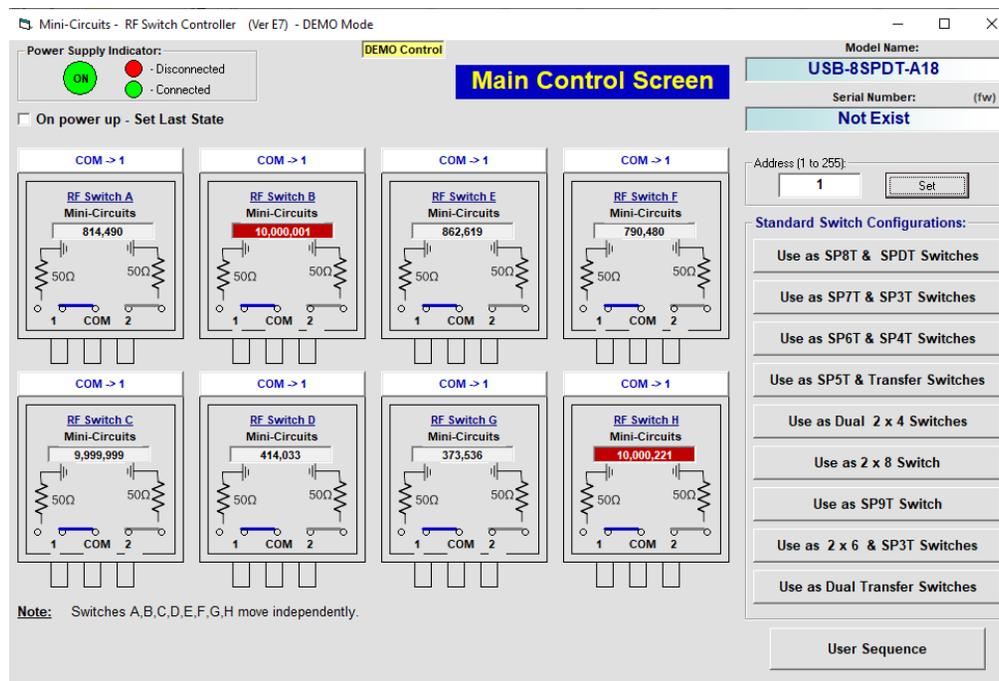

Figure 3.6.3: *Demo mode 8SPDT main screen*

Chapter 4 – Revision History

<u>Revision OR (Feb 06, 2014):</u>
- Initial revision of the user guide.

<u>Revision A (Dec 11, 2014):</u>
- Added legal notice.
- Moved trademark notice to the beginning of the user guide.

<u>Revision B (Dec 01, 2019):</u>
- Updated cover page to be more general.
- Added "Model Selection Guide" section.
- Removed "Accessories and Options" section.
- Updated "Software Setup and Installation" section.
- Updated overall GUI images.

<u>Revision C (Aug 15, 2021):</u>
- Updated "Model Selection Guide" section.
- Restructured "Starting the GUI Program" section.
- Added "Ethernet Configuration" section.
- Removed mention of obsolete USB series of switches.
- Updated images.

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