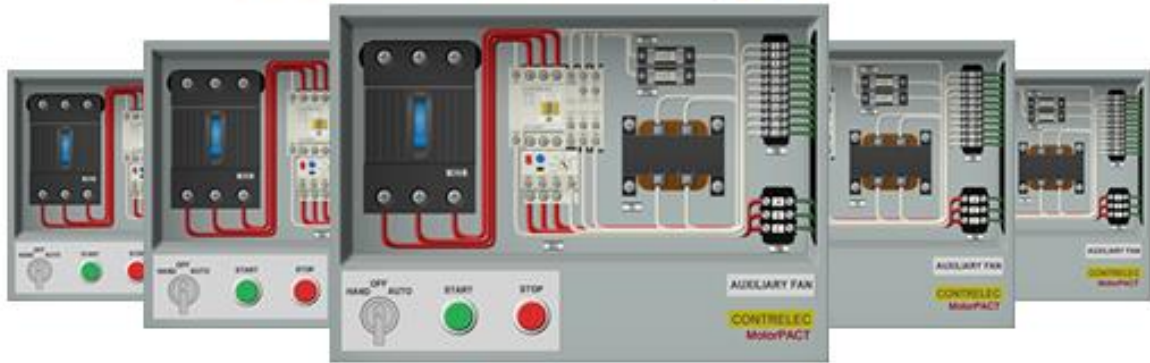# MCC*Logic*

User Manual

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2 INTRODUCTION

MCCLogic is a software simulation package for training electricians to troubleshoot electrical systems, and is based on a simple motor starter typical of types found in most Motor Control Centres (MCCs).

The software is built of two parts: the graphic representation of the system equipment, and a mathematical simulation of the analogue circuits. The student can probe terminals on the simulation screens and measure the voltage at each point. Faults can be applied to the circuit, which then allows the student to practice identification of faults by understanding the schematics and the observed measurements.

Faults can be introduced manually or from a pre-defined timed sequence of events controlled by a script running in the background. Scripts can be customised and saved and can create complex scenarios which will test the abilities of the most experienced technician.

The simulated system contains includes a remote control station (pendant) with additional controls

This program assumes that the user understands what a motor starter is, what it is used for and how it works, and is familiar with the terminology associated with it.

MCCLogic is the little brother of SCRLogic – a complete simulation of the SCR drilling motor controls on a drilling rig. For more information or to download a demo of SCRLogic please visit http://www.contrelec.co.uk/scrlogic.

3   INSTALLATION

The software is available as a free download from the Contrelec web site, and is completely free and unlimited to use. If you like the program, or use it regularly, please consider making a support contribution via the link in the program.

The software has complex calculations to perform to simulate the analogue circuitry, so a Windows (version 7 or later) PC with plenty of memory (at least 4Gb) and a powerful CPU will improve the user experience. The software will run on 32-bit machines, but these may experience memory problems due to memory fragmentation, so 64-bit is recommended. A mouse with a scroll wheel is required.

To install the software download the installation files from this link:

http://www.contrelec.co.uk/pages/mcclogic

This installs a demo of the version which has some features restricted (most notably scripting and a limited number of faults) and will time out after 20 minutes of use. To unlock all the features a full license is required.

4   LICENSING

The software is completely free and unlimited to use. If you like the program, or use it regularly, please consider making a support contribution via the link in the program.

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5 QUICK START

5.1 General Operation

On start-up the opening screen looks like this:

This shows an MCC starter can with the compartment door open.

Below the image are tabs which reveal various views associated with the equipment. To view the remote control pendant click

The view can be zoomed in using the mouse wheel or by clicking and dragging the slider to the left of the display.

To look at a particular part of the equipment click and hold down the left mouse button and drag the view.

To control an item, such as closing a circuit breaker or operating a switch, the CONTROL key is used. To operate a pushbutton hold down the control key and left-click on the button. To close the MCC circuit breaker navigate to the MCC screen, and hover the mouse over the blue lever of the moulded case circuit breaker and hold down the CONTROL key. Flick the mouse scroll wheel up to close the breaker and the circuit breaker will be heard to close. To open the breaker, repeat the process, but this time flick the mouse scroll wheel down.

Close the breaker and turn the LOCAL-OFF-REMOTE control switch to LOCAL by hovering the mouse over the switch and flicking the mouse scroll wheel down while holding down the CONTROL key.

With the CONTROL key held down, left-click the START pushbutton and the contactor will be seen and heard to pull in. The starter is now in the running state.

Don't forget to click the START button again to release it (this method of operating the pushbuttons is so that it is easier to fault find within the simulation).

Take a look at the remote control pendant by clicking the REMOTE tab at the foot of the screen.

Note that the running indication lamp is now bright.

Starting control can be transferred to the remote pendant by turning the starter control switch to REMOTE. Note that the STOP pushbuttons work regardless of the position of the control switch.

5.2 Fault Finding

An essential part of troubleshooting is to be able to measure voltages at various points in the circuit. Navigate to the MCC view. Hover the mouse over the top left-hand terminal of the moulded case circuit breaker
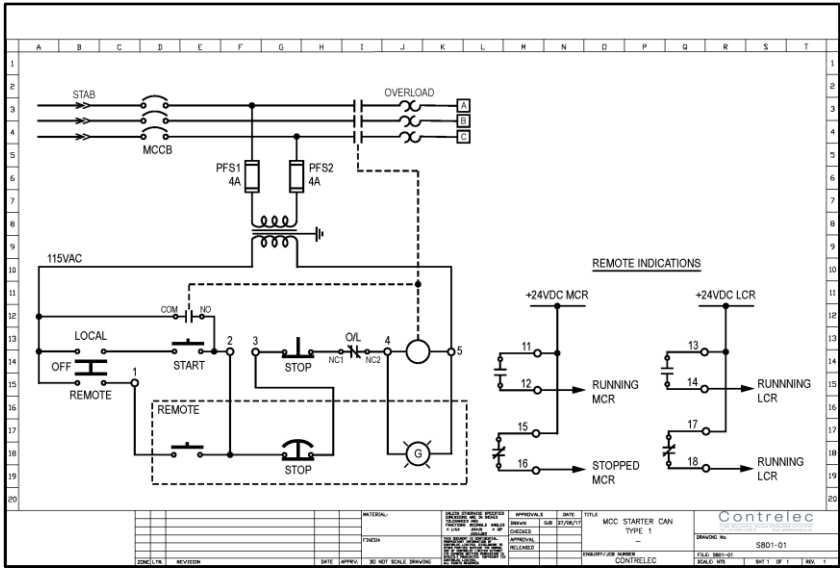

The connection will highlight and the mouse cursor will change to a probe. In the bottom right hand corner of the screen the ID box will show MCC and the Term box will show 1 indicating that the terminal is MCC-1-.

Click and hold the mouse right-hand button and a meter pops up showing the measured value. The meter is auto-ranging and auto-sensing, so will automatically switch range and AC or DC. Release the mouse button and the meter stays in place.

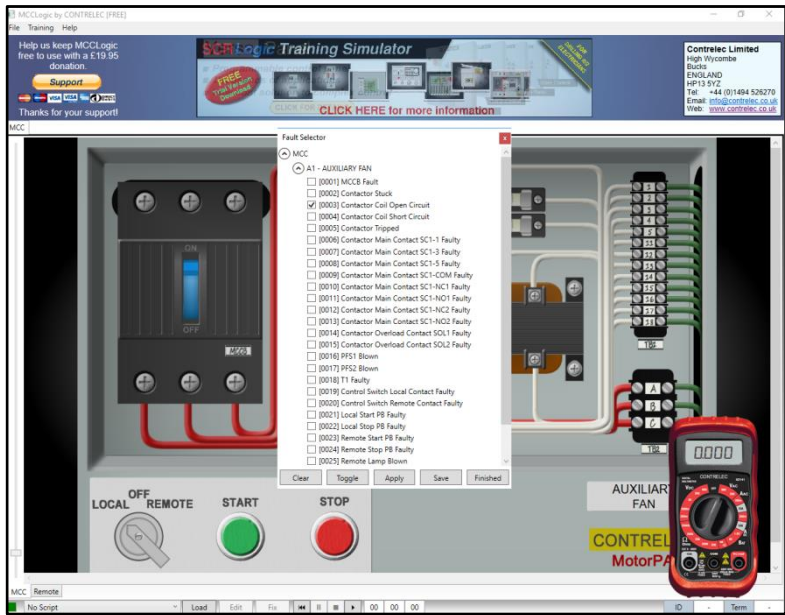To make it disappear and re-appear on every probe check the Training→Auto Hide Meter option on the main menu. Probe the other terminals to get a feel for how this works.

Now let's try some fault-finding.

To troubleshoot the simulation you will need some schematics. Select Help→Schematics to open up the system drawing, which is a PDF file which can be printed off for easier working (A3 recommended).

Measure the voltage at various points on the schematic with the MCCB closed and the starter stopped and running.

Set the starter running, then select Training→Fault Selector, expand the MCC tab, then A1 – AUXILIARY FAN. Check the Contactor Coil Open Circuit box then click Apply. The contactor will open. Close the fault selector window by clicking Finished.

Follow the 115VAC logic through from the transformer secondary to the contactor coil to verify the starter circuitry. (Tip: the START pushbutton will have to be 'held in' by CONTROL Left Clicking once).

The fault can be cleared several ways, but this time click Training→Fix Fault, expand MCC and A1 – AUXILIARY FAN. Click the Contactor Coil SHORT Circuit box and click Fix. The system will tell you that the wrong fault has been identified. Repeat the process but this time select the correct fault (Contactor Coil OPEN Circuit).

Once fixed, the contactor may pull in straight away if the START pushbutton is 'held down'. Click the START pushbutton to release it.

5.3 Additional Tips

Please read through these notes:

Moving Between Locations

When fault-finding remember that moving between the MCC and the remote location is quick in the simulation, but may be a lot slower in real life. Practice your fault finding with this in mind.

Pushbuttons

These require a CONTROL-click to set and a CONTROL-click to release. This is to allow fault finding to be done with the button pressed.

Processing Indicator

In the bottom left-hand corner of the screen is an indicator showing the status of the simulation. During normal operation the indicator flashes green/grey, but if the simulation fails it will turn red, and may require a program restart.
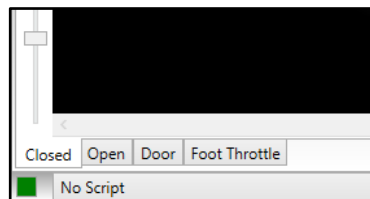
Multiple Faults

Take care when introducing multiple short-circuit faults. The simulation can be forced into an unresolvable configuration when power supplies are short-circuited together.

Fault List

A complete list of available faults can be obtained for reference by selecting File→Print Faults.

Sound Mute

The program sound effects can be silenced by selecting Training→Sound Mute

6 SCRIPTING

MCCLogic users can write, load and run scripts (this feature is restricted to full license holders in SCRLogic).

Scripts are pre-programmed sequences of timed events. An event can be an instruction, alert, fault set or fault fix. Once written they can be loaded and run to create complex fault scenarios for students.

6.1 Example Scripts

A number of scripts are provided as standard:

Name   Description

SCRIPT-001   Contactor Trip

SCRIPT-002   Fuse and Transformer Fault

SCRIPT-003   Latching Contact Fault

SCRIPT-004   Remote Contact Faults

SCRIPT-005   Remote indication fault and overload contact fault

6.2 Creating a New Script

Scripts are created and edited using the Script Writer which is accessed by selecting File→Script Writer. Note that for the Script Writer to be available no script must be running.
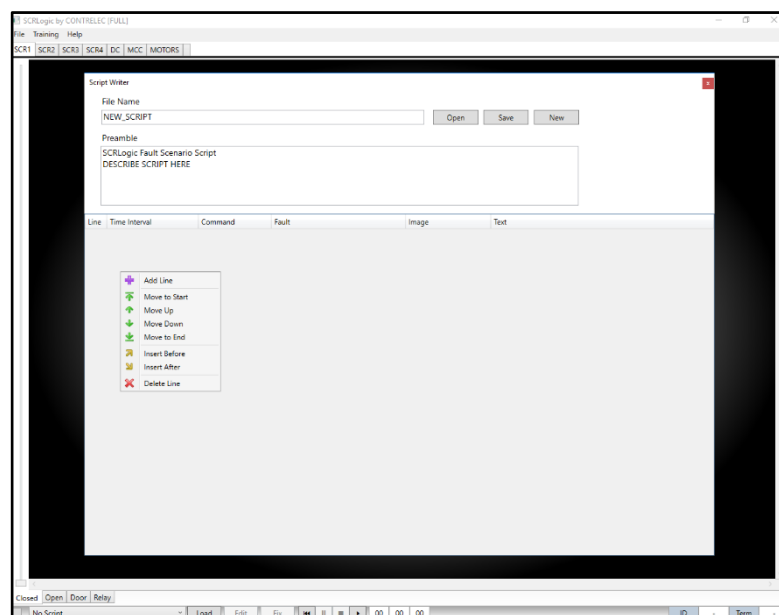
It is recommended to create a new script by editing an existing one and saving under a new file name, but to start from scratch opens with the default script template which contains only the file name and a dummy header.

Enter the script File Name and some descriptive text for the Preamble. The Preamble is never visible when the script is run, so details about the script can be explicit.

Below the Preamble box is an empty table which will list the script events. To create a new event, right-click in this area and select Add Line to create a new event line. Continue to add lines in this way to build your script.
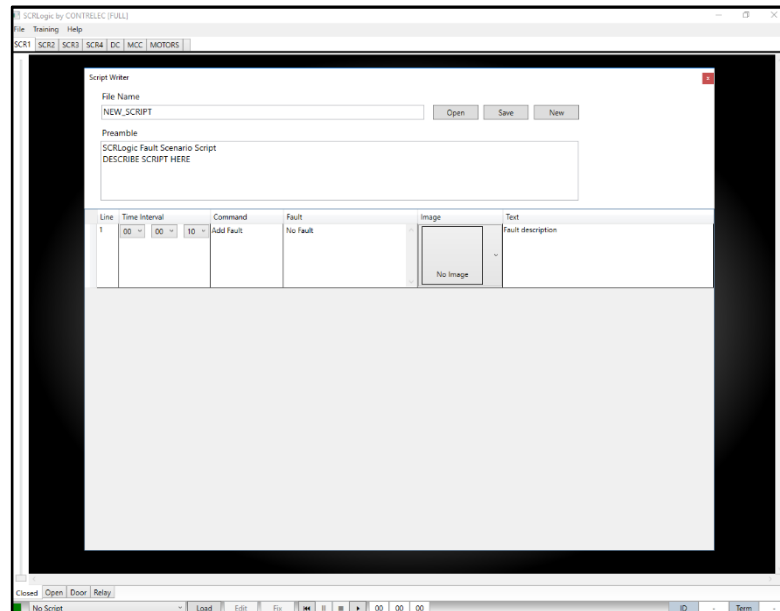
Once complete, save the script by clicking SAVE.

The contents of each line are as follows:

<u>Time Interval</u>

This sets the time delay between the previous event and this one. For example, a Time Interval of 15 seconds in the first event means that the event will not occur until 15 seconds after the start. Time Intervals of zero are permitted to allow several events to occur at the same time.

Command

There are four basic commands, which can be selected from a drop-down list:

- Instruction (requires resume)
  This displays a message box, and is use to provide instructions to the user on things like how to set up the simulator before starting, what to do next. It also pauses the script to allow longer messages to be read, so the user must click the PLAY/RESUME button in the script transport controls at the foot of the screen.

- Message
  Similar to an Instruction except that the script is not paused.
- Add Fault
  Allows a fault to be applied to the system.
- Fix Fault
  Allows a previously applied fault to be 'fixed'.
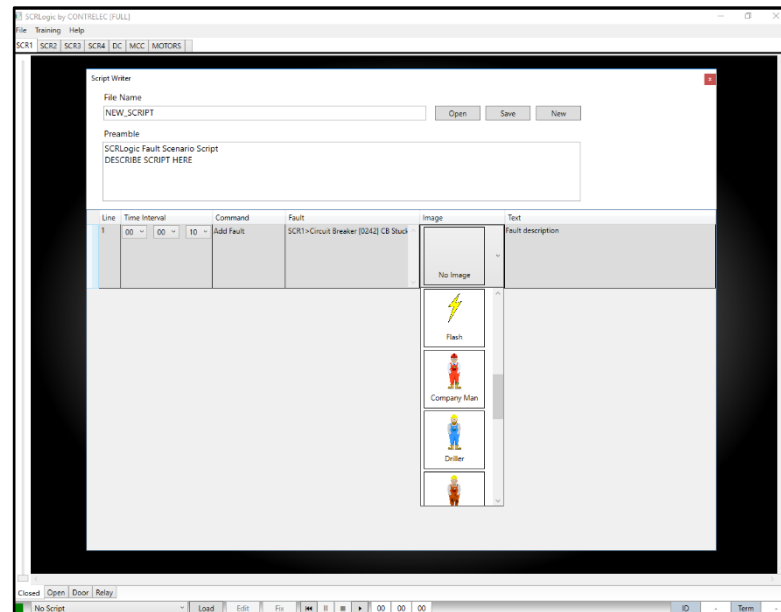
Fault

In association with the Add Fault or Fix Fault commands a system fault can be selected from an expandable, categorised list of available faults. The faults are pre-set within the program and can not be altered. This setting is ignored with the Instruction and Message commands.
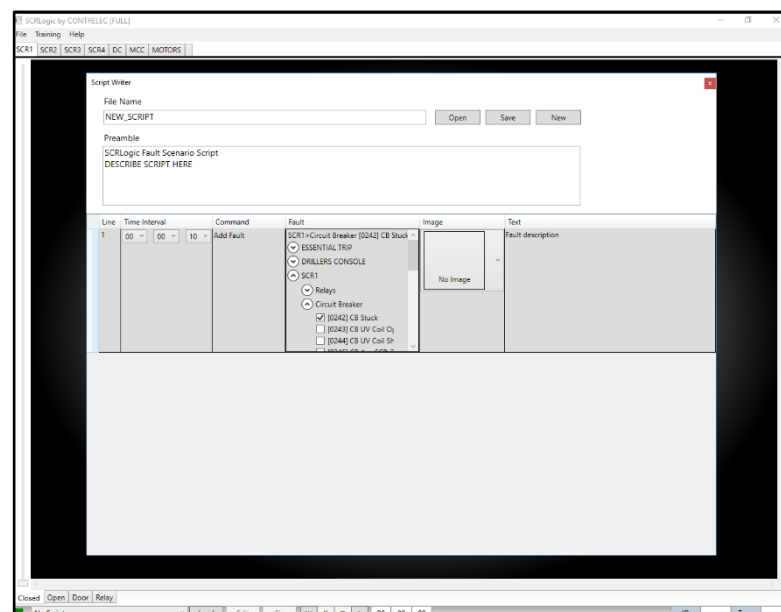
Image

An image can be selected from a small library to be displayed alongside the message which appears for as events occur. For no image, select No Image. This setting is ignored with the Add Fault and Fix Fault commands.

Text

In association with the Instruction and Message commands, the text to be displayed is entered here. Plain text or HTML (for better formatting control) can be entered. To display no text (i.e. for simultaneous events or 'quiet' faults) leave this box empty.

6.3 Editing an Existing Script

To edit or modify an existing script, open the Script Writer (File→Script Writer) and click the OPEN button. Using the file browser navigate to the required script, select it then click OPEN. Note that for the Script Writer to be available no script must be running.

The contents of each line can be altered individually, but to add, insert, move or delete lines access the menu by right-clicking the script line area:

Adding Lines

To add a line at the end of the script right-click the script line area and select ADD LINE.

Inserting Lines

Lines can be inserted above or below the selected line.

Select a line, them right-click and select either Insert Above or Insert Below as appropriate.

<u>Moving Lines</u>

Lines can be moved to the top of the list by right-clicking the line and selecting Move to Top. Similarly, a line can be moved to the end by right-click→Move to End.

To move a line up or down one step at a time, right-click then select Move Up or Move Down as required.

Lines can also be moved by left-clicking and dragging into position.

<u>Deleting Lines</u>

To delete a line right-click it and select Delete Line from the menu.

6.4 Simultaneous Events

Events can be set to occur simultaneously by entering a time interval of zero between them. For example, to make 3 events occur after an interval of 5 minutes from the previous event, give the first event an interval of 5 minutes but give the next two event a time interval of zero.

This means that the first event will occur after an interval of 5 minutes, and the next two immediately afterwards.

With simultaneous events, you may only require a single message to the user, so leave the first two text boxes blank and enter your message in the third event text box.

Demo SCRIPT-001 has an example of simultaneous events (events 2 & 3).

## 6.5 Loading and Running Scripts

<u>Loading</u>

A script must be loaded before it can be run. Please note that loading a script is not the same as opening it for editing in the Script Writer.

To load a script, select File→Load Script or click the Load button at the foot of the screen. Select the script to be loaded from the File Browser, and once loaded it will appear as an option in the Script Selector at the foot of the screen.
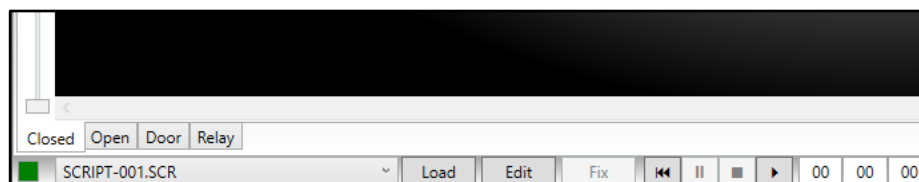
Note that, with a script loaded, the Edit button becomes available, and can be used to open the Script Writer to make changes to the script.

Any number of scripts can be pre-loaded in this way, and each one can be selected for running from the Script Selector
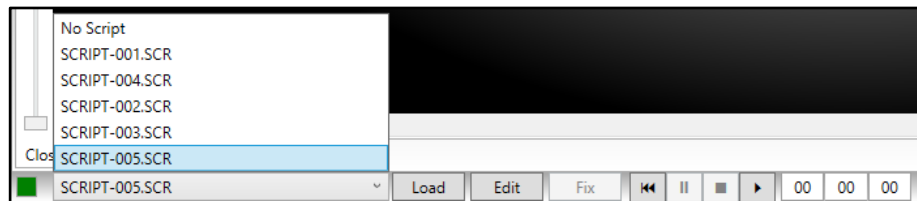
Running

To run a script first select it from the loaded scripts in the script selector then click the Play/Resume button in the script transport controls at the foot of the screen. To ensure a script runs from the beginning click the Rewind button first.

When a script is running the time counter at the foot of the screen increments, and messages will appear or faults will be applied in accordance with the scripted instruction. One of the script commands, Instruction, pauses the timer to allow the user to take actions as instructed. Once complete the Play/Resume button must be clicked to restart the timer and complete the remainder of the script.

Pausing

A script can be paused at any time by clicking the Pause button in the transport control.
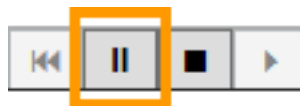
Stopping

A script can be terminated by clicking the Stop button in the transport control. Note that stopping a script does not automatically clear all outstanding faults. To clear all remaining faluts click Training→Clear All Faults


Correcting Faults

As the script runs, one or more faults will be introduced which must be identified using a systematic method of fault finding. Not only must the faulty component be identified, but the nature of the fault must be determined (i.e. short circuit, open circuit, stuck).

Once the user is confident that the fault has been identified a fix can be applied by clicking the Fix button. The exact fault must then be identified from the expanding list of faults available. If a fault is correctly identified the program will confirm this and an internal fix applied.

Finishing The Script

The script will announce when all commands have been executed all faults fixed.
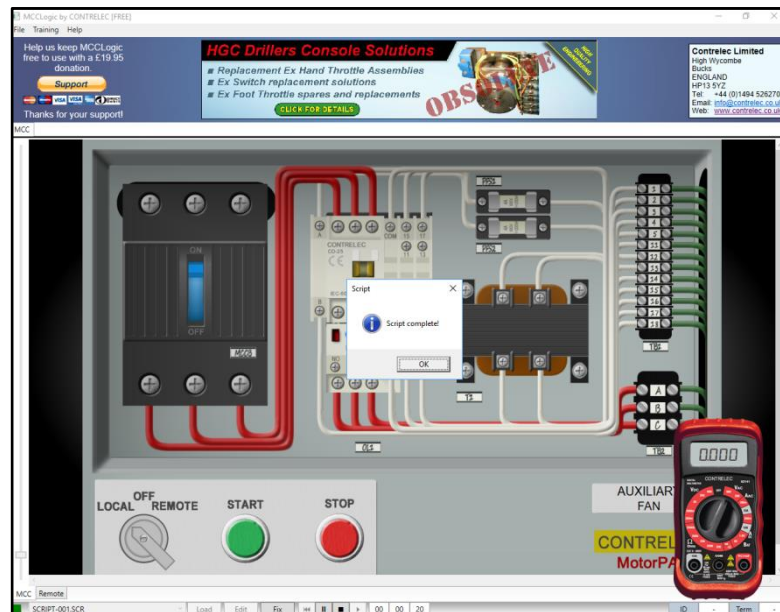
7   MENU COMMANDS

7.1 File Menu

Load Script

Scripts must be loaded before they can be run. This option opens the File Browser to choose a script to load for execution. To edit or create a script, see the section on Scripting.

Script Writer

The Script Writer is an editor for creating and modifying scripts. Refer o the Scripting section for more details.
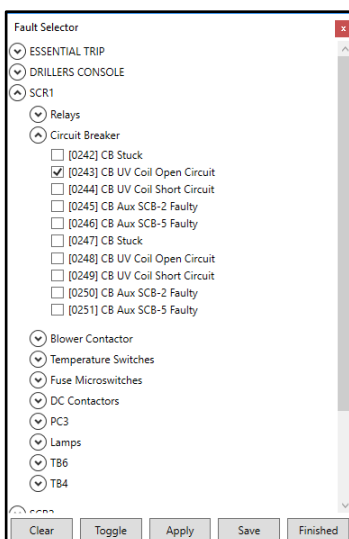
Print Faults

This option provides a structured text file of all the faults available within the program which can then be saved and printed.

Exit

Closes all windows and exits the program.

7.2 Training Menu

Fault Selector

The fault selector is used to manually select and apply faults.

Faults are grouped and categorised into expanding sections. To open or close a group or section, click on the expander button.

Faults are selected by clicking the check box, and fixed by un-checking, but the action is not performed until the Apply button is clicked.

The Clear button clears all selections and applies fixes to outstanding faults.

The Toggle button inverts the selection. The selection is not applied until the Apply button is clicked.

Save will store the current fault selection but will not apply it.

Finished closes the window but does not save the current selection or apply it so these actions must be performed before closing the window.

Apply Selected Faults

This applies the fault scenario currently selected in the Fault Selector

Clear Faults (Keep Selection)

This fixes all faults currently applied but does not clear the selection in the Fault Selector so it can be re-applied later if required.

Clear All Faults and Selection

This option fixes all faults and clears the selection in the Fault Selector.

Fix Fault

Opens the Fault Selector in to fix a fault. Only one fault can be selected for fixing and the program will confirm if the fix was successful. To fix more than one fault at a time use the Fault Selector option.

Fix Fault is intended to be used by trainees during an exercise or when running a script.

Start Timer

Starts the script timer running. The timer can be used without running a script as a performance measure when tracing manually applied faults.

Stop Timer

Stops the timer and consequently the current script if loaded and running.

Reset Timer

Stops the timer and consequently the current script if loaded and running.

Sound Mute

Mutes all sound effects when checked.

Auto Hide Meter

Automatically hides the meter when not being used. To keep the meter visible all the time un-check this box.

7.3 Help Menu

MCCLogic User Manual

Opens a PDF version of this manual.

Schematics

Opens a PDF of the schematic associated with this simulation.

About MCCLogic

Displays information about the program version.

Contrelec Web Site

Opens a browser at the Contrelec web site (http://www.contrelec.co.uk)

8 FAULT FINDING TIPS

Here are some tips for safe, fast and efficient fault finding:

Be Safe

Always work safely with suitably rated equipment. Handheld meters should be rated at least up to 1000VDC and the probes should be similarly rated and in good condition.

Understand the Circuit

There is no substitute for a good understanding of how the circuit SHOULD work. Study the schematics or seek further training to improve understand.

Check Your Instruments

Although not an issue with this simulator in real life faulty instruments can waste time. Check also that the coloured leads are correctly inserted and in the correct connection points for the type of measurement you are taking (i.e. not crossed or in the wrong place). Always check the polarity of DC readings. Don't assume that because you see 14V it is minus 14V, or vice versa.

Methodical Approach

Work methodically through the schematic and make NO ASSUMPTIONS. Disregard any pre-conceptions about what might be wrong. This simulation makes it easy to move between the MCC and the remote station. In reality this may be time consuming and inefficient. Take as many measurements as possible from one location to pinpoint the location of the fault.

Make Notes

Make notes of measurements on a copy of the schematic. This will save time and remove guesswork from the process.

Fix the Obvious

If something is obviously wrong fix it first. This may seem obvious except you may be pursuing what you think is an unrelated fault but another obvious fault might be affecting your ability to be able to pinpoint the fault you are pursuing.

Keep Records

Records of faults are extremely useful for identifying repeat failures and components which may be under-rated. They can also be useful as a short cut when tracing new faults, but don't be unduly influenced. The methodical approach will always get to the root of the problem.