

# RelayPro™

# User Manual



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## 1. INTRODUCTION

### 1.1 WHAT IS RELAYPRO

RelayPro is an automated relay tester that performs rapid testing and analysis of a relay's operation. Simply plug in relay, select relay type and press 'TEST'. RelayPro's auto logic identifies Pass/Fail status of the relay automatically.

RelayPro tests Static contact resistance, Contact configuration, Contact switch time, Coil resistance, Coil power, Energize voltage and Release voltage.

RelayPro displays Test Results in table and graphical format. Reports are created automatically and can be printed in single or batch modes.

RelayPro suits many styles of relays, including BR-930 Style Q Relays, US&S PN150/PN250, GRS/Safetran vital plug in relays and NS.1 relays. Customised solutions may be available to suit other applications.

RelayPro is capable of testing 5V DC to 50V DC Relays (Other voltages upon request).

### 1.2 WHY USE RELAYPRO

- Reduce downtime in your signalling system
- Reduce maintenance costs
- Implement preventative maintenance
- Easily track down previously hard-to-find faults
- Clean contacts with the RelayPro controlled current burst cleaner
- Know the condition of your relays

### 1.3 WHAT TYPE OF RELAYS CAN BE TESTED

RelayPro is capable of testing many styles of relays. An external port labelled Test Base at the rear of the unit allows for connection to a relay base. This may be wired to suit any style of relay being powered by 5-50V DC. This port is capable of testing up to twenty contacts simultaneously.

The list of testable Relays is updated frequently, in accordance with client requests. The list in Appendix 2 is current at time of publication. Please contact [support@mrd.com.au](mailto:support@mrd.com.au) if you have an application that is not on the list. Relay types can be tested if the specification details are added to the Profile Table (Section 4).

If a Relay fails a test, please ensure the profile table for selected relay matches the manufacturer's specification. Please see Section 4 (Profile Editor) for instructions.

### 1.4 LIMITATIONS

RelayPro tests and documents specific Relay performance parameters, assisting Operators to assess operational condition. Operators are required to perform Visual inspections.

RelayPro tests a relay to the test parameters set and stored by the user in the profile table. Please see 'Tests Performed' for details of how a relay is tested. RelayPro does not test a relay for reverse voltage operation and AC immunity as this is not practical in a portable test unit of this size.

As each user has different performance requirements for the relays they are testing, the profile table can be edited. It is the responsibility of the user to produce and ensure test parameters are correct. A profile table is provided with the system to get user started.

## 1.5 PERFORMANCE SPECIFICATION

Contact Resistance	+/- 1% + 0.001Ω, 0.001Ω resolution
Coil Resistance	+/- 1% + 0.1Ω, 0.1Ω resolution
Contact Switch Time	+/- 0.01 sec, 0.001s resolution
Flash Clean Current	100mA to 3000 mA CCS +/- 1%
Voltage Output	0 – 50V @ 500mA (+/- 1% + 0.1V, 0.1V resolution)

## 1.6 POWER REQUIREMENTS

Voltage	12-24 Vdc
Current	3.75A (minimum)

(Targus APA30 Notebook PSU or similar is suitable)

## 1.7 SOFTWARE

- Operating System: Microsoft Windows XP or higher
- Install RelayPro software from CD or USB drive.

## 1.8 SETUP - HARDWARE INSTALLATION

- Connect provided USB cable between computer and the RelayPro test box
- Windows will recognize the RelayPro as a new device. The USB driver is located on the installation CD or USB Drive, or in the folder \RelayPro\USB driver
- Plug power cable into power socket located on rear of the test box
- Connect the RelayPro and Test Base using the 50-pin D-Sub cable
- Switch test box on. Switch located on back of test box
- Front power indicator should illuminate
- Execute RelayPro.exe to begin testing relays.

## 2. SCREEN OVERVIEW

The following overview will help you to familiarize yourself with the RelayPro testing environment. RelayPro’s main screen is divided into seven boxes. Contained in these boxes are the following categories: Report Details, Relay Parameters, Status Window, Controls, Contact Results, Coil Results and Relay Data/Notes.

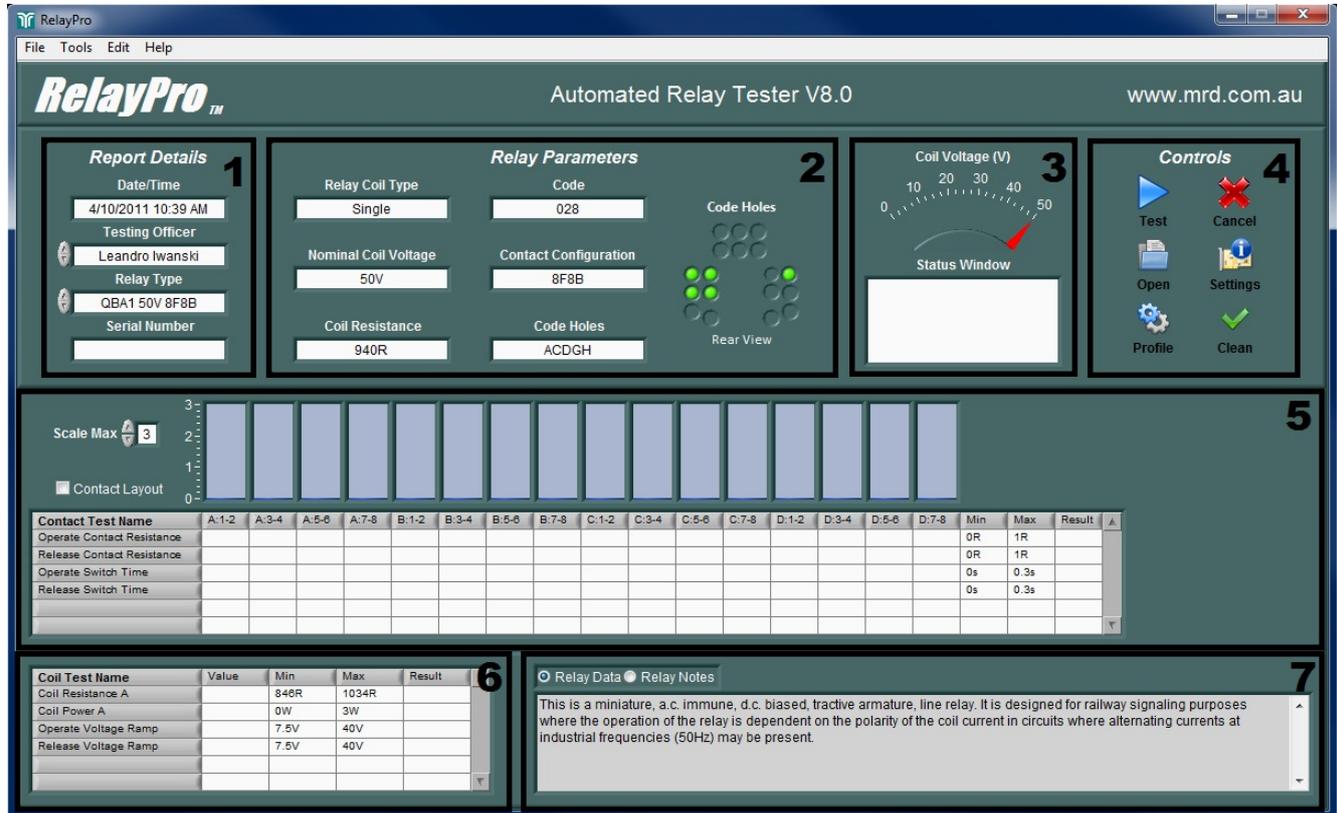


Figure 1 – Screen Overview

### 2.1 REPORT DETAILS

Information selected in the ‘Report Details’ box appears on the test report for each relay.

#### 2.1.1 Date/Time

The current Date/Time appears on each test report.

You can also open the Date/Time properties dialog box by clicking Start, Settings, Control Panel and then double clicking Date/Time.

#### 2.1.2 Testing Officer

By clicking in the Testing Officer window or clicking the up/down arrows located beside this parameter, the current Testing Officer can be changed. The selected Testing Officer is printed on the report when testing a relay. This person also appears as signatory on the test report. You can add/delete Testing Officers names and change access rights through the User tab in the Settings window.

#### 2.1.3 Relay Type

Set the Relay Type by selecting from the list. The Relay Type setting recalls Relay Test parameters, and appears on the test report. You can add/delete relays by editing the Relay Profile.

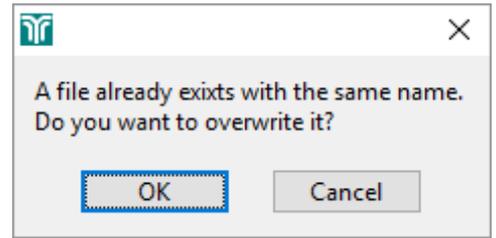
**Note: RelayPro DOES NOT automatically identify the Relay. The Relay Type must be correct otherwise the Relay may be overloaded under test.**

### 2.1.4 Serial Number

Enter the Relay’s serial number in this field. The Serial Number controls the filename of the PDF report. For example, serial number Q123456 will generate report file Q123456.pdf.

Note: The software creates the filename using the exact text of the Serial Number: No on-the-fly changes are possible. If the Serial Number is not changed, RelayPro will overwrite the existing file.

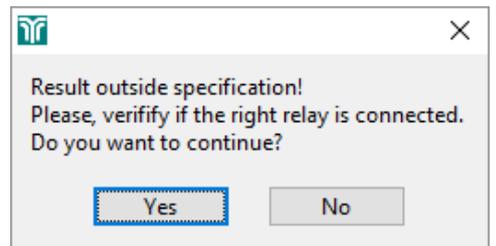
RelayPro warns before overwriting any file.



## 2.2 RELAY PROTECTION

RelayPro initially tests the Relay Coil Resistance and compares this to the allowable range defined in the Test Parameters. If the measured resistance is too low or too high, RelayPro displays a warning message. Operators are expected to review their actions when warnings appear.

**WARNING: Ignoring the warning message may cause damage from high voltage being applied.**



Note: Test Parameters are secure. Only Administrators may modify The Relay Profile.

## 2.3 STATUS WINDOW

The Status Window displays the actual relay coil voltage and additional test information.

## 2.4 CONTROLS

The Controls box contains the frequently used controls of the RelayPro. Other controls and functions can be found in the menu options located horizontally at the top of the screen.

## 2.5 CONTACT RESULTS

This box contains contact test parameters and results from the relay under test. It is displayed in graphical and numerical formats. The selected relays contact label and layout are also shown as table header. Check or uncheck “Contact Layout / Contact Label” to display contact label or configuration as header. The bar graph maximum scale can be changed using Scale Max control. See Figure 2 and Figure 3.

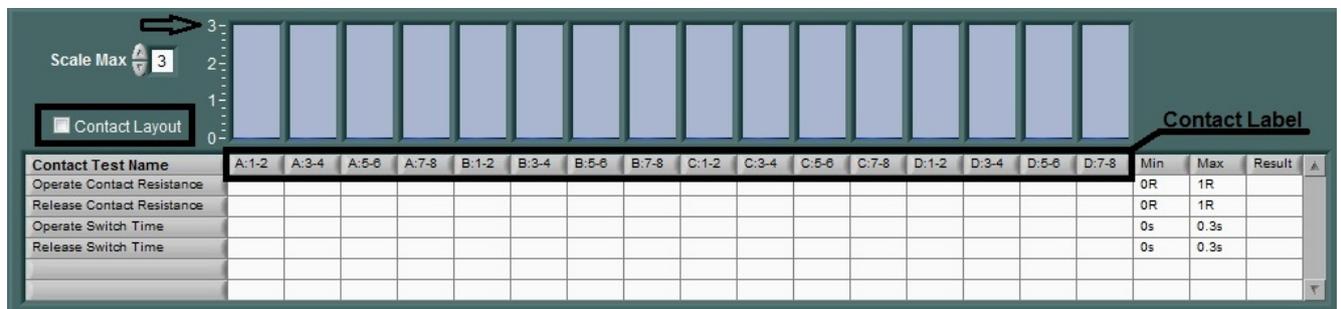


Figure 2 – Contact Label

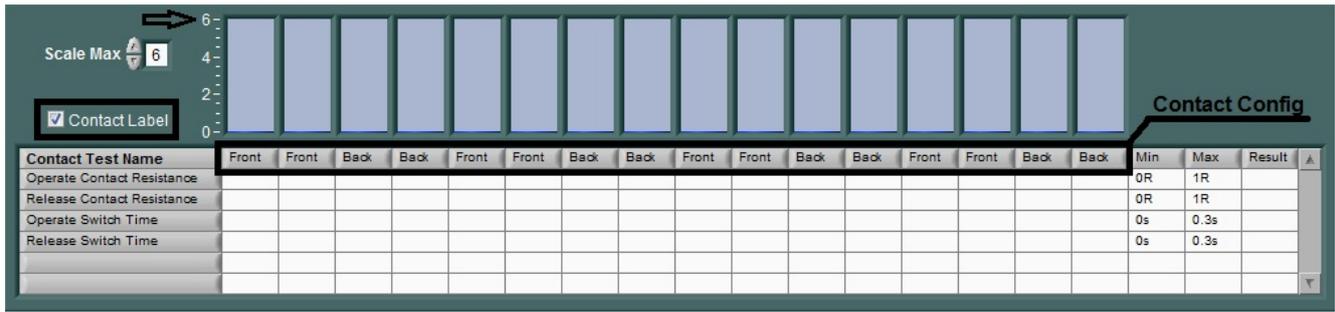


Figure 3 – Contact Configuration

Every table row indicates a contact test in this example the “Operate Contact Resistance” will be the first contact test performed. Also, the Min and Max specification is displayed as well as Result. After the test is completed, select which parameter will be displayed in a graphical format. See Figure 4.



Figure 4 – Contact Test Result

## 2.6 COIL RESULTS

This table displays coil test parameters and results. Each row indicates the test performed.

Administrators can edit all parameters in the Relay Profile, current for example.

## 2.7 RELAY DATA / RELAY NOTES

This window contains two text fields. Use the Radio buttons to toggle between fields.

### 2.7.1 Relay Data

Relay Data displays text recalled from the Relay Profile. The information is generic, relating only to that type of relay.

### 2.7.2 Relay Notes

Operators create and edit Relay Notes. Notes are included in the Test report. Typical notes might include General appearance, damage etc.

## 3. SETTINGS

### 3.1 USERS

Testing Officers can be added/delete/edit through this window. To add simply click Add then enter the new testing officer or to delete just select the user then click Delete. Click Edit to change password and right of a particular testing officer. As default, all added users are “Operator” and it is required an Administrator Password to change rights. The default password is “relaypro”. No password is required if the operator is logged in as an administrator. See Table access restrictions.

Functions	Operator	Administrator
Test Relay	✓	✓
Clean Relay	✓	✓
Settings	✓	✓
Relay Profile	x	✓
Calibrate	x	✓
Software Update	x	✓

As the user selects a Testing Officer which has a password it will be asked after it is selected.

### 3.2 REPORT

- Report – Select where all reports will be saved. It supports mapped network drive.
- Logo – Select a .jpg picture to be used in the report. Depending on the resolution of the picture it may not work. In this case just reduce the picture resolution.
- Logo Scale – This control can scale up or down to suit the report.
- RelayPro Serial Number – Enter the RelayPro Serial Number in this field. If not empty it will be displayed in the report and calibration certificate.
- Append Data to Report Name – when select all new test report will concatenate date to the relay serial number. This is useful when testing relays periodically.
- Report Sample – Generates a sample report to verify logo size and Organization information.

### 3.3 ORGANIZATION

Enter the organization details in this field. All information will be displayed in the report.

### 3.4 ADVANCED OPTIONS

#### 3.4.1 Profile Folder

Select the profile folder to be display in the Relay Type list. The default is the main root of the profile folder. If the user selects a specific folder the list will only display the Relay Profile under that root.

#### Example

\RelayPro\Profiles path is selected as default, even if a folder is inside this path all files containing a relay profile will be displayed in the Relay Type List. However, if the user selects a specific folder \RelayPro\Profiles\Q-Style only the relay profiles inside Q-Style folder will be displayed.

### 3.5 TEST OPTIONS

#### 3.5.1 Contact Resistance State

This sets a value where the RelayPro will identify the contact state of a relay. As default any value measured bigger than 470R will be identified as open state and any value smaller than 4.7R will be identified as close state. This setting is used when measuring contact resistance, switch time, operate voltage and others. This is a global setting used for all relay profiles.

## 4. PROFILE EDITOR

Use the Profile Editor to create, open, modify or delete Relay Profiles. There four tabs: Relay Parameters, Contact Parameters, Test Parameters and Advanced Options. Users must actively Save changes before closing the Profile Editor, or opening another Profile.

### 4.1 RELAY INFORMATION

- Relay Type – This field is used as a file name and also will be added in Relay Type drop down menu in the main screen. This name should contain basic information to identify the relay.
- Relay Coil Type – This field is displayed on the main screen and report. It can be Single, Dual, Latch or Current depending the relay.
- Coil Voltage – The coil voltage is the nominal voltage applied to the relay when testing.
- Coil Resistance – DC Coil Resistance is the nominal coil resistance of the relay.
- Code – Relay Code (leave blank if not applicable).
- Contact Configuration – Inform contact arrangement.
- Code Holes – Relay Code Holes (leave blank if not applicable).
- Code Holes Type – Select a defined type of code holes (graphical indication).
- Relay Data – Extra information about the relay. This is display in the main screen.

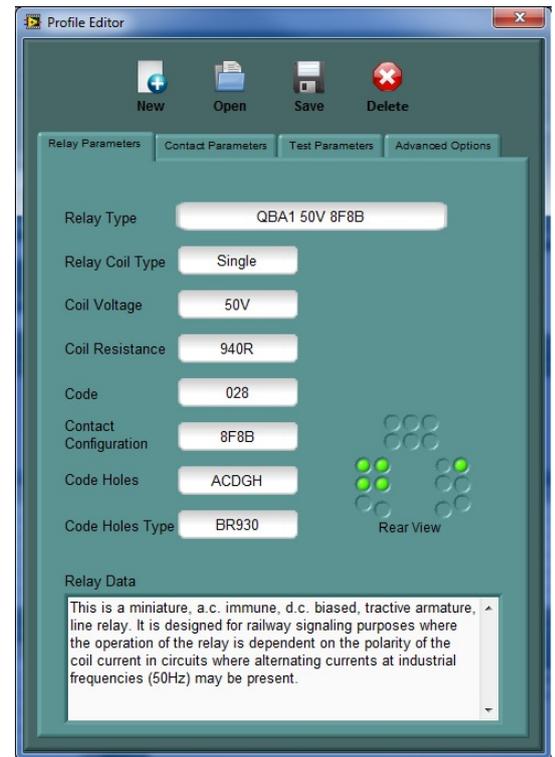


Figure 5 - Profile Editor

### 4.2 RELAY PARAMETERS

#### 4.2.1 Contact Layout – define each contact configuration.

- F – Front
- B – Back
- HF – Heavy Front
- HB – Heavy Back
- “ “ – skip
- OPEN – verify if the contact is open at any coil state
- CLOSE – verify if the contact is close at any coil state
- Contact Label – define each contact name.
- Coil Layout – define coil polarity.

Note: For Latch relay coil A is used to energize and B to de energize relay coil.

## 4.3 TEST PARAMETERS

In this section, the user can select and set PASS/FAIL threshold for each test.

### 4.3.1 Add / Remove / Edit Test Parameters

There are two ways to add a new test to the relay profile by simply clicking “ADD” or right click on the table then select “ADD”. Follow the same instruction to remove and edit a test. See Figure 6.

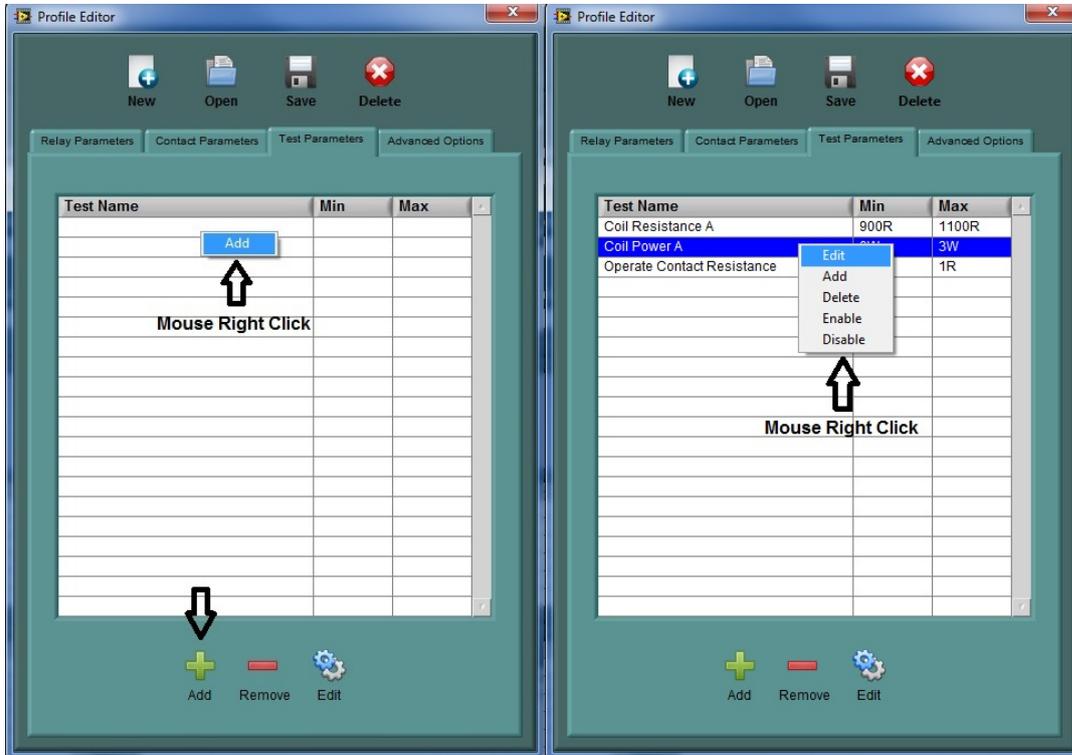


Figure 6 - Add/Remove/Edit Test Parameters

### 4.3.2 Test Parameters Settings

When adding or editing the Test Parameters Settings window will be displayed. Select a test from a list of pre-programmed scripts. Depending on the test selected different options set will appear. The RelayPro software executes the test list in sequence. The order of the test can be modified dragging the test. Using the CTRL keyboard + dragging will duplicate the test.

Note: In this list there are different types of test and some are specific for a relay type. It may not be suitable for all relays. Others are just configuration tests and they will not appear in the test table in the main screen.

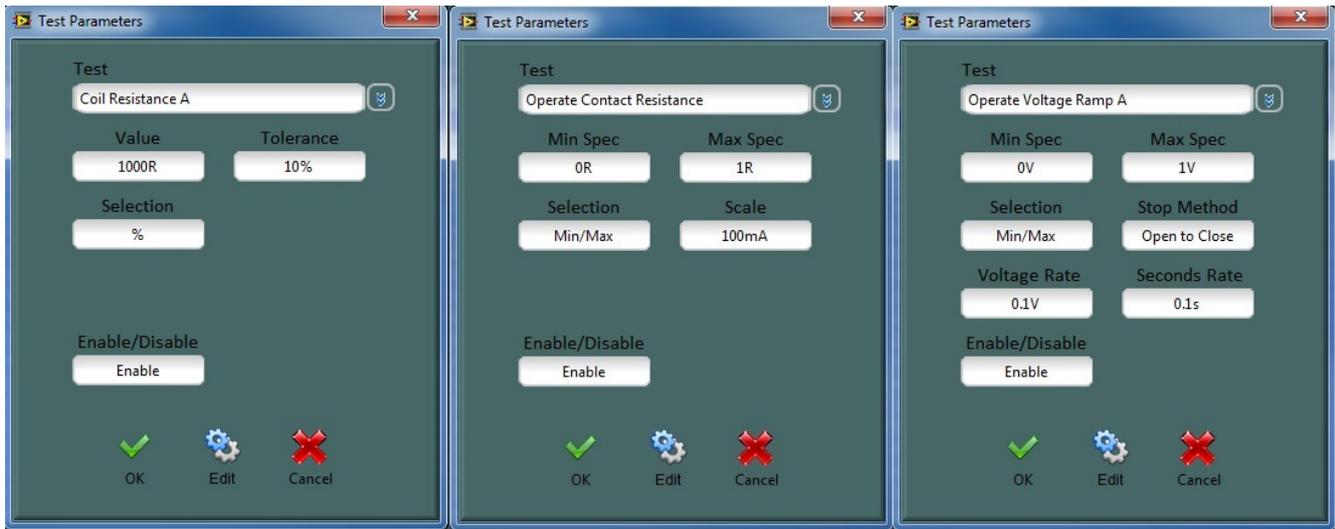


Figure 7 - Test Parameters Settings

- Selection – This control changes between Min/Max Spec to a Value/Tolerance. It mainly use when the user need to setup threshold around a number.
- Enable/Disable – Enable or disable the selected test. When the test is disabled it will not be tested. There are 2 ways to enable or disable a test, right click on the Test Parameters table (see Figure 6) or through this control.
- Scale – This option is enabled when testing contact resistance. It defines the constant current source. The RelayPro uses an automatic scale (see table for more information).
- Stop Method – This option is enabled when voltage ramp test is selected. It defines which contact state the test should stop.
- Voltage/Second Rate – This option is enabled when voltage ramp test is selected. It defines the voltage step and time.
- Edit – This function will call the Test Script Editor. Please refer to Test Script for more information.

## 4.4 ADVANCED OPTIONS

### 4.4.1 Contact Cleaner

- Clean Current – Set the Current used when cleaning a contact. Range is 100mA to 3A.
- Repetition – Set the number of cleaning cycles that will be completed
- ON/OFF Time – This is the Current duration during each cycle

## 5. FUNCTIONS

This section describes all RelayPro functions.

### 5.1 TEST

To start testing a relay simply select the relay from the relay Type menu then click test from the Controls box or through Tools – Test Menu. As soon as the test starts the status window indicates the current test.

### 5.2 CLEAN

The ‘Clean’ function applies a controlled current burst to the selected contact whilst at the same time the relay coil is energized/de-energized (see Contact Cleaner). The resulting plasma arc cleans the contact surface.

The flash cleaning method is only to be used with relays that have contacts in good mechanical surface condition (determine by visual inspection) but have high contact resistance due to oxidized residue or any minor contaminants at the point of contact. This method eliminates the need to open the relay for manual cleaning, thereby, reducing the turn-around time, and reducing the risk of inadvertent alteration to the relay characteristics.

The relay should be tested before and after the cleaning process and contact resistance measurements recorded for comparison with the corresponding relay specifications.

### 5.3 VERIFY

The Verification routine verifies the main parameters measured by the RelayPro. It provides enough information to ensure the tester is working within the specification. This process is divided in two parts: Verify and Zero.

The “Verify Test” measures and compares the following parameters, Contact Resistance, Coil Resistance and Coil Voltage. The 1R Precision Reference (provided) and a calibrated Voltmeter (not provided) are needed to proceed with the test. It is responsibility of the user to ensure the voltmeter is calibrated.

To start click Tools → Verify, then follow the instructions on the screen. After the verification is completed a Verification dd-mm-yyyy.pdf report will be generated under “Report” folder. The report contains the following information:

- Company Logo
- Organization Details
- Testing Officer
- Date
- Result
- RelayPro Serial Number

All details can be altered in the Settings menu.

### 5.4 ZERO REFERENCE

The Test Base contacts degrade with use. The “Zero Test” routine measures the resistance between the Test Base contact and the Zero Reference, indicating the severity of degradation.

The Zero Reference has 0Ω in every contact. Any resistance measured in this test is an error and is added to the Relay contact resistance. It is the responsibility of the user to check if this error is within an acceptable value (less than 0.1Ω). External factors affect this value: it is not constant, and cannot be simply deducted from the contact resistance. The Test Base can be cleaned using a contact cleaner (it may or may not solve any problem).

The Test Base is a consumable part: it will degrade with use and is not covered by warranty. The Test Base contacts are repairable, or the entire unit is replaceable.

### To start the Zero Test routine

- Select “Zero Reference” in Relay Type
- Select “Test” in the Controls Panel

RelayPro displays the results on the main screen.

## 6. TEST DESCRIPTION

### 6.1 CONTACT RESISTANCE

The Contact Resistance Test passes a precise constant current through each contact, measures the associated voltage drop, and calculates contact resistance. Results are displayed in graph and digital format.

The contact resistance measurement features an auto range using three different scales for high precision.

Scale	Current (mA)	Range (ohm)	Precision (ohm)
1	100	0-5	0.001
2	10	5-50	0.01
3	1	50-500	0.1

The selected Current in the Test Parameters at Relay Profile is the starting point of the scale. For example, 100mA is selected then 100mA, 10mA and 1mA will be used. If 1mA is selected then only 1mA will be used.

Accurate results are achieved through a 4 Wire Kelvin measurement method up to the Test Base contact. This eliminates resistance error from cables and connections between the RelayPro and relay.

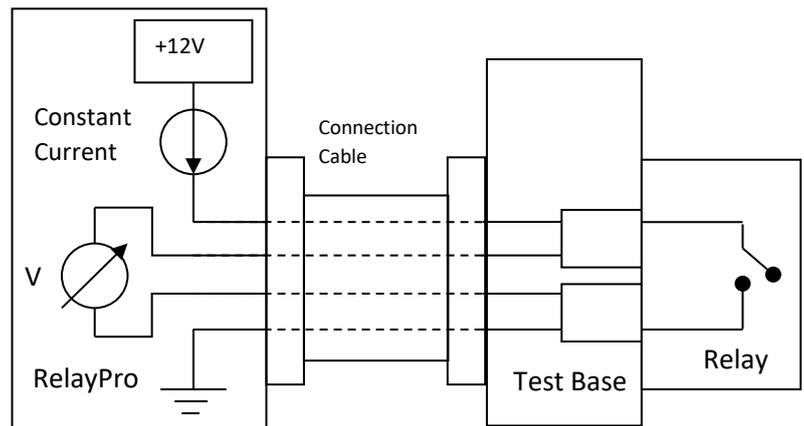
### 6.2 SWITCH TIME

This test is performed by measuring the time it takes for a relay contact to change state from Open to Close or Close to Open. Open and Close values are defined at the Settings Menu.

### 6.3 COIL RESISTANCE

Coil resistance is performed by passing a precise constant current through the coil. The voltage drop across the coil is measured and the coil resistance is calculated. The result

is displayed on screen in digital format. The coil resistance measurement features an auto range using 2 different scales for high precision results.



Scale	Current (mA)	Range (ohm)	Precision (ohm)
1	10	0-500	1
2	1	500-5000	1

### 6.4 RAMP VOLTAGE

The relay Operate / Release voltage is measured using a Ramp Method. It consists of sweeping the coil supply voltage from zero up to nominal rated voltage, while measuring if any front contact changes state.

The ramp parameters can be set in the Relay Profile – Test Parameters.

## 7. HELP

### 7.1 CALIBRATION

It is recommended that the RelayPro is calibrated on a regular basis to verify and correct any measurement drift that has occurred at any stage over this period.

Complete Calibration by:

- Returning tester to the manufacturer, or
- The unit can be calibrated by the end user (optional RelayPro Cal Kit required)

### 7.2 ZERO FAILURE

Zero failure may occur in the following instances:

#### 7.2.1 Test Base is dirty or damaged.

Solution: Clean Test Base contacts using a cotton swab and contact cleaner.

#### 7.2.2 Zero results exceed the maximum trim limits.

Solution: Replace contacts in the Test Base or order a replacement.

### 7.3 CALIBRATION

It is recommended that the RelayPro is calibrated on a regular basis to verify and correct any measurement drift that has occurred at any stage over this period.

Calibration can be performed by returning tester to the manufacturer or alternatively the unit can be calibrated using the RelayPro Cal Kit (not provided).

### 7.4 COMMS FAILURE

If Comms Failure occurs check the following:

1. USB cable is connected between the computer and the test box.

### 7.5 F.A.Q.

Q. Why do readings sometimes change when re-testing the same relay?

A: Possible reasons:

1. Dirty or pitted contacts exhibit a dynamic resistance. Current cleaning is effective in removing oxidation film and contact dust.
2. Temperature affects the contacts resistance by a small amount. RelayPro is accurate enough to measure this change. Allow the relay to cool down following the current cleaning of the contacts.
3. Calibration drift can affect RelayPro's accuracy. This drift could represent a very small measurement error. To ensure high accuracy, RelayPro should be calibrated on a regular basis.

### 7.6 TO UNINSTALL APPLICATION

- Open the Start menu, Settings and Control panel in the Windows task bar.
- Click Add/Delete Program
- Choose RelayPro from the list
- Click Add/Delete
- Follow uninstall instructions

## 8. UPDATES AND TECHNICAL SUPPORT

### 8.1 SOFTWARE & HARDWARE UPDATES

When available, Software & Hardware updates are located at [www.mrd.com.au](http://www.mrd.com.au).

### 8.2 TECHNICAL SUPPORT

Please email any support questions to [support@mrd.com.au](mailto:support@mrd.com.au)

Alternatively phone MRD office on: +61 7 3821 5151

# Appendix

## A1 LEGAL

### A1.1 USER LICENSE AGREEMENT

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## A2 RELAYS (TESTABLE)

The list below is current at time of publication. If you have a requirement that is not listed here or in the RelayPro software, please contact [support@mrd.com.au](mailto:support@mrd.com.au) for assistance.

Note: The RelayPro includes a Q-style Test Base by default. Other Relays require a compatible Test Base, sold separately.

#	Relay Type
<b>Q-Style</b>	
1.	QBA1 12V 12F4B
2.	QBA1 12V 8F8B
3.	QBA1 24V 12F4B
4.	QBA1 24V 4F4B
5.	QBA1 24V 6F6B
6.	QBA1 24V 8F4B
7.	QBA1 24V 8F8B
8.	QBA1 50V 12F4B
9.	QBA1 50V 4F4B
10.	QBA1 50V 6F6B
11.	QBA1 50V 8F4B
12.	QBA1 50V 8F8B
13.	QBBA1 12V 2x4F4B
14.	QBBA1 12V 2x6F2B
15.	QBBA1 24V 2x4F4B
16.	QBBA1 24V 2x6F2B
17.	QBBA1 50V 2x4F4B
18.	QBBA1 50V 2x6F2B
19.	QBCA1 12V 2HF4F4B
20.	QBCA1 24V 2HF4B
21.	QBCA1 24V 2HF4F4B
22.	QBCA1 50V 2HF4B
23.	QBCA1 50V 2HF4F4B
24.	QBCA1 50V 2HF6B
25.	QL1 12V 11F4B
26.	QL1 24V 11F4B
27.	QL1 24V 8F6B
28.	QL1 50V 11F4B
29.	QL1 50V 8F6B
30.	QN1 12V 12F4B
31.	QN1 12V 8F4B
32.	QN1 12V 8F8B
33.	QN1 24V 12F4B
34.	QN1 24V 4F4B
35.	QN1 24V 6F6B
36.	QN1 24V 8F4B
37.	QN1 24V 8F8B 250R
38.	QN1 24V 8F8B
39.	QN1 50V 12F4B

#	Relay Type
40.	QN1 50V 4F4B
41.	QN1 50V 6F6B
42.	QN1 50V 8F4B
43.	QN1 50V 8F8B
44.	QNA1 24V 12F4B
45.	QNA1 24V 4F4B
46.	QNA1 24V 6F6B
47.	QNA1 24V 8F4B
48.	QNA1 24V 8F8B
49.	QNA1 50V 12F4B
50.	QNA1 50V 4F4B
51.	QNA1 50V 6F6B
52.	QNA1 50V 8F4B
53.	QNA1 50V 8F8B
54.	QNA2 50V 16F
55.	QNA2 50V 8F4B
56.	QNC1 24V 2HF4B
57.	QNC1 50V 2HF2F2B
58.	QNC1 50V 2HF4B
59.	QNC1 50V 2HF5B
60.	QNCM1 12V 2HF4MB
61.	QNCM1 12V 2HF4MF4MB
62.	QND2 24V 12F4B
63.	QND2 24V 8F8B
64.	QND2 50V 12F4B
65.	QND2 50V 8F8B
66.	QNM1 12V 4MF4MB
67.	QNN1 12V 2x4F4B
68.	QNN1 12V 2x6F2B
69.	QNN1 24V 2x4F4B
70.	QNN1 24V 2x6F2B
71.	QNN1 50V 2x4F4B
72.	QNN1 50V 2x6F2B
73.	QNNA1 50V 2x2F2B
74.	QNNA1 50V 2x4F2B
75.	QNNA1 50V 2x4F4B
76.	QNNA1 50V 2x6F2B
77.	QNNM1 50V 2x5F3B
78.	QNNM2 50V 2x2F2B
79.	QNNM2 50V 2x2F3B
80.	QNNM2 50V 2x4F4B
81.	QNNS1 24V 2x4F4B
82.	QNNS1 24V 2x6F2B
83.	QNNS1 50V 2x4F4B
84.	QNNS1 50V 2x6F2B
85.	QR15 50V 4X2 CO *
86.	QS2 12V 6F6B

#	Relay Type
87.	QS2 24V 8F4B
88.	QS2 50V 8F4B
89.	QSPA1 24V 8F4B
90.	QSPA1 50V 8F4B
91.	QSR2 24V 8F4B
92.	QSRA1 12V 8F4B
93.	QSRA1 24V 8F4B - PSS
94.	QSRA1 24V 8F4B
95.	QSRA1 50V 4F2B
96.	QSRA1 50V 6F6B
97.	QSRA1 50V 8F4B - 1000
98.	QSRA1 50V 8F4B - 1420
99.	QSRA4 12V 6F2B
100.	QSRA450V 6F2B
101.	QT2 125MA 2F
102.	QT2 125MA 2F1B
103.	QT2 125MA 2F2B
104.	QT2 155MA 2F2B
105.	QTA2100MA 2F
106.	QTA2100MA 2F2B
107.	QTA2155MA 2F
108.	QTA2155MA 2F2B
109.	ZeroReference
110.	ZJ1511
111.	ZJ1611
112.	ZJ4511
113.	ZJ4611
114.	ZJ5511
115.	ZJ5611

### Alstom Relays\*

116.	56001-785
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### BLIB Relays\*

117.	SR840
118.	SR844

### PN250\*

119.	N322554-701
120.	N322554-702

### PN150

121.	N322500-701
122.	N322500-702
123.	N322500-705
124.	N322500-801
125.	N322500-812
126.	N322502-001
127.	N322503-702
128.	N322503-902

#	Relay Type
129.	N322504-001A
130.	N322504-001B
131.	N322505-701
132.	N322505-806
133.	N322507-701
134.	N322508-703
135.	N322516-701
136.	N322525-001
137.	N436788

#### NS1 Relays\*

138.	NS1-L-1232
139.	NS1-L-428
140.	NS1-L-828
141.	NS1-P-1232
142.	NS1-P-428

#### JRF Relays\*

143.	JRF-51103 6F2B
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## End of Manual