Application Note

RELAY TESTING

Dynalab
TEST SYSTEMS

Relay Testing

This document explains how to use PASS 6.0 software to program the Dynalab Analyzer to test relays. This document has the following main sections:

1. A list of assumptions – knowledge required to perform the tasks outlined in this document.
2. Recommended approach
3. An explanation of how to accomplish active relay testing for two examples

Assumptions

To successfully use this document, the following knowledge is required:

- basic knowledge of how to enter harness data using PASS® 6.0
- knowledge of how to use the Sequence table to create a Sequence

For assistance on how to use features of PASS® 6.0, see the PASS® 6.0 Help file.

Recommended Approach

When testing a wiring harness that contains one or more relays, Dynalab recommends that the test be designed to simply check for the presence of the relay in the de-energized state by testing for continuity through the coil and through the normally-closed relay contacts. This approach assures that the relay is properly assembled to the harness. It is not necessary to activate the relay coil and check continuity through the normally-open contacts.

It is useful to note that relay manufacturers do extensive testing of their product. In fact, most relay manufacturers perform 100% testing of their relays. In order to validate that the relay is good, manufacturers test many of the following parameters:

- Coil minimum operate voltage
- Coil minimum release voltage
- Coil resistance, inductance, rated voltage, and allowable overdrive voltages.
- Max continuous current
- Max make current
- Max break current
- Max switching rate
- Max switching power
- Dielectric strength
- Operate time
- Release time

This extensive testing provides assurance that the relay is of good quality. When testing a harness that contains a relay, it is therefore only necessary to test that it has been correctly assembled to the harness. This can be done in the de-energized state. This approach is documented in the Application Note entitled *Testing Electrical Parts That Mate With A Harness Connector*. Please refer to this Application Note for details.

The Dynalab Analyzer is not capable of performing the extensive parametric testing of relays that manufacturers do. The Dynalab Analyzer is only capable of applying a voltage to the relay coil, and verifying that the contacts have changed state. If it is absolutely necessary to activate the relay as part of the test, the remainder of this Application Note may be consulted.

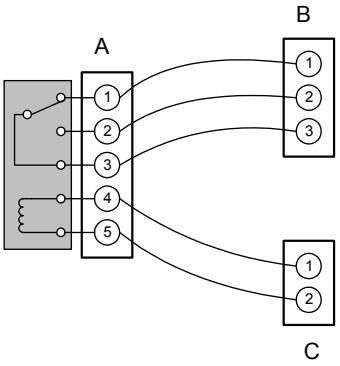
Active Relay Testing

This section explains how to program the Analyzer to test a relay in both the de-energized state and the energized state. Two examples will be presented in detail. Both examples assume that the relay to be tested is "connectorized" – the relay mates with a harness connector.

Example 1 is a simple example in which the relay coil and relay contacts are isolated.

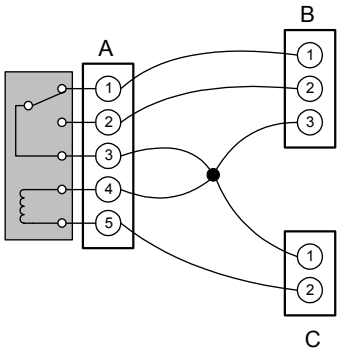
Example 2 is a more complex example in which one leg of the relay coil is electrically connected to the relay contact common point. This sort of wiring arrangement is common, since it simplifies power distribution through the harness

EXAMPLE 1



In Example 1, the relay coil is electrically isolated from the relay contacts.

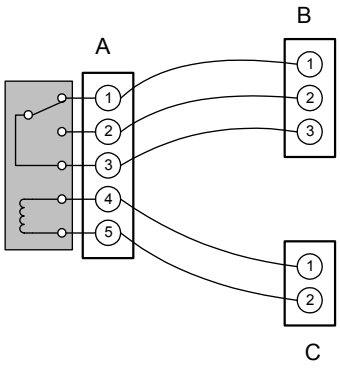
EXAMPLE 2



In Example 2, one leg of the relay coil is electrically connected to the relay contact common point through the harness wiring.

Each example is presented in detail in the following sections.

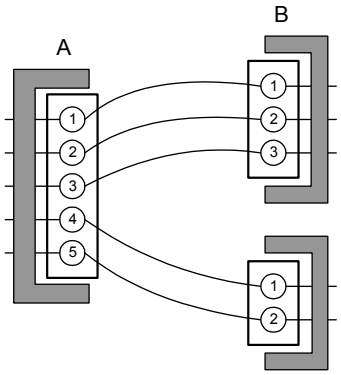
Example 1



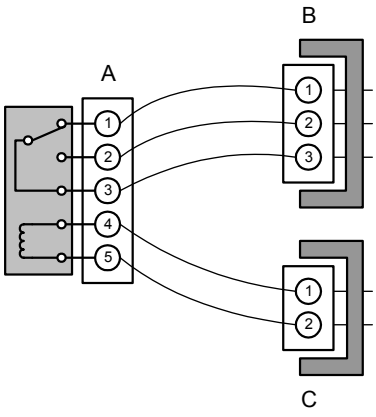
Consider the example harness shown here. This harness contains three connectors (A, B and C). It also has a relay which mates with connector A. The harness is wired in such a way as to isolate the relay coil from the relay contacts.

The method for testing a relay that mates with a harness connector has three steps:

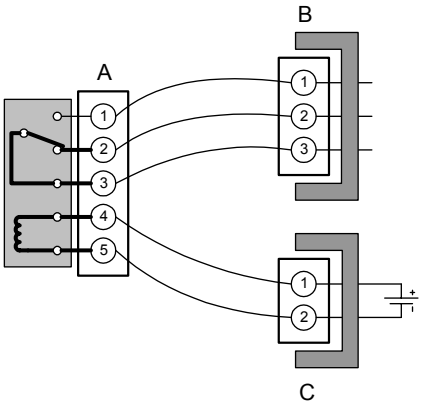
1. Test the harness without the relay
2. Prompt the operator to install the relay, and then test for electrical continuity through the Normally Closed contacts and through the relay coil.
3. Energize the relay coil, and test for electrical continuity through the Normally Open contacts.



STEP 1:
Test the harness without the relay



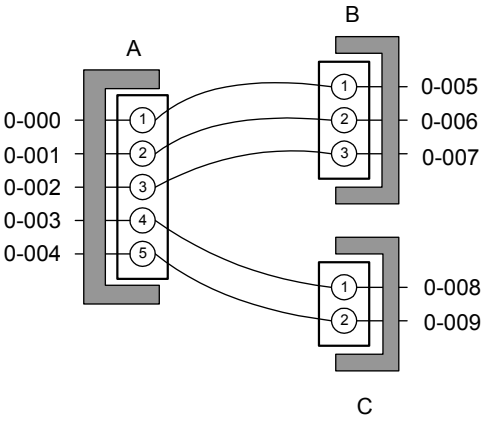
STEP 2:
Prompt the operator to remove the mating connector from the test fixture, and install the relay. Test for continuity through NC relay contacts

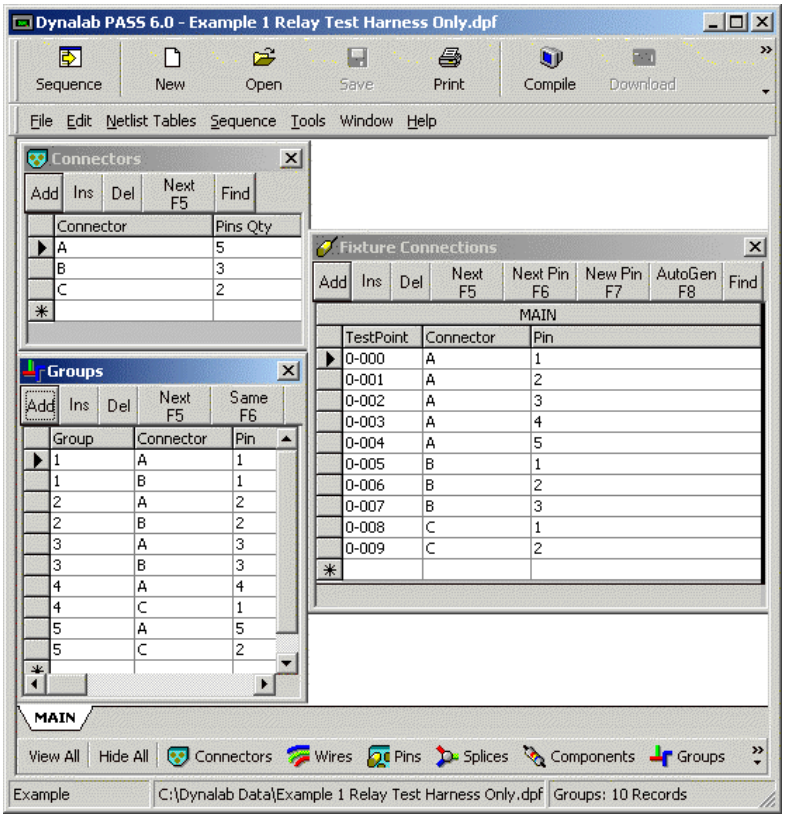


STEP 3:
Energize the relay coil, and test for electrical continuity through the NO relay contacts.

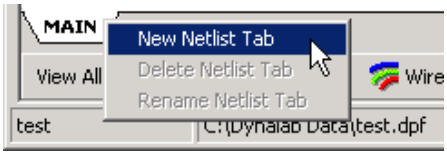
Program the harness without the relay using the MAIN Netlist tab

This shows the MAIN Netlist for the example harness without the relay, programmed using the Group Method.

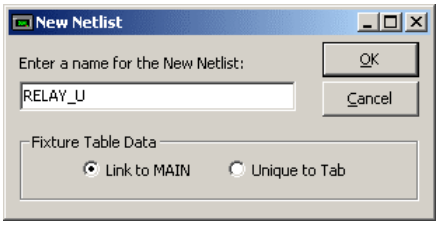




Program the relay in the un-energized state using an additional Netlist

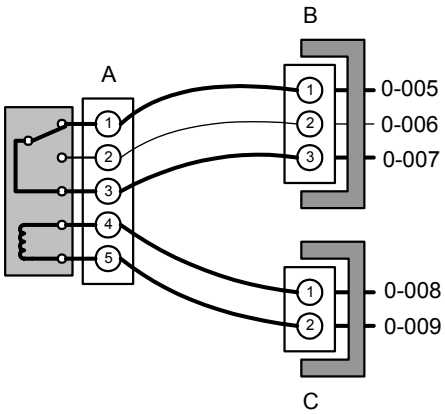


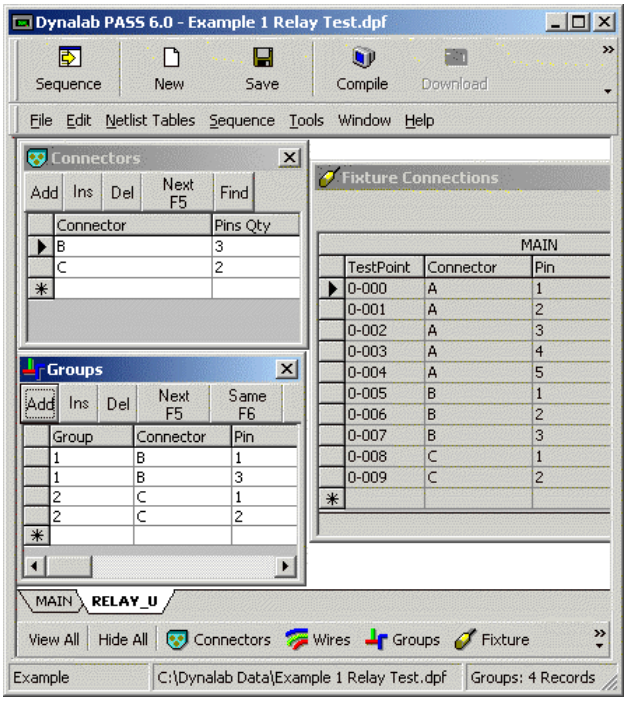
To program the relay in the un-energized state, create a New Netlist Tab. This is done by pointing to the MAIN Netlist tab located at the lower left of the PASS window, right clicking and selecting New Netlist Tab:



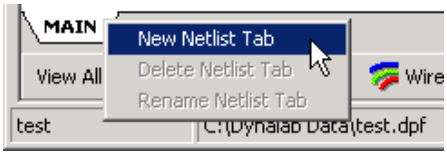
In the "New Netlist" box, enter the name of the new Netlist. For this example, "RELAY_U" is the new Netlist name. Make sure that the "Link to MAIN" button is selected.

In the new Netlist tab, create the appropriate Connector(s) and Group(s) to define the connections that are made by the addition of the un-energized relay. In this example, adding the relay causes continuity to be established between Connector B, Pins 1 and 3 and Connector C, Pins 1 and 2. (This assumes that the relay coil resistance is below the threshold set for an open circuit; i.e. less than 1000 ohms).

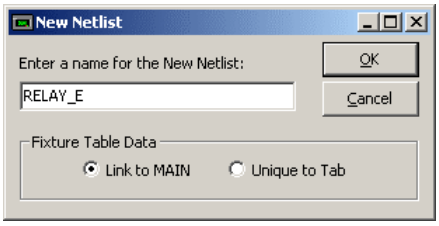




Program the relay in the energized state using an additional Netlist

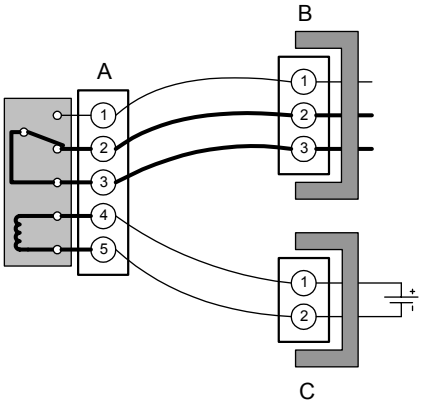


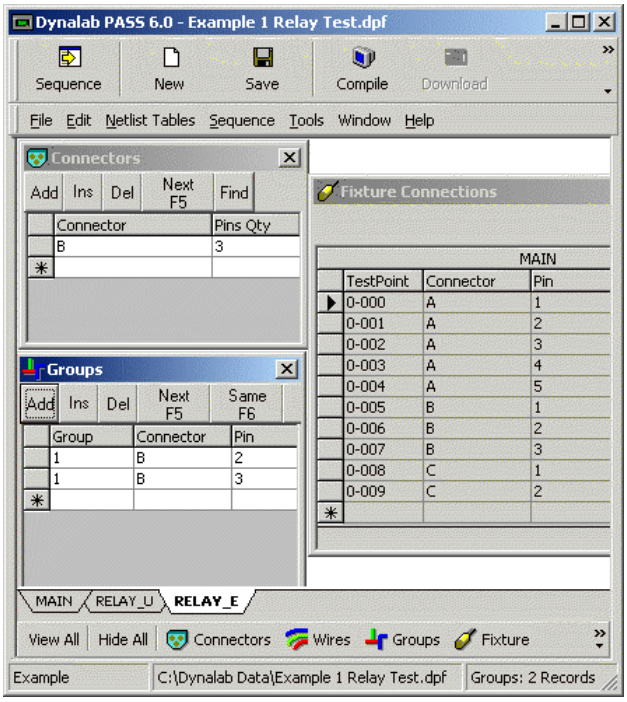
To program the relay in the energized state, create a New Netlist Tab. This is done by pointing to the MAIN Netlist tab located at the lower left of the PASS window, right clicking and selecting New Netlist Tab:



In the "New Netlist" box, enter the name of the new Netlist. For this example, "RELAY_U" is the new Netlist name. Make sure that the "Link to MAIN" button is selected.

In this new Netlist tab, create the appropriate Connector(s) and Group(s) to define the connections that are made by the addition of the un-energized relay. In this example, energizing the relay causes continuity to be established between Connector B, Pins 2 and 3.





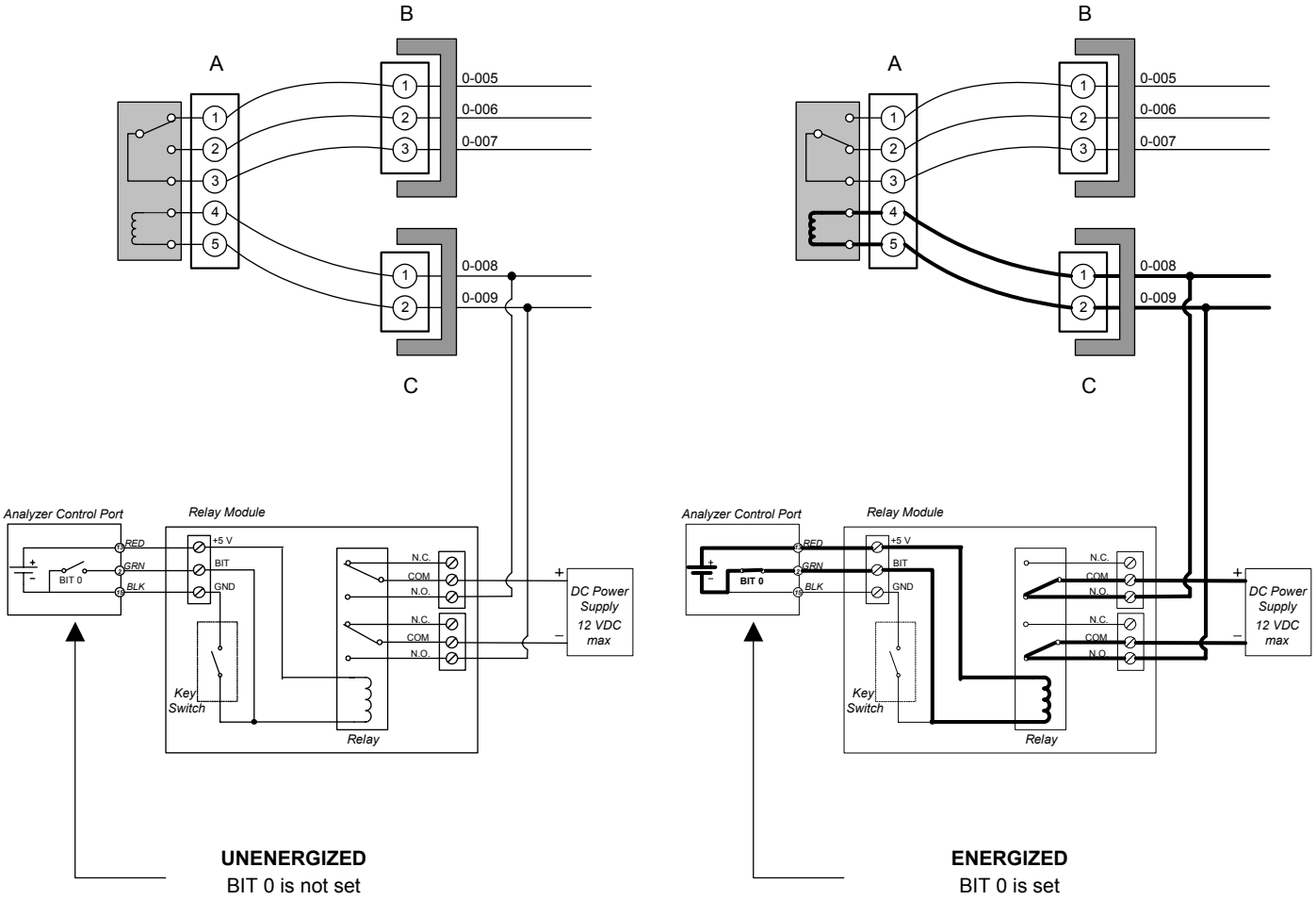
How to energize the relay under test

To energize the relay, voltage from a power supply must be applied to its coil. Dynalab recommends use of the Relay Module[1], part number 212-2009 to control application of voltage to the relay under test. As seen below, an external power supply is connected across the coil of the connectorized harness relay through a contact of the Relay Module. The Relay Module is connected to the Analyzer's Control Port. When BIT 0 is set, the Relay Module energizes, and the contact closure completes the circuit through the DC power supply, resulting in the application of DC power across test points 0-008 and 0-009. This applies voltage to the connectorized harness relay, causing its associated contacts to change state.

BIT 0 is set and cleared through the PASS program – this will be illustrated later.

Caution:

Use a regulated power supply with a maximum output voltage of 12 VDC. Use of an un-regulated supply can result in voltage levels that might damage the Analyzer's test point board.



[1] For a detailed explanation of the operation of Dynalab's Relay Module, refer to the Application Note entitled *Relay Module.*

Program the Sequence

The Sequence must be programmed to accomplish each of the three steps outlined earlier:

1. Test the harness without the relay
2. Prompt the operator to install the relay, and then test for electrical continuity through the Normally Closed contacts and through the relay coil.
3. Energize the relay coil, and test for electrical continuity through the Normally Open contacts.

The following table illustrates a Sequence that performs all three steps.

Basic Testing Sequence

Line	Sequence item	Parameter	Application Effect
1	ADVOFF		Forces the operator to repair errors before continuing the test
2	TEST	MAIN	Performs a complete Netlist scan of MAIN
3	SOUND	4	Play sound 4
4	LINE4	10	Displays message 10 on 4th line "INSTALL RELAY"
5	CONTINUITY	RELAY_U	Performs a continuity scan of the Netlist "RELAY_U"
6	LINE4	15	Displays message 15 on 4th line" ENERGIZING RELAY"
7	BSET	0	Sets BIT 0 – energizes relay
8	DELAYT	5	Pause for 5 tenths of a second
9	CONTINUITY	RELAY_E	Performs a continuity scan of the Netlist "RELAY_E"
10	BCLR	0	Clears BIT 0 – deenergizes relay
11	SOUND	0	Plays sound 0
12	MESSAGE	20	Displays message 20 : "HARNESS PASSED... REMOVE HARNESS TO CONTINUE"
13	KWAIT		Waits for operator to press START button
14	REPEAT		Go to line 1 and continue Sequence execution

Note: *The LINE4 Sequence item requires EPROM version 7.002 or later*

Line 1 The ADVOFF Sequence item at the beginning of the Sequence instructs the Analyzer not to accept input from the START button when stopped on an error encountered during the TEST scan. This Sequence item prevents the operator from advancing and completing the test until the error has been fixed.

Line 2 TEST instructs the Analyzer to perform a complete test of the Netlist specified by the parameter, in this case, MAIN. (The TEST Sequence item is actually a macro. See PASS Help for more information about the TEST Sequence item.)

Line 3 Plays sound 4 – 4 "chirps". This sound is used to indicate that the harness has passed continuity and short scans.

Line 4 LINE4 displays message 10 on the 4th line. This message instructs the operator to install the relay. The message "INSTALL RELAY" persists on line 4, allowing any error messages to be visible on lines 1-3

Line 5 CONTINUITY performs a continuity scan of the RELAY_U Netlist.

Line 6 LINE4 displays message 15 on the 4th line. This message informs the operator that the relay is now energized. The message "ENERGIZING RELAY" persists on line 4, allowing any error messages to be visible on lines 1-3.

Line 7 BSET 0 sets bit 0. If the Analyzer and Relay Module are wired in accordance with the diagram shown in the previous section of this document, this will cause the relay to energize.

Line 8 DELAYT 5 pauses for 5 tenths of a second.

Line 9 CONTINUITY performs a continuity scan of the RELAY_E Netlist.

Line 10 BCLR 0 clears bit 0. This de-energizes the relay.

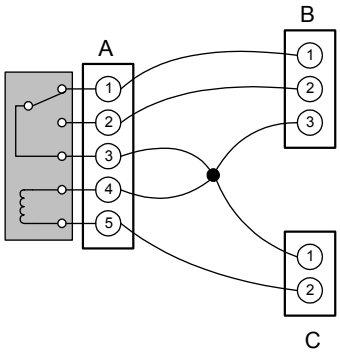
Line 11 SOUND 0 plays a twirl, indicating a successful test.

Line 12 MESSAGE 20 displays message 20 "HARNESS PASSES…REMOVE HARNESS TO CONTINUE"

Line 13 KWAIT waits for the operator to press the START button to continue.

Line 14 REPEAT causes execution to start again at Line 1

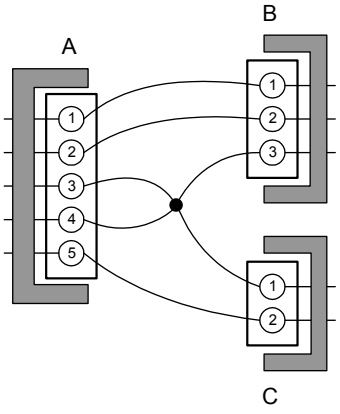
Example 2



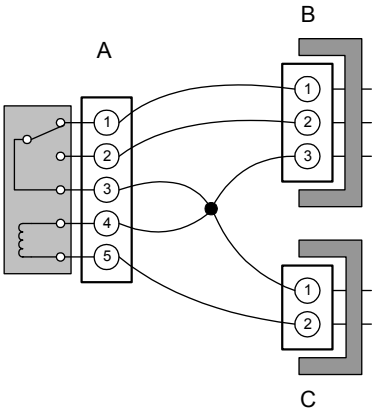
Consider the example harness shown here. This harness contains three connectors (A, B and C). It also has a relay which mates with connector A. The harness is wired such that one leg of the relay coil is electrically connected to the relay contact common point This method of wiring a relay in a harness is encountered frequently, since it simplifies power distribution. Even though it is similar to Example 1, there are some important differences.

The method for testing a relay that mates with a harness connector has three steps:

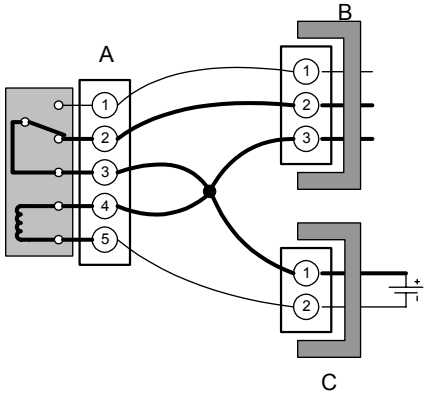
1. Test the harness without the relay
2. Prompt the operator to install the relay, and then test for electrical continuity through the Normally Closed contacts and through the relay coil.
3. Energize the relay coil, and test for electrical continuity through the Normally Open contacts.



STEP 1:
Test the harness without the relay



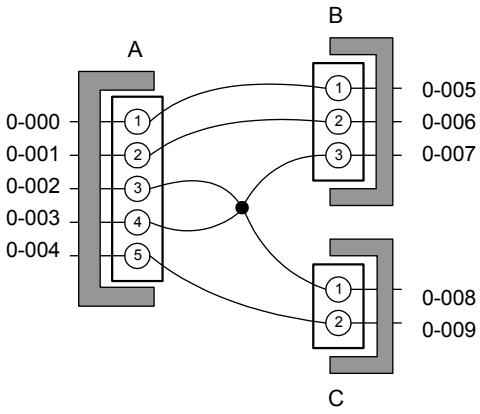
STEP 2:
Prompt the operator to remove the mating connector from the test fixture, and install the relay. Test for continuity through NC relay contacts

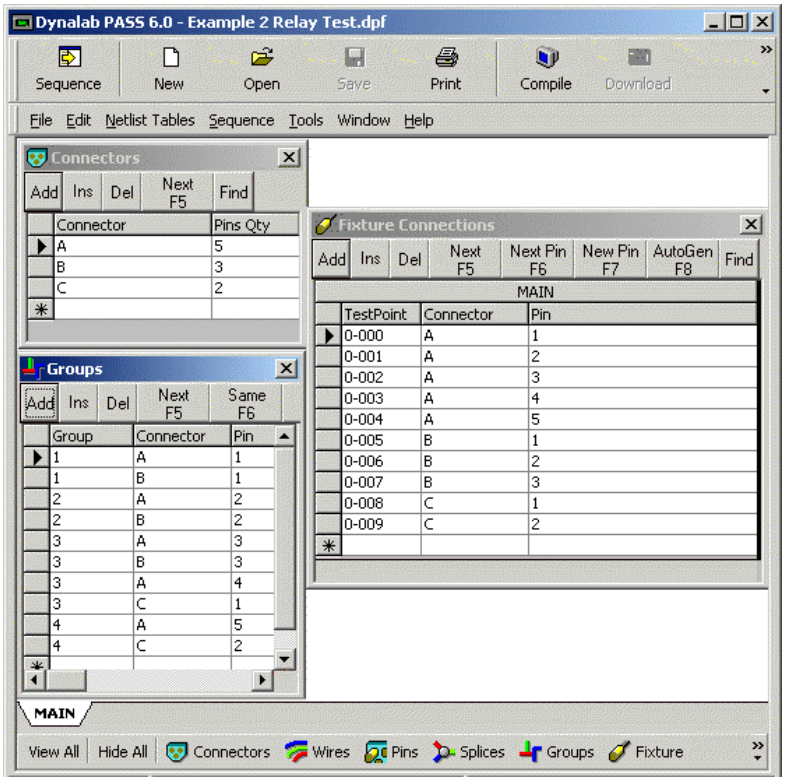


STEP 3:
Energize the relay coil, and test for electrical continuity through the NO relay contacts.

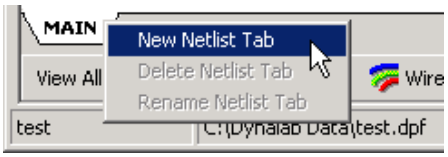
Program the harness without the relay using the MAIN Netlist tab

This shows the MAIN Netlist for the example harness without the relay, programmed using the Group Method.

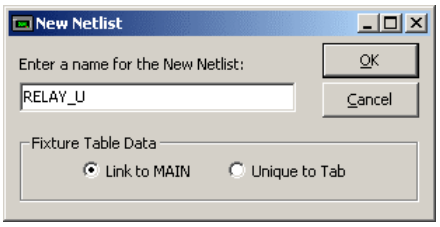




Program the relay in the un-energized state using an additional Netlist

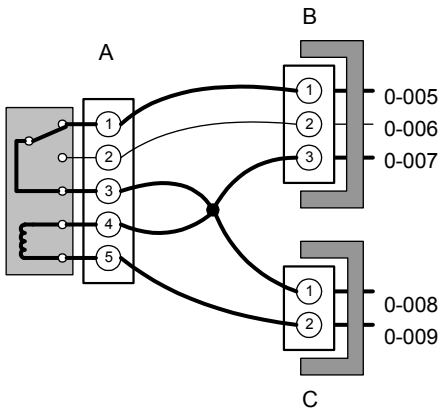


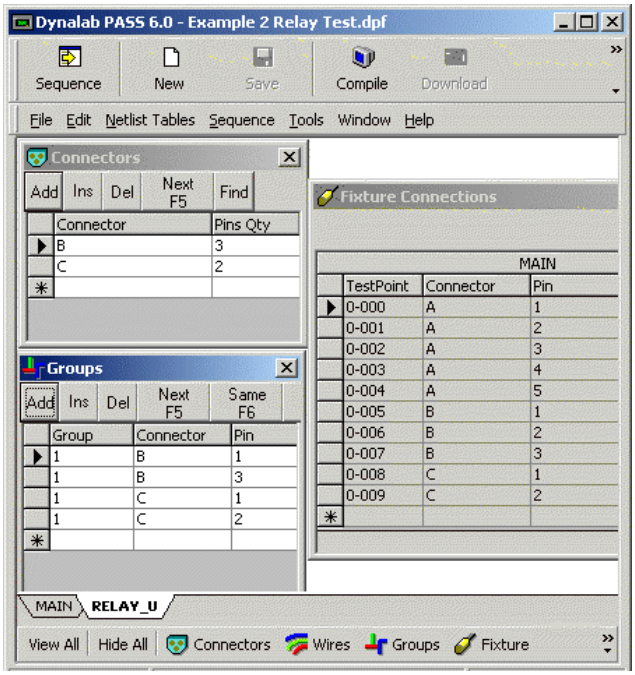
To program the relay in the un-energized state, create a New Netlist Tab. This is done by pointing to the MAIN Netlist tab located at the lower left of the PASS window, right clicking and selecting New Netlist Tab:



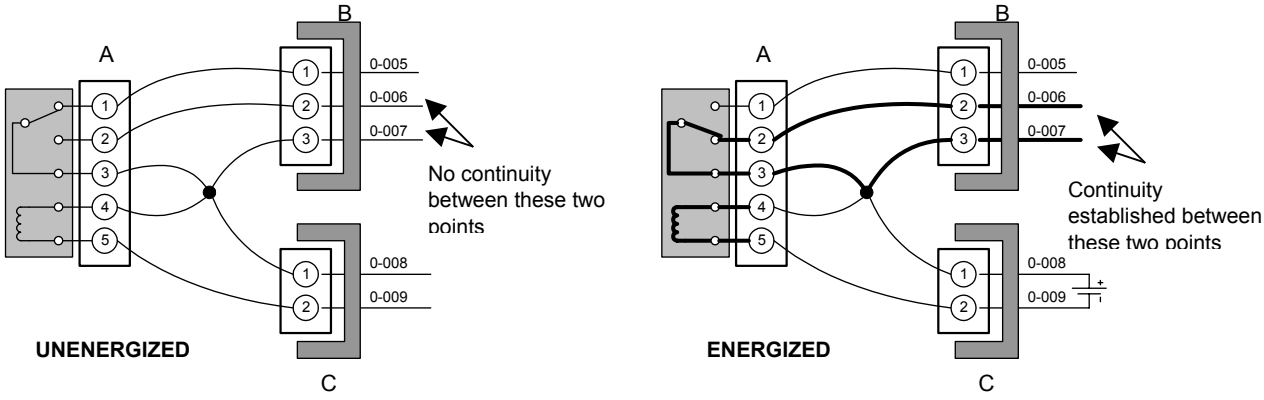
In the "New Netlist" box, enter the name of the new Netlist. For this example, "RELAY_U" is the new Netlist name. Make sure that the "Link to MAIN" button is selected.

In the new Netlist tab, create the appropriate Connector(s) and Group(s) to define the connections that are made by the addition of the un-energized relay. In this example, adding the relay causes continuity to be established between Connector B, Pins 1 and 3 and Connector C, Pins 1 and 2. (This assumes that the relay coil resistance is below the threshold set for an open circuit; i.e. less than 1000 ohms).



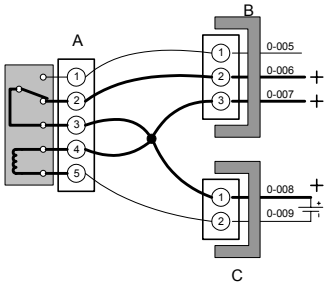


Program the relay in the energized state using a Manual Netlist



When in the unenergized state, there is no continuity between Connector B, pins 2 and 3. When the relay is energized, the contact will change state – this will result in continuity being established between Connector B pins 2 and 3. So, after the relay coil is energized, it is only necessary to determine that continuity is established between pins 2 and 3 of Connector B. This test will validate that the relay is operating properly.

In this particular example, a problem is introduced which makes continuity testing a bit more of a challenge because of the way the harness is wired. Note that one leg of the relay coil is connected to the common point of the relay switch (on Connector A, pin 4 is connected to pin 3 through the harness wiring). This sort of wiring arrangement is common, since it simplifies power distribution through the harness.



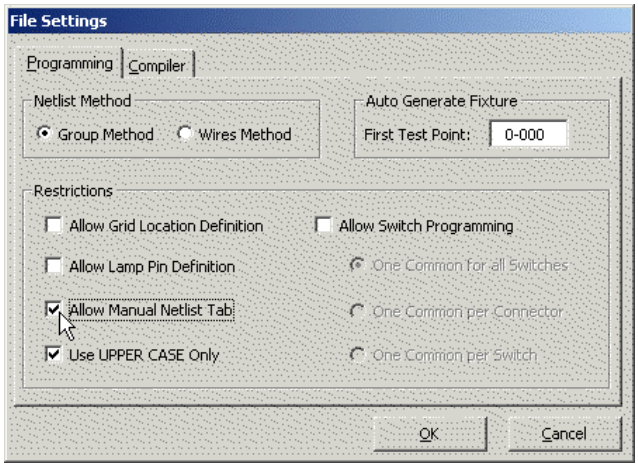
Note that if positive voltage is applied through test point 0-008 to Connector C – pin1, the voltage is distributed by the harness wiring in such a way that Connector B pins 2 and 3 will both have positive voltage applied. This is a problem, since it is these very two pins through which it is necessary to test for continuity.

Normally, when testing for continuity between two points, the Analyzer will apply voltage to one point (drive) and determine if the voltage exists at the other point (sense). Therefore, one point is the drive point and the other is the sense point. In this example, if Connector B pin 2 is the drive and pin 3 is the sense, the test will pass even if there is no continuity, since pin 3 has positive voltage introduced from an external source through the harness wiring.

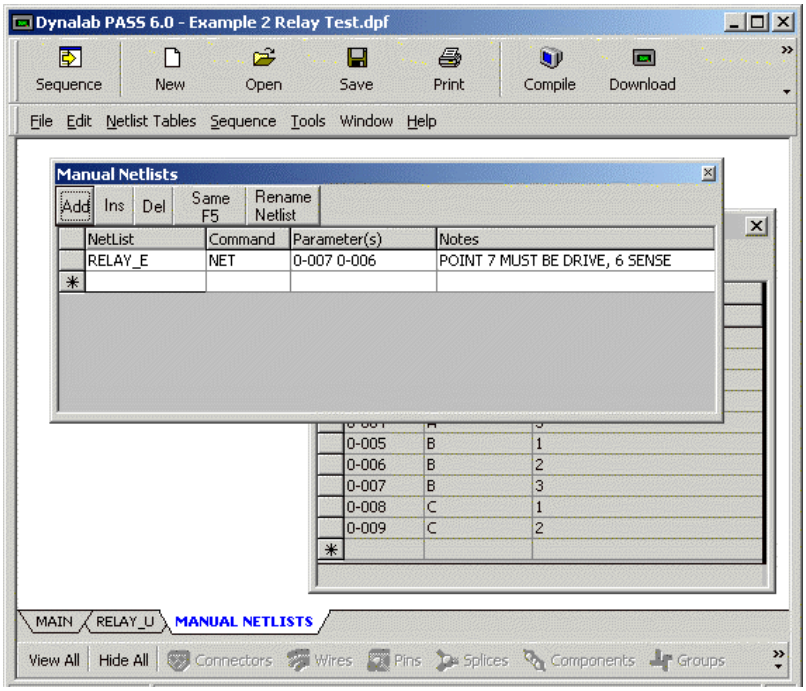
If pin 3 is selected as the drive and pin 2 as the sense, then this will result in a suitable test.

Since the harness wiring has already been previously verified, the only possible cause for a lack of continuity between these 2 points would be if the relay contact did not close, in which case pin 2 would not have any voltage distributed to it from the external source. So, it will be necessary to construct the program to ensure that pin 3 (test point 0-007) is the drive and pin 2 (test point 0-006) is the sense. This sort of control is only available by using a Manual Netlist.

The following steps apply to setting up a Manual Netlist to check continuity between test point 0-007 and 0-006, insuring that 0-007 is the drive and 0-006 is the sense.



In the File Settings, check the box labeled "Allow Manual Netlist Tab".



Make an entry in the Manual Netlists table. In this example, the Netlist Name is RELAY_E. The Command is NET and the Parameters are 0-007 and 0-006. This ensures that test point 7 is the drive and test point 6 is the sense. The entry in the NOTES field is optional.

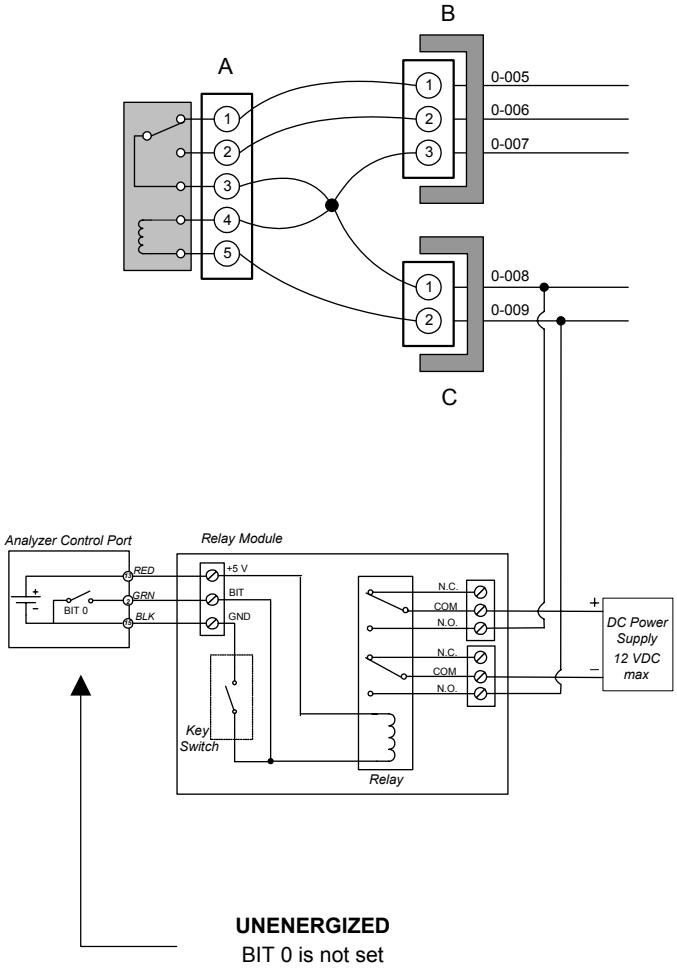
How to energize the relay under test

To energize the connectorized harness relay, voltage from a power supply must be applied to its coil. Dynalab recommends use of the Relay Module[2], part number 212-2009 to control application of voltage to the relay under test. As seen below, an external power supply is connected across the coil of the connectorized harness relay through a contact of the Relay Module. The Relay Module is connected to the Analyzer's Control Port. When BIT 0 is set, the Relay Module energizes, and the contact closure completes the circuit through the DC power supply, resulting in the application of DC power across test points 0-008 and 0-009. This applies voltage to the connectorized harness relay, causing its associated contacts to change state.

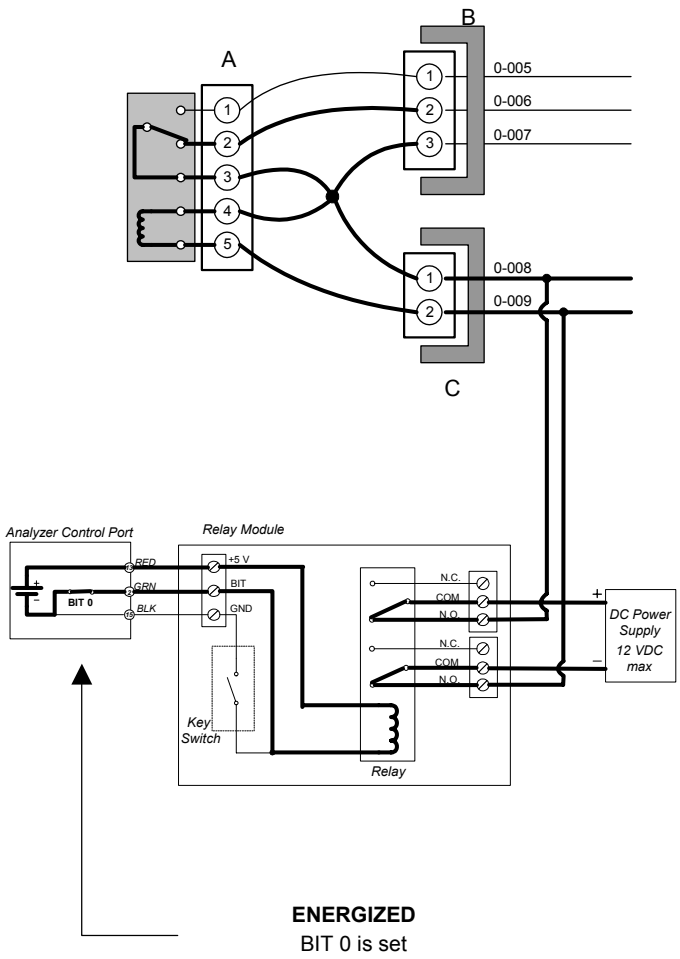
BIT 0 is set and cleared through the PASS program – this will be illustrated later.

Caution:

Use a regulated power supply with a maximum output voltage of 12 VDC. Use of an un-regulated supply can result in voltage levels that might damage the Analyzer's test point board.



UNENERGIZED
BIT 0 is not set



ENERGIZED
BIT 0 is set

[2] For a detailed explanation of the operation of Dynalab's Relay Module, refer to the Application Note entitled *Relay Module.*

Program the Sequence

The Sequence must be programmed to accomplish each of the three steps outlined earlier:

1. Test the harness without the relay
2. Prompt the operator to install the relay, and then test for electrical continuity through the Normally Closed contacts and through the relay coil.
3. Energize the relay coil, and test for electrical continuity through the Normally Open contacts.

The following table illustrates a Sequence that performs all three steps.

Basic Testing Sequence

Line	Sequence item	Parameter	Application Effect
1	ADVOFF		Forces the operator to repair errors before continuing the test
2	TEST	MAIN	Performs a complete Netlist scan of MAIN
3	SOUND	4	Play sound 4
4	LINE4	10	Displays message 10 on 4th line "INSTALL RELAY"
5	CONTINUITY	RELAY_U	Performs a continuity scan of the Netlist "RELAY_U"
6	LINE4	15	Displays message 15 on 4th line" ENERGIZING RELAY"
7	BSET	0	Sets BIT 0 – energizes relay
8	DELAYT	5	Pause for 5 tenths of a second
9	CONTINUITY	RELAY_E	Performs a continuity scan of the Netlist "RELAY_E"
10	BCLR	0	Clears BIT 0 – deenergizes relay
11	SOUND	0	Plays sound 0
12	MESSAGE	20	Displays message 20 : "HARNESS PASSED... REMOVE HARNESS TO CONTINUE"
13	KWAIT		Waits for operator to press START button
14	REPEAT		Go to line 1 and continue Sequence execution

Note: *The LINE4 Sequence item requires EPROM version 7.002 or later*

Line 1 The ADVOFF Sequence item at the beginning of the Sequence instructs the Analyzer not to accept input from the START button when stopped on an error encountered during the TEST scan. This Sequence item prevents the operator from advancing and completing the test until the error has been fixed.

Line 2 TEST instructs the Analyzer to perform a complete test of the Netlist specified by the parameter, in this case, MAIN. (The TEST Sequence item is actually a macro. See PASS Help for more information about the TEST Sequence item.)

Line 3 Plays sound 4 – 4 "chirps". This sound is used to indicate that the harness has passed continuity and short scans.

Line 4 LINE4 displays message 10 on the 4th line. This message instructs the operator to install the relay. The message "INSTALL RELAY" persists on line 4, allowing any error messages to be visible on lines 1-3

Line 5 CONTINUITY performs a continuity scan of the RELAY_U Netlist.

Line 6 LINE4 displays message 15 on the 4th line. This message informs the operator that the relay is now energized. The message "ENERGIZING RELAY" persists on line 4, allowing any error messages to be visible on lines 1-3.

Line 7 BSET 0 sets bit 0. If the Analyzer and Relay Module are wired in accordance with the diagram shown in the previous section of this document, this will cause the relay to energize.

Line 8 DELAYT 5 pauses for 5 tenths of a second.

Line 9 CONTINUITY performs a continuity scan of the RELAY_E Netlist.

Line 10 BCLR 0 clears bit 0. This de-energizes the relay.

Line 11 SOUND 0 plays a twirl, indicating a successful test.

Line 12 MESSAGE 20 displays message 20 "HARNESS PASSES…REMOVE HARNESS TO CONTINUE"

Line 13 KWAIT waits for the operator to press the START button to continue.

Line 14 REPEAT causes execution to start again at Line 1