

MICRO-AIDE



TRAINING MANUAL

LOCAL CONTROL UNIT TRAINING MANUAL



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ABOUT THIS TRAINING

Introduction

MICRO-AIDE has been manufacturing Local Control Units (LCU) to TxDOT for more than 20 years.

MICRO-AIDE also provides TxDOT with Relay Load Switches (RLS), Head Assembly Current Sensors (HACS) and Limited Distance Modems (LDM).

The LCU was designed and manufactured to specific requirements defined by TxDOT.

From the start the LCU has utilized STD Bus Printed Circuit Boards (PCBs).

MICRO-AIDE and TxDOT worked together to design the collection of PCBs.

All of the software used by the LCU was designed by TxDOT, not MICRO-AIDE.

What This Training is About

This training session will span two days of work.

The training will be “hands on”.

We'll cover the following major topics and answer the following questions.

- Why is an LCU used?
- How and where is an LCU installed?
- What major components comprise an LCU?
- What are the major external components?
- What are the major internal components?
- What is the correct ordering of internal PCBs?
- How is each PCB properly configured?
- How do I install a program?
- How do I test an LCU?

WHAT IS AN LCU?

Background

An LCU is an electronic device that consists of a chassis, many electronic components and several plug-in PCBs.

Everything the LCU does is controlled by a micro-processor chip.

The micro-processor “reads” instructions from a memory chip and executes those instructions to perform its task.

The contents of the memory chip is the program.

The LCU’s task is to control and monitor the status of LCS indications.

Typical Installation

As regards the LCU, a typical TxDOT roadside house includes the following major equipment items.

- A power source - 120Vac and 24Vdc for the LCU, etc.
- A Local Control Panel - used to interconnect everything.
- Communications equipment that allows the Traffic Center to communicate with the LCU.
- One or more LCUs.
- Several RLS devices that turn AC power on and off to individual LCS indications.

- Several HACS devices that verify power is applied to an indication.

Installation Block Diagram

Figure 1 on page 6 includes a simplified block diagram of a typical facility.

Description of Equipment Items

Power

- Commercial power, 120Vac 60Hz is used to power the LCU.
- A UPS may be used in some facilities.
- The RLS, HACS and outputs of the LCU require 24Vdc power.

Local Control Panel

- The LCP provides numerous screw-down terminals for interconnecting the LCU outputs and inputs to the RLS and HACS devices.

Communications

- The communications sub-system comprises all of the fiber-optic, T-1, Sonnet, modem and RS-232 equipment that allows the Traffic Center to communicate remotely with an LCU.
- The communications sub-system terminates at the DB-25 connector of the LCU.

LCU

- The LCU is in constant communication with the Traffic Center.
- It responds to commands from the Traffic Center to turn on and off specific LCS indications.
- It also reports to the Traffic Center the on/off state of each LCS indication.

- LCS on/off indications are determined by the HACS, but “read” by the LCU.
- An LCU includes 120 Inputs and 72 Outputs. Inputs “read” and report status. Outputs turn things on and off.

RLS

- The RLS uses an internal relay to apply power on and off to the LCS indication. There are three relays per RLS. It replaces the triac-based Load Switches.
- Each RLS relay is wired to an output of the LCU.
- A red LED indicates the state of the relay.

HACS

- The HACS is an AC current sensing device.
- It monitors the AC current from the RLS to the power supply of the LCS indication.
- It turns “on” its output bit if the current is adequate and “off” if the current is too low.
- A green LED indicates the state of the output bit and current level.
- The output bit is wired to an input of the LCU.

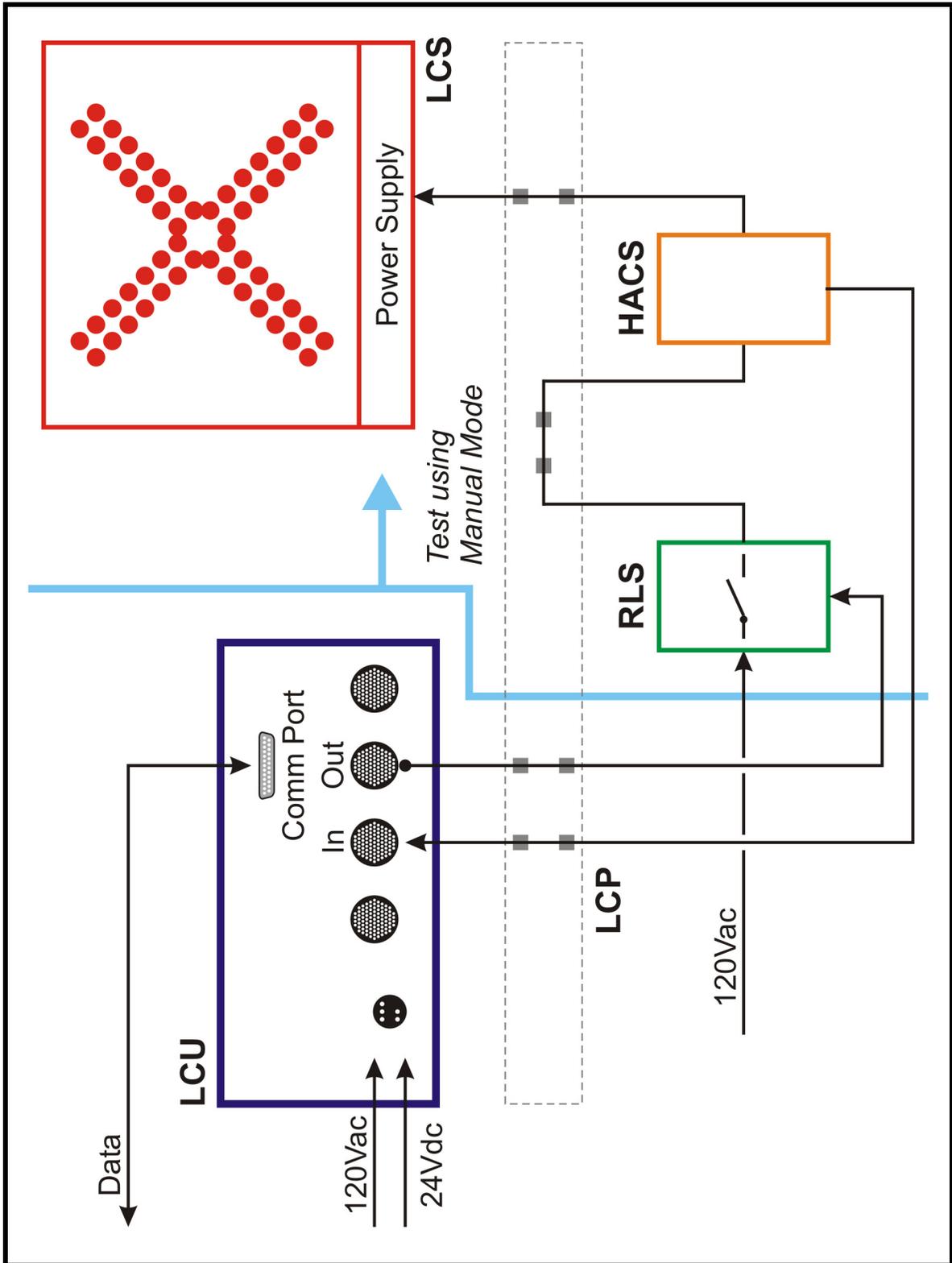


Figure 1 - Block Diagram - Typical Installation

INSTALLATION

Preparation

Prior to installing the LCU the following list of items must be prepared and/or available.

- Sturdy shelf upon which the LCU will be placed.
- 120Vac and 24Vdc power terminated in the appropriate round, power connector.
- I/O cables properly wired and terminated to the LCP.
- Serial communications cable terminated in a DB-25, male connector.

The following items are critical. They will be discussed at length later in this training session.

- The correct jumpers must be set on each PCB.
- The PCBs must be installed in the correct card slot positions.
- The CPU must include the correct TxDOT specified program.

Mounting

Place the LCU atop the shelf. Its location should provide adequate slack in the various cables.

Making the Connections

Attach the I/O cables to the appropriate round connectors labeled “I/O-1” through “I/O-4”.

Attach the power cable to the connector labeled “Power”.

Attach the data cable to the DB-25 connector labeled “Communications Port”.

Assigning the Channel Address

Place the switch labeled “Online Status” in the up position.

Assign a Channel Address in the range of 1 to 8 that is **unique** to this LCU. Press the up and down buttons to change the address.

Applying Power

Check all of the connections and verify that they are correct.

Apply power to the LCU. The Power Switch should illuminate.

- The LEDs labeled “5V”, “+12V” and “-12V” must illuminate. If they do not, there is a problem. Notify MICRO-AIDE.
- The LED labeled “Online Status” should illuminate.

If the LCU fails to perform properly the procedures described in the remainder of this Training Manual should be examined.

CORRECT PCB INSTALLATION

Set of PCBs

An LCU always includes 11 plug-in PCBs as listed below.

- Qty. 1 - 80-0026 CPU
- Qty. 1 - 80-0042 Watch Dog Timer
- Qty. 5 - 80-0023 Opto-Input
- Qty. 3 - 80-0030 Opto-Output
- Qty. 1 - 80-0041 Power Supply

The PCBs **MUST** be installed in the correct order.

PCB Card Slot Locations

Figure 2 on page 10 illustrates the MICRO-AIDE recommended card slot location for each PCB. Card Slots 1 and 12 can be left empty. The Power Supply occupies the last three card slots (13-15).

Opto-Input and Opto-Output PCBs **MUST** be installed in the left-right sequence shown. Failing to do so will cause an operational failure of the LCU.

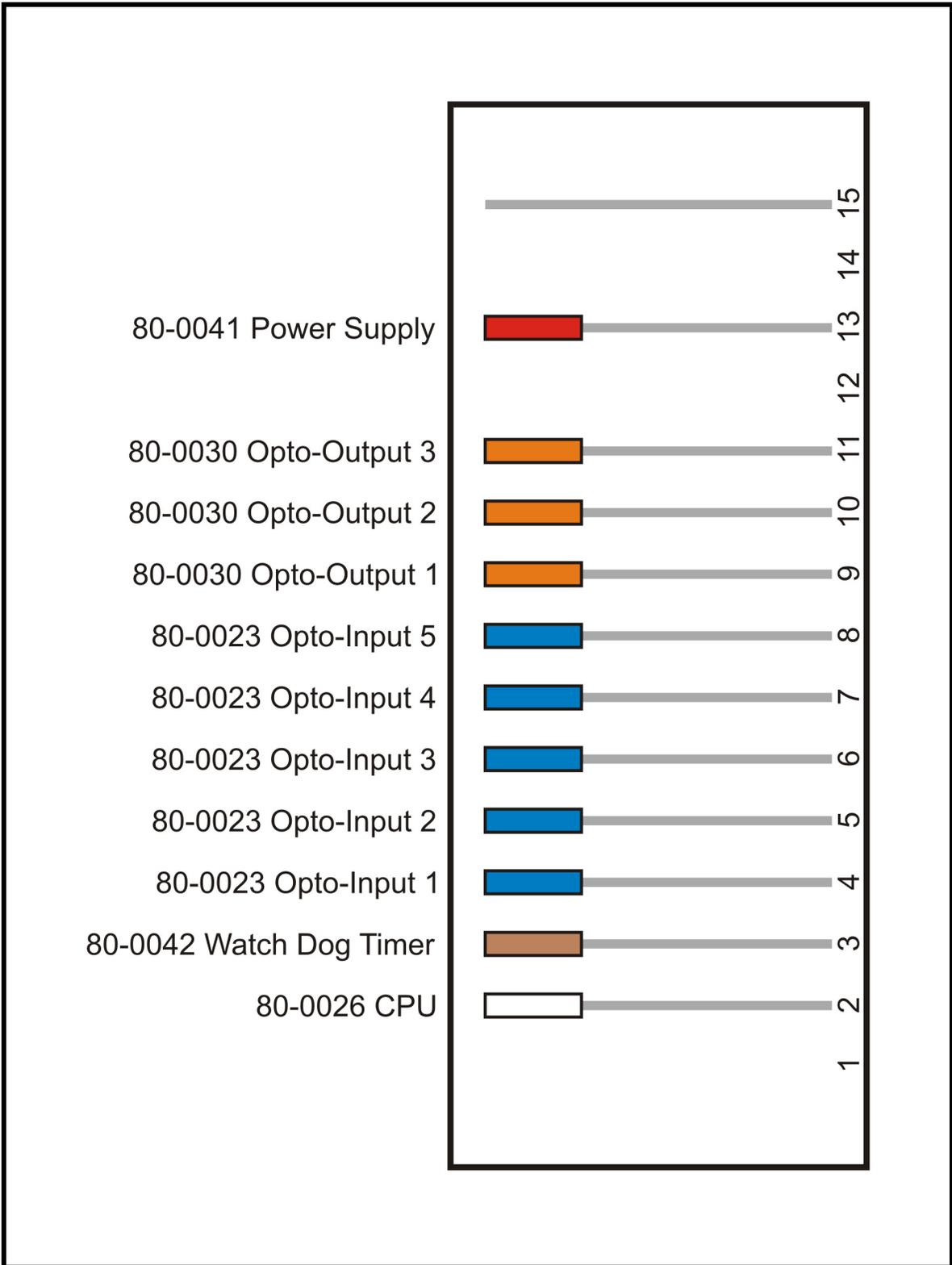


Figure 2 - Recommended PCB Locations

Flat Cable Connections

Each Opto-Input and Opto-Output PCB connects to the round connectors of the front panel via a separate flat cable.

Figure 3 on page 12 depicts the correct cable connections.

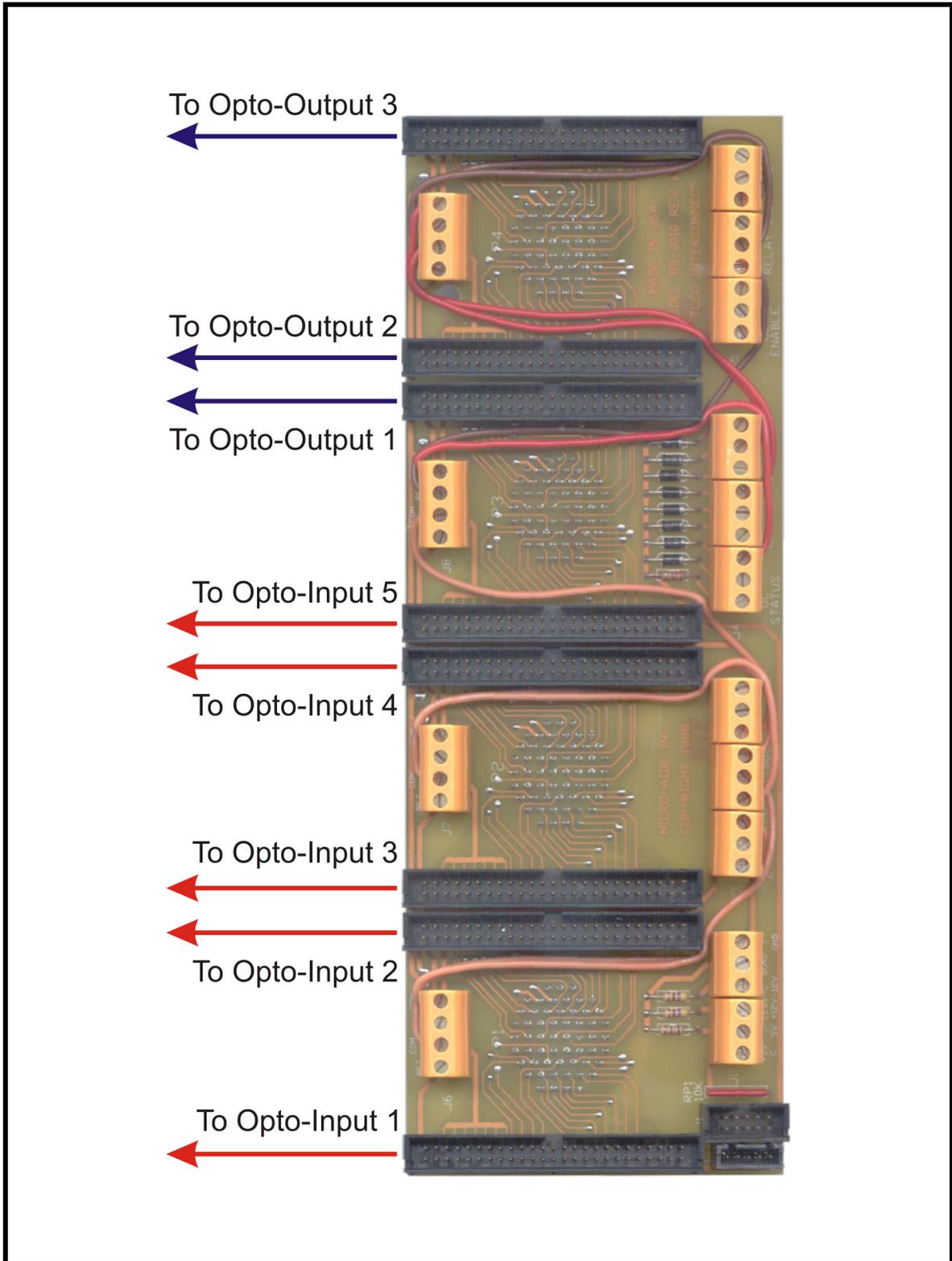


Figure 3 - Opto-Input and Opto-Output Cable Connections

CONFIGURING THE PCBs

Importance of Jumper and Switch Settings

The CPU, Watch Dog Timer, Opto-Input and Opto-Output PCBs include numerous settings that are controlled by jumpers and/or switch settings.

These settings allow the PCBs to be used in a variety of memory and I/O configurations. In the case of the LCU, only one combination of settings is correct.

The LCU will not operate properly if the jumpers and switches are not correctly set.

Reference Photos

This section includes a photo image of the CPU, Watch Dog Timer, Opto-Input and Opto-Output PCBs.

Each image shows the correct jumper and switch settings. These images should be used as guides to insure that each PCB is correctly configured.

Remember the following:

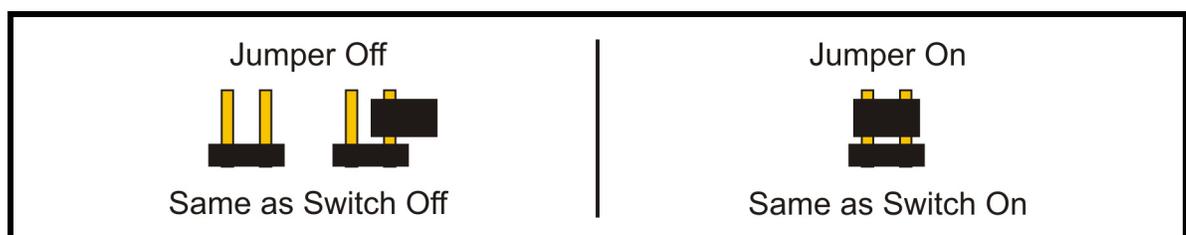


Figure 4 - Jumper On and Off

80-0042 Watch Dog Timer

- Jumpers and switches must be set correctly.

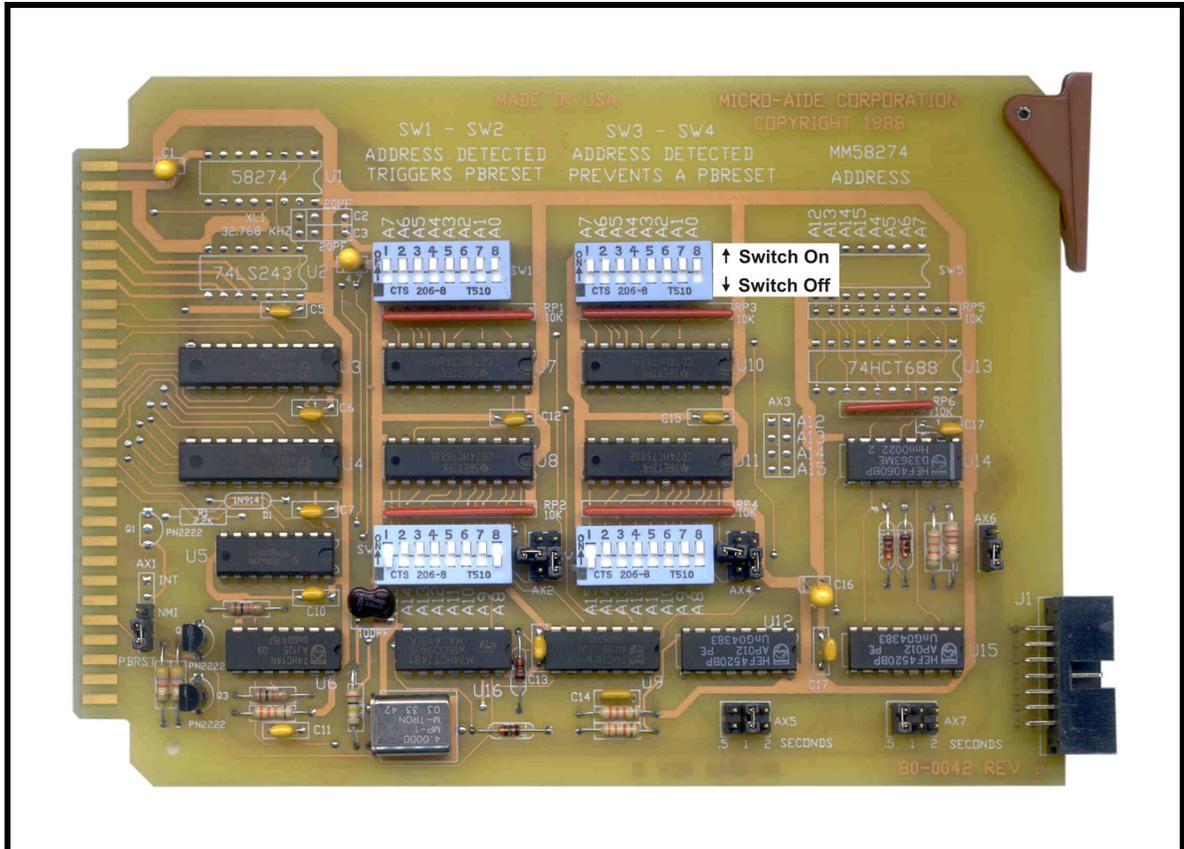


Figure 6 - 80-0042 Watch Dog Timer

80-0023 Opto-Input

- Each of the five Opto-Input PCBs has a unique arrangement of jumper settings.
- These jumpers are critical.

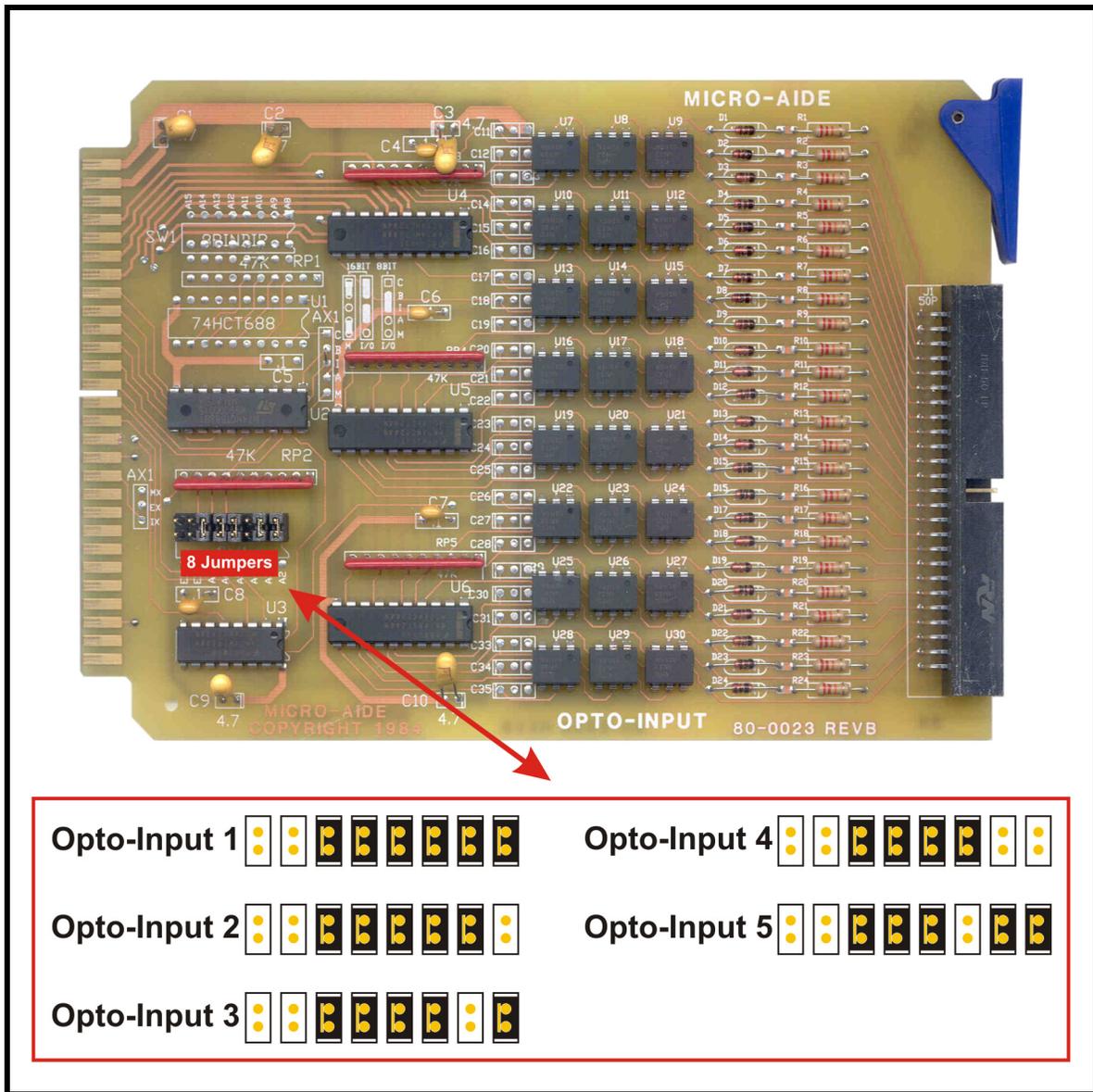


Figure 7 - 80-0023 Opto-Input

80-0030 Opto-Output

- Each of the three Opto-Output PCBs has a unique arrangement of jumper settings.
- These jumpers are critical.

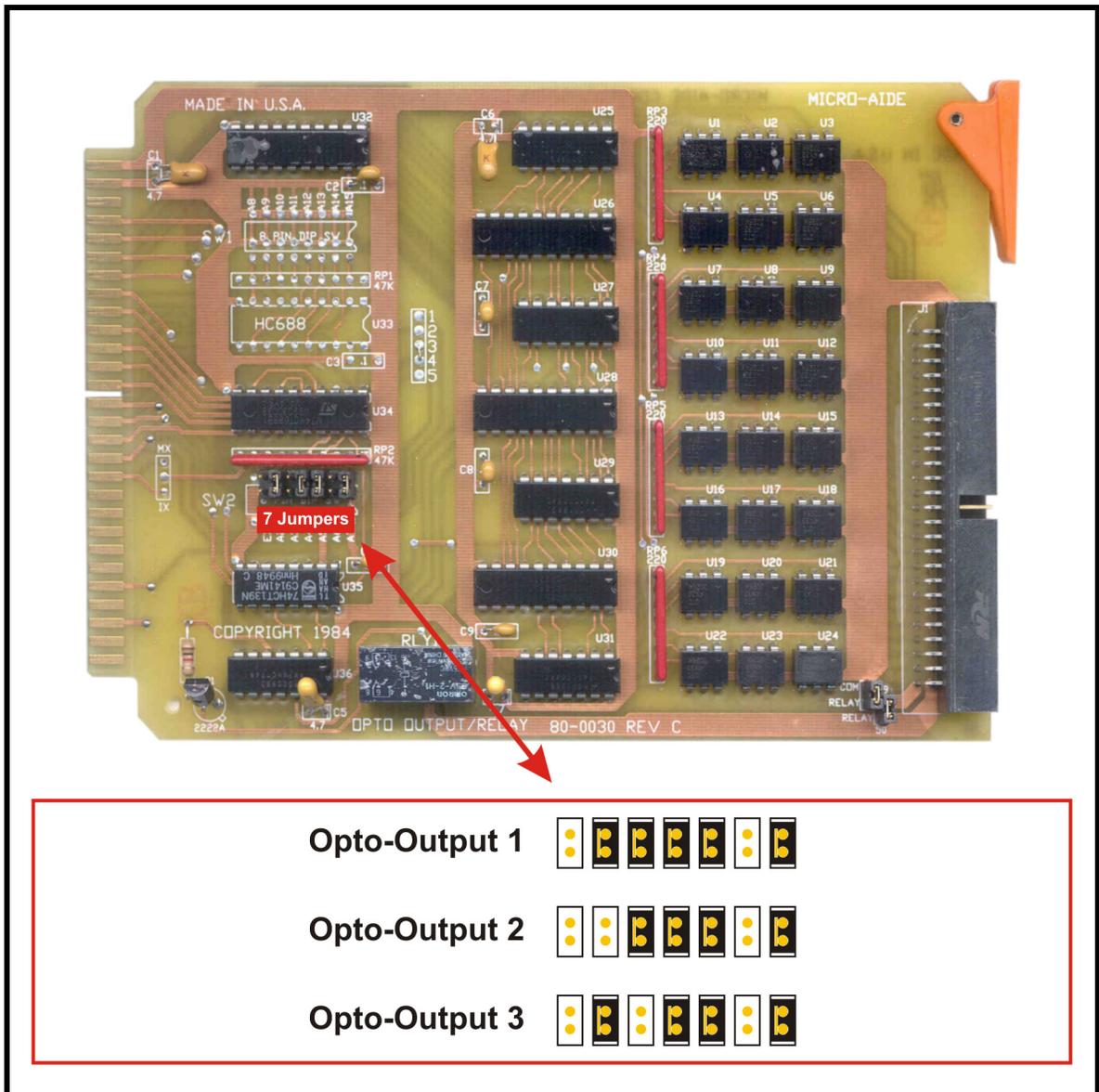


Figure 8 - 80-0030 Opto-Output

TESTING THE LCU

What This Test Does

This test uses a program written by TxDOT. It does a very good job of testing the LCU.

- Tests many of the CPU and Watch Dog Timer functions.
- Tests communications between the Communications and Diagnostic ports.
- Verifies the operation of each Opto-Output by changing its status and then reading its status via an Opto-Input.

Items That are Required

- Test EPROM containing LCU Test program.
- LCU power cord.
- 120Vac and 14 to 24Vdc power.
- Communications to Diagnostic Port flat cable.
- I/O loop-back cables (set of two).
- PC running HyperTerminal or Procomm.
- DE-9 to DE-9, female-to-female, straight-through cable.
- 9- to 25-pin, male-to-male connector adapter.

Initial Setup

- With no power applied, remove the CPU PCB. Install the LCU I/O Test EPROM. Reinstall the CPU PCB.
- Connect the Communications Port to the Diagnostic Port using the flat cable.
- Using the two-ended loop-back cable, connect I/O-1 to I/O-4. Attach the single-ended loop-back cable to I/O-3.
- Connect, but do not turn on, AC and DC power to the LCU.
- Verify everything is connected properly.

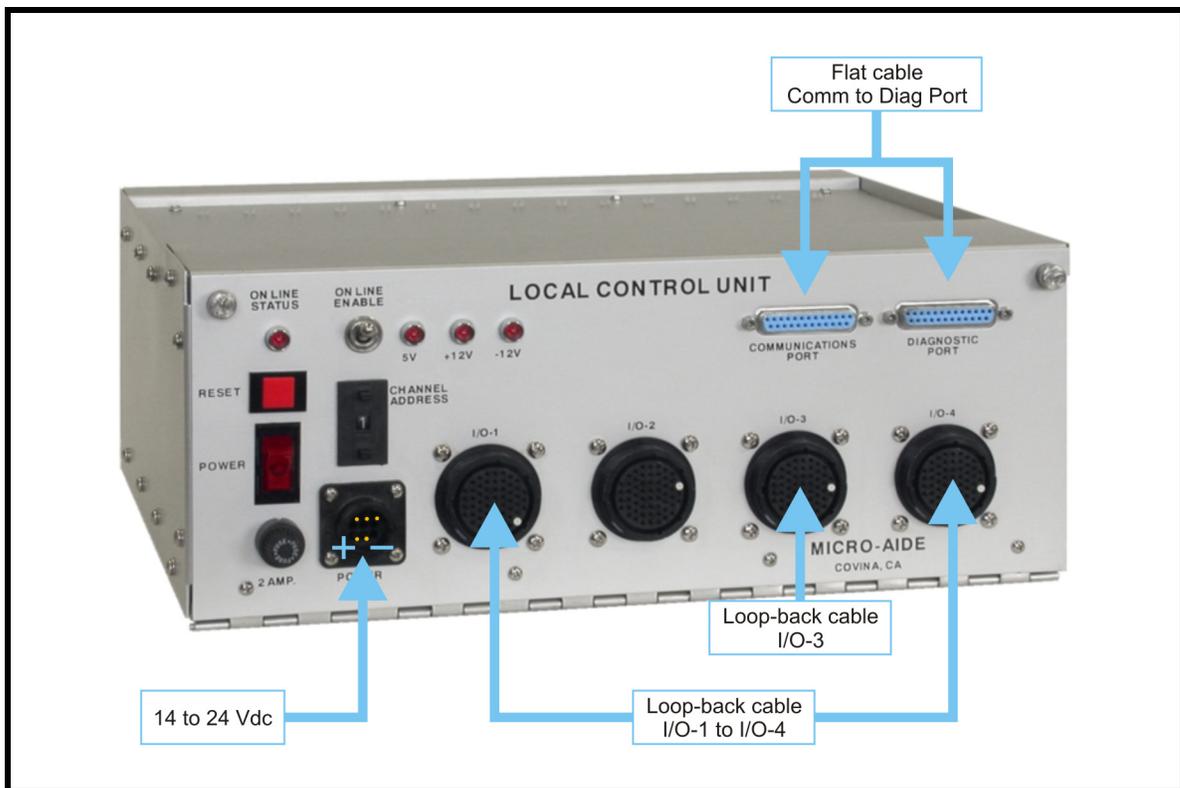


Figure 9 - Initial Test Connections

Start the Test

Communications to Diagnostic Port Test

- Turn the LCU Power Switch on.
- Verify the front panel +5V, +12V and -12V LEDs are illuminated.
- Open the front cover of the LCU. The CPU PCB must be observed.
- The LEDs on the front edge of the CPU must illuminate according to the following sequence.

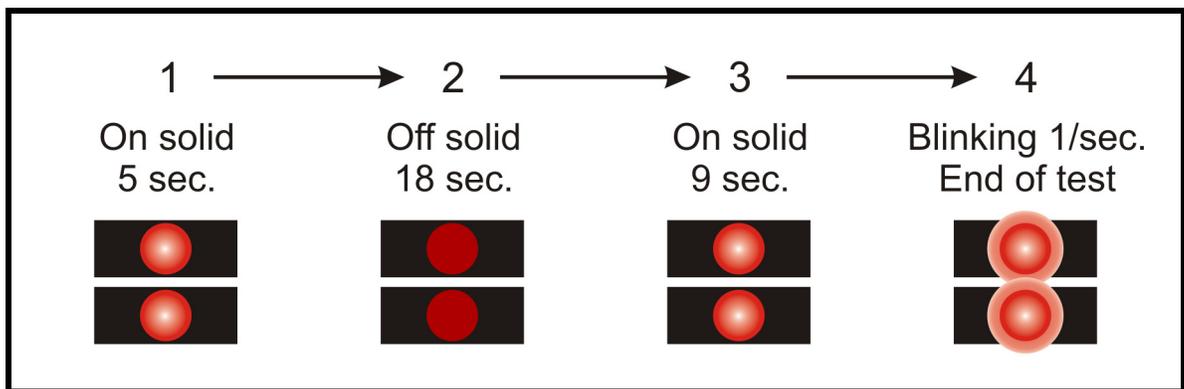


Figure 10 - Comm to Diag Port Test - LED Sequence

- After approximately 32 seconds the LEDs should start to blink once per second. **The Communications and Diagnostic Ports have passed the test.**

Connect and Set Up the PC

- Disconnect the flat cable from the Diagnostic Port.
- Connect the PC comm port to the LCU Diagnostic Port using the 25-pin adapter.
- Launch HyperTerminal or Procomm set to run at 9600 Baud and N-8-1.

EEPROM Test

- The following message will be continuously displayed at the PC.

```
Press any key to continue  
Press any key to continue
```

- Press any key.** The following EEPROM test data will be displayed.

```
EEPROM at 6000H, Already tested and page length= 40H  
  
Press any key when ready
```

- Press any key.** The following EEPROM test data will be displayed.

```
EEPROM at 4000H, Already tested and page length= 40H  
  
Press any key when ready
```

- The EEPROMs have passed the test.** Press any key to proceed.

Watch Dog Timer Test

- The following test data will be displayed.

```
No error conditions have been detected  
Watchdog timer periodic reset sample times (ms)  
 1048 1048 1048 1048 1048 1048 1048 1048  
 1048 1048 1048 1048 1048 1048 1048 1048  
Average time 1048  
Remote reset sample times (ms)  
 523 523 523 523 523 523 523 523  
 523 523 523 523 523 523 523 523  
Average time 523  
  
I/O Test 1  
  
Install test fixtures on front panel connectors I/O-1,3,4  
  
Make sure ON-LINE ENABLE switch is in the UP position  
  
Press any key when ready
```

- If no errors are reported, **the WDT PCB has passed the test.**

- Ensure the Online Enable Switch is Up. [Press any key to proceed.](#)

LCU Channel Address Test

- The following message will be displayed.

```
Verify the operation of the thumbwheel/pushbutton hex switch

Press any key to terminate the test

Current input is 1
```

- Press the + and - buttons several times on the switch labeled “Channel Address”. The new address will be reported at the PC. Addresses run from 0 to 15.

- [Press any key to proceed.](#)

Opto-Output Relay Tests

- The following message will be displayed.

```
Initial power on condition - all bits should be off OK
Verify that the ON-LINE STATUS LED is OFF

Press any key when ready
```

- Verify the Online Status LED is Off. [Press any key.](#) The following message will be displayed.

```
Testing relays

Relay 1 is ON - Verify that the ON-LINE STATUS LED is ON

Press any key when ready
```

- Verify the Online Status LED is On. **Press any key.** The following message will be displayed.

```
Relay 1 is OFF - Verify that the ON-LINE STATUS LED is OFF  
Press any key when ready
```

- Verify the Online Status LED is Off. **Press any key.** The following message will be displayed.

```
Relay 2 is ON - Verify that the ON-LINE STATUS LED is ON  
Press any key when ready
```

- Verify the Online Status LED is On. **Press any key.** The following message will be displayed.

```
Relay 2 is OFF - Verify that the ON-LINE STATUS LED is OFF  
Press any key when ready
```

- Verify the Online Status LED is Off. **Press any key.** The following message will be displayed.

```
Relay 3 is ON - Verify that the ON-LINE STATUS LED is ON  
Press any key when ready
```

- Verify the Online Status LED is On. **Press any key.** The following message will be displayed.

```
Relay 3 is OFF - Verify that the ON-LINE STATUS LED is OFF  
Press any key when ready
```

- Verify the Online Status LED is Off. **Press any key.** The following message will be displayed.

```
Place the ON-LINE ENABLE switch in the DOWN position

Press any key when ready
```

- Ensure the Online Enable Switch is Down. **Press any key.** The following message will be displayed.

```
OK
Verify that the ON-LINE STATUS LED is OFF

Press any key when ready
```

- Verify the Online Status LED is Off. **Press any key.** The following message will be displayed.

```
Place the ON-LINE ENABLE switch in the UP position

Press any key when ready
```

- Ensure the Online Enable Switch is Up. **Press any key.** The following message will be displayed.

```
OK
Verify that the ON-LINE STATUS LED is ON

Press any key when ready
```

- The Relays have passed the test.**

- Press any key to proceed.** The following message will be displayed.

I/O Test - Part 1

- The following data will be displayed.

```
Testing individual ports

OUTPUT: Connector I/O-4a PORT 0 OK
OUTPUT: Connector I/O-4a PORT 1 OK
OUTPUT: Connector I/O-4a PORT 2 OK
OUTPUT: Connector I/O-4b PORT 0 OK
OUTPUT: Connector I/O-4b PORT 1 OK
OUTPUT: Connector I/O-4b PORT 2 OK
OUTPUT: Connector I/O-3b PORT 0 OK
OUTPUT: Connector I/O-3b PORT 1 OK
OUTPUT: Connector I/O-3b PORT 2 OK

I/O Test 2

Move connector from I/O-1 to I/O-2

Press any key when ready
```

- If no errors are reported these input and output bits passed the test.
- Move the loop-back cable connector from I/O-1 to I/O-2. Press any key to proceed.

I/O Test - Part 2

- The following data will be displayed.

```
Testing individual ports

OUTPUT: Connector I/O-4a PORT 0 OK
OUTPUT: Connector I/O-4a PORT 1 OK
OUTPUT: Connector I/O-4a PORT 2 OK
OUTPUT: Connector I/O-4b PORT 0 OK
OUTPUT: Connector I/O-4b PORT 1 OK
OUTPUT: Connector I/O-4b PORT 2 OK
OUTPUT: Connector I/O-3b PORT 0 OK
OUTPUT: Connector I/O-3b PORT 1 OK
OUTPUT: Connector I/O-3b PORT 2 OK
Testing Complete
```

- If no errors are reported these input and output bits passed the test.
- The test has been successfully completed.

Restart the Test

- After completion, press the push-button switch labeled “Reset” to run the test again from the beginning.
- Press the Reset switch during any portion of the test to restart the test from the beginning.

Material Return Policy

In the event the customer identifies a malfunction in any product, call or write MICRO-AIDE and obtain a Return Material Authorization (RMA) number from the customer service department. Return the product to MICRO-AIDE, freight prepaid, with a note (in-warranty repair) or a purchase order (out-of-warranty) for the repair listing the following information:

- RMA number from MICRO-AIDE
- Return shipment address
- Name and telephone number of person familiar with the problem
- Brief description of the problem (include any printouts that may have a bearing on the problem)
- Method of payment for repair costs (out-of-warranty)
- Send product to the following address:

MICRO-AIDE CORPORATION

685 Arrow Grand Circle

Covina, CA 91722

Tel: 626-915-5502 Fax: 626-331-9484

E-mail: support@micro-aide.com

Limited Warranty

MICRO-AIDE warrants its products to be free from defects in material and workmanship for a period of five (5) years from the date of shipment. This warranty is in lieu of any other warranty, expressed or implied. In no event shall MICRO-AIDE be held liable for incidental or consequential damage resulting from (1) the use of any of its products, or (2) any alleged breach of this warranty provision. MICRO-AIDE's liability shall be limited to repairing or replacing, at its sole discretion, any defective product which is returned in accordance with the MICRO-AIDE Material Return Policy.

Product that has been subjected to abuse, misuse, alteration, accident, lightning damage, neglect or unauthorized installation or repair shall not be covered by this warranty. MICRO-AIDE reserves the right to make a final decision as to the existence of any failures and the cause of such failures. No warranty is made with respect to custom equipment or products produced to buyer's specifications except as mutually agreed upon in writing.

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