UNION SWITCH & SIGNAL

1000 TECHNOLOGY DRIVE
PITTSBURGH, PA 15219-3120

SM-6800E

MICROLOK® II

Addendum to Version 2.5 Service Manuals

ECode and i-Lok

Features Description

December 2002
Original

Proprietary Notice

Important Notice

US&S constantly strives to improve our products and keep our customers apprised of changes in technology. Following the recommendations contained in the attached service manual will provide our customers with optimum operational reliability. The data contained herein purports solely to describe the product, and does not create any warranties.

Within the scope of the attached manual, it is impossible to take into account every eventuality that may arise with technical equipment in service. Please consult your local US&S sales representative in the event of any irregularities with our product.

We expressly disclaim liability resulting from any improper handling or use of our equipment, even if these instructions contain no specific indication in this respect. We strongly recommend that only approved US&S spare parts be used as replacements.

Revision History				
Revision	**Date**	**Author**	**Nature of Revision**	**Review & Approval Date**
Original	December 2002		Renamed SM 7101 to SM 6800 E. Incorporated ECO 139748-6 and made editorial and format changes.	

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1 Introduction

1.1 Purpose

This addendum to the MICROLOK II service manuals (2.5 release) is meant to acquaint the reader with additional system features recently developed for the product.

The information in this addendum will be incorporated into the 3.0 release of the MICROLOK II documentation (SM-6800A, SM-6800B, SM-6800C, and SM-6800D). Until that release, this document will serve as the primary source of reference on the new features.

1.2 Scope

Separate chapters in this addendum will describe four major categories of product enhancements:

- ECode Coded Track Circuit
- i-Lok Operation
- Miscellaneous MICROLOK II Features
- Use of the Comparison Tool

Along with describing the product enhancements, this addendum will identify the particular MICROLOK II manuals and sections impacted by the new information.

1.3 Product Trademarks

MICROLOK ®, MICROLOK ® II, ECode, and i-Lok are trademarks or registered trademarks of Union Switch & Signal Inc.

Electro Code 4 ® (EC4) and Electro Code 5 ® (EC5) are registered trademarks of GE Transportation Systems Global Signaling.

1.4 Overview of New Features

1.4.1 ECode Coded Track Circuit

The existing MICROLOK II product supports the MICROTRAX Coded Track Circuit, which is designed to provide train detection and communications through the rails. ECode is another track circuit option now available within MICROLOK II. ECode is compatible with the Electro Code® family of products.

With the inclusion of ECode into the MICROLOK II product line, MICROLOK II is now capable of communicating with both the MICROTRAX and the Electro Code® track circuits.

1.4.2 i-Lok

i-Lok is an extension of the MICROLOK II product line. The standard MICROLOK II card file is designed to address many different types of applications, from very small applications to large, complex applications. The i-Lok cardfile is designed to address intermediate signal applications.

Patterned after MICROTRAX, the i-Lok cardfile is designed to include:

- a track circuit board (either MICROTRAX or ECode)
- 1 or 2 MICROTRAX Color Light or Searchlight Lamp Driver boards
- 1 mixed I/O board

With these I/O configurations, i-Lok is suited for intermediate and cut-section (repeater) locations.

1.4.3 Miscellaneous MICROLOK II Features

Chapter 4 of this addendum describes these additional MICROLOK II features:

- Reset Configuration – Enables the user to adjust the track length for the MICROTRAX track board and/or the lamp wattage on the LAMP16 driver board while in the reset menu.
- Serial Testing - Enables users to view code and current data for carrier alignment. This branch of the on-line menu enables you to generate test-signals to be used for testing attached serial communication circuits.
- Identifying PC cards - Enables users to identify the status location of the PC Card on the CPU front panel display.
- Chapter 4 also discusses the new selections available from the Development System Program main menu.

1.4.4 Comparison Tool

The MICROLOK II Application Comparison Tool compares two MICROLOK II applications and reports the differences between them. The Tool serves two purposes. First, it can compare an original MICROLOK II application with its reverse-compiled application. The Comparison Tool can also compare two different versions of a MICROLOK II Application. The Comparison Tool is a part of the MICROLOK II Development System.

2 ECode Coded Track Circuit

The sections that follow describe the MICROLOK II product's ECode coded track circuit functionality.

2.1 ECode Coded Track Circuit Control

Summary:

Chapter 2 in SM-6800A describes the general application and functions of the MICROLOK II interlocking control system. Section 2.3 in SM-6800A describes MICROLOK II system configurations for application types. The ECode coded track circuit feature is an additional application type.

The new ECode coded track circuit option is compatible with all versions of Electro Code ®. ECode consists of two elements: a track PCB and a track interface panel. The ECode PCB interfaces with MICROLOK II's CPU, where the functions of track messaging and train detection are performed. Both the track PCB and the interface panel are dual units to handle two independent track circuits. The interface panel is designed for compatibility with highway crossing audio overlay equipment and provides secondary surge protection. It is functionally and mechanically equivalent to the Electro Code 5® (EC5) track interface panel – TIP-2. ECode operates at a fixed receiver sensitivity of 0.5 amperes and circuits are adjusted at the transmitter via 10 selected output voltages ranging from 1.0 to 2.5 volts.

Two possible applications of ECode and/or MICROTRAX coded track circuits and interface panels are illustrated in Figure 2-1 and Figure 2-2.

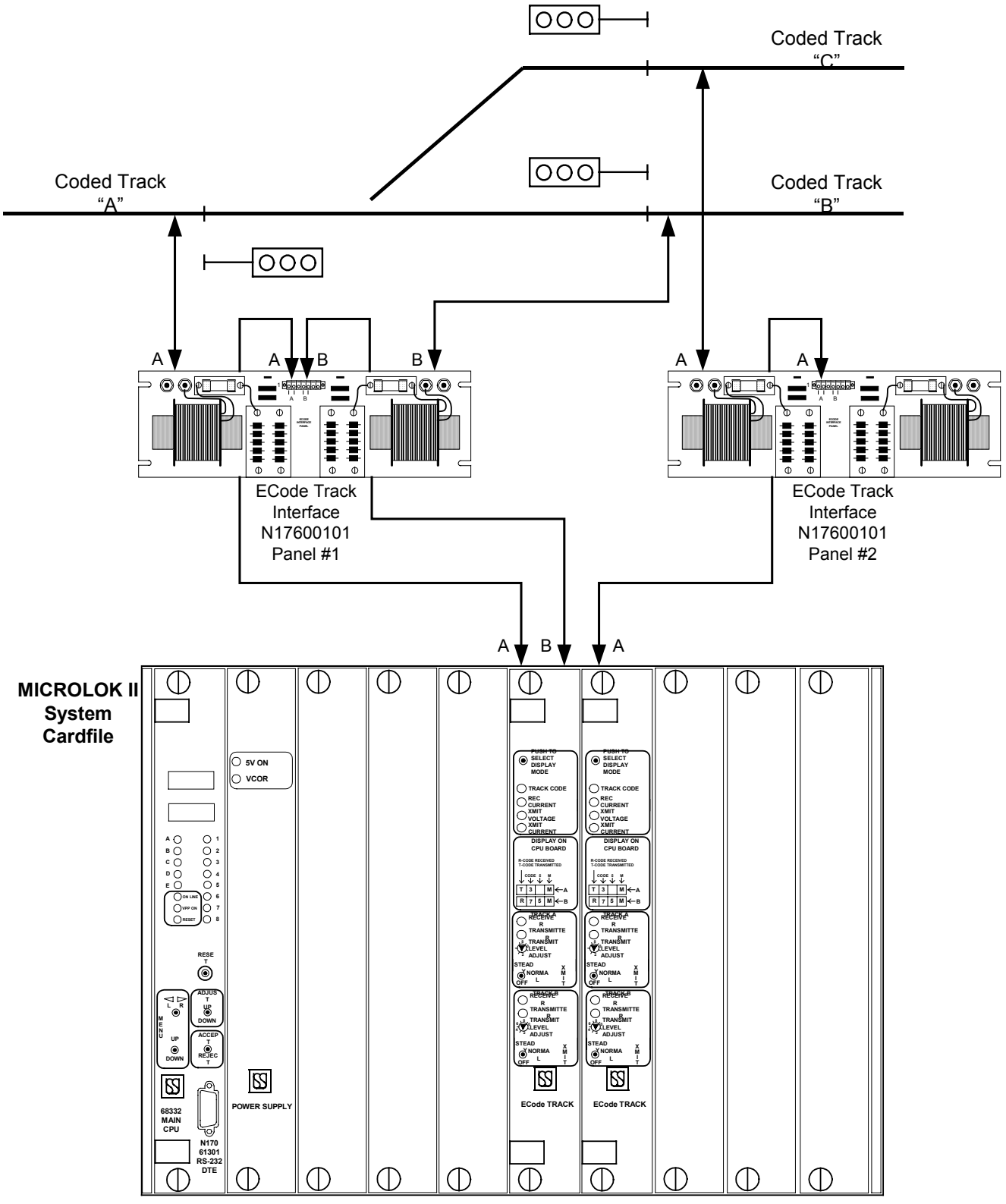


Figure 2-1 - MICROLOK II ECode Coded Track Circuit Configuration

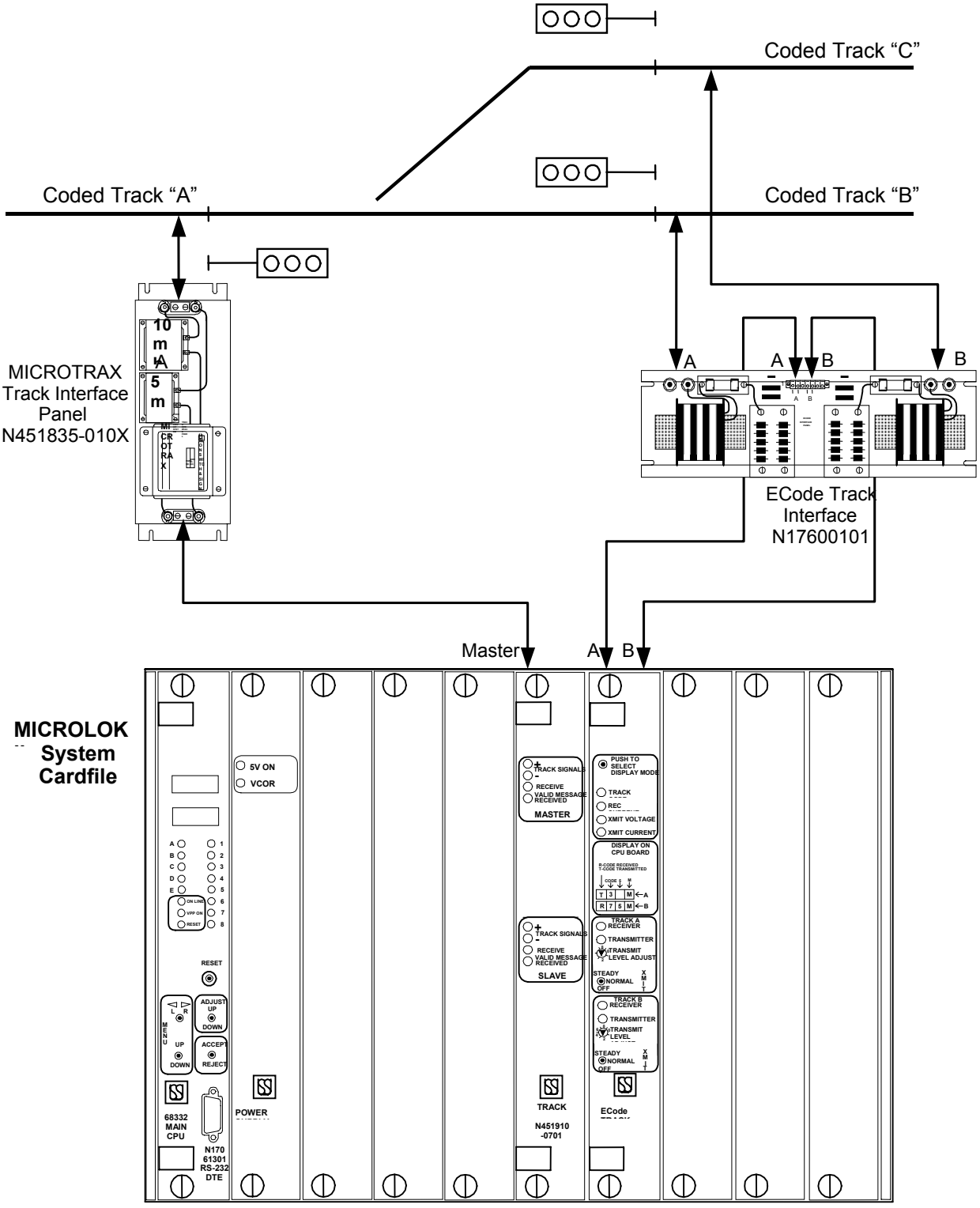


Figure 2-2 - MICROLOK II ECode Coded Track Circuit and MICROTRAX Track Circuit Configuration

2.2 ECode Coded Track Circuit PCB Description and Operation

Summary:

Chapter 2 in SM-6800A describes the general application and functions of the MICROLOK II interlocking control system. Section 2.5 in SM-6800A describes the MICROLOK II system cardfile. The ECode coded track circuit PCB is a new board that can be included in the cardfile.

The ECode coded track circuit PCB is linked to both the CPU board and the track interface panel. The CPU extracts information from the ECode PCB to determine track occupancy and track messages. The interface panel terminates on the track and is also connected to the ECode coded track circuit PCB.

Table 2-1 describes the functions on the ECode coded track circuit board front panel.

Table 2-1 - Functions on ECode Front Panel

Fig. Ref.	Label	Device	Purpose
1	**PUSH TO SELECT DISPLAY MODE**	Momentary pushbutton switch	Push once to display the transmitted and received codes for tracks A and B. Push twice to display the Received Current. Push three times to display the Transmit Voltage. Push four times to display the Transmit Current. Push five times to return to the scrolling menu.
2	**TRACK CODE**	red LED	When lit, the transmitted and received codes will be displayed on the CPU board.
	REC CURRENT	red LED	When lit, the receiver current will be displayed on the CPU board. Range from 0.0 to 3.6 amps in 0.1 amp increments.
	XMIT VOLTAGE	red LED	When lit, the transmit voltage will be displayed on the CPU board. Range from 1.0 to 2.5 volts, dependent on rotary switch position.
	XMIT CURRENT	red LED	When lit, the transmit current will be displayed on the CPU board. Range from 0.0 to 6.0 amps in 0.1 amp increments.
3	**TRACK A, RECEIVER**	green LED	When lit, indicates that the received current is greater than 0.5 amps. Flashing LED represents the received code.
4	**TRACK A, TRANSMITTER**	red LED	When lit, indicates that the transmitter is turned on and applying a DC signal to the track. Flashing LED represents the transmitted code.

Fig. Ref.	Label	Device	Purpose
5	**TRACK A TRANSMIT LEVEL ADJUST**	10 position rotary switch	Sets the transmitter output voltage, dependent on track circuit length. Refer to adjustment table.
6	**TRACK A XMIT switch**	Three-position toggle switch	**NORMAL** position: Board configured for normal track circuit operation. **STEADY** position: Steady DC energy applied to Track A at a level of 1.0 volt for troubleshooting. **OFF** position: Transmitter A is turned off and receiver A is turned on steady for troubleshooting.
7	**TRACK B, RECEIVER**	green LED	When lit, indicates that the received current is greater than 0.5 amps. Flashing LED represents the received code.
8	**TRACK B, TRANSMITTER**	red LED	When lit, indicates that the transmitter is turned on and applying a DC signal to the track. Flashing LED represents the transmitted code.
9	**TRACK B TRANSMIT LEVEL ADJUST**	10-position rotary switch	Sets the transmitter output voltage, dependent on track circuit length. Refer to adjustment table.
10	**TRACK B XMIT switch**	Three-position toggle switch	**NORMAL** position: Board configured for normal track circuit operation. **STEADY** position: Steady DC energy applied to Track B at a level of 1.0 volt for troubleshooting. **OFF** position: Transmitter B is turned off and receiver B is turned on steady for troubleshooting.

The figure on the next page illustrates ECode coded track circuit PCB front panel layout.

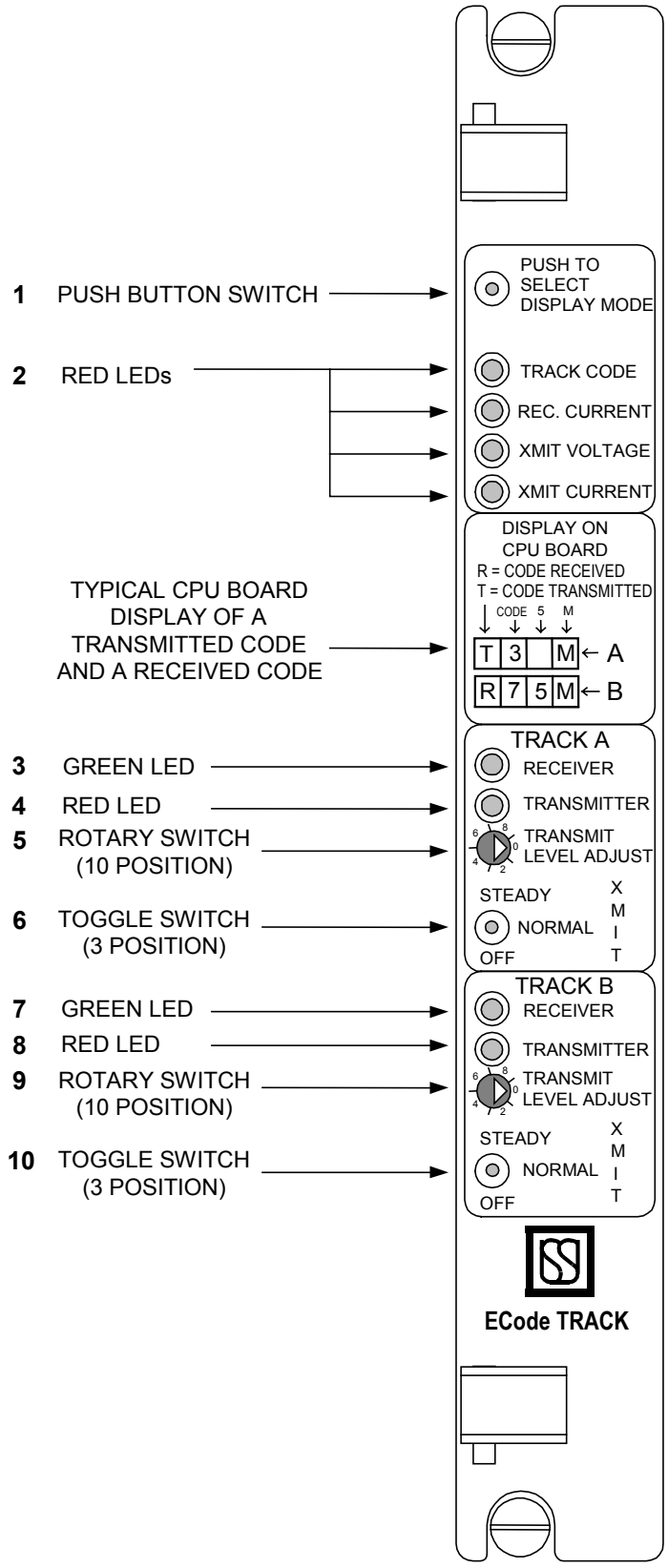


Figure 2-3 - An ECode Coded Layout Track Circuit PCB - Front Panel

2.3 ECode Coded Track Circuit Interface Panel

Summary:

Chapter 2 in SM-6800A describes the general application and functions of the MICROLOK II interlocking control system. Section 2.6 in SM-6800A describes MICROLOK II auxiliary equipment. The ECode Coded Track Circuit Interface Panel is additional auxiliary equipment.

The ECode coded track circuit interface panel carries all coded track communications between the MICROLOK II system cardfile and the rails. The circuitry associated with the interface panel minimizes interference from other signals on the rails. The US&S part number for the ECode coded track circuit interface panel is N17600101.

Figure 2-4 shows an ECode coded track circuit interface panel.

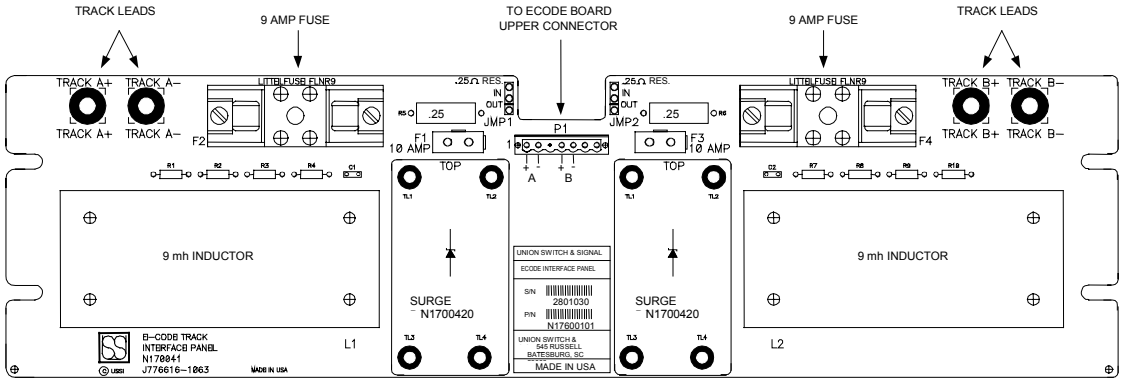


Figure 2-4 - An ECode Coded Track Circuit Interface Panel

Panel components include a series connected inductor, a replaceable surge protection board with 6.0 volt transzorbs, two fuses, and a series 0.25 ohm resistor that can be shorted out. (Refer to the figure on the next page.) These components are mounted on a 1/8 inch thick printed circuit board that is made to be rack-mounted. External wiring to the track is made using two-way AAR terminal blocks. Wiring to the cardfile is made through four terminals of a seven-way plug connector with cage clamp terminations.

For cab signal applications, a 10 mh inductor (J702288) must be wired in series with the positive track terminal of the track interface panel. This will block the 100 Hz cab signal from entering the ECode coded track circuit receiver.

Figure 2-5 is a schematic of the ECode Coded Track Circuit Interface Panel.

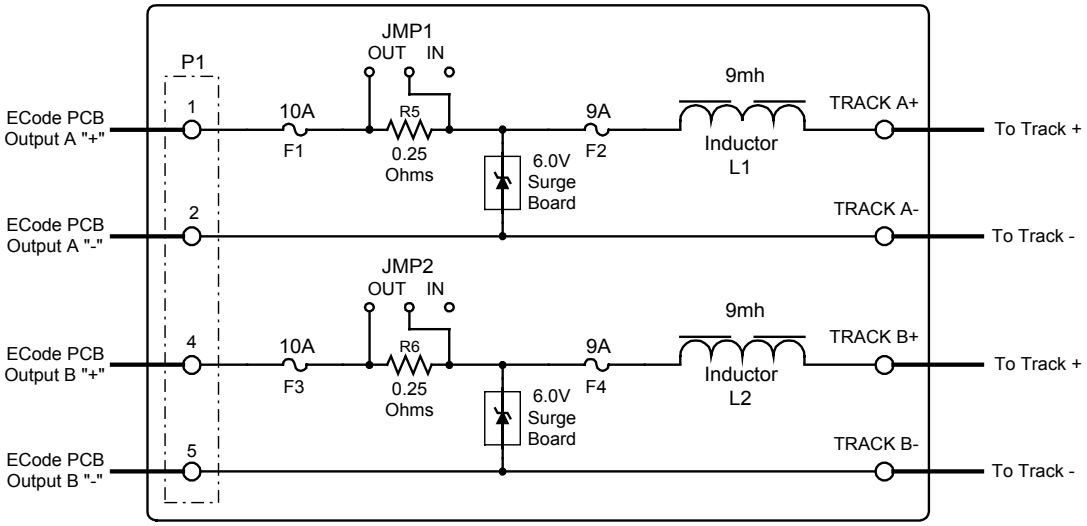


Figure 2-5 - ECode Coded Track Circuit Interface Panel Schematic

2.4 ECode Coded Track Circuit Installation

Summary:

Chapter 2 in SM-6800B describes MICROLOK II cardfile and circuit board installation. Keying plug installation information for an ECode Coded Track Circuit PCB is highlighted in the table that appears below.

Chapter 3 in SM-6800B describes the installation of MICROLOK II system peripheral devices. Summarized installation information about the ECode coded track circuit interface panel is highlighted in the table that appears below.

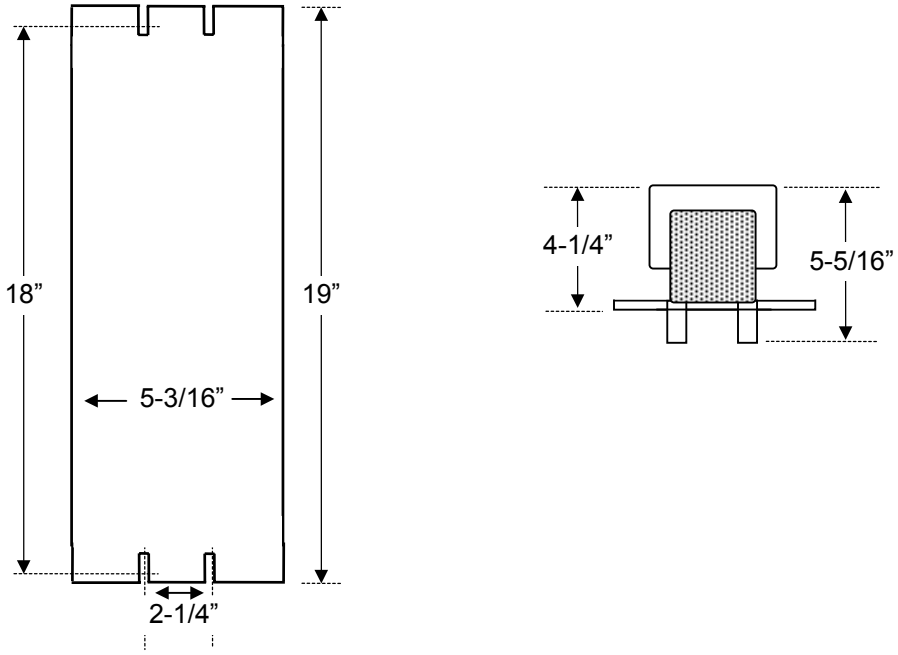
2.4.1 ECode Coded Track Circuit Board Keying Plug Installation

Printed Circuit Board	Part No.	Keying Plug Location											
		1	2	3	4	5	6	7	8	9	10	11	12
ECode coded track circuit	N17063901	✓	✓	✓	✓			✓				✓	

2.4.2 ECode Coded Track Circuit Interface Panel Installation

Wire resistance to and from the interface panel is critical. Adjustment tables, in section 2.8.3.1 of this document, are based on maintaining the resistance of track leads and resistance to the seven-pin connector to 0.1 ohms or less. Ultimate track circuit length is affected if greater than 0.1 ohms as indicated in the adjustment tables.

The figure below illustrates specifications for mounting the ECode Coded track circuit interface panel:



Mounting Dimensions for ECode Interface Panel

2.5 ECode Coded Track Circuit Specifications

Summary:

Chapter 3 in SM-6800A provides operating specifications for the various MICROLOK II printed circuit boards. The specifications for the ECode coded track circuit will be detailed in a new section (a preliminary version of which is provided below).

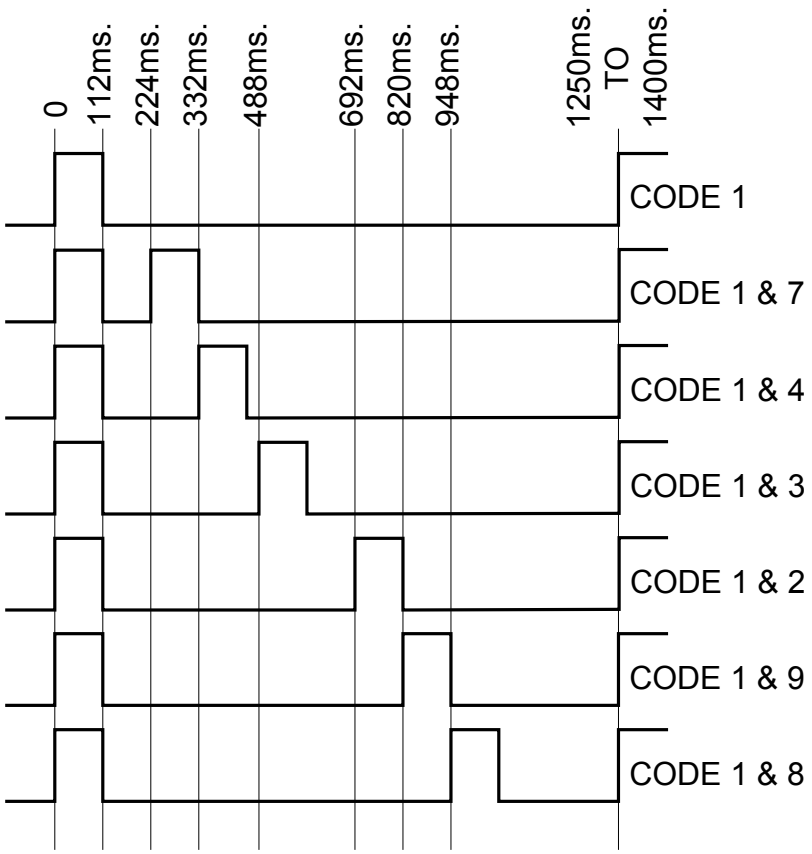
2.5.1 Track Circuit Length

Maximum Track Circuit Length		
ECode to ECode	Up to 24,000 ft.	@ 3 ohms per 1000 ft. ballast
ECode to Electro Code 4® (EC4)	Up to 15,000 ft.	@ 3 ohms per 1000 ft. ballast
ECode to Electro Code 5® (EC5)	Up to 24,000 ft.	@ 3 ohms per 1000 ft. ballast

2.5.2 Track Codes

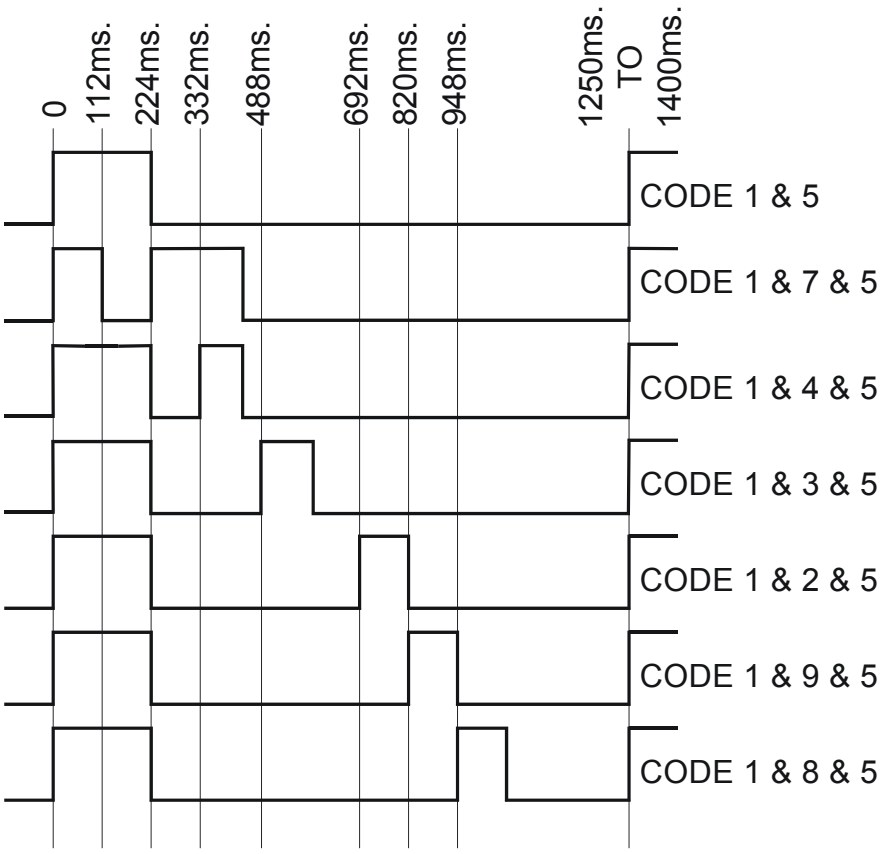
2.5.2.1 Vital Freight Codes

Code	First Pulse Width	Time Between Leading Edges	Second Pulse Width
1	112ms.	N/A	N/A
1 & 7	112ms.	224ms.	112ms.
1 & 4	112ms.	332ms.	112ms.
1 & 3	112ms.	488ms.	112ms.
1 & 2	112ms.	692ms.	112ms.
1 & 9	112ms.	820ms.	112ms.
1 & 8	112ms.	948ms.	112ms.



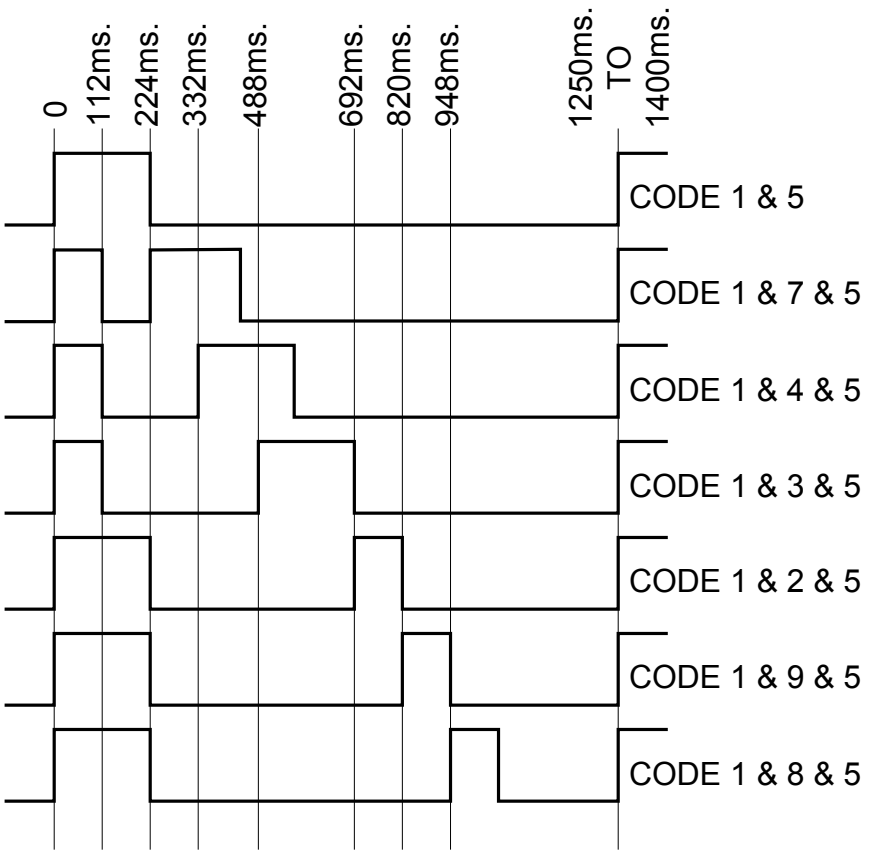
2.5.2.2 Normal Code 5 - Freight

Code	First Pulse Width	Time Between Leading Edges	Second Pulse Width
1 & 5	224ms.	N/A	N/A
1 & 7 & 5	112ms.	224ms.	224ms.
1 & 4 & 5	224ms.	332ms.	112ms.
1 & 3 & 5	224ms.	488ms.	112ms.
1 & 2 & 5	224ms.	692ms.	112ms.
1 & 9 & 5	224ms.	820ms.	112ms.
1 & 8 & 5	224ms.	948ms.	112ms.



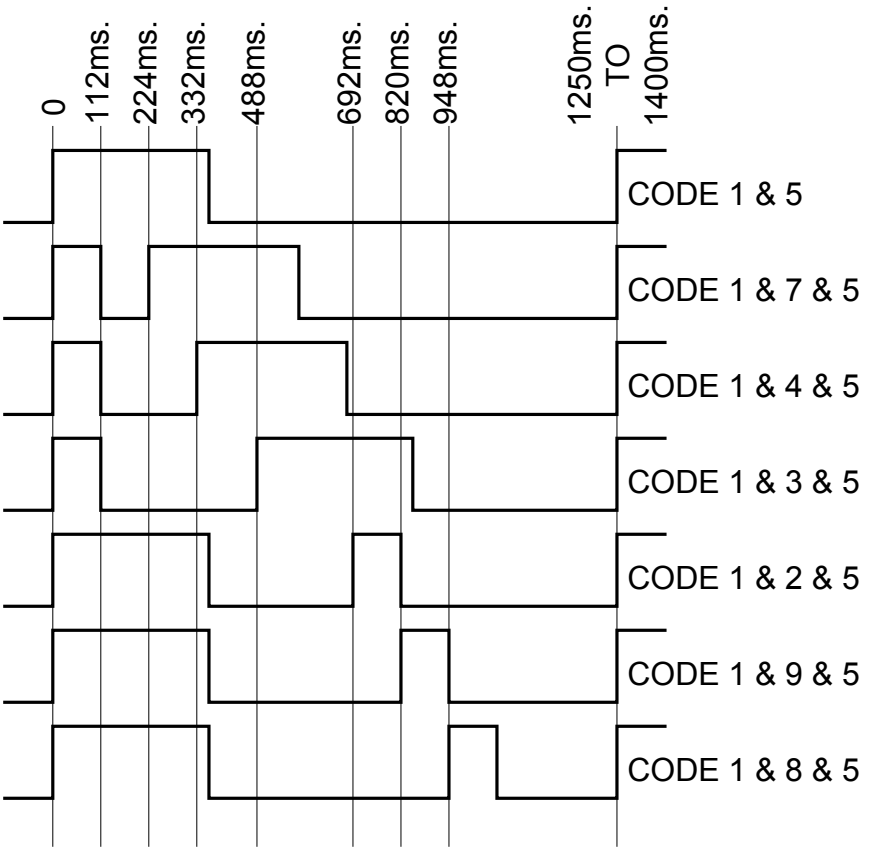
2.5.2.3 Alternating Code 5 - Freight

Code	First Pulse Width	Time Between Leading Edges	Second Pulse Width
1 & 5	224ms.	N/A	N/A
1 & 7 & 5	112ms.	224ms.	224ms.
1 & 4 & 5	112ms.	332ms.	224ms.
1 & 3 & 5	112ms.	488ms.	224ms.
1 & 2 & 5	224ms.	692ms.	112ms.
1 & 9 & 5	224ms.	820ms.	112ms.
1 & 8 & 5	224ms.	948ms.	112ms.



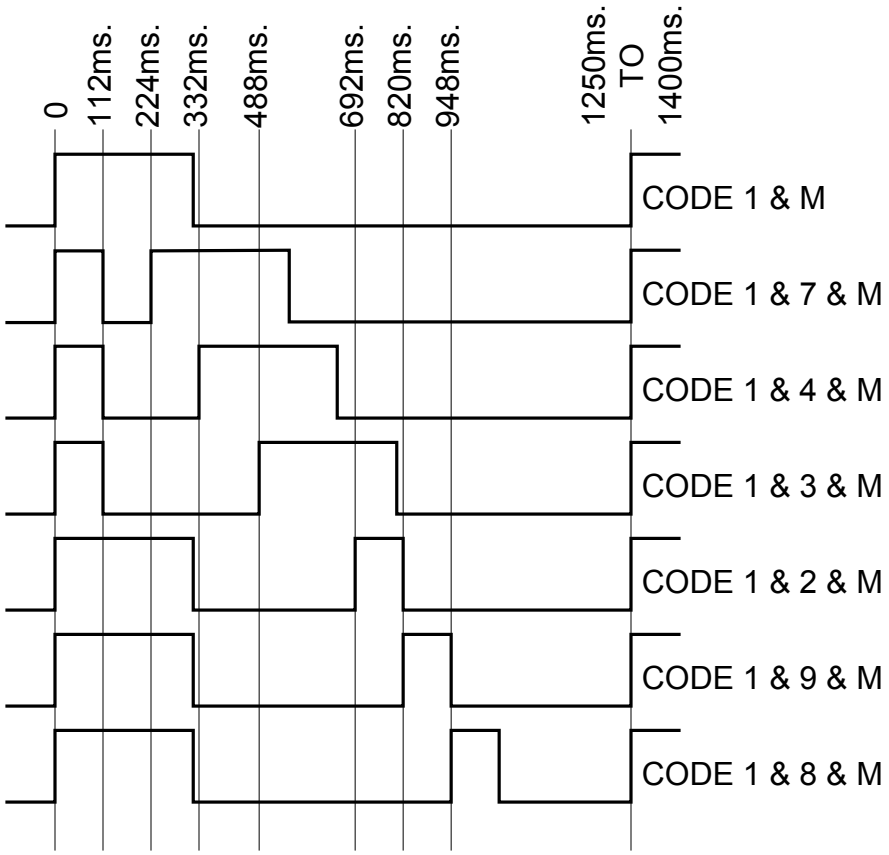
2.5.2.4 Long Code 5

Code	First Pulse Width	Time Between Leading Edges	Second Pulse Width
1 & 5	350ms.	N/A	N/A
1 & 7 & 5	112ms.	224ms.	350ms.
1 & 4 & 5	112ms.	332ms.	350ms.
1 & 3 & 5	112ms.	488ms.	350ms.
1 & 2 & 5	350ms.	692ms.	112ms.
1 & 9 & 5	350ms.	820ms.	112ms.
1 & 8 & 5	350ms.	948ms.	112ms.



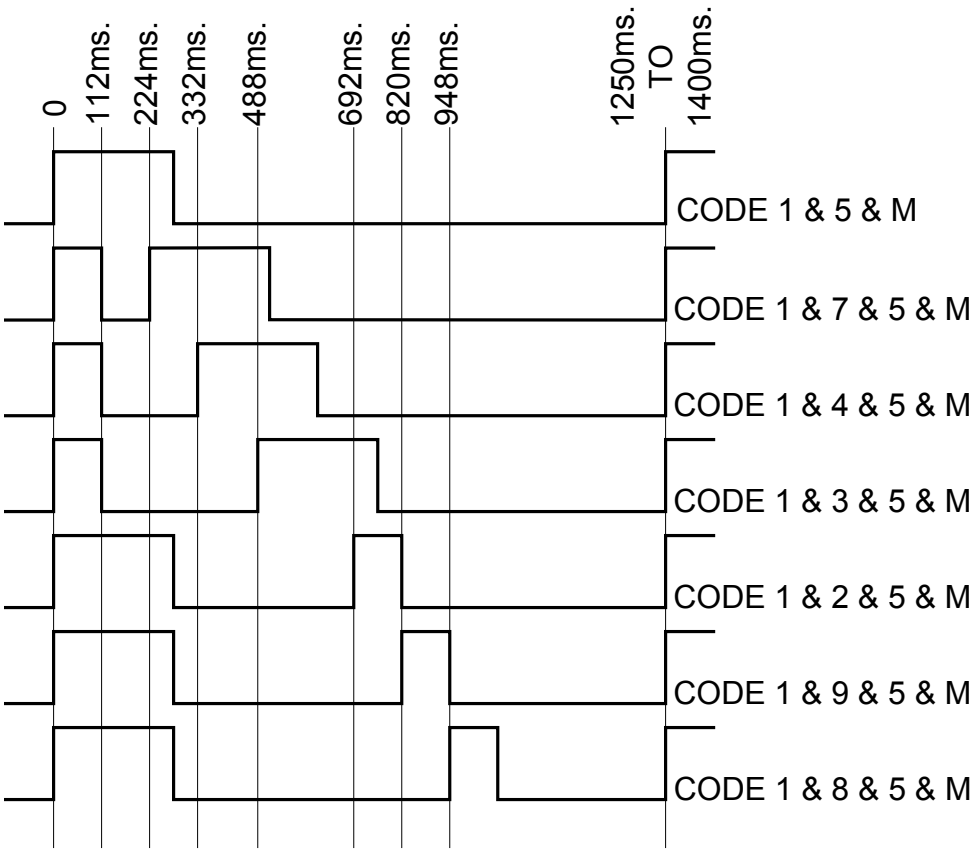
2.5.2.5 Alternating Code M

Code	First Pulse Width	Time Between Leading Edges	Second Pulse Width
1 & M	304ms.	N/A	N/A
1 & 7 & M	112ms.	224ms.	304ms.
1 & 4 & M	112ms.	332ms.	304ms.
1 & 3 & M	112ms.	488ms.	304ms.
1 & 2 & M	304ms.	692ms.	112ms.
1 & 9 & M	304ms.	820ms.	112ms.
1 & 8 & M	304ms.	948ms.	112ms.



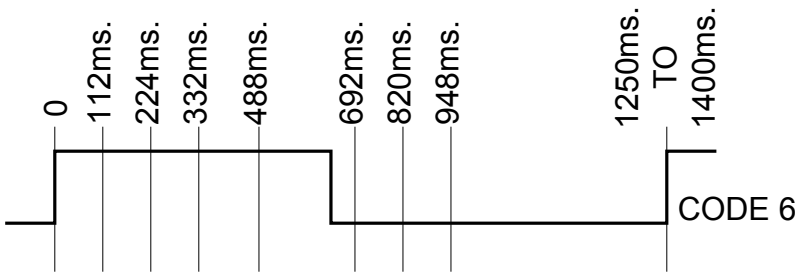
2.5.2.6 Alternating Codes 5 and M

Code	First Pulse Width	Time Between Leading Edges	Second Pulse Width
1 & 5 & M	264ms.	N/A	N/A
1 & 7 & 5 & M	112ms.	224ms.	264ms.
1 & 4 & 5 & M	112ms.	332ms.	264ms.
1 & 3 & 5 & M	112ms.	488ms.	264ms.
1 & 2 & 5 & M	264ms.	692ms.	112ms.
1 & 9 & 5 & M	264ms.	820ms.	112ms.
1 & 8 & 5 & M	264ms.	948ms.	112ms.



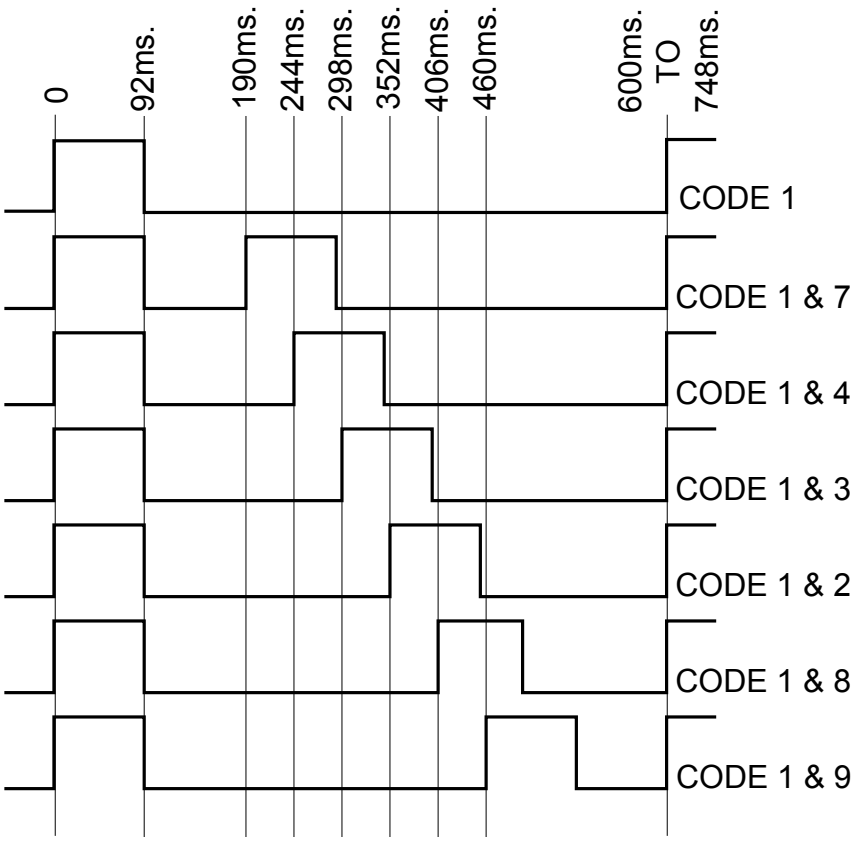
2.5.2.7 Code 6

Code	First Pulse Width	Time Between Leading Edges	Second Pulse Width
6	600ms.	N/A	N/A



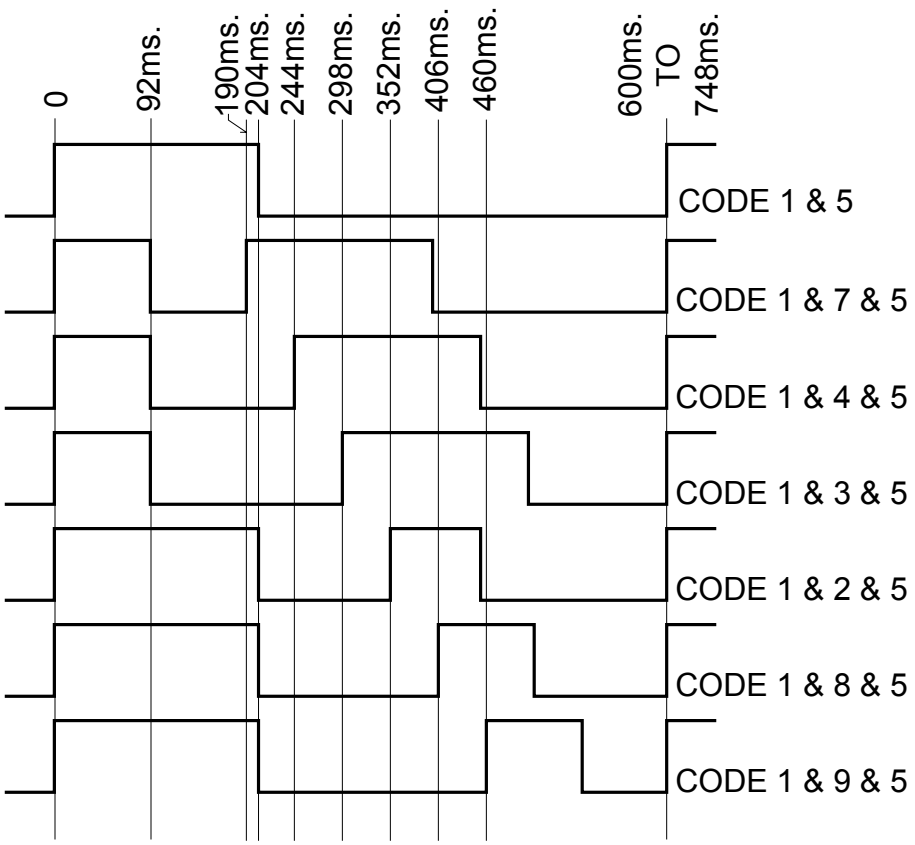
2.5.2.8 Vital Transit Codes

Code	First Pulse Width	Time Between Leading Edges	Second Pulse Width
1	92ms.	N/A	N/A
1 & 7	92ms.	190ms.	92ms.
1 & 4	92ms.	244ms.	92ms.
1 & 3	92ms.	298ms.	92ms.
1 & 2	92ms.	352ms.	92ms.
1 & 8	92ms.	406ms.	92ms.
1 & 9	92ms.	460ms.	92ms.



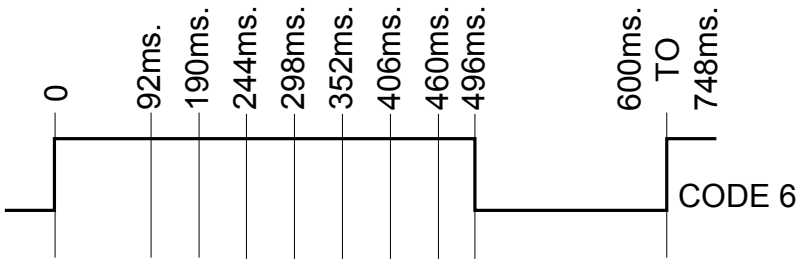
2.5.2.9 Normal Code 5 = Transit

Code	First Pulse Width	Time Between Leading Edges	Second Pulse Width
1 & 5	204ms.	N/A	N/A
1 & 7 & 5	92ms.	190ms.	208ms.
1 & 4 & 5	92ms.	244ms.	208ms.
1 & 3 & 5	92ms.	298ms.	208ms.
1 & 2 & 5	204ms.	352ms.	92ms.
1 & 8 & 5	204ms.	406ms.	92ms.
1 & 9 & 5	204ms.	460ms.	92ms.



2.5.2.10 Code 6 - Transit

Code	First Pulse Width	Time Between Leading Edges	Second Pulse Width
6	496ms.	N/A	N/A



2.5.3 Shunt Detection Times

Shunt Detection		
Std. Shunt Detect Response	**Std. Shunt Clear Response**	**Quick Shunt Detect Option**
3.7 - 6.3 seconds	11.2 - 12.6 seconds	100 msec (approximate)

2.5.4 Operating Parameters

Operating Parameters

Operating Temperature:

-40°C to +70°C

Supply Voltage:

Battery	9.8 - 16.2 VDC

System Supply Current Draw:

+5V	110 milliamps (ma)
+12V	43 ma
-12V	52 ma

Battery 180 ma average, 1.1 amps max.

Transmitter:

Output voltage to 1.25 ohms	1.0 to 2.5 volts DC
Output impedance	0.15 ohms
Current Measurement Range	0 to 6.0 amps

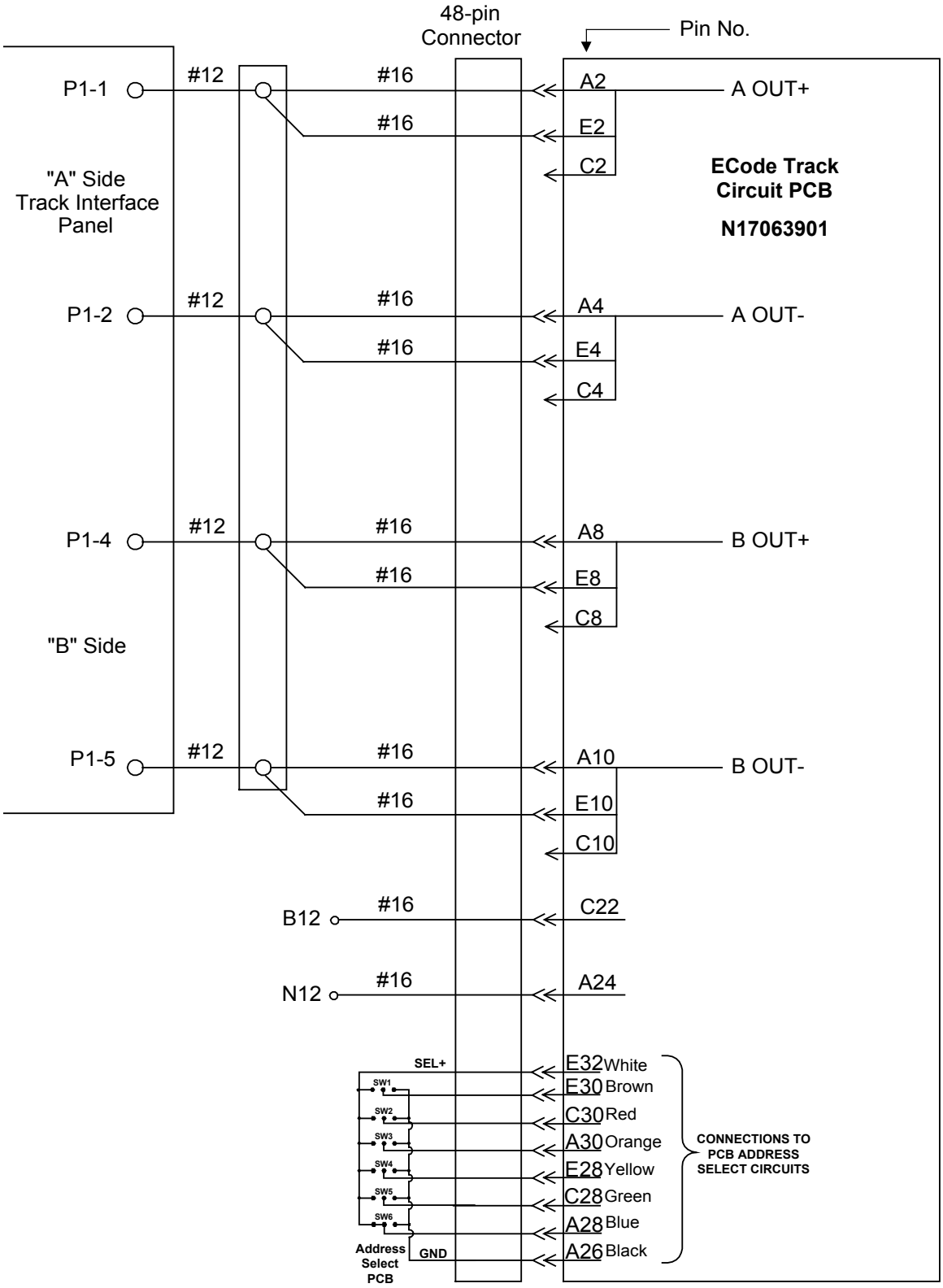
Receiver:

Input Impedance	0.15 ohms
Current Measurement Range	0 to 3.6 amps

2.6 ECode Coded Track Circuit Wiring Diagrams

2.6.1 ECode Coded Track Circuit PCB Basic Interface Wiring

The following diagram illustrates the ECode Coded Track Circuit PCB's basic interface wiring.



ECode Coded Track Circuit PCB - Basic Interface Wiring

2.6.2 ECode Coded Track Circuit Interface Panel – Basic Track Wiring

Figure 2.6-1 shows the basic wiring for an ECode track circuit around the insulated joints of a double crossover. Two ECode Track boards inside the Microlok II cardfile drive the two ECode Track Interface Panels. Note the polarity reversals across the insulated joint for each rail, this is done to protect against a shorted insulated joint.

2.6.3 Cab Signal Interface Panel Wiring with an ECode Coded Track Circuit Interface Panel

Figure 2.6-2 shows the basic wiring for an ECode track circuit with 100 Hz cab signaling. The Cab Interface Panel is driven by the Coder Output and Cab Amplifier boards inside the Microlok II cardfile. The output terminals on the Cab Interface Panel (1, 2, 3, & 4) connect directly to the rails. An external 10 mh inductor must be placed in series with the TRACK A+ and TRACK B+ terminals on the ECode Track Interface Panel. This inductor is required to block the 100 Hz cab signal, to keep it from entering the ECode receiver. For more details on the wiring, installation, adjustment, and programming of the Cab Signal Transmitter see Service Manuals SM-6800B and SM-6800C.

2.6.4 Quick Shunt Module Application and Installation

The optional quick shunt module (N451052-4601) is used in applications where an improved shunt detection time is required. The quick shunt module reduces the detection time to approximately 100 milliseconds and contains circuitry for independent train detection on both sides of the insulated joint. Two 8-way screw-lock connectors are provided for external wiring.

The two independent transmitters and receivers on this device should be connected to the ECode track interface panel (N17004101) as shown in Figure 2.6-3. With this configuration, true shunt mode operation is attained without the need for separate track termination leads. The detection zone is limited to approximately 75 feet. For greater lengths, the transmitted and receiver track terminations must be separated.

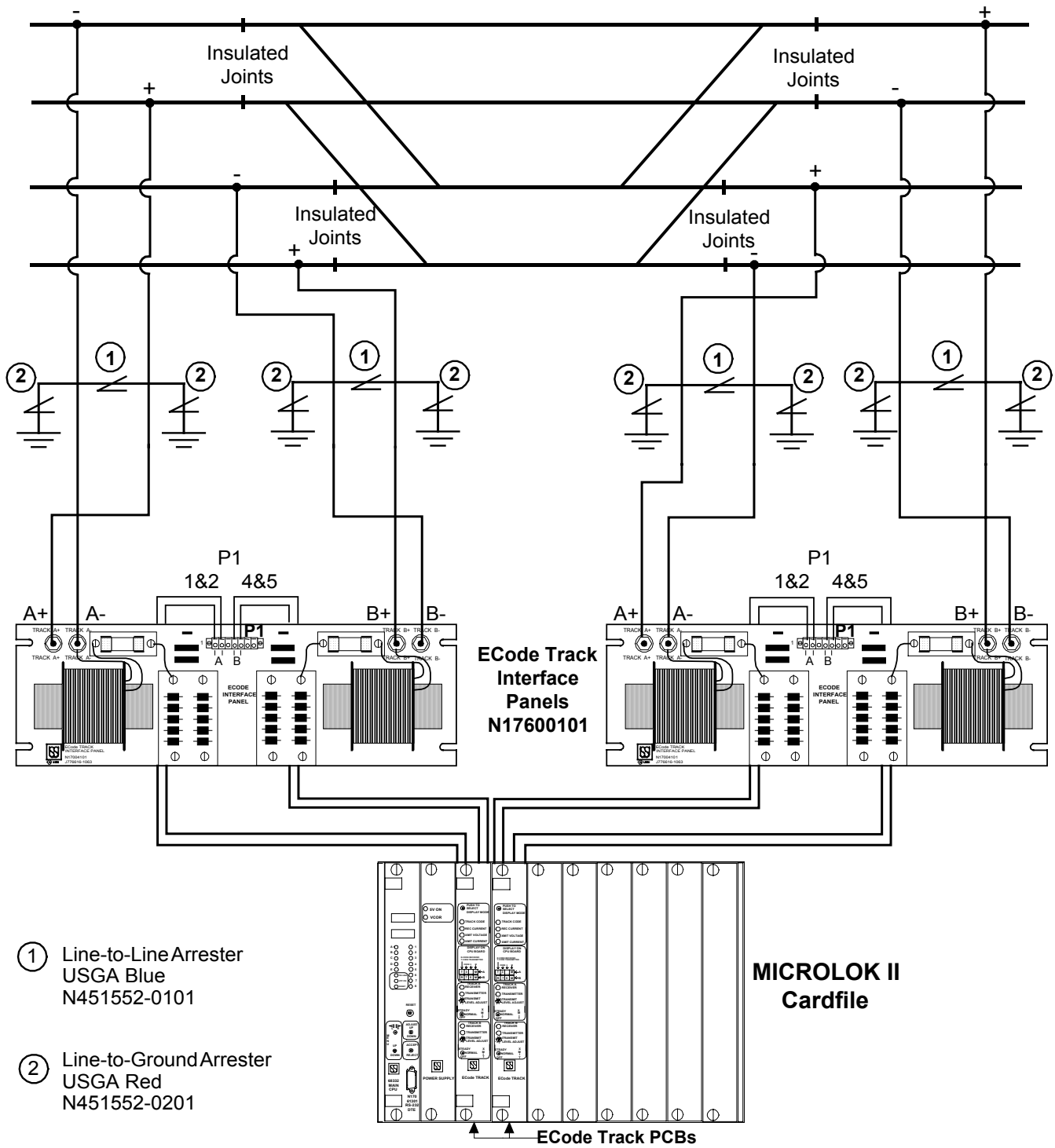


Figure 2.6-1. Basic Wiring for a Double Crossover for ECode Track Circuit Interface Panels

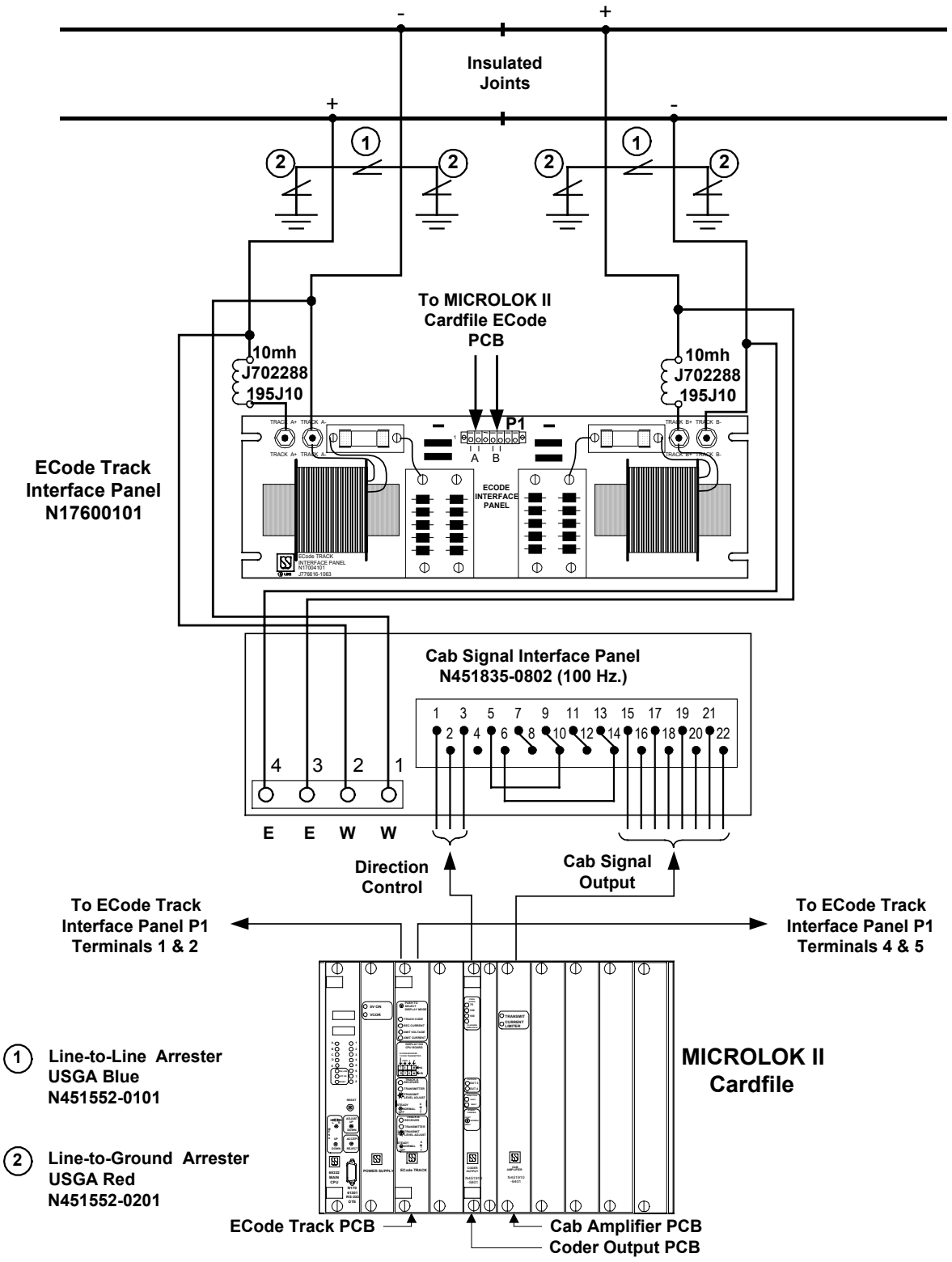


Figure 2.6-2. Basic Wiring for ECode Track Circuit with Cab Signaling

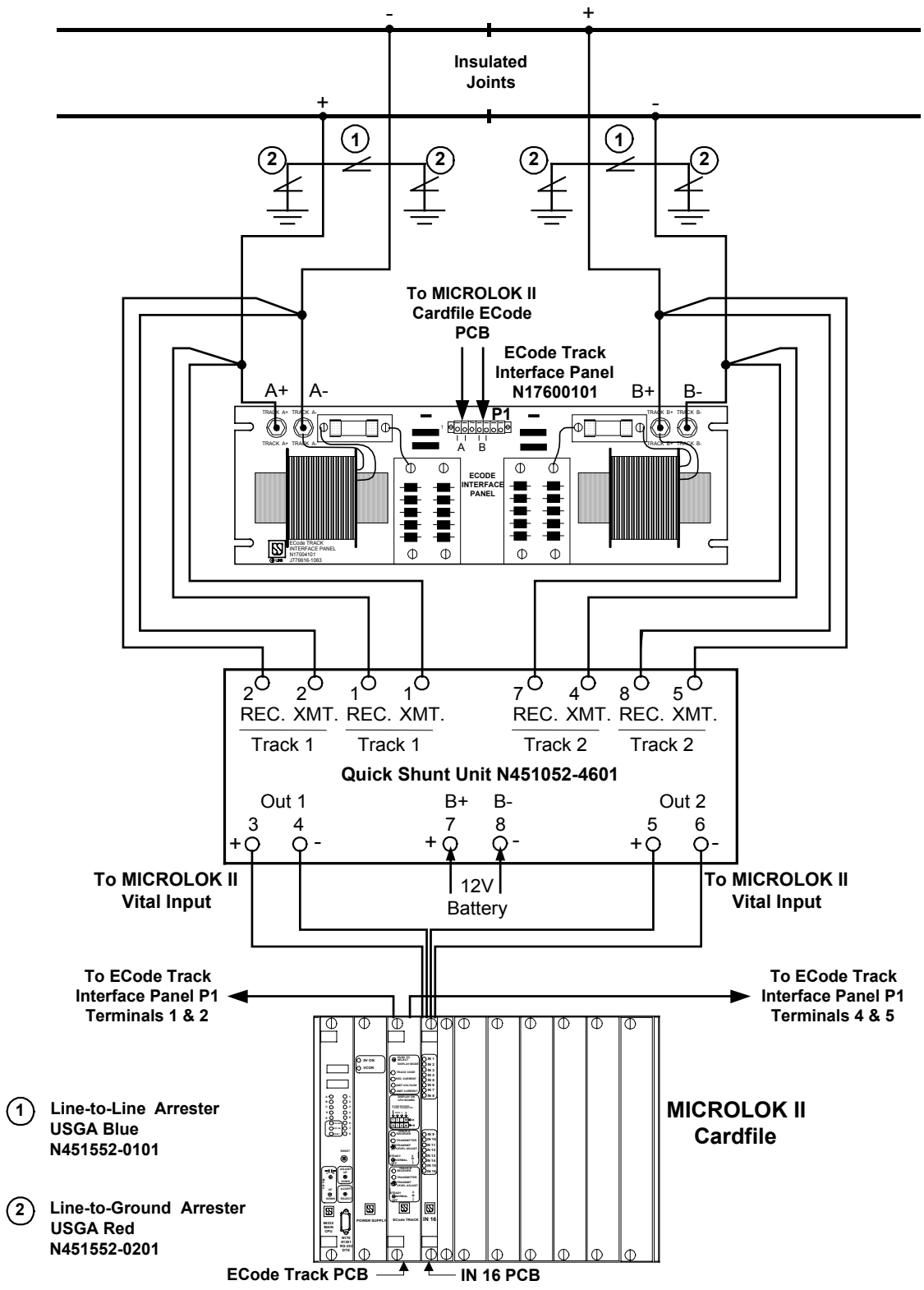


Figure 2.6-3. Basic wiring for ECode Coded Track Circuit with a Quick Shunt Unit

2.7 Displaying the ECode Coded Track Circuit Board Status

Summary:

Chapter 3 in SM-6800C describes the navigation to and selection of menu options via the CPU board's front panel displays. Section 3.4 in SM-6800C describes the options for the On-line Menu, which provides access to administrative and diagnostic functions. There are five new selections under the "DISPlay IO" option; one of them is for the ECode coded track circuit board.

2.7.1 Using the Front Panel Push Button

By using the push button on the ECode coded track circuit PCB front panel, users can view the transmitted/received codes, receive current, transmit voltage and transmit current for a selected ECode coded track circuit board. Use the following procedure to view the available data:

1. Push once to display the transmitted and received codes for tracks A and B.
2. Push twice to display the Received Current.
3. Push three times to display the Transmit Voltage.
4. Push four times to display the Transmit Current.
5. Push five times to return to the scrolling menu.

2.7.2 Navigating the On-Line Menu System

The ECODe BoaRDS option lets users view the transmitted/received codes, receive current, transmit voltage and transmit current for a selected ECode coded track circuit board. Use the following procedure to select an ECode coded track circuit board and view the available data:

1. With **ECOD|BRDS** showing on the CPU board displays, toggle the MENU UP-DOWN switch to the DOWN position.
2. The CPU board displays will show **ECOD|BD#**, indicating the selection of one of the installed ECode coded track circuit boards.
3. To change the ECode coded track circuit board selection, toggle the MENU L-R switch as necessary until the desired board number is indicated in the lower display.
4. Toggle the MENU UP-DOWN switch to the DOWN position. The CPU displays will show the transmitted and received codes for the **A** track on the upper display, and for the **B** track on the

lower display. The left-most character will display "**T**" for transmit and "**R**" for receive, with the three remaining characters displaying the actual code. If the ECode coded track circuit board's XMIT switch is currently in the "STEADY" position, the display will show "**STDY**." Likewise, if the XMIT switch is in the "OFF" position, the display will show "**OFF**." If no codes are being transmitted or received, the displays will show only the "**T**" and "**R**" characters.

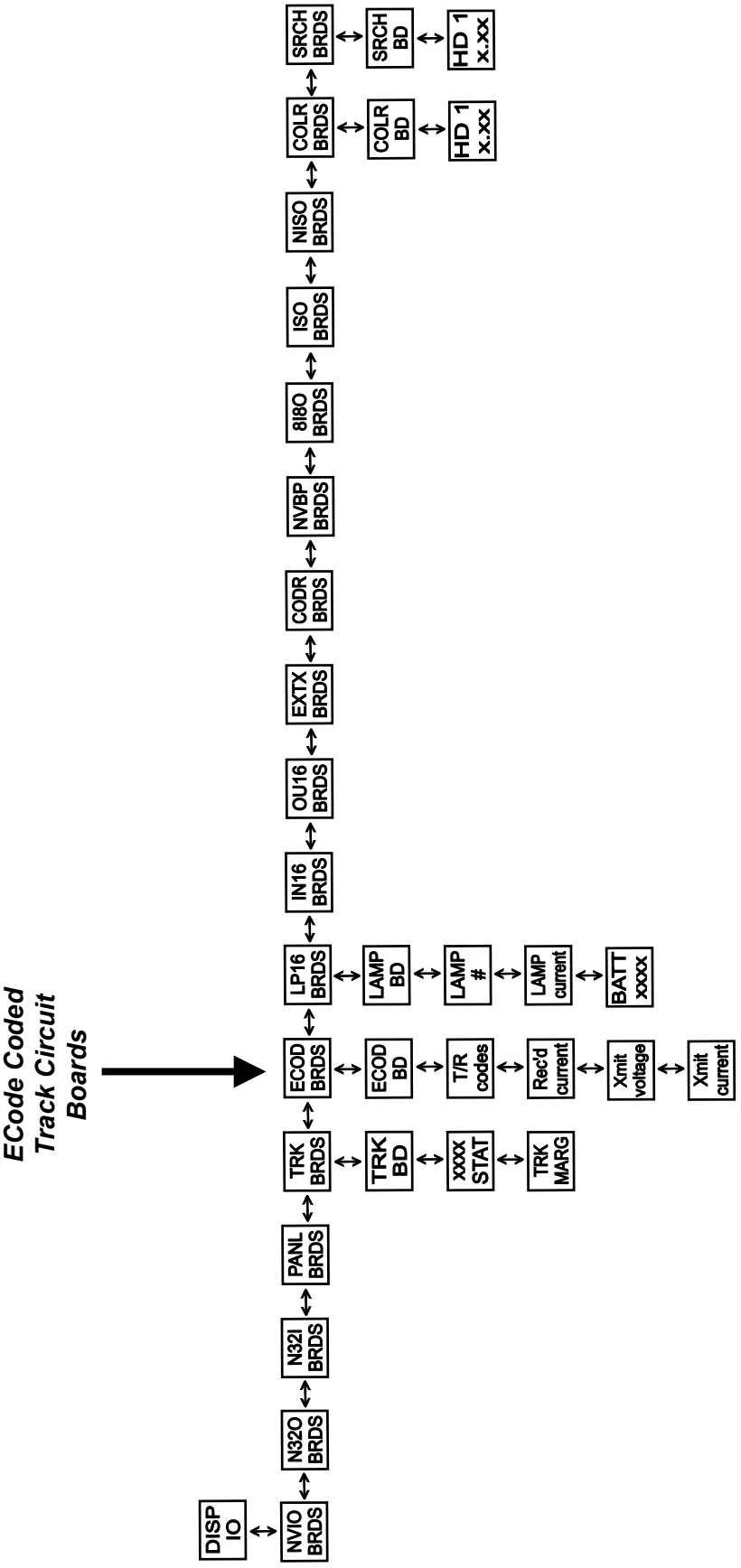
5. To display the received current from the display codes menu, toggle the MENU UP-DOWN switch to the DOWN position. The CPU displays will show the received current for each track half. The received current ranges from 0.0A to 3.6A. If the received current is greater then 3.6A then the display will show "**HIGH**." Likewise, if the current is too low (negative), it will display "**LOW**." If the XMIT switch is in the "STEADY" position, the display will be blank.

6. To display the transmit voltage for the receive current menu, toggle the MENU UP-DOWN switch to the DOWN position. The CPU displays will show the transmitted voltage for each track half. The transmit voltages are based on the 10-position rotary switch on the front of the ECode coded track circuit board. The possible values are 1.0, 1.2, 1.5, 1.7, 2.0, 2.1, 2.2, 2.3, 2.4, and 2.5V. If the value is unknown the display will show "**x.x**." If the XMIT switch is in the "STEADY" position, the display will display **1.0V**. If the XMIT switch is in the "OFF" position, the display will be blank.

7. To display the transmitted current from the transmit voltage menu, toggle the MENU UP-DOWN switch to the DOWN position. The CPU displays will show the transmitted current for each track half. The transmitted current ranges from 0.0A to 6.0A. If the transmitted current is greater then 6.0A then the display will show "**HIGH**." Likewise, if the current is too low (negative), it will display "**LOW**." If the XMIT switch is in the "OFF" position, the display will be blank.

Note:
If either half of the ECode coded track circuit board is disabled, then the display will show "**DSBL**" no matter which menu function is selected.

The illustration on the next page highlights the ECode selections on the On-line Menu:


ECode Coded Track Circuit Boards
DISP IO
NVIO BRDS
N32O BRDS
N32I BRDS
PANL BRDS
TRK BRDS
TRK BD
XXXX STAT
TRK MARG
ECOD BRDS
ECOD BD
T/R codes
Rec'd current
Xmit voltage
Xmit current
LP16 BRDS
LAMP BD
LAMP #
LAMP current
BATT XXXX
IN16 BRDS
OU16 BRDS
EXTX BRDS
CODR BRDS
NVBP BRDS
8I8O BRDS
ISO BRDS
NISO BRDS
COLR BRDS
COLR BD
HD 1 x.xx
SRCH BRDS
SRCH BD
HD 1 x.xx

2.8 Performing ECode Coded Track Circuit Checks and Adjustments

Summary:

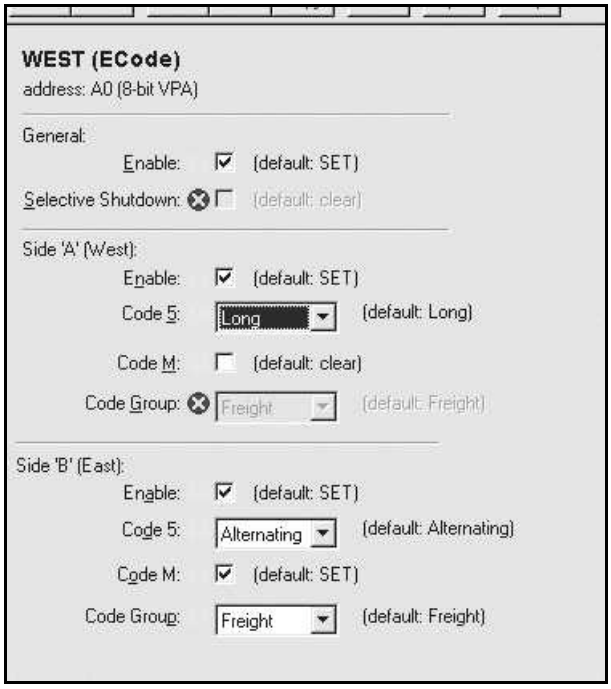
Chapter 4 in SM-6800C describes how to configure circuit boards and to view circuit board statistics through the MICROLOK II System Development Tools. Chapter 6 in SM-6800C describes circuit board checks and adjustments. Within the section dealing with system configuration, a new subsection describes ECode coded track circuit checks and adjustments (a preliminary version of which is provided below).

2.8.1 Configuring the ECode Coded Track Circuit Boards (ECODE.TRACK)

Check/configure the ECode coded track circuit boards as follows:

NOTE
The following procedure can also be performed using the MICROLOK II CPU board front panel controls and displays. Use of the MICROLOK II Development System program, however, is the preferred method due to ease of operation and the details provided.

1. With the system configuration displayed on the PC screen, click on one of the ECODE.TRACK selection buttons. The ECode coded track circuit board configuration screen shown below will be displayed. The screen shows the current configuration of the selected board, including the system default settings.



2. Make certain that the **Enable** selection box at the top of the screen is checked. If necessary, click on the **Enable** selection box to insert a check mark.

3. If the A track for the board is to be used, make certain that the **Side "A" Enable** box is checked. If necessary, click on the Side A **Enable** selection box to insert a check mark.

4. Select the type of Code 5 required. Selections are "Standard," "Long," "Smart," and "Alternating." Select by clicking on the down arrow to the right of the selection box, and then click on the desired Code 5 type.

   - The type of Code 5 used is dictated by the installation. Standard, Long, and Smart Code 5 selections should be used for compatibility with existing equipment. Typically, new installations should use Alternating Code 5

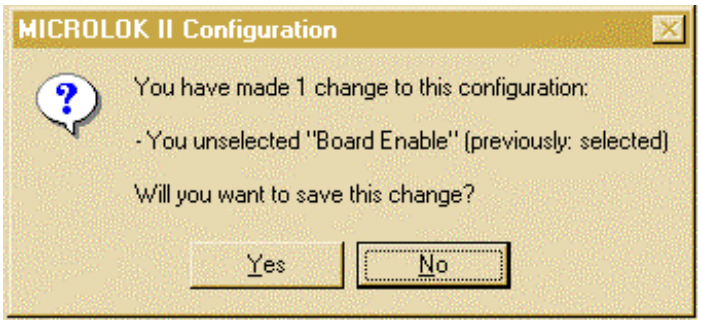
5. Select Code M support, if required. Click on the Code M selection box to insert a checkmark if Code M support is required. Code M is supported only with Alternating Code 5 selected.

6. Select "Freight" of "Transit" Code Group. Select by clicking on the down arrow to the right of the selection box and then click on the desired Code Group.

7. If side "B" is to be used, make certain that the side B "Enable" box is checked. If necessary, click on the side B "Enable" selection box to insert a checkmark.

8. Proceed as in steps 4 through 6 above to configure side B of the ECode coded track circuit board.

9. When all configuration parameters for the ECode coded track circuit board have been set to the desired values, click on the "Done" button at the lower left corner of the screen. A dialog box similar to the one shown below then appears:



10. Click on the "Yes" button to save the configuration changes and complete the board configuration. The system configuration selection screen will again be displayed on the PC screen.

11. Repeat steps 1 through 10 to configure any additional ECode coded track circuit boards.

2.8.2 Displaying ECode Coded Track Circuit Operating Statistics

The MICROLOK II executive collects operating statistics from the ECode coded track circuit boards defined in the MICROLOK II application program. These statistics may be used during general preventative maintenance and during troubleshooting to evaluate the operation of ECode coded track circuits.

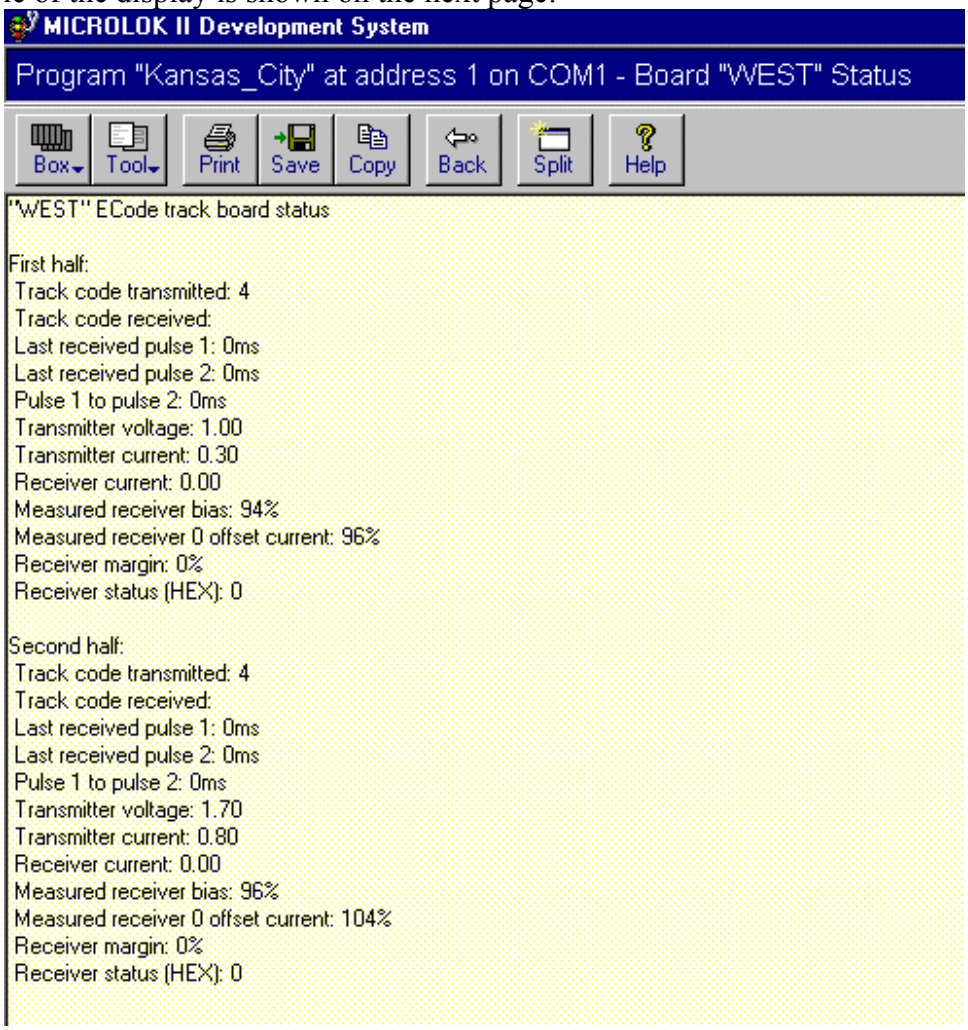
ECode coded track circuit board statistics can easily be viewed using the MICROLOK II Development Tool. To display this information:

1. Go to the Development Tool main menu.

2. Click on the "Board Information" selection button.

3. Click on the ECODE.TRACK selection button for the desired ECode coded track circuit board. Statistics for the selected board will be displayed and dynamically updated.

   An example of the display is shown on the next page:



ECode Coded Track Circuit Status Screen

Each ECode coded track circuit board supports two "track halves." Each track half is physically connected to one end of a track circuit. The following statistics are displayed for each track half:

- Track code transmitted

  This parameter indicates the track code(s) currently being sent out on the local end of the connected track circuit.

- Track code received

  This parameter indicates the track code(s) currently being received from the remote end of the connected track circuit. When no code is displayed the track circuit is shunted or the track code from the other end is otherwise disrupted or no code is currently being sent from the remote end of the track.

- Last received pulse 1

  This parameter indicates the length of pulse 1 in milliseconds in the last code received. If "0" is displayed, no code was received. Comparing the length of this pulse with the standard length of the transmitted pulse is useful in determining the condition of the track circuit ballast and the operating margin of the track circuit.

- Last received pulse 2

  This parameter indicates the length of pulse 2 in milliseconds in the last code received. If "0" is displayed, the received code contained no readable second pulse was received. Comparing the length of this pulse with the standard length of the transmitted pulse is useful in determining the condition of the track circuit ballast and the operating margin of the track circuit.

- Pulse 1 to pulse 2

  This parameter indicates the time in milliseconds between the rising edge of pulse 1 and the rising edge of pulse 2 as measured by the ECode coded track circuit receiver. Comparing this spacing with the transmitted spacing is useful in determining the condition of the track circuit and the operating margin of the track circuit.

- Transmitter voltage

  This parameter indicates the selected transmitter voltage in Volts.

- Transmitter current

  This parameter indicates the current in Amps that the transmitter is feeding into the rails. If this current is significantly higher than normal, a shunted track circuit is indicated. If this current is substantially lower than normal, a broken rail is indicated. If this current is zero or nearly zero, an open track lead is indicated.

- Receiver current

  This parameter indicated the peak current in Amps detected while the last track code was received. This parameter will typically be higher when a code containing Code 5 or Code M is received. It will be slightly higher when receiving a two-pulse code. Typically, the minimum acceptable peak current while receiving a code under low ballast conditions is 0.5 to 0.7 Amps. Under good ballast conditions, the peak current may rise to 1.2 to 2.0 Amps depending on the length and ballast conditions for the track circuit.

- Measured receiver bias

  This parameter is an indicator of ECode coded track circuit receiver integrity used by US&S engineering. Typically, it should read between 90 and 110 percent.

- Measured receiver 0 offset current

  This parameter is an indicator of ECode coded track circuit receiver integrity used by US&S engineering. Typically, it should read between 90 and 110 percent.

- Receiver status

  This parameter is not used and is always "0."

2.8.3 ECode Coded Track Circuit Checks and Adjustments

Setting up the ECode coded track circuit is a four-step process. This process involves:

- Checking/adjusting the track circuit lengths according to the adjustment tables.
- Checking the track circuit receiver current.
- Performing the track circuit shunting test.
- Performing the track circuit polarity check.

2.8.3.1 Setting the Transmitter Output Level

The transmitter output voltage must be properly adjusted to obtain a safe and reliable track circuit. Refer to the appropriate adjustment table (provided later in this subsection) to determine the transmit voltage level. There are three tables: one for ECode to ECode communications, one for ECode to Electro Code 4® (EC4), and one for ECode to Electro Code 5® (EC5) communications. Select the nearest track circuit length from the left column and go to the right to find the required Xmit voltage level. Also note the correct settings for the jumpers on the track interface panel. For ECode to ECode communications the jumpers should always be in the OUT position.

To display the transmit voltage, press the Display Mode push button three times until the Xmit Voltage LED is lit. The CPU board will now display the current setting of the transmit voltage level. Use a small screwdriver to adjust the rotary switches for track A and B until the proper voltage is displayed.

When communicating with an Electro Code 4® (EC4) or Electro Code 5® (EC5) at the other end of the track circuit, use the tables for the correct settings on that equipment. On the following page is an example of the correct settings for each case with a 10,000-foot track circuit:

Track Circuit	Settings
ECode to ECode	Xmit voltage to 1.2V and jumper to the OUT position.
ECode to Electro Code 4® (EC4)	On ECode unit, Xmit voltage to 1.7V and jumper to the OUT position. On Electro Code 4® (EC4) unit, set 2R Card Transmit Level Tap to LOW and 7K Receiver Resistance board to Short. *
ECode to Electro Code 5® (EC5)	On ECode unit, Xmit voltage to 1.5V and jumper to the IN position. On Electro Code 5® (EC5) unit, set Xmit voltage to 1.5V and Receive Reference to 0.50A.
* *"Short" means to remove all of the receiver resistance by placing the shorting straps in the "IN" position.*	

2.8.3.1.1 ECode to ECode Adjustment Table

ECode to ECode Adjustment Table For minimum ballast of 3 Ω/1,000 ft.					
.06 Ω Shunt	Recommended Settings on ECode Board			Typical Receive Current Amps Peak	
Track Circuit Length	*Rotary switch position*	*XMIT Voltage*	*Jumper on Interface Panel* *JMP1 / JMP2*	*Low*	*High*
1,000 ft	0	1.0V	OUT	1.3A	1.4A
2,000 ft	0	1.0V	OUT	1.2A	1.4A
3,000 ft	0	1.0V	OUT	1.1A	1.3A
4,000 ft	0	1.0V	OUT	1.0A	1.3A
5,000 ft	0	1.0V	OUT	1.0A	1.3A
6,000 ft	0	1.0V	OUT	0.9A	1.2A
7,000 ft	0	1.0V	OUT	0.8A	1.2A
8,000 ft	1	1.2V	OUT	1.0A	1.5A
9,000 ft	1	1.2V	OUT	0.9A	1.5A
10,000 ft	1	1.2V	OUT	0.8A	1.4A
11,000 ft	2	1.5V	OUT	0.9A	1.7A
12,000 ft	2	1.5V	OUT	0.9A	1.7A
13,000 ft	3	1.7V	OUT	0.9A	1.9A
14,000 ft	3	1.7V	OUT	0.9A	1.9A
15,000 ft	3	1.7V	OUT	0.8A	1.9A
16,000 ft	4	2.0V	OUT	0.9A	2.1A
17,000 ft	4	2.0V	OUT	0.8A	2.1A
18,000 ft	4	2.0V	OUT	0.8A	2.0A
19,000 ft	5	2.1V	OUT	0.7A	2.1A
20,000 ft	6	2.2V	OUT	0.7A	2.2A
21,000 ft	7	2.3V	OUT	0.7A	2.2A
22,000 ft	8	2.4V	OUT	0.7A	2.3A
23,000 ft	9	2.5V	OUT	0.6A	2.4A
24,000 ft	9	2.5V	OUT	0.6A	2.3A

2.8.3.1.2 ECode to Electro Code 4® (EC4) Adjustment Table

ECode to Electro Code 4® (EC4) Adjustment Table

For minimum ballast of 3 Ω/1,000 ft.

0.06 Ω Shunt	Recommended Settings on ECode Board					EC4 Recommended Settings			
Track Circuit Length	*Rotary switch position*	*XMIT Voltage*	*Jumper on Interface Panel JMP1 / JMP2*	*Typical Receive Current Amps Peak*		*2 R Tap*	*7 K Resistor*	*Typical Receive Current Amps Peak*	
				Low	High			Low	High
1,000 ft.	1	1.2V	IN	1.4A	1.5A	Low	Short	1.12A	1.20A
2,000 ft.	1	1.2V	IN	1.2A	1.5A	Low	Short	1.02A	1.20A
3,000 ft.	1	1.2V	IN	1.1A	1.5A	Low	Short	0.94A	1.18A
4,000 ft.	1	1.2V	OUT	1.3A	1.8A	Low	Short	1.16A	1.47A
5,000 ft.	2	1.5V	OUT	1.2A	1.7A	Low	Short	1.29A	1.73A
6,000 ft.	2	1.5V	OUT	1.1A	1.7A	Low	Short	1.20A	1.70A
7,000 ft.	2	1.5V	OUT	1.0A	1.7A	Low	Short	1.11A	1.67A
8,000 ft.	3	1.7V	OUT	0.9A	1.7A	Low	Short	1.20A	1.92A
9,000 ft.	3	1.7V	OUT	0.9A	1.6A	Low	Short	1.12A	1.88A
10,000 ft.	3	1.7V	OUT	0.8A	1.6A	Low	Short	1.04A	1.85A
11,000 ft.	3	1.7V	OUT	0.7A	1.6A	Low	Short	0.97A	1.82A
12,000 ft.	6	2.2V	IN	0.9A	2.2A	Medium	Short	0.80A	1.84A
13,000 ft.	7	2.3V	IN	0.8A	2.2A	Medium	Short	0.78A	1.89A
14,000 ft.	9	2.5V	IN	0.7A	2.2A	Medium	Short	0.78A	2.03A
15,000 ft.	9	2.5V	IN	0.7A	2.2A	Medium	Short	0.73A	2.01A

2.8.3.1.3 ECode to Electro Code 5® (EC5) Adjustment Table

ECode to Electro Code 5® (EC5) Adjustment Table For minimum ballast of 3 Ω/1,000 ft.							
.06 Ω Shunt	Recommended Settings on ECode Board			EC5 Recommended Settings		Typical Receive Current for ECode & EC5 Amps Peak	
Track Circuit Length	*Rotary switch position*	*XMIT Voltage*	*Jumper on Interface Panel JMP1 / JMP2*	*Transmitter Voltage*	*Receiver Reference*	*Low*	*High*
1,000 ft	0	1.0V	OUT	1.0V	0.50A	1.3A	1.4A
2,000 ft	0	1.0V	OUT	1.0V	0.50A	1.2A	1.4A
3,000 ft	0	1.0V	OUT	1.0V	0.50A	1.1A	1.3A
4,000 ft	0	1.0V	OUT	1.0V	0.50A	1.0A	1.3A
5,000 ft	0	1.0V	OUT	1.0V	0.50A	1.0A	1.3A
6,000 ft	0	1.0V	OUT	1.0V	0.50A	0.9A	1.2A
7,000 ft	0	1.0V	OUT	1.0V	0.50A	0.8A	1.2A
8,000 ft	2	1.5V	IN	1.5V	0.50A	0.8A	1.4A
9,000 ft	2	1.5V	IN	1.5V	0.50A	0.8A	1.4A
10,000 ft	2	1.5V	IN	1.5V	0.50A	0.7A	1.4A
11,000 ft	2	1.5V	OUT	1.5V	0.50A	0.9A	1.7A
12,000 ft	2	1.5V	OUT	1.5V	0.50A	0.9A	1.7A
13,000 ft	4	2.0V	IN	2.0V	0.50A	0.8A	1.8A
14,000 ft	4	2.0V	IN	2.0V	0.50A	0.7A	1.7A
15,000 ft	4	2.0V	IN	2.0V	0.50A	0.6A	1.7A
16,000 ft	4	2.0V	OUT	2.0V	0.50A	0.9A	2.1A
17,000 ft	4	2.0V	OUT	2.0V	0.50A	0.8A	2.1A
18,000 ft	4	2.0V	OUT	2.0V	0.50A	0.7A	2.0A
19,000 ft	9	2.5V	IN	2.5V	0.50A	0.6A	2.0A
20,000 ft	9	2.5V	IN	2.5V	0.50A	0.6A	2.0A
21,000 ft	7	2.3V	OUT	2.5V	0.50A	0.7A	2.2A
22,000 ft	8	2.4V	OUT	2.5V	0.50A	0.7A	2.3A
23,000 ft	9	2.5V	OUT	2.5V	0.50A	0.6A	2.4A
24,000 ft	9	2.5V	OUT	2.5V	0.50A	0.6A	2.3A

2.8.3.1.4 Track Wire Resistance Influence On Maximum Track Circuit Length

ECode adjustment tables are based on a generally conservative standard for minimum ballast of 3 Ω/M', and track leads at each end of 0.1 Ω or a total of 0.2 Ω combined for both ends. Number 6 wire is commonly used for track leads and has a resistance of 0.4 Ω/M'. Track leads of 125 feet at each track circuit end of #6 wire add up to a total of 500 feet of wire and a total resistance of 0.2 Ω. For track leads where the combined resistance exceeds 0.2 Ω ultimate track circuit length is reduced. The table below illustrates the effect of increased lead resistance on limiting track circuit length for 3 Ω and 2 Ω minimum ballast.

Track Wire Resistance Influence On Maximum Track Circuit Length

Combined Track Lead Resistance	Maximum Track Circuit Length For Minimum Anticipated Ballast of 3 Ω/M'	Maximum Track Circuit Length For Minimum Anticipated Ballast of 2 Ω/M'
0.2 Ω	24,000 feet	14,000 feet
0.3 Ω	20,000 feet	12,000 feet
0.4 Ω	18,000 feet	11,000 feet
0.5 Ω	16,000 feet	10,000 feet
0.75 Ω	12,000 feet	7,000 feet
1.0 Ω	8,000 feet	5,000 feet
2.0 Ω	2,000 feet	1,000 feet

ECode may be used as a vital communications link and as such a track circuit is not involved. Instead of connections through the rails, ECode units are linked together via line wire. For these applications, it is recommended the track interface panel still be used because it provides the first line of defense for lightning protection. Circuits are limited by a total of 4 Ω in the aggregate of all the connecting wire.

2.8.3.2 Displaying the Track Circuit Receive Current

The track Receive Current is a value that is used to determine whether a track circuit is properly adjusted. The value represents the peak current of the received signal. A received current value or 0.5 Amps or higher is required before the system will recognize a valid code.

With the track circuit Transmit Voltage level set according to the tables, the received current value should be between 0.6 and 2.4 amps. Dry ballast will produce a higher current and wet ballast will give a lower value. The tables have taken this into consideration to provide a reliable track circuit. The nominal current value is between 1.0 and 2.0 amps. If the current is greater than 2.4 amps the track circuit may not shunt at 0.06 ohms (which represents the nominal resistance of the wheels and axle on a car). In this case, the transmitter voltage level can be reduced at the other end of the track circuit. If the transmit level is at the minimum of 1.0 volt, a 0.25 ohm resistor can be placed in series

with the track leads by setting the jumper JMP1/JMP2 on the track interface panel to the IN position. This may be required to achieve 0.06 ohm shunting.

Track circuit Receive Current can be displayed on the MICROLOK II CPU board four-character displays. The upper display shows the receive current for Track A and the lower display is for Track B. To display the Receive Current, press the pushbutton switch at the top of the ECode Coded Track Circuit Board twice. The red LED next to REC CURRENT should be lit. The CPU display will now show the received current for Tracks A and B.

2.8.3.3 ECode Coded Track Circuit Shunting Test

The next step in the track circuit configuration process is to perform a shunting test using a 0.06 ohm shunt. This test simulates an occupancy within the track circuit and checks the system's response to the installation of the shunt. The figure that follows shows the test installation.

This test is in accordance with FRA regulation 236.53, which requires that the track circuit system be certified as properly responding to the presence of a shunt. If a track (A or B) has not been enabled in the application software, the information for that track will not be displayed. This test is conducted using the following procedure.

1. Display the TRACK CODE for the track circuit under test by pressing the push button switch on the ECode board once. The red LED next to TRACK CODE should be lit.

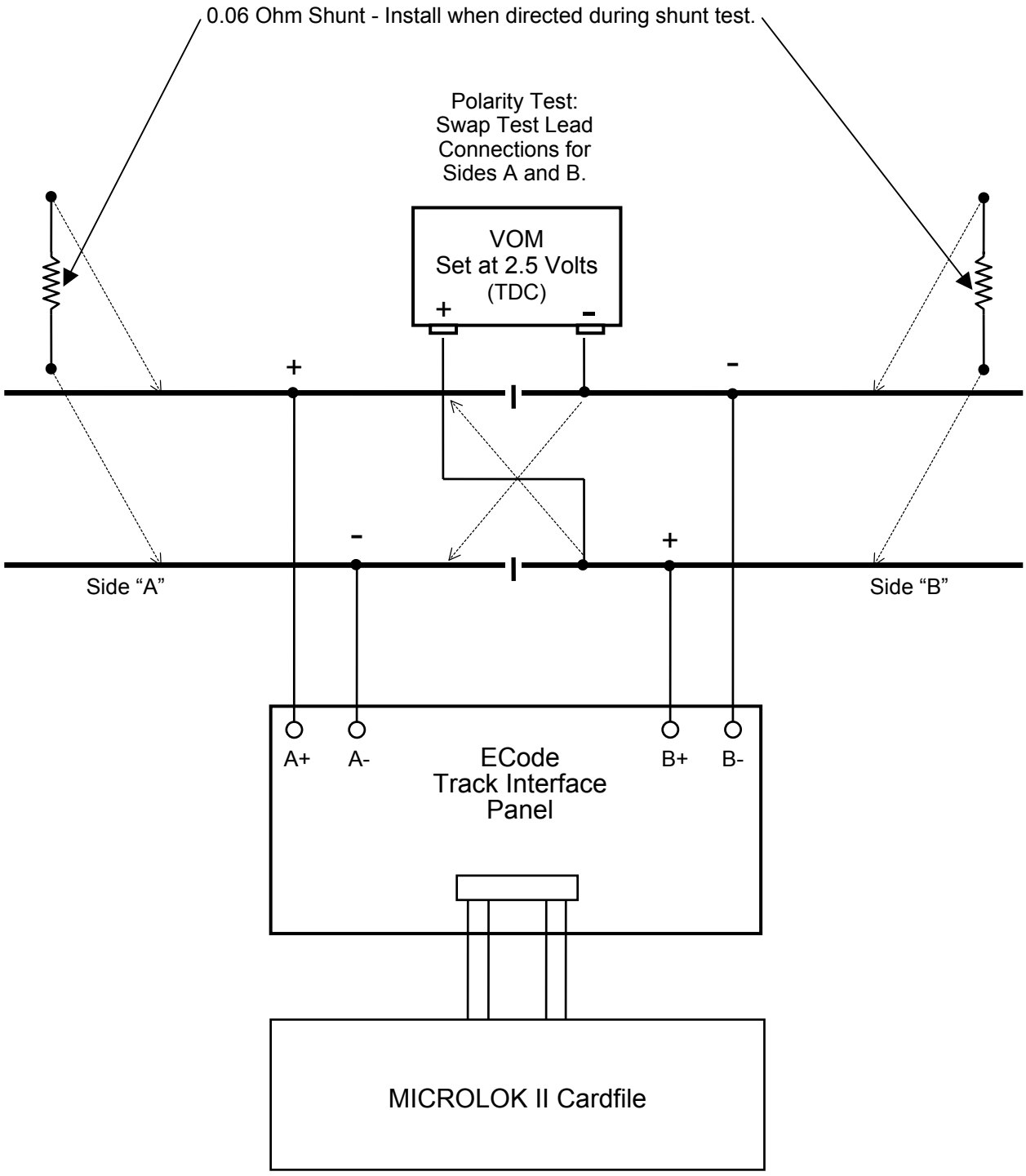
2. Install a 0.06 ohm shunt across the track on the (A) side of the insulated joint. Verify that there is NO Received Code on the upper display for Track A. The display will show an "R" with no code next to it. Note that transmitter A will continue to transmit a code, and track B will continue to receive a valid code. Leave the shunt in place for at least 30 seconds to make certain that the occupancy indication remains constant.

3. Remove the shunt from the (A) side of the insulated joint. Verify that a valid code is being received for Track A, such as "R4".

4. Install a 0.06 ohm shunt across the track on the (B) side of the insulated joint. Verify that there is NO Received Code on the upper display for Track B. The display will show an "R" with no code next to it. Note that transmitter B will continue to transmit a code, and track A will continue to receive a valid code. Leave the shunt in place for at least 30 seconds to make certain that the occupancy indication remains constant.

5. Remove the shunt from the (B) side of the insulated joint. Verify that a valid code is being received for Track B, such as "R8".

6. If the shunting test fails, either the resistance of the shunt is higher than 0.06 ohms, or the transmitter voltage level is too high, or the jumper on the Track Interface Panel is set incorrectly. Refer to the adjustment tables to verify the proper settings. After any corrections, repeat steps 1 through 5.



Test Set-Up for ECode Coded Track Circuit Shunting Test and Polarity Check

2.8.3.4 Track Circuit Polarity Check

The rail polarity of each coded circuit must be checked to confirm that proper polarity is established between adjacent track circuit blocks. The polarity of the track circuit feed changes polarity from one side of an isolation joint to the other. This procedure requires a Simpson 260, TS-111, or an equivalent volt-ohmmeter (VOM). See the figure on the previous page for the test set-up.

1. Set the VOM to the 2.5 volt (+DC) scale.

2. On one side of the isolation joint, connect the VOM (+) lead to the rail that is connected to the TRACK A+ track signal feed. On the same side of the isolation joint, connect the VOM common lead to the rail that is connected to the TRACK A- track signal feed.

3. Set up the system such that the ECode track circuit transmitter periodically transmits a code to the rails. Monitor the VOM indication.

    a. During intervals with no track circuit transmission, the VOM should indicate 0 volts.

    b. During transmit intervals, the VOM should go above 0.5 volts

    c. During receive intervals, the VOM indication should be considerably less than the transmit voltage. The actual value depends on track circuit length.

4. If the meter readings are not as described in step 3, check the polarity of the track signal connections between the cardfile and the ECode Track Interface Panel, and between the interface panel and the rails. Correct any wiring discrepancies found.

5. Move the test lead connections to the opposite side of the isolation joint. Make certain that the VOM (+) test lead is connected to the TRACK B+ rail and that the common test lead is connected to the TRACK B- rail.

6. Observe the VOM voltage readings as the track circuit cycles the output signal. The reading should be identical to those described in step 3. If the meter readings are not as described in step 3, check the polarity of the track signal connections between the cardfile and the ECode Track Interface Panel, and between the interface panel and the rails. Correct any wiring discrepancies.

Note: If the polarity test proves that the track leads must be reversed, do not do so until it is determined that the intended sequence of polarity reversals for the entire block section will not be violated.

2.9 Performing ECode Coded Track Circuit Troubleshooting

Summary:

Chapter 7 in SM-6800C describes procedures for system troubleshooting and recovery. Within the section dealing with malfunction isolation, a new subsection describes ECode coded track circuit checks and adjustments (a preliminary version of which is provided below).

2.9.1 Troubleshooting an ECode Coded Track Circuit

The front panel of the ECode coded track circuit board contains a toggle switch for each track circuit to enable a test mode to aid in troubleshooting the track circuits. Moving either switch from the NORMAL position will disrupt track circuit communications. Placing the XMIT switch in the STEADY position provides a constant 1.0 volt DC output, instead of the normal pulse code output. Placing the switch in the OFF position disables the transmitter and enables the receiver full time.

If the received current is low and operation of the track circuit proves to be unreliable, the most likely causes to investigate are:

- A poor electrical connection somewhere within the track circuit. Possible causes are broken rail or missing bond wires.

- A leakage path between the two rails at some point in the track circuit. An example would be shorted rail gage plates or conditions of low ballast.

A quick way to determine if the problem is an open circuit or a short-circuit is to examine the transmitter output current. Use the pushbutton switch to display the XMIT CURRENT. If the transmitter output current is 0.0A, then there is an open connection in the circuit. If the transmit current is at or above its normal value, then either the ballast is very low or there is a short in the circuit.

To troubleshoot a faulty track circuit, adjust the voltmeter to a low voltage scale (about 5V DC full-scale deflection). Set the XMIT switch to the STEADY position on the track circuit of interest. On the far end of the same track circuit, set the XMIT switch to the OFF position to turn off the other transmitter. Start at the end of the track circuit where the transmitter is turned on steady. Connect the meter leads across the rails and test as if this were a simple DC track circuit, observe the correct rail polarity. The problem area will be between points on the rail where a large drop in the voltage reading is observed. Investigate to determine if there is an open circuit in the rail or a short circuit across the rails.

2.9.2 ECode Coded Track Circuit Board Fuses

Fuses provide protection for the ECode coded track circuit board in the event that a lightning strike or power surge exceeds the limiting capability of the Interface Panel. Refer to the fuse chart below:

Fuse Designation	Manufacturer	Value	Quantity
Cartridge (FLNR9) F2 and F4	Littelfuse®	9 Amp (Slo-Blo)	2
Automotive Style (ATO-10) F1 and F3	Littelfuse®	10 Amp	2

The 9-Amp cartridge fuse protects against high current surges such as downed power lines or welders across the rails. The 10-Amp automotive-style fuse is the final level of protection against power surges.

2.10 Defining an ECode Coded Track Circuit Board

Summary:

Chapter 3 in SM-6800D describes the procedure for defining I/O Boards in a MICROLOK II Application. The interface section of a MICROLOK II program defines all of the local and serial I/O for the MICROLOK II card file. In the LOCAL subsection of the INTERFACE section, the physical I/O cards are defined. The information below describes how to define an ECode coded track circuit board.

Board Type: ECODE.TRACK

Address Class: 8 Bit VPA

A definition of this card looks like:

```
BOARD: <USER NAME>
        [ADJUSTABLE | FIXED] ENABLE: <FLAG>

TYPE: ECODE.TRACK
        TRACKA:
                [TRACK.NAME: <name for track half>]
                [[ADJUSTABLE | FIXED] ENABLE: <flag>;]
                [[ADJUSTABLE | FIXED] CODE5.SUPPORT:
<STANDARD,LONG,SMART,ALTERNATING>;]
                [[ADJUSTABLE | FIXED] CODEM.SUPPORT.ENABLED: <flag>;]
                [[ADJUSTABLE | FIXED] CODE.GROUP.SELECT: <FREIGHT, TRANSIT>;]
        TRACKB:
                [TRACK.NAME: <name for track half>]
                [[ADJUSTABLE | FIXED] ENABLE: <flag>;]
                [[ADJUSTABLE | FIXED] CODE5.SUPPORT:
<STANDARD,LONG,SMART,ALTERNATING>;]
                [[ADJUSTABLE | FIXED] CODEM.SUPPORT.ENABLED: <flag>;]
                [[ADJUSTABLE | FIXED] CODE.GROUP.SELECT: <FREIGHT, TRANSIT>;]
```

Both track portions of the board must be defined.

If the TRACK.NAME statement is not present, the compiler will assign a default name of TRACK_x, where x is A or B.

If an ENABLE statement is not supplied for half of the board, the compiler will provide a FIXED default value of 0.

The CODE5.SUPPORT statement controls whether the CODE5 will be STANDARD, LONG, SMART, or ALTERNATING. If no CODE5.SUPPORT statement is present, the compiler will provide a FIXED default value of STANDARD.

The CODE.GROUP.SELECT can be either FREIGHT or TRANSIT. If the CODE.GROUP.SELECT statement is not present, the compiler will provide a FIXED default value of FREIGHT.

The CODEM.SUPPORT.ENABLED can only be set under the following conditions or the compiler will generate an error:

CODE.GROUP.SELECT: FREIGHT;
CODE5.SUPPORT: ALTERNATING

If the CODEM.SUPPORT.ENABLED statement is not present, the compiler will provide a FIXED default value of 0.

The compiler also defines the following bits:

<board name>.TRACKx.ENABLED (Read only)

<board name>.TRACKx.ADJUST.ENABLE	(Read only)
<board name>.TRACKx.CODEM.SUPPORT.ENABLED	(Read only)
<board name>.TRACKx.TRACK.FAILED	(Read only)
<board name>.TRACKx.CODE.1.OUT	
<board name>.TRACKx.CODE.8.OUT	
<board name>.TRACKx.CODE.9.OUT	
<board name>.TRACKx.CODE.2.OUT	
<board name>.TRACKx.CODE.3.OUT	
<board name>.TRACKx.CODE.4.OUT	
<board name>.TRACKx.CODE.7.OUT	
<board name>.TRACKx.CODE.6.OUT	
<board name>.TRACKx.CODE.5.OUT	
<board name>.TRACKx.CODE.M.OUT	
<board name>.TRACKx.CODE.1.IN	(Read only)
<board name>.TRACKx.CODE.8.IN	(Read only)
<board name>.TRACKx.CODE.9.IN	(Read only)
<board name>.TRACKx.CODE.2.IN	(Read only)
<board name>.TRACKx.CODE.3.IN	(Read only)
<board name>.TRACKx.CODE.4.IN	(Read only)
<board name>.TRACKx.CODE.7.IN	(Read only)
<board name>.TRACKx.CODE.6.IN	(Read only)
<board name>.TRACKx.CODE.5.IN	(Read only)
<board name>.TRACKx.CODE.M.IN	(Read only)

3 i-Lok Operation

The sections that follow describe the i-Lok System's functions.

3.1 i-Lok System Overview

Summary:

Chapter 2 in SM-6800A provides a general MICROLOK II system description. A new section will be added to describe the i-Lok System (a preliminary version of which is provided below).

The i-Lok system is a solid-state programmable, microprocessor-based system designed to control wayside circuit applications in non-electrified territory. Primarily i-Lok is used to manage track circuits providing end-to-end rail integrity, including detection of train shunt, faulty insulated joints or broken rail. In addition to managing track circuits, this system allows the user to control signals, drive relay outputs, and receive inputs from external sources.

3.2 i-Lok System Description

The i-Lok system is a solid-state programmable, microprocessor-based system designed to control wayside track circuit applications in non-electrified territory, such as repeater or intermediate locations.

An i-Lok consists of a cardfile assembly with plug-in modules and track interface panel/panels for the operating tracks. Within the cardfile assembly are the plug-in modules specific to the requirements of the location being designed. For example, certain locations may only require track circuit operation, others may require signal lighting and others may require driving relays and/or receiving inputs. Each individual location may combine portions or all of the options noted.

Features of the i-Lok system include:

- Configurable software allowing a single "typical" program usable for all customer locations including intermediate signals and repeater locations.
- The executive and application software are uploaded and stored in flash PROM.
- Uploading of software and troubleshooting is done through the MICROLOK II Development System program.
- Track circuits include either MICROTRAX or ECode type.
- Adjustments for track circuits and signal lighting made with the aid of the CPU module.
- Compatibility with highway crossing motion sensors/predictors without the need for external blocking units.

The i-Lok unit can function independently, managing track circuits and controlling signals at an intermediate location, or can be interfaced to a vital relay interlocking or a master controlling unit such as a MICROTRAX End-of-Siding unit or a MICROLOK unit.

The i-Lok unit can be serially connected to other i-Lok units. MICROTRAX Coded Track units, MICROTRAX End-of-Siding units, MICROLOK units or MICROLOK II units. This system allows up to 16 units to be connected to one interlocking controller in a daisy chain configuration. Maximum allowable cable length between two serially connected units is 50 ft. A modem is required for units that are further than 50 ft. apart.

3.2.1 General Configuration

The i-Lok system cardfile contains the system's central controlling logic and circuits that interface this logic directly to external circuits, track interface panels for track circuits, relays, and signal aspects. Logic and interface circuits are contained on the familiar Eurocard format plug-in printed circuit boards. The system cardfile contains six card slots (although not all slots will be used in every application) and a Vital Cut-Off Relay. Each installed circuit board plugs into a common backplane motherboard. The backplane distributes circuit board operating power and enables the CPU board to control and monitor other boards in the cardfile.

The specific circuit boards used in each i-Lok system are determined by the system application and the boards available in the i-Lok cardfile. Typical configurations are recommended to optimize available cardfile space. To simplify the cardfile configuration, the slots are restricted to a particular set of boards. In addition, the board configuration must agree with the configuration defined in the application logic software.

To prevent accidental insertion of a board into the wrong cardfile slot, each board is equipped with male keying pins. These pins correspond with keying plugs installed in the associated backplane slot connector. The keying pins are installed from the factory and will correspond to the boards assignment for each slot.

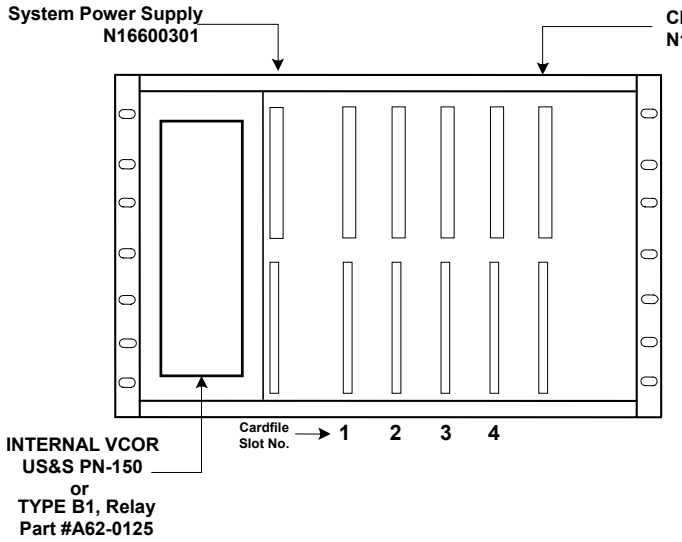
To allow communications between the CPU board and the other boards in the cardfile, each board must have its bus address configured in hardware. This is accomplished by nine of the pins on the upper connector on the cardfile motherboard; this address assignment cannot be changed. In the application software, boards must appear in a specific order to agree with the proper order of the board addressing.

The table below describes the order that each board must be defined in the application, and it also describes the slot position in the cardfile for each board.

Order of Assignment	Slot Position	Board Assignment
1st	4	Track PCB - MICROTRAX or ECode
2nd	1	Lamp Driver or Non-Isolated I/O
3rd	2	Lamp Driver or Non-Isolated I/O
4th	3	Isolated I/O

The CPU used in the i-Lok system is the same board and executive program that is used in the MICROLOK II system. It comes with the same software features as a MICROLOK II, including the PC interface with a Windows-based System Development program.

Refer to SM-6800A through D for specific CPU information.



Slot No.	PCB or Panel
1 and 2	Color Light Lamp Driver N451910-1501 or Searchlight Lamp Driver N451910-7301 or Non-Isolated I/O N451910-660X
3	Isolated I/O N451910-2101
4	MICROTRAX Track I/O N451910-070X or ECode N17063901

System Cardfile Functional Configuration

For examples of what a typical cardfile looks like, refer to section 3.5.3 of this document.

3.2.2 Color Light and Searchlight Lamp Driver Boards

The i-Lok units can provide direct control of Color Light (Figure 3.2-1) or Searchlight (Figure 3.2-2) signals. Signal lamp outputs are regulated and do not require the use of external adjustment resistors. Adjustment of the lamps for proper lamp voltage/intensity can be accomplished at the i-Lok unit. (For adjustment procedures, refer to "Color Light and Searchlight Lamp Driver Boards Signal Lamp Adjustment" in subsection 3.9.1.3.)

The table below, describes the layout of the Color Light Lamp Driver PCB Front Panel.

Fig. Ref	Label	Device	Purpose
1	**INPUT 1**	green LED	Monitor state of vital input #1. When lit, indicates respective input is turned on.
2	**INPUT 2**	green LED	Monitor state of vital input #2. When lit, indicates respective input is turned on.
3	**LAMP ADJUST**	Potentiometer (Screw Adjust)	Multi-turn potentiometer, used to adjust the signal lamp voltage for Head 1. CW increases the lamp voltage, CCW decreases the lamp voltage.
4	**HEAD 1 MASTER SIDE**	red LED	Monitors state of the Head 1 red lamp drive. When lit, indicates that the red aspect is turned on and it should be lit. When flashing, the board is performing cold filament test on the red aspect.
5	**HEAD 1 MASTER SIDE**	yellow LED	Monitors state of the Head 1 yellow lamp drive. When lit, indicates that the yellow aspect is turned on and it should be lit. When flashing, the board is performing cold filament test on the yellow aspect.
6	**HEAD 1 MASTER SIDE**	green LED	Monitors state of the Head 1 green lamp drive. When lit, indicates that the green aspect is turned on and it should be lit. When flashing, the board is performing cold filament test on the green aspect.
7	**LAMP ADJUST**	Potentiometer (Screw Adjust)	Multi-turn potentiometer, used to adjust the signal lamp voltage for Head 2. CW increases the lamp voltage, CCW decreases the lamp voltage.
8	**HEAD 2 SLAVE SIDE**	red LED	Monitors state of the Head 2 red lamp drive. When lit, indicates that the red aspect is turned on and it should be lit. When flashing, the board is performing cold filament test on the red aspect.
9	**HEAD 2 SLAVE SIDE**	yellow LED	Monitors state of the Head 2 yellow lamp drive. When lit, indicates that the yellow aspect is turned on and it should be lit. When flashing, the board is performing cold filament test on the yellow aspect.
10	**HEAD 2 SLAVE SIDE**	green LED	Monitors state of the Head 2 green lamp drive. When lit, indicates that the green aspect is turned on and it should be lit. When flashing, the board is performing cold filament test on the green aspect.

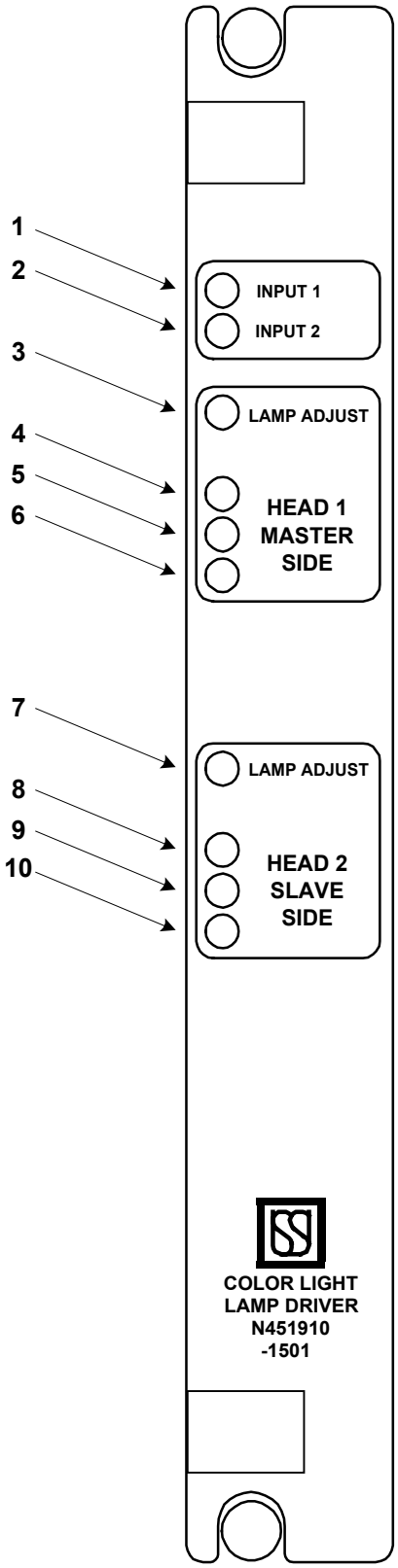


Figure 3.2-1. Color Light Lamp Driver PCB Front Panel Layout

The table below, describes the Searchlight Lamp Driver PCB front panel layout.

Fig. Ref	Label	Device	Purpose
1	**INPUT 1**	green LEDs	Monitor state of vital input #1. When lit, indicates respective input is turned on.
2	**INPUT 2**	green LEDs	Monitor state of vital input #2. When lit, indicates respective input is turned on.
3	**LAMP ADJUST**	Potentiometer (Screw Adjust)	Multi-turn potentiometer, used to adjust the signal lamp voltage for Head 1. CW increases the lamp voltage, CCW decreases the lamp voltage.
4	**HEAD 1**	red LEDs	Monitor state of the lamp drive for Head 1. When lit, indicates that the signal mechanism is in the red position. When flashing, the board is performing cold filament test on the lamp.
5	**HEAD 1**	yellow LEDs	When lit, indicates that the Head 1 signal mechanism is in the yellow position.
6	**HEAD 1**	green LEDs	When lit, indicates that the Head 1 signal mechanism is in the green position.
7	**LAMP ADJUST**	Potentiometer (Screw Adjust)	Multi-turn potentiometer, used to adjust the signal lamp voltage for Head 2. CW increases the lamp voltage, CCW decreases the lamp voltage.
8	**HEAD 2**	red LEDs	Monitor state of the lamp drive for Head 2. When lit, indicates that the signal mechanism is in the red position. When flashing, the board is performing cold filament test on the lamp.
9	**HEAD 2**	yellow LEDs	When lit, indicates that the Head 2 signal mechanism is in the yellow position.
10	**HEAD 2**	green LEDs	When lit, indicates that the Head 2 signal mechanism is in the green position.
11	**HEAD 1 GP** **HEAD 2 GP**	#6 Screw Terminal	Provides the connection for the Green Repeater input wire from the Searchlight mechanism for both HEAD 1 and HEAD 2.

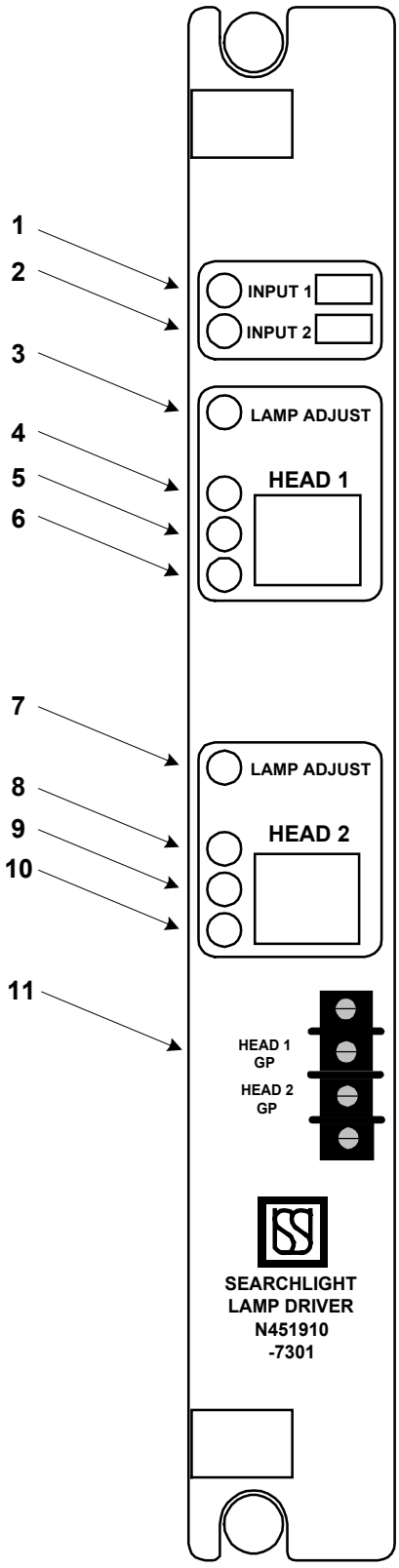


Figure 3.2-2. Searchlight Lamp Driver PCB Front Panel Layout

3.2.3 Isolated I/O Board

The i-Lok units provide isolated inputs and outputs for remote equipment located outside of the case/house in accordance with double break circuit design. Each isolated output can be used to operate a switch lock coil and/or any 12-volt relay with a minimum of 150 ohms. The isolated module (Figure 3.2-3) contains four inputs and two outputs.

The table below describes the Isolated I/O PCB front panel layout. (Figure 3.2-3)

Fig. Ref	Label	Device	Purpose
1	**INPUT 1 QUICK RELEASE**	green LED	Monitor the state of isolated input #1. When lit, indicates respective input is turned on.
2	**INPUT 2 TIMED RELEASE**	green LED	Monitor the state of isolated input #2. When lit, indicates respective input is turned on.
3	**OUTPUT 1 LOCK RELEASE**	red LED	Monitor state of isolated output #1. When lit, indicates respective output is turned on.
4	**INPUT 3 QUICK RELEASE**	green LED	Monitor state of isolated input #3. When lit, indicates respective input is turned on.
5	**INPUT 4 TIMED RELEASE**	green LED	Monitor state of isolated input #4. When lit, indicates respective input is turned on.
6	**OUTPUT 2 LOCK RELEASE**	red LED	Monitor state of isolated output #2. When lit, indicates respective output is turned on.

3.2.4 Non-Isolated I/O Board

The i-Lok units provide logic inputs and outputs that do not require isolation from battery. These are used for I/O within the i-Lok equipment case/house. Non-isolated I/O are typically used in an interface to a relay-based interlocking control system. Two versions of this module (12-volt outputs driving minimum 65-ohm coils, or 24-volt outputs driving minimum 130-ohm coils) are available. The non-isolated module (Figure 3.2-4) contains four inputs and four outputs.

The table below describes the Non-Isolated I/O PCB front panel layout. (Figure 3.2-4)

Fig. Ref	Label	Device	Purpose
1	**INPUT 1 - 4**	green LEDs	Monitor the state of vital non-isolated inputs #1 – 4. When lit, indicates respective input is turned on.
2	**OUTPUT 1 - 4**	yellow LEDs	Monitor the state of vital non-isolated outputs #1 - 4. When lit, indicates respective input is turned on.

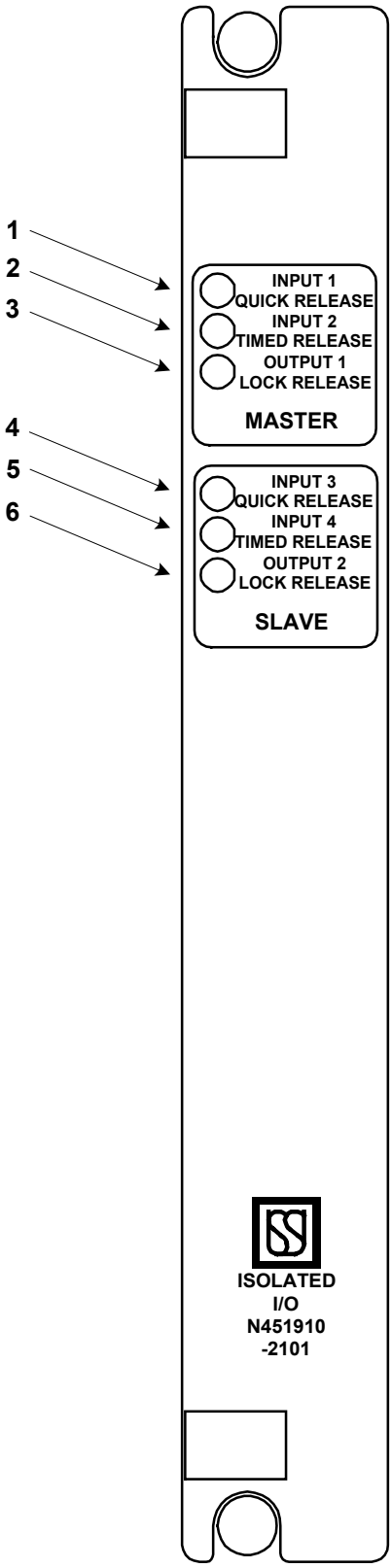


Figure 3.2-3. Isolated I/O PCB Front Panel Layout

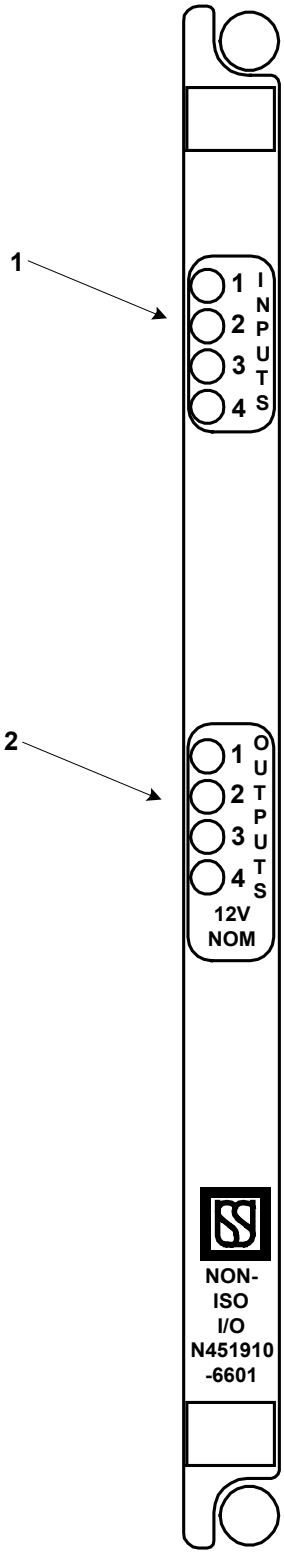


Figure 3.2-4. Non-Isolated I/O PCB Front Panel Layout

3.2.5 i-Lok Processor Control

The i-Lok system is managed by a single microprocessor and standard Executive software located on the CPU module in flash memory. The CPU module is responsible for these basic functions:

- Encoding and output of transmitted track codes
- Decoding and processing of received track codes
- Responding to loss of track codes (train shunts, broken rail, etc.)
- Sending output commands to local devices (relays, signals, switch locks, etc.)
- Reading input indications from local devices (relays, etc.)
- Responding to signal lamp filament and Searchlight mechanism statuses
- Controlling power to vital outputs
- Processing on-site configuration inputs from user
- Displaying information for track circuit setup and lamp adjustments
- Performing internal diagnostics
- Managing vital slave serial communications

CPU communication with all other modules is carried over a common data bus. Successful diagnostic tests result in a 250Hz output to a conditional power supply on the System Power Supply module, which energizes the VCOR (vital cut-off) relay. Vital or "critical" faults detected within the system cause this relay to de-energize removing power from all outputs.

There are three operational modes associated with the i-Lok system: "Normal" mode, "Selective Shutdown" mode, and "Full Shutdown" mode. If all diagnostic tests are passed, the CPU maintains the system in "Normal" mode.

After a "critical" failure is detected, the unit will reset and go through the power-up sequence and attempt normal operation. However, if five "critical" errors occur within 40 seconds of operational time, the unit enters the "Selective Shut-Down" mode. In this mode, the VCOR is de-energized and all Outputs become deactivated; however, track communications can continue. This feature will allow trains to approach the affected location although the outputs are de-energized preventing signals from being cleared.

If the unit is currently in the "Selective Shut-Down" mode and the unit detects five "critical" errors in 40 seconds of operational time, the unit enters the "Full Shutdown" mode and all operations including track communications are stopped.

3.2.6 Vital Cut-Off Relay

All i-Lok units are equipped with a vital cut-off relay (VCOR) which controls power to the outputs. The vital cut-off relay is mounted internally within the i-Lok unit. This relay is energized so long as CPU internal diagnostics are passed. Any vital failure causes the relay to drop, thus removing power from all outputs.

The i-Lok cardfile can be ordered with either a US&S PN-150B or a type B1, Relay Part # A62-0125 relay used for the VCOR.

When used with the MICROLOK II cardfile, the VCOR is externally mounted. For installation and wiring information, refer to SM-6800A, Chapter 6 and SM-6800B, Section 3.2 "Vital Cut-Off Relay (VCOR) Installation and Wiring."

3.3 i-Lok System Specifications

Summary:

Chapter 3 in SM-6800A provides information about MICROLOK II system specifications. A new section will be added to describe the i-Lok system specifications (a preliminary version of which is provided below).

3.3.1 System Operating Power

Power Input to System Cardfile				
Voltage Range	**Nominal Voltage**	**Min. Sys. Start-Up**	**Maximum Ripple**	**Current Draw**
9.5 to 16.5 VDC	12 VDC	11.5 VDC	0.5 V P-P	Determined by installation (number of signal lamps and relays.)

Cardfile Power Supply Printed Circuit Board (N16660301)*		
For System Cardfile PCB 5V Internal Circuits	**For System Cardfile PCB 12V Internal Circuits**	**To VCOR Relay**
+5V @ 3A	+12V @ 1A, -12V @ 1A	-12V into 400 - 500 ohm coil
*Not used to power vital or non-vital external devices or circuits		

The table below is a list of the worst-case current draws for i-Lok system boards:

Board	Condition	+5V	+12V	-12V
COLOR.LIGHT N451910-1501	4 LEDs on	25ma.	16ma.	76ma.
SEARCH.LIGHT N451910-7301	4 LEDs on	30ma.	13.2ma.	90ma.
IN4.OUT4 N451910-660X	8 LEDs on	44ma.	60ma.	1ma.
IN4.OUT2.ISO N451910-2101	6 LEDs on	16.6ma.	28.2ma.	60ma.

The following tables describe lamp, input, and output specifications for each i-Lok PCB.

Vital Color Light Lamp Driver Printed Circuit Board				
Lamp Specifications				
US&S Part No.	**Signal Lamp Voltage Range**	**Max. Battery Voltage**	**Signal Lamp Wattage Range**	**Number of Signals**
N451910-1501	From 8.5V to Battery -1Volt	16.2V	18W - 25W	Six lamps total, comprised of two heads with three signals per head
Input Specifications				
US&S Part No.	**Nom. Input Voltage**	**Min. Voltage to Ensure ON State**	**Voltage to Ensure OFF State**	**Max. Sustained Input Voltage**
N451910-1501	12V	9.5V	7.0V or less	16.2V

Vital Searchlight Lamp Driver Printed Circuit Board				
Lamp Specifications				
US&S Part No.	**Signal Lamp Voltage Range**	**Max. Battery Voltage**	**Signal Lamp Wattage Range**	**Number of Signals**
N451910-7301	From 8.5V to Battery -1 Volt	16.2V	18W - 25W	Two lamps total, comprised of two heads with three aspect searchlight per head
Input Specifications				
US&S Part No.	**Nom. Input Voltage**	**Min. Voltage to Ensure ON State**	**Voltage to Ensure OFF State**	**Max. Sustained Input Voltage**
N451910-1501	12V	9.5V	7.0V or less	16.2V

Vital IN4.OUT4 I/O Printed Circuit Boards				
Input Specifications				
US&S Part No.	**Nom. Input Voltage**	**Min. Voltage to Ensure ON State**	**Voltage to Ensure OFF State**	**Max. Sustained Input Voltage**
N451910-6601	12V	9.5V	7.0V or less	16.2V
N451910-6602	12V	9.5V	7.0V or less	16.2V
Output Specifications				
US&S Part No.	**Voltage V_{BATT} Range**	**Load Resistance Range**	**Max. OFF Voltage**	**Min. ON Voltage**
N451910-6601	12V	65 Ω - ∞	0.75V	11.5V
N451910-6602	24V	150 Ω - ∞	1.5V	23.5V

Vital IN4.OUT2.ISO I/O Printed Circuit Boards				
Input Specifications				
US&S Part No.	**Nom. Input Voltage**	**Min. Voltage to Ensure ON State**	**Voltage to Ensure OFF State**	**Max. Sustained Input Voltage**
N451910-2101	12V	9.5V	7.0V or less	16.2V
Output Specifications				
US&S Part No.	**Voltage V_{BATT} Range**	**Load Resistance Range**	**Max. OFF Voltage**	**Min. ON Voltage (V_{BATT} 12V)**
N451910-2101	9.8 - 16.2V	240 Ω 500 Ω 750 Ω 1000 Ω	0.75V	15V 20V 23V 24V

3.3.2 i-Lok System Cardfile Hardware Configuration

Cardfile Mounting	PCB Mounting	Total I/O Slots	Vital Cutoff Relay	I/O Interface Connections	Battery Power Connector
Std. 19” rack, Shelf or wall	Eurocard	4	Internal to the Cardfile	Three 22-way screw lock terminals or two 22 and a 20-way cage clamp terminals	AAR Terminal Block
For MICROLOK II System cardfile hardware configuration, refer to Chapter 3 in SM-6800A.					

3.3.3 VCOR Relay

Type	Contacts	Coil Resist. (Ohms)	Pickup Amps	Pickup DC Volts	System Voltage
US&S PN-150B N322500-701	6FB	400Ω	0.0132A	5.3V	10V
Type B1 Relay Part # A62-0125 J070205-1463	6FB	500Ω	0.0121A	6.1V	10V

3.3.4 Environmental

System Cardfile Vibration	Operating Temperature Range (All Units)	Humidity Limit
5 - 20HZ.: 0.05" P-P displacement 20 – 200Hz.: 1.0G Peak Shock: 10G Peak	-40°C to +70°C	95% non-condensing

3.4 i-Lok Components

Summary:

Section 1.3 in Chapter 1 of SM-6800B details MICROLOK II system hardware. Additional information will be added to identify i-Lok components.

3.4.1 i-Lok System Installation Component List

i-Lok Major System Components

Name	US&S Part No.	Basic Function(s)
i-Lok cardfile	N34600401 - US&S Relay and Buchanan I/O connectors N34600402 - US&S Relay and Wago I/O connectors N34600403 - Type B1 Relay and Buchanan I/O connectors N34600404 - Type B1 Relay and Wago I/O connectors	Houses all plug-in printed circuit boards and the VCOR.

Name	US&S Part No.	Basic Function(s)
VCOR relay	N322500-701 (US&S PN-150B)	Switches power to all cardfile vital output circuits under the control of the i-Lok CPU board.
VCOR relay	J070205-1463 (Type B1 Relay Part # A62-0125)	Switches power to all cardfile vital output circuits under the control of the i-Lok CPU board.

3.4.2 MICROLOK II/i-Lok Cardfile Plug-In Components

MICROLOK II/i-Lok Cardfile Plug-In Components

Name	US&S Part No.	Basic Functions
Color Light PCB	N451910-1501	Provides vital regulated lamp control to two Color Light signal heads with both hot and cold filament checks. Lamp voltage adjustment is accomplished on board using two potentiometers while monitoring the lamp current on the CPU displays for both 18- and 25-watt lamps. Included on this board are two isolated inputs that are programmable by the system application.
Searchlight PCB	N451910-7301	Provides vital regulated lamp control to two Searchlight signal heads with both hot and cold filament checks and stuck-mechanism checks in the red, yellow, and green positions. Lamp voltage adjustment is accomplished on board using two potentiometers while monitoring the lamp current on the CPU displays for both 18- and 25-watt lamps. Included on this board are two isolated inputs that are programmable by the system application.
Non-Isolated I/O PCBs	N451910-6601 (12V Inputs and 12V Outputs) N451910-6602 (12V Inputs and 24V Outputs)	Provides four vital inputs and four outputs that are non-isolated type (common to N12). There are two versions of this board: N451910-6601 with 12-volt inputs and outputs, and an N451910-6602 with 12-volt inputs and 24-volt outputs.
Isolated I/O PCBs	N451910-2101 (12V)	Provides four vital isolated inputs and two isolated outputs. Both the inputs and outputs are nominal 12-volt type.

3.4.3 Installing the i-Lok Cardfile Plug-Ins

Installing the i-Lok system cardfile plug-ins is a four-step process. Each of the following steps must be performed for each circuit board to be installed:

- Selecting the appropriate cardfile slot for each circuit board (section 3.4.3.1).
- Configuring the cardfile keying plugs for each circuit board (section 3.4.3.2).
- Configuring the circuit board jumpers and firmware just prior to installation (section 3.4.3.3).
- Installing the circuit boards (section 3.4.3.4).

3.4.3.1 i-Lok Circuit Board Installation Rules

Observe the following arrangement rules when installing i-Lok printed circuit boards into the card file:

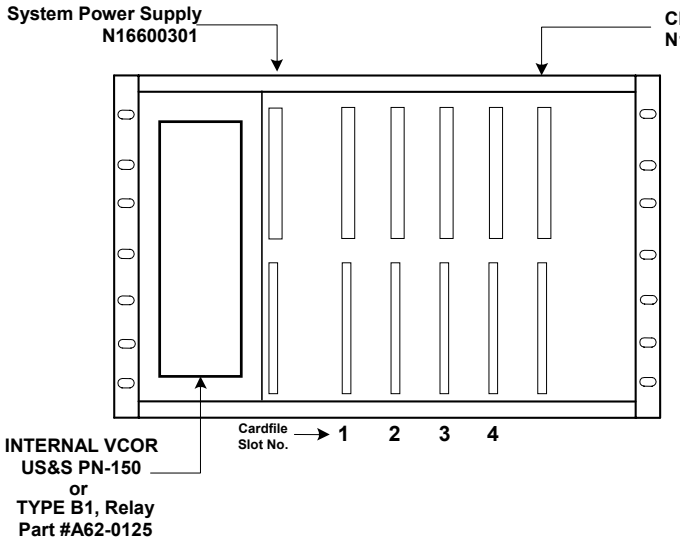
- Refer to the figure on the next page. All boards have assigned slots to be plugged into. The lower connector is provided with a keying plug connector that mechanically keys each type of board to the proper slot. These should not be changed or modified from the factory settings.
- Power supply board N16600301 (without front panel) must be positioned behind the large blank panel N34601301. This panel covers the VCOR and system power supply with the 5V ON and VCOR LEDs visible in the holes provided on the panel.
- All unused slots must be fitted with a blank shield panel so that the entire front face of the cardfile is covered. Available blank panels include:

  Single slot shield panel: N451850-2902

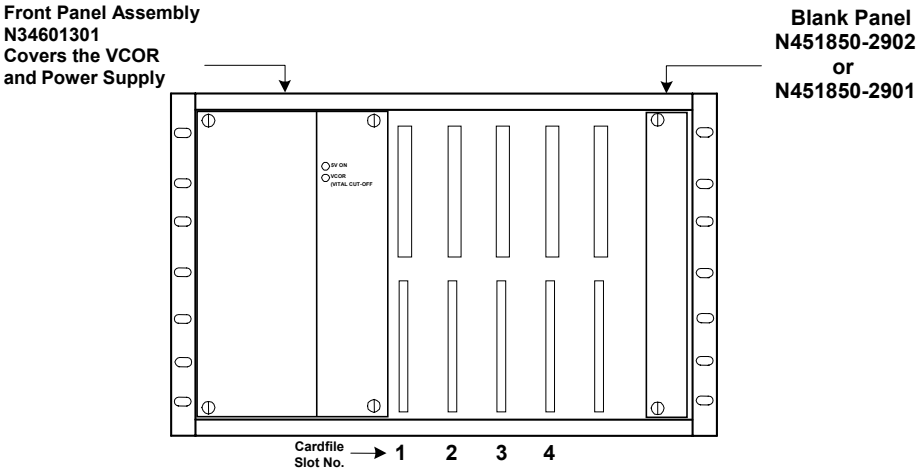
  Double slot shield panel: N451850-2901

- Secure the boards to the cardfile with the thumb-screws on the top and bottom of the front panel.

Cardfile PCB and Panel Installation Guidelines



Slot No.	PCB or Panel
1 and 2	Color Light Lamp Driver N451910-1501 or Searchlight Lamp Driver N451910-7301 or Non-Isolated I/O N451910-660X
3	Isolated I/O N451910-2101
4	MICROTRAX Track I/O N451910-070X or ECode N17063901



3.4.3.2 i-Lok Circuit Board Keying Plug Installation

Cardfile Motherboard Keying Plug Locations

Printed Circuit Board	Part No.	Keying Plug Location											
		1	2	3	4	5	6	7	8	9	10	11	12
Color Light	N451910-1501	✓	✓	✓	✓			✓		✓			
Searchlight	N451910-7301	✓	✓	✓	✓			✓		✓			
Non-Isolated I/O	N451910-6601	✓	✓	✓	✓			✓		✓			
Isolated I/O	N451910-2101	✓	✓	✓	✓			✓			✓		

3.4.3.3 i-Lok PCB Jumper and Firmware Configurations

The CPU printed circuit board is the only board that contains jumpers and firmware to be configured. The jumpers and firmware must be configured before the CPU printed circuit board is installed. For more information on how the jumpers and firmware should be configured, refer to SM-6800B, section 2.2.3.1, "Configuring the CPU Board."

3.4.3.4 Installing i-Lok Circuit Boards

US&S recommends that power is removed from the cardfile before removing or installing circuit boards.

Use the following procedure to install the i-Lok plug-in circuit boards:

1. On the bottom front edge of the cardfile, there is a label that provides information as to which boards are assigned to which slots. Use this as a guide when installing the circuit boards.

2. Hold the circuit board to be installed vertically in front of the cardfile.

3. Insert the board upper and lower edges into the plastic card guides inside the cardfile.

CAUTION
When installing any i-Lok circuit board into the card file, do not attempt to force the board into the slot. Damage to the circuit board and motherboard 96-pin connectors may result. If resistance is encountered when installing a board, gently rock the board to engage the male and female connectors. If the board still cannot be fully inserted into the card slot, remove the board from the cardfile and attempt to determine the source of the resistance.

4. Gently push the board into the cardfile until the board and cardfile connectors are fully engaged. If the board has an integral front panel, make certain that the rear face of the front panel is flush against the front of the cardfile.

5. If the board has an integral front panel, secure the board into position using the two retaining screws attached to the front panel.

3.5 i-Lok Cardfile Assembly and Modules

Summary:

Section 2.1 in Chapter 2 of SM-6800B provides information and diagrams to support the installation of MICROLOK II cardfiles. A new section will be added to describe the i-Lok intermediate track circuit unit assembly (a preliminary version of which is provided below).

3.5.1 i-Lok Assembly

The i-Lok cardfile is designed for use at intermediate operator locations. It consists of a cardfile assembly and plug-in modules of various types. Included within the cardfile is a vital relay mounted in the left-side and slots for six modules:

Slot	Module	Required ?
Left slot	Power Supply module	Always required
# 1	Color Light module, or Searchlight module, or Non-Isolated I/O module	All are design-dependent
# 2	Color Light module, or Searchlight module, or Non-Isolated I/O module	All are design-dependent
# 3	Isolated I/O module	Design-dependent
# 4	Track Interface module	Design-dependent
# 5	CPU module	Always required

Located on the left-side of the unit on the upper sloping panel are AAR terminals for connecting the input 12 volt battery power. The system will operate on a battery voltage range between 9.8 volts and 16.2 volts; however, to avoid premature loading of a recharging battery, the battery must be greater than 11.5 volts when the system is powered up. When batteries are used, a constant voltage charger is required. A transzorb-type surge suppressor is connected between the (+) and (-) posts to protect against transcend over-voltage. The On/Off switch for the unit is located next to the battery terminals.

Located on the right side of the unit on the upper sloping panel are two 25-pin "D" connectors. These are RS-485 and RS-232/423 serial data ports from the CPU module which can be programmed as vital and non-vital links. These ports allow the unit to be serially connected to a MICROLOK or MICROLOK II unit, a MICROTRAX unit, or other i-Lok units. The connectors are labeled PORT A and PORT B and the pin-out on each connector is identical which facilitate daisy-chaining of serial links. Table X below is a list of the signals and pins for the 2 serial ports.

Signal	25 D Connector Pin Number
COM1 TXD 485+	4
COM1 TXD 485-	16
COM1 RXD 485+	8
COM1 RXD 485-	6
COM1 CTS 485+	3
COM1 CTS 485-	14
COM1 DCD 485+	9
COM1 DCD 485-	21
COM1 RTS 485+	19
COM1 RTS 485-	17
COM1 TX CLK 485+	7
COM1 TX CLK 485-	5
COM1 RX CLK485-	18
COM1 RX CLK 485-	20
GND	1
COM3 TXD 232/423	25
COM3 RXD 232/423	12
COM3 CTS 232/423	11
COM3 DCD 232/423	23
COM3 RTS 232/423	24
COM3 REF	13
COM3 TX CLK 232/423	15
COM3 RX CLK 232/423	2
+12V	22
GND	10

Pin information for serial PORT A and B

All wire connections to the unit are made on three connectors located on the top of the unit. Two types of connectors are available: screw lock plug connectors or cage clamp connectors. The screw lock plug connectors are mounted on a common bar to allow simultaneous removal. The cage clamp connectors are color-coded and are keyed to allow for simultaneous removal. Located on the upper sloping panel is a label illustrating the correct wire connections for the application required.

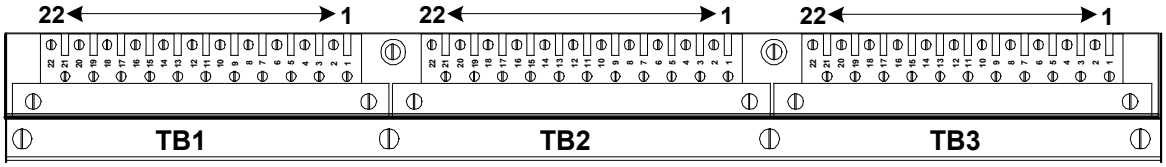
3.5.2 i-Lok Cardfile - Local I/O Connections

On the i-Lok cardfiles, all of the I/O connections are made through three connectors on the top of the cardfile. There are two options for these connectors using either screw lock or cage clamp style connections. For proper connection, bare no more than 3/8" of conductor for either style of connector. In the following table, there is a list of the I/O connectors that are used on the top of the cardfile and are supplied with the cardfile when ordered.

Wire Clamp Style	Number of Pins	Connector Mating End	US&S Part Number	Manufacturer's Part Number
Screw lock Buchanan	22	Printed Circuit Board	J709146-0476	PCB3A22S
Cage Clamp Wago	22	Socket End Gray	J709146-1472	231-122/037-000
Cage Clamp Wago	22	Socket End Orange	J709146-1473	231-322/037-000
Cage Clamp Wago	20	Socket End Light Gray	J709146-1474	721-120/037-000

3.5.2.1 Screw Lock Terminals

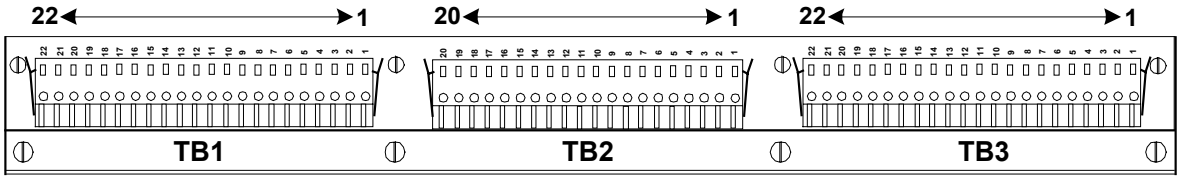
The figure below shows Buchanan 22-way screw lock plug connectors. These connectors are designed to hold up to #14 AWG wire. The three connectors are fastened to a fiberglass bar; this acts as a keying mechanism for ease of removal and replacement.



Buchanan-Style 22-Way Screw Lock Connectors on the Top of the Cardfile

3.5.2.2 Cage Clamp Terminals

The following figure shows two Wago 22-way and one 20-way cage clamp connectors. These connectors are designed to hold up to #12 AWG wire. Keying of these connectors is accomplished by means of color, size and different spacing of each connector. TB1 is dark gray, 22-way pins on .197" (5mm) centers. TB2 is light gray, 20-way pins on .197" (5mm) centers. TB3 is orange, 22-way pins on .2" centers.



Wago-Style 22-Way and 20-Way Cage Clamp Connectors on the Top of the Cardfile

3.5.2.3 Output Pin Assignment

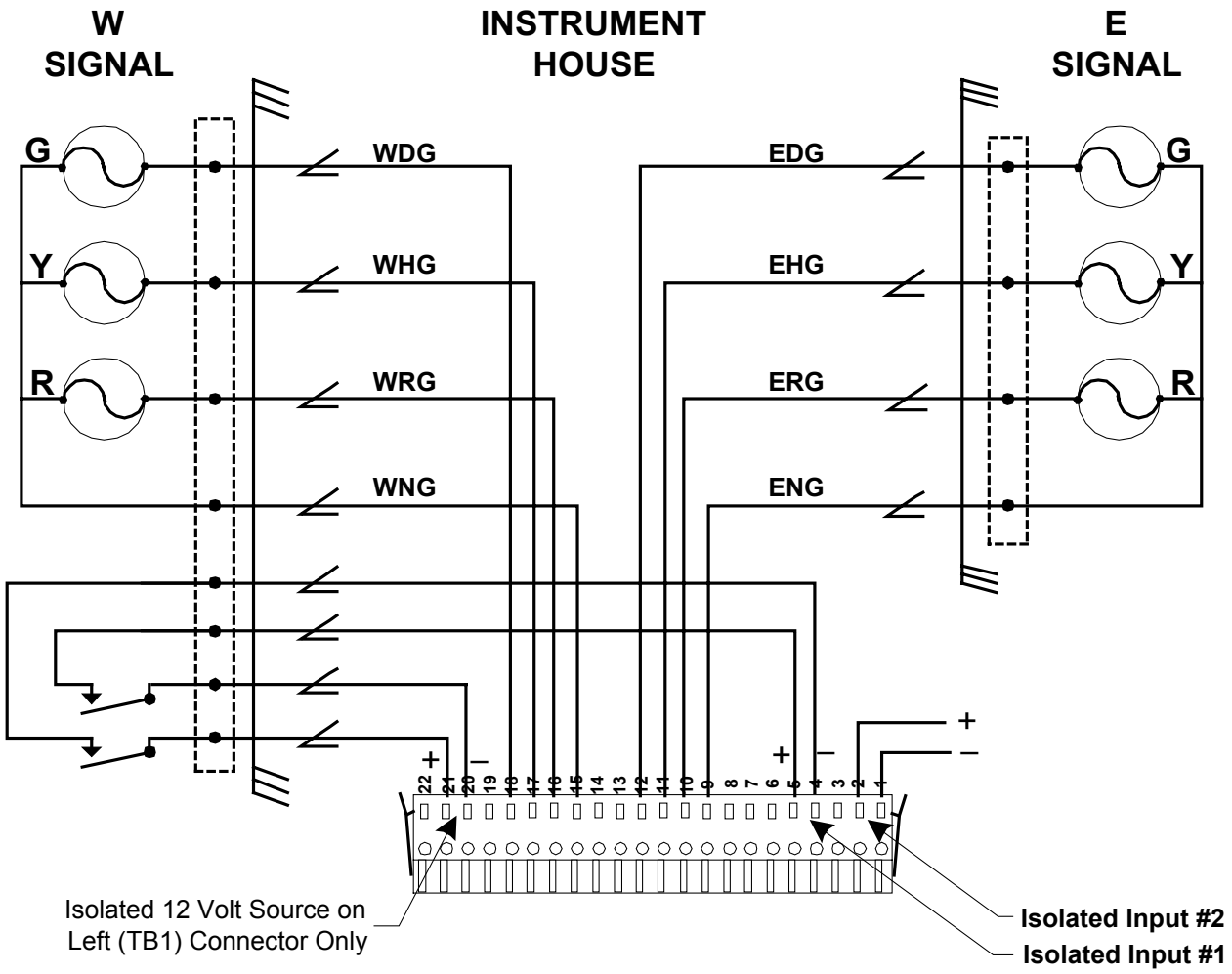
Connector pin-outs are listed in the following tables. In these tables, pin-outs are defined according to the type of module assigned to a specific slot. Connections to the same terminal block will be different depending on module placement in the unit, i.e., if a Color Light module is in I/O slot 1, it will be wired to pins 18 through 15 and 12 through 9 for HEAD 1 and HEAD 2. If a non-isolated module is in I/O slot 1, inputs 1 through 4 would be wired to pins 18 through 15 and outputs 1 through 4 are wired to pins 12 through 9.

3.5.2.3.1 Color Light Lamp Driver Board

The Color Light Lamp Driver board can be used in either Slot #1 and/or Slot #2. Slot #1 is wired to the left connector while slot #2 is wired to the center connector. The pin assignment for these two connectors is identical for both the Buchanan and Wago style connector. Each connector has pin-outs for two heads with red, yellow, green, and a positive common output for each head. Listed in the table below is the pin-out for both the left and center connectors. The figure that follows the table shows typical wiring for two heads from either slot #1 or #2.

Color Light Lamp Driver N451910-1501

Slot Number and Connector Position	Pin-Out	Purpose
Slot #1 Left (TB1)	1(-) and 2(+) 3(-) and 4(+) HEAD 2 9 10 11 12 20(-) and 21(+)	Isolated Input #2 Isolated Input #1 HEAD 2 Common Red Yellow Green 12 Volt Isolated Source
Slot #2 Center (TB2)	1(-) and 2(+) 3(-) and 4(+) HEAD 1 15 16 17 18	Isolated Input #2 Isolated Input #1 HEAD 1 Common Red Yellow Green



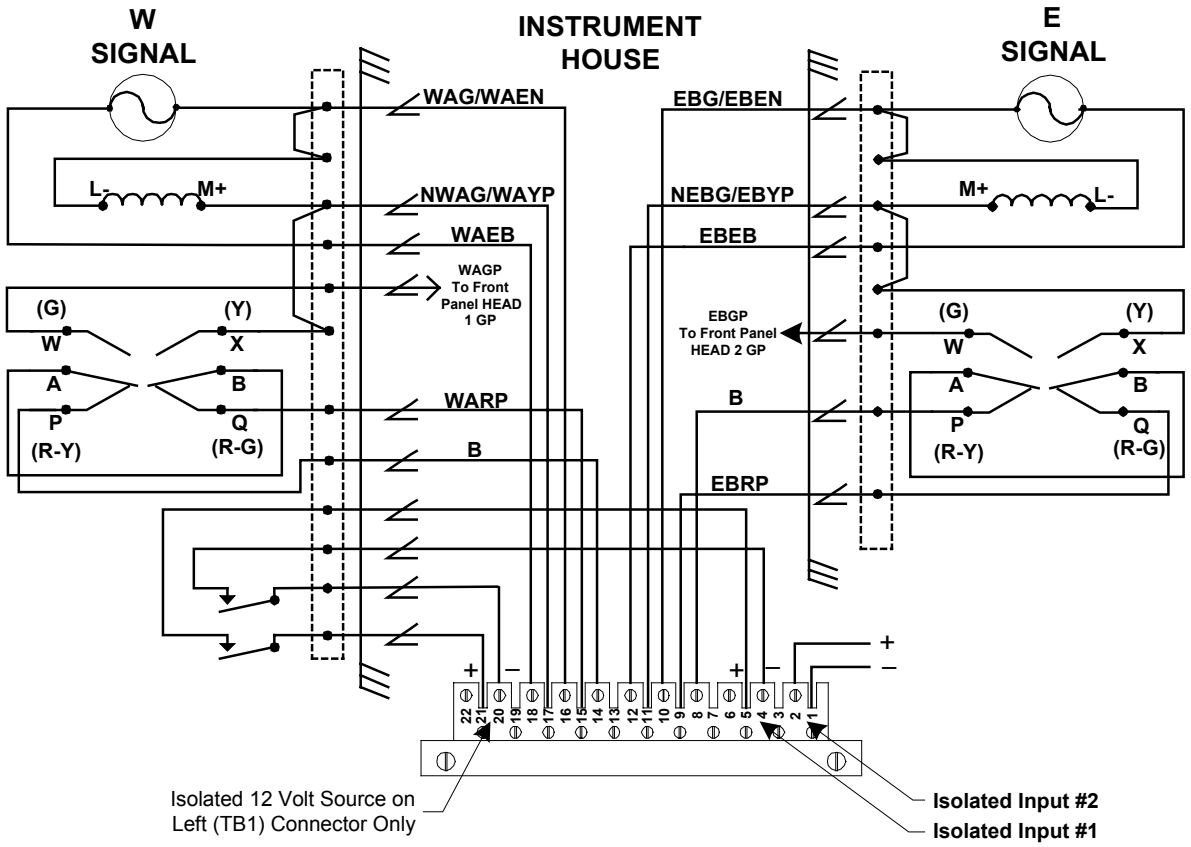
Typical Color Light Wiring for Left (TB1) or Center (TB2) Connectors

3.5.2.3.2 Searchlight Lamp Driver Board

The Searchlight Lamp Driver board can be used in either Slot #1 and/or Slot #2. Slot #1 is wired to the left connector while slot #2 is wired to the center connector. The pin assignment for these two connectors is identical for both the Buchanan and Wago style connector. Each connector has pin-outs for two heads with lamp drive, mechanism control, and red, yellow, and green repeater control for each head. Listed in the table that follows is the pin-out for both the left and center connectors. The figure that follows the table shows typical wiring for two heads from either slot #1 or #2.

Searchlight Lamp Driver N451910-7301

Slot Number and Connector Position	Pin-Out	Purpose
Slot #1 Left (TB1)	1(-) and 2(+) 3(-) and 4(+) <u>HEAD 2</u> 8 9 10 11 12 20(-) and 21(+)	Isolated Input #2 Isolated Input #1 <u>HEAD 2</u> Red/Yellow Check Input (RP and YP) Red/Green Check Output Lamp-/Coil Common Coil Drive (+/-)/Yellow Check Out Lamp+ 12 Volt Isolated Source
Slot #2 Center (TB2)	1(-) and 2(+) 3(-) and 4(+) <u>HEAD 1</u> 14 15 16 17 18	Isolated Input #2 Isolated Input #1 <u>HEAD 1</u> Red/Yellow Check Input (RP and YP) Red/Green Check Output Lamp-/Coil Common Coil Drive (+/-)/Yellow Check Out Lamp+



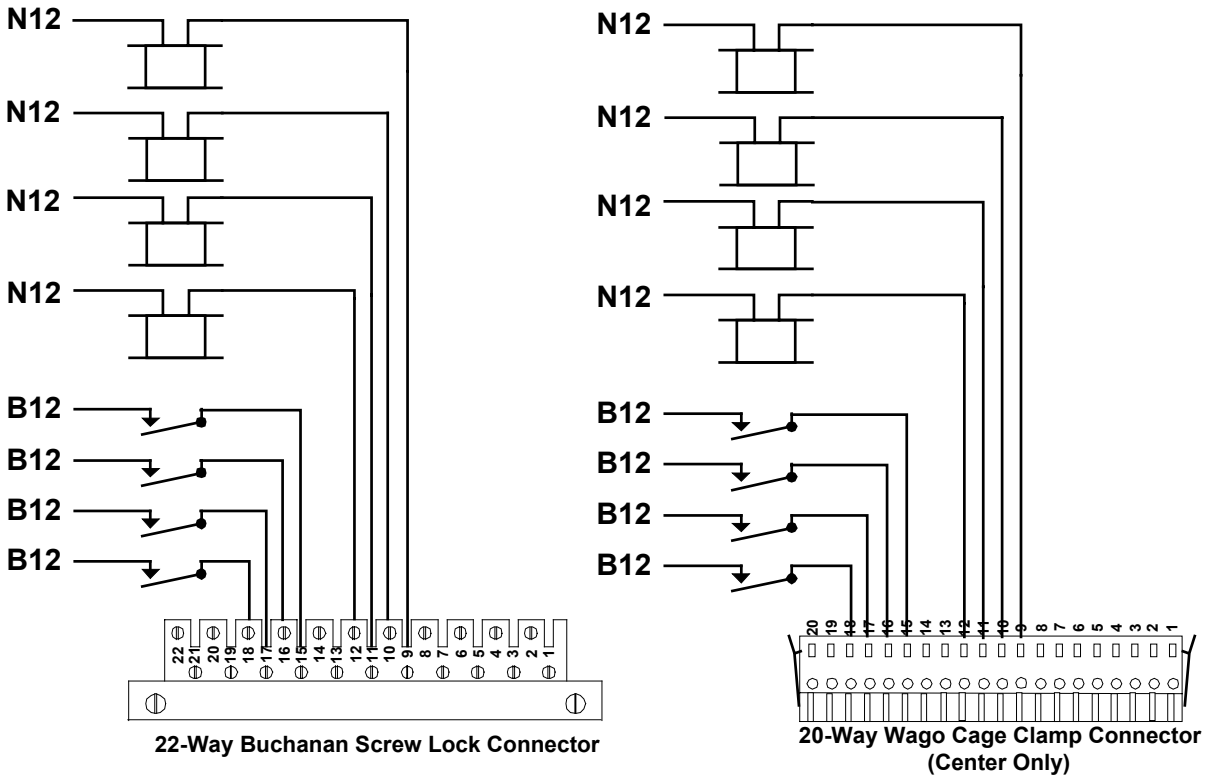
Typical Searchlight Wiring for Left (TB1) or Center (TB2) Connectors

3.5.2.3.3 Non-Isolated I/O Board

The Non-Isolated I/O board can be used in either Slot #1 and/or Slot #2. Slot #1 is wired to the left connector while slot #2 is wired to the center connector, and the pin assignment for these two connectors is identical for both the Buchanan and Wago style connector. Each connector has pin outs for 4 inputs and 4 outputs that are non-isolated and must be common to N12 battery. Listed in the following table is the pin out for both the left and center connectors. The figure that follows the table shows the typical wiring for four inputs and four outputs from either slot #1 or #2.

Non-Isolated I/O N451910-660X

Slot Number and Connector Position	Pin-Out	Purpose
Slot #1 Left (TB1)	1,2,4,5,7,8,13,14 9 thru 12 15 thru 18 20(-) and 21(+)	N12 (Battery Common B-) Output #4 thru #1 Input #4 thru #1 12 Volt Isolated Source
Slot #2 Center (TB2)	1,2,4,5,7,8,13,14 9 thru 12 15 thru 18	N12 (Battery Common B-) Output #4 thru #1 Input #4 thru #1



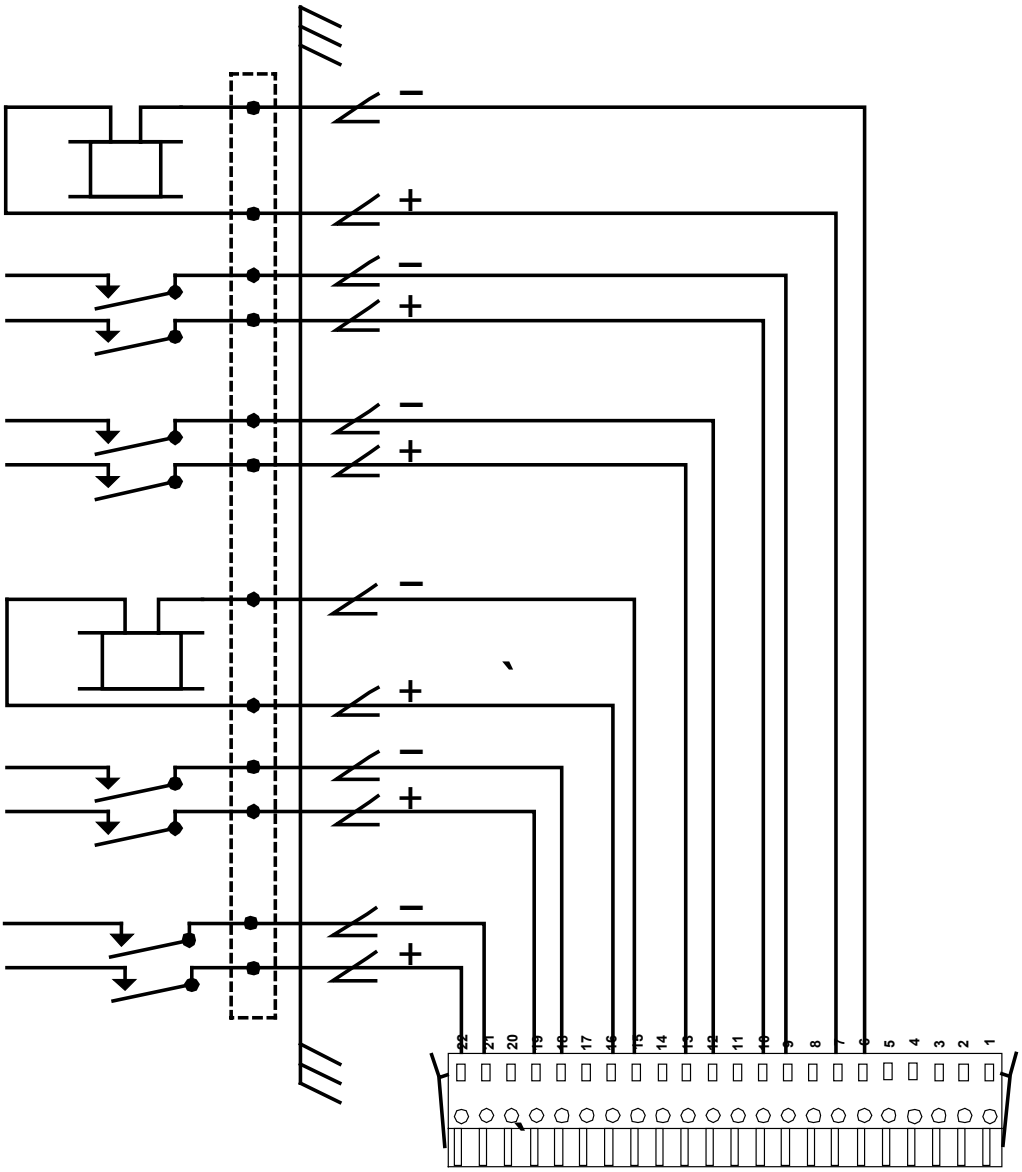
Typical Non-Isolated I/O wiring for Left (TB1) or Center (TB2) Connectors

3.5.2.3.4 Isolated I/O Board

The Isolated I/O board is used in Slot #3 and is wired to the right top connector. The pin assignment for this connector is identical for both the Buchanan- and Wago-style connector with pin-outs for four inputs and two outputs. The inputs and outputs are isolated and require both a positive and negative connection. Listed in the table below is the pin-out for the right connector. The figure that follows shows typical wiring for four inputs and two outputs from the right top connector with the board in slot #3.

Isolated I/O N451910-2101

Slot Number and Connector Position	Pin-Out	Purpose
Slot #3 Right (TB3)	6(-) and 7(+) 9(-) and 10(+) 12(-) and 13(+) 15(-) and 16(+) 18(-) and 19(+) 21(-) and 22(+)	Output #2 Relay Drive Input #4 Input #3 Output #1 Relay Drive Input #2 Input #1



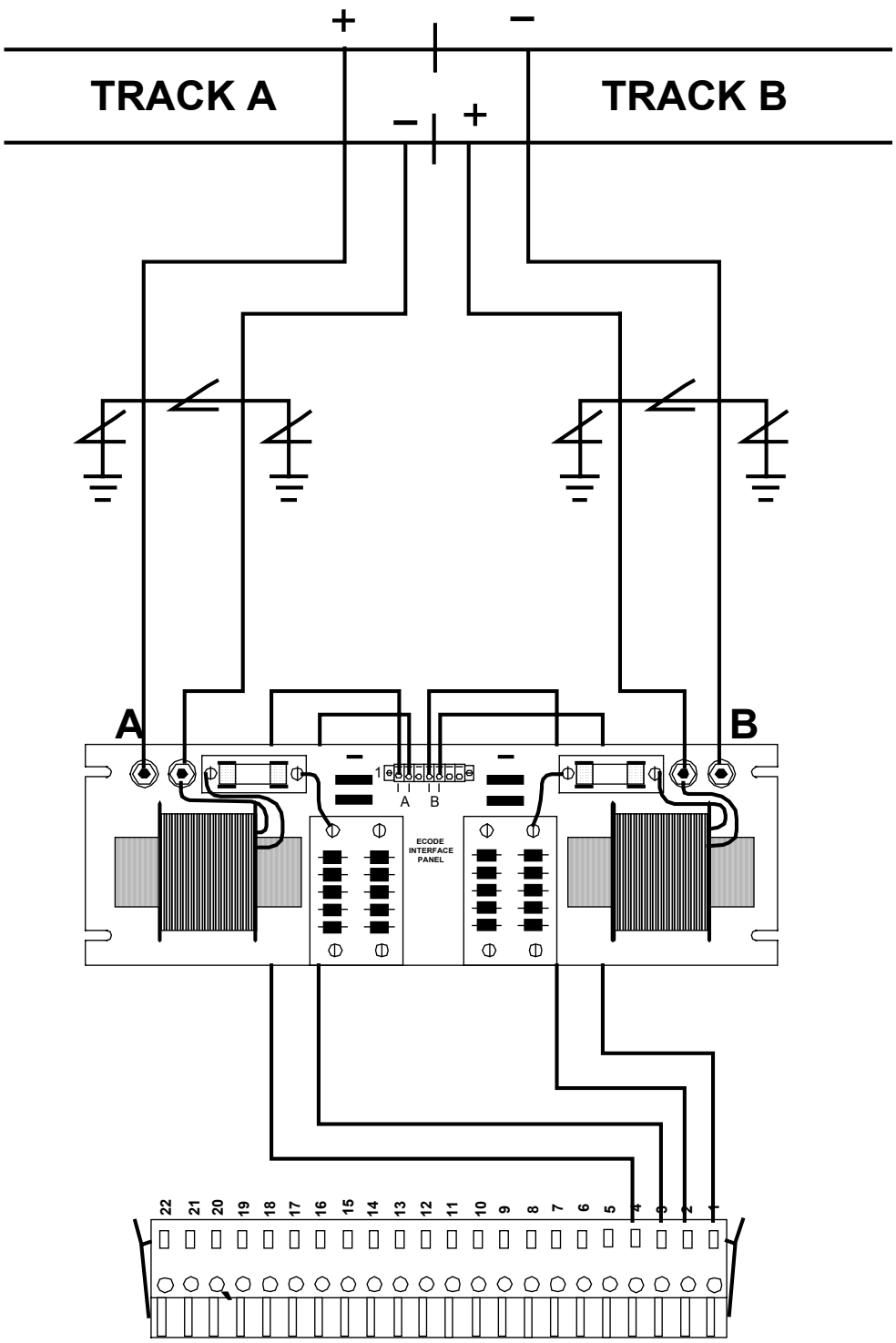
Typical Isolated Wiring for Right (TB3) Connector

3.5.2.3.5 ECode Coded Track Circuit Board

The ECode Track board is used in Slot #4 and is wired to the right-top connector. The pin assignment for this connector is identical for both the Buchanan- and Wago-style connector with pin-outs for Track A and Track B. Listed in the table below is the pin-out for the right connector. The figure that follows the table shows typical wiring for two track circuits from the right top connector with the board in slot #4.

ECode Track N17063901

Slot Number and Connector Position	Pin-Out	Purpose
Slot #4 Right (TB3)	1(-) and 2(+) 3(-) and 4(+)	Track "B" Output Track "A" Output



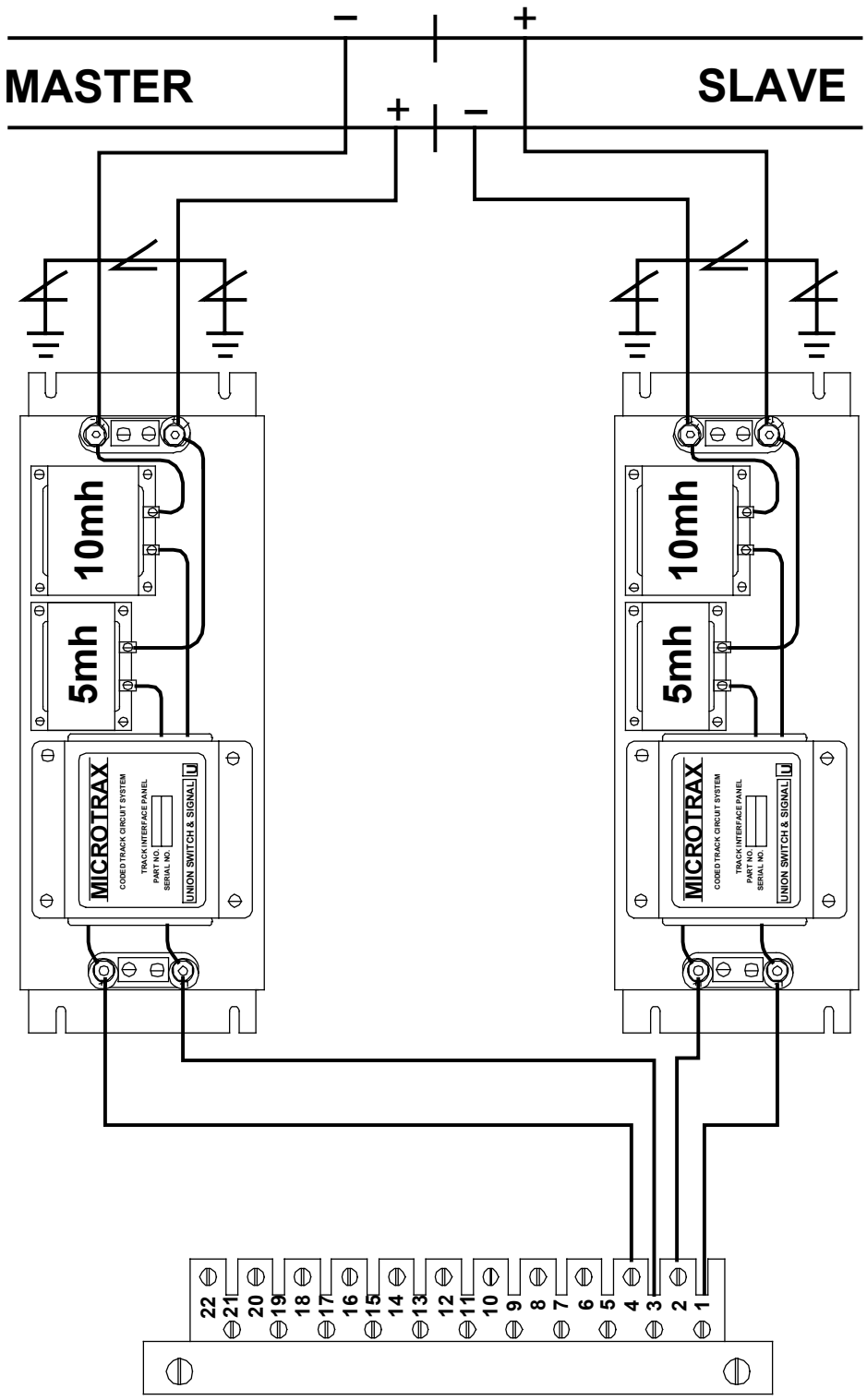
Typical ECode Wiring for Right (TB3) Connector

3.5.2.3.6 MICROTRAX Coded Track Circuit Board

The MICROTRAX Track board is used in Slot #4 and is wired to the right-top connector. The pin assignment for this connector is identical for both the Buchanan- and Wago-style connector with pin-outs for the master and slave track circuits. Listed in the table below is the pin-out for the right connector. The figure that follows the table shows typical wiring for two track circuits from the right top connector with the board in slot #4.

MICROTRAX Track I/O N451910-070X

Slot Number and Connector Position	Pin-Out	Purpose
Slot #4 Right (TB3)	1(-) and 2(+) 3(-) and 4(+)	Slave Track Output Master Track Output



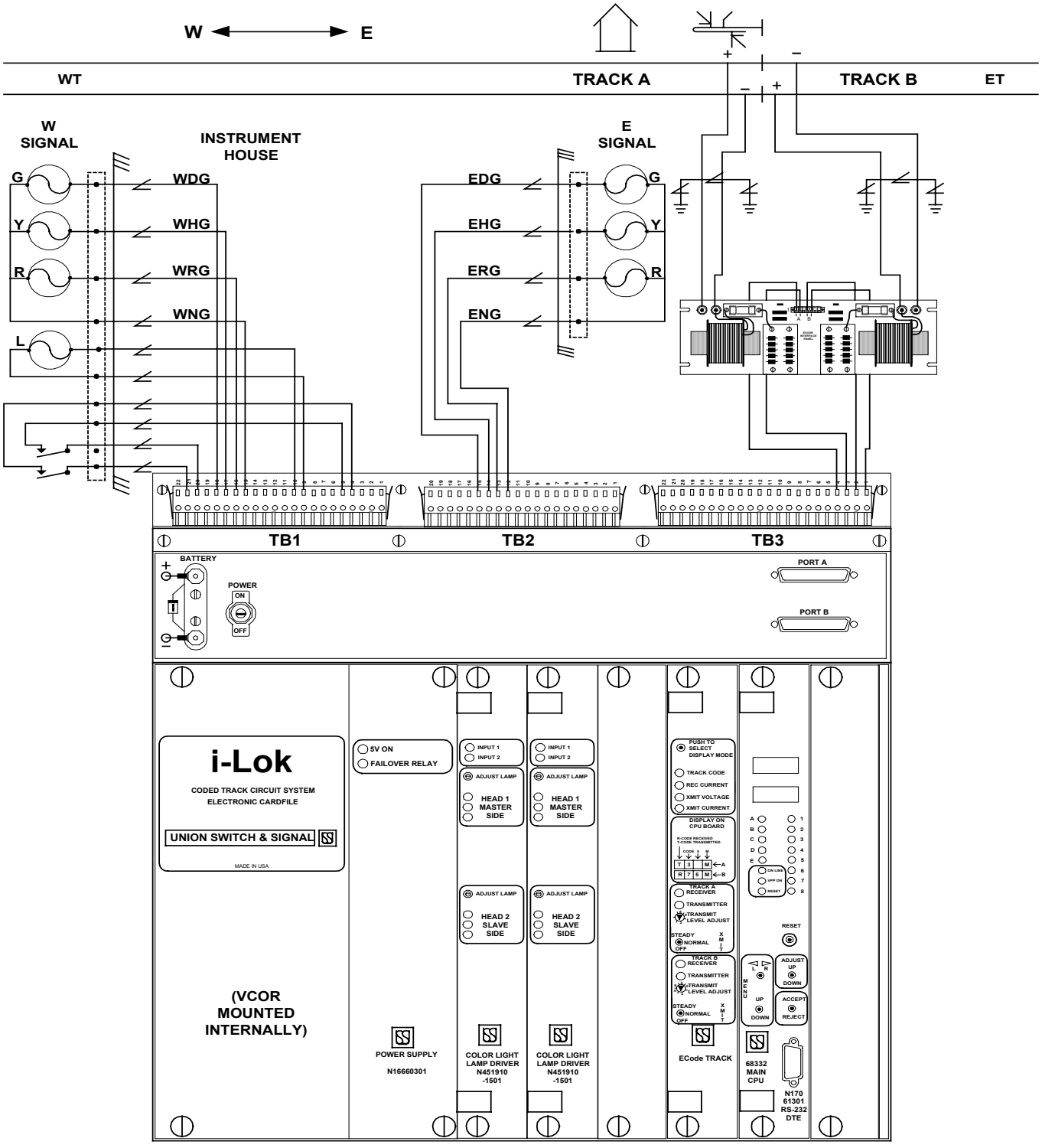
Typical MICROTRAX Wiring for Right (TB3) Connector

3.5.3 Typical i-Lok Wiring Diagrams

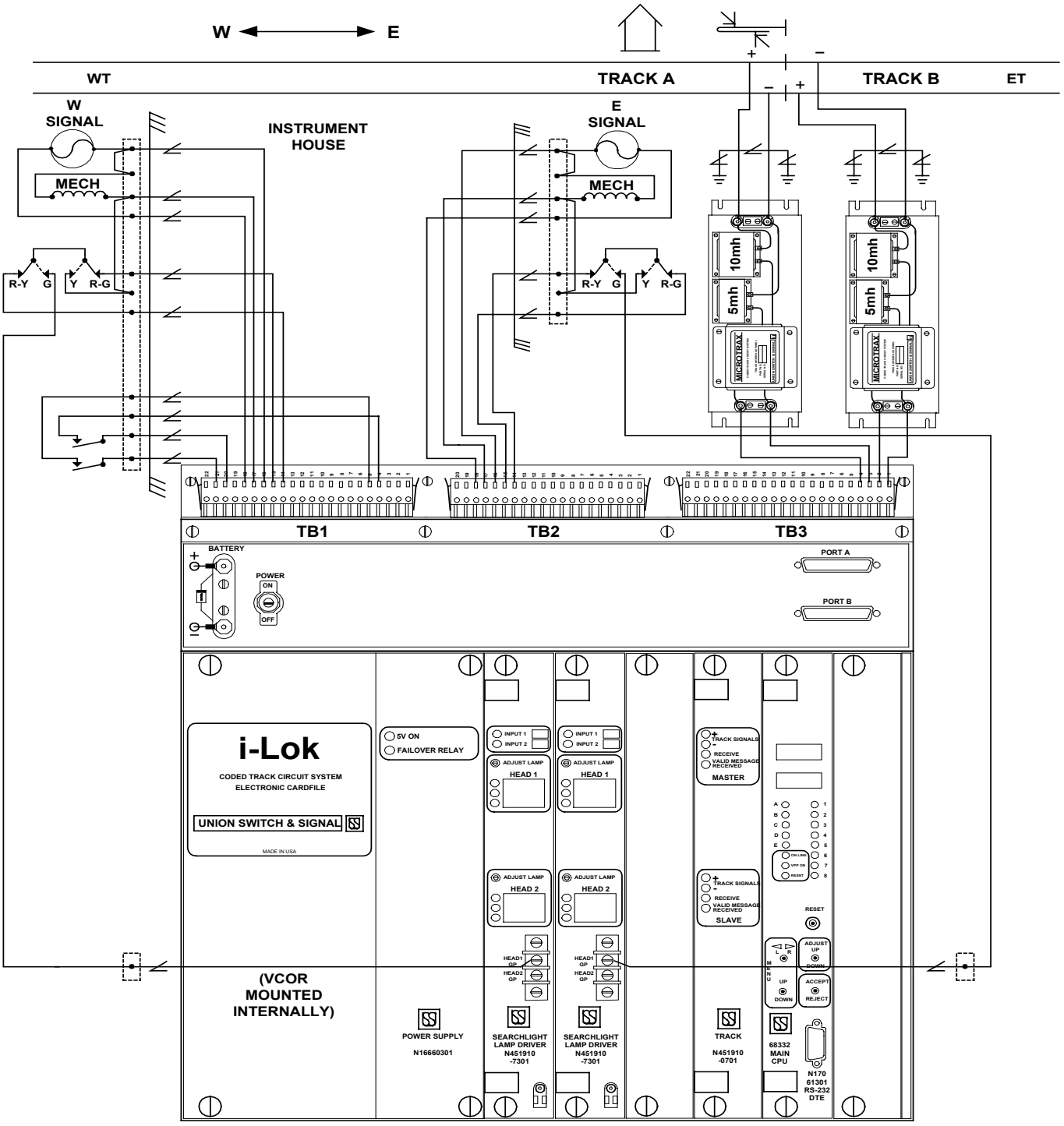
On the i-Lok cardfiles, all of the I/O connections are made through three connectors on the top of the Cardfile. There are two options for these connectors: Buchanan 22-way screw lock plug connectors, or two Wago 22-way and one 20-way (center connector only) cage clamp connectors. For a better description of these types of connectors, see Section 3.5.2, “i-Lok Cardfile - Local I/O Connections.”

The following diagrams show how to wire an i-Lok cardfile using either one of the connectors. For example, the Color Light Lamp Driver Board wiring diagram is shown with Wago cage clamp connectors, but you can use the Buchanan screw lock plug connectors with the Color Light Lamp Driver Board as well.

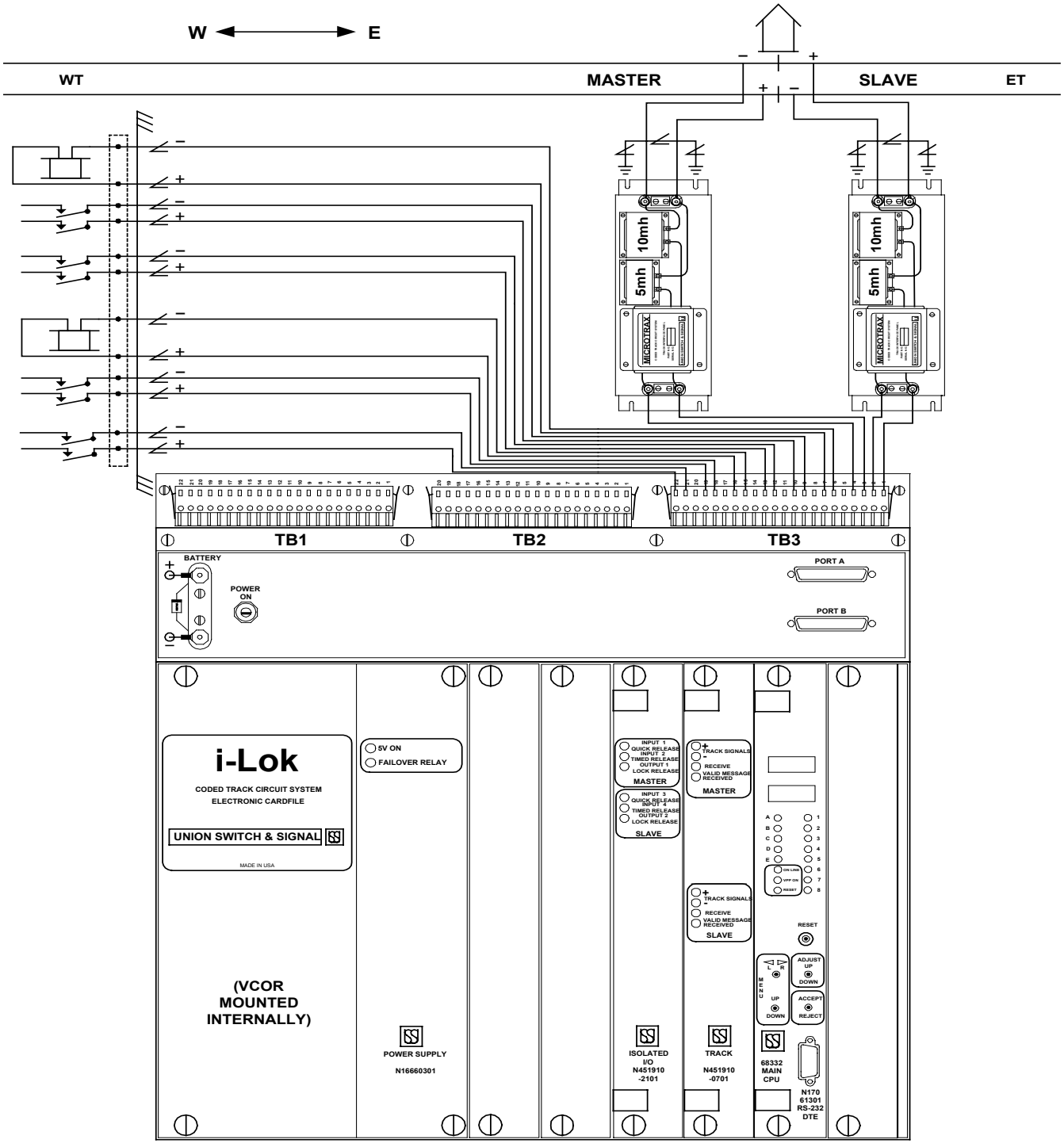
Along with two different kinds of connectors that are used in an i-Lok cardfile, two different kinds of track circuit controllers can also be used. Either an ECode Coded Track Circuit Board or a MICROTRAX Coded Track Circuit Board can be used interchangeably in the cardfile setup. Both track circuit controllers fit into the same slot on the cardfile, and they both have the same pin assignments. (See section 3.5.2.3, "Output Pin Assignment.") Note that when using an ECode Coded Track Circuit board, a single ECode Coded Track Circuit interface panel is used, and when using a MICROTRAX Coded Track Circuit board, two MICROTRAX Coded Track Circuit interface panels are used.



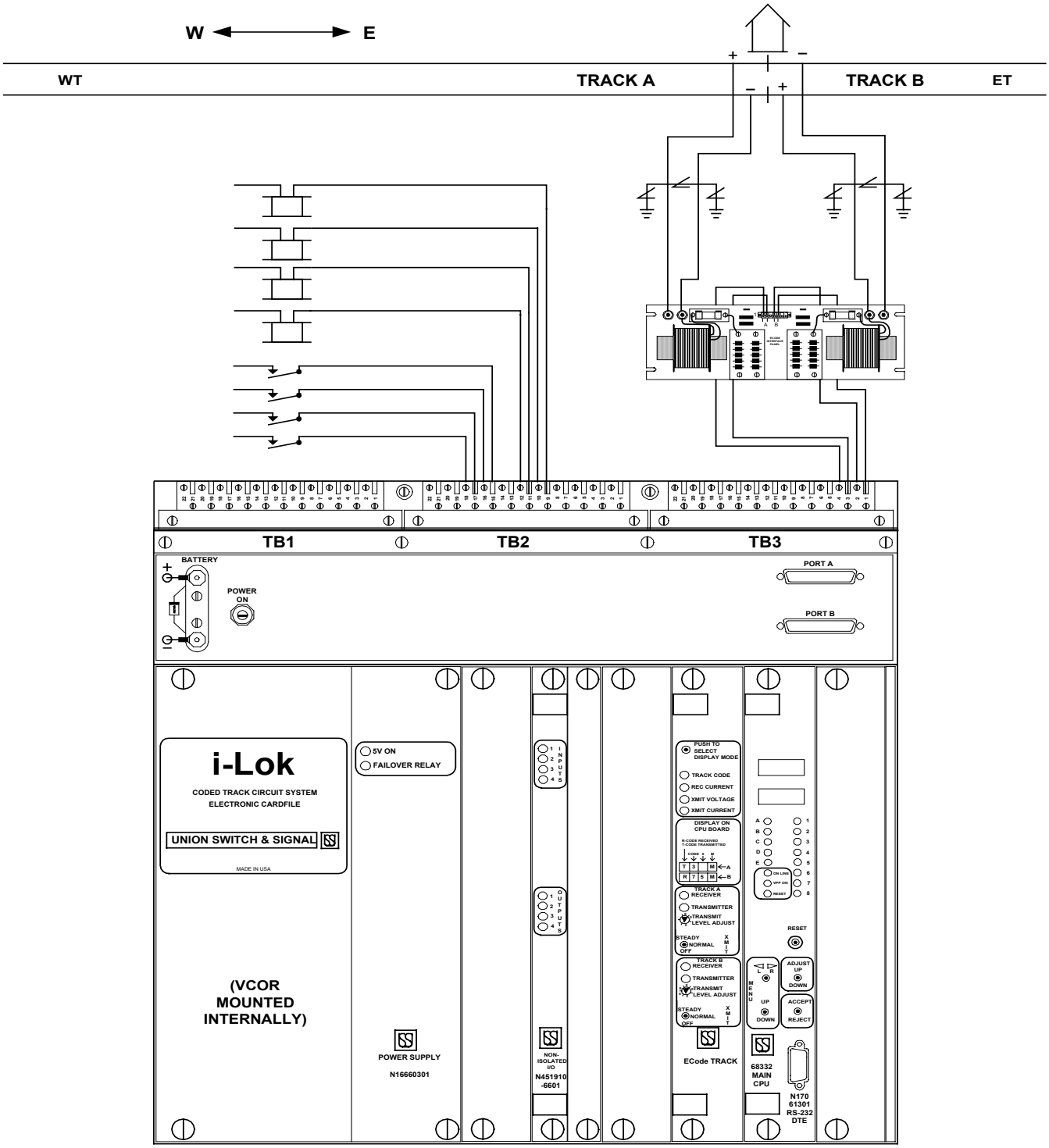
Color Light Lamp Driver and ECode Coded Track Circuit Boards with Wago Connectors



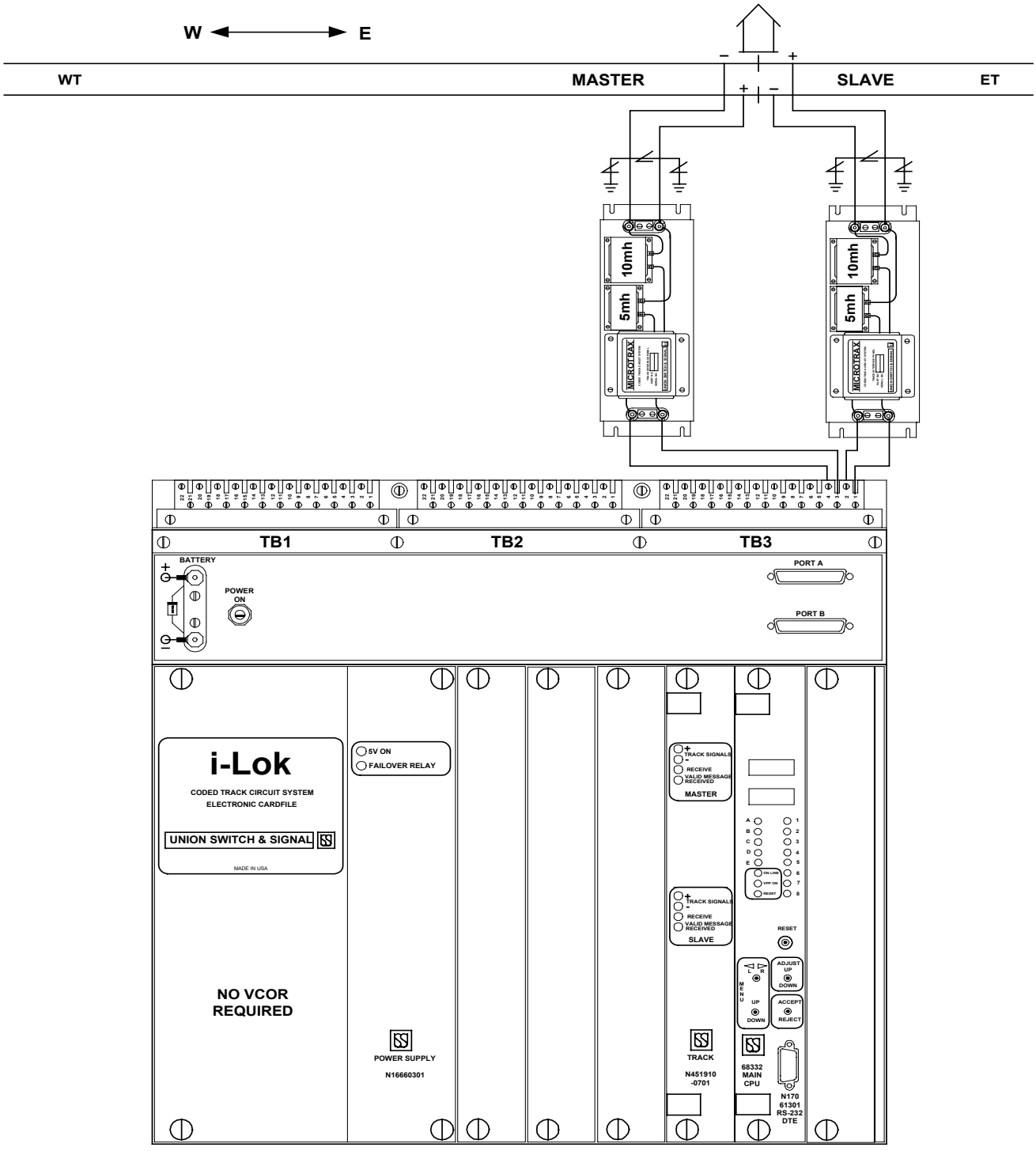
Search Light Lamp Driver and MICROTRAX Coded Track Circuit Boards with Wago Connectors



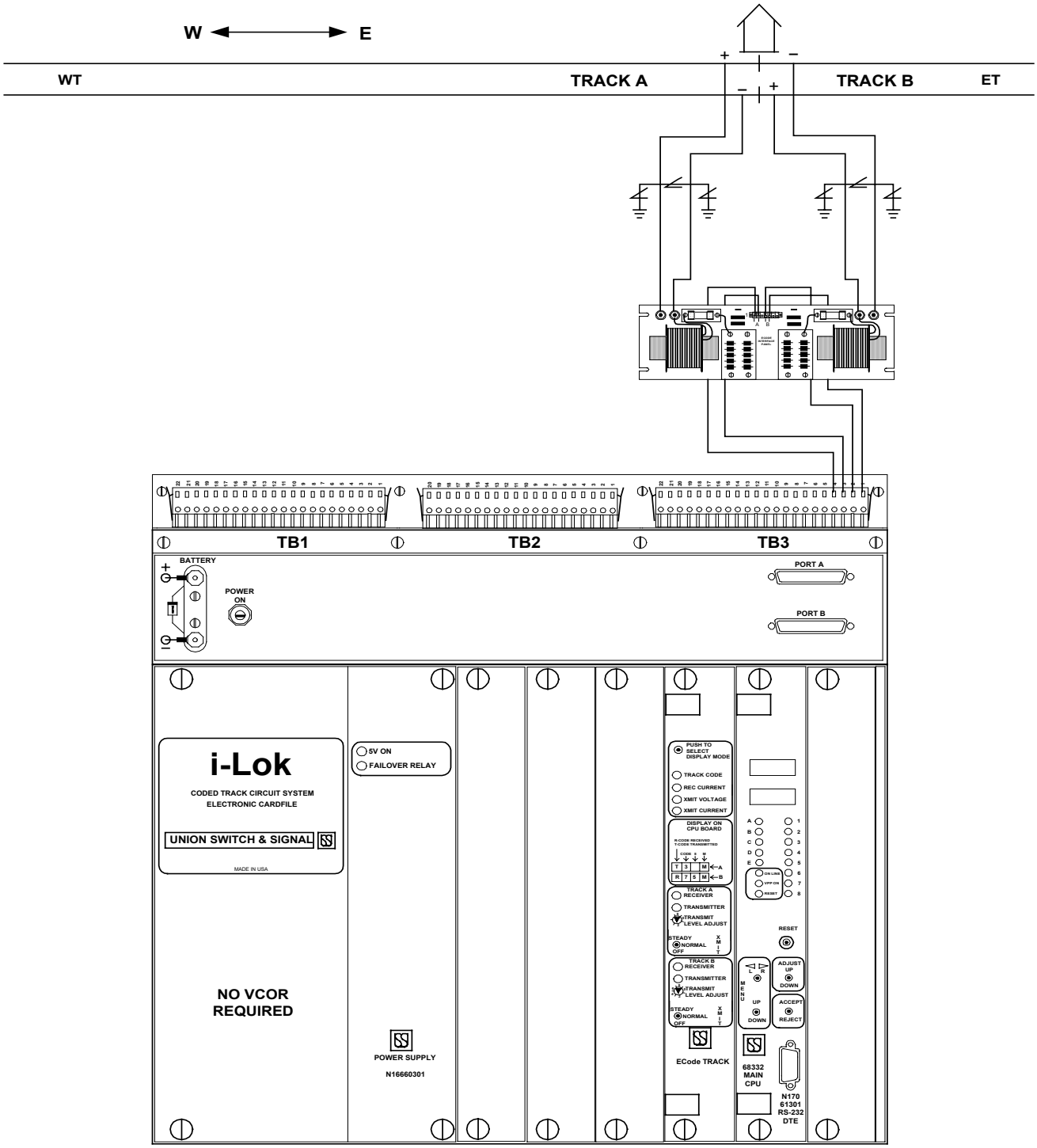
Isolated I/O and MICROTRAX Coded Track Circuit Boards with Wago Connectors



Non-Isolated I/O and ECode Coded Track Circuit Boards with Buchanan Connectors



i-Lok Repeater with MICROTRAX Coded Track Circuit Board and Buchanan Connectors



i-Lok Repeater with ECode Coded Track Circuit Board and Wago Connectors

3.5.4 MICROLOK II Compatibility

All of the I/O boards that are used within the i-Lok cardfile, can be used with the MICROLOK II cardfile. The Power Supply module and the CPU module in the i-Lok cardfile are the same modules that are used in the MICROLOK II cardfile. The wiring connections for all of the boards that are used in the i-Lok cardfile will be different when used in a MICROLOK II cardfile. Refer to SM-6800B for the correct wiring practices of a MICROLOK II cardfile. Note that in a MICROLOK II cardfile, boards can be used in any slot, unlike i-Lok cardfiles where slots are dedicated for specific boards.

3.6 i-Lok Circuit Board Connections

Summary:

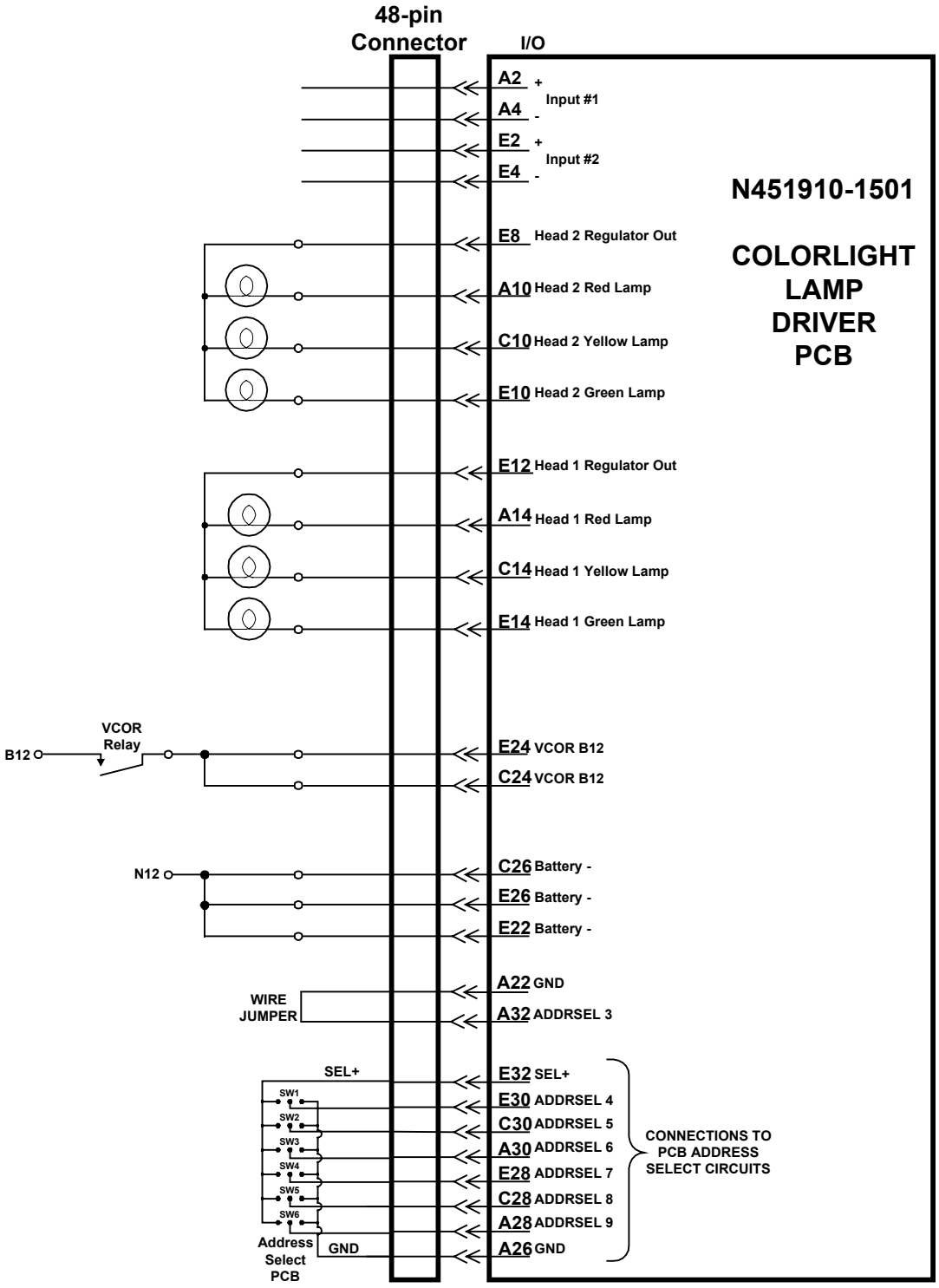
Section 2.4 in Chapter 2 of SM-6800B describes and illustrates circuit board connections to external circuits. A new subsection will be added to illustrate the i-Lok circuit board connections. (Preliminary versions of diagrams are presented in the following pages.)

3.6.1 Color Light Lamp Driver PCBs

The Color Light Lamp Driver board supports two three-aspect signal heads with lamps between 18 and 25 watts. The lamp driver is regulated B12 which is fed through a contact of the VCOR. Screw adjustment for setting lamp voltage for each head is built onto the board, do not use any external dropping resistors in the lamp circuit.

The Color Light Lamp Driver board has two isolated (double-break) inputs available that are defined in the application.

Vital Color Light Lamp Driver Printed Circuit Board				
Lamp Specifications				
US&S Part No.	**Signal Lamp Voltage Range**	**Max. Battery Voltage**	**Signal Lamp Wattage Range**	**Number of Signals**
N451910-1501	From 8.5V to Battery -1Volt	16.2V	18W - 25W	6 Lamps, Comprised of 2 Heads with 3 signals per Head
Input Specifications				
US&S Part No.	**Nom. Input Voltage**	**Min. Voltage to Ensure ON State**	**Voltage to Ensure OFF State**	**Max. Sustained Input Voltage**
N451910-1501	12V	9.5V	7.0V or less	16.2V

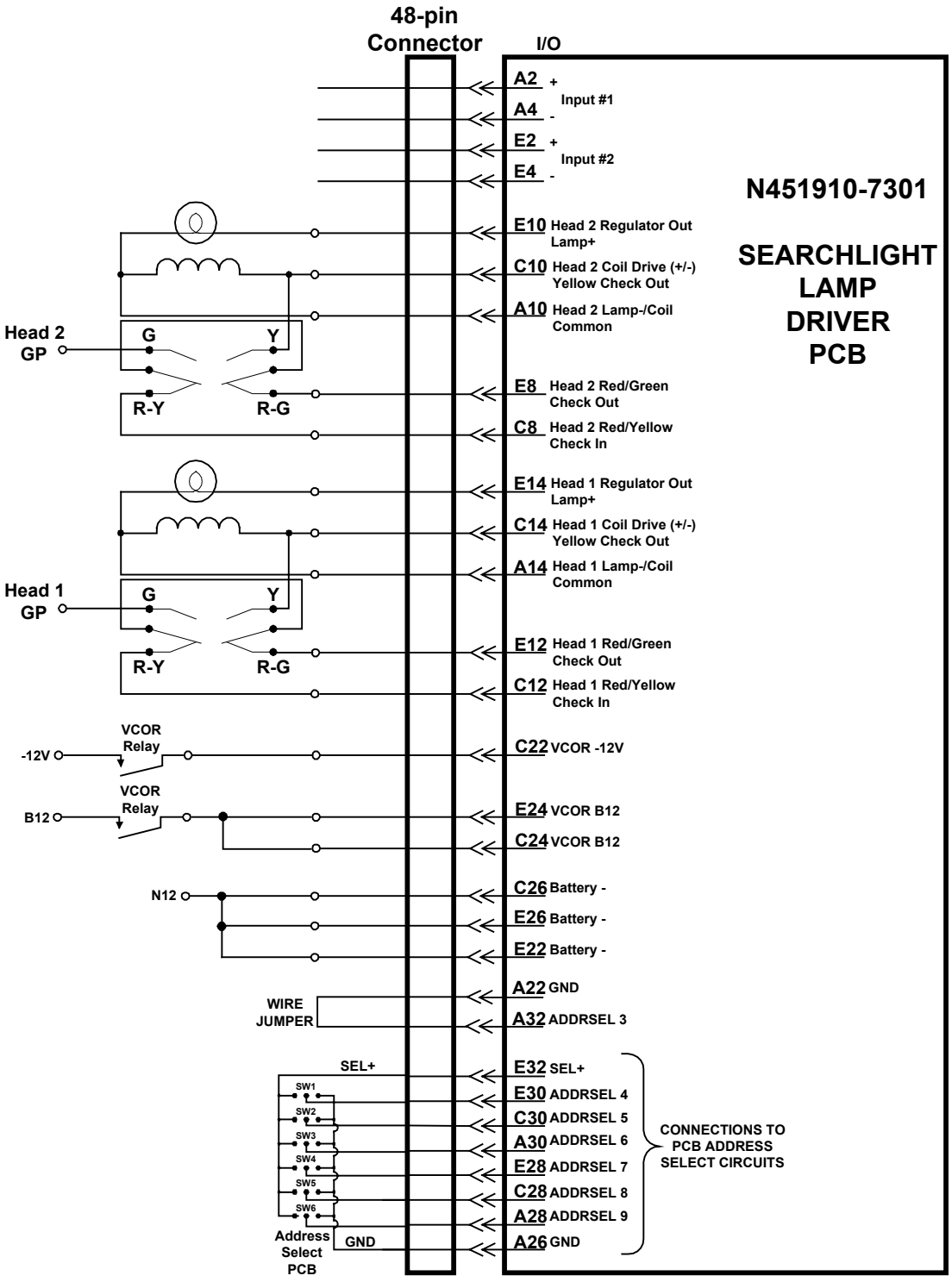

48-pin
Connector
I/O
A2 +
A4 -
Input #1
E2 +
E4 -
Input #2
N451910-1501
COLORLIGHT
LAMP
DRIVER
PCB
E8 Head 2 Regulator Out
A10 Head 2 Red Lamp
C10 Head 2 Yellow Lamp
E10 Head 2 Green Lamp
E12 Head 1 Regulator Out
A14 Head 1 Red Lamp
C14 Head 1 Yellow Lamp
E14 Head 1 Green Lamp
VCOR
Relay
B12
E24 VCOR B12
C24 VCOR B12
N12
C26 Battery -
E26 Battery -
E22 Battery -
A22 GND
WIRE
JUMPER
A32 ADDRSEL 3
SEL+
E32 SEL+
SW1
SW2
SW3
SW4
SW5
SW6
E30 ADDRSEL 4
C30 ADDRSEL 5
A30 ADDRSEL 6
E28 ADDRSEL 7
C28 ADDRSEL 8
A28 ADDRSEL 9
CONNECTIONS TO
PCB ADDRESS
SELECT CIRCUITS
Address
Select
PCB
GND
A26 GND

3.6.2 Searchlight Lamp Driver PCBs

The Searchlight Lamp Driver board supports two search light mechanisms. Each signal can drive a lamp rated between 18 and 25 watts. The lamp driver is regulated B12 which is fed through a contact of the VCOR. Screw adjustment for setting lamp voltage for each head is built onto the board, do not use any external dropping resistors in the lamp circuit. The wiring to the signal heads includes stuck mechanism checks circuits for the red, yellow and green positions. Red and yellow repeater circuits are wired through the 48 way connector on the back of the board. The green repeater circuit comes onto the board through two screw connections on the front panel of the Searchlight board.

The Searchlight Lamp Driver board has two isolated (double-break) inputs available which are defined in the application.

Vital Searchlight Lamp Driver Printed Circuit Board				
Lamp Specifications				
US&S Part No.	**Signal Lamp Voltage Range**	**Max. Battery Voltage**	**Signal Lamp Wattage Range**	**Number of Signals**
N451910-7301	From 8.5V to Battery -1 Volt	16.2V	18W - 25W	2 Lamps, Comprised of 2 Heads with 3 aspects per Head
Input Specifications				
US&S Part No.	**Nom. Input Voltage**	**Min. Voltage to Ensure ON State**	**Voltage to Ensure OFF State**	**Max. Sustained Input Voltage**
N451910-1501	12V	9.5V	7.0V or less	16.2V

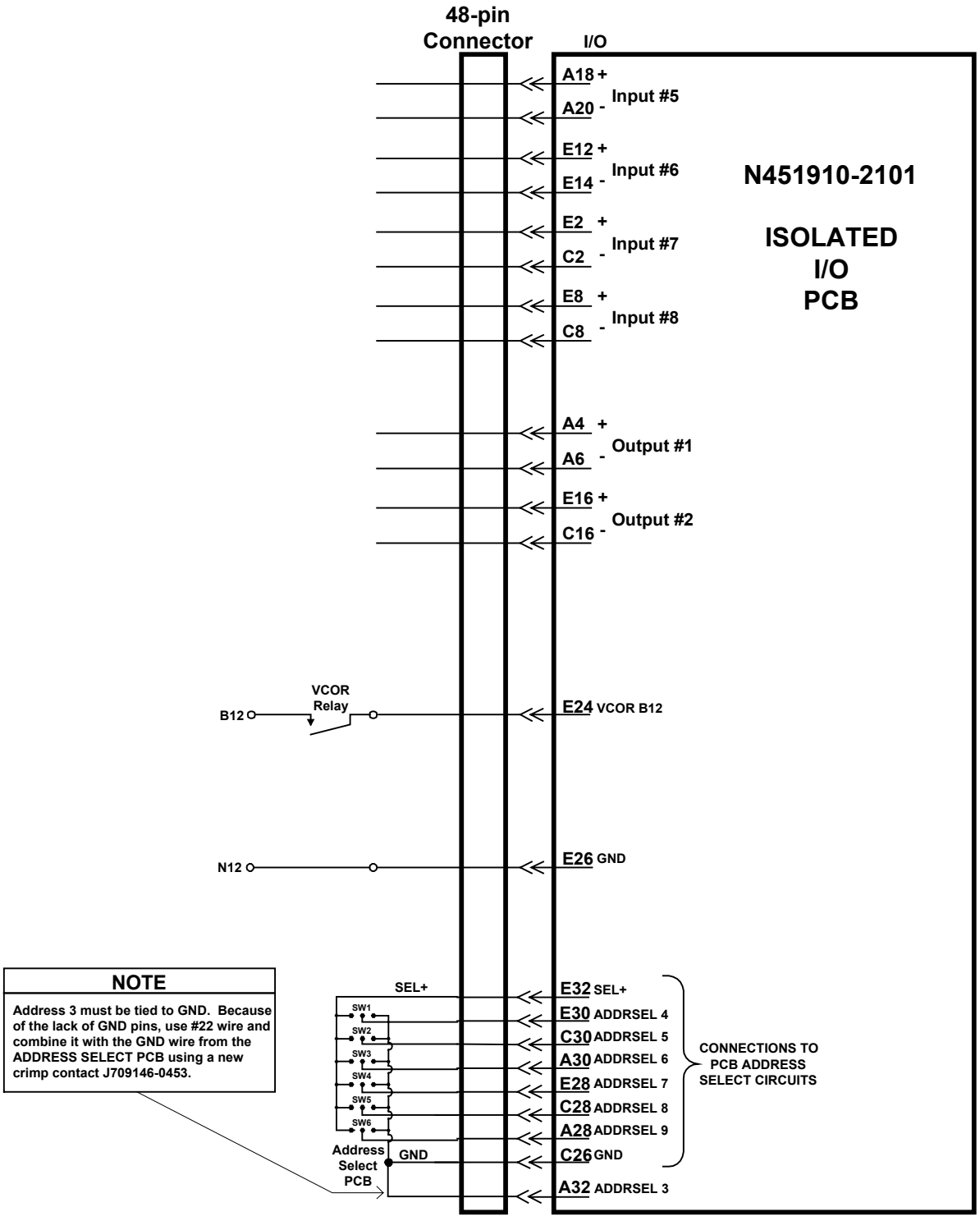

48-pin
Connector
I/O
A2 +
A4 -
Input #1
E2 +
E4 -
Input #2
N451910-7301
SEARCHLIGHT
LAMP
DRIVER
PCB
E10 Head 2 Regulator Out
Lamp+
C10 Head 2 Coil Drive (+/-)
Yellow Check Out
A10 Head 2 Lamp-/Coil
Common
Head 2
GP
G
Y
R-Y
R-G
E8 Head 2 Red/Green
Check Out
C8 Head 2 Red/Yellow
Check In
E14 Head 1 Regulator Out
Lamp+
C14 Head 1 Coil Drive (+/-)
Yellow Check Out
A14 Head 1 Lamp-/Coil
Common
Head 1
GP
G
Y
R-Y
R-G
E12 Head 1 Red/Green
Check Out
C12 Head 1 Red/Yellow
Check In
VCOR
Relay
-12V
C22 VCOR -12V
VCOR
Relay
B12
E24 VCOR B12
C24 VCOR B12
N12
C26 Battery -
E26 Battery -
E22 Battery -
A22 GND
WIRE
JUMPER
A32 ADDRSEL 3
SEL+
E32 SEL+
SW1
SW2
SW3
SW4
SW5
SW6
E30 ADDRSEL 4
C30 ADDRSEL 5
A30 ADDRSEL 6
E28 ADDRSEL 7
C28 ADDRSEL 8
A28 ADDRSEL 9
CONNECTIONS TO
PCB ADDRESS
SELECT CIRCUITS
Address
Select
PCB
GND
A26 GND

3.6.3 Isolated I/O PCBs

The Isolated I/O board contains four (4) isolated inputs and two (2) isolated outputs. These inputs and outputs are intended for all logic circuits that run outside the case/house containing the system. They are isolated from system battery (B12 and N12) and are based on standard double break circuits for external I/O circuits.

Typically the Isolated I/O board is used for switch lock applications but may be applied to any application needing double break circuit control.

Vital IN4.OUT2.ISO I/O Printed Circuit Boards				
Input Specifications				
US&S Part No.	**Nom. Input Voltage**	**Min. Voltage to Ensure ON State**	**Voltage to Ensure OFF State**	**Max. Sustained Input Voltage**
N451910-2101	12V	9.5V	7.0V or less	16.2V
Output Specifications				
US&S Part No.	**Voltage V_{BATT} Range**	**Load Resistance Range**	**Max. OFF Voltage**	**Min. ON Voltage (V_{BATT} 12V)**
N451910-2101	9.8 - 16.2V	240 Ω	0.75V	15V
		500 Ω	0.75V	20V
		750 Ω	0.75V	23V
		1000 Ω	0.75V	24V

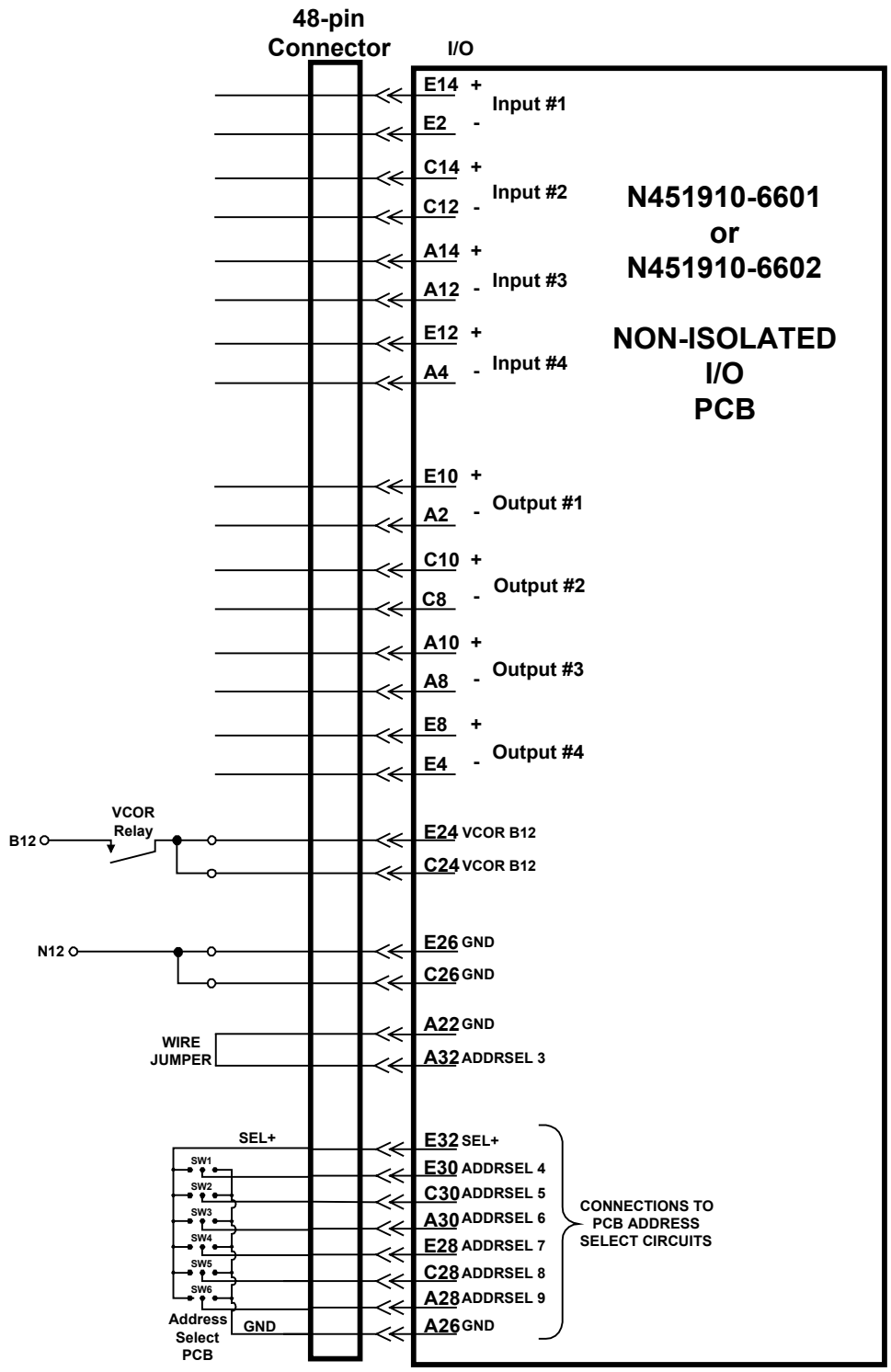

48-pin
Connector
I/O
A18 +
A20 -
Input #5
E12 +
E14 -
Input #6
E2 +
C2 -
Input #7
E8 +
C8 -
Input #8
N451910-2101
ISOLATED
I/O
PCB
A4 +
A6 -
Output #1
E16 +
C16 -
Output #2
VCOR
Relay
B12
E24 VCOR B12
N12
E26 GND
NOTE
Address 3 must be tied to GND. Because of the lack of GND pins, use #22 wire and combine it with the GND wire from the ADDRESS SELECT PCB using a new crimp contact J709146-0453.
SEL+
SW1
SW2
SW3
SW4
SW5
SW6
Address
Select
PCB
GND
E32 SEL+
E30 ADDRSEL 4
C30 ADDRSEL 5
A30 ADDRSEL 6
E28 ADDRSEL 7
C28 ADDRSEL 8
A28 ADDRSEL 9
C26 GND
CONNECTIONS TO
PCB ADDRESS
SELECT CIRCUITS
A32 ADDRSEL 3

3.6.4 Non-Isolated I/O PCBs

The Non Isolated I/O board contains four (4) inputs and four (4) outputs. Since these boards are not isolated from the local battery (B12/N12), they should only be used for I/O circuits that share the same equipment/house as the MICROLOK II or i-Lok system battery. The typical application of the Non-Isolated I/O is to interface to a relay-based interlocking control system at an end point location. Inputs from battery are routed directly through external relay contacts. Outputs switch a battery source which is fed through a contact of the VCOR.

The 4 inputs and 4 outputs on this board are not limited to any specific application. They may be used for any type of external logic as defined in the application.

Vital IN4.OUT4 I/O Printed Circuit Boards				
Input Specifications				
US&S Part No.	**Nom. Input Voltage**	**Min. Voltage to Ensure ON State**	**Voltage to Ensure OFF State**	**Max. Sustained Input Voltage**
N451910-6601	12V	9.5V	7.0V or less	16.2V
N451910-6602	12V	9.5V	7.0V or less	16.2V
Output Specifications				
US&S Part No.	**Voltage V_{BATT} Range**	**Load Resistance Range**	**Max. OFF Voltage**	**Min. ON Voltage**
N451910-6601	12V	65 Ω - ∞	0.75V	11.5V
N451910-6602	24V	130 Ω - ∞	1.5V	23.5V

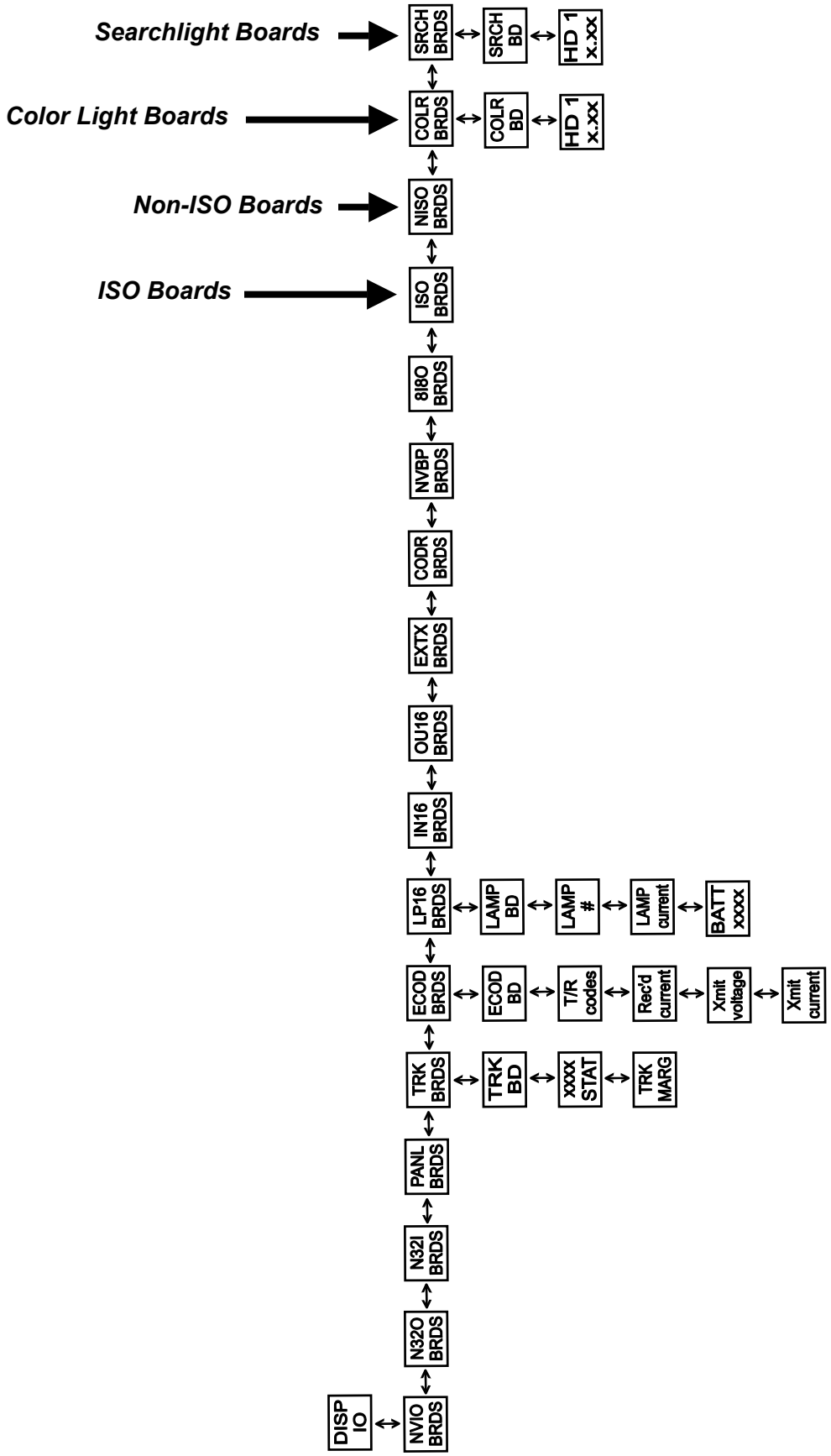

48-pin Connector
I/O
E14 +
Input #1
E2 -
C14 +
Input #2
C12 -
A14 +
Input #3
A12 -
E12 +
Input #4
A4 -
N451910-6601
or
N451910-6602
NON-ISOLATED
I/O
PCB
E10 +
Output #1
A2 -
C10 +
Output #2
C8 -
A10 +
Output #3
A8 -
E8 +
Output #4
E4 -
VCOR
Relay
B12
E24 VCOR B12
C24 VCOR B12
N12
E26 GND
C26 GND
WIRE
JUMPER
A22 GND
A32 ADDRSEL 3
SEL+
E32 SEL+
SW1
SW2
SW3
SW4
SW5
SW6
E30 ADDRSEL 4
C30 ADDRSEL 5
A30 ADDRSEL 6
E28 ADDRSEL 7
C28 ADDRSEL 8
A28 ADDRSEL 9
Address
Select
PCB
GND
A26 GND
CONNECTIONS TO
PCB ADDRESS
SELECT CIRCUITS

3.7 Navigating the Online I/O Menu

Summary:

Subsection 3.4.4 in Chapter 3 of SM-6800C describes how users can assess the status of the circuit boards installed in the MICROLOK II cardfile. Four additional lower-level subsections will be added to describe how users can assess status information for the new i-Lok boards. (Preliminary versions of the descriptions are presented in the following pages.)

The illustration on the next page highlights the i-Lok selections for the On-line Menu:


Searchlight Boards
Color Light Boards
Non-ISO Boards
ISO Boards
SRCH BRDS
SRCH BD
HD 1 x.xx
COLR BRDS
COLR BD
HD 1 x.xx
NISO BRDS
ISO BRDS
8I8O BRDS
NVBP BRDS
CODR BRDS
EXTX BRDS
OU16 BRDS
IN16 BRDS
LP16 BRDS
LAMP BD
LAMP #
LAMP current
BATT xxxx
ECOD BRDS
ECOD BD
T/R codes
Rec'd current
Xmit voltage
Xmit current
TRK BRDS
TRK BD
xxxx STAT
TRK MARG
PANL BRDS
N32I BRDS
N32O BRDS
DISP IO
NVIO BRDS

3.7.1 Color Light/Searchlight Lamp Driver Boards

The first step is to navigate the MICROLOK II menu structure to get to the **COLR|BRDS** or **SRCH|BRDS** display (depending on which board is installed). Beginning with the CPU displays in the normal start-up "scrolling" mode:

1. Toggle the MENU UP/DOWN Switch until the **SYS**tem **C**o**NF**ig display is reached.

2. Toggle the MENU L/R Switch until the **DISP**lay **IO** display is reached.

3. Toggle the MENU UP/DOWN Switch until the **NVIO BRDS** display is reached. When used in an i-Lok cardfile, only the four boards listed in the following sub-sections and a track board will be displayed.

4. Toggle the MENU L/R Switch until either the **COLR BRDS** or **SRCH BRDS** display is reached.

At this point, proceed to the desired I/O board subsection below.

3.7.1.1 Color Light Lamp Driver Board

The COLoR BoaRDS option enables you to view the signal lamp currents associated with each head of the Color Light Lamp Driver board. Use the following procedure to select a Color Light Lamp Driver board and view the available data:

1. With **COLR|BRDS** showing on the CPU board displays, toggle the MENU UP-DOWN switch to the DOWN position.

2. The CPU board displays will show **COLR|BD#**, indicating the selection of one of the installed Color Light Lamp Driver boards.

3. To change the Color Light Lamp Driver board selection, toggle the MENU L-R switch as necessary until the desired board number is indicated in the lower display.

4. Toggle the MENU UP-DOWN switch to the DOWN position. The CPU displays will show **HD 1** (default - HEAD "1") in the upper display and the current of the "ON" lamp in the lower display.

5. To change the head being displayed, toggle the MENU L-R switch. This will toggle the display between the "1" and "2" heads.

6. To return to the **COLR|BD#**, to select another board, toggle the MENU UP-DOWN switch to the UP position. Repeat steps 2 - 4.

7. To return to the **COLR|BRDS** option from the **COLR|BD#** option, toggle the MENU UP-DOWN switch to the UP position.

3.7.1.2 Searchlight Lamp Driver Board

The SeaRCH BoaRDS option enables you to view the signal lamp currents associated with each head of the Searchlight Lamp Driver board. Use the following procedure to select a Searchlight Lamp Driver board and view the available data:

1. With **SRCH|BRDS** showing on the CPU board displays, toggle the MENU UP-DOWN switch to the DOWN position.

2. The CPU board displays will show **SRCH|BD#**, indicating the selection of one of the installed Searchlight Lamp Driver boards.

3. To change the Searchlight Lamp Driver board selection, toggle the MENU L-R switch as necessary until the desired board number is indicated in the lower display.

4. Toggle the MENU UP-DOWN switch to the DOWN position. The CPU displays will show **HD 1** (default - HEAD "1") in the upper display and the current of the "ON" lamp in the lower display.

5. To change the head being displayed, toggle the MENU L-R switch. This will toggle the display between the "1" and "2" heads.

6. To return to the **SRCH|BD#**, to select another board, toggle the MENU UP-DOWN switch to the UP position. Repeat steps 2 - 4.

7. To return to the **SRCH|BRDS** option from the **SRCH|BD#** option, toggle the MENU UP-DOWN switch to the UP position.

3.7.2 Isolated I/O Board

If there is at least one enable Isolated I/O board installed in the MICROLOK II cardfile, the CPU board displays will show **ISO|BRDS** when the option is selected. This option provides no control or indication functions. MENU UP, MENU L, and MENU R are the only available toggle switch operations for this menu function.

3.7.3 Non-Isolated I/O Board

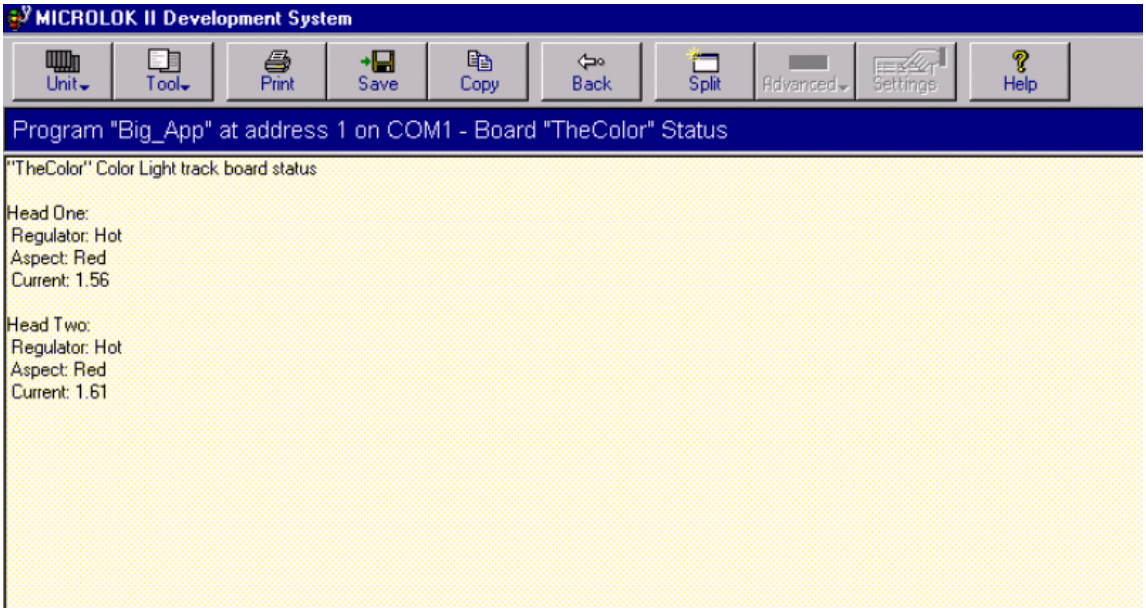
If there is at least one enable Non-Isolated I/O board installed in the MICROLOK II cardfile, the CPU board displays will show **NISO|BRDS** when the option is selected. This option provides no control or indication functions. MENU UP, MENU L, and MENU R are the only available toggle switch operations for this menu function.

3.8 Viewing i-Lok Circuit Board Status

Summary:

Section 4.5 in Chapter 4 of SM-6800C details how a user can view circuit board status displays. Two new subsections will be added to describe how a user can view i-Lok circuit board status displays. (Preliminary versions of the descriptions are presented below).

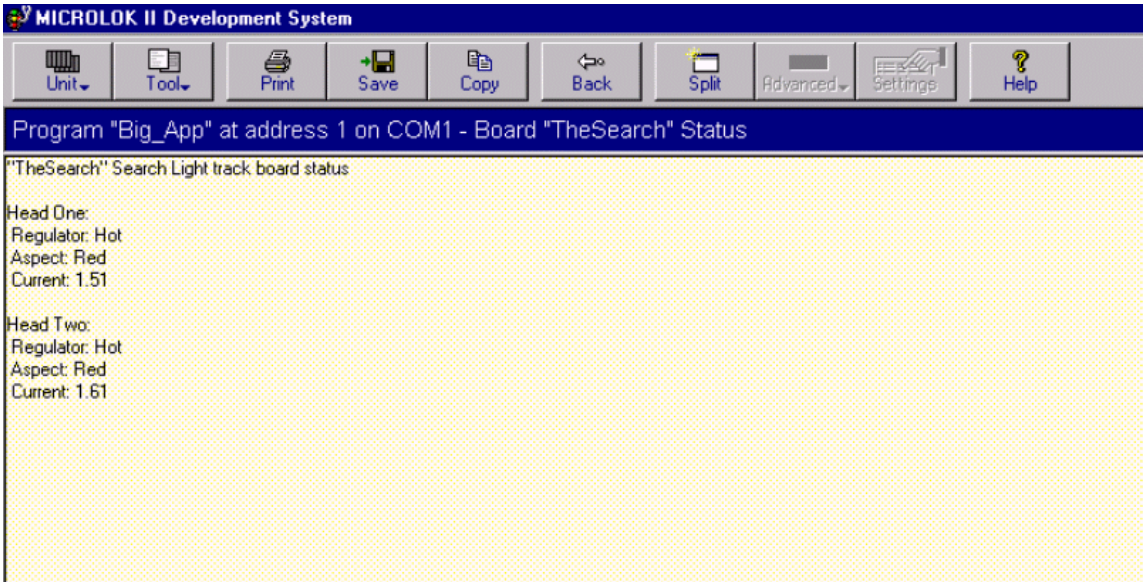
3.8.1 Viewing the Color Light Lamp Driver Board Status



Status Screen for the Color Light Lamp Driver Board

The easiest way to display the status of the Color Light Lamp Driver board is to call up the MICROLOK II Development System. After the Development System has been started, click on the Board Information button. Click on the Color.Light button to display the information for that board. On this screen you will see information displayed for Head 1 and Head 2, as shown in the figure above. For each head, the display will let you know if the lamp is hot or cold, which aspect is selected, and the lamp current. Note that all of the information on this screen is dynamically updated.

3.8.2 Viewing the Searchlight Lamp Driver Board Status



Status Screen for the Searchlight Lamp Driver Board

The easiest way to display the status of the Searchlight Lamp Driver board is to call up the MICROLOK II Development System. After the Development System has been started, click on the Board Information button. Click on the Search.Light button to display the information for that board. On this screen you will see information displayed for Head 1 and Head 2, as shown in the figure above. For each head, the display will let you know if the lamp is hot or cold, which aspect is selected, and the lamp current. Note that all of the information on this screen is dynamically updated.

3.9 Configuring i-Lok Circuit Boards

Summary:

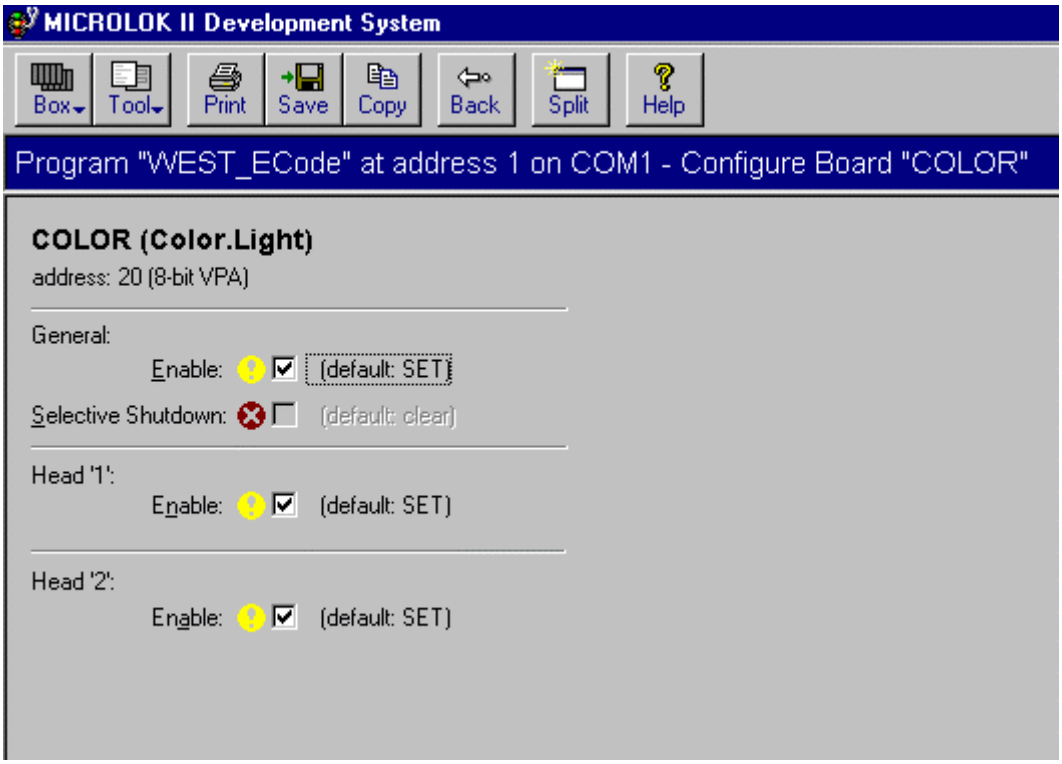
Section 6.2 in Chapter 6 of SM-6800C describes system configuration processes. Several additional subsections will be added to describe the configuration of i-Lok circuit boards. (Preliminary versions of the descriptions are presented below).

3.9.1 Color Light and Searchlight Lamp Driver Boards

3.9.1.1 Configuring the Color Light Lamp Driver Board

To configure a Color Light Lamp Driver board, click on one of the Color.Light selection buttons on the system configuration selection screen. A dialog box similar to the one shown on the following page will appear.

The only configurable option for the Color Light Lamp Driver board is the "Enable" option. This option is available for the board, Head 1, and Head 2. ("Selective Shutdown" is not yet implemented and will remain disabled.) "Enable" is user-configurable through the Development System program only if it is identified as an adjustable parameter in the application software.



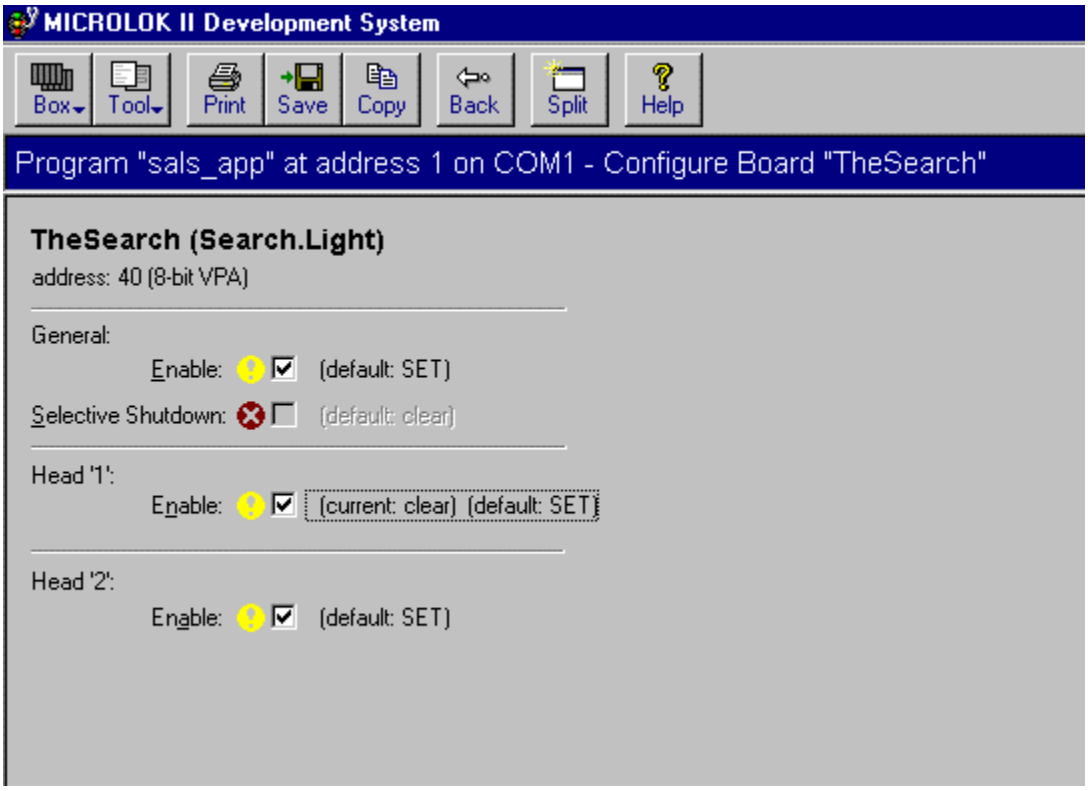
The Color.Light Configuration Screen

3.9.1.2 Configuring the Searchlight Lamp Driver Board

To configure a Searchlight Lamp Driver board, click on one of the Search.Light selection buttons on the system configuration selection screen. A dialog box similar to the one shown on the following page will appear.

The only configurable option for the Searchlight Lamp Driver board is the "Enable" option. This option is available for the board, Head 1, and Head 2. ("Selective Shutdown" is not yet implemented

and will remain disabled.) "Enable" is user-configurable through the Development System program only if it is identified as an adjustable parameter in the application software.



The Search.Light Configuration Screen

3.9.1.3 Color Light and Searchlight Lamp Driver Boards Signal Lamp Adjustment

3.9.1.3.1 General Considerations for Signal Lamp Adjustment

Note: To avoid high in-rush currents, it is good practice to include in the application software an approximate one-second time delay before turning on opposing signals.

MICROLOK systems allow adjustment of signal lamp voltage at the cardfile. This is done with small potentiometers on the front panel of the Color Light Lamp Driver and Searchlight Lamp Driver Modules, in conjunction with an adjustment program run and displayed on the CPU Module. Dropping resistors in the signal assembly are not required. With proper adjustment, signal lamp filament life is maximized without significant reduction of lamp intensity.

The figure that follows shows the relationship between lamp voltage, current, candlepower, and bulb-life for 18- and 25-watt lamps. During the CPU adjustment procedure, the CPU alphanumeric display shows current. To obtain the equivalent lamp voltage, translate this to voltage shown in the figure. For example, to adjust lamp voltage adjustment to 9.0 volts, note the following on the graph:

18W lamps: Corresponding current = 1.7 A

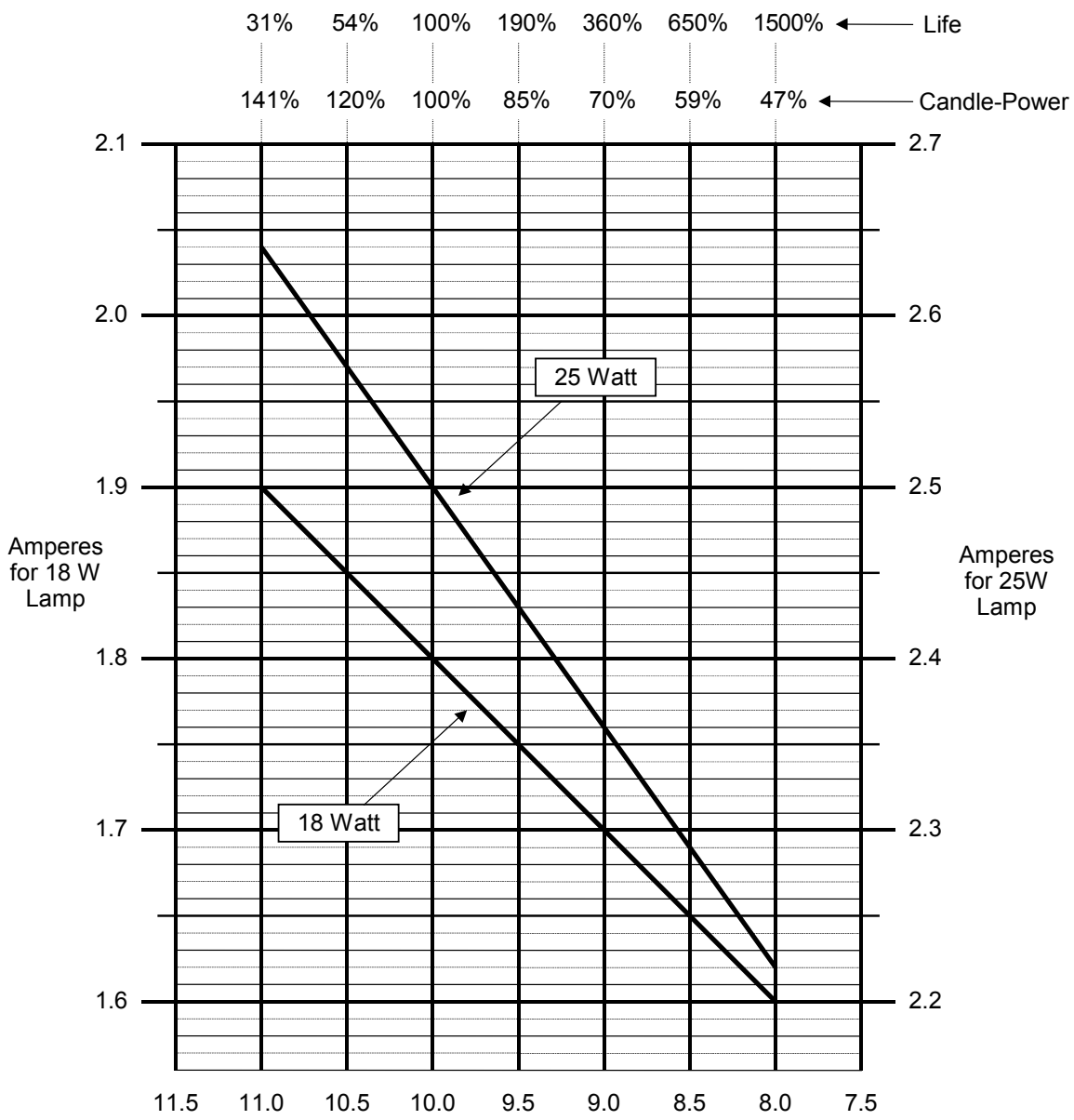
25W lamps: Corresponding current = 2.35 A

Projecting the 9.0 volt line upwards shows candle power of 70% and bulb life 3.6 times greater than adjustment at 10 volts. Note that the projected current is indicative of voltage across the bulb at the signal head and is independent of line drop. There will be some voltage variation due to variations in bulb manufacturing tolerances. Light output is more consistent if current (rather than voltage) is the parameter of adjustment, especially with aging of bulbs. Maximum output of the regulated MICROTRAX source is one volt less than battery voltage. This places a limit on the line-drop that can be tolerated.

The table below shows the maximum line resistance which can be used to operate 18W lamps at 1.7A (9 volts) and 25W lamps at 2.35A (9 volts):

Min. Battery Voltage	Max. Resistance 18W	Max. Resistance 25W
10V	0.0 ohms	0.0 ohms
11V	0.59 ohms	0.42 ohms
12V	1.18 ohms	0.85 ohms
13V	1.76 ohms	1.28 ohms

Maximum Line Resistance for 18W and 25W Lamps


31%
54%
100%
190%
360%
650%
1500%
Life
141%
120%
100%
85%
70%
59%
47%
Candle-Power
2.1
2.0
1.9
1.8
1.7
1.6
2.7
2.6
2.5
2.4
2.3
2.2
25 Watt
18 Watt
Amperes for 18 W Lamp
Amperes for 25W Lamp
11.5
11.0
10.5
10.0
9.5
9.0
8.5
8.0
7.5
Lamp Voltage

3.9.1.3.2 Special Considerations for Searchlight Signals

When adjusting voltage for a searchlight signal, lamp current and mechanism coil current are measured together. With red aspect selected, the current is accurate. With a green aspect selected, the displayed current is lower than the actual lamp current by 0.04 amperes. With a yellow aspect, the current displayed is higher than the actual lamp current by 0.04 amperes. (Refer to the previous figure for desired lamp current and compensate reading as required.)

For example: For an 18W lamp and desired voltage of 9.0 volts, the corresponding current is 1.7 amps. If green is selected, set the current to 1.66 A. If yellow is selected, set the current to 1.74 A. These readings will accurately reflect 9.0 volts across the lamp.

3.9.1.3.3 Color Light/Searchlight Lamp Driver Board Adjustment Procedure

The first step is to navigate the MICROLOK II menu structure (described and illustrated in Chapter 3 of SM-6800C) to get to the COLR|BRDS or SRCH|BRDS display (depending on which board is installed). Beginning with the CPU displays in the normal startup “scrolling” mode:

1. Toggle the MENU UP/DOWN Switch until the "Sys Config" display is reached.

2. Toggle the MENU L/R Switch until the "DISPlay IO" display is reached.

3. Toggle the MENU UP/DOWN Switch until the "**NVIO BRDS**" display is reached.

4. Toggle the MENU L/R Switch until either the "**COLR BRDS**" or "**SRCH BRDS**" display is reached.

At this point, proceed to either the Color Light Lamp Driver Boards or Searchlight Lamp Driver Boards subsection below.

3.9.1.3.3.1 Color Light Lamp Driver Boards

The COLoR BoaRDS option enables you to view and adjust the signal lamp currents associated with each head of the Color Light Lamp Driver board.

1. With **COLR|BRDS** showing on the CPU board displays, toggle the MENU UP-DOWN switch to the DOWN position.

2. The CPU board displays will show "**COLR|BD#**," indicating the selection of one of the installed Color Light Lamp Driver boards.

3. To change the Color Light Lamp Driver board selection, toggle the MENU L-R switch as necessary until the desired board number is indicated in the lower display.

4. Toggle the MENU UP-DOWN switch to the DOWN position. The CPU displays will show "**HD 1**" (default - HEAD "1") in the upper display and the current of the "ON" lamp in the lower display.

5. To change the head being displayed, toggle the MENU L-R switch. This will toggle the display between the "1" and "2" heads.

6. After the proper head is displayed, adjust the lamp current by turning the appropriate potentiometer on the front of the appropriate Color Light Lamp Driver Board. The current indicated on the bottom CPU display will change with the adjustment of the potentiometer.

Adjustment is now completed for this head. Use the MENU toggle switches to select a different head (or any other menu function).

3.9.1.3.3.2 Searchlight Lamp Driver Boards

The SeaRCH BoaRDS option enables you to view and adjust the signal lamp currents associated with each head of the Searchlight Lamp Driver board.

1. With **SRCH|BRDS** showing on the CPU board displays, toggle the MENU UP-DOWN switch to the DOWN position.

2. The CPU board displays will show "**SRCH|BD#**," indicating the selection of one of the installed Searchlight Lamp Driver boards.

3. To change the Searchlight Lamp Driver board selection, toggle the MENU L-R switch as necessary until the desired board number is indicated in the lower display.

4. Toggle the MENU UP-DOWN switch to the DOWN position. The CPU displays will show "**HD 1**" (default - HEAD "1") in the upper display and the current of the "ON" lamp in the lower display.

5. To change the head being displayed, toggle the MENU L-R switch. This will toggle the display between the "1" and "2" heads.

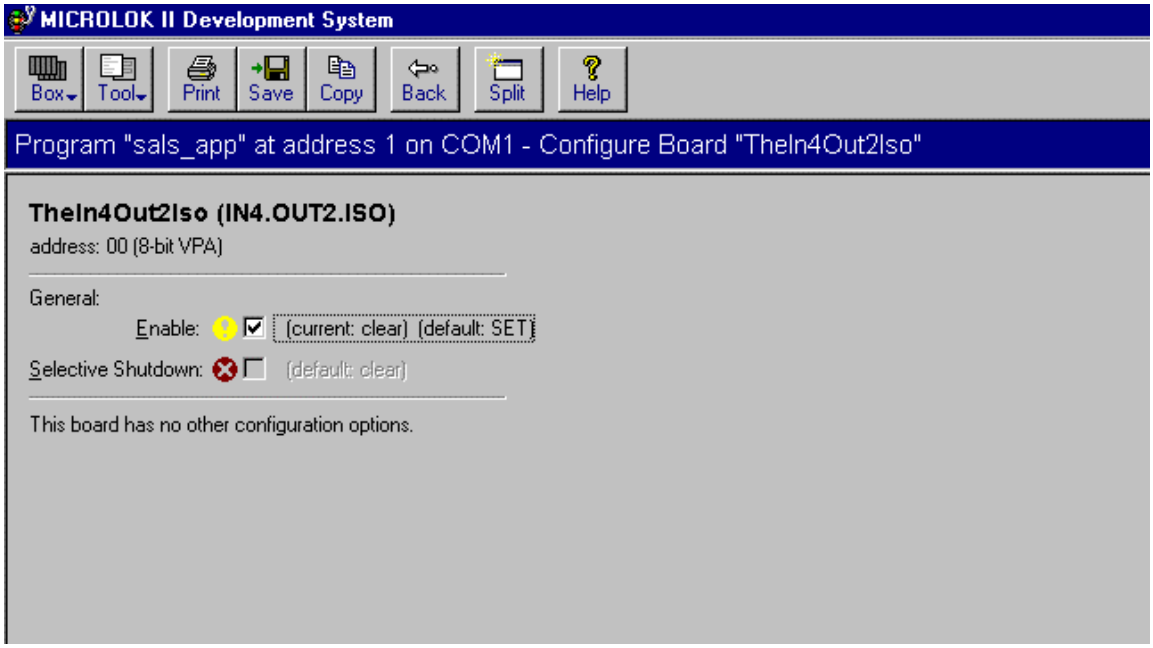
6. After the proper head is displayed, adjust the lamp current by turning the appropriate potentiometer on the front of the appropriate Searchlight Lamp Driver Board. The current indicated on the bottom CPU display will change with the adjustment of the potentiometer.

Adjustment is now completed for this head. Use the MENU toggle switches to select a different head (or any other menu function).

3.9.1.4 Configuring the Isolated I/O Board

To configure an isolated I/O board, click on one of the IN4.OUT2.ISO selection buttons on the system configuration selection screen. A dialog box similar to the one shown below will appear.

The only configurable option for the isolated I/O board is the "Enable" option. ("Selective Shutdown" is not yet implemented and will remain disabled.) "Enable" is user-configurable through the Development System program only if it is identified as an adjustable parameter in the application software.

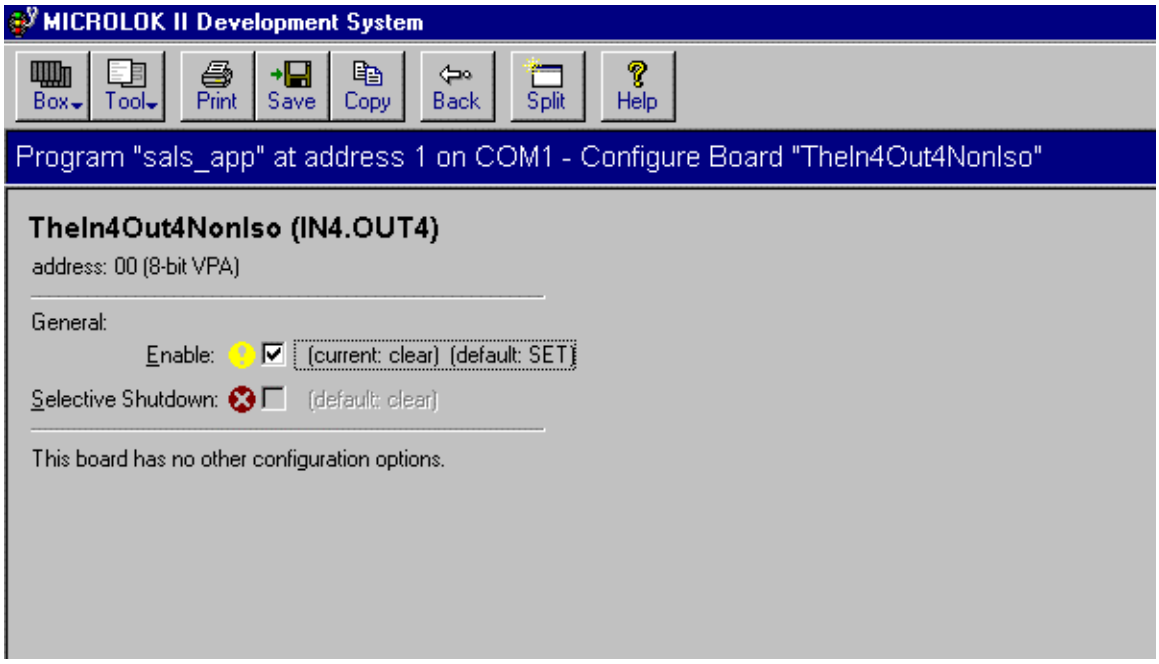


An Isolated I/O Board Configuration Screen

3.9.1.5 Configuring the Non-Isolated I/O Board

To configure a non-isolated I/O board, click on one of the IN4.OUT4 selection buttons on the system configuration selection screen. A dialog box similar to the one shown on the following page will appear.

The only configurable option for the non-isolated I/O board is the "Enable" option. ("Selective Shutdown" is not yet implemented and will remain disabled.) "Enable" is user-configurable through the Development System program only if it is identified as an adjustable parameter in the application software.



A Non-Isolated I/O Board Configuration Screen

3.10 Defining i-Lok I/O Boards

Summary:

Chapter 3 in SM-6800D describes the procedure for defining I/O Boards in a MICROLOK II Application. The interface section of a MICROLOK II program defines all of the local and serial I/O for the MICROLOK II card file. In the LOCAL subsection of the INTERFACE section, the physical I/O cards are defined. The information below describes how to define these i-Lok boards:

- Color Light lamp driver board
- Searchlight lamp driver board
- Isolated I/O board
- Non-Isolated I/O board

3.10.1 Color Light Lamp Driver Board

Board type COLOR.LIGHT

Address Class: 8 Bit VPA

A definition of this card looks like:

```
BOARD: <USER NAME>
[ADJUSTABLE | FIXED] ENABLE: <FLAG>

TYPE: COLOR.LIGHT

HEAD1
        [[ADJUSTABLE | FIXED] ENABLE: <flag>;]
        LAMP: <lamp bit>;
        ASPECT: <aspect bit list>;
        [LAMP.OUT: <lamp out bit list>;]                    (Read Only)

HEAD2
        [[ADJUSTABLE | FIXED] ENABLE: <flag>;]
        LAMP: <lamp bit>;
        ASPECT: <aspect bit list>;
        [LAMP.OUT: <lamp out bit list>;]                    (Read Only)

[INPUT: <input bit list>;]                                  (Read Only)
```

Both HEAD1 and HEAD2 portions of the board must be defined.

If an enable statement is not supplied for a half of the board, the head will be given a default configuration of FIXED ENABLE: 0.

The ASPECT statement defines between one and three aspects.

The LAMP.OUT statement may not define bits where there are no corresponding bits in the ASPECT statement. A bit can be defined as SPARE here to skip a corresponding aspect bit.

The INPUT statement can define a maximum of two bits.

The compiler defines the following bit for each color.light board defined:

<board name>.TEST.BIT (Read/Write)

3.10.2 Searchlight Lamp Driver Board

Board type SEARCH.LIGHT

Address Class: 8 Bit VPA

A definition of this card looks like:

```
BOARD: <USER NAME>
[ADJUSTABLE | FIXED] ENABLE: <FLAG>

TYPE: SEARCH.LIGHT

HEAD1
        [[ADJUSTABLE | FIXED] ENABLE: <flag>;]
        LAMP: <lamp bit>;
        ASPECT: <aspect bit list>;
        [LAMP.OUT: <lamp out bit>;]                    (Read Only)

HEAD2
        [[ADJUSTABLE | FIXED] ENABLE: <flag>;]
        LAMP: <lamp bit>;
        ASPECT: <aspect bit list>;
        [LAMP.OUT: <lamp out bit>;]                    (Read Only)

[INPUT: <input bit list>;]                             (Read Only)
```

Both HEAD1 and HEAD2 portions of the board must be defined.

If an enable statement is not supplied for a half of the board, the head will be given a default configuration of FIXED ENABLE: 0.

The ASPECT statement defines between one and three aspects.

The INPUT statement can define a maximum of two bits.

The compiler defines the following bit for each search.light board defined:

<board name>.TEST.BIT (Read/Write)

3.10.3 Isolated I/O Board

Board type IN4.OUT2.ISO

Address Class: 8 Bit VPA

A definition of this card looks like:

BOARD: <USER NAME>
[ADJUSTABLE | FIXED] ENABLE: <FLAG>

TYPE: IN4.OUT2.ISO
[OUTPUT: <output bit list>;]
[INPUT: <input bit list>;] (Read Only)

At least one of the INPUT or OUTPUT sections must be defined. If both sections are defined, the OUTPUT section must be defined before the INPUT section.

The INPUT statement can define a maximum of four bits.

The OUTPUT statement can define a maximum of two bits.

3.10.4 Non-Isolated I/O Board

Board type IN4.OUT4

Address Class: 8 Bit VPA

A definition of this card looks like:

BOARD: <USER NAME>
[ADJUSTABLE | FIXED] ENABLE: <FLAG>

TYPE: IN4.OUT4
[OUTPUT: <output bit list>;]
[INPUT: <input bit list>;] (Read Only)

At least one of the INPUT or OUTPUT sections must be defined. If both sections are defined, the OUTPUT section must be defined before the INPUT section.

The INPUT statement can define a maximum of four bits.

The OUTPUT statement can define a maximum of four bits.

4 Miscellaneous MICROLOK II Features

4.1 Configuration from the Reset Menu

Summary:

Chapter 3 in SM-6800C describes the navigation to and selection of menu options via the CPU board's front panel displays. Section 3.3 in SM-6800C, describes the options for the Reset Menu, which provides access to off-line administrative and diagnostic functions. "Reset Configuration" is a new selection on the Reset Menu. This selection lets users adjust the configuration of a Vital Lamp Driver board or a MICROTRAX Coded Circuit Track board.

4.1.1 Reconfiguring the Lamp Driver/MICROTRAX Board

This function allows you to adjust the configuration of lamp wattage on a Vital Lamp16 Driver board, or to adjust the track length on a MICROTRAX Coded Circuit Track board. The first step is to navigate the MICROLOK II Reset Menu structure (shown below) to get to the LAMP|ADJ or TRK|ADJ display (depending on which board is installed or needs to be configured). To enter the reset mode:

1. Press and release the RESET pushbutton on the CPU board front panel.

2. Quickly operate any one of the four front panel toggle switches. Hold the switch in the toggled position.

3. Release the toggle switch that was operated in step 2 after the CPU board four-character displays shows **RES|MENU**.

4. Toggle the MENU UP-DOWN switch to the DOWN position. The CPU board four-character displays will show **VIEW|SLOG**.

5. Toggle the MENU LEFT-RIGHT switch until the CPU board displays show **RES|CFG**.

6. Toggle the MENU UP-DOWN switch to the DOWN position. The CPU board four-character displays will show **BRD|CFG**.

7. Toggle the MENU UP-DOWN switch to the DOWN position. After performing some diagnostics the CPU board four-character displays will show **TRK|ADJ**.

At this point, proceed to either the Vital Lamp16 Driver Board or the MICROTRAX Coded Track Circuit Boards subsection.

4.1.1.1 Track Adjust Menu

NOTE:
The track adjust menu options are displayed only if there is at least one coded track circuit printed circuit board installed in the cardfile, as well as enabled and configured.

This function is used to configure the track lengths for the A and B track circuits associated with the MICROLOK II coded track circuit printed circuit boards. In order to be able to change the track length without the use of a laptop computer, the MICROLOK II unit must have at least one coded track circuit printed circuit board with at least one channel enabled for track length adjustment.

For security purposes, the track adjustments are enabled only if the track is enabled and the unit is not in default configuration mode. In addition, because these actions override the configuration information stored in the EEPROM, a special time-stamp marker is added to the EEPROM to mark that a field track adjustment was performed. Also, the previously loaded configuration must be correct and valid.

If the configuration had errors and the system bit CONFIG.ERR is set, the setting for the length of the track may not be chanced. Note that the MICROLOK II unit will be in an off-line mode while track adjustments are being made.

Use the following procedure to change the track length setting for a selected track circuit:

1. From **TRK|ADJ**, select DOWN once more. The CPU displays will show **TKxx|A yy**, where xx represents the board number and yy is the track length for Track A. The length may be incremented/decremented using the ADJUST UP-DOWN switch. To accept the length of Track A, toggle the ACCEPT-REJECT switch to ACCEPT.

2. After you have accepted the Track A data, the CPU display will show **TKxx|B yy**, where xx represents the board number and yy is the track length for Track B. The length may be incremented/decremented using the ADJUST UP-DOWN switch. To accept the length of Track B, toggle the ACCEPT-REJECT switch to ACCEPT.

3. Accepting the Track B length will take you to the **VER|ADJ** option. Toggle the UP-DOWN switch DOWN to display the track data for verification.

4. The CPU displays will now show the Track A configuration in the form **A yy|TKxx**. To accept the Track A data, toggle the ACCEPT-REJECT switch to ACCEPT.

5. After the Track A data has been accepted, the CPU displays show the Track B configuration in the form **B yy|TKxx**. To accept the Track B data, toggle the ACCEPT-REJECT switch to ACCEPT.

6. After you have verified the track data, the CPU displays will show **SAVE|ADJ?**. To save these track lengths, toggle the ACCEPT-REJECT switch to ACCEPT. The CPU displays will now show **TRK|DONE**. Toggling any switch on the CPU front panel will return you back to the **TRK|ADJ** option.

4.1.1.2 Lamp Adjust Menu

NOTE:
The lamp adjust menu options are displayed only if there is at least one lamp driver printed circuit board installed in the cardfile, as well as enabled and configured.

Signal lamp wattages are normally specified in the application PROM. There are situations, however, when it may be necessary to change these settings in the field. Because the use of a laptop computer for this operation may not always be practical, the adjustments can be made using the toggle switches and displays on the MICROLOK II CPU board front panel.

In order to change the lamp wattages, the unit must have at least one enabled vital lamp driver PCB and at least one enabled lamp wattage. Because making adjustments to the lamp settings alters the stored configuration in the E2PROM, the previously loaded configuration must be correct and valid. If the configuration contained errors and the system bit CONFIG.ERR is set, the wattage of the lamp cannot be changed. It should be noted that the MICROLOK II unit will be in a non-operational mode while lamp adjustments are being made.

Use the following procedure to change the wattage settings for a selected vital lamp driver PCB:

1. From the **TRK|ADJ** option, toggle the MENU L-R switch to go to the **LAMP|ADJ** option.

2. From **LAMP|ADJ,** toggle the MENU UP-DOWN switch to the DOWN position. The CPU displays will show **LAMP|MODE**. By using the ACCEPT-REJECT toggle switch to ACCEPT this mode, the system will run the LAMP boards in a reduced diagnostic mode for 15 minutes to allow lamp adjustments without causing events/warnings/errors to be logged.

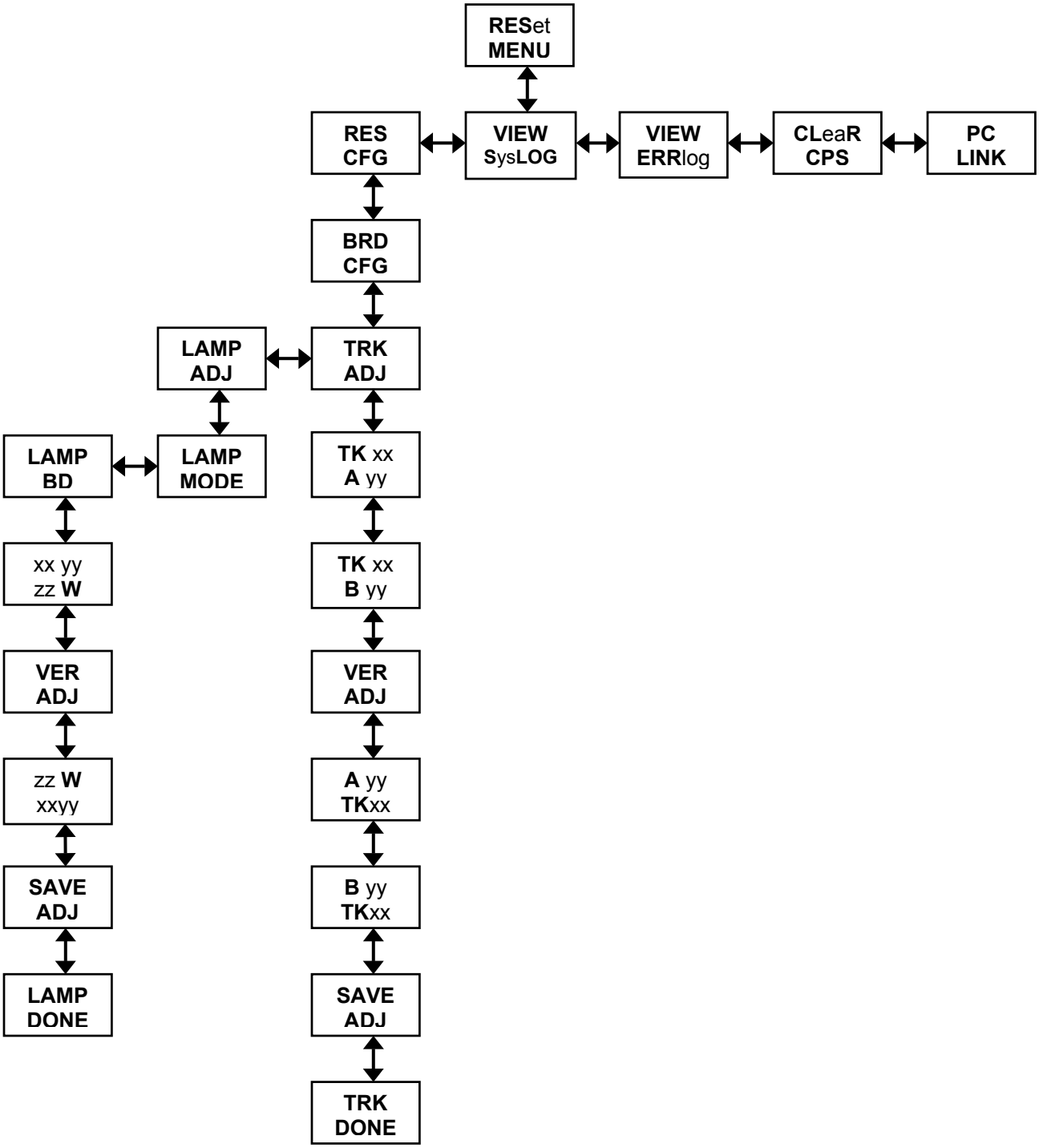
3. From the **LAMP|MODE** display, toggle the MENU L-R switch LEFT to go to the **LAMP|BD** option.

4. From the **LAMP|BD** option, toggle the UP-DOWN switch to the DOWN position to display **xxyy|zz W**, where xxyy represents the lamp number (1-16) and zz is the lamp wattage. Use the MENU L-R switch to step through each of the lamps. Use the ADJUST UP-DOWN switch to adjust the wattage values. To accept the lamp wattage values, toggle the ACCEPT-REJECT switch to ACCEPT.

5. Accepting the wattages will take you to the **VER|ADJ** option. Toggle the UP-DOWN switch to DOWN to display the lamp data for verification.

6. The CPU displays will now show the Lamp Configuration in the form **zz W|xxyy**. Use the MENU L-R switch to step through each of the lamps. Toggle the ACCEPT-REJECT switch to ACCEPT the lamp data.

7. After you have verified the lamp data, the CPU displays will show **SAVE|ADJ**. To save these lamp wattages, toggle the ACCEPT-REJECT switch to ACCEPT. The CPU front panel displays will now show **LAMP|DONE**. Toggling any switch on the CPU front panel will return you back to the **LAMP|ADJ** option.


RESet
MENU
RES
CFG
VIEW
SysLOG
VIEW
ERRlog
CLeaR
CPS
PC
LINK
BRD
CFG
LAMP
ADJ
TRK
ADJ
LAMP
BD
LAMP
MODE
TK xx
A yy
xx yy
zz W
TK xx
B yy
VER
ADJ
VER
ADJ
zz W
xxyy
A yy
TKxx
SAVE
ADJ
B yy
TKxx
LAMP
DONE
SAVE
ADJ
TRK
DONE

4.2 Accessing the Serial Test Selection Features

Summary:

Chapter 3 in SM-6800C describes the navigation to and selection of menu options via the CPU board's front panel displays. Section 3.4 in SM-6800C describes the options for the On-line Menu, which provides access to administrative and diagnostic functions. "SERiaL TEST" is a new selection on the On-line Menu. This selection lets users view code and current data for carrier alignment.

This branch of the on-line menu enables you to generate test-signals to be used for testing attached serial communication circuits. To get to the **SERL TEST** option from the DISPlay IO option, just toggle the MENU L-R switch to the R position.

Use the following procedure for selecting a serial port to test, and to generate test-signals on that port:

1. Toggle the MENU UP-DOWN switch to the DOWN position. If no serial ports are defined and active, the CPU display will not change and it will not be possible to enter the serial port test menus; otherwise, the upper CPU display will show the phrase **PORT** and the format for the four characters in the lower display is as follows:

- The left-most character will be **G** for Genisys.
- The second character will be **M** for master or **S** for slave.
- The third character is blank.
- The right-most character is the physical port number (1 through 4).

2. To select the serial port to be tested, repeatedly toggle the MENU L-R switch to either position until the desired physical serial port number is shown in the lower CPU four-character display.

3. Toggle the MENU UP-DOWN switch to the down position. The upper CPU board display will show the port protocol and the physical port number. The lower display will show the Port Test mode. On initial entry, the current test mode will be NORM (normal, or no test in progress). In Normal mode, the normal operation of the serial link attached to the serial port to be tested continues.

4. To change the test mode for the selected port, toggle the MENU L-R switch to the right or left position to select the desired test mode. Options are:

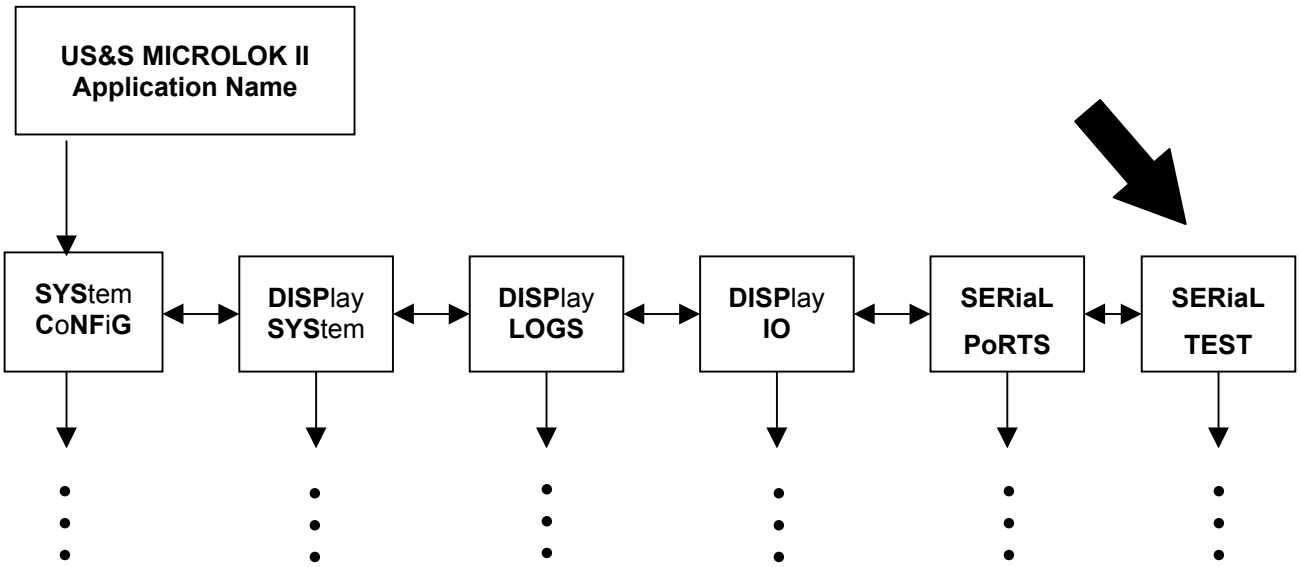
- **NORM** - Normal operation or no port test mode selected
- **MARK** - Port sends a continuous mark
- **SPAC** - Port sends a continuous space
- **CYCL** - Port sends a 50 percent duty cycle at the configured data rate

5. When the desired test mode has been selected, the test mode can be initiated by toggling the MENU UP-DOWN switch to the down position. The CPU display will then show **TST#/[TEST STATUS]**, in which "**#**" is the physical port number, and [TEST STATUS] is **NORM**, **MARK**, **SPAC**, or **CYCL**. The selected test mode will remain in effect until a new mode is selected.

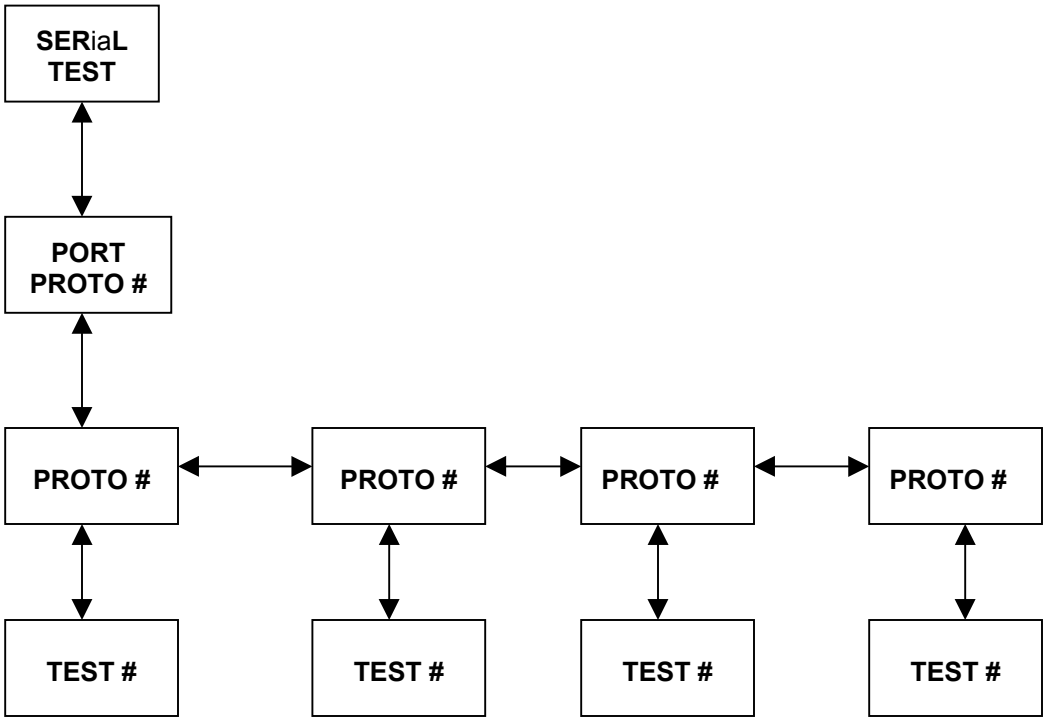
6. A new test mode may be selected by toggling the MENU L-R switch to either the left or right position, until the new desired test mode appears on the CPU display. The new test mode can be activated by toggling the MENU UP-DOWN switch to the down position.

7. To exit Serial Port Test mode, select Normal mode (**NORM**) by toggling the MENU L-R switch to either the left or right until **NORM** appears on the CPU display. Select Normal mode and exit the serial port text menus by toggling the MENU UP-DOWN switch to the down position twice. Note that it is not possible to exit the serial port test menus until the serial port under test has returned to Normal mode.

The new menu selection is identified on the On-line Menu illustrated on the next page:



The options under the "Serial Test" selection are illustrated below:



Text shown in each menu block in upper-case letters appears on the MICROLOK II CPU board four-character displays.

4.3 Accessing PC Card Information

Summary:

Chapter 3 in SM-6800C describes the navigation to and selection of menu options via the CPU board's front panel displays. Section 3.4 in SM-6800C describes the options for the On-line Menu, which provides access to administrative and diagnostic functions. "PC CARD" is a new selection on the On-line Menu. This selection lets users identify the code for an installed PC card.

This option displays the status location of the PC Card. Use the following procedure to access this function from the DISPLAY BITS option:

1. Toggle the MENU L-R switch to the "R" position.

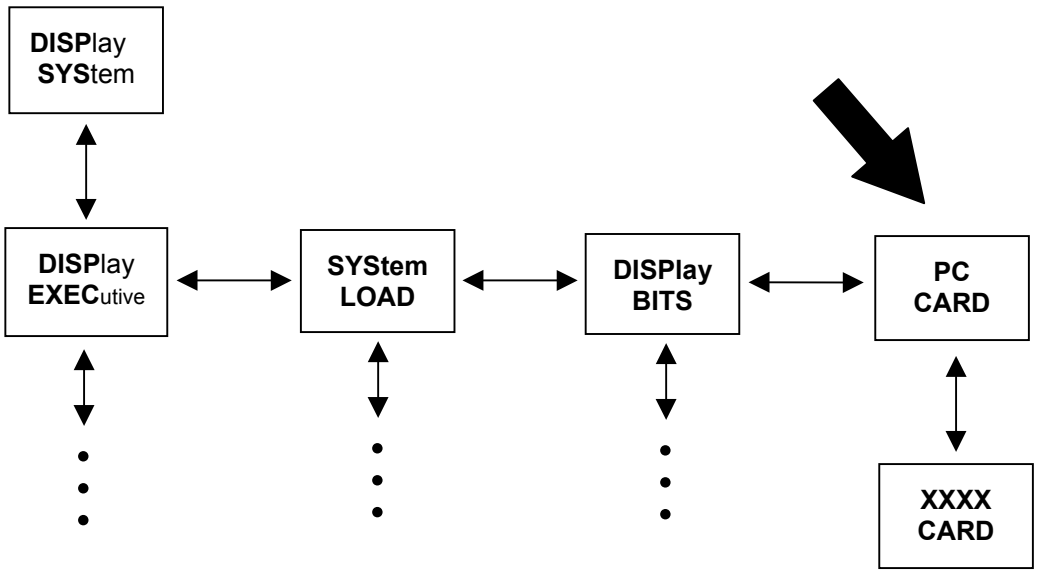
   The upper and lower four-character on the CPU front panel will indicate "**PC|CARD**."

2. Toggle the MENU UP-DOWN switch to the "DOWN" position.

   The upper four-character display will indicate the location of the PC Card ("NO," "TOP," or "BOT"), and the lower display will show "CARD."

3. To return to the PC CARD option, toggle MENU UP-DOWN switch to the UP position.

The PC Card options appear under menu selection "DISPlay SYStem" on the On-line Menu, as illustrated below:



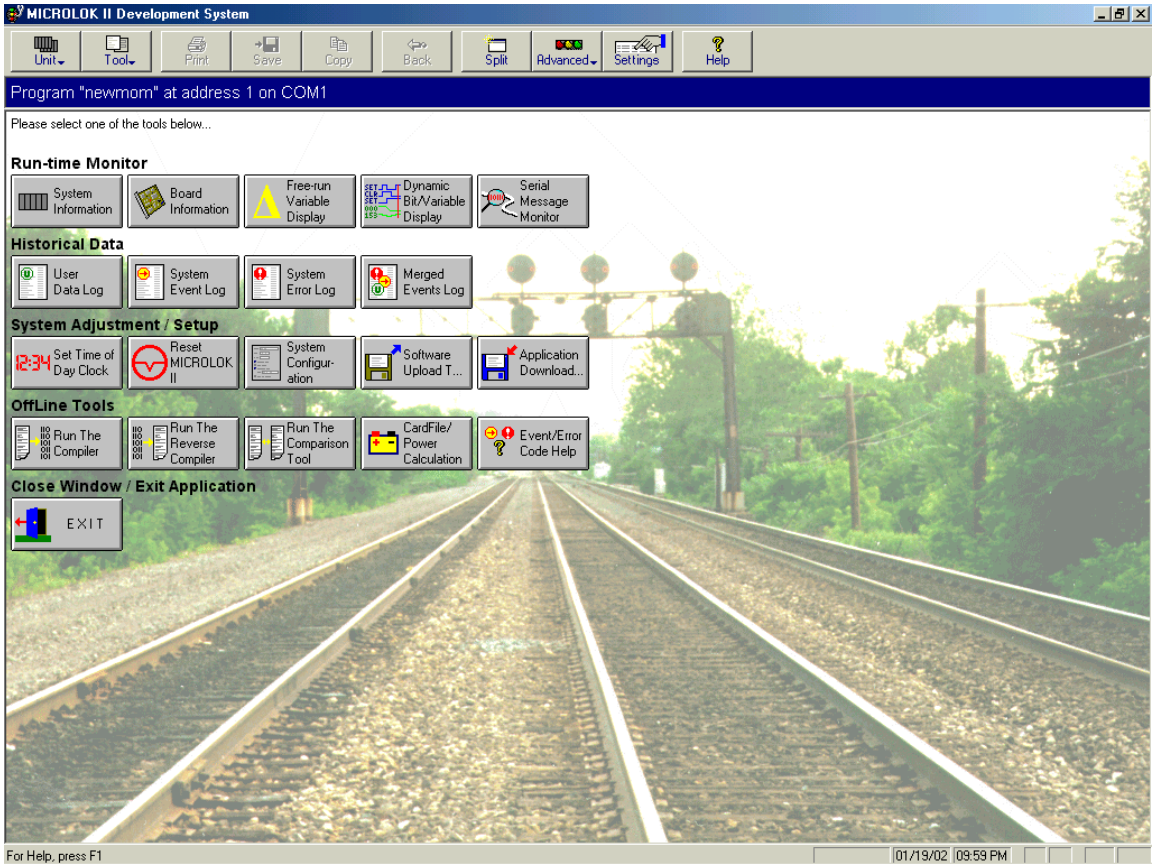
4.4 New MICROLOK II Development System Menu Selections

Summary:

Chapter 4 in SM-6800C provides an overview on the Development System program. Section 4.1 in SM6800C introduces the selections on the Development System main menu. The information below will provide introductory information about new menu selections, as well further define those that existed previously.

4.4.1 MICROLOK II Development System Program Main Menu

An example of the MICROLOK II Development System Program main menu is shown below:



Development System Program Main Menu

This is the screen shown when executing the MICROLOK II Development System. It shows the tools available for maintaining the MICROLOK II. They are selected by clicking on the appropriate button on the display.

4.4.1.1 Run-time Monitor

These buttons lead to views that display data about an operating MICROLOK II and its application.

- ***System Information***

  Provides current executive, application, and compiler data. It also displays the system adjustment table consisting of events.

- ***Board Information***

  Provides status information about track boards, lamp boards, and also any links included in the Configuration such as the MICROLOK Master Status.

- ***Free-run Variable Display***

  Provides a list of current values for selected variables and bits as well as a real-time list of changes. The user can also save the free run listing to a log file or current buffer file.

- ***Dynamic Bit/Variable Display***

  Produces a strip-chart view of bit and variable changes in real time.

- ***Serial Message Monitor***

  Lets users monitor the serial messages for a serial link.

4.4.1.2 Historical Data

These buttons lead to views that display data that an operating MICROLOK II has collected and stored.

- ***User Data Log***

  Records changes of selected bit and numeric variables as requested by the application or configuration. The Save Comma Delimited button in the User Data Log view allows the user to save the user data log to a comma delimited file format suitable for Microsoft Excel.

- ***System Event Log***

  Contains the most recent system information concerning critical errors, warnings and events. Any system critical error or warning will be logged in the system log. Events are used to relay miscellaneous system information and may be limited by use of the configuration.

- ***System Error Log***

Because older events may be lost, the system error log contains a list of the last 50 time stamped critical system errors. The system error log follows the same rules as the system log, but is limited to critical errors.

- ***Merged Events Log***

  Provides User Data Log, System Event Log, System Error log, and Dynamic variable changes merged onto the same time axis.

4.4.1.3 System Adjustment / Setup

These buttons lead to views that modify parameters of the MICROLOK II.

- ***Set Time of Day Clock***

  Sets the MICROLOK II's on-board clock.

- ***Reset MICROLOK II***

  Resets the MICROLOK II Unit; identical to a manual front panel reset. Asks for confirmation.

- ***System Configuration***

  Lets authorized users change configurable parameters such as track length or lamp wattage. Requires password to modify parameters.

- ***Software Upload***

  Lets authorized users change the application/executive program in the unit. This button will allow a user to upload an application and/or executive program from disk to the MICROLOK II Unit.

- ***Application Download***

  Lets authorized users download an application program from the MICROLOK II unit to disk.

4.4.1.4 OffLine Tools

These buttons lead to dialog boxes that allow other MICROLOK II software to be executed. They also lead to the Spreadsheet view and Event/Error Code help.

- ***Run The Compiler***

  Allows the user to run the MICROLOK II compiler executable from within the Development System. The compiler converts a MICROLOK II text (ML2) file into an application (MLP) file.

- ***Run The Reverse Compiler***

  Allows the user to run the MICROLOK II reverse compiler executable from within the Development System. The reverse compiler converts a MICROLOK II application (MLP) file into a MICROLOK II text (MLR) file.

- ***Run The Comparison Tool***

  Allows the user to run the MICROLOK II comparison tool executable from within the Development System. The comparison tool compares two MICROLOK II (ML2 or MLR) files.

- ***CardFile/Power Calculation***

  This button leads to a spreadsheet view in which the user enters a board quantity in the MICROLOK II System and the spreadsheet will calculate a power calculation based on +5 Volts @ 3 Amps and +- 12 volts @ 1 Amp.

- ***Event/Error Code Help***

  This button leads to an edit box where the user can enter a 16-digit hex help error/event code; the resulting help description window will pop up.

4.4.1.5 Close Window/Exit Application

This button lets users quit the Development System and return to Windows, or close a MICROLOK II Development System window.

- ***Exit***

  Quits the application or closes the window if more than one window is open.

4.4.1.6 Toolbar buttons

- ***Unit***

  Lets the user specify a particular MICROLOK II unit on a COM link, or to configure communications.

- ***Tool***

  Lets the user select a Development System option, Customer Service, About, or Exit. The Development System options are the same as the buttons shown on the main display. Customer Service leads to a dialog that displays the 1-800 number to call for help by phone. The About dialog displays the program name, version, build date, copyright information, and part number.

- ***Split***

  This button allows the user to run simultaneous Development System sessions. This is helpful when running multiple MICROLOK II units off of multiple COM ports. It can also be used with one MICROLOK II unit.

- ***Advanced***

  This button leads to views that allow special diagnostic functions to be performed:

  System Memory Dump - Allows US&S personnel to provide specialized debugging assistance.

MICROLOK Message Diagnostic - Allows US&S personnel to provide specialized debugging assistance.

- ***Settings***

  Lets authorized users select preferences for operation of this program. The MICROLOK II Program Settings dialog box contains four tabbed dialogs:

  View - Contains general display options and raw data display options.

  Sy*mbol Files* - Contains a listing of the symbol files.

  Logic Monitor - Includes a polling interval, a choice for the free-run processing time messages, and a symbol group size.

  Advanced - Includes where the Data and Symbols directories will be created, comm port timeout, comm transit delay, a configure application download for MicroCab checkbox, and an Event/Error log packet size.

- ***Help***

  This button leads to an extensive on-line program help.

5 Comparison Tool Functionality

The information that follows is intended to acquaint the reader with the operational features of the MICROLOK II Application Logic Comparison Tool. It also includes sections that describe the installation and functional features of the Comparison Tool.

(Note that the Comparison Tool description that follows was originally produced as a separate addendum to the MICROLOK II documentation. It is reproduced here in its entirety.)

5.1 Overview

The MICROLOK II Application Comparison Tool is a tool that compares two MICROLOK II applications and reports the differences between them.

The Comparison Tool serves two purposes. First, it will be able to compare an original MICROLOK II application with its Reverse Compiled application. Second, the Comparison Tool will also be able to compare two different versions of a MICROLOK II application.

Section 5.1.1 further explains the MICROLOK II applications, while section 5.1.2 lists the methods that the Comparison Tool uses to compare two MICROLOK II applications.

5.1.1 MICROLOK II Applications

MICROLOK II is programmed for specific applications using a specialized language developed by Union Switch & Signal. That language is translated by the Application Compiler into a file containing data tables that are used by the Generic System Software to perform the specific application. The Reverse Compiler performs the opposite operation of the Application Compiler. That is, it translates the file containing the data tables into a file containing the specialized language. These two translations are illustrated below in Figure 1.1.

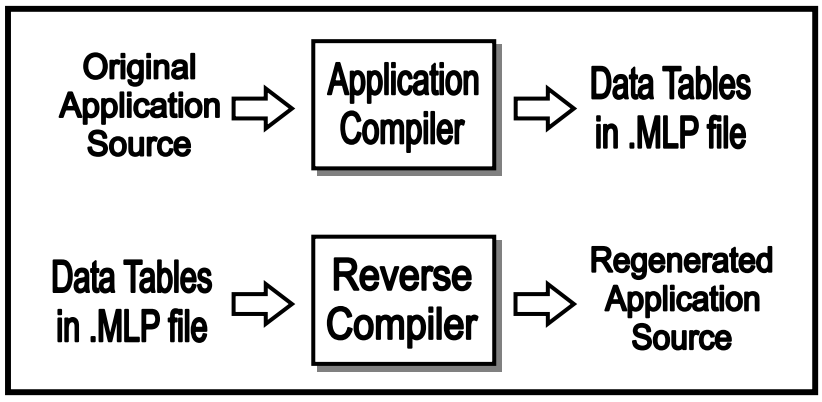


Figure 1.1

The Comparison Tool will be able to compare any two MICROLOK II applications.

The application program in Figure 1.2 below compiles to produce an application image similar to the one in Figure 1.3. The Reverse Compiler then translates the application image in Figure1.3 to produce source similar to that of Figure 1.4. The process of the compilation and reverse compilation is the same as that illustrated by Figure 1.1. The source code in Figure 1.2 and Figure 1.4 could then be compared to make sure that both application programs were functionally equivalent. This will show that nothing was added to the application program by the application compiler translation process as identified in Figure 2.1.

```
microlok_II program example_1;

interface
    local
        board: IO_BOARD
        enable:1
        type: in8.out8
        output: o1, o2, o3;
        input:  i1, i2, i3;

boolean
    bits    flash,stick;

timer bits
    flash: set = 1:sec clear = 1500:msec;

logic begin

    assign 1 to cps.enable;

    assign ~flash to flash;

    assign i1 to o1;    //maps straight through
    assign (stick + i2) * ~i3 to stick; //i2 sets, i3 clears

    assign flash to o2; //Flasher out on o2
    assign flash * stick to o3; //o3 flashes when stick is up

end logic

end program
```

Figure 1.2

```
S224200000004B00200C360000000100000000002003EA00200C0A00200490002008B200201C
S2242000200C1C00010049004A005000200C2200000000002001DC002003DE00200CD2002025
S22420004015FE6578616D706C655F3100000000000000000000000000000000000000000EC
S22420006000000000000000000000000000000000000000000000000000000000000005B
S2242000800000030A4D32000100014A520020009A0020178C00000000ED1F0002002000A4C2
.
.
.
S2242017800000FFFFFFFF0000000000000007AC8200200000FC9C040000200400CBB0040094
S2242017A000200800C2A4040000200C00DA84040000201000D5C20400002014002A22038C0A
S20C2017C00000000000000000FC
```

Figure 1.3

```
MICROLOK_II PROGRAM example_1;

INTERFACE
LOCAL
BOARD: IO_BOARD
FIXED ENABLE:1
TYPE: in8.out8
OUTPUT: o1, o2, o3;
INPUT:  i1, i2, i3;

BOOLEAN
BITS
flash,
stick;

TIMER BITS
FIXED flash: SET = 1:SEC CLEAR = 1500:MSEC;

LOGIC BEGIN
ASSIGN 1 TO CPS.ENABLE;
ASSIGN ~flash to flash;
ASSIGN i1 to o1;
ASSIGN (stick + i2) * ~i3 to stick;
ASSIGN flash to o2;
ASSIGN flash * stick to o3;
END LOGIC

END PROGRAM
```

Figure 1.4

5.1.2 Comparison Methods

When comparing MICROLOK II applications, three issues must be addressed:

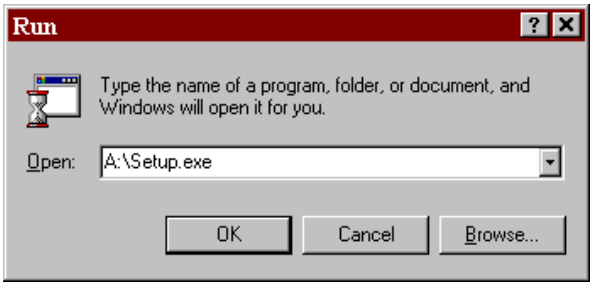
- Functional Equivalencies - This is when the applications differ in context, but they are functionally equivalent to each other. These instances will not be flagged as a difference.
- Altered Functional Equivalencies – This is when the applications are functionally equivalent but contain unexpected output that could only have been caused by one of the applications having been edited by an outside user. These instances will be flagged as a warning.
- Actual Differences – This is when the applications are not functionally equivalent to each other. These instances will be flagged as a difference.

Appendix A gives descriptions and examples on how each section of an application will be compared according to the issues listed above. The Comparison Tool will identify all altered functional equivalencies and all actual differences.

5.2 Software Installation

5.2.1 Installation

1. Insert Disk 1.
2. Select *Run* under the Start Menu.
3. Enter "A:\Setup.exe" in the Open box (as shown below) and click the OK button.

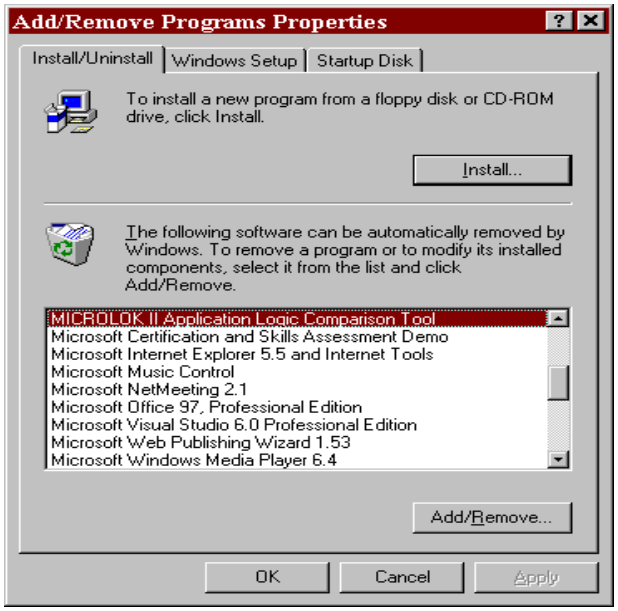


4. Follow the setup instructions on the screen.

Note: *Restart the computer before running the Comparison Tool.*

5.2.2 Removing the Comparison Tool

1. Select *Control Panel* under the Start Menu.
2. Select *Add/Remove Programs*.
3. Highlight *MICROLOK II Application Comparison Tool*, as shown below:



4. Click on the Add/Remove button.
5. Follow the instructions on the screen.

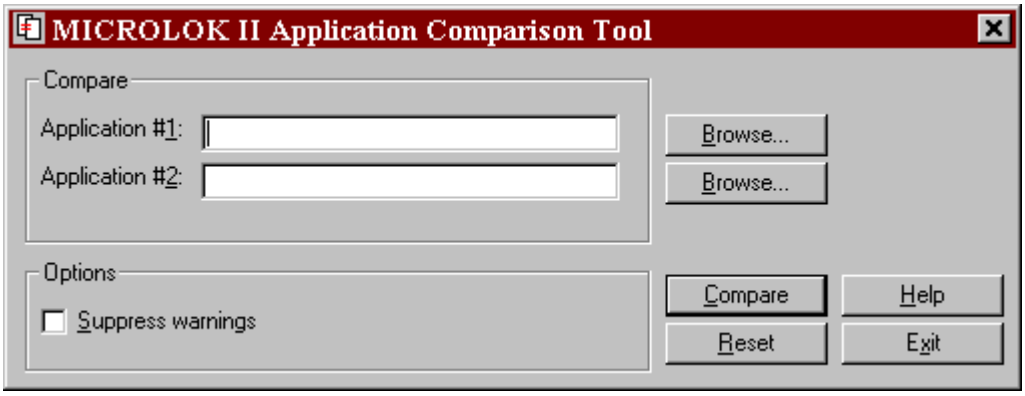
5.3 Operational Description

5.3.1 Start up

When the Comparison Tool is executed the following splash screen (shown below) will be displayed for a few seconds. Click on the splash screen to have it disappear, or wait and it will go away on its own.

5.3.2 Graphical User Interface

5.3.2.1 Main Display



1. Enter the two MICROLOK II applications that are to be compared in the two text boxes. (The Browse buttons can be used to select the applications.)

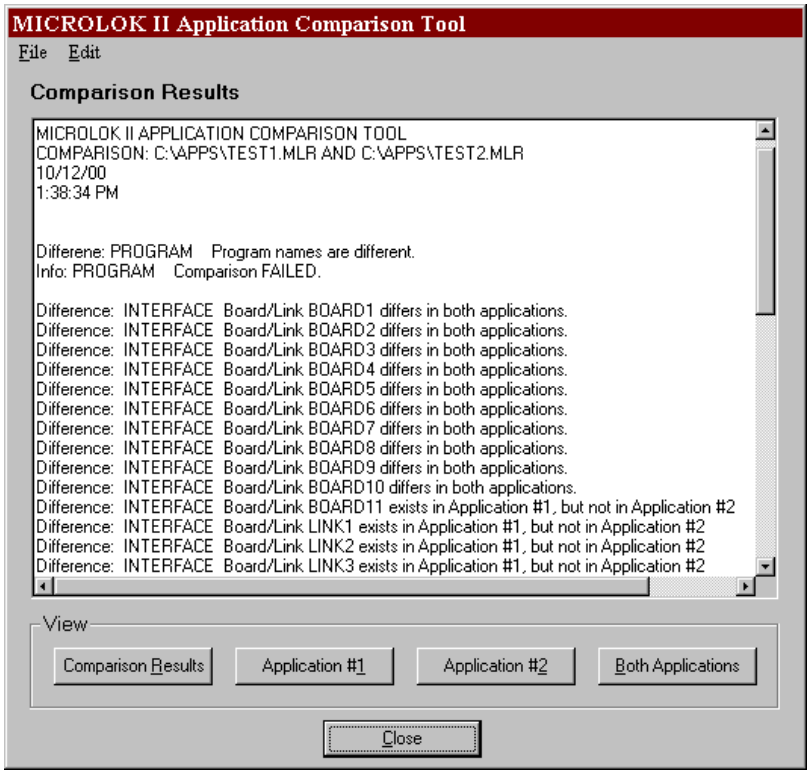
   You also have these options:

- Use the Reset button to clear the text boxes.
- Check the Suppress Warnings box to exclude warnings.

2. Click on the Compare button to compare the two applications.

5.3.2.2 Output Display

The Comparison Results screen appears after the comparison is complete:



The screen provides these options:

- Click on the Application #1 button to view the first application.
- Click on the Application #2 button to view the second application.
- Click on Both Applications to view both applications side-by-side.

After you review the desired information you can click on the Comparison Results button to return to the Comparison Results screen, or click on the Close button to return to the main display.

Note: The Comparison Results are explained in Section 5.3.3.

5.3.3 Understanding the Comparison Results

Each line of the results file is in the following format:

Info/Difference/Warning: Section Message

E.g.

Info:	LOG	Comparison OK.
Difference:	INTERFACE	Board/Link board1 differs in both applications.
Warning:	BOOLEAN BITS	May not be in the same order in both applications.

- **Info:** An Info message lets the user know if a comparison passed or failed in a particular section. An Info message will also let the user know if a section is not present in an application.
- **Difference:** A difference message flags a functional difference (See Section 5.1.2).
- **Warning:** A warning flags an actual difference (See Section 5.1.2). Warnings can be suppressed by checking the Suppress Warnings box on the main display.

Appendix A Functional Equivalencies

The following tables give descriptions and examples on how each section of an application will be compared. The Comparison Tool will identify all altered functional equivalencies and all actual differences.

All Application Sections

The descriptions and examples given in this section will apply to all sections of an application.

Table A-1
Description: The Comparison Tool will ignore comments.

Not flagged as a difference:

Application #1:	*BIT_1, BIT_2; // Comments*
Application #2:	*BIT_1, BIT_2;*

Table A-2
Description: The Comparison Tool will ignore all types of white spaces.

Not flagged as a difference:

Application #1:	*ASSIGN BIT_1 TO BIT_2;*
Application #2:	*ASSIGN BIT_1 TO BIT_2;*

Table A-3
Description: The Comparison Tool is case insensitive because the application language is case insensitive.

Not flagged as a difference:

Application #1:	*type: nv.out32*
Application #2:	*TYPE NV.OUT32*

Individual Application Sections

Pragma

The pragma section contains compiler switches as they would have been entered on the command line. The two possible compiler switches are listed below:

- -n This switch suppresses the inclusion of bit names in the application image.
- -d[<filename>] This switch generates a symbol name file. If a <filename> is not provided, a default name is used.

The Comparison Tool will ignore the pragma section of an application because the compiler switches can be listed on the command line. Also, when the "-n" compiler switch is used, the reverse compiler will not reproduce an application because the bit names are suppressed. So, it is not possible to compare an original application to its reverse compiled application when this compiler switch is used. The "-d" switch just generates a symbol name file and therefore does not have any effect on an application.

Table A-4
Description: The Comparison Tool will ignore the pragma section.

Not flagged as a difference:

Application #1:	*PRAGMA "-n –d[symbol.mld]"*
Application #2:	

Program

The program section must be in one of the two following forms:

- *MICROLOK_II PROGRAM <name>;*
- *MICROCAB_II PROGRAM <name>;*

Table A-5	
Description:	The Comparison Tool will flag the program section if the program names do not match.

Flagged as a difference:

Application #1:	*MICROLOK_II PROGRAM BIG_BOARD;*
Application #2:	*MICROLOK_II PROGRAM LITTLE_BOARD;*

Table A-6	
Description:	The Comparison Tool will flag the program section if the program types do not match.

Flagged as a difference:

Application #1:	*MICROCAB_II PROGRAM BIG_BOARD;*
Application #2:	*MICROLOK_II PROGRAM BIG_BOARD;*

Interface

The interface section defines all of the local and serial I/O for the MICROLOK II card file. The interface section must be in the following form:

INTERFACE

[LOCAL

<Local I/O Definitions>]

[COMM

<Link Definitions>]

Tables A-7 and A-8 apply to both of the local and comm sections of the interface section.

TableA-7	
Description:	The Comparison Tool will not flag default values that are not included in an application. (Refer to ML2-RS-002 for default values)

Not flagged as a difference:

Application #1:	*ENABLE: 1*
Application #2:	*FIXED ENABLE :1*

Table A-8	
Description:	The Comparison Tool will not flag time values that are equivalent but have different units of time in the interface section.

Not flagged as a difference:

Application #1:	*FIXED MASTER.TIMEOUT:1:SEC;*
Application #2:	*FIXED MASTER.TIMEOUT:1000:MSEC;*

Local

The local section specifies the physical I/O installed in the card file. The local section must be in the following form:

BOARD: <board name>

[ADJUSTABLE | FIXED] ENABLE: <flag>

[SHUTDOWN: <bit>]

TYPE: <board type>

<board specific definitions>

Table A-9	
Description:	The bit ordering in the local I/O section must be identical in both applications or the Comparison Tool will flag that section as a difference.
Flagged as a difference:	
Application #1:	*Type: Coder.Out* *Output: first, second, third, fourth;*
Application #2:	*Type: Coder.Out* *Output: second, first, third, fourth;*

Table A-10	
Description:	The keyword spare is used as a place-holder for bit positions that are not being used. The Comparison Tool will not flag spare bits added at the end of a bit declaration.
Not flagged as a difference:	
Application #1:	*Type: Coder.Out* *Output: first;*
Application #2:	*Type: Coder.Out* *Output: first, spare, spare, spare;*

Comm

The comm section specifies the serial and shared ram links defined. The comm section must be in the following form:

LINK: <link name>

[ADJUSTABLE | FIXED] ENABLE: <flag>

PROTOCOL: <protocol type>

<Physical Port Definitions>

<Protocol Definitions>

<Station Address Definitions>

Table A-11	
Description:	In the comm section of the applications, the bit ordering must be identical in both applications or the Comparison Tool will flag that section as a difference.

Flagged as a difference:

Application #1:	*NUMERIC.INPUT: a, b, SPARE, c;*
Application #2:	*NUMERIC.INPUT: a, b, c, SPARE;*

Boolean Bits

The boolean bit definition is in the following form:

BOOLEAN BITS

<bit list>;

Table A-12	
Description:	If a bit is defined in one application, but not in the other, the Comparison Tool will flag this as a difference.

Flagged as a difference:

Application #1:	*Boolean Bits* *a, b, c;*
Application #2:	*Boolean Bits* *a, b;*

Table A-13	
Description:	If all bits are present in both applications, but the ordering is different, the Comparison Tool will generate a warning.

Flagged as a warning:

Application #1:	*Boolean Bits* *a, b, c, d;*
Application #2:	*Boolean Bits* *b, a, d, c;*

Table A-14	
Description:	If a bit is declared vital in one application and then declared non-vital in another application, the Comparison Tool will flag this as a difference.

Flagged as a difference:

Application #1:	*Boolean Bits* *a, b, c;* *NV.Boolean Bits* *d, e, f;*
Application #2:	*Boolean Bits* *b, c;* *NV.Boolean Bits* *a, d, e, f;*

NV.Boolean Bits

The non-vital boolean bit definition is in the following form:

NV.BOOLEAN BITS

<bit list>;

Table A-15	
Description:	If a non-vital boolean bit is defined in one application, but not in the other, the Comparison Tool will flag this as a difference.

Flagged as a difference:

Application #1:	*NV.Boolean Bits* *a, b, c;*
Application #2:	*NV.Boolean Bits* *a, b;*

Table A-16	
Description:	If all non-vital bits are present in both applications, but the ordering is different, the Comparison Tool will generate a warning.
Flagged as a warning:	
Application #1:	*NV.Boolean Bits* *a, b, c, d;*
Application #2:	*NV.Boolean Bits* *b, a, d, c;*

Table A-17	
Description:	If a bit is declared non-vital in one application and then declared vital in another application, the Comparison Tool will flag this as a difference.
Flagged as a difference:	
Application #1:	*Boolean Bits* *a, b, c;* *NV.Boolean Bits* *d, e, f;*
Application #2:	*Boolean Bits* *a, b, c, f;* *NV.Boolean Bits* *d, e;*

Numeric Variables

The numeric variables definition is in the following form:

NUMERIC VARIABLES

<bit list>;

Table A-18

Description: If a numeric is defined in one application, but not in the other, the Comparison Tool will flag this as a difference.

Flagged as a difference:

Application #1:	*Numeric Variables* *a, b, c;*
Application #2:	*Numeric Variables* *a, b;*

Table A-19

Description: If all numerics are present in both applications, but the ordering is different, the Comparison Tool will generate a warning.

Flagged as a warning:

Application #1:	*Numeric Variables* *a, b, c, d;*
Application #2:	*Numeric Variables* *b, a, d, c;*

Table A-20

Description: If a numeric is declared vital in one application and then declared non-vital in another application, the Comparison Tool will flag this as a difference.

Flagged as a difference:

Application #1:	*Numeric Variables* *a, b, c;* *NV.Numeric Variables* *d, e, f;*
Application #2:	*Numeric Variables* *b, c;* *NV.Numeric Variables* *a, d, e, f;*

NV.Numeric Variables

The non-vital numeric variables definition is in the following form:

NV.NUMERIC VARIABLES

<bit list>;

Table A-21	
Description:	If a non-vital numeric is defined in one application, but not in the other, the Comparison Tool will flag this as a difference.
Flagged as a difference:	
Application #1:	*NV.Numeric Variables* *a, b, c;*
Application #2:	*NV.Numeric Variables* *a, b;*

Table A-22	
Description:	If all non-vital numerics are present in both applications, but the ordering is different, the Comparison Tool will generate a warning.
Flagged as a warning:	
Application #1:	*NV.Numeric Variables* *a, b, c, d;*
Application #2:	*NV.Numeric Variables* *b, a, d, c;*

Table A-23	
Description:	If a numeric is declared non-vital in one application and then declared vital in another application, the Comparison Tool will flag this as a difference.

Flagged as a difference:

Application #1:	*Numeric Variables* *a, b, c;* *NV.Numeric Variables* *d, e, f;*
Application #2:	*Numeric Variables* *a, b, c, f;* *NV.Numeric Variables* *d, e;*

Attributes

All Numeric variables have attributes of range, initial value, and error value. The attributes section is in the following form:

ATTRIBUTES

<numeric list >: RANGES FROM <value> TO <value>

INITIALIZED WITH <value>

AND <value> WHEN ERROR;

<additional variable list with attributes>

Table A-24	
Description:	A numeric variable that has attributes that differ between two applications will be flagged as a difference by the Comparison Tool.

Flagged as a difference:

Application #1:	*Attributes* *a: RANGES FROM –2147483648 TO 2147483647* *INITIALIZED WITH 0 AND 0 WHEN ERROR;*
Application #2:	*Attributes* *a: RANGES FROM –48 TO 47* *INITIALIZED WITH 0 AND 0 WHEN ERROR;*

Table A-25

Description: A numeric variable that is not given specific attributes is assumed to have the default values. The Comparison Tool will not flag numerics that are not listed in the attributes section in one application and have the default attributes in another application. A warning will be issued to inform the user that the default values were used.

Not flagged as a difference:

Application #1:	*Numeric Variables* *a, b;* *// No Attributes Section*
Application #2:	*Numeric Variables* *a, b;* *Attributes* *a: RANGES FROM –2147483648 TO 2147483647 INITIALIZED WITH 0 AND 0 WHEN ERROR;* *b: RANGES FROM –2147483648 TO 2147483647 INITIALIZED WITH 0 AND 0 WHEN ERROR;*

Table A-26

Description: The Comparison Tool will not flag numerics that are listed together in the same attribute declaration in one application and then are listed separately in another application.

Not flagged as a difference:

Application #1:	*Numeric Variables* *a, b;* *Attributes* *a, b: RANGES FROM –2147483648 TO 2147483647 INITIALIZED WITH 0 AND 0 WHEN ERROR;*
Application #2:	*Numeric Variables* *a, b;* *Attributes* *a: RANGES FROM –2147483648 TO 2147483647 INITIALIZED WITH 0 AND 0 WHEN ERROR;* *b: RANGES FROM –2147483648 TO 2147483647 INITIALIZED WITH 0 AND 0 WHEN ERROR;*

Table A-27	
Description:	The Comparison Tool will not flag numerics in the attributes section that are defined in a different order in separate applications.
Not flagged as a difference:	
Application #1:	*Numeric Variables* *a, b;* *Attributes* *a: RANGES FROM –2147483648 TO 2147483647 INITIALIZED WITH 0 AND 0 WHEN ERROR;* *b: RANGES FROM –2147483648 TO 2147483647 INITIALIZED WITH 0 AND 0 WHEN ERROR;*
Application #2:	*Numeric Variables* *a, b;* *Attributes* *b: RANGES FROM –2147483648 TO 2147483647 INITIALIZED WITH 0 AND 0 WHEN ERROR;* *a: RANGES FROM –2147483648 TO 2147483647 INITIALIZED WITH 0 AND 0 WHEN ERROR;*

Timer Bits

Timing characteristics such as a slow-pick and/or a slow-drop delay can be added to previously defined boolean bits in the timer bits section. The timer bits section is in the following form:

TIMER BITS

[ADJUSTABLE | FIXED] <bit list>: SET=<time value>: <unit> CLEAR <time value>:<unit>;

<additional timer bit definitions>

Table A-28

Description: If a timer is defined in one application and not in another, the Comparison Tool will flag this instance as a difference.

Flagged as a difference:

Application #1:	*TIMER BITS* *FIXED a: SET=0:MSEC CLEAR=20:MSEC;* *FIXED b: SET=0:MSEC CLEAR=20:MSEC;*
Application #2:	*TIMER BITS* *FIXED a: SET=0:MSEC CLEAR=20:MSEC;*

Table A-29

Description: If no qualifier is present before a timer bit list, the fixed qualifier will be used as the default. If the fixed qualifier is used in one application, and no qualifier is present in the other application, the Comparison Tool will not flag this as a difference.

Not flagged as a difference:

Application #1:	*TIMER BITS* *a: SET=0:MSEC CLEAR=20:MSEC;*
Application #2:	*TIMER BITS* *FIXED a: SET=0:MSEC CLEAR=20:MSEC;*

Table A-30

Description: The Comparison Tool will not flag time values that are equivalent but have different units of time in the timer bits section.

Not flagged as a difference:

Application #1:	*TIMER BITS* *FIXED a: SET=0:MSEC CLEAR=1000:MSEC;*
Application #2:	*TIMER BITS* *FIXED a: SET=0:SEC CLEAR=1:SEC;*

Table A-31	
Description:	The Comparison Tool will not flag timer bits that are listed together in the same timer bit definition in one application and then are listed separately in another application.

Not flagged as a difference:

Application #1:	*TIMER BITS* *ADJUSTABLE a, b: SET=0:MSEC CLEAR=20:MSEC;*
Application #2:	*TIMER BITS* *ADJUSTABLE a: SET=0:MSEC CLEAR=20:MSEC* *ADJUSTABLE b: SET=0:MSEC CLEAR=20:MSEC*

Table A-32	
Description:	The Comparison Tool will not flag timer bits that are defined in a different order in separate applications.

Not flagged as a difference:

Application #1:	*TIMER BITS* *FIXED a: SET=0:MSEC CLEAR=20:MSEC;* *ADJUSTABLE b: SET=0:MSEC CLEAR=20:MSEC*
Application #2:	*TIMER BITS* *ADJUSTABLE b: SET=0:MSEC CLEAR=20:MSEC* *FIXED a: SET=0:MSEC CLEAR=20:MSEC*

Coded Outputs

When it is required to toggle a physical output, a toggle statement in the coded outputs section should be used to modify a previously defined bit in the local interface section. The coded outputs section is in the form:

CODED OUTPUTS

TOGGLE <bit> ON FOR <time value>:<unit>

THEN OFF FOR <time value>:<unit>

IF <control bit>;

<additional toggle statements>

A toggle definition can also have multiple if statements.

CODED OUTPUTS
TOGGLE <bit> ON FOR <time value>:<unit>
THEN OFF FOR <time value>:<unit>
IF <control bit>,
ON FOR <time value>:<unit>
THEN OFF FOR <time value>:<unit>
IF <control bit>,
ON FOR <time value>:<unit>
THEN OFF FOR <time value>:<unit>
IF <control bit>;

<additional toggle statements>

Table A-33
Description: If a toggle statement is defined in one application and not defined in another, the Comparison Tool will flag this as a difference.

Flagged as a difference:

Application #1:	*CODED OUTPUTS* *TOGGLE A ON FOR 1000:MSEC* *THEN OFF FOR 1000:MSEC* *IF CONTROL_BIT;* *TOGGLE B ON FOR 1000:MSEC* *THEN OFF FOR 1000:MSEC* *IF CONTROL_BIT;*
Application #2:	*CODED OUTPUTS* *TOGGLE A ON FOR 1000:MSEC* *THEN OFF FOR 1000:MSEC* *IF CONTROL_BIT;*

Table A-34
Description: The Comparison Tool will not flag toggle statements that are defined in a different order in separate applications.

Not flagged as a difference:

Application #1:	*CODED OUTPUTS* *TOGGLE A ON FOR 1000:MSEC* *THEN OFF FOR 1000:MSEC* *IF CONTROL_BIT;* *TOGGLE B ON FOR 1000:MSEC* *THEN OFF FOR 1000:MSEC* *IF CONTROL_BIT;*
Application #2:	*CODED OUTPUTS* *TOGGLE B ON FOR 1000:MSEC* *THEN OFF FOR 1000:MSEC* *IF CONTROL_BIT;* *TOGGLE A ON FOR 1000:MSEC* *THEN OFF FOR 1000:MSEC* *IF CONTROL_BIT;*

Table A-35
Description: The Comparison Tool will not flag time values that are equivalent but have different units of time in the coded outputs section.

Not flagged as a difference:

Application #1:	*CODED OUTPUTS* *TOGGLE A ON FOR 1:SEC* *THEN OFF FOR 1:SEC* *IF CONTROL_BIT;*
Application #2:	*CODED OUTPUTS* *TOGGLE A ON FOR 1000:MSEC* *THEN OFF FOR 1000:MSEC* *IF CONTROL_BIT;*

Table A-36	
Description:	If a toggle statement has multiple if statements and the order of the if statements differ between applications, the comparison tool will flag this as a difference.

Flagged as a difference:

Application #1:	*CODED OUTPUTS* *TOGGLE A ON FOR 1000:MSEC* *THEN OFF FOR 1000:MSEC* *IF CONTROL_BIT_A,* *ON FOR 500:MSEC* *THEN OFF FOR 500:MSEC* *IF CONTROL_BIT_B,* *ON FOR 200:MSEC* *THEN OFF FOR 200:MSEC* *IF CONTROL_BIT_C;*
Application #2:	*CODED OUTPUTS* *TOGGLE A ON FOR 1000:MSEC* *THEN OFF FOR 1000:MSEC* *IF CONTROL_BIT_A,* *ON FOR 200:MSEC* *THEN OFF FOR 200:MSEC* *IF CONTROL_BIT_C,* *ON FOR 500:MSEC* *THEN OFF FOR 500:MSEC* *IF CONTROL_BIT_B;*

Log

The log section defines which previously defined bits or variables are logged by the MICROLOK II user data log. Because the log section is non-vital, all differences will be flagged as warnings. The log section is in the form:

LOG

[BITS <bit list>;]

[NUMERICS <numeric list>;]

Table A-37	
Description:	Bits or variables defined in one applications log section and not in another application will be flagged as a warning by the Comparison Tool.

Flagged as a warning:

Application #1:	*LOG* *BITS a, b, c;*
Application #2:	*LOG* *BITS b, c;*

Table A-38	
Description:	The log section can contain special identifiers for logging an entire subsets of bits and/or numerics (See SM-6800D for a list of special identifiers). If one application contains an identifier and another application lists the entire subset, the Comparison Tool will not flag this as a warning.

Not flagged as a warning:

Application #1:	*LOG* *BITS Local_IO;*
Application #2:	*LOG* *BITS a, b, c, d; // where a, b, c, & d are all the local i/o*

Table A-39	
Description:	If the ordering in the log section is different between two applications, the Comparison Tool will not flag this as a warning.

Not flagged as a warning:

Application #1:	*LOG* *BITS a, b, c, d;*
Application #2:	*LOG* *BITS d, c, b, a;*

Constants

The constants section is in the following form:

CONSTANTS
[BOOLEAN
<boolean constant list>;]
[NUMERIC
<numeric constant list>;]

The Comparison Tool will handle the constants section depending on which applications that are being compared contain a constants section. There are three possible scenarios:

1. Both applications contain a constants section.
2. Only one application contains a constants section.
3. Neither application contains a constants section.

If both applications contain a constants section, the Comparison Tool will do a comparison on the constants section. The descriptions in Tables A-34 – A-36 give examples on how the Comparison Tool will handle this scenario.

If only one application contains a constants section, the Comparison Tool will substitute the value of each constant in the logic and numeric sections. The constants section will then be disregarded and not compared. An example of how the Comparison Tool will handle this scenario is given in Example A-1 below.

If neither application contains a constants section the Comparison Tool will continue on to the next section of the application.

Example A-1:

When only one application contains a constants section, the value of each constant will be substituted in the logic and numeric sections.

Before the Comparison Tool makes the substitution:

```
CONSTANTS
BOOLEAN
TRUE=1;

LOGIC BEGIN
ASSIGN TRUE TO BIT_1;
```

After the Comparison Tool makes the substitution:

```
// No Constants Section

LOGIC BEGIN
ASSIGN 1 TO BIT_1;
```

Table A-40

Description: If the ordering in the constant section is different between two applications, the Comparison Tool will not flag this as a difference.

Not flagged as a difference:

Application #1:	*CONSTANTS* *BOOLEAN* *TRUE=1;* *FALSE=0;*
Application #2:	*CONSTANTS* *BOOLEAN* *FALSE=0;* *TRUE=1;*

Table A-41	
Description:	If a constant is defined in one application and not in the other application, the Comparison Tool will flag this as a difference.

Flagged as a difference:

Application #1:	*CONSTANTS* *BOOLEAN* *TRUE=1;* *FALSE=0;*
Application #2:	*CONSTANTS* *BOOLEAN* *FALSE=0;*

Table A-42	
Description:	If a constant value differs between applications, the Comparison Tool will flag this as a difference.

Not flagged as a difference:

Application #1:	*CONSTANTS* *BOOLEAN* *TRUE=1;*
Application #2:	*CONSTANTS* *BOOLEAN* *TRUE=0;*

Arrays

Constant arrays of numeric values can be defined in the arrays section. The arrays section is in the following form:

ARRAYS

<array name>[<# of elements>] = { value, value, ... };

< additional array definitions >

Table A-43

Description: If an array is defined in one application and not in the other, the Comparison Tool will flag this as a difference.

Flagged as a difference:

Application #1:	*ARRAYS* *FIRST[3] = {1 ,2 ,3};* *SECOND[5] = { 5, 6, 7, 8, 9}*
Application #2:	*ARRAYS* *FIRST[3] = {1 ,2 ,3};*

Table A-44

Description: If the array names are the same in both applications and the elements differ, the Comparison Tool will flag this as a difference.

Flagged as a difference:

Application #1:	*ARRAYS* *FIRST[3] = {1 ,2 ,3};*
Application #2:	*ARRAYS* *FIRST[3] = {1 ,3 ,2};*

Table A-45

Description: If the array names are the same in both applications and the number of elements differ, the Comparison Tool will flag this as a difference.

Flagged as a difference:

Application #1:	*ARRAYS* *FIRST[3] = {1 ,2 ,3};*
Application #2:	*ARRAYS* *FIRST[4] = {1 ,2 ,3, 4};*

Table A-46	
Description:	If the ordering in the arrays section differs between two applications, the Comparison Tool will not flag this as a difference.

Not flagged as a difference:

Application #1:	*ARRAYS* *FIRST[3] = {1 ,2 ,3};* *SECOND[2] = {0, 1};*
Application #2:	*ARRAYS* *SECOND[2] = {0, 1};* *FIRST[3] = {1 ,2 ,3};*

Table A-47	
Description:	Version 3.xx of the compiler does not keep the array names. The reverse compiler will assign the default array names ARRAY_1, ARRAY_2, ... , ARRAY_N. The number of elements of the array and the values of the elements will then be used for comparison. The Comparison Tool will not flag this naming scheme as a difference.

Not flagged as a difference:

Application #1:	*ARRAYS* *FIRST[5] = { 1, 3, 5, 7, 9};* *SECOND[5] = { 0, 2, 4, 6, 8};*
Application #2:	*ARRAYS* *ARRAY_1[5] = { 1, 3, 5, 7, 9};* *ARRAY_2[5] = { 0, 2, 4, 6, 8};*

Configuration

The configuration section specifies various system parameters. The configuration section is in the form:

CONFIGURATION

[SYSTEM <configuration items>]

[USER BIT <configurable bit list>]

[USER NUMERIC <configurable numeric list >]

Table A-48

Description: If the configuration section is not present or does not list all of the system configuration items in one application and the second application lists all the system configuration items with their default values, the Comparison Tool will not flag this as a difference.

Not flagged as a difference:

Application #1:	*// NO CONFIGURATION SECTION*
Application #2:	*CONFIGURATION* *SYSTEM* *FIXED DEBUG_PORT_ADDRESS: 1;* *FIXED DEBUG_PORT_BAUDRATE: 4800;* *FIXED LOGIC_TIMEOUT: 1000:MSEC;* *FIXED DELAY_RESET: 0:MSEC;*

Table A-49

Description: If no qualifier is present before a system configuration statement, the fixed qualifier will be used as the default. If the fixed qualifier is used in one application, and no qualifier is present in the other application, the Comparison Tool will not flag this as a difference.

Not flagged as a difference:

Application #1:	*DELAY_RESET:0:MSEC;*
Application #2:	*FIXED DELAY_RESET:0:MSEC;*

Table A-50

Description: The Comparison Tool will not flag time values that are equivalent but have different units of time in the configuration section.

Not flagged as a difference:

Application #1:	*FIXED LOGIC_TIMEOUT:1:SEC;*
Application #2:	*FIXED LOGIC_TIMEOUT:1000:MSEC;*

Logic

The boolean logic statement supports assign and nv.assign statements only. The boolean logic section is in the form:

LOGIC BEGIN

(ASSIGN | NV.ASSIGN) <boolean expression> TO <boolean bits>;

<additional assign and/or nv.assign statements>

LOGIC END

Table A-51	
Description:	If an application uses an operator symbol or keyword and the other application uses an equivalent operator symbol or keyword, the Comparison Tool will not flag this as a difference. (Refer to ML2-RS-002 for a complete list of operator symbols and keywords)

Not flagged as a difference:

Application #1:	*ASSIGN (A AND B) OR C TO D;*
Application #2:	*ASSIGN (A * B) | C TO D;*

Table A-52	
Description:	If an assign or nv.assign statement differs from one application to another, the Comparison Tool will flag this as a difference.

Flagged as a difference:

Application #1:	*ASSIGN A * B TO C;*
Application #2:	*ASSIGN B * A TO C;*

Table A-53	
Description:	If an assign or nv.assign statement differ in the number of parenthesis but the order of operations is consistent, the Comparison Tool will not flag this as a difference.

Not flagged as a difference:

Application #1:	*ASSIGN (A * (B | C)) TO D;*
Application #2:	*ASSIGN A * (B | C) TO D;*

Table A-54	
Description:	If an assign or nv.assign statement is in one application and not in the other application, the Comparison Tool will flag this as a difference.

Flagged as a difference:

Application #1:	*NV.ASSIGN A TO B;* *NV.ASSIGN C TO D;* *NV.ASSIGN E TO F;*
Application #2:	*NV.ASSIGN A TO B;* *NV.ASSIGN E TO F;*

Table A-55	
Description:	If the order of assign or nv.assign statements differ between applications, the Comparison Tool will flag this as a difference.

Flagged as a difference:

Application #1:	*NV.ASSIGN A TO B;* *NV.ASSIGN C TO D;* *NV.ASSIGN E TO F;*
Application #2:	*NV.ASSIGN C TO D;* *NV.ASSIGN E TO F;* *NV.ASSIGN A TO B;*

Tables

Lookup tables provide a means by which boolean or numeric input conditions can yield one or more output values. The tables section has the following form:

TABLES BEGIN

TABLE <table number> TRIGGERS ON <boolean bits> AND STALE AFTER <time value>:<unit>;

[INTERPOLATE] INPUTS: <input list> OUTPUTS: <output list>;

<state mapping list>

END TABLE

<additional table definitions>

TABLES END

Table A-56 is the only time that the tables section will have a functional equivalency that is not identical in context. All other differences in context in the tables section will be flagged as a difference.

Table A-56	
Description:	The Comparison Tool will not flag time values that are equivalent but have different units of time in the tables section.
Not flagged as a difference:	
Application #1:	*TABLE 2 TRIGGERS ON X* *AND STALE AFTER 60:SEC;* *INPUTS: A, B, C OUTPUTS: P,Q;* *STATE: 0, 1, 1 YIELDS: 0, 0;* *STATE: 1, ?, ? YIELDS: 1, 1;* *UNDEFINED STATE YIELDS: ?, 1;* *END TABLE*
Application #2:	*TABLE 2 TRIGGERS ON X* *AND STALE AFTER 1:MIN;* *INPUTS: A, B, C OUTPUTS: P,Q;* *STATE: 0, 1, 1 YIELDS: 0, 0;* *STATE: 1, ?, ? YIELDS: 1, 1;* *UNDEFINED STATE YIELDS: ?, 1;* *END TABLE*

Numeric

The purpose of the numeric section is to perform basic math functions. The numeric section should be in the following format:

NUMERIC BEGIN

BLOCK <block number> TRIGGERS ON <boolean bit> AND STALE AFTER <time value>:<unit>;

ASSIGN statements;

EVALUATE <numeric expression> TO <numeric variable list>;

IF <expression> THEN

ASSIGN statements;

EVALUATE statements;

ELSE

ASSIGN statements;

EVALUATE statements;

END IF

END BLOCK

<additional blocks>

END NUMERIC

Table A-57	
Description:	In the numeric section, if an one application uses an operator symbol or keyword and the other application uses an equivalent operator symbol or keyword, the Comparison Tool will not flag this as a difference. (Refer to ML2-RS-002 for a complete list of operator symbols and keywords)

Not flagged as a difference:

Application #1:	*ASSIGN (A AND B) OR C TO D;*
Application #2:	*ASSIGN (A * B) | C TO D;*

Table A-58	
Description:	If an assign or nv.assign statement inside a numeric block differ in the number of parenthesis but the order of operations is consistent, the Comparison Tool will not flag this as a difference.

Not flagged as a difference:

Application #1:	*ASSIGN (A * (B | C)) TO D;*
Application #2:	*ASSIGN A * (B | C) TO D;*

Table A-59
Description: The Comparison Tool will not flag time values that are equivalent but have different units of time in the numeric section.

Not flagged as a difference:

Application #1:	*AND STALE AFTER 1:SEC;*
Application #2:	*AND STALE AFTER 1000:MSEC;*