Genrakode™ II Track Circuit and Communications System

System Operation and Maintenance Manual
P2160B, Volume 1 of 2

Genrakode™ II Track Circuit and Communications System

Operation and Maintenance Manual
Alstom Signaling Inc.

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PREFACE

NOTICE OF CONFIDENTIAL INFORMATION

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ABOUT THE MANUAL

This manual is intended to provide the necessary information to maintain and ensure proper operation of an Alstom Genrakode II DC System. The information provided is not limited to the components of the switch machine.

The information in this manual is arranged into sections. The title and a brief description of each section follow:

Section 1 – GENERAL DESCRIPTION: This section gives general information on the components of the Genrakode II DC System. Safety precautions are also provided in this section.

Section 2 – THEORY OF OPERATION: This section gives general information on the operation of the Genrakode II DC System and components. Safety precautions are also provided in this section.

Section 3 – INSTALLATION: This section describes the field installation and setup of the Genrakode II DC System.

Section 4 – PREVENTIVE MAINTENANCE: This section describes the tools, preventive maintenance procedures, and functional tests used on Genrakode II DC System. The frequency and interval, for the performance of the given information, are also included.

Section 5 – TROUBLESHOOTING: This section describes possible failures/symptoms along with the corrective action for the Genrakode II DC System.

Section 6 – DIAGNOSTICS: This section describes the diagnostics functions of the Genrakode II DC System.

Appendix A – **MODULE BOARD REFERENCE DATA:** This section contains reference data for the boards used in the Genrakode II DC System.

Appendix B – **CPU HARDWARE AND SOFTWARE:** This section contains supporting details for the Genrakode II DC System CPU hardware and software.

Appendix C – **SYSTEM SPECIFICATIONS:** This section summarizes the system specifications to consider when applying the Genrakode II DC System.

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MANUAL SPECIAL NOTATIONS

In the Alstom manuals, there are three methods used to convey special informational notations to the reader. These notations are warnings, cautions, and notes. Both warnings and cautions are readily noticeable by boldface type two lines beneath the caption.

Warning

A warning is the most important notation to heed. A warning is used to tell the reader that special attention needs to be paid to the message because if the instructions or advice is not followed when working on the equipment then the result could be either serious harm or death. The sudden, unexpected operation of a switch machine, for example, or the technician contacting the third rail could lead to personal injury or death. An example of a typical warning notice follows:

WARNING

> WHENEVER THE GEAR COVER IS REMOVED DISCONNECT THE MOTOR ENERGY. OTHERWISE, THE SWITCH MACHINE MAY OPERATE UNEXPECTEDLY AND POSSIBLY CAUSE PERSONAL INJURY.

Caution

A caution statement is used when an operating or maintenance procedure, practice, condition, or statement, which if not strictly adhered to, could result in damage to or destruction of equipment. A caution statement is also used when personnel could be surprised if shocked by a circuit operating at a low current. A typical caution found in a manual is as follows:

CAUTION

> Turn power off before attempting to remove or insert circuit boards into a module. Boards can be damaged if power is not turned off.

Note

A note is normally used to provide minor additional information to the reader to explain the reason for a given step in a test procedure or to just provide a background detail. An example of the use of a note follows:

NOTE

> A capacitor may be mounted on the circuit board with a RTV adhesive. Use the same color RTV.

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1. SECTION 1 – GENERAL DESCRIPTION

1.1. SCOPE OF MANUAL

The purpose of this manual is to describe the features of the Genrakode™ II system and to explain how to properly inspect, service, test, remove, and replace the recommended spare parts.

The Genrakode II system is available in DC or AC versions. This manual discusses the DC version of the system. The operation and maintenance manual for AC Genrakode is identified as P2160AC.

1.2. GENRAKODE II SYSTEM DESCRIPTION

The Genrakode II System, shown in Figure 1–1, is a microprocessor-based system used for train detection, vital communication through the rails, and cab signaling. The system is based on microprocessors that vitally direct the operation of control modules.

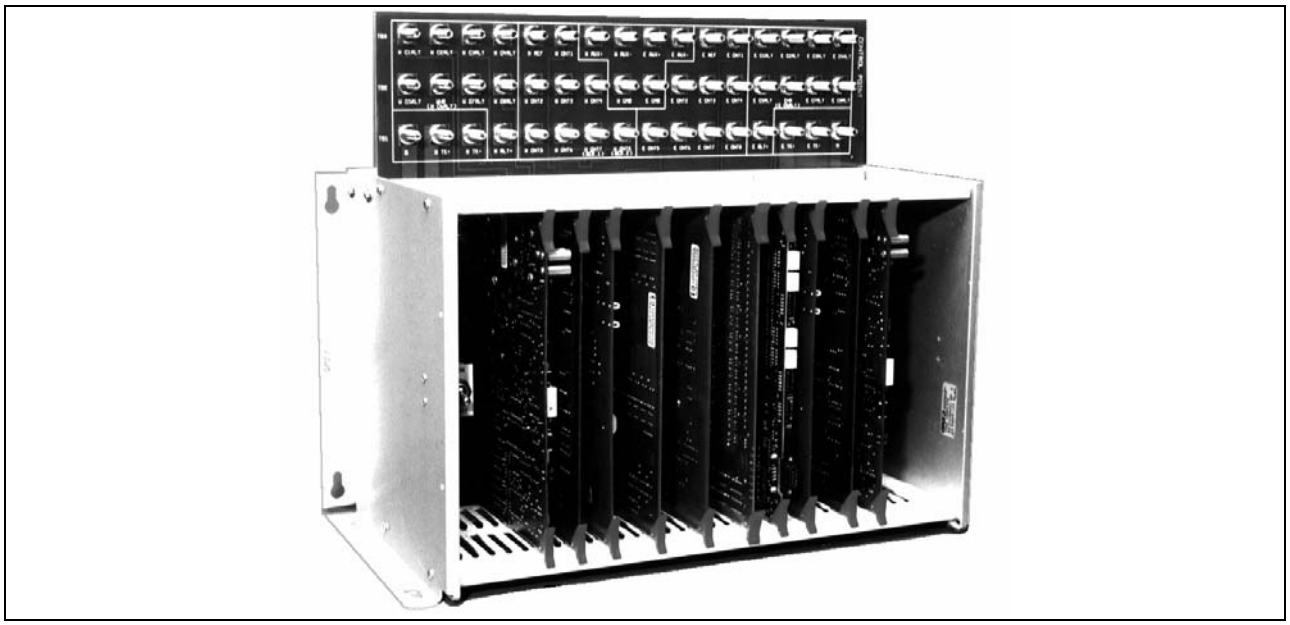


Figure 1–1. Genrakode II™ System

1.2.1. Genrakode II Modules

The Genrakode II System consists of four main module types that provide all functions for complete wayside signaling. The modules consist of boards located within an enclosure, as shown in Figure 1–1.

The standard system includes the following modules: Control Point module, Intermediate module, Repeater module, and Switch Lock module. If cab signaling is required, an optional Cab Signaling module is used with and controlled by one of the four main module types to apply cab signal to the rails.

- The standard Control Point module can handle one or two independent track circuits. Control Point modules either interface with the interlocking relay logic at the location or can be linked directly to a Vital Processor Interlocking (VPI®) system unit. A 4-track Control Point module is also available for use as part of the Alstom Control-Point-in-a-Box (CPIB) system that interfaces to VPI using a Vital Serial Link.

- The Intermediate module controls two track circuits and the signals for both directions at a location. No relays are required, and the stick logic for following moves can be easily implemented in application logic created graphically with the PGKCAA (application development tool).

- The Repeater module is used at cut sections to repeat code information in both directions.

- The Switch Lock module is used at hand-throw switches with electric locks to control the electric lock mechanism based on a local unlock request input and received track codes to ensure the safety of siding-to-mainline and mainline-to-siding train moves.

- An optional Cab Signal module is used in conjunction with one of the four main module types to overlay 60, 100, or 250 Hz cab signaling on the track circuit. The Cab Signal module generates the 60, 100, or 250 Hz carrier signal that is controlled (modulated by the required code rate) directly by the Control Point, Intermediate, Repeater, or Switch Lock module at a given location.

1.2.2. CODES

The system provides nine codes that are used for detecting trains, signal clearing, and block indication. These codes can be sent on the tracks or line wire. The coding format consists of unipolar pulses and utilizes pulse spacing and pulse width variation to signify different codes. The Alstom Code T mode (patented) is also available to provide communication between Genrakode modules of location-specific information such as commercial power status and lamp filament failures. Code T provides this non-vital communication channel without interfering with the standard vital codes and block indications.

1.3. GENRAKODE II SYSTEM FEATURES

The Genrakode II system includes features that improve system performance, application, and maintenance compared to the original Genrakode.

- The system is user programmable.
- The system can be applied to existing relay and signal systems.
- Fail-safe operation is acheived by applying Numerically Integrated Safety Assurance Logic (NISAL). NISAL is used for the design of fail-safe, microprocessor-based products and systems to insure system safety.
- The systems CPU board is user programmable with computer aided application (CAA) software, provides integrated data logging, many field-configurable settings, and excellent diagnostic features.
- A cable integrity check provides additional security by detecting external cable failures.
- Real-time independent Code 5 selection for each track circuit allows for compatibility with adjacent coded track circuits.
- Automatic receiver checking eliminates the need for manual periodic verification.
- Diagnostics are programmed into the CPU software, enabling troubleshooting of a module by observing LED indicators on the CPU board. These indicators provide quick identification of the board or function that is not operating properly.
- A PC based simulator is available to assist with development of the application programming.
- A PC based configuration tool simplifies ordering by generating the appropriate part number.
- Vital outputs and the logic power supply are completely isolated from the signal battery. This improves lightning and noise immunity.
- Direct filament and mechanism drive are provided for colorlight and searchlight signals at intermediate locations. Regulated lamp drive voltage maximizes signal bulb life. Filament checking and power-out detection are also provided.
- Vital inputs provide downgrade of signals as a result of switch circuit controller status, slide fence failure, high water detector activation, or other location-specific conditions.
- A track-to-line board simplifies application when applying Genrakode in dark territory with existing DC crossing circuits.

- A serial communications link between Genrakode and VPI is available that eliminates relay interfaces and the number of discrete wires required for installation.
- AAR posts are readily accessible, making installation quick and easy.
- Long track circuit length minimizes the number of track circuits required; track circuit lengths of up to 29,000 ft are attainable on welded rail with 10 ohms DC ballast.
- 100% solid state construction reduces maintenance costs by eliminating relays.
- A vital code, Code 9 provides additional vital signaling capabilities.
- A non-vital code, Code T provides up to four individual indications for advanced diagnostic and maintenance functions.
- There are three available cab signal generators each capable of generating the 5 standard cab signal rates- 75, 120, 180, 270, and 420ppm. Carrier frequencies of 60Hz, 100Hz, and 250Hz are available.
- Remote operation is available via serial communications link at intermediate signal locations, permitting remote control of signals and codes.
- A Genrakode™ Test Unit can be used in conjunction with a module being put into service or under test to simulate the opposite end of a track circuit. This allows functional testing of transmission and reception of codes so operation can be checked prior to the module's connection to the rails without requiring a person at the opposite end of the track circuit.

1.3.1. Interoperability

Genrakode II is capable of being applied in any application where interface to existing relay and signal systems is required in the performance of coded track circuit functionality. With regard to other supplier’s electronic coded track circuit products, Genrakode II provides the flexibility to adapt to track coding patterns utilized for train detection, block indication, signal clearing, maintenance and block tumble-down functions. Specifically, Genrakode II is fully compatible with the ElectroCode Series of coded track circuits provided by GE/Harmon Industries. This has been demonstrated on several North American railroad properties.

1.4. SYSTEM SAFETY DESIGN

Genrakode II operates in a fail-safe manner employing a single microprocessor. Numerically Integrated Safety Assurance Logic (NISAL) techniques are utilized within the product design to vitally assure product safety when applied correctly.

Numerically based safety systems, like most vital transportation control systems, utilize the concept of diversity as a prime mechanism upon which the vital system design is constructed. A NISAL, single processor approach uses independent calculations involving diverse data sets (data channels) rather than diverse hardware or software. In order for a system result to assume a permissive state, both data sets must be permissive. Vital parameters are represented within the system as diverse and uniquely coded 32-bit values. More detailed characteristics of the data representations and the mathematical concepts employed are not included in this manual.

Vital parameters such as application logic results, the states of inputs and outputs, and internal system processing checks are formed through the execution of vital software algorithms under direction of the system executive program. NISAL software algorithms are designed to account for any and all failures in processing hardware or software coding. Any processing failure that could adversely affect the safe execution of a vital process leads to the corruption of one or both of the diverse results of that process. Lack of proper and diverse permissive results directly leads the system to attain a more restrictive operating state. Verification of processor integrity is accomplished through the generation of system checkwords.

1.4.1. Memory Integrity Verification

One advantage of a NISAL-based system design is that failures to data or system program memory can lead to an erroneously permissive output only with an extremely low probability. In other words, the safety of the system is not compromised by random errors in data or program memory. For this reason, continuous data or program memory verification is not required to assure safety of the system.

For software configuration verification, program memory checksums and CRCs (Cyclic-Redundancy Checks) are computed as part of the application compilation (using the Genrakode II Computer Aided Application Package (CAA)), during download of the application and (if required) system software to the Programmable Genrakode (PGK) CPU, and on-line during Genrakode II operation. See Appendix B for PGK CPU serial commands to query this information.

1.4.2. Programmable CPU Board

The heart of the Genrakode II system is the Programmable Genrakode (PGK) CPU board. This board offers many advantages over the previous conventional Genrakode CPU board including easy user-programmability of application logic, integrated data logging, many field-configurable settings, and excellent diagnostic features.

User-defined application programs are downloaded to the PGK CPU board using a standard RS-232 connection from a PC using the Alstom software utility DloadWin. The application program and system (executive) software are stored in Flash memory but on physically separate memory devices. The system software version required by the application is also downloaded to Flash memory if required (if the proper version is not already present on the CPU board). Application and system checksums and CRCs are displayed after downloading and on request from the CPU serial port interface by entering the command “CRC”.

See Appendix B for a listing of the configuration and diagnostic commands available with the PGK CPU board. See Section 3 for instructions on installation and configuring specific settings. Be aware that as new features continue to be introduced with the Genrakode II system, older software versions may not support all features currently described in this manual. The Release Notes supplied with the current version of the Genrakode II CAA package contain a listing of which versions support which features.

1.4.2.1. Application Programming

User-programmability is provided with the Genrakode II system using the Genrakode II CAA package, a suite of application development tools that allow graphical development of application logic, full simulation and testing, and software downloading to the Genrakode II hardware. Additionally, full on-line help and a training tutorial are provided to help new users gain proficiency with the tools. The CAA installation package is supplied to customers on a single CD.

2. SECTION 2 – THEORY OF OPERATION

2.1. GENERAL

This section contains the Theory of Operation of the Alstom Genrakode II system.

Genrakode II is a DC-coded, bi-directional track circuit and communications system using the rails for train detection, communication of vital and non-vital signal control and status information, and block indication. The system eliminates the need for line wire circuits in most cases which are both costly to install and costly to maintain by railroads.

2.2. SYSTEM OPERATION

Bi-directional train detection and signal control circuits operate in a time sharing mode with regard to usage of the rails within a track circuit. The basic system period operates on a 2.8 second cycle, with operation in one direction for 1.4 seconds and operation in the opposite direction for the remaining 1.4 seconds. All EAST direction transmissions occur every 2.8 seconds when no code is received. All WEST direction transmissions occur every 2.9 seconds when no code is received. After the two sides are synchronized the cycle reverts to 2.8 seconds. The difference in unsynchronized cycle periods between the tracks helps both ends of a track circuit synchronize in the minimum period of time when the modules are powered up or when a train vacates the track circuit.

The coding format is unipolar DC type pulses with pulse pairs used to signify vital signal clearing codes. The time between leading edges of a pulse pair signifies the specific signal clearing code being transmitted and received. Nine distinct codes are provided; six for vital signal clearing codes, one for vital train detection, one for non-vital block indication, and one for non-vitally initiating the tumble-down of signals in one direction.

The polarity of pulses transmitted on the rails from either end of a track circuit is the same. The system is a unipolar pulse polarity system; therefore reversing the polarity of rail connections to track circuits adjacent to the insulated joints provides insulated joint protection.

2.3. CODE DEFINITIONS

The Genrakode system transmits and receives DC current pulses to enable each Genrakode module to communicate vitally with its adjacent modules using the tracks as the communication medium. This is an advantage over the miles of line wire that had to be strung and maintained along the tracks for use in communication previously.

The coding scheme gives the railroad (and thus the application programmer) the ability to send both vital and non-vital codes from location to location along the tracks. These codes can be used for control of signal aspects, block occupancy indication, and other purposes. The application logic at each location allows complete control over the communications between each module.

Code 1: When transmitted by itself and decoded at the receive end of a track circuit, Code 1 indicates that the track circuit is unoccupied. It is also decoded in the same manner when pulse pairs are transmitted, since any code received other than a Code 1 implies a Code 1. From no code received, reception of Code 1 pulses in two consecutive 2.8 second Genrakode cycles is required to validate Code 1, except for the Fast Repeater option which validates in one cycle. Validation of Code 1 is dropped when Code 1 pulses are not received in two out of three consecutive Genrakode cycles. Code 1 by itself is a single 112 ms pulse, but can also carry a Code 5 (non-vital code) which extends the single pulse length to 224 ms or 352 ms depending on the type of Code 5 selected.

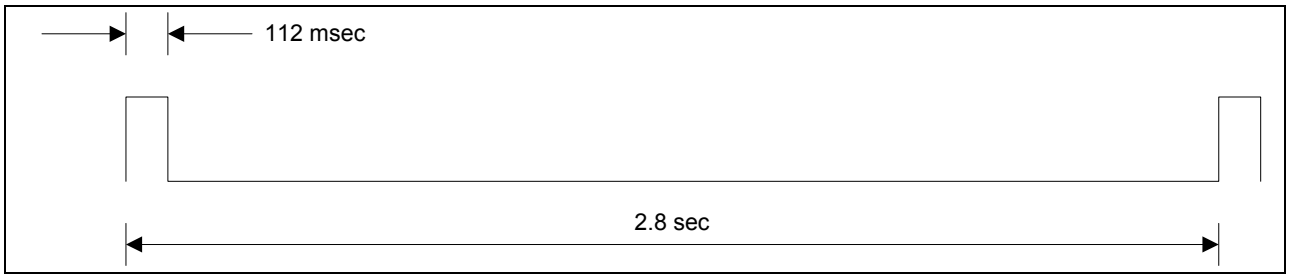


Figure 2–1. Code 1 Pulse

The 2.8 second Genrakode cycle includes both a transmit portion and a receive portion. This enables two modules to communicate bi-directionally on a track circuit. For example, while module 1 is transmitting, module 2 is receiving, and vice-versa.

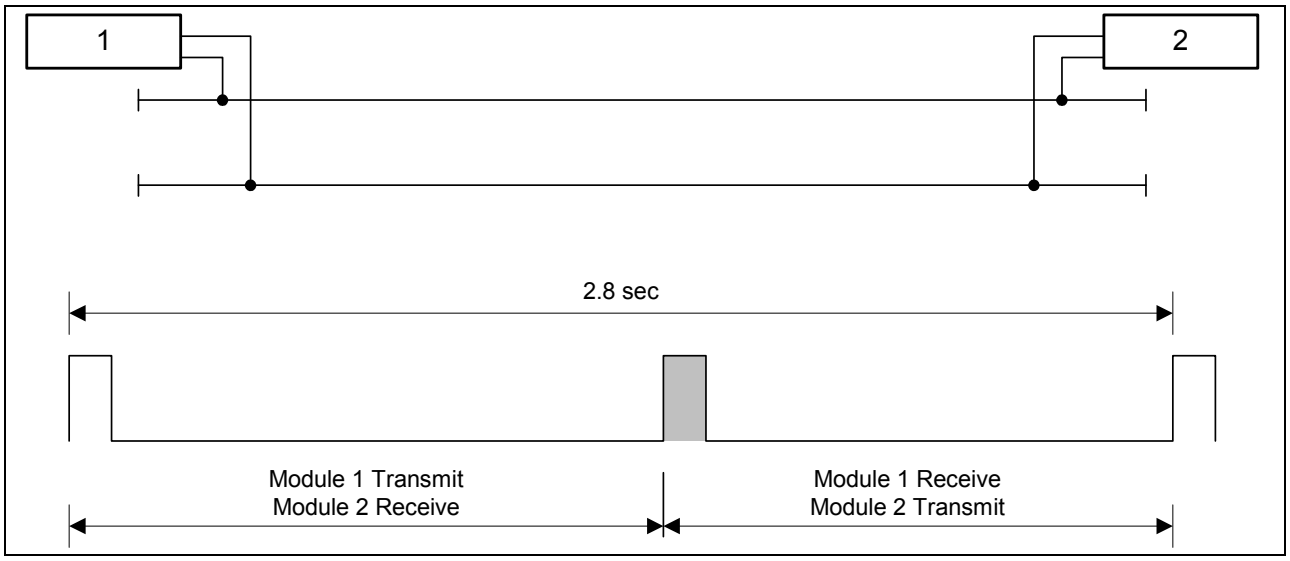


Figure 2–2. Bi-directional Code Communication

Codes 7, 4, 3, 2, 9, 8: These are the six vital two-pulse codes, also known as signal clearing codes. Code 8 typically represents the most restrictive code and Code 7 represents the least restrictive code, although there is no safety requirement to observe this order. Code 8 has the longest time period between the pulse pair, and Code 7 has the shortest time period between the pulse pair. Vital spacing between the pulses is measured from leading edge of the first pulse to leading edge of the second pulse.

The standard validation rules for the signal clearing codes state that from no code received (track previously shunted), reception of a signal clearing code in three consecutive 2.8 second Genrakode cycles is required to validate the clearing code (Code 1 validates after the second Genrakode cycle). If Code 1 or another signal clearing code is currently validated, reception of a new signal clearing code in two consecutive Genrakode cycles is required to validate that code. Validation of a signal clearing code is dropped when that code is not received in two out of three consecutive Genrakode cycles. Note that these validation rules only apply to the application logic parameters representing the validated state of each code (for example parameter ECR_RECCODE_7 for Code 7 received on the East). A corresponding set of logic parameters representing the cycle-by-cycle received code on each track are also provided for use by the application programmer. These parameters should not be used to directly drive vital outputs but can be used to repeat codes where maximum speed is required.

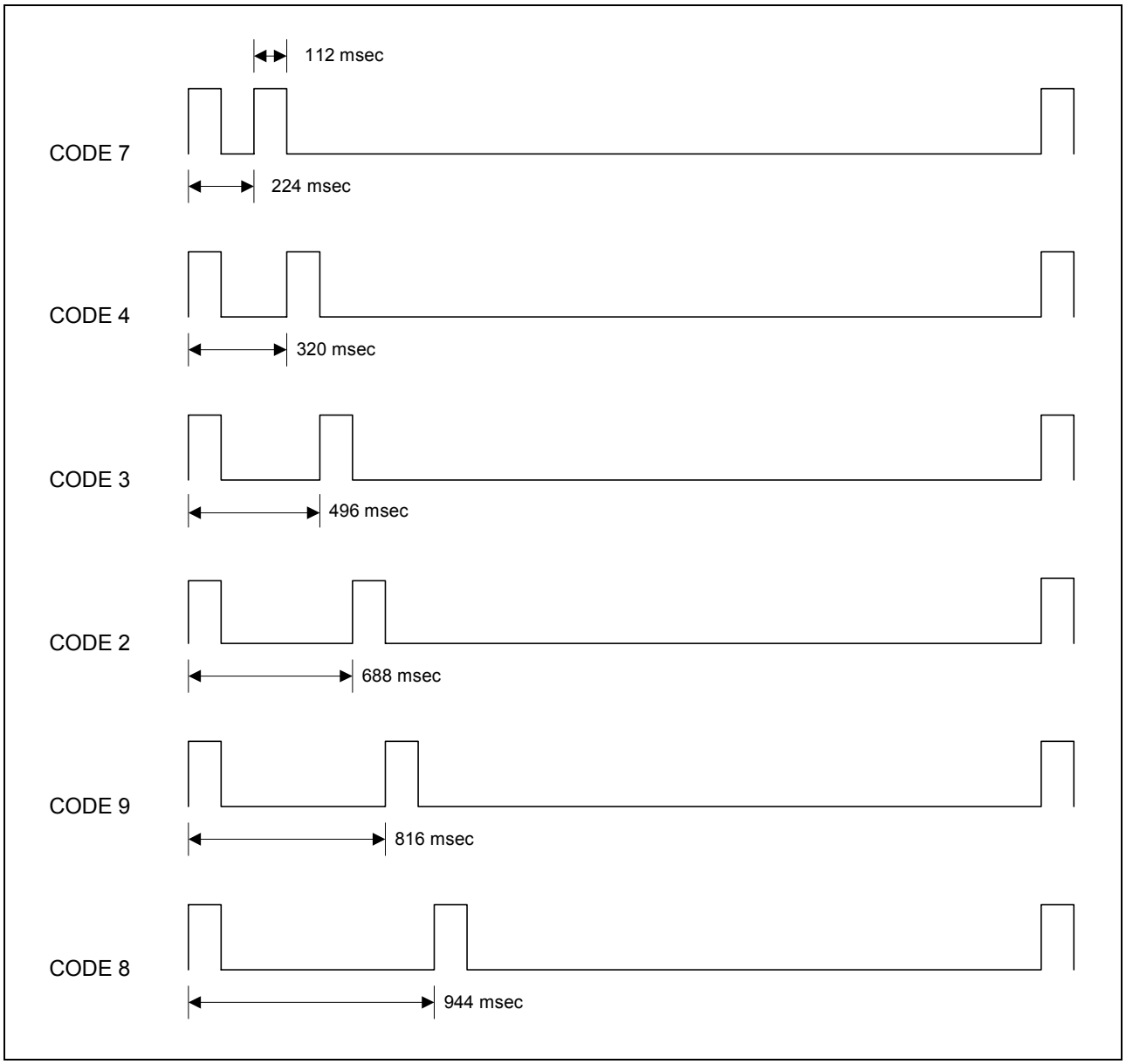


Figure 2–3. Vital Code Pulses

The vital spacing between the two pulses is the fail-safe property of this coding scheme, not the pulse widths. Only non-vital information (such as Code 5) can be encoded by varying the pulse widths. As with Code 1, these codes can be transmitted bi-directionally by the modules at each end of the track circuit.

Code 5: This non-vital code provides the ability to indicate block occupancy starting at any track circuit boundary location desired within a Control Point-to-Control Point block. The information is decoded at the Control Point location. Code 5 information can be transmitted to either or both Control Point locations with a track block boundary defined in both directions. Code 5 is added to Code 1 or to a signal clearing code by lengthening the first or second transmitted pulse from 112 ms to either 224 ms (standard) or 352 ms (long). It is therefore possible to send three codes at one time along the track: Code 1, Code 5, and a signal clearing code. Three Code 5 formats are supported: Standard (standard length pulse transmitted every cycle when selected), Alternating (standard length pulse transmitted every cycle when selected), and Long (long length pulse transmitted every cycle when selected). The Code 5 format used in an application for each track can be selected during the development of an application program with the Genrakode II CAA, but can also be changed in the field without changing the application program. Different format settings on each track at a location are supported, but the format at each end of a track circuit must be same for proper Code 5 performance.

Standard Code 5 is generally used where maximizing the propagation speed of Code 5 is paramount, while Alternating Code 5 provides the most reliable operation especially in poor ballast conditions but is slightly slower than Standard Code 5. Long Code 5 is not generally used except where it is necessary to interface to older equipment using this format.

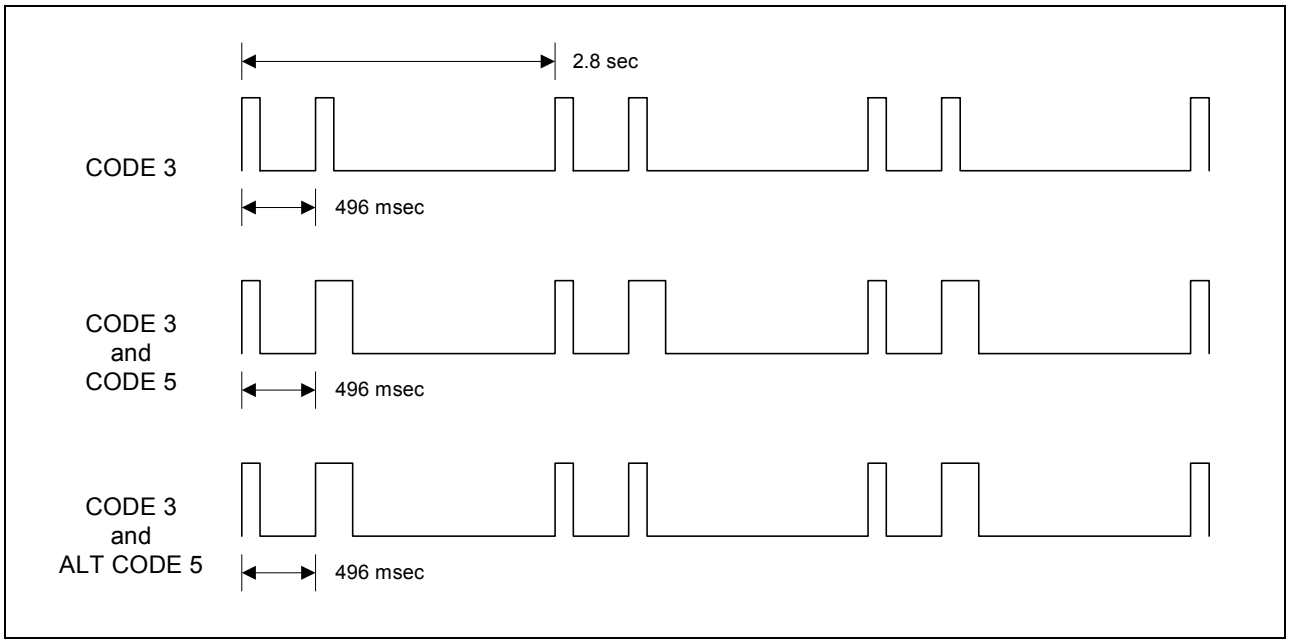


Figure 2–4. Example Code 5 Pulses

Code 6: This non-vital code decreases the tumbledown time of signals in one traffic direction. Traffic direction and the tumble-up of signals are initiated by sending a signal clearing code from a Control Point module. This sets the traffic direction towards the Control Point module. To tumble down the signals in that direction, the signal clearing code transmission from the Control Point module is stopped and Code 6 is transmitted from the Control Point module. The Code 6 transmission causes the Code 1 pulse to lengthen to 600 ms and to stop transmission of the signal clearing code. The Code 6 pulse is transmitted for one Genrakode cycle only and is immediately validated at the opposite track circuit end. The user-defined application logic normally has signal aspects set to stop in the appropriate direction on validation of Code 6, and initiates a repeating of Code 6 to the next track circuit during the next Genrakode cycle.

The fact that the signal clearing code transmission at the Control Point is stopped initiates a fail-safe tumbledown of signals. In this case, signal drop out time is 4.2 to 5.6 seconds. The transmission of no code or Code 1 only from the Control Point also triggers a tumbledown of signals. Typical user-defined application logic also initiates Code 6 transmission in both directions if a train enters a track circuit from a siding or if a NWP input drops.

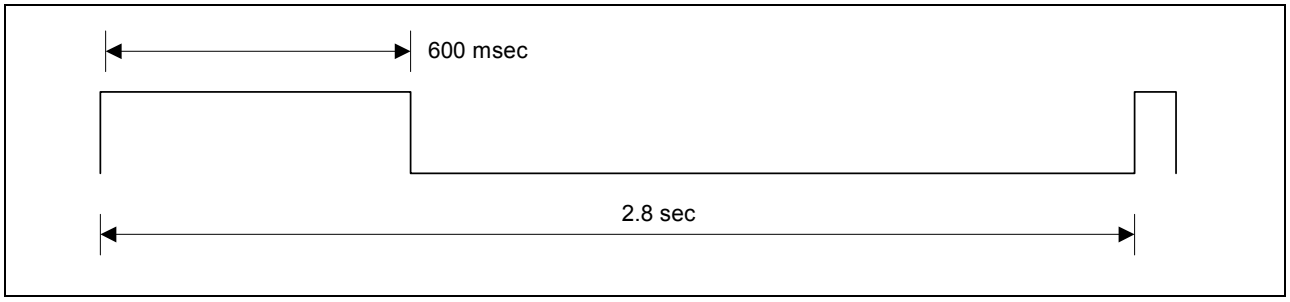


Figure 2–5. Code 6 Pulse

Train detection is provided by the wheel axle shunting method with shunting sensitivities designed for 0.06 Ω shunting. Receiver sensitivity is fixed at a 0.5 ampere threshold that is consistent with many prior relay coded track circuits. Since the track circuit is a DC-pulse format, the "pick" point and "drop away" point of track circuit operation is essentially the "pick" point current level of the receiver, and hysteresis or receiver "drop away" plays no important part in track circuit operation. This is also consistent with relay coded track circuits.

The frequency content of the coding format is a very low frequency, and the track circuit is not a DC relay track circuit, so very long track circuits can be used. This minimizes the number of insulated joints and cut section repeater locations needed. Many factors influence the maximum obtainable track circuit length. These include track circuit lead length and wire size, rail size, welded or railhead bonding, and the minimum ballast resistance conditions. See Section 3, heading 3.7.1., Track Circuit Adjustment for a discussion of maximum track circuit lengths. See Table 3-7 for a summary of how track lead length affects track circuit lengths.

Track circuits often have to share the rails with other types of equipment such as overlay circuits, motion detectors, and predictors and are also subjected to induced levels of 60 Hz interference and lightning surges. These factors have been considered in the design of the Genrakode II system to minimize their influence and thereby produce a reliable and compatible system.

Track filters are provided within the modules to accommodate the majority of situations encountered.

Genrakode II modules operate from a nominal 12VDC signal battery source. For the track circuit operation, Genrakode II converts this 12V power source to a lower voltage that is completely isolated from the signal battery, to operate the track circuit. The voltage can be selected from 1.5 Volts to 4 Volts. This feature allows operation of the track circuit without the necessity of a separate track circuit battery.

Signal lighting and light out detection is provided internally to Genrakode II modules at Intermediate locations. No relays are required at such a location, and an isolated, regulated lamp voltage drive is provided to maximize signal lamp life.

At Control Point locations, where the interlocking logic is performed by vital relays, Genrakode II modules provide decoded outputs for driving relays and code select circuits which operate with relay contact closures or a DC input voltage.

If the interlocking logic is performed by a VPI (Vital Processor Interlocking) system, relays are not required for the interface between VPI and Genrakode II. A direct connection or Vital Serial Link performs the interface of VPI to Genrakode II. For a direct connection, the decoded outputs from Genrakode II are connected to vital input circuits of VPI and double-break outputs of VPI are connected to vital DC code select inputs of Genrakode II. For a Vital Serial Link, a two-wire serial connection is connected between the VPI Vital Serial Controller board and the Programmable Genrakode CPU board (a 4-track Genrakode module chassis is required for Vital Serial Link operation).

The Genrakode II system also incorporates the facility for cab signaling, if desired. The traditional 100 Hz coded, or two-aspect ON-OFF control system is implemented by overlaying the cab signal system on the Genrakode II track circuit. To transmit the cab signal aspect onto the rails, the Genrakode II modules, by way of the track codes being decoded or selected, produce a code rate signal that controls a separate module containing the 100 Hz generator and power amplifier. Maximum track circuit length is necessarily shortened in a cab signal system due to increased signal attenuation along the rails at the 100 Hz carrier frequency. Filtering is provided in the Cab Signal module to isolate signals to and from the Genrakode unit, the Cab Signal module and other track circuit equipment. 60 and 250 Hz cab signal equipment are also available.

See Appendix A for typical application circuits and a typical control line diagram for applying Genrakode II through the rails.

2.3.1. Non-Vital Code T

The Genrakode II Code T mode allows transmission of specific Trouble Codes from PGK Intermediate, Repeater, and Switch Lock modules in a block to PGK Control Points at the ends of the block. The use of Code T is only available with PGK CAA versions 2.01 and above. Each module in the block is assigned unique Trouble Codes (up to eight per location) which can be transmitted to alert maintenance personnel to such conditions as failed lamp filaments, loss of commercial power, stuck searchlight signal mechanisms, and other problems. Unlike a single, generic, maintenance code, the Code T mode provides specific information on the location and nature of events requiring maintenance action. The Genrakode II modules in the block store the Trouble Codes received from other modules in the block and these Trouble Codes can be accessed through the PGK serial port interface. Trouble Code information received at the Control Points can be transmitted to the office (as an option) through various means.

Use of Code T requires all modules in a contiguous section of a block to be PGK modules with appropriate software versions and enable settings – the mode is not compatible with conventional Genrakode, PGK without Code T enabled, or other manufacturers' equipment. Code T operation can be enabled or disabled for an application program through the PGKCAA, as well as enabled or disabled in the field through the serial port interface. See the software settings discussion in Section 3, Installation.

Code T, like Code 5, is not a standalone code but can be encoded on all standalone codes except Code 6. Trouble Code information is encoded using Code T in a multi-cycle frame. The number of code cycles required to transmit one frame is based on the number of track circuits in a block this mode can support (currently 28) and the number of unique Trouble Codes per location (selectable between 4 and 8).

Only properly configured PGK Intermediate, Repeater, and Switch Lock modules can transmit Trouble Codes. If Code T operation is fully enabled, a Trouble Code is transmitted by a module when either of the following conditions is met:

- One of the module's trouble code parameters is set True by the application logic. This trouble code is sent in both directions (unless otherwise configured).

- A Trouble Code is received from an adjacent module. This trouble code is not sent in both directions; it is only repeated. The code is received on the East and is transmitted to the West.

- See Appendix B for more information concerning Code T enabling options.

If the track circuit drops for even a single Genrakode cycle while a Trouble Code is being sent, both ends of the circuit reset their Code T processes. The transmitting end waits until the track is up again to restart the same Trouble Code that was interrupted, and the receive end ignores the incomplete Trouble Code frame and waits for another valid frame to begin.

When any module (including Control Point) receives a complete, valid, Trouble Code frame, that Trouble Code is logged to the module's Block Trouble Queue. For Intermediate, Repeater, and Switch Lock modules that Trouble Code is also queued up for transmit on the other track if the repeating function for that direction is enabled.

Several serial port commands are available to configure Code T operation and display Trouble Code information. See Appendix B for complete details.

2.4. CONTROL POINT MODULE

The Control Point module is used at end-of-block signal locations to initiate code transmission to other signal locations through the rails, to decode signals from the rails, to energize relay outputs to reflect the decoded codes, and provides the option to generate cab signal rates.

The Control Point module is available in three basic configurations. Two of the configurations (EAST-only and WEST-only) interface with a single-track circuit, decoding and transmitting signals from one direction only. Both configurations operate similarly but differ in three areas: 1) terminals used to connect the module to external circuits, 2) location of the PC boards in the module, 3) the "free running" cycle time. All EAST direction transmissions occur every 2.8 seconds when no code is received. All WEST direction transmissions occur every 2.9 seconds when no code is received. After the two sides are synchronized the cycle reverts to 2.8 seconds. The difference is required so that both ends of a track circuit can synchronize as quickly as possible when the modules are powered up or when a train vacates the track circuit.

The third configuration is a combination of both the EAST and the WEST configurations. This module contains all the hardware necessary to interface with two track circuits. The operation of EAST and the WEST functions of this configuration are totally independent. One CPU board runs both the EAST and the WEST programs simultaneously.

Selecting a code to be transmitted can be accomplished in two ways, depending upon the type of Code Select board installed. Using the Relay Code Select board (P/N 59473-830-01), a connection is made between a common select terminal, called a REFERENCE terminal, to one or more code select terminals through a relay contact or a network of relay contacts. This Code Select board is used in the majority of applications.

A single Code Select board contains the required circuitry to select the codes to be transmitted to the EAST and the WEST directions. If a single direction configuration is used, the unused code select terminals are typically left unconnected, but can be used as general purpose inputs.

When any code is to be transmitted, Code 1 must also be selected along with the desired code.

Codes received from the rails are decoded and typical user-defined application logic energizes a relay output(s) to reflect the received code(s). There are eight relay outputs per direction. As there are nine codes, either one must not cause a relay output to be energized at all or a combination of relay outputs must be used to represent the reception of that code. If such combinations are used, they must be implemented vitally, so that if any single relay output fails, a less permissive code must be indicated.

With the addition of an Auxiliary I/O Board, a number of functions can be added to the Control Point module. Two vital auxiliary inputs are provided for general use (determined by user-defined application logic), such as downgrading the transmitted

codes based on external conditions. This could typically include input from equipment such as switch controllers, slide fences, high water detectors, dragging equipment detectors, etc. Cab signal outputs are provided for the EAST and WEST directions. These outputs, controlled by the Auxiliary I/O Board, interface with the Genrakode Cab Signal module and provide the coded cab signal rates.

NOTE

No other inputs or outputs of the Auxiliary I/O board are available in the Control Point module except for the ones listed above.

2.4.1. Hardware Configurations

The Genrakode II Control Point module is available in three basic hardware configurations. These are the EAST-only configuration, the WEST-only configuration, and the dual EAST/WEST configuration. Each module requires a PGK CPU board and a Code Select board from the start. The Code Select board also has two options -- it can be a Relay Code Select or a DC Code Select board. Relay-type code select inputs are the standard type and only require a contact or group of contact closures to select a code. DC-type code select inputs require the presence of a DC voltage to select a code. DC code select inputs are required when the code selection is generated by another electronic device, such as VPI, as opposed to relays.

Each module requires either a Standard Regulator/Filter board or a Power Supply Regulator/Filter board. If Low Signal Battery and Ground Fault Monitoring functions are needed, a Power Supply board must be used. Otherwise, a Standard Regulator/Filter board is sufficient. Note that a Power Supply board can be used to provide the Regulator and Filter functions even if the additional functions are not needed.

In addition, for each direction (EAST and/or WEST) for which the module interfaces, a VPC board, a Decode Output board, and a code interface board are required. The Decode Output board can be the Group 01 high AC-noise immunity version or the Group 02 Cable Integrity Check version. The code interface board can be the CONV/RCVR Group 01 for interfacing to track or the Group 02 line drive/receiver if connecting to line wire.

A Control Point module can also include an Auxiliary I/O board, the AUX I/O I, II, or III. The addition of an Auxiliary I/O Board provides EAST and WEST two wire auxiliary inputs and EAST and WEST cab signal outputs. Auxiliary inputs are typically used to downgrade the signaling system due to an external condition. The cab signal outputs interface with the Cab Signal module and generate the appropriate cab signal rates. An Auxiliary I/O Board is required if the auxiliary inputs/outputs or cab signal outputs are used.

Table 2–1. Control Point Module Component Part Numbers

Name	Part Number
CONV/RCVR	59473-833-01 or –02
DECODE OUT	59473-838-01 or -02
VPC	59473-835-01
RLY CODE SEL	59473-830-01
DC CODE SEL	59473-895-01
REG/FILTER	59473-834-01 or 31166-338-02
POWER SUPPLY REG/FILTER	31166-338-01
CPU	31166-141-04
AUXILIARY I/O I	59473-837-01
AUXILIARY I/O II	59473-958-01
AUXILIARY I/O III	31166-043-01

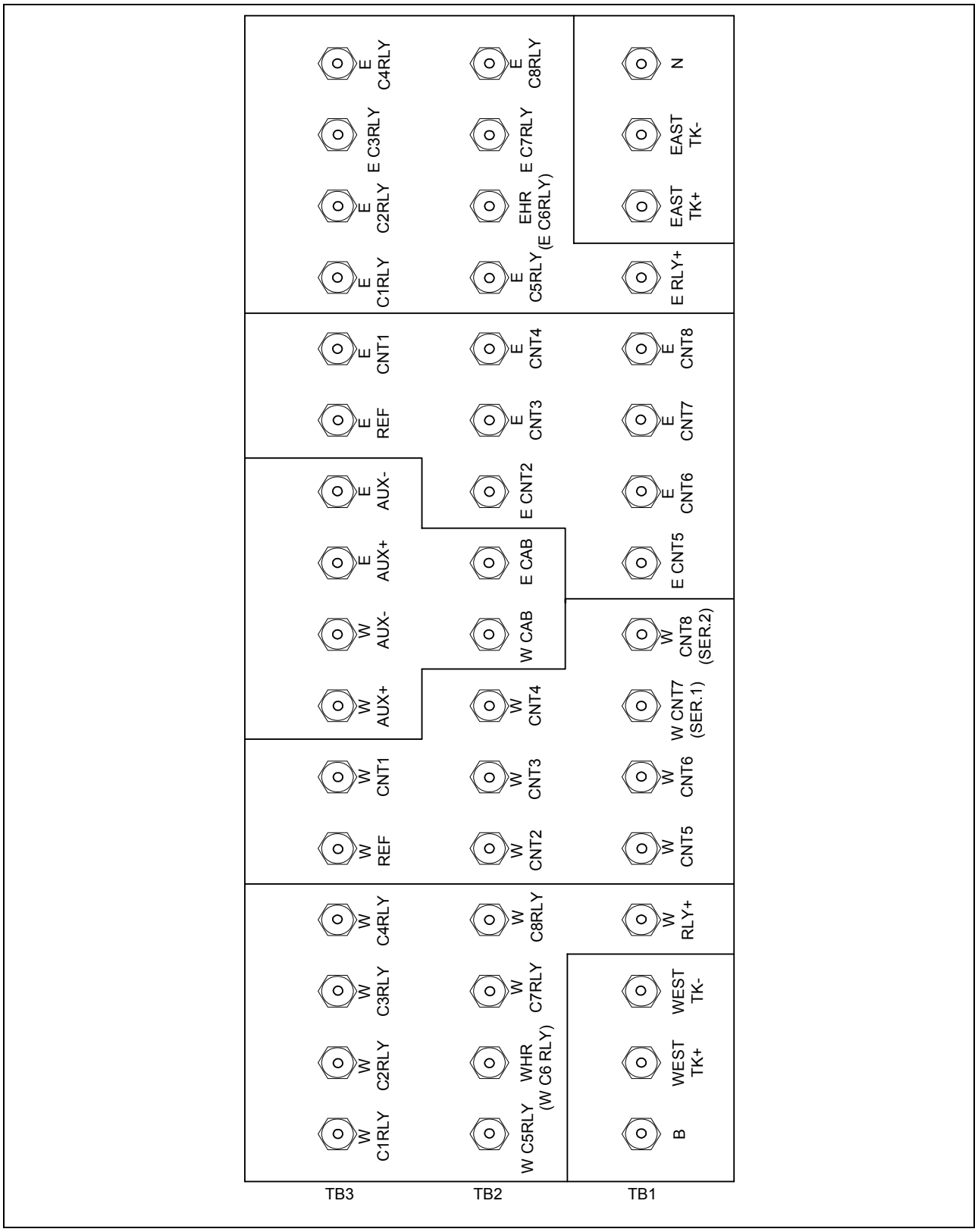


Figure 2–6. Control Point Module AAR Terminals

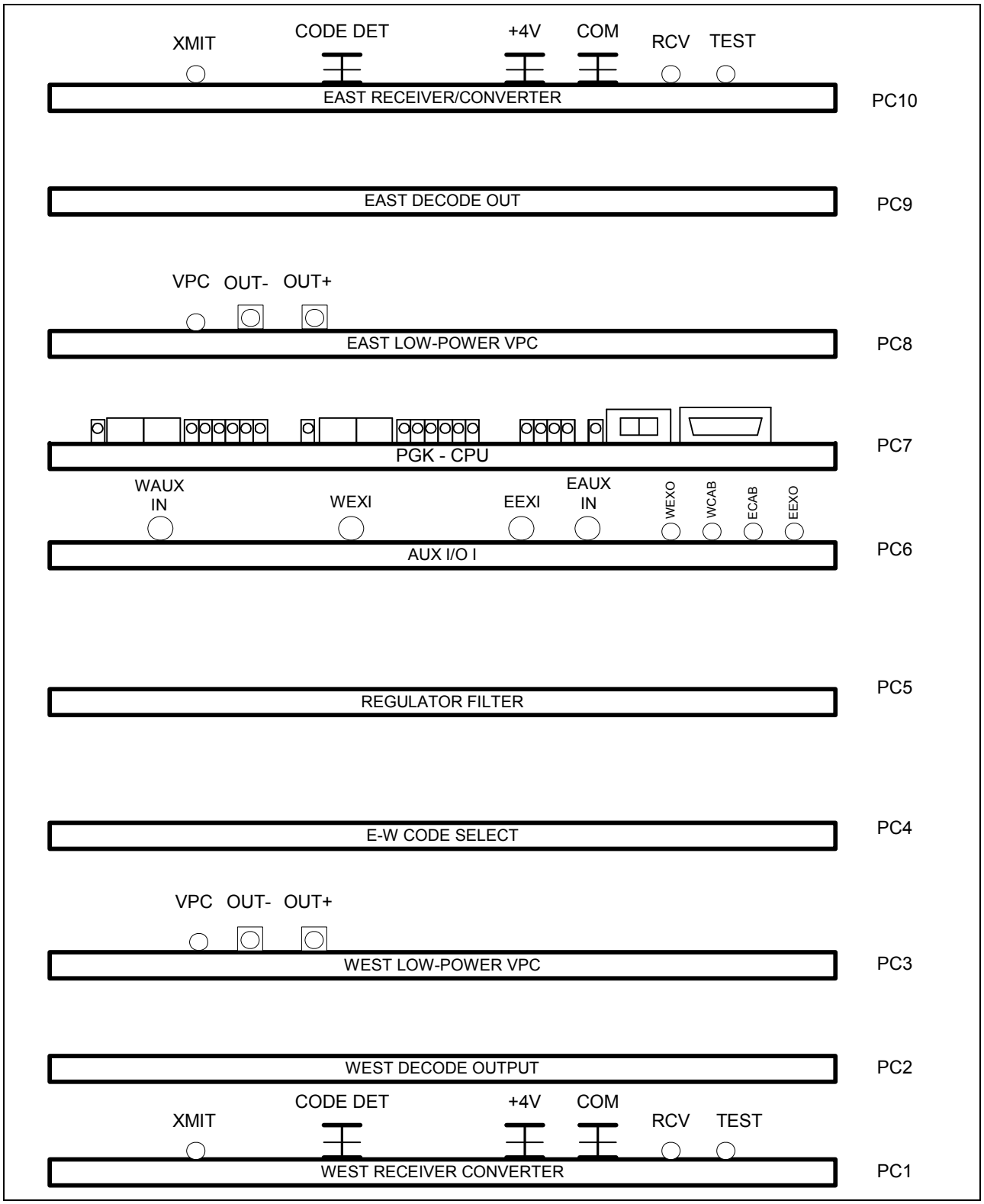


Figure 2–7. LED / Test Point Locations for Control Point Module Boards
(An optional Auxiliary I/O I board is shown as an example)

2.5. 4-TRACK CONTROL POINT MODULE

The 4-Track Control Point module is used with a VPI module in a Control Point in a Box (CPIB) enclosure. It enables the CPIB system to interface with up to 4 separate track circuits to transmit and receive codes through the rails and provides the option to generate cab signal rates.

The 4-Track Control Point module can be thought of as two traditional Control Point modules combined into one module except that the decode output and code select input functions are provided by a Vital Serial Link to the VPI module. The A side makes up one Control Point, and the B side makes up the other, with two tracks controlled by each side. Each of the two sides, A and B, are independent except for the Regulator/Filter board which they share in common. Each side contains two Converter/Receiver boards, a CPU board, a VPC (Vital Power Controller) board, and an optional Aux I/O board.

With the 4 track circuits labeled 1A, 2A, 3B, and 4B, CPU A interfaces to track circuits 1A and 2A through Converter/Receiver boards 1A and 2A, respectively, and CPU B interfaces to track circuits 3B and 4B through Converter/Receiver boards 3B and 4B, respectively. Note that some system documentation still refers to the tracks in terms of East and West. For CPU A, track 1A is the “West” track and track 2A is the “East” track. Likewise for CPU B, track 3B is “West” and track 4B is “East”. It is still advised, though not required, to follow this East/West nomenclature in the sense that “East” tracks should talk to “West” tracks and vice versa.

Each CPU board then communicates to the VPI module via the Vital Serial Link, and the VPI module handles all of the decode output and code select input functions of a typical Control Point module. The CPU boards must be either PGK CPU Group 01 or Group 03; only those two versions of the PGK CPU board contain the Vital Serial Link hardware.

With the addition of an Auxiliary I/O Board, a number of functions can be added to the 4-Track Control Point module. Vital inputs are provided (both single-ended and differential) for general use. Vital outputs are also provided, including ones that can be used to interface with the Genrakode Cab Signal module and provide coded cab signal rates.

2.5.1. Hardware Configurations

The Genrakode II 4-Track Control Point module requires (as previously described) a PGK CPU board, a VPC board, and two Converter/Receiver boards for each side, along with a common Regulator/Filter board. In addition, each side can include an optional Aux I/O board to provide additional vital input and outputs. The list of boards (from left to right facing the module) is as follows:

- PC01 Converter/Receiver 1A
- PC02 Converter/Receiver 2A
- PC03 Aux I/O A (optional)
- PC04 VPC A
- PC05 CPU A
- PC06 Regulator/Filter (common)
- PC07 CPU B
- PC08 VPC B
- PC09 Aux I/O B (optional)
- PC10 Converter/Receiver 3B
- PC11 Converter/Receiver 4B

Table 2–2. 4-Track Control Point Module Components

Name	Part Number
CONV/RCVR	59473-833-01 or –02
VPC	59473-872-01
REG/FILTER	59473-834-01 or 31166-338-02
CPU	31166-141-03
AUXILIARY I/O I	59473-837-01
AUXILIARY I/O II	59473-958-01
AUXILIARY I/O III	31166-043-01

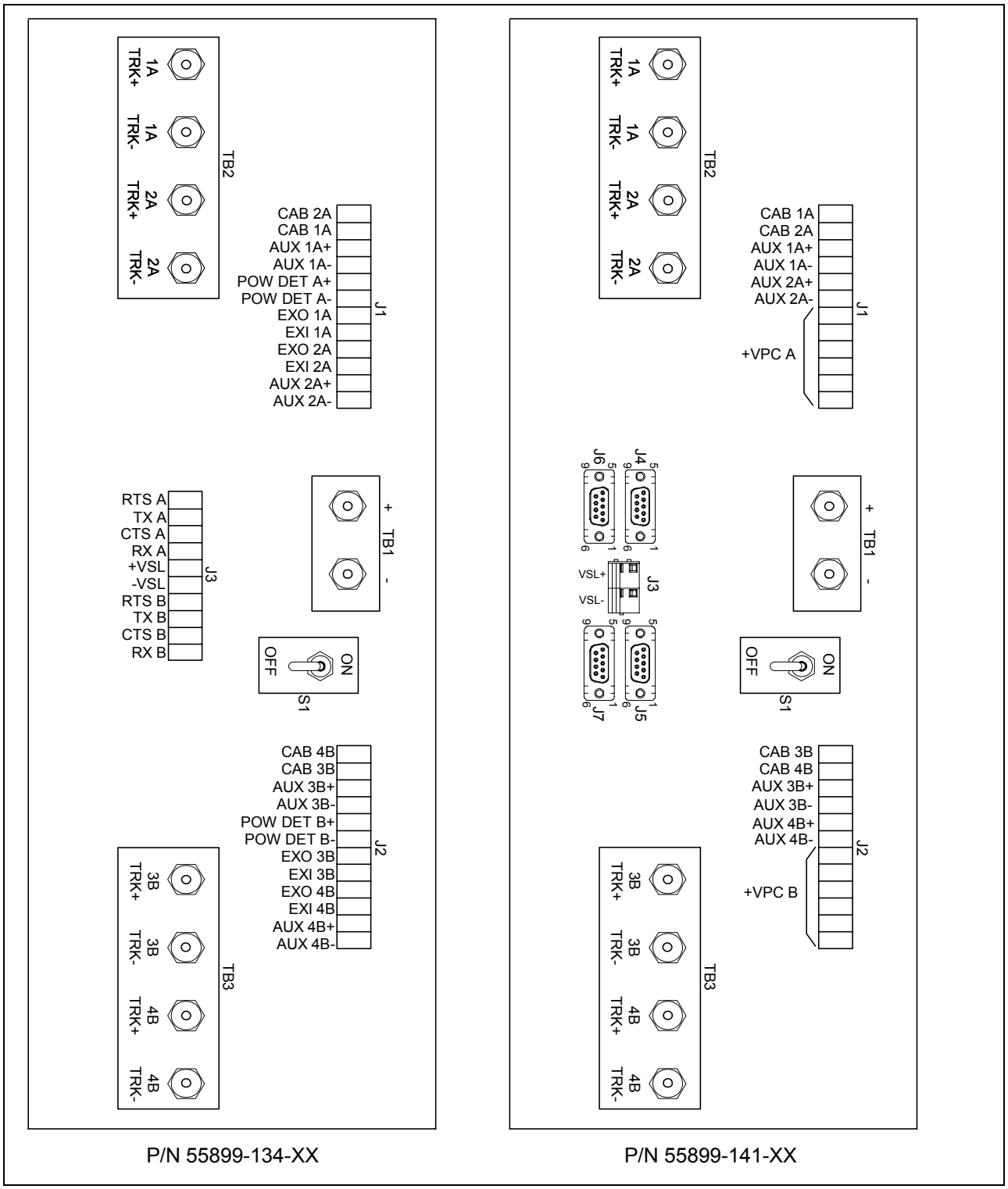


Figure 2–8. 2 Configurations of 4-Track Control Point Module Terminals

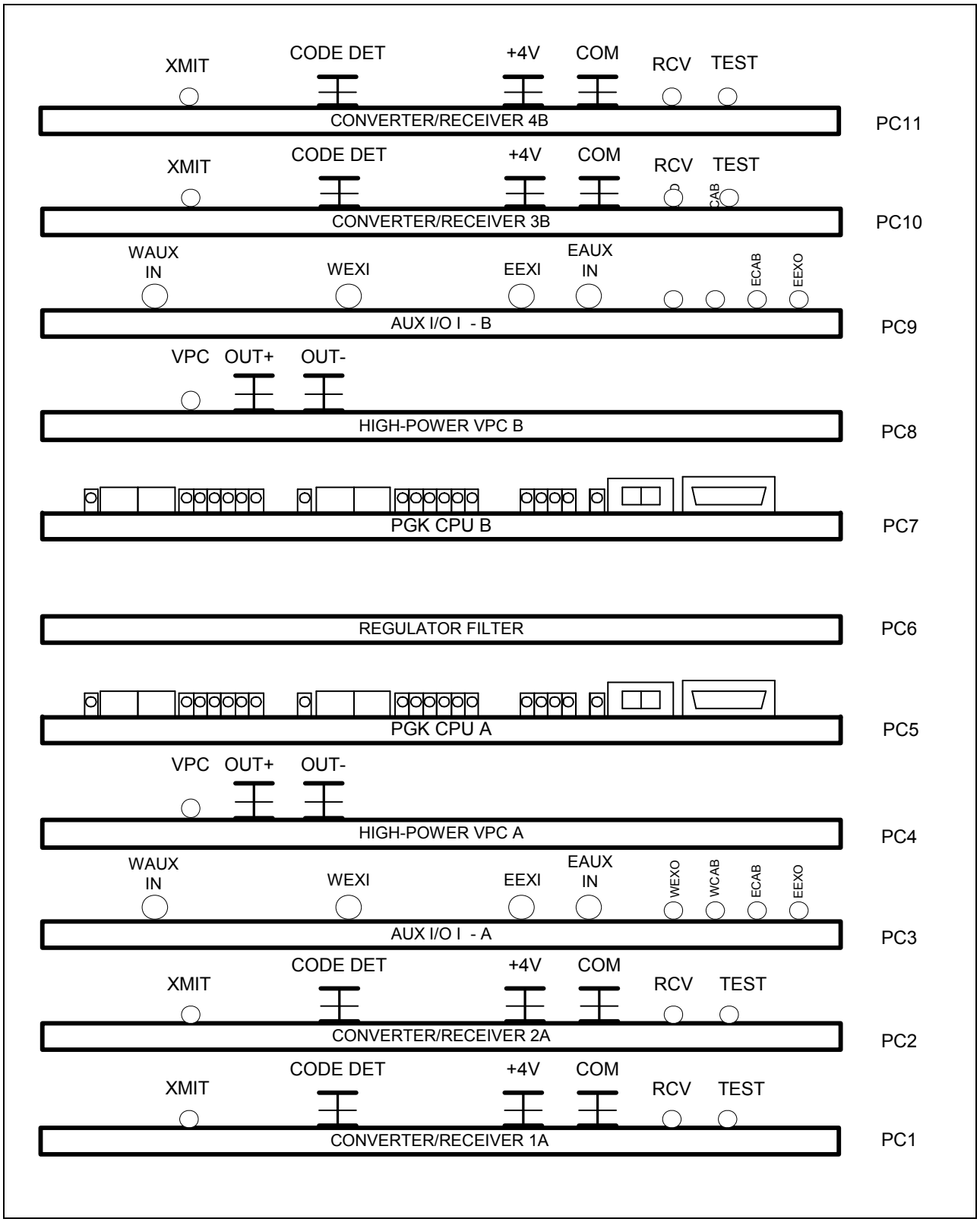


Figure 2–9. LED / Test Point Locations for 4-Track Control Point Module Boards
(An optional Auxiliary I/O I boards are shown as an example)

2.6. INTERMEDIATE MODULE

The Intermediate module is used at intermediate signal locations to decode signals from the rails, drive various types of signals, transmit signals to other modules through the rails, and provides the option to generate cab signal rates. No relays are necessary at an intermediate location. Genrakode II can drive lamps and mechanisms directly and perform all required light out detection. One Intermediate module receives, transmits, and drives signals for both the EAST and WEST directions.

The Intermediate module can drive two types of signals: searchlight and colorlight. Codes received from the rails are decoded. Then, based on these, and any other data such as open filaments, stuck mechanisms, auxiliary inputs, etc., the application in the PGK CAA (Computer-Aided Application) determines what aspect(s) to display and what codes to transmit to the next location.

Signal lamp filaments are tested to be intact every 512 ms. Typically if a filament is determined to be open, the displayed aspect and the code transmitted to the next location can be downgraded. For colorlight signals, only lamps that are required to be on and that have open filaments cause the system to be downgraded. Open filaments in lamps required to be off have no effect on the signaling system. Such decisions of downgrading in response to open filaments are left to the application programmer according to the operating rules of an individual railroad.

For searchlight operation, the position of the mechanism is checked every 512 ms. Typically if a mechanism is determined to be out of correspondence, the signal is set dark and the signaling system is downgraded. These decisions are made at the application level.

Options are provided to allow the signals to be approach lit. When signals are approach lit, they are normally off until the track circuit is shunted.

With the addition of an Auxiliary I/O Board, more functions can be added to the Intermediate module. An EAST and a WEST auxiliary input is provided that allows the displayed aspect and the transmitted code to be downgraded. These inputs are typically used for equipment such as switch controllers, slide fences, high-water detectors, or dragging equipment detectors where the signaling system must be informed of various external conditions. These inputs can also be used for other functions where special signaling conditions arise, such as double track approach lighting.

A dedicated input, called the power detect input, is provided on three versions of the Auxiliary I/O Board to detect the presence/absence of 110-VAC power. This input can be used to approach-light signals if AC power is lost; reducing drain on their batteries.

Cab signal outputs are provided for both the EAST and WEST directions. These outputs, located on the Auxiliary I/O Board, interface to the Genrakode cab-signaling module and provide the coded cab signal rates. An available option is to use cab signal outputs to energize a relay when a particular code or set of codes is decoded.

2.6.1. Colorlight Control

The Intermediate module can drive from one to six lamps (per direction) via the Colorlight Driver Board. All outputs are checked to be in the correct state (on or off). All lamps are checked to insure that the filaments are intact.

Lamps are checked once every 512 ms to insure that the filament is intact. If a filament is determined to be open, both the displayed aspect and the transmitted code typically are downgraded according to the application program.

The state of the lamps (on or off) is checked every 64 ms to insure that the lamp drive circuitry has not failed. If this hardware failure does occur, energy is removed from all outputs in a fail-safe manner and no code is transmitted to the next signal locations (EAST and WEST).

The Colorlight Driver Group 2 board differs from the Group 1 version by the added function of Cable Integrity Check (CIC). When two outputs are shorted together the data returned to the CPU is corrupted, making the short detectable. The trade-off for this added feature is that the circuit is now more susceptible to transients (noise). So in high-noise environments, the Group 1 board, which has very high AC noise immunity but no CIC function, is the solution.

To allow Cable Integrity Check to operate properly, it is necessary to impose some application requirements that should not be unreasonable in the vast majority of applications. These requirements are as follows:

1. Must use independent dropping resistors.
2. Must keep cable resistance less than 0.2 Ohms (200 feet with #10 wire).
3. Must set each dropping resistor to provide between 9.5 and 10.5 Volts at each bulb (when ON).

2.6.2. Searchlight Control

The Intermediate module can drive one or two searchlight mechanisms (per direction) via the Searchlight Driver Board. Bipolar drive circuits provide the necessary drive to control the mechanism(s) and lamp drive circuits control the lamp(s).

The position of the mechanism is checked via three inputs read back from the mechanism contacts. If a four wire check circuit is used, all positions of the mechanism are proven. If a three wire check circuit is used, it is possible for the mechanism to be stuck in the green position and not be detected if the yellow position is called for. This condition may be acceptable if the "green" position and the "yellow" position display the same aspect. See Figure 2–10.

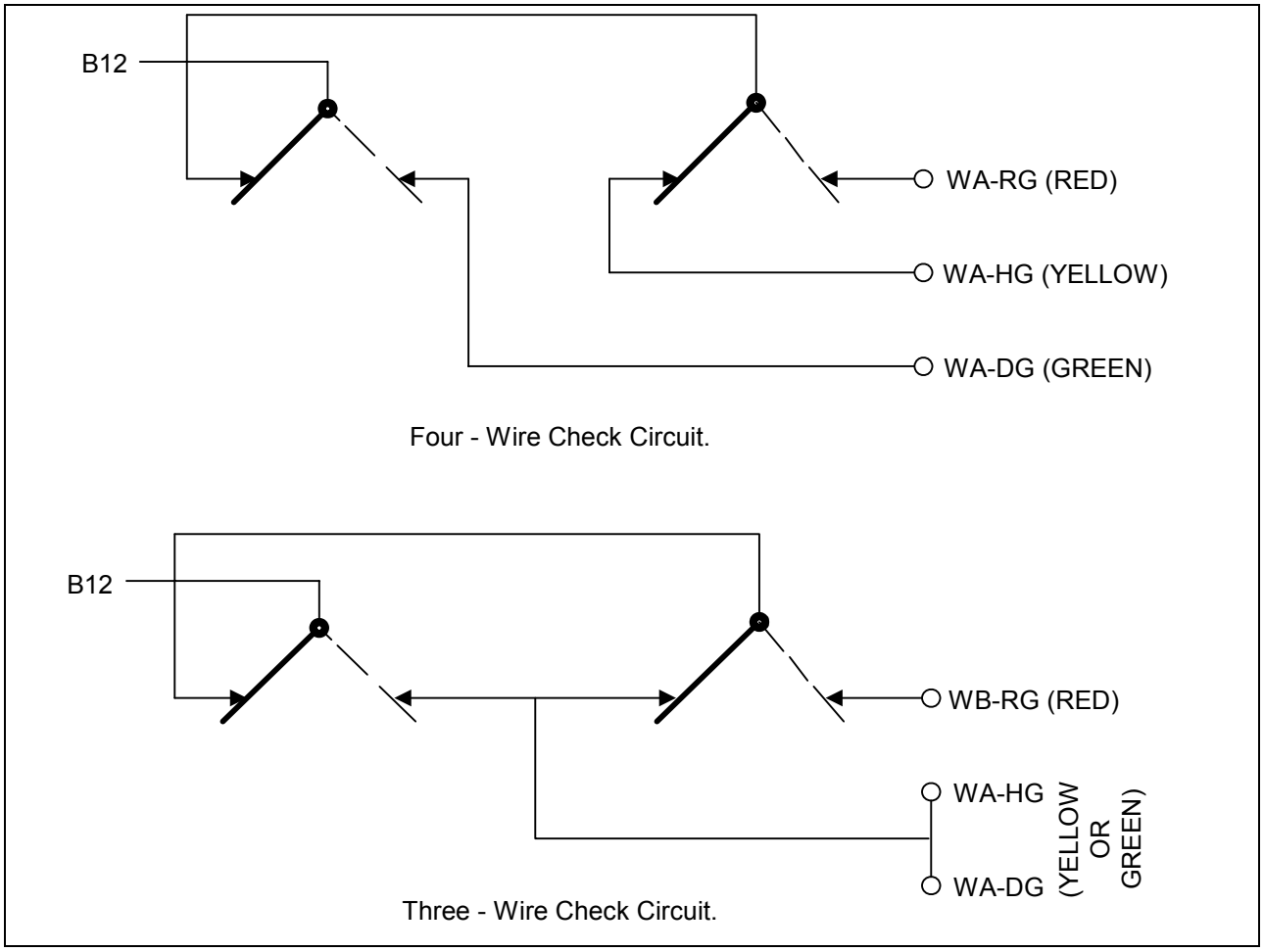


Figure 2–10. Three - and Four - Wire Searchlight Check Circuits

The position of the mechanism(s) is checked every 512 ms to prove that the correct aspect is being displayed. If the mechanism has been called to a new position, the new position is checked for correspondence after a typical delay of two seconds and every 512 ms thereafter.

Lamps are checked once every 512 ms to insure that the filament is intact. If a filament is determined to be open, both the displayed aspect and the transmitted code are typically downgraded according to the application program.

The state of the lamps (on or off) is checked every 64 ms to insure that the lamp drive circuitry has not failed. If this hardware failure does occur, energy is removed from all outputs in a fail-safe manner and no code is transmitted to the next signal locations (EAST and WEST).

The Group 2 of the Searchlight Driver board differs from the Group 1 due to the added function of Cable Integrity Check (CIC). When two outputs are shorted together the data returned to the CPU is corrupted, making the short detectable. The trade-off for this added feature is that the circuit is now much less resistant to AC noise immunity. So in high-noise environments, the Group 1 board, which has very high AC noise immunity but no CIC function, is the solution.

To allow Cable Integrity Check to operate properly, it is necessary to impose some application requirements that should not be unreasonable in the vast majority of applications. These requirements are as follows:

1. Must use independent dropping resistors
2. Must keep cable resistance less than 0.2 Ohms (200 feet with #10 wire)
3. Must set each dropping resistor to provide between 9.5 and 10.5 Volts at each bulb (when ON)

2.6.3. Hardware Configurations

The Genrakode II Intermediate module is available in many hardware configurations. There are four basic units: a colorlight configuration with and without an Auxiliary I/O board and a searchlight configuration with and without an Auxiliary I/O board. Each module requires a PGK CPU board, and then for each direction (EAST and WEST) a VPC board and a code interface board are required. The code interface board can be the CONV/RCVR Group 01 for interfacing to track or the CONV/RCVR Group 02 line drive/receiver if connecting to line wires.

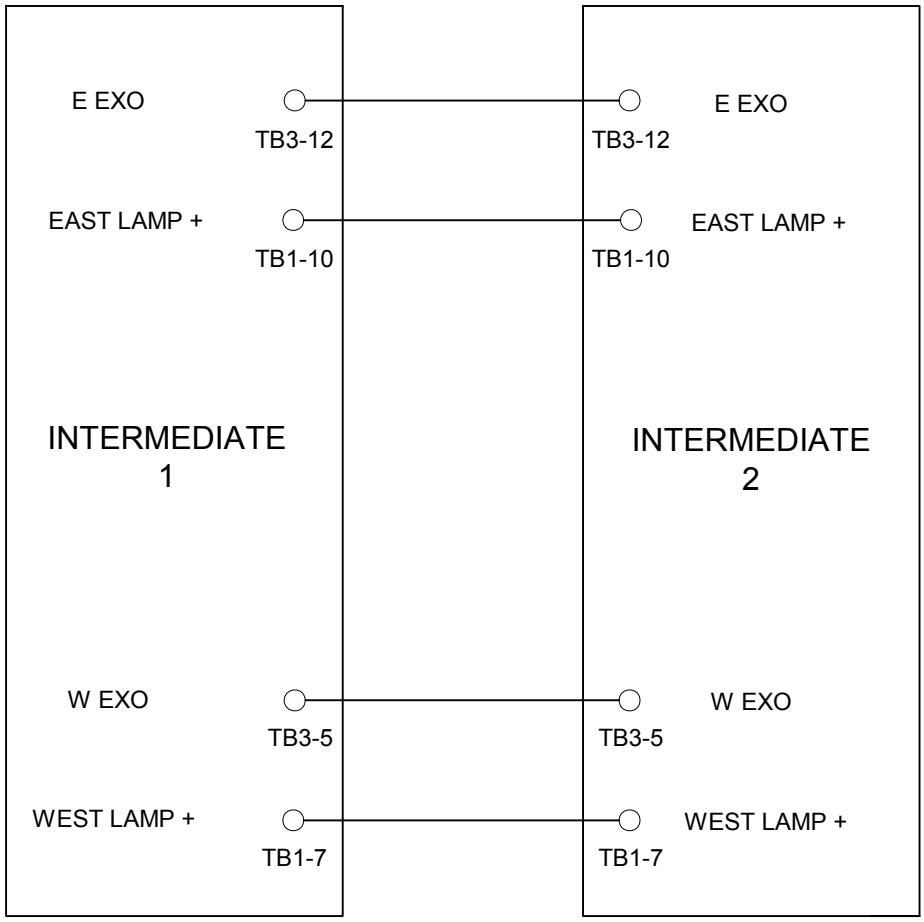
Each module requires either a Standard Regulator/Filter board or a Power Supply Regulator/Filter board. If Low Signal Battery and Ground Fault Monitoring functions are needed, a Power Supply board must be used. Otherwise, a Standard Regulator/Filter board is sufficient. A Power Supply board can be used to provide the Regulator and Filter functions even if the additional functions are not needed.

Each direction has the option of the type of signal it controls. The options are colorlight, searchlight, or none. The two directions can control the same type of signal or different. For example, one Intermediate module could control EAST/WEST colorlights, EAST colorlight / WEST searchlight, EAST searchlight / WEST none, etc. Both the Colorlight and Searchlight boards have the option to be the Group 01 Standard (higher AC-noise immunity) version or the Group 02 Cable Integrity Check version.

An Intermediate module can also include an Auxiliary I/O board, the AUX I/O I, II, or III. If an AUX board is added, the module must have both EAST and WEST VPC boards, regardless of single or dual direction. The addition of an Auxiliary I/O Board provides EAST and WEST two wire auxiliary inputs and EAST and WEST cab signal outputs. Auxiliary inputs are typically used to downgrade the signaling system due to an external condition. The cab signal outputs can interface with the Cab Signal module and generate the appropriate cab signal rates. An Auxiliary I/O Board is required if the auxiliary inputs/outputs, the AC power detect inputs, the cab signal outputs, or approach lighting is used.

Table 2–3. Intermediate Module Components

Name	Part Number
REGULATOR/FILTER	59473-834-01 or 31166-338-02
POWER SUPPLY REG/FILTER	31166-338-01
CPU	31166-141-04
CONVERTER/RECEIVER	59473-833-01 or -02
HIGH POWER VPC	59473-872-01
SEARCHLIGHT DRIVER	59473-863-01 or -02
COLORLIGHT DRIVER	59473-864-01 or -02
AUXILIARY I/O I	59473-837-01
AUXILIARY I/O II	59473-958-01
AUXILIARY I/O III	31166-043-01



For EAST Double Track Approach Lighting:

- Connect E EXO Terminals (TB3-12) From Module 1 to Module 2
- Connect EAST Lamp + Terminals (TB1-10) From Module 1 to Module 2

For WEST Double Track Approach Lighting:

- Connect W EXO Terminals (TB3-5) From Module 1 to Module 2
- Connect WEST Lamp + Terminals (TB1-7) From Module 1 to Module 2

Figure 2–11. Connections for Double Track Approach Lighting (using Aux I/O #2)

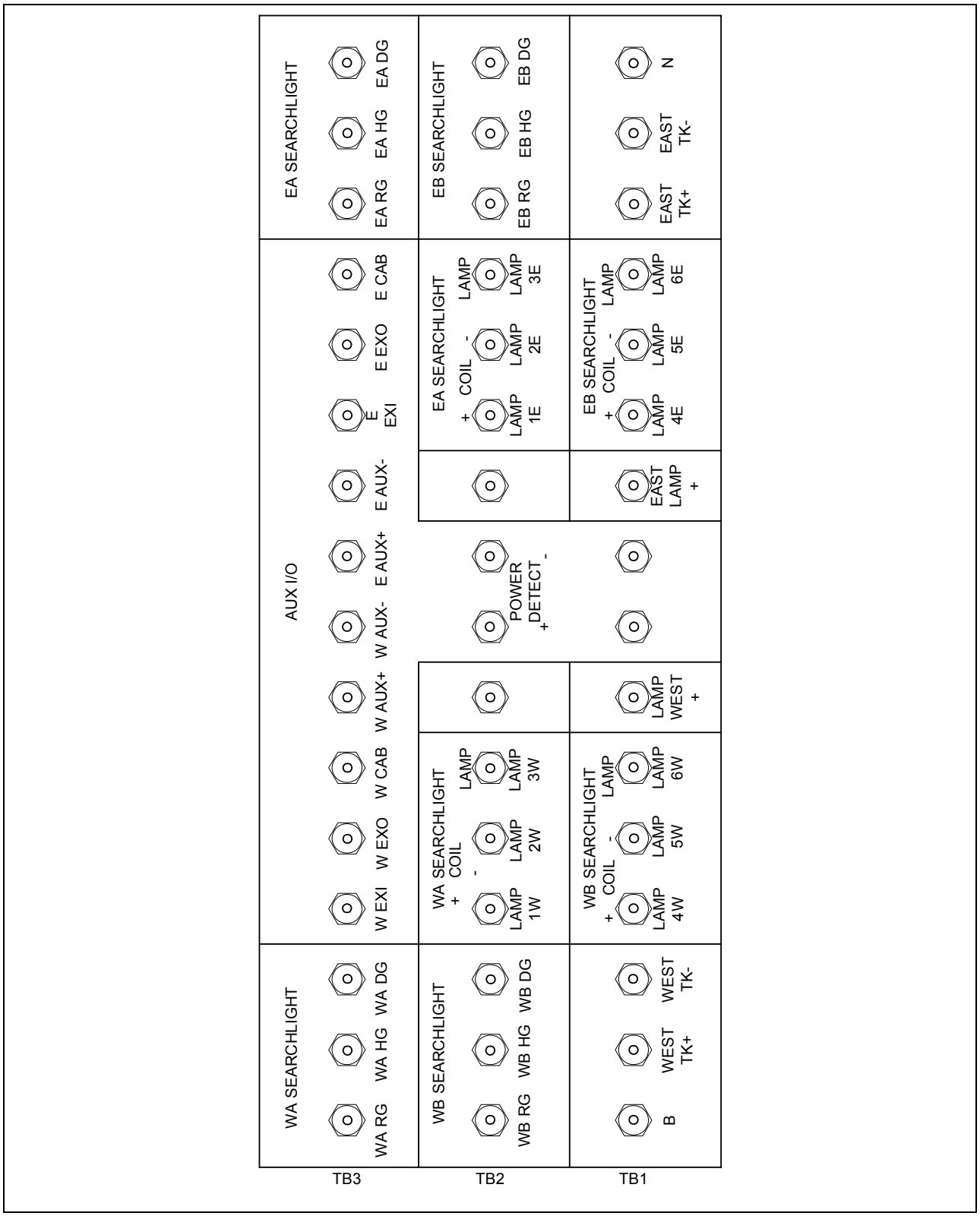


Figure 2–12. Intermediate Module AAR Terminals

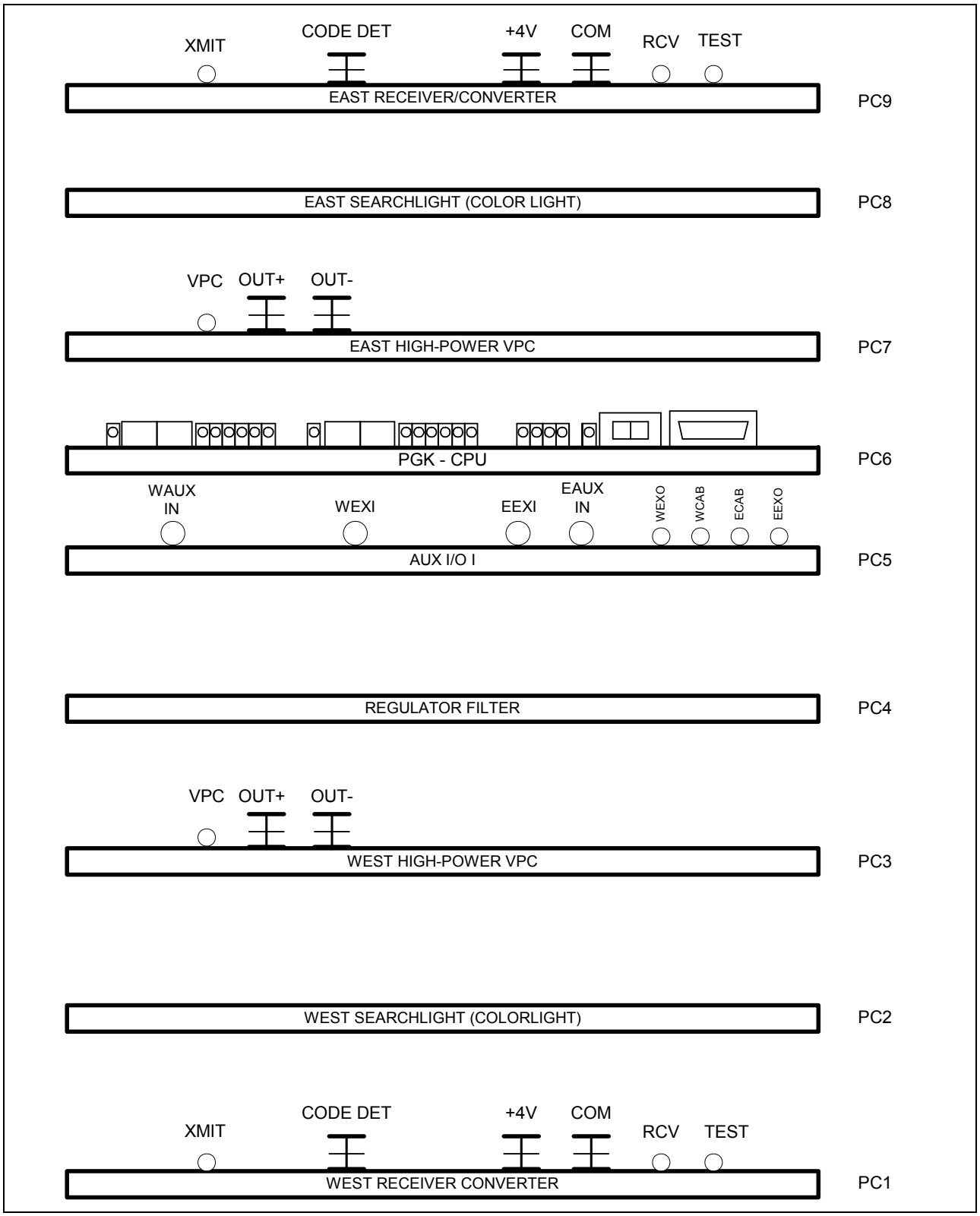


Figure 2–13. LED / Test Point Locations for Intermediate Module Boards
(An optional Auxiliary I/O I board is shown as an example)

2.7. REPEATER MODULE

The Repeater module, a regenerative repeater, receives signals from the rails on one side of an insulated joint and transmits a regenerated copy of the same signal to the other side of the joint. The Repeater module transmits and receives from both the EAST and the WEST directions.

The Repeater module uses the same motherboard as the dual Control Point module, but not all of the AAR posts are present. This allows a Repeater case to be used as a Control Point case if the missing AAR posts are installed. Likewise, a dual Control Point case can be used as a Repeater case. Another way to create a Repeater module is to use an Intermediate module chassis without any signal driver boards. Then, if signals are added to that location, the module can easily be converted to an Intermediate. If an Intermediate module chassis is used to implement the Repeater module, see Appendix A for terminal definitions.

2.7.1. Asynchronous Repeater

The Asynchronous Repeater transmits on one side anywhere between 0 and 2.8 seconds after receiving a code on the other side. The received code is fully decoded and, if it falls within the tolerances of a valid code, is transmitted to the next track circuit at the next transmission cycle. Since transmission is started after a code has been completely decoded, no code is transmitted if an invalid code is received.

The application program sets the default Code 5 type. It can be set as repeated, terminated, or initiated and set as standard, long, or alternating. These choices can be changed during module operation by using the rocker switch on the front of the CPU board. See Section 6 for instructions on the operation of the rocker switch.

The number of consecutive Asynchronous Repeaters that can be used in one block is unlimited. The transmission time on one side of the Repeater is not synchronized to the reception of codes on the other side.

With the addition of an Auxiliary I/O Board, a number of functions can be added to the basic repeating function. EAST and WEST auxiliary inputs are provided typically to cause the transmitted code to be downgraded due to such things as switch circuit controllers, slide fences, high-water detectors, dragging equipment detectors, etc., especially where the signaling system must be informed of various external conditions. This input can also be used for other functions where special signaling conditions arise.

Cab Signal outputs are provided for the EAST and the WEST direction. These outputs, located on an Auxiliary I/O Board, interface with the Genrakode Cab Signal module and provide the coded cab signal rates. An available option is to use cab signal outputs to energize a relay when a particular code or set of codes are decoded. The application programmer determines the use of these outputs.

NOTE

No Auxiliary I/O board inputs or outputs are available in the Repeater module other than the ones listed above.

2.7.2. Hardware Configurations

The Genrakode II Repeater module is available in two hardware configurations. The first configuration includes all the required hardware to operate a Repeater module without any auxiliary functions (auxiliary inputs, cab signal outputs, decoded outputs). The second configuration is identical to the first, with the addition of an Auxiliary I/O Board. Each module requires a PGK CPU board, and then, for each direction (EAST and WEST), both a VPC board and a code interface board are required. The code interface board can be the CONV/RCVR Group 01 for track interfacing or the CONV/RCVR Group 02 line drive/receiver if connecting to line wires.

Each module requires either a Standard Regulator/Filter board or a Power Supply Regulator/Filter board. If Low Signal Battery and Ground Fault Monitoring functions are needed, a Power Supply board must be used. Otherwise, a Standard Regulator/Filter board is sufficient. A Power Supply board can be used to provide the Regulator and Filter functions even if the additional functions are not needed.

A Repeater module can also include an Auxiliary I/O board, the AUX I/O I, II, or III. If an AUX board is added, the module must have both EAST and WEST VPC boards, regardless of single or dual direction. The addition of an Auxiliary I/O Board provides EAST and WEST two wire auxiliary inputs and EAST and WEST vital outputs (typically used for cab signaling). Auxiliary inputs are typically used to downgrade the signaling system due to an external condition. The vital outputs (W CAB and E CAB) can interface with the Cab Signal module and generate the appropriate cab signal rates. Or as an option, these outputs can be used to energize a relay when a particular code (or set of codes) is decoded.

Table 2–4. Repeater Module Components

Name	Part Number
CONV/RCVR	59473-833-01 or -02
VPC	59473-835-01
REGULATOR/FILTER	59473-834-01 or 31166-338-02
POWER SUPPLY REG/FILTER	31166-338-01
CPU	31166-141-04
AUXILIARY I/O I	59473-837-01
AUXILIARY I/O II	59473-958-01
AUXILIARY I/O III	31166-043-01

2.8. SWITCH LOCK MODULE

The Switch Lock Module is used at hand-throw switches equipped with electric locks to safely control siding-to-mainline and mainline-to-siding train moves. Whenever a train crew wishes to unlock the switch, they must issue an unlock request by opening the door on the switch lock stand and issuing the request. The Switch Lock Module only energizes the lock relay, releasing the lock, if conditions defined in the application logic are met to ensure safety. When the lock relay is energized, the switch lever can be moved (and thus the points) so that the train can move between the mainline and the siding.

The Switch Lock Module inputs are:

- Unlock request
- NWP (Normal Switch Position) from the switch circuit controller
- Internal overlay
- Remote overlay
- Codes received from EAST and WEST
- Field programmable long timer, not yet implemented in Genrakode II
- Field programmable unlock code selection, not yet implemented in Genrakode II

Unlike the Genrakode I Switch Lock module, the safety conditions under which a lock relay can be energized are entirely under the control of the application programmer using the PGKCAA application design package.

2.8.1. Switch Lock Inputs And Outputs

The primary I/O circuits that are unique to the Switch Lock module type are located on the Switch Lock I/O Board which contains 3 inputs, 4 outputs, and jumpers for EAST and WEST Lock/Unlock Code selection. See Appendix A for how to select and interpret switch lock codes.

2.8.1.1. Inputs

Unlock Request Input - This vital input is referenced to 12V common. Application of battery +12V energy indicates to the system that an unlock request has occurred. This input terminal is usually connected to the unlock request terminal on the lock stand. AAR label and location: UNL REQ INP, TB1-4.

Remote Overlay Input - This non-vital input is isolated and presence of energy indicates that the external overlay equipment is indicating occupancy. AAR labels and locations: +RMTE OL INP, TB2-4. -RMTE OL INP, TB2-5.

NWP Input - This vital input is connected to the switch circuit controller and if energy is removed, indicates to the application logic that the switch is not in the normal position. AAR labels and locations: +NWP INP, TB2-2. -NWP INP, TB2-3.

2.8.1.2. Outputs

The following outputs are current sinking and referenced to +VPC.

Lamp Output - This non-vital output provides energy return for a lamp of up to 25 watts. This lamp output is normally turned on when the lock relay is energized. AAR label and location: PBKE LMP OUT, TB1-6.

Lock Relay Output - This vital output provides energy return for the lock coil. Coil resistance can be as low as 50 ohms. AAR label and location: LK RLY OUT, TB1-5.

Remote Overlay Output - This non-vital output is energized to provide current sinking output whenever the internal overlay shows occupancy. Coil resistance can be as low as 50 ohms. AAR label and location: OL RLY OUT, TB2-7.

Relay Output - This vital output is used as a general purpose relay output for certain applications. Coil resistance can be as low as 50 ohms. AAR label and location: OUTPUT, TB2-6.

2.8.2. Series Overlay Function

The Series Overlay board detects the presence of a train in the vicinity of the switch on the mainline using a short-range AC track circuit. LED (CR1) on the board indicates when the overlay circuitry has detected the presence of a train. The LED turns on when occupancy has been detected. AAR labels and locations: SERIES TK+, TB1-12; SERIES TK-,TB1-13.

2.8.3. Hardware Configurations

The Genrakode II Switch Lock module is available in many hardware configurations. Each module requires a PGK CPU board, a Switch Lock I/O board, a VPC board, and two code interface boards. The code interface boards can be the CONV/RCVR Group 01 for interfacing to track or the CONV/RCVR Group 02 line driver/receiver if connecting to line wires.

Each module requires either a Standard Regulator/Filter board or a Power Supply Regulator/Filter board. If Low Signal Battery and Ground Fault Monitoring functions are needed, a Power Supply board must be used. Otherwise, a Standard Regulator/Filter board is sufficient. Note that a Power Supply board can be used to provide the Regulator and Filter functions even if the additional functions are not needed.

Furthermore, a Switch Lock module can also include an Auxiliary I/O board, the AUX I/O I, II, or III. The addition of an Auxiliary I/O Board provides EAST and WEST two wire auxiliary inputs and EAST and WEST cab signal outputs. Auxiliary inputs are typically used to downgrade the signaling system due to an external condition. The cab signal outputs can interface with the Cab Signal module and generate the appropriate cab signal rates. An Auxiliary I/O Board is required if the auxiliary inputs/outputs, the AC power detect inputs, or the cab signal outputs are used.

If only the remote overlay input on the Switch Lock I/O Board is used, then the Series Overlay Board is not required. When this board is used the Switch Lock Module checks the remote overlay input and the Series Overlay Board for track occupancy. In typical application logic for a mainline to siding move, if either of these indicates occupancy, then the lock relay is energized without running time.

Table 2–5. Switch Lock Module Components

Name	Part Number
REGULATOR/FILTER	59473-834-01 or 31166-338-02
POWER SUPPLY REG/FILTER	31166-338-01
CPU	31166-141-04
CONVERTER/RECEIVER	59473-833-01 or –02
HIGH POWER VPC	59473-872-01
SWITCH LOCK I/O	59473-878-01
SERIES OVERLAY	59473-877-01
VITAL TIMER	59473-879-01
AUXILIARY I/O I	59473-837-01
AUXILIARY I/O II	59473-958-01
AUXILIARY I/O III	31166-043-01

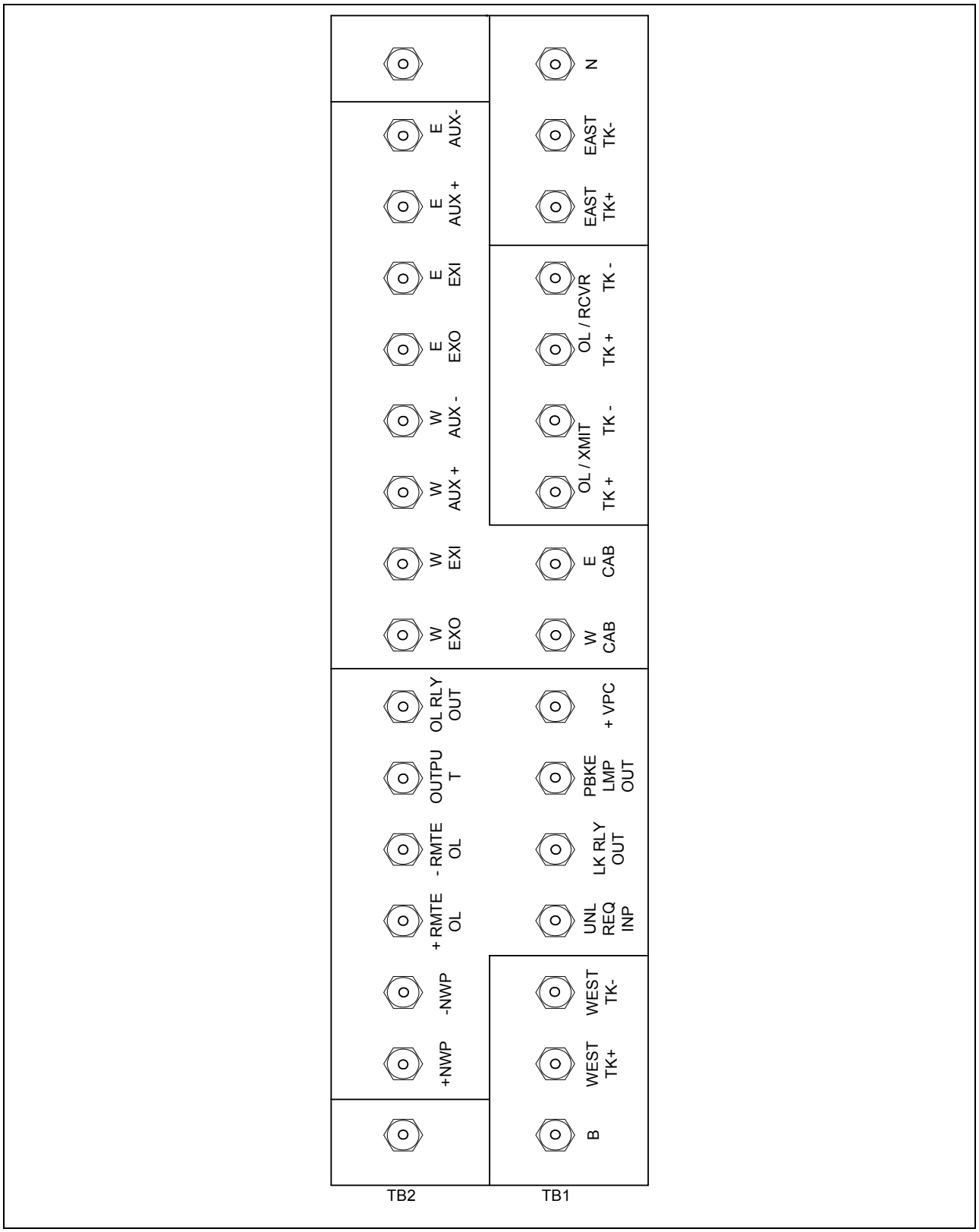


Figure 2–14. Switch Lock Module AAR Terminals

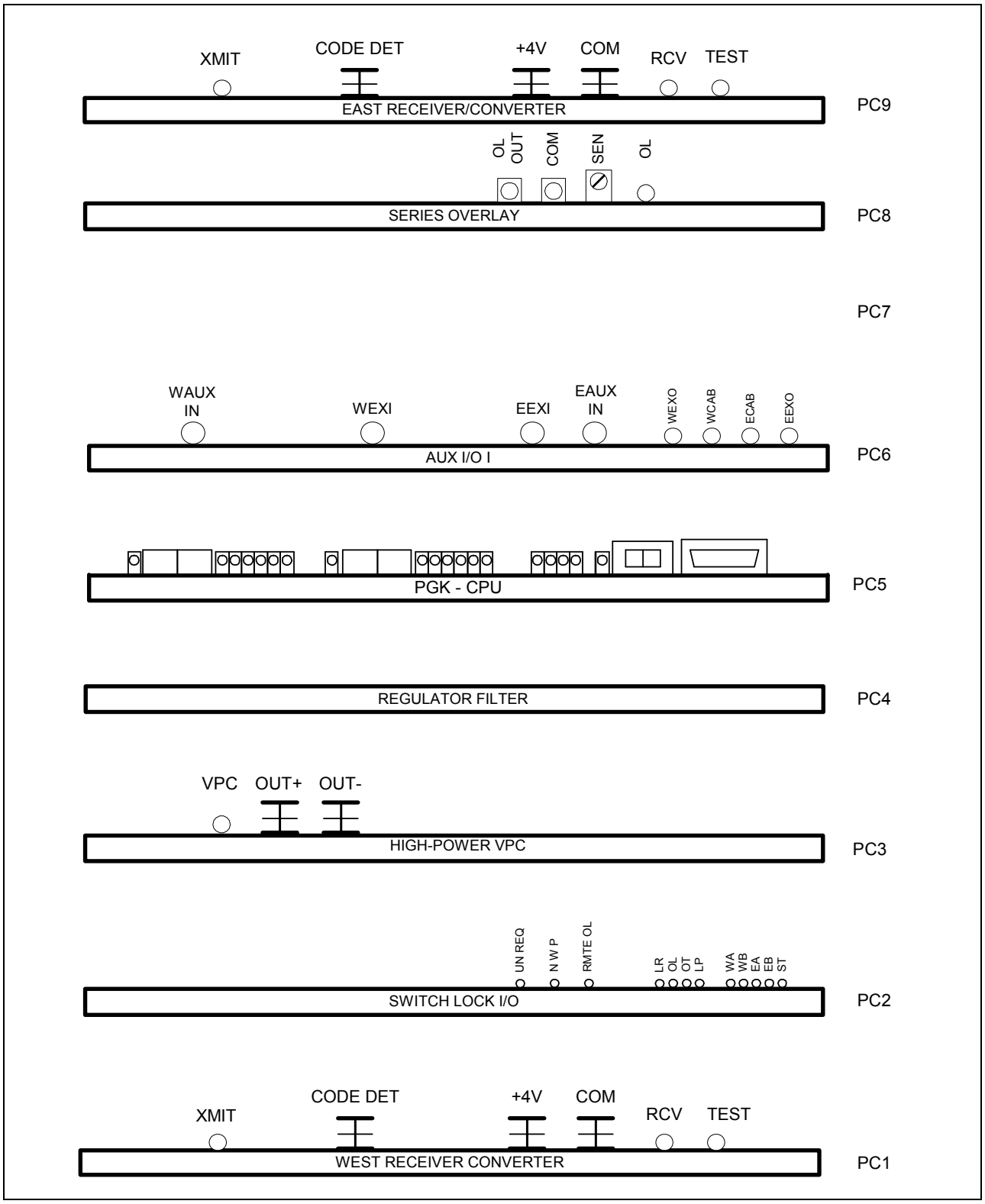


Figure 2–15. LED / Test Point Locations for Switch Lock Module Boards
(An optional Auxiliary I/O I board is shown as an example)

2.9. CAB SIGNAL MODULE

The Cab Signal module is used in conjunction with the Control Point module, Intermediate module, Repeater module, or the Switch Lock module to provide cab signaling to the rails. If an aspect changes while a suitably equipped train is in a block, cab signaling allows the engineer to adjust the speed of the train accordingly without waiting for the next wayside signal.

The module uses one Oscillator/Filter Board and one Driver Board. See Table 2–6. The module contains a 5-Ampere fuse for the low power used by the electronic components and a 15-Ampere fuse for the high power required to drive the cab signal.

Coded cab signal rates are supplied by the Genrakode II track module using a vital power source. The carrier frequency is generated internally on the Oscillator/Filter Board. There are two versions of the Cab Signal module for DC-coded track circuits based on this carrier frequency. One is 100 Hz and the other is 60 Hz. The transmitted signal then is 100% modulation of this carrier frequency at rates provided by a Control Point, Intermediate, Repeater, or Switch Lock module. See Appendix C for a listing of those rates.

The signal is transformer-coupled to the track to provide isolation from the battery. It then passes through a series pass filter to convert the coupled square wave to a sinusoidal waveform and also to reduce the loading of other equipment on the track. To prevent the cab signal from affecting the track module, a parallel blocking filter is used between the track module inputs and the track outputs.

There are four selectable power output taps available at the AAR posts, 100%, 80%, 50%, and 25% to allow adjustment for track circuit length and ballast condition. See Table 3–13 for the Cab Signal Module Output Adjustment Procedure. The Cab Signal module can supply 3 Amperes (for the 100 Hz module or 2 Amperes for the 60 Hz version) into a .06 Ohm shunt at 6,500 feet with 3 Ohms/1000 feet of ballast resistance.

2.9.1. Hardware Configuration

The Cab Signal module contains two circuit boards – a Driver board and an Oscillator board. Three Oscillator board groups provide the different cab signal frequencies.

Table 2–6. Cab Signal Module Hardware Composition

Name	Part Number
Driver Board	59473-907-01
Oscillator Board, 100 Hz	59473-906-01
Oscillator Board, 250 Hz	59473-906-02
Oscillator Board, 60 Hz	59473-906-03

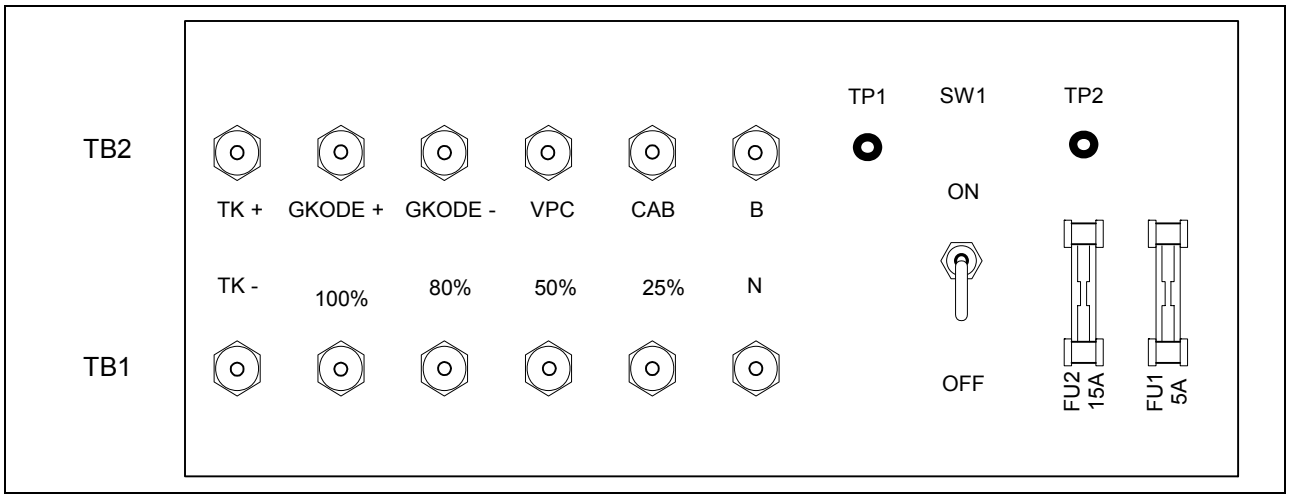


Figure 2–16. Cab Signal Module AAR Terminals

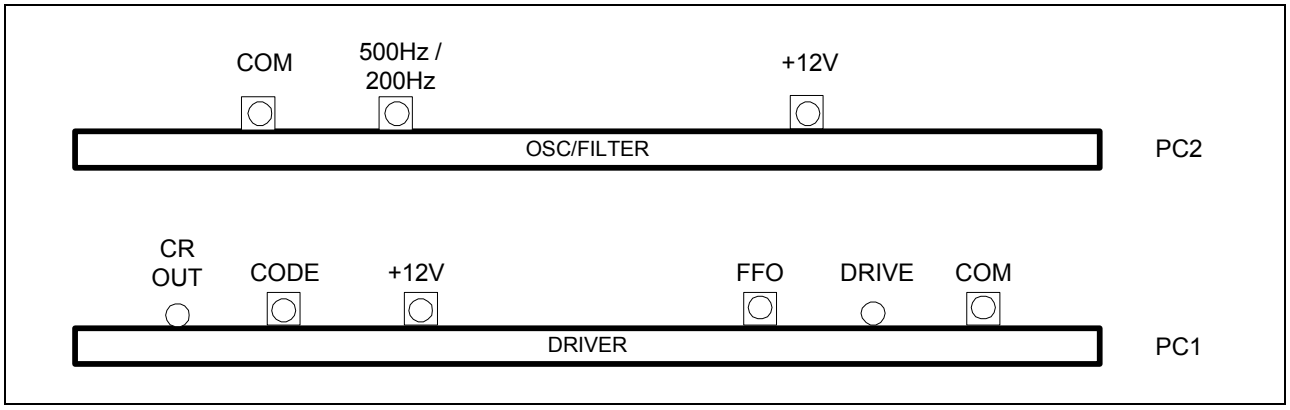


Figure 2–17. LED / Test Point Locations for Cab Signal Module Boards

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3. SECTION –3 INSTALLATION

3.1. GENERAL

This section contains the installation information for the DC version of the Genrakode II system.

3.2. INSTALLATION REQUIREMENTS

Genrakode II modules are either shelf-mounted or mounted on a wall, except for the 4-track Control Point module, which is rack-mounted. Module dimensions vary slightly, depending on application. A typical module is approximately 19 inches wide by 10.0 to 10.5 inches tall. Figure 3–1 shows an intermediate module. All modules come with mounting holes.

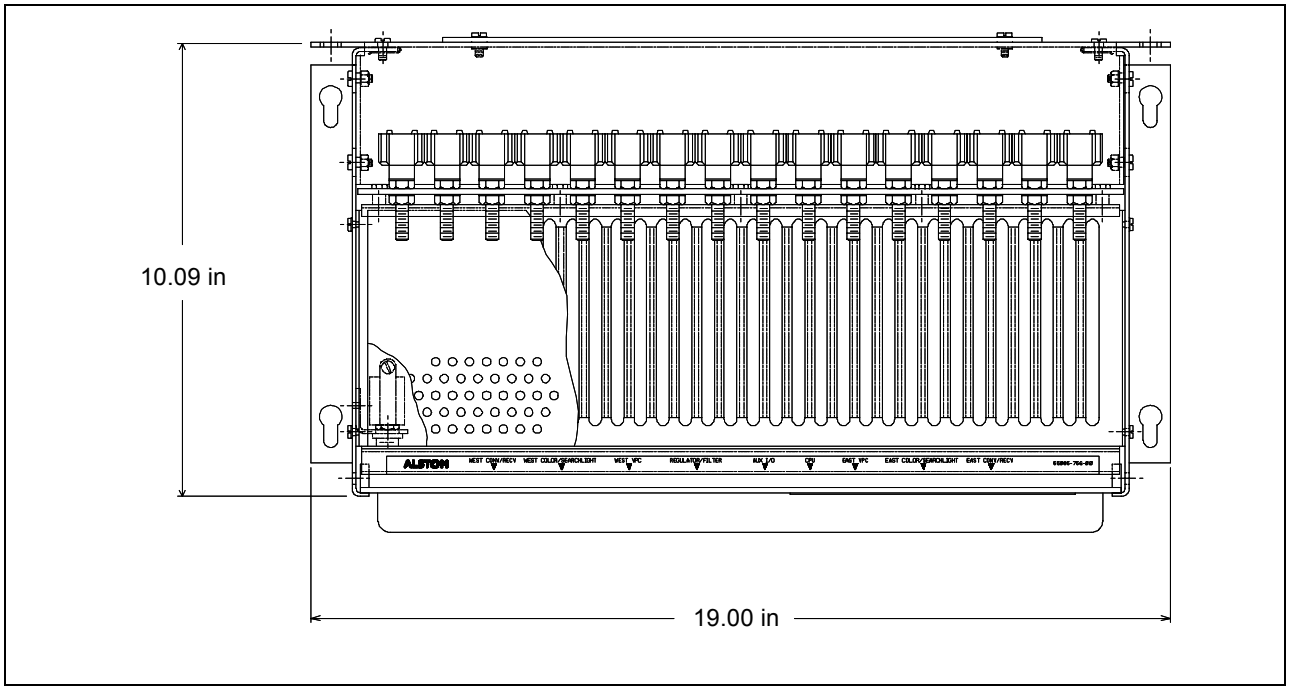


Figure 3–1. Typical Genrakode II Module Dimensions

Besides space requirements, several basic rules must be heeded during installation if the system is to operate properly.

1. **Power Supply** – Genrakode II modules operate on input power ranging from 9 to 16 Volts DC. The standard power source is a 12.0 Volt signal battery. Battery connections to the module should be made with AWG #10 or larger copper wire.

2. **Signal Wiring** – Output connections from the modules to signal lights should be made with at least AWG #10 copper wire. The output voltage to the signal lights is 12.5 ± 0.4 Volts and the resistance of #10 copper wire is 1.0 Ohm per 1000 feet. If the distances are long, it may be necessary to use heavier wire. Signal lamp wiring should be sized to allow at least 10 Volts at the signal lamps. External resistance in the wire and the lamp adjustment resistor should be about 1.0 Ohm.

3. **Track Wiring** – For wiring to the track, AWG #6 or larger copper wire should be used. The resistance of both leads added together should be less than 0.15 Ohm. The resistance of #6 copper wire is 0.4 Ohm per 1000 feet. Special considerations for maximum track circuit lengths must be taken into account per Table B–2 for lead lengths above 200 feet.

   - For the Switch Lock module, AWG #6 twisted pair copper wire should be used to connect the module series overlay input/output to the rails. If AWG #9 twisted pair is used, then the lead length should not exceed 300 feet. (Twisted pair to have a minimum of 1 twist per foot).

   - For line wire between Genrakode II modules (used with Converter/Receiver Bd. P/N 59473-833-02), AWG #6 copper wire should be used for distances up to 15000 ft. For other wire sizes at reduced distances for line wire, see Tables B–3 through B-5. Use twisted pair for buried cable line wire.

4. **Other Wiring** – For other communications, such as outputs to relays or inputs such as code selects or auxiliary vital inputs, use AWG #16 or larger copper wire.

5. **Protection** – Secondary lightning and surge protection is provided within the module. Primary arrestors and equalizers are required on the battery input and all track input/outputs. Arrestors are recommended for inputs and outputs that travel on line wire circuits and/or over long distances and may be subjected to primary lightning strikes.

6. **Insulated Joints** – Track polarity must be staggered on alternate track circuits. If the polarity of the received pulse is not correct, the receiver does not detect it. This feature provides insulated joint (IJ) breakdown protection but only if the polarity on the opposite side of the IJ is reversed.

7. **Cab Signal** – For wiring the Cab Signal module, the above rules apply. B and N are the Power Supply connections. GKODE +, GKODE-, TK+, and TK- are the Track Wiring, and VPC and CAB are “Other Wiring” and can use AWG #16 or larger copper wire. AWG #10 copper wire or larger should be used for jumpering the percentage output terminal to the TK- terminal.

3.3. COMPATIBILITY WITH OTHER TRACK EQUIPMENT

Under some conditions, other types of signal equipment may share the rails with Genrakode. This group of equipment includes overlay track circuits, motion sensors, and constant warning time systems. Although the specific characteristics of each type and brand of equipment varies, the following general statements can be made:

- Any interference that may occur between Genrakode and other equipment most likely effects the other equipment and not Genrakode. This is due to the relative signal levels applied to the rails; Genrakode signals are high (1 - 2 Amperes) whereas signals from other equipment are low.

- The distance between the rail connections of Genrakode and the rail connections of other equipment has a large impact on the ability for the equipment to co-exist. The further apart the two connections, the lower the level of interference.

- The lower the Genrakode transmit level, the lower the level of interference. The higher the operating frequency of the other equipment, the lower the level of interference.

3.3.1. Overlay Equipment

Audio frequency overlay equipment is typically not a problem for either Genrakode or the AF equipment. Genrakode operates without interference with signal amplitude up to 25 V RMS and frequencies between 1 kHz and 20 kHz. See Table C–11 in Appendix C for frequency versus track input impedance data for AF equipment.

3.3.2. Motion Sensors and Constant Warning Time Equipment

Motion sensors and constant warning time equipment (GCP, HXP) determine motion and speed by measuring small changes in applied signals over relatively long periods of time. This process makes the equipment susceptible to any changes of impedance that may appear across the rails. During the transmission and reception of codes, the Genrakode input impedance may experience small changes. Depending on a number of variables, the changes may be sufficient to disturb the MS/CWT equipment. Although it is impractical to attempt to address all possible applications, the following guidelines reduce the potential for interference:

- Where practical, maximize the rail distance between Genrakode and MS/CWT equipment

- Use the highest MS/CWT frequency possible to achieve the desired operation

- When Genrakode and MS/CWT equipment reside at the same location, use separate track leads to connect each to the rails

- Use the lowest possible Genrakode transmit setting that produces reliable track circuit operation

For proper Genrakode operation, all terminating shunts must be of the narrow band style. Wide band shunts should be avoided, as they distort the Genrakode signals and cause intermittent operation. Refer to the manufacturer's specific requirements when bypassing insulated joints.

3.3.3. Filter Requirements

As a general rule of thumb, if Genrakode is installed at the same location as a motion sensor or constant warning time system, a filter should be installed, regardless of the operating frequency. The Safetran Track Isolation Unit (6A-342-5) is the preferred device. This unit is not frequency dependent, and as such can be used in all applications. Alternatively, a Harmon tuned filter (TF-xxx) can be used. Refer to each manufacturer's instruction for installation details.

If Genrakode resides within the MS/CWT approach track circuit, but not at the same location (a few hundred feet or more between the two), a filter may or may not be required. A number of variables including specific operating characteristics (such as software "enhancements") of the various manufacturers product impact the need for a filter. In general, the newer versions of the microprocessor based MS/CWT products are less susceptible to interference, and as such may not require any filtering. It is recommended that a filter be readily available, if it is not initially designed in.

If Genrakode resides outside the approach track circuit, a filter is typically not required. Again, a number of variables impact the need for a filter, and it is conceivable that with older style non-microprocessor based equipment a filter may still be required. The greater the distance between Genrakode and the terminating shunt, the less likely a filter is required.

3.4. PRELIMINARY CHECKS AND SETTINGS

Before turning on the power, check the set of plans associated with the installation location to verify:

- Correct type and number of modules and boards are present
- Battery power connections to B and N are correct
- All auxiliary inputs are wired correctly

3.4.1. Site ID And Revision ID

In the PGK CAA the user can designate a Site ID (SID) and a Revision ID (REV). SID defaults to 100 and REV defaults to 1. The Application Programmer can choose any SID they wish for their own unique configuration management. They may even wish to use the same SID for multiple modules (for example contiguous Intermediates). The REV is for general use by the Application Programmer to keep track of changes (Revisions) to the application. By then subsequently wiring the REV jumpers accordingly, the individual installing the newest Revision can be forced to recognize the change at the module before it functions. These jumpers are located behind the existing CPU board edge (the side that meets the Motherboard) on the 70 pin board edge connector, shown in Figure 3–2. There are 3920 possible SID's and 28 possible REV's. There are always a total of nine jumpers regardless of the SID and REV values. The PGK CAA generates a wiring list for the selected SID and REV of an application. See the CAA User's Manual.

NOTE

The Site ID and Rev ID (and therefore the ID jumper list) are completely under the control of the Application Programmer, who must determine whether an ID change is required (for safety reasons) when an application program is modified.

NOTE

The ID jumpers are located on the back of the module and should be set/checked prior to mounting the chassis. ID jumpers can be either wire-wrap or "push-on" jumpers.

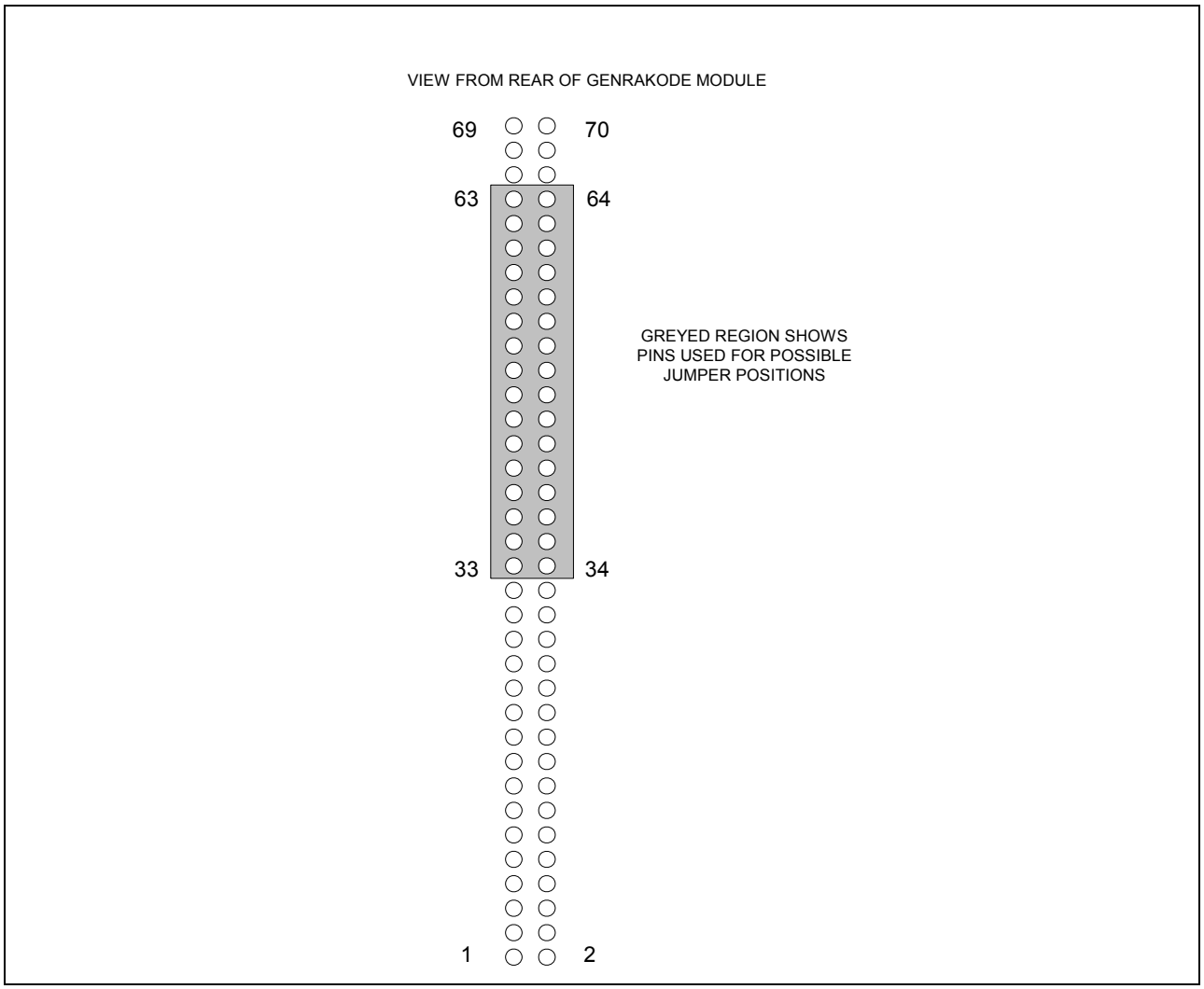


Figure 3–2. ID Jumpers

3.4.2. Hardware and Software Settings

Once the module is properly wired, there are hardware adjustments that must be performed, and there are field-selectable software settings that may need to be adjusted (usually indicated on the set of plans for the location).

See Heading 3.7., Hardware Adjustment Procedures, for details on the adjustments that must be performed.

See Heading 3.8.2., Software Settings, for details on displaying or modifying the field-selectable module settings.

3.5. FINAL CONNECTIONS

Before making the final connections to the track, check that the operation of the module is in accordance with the requirements of the plans for that location.

If available, a Genrakode Test Unit can be used to verify a module's operation. See the Genrakode Test Unit User's Manual (P2160TU) for more details on connecting and using the test unit.

Once preliminary testing is finished, connect the track or line wire leads to the module and adjust the track circuits using the procedures provided in Tables 3–5 through 3–8. It is recommended that pertinent Maintenance Data be recorded in a log. Suggested recorded data includes track length, type of rail (bonded or welded), converter settings (primary and secondary), and receiver screw switch settings. Also, record the peak receiver current, the peak transmit current and the peak transmit voltage. There is a sample Maintenance Log provided in Figure 4–1 at the end of Section 4, Preventive Maintenance.

WARNING

THE P/N 59473-833-02 CONVERTER/RECEIVER LINE DRIVER BOARD IS ONLY INTENDED TO BE USED FOR LINE WIRE APPLICATIONS AND MUST NOT BE USED IN APPLICATIONS FOR NORMAL TRACK OPERATION. USAGE MAY RESULT IN EXCESSIVE TRACK CURRENT, CAUSING THE INABILITY TO DETECT TRAINS IN THE TRACK CIRCUIT.

3.6. RECOMMENDED INSTALLATION CHECKLIST

Upon installation verify the safety critical checks in Table 3–1, operational checks in Table 3–2, to verify functionality and recommended checks in Table 3–3. Table 3–4 contains additional optional checks that may be required by your authority. The tables are provided in checklist format.

Table 3–1. Safety Critical Checklist

Safety Check	Description	Completion Date
Track Circuit Adjustment	The track circuits must be properly adjusted to ensure that no codes are received when a 0.06 Ohm shunt is applied, follow the procedure provided in Table 3–5.	
Track Lead Polarity	Track polarity must be staggered on alternate track circuits for insulated joint (IJ) breakdown protection. See the Installation Requirements provided on Page 3–1.	
Line Wire Circuits	The P/N 59473-833-02 Line Driver Converter/Receiver board is only intended to be used for line wire applications and must not be used in applications for normal track operation. Usage may result in excessive track current, causing the inability to detect trains in the track circuit. See the Installation Requirements provided on Page 3–1.	

Table 3–2. Operational Checks Checklist

Operational Check	Description	Completion Date
Input Battery Voltage	Genrakode modules operate on input power ranging from 9 to 16 Volts DC, nominally a 12 Volt signal battery. Check the B12 and N12 terminals. See the Installation Requirements provided on Page 3–1.	
External Wiring	Check for proper connections from external apparatus to the Genrakode module and verify the module inputs have proper polarity and voltage level. See the Installation Requirements provided on Page 3–1.	
Software Settings	There are various software options that must be set upon installation in accordance with the plans for the location, such as Code 5 and optional Code T settings. See the Installation Requirements provided on Page 3–1.	
System Diagnostics	The system diagnostics should be checked to verify that there are no system errors. This includes the board LEDs and the Error Queue. See the Section 6 for diagnostics instructions.	

Table 3–3. Recommended Checks Checklist

Recommended Check	Description	Completion Date
Set CPU Date and Time	Set the date and time of the PGK CPU board for more accurate data logging. See Heading 3.8.2., Software Settings.	
Clear CPU Logs	Clear the Error and Event Queues of the PGK CPU board so future logs only contain post-installation data. See Heading 3.8.2., Software Settings.	

Upon installation and during normal operation, it is not necessary to verify the items in Table 3–4. The safety design of the system prevents the module from running if any of these do not match the expectations of the application and location.

Table 3–4. Optional Checks Checklist

Optional Check	Description	Completion Date
Correct Boards in Correct Slots	The Genrakode module does not run if a board is in the incorrect slot or if an expected board is missing. Board keying and module labels are also available to aid in preventing incorrect board placement. Damage to a board can occur if placed into an incorrect slot, so care should be taken. **CAUTION** As per the Safety Critical item above, do not use a Line Wire Converter/ Receiver board when connecting to track.	
Correct Software CRCs	The Genrakode module only runs if the CRCs of the software match the expected values.	
Correct Rev/Site ID	The Genrakode module only runs if the wire-wrap (or push-on jumper) signature matches the Revision and Site ID of the loaded application.	

3.7. HARDWARE ADJUSTMENT PROCEDURES

3.7.1. Track Circuit Adjustment

The P/N 59473-833-01 Converter/Receiver board must be used in track circuit applications, one at each end of the track circuit. Do not use P/N 59473-833-02 boards for track circuits. Track circuits must be adjusted to be able to detect a train with a worst-case shunting impedance of 0.06 Ohm. The receiver sensitivity is 0.5 ampere for shunting. The receiver current should be adjusted higher to take into consideration track variations and signal battery power supply variations. Receive current should be adjusted to fall between 1.0 and 1.4 amperes. The current should be adjusted closer to the low value if the adjustment is made on a wet track and closer to the high value if the track is adjusted under arid conditions. Under normal weather, the current should be adjusted to about 1.2 amperes.

Set the receiver current by adjusting both the converter output voltage and the receiver input resistance. Adjust screw switches to perform the adjustments. There are four adjustments for the converter output voltage and eight receiver input adjustments. A peak reading meter, a Simpson® TS-111 or equivalent is needed to read the pulsed DC current.

NOTE

If using a digital peak reading multimeter, verify that the sample rate is sufficiently high (≤10ms per sample). The Fluke® 187 “fast min-max” peak measurement is one recommendation. The converter output is adjustable from 1.5 to 4.0 Volts and the receiver input resistance is adjustable from 0 Ohm to 1.65 Ohms.

Figure 3–3 lists the converter output voltages and the corresponding switch positions and the receiver input resistance and the corresponding switch positions required.

The module itself adds about 0.36 Ohm besides the listed values in Figure 3–3. Usually, the converter output voltage only needs to be adjusted during the module installation. Table 3–6 lists a convenient starting point for converter output voltages and receiver input resistances for given lengths of tracks at 3, 5, and 10 Ohm per 1000 feet ballast resistance for bonded or welded rails. If track circuit readjustment is required, the adjustment can probably be achieved at only the receiver location, without changing the transmit location.

To perform adjustment of the receiver current, adjusting the track circuit, follow the procedure provided in Table 3–5 while referencing the adjustment locations indicated in Figure 3–3.

Track Converter/Receiver Board Adjustment Locations
59473-833-01

Transmitter Converter adjustment by screw-switch selection on transformer T2

Output (volts)	Primary Side Screw-Switch (tap) Selection	Secondary Side Screw-Switch (tap) Selection
1.5	L - L	1.5-2.0 & 1.5-2.0
2.0	H - H	1.5-2.0 &1.5-2.0
3.0	L - L	3.0-4.0 & 3.0-4.0
4.0	H - H	3.0-4.0 & 3.0-4.0

Receiver adjustment by screw-switch selection of resistors SS1, SS2 and SS3.

Receiver Resistance (ohms)	SS1	SS2	SS3
0.00	IN	IN	IN
0.27	IN	OUT	IN
0.56	OUT	IN	IN
0.83	OUT	OUT	IN
0.82	IN	IN	OUT
1.09	IN	OUT	OUT
1.38	OUT	IN	OUT
1.65	OUT	OUT	OUT

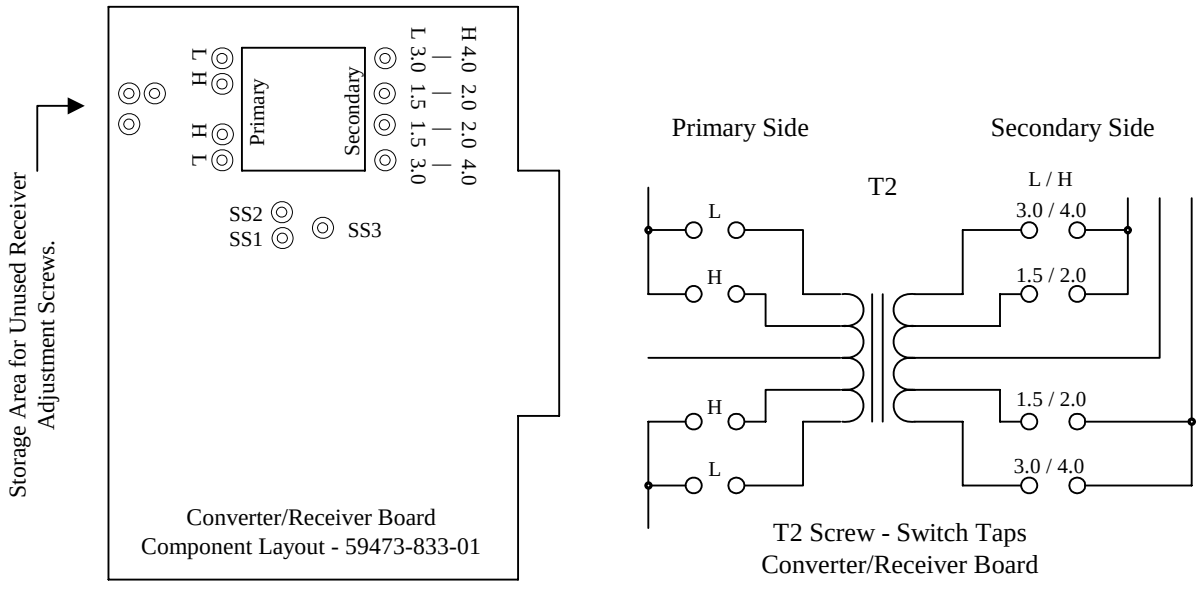


Figure 3–3. Track Converter/Receiver Board Adjustment Locations

Table 3–5. Converter/Receiver Board Adjustment Procedure

Step	Action
1	Starting at either end of the track circuit, set the output voltage and the receiver resistance switch positions as indicated in Figure 3–3 for the track circuit length, rail type, and minimum ballast conditions. To do this, turn the module power off and remove the receiver/converter board. Referring to Figure 3–3, place the screw switches in their respective positions. Replace the receiver/converter board and turn the module power on.
2	At the other end of the track circuit, set the output voltage and the receiver resistance switch positions as indicated in Figure 3–3, which are the same settings as the opposite end of the track circuit. Turn the module power off and remove the receiver/converter board. Referring to Figure 3–3, place the screw switches in their respective positions. Replace the receiver/converter board and turn on the module power.
3	Disconnect the TK- (negative track) lead from the Genrakode II module and connect the peak reading meter in series such that the negative meter terminal is connected to the negative rail and the positive meter terminal is connected to the TK- terminal on the module. Rather than removing the track lead from the Genrakode module to measure current, it may be more convenient to use a ‘gold nut’ connection on the TK- lead on the entrance panel (if available). If any other track equipment shares the track lead at this entrance panel connection (overlay circuit, for example) the measurement should made at the Genrakode module connection as described above.
4	Verify the received peak current is between 1.0 to 1.4 amperes. If it is not, turn off the module power, remove the receiver/converter board, and re-adjust the receiver resistance as required by moving the screw switch positions. Remember to keep the track circuit conditions (wet/dry) in mind. Repeat this step until the receiver current is correct.
5	After the receiver current is correctly adjusted, place a 0.06 Ohm shunt rail-to-rail across the track circuit and note that the track occupancy LED (OCC) on the CPU board is on. If it is not, the receiver current is too high. Repeat Step 4 to decrease the receiver current. If the OCC LED is on, remove the shunt and note that the track occupancy LED is off. If it is not, the receiver current is too low. Repeat Step 4 to increase the receiver current.
6	Return to the other end of the track circuit and set the screw switch to the same position as the opposite end.
7	Repeat Steps 3 through 5 at this location.
8	This completes the track circuit adjustments.

Table 3–6. Transmit and Receive Settings for Rail Lengths

MINIMUM BALLAST RESISTANCE (Ohms/1000 FT)	XMIT OUTPUT VOLTAGE (Volts)	RCVR RESISTANCE (Ohms)	RAIL LENGTH (FT)	
			BONDED	WELDED
10	1.5	0.27	under 8000	under 11000
10	1.5	0.00	8000 to 11500	11000 to 17000
10	2.0	0.00	11500 to 16000	17000 to 23000
10	3.0	0.27	16000 to 21000	23000 to 29000
5	1.5	0.27	under 5500	under 7500
5	1.5	0.00	5500 to 8500	7500 to 12000
5	2.0	0.00	8500 to 12000	12000 to 18000
5	3.0	0.27	12000 to 15000	18000 to 20000
3	1.5	0.27	under 4000	under 5000
3	1.5	0.00	4000 to 6500	5000 to 10000
3	2.0	0.00	6500 to 11000	10000 to 14000

Track circuit adjustments are based on 50-foot track leads (100 feet of wire) of AWG #6 copper wire at each end of the track circuit. Table 3–7 provides a correlation between track ballast resistance and the type of rail-to-rail connections and gives a value to be used for figuring track length reductions for each additional 100 feet of track lead.

Table 3–7. Track Lead Increases versus Track Length Reductions

RAIL LENGTH REDUCTION (FT) PER ADDITIONAL 100 FT OF TRACK LEAD		
Ballast (Ohms)	**Bonded**	**Welded**
3	700	1100
5	800	1300
10	900	1500

The following is an example of how to use the information in Table 3–7. If a track circuit:

- Is rail head bonded, with 5-Ohms ballast
- Has a Genrakode II module 150 feet from the rails at one end of the track circuit (thus totaling 300 feet of wire, 150 feet of track lead)
- Has another Genrakode II module located 50 feet from the rails at the other end of the track circuit (thus totaling 100 feet of wire, 50 feet of track lead)

The configuration used for Table 3–7 includes two Genrakode II modules (one at each end), each 50 feet from the rails, for a total of 100 feet of track lead. The example configuration above has a total of 200 feet of track lead. This is 100 extra feet of track lead compared to the configuration used for the table. Therefore, taking into consideration the extra 100 feet of track lead, the length of this track circuit should be reduced by 800 feet.

3.7.2. Line Wire Circuit Adjustment

The P/N 59473-833-02 Converter/Receiver board is intended for use in line wire circuit applications, one at each end of the line wire circuit. The receiver sensitivity is 0.25 ampere, however, the receiver current should be adjusted higher to take into consideration line variations and battery power supply variations. Receive current should be adjusted to fall between 0.6 and 0.8 amperes. Under normal conditions the current should be adjusted to about 0.7 amperes.

Receiver current is set by adjusting the converter output voltage and the receiver input resistance. There are four adjustments for the converter output voltage and eight receiver input adjustments. A peak reading meter, a Simpson® TS-111 or equivalent, is needed to read the pulsed DC current. The converter output is adjustable from 3.0 to 8.0 Volts and the receiver input resistance is adjustable from 0 Ohm to 3.56 Ohms. Adjustments are made with screw switches.

Figure 3–4 lists the converter output voltages and the corresponding switch positions as well as the receiver input resistance and the corresponding switch positions required. Figure 3–4 also shows the screw switch positions on the board.

NOTE

The actual output voltage is 2x the value shown at the secondary screw switch position.

Track Converter/Receiver Board Adjustment Locations
59473-833-02

Transmitter Converter adjustment by screw-switch selection on transformer T2

Output (volts)	Primary Side Screw-Switch (tap) Selection	Secondary Side Screw-Switch (tap) Selection
3.0	L - L	1.5-2.0 & 1.5-2.0
4.0	H - H	1.5-2.0 &1.5-2.0
6.0	L - L	3.0-4.0 & 3.0-4.0
8.0	H - H	3.0-4.0 & 3.0-4.0

Receiver adjustment by screw-switch selection of resistors SS1, SS2 and SS3.

Receiver Resistance (ohms)	SS1	SS2	SS3
0.00	IN	IN	IN
0.56	IN	OUT	IN
1.00	OUT	IN	IN
1.56	OUT	OUT	IN
2.00	IN	IN	OUT
2.56	IN	OUT	OUT
3.00	OUT	IN	OUT
3.56	OUT	OUT	OUT

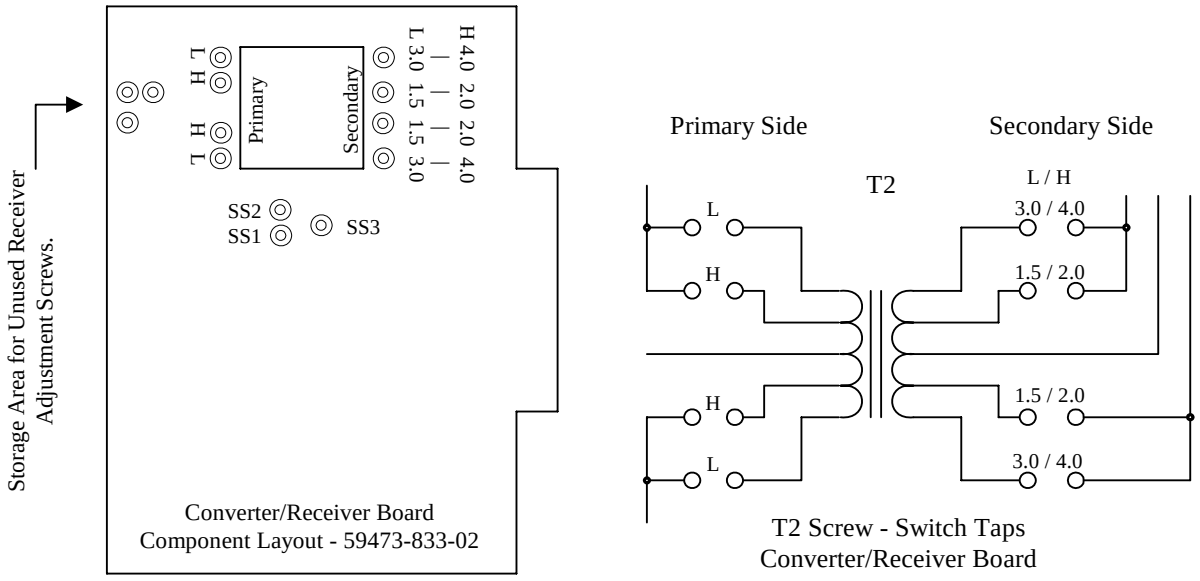


Figure 3–4. Line Wire Converter/Receiver Board Adjustment Locations

Each module itself adds about 0.36 Ohm besides the preceding listed values. Usually, the converter output voltage only needs to be adjusted during the module installation. Table 3–9 includes a convenient starting point for converter output voltages and receiver input resistances for given lengths of line wire. The starting point values are only approximate; they largely depend on the actual wire resistance per 1000 ft. If line wire circuit readjustment is required, the adjustment can probably be achieved at only the receiver location, without changing the transmit location.

NOTE

When installing a P/N 59473-833-02 board in a slot of a Genrakode module, which had been previously configured for a P/N 59473-833-01 board, it is necessary to modify the motherboard slot keying to accept the P/N 59473-833-02 board. There are two key plugs in each slot, and since both the –01 and –02 board versions share one of the plug positions, it is only necessary to move one of the plugs (the lower of the two). Extract this plug from its current position using small needle nose pliers or equivalent tool, and replace it in the proper position to align it with the upper key slot on the P/N 59473-833-02 board edge (between the 14th and 15th gold fingers, counting from the bottom). Visually check the position and alignment of the key plug in the slot to verify it is centered between the correct gold fingers before inserting the P/N 59473-833-02 board to verify the installation.

Figure 3–4 shows Converter/Receiver Board adjustment locations. To facilitate adjustment of the receiver current, follow the procedure in Table 3–8.

Table 3–8. Receiver Current Adjustment Procedure

Step	Action
1	Starting at one end of the line wire circuit, set the output voltage and the receiver resistance switch positions as indicated in Table 3–9 for the line wire circuit length (distance between units). Table 3–9 is for AWG #6 copper wire only, Table 3–10 and 3–11 are for AWG #8 and #10 copper wire respectively. For a wire gauge not listed refer to Calculating Converter Voltage and Receiver Res. settings. To change settings turn the module power off and remove the receiver/converter board. Referring to Figure 3–4, place the screw switches in their respective positions. Replace the Converter/Receiver board and turn the module power on.
2	At the other end of the line wire circuit, set the output voltage and the receiver resistance switch positions to the same settings as in Step 1. Turn the module power off and remove the receiver/converter board. Referring to Figure 3–4, place the screw switches in their respective positions. Replace the converter/receiver board and turn the module power on.
3	Disconnect the TK- (negative track) lead from the Genrakode II module and connect a peak reading meter in series such that the negative meter terminal is connected to the negative line wire and the positive meter terminal is connected to the TK- terminal on the module. If the current test board is used, the line wire lead does not have to be disconnected. Loosen the terminal nut and pull the washer away from the copper trace to open the circuit. Then connect the positive and negative meter leads to the meter+ and meter- terminals respectively.
4	Turn on the module power and verify the received current is between 0.6 to 0.8 amperes. If it is not, turn off the module power, remove the converter/receiver board, and re-adjust the receiver resistance as required by moving the screw switch positions. Repeat this step until the receiver current is correct.
5	Return to the other end of the line wire circuit and set the screw switches to the same positions as those just set.
6	Repeat Steps 3 and 4 at this location.
7	This completes the line wire circuit adjustments.

Table 3–9. Transmit and Receive Settings for Wire Lengths (6 Gauge)

For AWG #6 Copper Wire Only		
XMIT VOLTS (V)	**RCVR RES (Ohms)**	**WIRE LENGTH (Ft)**
3.00	2.00	under 2000
3.00	0.00	2000 to 4000
4.00	0.56	4000 to 6000
6.00	2.00	6000 to 8000
6.00	0.56	8000 to 10000
8.00	2.00	10000 to 12000
8.00	0.56	12000 to 14000
8.00	0.00	14000 to 15000

Table 3–10. Transmit and Receive Settings for Wire Lengths (8 Gauge)

For AWG #8 Copper Wire Only		
XMIT VOLTS (V)	**RCVR RES (Ohms)**	**WIRE LENGTH (Ft)**
3.00	1.00	under 2000
4.00	0.00	2000 to 4000
6.00	1.00	4000 to 6000
8.00	1.56	6000 to 8000
8.00	0.00	8000 to 9400

Table 3–11. Transmit and Receive Settings for Wire Lengths (10 Gauge)

For AWG #10 Copper Wire Only		
XMIT VOLTS (V)	**RCVR RES (Ohms)**	**WIRE LENGTH (Ft)**
3.00	0.56	under 1500
4.00	0.00	1500 to 2500
6.00	1.00	2500 to 3500
8.00	0.00	3500 to 5500

3.7.3. Line Wire Circuit Resistance Setting Calculation

The settings for the converter voltage and receiver resistance can be approximately determined using the following equation:

$$L = \frac{1000 * \left(\frac{Vxmit}{Ircv.} - (2 * Rmod + Rrcvr) \right)}{2 * Rwire}$$

Where L is the distance between modules in feet, Vxmit is the converter output voltage setting in Volts, Ircv. is the desired received current: 0.6A, Rmod is the module resistance: 0.5 Ohms, Rrcvr is the Receiver input resistance setting, Rwire is the Resistance per 1000 ft of the wire between the modules.

To perform a Line Wire Circuit Resistance setting calculation:

1. Determine the wire resistance per 1000 ft.
2. Use the lowest converter voltage setting for Vxmit: 3.0 V.
3. Use 0 for Rrcvr.
4. Calculate L with the formula below

$$L = \frac{1000 * \left(\frac{Vxmit}{0.6} - (1 + Rrcvr) \right)}{2 * Rwire}$$

5. A distance of 0 - 1500 feet over the target distance is required. If L is too small increase the converter voltage Vxmit to the next higher setting. Repeat Step 4 and 5 until the desired length is found.
6. Now use resistance values from Table 3–9, Table 3–10, or Table 3–11 as appropriate, for Rrcvr starting with the smallest value.
7. Calculate L using formula adjusting Rrcvr to get to L closest to the desired length as possible.

For the example: Target distance is 3200 feet, #8 gauge wire is used. Actual measured wire resistance per 1000 feet = 0.653 Ohms.

1. Start with Vxmit = 3.0 V and Rrcvr = 0.0, Calculated L = 3062 feet. This is not long enough to support the target distance of 3200 feet, so go to the next voltage setting.

2. Now use Vxmit = 4.0 V and Rrcvr = 0.0, Calculated L = 4339 feet. This is long enough to support the target distance of 3200 feet.

3. Increase Rrcvr to 0.56 Ohms, Calculated L = 3910 feet. Perform another calculation to see if a closer result can be obtained.

4. Increase Rrcvr to 1.00 Ohms, Calculated L = 3573 feet. Perform another calculation to see if a closer result can be obtained.

5. Increase Rrcvr to 1.56 Ohms, Calculated L = 3144 feet. This result is just below 3200 feet so it is acceptable to choose 1.00 or 1.56 Ohms, to just be over 0.6A at the receiver, choose Rrcvr = 1.00 Ohms and Vxmit = 4.0 V setting.

WARNING

THE P/N 59473-833-02 CONVERTER/RECEIVER LINE DRIVER BOARD IS ONLY INTENDED TO BE USED FOR LINE WIRE APPLICATIONS AND MUST NOT BE USED IN APPLICATIONS FOR NORMAL TRACK OPERATION. USAGE MAY RESULT IN EXCESSIVE TRACK CURRENT, CAUSING THE INABILITY TO DETECT TRAINS IN THE TRACK CIRCUIT.

NOTE

The P/N 59473-833-02 Converter/Receiver Line Driver board is not compatible with the Electrocode Line Wire boards (2L Line Converter, 7L Receiver, and 9L Track Choke). Use the P/N 59473-833-02 board at both ends of a line circuit.

3.7.4. Series Overlay Track Circuit Adjustment

A Series Overlay is used at Switch Lock locations to provide quick release of the lock when the mainline track is occupied. AWG #6 twisted pair copper wire should be used to connect the module series overlay input/output to the rails. The Series Overlay Board can accommodate up to 500 feet of AWG #6 twisted pair. If AWG #9 twisted pair is used, then the lead length should not exceed 300 feet. A three position screw switch is provided to compensate for lead-length to the track. It is important for proper operation that the overlay track lead wires be a twisted pair with a minimum of 1 twist per foot to minimize the inductance of the wires.

The procedure in Table 3–12 is performed to set up the series overlay track circuit. Figure 3–5 shows the screw switches for the series overlay.

Table 3–12. Series Overlay Track Circuit Setup Procedure

Step	Action
1	When initially setting up the series overlay track circuit, check that the screw switch is in the SS1 position.
2	Turn the sensitivity pot adjustment R101 fully counterclockwise.
3	Connect a shunt strap with a 0.06-ohm resistor across the rails 80 feet from the overlay track connection.
4	Turn on the module power. The LED on the Series Overlay Board is not illuminated (is dark).
5	Turn R101 slowly clockwise until the LED illuminates. If LED illuminates, go to Step 6. If the LED remains dark, turn off the module power and place the screw switch in position SS2. Repeat Step 4. If LED illuminates, go to Step 6. If the LED remains dark, turn off the module power and place the screw switch in position SS3. Repeat Step 4. If LED illuminates, go Step 6. If the LED still remains dark, troubleshoot the system: • verify module wiring • wayside cables and hardware • repeat this procedure SS1 is normally used for cable lengths up to 300 feet. SS2 is usually used for lengths of 200 to 400 feet. SS3 is used for lengths of 300 feet to 500 feet; always start with the switch at SS1.
6	Measure the overlay RMS output voltage between J1 and J2. Record the output voltage and the switch setting.
7	Remove the shunt strap and note that the LED turns off. This completes the overlay track circuit adjustment.

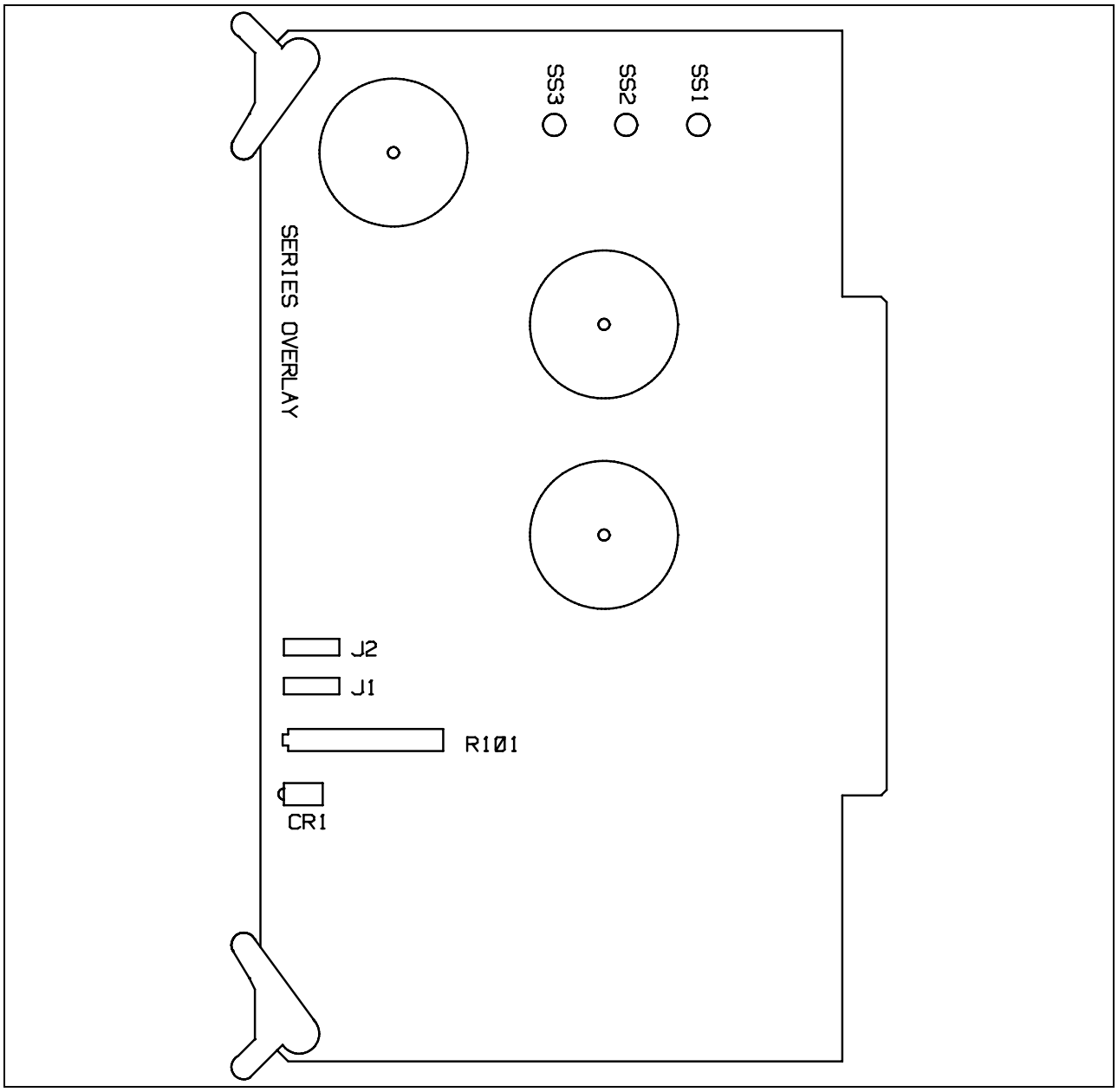


Figure 3–5. Series Overlay Adjustment Locations

3.8. CAB SIGNAL TRACK CIRCUIT ADJUSTMENT

The cab signal output power should be adjusted to provide 3 Amps for the 100 Hz Cab Signal module and 2 Amps for the 60 Hz version at the entering end of the track circuit through a shunt.

The procedure in Table 3–13 is performed to adjust the output power of the Cab Signal module.

Table 3–13. Cab Signal Module Output Adjustment Procedure

Step	Action
1	Set the output power by placing a jumper, AWG #10 copper wire or larger, across AAR terminal TK- and the AAR terminal output power setting according to the rail length: Rail Length (ft) — Output Power Setting 0 to 1000 — 25% 1000 to 3500 — 50% 3500 to 6000 — 80% 6000 to 7500 — 100% **CAUTION** For steady cab do not use the 100% power setting for either the 100 Hz or 60 Hz modules. If the module is operated for too long, an internal PC board may overheat and fail.
2	Turn on the power for the Cab Signal module and for the module controlling the track (Control Point, Intermediate, or Repeater module).
3	At the entering end of the track circuit, place a shunt across the rails with the Simpson® TS-111 meter or equivalent in series, set at 30 Amps AC.
4	Verify that the current is 3 Amps or greater (for the 100 Hz module, but 2 Amps or greater for the 60 Hz version). If the current is too low, then remove the shunt, turn off the module power, place the jumper on the next higher setting, and repeat Steps 2 and 3.

3.8.1. Power Supply Board Adjustments

If a Power Supply Regulator/Filter board (P/N 31166-338-01) is present in the system and the Low Signal Battery and Ground Fault Monitoring functions are being used by the application, adjustments must be performed to these circuits. If the Power Supply board is not present or is being used solely for its Regulator/Filter functions, then the following adjustment procedures do not apply.

To prevent any Low Signal Battery, Ground Fault, or Test Failure conditions from generating system errors prior to adjustment, place the LSB switch (S1) in the “SET” position and the GFM switch (S2) in the “POS TEST” (up) position before powering up the module. Perform the battery and ground fault monitor adjustment procedures provided in Tables 3–14, 3–15, and 3–16. See Figure 3–6 for a diagram of the board edge.

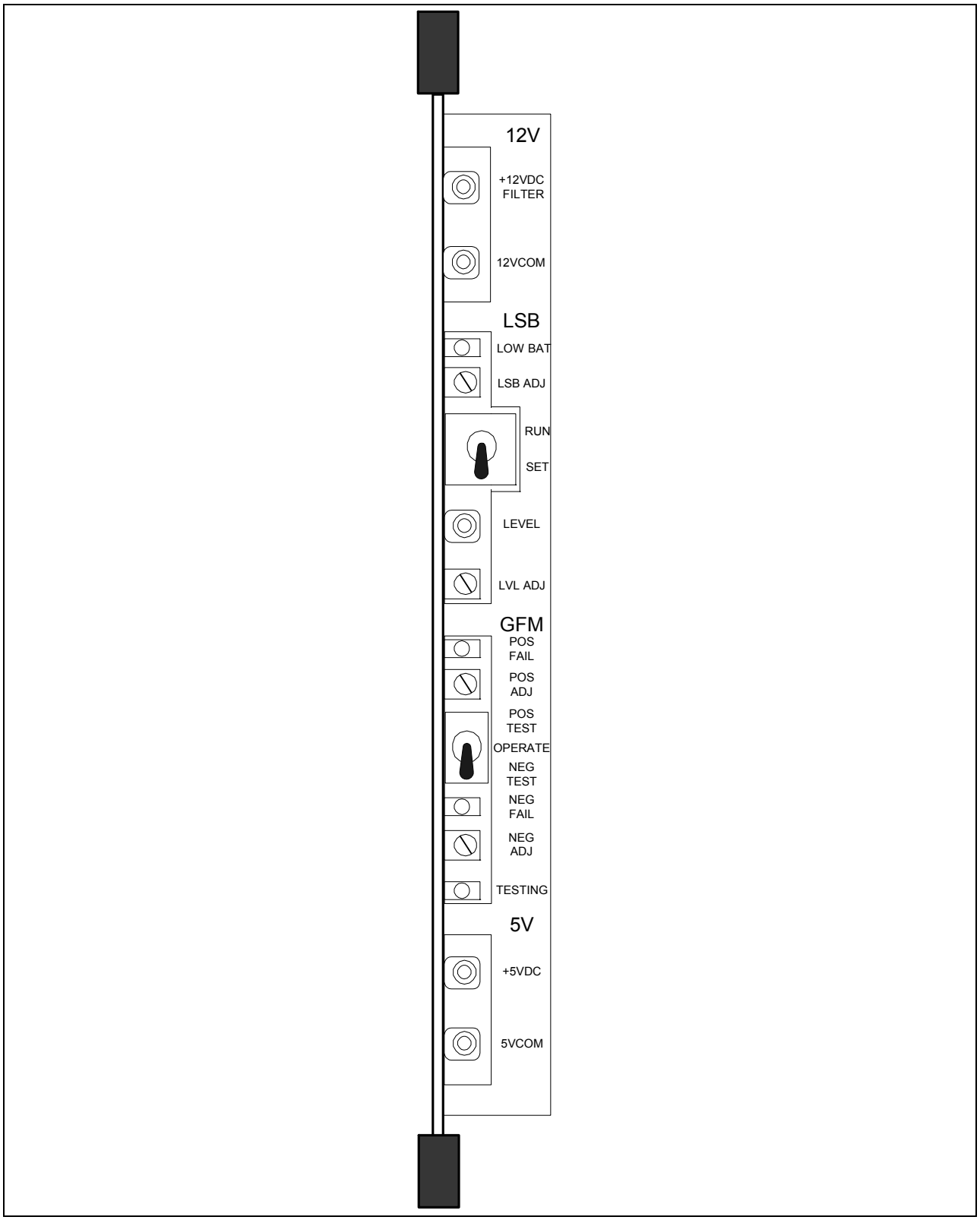


Figure 3–6. Power Supply Board Edge

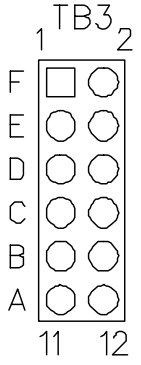
To adjust the low signal battery threshold, perform the procedure in Table 3–14.

Table 3–14. Low Signal Battery Threshold Adjustment Procedure

Step	Action
1	Move the LSB switch (S1) down to the “SET” position. The “supply” voltage for the LSB circuit is now based on the wiper of potentiometer “LEVEL ADJ”.
2	Connect a DC voltmeter to the test jacks on the front edge of the Power Supply board, positive to test point TP3 (LEVEL), negative to test point TP2 (12VCOM).
3	Adjust the “LEVEL ADJ” potentiometer so that the voltage from TP3 to 12VCOM is equal to the desired low signal battery detection voltage. Note that this level is initially factory preset to 9.5VDC.
4	The “LOW BAT” LED should be off. If it is on, rotate the “LSB ADJ” potentiometer counter-clockwise until the LED extinguishes.
5	Adjust the “LSB ADJ” potentiometer clockwise so that the “LOW BAT” LED lights solid.
6	Return the LSB switch (S1) to the “RUN” position.
7	This completes the adjustment procedure. The “LOW BAT” LED now illuminates when the actual signal battery goes below the voltage set in Step 3 above.

To change the Fault Detection Threshold so that the Ground Fault Monitor detects a lower or higher ground fault resistance, perform the procedure in Table 3–15.

Table 3–15. Ground Fault Monitor Fault Detection Threshold Adjustment Procedure

Step	Action
1	Power down the module using the main power switch on the left side of the module. This prevents transmission and reception of codes, so it requires track time.
2	Remove the Power Supply Regulator/Filter board from the module.
3	The six jumper positions on jumper block TB3 are labeled “A” through “F”. The factory default is position “B” which corresponds to a detection threshold of 20 kOhms (0.6mA). The position of the jumper must be verified present in the correct location (even if the factory default is desired) prior to installation. Move the jumper to the desired position as follows: position “A” = 30 kOhms (0.4mA) position “B” = 20 kOhms (0.6mA) – factory default position “C” = 10 kOhms (1.2mA) position “D” = 6.0 kOhms (2mA) position “E” = 3.0 kOhms (4mA) position “F” = 1.5 kOhms (8mA) 
4	Return the Power Supply board to its proper slot. Move the GFM Switch (S2) to the “POS TEST” (up) position. Then power up the module.
5	Once the module is running (the LED on the East and/or West VPC board is on), follow the procedure in Table 3–16 beginning at Step 3.

To set the “POS ADJ” and “NEG ADJ” potentiometers so that the Ground Fault Monitor detects ground faults, perform the procedure in Table 3–16

Table 3–16. Ground Fault Monitor Potentiometer Adjustment Procedure

Step	Action
1	With the GFM Switch (S2) is in “OPERATE” (center) position, make sure that the “TESTING” LED is dark before proceeding. If it is illuminated, an automatic test is being performed. Wait for the “TESTING” LED to extinguish before proceeding.
2	Move the GFM Switch (S2) to the “POS TEST” (up) position and wait 5 seconds.
3	The “POS LED” should be off. If it is on, rotate the “POS ADJ” potentiometer counter-clockwise slowly until the LED turns off.
4	Adjust the “POS ADJ” potentiometer clockwise slowly until the LED just illuminates. Due to the filtering on the input, wait a couple seconds between adjustments while approaching the final point. Be aware that there is some hysteresis as well. Once the LED illuminates, rotate the “POS ADJ” potentiometer another 1/4 turn clockwise
5	Move the GFM Switch (S2) to the “NEG TEST” (down) position and wait 5 seconds.
6	The “NEG LED” should be off. If it is on, rotate the “NEG ADJ” potentiometer counter-clockwise slowly until the LED turns off.
7	Adjust the “NEG ADJ” potentiometer clockwise slowly until the LED just illuminates. Due to the filtering on the input, wait a couple seconds between adjustments while approaching the final point. Be aware that there is some hysteresis as well. Once the LED just illuminates, rotate the “NEG ADJ” potentiometer another 1/4 turn clockwise.
8	Move the GFM switch (S2) to “OPERATE”. The automatic test begins momentarily and the “TESTING” LED illuminates.
9	When the automatic test completes the “TESTING” LED turns off. Verify that the test passed by observing the “POS FAIL” and “NEG FAIL” LEDs. Both should be off. If the automatic test fails, the “POS FAIL” and “NEG FAIL” LEDs both blink. If this occurs, repeat the adjustment steps above, starting at Step 1.

3.8.2. Software Settings

Many system settings of a Genrakode II module are field-selectable with the PGK CPU board P/N 31166-141-XX. The two methods for viewing or modifying system settings are:

1) On-board Controls and Displays: Rocker Switch and LED displays, see Figure A–9

2) RS-232 serial port interface using a PC; see the pages that follow for more details on each method

It may be required to verify or change any field-selectable system settings upon installation of the Genrakode module. See the plans for the location for details. The following settings are field-selectable (some are only able to be modified using the Rocker Switch and others only by using the Serial Port):

- Code 5 Default Send Mode (Rocker Switch only – see Modes 5 and 6)
- Code T Location ID (Rocker Switch – see Mode 7, Serial Port – TID)
- Code T Enable Settings (Serial Port only – DTS/MTS)
- Code T Expiration Time(Serial Port only – MTX)
- Code 5 Format (Serial Port only – DC5/C5)
- Filament Error Reporting (Serial Port only – CFR)
- Non-vital Inputs (Serial Port only – NVI)

Besides field-selectable system settings, it is also recommended practice to set the date and time of the PGK CPU board and clear the error and event queues upon installation. These actions are performed using the serial port. For instructions on setting up and using the RS-232 serial port interface, see Appendix B. The commands are as follows:

- Set Date `SD MM/DD/YY`
- Set Time `ST HH:MM:SS`
- Clear Error Queue `CEQ`
- Clear Event Queue `CVQ`

The Error Queue can be cleared using the rocker switch as well. To clear the Error Queue (assuming it is not empty), press the rocker switch down while in Mode 3 until the bottom two displays are blank. Then press and hold the rocker switch down until the Malfunction LED goes OFF (approximately 10 seconds).

NOTE

If a persistent error condition exists, such as an open lamp filament, the Malfunction LED remains flashing. See the Section 6, Diagnostics, for more details.

3.8.3. On-Board Controls And Displays

The Rocker Switch (S1) is used in combination with the four 7-segment LED displays and the individual LEDs on the CPU board edge to display system information such as track occupancy, transmitted and received codes, or Error Queue status. S1 is also used to view and change various system settings. The Rocker Switch controls which system display or setting information is displayed at any given time. There are several display modes, but the number of display modes available for a given application depends on the module type and application settings that are currently in use. Figure 3–7 shows the display modes and their order for the various module types. Moving the Rocker Switch to the UP position switches to the next display mode.

3.8.4. Mode Descriptions:

Mode 1 is the mode the PGK CPU board enters at startup. All LED displays are OFF except for bottom POWER LED and possibly the other LEDs located above that one in the ‘SYSTEM’ group of LEDs if warranted by their associated functions.

Mode 2 is the mode that displays the transmitted and received codes on each track using a combination of 7-segment LED displays and discrete LEDs. The indication of each LED is labeled on the PGK CPU board.

Mode 3 is the mode that can display any system error codes currently in the Error Queue. A flashing ‘0’ in the topmost 7-segment LED display (DS2) indicates the system is in Mode 3. If there are any error codes to be displayed, the Malfunction LED (DS20) flashes. To view the two-digit hex error codes while in this mode, rock the Rocker Switch down to display each code on the lower two 7-segment displays. When the switch is rocked down and those displays go blank, the last error code has been displayed.

NOTE

To cycle through the error codes again it is necessary to toggle through the rest of the display modes back to Mode 3.

Mode 4 is used for an application using the Vital Serial Link. This mode displays Link and Drop settings. DS2 shows ‘L’ to indicate that DS3 displays the Link number (1 or 2), and DS11 shows ‘d’ to indicate that DS12 displays the Drop number (1 or 2). Currently, Vital Serial Link operation is only supported for CPIB Control Point applications.

Mode 5 is used to display and change (if desired) the Code 5 Default Send mode for the East Track. It is only present in Intermediate, Repeater, and Switch Lock applications. This mode is indicated by a flashing ‘C5’ on the top two 7-segment LED displays, and the current setting for the East track is displayed on the bottom two displays.

Table 3–17 summarizes the settings for the Code 5 Default Send mode for the East Track. The Code 5 Default Send mode setting is defined by the application programmer when the application is created using the PGKCAA. This setting can be modified in the field. To modify the setting, rock the Rocker Switch down to toggle to the next setting (continue to toggle to get back to the original setting). Stop when the desired setting is displayed and rock the Rocker Switch up to change to the next display mode.

NOTE

If the East Track Code 5 Default Send mode setting is modified, a special mode (Confirm Setting Change) appears after the last normal display mode to let the user confirm that a setting change is desired. If confirmed, the change is written to non-volatile flash memory followed by an automatic reset of the module (required for the flash memory update). See the description of the Confirm Setting Change mode that follows.

Table 3–17. Code 5 EAST

7-segment Displays (DS11 & DS12)	Code 5 Default Send Mode Setting
0b	Transmit Code 5 (to EAST) Always
00	Transmit Code 5 (to EAST) on Code 1 Received (from WEST)
Ab	Transmit Code 5 (to EAST) under application program control ONLY
b0	Transmit Code 5 (to EAST) on Code 5 Received (from WEST)

Mode 6: This is the mode used to display and change (if desired) the Code 5 Default Send mode for the West Track. This mode is identical to Mode 5 except that the setting applies to the West Track. Table 3–18 summarizes the settings for the Code 5 Default Send mode for the West Track.

Table 3–18. Code 5 WEST

7-segment Displays (DS2 & DS3)	Code 5 Default Send Mode Setting
0b	Transmit Code 5 (to WEST) Always
00	Transmit Code 5 (to WEST) on Code 1 Received (from EAST)
Ab	Transmit Code 5 (to WEST) under application program control ONLY
b0	Transmit Code 5 (to WEST) on Code 5 Received (from EAST)

Mode 7: This is the mode used to display and change (if desired) the Code T Location ID. It is only present in Intermediate, Repeater, and Switch Lock applications if Code T operation is enabled. This mode is indicated by a flashing ‘C’ on the top 7-segment LED display, and the current Location ID setting for the module is displayed (as a decimal number from 0 – 27) on the bottom two displays. To change the Location ID, rock the Rocker Switch down to increment the ID to the desired value. Incrementing past a value of 27 wraps back around to a value of 0.

NOTE

If the Location ID setting is modified, a special mode (Confirm Setting Change) appears after the last normal display mode. This forces the user to confirm that a setting change is desired, which is written to non-volatile flash memory followed by an automatic reset of the module (required for the flash memory update). See the description of the Confirm Setting Change mode that follows.

Confirm Setting Change Mode only appears if the user has modified a system setting using the Rocker Switch. A flashing “UP” (for Update) on the lower two 7-segment displays indicates the system is in Confirm Setting Change Mode. To confirm and apply the setting changes, the Rocker Switch must be rocked and held in the down position until the PGK CPU resets (‘P-UP’ is displayed on the 7-segment displays). This takes approximately 8 seconds to occur. Rocking up to advance the mode back to Mode 1 before resetting the module results in any setting changes being ignored, and the settings revert back to their previous values.

If the settings were changed and the system is reset to apply the new settings, the newly changed settings are active when the system comes up. The settings are saved in flash memory, so the system remembers the new settings through future power up/down sequences (resets), but future application downloads overwrite these settings For example, the flash settings are reinitialized when an application is downloaded to the PGK CPU board.

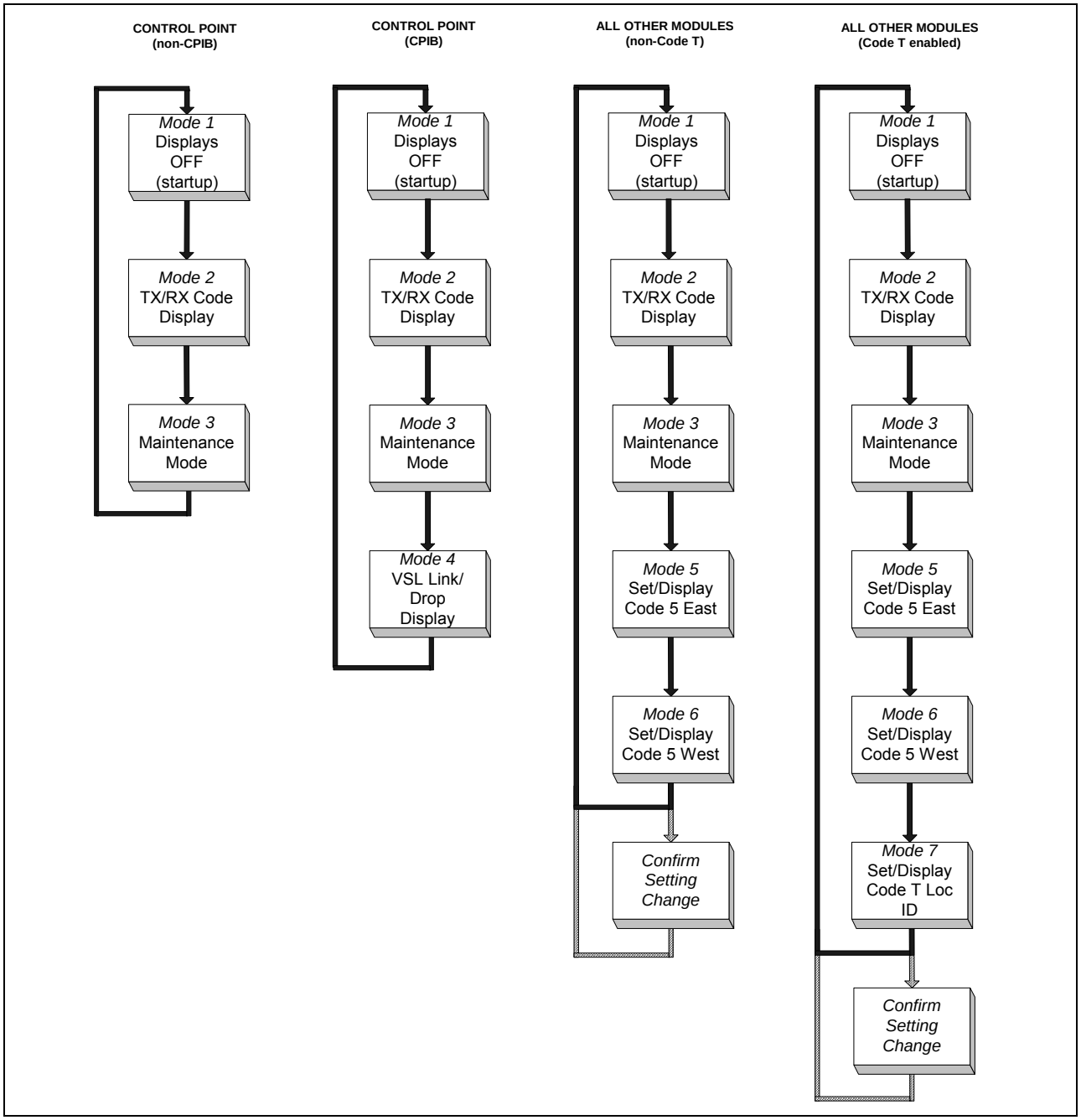


Figure 3–7. Rocker Switch Display Modes

3.9. RS-232 SERIAL PORT INTERFACE

The module settings that are field-selectable using the serial port are described below. For instructions on setting up and using the RS-232 serial port interface, see Appendix B. For more details and examples of the serial port commands discussed below, see Appendix B.

NOTE

Except for the non-vital inputs, these field-selectable module settings are stored in nonvolatile memory. To apply any changes, the user is prompted to confirm that the changes should be applied, and if the user agrees then the system resets automatically. If the settings were changed and the system is reset to apply the new settings, the newly changed settings are active when the system comes up. The settings are saved in flash memory, so the system remembers the new settings through future power up/down sequences (resets), but future application downloads overwrite these settings. For example, the flash settings are reinitialized when an application is downloaded to the PGK CPU board.

3.9.1. Code T Location ID

The TID command allows display and modification of the Code T Location ID for a module. The default value when Code T is enabled for an application in the PGKCAA is 0. A Location ID of 0 disables Code T since the valid range of IDs is 1 to 27. All the modules in a Code T-enabled block must have unique Location IDs or it is impossible to isolate Trouble Codes to one location.

3.9.2. Code T Enable Settings

The DTS command (Display Code T Enable Settings command) displays the Code T mode settings relevant to the module type. The settings are modified with the MTS command (Modify Code T Enable Settings command). These commands are discussed furthering Appendix B.

The enable settings that can be changed are the following:

- Code T Operation (per track)
- Trouble Code Parameter (per available parameter)
- Code T Initiate (per track)
- Code T Repeat (per track)

3.9.3. Code T Expiration Time

The MTX command (Display/modify Code T Expiration Time command) allows display and modification of the Trouble Queue Expiration Time. The default value when Code T is enabled for an application in the PGKCAA is 0, which is interpreted as 'NEVER'. The Expiration Time can be set between 1 and 96 hours, in one hour steps, or to NEVER where Block Trouble Queue entries can only be removed with the CTQ command (Clear Block Trouble Queue command). If the Expiration Time is set to a value between 1 and 96 hours, the value defines the period of time that an entry stays in the Queue before being deleted automatically. These commands are discussed furthering Appendix B.

NOTE

If a Trouble Code is continuously being received at a location (due to a non-intermittent trouble condition at another module), a new Queue entry with the same Trouble Code is logged within one frame period (approximately 84 seconds) after the previous entry is deleted.

3.9.4. Code 5 Format

Use the DC5 command to display the current Code 5 Format settings. To change the settings, use the C5 command. The Code 5 Format (Standard, Alternating, or Long) can be selected individually per track.

3.9.5. Filament Error Reporting

Use the CFR command to display/modify the current status of filament error reporting. The status of each lamp available in the application is displayed one at a time, and the user can retain or change each one. This provides the capability to have a lamp defined in the application but not actually present at the location to not log a filament error.

3.9.6. Non-vital Inputs

Use the NVI command to display/modify the states of the non-vital inputs. Typing NVI at the prompt displays the states of all inputs. Typing NVI 4 T, for example, sets input 4 to true, and NVI 4 F sets it to false.

Table 3–19. Site Configuration Sheet

Application Documentation	
S/N	
APP NAME	
APP ID	
COMPILE DATE	
COMPILE TIME	
DESIGNER	
CHECKER	
REVISION LEVEL	
SITE ID	
Module Configuration	
MODULE TYPE	
MODULE CFG ID	
AUX IO	
DIRECTION	
CODE 5 FORMAT	
CODE 5 SND EAST	
CODE 5 SND WEST	
SIG TYPE EAST	
SIG TYPE WEST	
FLASH RATE	
PGK CAA Software	
CAA VER NAME	
DATE	
PGK CAA #	
System Flash Configuration Report	
SYS VER NAME	
DATE	
PGK SYS SW#	
Application Checksum = (Note 1)	
System Software Checksum = (Note 1)	
Application File CRC = (Note 2)	
Application Logic CRC = (Note 2)	
System Software CRC = (Note 2)	

(This information can be attained by typing ‘RPT’ at the PGK prompt.)

Note 1: These entries apply only to PGK CAA versions 1.59 and earlier.
Note 2: These entries apply only to PGK CAA versions 2.00 and later.

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4. SECTION 4 – SCHEDULED MAINTENANCE

4.1. GENERAL

This section provides the preventive maintenance procedure for the Genrakode II system.

4.2. MAINTENANCE APPROACH

A systematic approach to preventive maintenance can be used to insure continued satisfactory operation of the Genrakode II DC-coded equipment.

1. Track circuit adjustment should be verified whenever track work, such as welding, bonding, ballast cleaning, etc. is performed. See Table 4–2 for the Current Measurement Procedure.
   - Adjustment should also be verified periodically as required by federal and railroad regulations.
   - Track lead polarity should be verified if track work has created the risk of a swap of the leads.
2. The system diagnostics should be checked whenever a location is visited. This includes the board LEDs and the Error Queue. A detailed discussion of the use of diagnostics is provided in Section 6. Software Settings are discussed in Section 3, Installation.
   - Once any errors are resolved or determined not to be current, the Error and Event Queues should be cleared so that future logs show only new information.
   - It is also recommended that the date and time of the PGK CPU board be checked and updated if necessary for more accurate data logging.

3. See Section 5, Troubleshooting, for tips, instructions, and a detailed flowchart. The Genrakode module does not run if a board is in the incorrect slot or if an expected board is missing. Generic board replacement instructions are found in Table 4–1, Always heed the warning at the bottom of this page when replacing a board in the Genrakode module.

   - Board keying and module labels are also available to aid in preventing incorrect board placement.

   - Damage to a board can occur if placed into an incorrect slot, so care should be taken.

   - If the CPU board is replaced, there are various software options that must be set in accordance with the plans for the location, such as Code 5 and optional Code T settings. See Software Settings in Section 3, Installation.

   - If the Converter/Receiver board is replaced, set the screw switches to match the board that was removed and then verify the adjustment of the track circuit. See page 4–3 for Track Maintenance instructions. The track circuits must be properly adjusted to ensure that no codes are received when a 0.06 Ohm shunt is applied. Important: Do not use a Line Wire Converter/Receiver board when connecting to track.

CAUTION

When replacing boards in a vital, electronic system, the user should be guided by the instructions and requirements of the operating agency with regard to any testing that must be performed before placing the altered equipment back in service.

CAUTION

Voltage potentials in the Module could damage printed circuit boards if removed with power applied. Disconnect power from the Module prior to removing boards. Failure to do so could result in damage to the boards.

Boards in the Module contain Electrostatic Discharge (ESD) sensitive components which could be damaged by improper handling. Always ensure boards are transported and stored in static-safe packaging. Before handling any bare board or connecting diagnostic equipment to any board, touch something verified to be grounded and work wearing at least a grounded static-control wrist strap whenever possible. Handle boards only by their edges and do not touch signal traces, leads or output pins on the boards.

Table 4–1. Board Replacement Procedure

Step	Procedure
1	Remove system power.
2	Remove the failed board.
3	Verify that any jumper and switch settings on the replacement board are the same as the board being replaced.
4	Install the board in the appropriate slot, apply system power, and observe the processor messages for errors.
5	Set any software options, such as Code 5 or optional Code-T, as appropriate.

4.2.1. Track Circuit Maintenance

If a permanent record was generated of the track circuit data during the installation of the equipment, this can serve as a future reference for routine track maintenance or as an aid for isolating troubles. A maintenance schedule consistent with good railroad safety practices should be set up and complied with.

A sample Track Maintenance Log form is shown in Figure 4–1. During the installation; the track length, rail type, initial Converter screw-switch settings, and Receiver screw-switch settings should have been recorded in that log or some equivalent. If readjustment of the screw-switches is required, the new settings should be noted.

4.2.2. Recommended Equipment

The recommended equipment needed for track maintenance is a peak reading multimeter such as a Simpson® TS-111 or equivalent and a track shunt strap with a 0.06 Ohm resistor.

NOTE

If using a digital peak reading multimeter, verify that the sample rate is sufficiently high (≤10ms per sample). The Fluke® 187 “fast min-max” peak measurement is one recommendation.

4.2.3. Maintenance Test Procedure

The procedure provided in Table 4–2 describes making track current measurements by inserting a meter in series with the track by removing a track lead connected to the Genrakode module.

NOTE

Although it may be more convenient to use a 'gold nut' connection on the TK- lead on the entrance panel (if available), be aware that if any other track equipment shares the track lead at this entrance panel connection, such as an overlay circuit, the measurement should be made at the Genrakode module connection as described in Table 4–2.

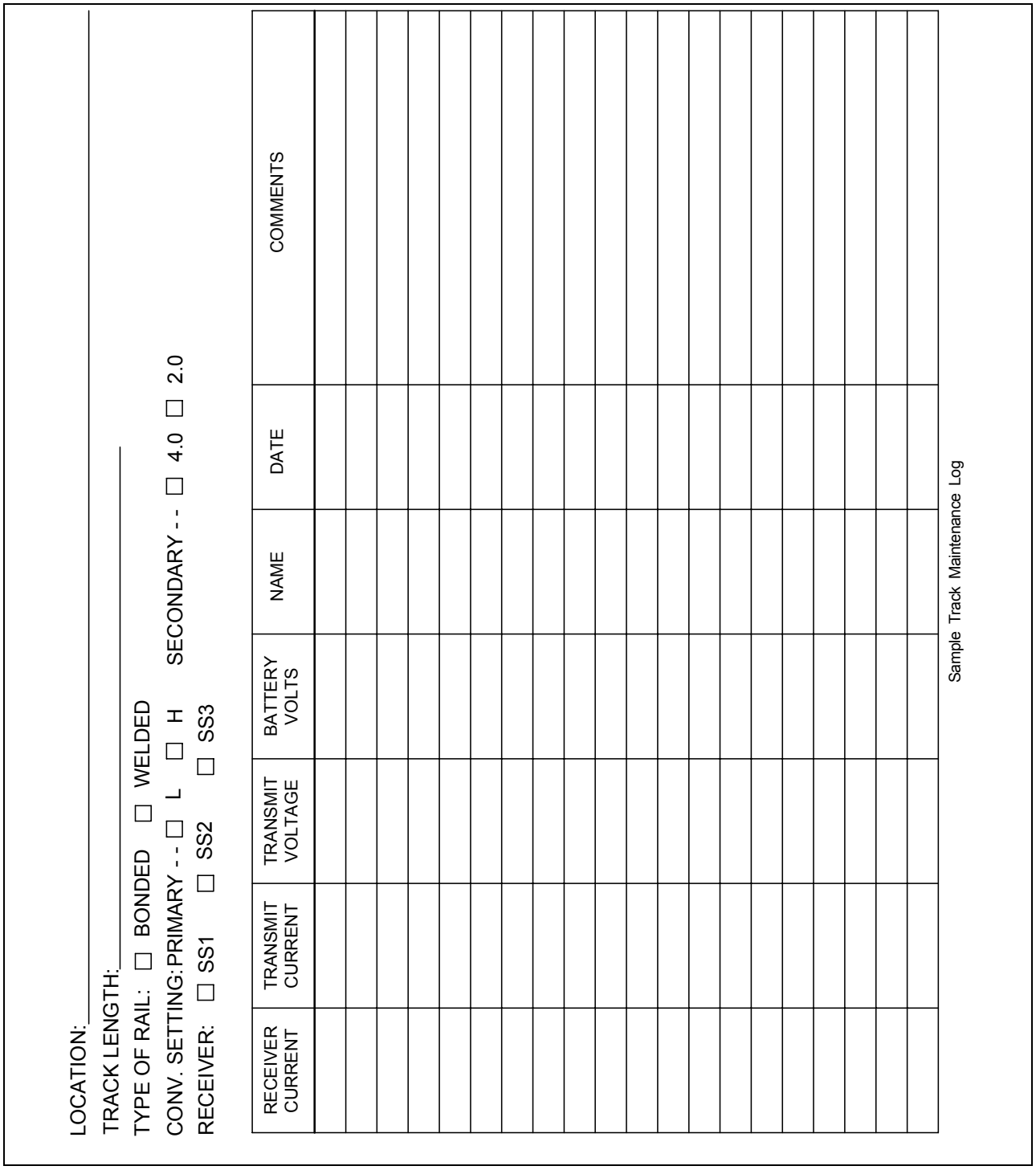
Table 4–2. Current Measurement Procedure

Step	Action
1	Measure Receive Current: Set a peak reading ammeter to its 3-Ampere (or closest available) scale for receive current measurement. Disconnect the TK- lead. Connect the positive lead of the meter to the TK- terminal and the negative lead of the meter to the wire from the minus track. Record the peak receive current observed over several code cycles. If the peak receive current is outside of the 1.0 – 1.4 Ampere range or the receive current is not nominal given current conditions (wet/dry), perform the Converter/Receiver Board Adjustment procedure in Table 3–5.
2	Measure Transmit Current: Reverse the meter leads from the receive current measurement (connect the positive lead of the meter to the minus track wire and the negative lead of the meter to the TK- terminal). Record the peak transmit current observed over several code cycles. Some railroads may require transmit current measurements with and without a shunt applied. After both receive and transmit current have been measured, remove the meter and restore the track connections. Note that a different meter scale setting may be required for the transmit current measurement, which can approach 10A if the measurement is performed with a hardwire shunt applied.
3	Measure Transmit Voltage: Using a peak reading voltmeter set to the 15 Volt (or closest available) scale, measure the transmit output by connecting the positive terminal on the TK+ terminal and the negative lead on the TK- terminal. Record the peak transmit voltage reading observed over several code cycles.

Table 4–2. Current Measurement Procedure (Cont.)

Step	Action
4	Measure Battery Voltage: Using a DC voltmeter, read and record the battery voltage from the B terminal to the N terminal.
5	Verify Shunting Sensitivity: Connect the shunt strap with the 0.06 Ohm resistor across the rails and verify that the TRK LED light for the appropriate direction comes on within approximately 6 seconds. Remove the shunt strap.

Figure 4–1. Sample Track Maintenance Log



LOCATION:_____

TRACK LENGTH:_____

TYPE OF RAIL: ☐ BONDED ☐ WELDED

CONV. SETTING: PRIMARY - - ☐ L ☐ H SECONDARY - - ☐ 4.0 ☐ 2.0

RECEIVER: ☐ SS1 ☐ SS2 ☐ SS3

RECEIVER CURRENT	TRANSMIT CURRENT	TRANSMIT VOLTAGE	BATTERY VOLTS	NAME	DATE	COMMENTS

Sample Track Maintenance Log

5. SECTION 5 – TROUBLESHOOTING

5.1. GENERAL

This Section includes troubleshooting flowcharts used to facilitate isolation of failures in the track circuits, Genrakode II utilizes board LEDs and an Error Queue data log. There are LEDs on the Converter/Receiver, Vital Power Controller (VPC), Auxiliary I/O, and CPU boards. The PC board arrangement including LEDs and test points is provided in Appendix A. The Error Queue is stored on the PGK CPU board. See Section 6, Diagnostics, for instructions on accessing this log. If the problem has been isolated to the module itself, the diagnostics help to isolate the problem to the board level.

5.1.1. Recommended Equipment

When going on a trouble call, take the following items: a peak reading multimeter such as a Simpson® TS-111 or equivalent, a shunt strap with a 0.06 Ohm resistor, and a complete set of spare boards. Note: if using a digital peak reading multimeter, verify that the sample rate is sufficiently high (<10ms per sample). The Fluke® 187 “fast min-max” peak measurement is one recommendation.

To easily display the Error and Event Queues for faster and more accurate diagnosis bring a laptop with terminal emulation software such as the PGK CAA Download program or HyperTerminal©.

5.1.2. Troubleshooting Approach

If the problem has been isolated to the Genrakode module, use the board LEDs, especially those on the PGK CPU board, to determine what state the module is in – Running State, Start-up Sequence, or Reset Loop.

Follow the Troubleshooting Flowchart in Figure 5–1 to diagnose the problem. Here are some general tips:

- If there are no LEDs lit on the Genrakode module, then loss of power is the most likely cause. Check the battery input leads, voltages, fuses, etc.

- If the module is in the Running State, check the Error Queue for any errors in the system. See Section 6, Diagnostics, for instructions on displaying and clearing the Error Queue using the rocker switch on the PGK CPU board or via a laptop connected to the serial port. A recommended approach for determining if an error condition still currently exists is to clear the Error Queue, reset the module, and the check the Error Queue after the module restarts.

- If the module is in the Reset Loop, the Reset Loop must be interrupted before the Error Queue can be displayed or cleared. See Section 6 for instructions.

- If the Error Queue lists an error with a particular board, swap that board with a spare board. Another useful approach is to swap the suspect board with the other board of that type in the system. For example, swap the East and West Colorlight Driver boards. If the error tracks to the other side, the board is the culprit. Otherwise, the VPC board on the original side may be a suspect.

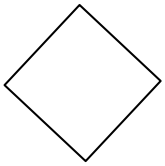
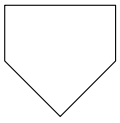
Resolve the problem by checking wiring, swapping boards, adjusting track circuits, etc. as required. See Table 4–1 for instructions and the preceding paragraphs in Section 4 for warnings regarding circuit board removal and replacement.

Once any errors are resolved or determined not to be current, the Error and Event Queues should be cleared so that future access of the logs shows only new information. It is also recommended that the date and time of the PGK CPU board be checked for more accurate data logging. See Software Settings in Section 3, Installation.

5.2. TROUBLESHOOTING FLOWCHART

Figure 5–1 is a multi-page flowchart to assist in trouble-shooting a Genrakode module. Definitions of terms used in the flowchart are provided below, and some of the actions to perform are explained in detail in the Section 6, Diagnostics.

Table 5–1. Troubleshooting Flowchart Symbols

Symbol	Explanation
	Malfunction statement as derived from operator..
	A basic instruction for preparation of a test, procedure or observation. The action taken results in a diagnostic decision.
	A decision point; a result from an observation or previous action that is answered yes or no. If result is within tolerance, answer yes. If not, answer no. Do not consider any gray areas between yes or no.
	Final step of instructions involving corrective measures. Reference publication indicates suspected problem area.
	An off page reference.

5.2.1. Flowchart Term Definitions

The following terms are used in the flowchart provided in Figure 5–1.

Running State – A Programmable Genrakode module is in normal operating mode if the power LED on the CPU board is lit and the LED on each VPC board present in the system is lit. This indicates that the 12V battery input and 5V digital input are good and that the repetitive output and receiver tests are being passed.

Start-up Sequence – When powered up, the Programmable Genrakode module should go through the following sequence of steps:

- Power LED on the CPU board illuminates
- 7-segment LEDs on the CPU board read “P-UP”
- LEDs located above the Malfunction LED on the CPU board illuminate
- LEDs on the CPU board turn off one at a time
- Module enters the Running State.

Reset Loop – When a Programmable Genrakode module goes through the Start-up Sequence repetitively without entering the Running State, the module is in a Reset Loop.

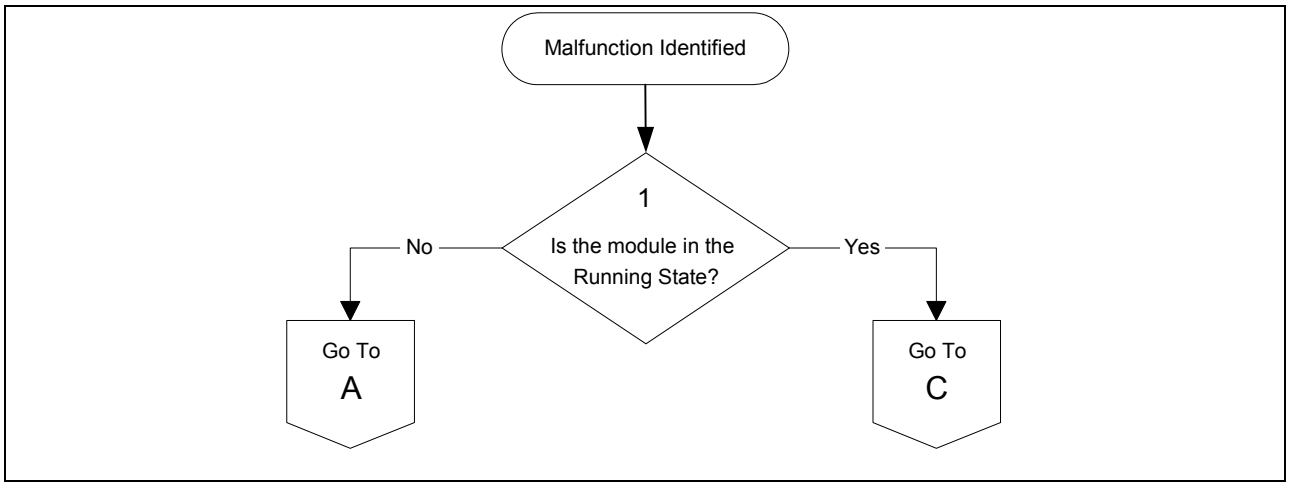


Figure 5–1. Troubleshooting Flowchart

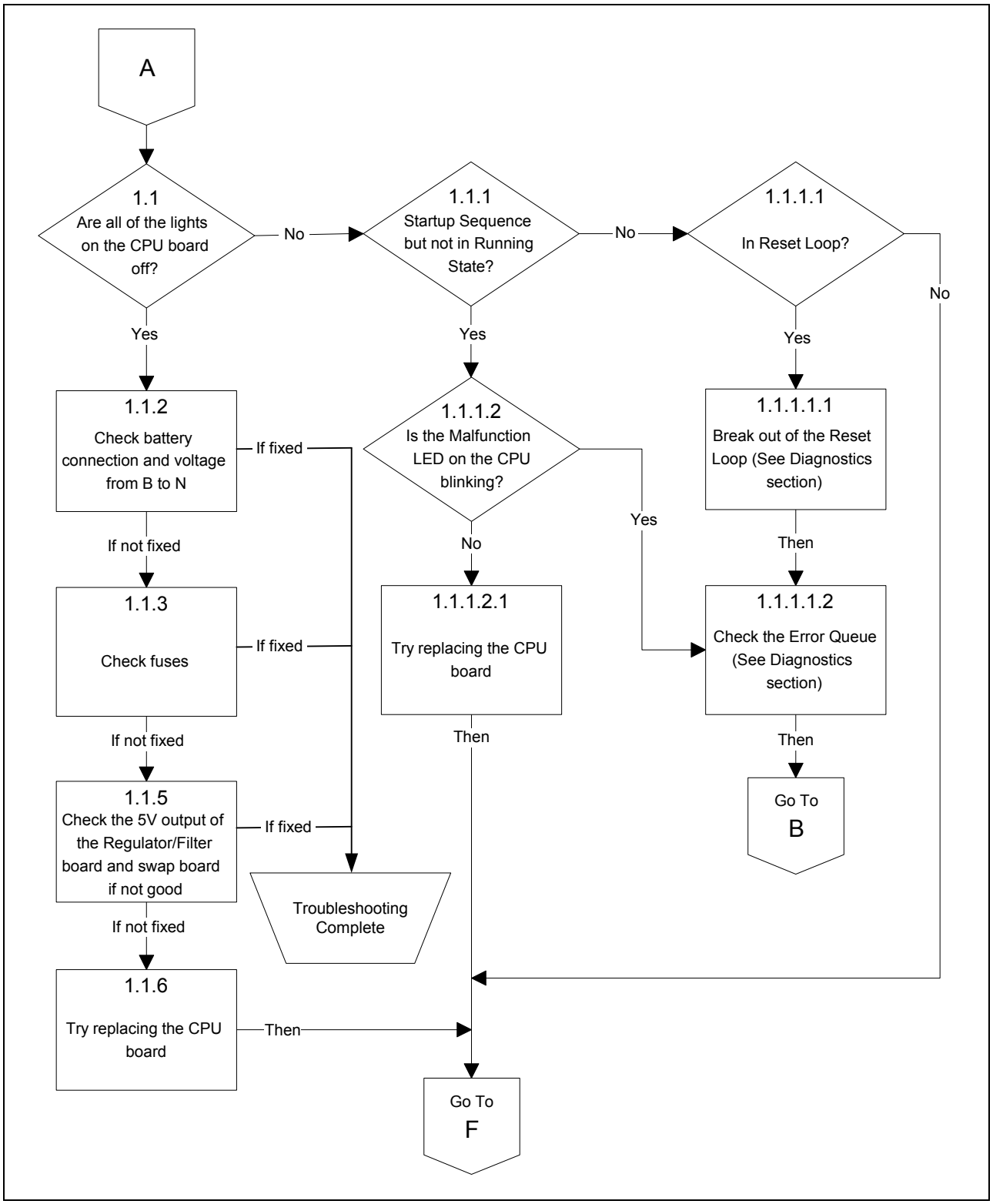


Figure 5–1. Troubleshooting Flowchart (Cont.)

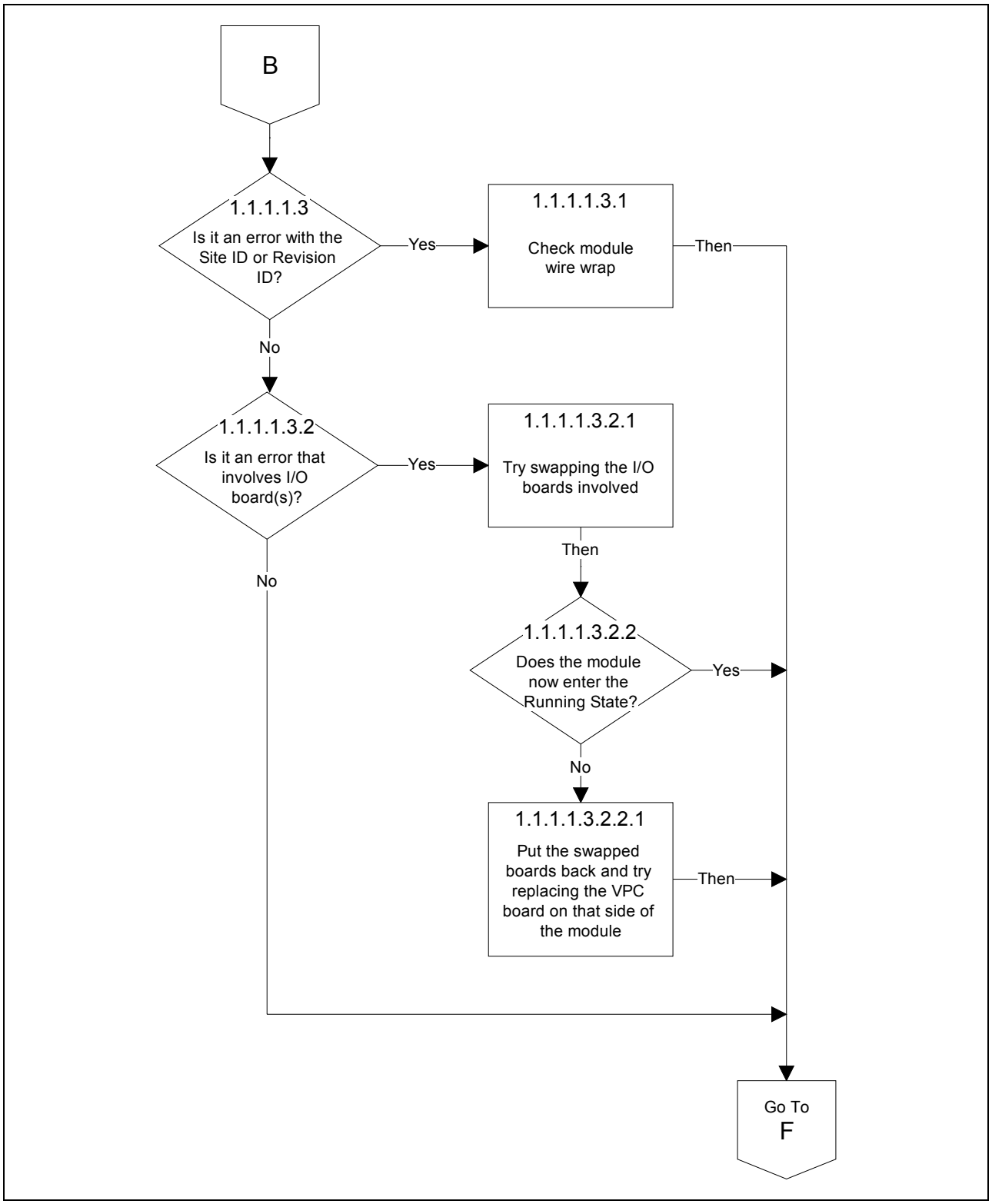


Figure 5–1. Troubleshooting Flowchart (Cont.)

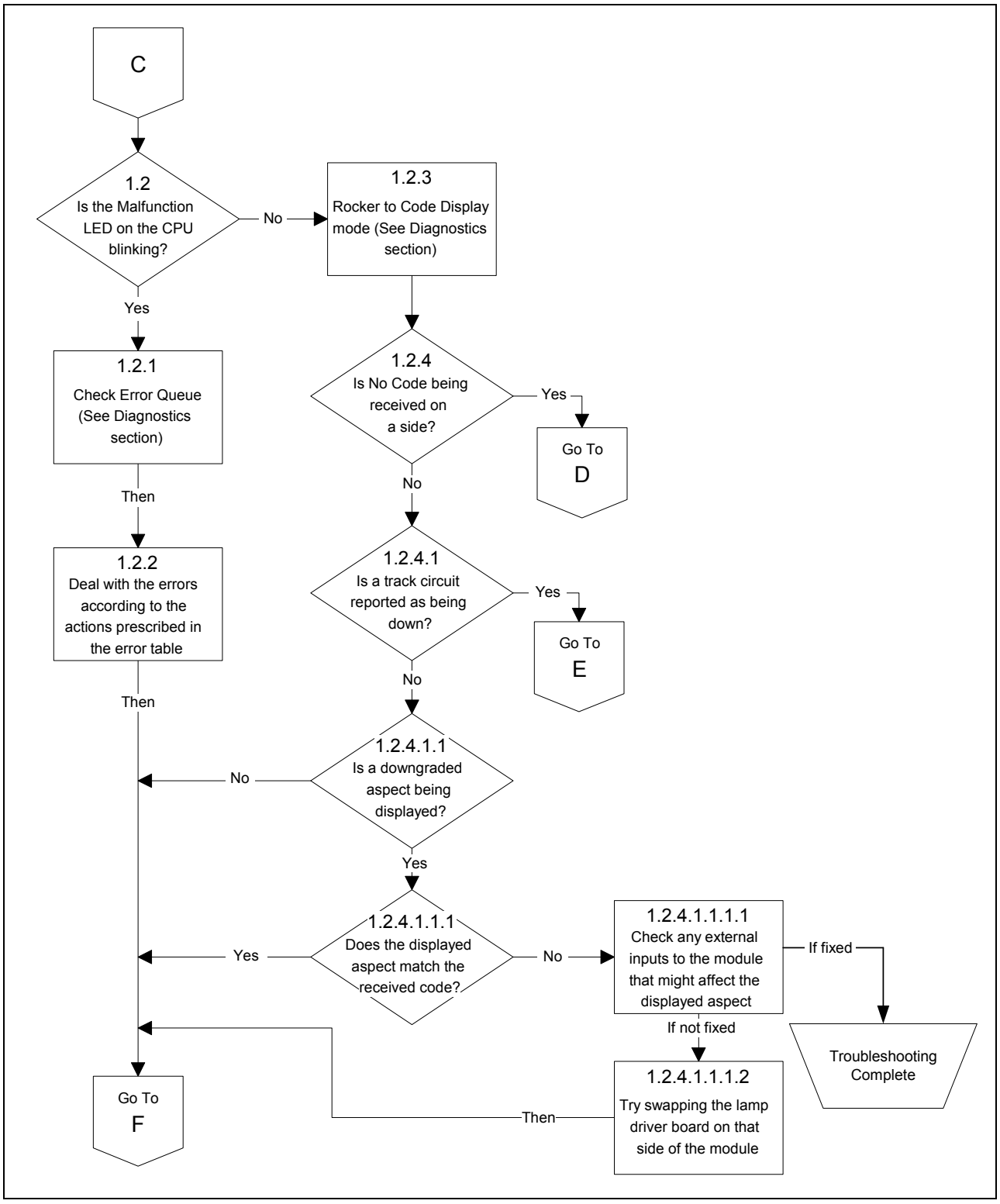


Figure 5–1. Troubleshooting Flowchart (Cont.)

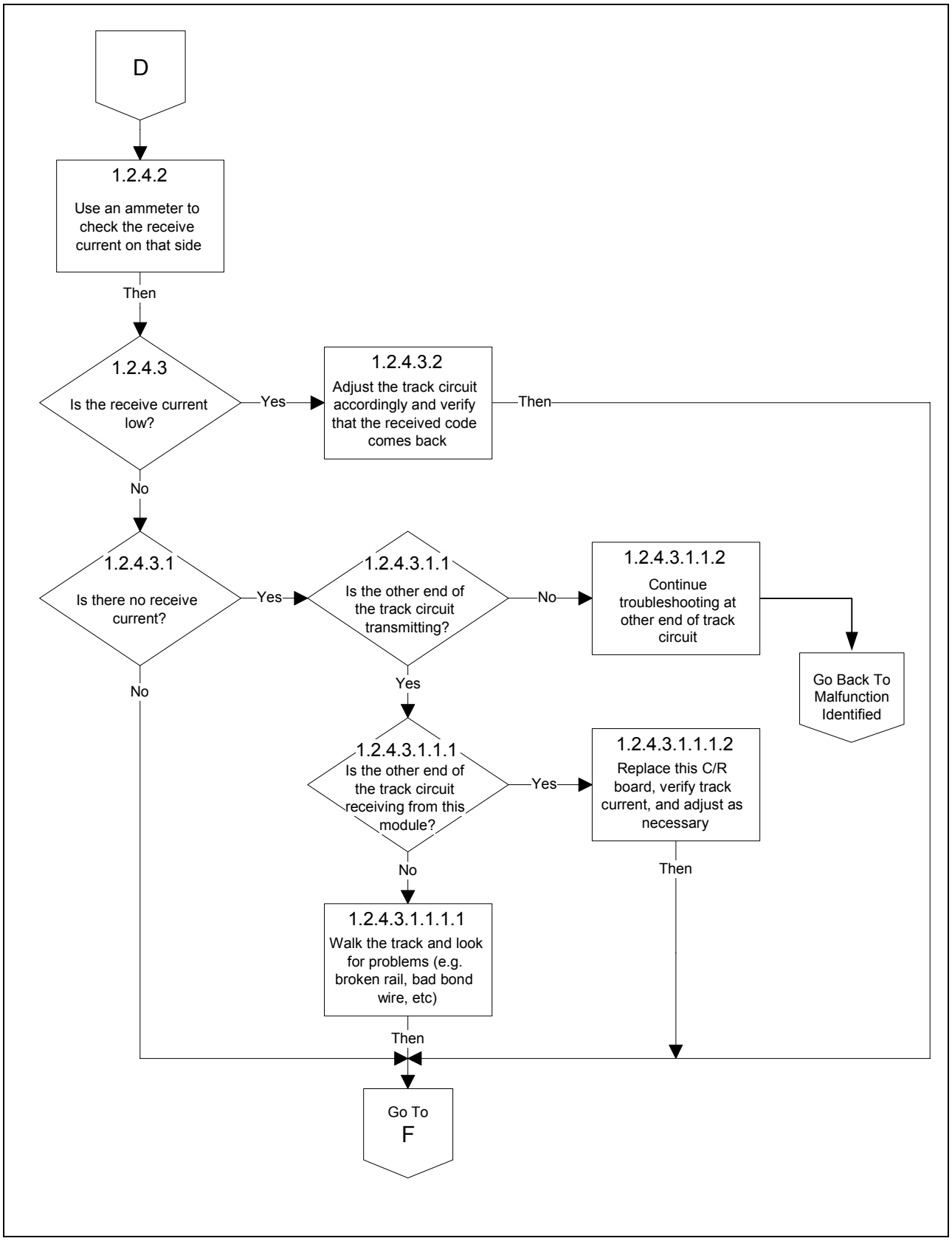


Figure 5–1. Troubleshooting Flowchart (Cont.)

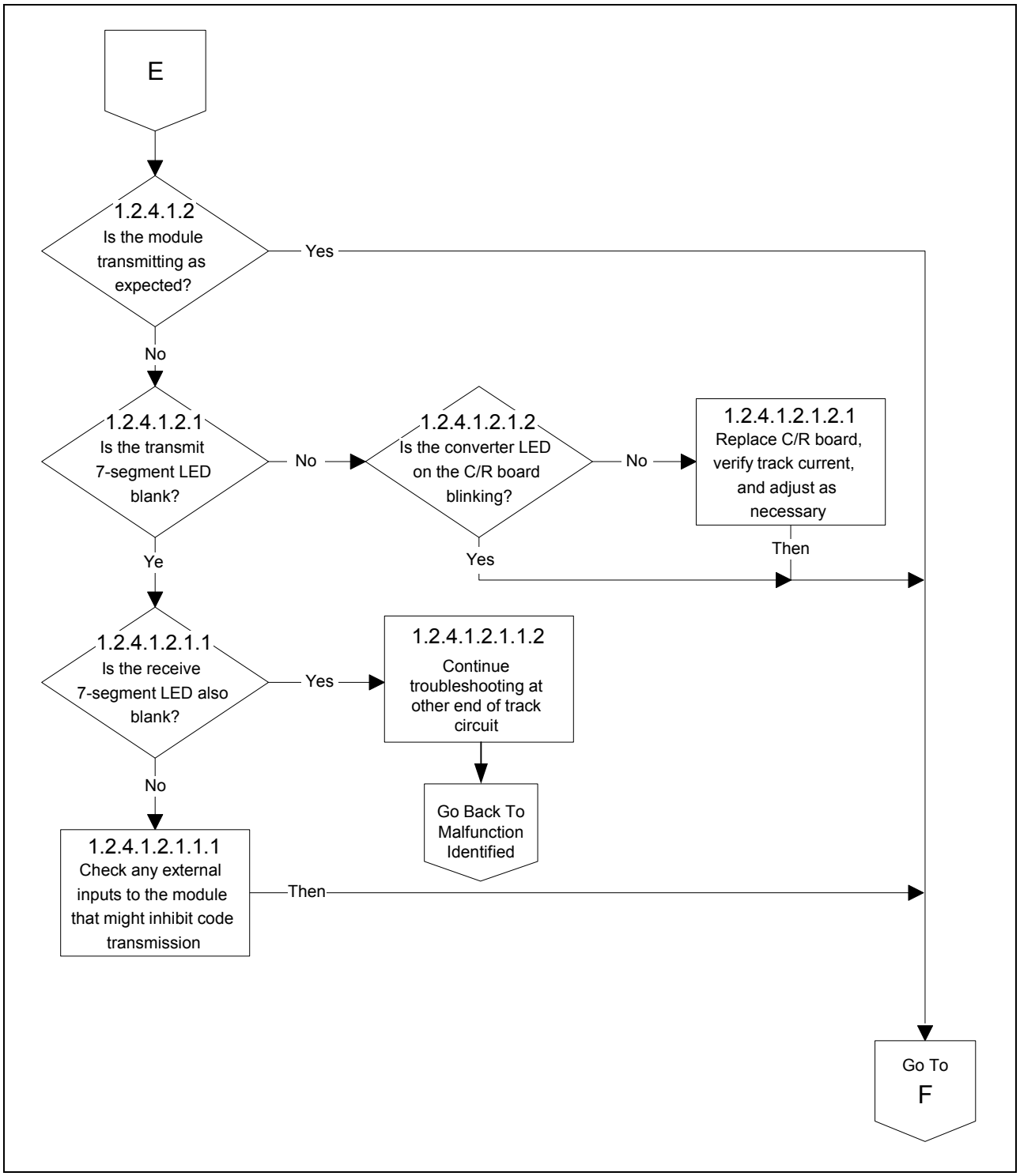


Figure 5–1. Troubleshooting Flowchart (Cont.)

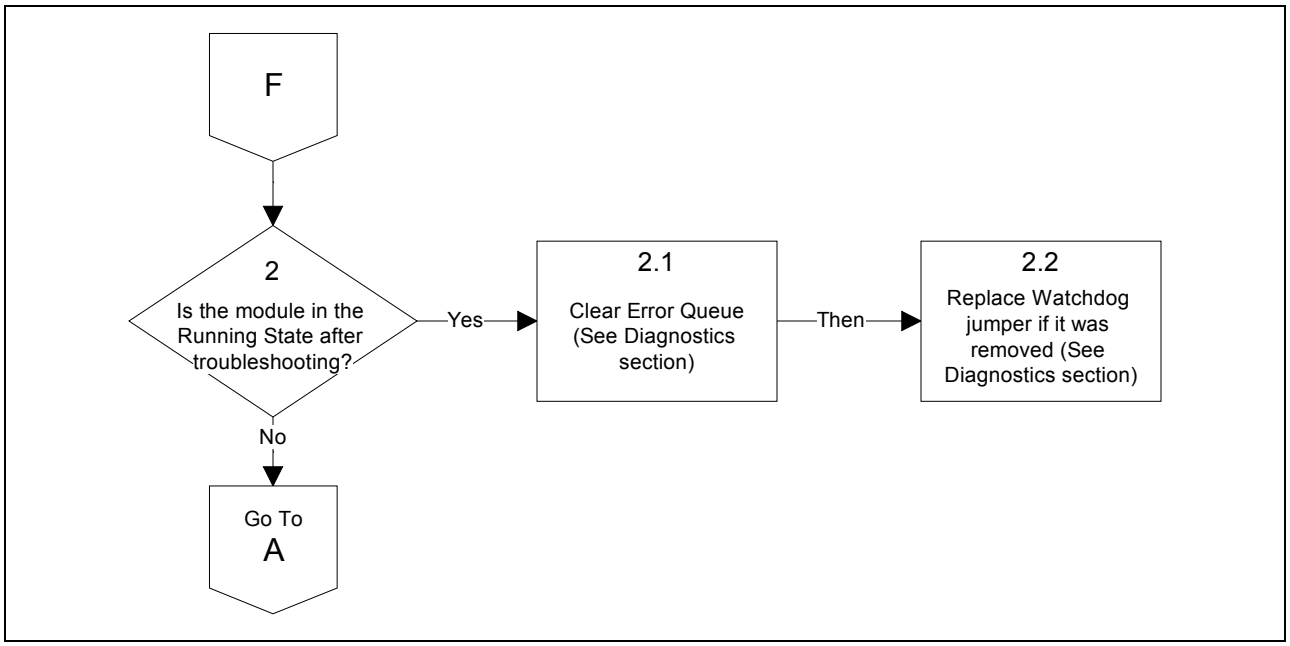


Figure 5–1. Troubleshooting Flowchart (Cont.)

6. SECTION 6 – DIAGNOSTICS

6.1. GENERAL

All Genrakode II modules have internal diagnostics to help the maintainer return a failed location to working order.

6.1.1. Software Errors

When power is first applied to a module, the microprocessor begins to execute a series of instructions that test basic functions of the system. This software, called the “Boot Loader”, is stored in an EPROM on the CPU board. The Boot Loader verifies the application and system software integrity by mathematically computing a checksum that must agree with the one stored in the CPU programmable FLASH memory. If the checksum does not agree, the 7-segment LEDs on the CPU board displays “Prog” to indicate that the unit must be reprogrammed with new software. To accomplish the download of application and system software, a Personal Computer must be attached to the RS-232 port on the CPU board. Specific details of this connection and the use of the Alstom Download program are provided in Appendix B.

6.1.2. Hardware Errors

As the CPU runs in normal operation, various tests and checks are continuously made on the hardware internal and external to the PGK CPU board. These tests and checks must indicate that all phases of operation are being executed correctly for operation to continue. If anything internal to the Genrakode II module is detected as being incorrect, the CPU shuts down the VPC(s) to remove vital power from all outputs and to disable code transmission. After a delay period of approximately twenty seconds, the CPU restarts the program and continues its tests and checks. If the failure is transient in nature such as power surges from a nearby lightning storm, the system resumes normal operation but any detected error condition is recorded in the Error Queue.

To enable the maintainer to diagnose a problem, the CPU places a number (error code) into a special section of memory called the Error Queue whenever the CPU detects a fault. The Error Queue may be accessed by either using the 7-segment displays on the CPU board to display error codes on the board edge or by connecting a personal computer (PC) to the CPU board serial port. See the following discussions of On-Board Controls and Displays and of RS-232 Serial Port Interface for more details, respectively.

If a failure mode causes the system to enter a Reset Loop, access diagnostics by interrupting this repetitive resetting. This is most simply done using a PC connected to the serial port, but it can also be accomplished by pulling a jumper on the CPU board. See the Interrupting a Reset Loop discussion for more details.

6.2. ON-BOARD CONTROLS AND DISPLAYS

The Rocker Switch (S1) is used in combination with the four 7-segment LED displays and the individual LEDs on the CPU board edge to display system information such as track occupancy, transmitted and received codes, and Error Queue status. S1 is also used to view and change various system settings. The Rocker Switch controls which system display or setting information is displayed at any given time.

The number of display modes available for a given application depends on the module type and application settings that are currently in use. Figure 6–1 shows the display modes and their order for the various module types. Moving the Rocker Switch to the UP position switches to the next display mode. There are eight (8) possible display modes:

1. Mode 1: This is the mode the PGK CPU board enters at startup. LED displays are OFF, except for bottom POWER LED and possibly the LEDs in the ‘SYSTEM’ group of LEDs if warranted by their associated functions.

2. Mode 2: This mode is used to display the transmitted and received codes on each track using a combination of 7-segment LED displays and discrete LEDs. The indication of each LED is labeled on the PGK CPU board.

3. Mode 3: This mode is used to display the system error codes currently in the Error Queue. This mode is indicated by a flashing ‘0’ in the topmost 7-segment LED display (DS2). If there are any error codes to be displayed, the Malfunction LED (DS20) flashes. To view the two-digit hex error codes while in this mode, rock the Rocker Switch down to display each code on the lower two 7-segment displays. When the switch is rocked down and those displays go blank, the last error code has been displayed.

   Be aware that to cycle through the error codes again it is necessary to toggle through the rest of the display modes back to Mode 3.

4. Mode 4: For an application using the Vital Serial Link, this mode displays Link and Drop settings. DS2 shows ‘L’ to indicate that DS3 displays the Link number (1 or 2), and DS11 shows ‘d’ to indicate that DS12 displays the Drop number (1 or 2). Currently, Vital Serial Link operation is only supported for CPIB Control Point applications.

5. Mode 5: This mode is used to display and change (if desired) the Code 5 Default Send mode for the East Track. It is only present in Intermediate, Repeater, and Switch Lock applications. This mode is indicated by a flashing ‘C5’ on the top two 7-segment LED displays, and the current setting for the East track is displayed on the bottom two displays.

6. Mode 6: This mode is used to display and change (if desired) the Code 5 Default Send mode for the West Track. This mode is identical to Mode 5 except that the setting applies to the West Track.

7. Mode 7: This mode is used to display and change (if desired) the Code T Location ID. It is only present in Intermediate, Repeater, and Switch Lock applications if Code T operation is enabled. This mode is indicated by a flashing 'C' on the top 7-segment LED display, and the current Location ID setting for the module is displayed (as a decimal number from 0 – 27) on the bottom two displays.

8. Confirm Setting Change Mode: This mode only appears if the user has modified a system setting using the Rocker Switch. A flashing "UP" (for Update) on the lower two 7-segment displays indicates this mode.

See Section 3 for additional software setting details.

If errors have been stored in the Error Queue, the CPU front edge Malfunction LED flashes. The procedures for entering Monitor Mode to view the errors are provided in Tables 6–1 and 6–2.

NOTE

If the Genrakode module is in a reset loop, the Rocker Switch is not able to access the Error Queue. However, if the Watchdog jumper is removed, the reset loop stops and the diagnostics can be accessed. See Table 6–2 for instructions on removing the Watchdog jumper.

6.2.1. Displaying Errors

To display errors using the CPU 7-segment LEDs, move the Rocker Switch up to Mode 3. See Figures A–9 through A–12 for CPU board LED indicators in normal mode, maintenance mode, and two code 5 always examples.

Refer back to the mode descriptions for details on how to step through the list of error codes logged in the Error Queue.

6.2.2. Clearing Errors

To clear the Error Queue (assuming it is not empty), press the rocker switch down while in Mode 3 until the bottom two displays are blank. Then press and hold the rocker switch down until the Malfunction LED goes OFF (approximately 10 seconds). Note: if a persistent error condition exists such as an open lamp filament, the Malfunction LED remains flashing.

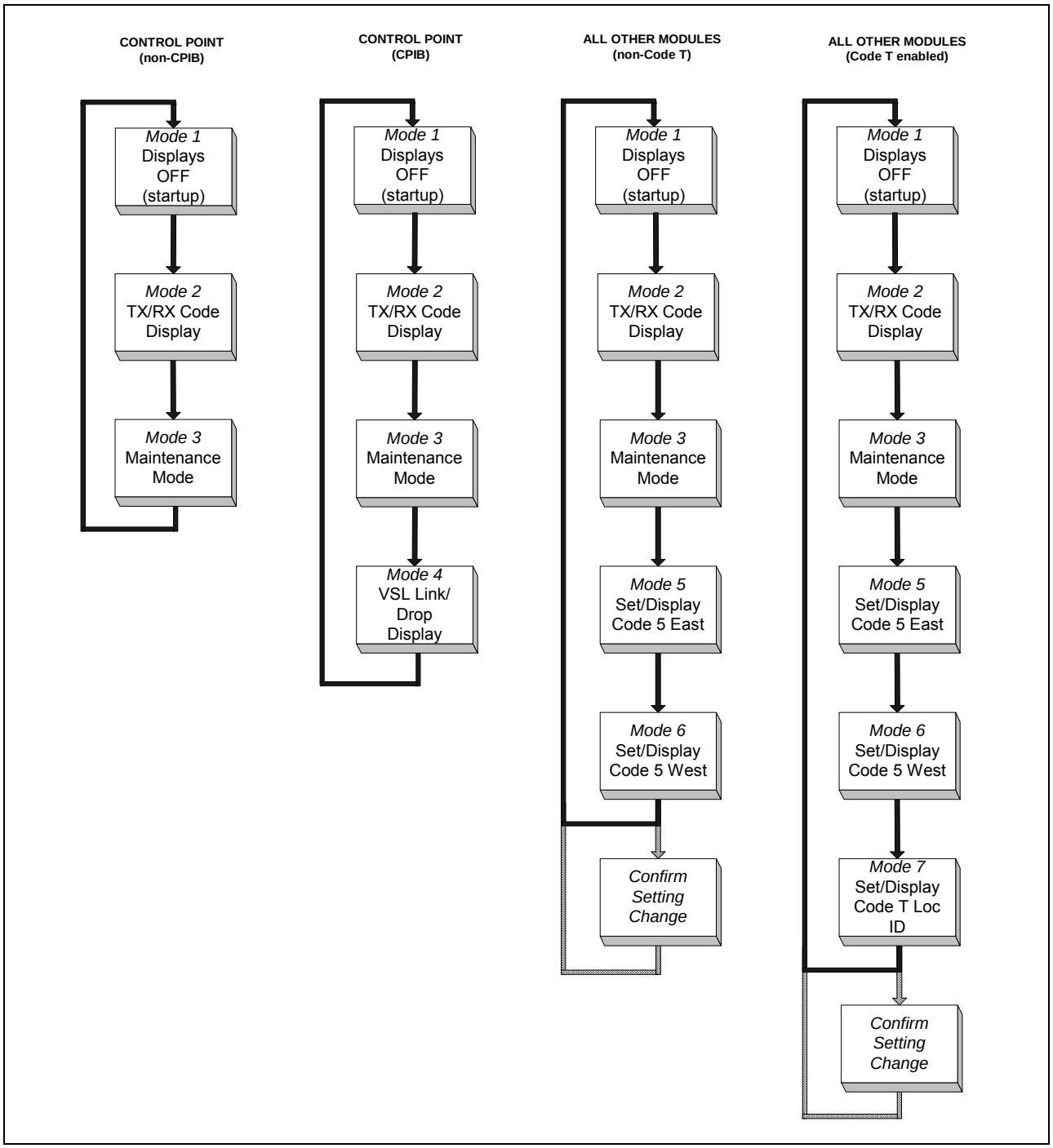


Figure 6–1. Rocker Switch Display Modes

6.3. RS-232 SERIAL PORT INTERFACE

The RS-232 serial port can be used to access diagnostics.

There are two devices that can be connected to this interface:

- Desktop computer or laptop with appropriate emulation software
- Hand Held Terminal (HHT)

6.3.1. Desktop Computer or Laptop

A computer or laptop with DEC VT-100 compatible terminal emulation software is required to run the Alstom Download program to download Application software to the CPU board. For this PC interface, jumper W5 on the CPU board should be OUT. Figure 6–2 shows the complete wiring.

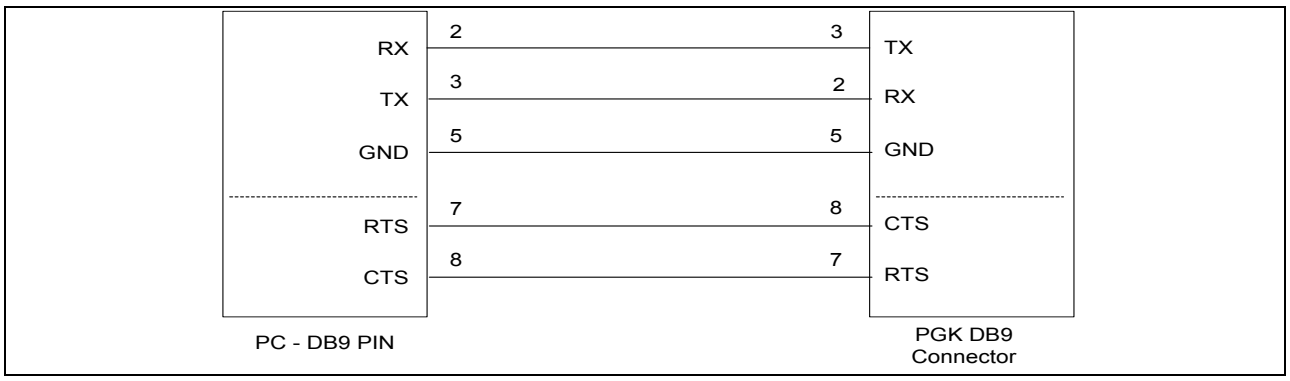


Figure 6–2. PGK DB9 Connector Wiring

The RTS and CTS lines are not required for accessing the diagnostics of the system. They are only included since they might be used for future code system interfaces via modem. Note that a straight through DB9<-->DB9 with a Null Modem then works for all serial port needs except for that special case.

The required communications protocol for accessing the PGK CPU System Commands using any terminal emulation software is: 1200 Baud, 8 Data Bits, 1 Stop Bit, no parity.

6.3.2. Handheld Terminal

A Handheld Terminal (HHT) specifically designed to connect to this interface (P/N 31609-012-00) can be used. This method only allows access to the PGK CPU System Commands and cannot be used for downloading Application software. For this interface method, jumper W5 should be IN to provide power to the HHT.

6.3.3. Error Queue

The error queue can be accessed with the RS-232 Interface Port. Use the DEQ command to display the entire Error Queue. Use the CEQ command to clear the Error Queue.

6.3.4. Event Queue

The Event Queue can be a useful diagnostic tool in addition to the Error Queue. The Event Queue stores a log of system events and can be used to investigate changes to system parameters over time. For example, when a lamp is turned on or a track circuit becomes occupied, the date and time of the event is logged. This information, along with the comparison of timestamps with the Error Queue, can be valuable. Use the DVQ command to display the Event Queue.

6.4. INTERRUPTING A RESET LOOP

Two methods are available for interrupting a reset loop in order to access the system diagnostics and enter Monitor mode. The preferred method is to connect a PC to the PGK CPU serial port and enter Monitor Mode as described in Table 6–1. The second method that should be used with extreme caution is to remove the Watchdog jumper as described in Table 6–2.

Table 6–1. Enter Monitor Mode With a PC

Step	Action
1	Leave the Watchdog jumper in and connect a null modem DB9 serial cable from the laptop to the CPU.
2	Run a terminal emulation program at 1200 bps, 8-None-1. See Appendix B for more details on connecting to the serial port.
3	As the CPU goes through the repeated Startup Sequence, the terminal displays “Press <Enter> now to enter Monitor Mode” Press the <Enter> key and the Monitor Mode prompt is displayed (MON>). Then the DEQ and CEQ commands are available to display and clear the Error Queue, respectively. Note that the Event Queue is not available in Monitor Mode.

Table 6–2. Enter Monitor Mode Without a PC

Step	Action
1	Power down the module using the switch located on the left side of the module.
2	Remove the CPU board from the module.
3	Remove the Watchdog jumper (W8). **CAUTION** The Watchdog jumper (W8) **MUST** be returned after troubleshooting is complete. Failure to do so prevents the module from automatically recovering from future reset conditions, thus requiring manual reset. Return the CPU board to its proper slot.
4	Power up the module. The module now performs the Start-up Sequence once and then stops. The diagnostics are now accessible through the rocker switch and 7-segment displays. See the previous On-Board Controls and Displays discussion.
5	Perform the desired diagnostics.
6	When diagnostics are complete the Watchdog jumper **MUST** be returned. Power down the module using the switch located on the left side of the module.
7	Remove the CPU board from the module, re-install the Watchdog jumper (W8), and return the CPU board to its proper slot.
8	Power up the module. The module should go through the Start-up Sequence and then enter the Running State. If not, return to the beginning of the troubleshooting flowchart in Section 5.

6.5. ERROR CODES

Table 6–3 lists the PGK Error Codes for PGK CAA Versions 1.55 through the current version.

The following note applies to many of the remedies, as indicated in the Corrective Action column.

NOTE

If a CIC (Cable Integrity Check) version of the board is present, check that no cable shorts are present between outputs. Such shorts can cause state, toggle, and filament check errors. See Section 2, Heading 2.6.1. for a discussion of the CIC function.

Table 6–3. Error Code Diagnostics

Error Number	Failure	Corrective Action
00	Warning - Replace CPU Battery	Replace 3V battery on CPU Board.
01	PGK Board Failure	Replace CPU Board if problem persists.
02	LL Cycle Capacity Warning!	Contact Application Programmer.
03	Incorrect IOC software version	Install correct IOC PROM (U30) version.
05	IOC Comm Error: Config Report	Replace CPU Board if problem persists.
06	IOC Comm Error: Op Request	Replace CPU Board if problem persists.
07	IOC Comm Error: IOC Status	Replace CPU Board if problem persists.
08	IOC Comm Error: LGC Ready	Replace CPU Board if problem persists.
09	IOC Comm Error: Op Data	Replace CPU Board if problem persists.
0F	East Decode Output Failure	Replace EAST Decode Output Board.
10	East DO 1 Toggle Failure	Replace EAST Decode Output Board and/or EAST VPC Board. (See Note)
11	East DO 2 Toggle Failure	Replace EAST Decode Output Board and/or EAST VPC Board. (See Note)

Table 6–3. Error Code Diagnostics (Cont.)

Error Number	Failure	Corrective Action
12	East DO 3 Toggle Failure	Replace EAST Decode Output Board and/or EAST VPC Board. (See Note)
13	East DO 4 Toggle Failure	Replace EAST Decode Output Board and/or EAST VPC Board. (See Note)
14	East DO 5 Toggle Failure	Replace EAST Decode Output Board and/or EAST VPC Board. (See Note)
15	East DO 6 Toggle Failure	Replace EAST Decode Output Board and/or EAST VPC Board. (See Note)
16	East DO 7 Toggle Failure	Replace EAST Decode Output Board and/or EAST VPC Board. (See Note)
17	East DO 8 Toggle Failure	Replace EAST Decode Output Board and/or EAST VPC Board. (See Note)
18	East DO 1 State Failure	Replace EAST Decode Output Board and/or EAST VPC Board. (See Note)
19	East DO 2 State Failure	Replace EAST Decode Output Board and/or EAST VPC Board. (See Note)
1A	East DO 3 State Failure	Replace EAST Decode Output Board and/or EAST VPC Board. (See Note)
1B	East DO 4 State Failure	Replace EAST Decode Output Board and/or EAST VPC Board. (See Note)
1C	East DO 5 State Failure	Replace EAST Decode Output Board and/or EAST VPC Board. (See Note)
1D	East DO 6 State Failure	Replace EAST Decode Output Board and/or EAST VPC Board. (See Note)
1E	East DO 7 State Failure	Replace EAST Decode Output Board and/or EAST VPC Board. (See Note)
1F	East DO 8 State Failure	Replace EAST Decode Output Board and/or EAST VPC Board. (See Note)
20	East SA Failure	Replace EAST Search Light Drive Board.
22	ESL A Filament Failure	Check/Replace EAST A Lamp or Replace EAST Search Light Drive Board and/or EAST VPC Board. (See Note)

Table 6–3. Error Code Diagnostics (Cont.)

Error Number	Failure	Corrective Action
23	ESL B Filament Failure	Check/Replace EAST B Lamp or Replace EAST Searchlight Drive Board and/or EAST VPC Board. (See Note)
24	ESL A Toggle Failure	Replace EAST Search Light Drive Board and/or EAST VPC Board. (See Note)
25	ESL B Toggle Failure	Replace EAST Search Light Drive Board and/or EAST VPC Board. (See Note)
26	ESL A State Failure	Replace EAST Search Light Drive Board and/or EAST VPC Board. (See Note)
27	ESL B State Failure	Replace EAST Search Light Drive Board and/or EAST VPC Board. (See Note)
28	SWL Lock Relay State Failure	Replace Switch Lock I/O Board.
29	SWL Ovly Relay State Failure	Replace Switch Lock I/O Board.
2A	SWL Output Relay State Failure	Replace Switch Lock I/O Board.
2B	SWL Lock Relay Toggle Failure	Replace Switch Lock I/O Board.
2C	SWL Ovly Relay Toggle Failure	Replace Switch Lock I/O Board.
2D	SWL Output Relay Toggle Failure	Replace Switch Lock I/O Board.
2E	SWL Input Drive Failure	Replace Switch Lock I/O Board.
2F	Overlay Input Drive Failure	Replace Series Overlay Board.
30	East CLD Failure	Replace EAST Color Light Drive Board.
32	ECL Grn A Toggle Failure	Replace EAST Color Light Drive Board and/or EAST VPC Board. (See Note)
33	ECL Yel A Toggle Failure	Replace EAST Color Light Drive Board and/or EAST VPC Board. (See Note)
34	ECL Red A Toggle Failure	Replace EAST Color Light Drive Board and/or EAST VPC Board. (See Note)
35	ECL Grn B Toggle Failure	Replace EAST Color Light Drive Board and/or EAST VPC Board. (See Note)

Table 6–3. Error Code Diagnostics (Cont.)

Error Number	Failure	Corrective Action
36	ECL Yel B Toggle Failure	Replace EAST Color Light Drive Board and/or EAST VPC Board. (See Note)
37	ECL Red B Toggle Failure	Replace EAST Color Light Drive Board and/or EAST VPC Board. (See Note)
38	ECL Grn A Fil Failure	Check/Replace EAST A Lamp or Replace EAST Color Light Drive Board and/or EAST VPC Board. (See Note)
39	ECL Yel A Fil Failure	Check/Replace EAST A Lamp or Replace EAST Color Light Drive Board and/or EAST VPC Board. (See Note)
3A	ECL Red A Fil Failure	Check/Replace EAST A Lamp or Replace EAST Color Light Drive Board and/or EAST VPC Board. (See Note)
3B	ECL Grn B Fil Failure	Check/Replace EAST B Lamp or Replace EAST Color Light Drive Board and/or EAST VPC Board. (See Note)
3C	ECL Yel B Fil Failure	Check/Replace EAST B Lamp or Replace EAST Color Light Drive Board and/or EAST VPC Board. (See Note)
3D	ECL Red B Fil Failure	Check/Replace EAST B Lamp or Replace EAST Color Light Drive Board and/or EAST VPC Board. (See Note)
3F	West Decode Output Failure	Replace WEST Decode Output Board
40	West DO 1 Toggle Failure	Replace WEST Decode Output Board and/or WEST VPC Board. (See Note)
41	West DO 2 Toggle Failure	Replace WEST Decode Output Board and/or WEST VPC Board. (See Note)
42	West DO 3 Toggle Failure	Replace WEST Decode Output Board and/or WEST VPC Board. (See Note)
43	West DO 4 Toggle Failure	Replace WEST Decode Output Board and/or WEST VPC Board. (See Note)
44	West DO 5 Toggle Failure	Replace WEST Decode Output Board and/or WEST VPC Board. (See Note)

Table 6–3. Error Code Diagnostics (Cont.)

Error Number	Failure	Corrective Action
45	West DO 6 Toggle Failure	Replace WEST Decode Output Board and/or WEST VPC Board. (See Note)
46	West DO 7 Toggle Failure	Replace WEST Decode Output Board and/or WEST VPC Board. (See Note)
47	West DO 8 Toggle Failure	Replace WEST Decode Output Board and/or WEST VPC Board. (See Note)
48	West DO 1 State Failure	Replace WEST Decode Output Board and/or WEST VPC Board. (See Note)
49	West DO 2 State Failure	Replace WEST Decode Output Board and/or WEST VPC Board. (See Note)
4A	West DO 3 State Failure	Replace WEST Decode Output Board and/or WEST VPC Board. (See Note)
4B	West DO 4 State Failure	Replace WEST Decode Output Board and/or WEST VPC Board. (See Note)
4C	West DO 5 State Failure	Replace WEST Decode Output Board and/or WEST VPC Board. (See Note)
4D	West DO 6 State Failure	Replace WEST Decode Output Board and/or WEST VPC Board. (See Note)
4E	West DO 7 State Failure	Replace WEST Decode Output Board and/or WEST VPC Board. (See Note)
4F	West DO 8 State Failure	Replace WEST Decode Output Board and/or WEST VPC Board. (See Note)
50	West SA Failure	Replace WEST Search Light Drive Board.
52	WSL A Filament Failure	Check/Replace WEST A Lamp or Replace WEST Search Light Drive Board and/or WEST VPC Board. (See Note)
53	WSL B Filament Failure	Check/Replace WEST B Lamp or Replace WEST Search Light Drive Board and/or WEST VPC Board. (See Note)
54	WSL A Toggle Failure	Replace WEST Search Light Drive Board and/or WEST VPC Board. (See Note)

Table 6–3. Error Code Diagnostics (Cont.)

Error Number	Failure	Corrective Action
55	WSL B Toggle Failure	Replace WEST Search Light Drive Board and/or WEST VPC Board. (See Note)
56	WSL A State Failure	Replace WEST Search Light Drive Board and/or WEST VPC Board. (See Note)
57	WSL B State Failure	Replace WEST Search Light Drive Board and/or WEST VPC Board. (See Note)
60	West CLD Failure	Replace WEST Color light Driver Board.
62	WCL Grn A Toggle Failure	Replace WEST Color Light Drive Board and/or WEST VPC Board. (See Note)
63	WCL Yel A Toggle Failure	Replace WEST Color Light Drive Board and/or WEST VPC Board. (See Note)
64	WCL Red A Toggle Failure	Replace WEST Color Light Drive Board and/or WEST VPC Board. (See Note)
65	WCL Grn B Toggle Failure	Replace WEST Color Light Drive Board and/or WEST VPC Board. (See Note)
66	WCL Yel B Toggle Failure	Replace WEST Color Light Drive Board and/or WEST VPC Board. (See Note)
67	WCL Red B Toggle Failure	Replace WEST Color Light Drive Board and/or WEST VPC Board. (See Note)
68	WCL Grn A Fil Failure	Check/Replace WEST A Lamp or Replace WEST Color Light Drive Board and/or WEST VPC Board. (See Note)
69	WCL Yel A Fil Failure	Check/Replace WEST A Lamp or Replace WEST Color Light Drive Board and/or WEST VPC Board. (See Note)

Table 6–3. Error Code Diagnostics (Cont.)

Error Number	Failure	Corrective Action
6A	WCL Red A Fil Failure	Check/Replace WEST A Lamp or Replace WEST Color Light Drive Board and/or WEST VPC Board. (See Note)
6B	WCL Grn B Fil Failure	Check/Replace WEST B Lamp or Replace WEST Color Light Drive Board and/or WEST VPC Board. (See Note)
6C	WCL Yel B Fil Failure	Check/Replace WEST B Lamp or Replace WEST Color Light Drive Board and/or WEST VPC Board. (See Note)
6D	WCL Red B Fil Failure	Check/Replace WEST B Lamp or Replace WEST Color Light Drive Board and/or WEST VPC Board. (See Note)
70	East Conv/Rcvr Failure	Replace EAST Converter/Receiver Board.
71	ECR ULD Up Lvl Tst Failure	Replace EAST Converter/Receiver Board if problem persists.
72	ECR LLD Up Lvl Tst Failure	Replace EAST Converter/Receiver Board if problem persists.
73	ECR ULD Lo Lvl Tst Failure	Replace EAST Converter/Receiver Board if problem persists.
74	ECR LLD Lo Lvl Tst Failure	Replace EAST Converter/Receiver Board if problem persists.
75	ECR Converter Rdbk Failure	Replace EAST Converter/Receiver Board if problem persists.
7A	ECL Grn A State Failure	Replace EAST Color Light Drive Board and/or EAST VPC Board. (See Note)
7B	ECL Yel A State Failure	Replace EAST Color Light Drive Board and/or EAST VPC Board. (See Note)
7C	ECL Red A State Failure	Replace EAST Color Light Drive Board and/or EAST VPC Board. (See Note)
7D	ECL Grn B State Failure	Replace EAST Color Light Drive Board and/or EAST VPC Board. (See Note)

Table 6–3. Error Code Diagnostics (Cont.)

Error Number	Failure	Corrective Action
7E	ECL Yel B State Failure	Replace EAST Color Light Drive Board and/or EAST VPC Board. (See Note)
7F	ECL Red B State Failure	Replace EAST Color Light Drive Board and/or EAST VPC Board. (See Note)
80	West Conv/Rcvr Failure	Replace WEST Converter/Receiver Board
81	WCR ULD Up Lvl Tst Failure	Replace WEST Converter/Receiver Board if problem persists.
82	WCR LLD Up Lvl Tst Failure	Replace WEST Converter/Receiver Board if problem persists.
83	WCR ULD Lo Lvl Tst Failure	Replace WEST Converter/Receiver Board if problem persists.
84	WCR LLD Lo Lvl Tst Failure	Replace WEST Converter/Receiver Board if problem persists.
85	WCR Converter Rdbk Failure	Replace WEST Converter/Receiver Board if problem persists.
8A	WCL Grn A State Failure	Replace WEST Color Light Drive Board and/or WEST VPC Board. (See Note)
8B	WCL Yel A State Failure	Replace WEST Color Light Drive Board and/or WEST VPC Board. (See Note)
8C	WCL Red A State Failure	Replace WEST Color Light Drive Board and/or WEST VPC Board. (See Note)
8D	WCL Grn B State Failure	Replace WEST Color Light Drive Board and/or WEST VPC Board. (See Note)
8E	WCL Yel B State Failure	Replace WEST Color Light Drive Board and/or WEST VPC Board. (See Note)
8F	WCL Red B State Failure	Replace WEST Color Light Drive Board and/or WEST VPC Board. (See Note)
90	Code Select Board Failure	Replace Code Select Board.
96	ECS Grp-1 Inp Drive Failure	Replace Code Select Board.

Table 6–3. Error Code Diagnostics (Cont.)

Error Number	Failure	Corrective Action
99	ECS Grp-2 Inp Drive Failure	Replace Code Select Board.
9C	WCS Grp-1 Inp Drive Failure	Replace Code Select Board.
9F	WCS Grp-2 Inp Drive Failure	Replace Code Select Board.
A0	AUX I/O Failure	Replace AUX/IO Board.
A2	WCAB Toggle Failure	Replace AUX I/O Board.
A3	WEXO Toggle Failure	Replace AUX I/O Board.
A4	ECAB Toggle Failure	Replace AUX I/O Board.
A5	EEXO Toggle Failure	Replace AUX I/O Board.
A6	WCAB100 Toggle Failure	Replace AUX I/O Board.
A7	WCAB250 Toggle Failure	Replace AUX I/O Board.
A8	ECAB100 Toggle Failure	Replace AUX I/O Board.
A9	ECAB250 Toggle Failure	Replace AUX I/O Board.
AC	WCODEP Toggle Failure	Replace AUX I/O Board.
AD	ECODEP Toggle Failure	Replace AUX I/O Board.
B1	FIFO Init Failure	Replace CPU Board.
B2	IOC Init Failure	Replace CPU Board.
B3	Real Time Clock Init Failure	Replace CPU Board.
B4	Real Time Clock not running	Check CPU battery, replace if necessary. Reset RTC date and time. Replace CPU if problem persists.
B6	WCAB State Failure	Replace AUX I/O Board.
B7	WEXO State Failure	Replace AUX I/O Board.
B8	ECAB State Failure	Replace AUX I/O Board.
B9	EEXO State Failure	Replace AUX I/O Board.
BA	WCAB100 State Failure	Replace AUX I/O Board.
BB	WCAB250 State Failure	Replace AUX I/O Board.
BC	ECAB100 State Failure	Replace AUX I/O Board.
BD	ECAB250 State Failure	Replace AUX I/O Board.
BE	WCODEP State Failure	Replace AUX I/O Board.
BF	ECODEP State Failure	Replace AUX I/O Board.
C3	Config Req Length Error	Replace CPU Board.

Table 6–3. Error Code Diagnostics (Cont.)

Error Number	Failure	Corrective Action
C4	Event Log Clr Error	Replace CPU Board.
C5	Error Log Clr Error	Replace CPU Board
C6	RAM Test Failure	Replace CPU Board.
C7	BB-RAM Test Failure	Replace CPU Board.
C8	PD Test Failure	Replace CPU Board.
C9	Code PROM Test Failure	Replace CPU Board.
CA	App PROM Test Failure	Replace CPU Board.
CB	VSL Test Failure	Replace CPU Board.
CC	Power Supply Board Init Failure	Replace Power Supply Board.
D0	Invalid VPCChkWrd	Replace CPU Board.
D1	Unknown FIFO MsgType	Replace CPU Board.
D2	Bad OpData Msg Length	Replace CPU Board.
D4	FIFO not empty on swap	Replace CPU Board.
D5	Low Signal Battery Voltage	Restore signal battery voltage. If error persists though voltage okay, check adjustment of Power Supply Board. Then try replacing the Power Supply Board.
D6	VSL MED Sync check bad	Troubleshoot PGK to VPI VSC link. Replace CPU Board if problem isolated to PGK.
D7	PS POS Fault Test Failure	Verify that no Ground faults are present. If problem persists, replace Power Supply Board.
D8	PS NEG Fault Test Failure	Verify that no Ground faults are present. If problem persists, replace Power Supply Board.
D9	PS Earth GND Wire Open	Check Ground wire connection to module and to Earth Ground.
DA	PS Internal Test Failure	Verify that no Ground faults are present. If problem persists, replace Power Supply Board.

Table 6–3. Error Code Diagnostics (Cont.)

Error Number	Failure	Corrective Action
DB	PS POS GND Fault Detected	Remove positive ground fault or re-adjust Power Supply Board detection threshold.
DC	PS NEG GND Fault Detected	Remove negative ground fault or re-adjust Power Supply Board detection threshold.
DD	VSL Message Drop-Out	No Action Required if this error occurs when the CPU is powered up when VPI is already running (not a problem). Otherwise, trouble-shoot PGK to VPI VSC link. Replace CPU Board if problem isolated to PGK.
DE	Ch1 offset sync lost	Troubleshoot PGK to VPI VSC link. Replace CPU Board if problem isolated to PGK.
DF	Ch2 offset sync lost	Trouble-shoot PGK to VPI VSC link. Replace CPU Board if problem isolated to PGK.
E1	Illegal VSL Link setting	Verify Module Wire-wrap. Replace CPU if physical wire-wraps are confirmed with Ohmmeter.
E2	Illegal VSL Drop setting	Verify Module Wire-wrap. Replace CPU if physical wire-wraps are confirmed with Ohmmeter.
E3	VSL RecCount Overrun	Troubleshoot PGK to VPI VSC link. Replace CPU Board if problem isolated to PGK.
E4	Invalid VSL address byte	Troubleshoot PGK to VPI VSC link. Replace CPU Board if problem isolated to PGK.
E5	Invalid VSL control byte	Troubleshoot PGK to VPI VSC link. Replace CPU Board if problem isolated to PGK.
E6	Invalid VSL XOFCHG	Troubleshoot PGK to VPI VSC link. Replace CPU Board if problem isolated to PGK.

Table 6–3. Error Code Diagnostics (Cont.)

Error Number	Failure	Corrective Action
E7	Invalid VSL CH1 rec msgs	Troubleshoot PGK to VPI VSC link. Replace CPU Board if problem isolated to PGK.
E8	Invalid VSL CH2 rec msgs	Troubleshoot PGK to VPI VSC link. Replace CPU Board if problem isolated to PGK.
E9	ERR_VSL_BadMsgGrp	Troubleshoot PGK to VPI VSC link. Replace CPU Board if problem isolated to PGK.
EB	VSL Msg CRC Error	Troubleshoot PGK to VPI VSC link. Replace CPU Board if problem isolated to PGK.
ED	VSL RxMsg Overrun Error	Troubleshoot PGK to VPI VSC link. Replace CPU Board if problem isolated to PGK.
EE	Unknown HL Equation Type	Verify Proper Version of CAA was used to generate Application.
F0	Switch Lock I/O Failure	Replace Switch Lock I/O Board.
F1	Series Overlay Failure	Replace Series Overlay Board.
F6	FIFO Msg Length Error	Fix Any Other Errors and Retry. If Persists, Replace CPU Board.
F7	Invalid FIFO Msg Error	Fix Any Other Errors and Retry. If Persists, Replace CPU Board.
F8	Invalid Rec Msg Type	Replace CPU Board.
F9	SID Image Test Failure	Verify Site ID Wire Wrap. Replace CPU if physical wire-wraps are confirmed correct with Ohmmeter.
FA	SID Verify Test Failure	Verify Site ID Wire Wrap. Replace CPU if physical wire-wraps are confirmed with Ohmmeter.
FB	REV Image Test Failure	Verify Revision Wire Wrap. Replace CPU if physical wire-wraps are confirmed correct with Ohmmeter.

Table 6–3. Error Code Diagnostics (Cont.)

Error Number	Failure	Corrective Action
FC	REV Verify Test Failure	Verify Revision Wire Wrap. Replace CPU if physical wire-wraps are confirmed correct with Ohmmeter.
FD	DCRKEY Failure	Fix Any Other Errors and Retry. If Persists, Replace CPU Board.
FE	Unknown Equation Type	Verify Proper Version of CAA was used to generate Application.
FF	Initialization Failure	Replace CPU Board.

A. APPENDIX A - MODULE AND BOARD REFERENCE DATA

A.1. OVERVIEW

This appendix includes the following reference information:

- Module Terminal Definitions
- Switch Lock Module- Unlock Code Selection
- Typical Application Circuits
- Circuit Board Descriptions

A.2. MODULE TERMINAL DEFINITIONS

A.2.1. Control Point Module Terminal Definitions

The Genrakode II Control Point module has 48 AAR terminals arranged in three rows of 16. The rows are identified as TB1, TB2, or TB3. Row TB1 is the bottom most row. A list of all the terminals by function and terminal location in parentheses follows.

B (TB1-1) B12 input connection for the positive battery terminal.

N (TB1-16) N12 input connection for the negative battery terminal.

W TK+ (TB1-2) Connection to the positive rail of the WEST track.

W TK- (TB1-3) Connection to the negative rail of the WEST track.

W RLY+ (TB1-4) WEST Vital Power Controller (VPC) positive voltage terminal (isolated from the battery) used as the common connection for all WEST decoded output relays.

W C1RLY (TB3-1) Current sink output (active low) to operate a relay when a code (typically Code 1) is decoded from the WEST. The negative side of the relay coil is connected to this terminal. The positive side of the relay is connected to W RLY+ (TB1-4).

W C2RLY (TB3-2) Current sink output (active low) to operate a relay when a code (typically Code 2) is decoded from the WEST. The negative side of the relay coil is connected to this terminal. The positive side of the relay is connected to W RLY+ (TB1-4).

W C3RLY (TB3-3) Current sink output (active low) to operate a relay when a code (typically Code 3) is decoded from the WEST. The negative side of the relay coil is

connected to this terminal. The positive side of the relay is connected to W RLY+ (TB1-4).

W C4RLY (TB3-4) Current sink output (active low) to operate a relay when a code (typically Code 4) is decoded from the WEST. The negative side of the relay coil is connected to this terminal. The positive side of the relay is connected to W RLY+ (TB1-4).

W C5RLY (TB2-1) Current sink output (active low) to operate a relay when a code (typically Code 5) is decoded from the WEST. The negative side of the relay coil is connected to this terminal. The positive side of the relay is connected to W RLY+ (TB1-4).

W HR / W C6RLY (TB2-2) Current sink output (active low) to operate a relay when a code is decoded from the WEST. This output is usually used with Code 6 or with an HR code.

W C7RLY (TB2-3) Current sink output (active low) to operate a relay when a code (typically Code 7) is decoded from the WEST. The negative side of the relay coil is connected to this terminal. The positive side of the relay is connected to W RLY+ (TB1-4).

W C8RLY (TB2-4) Current sink output (active low) to operate a relay when a code (typically Code 8) is decoded from the WEST. The negative side of the relay coil is connected to this terminal. The positive side of the relay is connected to W RLY+ (TB1-4).

W REF (TB3-5) Common terminal for all WEST code selections. When using the contact closure type Code Select Board (P/N 59473-830-01), connect this terminal to one, two or three code select terminals through a relay contact or a network of relay contacts to select the appropriate code(s) to be transmitted to the WEST. When using the DC input code select board (P/N 59473-890-01) connects this terminal to the negative voltage terminal of the code select network.

W CNT1 (TB3-6) Terminal for selecting a code (typically Code 1) to be transmitted to the WEST. When using the contact closure Code Select Board (P/N 59473-830-01), connect this terminal through a relay contact or network of relay contacts to W REF (TB3-5) to select Code 1. When using the DC input Code Select Board, connect this terminal to the positive voltage terminal of the code select network to select Code 1.

W CNT2 (TB2-5) Terminal for selecting a code (typically Code 2) to be transmitted to the WEST. When using the contact closure Code Select Board (P/N 59473-830-01), connect this terminal through a relay contact or network of relay contacts to W REF (TB3-5) to select Code 2. When using the DC input Code Select Board, connect this terminal to the positive voltage terminal of the code select network to select Code 2.

W CNT3 (TB2-6) Terminal for selecting a code (typically Code 3) to be transmitted to the WEST. When using the contact closure Code Select Board (P/N 59473-830-01), connect this terminal through a relay contact or network of relay contacts to W REF (TB3-5) to select Code 3. When using the DC input Code Select Board, connect this terminal to the positive voltage terminal of the code select network to select Code 3.

W CNT4 (TB2-7) Terminal for selecting a code (typically Code 4) to be transmitted to the WEST. When using the contact closure Code Select Board (P/N 59473-830-01), connect this terminal through a relay contact or network of relay contacts to W REF (TB3-5) to select Code 4. When using the DC input Code Select Board, connect this terminal to the positive voltage terminal of the code select network to select Code 4.

W CNT5 (TB1-5) Terminal for selecting a code (typically Code 5) to be transmitted to the WEST. When using the contact closure Code Select Board (P/N 59473-830-01), connect this terminal through a relay contact or network of relay contacts to W REF (TB3-5) to select Code 5. When using the DC input Code Select Board, connect this terminal to the positive voltage terminal of the code select network to select Code 5.

W CNT6 (TB1-6) Terminal for selecting a code (typically Code 6) to be transmitted to the WEST. When using the contact closure Code Select Board (P/N 59473-830-01), connect this terminal through a relay contact or network of relay contacts to W REF (TB3-5) to select Code 6. When using the DC input Code Select Board, connect this terminal to the positive voltage terminal of the code select network to select Code 6.

W CNT7 (TB1-7) Terminal for selecting a code (typically Code 7) to be transmitted to the WEST. When using the contact closure Code Select Board (P/N 59473-830-01), connect this terminal through a relay contact or network of relay contacts to W REF (TB3-5) to select Code 7. When using the DC input Code Select Board, connect this terminal to the positive voltage terminal of the code select network to select Code 7.

W CNT8 (TB1-8) Terminal for selecting a code (typically Code 8) to be transmitted to the WEST. When using the contact closure Code Select Board (P/N 59473-830-01), connect this terminal through a relay contact or network of relay contacts to W REF (TB3-5) to select Code 8. When using the DC input Code Select Board, connect this terminal to the positive voltage terminal of the code select network to select Code 8.

E TK+ (TB1-14) Connection to the positive rail of the EAST track.

E TK- (TB1-15) Connection to the negative rail of the EAST track.

E REF (TB3-11) Common terminal for all EAST code selections. When using the contact closure type Code Select Board (P/N 59473-830-01), connect this terminal to one, two or three code select terminals through a relay contact or a network of relay contacts to select the appropriate code(s) to be transmitted to the EAST. When using the DC input Code Select Board (P/N 59473-890-01) connects this terminal to the negative voltage terminal of the code select network.

E CNT1 (TB3-12) Terminal for selecting a code (typically Code 1) to be transmitted to the EAST. When using the contact closure Code Select Board (P/N 59473-830-01), connect this terminal through a relay contact or network of relay contacts to E REF (TB3-11) to select Code 1. When using the DC input Code Select Board, connect this terminal to the positive voltage terminal of the code select network to select Code 1.

E CNT2 (TB2-10) Terminal for selecting a code (typically Code 2) to be transmitted to the EAST. When using the contact closure Code Select Board (P/N 59473-830-01), connect this terminal through a relay contact or network of relay contacts to E REF (TB3-11) to select Code 2. When using the DC input Code Select Board, connect this terminal to the positive voltage terminal of the code select network to select Code 2.

E CNT3 (TB2-11) Terminal for selecting a code (typically Code 3) to be transmitted to the EAST. When using the contact closure Code Select Board (P/N 59473-830-01), connect this terminal through a relay contact or network of relay contacts to E REF (TB3-11) to select Code 3. When using the DC input Code Select Board, connect this terminal to the positive voltage terminal of the code select network to select Code 3.

E CNT4 (TB2-12) Terminal for selecting a code (typically Code 4) to be transmitted to the EAST. When using the contact closure Code Select Board (P/N 59473-830-01), connect this terminal through a relay contact or network of relay contacts to E REF (TB3-11) to select Code 4. When using the DC input Code Select Board, connect this terminal to the positive voltage terminal of the code select network to select Code 4.

E CNT5 (TB1-9) Terminal for selecting a code (typically Code 5) to be transmitted to the EAST. When using the contact closure Code Select Board (P/N 59473-830-01), connect this terminal through a relay contact or network of relay contacts to E REF (TB3-11) to select Code 5. When using the DC input Code Select Board, connect this terminal to the positive voltage terminal of the code select network to select Code 5.

E CNT6 (TB1-10) Terminal for selecting a code (typically Code 6) to be transmitted to the EAST. When using the contact closure Code Select Board (P/N 59473-830-01), connect this terminal through a relay contact or network of relay contacts to E REF (TB3-11) to select Code 6. When using the DC input Code Select Board, connect this terminal to the positive voltage terminal of the code select network to select Code 6.

E CNT7 (TB1-11) Terminal for selecting a code (typically Code 7) to be transmitted to the EAST. When using the contact closure Code Select Board (P/N 59473-830-01), connect this terminal through a relay contact or network of relay contacts to E REF (TB3-11) to select Code 7. When using the DC input Code Select Board, connect this terminal to the positive voltage terminal of the code select network to select Code 7.

E CNT8 (TB1-12) Terminal for selecting a code (typically Code 8) to be transmitted to the EAST. When using the contact closure Code Select Board (P/N 59473-830-01), connect this terminal through a relay contact or network of relay contacts to E REF (TB3-11) to select Code 8. When using the DC input Code Select Board, connect this terminal to the positive voltage terminal of the code select network to select Code 8.

E RLY+ (TB1-13) EAST Vital Power Controller (VPC) positive voltage terminal (isolated from the battery) used as the common connection for all EAST decoded output relays.

E C1RLY (TB3-13) Current sink output (active low) to operate a relay when a code (typically Code 1) is decoded from the EAST. The negative side of the relay coil is connected to this terminal. The positive side of the relay is connected to E RLY+ (TB1-13).

E C2RLY (TB3-14) Current sink output (active low) to operate a relay when a code (typically Code 2) is decoded from the EAST. The negative side of the relay coil is connected to this terminal. The positive side of the relay is connected to E RLY+ (TB1-13).

E C3RLY (TB3-15) Current sink output (active low) to operate a relay when a code (typically Code 3) is decoded from the EAST. The negative side of the relay coil is connected to this terminal. The positive side of the relay is connected to E RLY+ (TB1-13).

E C4RLY (TB3-16) Current sink output (active low) to operate a relay when a code (typically Code 4) is decoded from the EAST. The negative side of the relay coil is connected to this terminal. The positive side of the relay is connected to E RLY+ (TB1-13).

E C5RLY (TB2-13) Current sink output (active low) to operate a relay when a code (typically Code 5) is decoded from the EAST. The negative side of the relay coil is connected to this terminal. The positive side of the relay is connected to E RLY+ TB1-13).

E HR / E C6RLY (TB2-14) Current sink output (active low) to operate a relay when A code is decoded from the EAST. This output is usually used with Code 6 or with an HR code.

E C7RLY (TB2-15) Current sink output (active low) to operate a relay when a code (typically Code 7) is decoded from the EAST. The negative side of the relay coil is connected to this terminal. The positive side of the relay is connected to E RLY+ (TB1-13).

E C8RLY (TB2-16) Current sink output (active low) to operate a relay when a code (typically Code 8) is decoded from the EAST. The negative side of the relay coil is connected to this terminal. The positive side of the relay is connected to E RLY+ (TB1-13).

W AUX+ (TB3-7) An Auxiliary I/O board is required for use of this terminal.

- For Aux I/O #1 or #2: Positive vital input terminal of an isolated two-wire auxiliary input, typically used for downgrading the signaling system under various conditions, including switch controllers, slide fences, high water detectors, dragging equipment detectors, etc. Referenced to W AUX- (TB3-8).

- For Aux I/O #3: Local one-wire vital input referenced to the WEST Vital Power Controller (VPC) voltage, W LAMP + (TB1-7).

W AUX- (TB3-8) An Auxiliary I/O board is required for use of this terminal.

- For Aux I/O #1 or #2: Negative vital input terminal of an isolated two-wire auxiliary input, typically used for downgrading the signaling system under various conditions, including switch controllers, slide fences, high water detectors, dragging equipment detectors, etc.

- For Aux I/O #3: WEST 250 Hz Cab Signal Output, connected to the CAB terminal (TB2-5) on 250 Hz Cab Signal Unit for the WEST track circuit.

E AUX+ (TB3-9) An Auxiliary I/O board is required for use of this terminal.

- For Aux I/O #1 or #2: Positive vital input terminal of an isolated two-wire auxiliary input, typically used for downgrading the signaling system under various conditions, including switch controllers, slide fences, high water detectors, dragging equipment detectors, etc. Referenced to E AUX- (TB3-10).

- For Aux I/O #3: Local one-wire vital input referenced to the EAST Vital Power Controller (VPC) voltage, E LAMP + (TB1-10).

E AUX- (TB3-10) An Auxiliary I/O board is required for use of this terminal.

- For Aux I/O #1 or #2: Negative vital input terminal of an isolated two-wire auxiliary input, typically used for downgrading the signaling system under various conditions, including switch controllers, slide fences, high water detectors, dragging equipment detectors, etc.

- For Aux I/O #3: EAST 250 Hz Cab Signal Output, connected to the CAB terminal (TB2-5) on 250 Hz Cab Signal Unit for the EAST track circuit.

W CAB (TB2-8)

An Auxiliary I/O board is required for use of this terminal.

- For Aux I/O #1 or #2: This is a current sink (active low) output referenced to the WEST Vital Power Controller (VPC) voltage, W RLY + (TB1-4). It can also be used to interface the module with the optional Cab Signal module, by generating the appropriate coded cab signal rates for the WEST track circuit.

- For Aux I/O #3: WEST 100 Hz Cab Signal Output, connected to the CAB terminal (TB2-5) on 100 Hz Cab Signal Unit for WEST track circuit.

E CAB (TB2-9) An Auxiliary I/O board is required for use of this terminal.

- For Aux I/O #1 or #2: This is a current sink (active low) output referenced to the EAST Vital Power Controller (VPC) voltage, E RLY + (TB1-13). It can also be used to interface the module with the optional Cab Signal module, by generating the appropriate coded cab signal rates for the EAST track circuit.

- For Aux I/O #3: EAST 100 Hz Cab Signal Output, connected to the CAB terminal (TB2-5) on 100 Hz Cab Signal Unit for EAST track circuit.

A.2.2. 4-Track Control Point Module Terminal Definitions (P/N 55899-134-XX)

The 4-Track Control Point module has AAR terminals and Wago blocks. There are three groups of AAR terminals: TB1, TB2, and TB3, and three groups of Wago blocks: J1, J2, and J3. A list of all the terminals by function with terminal location in parentheses follows.

+ (TB1-1) B12 input connection for the positive battery terminal.

- (TB1-2) N12 input connection for the negative battery terminal.

1A TRK+ (TB2-1) Connection to the positive rail of the 1A track.

1A TRK- (TB2-2) Connection to the negative rail of the 1A track.

2A TRK+ (TB2-3) Connection to the positive rail of the 2A track.

2A TRK- (TB2-4) Connection to the negative rail of the 2A track.

3B TRK+ (TB3-1) Connection to the positive rail of the 3B track.

3B TRK- (TB3-2) Connection to the negative rail of the 3B track.

4B TRK+ (TB3-3) Connection to the positive rail of the 4B track.

4B TRK- (TB3-4) Connection to the negative rail of the 4B track.

RTS A (J3-1) “Ready To Send” signal line for the diagnostic/code system serial port of CPU A.

TX A (J3-2) Transmit signal line for the diagnostic/code system serial port of CPU A.

CTS A (J3-3) “Clear To Send” signal line for the diagnostic/code system serial port of CPU A.

RX A (J3-4) Receive signal line for the diagnostic/code system serial port of CPU A.

+VSL (J3-5) Positive connection for Vital Serial Link to VPI module.

-VSL (J3-6) Negative connection for Vital Serial Link to VPI module.

RTS B (J3-7) “Ready To Send” signal line for the diagnostic/code system serial port of CPU B.

TX B (J3-8) Transmit signal line for the diagnostic/code system serial port of CPU B.

CTS B (J3-9) “Clear To Send” signal line for the diagnostic/code system serial port of CPU B.

RX B (J3-10) Receive signal line for the diagnostic/code system serial port of CPU B.

NOTE

The following terminals, in positions J1 and J2 are only provided if the 4-Track Control Point module is specifically ordered with an Auxiliary I/O board.

CAB 2A (J1-1) An Auxiliary I/O board is required for use of this terminal.

- For Aux I/O #1 or #2: This is a current sink (active low) output. It can also be used to interface the module with the optional Cab Signal module, by generating the appropriate coded cab signal rates for the 2A track circuit.

CAB 1A (J1-2) An Auxiliary I/O board is required for use of this terminal.

- For Aux I/O #1 or #2: This is a current sink (active low) output. It can also be used to interface the module with the optional Cab Signal module, by generating the appropriate coded cab signal rates for the 1A track circuit.

AUX 1A+ (J1-3) An Auxiliary I/O board is required for use of this terminal.

- For Aux I/O #1 or #2: Positive vital input terminal of an isolated two-wire auxiliary input, typically used for downgrading the signaling system under various conditions, including switch controllers, slide fences, high water detectors, dragging equipment detectors, etc. Referenced to AUX 1A- (J1-4).

AUX 1A- (J1-4) An Auxiliary I/O board is required for use of this terminal.

- For Aux I/O #1 or #2: Negative vital input terminal of an isolated two-wire auxiliary input, typically used for downgrading the signaling system under various conditions, including switch controllers, slide fences, high water detectors, dragging equipment detectors, etc.

POW DET A+ (J1-5) An Auxiliary I/O board is required for use of this terminal.

- Positive input terminal for detection of external (commercial) power. Use of the power detect differential, non-vital input provides an input to the application logic indicating the presence or absence of commercial power. This terminal is usually connected to BX 110.

POW DET A- (J1-6) An Auxiliary I/O board is required for use of this terminal.

- Negative input terminal for detection of external (commercial) power. Use of the power detect differential, non-vital input provides an input to the application logic indicating the presence or absence of commercial power. This terminal is usually connected to NX 110.

EXO 1A (J1-7) An Auxiliary I/O board is required for use of this terminal.

- For Aux I/O #1: Current sink (active low) output.
- For Aux I/O #2: Non-vital, bi-directional I/O line, which is typically used for double track approach lighting (not applicable for Control Point).

EXI 1A (J1-8) An Auxiliary I/O board is required for use of this terminal.

- For Aux I/O #1 or #2: Local one-wire vital input.

EXO 2A (J1-9) An Auxiliary I/O board is required for use of this terminal.

- For Aux I/O #1: Current sink (active low) output.
- For Aux I/O #2: Non-vital, bi-directional I/O line, which is typically used for double track approach lighting (not applicable for Control Point).

EXI 2A (J1-10) An Auxiliary I/O board is required for use of this terminal.

- For Aux I/O #1 or #2: Local one-wire vital input.

AUX 2A+ (J1-11) An Auxiliary I/O board is required for use of this terminal.

- For Aux I/O #1 or #2: Positive vital input terminal of an isolated two-wire auxiliary input, typically used for downgrading the signaling system under various conditions, including switch controllers, slide fences, high water detectors, dragging equipment detectors, etc. Referenced to AUX 2A- (J1-12).

AUX 2A- (J1-12) An Auxiliary I/O board is required for use of this terminal.

- For Aux I/O #1 or #2: Negative vital input terminal of an isolated two-wire auxiliary input, typically used for downgrading the signaling system under various conditions, including switch controllers, slide fences, high water detectors, dragging equipment detectors, etc.

CAB 4B (J2-1) An Auxiliary I/O board is required for use of this terminal.

- For Aux I/O #1 or #2: This is a current sink (active low) output. It can also be used to interface the module with the optional Cab Signal module, by generating the appropriate coded cab signal rates for the 4B track circuit.

CAB 3B (J2-2) An Auxiliary I/O board is required for use of this terminal.

- For Aux I/O #1 or #2: This is a current sink (active low) output. It can also be used to interface the module with the optional Cab Signal module, by generating the appropriate coded cab signal rates for the 3B track circuit.

AUX 3B+ (J2-3) An Auxiliary I/O board is required for use of this terminal.

- For Aux I/O #1 or #2: Positive vital input terminal of an isolated two-wire auxiliary input, typically used for downgrading the signaling system under various conditions, including switch controllers, slide fences, high water detectors, dragging equipment detectors, etc. Referenced to AUX 3B- (J2-4).

AUX 3B- (J2-4) An Auxiliary I/O board is required for use of this terminal.

- For Aux I/O #1 or #2: Negative vital input terminal of an isolated two-wire auxiliary input, typically used for downgrading the signaling system under various conditions, including switch controllers, slide fences, high water detectors, dragging equipment detectors, etc.

POW DET B+ (J2-5) An Auxiliary I/O board is required for use of this terminal.

- Positive input terminal for detection of external (commercial) power. Use of the power detect differential, non-vital input provides an input to the application logic indicating the presence or absence of commercial power. This terminal is usually connected to BX 110.

POW DET B- (J2-6) An Auxiliary I/O board is required for use of this terminal.

- Negative input terminal for detection of external (commercial) power. Use of the power detect differential, non-vital input provides an input to the application logic indicating the presence or absence of commercial power. This is typically used to approach light signals when there is a loss of AC power. This terminal is usually connected to NX 110.

EXO 3B (J2-7) An Auxiliary I/O board is required for use of this terminal.

- For Aux I/O #1: Current sink (active low) output.

- For Aux I/O #2: Non-vital, bi-directional I/O line, which is typically used for double track approach lighting (not applicable for Control Point).

EXI 3B (J2-8) An Auxiliary I/O board is required for use of this terminal.

- For Aux I/O #1 or #2: Local one-wire vital input.

EXO 4B (J2-9) An Auxiliary I/O board is required for use of this terminal.

- For Aux I/O #1: Current sink (active low) output.

- For Aux I/O #2: Non-vital, bi-directional I/O line, which is typically used for double track approach lighting (not applicable for Control Point).

EXI 4B (J2-10) An Auxiliary I/O board is required for use of this terminal.

- For Aux I/O #1 or #2: Local one-wire vital input.

AUX 4B+ (J2-11) An Auxiliary I/O board is required for use of this terminal.

- For Aux I/O #1 or #2: Positive vital input terminal of an isolated two-wire auxiliary input, typically used for downgrading the signaling system under various conditions, including switch controllers, slide fences, high water detectors, dragging equipment detectors, etc. Referenced to AUX 4B- (J2-12).

AUX 4B- (J2-12) An Auxiliary I/O board is required for use of this terminal.

- For Aux I/O #1 or #2: Negative vital input terminal of an isolated two-wire auxiliary input, typically used for downgrading the signaling system under various conditions, including switch controllers, slide fences, high water detectors, dragging equipment detectors, etc.

A.2.3. 4-Track Control Point Module Terminal Definitions (P/N 55899-141-XX)

The 4-Track Control Point module has AAR terminals and Wago blocks. There are three groups of AAR terminals: TB1, TB2, and TB3, three groups of Wago blocks: J1, J2, and J3, and four DB9 serial connectors: J4 through J7. A list of all the terminals by function with terminal location in parentheses follows.

+ (TB1-1) B12 input connection for the positive battery terminal.

- (TB1-2) N12 input connection for the negative battery terminal.

1A TRK+ (TB2-1) Connection to the positive rail of the 1A track.

1A TRK- (TB2-2) Connection to the negative rail of the 1A track.

2A TRK+ (TB2-3) Connection to the positive rail of the 2A track.

2A TRK- (TB2-4) Connection to the negative rail of the 2A track.

3B TRK+ (TB3-1) Connection to the positive rail of the 3B track.

3B TRK- (TB3-2) Connection to the negative rail of the 3B track.

4B TRK+ (TB3-3) Connection to the positive rail of the 4B track.

4B TRK- (TB3-4) Connection to the negative rail of the 4B track.

+VSL (J3-1) Positive connection for Vital Serial Link to VPI module.

-VSL (J3-2) Negative connection for Vital Serial Link to VPI module.

CAB 1A (J1-1) An Auxiliary I/O board is required for use of this terminal.

- For Aux I/O #1 or #2: This is a current sink (active low) output. It can also be used to interface the module with the optional Cab Signal module, by generating the appropriate coded cab signal rates for the 1A track circuit.

CAB 2A (J1-2) An Auxiliary I/O board is required for use of this terminal.

- For Aux I/O #1 or #2: This is a current sink (active low) output. It can also be used to interface the module with the optional Cab Signal module, by generating the appropriate coded cab signal rates for the 2A track circuit.

AUX 1A+ (J1-3) An Auxiliary I/O board is required for use of this terminal.

- For Aux I/O #1 or #2: Positive vital input terminal of an isolated two-wire auxiliary input, typically used for downgrading the signaling system under various conditions, including switch controllers, slide fences, high water detectors, dragging equipment detectors, etc. Referenced to AUX 1A- (J1-4).

AUX 1A- (J1-4) An Auxiliary I/O board is required for use of this terminal.

- For Aux I/O #1 or #2: Negative vital input terminal of an isolated two-wire auxiliary input, typically used for downgrading the signaling system under various conditions, including switch controllers, slide fences, high water detectors, dragging equipment detectors, etc.

AUX 2A+ (J1-5) An Auxiliary I/O board is required for use of this terminal.

- For Aux I/O #1 or #2: Positive vital input terminal of an isolated two-wire auxiliary input, typically used for downgrading the signaling system under various conditions, including switch controllers, slide fences, high water detectors, dragging equipment detectors, etc. Referenced to AUX 2A- (J1-12).

AUX 2A- (J1-6) An Auxiliary I/O board is required for use of this terminal.

- For Aux I/O #1 or #2: Negative vital input terminal of an isolated two-wire auxiliary input, typically used for downgrading the signaling system under various conditions, including switch controllers, slide fences, high water detectors, dragging equipment detectors, etc.

+VPC A (J1-7 to J1-12) Vital power controller positive voltage terminal (isolated from battery).

- Used as the common connection for all vital inputs and outputs for CPU A.

CAB 3B (J2-1) An Auxiliary I/O board is required for use of this terminal.

- For Aux I/O #1 or #2: This is a current sink (active low) output. It can also be used to interface the module with the optional Cab Signal module, by generating the appropriate coded cab signal rates for the 3B track circuit.

CAB 4B (J2-2) An Auxiliary I/O board is required for use of this terminal.

- For Aux I/O #1 or #2: This is a current sink (active low) output. It can also be used to interface the module with the optional Cab Signal module, by generating the appropriate coded cab signal rates for the 4B track circuit.

AUX 3B+ (J2-3) An Auxiliary I/O board is required for use of this terminal.

- For Aux I/O #1 or #2: Positive vital input terminal of an isolated two-wire auxiliary input, typically used for downgrading the signaling system under various conditions, including switch controllers, slide fences, high water detectors, dragging equipment detectors, etc. Referenced to AUX 3B- (J2-4).

AUX 3B- (J2-4) An Auxiliary I/O board is required for use of this terminal.

- For Aux I/O #1 or #2: Negative vital input terminal of an isolated two-wire auxiliary input, typically used for downgrading the signaling system under various conditions, including switch controllers, slide fences, high water detectors, dragging equipment detectors, etc.

AUX 4B+ (J2-5) An Auxiliary I/O board is required for use of this terminal.

- For Aux I/O #1 or #2: Positive vital input terminal of an isolated two-wire auxiliary input, typically used for downgrading the signaling system under various conditions, including switch controllers, slide fences, high water detectors, dragging equipment detectors, etc. Referenced to AUX 4B- (J2-12).

AUX 4B- (J2-6) An Auxiliary I/O board is required for use of this terminal.

- For Aux I/O #1 or #2: Negative vital input terminal of an isolated two-wire auxiliary input, typically used for downgrading the signaling system under various conditions, including switch controllers, slide fences, high water detectors, dragging equipment detectors, etc.

+VPC B (F2-7 t o J2-12) Vital power controller positive voltage terminal (isolated from battery).

- Used as the common connection for all vital inputs and outputs for CPU B.

J4 CPU A serial port

- Same as serial port on front edge of CPU A.

J5 CPU B serial port

- Same as serial port on front edge of CPU B.

J6, J7 Reserved for future use.

A.2.4. Intermediate Module Terminal Definitions

The Intermediate module has 48 AAR terminals arranged in three rows of 16. The rows are identified as TB1, TB2, or TB3. Row TB1 being the B1 bottom most row. Since the Intermediate module is used for driving both searchlight and colorlight signals, 12 of the terminals have two sets of nomenclature. A list of all the terminals by function and the terminal location in parentheses follows.

B (TB1-1) B12 input connection for the positive battery terminal.

N (TB1-16) N12 input connection for the negative battery terminal.

WEST TK+ (TB1-2) Connection to the positive rail of the WEST track.

WEST TK- (TB1-3) Connection to the negative rail of the WEST track.

WEST LAMP + (TB1-7) WEST Vital Power Controller (VPC) positive voltage terminal (isolated from the battery) used as the common connection for all WEST lamps (searchlight or colorlight).

WA SEARCHLIGHT + COIL / WEST COLORLIGHTS LAMP 1W (TB2-4) The function of this terminal depends on the type of signal driven. For searchlight operation, this terminal is the positive coil connection for the WEST A signal mechanism. For color light operation, this terminal is a current sink output (active low) for one of six lamps for the WEST signal. Typically, this is the GREEN lamp in the A signal head for the WEST direction. One side of the lamp is connected to this terminal. The other side of the lamp is connected to WEST LAMP + (TB1-7)

WA SEARCHLIGHT - COIL / WEST COLORLIGHTS LAMP 2W (TB2-5) The function of this terminal depends on the type of signal driven. For searchlight operation, this terminal is the negative coil connection for the WEST A signal mechanism. For color light operation, this terminal is a current sink output (active low) for one of six lamps for the WEST signal. Typically, this is the YELLOW lamp in the A signal head for the WEST direction. One side of the lamp is connected to this terminal. The other side of the lamp is connected to WEST LAMP + (TB1-7).

WA SEARCHLIGHT LAMP / WEST COLORLIGHTS LAMP 3W (TB2-6) The function of this terminal depends on the type of signal driven. For searchlight operation, this terminal is a current sink output (active low) for the WEST A signal lamp. For color light operation, this terminal is a current sink output (active low) for one of six lamps for the WEST signal. Typically, this is the RED lamp in the A signal head for the WEST direction. One side of the lamp is connected to this terminal. The other side of the lamp is connected to WEST LAMP + (TB1-7).

WB SEARCHLIGHT + COIL / WEST COLORLIGHTS LAMP 4W (TB1-4) The function of this terminal depends on the type of signal driven. For searchlight operation, this terminal is the positive coil connection for the WEST B signal mechanism. For color light operation, this terminal is a current sink output (active low) for one of six lamps for the WEST signal. Typically, this is the GREEN lamp in the B signal head for the WEST direction. One side of the lamp is connected to this terminal. The other side of the lamp is connected to WEST LAMP + (TB1-7).

WB SEARCHLIGHT - COIL / WEST COLORLIGHTS LAMP 5W (TB1-5) The function of this terminal depends on the type of signal driven. For searchlight operation, this terminal is the negative coil connection for the WEST B signal mechanism. For color light operation, this terminal is a current sink output (active low) for one of six lamps for the WEST signal. Typically, this is the YELLOW lamp in the B signal head for the WEST direction. One side of the lamp is connected to this terminal. The other side of the lamp is connected to WEST LAMP + (TB1-7).

WB SEARCHLIGHT LAMP / WEST COLORLIGHTS LAMP 6W (TB1-6) The function of this terminal depends on the type of signal driven. For searchlight operation, this terminal is a current sink output (active low) for the WEST B signal lamp. For color light operation, this terminal is a current sink output (active low) for one of six lamps for the WEST signal. Typically, this is the RED lamp in the B signal head for the WEST direction. One side of the lamp is connected to this terminal. The other side of the lamp is connected to WEST LAMP + (TB1-7).

WA SEARCHLIGHT WA RG (TB3-1) The function of this terminal depends on the type of signal driven. For searchlight operation, this terminal is a vital input typically from the WEST A signal mechanism. Connect it to the mechanism, usually to the RED position contact. Then, a nominal +12 V DC (reference to the battery N) is present if the mechanism is in the RED position. Then if the voltage is not present, Genrakode II interprets the missing input as a stuck mechanism, and the application can use this indication to downgrade the signaling system For color light operation, this terminal is unused and no connection is required.

WA SEARCHLIGHT WA HG (TB3-2) The function of this terminal depends on the type of signal driven. For searchlight operation, this terminal is a vital input typically from the WEST A signal mechanism. Connect it to the mechanism, usually to the YELLOW position contact. Then, a nominal +12 V DC (reference to the battery N) is present if the mechanism is in the YELLOW position. Then if the voltage is not present, Genrakode II interprets the missing input as a stuck mechanism, and the application can use this indication to downgrade the signaling system. For color light operation, this terminal is unused and no connection is required.

WA SEARCHLIGHT WA DG (TB3-3) The function of this terminal depends on the type of signal driven. For searchlight operation, this terminal is a vital input typically from the WEST A signal mechanism. Connect it to the mechanism, usually to the GREEN position contact. Then, a nominal +12 V DC (reference to the battery N) is present if the mechanism is in the GREEN position. Then if the voltage is not present, Genrakode II interprets the missing input as a stuck mechanism, and the application can use this indication to downgrade the signaling system. For color light operation, this terminal is unused and no connection is required.

WB SEARCHLIGHT WB RG (TB2-1) The function of this terminal depends on the type of signal driven. For searchlight operation, this terminal is a vital input typically from the WEST B signal mechanism. Connect it to the mechanism, usually to the RED position contact. Then, a nominal +12 V DC (reference to the battery N) is present if the mechanism is in the RED position. Then if the voltage is not present, Genrakode II interprets the missing input as a stuck mechanism, and the application can use this indication to downgrade the signaling system. For color light operation, this terminal is unused and no connection is required.

WB SEARCHLIGHT WB HG (TB2-2) The function of this terminal depends on the type of signal driven. For searchlight operation, this terminal is a vital input typically from the WEST B signal mechanism. Connect it to the mechanism, usually to the YELLOW position contact. Then, a nominal +12 V DC (reference to the battery N) is present if the mechanism is in the YELLOW position. Then if the voltage is not present, Genrakode II interprets the missing input as a stuck mechanism, and the application can use this indication to downgrade the signaling system. For color light operation, this terminal is unused and no connection is required.

WB SEARCHLIGHT WB DG (TB2-3) The function of this terminal depends on the type of signal driven. For searchlight operation, this terminal is a vital input typically from the WEST B signal mechanism. Connect it to the mechanism, usually to the GREEN position contact. Then, a nominal +12 V DC (reference to the battery N) is present if the mechanism is in the GREEN position. Then if the voltage is not present, Genrakode II interprets the missing input as a stuck mechanism, and the application can use this indication to downgrade the signaling system For color light operation, this terminal is unused and no connection is required.

EAST TK+ (TB1-14) Connection to the positive rail of the EAST track.

EAST TK- (TB1-15) Connection to the negative rail of the EAST track.

EAST LAMP + (TB1-10) EAST Vital Power Controller (VPC) positive voltage terminal (isolated from the battery) used as the common connection for all EAST lamps (searchlight or colorlight).

EA SEARCHLIGHT + COIL / EAST COLORLIGHTS LAMP 1E (TB2-11) The function of this terminal depends on the type of signal driven For searchlight operation, this terminal is the positive coil connection for the EAST A signal mechanism. For color light operation, this terminal is a current sink output (active low) for one of six lamps for the EAST signal. Typically, this is the GREEN lamp in the A signal head for the EAST direction. One side of the lamp is connected to this terminal. The other side of the lamp is connected to EAST LAMP + (TB1-10).

EA SEARCHLIGHT - COIL / EAST COLORLIGHTS LAMP 2E (TB2-12) The function of this terminal depends on the type of signal driven For searchlight operation, this terminal is the negative coil connection for the EAST A signal mechanism. For color light operation, this terminal is a current sink output (active low) for one of six lamps for the EAST signal. Typically, this is the YELLOW lamp in the A signal head for the EAST direction. One side of the lamp is connected to this terminal. The other side of the lamp is connected to EAST LAMP + (TB1-10).

EA SEARCHLIGHT LAMP / EAST COLORLIGHTS LAMP 3E (TB2-13) The function of this terminal depends on the type of signal driven For searchlight operation, this terminal is a current sink output (active low) for the EAST A signal lamp. For color light operation, this terminal is a current sink output (active low) for one of six lamps for the EAST signal. Typically, this is the RED lamp in the A signal head for the EAST direction. One side of the lamp is connected to this terminal. The other side of the lamp is connected to EAST LAMP + (TB1-10).

EB SEARCHLIGHT + COIL / EAST COLORLIGHTS LAMP 4E (TB1-11) The function of this terminal depends on the type of signal driven For searchlight operation, this terminal is the positive coil connection for the EAST B signal mechanism. For color light operation, this terminal is a current sink output (active low) for one of six lamps for the EAST signal. Typically, this is the GREEN lamp in the B signal head for the EAST direction. One side of the lamp is connected to this terminal. The other side of the lamp is connected to EAST LAMP + (TB1-10).

EB SEARCHLIGHT - COIL / EAST COLORLIGHTS LAMP 5E (TB1-12) The function of this terminal depends on the type of signal driven For searchlight operation, this terminal is the negative coil connection for the EAST B signal mechanism. For color light operation, this terminal is a current sink output (active low) for one of six lamps for the EAST signal. Typically, this is the YELLOW lamp in the B signal head for the EAST direction. One side of the lamp is connected to this terminal. The other side of the lamp is connected to EAST LAMP + (TB1-10).

EB SEARCHLIGHT LAMP / EAST COLORLIGHTS LAMP 6E (TB1-13) The function of this terminal depends on the type of signal driven For searchlight operation, this terminal is a current sink output (active low) for the EAST B signal lamp. For color light operation, this terminal is a current sink output (active low) for one of six lamps for the EAST signal. Typically, this is the RED lamp in the B signal head for the EAST direction. One side of the lamp is connected to this terminal. The other side of the lamp is connected to EAST LAMP + (TB1-10).

EA SEARCHLIGHT EA RG (TB3-14) The function of this terminal depends on the type of signal driven For searchlight operation, this terminal is a vital input typically from the EAST A signal mechanism. Connect it to the mechanism, usually to the RED position contact. Then, a nominal +12 V DC (reference to the battery N) is present if the mechanism is in the RED position. Then if the voltage is not present, Genrakode II interprets the missing input as a stuck mechanism, and the application can use this indication to downgrade the signaling system For color light operation, this terminal is unused and no connection is required.

EA SEARCHLIGHT EA HG (TB3-15) The function of this terminal depends on the type of signal driven For searchlight operation, this terminal is a vital input typically from the EAST A signal mechanism. Connect it to the mechanism, usually to the YELLOW position contact. Then, a nominal +12 V DC (reference to the battery N) is present if the mechanism is in the YELLOW position. Then if the voltage is not present, Genrakode II interprets the missing input as a stuck mechanism, and the application can use this indication to downgrade the signaling system For color light operation, this terminal is unused and no connection is required.

EA SEARCHLIGHT EA DG (TB3-16) The function of this terminal depends on the type of signal driven For searchlight operation, this terminal is a vital input typically from the EAST A signal mechanism. Connect it to the mechanism, usually to the GREEN position contact. Then, a nominal +12 V DC (reference to the battery N) is present if the mechanism is in the GREEN position. Then if the voltage is not present, Genrakode II interprets the missing input as a stuck mechanism, and the application can use this indication to downgrade the signaling system For color light operation, this terminal is unused and no connection is required.

EB SEARCHLIGHT EB RG (TB2-14) The function of this terminal depends on the type of signal driven For searchlight operation, this terminal is a vital input typically from the EAST B signal mechanism. Connect it to the mechanism, usually to the RED position contact. Then, a nominal +12 V DC (reference to the battery N) is present if the mechanism is in the RED position. Then if the voltage is not present, Genrakode II interprets the missing input as a stuck mechanism, and the application can use this indication to downgrade the signaling system. For color light operation, this terminal is unused and no connection is required.

EB SEARCHLIGHT EB HG (TB2-15) The function of this terminal depends on the type of signal driven For searchlight operation, this terminal is a vital input typically from the EAST B signal mechanism. Connect it to the mechanism, usually to the YELLOW position contact. Then, a nominal +12 V DC (reference to the battery N) is present if the mechanism is in the YELLOW position. Then if the voltage is not present, Genrakode II interprets the missing input as a stuck mechanism, and the application can use this indication to downgrade the signaling system. For color light operation, this terminal is unused and no connection is required.

EB SEARCHLIGHT EB DG (TB2-16) The function of this terminal depends on the type of signal driven For searchlight operation, this terminal is a vital input typically from the EAST B signal mechanism. Connect it to the mechanism, usually to the GREEN position contact. Then, a nominal +12 V DC (reference to the battery N) is present if the mechanism is in the GREEN position. Then if the voltage is not present, Genrakode II interprets the missing input as a stuck mechanism, and the application can use this indication to downgrade the signaling system. For color light operation, this terminal is unused and no connection is required.

POWER DETECT + (TB2-8) An Auxiliary I/O board is required for use of this terminal. Positive input terminal for detection of external (commercial) power. Use of the power detect differential, non-vital input provides an input to the application logic indicating the presence or absence of commercial power. This is typically used to approach light signals when there is a loss of AC power. This terminal is usually connected to BX 110.

POWER DETECT - (TB2-9) An Auxiliary I/O board is required for use of this terminal. Negative input terminal for detection of external (commercial) power. Use of the power detect differential, non-vital input provides an input to the application logic indicating the presence or absence of commercial power. This is typically used to approach light signals when there is a loss of AC power. This terminal is usually connected to NX 110.

W EX I (TB3-4) An Auxiliary I/O board is required for use of this terminal.

- For Aux I/O #1 or #2: Local one-wire vital input referenced to the WEST Vital Power Controller (VPC) voltage, W LAMP + (TB1-7).

- For Aux I/O #3: WEST Track Relay (CODE 1) Output. Connect the negative side of relay to this terminal and positive side of relay to W LAMP+ (TB1-7).

W EX O (TB3-5) An Auxiliary I/O board is required for use of this terminal.

- For Aux I/O #1: Current sink (active low) output referenced to the WEST Vital Power Controller (VPC) voltage, W LAMP + (TB1-7).

- For Aux I/O #2 or #3: Non-vital, bi-directional I/O line, which is typically used for double track approach lighting of the Westbound signal (WDTA).

W AUX+ (TB3-7) An Auxiliary I/O board is required for use of this terminal.

- For Aux I/O #1 or #2: Positive vital input terminal of an isolated two-wire auxiliary input, typically used for downgrading the signaling system under various conditions, including switch controllers, slide fences, high water detectors, dragging equipment detectors, etc. Referenced to W AUX- (TB3-8).

- For Aux I/O #3: Local one-wire vital input referenced to the WEST Vital Power Controller (VPC) voltage, W LAMP + (TB1-7).

W AUX- (TB3-8) An Auxiliary I/O board is required for use of this terminal.

- For Aux I/O #1 or #2: Negative vital input terminal of an isolated two-wire auxiliary input, typically used for downgrading the signaling system under various conditions, including switch controllers, slide fences, high water detectors, dragging equipment detectors, etc.

- For Aux I/O #3: WEST 250 Hz Cab Signal Output, connected to the CAB terminal (TB2-5) on 250 Hz Cab Signal Unit for the WEST track circuit.

W CAB (TB3-6) An Auxiliary I/O board is required for use of this terminal.

- For Aux I/O #1 or #2: This is a current sink (active low) output referenced to the WEST Vital Power Controller (VPC) voltage, W LAMP + (TB1-7). It can also be used to interface the module with the optional Cab Signal module, by generating the appropriate coded cab signal rates for the WEST track circuit.

- For Aux I/O #3: WEST 100 Hz Cab Signal Output, connected to the CAB terminal (TB2-5) on 100 Hz Cab Signal Unit for WEST track circuit.

E EX I (TB3-11) An Auxiliary I/O board is required for use of this terminal.

- For Aux I/O #1 or #2: Local one-wire vital input referenced to the EAST Vital Power Controller (VPC) voltage, E LAMP + (TB1-10).

- For Aux I/O #3: EAST Track Relay (CODE 1) Output. Connect the negative side of relay to this terminal and positive side of relay to E LAMP+ (TB1-10).

E EX O (TB3-12) An Auxiliary I/O board is required for use of this terminal.

- For Aux I/O #1: Current sink (active low) output referenced to the EAST Vital Power Controller (VPC) voltage, E LAMP + (TB1-10).

- For Aux I/O #2 or #3: Non-vital, bi-directional I/O line, which is typically used for double track approach lighting of the Eastbound signal (EDTA).

E AUX+ (TB3-9) An Auxiliary I/O board is required for use of this terminal.

- For Aux I/O #1 or #2: Positive vital input terminal of an isolated two-wire auxiliary input, typically used for downgrading the signaling system under various conditions, including switch controllers, slide fences, high water detectors, dragging equipment detectors, etc. Referenced to E AUX- (TB3-10).

- For Aux I/O #3: Local one-wire vital input referenced to the EAST Vital Power Controller (VPC) voltage, E LAMP + (TB1-10).

E AUX- (TB3-10) An Auxiliary I/O board is required for use of this terminal.

- For Aux I/O #1 or #2: Negative vital input terminal of an isolated two-wire auxiliary input, typically used for downgrading the signaling system under various conditions, including switch controllers, slide fences, high water detectors, dragging equipment detectors, etc.

- For Aux I/O #3: EAST 250 Hz Cab Signal Output, connected to the CAB terminal (TB2-5) on 250 Hz Cab Signal Unit for the EAST track circuit.

E CAB (TB3-13) An Auxiliary I/O board is required for use of this terminal.

- For Aux I/O #1 or #2: This is a current sink (active low) output referenced to the EAST Vital Power Controller (VPC) voltage, E LAMP + (TB1-10). It can also be used to interface the module with the optional Cab Signal module, by generating the appropriate coded cab signal rates for the EAST track circuit.

- For Aux I/O #3: EAST 100 Hz Cab Signal Output, connected to the CAB terminal (TB2-5) on 100 Hz Cab Signal Unit for EAST track circuit.

GND-1 (TB1-8) Primary ground connection required when the power supply/ground fault monitor board (P/N 31166-338-01) is used.

GND-2(TB1-9) Secondary ground connection required when the power supply/ground fault monitor board (P/N 31166-338-01) is used.

(TB2-7) Unused terminal. No connection required.

(TB2-10) Unused terminal. No connection required.

A.2.5. Repeater Module Terminal Definitions

A Repeater module can use either a Control Point chassis or an Intermediate chassis. In a Control Point chassis, the Repeater module uses the same AAR terminal arrangement as the chassis it occupies. See the previous discussions on the Control Point and Intermediate Modules for terminal definitions.

In a Control Point chassis, a Repeater module uses the following terminals:

- B (TB1-1)
- N (TB1-16)
- W TK+ (TB1-2)
- W TK- (TB1-3)
- W RLY+ (TB1-4)
- E TK+ (TB1-14)
- E TK- (TB1-15)
- E RLY+ (TB1-13)
- W AUX+ (TB3-7)
- W AUX- (TB3-8)
- E AUX+ (TB3-9)
- E AUX- (TB3-10)
- W CAB (TB2-8)
- E CAB (TB2-9)

In an Intermediate chassis, a Repeater module uses the following terminals:

- B (TB1-1)
- N (TB1-16)
- W TK+ (TB1-2)
- W TK- (TB1-3)
- W LAMP+ (TB1-7)
- E TK+ (TB1-14)
- E TK- (TB1-15)
- E LAMP+ (TB1-10)
- W AUX+ (TB3-7)
- W AUX- (TB3-8)
- E AUX+ (TB3-9)
- E AUX- (TB3-10)
- W CAB (TB3-6)
- E CAB (TB3-13)

A.2.6. Switch Lock Module Terminal Definitions

The Switch Lock Module has 32 AAR terminals arranged in two rows of 16. The rows are identified as TB1 or TB2. Row TB1 is the bottom most row. A list of all the terminals by function and terminal location in parentheses follows.

B (TB1-1) B12 input connection for the positive battery terminal.

N (TB1-16) N12 input connection for the negative battery terminal.

WEST TK+ (TB1-2) Connection to the positive rail of the WEST track.

WEST TK- (TB1-3) Connection to the negative rail of the WEST track.

+ VPC (TB1-7) Vital Power Controller (VPC) positive voltage terminal (isolated from the battery) used as the common connection for all outputs (Lock Relay, Overlay Relay, Lamp Output, EAST and WEST Auxiliary Outputs (if used) and Auxiliary Inputs EEXI and WEXI (if used)).

PBKE LMP OUT (TB1-6) Current sink (active low) output referenced to the Vital Power Controller (VPC) voltage, + VPC (TB1-7). Typical application is connect this terminal to a lamp which is used to indicate that the unlock relay is energized.

LK RLY OUT (TB1-5) Current sink (active low) output referenced to the Vital Power Controller (VPC) voltage, + VPC (TB1-7). This terminal is typically used to energize the lock coil in the switch lock mechanism.

OUTPUT (TB2-6) Current sink (active low) output referenced to the Vital Power Controller (VPC) voltage, + VPC (TB1-7). This terminal can be used to energize a relay for any generic application requirement.

OL RLY OUT (TB2-7) Current sink (active low) output referenced to the Vital Power Controller (VPC) voltage, + VPC (TB1-7). This terminal can be used to energize a relay to indicate the status of the internal overlay. Typical application is to energize this output if the internal overlay is shunted.

UNL REQ INP (TB1-4) Single-wire input from positive battery voltage, B (TB1-1) typically used to indicate a request has been made to unlock the switch lock mechanism. A positive input is present to indicate an unlock request.

+NWP (TB2-2) Positive input terminal of an isolated two-wire input typically used for switch circuit controller indication. Referenced to -NWP (TB2-3).

-NWP (TB2-3) Negative input terminal of an isolated two-wire input typically used for switch circuit controller indication.

+RMTE OL (TB2-4) Positive input terminal of an isolated two-wire input typically used to indicate occupancy when an external overlay is used (referenced to -RMTE OL (TB2-5). There is no connection to this terminal when the remote overlay is not used.

-RMTE OL (TB2-5) Negative input terminal of an isolated two-wire input typically used to indicate occupancy when an external overlay is used. This input is connected to negative energy referenced to +RMTE OL (TB2-4). There is no connection to this terminal when the remote overlay is not used.

EAST TK+ (TB1-14) Connection to the positive rail of the EAST track.

EAST TK- (TB1-15) Connection to the negative rail of the EAST track.

OL/XMIT+ (TB1-10) No connection.

OL/XMIT- (TB1-11) No connection.

SERIES (OL RCVR) TK+ (TB1-12) Connection to the positive rail for Series Overlay. When the Series Overlay is used, connect to EAST TK+ (TB1-14) or WEST TK+, (TB1-2).

SERIES (OL RCVR) TK- (TB1-13) Connection to the negative rail for Series Overlay. When the Series Overlay is used, connect to EAST TK- (TB1-15) or WEST TK-, (TB1-3).

W EX I (TB2-9) Local one-wire input. This terminal is normally unused and is provided for special signaling applications that may arise in the future. For normal application, no connection is required. When used, the input voltage must originate from + VPC (TB1-7).

W EX O (TB2-8) Current sink (active low) output referenced to WEST Vital Power Controller (VPC) voltage, + VPC (TB1-7). This terminal is normally unused and is provided for special signaling applications that may arise in the future.

W AUX+ (TB2-10) Positive input terminal of an isolated two-wire auxiliary input for downgrading the signaling system under various conditions. Typical applications include switch controllers, slide fences, high water detectors, dragging equipment detectors, etc. Referenced to W AUX- (TB2-11).

W AUX- (TB2-11) Negative input terminal of an isolated two-wire auxiliary input for downgrading the signaling system under various conditions. Typical applications include switch controllers, slide fences, high water detectors, dragging equipment detectors, etc.

W CAB (TB1-8) Current sink (active low) output used to interface the Switch Lock Module to the optional Cab Signal Module. This output generates the appropriate coded cab signal rates for the WEST track circuit. This output is referenced to WEST Vital Power Controller (VPC) voltage, + VPC (TB1-7).

E EX I (TB2-13) Local one-wire input. This terminal is normally unused and is provided for special signaling applications that may arise in the future. For normal application, no connection is required. When used, the input voltage must originate from + VPC (TB1-7).

E EX O (TB2-12) Current sink (active low) output referenced to EAST Vital Power Controller (VPC) voltage, + VPC (TB1-7). This terminal is normally unused and is provided for special signaling applications that may arise in the future.

E AUX+ (TB2-14) Positive input terminal of an isolated two-wire auxiliary input for downgrading the signaling system under various conditions. Typical applications include switch controllers, slide fences, high water detectors, dragging equipment detectors, etc. Referenced to E AUX- (TB2-15).

E AUX- (TB2-15) Negative input terminal of an isolated two-wire auxiliary input for downgrading the signaling system under various conditions. Typical applications include switch controllers, slide fences, high water detectors, dragging equipment detectors, etc.

E CAB (TB1-9) Current sink (active low) output used to interface the Repeater Module to the optional CAB SIGNAL module. This output generates the appropriate coded cab signal rates for the EAST track circuit. This output is referenced to Vital Power Controller (VPC) voltage, + VPC (TB1-7).

(TB2-1) Unused terminal. No connection required.

(TB2-16) Unused terminal. No connection required

A.2.7. Cab Signal Module Terminal Definitions

The Cab Signal module has 12 AAR terminals arranged in two rows of six. A list of all terminals by function, followed by the terminal location in parentheses follows.

B (TB2-6) Positive terminal for primary battery power, nominally 12 Volts.

N (TB1-6) Negative terminal for primary battery power.

VPC (TB2-4) Positive VPC voltage input from the Genrakode II track module which is used as the modulator power source (W RLY+ / W LAMP+ or E RLY+ / E LAMP+).

CAB (TB2-5) Negative VPC voltage input from the Genrakode II track module that is modulated at the cab rate (Aux I/O E CAB or W CAB outputs).

GKODE+ (TB2-2) Positive track input from the Genrakode II track module.

GKODE- (TB2-3) Negative track input from the Genrakode II track module.

TK+ (TB2-1) Positive output/input connection to track.

TK- (TB1-1) Negative output/input connection to track.

100% (TB1-2) Transformer output terminal to be jumpered to the TK- terminal for 100% cab signal output.

80% (TB1-3) Transformer output terminal to be jumpered to the TK- terminal for 80% cab signal output.

50% (TB1-4) Transformer output terminal to be jumpered to the TK- terminal for 50% cab signal output.

25% (TB1-5) Transformer output terminal to be jumpered to the TK- terminal for 25% cab signal output.

A.3. SWITCH LOCK MODULE UNLOCK CODE SELECTION

There are two groups of jumper sockets for both directions EAST and WEST. There has to be one jumper installed for each direction. The jumper sockets are labeled on the Switch Lock I/O board as:

WEST:	EAST:
A - 8,2,3,4,7	A - 8,2,3,4,7
B - 2,3,4,7	B - 2,3,4,7
C - 3,4,7	C - 3,4,7
D - 4,7	D - 4,7
E - 7	E - 7

For example, if:

- in response to an unlock request for a siding to mainline move and
- the lock is to be released without running time when codes 4 or 7 are received from the WEST and
- codes 3, 4 or 7 are received from the EAST,
- then a jumper is placed in the D slot for the WEST and another in the C slot for the EAST.

Typical Switch Lock application logic for a siding to mainline move specifies that if unlock (UC) codes are received from both directions then the lock relay is energized after tumble down is transmitted in both directions and some short timer has expired.

A.3.1. Interpreting Switch Lock I/O LEDs

There are three groups of LEDs on the Switch Lock I/O Board.

The first group is located about two inches from the edge of the board and is used to indicate the status of the three inputs. These LEDs is on whenever there is energy on the corresponding input. Input LEDs are designated as follows:

PC Board Label	Function	Location
UN. REQ.	Unlock Request input	--top LED--
NWP	NWP Input	
RMTE. OL.	Remote Overlay input	--bottom LED--

The next group contains four LEDs; they identify the states of the outputs. When one of these LEDs is on, it means the CPU has energized the corresponding output.

PC Board Label	Function	Location
LR	Lock Relay Output	--top LED--
OL	Overlay Relay Output	
OT	Output Relay Output	
LP	Lamp Output	--bottom LED--

The third group is located on bottom of the board by the edge and is used for LC/UC indication and short timer status.

NOTE

These LEDs are not currently used in the Genrakode II system.

PC Board Label	Function	Location
WA	WEST LC code received	--top LED--
WB	WEST UC code received	
EA	EAST LC code received	
EB	EAST UC code received	
ST	Short timer	--bottom LED--

The LEDs indicate the following:

WA-on, WB-off:	WEST LC code received.
WA-off, WB-on:	WEST UC code received.
WA-on, WB-on:	No vital codes (8,2,3,4,7) received from WEST.
EA-on, EB-off:	EAST LC code received.
EA-off, EB-on:	EAST UC code received.
EA-on, EB-on:	No vital codes (8,2,3,4,7) received from EAST.
ST-off:	Short timer is reset (not currently supported in Genrakode II)
ST-flashing:	Short timer is running (not currently supported in Genrakode II)
ST-on:	Short timer has expired (not currently supported in Genrakode II)

A.4. TYPICAL APPLICATION CIRCUITS

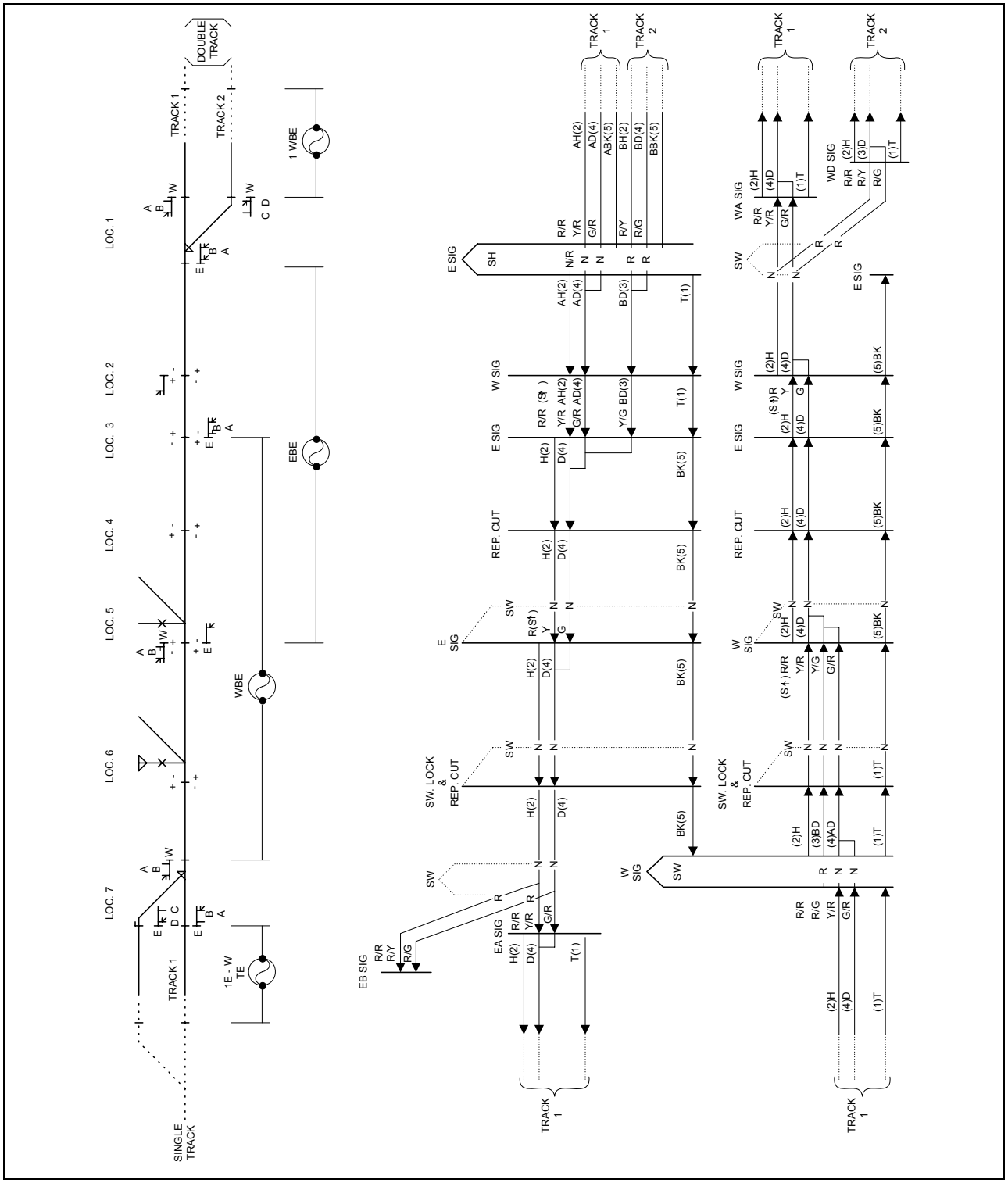


Figure A–1. Track Layout Example: Code and Aspect Chart

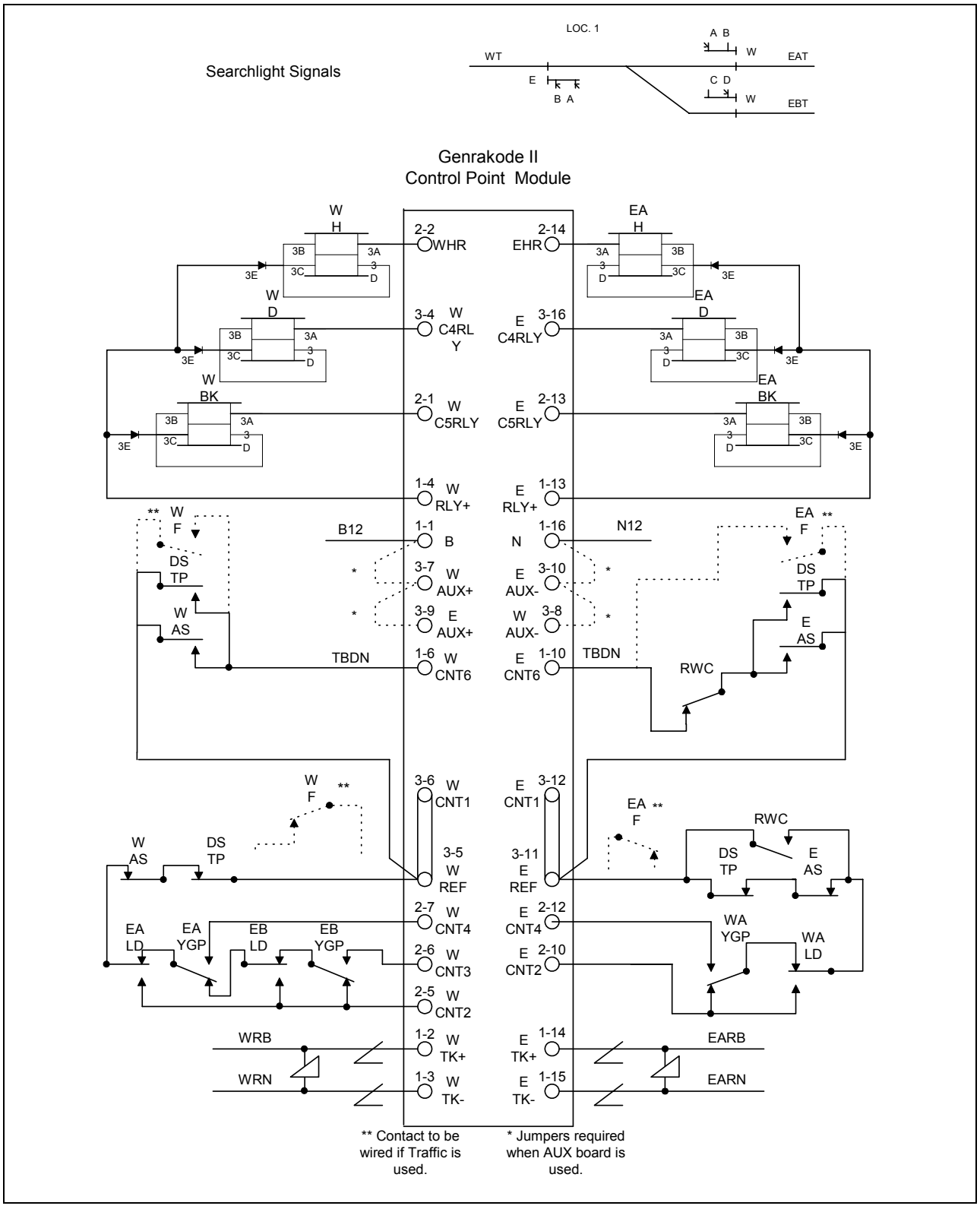


Figure A–2. Location 1: Control Point Module

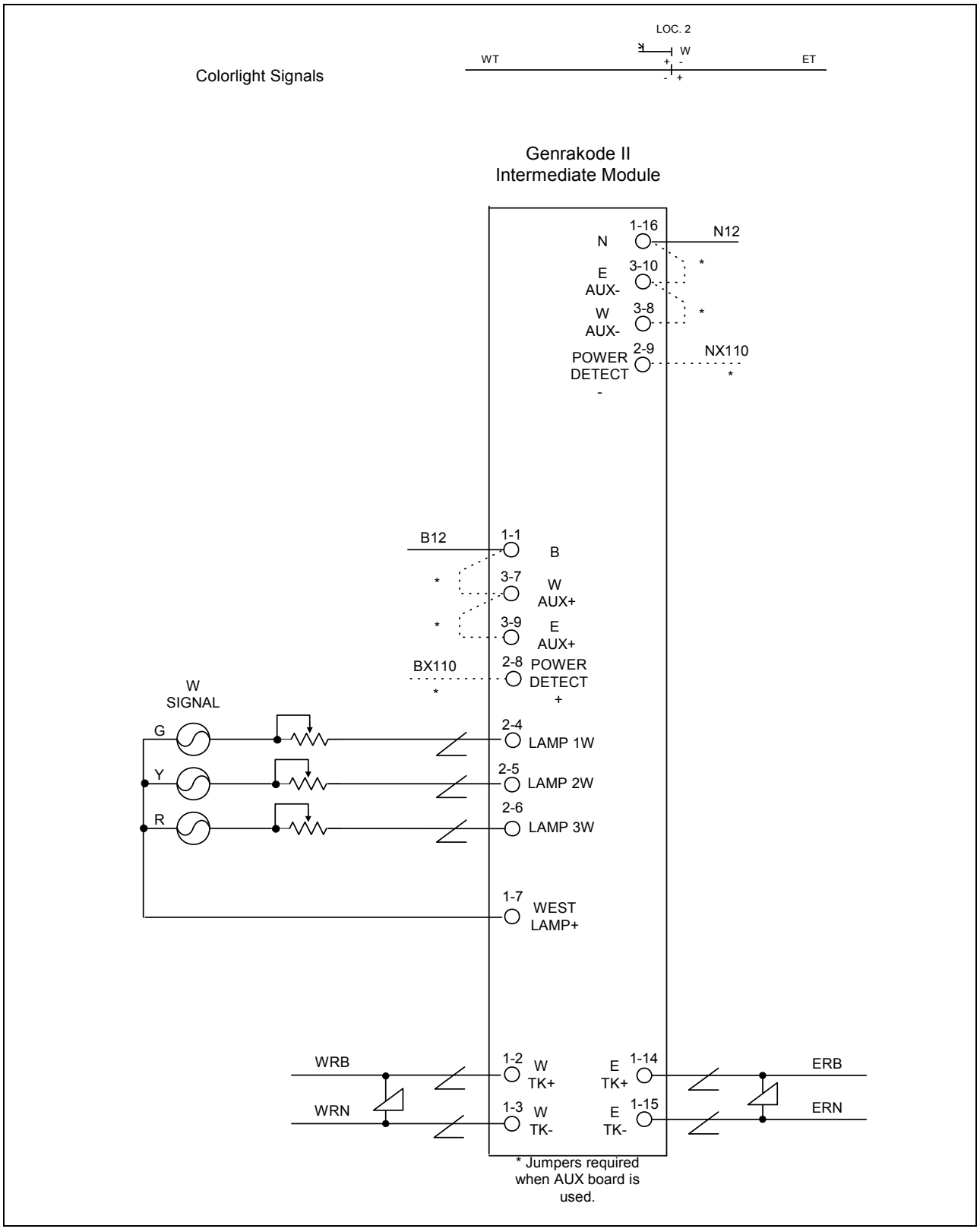


Figure A–3. Location 2: Intermediate Module Driving Staggered Colorlight Signal

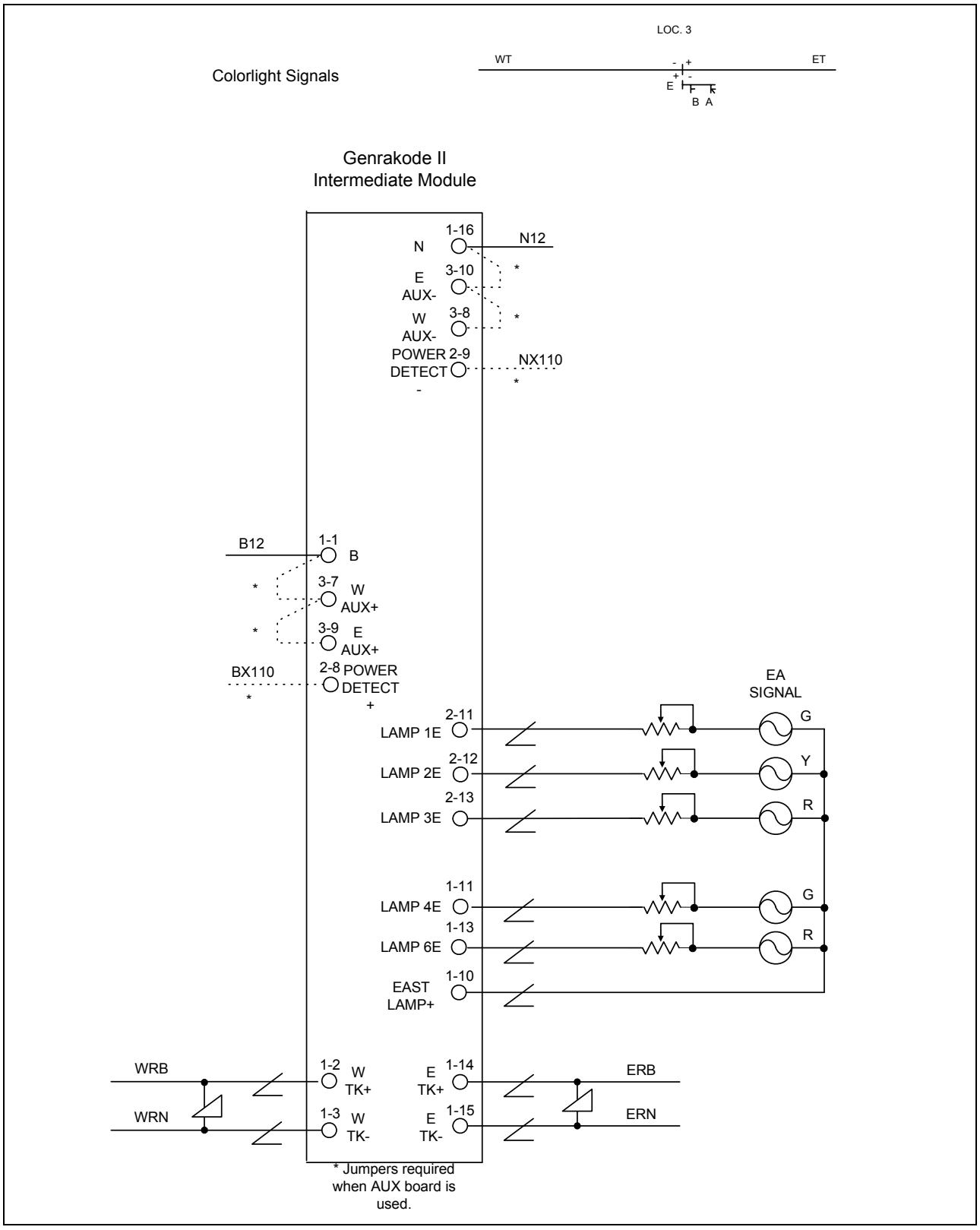


Figure A–4. Location 3: Intermediate Module Driving Staggered Colorlight Signal

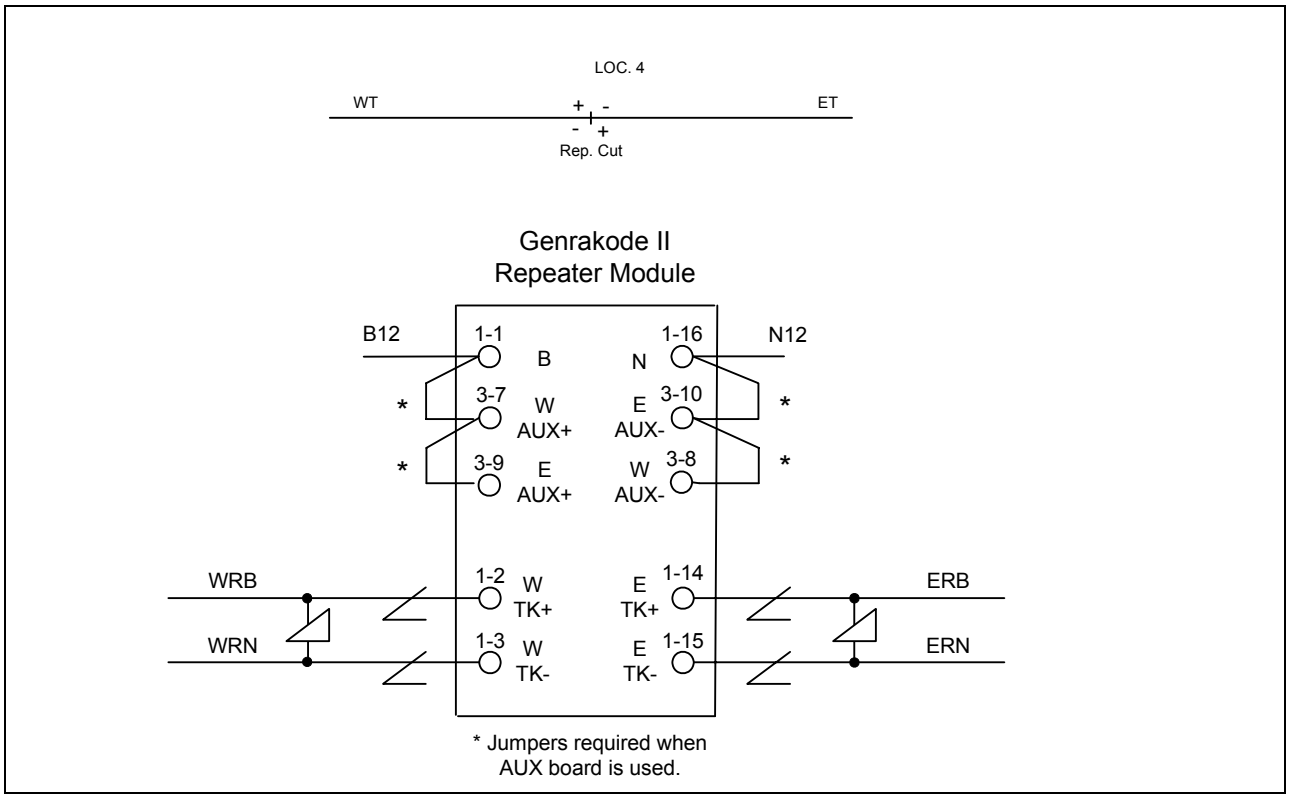


Figure A–5. Location 4: Demonstrating Application of Repeater

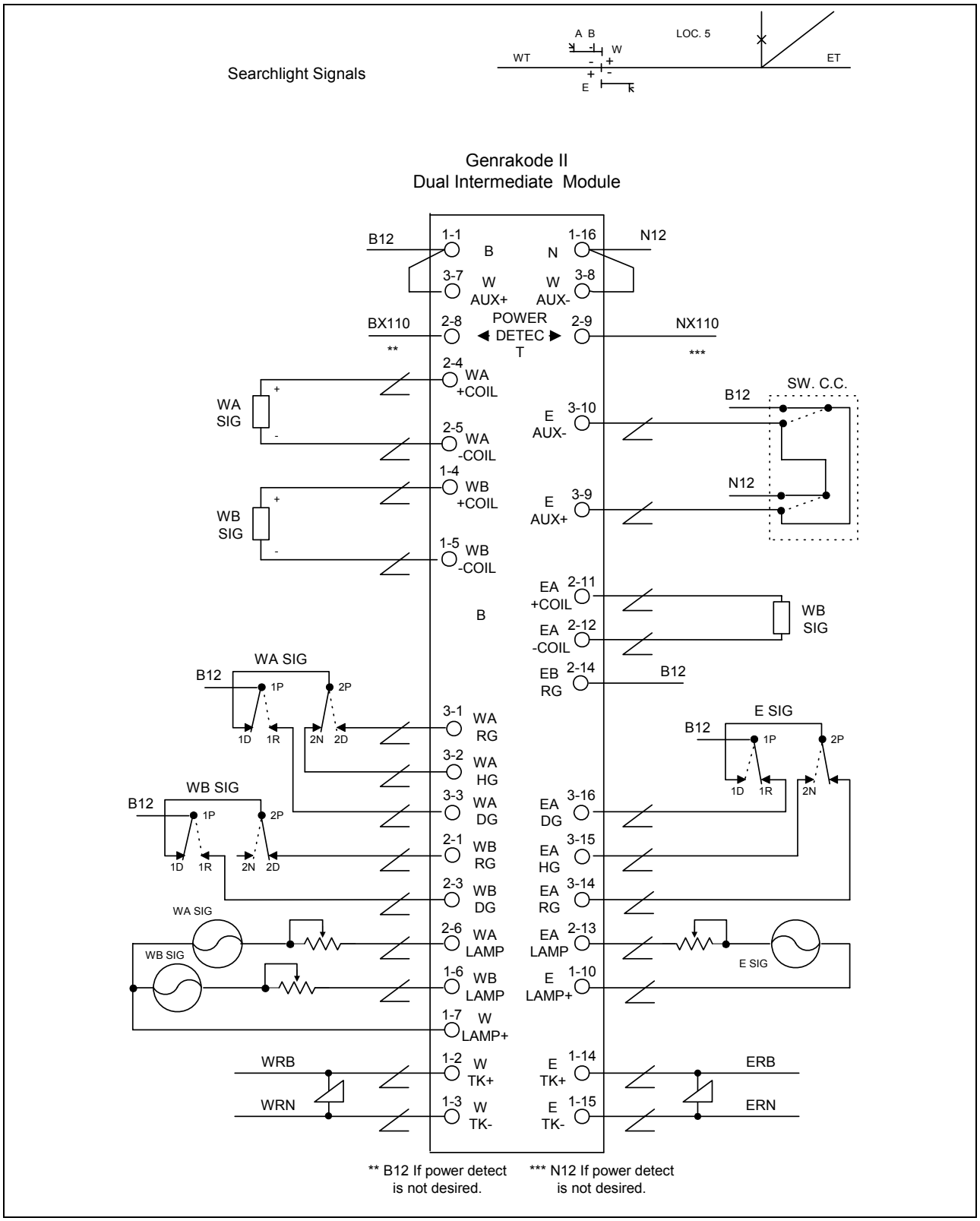


Figure A–6. Location 5: Intermediate Module Driving Searchlight

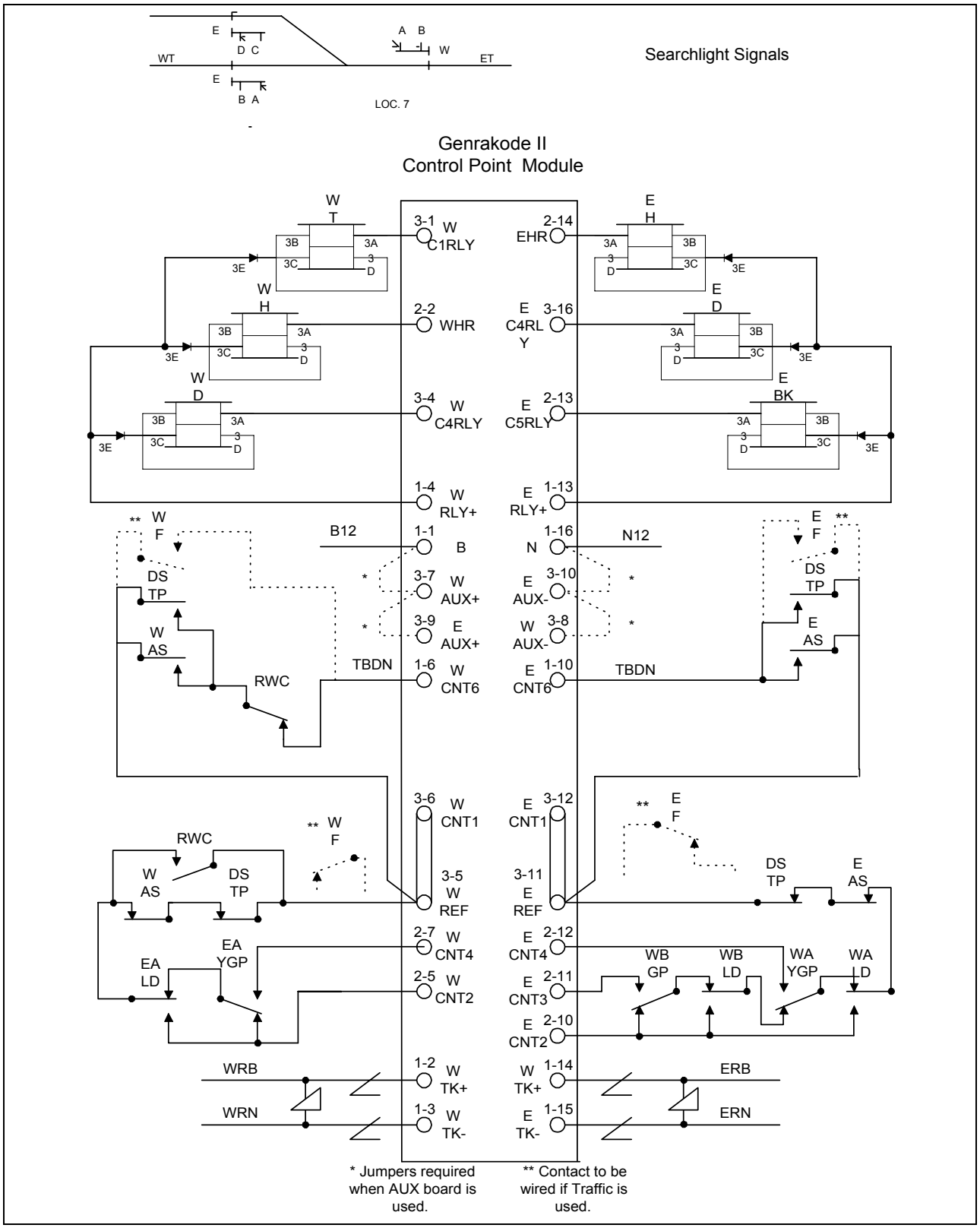


Figure A–7. Location 7: Control Point Module

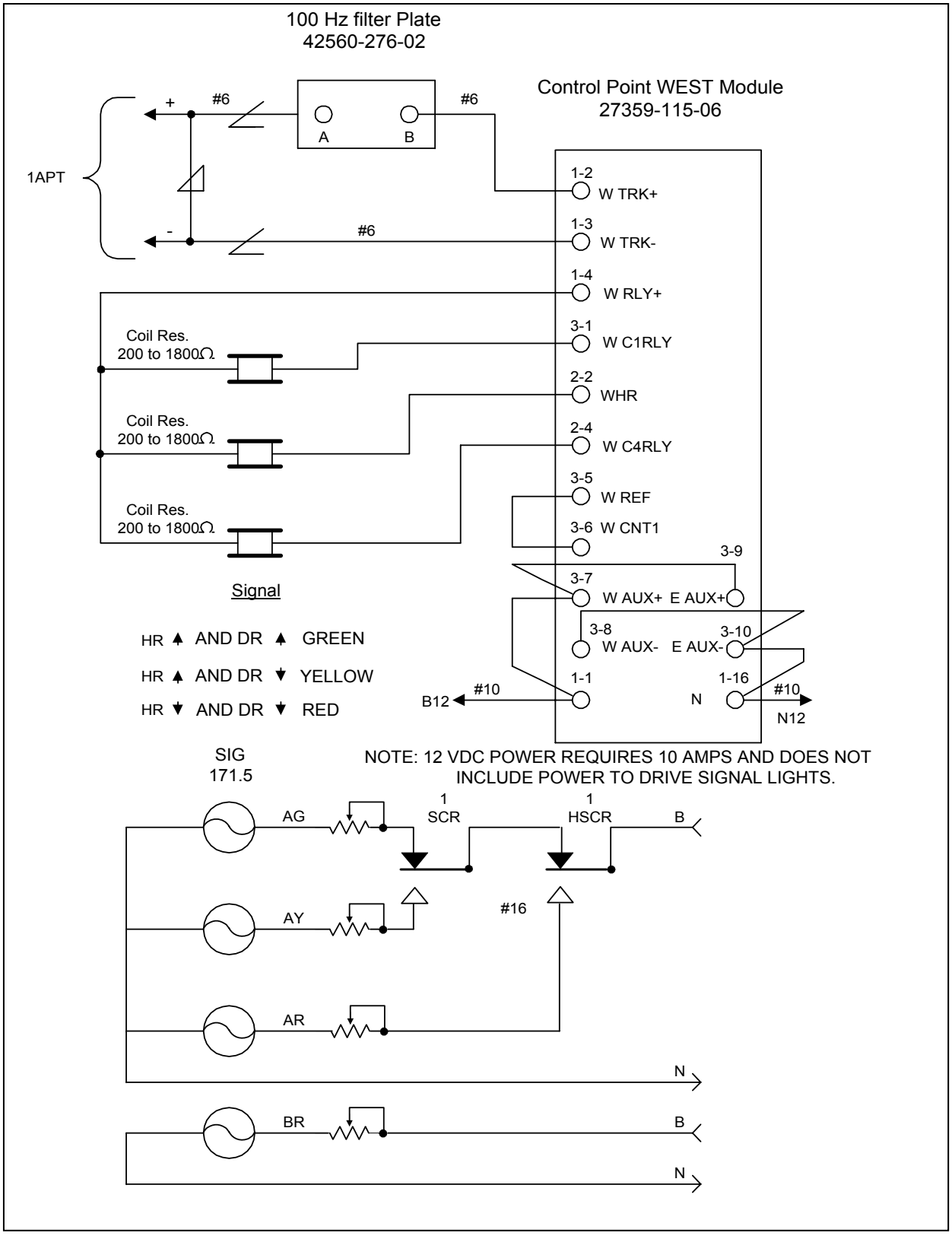


Figure A–8. 100 Hz External Filter Application

A.5. CIRCUIT BOARD DESCRIPTIONS

Each circuit board available for Genrakode II modules is described in the following pages. Each board is identified by name, group number, function(s) and the modules where can be used.

A.5.1. Auxiliary I/O Boards

Each Genrakode module (except for Cab Signal modules) includes a card slot for an optional Auxiliary I/O board. Three varieties of Auxiliary I/O board are available for use with the Genrakode system. The board types and associated part numbers are provided in Table A–1.

Table A–1. Aux I/O Boards and Uses

Board	Part Number	Used With
Aux I/O I	59473-837-01	All module types.
Aux I/O II	59473-958-01	All module types.
Aux I/O III	31166-043-01	All module types where dual-rate cab signal (100/250 Hz) or more than four vital outputs (for any reason) is required.

NOTE

Double-track approach lighting function provided by bi-directional I/O lines available on the Aux I/O II and III is only applicable to Intermediate modules.

Each board type is functionally similar, with the major difference between them being the number and type of inputs and outputs. The Aux I/O I board provides four vital inputs, one non-vital input, and four vital outputs. The Aux I/O II board provides four vital inputs, one non-vital input, two vital outputs, and two non-vital bi-directional I/O lines (normally used for double-track approach lighting). The Aux I/O III board provides two vital inputs, one non-vital input, six vital outputs, and two non-vital (NV) bi-directional I/O lines.

The following discussion and tables summarize the I/O capabilities of each board. Standard application information is provided, although inputs and outputs can be used to meet any customer requirements, within the limits of the electrical characteristics listed.

The two-wire (differential) vital input circuits can be operated from a local or remote power source.

	min.	nominal	max.
Voltage (DC):	9	12	16
Current (mA DC):	7	10	13

The single-ended vital inputs are referenced to VPC common and must obtain their input energy from the RLY+ (for Control Point and Repeater modules) or the LAMP+ (for Intermediate modules) AAR terminals.

	min.	nominal	max.
Voltage (DC):	12.1	12.5	12.9
Current (mA DC):	7	10	13

The single-ended vital outputs are current sink (active low) outputs referenced to VPC energy obtained from the RLY+ (for Control Point and Repeater modules) or the LAMP+ (for Intermediate modules) AAR terminals.

	min.	nominal	max.
Voltage (DC):	12.1	12.5	12.9
Current (mA DC):	–	–	60

The AC power off detection circuit (POR) is a non-vital input circuit which can be connected to 110 VAC power at an Intermediate location to provide for selectable approach lighting upon the loss of AC power.

	min.	nominal	max.
Voltage (DC):	9	12	16
Current (mA DC):	2	3	4
Voltage (V AC rms):	100	120	140
Current (mA rms):	3	4	5

The two non-vital (NV) bi-directional input/output circuits are used for the Double Track Approach (DTA) lighting feature available on the Intermediate modules. These circuits are used for inter-module communications, when one unit must inform a second of an approaching train.

The numbers of each type of input/output for Aux I/O I, II, and III are provided in Tables A–2 through A–4.

Table A–2. Aux I/O I Input/Output Types

I/O Type	Number	Description
Vital Input	4	2 Differential, 2 Single-ended
Non-Vital Input	1	Differential
Vital Output	4	Single-ended

Table A–3. Aux I/O II Input/Output Types

I/O Type	Number	Description
Vital Input	4	2 Differential, 2 Single-ended
Non-Vital Input	1	Differential
Vital Output	2	Single-ended
Bi-directional (NV)	2	Single-ended

Table A–4. Aux I/O III Input/Output Types

I/O Type	Number	Description
Vital Input	2	Single-ended
Non-Vital Input	1	Differential
Vital Output	6	Single-ended
Bi-directional (NV)	2	Single-ended

Standard uses for Aux I/O I, II, and III are provided in Tables A–5 through A–7.

NOTE

Although the inputs and outputs identified with an asterisk (*) are provided by the Auxiliary I/O boards, the Control Point module and a Repeater module configured from a Control Point module chassis (the default) do not have access to these inputs and outputs due to a shortage of AAR terminals.

Table A–5. Aux I/O I Standard Uses

Name	Standard Use	Interface
Vital Inputs		
WAUX	Switch controller, slide fence, high water detector, etc.	Differential
EAUX	Switch controller, slide fence, high water detector, etc.	Differential
WEXI *	Generic input	Single-ended
EEXI *	Generic input	Single-ended
Non-Vital Input		
POR *	Power-on relay (AC power detection)	Differential
Vital Outputs		
WCAB	Cab signal drive	Single-ended
ECAB	Cab signal drive	Single-ended
WEXO *	Generic output	Single-ended
EEXO *	Generic output	Single-ended

Table A–6. Aux I/O II Standard Uses

Name	Standard Use	Interface
Vital Inputs		
WAUX	Switch controller, slide fence, high water detector, etc.	Differential
EAUX	Switch controller, slide fence, high water detector, etc.	Differential
WEXI *	Generic input	Single-ended
EEXI *	Generic input	Single-ended
Non-Vital Input		
POR *	Power-on relay (AC power detection)	Differential
Vital Outputs		
WCAB	Cab signal drive	Single-ended
ECAB	Cab signal drive	Single-ended
Bi-directional		
WDTAP *	Double track approach lighting (Intermediate only)	Single-ended
EDTAP *	Double track approach lighting (Intermediate only)	Single-ended

Table A–7. Aux I/O III Standard Uses

Name	Standard Use	Interface
Vital Inputs		
WAUX	Switch controller, slide fence, high water detector, etc.	Single-ended
EAUX	Switch controller, slide fence, high water detector, etc.	Single-ended
Non-Vital Input		
POR *	Power-on relay (AC power detection)	Differential
Vital Outputs		
WCAB100P	Cab signal drive (100 Hz)	Single-ended
ECAB100P	Cab signal drive (100 Hz)	Single-ended
WCAB250P *	Cab signal drive (250 Hz)	Single-ended
ECAB250P *	Cab signal drive (250 Hz)	Single-ended
WCODEP *	Code 1 received status	Single-ended
ECODEP *	Code 1 received status	Single-ended
Bi-directional		
WDTAP *	Double track approach lighting (Intermediate only)	Single-ended
EDTAP *	Double track approach lighting (Intermediate only)	Single-ended

The positions and functions for the Aux I/O I, II, and III LEDs are provided in Tables A–8 through A–10.

Table A–8. Aux I/O I Board LEDs

Component	Position	Description	Function
CR9	Top	Large, recessed	WAUX
CR10	||	Large, recessed	WEXI
CR12	||	Large, recessed	EEXI
CR11	||	Large, recessed	EAUX
CR5	||	Small, on edge	WEXO
CR6	||	Small, on edge	WCAB
CR7	\/	Small, on edge	ECAB
CR8	Bottom	Small, on edge	EEXO

Table A–9. Aux I/O II Board LEDs

Component	Position	Description	Function
CR1	Top	Large, recessed	WAUX
CR2	||	Large, recessed	WEXI
CR3	||	Large, recessed	EEXI
CR4	||	Large, recessed	EAUX
CR5	||	Small, on edge	WDTA
CR6	||	Small, on edge	EDTA
CR7	\/	Small, on edge	WCAB
CR8	Bottom	Small, on edge	ECAB

Table A–10. Aux I/O III Board LEDs

Component	Position	Description	Function
CR2	Top	Large, recessed	WAUX
CR10	||	Small, on edge	WCODE
CR9	||	Large, recessed	EAUX
CR11	||	Small, on edge	ECODE
CR12	||	Small, on edge	WDTA
CR13	||	Small, on edge	EDTA
CR14	||	Small, on edge	WC250
CR15	||	Small, on edge	EC250
CR16	\/	Small, on edge	EC100
CR17	Bottom	Small, on edge	WC100

A.5.2. Color Light Driver Board (P/N 59473-864-01, -02)

Function: Provide lamp drive capability and filament checking for up to six lamps.

Where Used:

- Intermediate module

Six identical circuits are provided on this board for driving six different lamps with power requirements of up to 25 Watts each.

Once every system cycle (2.8 seconds), outputs are cycle-checked (turned on and off) by the CPU to determine that they are operable, controllable and that the circuitry can be changed to both the on and off state. In between the 2.8 second period, the CPU periodically reads the state of each output to determine that it is in the correct state. The lamp drive board also contains circuitry to perform filament checking for each lamp. Once each system cycle (2.8 seconds) a lamp filament cycle check is performed.

VPC energy must be present in order for the lamp drive output circuits to operate. VPC energy is present only when the module is operating in a safe manner.

The Group 2 differs from the Group 1 due to the added function of Cable Integrity Check (CIC). When two outputs are shorted together the data returned to the CPU is corrupted, making the short detectable. The trade-off for this added feature is that the circuit is now much less resistant to AC noise immunity. So in high-noise environments, the Group 1 board, which has very high AC noise immunity but no CIC function, is the solution.

To allow Cable Integrity Check to operate properly, it is necessary to make some application requirements. These requirements are not expected to impose any unreasonable constraints in most applications. These requirements are as follows:

1. Must use independent dropping resistors
2. Must keep cable resistance less than 0.2 Ohms (200 feet with #10 wire)
3. Must set each dropping resistor to provide between 9.5 and 10.5 Volts at each bulb (when ON)

Specifications:

Lamp output drive capabilities - Colorlight:

Regulated Lamp

	min.	nominal	max.
Lamp Voltage (DC):	12.1	12.5	12.9
Lamp Wattage (W):	5	18	25

NOTE

Dropping-resistors are required at the signal head (1 per lamp) to adjust each lamp voltage for 10 V DC.

NOTE

A maximum of 3 - 25 Watt bulbs can be simultaneously lit per direction (6 - 25 W bulbs max per module).

A.5.3. Converter/Receiver Board (P/N 59473-833-01)

Function: Converter portion creates isolated DC pulses for transmission on the rails. Receiver portion provides an isolated pulse detection circuit for pulse codes received on the rails.

Where Used:

- All module types

The converter is essentially a transformer-isolated, DC to DC converter that converts the 12V signal battery supply to a track battery voltage level for transmitting. Four nominal track voltage levels are selectable by screw switches on taps of output transformer T2. Nominal track voltage levels available are 1.5, 2.0, 3.0 and 4.0 Volts DC (into a 1 Ohm load). The converter operates at a relatively high frequency above the audio range. This allows quiet operation and the use of small transformers.

VPC energy must be present in order for CPU code pulses to be transmitted to the rails. VPC energy is present only when the module is operating in a safe manner.

The receiver is connected and disconnected from the rails for receiving and transmitting, respectively. 3 screw switches allow the receiver resistance, and thus the current level, to be adjusted. The receiver resistance can be set to 0, 0.27, 0.56, 0.83, 0.82, 1.09, 1.38, or 1.65 Ohms. The module wiring resistance adds approximately 0.36 Ohms to the selected adjustable resistance value.

The CPU performs a cycle test of the receiver once every system cycle (2.8 seconds) to insure that the receiver is operating correctly and that its gain has not changed.

Three test posts lugs are placed at the front edge of the board. The top post is the amplified receive and test current voltage levels that are applied to the input of the level detectors. This voltage may be viewed with reference to the +4V reference (middle test lug) or 12V Common (lower test lug).

Table A–11. Converter/Receiver Board LEDs

Component	Position	Function
CR13	top	Flashes coincident with each transmitted pulse
CR8	middle	Flashes coincident with each received pulse above the receive threshold level and with the upper level test current pulse
CR1	bottom	Flashes coincident with receiver test current pulses

Table A–12. Output Voltage vs. Tap Selection for Track Converter

Output Voltage (Volts)	Primary Taps	Secondary Taps
1.5	L-L	1.5/2.0, 1.5/2.0
2.0	H-H	1.5/2.0, 1.5/2.0
3.0	L-L	3.0/4.0, 3.0/4.0
4.0	H-H	3.0/4.0, 3.0/4.0

Table A–13. Receiver Input Resistance and Switch Positions

Total Receiver Resistance	Switch Position		
(Ohms)	SS1	SS2	SS3
0	in	in	in
0.27	in	out	in
0.56	out	in	in
0.83	out	out	in
0.82	in	in	out
1.09	in	out	out
1.38	out	in	out
1.65	out	out	out

Receiver sensitivity: pick/drop - 0.5 A DC
60 Hz rejection: 10 V AC rms rail-to-rail

NOTE

Module resistance adds 0.63 Ohm (Ω).

A.5.4. Converter/Receiver Board (P/N 59473-833-02)

Function: Converter portion creates isolated DC pulses for transmission on line wires. Receiver portion provides an isolated pulse detection circuit for pulse codes received on line wires.

Where Used:

- All module types

WARNING

THE P/N 59473-833-02 CONVERTER/RECEIVER LINE DRIVER BOARD IS ONLY INTENDED TO BE USED FOR LINE WIRE APPLICATIONS AND MUST NOT BE USED IN APPLICATIONS FOR NORMAL TRACK OPERATION. USAGE MAY RESULT IN EXCESSIVE TRACK CURRENT, CAUSING THE INABILITY TO DETECT TRAINS IN THE TRACK CIRCUIT.

NOTE

The P/N 59473-833-02 Converter/Receiver Line Driver board is not compatible with the Electrocode Line Wire boards (2L Line Converter, 7L Receiver, and 9L Track Choke). Use the P/N 59473-833-02 board at both ends of a line circuit.

The P/N 59473-833-02 board is essentially the same as the P/N 59473-833-01 board, except that it is redesigned to work over line wire instead of over rail. The new output transformer has different output voltages, 3.0, 4.0, 6.0, and 8.0 Volts DC (into a 1 Ohm load). The sensitivity of the receiver increases from 0.5A to 0.25A as well. These two changes allow the Line Driver Converter/Receiver board to communicate over greater distances, see Section 3 for details. The 3 screw switches now provide the following levels of receiver input resistance: 0, 0.56, 1.00, 1.56, 2.00, 2.56, 3.00, and 3.56 Ohms. The module wiring resistance now adds approximately 0.50 Ohms to the selected adjustable resistance value.

Table A–14. Output Voltage vs. Tap Selection for Line Wire Converter

Output Voltage (Volts)	Primary Taps	Secondary Taps
3.0	L-L	3.0/4.0, 3.0/4.0
4.0	H-H	3.0/4.0, 3.0/4.0
6.0	L-L	6.0/8.0, 8.0/6.0
8.0	H-H	6.0/8.0, 8.0/6.0

Table A–15. Receiver Input Resistance and Switch Positions

Total Receiver Resistance	Switch Position		
(Ohms)	SS1	SS2	SS3
0	in	in	in
0.56	in	out	in
1.00	out	in	in
1.56	out	out	in
2.00	in	in	out
2.56	in	out	out
3.00	out	in	out
3.56	out	out	out

Receiver sensitivity: pick/drop - 0.25 A DC
60 Hz rejection: 10 V AC RMS rail-to-rail

NOTE

Module resistance adds 0.50 Ohm (Ω).

A.5.5. CPU Board (P/N 31166-141-XX)

Function: Controls overall Genrakode II operation in each module. Performs safety checks, controls all inputs and outputs according to Application Logic, and includes status indications, configuration functions, and diagnostic functions through CPU indicators/controls and an RS-232 serial port interface.

Where Used:

- Control Point module (including CPIB)

  Intermediate module

  Repeater module

  Switch Lock module

The PGK CPU board provides significant enhancements to the Genrakode product. In addition to user programmability, the CPU also has extensive diagnostic capabilities. While maintaining most of the front card-edge LED indicators present with the previous CPU board, the PGK CPU adds 7-segment LEDs for numerical transmit and receive code display. It has an RS-232 serial port interface for downloading of Application Logic to Flash memory which eliminates the need for handling EPROMs. This serial interface gives the user access (via a PC with terminal emulation software) to many configuration and diagnostic commands, such as displaying the system Event and Error queues. This serial interface can be extended through the use of a modem to a remote location, and can be used to interface to a code system using Data Train VIII and Genisys protocols for non-vital controls and indications.

A.5.5.1. Board Versions

There are four versions of this board: P/N 31166-141-03, and -04.

Groups 01 and 03 are for CPIB (Control Point-In-a-Box) applications since they are equipped with Vital Serial Link (VSL) capability.

Groups 02 and 04 do not have the VSL capability and are for Genrakode II (non-CPIB) applications only.

An obsolete part on the Group 02 required a board design change. Therefore Group 3 supersedes Group 1 and Group 4 supersedes Group 2.

Be aware that the Group 01 cannot be used for Genrakode II (non-CPIB) applications – only for CPIB. However, though the Group 03 supersedes the Group 01, the Group 03 can in fact be used for both CPIB and Genrakode II (non-CPIB) applications. Table A-16 illustrates the capabilities of each board type.

Table A–16. PGK CPU Board Types

Part Number	Status	Application
31166-141-03	Active	All
31166-141-04	Active	Genrakode II-only (non-CPIB)

The Programmable Genrakode CPU board is designed to provide the customer with a simple approach to application or system software upgrades or changes. This is accomplished with a RS232 serial port located on the CPU board. Other added capabilities include event and error logging, a real time clock and numeric card-edge displays. The hardware of the CPU is divided into two separate sections, a Logic Controller and an I/O Controller. Each section contains a microcontroller and memory. The I/O Controller controls the interface to the Genrakode II bus. It provides input and output capabilities along the card edge, monitors and controls all I/O (vital and non-vital), and reports that information to the Logic Controller. The Logic Controller carries out the decision making, event logging, and controls the card edge displays. The two sections communicate through a bi-directional FIFO (First-In-First-Out buffer) register.

A.5.5.2. I/O Controller

The I/O Controller is a 40-pin DIP version of the Dallas 80C320 microcontroller. The I/O Controller utilizes an external PROM, RAM, and an Altera Programmable Logic. The I/O Controller is also the master unit for the interface FIFO though which data is transmitted to the Logic Controller. An independent timer interface is included to verify the duration of the I/O Controller cycle.

A.5.5.3. Logic Controller

The Logic Controller is an 84-pin PLCC version of the Intel 80C188EB microprocessor. The controller uses external Flash memory for the main operation program as well as the specific application data. System RAM is provided for temporary storage and a battery-backed RAM is utilized for error and event logging.

A.5.5.4. Interface FIFO

The interface FIFO provides the only means of communication between the Logic Controller and the I/O Controller. The FIFO is bi-directional. The I/O Controller controls the direction of data transfer. The FIFO main buffer communicates in only one direction at a time.

A.5.5.5. Data Logging

Event and error logging are accomplished using a power management device, a 3 Volt battery, and static RAM. The power management chip monitors the 5 Volt power supply and switches the RAM to battery power if it detects low power. The power management device can also determine a low battery condition. If a low battery is detected, the power management device sends a signal to the Logic Controller that logs an appropriate error to the Error queue.

A.5.5.6. Real Time Clock

A real-time clock is also located on the board to provide an accurate time stamping of logged data. The real time clock is also battery-backed, utilizing an internal power management section.

A.5.5.7. PGK CPU Board Edge

The PGK CPU board edge displays system information, Figures A–9 through A–12 provide four displays: normal mode, maintenance mode, and two code 5 always examples.

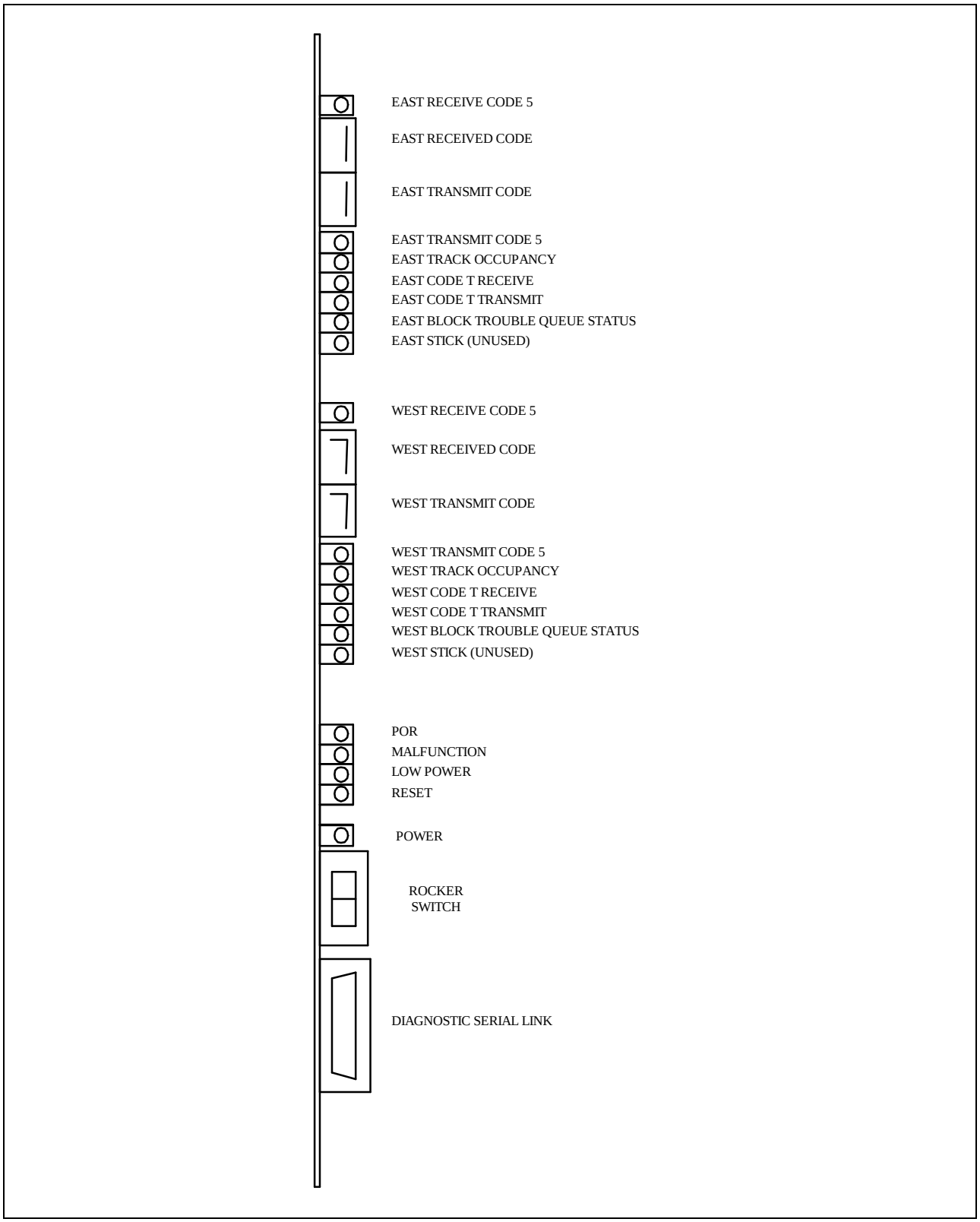


Figure A–9. CPU Board Normal Mode Displays

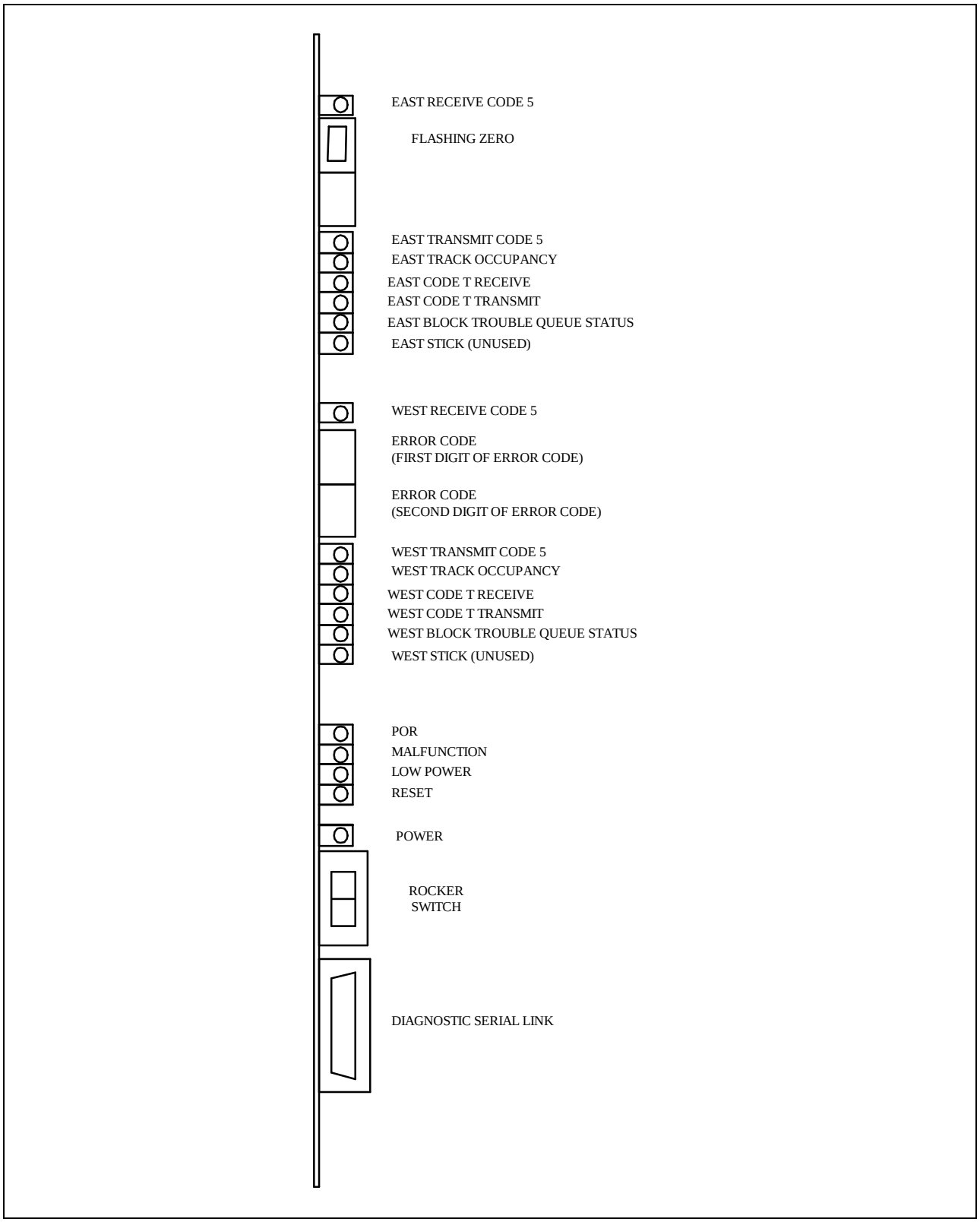


Figure A–10. CPU Board Maintenance Mode Displays

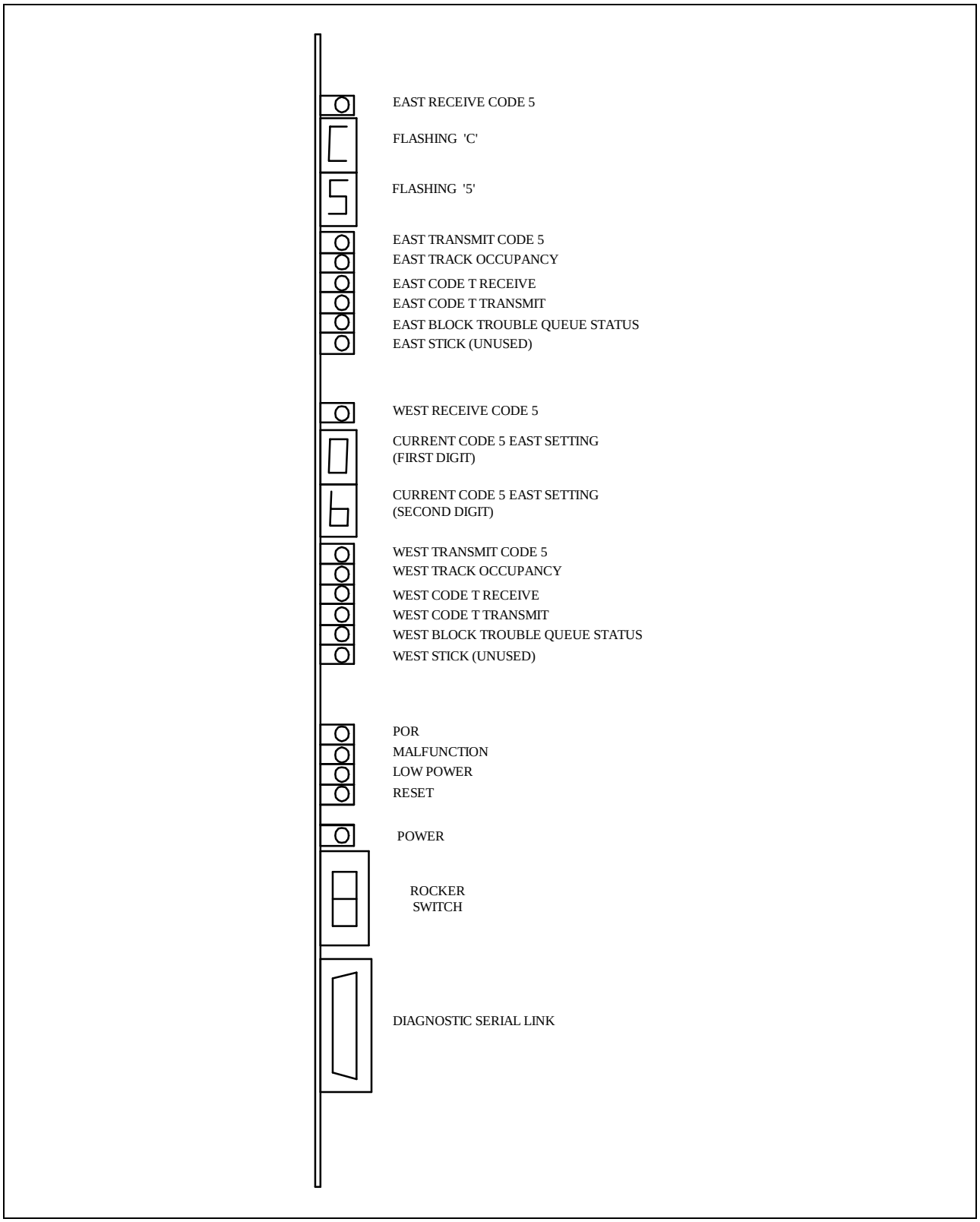


Figure A–11. CPU Board Code 5 EAST Mode Displays (Code 5 Always Example)

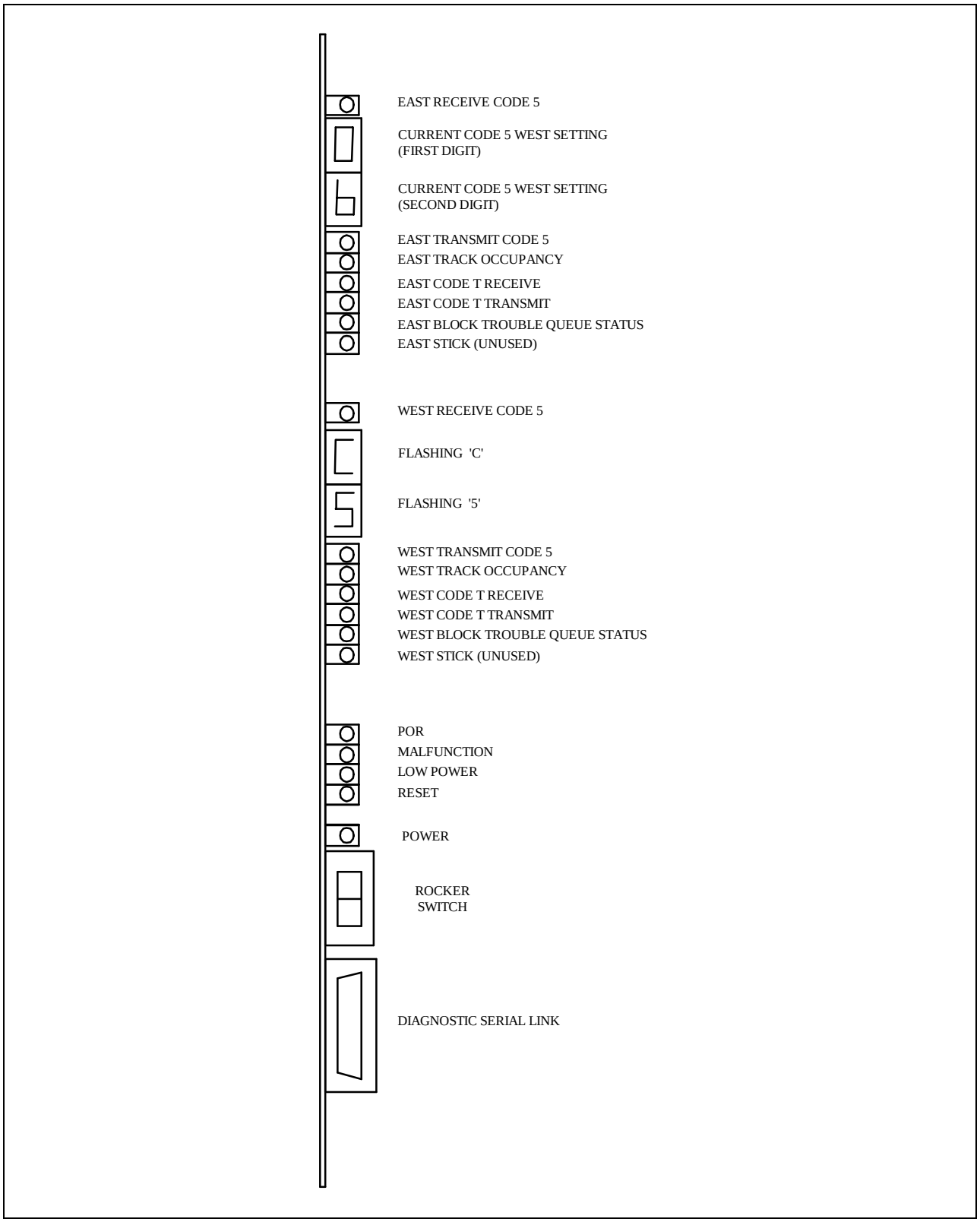


Figure A–12. CPU Board Code 5 WEST Mode Displays (Code 5 Always Example)

A.5.6. DC Code Select Input Board (P/N 59473-895-01)

Function: Interface between VPI circuitry at head blocks, which selects codes to be transmitted by Genrakode II. Operates on circuit contact closures.

Where Used:

- Control Point module

The DC Code Select Input Board contains 16 vital input circuits (eight for the EAST, and eight for the WEST direction) by which codes 1 through 8 can be selected for transmission from the location. Code 1 must be selected to enable transmission of any of the signal clearing codes. No more than three codes may be selected at one time, such as code 1, code 5 and code 4. Two signal clearing codes selected simultaneously inhibits any code transmission.

The DC Code Select Board is capable of detecting DC inputs when interrogated by the CPU board. The board is divided into the WEST and EAST sections and thus it has separate digital and analog circuitry for each side. The DC inputs are generated by other external controlling elements (outside the Control Point module).

Specifications:

Code select inputs - DC input type:

	min.	nominal	max.
Voltage (DC):	9.0	12.0	16.0
Current (mA DC):	10	13	17

A.5.7. Decode/Output Board (P/N 59473-838-01, -02)

Function: Output drivers for signals received and decoded at Control Point modules.

Where Used:

- Control Point module

The Decode Output Board contains eight identical circuits which are used to drive external relays in response to decoded receive codes. Two boards are used in each module to provide both EAST and WEST outputs. Each output is a current sinking (or active low state) output capable of driving relay coils of 200 Ohms to 1800 Ohms. Each output has surge protection provided.

5V logic circuitry is completely isolated from the 12V output circuitry. VPC energy must be present in order for the output circuits to be energized. VPC energy is present only when the module is operating in a safe manner. A separate checking circuit is provided for each output so that the CPU can determine that each particular output is in its correct state and that each output is controllable. If the CPU finds that an output has failed, power to the outputs is removed via the VPC board.

Each output state is rechecked every 8-16 ms and each output is toggled on and off once each system cycle (2.8 seconds) to determine that the CPU has control of the output.

The Group 2 differs from the Group 1 due to the added function of Cable Integrity Check (CIC). When two outputs are shorted together the data returned to the CPU is corrupted, making the short detectable. The trade-off for this added feature is that the circuit is now much less resistant to AC noise immunity. So in high-noise environments, the Group 1 board, which has very high AC noise immunity but no CIC function, is the solution.

Specifications:

Decoded relay output drive capabilities:

	min.	nominal	max.
Voltage (DC):	12.1	12.5	12.9
Coil Resistance (Ohms):	200	250	1800

A.5.8. Driver Board (P/N 59473-907-01)

Function: Cab Signal Driver and 12V High Power Filter

Where Used:

- Cab Signal module

The Driver Board contains a cab rate modulator, signal divider, power drive section and a 12V high power filter. The cab rate modulator is a fail-safe control of the input frequency. The signal divider is a flip-flop, which divides the input frequency by two. This is to insure that the output frequency duty cycle remains at 50 percent with voltage variations. The power drive section uses two dual FET drive circuits to handle the current levels required. There are two LEDs located at the edge of this board.

Table A–17. Driver Board LEDs

Component	Position	Function
CR4	Top	Indicates the Schmitt trigger is holding the outputs disabled
CR1	Bottom	Indicates power is being supplied to the drive transformer

The filter section provides filtering and surge protection for the 12V high power used for the track circuit. The input power to the filter comes from the module AAR B and N posts through the ON-OFF switch and the 15 Ampere fuse.

A.5.9. High Power Vital Power Controller (VPC) Board (P/N 59473-872-01)

Function: Provides a positive, vital, disconnect of power from signal lamp drive, searchlight mechanisms, and vital outputs in the event of failed output circuits or improper module operation. This board is also a positive disconnect for transmitted pulses.

Where Used:

- Intermediate module
- Switch Lock module
- 4-track Control Point module

The High Power VPC Board produces an isolated DC voltage source regulated to 12.5 Volts at the board, for use as lamp drive and searchlight mechanism outputs. The output voltage is regulated for both input voltage and lamp load current changes. Thus, signal lamps can be operated at a constant lamp voltage; this increases life and decreases signal maintenance. An external resistor is required to set the desired voltage across the lamp to 10 Volts.

The output voltage is only present when the CPU has determined that the module hardware and software is operating properly.

Table A–18. High Power VPC Board LED

Component	Function
CR9	Indicates vital power is being generated

A.5.10. Low Power Vital Power Controller (VPC) Board (P/N 59473-835-01)

Function: Provides a positive, vital disconnect of power from decoded output circuits in the event of failed output circuits or improper module operation. Also is a positive disconnect for transmitted pulses.

Where Used:

- Control Point module
- Repeater module

The VPC Board produces an isolated, nominal 12 Volts DC unregulated voltage source for use by decoded output circuits. The output voltage is only present when the CPU has determined that the module hardware and software are operating properly.

Table A–19. Low Power VPC Board LED

Component	Function
CR15	indicates vital power is being generated

A.5.11. Oscillator/Filter Board (P/N 59473-906-01)

Function: 200 Hz Oscillator and 12V Battery Low Power Filter

Where Used:

- Cab Signal module

The Oscillator/Filter Board contains a fail safe Hartley oscillator that supplies the Driver Board with a 200 Hz square wave used for cab carrier generation. The tank circuit sets the oscillation frequency, which has proven to be very stable even with voltage variations present.

The filter section provides filtering and surge protection for the 12V low power used by all of the boards. Input power to the filter comes from the module AAR B and N posts through the ON-OFF switch and the 5-Ampere fuse.

A.5.12. Power Supply Regulator/Filter Board (P/N 31166-338-01)

Function: 12V Battery Supply Filter and 5V Regulator for IC Logic

Low Signal Battery Monitoring

Ground Fault Monitoring

Where Used:

- All module types for Filter and Regulator functions

All module types (except for 4 Track Control Point) for Low Signal Battery and Ground Fault monitoring functions.

NOTE

The monitoring functions are only available with PGK applications compiled with CAA version 2.30 or later and with PGK U30 EPROM P/N 40025-283-23 Revision C or later.

A.5.12.1. 12V Battery Supply Filter and 5V Regulator for IC Logic:

The Power Supply Regulator/Filter board contains filtering and surge protection from the 12V signal battery for all the PC boards within the module (except the VPC boards which have their own filtering and surge protection). The Power Supply board also has a 5V regulator (PS2) for operating the digital logic portions of the system. The 5V logic supply voltage is completely isolated from the 12V signal battery and all other input/output circuits of Genrakode II. This provides isolation of the 5V logic from noise on the 12V supply and I/O lines.

The 5V regulator, PS2, also has a low battery detection circuitry that automatically shuts down the 5V supply at approximately 8 to 8.5 Volts signal battery voltage. This prevents the system from attempting to operate when the input voltage is too low for proper operation and removes virtually all Genrakode II module loading from an already discharged signal battery. The input power to the board comes from the module AAR B and N posts through the ON-OFF switch (located on the left side of the module) and the 5A fuse (located on the motherboard).

A.5.12.2. Low Signal Battery Monitoring

The Power Supply Regulator/Filter board includes circuitry to detect a signal battery that has decreased in voltage below a specified threshold. With the LSB switch (S1) in the “RUN” position, a low signal battery voltage condition (as set by the “LSB ADJ” potentiometer) is detected. An adjustable voltage reference circuit is provided to enable the setting of the detection voltage without having to adjust the actual signal battery level. Placing the LSB switch (S1) in the “SET” position directs this onboard voltage reference circuit to the low voltage detection circuit. The Low Signal Battery Threshold Adjustment Procedure is provided in Table 3–14.

A.5.12.3. Ground Fault Monitoring:

The Power Supply Regulator/Filter board detects faults between ground and both the positive (B) and negative (N) terminals to the Genrakode module. A positive ground fault occurs when there is an electrical path of less than some specified resistance (nominally 10kOhm) from GND to +12V. Similarly, a negative ground fault is a low resistance electrical path from GND to 12VCOM.

The ground fault resistance detection value is set with jumper block TB3, and the “POS ADJ” and “NEG ADJ” potentiometers are adjusted so that the detection circuitry responds to ground faults at the detection value chosen.

The Power Supply board periodically performs an automatic test to verify that the hardware is working properly. As part of this automatic test, simulated internal ground faults (not connected to the actual Earth ground) are created to test the detection circuitry.

The user can also perform a manual test of the hardware using the GFM switch (S2) on the board edge. Similar to the automatic test, placing the manual switch in the “POS TEST” position creates an internal ground fault to +12V (not connected to the actual Earth ground). The “POS FAIL” LED lights when the ground fault is detected by the hardware. Placing the manual switch in the “NEG TEST” position creates an internal ground fault to 12VCOM (not connected to the actual Earth ground). The “NEG FAIL” LED lights when the ground fault is detected by the hardware. These manual test positions are also used to adjust the potentiometers “POS ADJ” and “NEG ADJ” so that the detection circuitry trips at the desired ground fault resistance.

The adjustment of the “POS ADJ” and “NEG ADJ” potentiometers is necessary since the Power Supply board provides the ability to detect ground faults of various levels. Jumper block TB3 provides the ability to set the detection level to one of six ground fault resistances (corresponding to current levels). The nominal 10kOhm (1.2mA @ 12VDC) is provided, although 20kOhm (0.6mA) is the default jumper setting in order to give advance warning of a ground fault condition. Other jumper settings available are 30kOhm (0.4mA), 6kOhm (2mA), 3kOhm (4mA), and 1.5kOhm (8mA). The jumper position is determined based upon the desired detection level, and the “POS ADJ” and “NEG ADJ” potentiometers are adjusted so that the automatic testing of the circuitry is performed at the correct levels.

To change the Fault Detection Threshold so that the Ground Fault Monitor detects a lower or higher ground fault resistance, perform the Ground Fault Monitor Fault Detection Threshold Adjustment Procedure provided in Table 3–15.

To set the “POS ADJ” and “NEG ADJ” potentiometers so that the Ground Fault Monitor detects ground faults, perform the Ground Fault Monitor Potentiometer Adjustment Procedure provided in Table 3–16.

A.5.13. Regulator/Filter (Standard) Board (P/N 59473-834-01)

Function: 12V Battery Supply Filter and 5V Regulator for IC Logic

Where Used:

- All module types

The Standard Regulator/Filter Board contains filtering and surge protection from the 12V signal battery for all the PC boards within the module (except the VPC boards that have their own filtering and surge protection). The Standard Regulator/Filter Board also has a 5V regulator for operating the digital logic portions of the system. The 5V logic supply voltage is completely isolated from the 12V signal battery and all other input/output circuits of Genrakode II. This provides isolation of the 5V logic from noise on the 12V supply and I/O lines.

The 5V regulator, IC1, also has a low battery detection circuitry that automatically shuts down the 5V supply at approximately 7.5 to 8 Volts signal battery voltage. This prevents the system from attempting to operate when the input voltage is too low for proper operation and removes virtually all Genrakode II module loading from an already discharged signal battery. The input power to the filter boards comes from the module AAR B and N posts through the ON-OFF switch and the 5A fuse.

A.5.14. Relay Code Select Input Board (P/N 59473-830-01)

Function: Interface between relay circuitry at head blocks that selects codes to be transmitted by Genrakode II. Operates on relay contact closures.

Where Used:

- Control Point module

The Relay Code Select Input Board contains 16 vital input circuits (eight for the EAST, and eight for the WEST direction) by which codes 1 through 8 can be selected for transmission from the location. A code reference common AAR terminal (for each direction) supplies energy to an external relay selection network that selects the desired codes to be transmitted. Code 1 must be selected to enable transmission of any of the signal clearing codes. No more than three codes may be selected at one time, such as code 1, code 5 and code 4. Two signal clearing codes selected simultaneously inhibits any code transmission. The CPU "cycle checks" the Code Select board in such a manner that it can determine that only those codes which are indeed selected by the external relay circuitry are read as selected by the CPU.

Specifications:

Code select inputs - contact closure type:

	min.	nominal	max.
Voltage (DC):	12.1	12.5	12.9
Current (mA DC):	6	8	11

A.5.15. Series Overlay Board (P/N 59473-877-01)

Function: Detects the presence of the train in the vicinity of switchlock on the mainline (frequency = 13.8 kHz).

Where used:

- Switch Lock module

The board contains a 13.8 kHz transmitter and receiver combination. The transmitter generates the 13.8 kHz and drives a parallel tuned transformer (T1). The output of this tuned transformer is coupled to the transformer (T2) on the receiving side via a series tuned circuit (L1, C1) and the presence of the train. When the signal is received at the other side and has enough amplitude, it triggers a threshold detector whose output is sensed by the CPU. There is also an LED (CR1) on the board to indicate when the overlay circuitry has detected the presence of the train.

Three screw-on taps on the board compensate for the inductance of different lead lengths used; refer to Section 3 for Series Overlay adjustment procedures.

A.5.16. Searchlight Driver Board (P/N 59473-863-01, -02)

Function: Filament drive and check; mechanism drive; position check for 2 searchlight mechanisms.

Where Used:

- Intermediate module

Lamp filament drive and filament checking circuitry have the same configuration and operation as on the color light drive board. Two identical circuits are provided on this board for driving two different lamps with power requirements of up to 25 Watts each.

Two identical circuits are provided on this board for driving two different searchlight mechanisms from 200–1800 Ohms each. This design can handle a sustained short and can handle voltages applied across the outputs: up to 12VDC indefinitely, and up to 16VDC for 10 seconds.

Six vital input circuits are also provided, 3 for each mechanism, to read the mechanism position contacts.

The Group 2 differs from the Group 1 due to the added function of Cable Integrity Check (CIC). When two outputs are shorted together the data returned to the CPU is corrupted, making the short detectable. The trade-off for this added feature is that the circuit is now much less resistant to AC noise immunity. So in high-noise environments, the Group 1 board, which has very high AC noise immunity but no CIC function, is the solution.

To allow Cable Integrity Check to operate properly, it is necessary to make some application requirements. These requirements are not expected to impose any unreasonable constraints in most applications. These requirements are as follows:

1. Must use independent dropping resistors
2. Must keep cable resistance less than 0.2 Ohms (200 feet with #10 wire)
3. Must set each dropping resistor to provide between 9.5 and 10.5 Volts at each bulb (when ON)

Specifications:

Regulated Lamp

	min.	nominal	max.
Lamp Voltage (DC):	12.1	12.5	12.9
Lamp Wattage (W):	5	18	25

NOTE

Dropping resistors are required at the signal head (1 per lamp) to adjust each lamp voltage for 10 V DC.

NOTE

A maximum of 2 - 25 Watt bulbs can be simultaneously lit per direction (4 - 25 W bulbs max. per module).

NOTE

A maximum of 2 mechanisms can be simultaneously driven per direction (4 - mechanisms max. per module).

Regulated Mechanism

	min.	nominal	max.
Voltage (DC):	12.1	12.5	12.9
Coil Resistance (Ohms):	200	250	1800

Check Inputs

	min.	nominal	max.
Voltage (DC):	9.0	12.0	16.0
Current (mA DC):	6	10	13

A.5.17. Switch Lock I/O Board (P/N 59473-878-01)

Function: Contains circuitry to read switch lock inputs, outputs to drive three relays and one lamp output. Also this board contains jumpers for selecting unlock codes for EAST and WEST.

Where used:

- Switch Lock module

The Switch Lock I/O Board contains inputs and outputs to directly connect to electric lock mechanisms. Both inputs and outputs are isolated from the digital circuitry. Three inputs are used to bring the following into the Switch Lock Module: unlock request, remote overlay and NWP.

The unlock request input is referenced to 12V signal common. Applying +12V to this input indicates to the system of the request. LED CR11 is turned on when 12V is applied to the Unlock Request input.

The remote overlay input is used to sense track occupancy on the mainline; this input is isolated, and absence of energy indicates occupancy. When the remote overlay input is not going to be used, it should be connected to the signal battery terminals. When the remote overlay input is energized, the LED labeled CR14 is turned on.

The NWP input is tied to the switch controller; the Switch Lock Module expects this input to be energized when the switch is in correspondence. The NWP input is also isolated. LED CR13 is on when energy is applied. The CPU detects energy on one of these inputs when it is able to circulate data "through" that particular input.

The Switch Lock I/O Board contains three outputs used to drive relays with coil resistance of 50 ohms or more and 1 output used to drive a lamp of 25 watts. The three relay outputs are used to drive the lock relay coil, the remote overlay output, and the code 1 relay (optional). The LEDs labeled LR, OL, OT and LP correspond to LOCK RELAY, OVERLAY RELAY, OUTPUT RELAY and LAMP OUTPUT respectively.

The other section of the Switch Lock I/O Board contains jumpers to select unlock codes (UC) and lock codes (LC) for WEST and EAST directions. A jumper is required for each direction to select UC and LC codes. The jumper to select the unlock codes can be located in one of five locations labeled on the board as A, B, C, D, and E:

Jumper Setting	Unlock Codes Selected
A	8,2,3,4 or 7
B	2,3,4 or 7
C	3,4 or 7
D	4, or 7
E	7

LEDs on the board are controlled by the CPU to indicate the type of code received from the rails compared to the jumper setting. These LEDs are labeled on the board as WA, WB, EA, EB; and they are fully explained in Appendix B. This board also has an LED labeled ST that flashes when the short timer is running, and remains on when the short timer times out.

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B. APPENDIX B - CPU HARDWARE AND SOFTWARE

B.1. GENERAL

This section includes the following reference information:

- CPU Hardware and Software Reference
- Serial Port Modes and Commands
- Code T Reference

B.2. CPU HARDWARE AND SOFTWARE DETAILED REFERENCE

B.2.1. CPU Comm Port - RS232 Interface

The RS232 interface (board connector J2) on the board front edge serves three purposes:

- Downloading Application software to the PGK CPU (using Alstom Download program only).
- Accessing the PGK CPU System Commands for diagnostics and system configuration (using any terminal emulation software, including the Alstom Download program).
- Providing an RS-232 interface for a code system link using Data Train VIII or Genisys protocols. Contact an Alstom Sales Representative for application information if use of this capability is desired.

B.2.2. Board Jumpers

The following jumpers are the only ones that the user needs to be aware of:

- W5 - +5v power for use with Handheld Terminal (HHT), normally OUT
- W8 - Automatic restart enable, normally IN

B.2.3. CPU LED Indicators

The CPU card edge contains 19 LEDs in addition to the four seven-segment displays. These indicators are used to display system status and troubleshoot problems such as board failures, low CPU power, loss of external AC power, etc. A description of each indicator, as they appear on the board from top to bottom, is provided in Table B–1. See Figures A–9 through A–12 for CPU board LED indicators in normal mode, maintenance mode, and two code 5 always examples.

Table B–1. CPU LED Indicators

	LED	Indication
EAST	R CD5	lit when Code 5 is received from the EAST
	T CD5	lit when Code 5 is sent to the EAST
	T OCC	lit when EAST track circuit is occupied
	OUT A	Trouble Code receive in process
	OUT B	Trouble Code transmit in process
	INPUT	- lit steady when Trouble Code logged
	STICK	• flashing when WEST Approach Flag set • lit steady when EAST Stick picked
WEST	R CD5	lit when Code 5 is received from the WEST
	T CD5	lit when Code 5 is sent to the WEST
	T OCC	lit when WEST track circuit is occupied
	OUT A	Trouble Code receive in process
	OUT B	Trouble Code transmit in process
	INPUT	lit steady when Trouble Code logged
	STICK	flashing when EAST Approach Flag set lit steady when WEST Stick picked
SYSTEM	POR	lit when Aux I/O POR Input is de-energized (*)
	MFCTN	flashing when Error Queue contains one or more errors
	LOPWR	lit when 5 V supply is below 4.67 V
	RESET	lit when the PGK CPU is in reset
	POWER	lit when 5 V power is applied to the board

(*) The POR LED is lit when the POR Input is de-energized, but only after the Input has previously been energized.

B.2.4. CPU 7-Segment Displays

The 7-segment displays are used for several display modes and are controlled by Rocker Switch (S1) as described in the Sections 6.

B.2.5. Manual Reset

The PGK CPU can be reset by one of two methods: by 1) turning the module power OFF and then ON using the switch on the left side of the module or 2) pressing the reset switch on the bottom right side of the board (designated S2). When the CPU is reset, the 7-segment displays (from top down) spell out ‘P-UP’ for Power Up.

B.3. SERIAL PORT MODES AND COMMANDS

There are two available modes of operation when using an external terminal:

- Monitor mode
- PGK mode

B.3.1. Monitor Mode

The Monitor mode of operation is activated by applying power to the Genrakode II module and pressing the enter key when prompted. The monitor mode displays the prompt (MON>) and allow a limited number of diagnostic operations as shown below. Examples are shown for the commonly used commands only.

B.3.1.1. Monitor Mode Command Summary for Boot Loader Rev A [1.0] and Rev B (1.01]

```
Press 'D' to Display error queue
Press 'R' to view config Report
Press 'M' to use Memory monitor
```

Examples

Display Error Queue - ‘D’

```
MON> EQ: 02/10/97 15:06:45 Err#=A0
EQ: 02/10/97 15:06:45 Err#=60
EQ: 02/10/97 15:06:45 Err#=30
```

View Configuration Report - ‘R’

```
Application Documentation:

S/N             GK-0000-154
APP NAME
APP ID
COMPILE DATE    5 / 6 / 1999
COMPILE TIME    16:16:20
DESIGNER
CHECKER
REVISION LEVEL  1
SITE ID         100
press any key to continue...
Module Configuration:

MODULE CFG ID   29
AUX IO          1
DIRECTION       EAST AND WEST
```

```
CODE5 FMT (E/W) ALT/ALT
CODE 5 SND EAST USER DEFINED
CODE 5 SND WEST USER DEFINED
SIG TYPE EAST   SEARCHLIGHT
SIG TYPE WEST   SEARCHLIGHT
FLASH RATE      60
press any key to continue...

PGK CAA Software:

CAA VER NAME    1.54
DATE            05/06/99
PGK CAA #       40025-283-01
Copyright       ALSTOM, 1999
press any key to continue...

System Flash Configuration Report:
SYS VER NAME    Rel 1.13
DATE            04/30/99
PGK SYS SW#     40025-283-31[N]
Copyright       ALSTOM, 1999

Application Checksum = 0BFC

Program Checksum = 189E
```

Memory Monitor Mode – 'M'

The 'M' command is used for development testing only and is not required for field use.

B.3.1.2. Monitor Mode Command Summary for Boot Loader Rev C [1.02]

```
RPT - Display Configuration Report
DEQ - Display Error Queue
CEQ - Clear Error Queue
CHK - Display System Checksums and CRCs
MEM - Enter Memory Monitor Mode
```

See the PGK Mode discussion that follows for a description of these commands; these Monitor Mode commands are merely a subset of the PGK Mode commands.

Note: The 'MEM' command is used for development testing only and is not required for field use.

B.3.2. PGK Mode

The PGK (normal) mode of operation is entered when either the PC or HHT is connected to the CPU board and the Enter Key is not pressed when prompted. The CPU responds with the Programmable Genrakode Prompt as follows: PGK>. Commands to access various functions of the system may now be entered using upper or lower case letters. The functions with definitions and examples follow.

Upon startup the following should appear:

```
ALSTOM Programmable Genrakode
Boot Loader 1.02

Entering PGK.

ALSTOM PGK 04/30/99  (date is dependent on software version)
Initializing PGK
SysFLASH is AMD.
AppFLASH is Atmel.

(Enter ? for Command Summary)
PGK>
```

B.3.2.1. PGK Mode System Command Summary

```
(Enter ? for Command Summary)
PGK> ?

PGK Command Summary

RPT - Display Configuration Report
DVQ - Display Event Queue
CVQ - Clear Event Queue
DEQ - Display Error Queue
CEQ - Clear Error Queue
DAC - Display All Error Counters
CAC - Clear All Error Counters
DCE - Display Current Errors
CRC - Display System CRCs
RES - Display East Rx Code Statistics
RWS - Display West Rx Code Statistics
DC5 - Display Code 5 Format Settings
DD  - Display Date
DT  - Display Time
SD  - Set Date
ST  - Set Time
?T  - Display Code T Command Summary
??  - Display Advanced Command Summary




(Enter ? for Command Summary)
```

```
PGK> ??

PGK Advanced Command Summary

TDR - Toggle Time Display Resolution
DWW - Detect Wire-Wrap Signature of Module
RTD - Toggle Real-Time Display of Events
FEQ - Display First (oldest) Error Queue entry
FVQ - Display First (oldest) Event Queue entry
NEQ - Display Next (newer) Error Queue entry
NVQ - Display Next (newer) Event Queue entry
PEQ - Display Previous (older) Error Queue entry
PVQ - Display Previous (older) Event Queue entry
DEC - Display a particular Error Counter entry
CEC - Clear a particular Error Counter entry
C5  - Enter Code 5 Format Set Mode
AVQ - Display Event Queue entries After date,time
BVQ - Display Event Queue entries Before date,time
RVQ - Display Event Queue entries during date,time Range
DSA - Display Station Address for Code System Interface
SSA - Set Station Address for Code System Interface
MOD - Display the Genisys (Code System) Control Mode byte
TCS - Toggle Code System Message Output
CFR - Configure Lamp Filament Error Reporting
NVI - Display and/or Modify Non-Vital Input Parameters
NVU - Store Non-Vital Input Parameter State Changes

(Enter ? for Command Summary)
PGK> ?T

PGK Code T Command Summary

DTQ - Display Block Trouble Queue
CTQ - Clear Block Trouble Queue
TID - Display/Modify Code T Location ID
DTS - Display Code T Enable Settings
MTS - Modify Code T Enable Settings
MTX - Display/Modify Trouble Queue Expiration Time
TTI - Display Code T Transmit Intervals
MTC - Monitor Trouble Codes

Serial Commands
SO1 - Serial Data Out To VPI CH1
SO2 - Serial Data Out To VPI CH2
SI1 - Serial Data In From VPI CH1
SI2 - Serial Data In From VPI CH2
```

15 or 25 Bits

B.3.2.2. PGK Mode Command Examples

AVQ - Display Events After A Specified Date/Time

The Event Queue can contain many entries that take some time to display to the screen. To aid the user in displaying only those entries that occurred after a given date/time, the AVQ command is provided.

```
PGK> avq 10/04/00
EV: 10/04/00 09:08:06 E_TRK_OCC goes TRUE
EV: 10/04/00 09:08:06 W_TRK_OCC goes TRUE
EV: 10/04/00 09:08:06 POWER_UP goes TRUE
EV: 10/04/00 09:08:07 ECS_INCODE_1 goes TRUE
EV: 10/04/00 09:08:07 ECS_INCODE_2 goes TRUE
EV: 10/04/00 09:08:07 WCS_INCODE_1 goes TRUE
EV: 10/04/00 09:08:07 ECR_XMTCODE_1 goes TRUE
EV: 10/04/00 09:08:07 ECR_XMTCODE_2 goes TRUE
EV: 10/04/00 09:08:07 WCR_XMTCODE_1 goes TRUE
EV: 10/04/00 09:08:10 E_TXC2_SENT goes TRUE
EV: 10/04/00 09:08:10 W_TXC1_SENT goes TRUE

(Enter ? for Command Summary)
PGK> avq 10/04/00,08:00
EV: 10/04/00 09:08:06 E_TRK_OCC goes TRUE
EV: 10/04/00 09:08:06 W_TRK_OCC goes TRUE
EV: 10/04/00 09:08:06 POWER_UP goes TRUE
EV: 10/04/00 09:08:07 ECS_INCODE_1 goes TRUE
EV: 10/04/00 09:08:07 ECS_INCODE_2 goes TRUE
EV: 10/04/00 09:08:07 WCS_INCODE_1 goes TRUE
EV: 10/04/00 09:08:07 ECR_XMTCODE_1 goes TRUE
EV: 10/04/00 09:08:07 ECR_XMTCODE_2 goes TRUE
EV: 10/04/00 09:08:07 WCR_XMTCODE_1 goes TRUE
EV: 10/04/00 09:08:10 E_TXC2_SENT goes TRUE
EV: 10/04/00 09:08:10 W_TXC1_SENT goes TRUE

(Enter ? for Command Summary)
PGK> avq 10/04/00,10:00
EV: No Entries Found Matching Display Criteria.
```

BVQ - Display Events Before A Specified Date/Time

The Event Queue can contain many entries that take some time to display to the screen. To aid the user in displaying only those entries that occurred before a given date/time, the BVQ command is provided.

```
PGK> bvq 10/04/00
EV: 10/04/00 09:08:10 W_TXC1_SENT goes TRUE
EV: 10/04/00 09:08:10 E_TXC2_SENT goes TRUE
EV: 10/04/00 09:08:07 WCR_XMTCODE_1 goes TRUE
EV: 10/04/00 09:08:07 ECR_XMTCODE_2 goes TRUE
EV: 10/04/00 09:08:07 ECR_XMTCODE_1 goes TRUE
EV: 10/04/00 09:08:07 WCS_INCODE_1 goes TRUE
EV: 10/04/00 09:08:07 ECS_INCODE_2 goes TRUE
EV: 10/04/00 09:08:07 ECS_INCODE_1 goes TRUE
EV: 10/04/00 09:08:06 POWER_UP goes TRUE
EV: 10/04/00 09:08:06 W_TRK_OCC goes TRUE
EV: 10/04/00 09:08:06 E_TRK_OCC goes TRUE
EV: 10/03/00 16:52:58 WDO_OUTCODE_7 goes TRUE
EV: 10/03/00 16:52:58 WCR_RECCODE_1 goes FALSE
EV: 10/03/00 16:52:58 WCR_RECCODE_7 goes TRUE
EV: 10/03/00 16:52:47 WDO_OUTCODE_1 goes TRUE
EV: 10/03/00 16:52:47 EDO_OUTCODE_1 goes TRUE

(Enter ? for Command Summary)
PGK> bvq 10/04/00,09:00
EV: 10/03/00 16:52:58 WDO_OUTCODE_7 goes TRUE
EV: 10/03/00 16:52:58 WCR_RECCODE_1 goes FALSE
EV: 10/03/00 16:52:58 WCR_RECCODE_7 goes TRUE
EV: 10/03/00 16:52:47 WDO_OUTCODE_1 goes TRUE
EV: 10/03/00 16:52:47 EDO_OUTCODE_1 goes TRUE
EV: 10/03/00 16:52:47 WCR_RECCODE_1 goes TRUE
EV: 10/03/00 16:52:47 ECR_RECCODE_1 goes TRUE
```

CAC - Clear All Error Counters

Description: Error Counters keep track of the number of times an error code has been logged. Clear all of the counters with this command.

```
PGK> cac
EC: ALL ERROR COUNTERS CLEARED
```

C5 - Change Code 5 Format Settings

Description: The Code 5 Format can be field-selectable as Standard, Alternating, and Long Code 5. Modify the current settings with this command.

```
PGK> c5
  CODE 5 CONFIGURATION MENU
  ENTER EAST (RIGHT) TRACK SETTINGS
  1 = Standard
  2 = Alternating
  3 = Long
  Enter setting> 1
  ENTER WEST (LEFT) TRACK SETTINGS
  1 = Standard
  2 = Alternating
  3 = Long
  Enter setting> 1
Code 5 Mode settings were not changed.
```

CEC - Clear Error Counter (specify upper-case HEX error code to clear specific counter)

Description: Error Counters keep track of the number of times an error code has been logged. Clear an individual counter with this command.

```
PGK> cec FF
EC: FF ERROR COUNTER CLEARED
```

CEQ - Clear All Entries In Error Queue

Description: The Error Queue is a list of logged system errors. Clear the list with this command.

```
PGK> ceq
EQ: QUEUE IS EMPTY
```

CFR – Configure Filament Error Reporting

Description: Open filaments are logged as system errors. However, if a lamp or an entire head is not present at a given location, use this command to configure the system to not report that “open” filament as an error.

```
PGK> cfr



<< Filament Configuration Mode >>

East Colorlight Configuration

A Head Green Filament Error Reporting is: ENABLED.  Change it?(Y/N): n
A Head Yellow Filament Error Reporting is: ENABLED.  Change it?(Y/N): n
A Head Red Filament Error Reporting is: ENABLED.  Change it?(Y/N): n
B Head Green Filament Error Reporting is: ENABLED.  Change it?(Y/N): n
B Head Yellow Filament Error Reporting is: ENABLED.  Change it?(Y/N): n
B Head Red Filament Error Reporting is: ENABLED.  Change it?(Y/N): n

West Colorlight Configuration

A Head Green Filament Error Reporting is: ENABLED.  Change it?(Y/N): n
A Head Yellow Filament Error Reporting is: ENABLED.  Change it?(Y/N): n
A Head Red Filament Error Reporting is: ENABLED.  Change it?(Y/N): n
B Head Green Filament Error Reporting is: ENABLED.  Change it?(Y/N): n
B Head Yellow Filament Error Reporting is: ENABLED.  Change it?(Y/N): n
B Head Red Filament Error Reporting is: ENABLED.  Change it?(Y/N): n

Filament Error Reporting settings were not changed.
```

CTQ - Clear Entire Block Trouble Queue

The Block Trouble Queue is a list of Trouble Codes received at that location. Clear the list with this command.

```
PGK> ctq
TQ: QUEUE IS EMPTY
```

CVQ - Clear All Entries In Event Queue

The Event Queue is a list of system events, such as changes to the states of inputs, outputs, and other parameters. Clear the list with this command.

```
PGK> cvq
VQ: QUEUE IS EMPTY
```

DAC - Display All Error Counters

Error Counters keep track of the number of times an error code has been logged. Display all of the counters with this command.

```
PGK> dac
EC: Searching...,
EC: Err#=22 Cnt=00004 ESL A Filament Failure
EC: Err#=23 Cnt=00006 ESL B Filament Failure
EC: Err#=30 Cnt=00003 East CLD Failure
EC: Err#=52 Cnt=00004 WSL A Filament Failure
EC: Err#=53 Cnt=00004 WSL B Filament Failure
EC: Err#=60 Cnt=00003 West CLD Failure
```

DC5 - Display Code 5 Format Settings

The Code 5 Format can be field-selectable as Standard, Alternating, and Long Code 5. Display the current settings with this command.

```
PGK> dc5
<<< CODE 5 FORMAT SETTINGS >>>
EAST (RIGHT) TRACK SETTING: STANDARD
WEST (LEFT)  TRACK SETTING: STANDARD
```

DCE - Display Current Errors

Use this command to determine if an error in the Error Queue is currently true or if the condition that caused it to be logged is no longer present.

```
PGK> dce
EC: Err#=30 East CLD Failure
EC: Err#=60 West CLD Failure
EC: Err#=A0 AUX I/O Failure
```

DEC - Display Error Counter (specify upper-case HEX error code to display specific counter)

Error Counters keep track of the number of times an error code has been logged. Display an individual counter with this command.

```
PGK> dec FF
EC: Err#=FF Cnt=00000 Initialization Failure
```

DEQ - Display Entire Error Queue

The Error Queue is a list of logged system errors. Display the list with this command.

```
PGK> deq
EQ: 02/10/97 15:06:45 Err#=A0 AUX I/O Failure
EQ: 02/10/97 15:06:45 Err#=60 West CLD Failure
EQ: 02/10/97 15:06:45 Err#=30 East CLD Failure
```

DTS - Display Code T Enable Settings

The DTS command displays the Code T mode settings relevant to the module type. The settings are modified with the MTS command.

Example (for an Intermediate or Repeater – see Note below):

```
PGK> dts

Code T East Track Operation: ENABLED
Code T West Track Operation: ENABLED

Trouble Code 1 Parameter: ENABLED
Trouble Code 2 Parameter: ENABLED
Trouble Code 3 Parameter: ENABLED
Trouble Code 4 Parameter: ENABLED

Code T Initiate East: ENABLED
Code T Initiate West: ENABLED

Code T Repeat East: DISABLED
Code T Repeat West: DISABLED
```

Note: For a Control Point, only the first two settings are displayed as the others are not defined for the Control Point. Also, for the Intermediate and Repeater, if both Code T track operation settings are disabled, no other settings are displayed.

DTQ - Display Entire Block Trouble Queue

Description: The Block Trouble Queue is a list of Trouble Codes received at that location. Display the list with this command.

```
PGK> dtq
TQ: 12/06/00 09:42:57.40 East received Location ID: 7, Trouble Code: 4
TQ: 12/06/00 09:41:31.00 West received Location ID: 22, Trouble Code: 1
```

DVQ - Display All Entries In Event Queue

The Event Queue is a list of system events, such as changes to the states of inputs, outputs, and other parameters. Display the list with this command.

```
PGK> dvq
EV: 02/10/97 10:41:56 LLM_RCVR001D goes TRUE
EV: 02/10/97 10:41:56 LLM_RCVR0016 goes TRUE
EV: 02/10/97 10:41:56 W_TX_C4_CONT goes TRUE
EV: 02/10/97 10:41:56 IOCOUT_E_CLGHT_B_RED_DR goes TRUE
```

MTC – Monitor Trouble Codes

Use this command to display a cycle-by-cycle view of a Code T transmission or reception. For each cycle of the Code T message, the cycle number and whether that cycle is a Mark (M) or a Space (S) is displayed.

```
PGK> mtc
  SELECT CODE T COUNT TO DISPLAY

  1 = East RX
  2 = East TX
  3 = West RX
  4 = West TX
  Enter setting> 4

Location ID: 1, Trouble Code: 1
W TX:1 M
W TX:2 M
W TX:3 S
W TX:4 S
W TX:5 S
```

MTS - Modify Code T Enable Settings

The MTS command steps the user through each Code T mode settings relevant to the module type and allows ENABLE/DISABLE selection. If any settings are changed, the user is notified that the PGK CPU must reset to apply the changes and given a chance to cancel.

MTX - Display/modify Code T Expiration Time

The MTX command allows display and modification of the Trouble Queue Expiration Time. The default value when Code T is enabled for an application in the PGKCAA is 0, which is interpreted as ‘NEVER’. The Expiration Time can be set between 1 and 96 hours, in one hour steps, or to NEVER where Block Trouble Queue entries can only be removed with the CTQ command. If the Expiration Time is set to a value between 1 and 96 hours, the value defines the period of time that an entry stays in the Queue before being deleted automatically. Note: If a Trouble Code is continuously being received at a location (due to a non-intermittent trouble condition at another module), a new Queue entry with the same Trouble Code is logged within one frame period (approximately 84 seconds) after the previous entry is deleted.

```
PGK> mtx
Block Trouble Queue Entry Expiration Time = NONE

Do you wish to permanently change the Expiration Time?
   Press Y to proceed or N to cancel (Y/N) >n
```

NVI – Display/modify Non-Vital Inputs

16 non-vital inputs to the system are provided that can be changed via the serial interface. Use this command to display/modify the states of all 16.

```
PGK> nvi

NVI: (16) FFFF FFFF FFFF FFFF (1)

(Enter ? for Command Summary)
PGK> nvi 1 t

NVI: (16) FFFF FFFF FFFF FFFT (1)

(Enter ? for Command Summary)
PGK> nvi 1 f

NVI: (16) FFFF FFFF FFFF FFFF (1)
```

NVU – Update Non-Vital Inputs to Non-Volatile Memory

16 non-vital inputs to the system are provided that can be changed via the serial interface. Changes made to the states of these inputs are not updated in non-volatile memory, which means that the changes are lost upon module reset. Use this command to update the states of these inputs in non-volatile memory.

```
 (Enter ? for Command Summary)
PGK> nvu

Current Non-Vital Input States will be updated to non-volatile memory.

PGK must RESET to use the new settings.
   Press Y to proceed or N to cancel.
CONFIRM (Y/N) >n
```

RVQ - Display Events During A Specified Date/Time Range

The Event Queue can contain many entries which take some time to display to the screen. To aid the user in displaying only those entries that occurred during a given date/time range, the RVQ command is provided.

```
PGK> rvq 10/03/00,16:45 10/03/00,16:48
EV: 10/03/00 16:45:24 W_TRK_OCC goes TRUE
EV: 10/03/00 16:45:24 WCR_RECCODE_7 goes FALSE
EV: 10/03/00 16:45:25 WDO_OUTCODE_1 goes FALSE
EV: 10/03/00 16:45:25 WDO_OUTCODE_7 goes FALSE
EV: 10/03/00 16:45:47 W_TRK_OCC goes FALSE
EV: 10/03/00 16:45:47 WCR_RECCODE_1 goes TRUE
EV: 10/03/00 16:45:48 WDO_OUTCODE_1 goes TRUE
EV: 10/03/00 16:45:53 WCR_RECCODE_8 goes TRUE
EV: 10/03/00 16:45:53 WCR_RECCODE_1 goes FALSE
EV: 10/03/00 16:45:53 WDO_OUTCODE_8 goes TRUE

(Enter ? for Command Summary)
PGK> rvq 10/03/00,16:50 10/04/00
EV: 10/03/00 16:52:39 E_TRK_OCC goes TRUE
```

```
EV: 10/03/00 16:52:39 W_TRK_OCC goes TRUE
EV: 10/03/00 16:52:39 POWER_UP goes TRUE
EV: 10/03/00 16:52:40 ECS_INCODE_1 goes TRUE
EV: 10/03/00 16:52:40 ECS_INCODE_2 goes TRUE
EV: 10/03/00 16:52:40 WCS_INCODE_1 goes TRUE
EV: 10/03/00 16:52:40 ECR_XMTCODE_1 goes TRUE
EV: 10/03/00 16:52:40 ECR_XMTCODE_2 goes TRUE
EV: 10/03/00 16:52:40 WCR_XMTCODE_1 goes TRUE
EV: 10/03/00 16:52:43 W_TXC1_SENT goes TRUE
EV: 10/03/00 16:52:43 E_TXC2_SENT goes TRUE
EV: 10/03/00 16:52:46 W_TRK_OCC goes FALSE
EV: 10/03/00 16:52:46 E_TRK_OCC goes FALSE
EV: 10/03/00 16:52:47 ECR_RECCODE_1 goes TRUE
EV: 10/03/00 16:52:47 WCR_RECCODE_1 goes TRUE
EV: 10/03/00 16:52:47 EDO_OUTCODE_1 goes TRUE
EV: 10/03/00 16:52:47 WDO_OUTCODE_1 goes TRUE
EV: 10/03/00 16:52:58 WCR_RECCODE_7 goes TRUE
EV: 10/03/00 16:52:58 WCR_RECCODE_1 goes FALSE
EV: 10/03/00 16:52:58 WDO_OUTCODE_7 goes TRUE
EV: 10/04/00 09:08:06 E_TRK_OCC goes TRUE
EV: 10/04/00 09:08:06 W_TRK_OCC goes TRUE
EV: 10/04/00 09:08:06 POWER_UP goes TRUE
EV: 10/04/00 09:08:07 ECS_INCODE_1 goes TRUE
EV: 10/04/00 09:08:07 ECS_INCODE_2 goes TRUE
EV: 10/04/00 09:08:07 WCS_INCODE_1 goes TRUE
EV: 10/04/00 09:08:07 ECR_XMTCODE_1 goes TRUE
EV: 10/04/00 09:08:07 ECR_XMTCODE_2 goes TRUE
EV: 10/04/00 09:08:07 WCR_XMTCODE_1 goes TRUE
EV: 10/04/00 09:08:10 E_TXC2_SENT goes TRUE
EV: 10/04/00 09:08:10 W_TXC1_SENT goes TRUE
```

SD/ST - Setting The Real Time Clock

Description: The Programmable Genrakode CPU board contains a real time clock to aid in the analysis of failures or events. To set the time and date, type the following from the PGK prompt:

```
PGK>ST hh:mm:ss
PGK>SD mm/dd/yy
```

where:

hh	= hour (in 24 hour format)
mm	= minute
ss	= second
mm	= month of the year
dd	= day of the month
yy	= year

TDT - Terminal Display Toggle

Description: If the Hand Held Terminal is used, function TDT must be entered as the first command to prevent loss of information due to the small display size. In addition to the error queue, an area in the Genrakode II memory is dedicated to saving information concerning activity such as signal activation, track occupancy, etc. This information is contained in the Event Queue and is accessed using the "xVx" commands. Both Queue's are structured as LIFO (Last In First Out). This means that when viewing either the Event or Error queue, the first information printed on the terminal screen is the last event or error to occur. Programmable Genrakode II also provides the ability to analyze the total number of errors that have occurred in a period of time. This is accomplished through the use of the error count commands listed.

```
PGK> tdt
Display Type = HHT
PGK> tdt
Display Type = PC
```

TID - Display/modify Code T Location ID

The TID command allows display and modification of the Code T Location ID for a module. The default value when Code T is enabled for an application in the PGKCAA is 0. A Location ID of 0 disables Code T since the valid range of ID's is 1 to 27. All the modules in a Code T-enabled block must have unique Location ID's or it is impossible to isolate Trouble Codes to one location.

```
PGK> tid
Code T Location ID = 7

Do you wish to permanently change the LocationID?
   Press Y to proceed or N to cancel (Y/N) >n
```

TTD – Toggle Code T Debug Mode

The Block Trouble Queue is a list of Trouble Codes received at that location. With the Code T Debug mode disabled, only the first of given Trouble Code (with Location ID) is logged – any subsequent reception of the same code is not logged. To enable the logging of every reception, regardless of duplicates, use this command.

```
PGK> ttd

Code T Debug Mode = ENABLED

(Enter ? for Command Summary)
PGK> ttd

Code T Debug Mode = DISABLED
```

TTI – Display/modify Code T Transmit Intervals

Trouble Codes can be sent continuously (if all conditions are met to set a particular Trouble Code true), or they can be sent only once every given number of minutes/hours. The available range for the transmit interval is 3 minutes to 24 hours. Use this command to display/modify the transmit intervals for each Trouble Code.

```
PGK> tti

Trouble Code 1:  6 minutes
Trouble Code 2:  CONTINUOUS
Trouble Code 3:  CONTINUOUS
Trouble Code 4:  CONTINUOUS
Trouble Code 5:  CONTINUOUS
Trouble Code 6:  CONTINUOUS
Trouble Code 7:  CONTINUOUS
Trouble Code 8:  CONTINUOUS

Do you wish to permanently change any Transmit Intervals?
   Press Y to proceed or N to cancel (Y/N) >n
```

B.4. DOWNLOADING AN APPLICATION TO THE PGK CPU

After the Application HEX file has been successfully generated and verified by the PGKCAA, it can be downloaded.exe). This is a Windows™ application provided with the PGKCAA installation package and, like the PGKCAA, is compatible with Windows95™, Windows98™, and WindowsNT™ 4.0.

B.4.1. Running the Download Utility

On the PC, there are two ways to start the Download utility:

- Launch the utility from within the PGKCAA by selecting Tools->Download Hex File from the pull-down menu (if an application is currently open in the PGKCAA, that application is automatically opened by Dloadwin).
- Double-click on the Dloadwin.exe file from a File Explorer window (or select from the Windows™ Start menu). The program should start and display a window similar to Figure B–1.

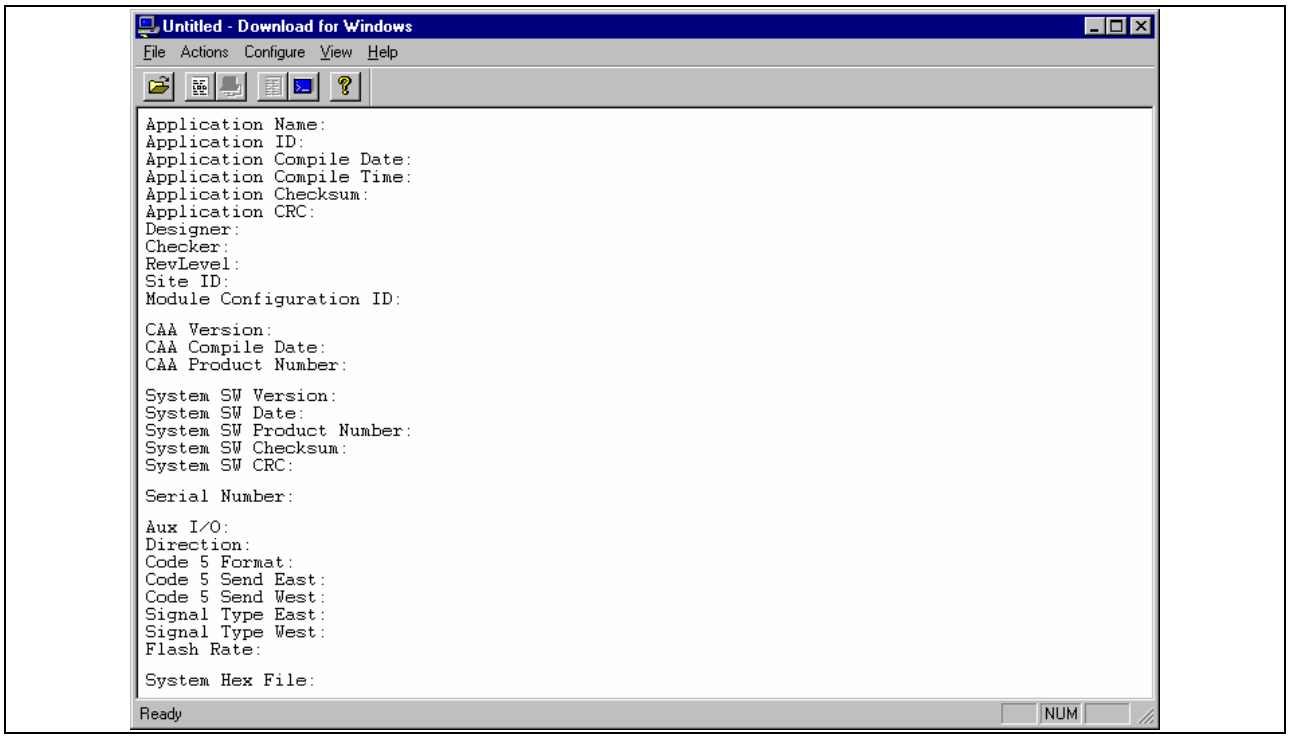

Figure B–1. Dloadwin (File Mode)

The Dloadwin utility requires the use a serial port on the PC for the serial data connection to the PGK CPU board, and defaults to COM1. If the serial data connection to the PGK CPU board uses a port other than COM1, it is necessary to change the COM Port setting in Dloadwin to match the port being used. Figure B–2 shows the pull-down menu selection to change the COM Port setting.

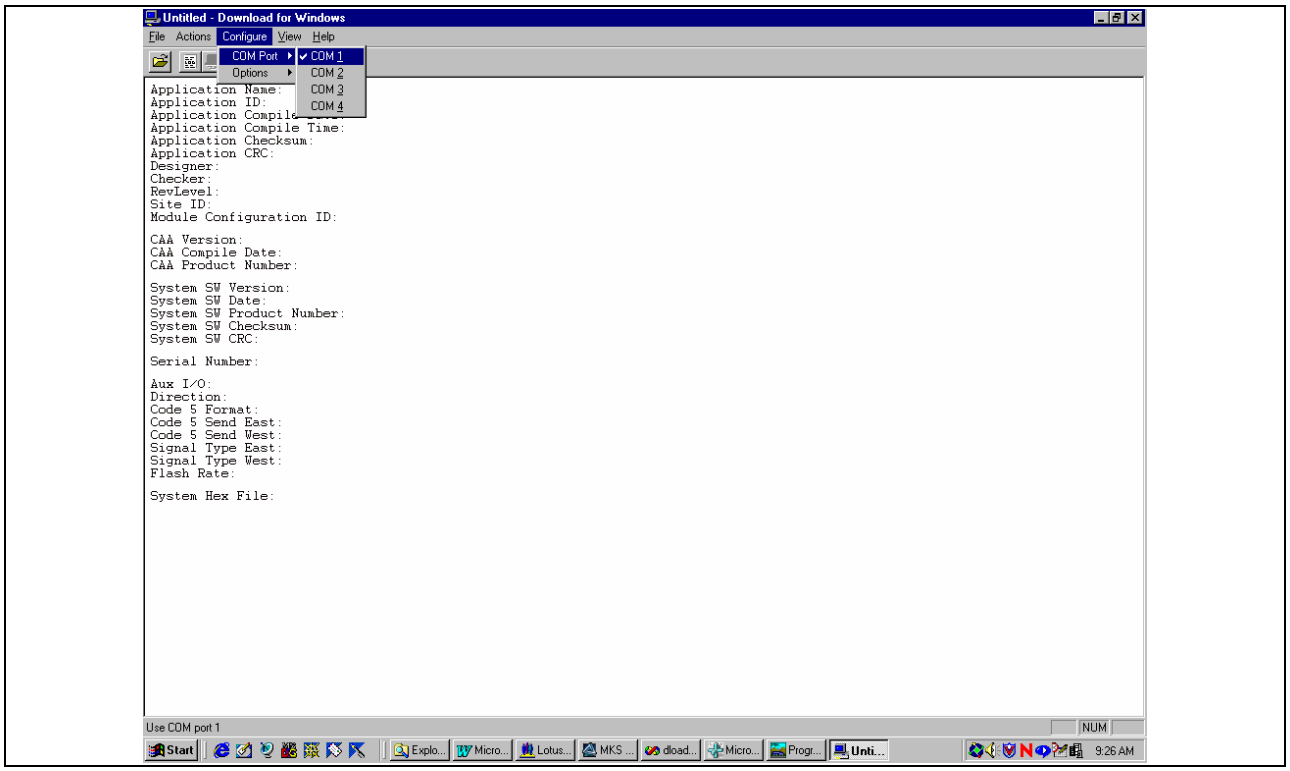

Figure B–2. COM Port Setting Change

Connect a null modem serial cable between the appropriate serial port on your PC and the DB9 serial port connector on the front edge of the PGK CPU board. See Figure A–9 for serial port location and Section 6, Heading 6.3. for serial port use.

Apply power to the module. The PGK CPU board should display ‘P-UP’ on its card edge LED display to indicate the Power-up sequence, which takes around 20 sec to complete, has begun. The Power-up sequence completes with one of three possible results:

1. The module enters normal operation (with VPC board LED(s) lit) if the PGK CPU already contains valid application and system software and the hardware configuration (including module wire-wrap signature) is valid.

2. The module enters Programming mode and display ‘Prog’ on its card edge LED display, indicating that the on-board application and/or system software is invalid or missing and needs to be downloaded to the board.

   NOTE:

   This is the normal condition when downloading to a new (unprogrammed) PGK CPU board for the first time.

3. The module attempts to enter normal operation but then automatically resets, displays ‘P-UP’, and re-runs the Power-up sequence. This ‘reset loop’ indicates that application and system software are present but some necessary condition is not being met to allow the module to enter normal operation. This could include a mismatch between application and system software versions on the PGK CPU board, an incorrect complement of I/O boards, or an incorrect module wire-wrap signature.

If cases 1 or 2 occur, go to “Starting the Download Process” to begin the download process. If case 3 occurs, go to “Establishing Communications Prior to Download”.

B.4.2. Establishing Communications Prior to Download

When the PGK module is in a reset loop, it is necessary to manually interrupt the loop to enable communications with the PC prior to downloading software to the PGK CPU. Switch from the File mode to the Terminal mode of the Dloadwin utility by selecting **Actions->Terminal Mode** from the pull-down menu. During each Power-up attempt, several lines are written to the terminal screen, similar to Figure B–3. One of the first lines to be displayed is “Press <Enter> now to use Monitor”. This is displayed only for a few seconds in each Power-up sequence to give the user a chance to interrupt the reset loop and enter the Monitor mode. Press <Return> **as soon as** this message is displayed on the screen. If <Return> is pressed in time, the reset loop is interrupted, ‘Prog’ is displayed on the PGK CPU card edge display, and the MON> prompt appears in the terminal window. The Monitor mode (indicated by the PGK CPU displaying the MON> prompt in the terminal window) is the mode from which software download can begin. Now go to “Starting the Download Process” to begin the download process.

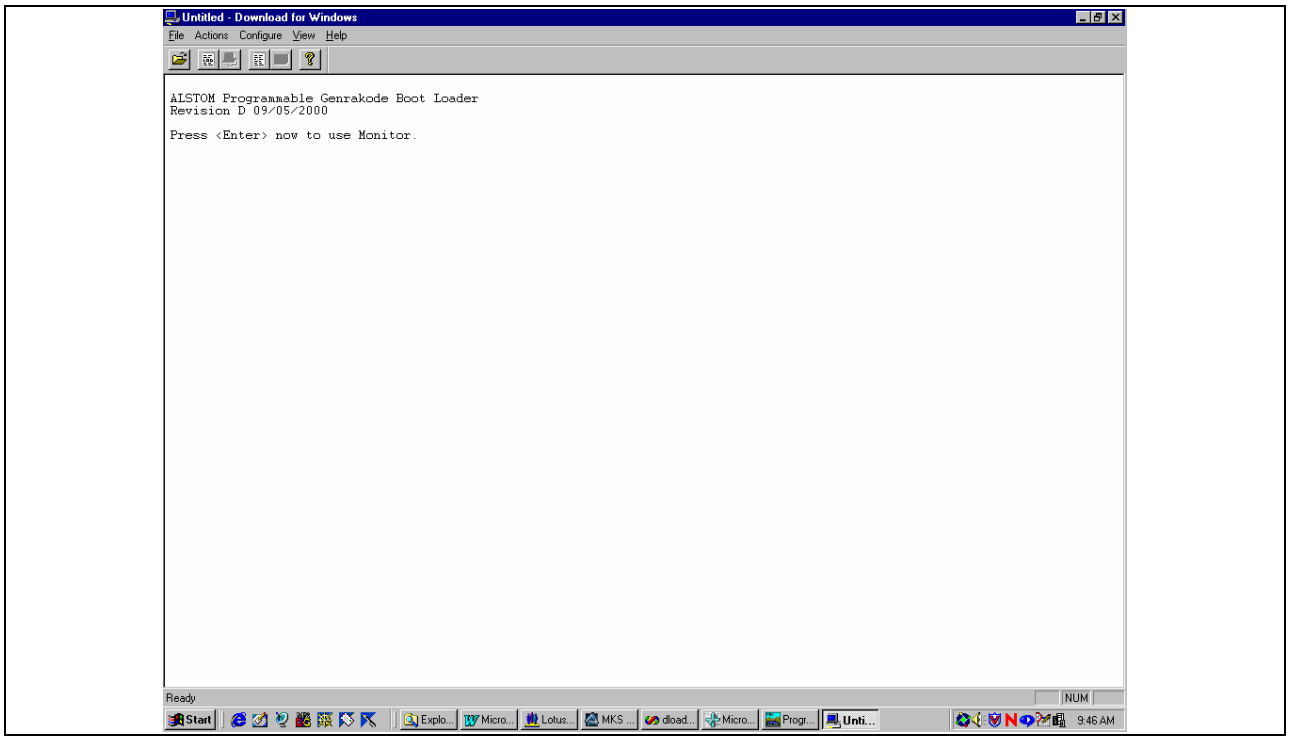

Figure B–3. Dloadwin (Terminal Mode)

B.4.3. Starting the Download Process

The Dloadwin utility automates most of the steps necessary to download application software (and system software, if required) to the PGK CPU board. To initiate download of an application, Dloadwin must be in the File Mode (if currently in Terminal Mode, switch to the File Mode by selecting **Actions->Terminal Mode** from the pull-down menu). Open the application HEX file to be downloaded (if the file is not already opened) by selecting **File->Open** from the pull-down menu.

NOTE

The System Software HEX file required by the Application HEX file **must** be present in the same directory as the application HEX file. Or else an error message is displayed stating that the program "Cannot open System HEX file, 402833XX.HEX", where the two X's in the filename vary depending on the software version. If this occurs, manually move this file to the directory containing the application HEX file and start again.

If the Application HEX file is successfully loaded, the File Mode window of Dloadwin is updated with application information loaded from the HEX file. See Figure B–4 for an example.

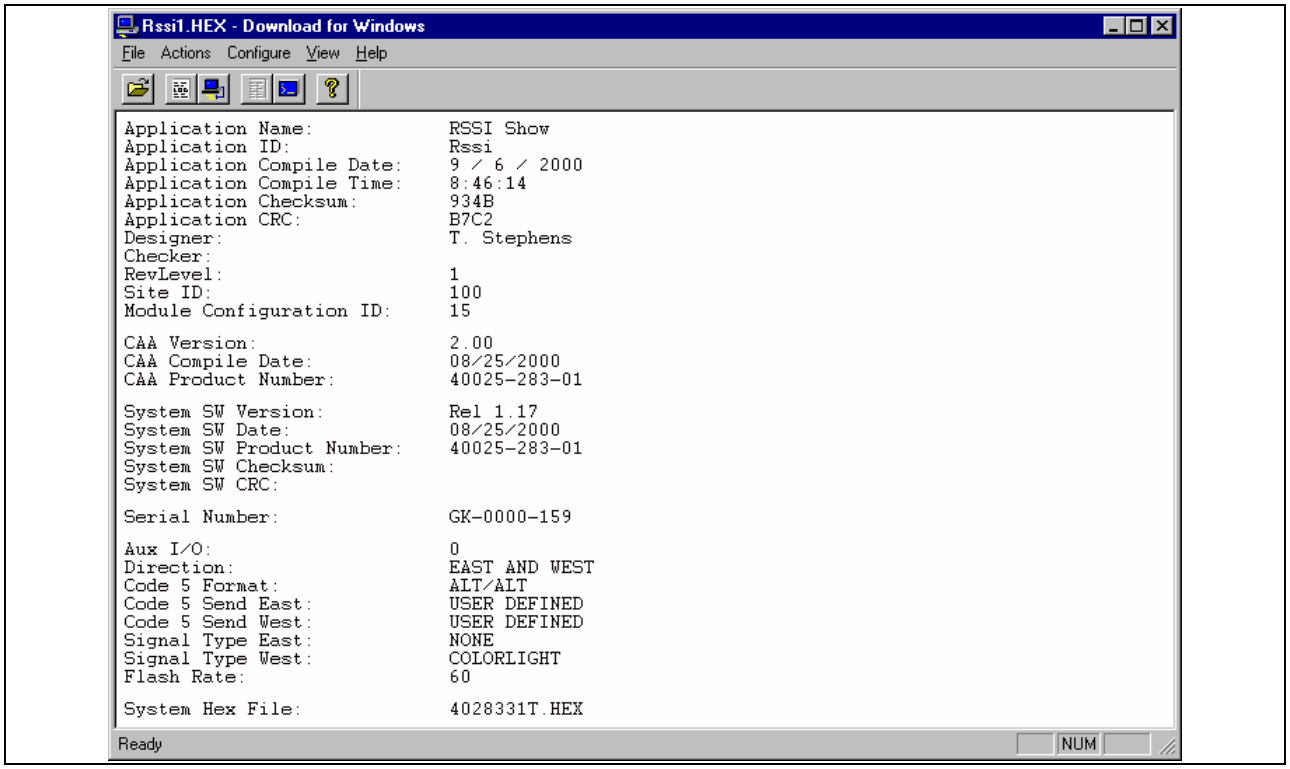

Figure B–4. File Mode with application loaded

Begin the download process by selecting **Actions->Download** from the pull-down menu (or clicking the Download button). A Status Window appears which provides step-by-step status of the download process and reported its progress in a bar graph format (see Figure B–5).

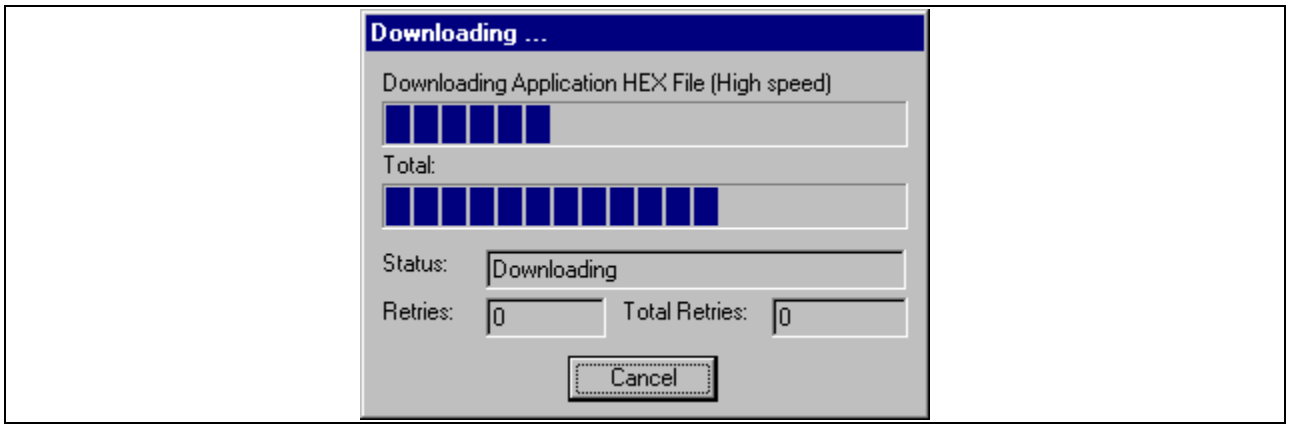

Figure B–5. Status Window During Download

The steps in the download process are listed below, in sequential order. The words in quotations are those which appear at the top of the Status Window as the download progresses:

1. “Establishing connection” sends commands to the PGK CPU to prepare the system for download.

2. “Querying Software Versions on the PGK CPU” prompts the Genrakode™ module for its system software version information. If the version information reported by the PGK CPU does not match the version required by the application, a warning is displayed. Abort or continue the download, thereby authorizing the replacement of the system software. The application cannot run unless the system software is replaced. The download program enforces compliance between the system software and the application's .HEX file. If the system software version on the PGK CPU board does not comply with the application .HEX file and continue is chosen, then the download program erases the existing system

3. "Erasing application memory” erases any application that is currently installed on the PGK CPU board.

4. "Erasing system memory" erases any system software that is currently installed on the PGK CPU board. Note: This step is only performed if the system software version on-board is not correct for the Application HEX file being downloaded.

5. "Speeding up communication" increases the baud rate on the serial line from 1200 baud to either 19.2 kbaud or 115 kbaud (depending on PGK CPU version) to maximize data download speed.

6. "Downloading Application HEX File" sends the currently-selected application HEX file to the PGK CPU, which stores this applications on the Application Flash memory IC (U12).

7. "Downloading System HEX File", if required, sends the version of system software required by the selected application to the PGK CPU board, which stores this applications on the System Flash memory IC (U15).

When the process is complete, the Application and System Software checksum values (and CRCs if supported by the PGK CPU version) are displayed in the Status window, and a command is sent to the PGK CPU board to reset and enter the normal operating mode.

B.5. CODE T REFERENCE

The Genrakode II Code T mode allows transmission of specific Trouble Code indications from Genrakode II Intermediate, Repeater, and Switch Lock modules in a block to Genrakode II Control Points at the ends of the block. Each module in the block is assigned unique Trouble Code indications (up to eight per location) which can be transmitted to alert maintenance personnel to such conditions as failed lamp filaments, loss of commercial power, stuck searchlight signal mechanisms, and other problems. It can also be used to continuously provide positive indications from the modules in a block to verify normally present inputs. Unlike a single, generic maintenance code, the Code T mode provides specific information on the location and nature of events requiring maintenance action. All Genrakode II modules in the block store the Trouble Codes received from other modules in the block and these Trouble Codes can be accessed at any module through the PGK CPU serial port interface. Trouble Code information received at the Control Points can also be transmitted to the control office through various means.

Use of Code T requires all modules in a contiguous section of a block to be Genrakode II modules with appropriate software versions and enable settings – the mode is not compatible with conventional Genrakode, PGK without Code T enabled, or other manufacturer's equipment. Code T operation can be enabled or disabled for an application program through the PGKCAA (PC-based application development tool), as well as enabled or disabled in the field through the serial port interface.

Code T, like Code 5, is not a standalone code but can be encoded on all standalone codes except Code 6. Trouble Code information is encoded using Code T in a multi-cycle frame. The number of code cycles required to transmit one frame is based on the number of track circuits in a block this mode can support (currently 28) and the number of unique Trouble Codes per location (selectable between 4 and 8).

Only properly configured PGK Intermediate, Repeater, and Switch Lock modules can transmit Trouble Codes. If all Code T mode enables are set True, a Trouble Code is transmitted by a module when either of the following conditions are met:

- One of the module’s trouble code parameters is set True by the application logic. This trouble code is sent in both directions (unless otherwise configured).

- A Trouble Code is received from an adjacent module. This trouble code is not sent in both directions; it is only repeated. If the code received on the East, it is transmitted to the West.

If the track circuit drops for even a single Genrakode cycle while a Trouble Code is being sent, both ends of the circuit reset their Code T processes:

- the transmitting end waits until the track is up again to restart the same Trouble Code that was interrupted
- the receive end ignores the incomplete Trouble Code frame and waits for another valid frame to begin

When any module (including Control Point) receives a complete and valid Trouble Code frame, that Trouble Code is logged to the module's Block Trouble Queue. For Intermediate, Repeater, and Switch Lock modules, that specific Trouble Code is also queued up for transmit on the other track if the repeating function for that direction is enabled.

Several serial port commands are available to configure Code T operation and display Trouble Code information, as discussed earlier in this section.

B.5.1. Code T Advantages

Prior to Code T, railroads generally had no remote access to data at modules other than Control Points. If a railroad desires access to maintenance-related information at every module in a pulse coded signaling system, the railroad must install telephone lines or data radios at every module to relay this information back to the control office. This may be prohibitively expensive for most railroads. In fact, the development of pulse coded signaling systems using the rails as a transmission medium occurred precisely to enable the railroads to eliminate the pole-line previously run to every signaling module to carry vital and non-vital signaling information.

The major advantage of Code T is that maintenance-related data (or any other non-vital information) can now be conveyed to/from any module using the same transmission medium (the rails) as the pulse coded vital signaling codes. This data can therefore be sent to the Control Points where a communication link to the central control office already exists. Since this new communication capability takes advantage of an existing transmission medium and existing hardware (the current signaling system), the cost to utilize this new capability is minimal.

With Code T, if any module in the block experiences a system fault, such as a failed signal lamp filament, the module transmits data which uniquely identifies both the location and nature of the fault to one or both of its adjacent modules. This is logged and repeated as necessary by other modules until the data reaches a Control Point, at which time this data can be relayed to the control office, providing the exact location and nature of the fault. This can allow much faster alerting and dispatching of maintenance personnel to correct the fault and minimize train delays. In many cases, it may allow a problem to be detected and corrected before it results in train delays.

B.5.2. Background

Pulse coded railroad signaling systems using the rails as a transmission medium were originally developed to provide vital (fail-safe) control of the signaling system without the use of traditional pole line, which railroads found increasingly expensive and inconvenient to maintain. These systems are composed of various transceiver stations or modules at opposite ends of track circuits (discrete sections of track electrically isolated by insulated joints – typically one to three miles in length), an example of which is shown in Figure B–6. Each module is located on the boundary of two track circuits defined by the insulated joints (see Figure B–7). These modules exchange electrical signals through the track circuit in a time sharing mode with a fixed cycle time (typically 2.8 seconds). Communication is bi-directional, where Module 1 may transmit for 1.4 seconds while Module 2 receives and then Module 2 transmits to Module 1 for the final 1.4 seconds of the cycle. The electrical signals are typically DC current pulses, although AC pulses are used on railroad properties where electrically powered locomotives operate and DC pulse operation is not possible.

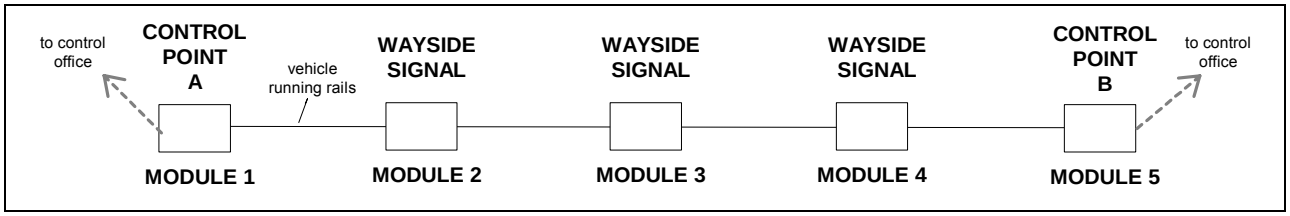

Figure B–6. Example Railroad Control Block

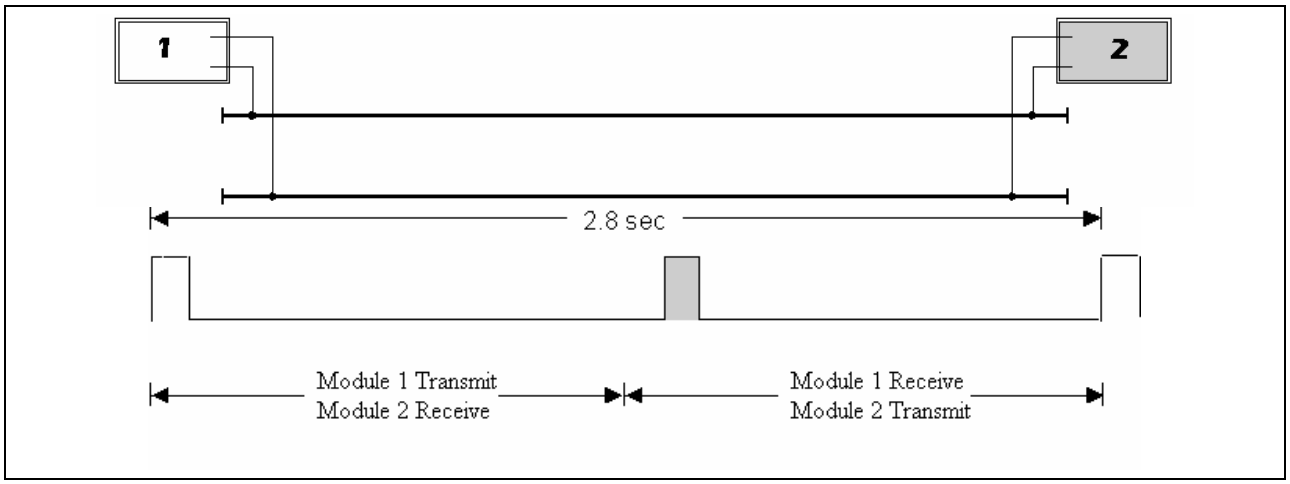

Figure B–7. Bi-directional Communication On A Track Circuit

Different combinations of pulses are produced by the transceiver modules by varying the number of pulses, spacing between multiple pulses (if present), and pulse length, to represent different codes. These modules transmit and receive these codes to/from their adjacent modules based on the operating rules of the railroad to control safety-critical wayside equipment such as signals and switch controllers. Except for the transceiver modules at the end of each control block (the Control Points), each transceiver module only directly communicates with the two modules on either side of it. A Control Point module only directly communicates with the module at the end of its track circuit. In Figure B–6 Module 1 can only directly communicate with Module 2, 2 with 3, and so on.

A fundamental limitation of this design is that the Control Point only has direct knowledge of the code(s) being transmitted by its one adjacent module, and has no direct knowledge of the specific codes being transmitted by other modules in the block. One prior approach to providing maintenance-related data from modules out in the block to the Control Points has been to define a non-vital maintenance code which can be added to most of the other codes by modifying pulse widths. In practice, if any module in the block experiences a system fault , such as a failed signal lamp filament, the module adds this indication to the code(s) it is currently transmitting. This is repeated as necessary by other modules until the code reaches a Control Point. At this time an indication can be generated to the control office to communicate that a fault is present at a module in the control block, although no information is available on the nature of the fault or the exact location of the fault. Code T addresses this limitation by using binary data transmission through the block to transfer specific indications from modules in the block to the Control Points. Code T provides this new capability by overlaying a binary data protocol on the existing pulse coding scheme to send binary data from any module in the block to any other module, while not interfering with the existing operation of the signaling system.

B.5.3. Enabling and Using Code T

For an application program to use Code T, the application must be properly configured using the PGK CAA application development tool (v2.01 or newer). Because of its flexibility, there are many options for Code T operation. Configuring an application for Code T involves two steps:

1. Creating the application logic equations required to control Trouble Code indication parameters based on particular inputs such as lamp outs, loss of AC power, or ground fault detection. These equations are created like any other application logic equations. See the on-line Help in the PGK CAA program for a description of the Trouble Code indication parameters and how to use them.

2. Setting up Code T enable selections and Trouble Queue expiration times. This is done through checkboxes and up/down numerical controls to control how Code T operates. With few exceptions, the selections made in the PGK CAA are merely default settings for the application and can be modified as desired in the field (using the PGK CPU serial port interface) without modifying or recompiling the application program. The available Code T settings are:

   - Code T Mode enable – This is a checkbox in the Module Configuration dialog box. If this box is not checked, Code T operation is disabled for this application and cannot be enabled in the field. No Code T indication parameters is available for use in application logic equations. If there is even a chance that an application program wants to use Code T (even repeating Trouble Codes from other modules), this checkbox should be checked.

   - Code T Operation enables (track-specific) – These checkboxes (one for East and one for West) are located in the Code T Settings dialog box. If enabled, Code T waveforms can be received and transmitted on the respective track, and the definition of Code 6 (both for transmit and receive) is changed from 600ms (nominal) to 812ms (nominal) For normal Code T operation, all tracks are enabled. However, certain special circumstances such as interfacing to another supplier's equipment on one end of a block may require enabling Code T operation in one direction only (at that boundary location). These enable settings may be modified in the field.

   - Code T Number of Parameters – Either four or eight Trouble Codes per location may be specified from a pull-down list in the Code T Settings dialog box. This setting may not be modified in the field.

- Individual Parameter Enables and Transmit Intervals – Each Trouble Code Parameter may be individually enabled or disabled in the Code T Parameter settings dialog box and a unique Transmit Interval may be specified for each one. These settings may be modified in the field. The parameter enables control whether a given Trouble Code is actually sent when the application logic sets its respective indication parameter True. This allows Trouble Code application logic to be present in the application that is intended to be used (for example) at a later date or only if problems are suspected. The transmit interval setting specifies the minimum interval is zero which enables continuous transmission, but there may be situations where some other setting could be useful.

- Code T Initiate Enables (track-specific) - These checkboxes (one for East and one for West) are located in the Code T Settings dialog box. If enabled, a Trouble Code is sent when its respective indication parameter is set True by the application logic and that Trouble Code's Parameter Enable is enabled (and Code T operation is enabled for the track). If disabled, the Trouble Code just described is not sent. Trouble Codes received from adjacent modules could still be repeated if so enabled For normal Code T operation, all tracks are enabled. These settings may be modified in the field.

- Code T Repeat Enables (track-specific) - These checkboxes (one for East and one for West) are located in the Code T Settings dialog box. If enabled, a Trouble Code is repeated to the East when received from an adjacent module on the West and vice-versa as long as Code T operation is enabled for the track. If disabled, the Trouble Code is not repeated when received For example, if a Trouble Code is received on the East but the West Repeat enable is disabled, the Trouble Code is not transmitted to the West. Trouble Codes initiated from the module could still be repeated if so enabled. For normal Code T operation, all tracks are enabled. These settings may be modified in the field.

- Code T Location ID – This is the location identifier (0 to 27) that should be uniquely assigned to each non-Control Point module in the block. It is recommended to assign consecutive numbers starting at one end of the block, but this is not required. A Location ID of 0 disables Code T transmit regardless of all other enable settings. A Location ID of 1 to 27 is required. This setting may be modified in the field, and generally must be if a given application is used at more than one location in the block. It is often common practice to leave the default value of 0 in the application and only assign the actual Location ID's in the field. The only exception is an application that is only used at a single, known location, so the proper Location ID can be assigned when the application program is created.

- Block Trouble Queue Entry Expiration Time – This is a time value specified in hours and minutes that a received Trouble Code logged in the module's Block Trouble Queue remains before it expires and is deleted. The selectable range is between 3 minutes and 96 hours. If a setting of 0 (default) is selected, Queue entries never expire, and are only deleted if the appropriate command to clear the Block Trouble Queue is entered through the PGK CPU serial port interface. This setting may be modified in the field.

C. APPENDIX C - SYSTEM SPECIFICATIONS

C.1. POWER SPECIFICATIONS

C.1.1. Control Point Module

Table C–1. Control Point Module Input Power Requirements

	Minimum	Nominal	Maximum
Voltage (DC)	9.0	12.0	16.0
Single direction Current (amps DC)*	0.6	0.7	0.8
Double direction Current (amps DC)*	0.9	1.0	1.1

* These currents are the current requirements for the module electronics only. The decoded relay current and the peak track transmit current must be added to these values to compute the total module current requirement.

Fuses:

- Output drive (FU1): 5A, type 3AG
- Electronics (FU2): 5A, type 3AG

Board-specific specifications, such as Code Select input and Decoded Output drive specifications, are provided in Appendix A.

C.1.2. Intermediate Module

Input Power Requirements:

Table C–2. Intermediate Module Input Power Requirements

	Minimum	Nominal	Maximum
Voltage (DC)	9.0	12.0	16.0
Current Dark (amps DC)*	1.4	1.5	1.6

* This current does not include the transmit current or the current requirements for the lamp drive outputs. Total input current for an Intermediate module is a function of the number and wattage of lamps driven. To compute the nominal 12 V DC input current, sum the TOTAL lamp current for all lamps driven at any one time (both EAST and WEST) and multiply by 1.25. Then add the Current Dark (amps DC) value indicated.

Fuses:

- Output drive (FU1): 30A, type 3AG slow-blow
- Electronics (FU2): 5A, type 3AG

Board-specific specifications, such as Colorlight lamp drive and Searchlight lamp and mechanism input/drive specifications, are provided in Appendix A.

C.1.3. Repeater Module

Table C–3. Repeater Module Input Power Requirements

	Minimum	Nominal	Maximum
Voltage (DC)	9.0	12.0	16.0
Current (amps DC)*	0.6	0.7	0.9

* These currents are the current requirements for the module electronics only. The peak track transmit current must be added to these values to compute the total module current requirements.

Fuses:

- Output drive (FU1): 5A, type 3AG
- Electronics (FU2): 5A, type 3AG

Board-specific specifications, such as Auxiliary I/O specifications, are provided in Appendix A.

C.1.4. Switch Lock Module

Table C–4. Switch Lock Module Input Power Requirements

	Minimum	Nominal	Maximum
Voltage (DC)	9.0	12.0	16.0
Current (amps DC)*	0.6	0.7	0.9

* These currents are the current requirements for the module electronics only. The peak track transmit current must be added to these values to compute the total module current requirements.

Fuses:

- Output drive (FU1): 10A, type 3AG
- Electronics (FU2): 5A, type 3AG

Board-specific specifications, such as Switch Lock I/O and Series Overlay specifications, are provided in Appendix A.

C.1.5. Lightning Protection

Primary lightning protection must be provided external to the module. Equalizers and arrestors are required for the signal battery and track circuit leads. Arrestors are recommended for inputs and outputs that travel on open line wires and/or over long distances and may be subjected to primary lightning strikes or high surge levels. All inputs and output circuits contain surge protection to guard against system malfunction and/or damage from surges that are normally present at a typical signal location.

C.2. TRACK CODE SPECIFICATIONS – STANDARD RATE

C.2.1. Cycle Time

Synchronized: 2.816 seconds

Unsynchronized: 2.816 seconds (East track)

2.944 seconds (West track)

C.2.2. Transmit Code Timing

Table C–5. Transmit Code Timing

CODE	1st Pulse Width (ms)	Pulse Spacing (ms)	2nd Pulse Width (ms)
1	112	---	---
1 & 7	112	224	112
1 & 4	112	320	112
1 & 3	112	496	112
1 & 2	112	688	112
1 & 9	112	816	112
1 & 8	112	944	112
6	600	---	---
1 & 5	224	---	---
1 & 7 & 5	112	224	224
1 & 4 & 5	112	320	224
1 & 3 & 5	112	496	224
1 & 2 & 5	224	688	112
1 & 9 & 5	224	816	112
1 & 8 & 5	224	944	112

The pulse spacing (indicated in the middle column) is measured from rising edge of 1st pulse to rising edge of 2nd pulse. Code 5 timing shown assumes standard (224 ms) width. For Long Code 5 timing substitute 352ms for 224ms. The Code 6 timing shown assumes Code T mode disabled. If enabled, substitute 812ms for 600ms.

C.2.3. Receive Code Decoding

Table C–6. Receive Code Decoding Specifications

CODE	1st Pulse Width (ms)		Pulse Spacing (ms)		2nd Pulse Width (ms)	
	min.	max.	min.	max.	min.	max.
1	64	160	---	---	---	---
1 & 7	64	160	176	256	64	160
1 & 4	64	160	288	368	64	160
1 & 3	64	160	448	544	64	160
1 & 2	64	160	640	736	64	160
1 & 9	64	160	768	864	64	160
1 & 8	64	160	896	992	64	160
6	496	704	---	---	---	---
1 & 5	176	272	---	---	---	---
1 & 7 & 5	64	160	176	256	176	272
1 & 4 & 5	64	160	288	368	176	272
1 & 3 & 5	176	272	448	544	64	160
1 & 2 & 5	176	272	640	736	64	160
1 & 9 & 5	176	272	768	864	64	160
1 & 8 & 5	176	272	896	992	64	160

The pulse spacing specifications (indicated in the middle columns) are measured from rising edge of 1st pulse to rising edge of 2nd pulse. Code 5 timing shown assumes standard (224 ms) width. For Long Code 5, the same absolute tolerances around the nominal 352ms pulse width apply. The Code 6 timing shown assumes Code T mode disabled. If enabled, the range is 720ms to 912ms.

C.3. TRACK CODE SPECIFICATIONS – TRANSIT RATE

C.3.1. Cycle Time

Synchronized: 1.920 seconds

Unsynchronized: 1.920 seconds (East track)

1.984 seconds (West track)

C.3.2. Transmit Code Timing

Table C–7. Transmit Code Timing

CODE	1st Pulse Width (ms)	Pulse Spacing (ms)	2nd Pulse Width (ms)
1	96	---	---
1 & 7	96	192	96
1 & 4	96	272	96
1 & 3	96	352	96
1 & 2	96	432	96
1 & 9	96	592	96
1 & 8	96	512	96
6	464	---	---
1 & 5	208	---	---
1 & 7 & 5	96	192	208
1 & 4 & 5	96	272	208
1 & 3 & 5	96	352	208
1 & 2 & 5	208	432	96
1 & 9 & 5	208	592	96
1 & 8 & 5	208	512	96

The pulse spacing (indicated in the middle column) is measured from rising edge of 1st pulse to rising edge of 2nd pulse. Code 5 timing shown assumes standard (208 ms) width. The Code 6 timing shown assumes Code T mode disabled. If enabled, substitute 608ms for 464ms.

C.3.3. Receive Code Decoding

Table C–8. Receive Code Decoding Specifications

CODE	1st Pulse Width (ms)		Pulse Spacing (ms)		2nd Pulse Width (ms)	
	min.	max.	min.	max.	min.	max.
1	48	144	---	---	---	---
1 & 7	48	144	176	208	48	144
1 & 4	48	144	256	288	48	144
1 & 3	48	144	336	368	48	144
1 & 2	48	144	416	448	48	144
1 & 9	48	144	576	608	48	144
1 & 8	48	144	496	528	48	144
6	368	560	---	---	---	---
1 & 5	160	256	---	---	---	---
1 & 7 & 5	48	144	176	208	160	256
1 & 4 & 5	48	144	256	288	160	256
1 & 3 & 5	160	256	336	368	48	144
1 & 2 & 5	160	256	416	448	48	144
1 & 9 & 5	160	256	576	608	48	144
1 & 8 & 5	160	256	496	528	48	144

The pulse spacing specifications (indicated in the middle columns) are measured from rising edge of 1st pulse to rising edge of 2nd pulse. Code 5 timing shown assumes standard (208 ms) width.. The Code 6 timing shown assumes Code T mode disabled. If enabled, the range is 576ms to 656ms.

C.4. ASPECT FLASHING

The following aspect flash rates (in pulses per minute) are supported: 40, 45, 50, 55, 60, and 65. All flashing aspects flash synchronously.

C.5. INSTALLATION WIRING

The following module wiring recommendations should be considered during installation:

- Battery connections to the module should be made with AWG #10 or larger wire.
- Module to rail connection - #6 wire (nominal 0.4 Ω per 1000 feet).
- Connections from the modules to signal lights should be made with at least AWG #10 wire (nominal 1.0 Ω per 1000 feet).
- For other communications, outputs to relays or inputs such as code selects or auxiliary vital inputs, use AWG #16 or larger wire.
- AWG #6 twisted pair should be used to connect the module series overlay input/output to the rails. Note: AWG #9 twisted pair can be used, but then the lead length should not exceed 300 feet. (Twisted pair to have a minimum of 1 twist per foot).
- AWG #6 twisted pair should be used for line wire between Genrakode II modules (used with Converter/Receiver Bd. P/N 59473-833-02) for distances up to 15000 ft. (Twisted pair to have a minimum of 1 twist per foot). For other wire sizes at reduced distances for line wire, see Section 3.

C.6. TRACK / LINE WIRE CURRENT

The following current recommendations should be considered during installation:

- Receive track current should be adjusted to fall between 1.0 and 1.4 amperes.
- Under average conditions, the current should be adjusted to about 1.2 amperes. Wet conditions may warrant adjusting closer to 1.0 amperes while very dry conditions may warrant adjusting closer to 1.4 amperes.

WARNING

EXCESSIVE TRACK CURRENT LEVELS (OVERDRIVE) CAN RESULT IN FAILURE TO DETECT TRAINS IN THE TRACK CIRCUIT.

- Receive line wire current should be adjusted to fall between 0.4 and 0.8 amperes. The line wire current level is not safety-critical.

C.7. MAXIMUM TRACK CIRCUIT LENGTHS

The following track circuit length recommendations should be considered during installation. These guidelines assume a maximum of 50 ft track leads (point-to-point):

Railhead bonded rail (assuming 0.05 Ω/1000 ft rail resistance):

- 11000 ft @ 3 Ohms DC ballast
- 15000 ft @ 5 Ohms DC ballast
- 21000 ft @ 10 Ohms DC ballast

Heavy welded rail (assuming 0.015 Ω/1000 ft rail resistance):

- 14000 ft @ 3 Ohms DC ballast
- 20000 ft @ 5 Ohms DC ballast
- 29000 ft @ 10 Ohms DC ballast

Table C–9. Track Lead Increases vs. Track Circuit Length Reductions

Track Circuit Length Reduction (ft) Per Additional 100 ft. of Track Lead		
Ballast (Ohms)	**Bonded**	**Welded**
3	700	1100
5	800	1300
10	900	1500

See the Section 3 for Track/Line Circuit Adjustment instructions.

C.8. CAB SIGNAL CODE RATES

The following cab signal code rate pulses per minute date should be considered during installation:

Table C–10. Cab Signal Code Rates

Code Rate	Pulses Per Minute
Constant ON	0
75	75.0
120	121.0
180	178.6
270	267.9
420 *	416.7

* A code rate of 420 is not available for the 60 Hz Cab Signal module.

CAUTION

For steady cab do not use the 100% power setting for either the 100 Hz or 60 Hz modules. If the module is operated for too long, an internal PC board may overheat and fail.

C.9. AUDIO FREQUENCY COMPATIBILITY

Genrakode III modules have internal filters that allow operation on the same track circuit with other equipment. The following two columns show frequency versus track input impedance data for the Genrakode III module to facilitate consideration of compatibility for specific applications.

Table C–11. Audio Frequency Versus Track Input Impedance

Frequency (Hz)	Impedance (Ohms)
DC	2
60	13
150	8
200	11
300	16
500	25
1000	45

C.10. ENVIRONMENTAL SPECIFICATION

Operating Temperature range: -40 degrees F to +158 degrees F

-40 degrees C to +70 degrees C

C.11. PHYSICAL SPECIFICATIONS

Table C–12. Module Dimensions and Weight

	All Modules Except Cab Signal Modules	**Cab Signal Module**
Length	19.0 inches (48.3 cm)	12.0 inches (30.5 cm)
Width	10.1 inches (25.7 cm)	10.1 inches (25.7 cm)
Height	15.0 inches (38.1 cm)	14.5 inches (36.8 cm)
Weight	28.0 pounds (12.7 kg)	29.0 pounds (13.2 kg)

Modules can be either shelf-mounted or wall-mounted.

C.11.1. Connections

All external connections to Genrakode II are made with AAR terminals mounted at the top of the module. A power switch is provided to remove battery energy from the module.

C.11.2. Accessories

- Extender Board (P/N 59473-850-01) is an extender board that can be inserted in any board slot in any module for troubleshooting and testing purposes. An assembly drawing of the extender board is provided in P2160B, Volume 2.
- 60 Hz Filter (P/N 42560-276-01) is an optional filter inserted in series with the track leads to provide greater 60 Hz rejection. An assembly drawing of the 60 Hz filter is provided in P2160B, Volume 2.
- 100 Hz Filter (P/N 42560-276-02) is an optional filter inserted in series with the track leads to provide 100 Hz rejection. This is used at a location where 100 Hz cab signal is present on the rails and there is no Cab Signal module being used. An assembly drawing of the 100 Hz filter is provided in P2160B, Volume 2.

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