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TRAIN CHIEF LOCOMOTIVE REMOTE CONTROL SYSTEM

**FCC Certification System
E-7859**

OPERATOR BRIEFING

***** PRELIMINARY *****

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A	9/15/98	Adapted from er00145a.doc (rlr)
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TABLE OF CONTENTS

OPERATIONAL BRIEF - INTRODUCTION	5
TERMINAL LAYOUT	5
CONTROL SWITCHES AND LEVER	5
<i>TERMINAL LEFT SIDE</i>	5
<i>LEFT SWITCH POD</i>	5
<i>RIGHT SWITCH POD</i>	5
<i>TERMINAL RIGHT SIDE</i>	5
<i>TOP SWITCH PANEL</i>	5
DISPLAY PANEL.....	6
<i>ON/ACTIVE (green)</i>	6
<i>ERROR (red)</i>	6
<i>STATUS (blue)</i>	6
<i>BAT LOW/DEAD (red)</i>	7
<i>BATTERY VOLTAGE Display</i>	7
<i>Audible Indicator</i>	7
TERMINAL START-UP PROCEDURE	10
PRE-START UP.....	10
POWER ON.....	10
INITIAL START UP OPERATION	10
GENERAL OPERATION PROCEDURES	11
BRAKE RELEASE OPERATION	11
DEADMAN OPERATION.....	11
OPERATOR ALERT OPERATION.....	11
TRAIN LINE BRAKE OPERATION	12
TILT.....	12
TILT BYPASS.....	12
EMERGENCY STOP SWITCH OPERATION	12
DIRECTIONAL CHANGE OPERATION	12
ACTIVE AND MAINTAIN COMMUNICATION MODES	13
EMERGENCY STOP.....	13
TRANSMITTER OPTIONS.....	14
SPARE TRANSMITTERS - GENERAL	14
BASIC SPARE TRANSMITTER.....	14
UNIVERSAL SPARE TRANSMITTER	14
PROGRAMMED CONTROLLER - OVERVIEW.....	17
CONTROLLER COMMUNICATION ANTENNA	17
COMMUNICATION CARD.....	17
<i>Communication Card Diagnostics</i>	17
PROCESSOR CARD	17
<i>Processor Card Diagnostics</i>	17
DIAGNOSTIC CODE DEFINITION	23
00-99 RELAY FAULTS.....	23
SPECIAL NOTE FOR COMMUNICATION ERROR CODES E0, E5, & E7.	23
E0 – SOH ERROR:.....	23
E1 – LOSS OF CARRIER:	23
E2 – ADDRESS ERROR:.....	23
E3 – OUTPUT ENABLE ERROR:.....	23

E4 – PROCESSOR TO PROCESSOR ERROR:.....	23
E5 - PARITY ERROR:.....	23
E6 – UNIDENTIFIABLE RELAY ERROR:.....	23
E7 – WORD SYNC ERROR:.....	24
E8 – RAM TEST ERROR:.....	24
E9 – I/O OPTO INPUT CARD ERROR:.....	24
EA – DIP SWITCH ADDRESS SETUP ERROR:.....	24
CONDITIONS FOR OPERATION.....	25
BRAKE RELEASE; LOCOMOTIVE BRAKES WILL NOT RELEASE IF:.....	25
THROTTLE ADVANCE; THROTTLE WILL NOT ADVANCE IF:.....	25
TROUBLESHOOTING AIDS.....	25
GENERAL TROUBLESHOOTING CHECK LIST:.....	25
PNEUMATICS TROUBLESHOOTING CHECK LIST:.....	26
TERMINAL TROUBLESHOOTING CHECK LIST:.....	26
CONTROLLER TROUBLESHOOTING CHECK LIST:.....	26
GENERAL COMMUNICATION LINK CHECKS:.....	26
RF INTERFERENCE CHECKS.....	27
REPORTING PROBLEMS TO PRODUCT SERVICE:.....	27

Table of Tables

TABLE 1 BATTERY VOLTAGE DISPLAY READING DEFINITION	7
TABLE 2 COMMUNICATION CARD LED INDICATOR FUNCTION DEFINITION	20
TABLE 3 PROCESSOR CARD LED INDICATOR FUNCTION DEFINITION	20
TABLE 4 TRAIN CHIEF CONTROLLER CPU CARD DIAGNOSTIC CODES	21
TABLE 5 TRAIN CHIEF CONTROLLER CPU CARD DIAGNOSTIC CODES (CONTINUED).....	22

Table of Figures

FIGURE 1 TERMINAL LAYOUT DRAWING.....	8
FIGURE 2 TERMINAL LAYOUT - FOUR VIEWS - GENERAL REFERENCE	9
FIGURE 3 UNIVERSAL TRANSMITTER LAYOUT DRAWING	16
FIGURE 4 CONTROLLER ELECTRONICS CARD RACK	18
FIGURE 5 PROCESSOR AND COMMUNICATION CARD DIAGNOSTIC INDICATORS.....	19

Operational Brief - Introduction

The objective of this briefing is to provide an overview of the Train Chief Remote Control System, particularly the Terminal and Controller, for the installer and End User.

In this document the following terminology is used.

Terminal is used when referring to the "Transmitter".

Controller is used when referring to the "Receiver/Decoder".

Reference: Please refer to the TRANSMITTER LAYOUT drawings in Figure 1 on page 8 and Figure 2 on page 9.

Terminal Layout

Control Switches and Lever

TERMINAL LEFT SIDE

E-Stop (Mushroom Switch)

ON/OFF (Key Switch)

LEFT SWITCH POD

ALERT (push button)

RIGHT SWITCH POD

HORN/RESET (push button)

SAND (push button)

TERMINAL RIGHT SIDE

THROTTLE/BRAKE

TOP SWITCH PANEL

Directional – FWD-NEUTRAL-REV (3-position locking toggle)

Display Panel**ON/ACTIVE** (green)

Terminal Ready – constant.

Active Mode – fast blink.

Maintain Mode – slow blink.

Off – power turned off or terminal in an error condition.

ERROR (red)

No Errors - Off

Software Stack Overflow Error – constant

This fatal error will inhibit all terminal operation. Contact the factory if this error occurs.

Terminal Error –blinking

This fatal error will inhibit all terminal operation. The specific error condition will be further described by the condition of the other LED indicators, as defined below:

BAT LOW/DEAD on constant:	Dead Battery
STATUS flashing slow:	Missing Switch Lever Module
STATUS flashing medium fast:	Invalid Switch Lever Module Address
STATUS flashing fast:	Other Switch Lever Module Error
STATUS on constant:	Switch Debounce Error
ON/ACTIVE on constant:	Miscellaneous Software Error

If the “Dead Battery” error is encountered, turn off power and replace the battery pack with a freshly charged one. If the error persists, contact the factory.

If any of the other errors are encountered, please turn off power momentarily then turn power back on. If the error persists, contact the factory.

STATUS (blue)

Locomotive Brake Set – On

Locomotive brakes are set for full application.

Locomotive Brake Warning – Blinking

Operator must move Throttle/Brake lever away from the center position, before the time out expires, or the locomotive brakes will be commanded for full application.

Locomotive Brake Release – Off

Locomotive Brake Release command is in effect, but brakes may still be applied as commanded by the Throttle/Brake lever.

BAT LOW/DEAD (red)Battery Low - Blinking

This is an indication that Terminal operational time is limited. The battery pack should be replaced with a freshly charged pack.

Battery Dead - Constant

The Battery Dead condition indicates the pack has reached a discharge level where continued operation could possibly degrade battery pack performance. When the terminal detects this condition, operation will be inhibited and the terminal is placed in the lowest power mode. The ERROR indicator will also be turned on when this condition occurs.

BATTERY VOLTAGE Display

The Battery Voltage display in the center of the Display Panel shows the actual battery voltage. The voltage reading of the meter can provide the operator with an indication of battery capacity. The table below lists the Voltage ranges used to "estimate" pack capacity.

Table 1 Battery Voltage Display Reading Definition

Battery Voltage Display	BATT LOW/DEAD Indicator	Description & Operator Action
13.85 to 10.00	OFF	Battery at sufficient capacity to support Terminal Operation.
10.00 to 8.90	Blinking	Operator has limited operation time to replace the battery pack with a re-charged pack.
8.90 to 8.85 and below	ON	Terminal Operation is inhibited. The Battery pack must be replaced.

Audible Indicator

Sounds to alert the operator of Tilt and E-Stop.

Slow beep - General operator alert. Warns the operator of a non-critical condition, such as, a switch is not in the idle position when attempting to re-start the unit.

Fast Beep - Operational alert. Warns the operator an E-Stop is being commanded because of a Tilt, or the E-Stop switch has been activated.

Figure 1 Terminal Layout Drawing

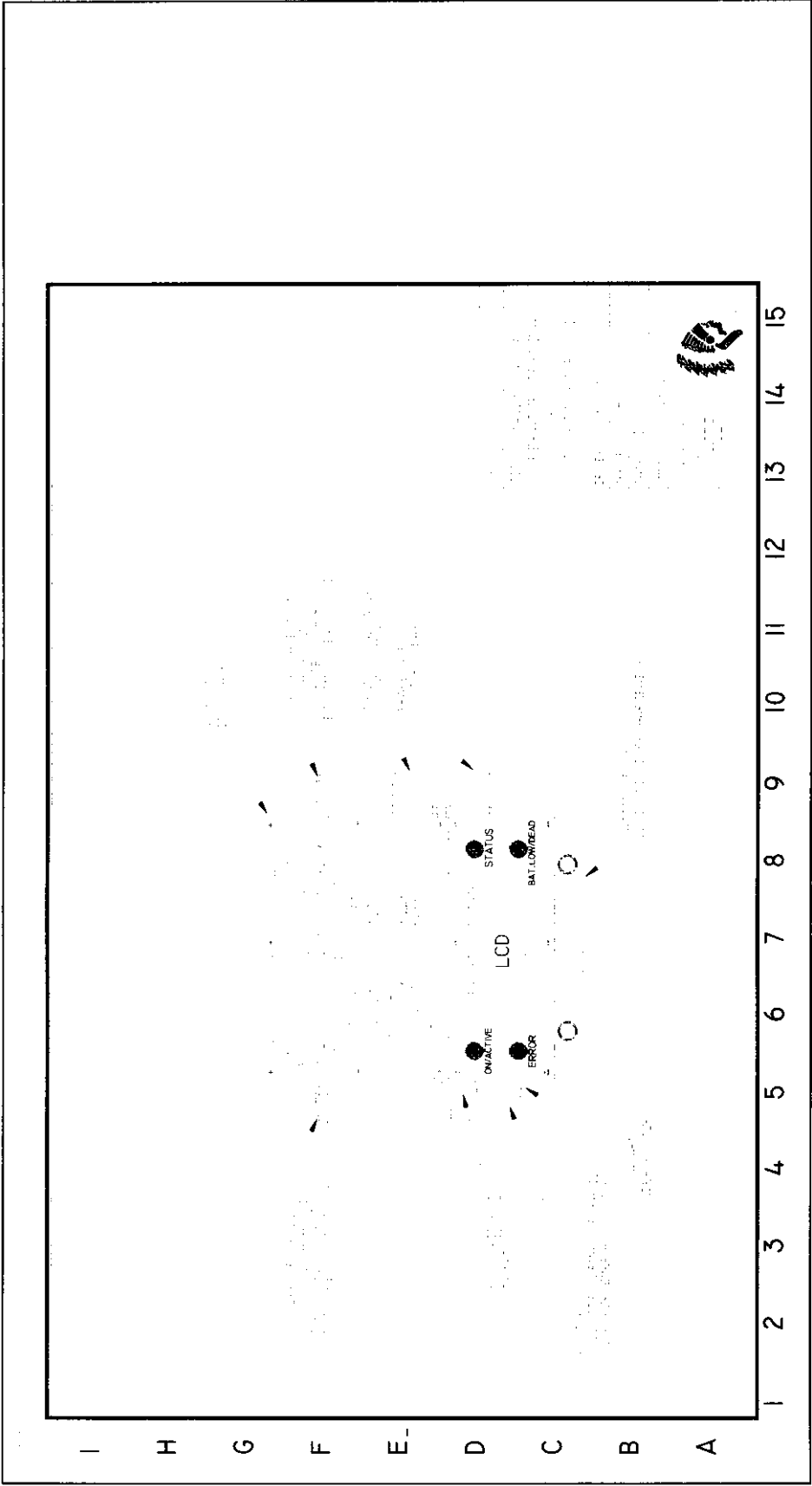
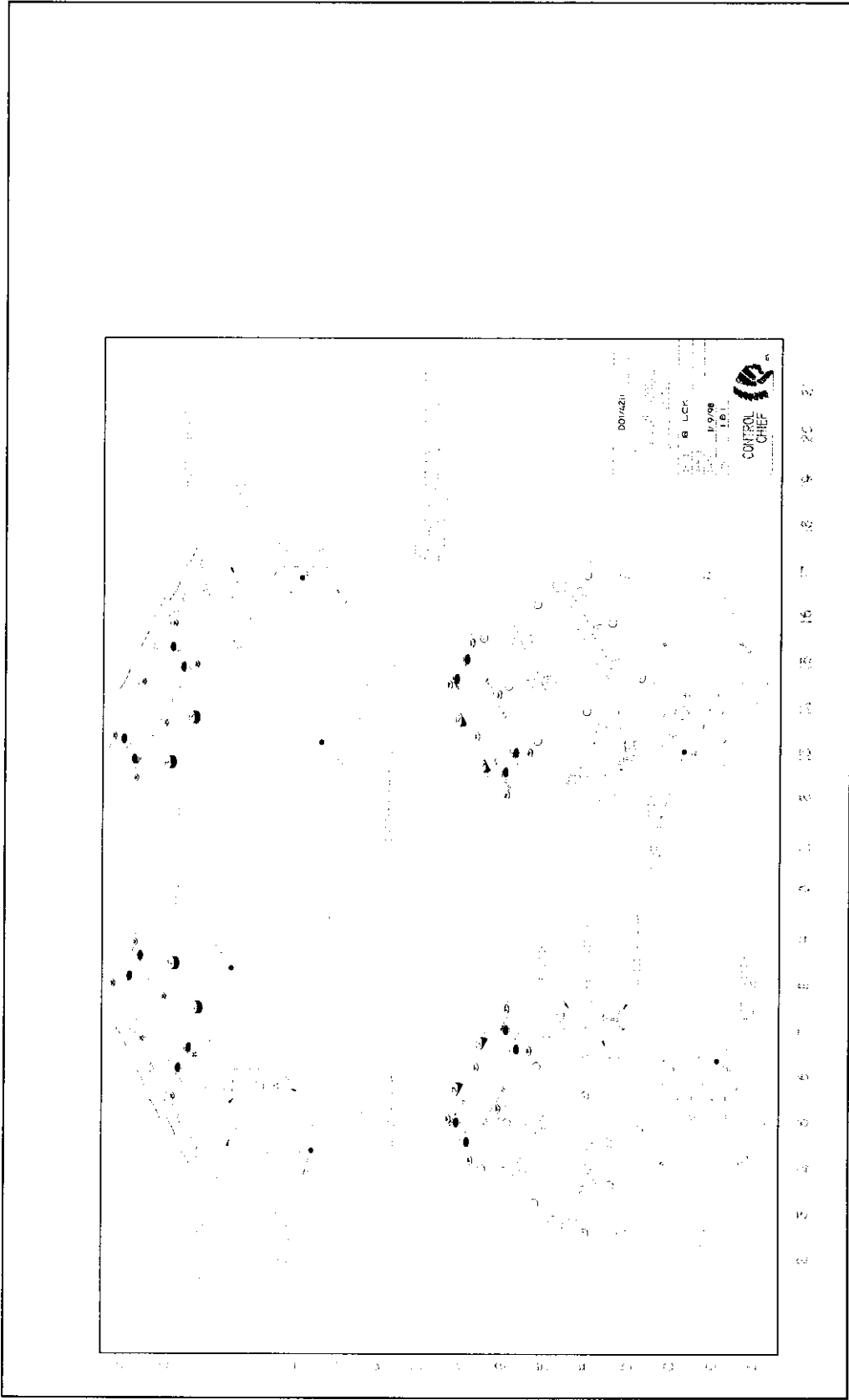


Figure 2 terminal Layout - Four Views - General Reference



Terminal Start-Up Procedure

Pre-Start Up

Before Power-On the operator must return all control switches and levers to their "idle" positions. Control switch and Lever idle positions are as follows: Forward-Neutral-Reverse in Neutral, Throttle/Brake centered, E-Stop pulled out, terminal NOT tilted, and ALL push buttons released (not pressed). Also be sure that there is a fully charged battery installed in the Terminal. Refer to Table 1 on page 7 for expected voltage reading on the LCD Battery Voltage Monitor.

Power ON

To turn on power, turn the keylock switch to the ON position. The Terminal commences with its initial power on checks indicated by the sequencing of the display panel LED indicators. At power-on the indicators will sequence in the following order: ON/ACTIVE, ERROR, BAT LOW/DEAD, and STATUS. (Similar to a "U" shape.) When the STATUS indicator is on then off, initialization is complete. The terminal is ready for operation when the ON/ACTIVE indicator is ON.

Initial Start Up Operation

When the ON/ACTIVE indicator is ON the terminal is ready. Pressing the HORN/RESET button will initiate communications with the Controller. If one or more control switches are NOT in their idle position when the HORN/RESET button is pressed, the Audible Indicator will sound, and communications will NOT be established. This should alert the operator to check control switches and place them in their idle positions, and then press the HORN/RESET button once again to proceed, and enter active mode.

When the Terminal enters active mode, as indicated by the blinking ON/ACTIVE indicator, the STATUS indicator should be on to show that Locomotive brake is commanded ON. Once in the active mode, the Terminal will establish a communication link with the controller.

General Operation Procedures

Brake Release Operation

Locomotive brakes are released by first moving the direction lever into either "FWD" or "REV" position, then moving the throttle/brake lever away from the center position. Full locomotive brakes will be commanded whenever the direction lever is in the "NEUT" position. This acts as a parking brake.

When brakes are released, the STATUS indicator on the Terminal will turn OFF, indicating that the Locomotive Brake Release command is being sent to the Controller. Note that locomotive brakes may still be applied if commanded by the throttle/brake lever.

Deadman Operation

To keep the Deadman from timing out and applying the locomotive brakes, the operator must be in active control. Meaning, he must be commanding throttle or brake. The Deadman time-out starts when the throttle/brake lever is returned to the center position. The Terminal alerts the operator that Deadman is about to time-out by blinking the STATUS indicator. When the time-out occurs, the STATUS indicator remains ON to show that locomotive brakes are being commanded for full application. Locomotive brakes can be released, by simply moving the throttle/brake lever away from the center position, presuming that the direction lever is not in the "NEUT" position.

NOTE: The first position in the Throttle direction, acts simply as a locomotive brake release and Deadman timer reset command. In this first position, the throttle is not advanced. The locomotive brakes remain off, so this can be used to allow the locomotive to "coast".

General Note: If Train Line Brake control is NOT installed on a transmitter, please disregard its reference in the operational instructions that follow.

Operator Alert Operation

This function will automatically send an emergency stop command (E-STOP) after 30 seconds, if there is no change on any of the command switches. The E-STOP command results in the throttle being inhibited and full application of Locomotive and Train Line Brakes. The Audible Alarm Indicator sounds after 20 seconds of inactivity, to alert the operator of the impending E-STOP. If the ALERT button is pressed AND released, within 10 more seconds, the alarm will turn off and the E-STOP command will not be sent.

The operator alert function is only active when the locomotive brakes are released.

Once the E-STOP command is sent, the alarm continues to sound about once every 3 seconds to indicate that the E-STOP command is still being sent. This continues until the condition is cleared, by pressing the ALERT button, turning power off, or until the battery becomes fully discharged. Operation can be resumed by following the Startup procedure described above (i.e. by pressing the Horn button).

Train Line Brake Operation

When the Train Line Brake switch is placed in the RELEASE position, Train Line Brakes are commanded for full pressure, which places the brakes in a fully released state. The brakes are progressively applied when the switch is momentarily moved to the APPLY position, each time the switch is toggled. If the switch is held in the APPLY position for more than 2 seconds, full brakes are commanded. The commanded pressure is held when the switch is returned to the center position.

Tilt

When communications are active and the terminal is tilted, the Audible indicator will sound a steady warning, for about 2.5 seconds before commanding an Emergency Stop (E-STOP). The E-STOP command results in the throttle being inhibited and full application of Locomotive and Train Line Brakes.

Once the E-STOP command is sent, the alarm no longer sounds continuously, but will sound once every 3 seconds to indicate that the E-STOP command continues to be sent. This continues as long as the Terminal remains tilted. The Tilt condition is cleared, and communications are terminated, when the Terminal is returned to its upright position, or when power is turned off, or when the battery becomes fully discharged. Operation can be resumed by following the Startup procedure described above (i.e. by pressing the Horn button).

Tilt Bypass

The Tilt function can be momentarily bypassed by holding the Alert push button ON.

Emergency Stop Switch Operation

When the Emergency Stop switch (the "red" mushroom shaped switch) is pushed in, while communications are active, an emergency stop (E-STOP) condition is immediately commanded. This results in the throttle being inhibited and full application of Locomotive and Train Line Brakes.

Directional Change Operation

The Terminal will not allow a directional change until locomotive brakes are fully applied, either by a Deadman time-out or actively by the operator commanding full locomotive brakes with the control lever. For example, at startup the directional switch is in neutral and locomotive brakes are fully applied. At this time the operator can select either forward or reverse and the terminal will command the direction selected. Once a direction has been selected and locomotive brakes released, the terminal will not allow a direction change until full locomotive brakes are applied once again. When the direction switch is moved to the opposite direction without commanding full locomotive brakes, the Terminal will command neutral and wait for Deadman to time-out or the operator to command full locomotive brakes.

Active and Maintain Communication Modes

During normal operations, when the operator is actively commanding the locomotive, communications with the controller occurs at an "Active" rate. In this condition, as indicated by fast blinking of the ON/ACTIVE indicator, communication occurs at a fast rate to ensure a fast response to the operator's commands. If the position of the control switches or levers are not changed for some time (about 6 seconds), then communication is switched to a slower "Maintain" rate to conserve battery power. The "Maintain" rate is indicated by slow blinking of the ON/ACTIVE indicator. If any control switch or lever is moved, while communications is at a "Maintain" rate, the "Active" rate is immediately activated to restore fast operator response.

Emergency Stop

To activate an immediate Emergency Stop command the operator must push-in the RED Emergency Stop (E-Stop) mushroom push button on the left side of the Terminal. Once the operator has pressed the Red E-Stop push button on the Terminal, the terminal will immediately command full Locomotive AND Train Line Brakes (if Train Line Brakes are installed). While the Terminal is commanding an E-Stop, all other functions are inhibited until the E-Stop condition is cleared.

Continued, operation can be achieved by following the Startup procedure described previously.

Transmitter Options

Spare Transmitters - General

The Spare Transmitter acts as the backup unit for the primary Transmitter. The Spare Transmitter is an exact duplicate of the original both in switch configuration and operation.

WARNING – Primary and/or Spare Transmitters that are NOT being used shall have the key removed from the Power On/Off switch, and the unit secured in a locked cabinet to prevent unintended operation of the locomotive by unauthorized personnel.

Before placing the Spare Transmitter into service, the Primary Transmitter shall be taken out-of-service to prevent unintentional interference and operation resulting in a DANGEROUS CONDITION.

A Spare Transmitter can have two configuration options, Basic and Universal, which are described below.

Basic Spare Transmitter

The Basic Spare Transmitter configuration consists of the same switch configuration and operation as the primary, and is assigned to communicate and control the same locomotive, as the Primary Transmitter.

As a general procedure, when placing the Spare Transmitter into service, the supervisor shall remove the Primary Transmitter from operation by removing the Power On/Off key and securing the unit in a locked cabinet.

The operation of the Basic Spare Transmitter is similar to the Primary Transmitter.

Universal Spare Transmitter

The Universal Spare Transmitter has the capability to provide backup support for up to four transmitters with similar switch configuration and operation. The Universal Transmitter is assigned to one of four predetermined systems by way of a keylock selector switch. The selector switch is engraved with the assigned Locomotive Identification numbers for selection indication. (Refer to Figure 3 on page 16.) The selector switch is on the left side of the transmitter, forward of the Power On/Off key lock switch.

WARNING – Before placing Universal Spare Transmitters into operation, remove the key from the Selector Switch to prevent re-selection during operation, which will cause a Transmitter Error.

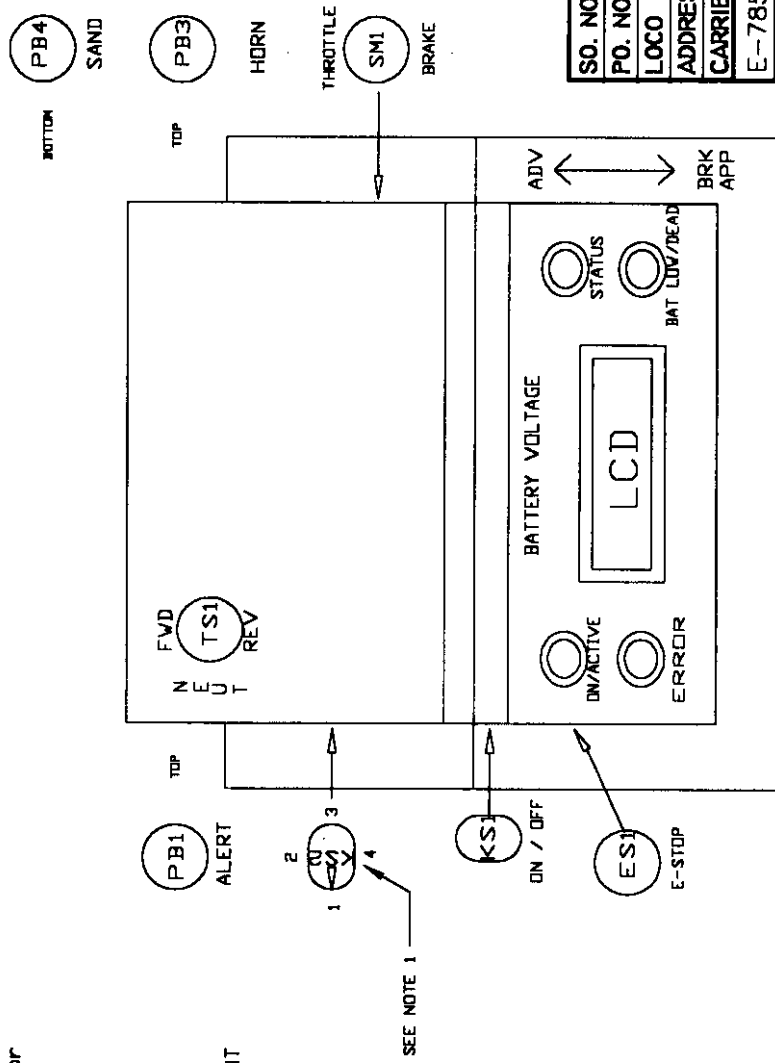
WARNING - Before placing a Universal Spare Transmitter into service, the Primary Transmitter shall be taken out-of-service to prevent unintentional interference and operation.

As a general procedure, with transmitter power turned OFF, the supervisor shall assign the Universal Spare Transmitter to the appropriate locomotive via the keylock selector switch, then remove the key from the selector switch. He then places the primary transmitter out-of-service by removing the Power On/Off key and securing the unit in a locked cabinet. To insure the Primary Transmitter is out-of-service the Power On/Off key and the Universal Spare Selector key are secured together under the supervisor's control.

Once the Universal Spare Transmitter has been assigned to the designated system, operation is similar to the Primary Transmitter.

NOTE 1:
KS2 - KEYLOCK SELECTOR SWITCH FOR UNIVERSAL SPARE TRANSMITTERS.
The maximum number of systems assignments for a Universal Spare Transmitter utilizing the keylock selector switch is four(4). Applications requiring more than four system assignments must utilize the LCD module option for the Transmitter.
DESIGNATORS 1, 2, 3, AND 4 ARE FOR ENGRAVING REFERENCE POSITIONS ONLY AND SHALL BE REPLACED WITH THE ACTUAL LOCOMOTIVE ID OR SERIAL NUMBER.
TABLE-1 WILL BE COMPLETED TO SHOW ASSIGNMENT OF LOCOMOTIVE ID NUMBER TO CONTROL CHIEF SYSTEM NUMBER FOR CONFIGURATION REFERENCE.

LEFT SIDE — AUX SW HOUSING BUTTONS — RIGHT SIDE



4	Not Used	Not Used	Not Used	Not Used
3	Chnl #3	E-7859	469.5625 MHz	1101
2	Chnl #2	E-7859	461.0375 MHz	1101
1	Chnl #1	E-7859	451.1875 MHz	1101
KS2 POSITION REFERENCE DESIGNATOR	LOCOMOTIVE SERIAL NO.	CONTROL CHIEF SYSTEM NO.	FREQUENCY	ADDRESS

TABLE-1 UNIVERSAL SPARE TRANSMITTER SYSTEM CONFIGURATION

SO. NO.	E-7859
PO. NO.	
LOCO	SEE CHART
ADDRESS	SEE CHART
CARRIER	SEE CHART
E-7859-00-1	
TITLE:	UNIVERSAL TRANSMITTER LAYOUT FCC CERTIFICATION
DR. BY: R. WORDEN	
APP. BY: R. WORDEN	
DATE: 12-3-98	
SHEET: 1 OF 1	



SEPTEMBER 1998, UNIVERSAL CONTROL CHIEF CORPORATION

Programmed Controller - Overview

The discussion below provides Controller setup and diagnostic guidelines, specifically for the Communication and Processor Cards, but before proceeding, a word on the Communication Antenna to be mounted on the Locomotive.

Controller Communication Antenna

The communication antenna for the Remote Control link consists of a half-wave rubber duck whip with a weatherproof connector. This type of antenna is very adaptable to the various types of locomotives in the field and can be mounted on the cab roof or on the Status Light brackets. **The Remote Control Communication Antenna MUST be located as far as possible from other communication antennas used on the Locomotive.** Not adhering to this requirement can greatly impact the performance of the Remote Control Communication link.

Communication Card

Communication Card Diagnostics

The Communication Card provides 4-LED indicators for troubleshooting the communication RF link. Please refer to Figure 5 on page 19 for LED location and Table 2 on page 20 for functional description.

Processor Card

The function of the Processor Card is to process the data from the Communication Card for relay card output and monitor the relay cards for proper actuation status. Where errors are detected the Processor Card will display the applicable error code, and if necessary, take appropriate action to maintain a safe system by shutting down all relay outputs. This is achieved with the application specific software programmed into the Processor Card Microcontroller.

Processor Card Diagnostics

Built-in Diagnostics are provided to assist the installer, and particularly the End User, to achieve reliable and efficient system installation, commissioning, and operation. Please refer to Figure 5 on page 19 for LED position definitions and Table 3 on page 20 for LED functional definitions. The Operational Diagnostic Codes are defined in Table 4 on page 21 and Table 5 on page 22 of this document. The Operational Diagnostics are provided to assist operators and maintenance personnel with system troubleshooting during actual operation. The eight LED's are divided into two groups. The top four are used as Direct Status Indicators. Each of these LED's has a particular indication function, and is not related to the two-digit display below. The Display Status indicators work with the two-digit seven-segment display immediately below. The two-digit seven-segment display is used to display an error code. When an active error code is displayed, the appropriate Display Indicator will be on to show the error code type, i.e. Communication Fault, I/O Fault, or CPU Status. If the CPU OK LED is the only indicator on then the error code shown on the two-digit seven-segment display shows the *last* active error code.

Figure 4 Controller Electronics Card Rack

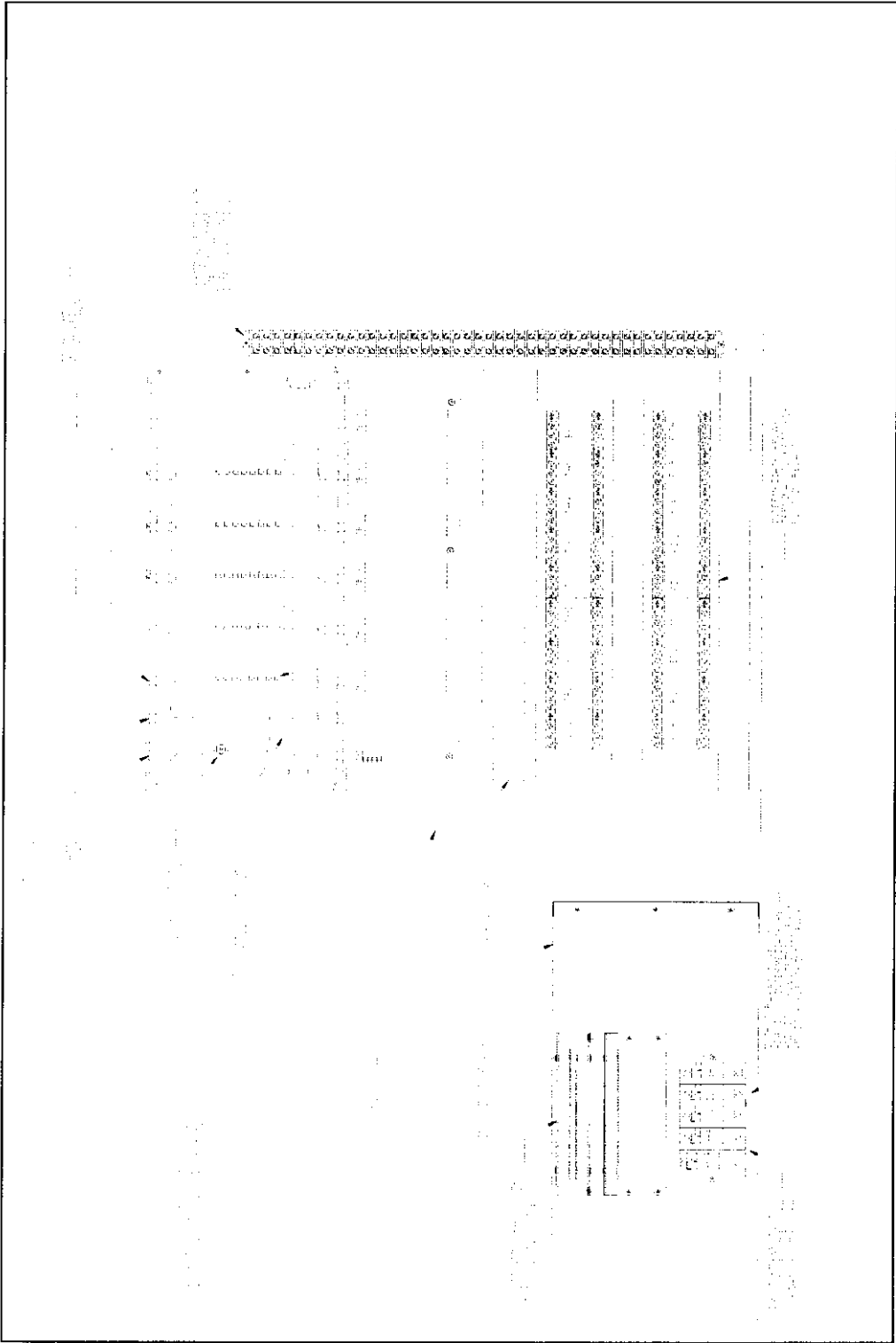


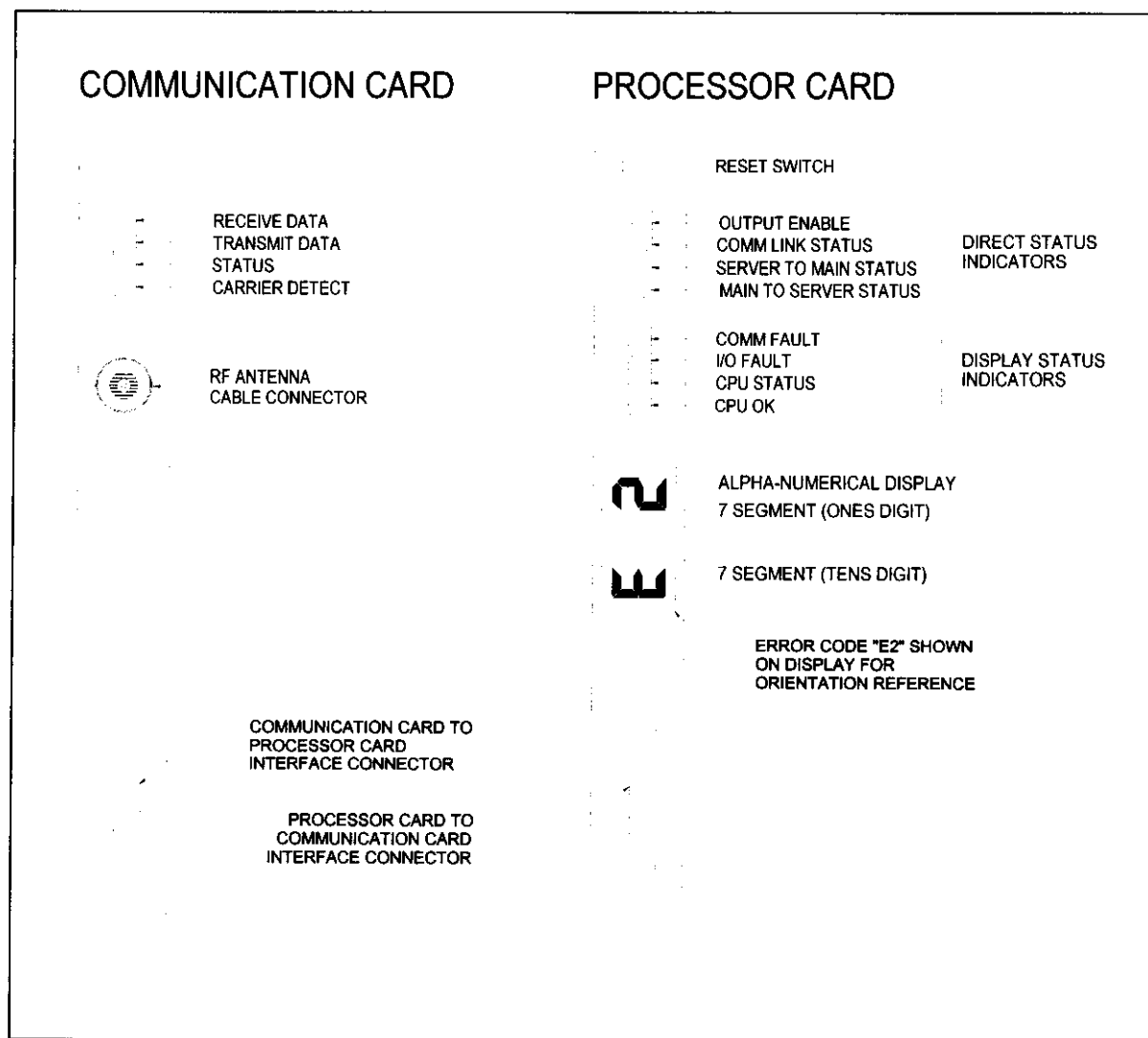
Figure 5 Processor and Communication Card Diagnostic Indicators

Table 2 Communication Card LED Indicator Function Definition

Function	Description
RECEIVE DATA	Blinks when Receiving Data
TRANSMIT DATA	Blinks when Transmitting Data
STATUS	ON indicates Radio Module Fault.
CARRIER DETECT	ON indicates sufficient RF Signal strength on the selected Frequency Channel for data processing.

Table 3 Processor Card LED Indicator Function Definition

Direct Status Indicator Function	Description
OUTPUT ENABLE	ON when Relays enable signal activated
COMM LINK STATUS	ON when a valid Remote Terminal has established communication.
SERVER TO MAIN STATUS	Blinks when data is being transferred from Main to Server. ON indicates transfer error.
MAIN TO SERVER STATUS	Blinks when data is being transferred from Server to Main. ON indicates transfer error.
Display Status Indicator Function	Description
COMM FAULT	ON indicates Communication Fault is active. Refer to double 7-segment display for error code.
I/O FAULT	ON indicates Relay or Input Card Fault is active. Refer to double 7-segment display for error code.
CPU STATUS	Blinking indicates Relay Safety checks are being performed.
CPU OK	On indicates all Self-Tests passed and ready for operation.

Display Status Indicators and Two Digit Seven Segment Display: When a Display Status Indicator is ON, (i.e. COMM FAULT, I/O FAULT, or CPU STATUS), the code shown on the seven segment display is an ACTIVE error condition. However, when the ONLY Display Status Indicator ON is the CPU OK then an error code shown on the seven segment display is the last active error condition (or error code history).

Table 4 Train Chief Controller CPU Card Diagnostic Codes

Indicator	Function	Power On	Power On Check OK	Relay Check	Relay Fault Detected	CPU Lock Up	SOH Error	Loss of Carrier	Address Error	Out Put Enable Error	Processor to Comm Error	Parity Error	Unidentifiable Relay Error	Word Sync Error
DP2-4	Output Enable	ON		ON or OFF										
DP2-3	Comm Link Status	ON												
DP2-2	Server/ Main	ON									ON			
DP2-3	Main/ Server	ON									NO			ON
DP1-4	Comm Fault						ON	ON	ON	ON		ON		
DP1-3	Relay Fault				ON	FLASH				ON			ON	
DP1-2	CPU Status			FLASH										
DP1-1	CPU OK		ON	ON		ON	ON	ON	ON	ON	ON	ON	ON	ON
DIS2	Ones Digit	Blank	Blank		Faulty Relay Number	Faulty Relay Number	E 0	E 1	E 2	E 3	E 4	E 5	E 6	E 7
DIS1	Tens Digit	Blank	Blank		Faulty Relay Number	Faulty Relay Number	E							
Comments						CPU Lockup - Requires Operator Reset to Clear.					Not Used			

Table 5 Train Chief Controller CPU Card Diagnostic Codes (Continued)

Indicator	Function	RAM Test Error	I/O Opto Input Card Error	DIP Switch Address Setup Error							Factory Use Only					
DP2-4	Output Enable															
DP2-3	Comm Link Status															
DP2-2	Server/ Main															
DP2-3	Main/ Server															
DP1-4	Comm Fault															
DP1-3	Relay Fault		FLASH													
DP1-2	CPU Status	ON														
DP1-1	CPU OK		ON	FLASH							OFF					
DIS2																
	Ones Digit	8	9	A	B	C	D	E								
DIS1	Tens Digit	E	E	E	E	E	E	E								
Comments				CPU Lockup - Requires Operator Reset to Clear.	Not Used	Not Used	Not Used									

Diagnostic Code Definition

00-99 Relay Faults

A decimal number from 00 to 99 identifies relay fault codes. The number on the display indicates a relay. The relay number can be crossed to the output schematic to determine its function in the circuit. To determine the relay card associated with the relay number, refer to the output terminal wiring diagram. Both the output schematic and output terminal wiring diagram are part of the system's print package.

Special Note for Communication Error Codes E0, E5, & E7.

These errors may be displayed periodically, which is normal, however if these errors persist and the operator is within typical remote control range it is an indication of external RF interference either by another radio or other source. Check that all relay and solenoid coils are suppressed and insure the receiver cabinet and other electrical equipment is properly grounded.

E0 – SOH Error:

Start Of Header Error. Possibly an indication of interference or on the borderline of operating range.

E1 – Loss of Carrier:

Communication Time Out or Loss of Carrier. This error code indicates that a packet was not received in the expected time frame. When this error condition is detected functions will be commanded off and Safety Relay (K8) will be maintained for 4 seconds before being commanded off.

E2 – Address Error:

The CPU DIP Switch is set for the incorrect Terminal Address (or visa versa) or another Terminal is attempting to send data on the same carrier frequency. Note: Unused Spare Terminals MUST BE secured to prevent interference with the primary control communication link.

E3 – Output Enable Error:

Output Enable Monitor Input check had incorrect result.

E4 – Processor to Processor Error:

Not applicable in this application.

E5 - Parity Error:

Possible indication of external RF interference.

Note: The interference did not cause the squelch to activate which would have resulted in an E7 error.

E6 – Unidentifiable Relay Error:

Restart the system from a "cold" start. (Remove and reapply power.) If error persists notify Control Chief Customer Service.

E7 – Word Sync Error:

Received Packet Time Out Error - Could be an indication of interference or on the "fringe" of range.

E8 – RAM Test Error:

Restart the system from a "cold" start. (Remove and reapply power.) If error persists notify Control Chief Customer Service.

E9 – I/O Opto Input Card Error:

Error indicates that the I/O Opto Input Card is not installed. Check to insure the card is "seated" in the card rack properly. If error persists notify Control Chief Customer Service.

EA – DIP Switch Address Setup Error:

This error message will be displayed if DIP Switches 1-4 are in the "off" or "open" position which address zero. Address zero is not allowed, the program will lockup and further operation will be inhibited. To clear this error set the DIP Switch Address for the correct system address and press the reset button on the CPU card.

Conditions for Operation

The system will not operate if relays "SR1" and "ES" are not activated. Relay "ES" is activated on system reset when the horn button is pushed. If an Engine Protection package is included then the "ES" relay will NOT activate if Main Reservoir Pressure, or Engine Temperature, or Lube Oil Pressure are NOT normal. Check indicator lights on pneumatics Cabinet to determine the active fault. (Note: For application information on relays SR1, ES and ADR refer to the system print package.)

Brake Release; Locomotive brakes will NOT release if:

1. Locomotive Manual Brake (in the cab) is not released.
2. Train Line Brake (if installed) is not released in the Locomotive Cab. This is necessary even if cars are not connected.
3. Solenoid valves BK5 and BKES are NOT energized. (Note: refer to System Prints for details on BK5 and BKES.)
4. Terminal direction toggle switch is in the Neutral position.

Throttle Advance; Throttle will NOT advance if:

1. Locomotive Brake is not released.
2. Throttle valve (THX) is NOT energized.

Note the Throttle can be advanced if the Main Reservoir pressure is low provided the direction toggle switch on the Terminal is selected to "Neutral", and Brake Pressure is adequate to hold the engine. This allows for charging of the Main Reservoir.

Troubleshooting Aids

The following troubleshooting guidelines and checklists are provided to assist users with operational problems. There are two primary objectives with these aids, first to help users determine a solution to a problem as quickly as possible and second if the user is not able to determine a solution collect sufficient information about the condition of the system for Product Service to provide additional support.

General Troubleshooting Check List:

- ❑ Before troubleshooting the pneumatic section, determine that the locomotive is operating correctly in manual mode.
- ❑ Next, determine if the remote terminal and programmed controller are functional. Following the normal operating procedure, does the terminal operate the programmed controller Relays? For example, when the terminal initially establishes a communication link with the programmed controller relays should be commanded on. If not, refer to the Terminal and Controller Checks lists below.
- ❑ However, if the terminal does operate controller relays and no faults are observed on the controller diagnostics, the problem could be in the intermediate relay section. The problem can be further isolated by "stepping through" the operational sequence and observing the results.

Pneumatics Troubleshooting Check List:

To aid with setup and troubleshooting the pneumatics section has pressure gauges installed to indicate Main Reservoir Pressure, Throttle Pressure (for pneumatic Throttles), Locomotive Brake Pressure, and if installed Train Line Brake Pipe Pressure.

- ☐ Check pneumatic air system filter. Is the filter clogged and in need of new cartridge? Is the filter valve in the proper position for normal operation? (Pointing in direction of airflow)
- ☐ Check indicator lights on the solenoid valves. The valve should actuate when the indicator is ON showing power is applied to the valve.
- ☐ The valve can be manually shifted for test purposes.

Terminal Troubleshooting Check List:

- ☐ Is the Power Keylock switch in the ON position?
- ☐ Check Battery Reading on display. Refer to Table-1 in Manual for reading definition.
- ☐ Does the Terminal initialize? If ERROR LED is flashing refer to Display Panel section on page 5 of this Manual
- ☐ Does the ACTIVE LED flash when HORN is pressed? If not test HORN switch using Switch Diagnostic Mode (this mode to be available in future upgrades).
- ☐ Check Antenna connectors, if equipped with an external antenna. If equipped with an internal antenna place in RF Diagnostic Mode (this mode to be available in future upgrades).

Controller Troubleshooting Check List:

- ☐ Check intermediate relay wiring. Look for loose wires and connections.
- ☐ Check input power supply. Be sure transfer switch is in Remote Position.
- ☐ Check controller 5vdc and 12vdc power supplies output. Terminal Block TB-1 provides test points and designators
- ☐ When power is applied note the status of the Communication and Processor LED's. Refer to Figure 5 and Table 3 for further details.

General Communication Link Checks:

- ☐ Check communication antenna on the Locomotive. Has it been knocked off? Is the connection loose? Hand tightening the connection is sufficient.
- ☐ Check antenna cable between antenna and controller electronic cabinet. Look for physical damage such as nicks or cuts in the insulation indicating the cable may have been pinched or the shield and center conductor is exposed.
- ☐ Check antenna cable connector at the Communication Card.
- ☐ When the initial startup procedure is completed from the Terminal does the Carrier Detect led flash on the Communications Card?
- ☐ Does the "ADR" relay turn on when the communication link is established?
- ☐ Note Error Codes on the Processor Card. Refer to Table 4 and Table 5 for code definitions.

RF Interference Checks.

- ❑ With the **Remote Terminal OFF** is the Carrier Detect (CD) LED on Communication Card blinking?
- ❑ If CD blinks periodically it may be an indication that another user is on the same channel. Check with your plant frequency manager to determine if another user has inadvertently moved to your control channel.
- ❑ If CD blinks erratically then possibly the interference is a source of EMI or RFI such as a bad high voltage connection or other source of potential RF radiators.

Reporting Problems to Product Service:

When experiencing system problems and after going through the checklists and general troubleshooting techniques then note the following items before calling Product Service for assistance.

- ❑ System number, i.e. E-1234. This number should be marked on the Toggle Switch Panel of the Terminal.
- ❑ Note the Controller Diagnostic Codes and Status of the LED indicators on the Communication Card and the Processor Card.
- ❑ What is the condition of system when the mal-function occurs? Note Pneumatic Pressure gauge readings. Is the communication link established? (Can the operator blow the Locomotive horn?) Can the operator Throttle-up and change direction?
- ❑ When a communication link dropout occurs note what is happening with the locomotive or other equipment.
- ❑ Does the communication link dropout occur at a particular location in your plant or yard? If so, are there any large structures or features unique to that area?
- ❑ Is the communication link dropout random or does the occurrence have a certain predictability?