



PO Box 141
Bradford, PA 16701
(814) 362-6811

TRAIN CHIEF LOCOMOTIVE RADIO REMOTE CONTROL SYSTEM

OWNERS MANUAL

*** PRELIMINARY ***

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Written By: Rob Reese/Dan Taylor
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General Information

Introduction

The Train Chief Locomotive Remote Control System is designed for wireless remote control of Short Line Locomotive and Track Mobile applications. The objective of this Owners Manual is provide operating and troubleshooting guidelines for the end user. Included in the Manual is an overview of the system components, start-up and general operating procedures, and Diagnostic Code Definitions.

The objective of The Operational Briefing is to provide an overview of the Train Chief Remote Control System, with particular emphasis on the Terminal and Controller components. The overview includes a discussion of General Operational Functions, a layout of the Terminal with a description of components and features, and a discussion of the Diagnostics in the Controller. Specific operational details are contained in the Application Variant Sections following the General Operational Sections. The sections on operational variants will provide the End User with the specific details required to operate the TCRCS in the application.

In this document the following terminology is used:

Terminal is used when referring to the "Transmitter".

Controller is used when referring to the "Receiver" mounted on the Locomotive.

System description

The basic Train Chief Locomotive Control System consists of two basic components; a battery powered operator terminal and a programmed controller with pneumatic interface. Peripheral support equipment includes a battery charger, rechargeable batteries, surge suppressors and Terminal carrying harness.

Operator Terminal

The Train Chief Remote Terminal is an industrial grade wireless remote control device specifically designed for operators of Short Line Locomotive applications. To achieve the ruggedness and operational ease for the Short Line Operator the Train Chief Remote Terminal provides the following features. The Terminal case is made of lightweight aluminum to withstand the abuse of a switch yard application. Control switches used in the Terminal are sealed and placed on the unit in the best operational position for the operator. Additionally, all switches are sealed and rated for industrial usage. The Terminal is designed to be used by the operator with a harness to facilitate "hands free" operation and to "keep" the unit with the operator in a convenient manner. The Train Chief Programmed Controller is configured specifically for the user's application. This unit is mounted in the user's Locomotive with the appropriate interface configuration. Each user application has its own specific requirements and the Train Chief RCS is able to meet those demands by its hardware and software versatility. Our application engineers review the user's application and determine the necessary control and safety operations to be implemented to provide safe and reliable "wireless" remote control.

Programmed Controller

The Train Chief Programmed Controller is configured specifically for the user's application. This unit is mounted in the user's Locomotive with the appropriate interface configuration. Each user application has its own specific requirements and the Train Chief RCS is able to meet those demands by its hardware and software versatility. Our application engineers review the user's application and determine the necessary control and safety operations to be implemented to provide safe and reliable "wireless" remote control.

The Programmed Controller will be mounted on the mobile unit in various sized enclosures depending on the options. The Programmed Controller consists of an electronics card rack, power supply, and a Pneumatic/Intermediate Relay Interface. (Some installations may require separate cabinets for the intermediate relays and pneumatic interfaces.)

The electronics card rack consists of a card cage Mother Board assembly that houses the Communication Card, Processor Card, and I/O Cards. All cards are keyed and color-coded to prevent insertion in the wrong slot.

Train Chief Locomotive Remote Control System Specifications

General	
Frequency	450-460 MHz
Operating Range	2500 ft. (762 m) Line-of-Sight, environment dependent
Temperature Range	-20 °F to +140 °F (-30 °C to +60 °C)
Battery Life	8 hours typical (continuous operation). Nickel Cadmium rechargeable battery pack
Environmental Conditioning	Terminal suited for outdoor usage, Controller sealed against dust per IP65
System Diagnostics	Built-in LED and Alpha-Numerical Indicators to provide operator prompts and troubleshooting aids.
System Address Capability	15 addresses
Encoding/Decoding Method	Microprocessor/Software based

Remote Terminal	
Dimensions	5.5 x 5.25 x 7.5 inches (14.0 x 13.3 x 19.0 cm)
Weight	5lbs (2.3Kg)
Case	Aluminum main body, left and right plastic switch housings, stainless steel handles
Carrying Method	Four point harness Vest
Switches	Push Buttons, Toggle Switches, Control Levers. Sealed and rated for Industrial usage
Supply Voltage	12 Volt DC NiCAD Rechargeable Battery Pack
RF Power Output	0.5 Watts
Frequency Stability	±1.5kHz over temperature range
Channel Spacing	12.5kHz
Modulation Type	F1D (Frequency Modulation, Digital-no subcarrier, Data)
Spurious Emissions	Conducted & Radiated in accordance with FCC part 90. (Approval in process.)
RF Output Impedance	50 ohms
Data Security	CRC-16
Duty Cycle	Operation Mode Dependent; Active 30%, Maintain 3%

Programmed Controller	
Enclosure	NEMA 12
Supply Voltage	64 VDC
Receiver Sensitivity	<-115 dBm for 12dB SINAD
Image Rejection	>80dB
Intermodulation Rejection	>65dB
Blocking	>84dB
Spurious Response Rejection	>80dB
Adjacent Channel Selectivity (@12.5Khz channel spacing)	>60dB
Modulation	F1D (Frequency Modulation, Digital-no subcarrier, Data)
RF Input Impedance	50 ohms
Data Security	CRC-16
Command Response Time	250 milliseconds
Relay Card Contact rating	15A 30VDC resistive
Intermediate Relay Contact Rating	20A 125 VDC NON-INDUCTIVE

General Features

Initial start up requires three distant actions from the operator so that accidental start-up is extremely unlikely.

The combination Throttle/Brake control lever and system logic precludes any effort to advance the Throttle while applying locomotive brake.

Direction selection is interlocked to prevent "plugging".

The Horn operates on initial start up, and can be sounded on command at any time.

The Bell will sound anytime the locomotive brakes are released, indicating the locomotive could move at anytime.

Optional Status Lights will indicate Brake, Throttle, and Forward or Reverse direction.

Terminal - Overview

The following paragraphs are presented to define and describe the GENERAL layout and operation of the Terminal. Please refer to Figure 1 on page 13 and Figure 2 on page 13 for typical Terminal Layout drawings showing switch locations and component definitions. For System Specific Layout Details refer to the System Print Package.

Control Switches and Throttle/Brake Lever

TERMINAL LEFT SIDE

Emergency Stop (Mushroom Switch)

PULL OUT for normal operation.

PUSH IN to command Emergency Stop action by the Locomotive controller.

Power ON/OFF (Key Switch)

In the OFF position, the key switch removes the power source (battery pack) from the circuit. When the terminal is not being used for long periods of time the key switch should be moved to the OFF position. In addition to extending the life of the battery, it will also provide a greater measure of safety.

Audible Indicator: Sounds to alert the operator when Terminal is TILTED and of a pending EMERGENCY-STOP or Alert Time-out.

Slow beep - Non-Critical alarm. Warns the operator of a non-critical condition, like a switch being "ON" when the Horn button is depressed to initiate communications.

Steady Tone - Tilt Alert. Warns the operator of an imminent E-STOP command resulting from a "tilt" condition. Returning the terminal to an upright position resets this alarm.

Keyed Select Switch: Utilized with Universal Spare Terminal's. The Keyed Select Switch provides a supervisor with the ability to secure a Universal Terminal as the primary remote control unit for any one of several on site Train Chief systems.

RIGHT and LEFT SWITCH POD

The Right and Left Switch Housings provide the best ergonomic location for typical pushbutton (sealed) switch functions, such as, Locomotive Horn, Sand,

Operator Alert, and Uncouple.

TERMINAL RIGHT SIDE

THROTTLE/BRAKE CONTROL LEVER:

The Throttle/Brake Lever incorporates a multi-position rotary switch with detent mechanism. The Throttle/Brake Control Lever is available in two configurations identified by the Control Lever shape. The standard configuration is identified by a "V-Lever" (Fore and Aft Paddles at right angles) and utilizes a Spring-Return-To-Center mechanism in the rotary switch. The Spring-Return-To-Center mechanism will return the Control Lever to an "Idle" position when the operator releases the Control Lever. This is an important safety feature for industrial control systems.

An optional configuration eliminates the Spring-Return-To-Center mechanism in the rotary switch. In the optional configuration the rotary switch will hold the throttle or brake step (by way of the detent mechanism) selected by the operator. A single paddle Control Lever identifies the optional configuration. The single paddle lever extends above the top of the Toggle Switch Panel to facilitate left-hand Throttle/Brake operation. Additionally, when the optional configuration of the Throttle/Brake Control Lever is implemented an Operator Alert function WILL be enabled to provide additional safety due to the absence of the Spring-Return mechanism.

The number of **Throttle Advance** and **Locomotive Independent Brake Apply** steps is dependent on the Application. Refer to the System Prints for specific details on the actual application.

TOGGLE SWITCH PANEL

The Toggle Switch Panel facilitates the use of sealed toggle switches. Toggle switches facilitate sophisticated operational functions such as Train Line Brake control or simply provide an immediate indication of function status, e.g. off/on.

Display Panel

ON/ACTIVE (green)

Constant - Terminal Ready

The Terminal has passed internal self-tests and is ready to initiate the communication link with the Programmed Controller. This status condition occurs on initial power-on and after an E-Stop command is cleared.

Fast Blink - Active Mode

The Operator is an active operation of the Controller. This status condition will occur when a switch or switches is actuated.

Slow Blink - Maintain Mode

This indicates a Battery Conservation Mode under operator control.

OFF – power turned off or terminal in an error condition

If Power-On key switch is NOT in the OFF position, check the status of the ERROR

indicators to determine terminal error condition for further action.

ERROR (red)OFF - No ErrorsConstant - Software Stack Overflow Error

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

Blinking - Terminal Error

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)On - Locomotive Brake Set

Locomotive brakes are set for full application.

Blinking - Locomotive Brake Warning

Operator must press the Deadman button (if present) or move Throttle/Brake lever away from the center position, before the time out expires, or the locomotive brakes will be commanded for full application.

Off - Locomotive Brake Release

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

BAT LOW/DEAD (red)Blinking - Battery Low

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

Constant - Battery Dead

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 recharged pack.
8.90 to 8.85 and below	ON	Terminal Operation is inhibited. The Battery pack must be replaced.

Battery Pack

The Terminal operates on a 12VDC Re-chargeable NiCAD Battery Pack. On a fully charged battery pack the typical operating time will vary from 8 to 12 hours. This variation is due to operating environment, charging cycle maintenance, and battery age.

Antenna

The antenna used in prototype versions of the Train Chief Terminal utilizes a quarter wave UHF Vertical Whip antenna mounted on the Front Panel. The quarter wave whip antenna provides Omni-directional coverage at unity gain. To achieve and realize the maximum performance of the antenna the operator should not use the antenna as a handle, or wrap the antenna around the handles, or tie it down to the unit. The antenna must not be obstructed if maximum performance is to be achieved with the remote terminal.

The primary antenna in the Train Chief Terminal is a patch antenna mounted to the Front Panel and protected by a plastic radome. The radiation pattern of the patch antenna is hemispherical with respect to the front of the unit.

Front Panel

The Front Panel provides primary access for the Train Chief Electronic and Radio Modules.

Figure 1 Terminal Layout Top-Down View – General Reference

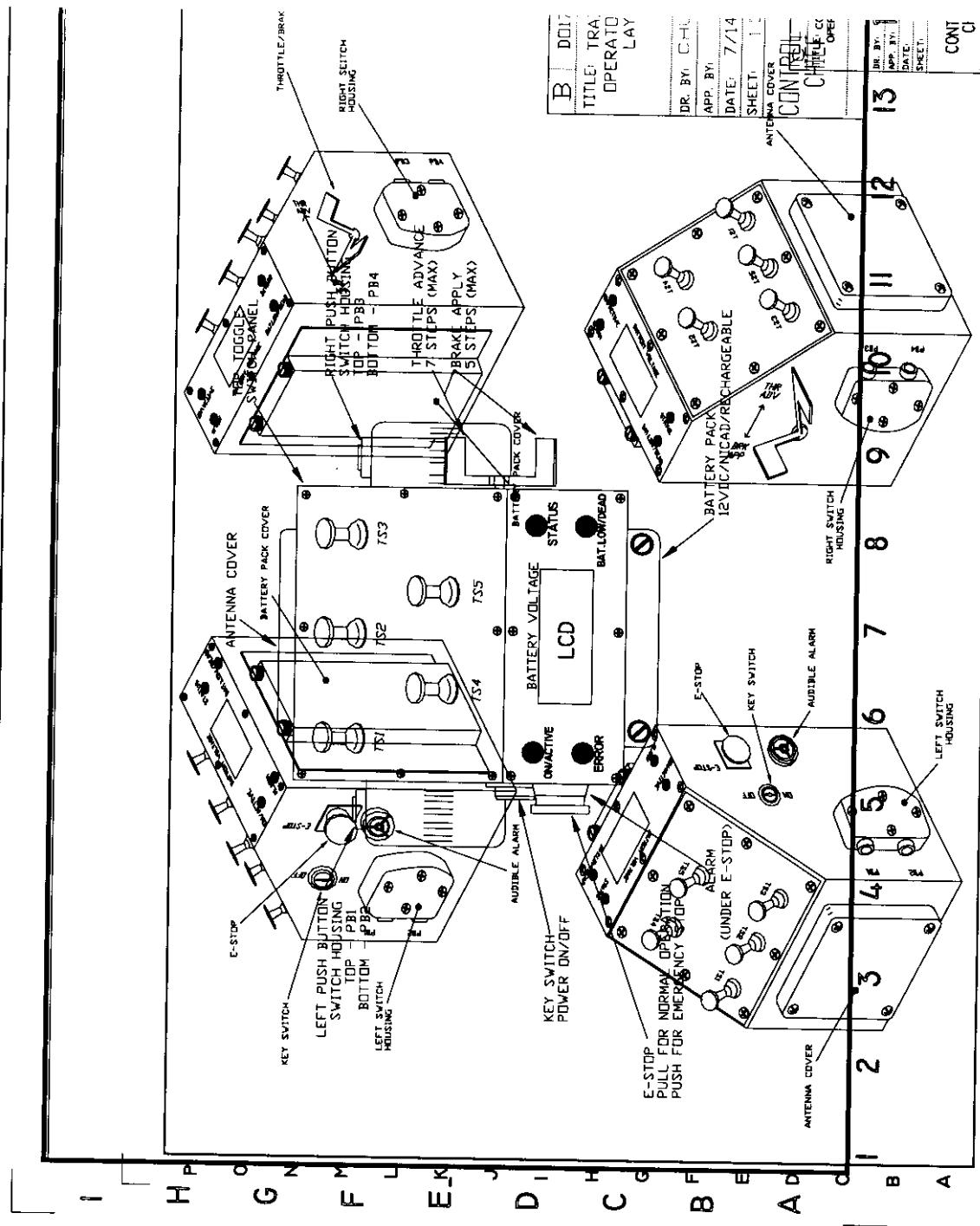


Figure 2 Terminal Layout - Four Views - General Reference

Remote Control Operation

Starting Procedure for Terminal with Standard Throttle/Brake Lever

The engine can only be started when the *Radio/Cab* transfer switch is in the *Cab* position. Before transferring the *Radio/Cab* transfer switch to the *Radio* position the engine should be run in manual until sufficient air pressure has built up (typically 100 psi), and all manual controls and engine status indicators have been checked.

1. Manual Throttle Control to the "Idle" position.
2. Direction Selector to the "Neutral" position and **remove** its handle.
3. "Automatic Brake" lever to "Run" position.
4. The isolation valve in the radio pneumatics' cabinet is open (handle straight).
5. Turn the *Radio/Cab* transfer switch to the *Radio* position. A "Low Main Reservoir Pressure" light on the side of the cabinet could indicate the isolation valve is in the wrong position. Re-check the isolation valve position.
6. Clip the Train Chief Terminal to the Operator Vest/Harness using the four D-rings and adjust for a comfortable fit.
7. Terminal Power-On pre-checks. All control switches and levers must be in their "idle" positions. Terminal Control switch and Lever idle positions are as follows: Forward-Neutral-Reverse in Neutral, Train Line in the center hold position, Throttle/Brake centered, E-Stop pulled out, terminal NOT tilted, and ALL push buttons released (not pressed). Any 2-position toggle switches should be in the "Off" position, if there is one.
8. Fully charged battery pack installed in the Terminal.
9. Terminal Power On. 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). Initialization is complete, and the terminal ready for operation, when the ON/ACTIVE indicator is ON and all the other indicators are turned OFF.
10. When the ON/ACTIVE indicator is ON, the terminal is ready for remote locomotive control. Pressing the HORN button will place the Terminal in Active Mode and initiate communications with the locomotive controller. This will be evident by the response of the Locomotive horn sounding a warning the locomotive is being prepared to move. However, if pressing the HORN button does not sound the locomotive horn, but the Terminal Audible Alarm sounds, then one or more control switches are NOT in their idle position. Check control switch positions and place them in their idle positions, and then press the HORN button once again to proceed.
11. When the Terminal enters active mode, as indicated by the *blinking* ON/ACTIVE indicator, the STATUS indicator should be on to show that locomotive brakes are commanded ON. Once in the active mode, the Terminal should have established a communication link with the controller.
12. From the *Cab* release the Independent Locomotive brake. Brake pressure will not be exhausted at this time because the Remote Terminal has control of the Locomotive brakes.
13. If applicable, close the Generator Field switch and place the isolation switch in "run".
14. If Train Line Brakes are being used, proceed outside and slowly turn the Remote Train Line Diverter Valve to the full counter clockwise, "Remote" position. This valve is usually located under the floor below the operator station.

15. Verify that all Brake Pipe hoses are connected and cutout valves are open.
16. Move the Train Line Brake toggle switch on the terminal to the "Release" position. This will charge the car brake systems. With the Terminal direction selector switch in "Neutral", the locomotive Bell will sound if the Main Reservoir air pressure goes low. To increase Main Reservoir air pressure to required operating pressure, advance the Throttle Lever to position 3 or 4 to increase engine RPM's. When the Main Reservoir has reached the required operating pressure the Throttle will automatically cutback to idle. Release the Throttle lever.
17. Select a direction of travel.
18. Move the Throttle Lever to the first position to release independent locomotive brakes. This position can also be used as a "coast" position. Once the Locomotive brakes have been released the Bell will ring indicating the Locomotive is capable of moving under power or coasting.
19. Continue to advance the Throttle lever forward to increase engine RPM's to accelerate the Locomotive in the selected direction of travel. Directional changes will not be acted on or allowed until full locomotive brakes are commanded and applied.
20. Locomotive Brakes are applied by moving the Throttle/Brake Control Lever in the Brake Apply direction (toward the operator). The further the lever is moved from the center position increases the Locomotive brake apply pressure, thereby, increasing braking effort. Moving the lever in the direction of Brake Apply will automatically retard the throttle to idle.

Re-Start Procedure from A Radio Shutdown

The Radio Shutdown (Emergency Stop) function is a major safety feature of any wireless remote control system. The Emergency Stop function in the Train Chief Locomotive Remote Control system is accommodated by a Red Mushroom push button on the Operator Terminal and on the outside of the Locomotive. When an Emergency Stop mushroom push button is actuated (pushed-in) the Emergency Stop function is activated which forces the Locomotive to a fail-safe condition. The fail-safe condition includes the following actions: locomotive throttle is cutback to idle, locomotive brakes are fully applied, and generator field is opened. If Train Line Brakes are implemented in the system, the Brake Pipe will be dumped and the Train Line Brakes will be at maximum braking effort. In summary, an Emergency Stop command will "dynamite" the train.

In addition to an operator initiated Emergency Stop command, the Remote system can initiate an Emergency Stop under the following conditions:

1. Terminal keyswitch turned off.
2. Terminal battery dead
3. Loss of communication link for more than 4 seconds.
4. Terminal Tilt timeout
5. Any Programmed Controller monitored engine status fault:
 - ◆ Low Main Reservoir Pressure
 - ◆ Low Engine Lube Oil Pressure
 - ◆ High Engine Temperature

After the cause of the Emergency Stop is corrected the operator can restart the system from the Terminal by pressing the Horn button to re-establish the communication link, and then release Train Line brakes with the toggle switch.

Emergency Stopping

Locomotives and Trains DO NOT stop quickly. It is imperative to anticipate stops well in advance. A good rule-of-thumb is to operate at speeds that will allow for controlled stops. And keep in mind, although obvious, the more cars the longer the stopping distances. Stopping short is easy to correct, however, overshooting a stop can be very hazardous. Get accustomed to the remote control system before operating in the production setting where unfamiliarity with the system can be hazardous.

For an Emergency situation the operator has the following options:

1. Activate emergency stop by **pushing the red Emergency-Stop** mushroom push button on the left side of the terminal. This action will inhibit all other command functions and immediately command full Locomotive and Train Line Brakes.
2. **Turn power off to the Terminal** by turning the keylock switch to the off position. This action will apply full Locomotive and Train Line Brakes within four seconds. (Note: The Controller does not consider the loss-of-communications an operator initiated Emergency-Stop command.)

Once the Controller has received an Emergency Stop command from the Terminal, the Terminal MUST BE turned OFF for at least five seconds in order to allow the Controller to clear the Emergency Stop condition. After the Emergency Stop is cleared, as indicated by the Communication Link Status LED on the Controller CPU Card, the Operator can restart the Terminal and re-establish the communication link between Terminal and Controller.

It would be a good idea to experiment with Emergency Braking in an area where you have plenty of room to get the feel of how far it takes to stop under various conditions.

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 (which is typically 3 seconds) 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".

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, generator field cutoff, 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. The ALERT button MUST be pressed AND released to turn off the alarm. After the alarm sounds, the E-STOP command will be sent after 10 seconds, if the alert button is not pressed, or no other change occurs.

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).

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, generator field cutoff, 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 pressing and holding the ALERT button.

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, generator field cutoff, 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. Locomotive brakes are also applied when the direction switch is placed in the NEUT position. 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 (i.e. without first selecting the NEUT position), the Terminal will command neutral and wait for Deadman to time-out or the operator to command full locomotive brakes.

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.

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. Slow blinking of the ON/ACTIVE indicator indicates the "Maintain" rate. 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 Operations

For an Emergency situation the operator has the following options:

3. **Activate emergency stop by pushing the red Emergency-Stop mushroom push button on the left side of the terminal.** This action will inhibit all other command functions and immediately command full Locomotive and Train Line Brakes.
4. **Turn power off to the Terminal** by turning the keylock switch to the off position. This action will apply full Locomotive and Train Line Brakes within four seconds. (Note: The Controller does not consider the loss-of-communications an operator initiated Emergency-Stop command.)

Once the Controller has received an Emergency Stop command from the Terminal, the Terminal MUST BE turned OFF for at least five seconds in order to allow the Controller to clear the Emergency Stop condition. After the Emergency Stop is cleared, as indicated by the Communication Link Status LED on the Controller CPU Card, the Operator can restart the Terminal and re-establish the communication link between Terminal and Controller.

Start-up Procedure for Terminal with Optional Throttle/Brake Lever

The engine can only be started when the *Radio/Cab* transfer switch is in the *Cab* position. Before transferring the *Radio/Cab* transfer switch to the *Radio* position the engine should be run in manual until sufficient air pressure has built up (about 100 psi), and all manual controls and engine status indicators have been checked.

1. Manual Throttle Control to the "Idle" position.
2. Direction Selector to the "Neutral" position and **remove** its handle.
3. "Automatic Brake" lever to "Run" position.
4. The isolation valve in the radio pneumatics' cabinet is open (handle straight).
5. Turn the *Radio/Cab* transfer switch to the *Radio* position. A "Low Main Reservoir Pressure" light on the side of the cabinet could indicate the isolation valve is in the wrong position. Re-check the isolation valve position.
6. Clip the Train Chief Terminal to the Operator Vest/Harness using the four D-rings and adjust for a comfortable fit.
7. Terminal Power-On pre-checks. All control switches and levers must be in their "idle" positions. Terminal Control switch and Lever idle positions are as follows: Forward-Neutral-Reverse in Neutral, Train Line in the center hold position, Throttle/Brake lever in the full Brake position (lever all the way back), E-Stop pulled out, terminal NOT tilted, and ALL push buttons released (not pressed). Any 2-position toggle switches should be in the "Off" position, if there is one.
8. Fully charged battery pack installed in the Terminal.
9. Terminal Power On. 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). Initialization is complete, and the terminal ready for operation, when the ON/ACTIVE indicator is ON and all the other indicators are turned OFF.
10. When the ON/ACTIVE indicator is ON, the terminal is ready for remote locomotive control. Pressing the HORN button will place the Terminal in Active Mode and initiate communications with the locomotive controller. This will be evident by the response of the Locomotive horn sounding a warning the locomotive is being prepared to move. However, if pressing the HORN button does not sound the locomotive horn, but the Terminal Audible Alarm sounds, then one or more control switches are NOT in their idle position. Check control switch positions and place them in their idle positions, and then press the HORN button once again to proceed.
11. When the Terminal enters active mode, as indicated by the *blinking* ON/ACTIVE indicator, the STATUS indicator should be on to show that locomotive brakes are commanded ON. Once in the active mode, the Terminal should have established a communication link with the controller.
12. From the *Cab* release the Independent Locomotive brake. Brake pressure will not be exhausted at this time because the Remote Terminal has control of the Locomotive brakes.
13. If applicable, close the Generator Field switch and place the isolation switch in "run".
14. If Train Line Brakes are being used, proceed outside and slowly turn the Remote Train Line Diverter Valve to the full counter clockwise, "Remote" position. This valve is usually located under the floor below the operator station.
15. Verify that all Brake Pipe hoses are connected and cutout valves are open.
16. Move the Train Line Brake toggle switch on the terminal to the "Release" position. This will charge the car brake systems. With the Terminal direction selector switch in

"Neutral", the locomotive Bell will sound if the Main Reservoir air pressure goes low. To increase Main Reservoir air pressure to required operating pressure, advance the Throttle Lever to position 3 or 4 to increase engine RPM's. When the Main Reservoir has reached the required operating pressure the Throttle will automatically cutback to idle. Release the Throttle lever.

17. Select a direction of travel. Selecting a direction will release the Locomotive "Parking" brake. The Throttle/Brake lever should be in 5th Brake position to hold the locomotive in place.
18. Move the Throttle/Brake Lever forward from 5th Brake position to "idle" noted by the raised marker on the Toggle Switch panel. One in the "idle" position the locomotive is in a "coast" mode since neither throttle nor brake is being actively commanded. Once the Locomotive brakes have been released the Bell will ring indicating the Locomotive is capable of moving under power or coasting.
19. Continue to advance the Throttle lever forward to increase engine RPM's to accelerate the Locomotive in the selected direction of travel. Directional changes will not be acted on or allowed until full locomotive brakes are commanded and applied.
20. Locomotive Brakes are applied by moving the Throttle/Brake Control Lever in the Brake Apply direction (toward the operator). The further the lever is moved from the center position increases the Locomotive brake apply pressure, thereby, increasing braking effort. Moving the lever in the direction of Brake Apply will automatically retard the throttle to idle.

Re-Start Procedure from A Radio Shutdown

The Radio Shutdown (Emergency Stop) function is a major safety feature of any wireless remote control system. The Emergency Stop function in the Train Chief Locomotive Remote Control system is accommodated with push buttons on the Operator Terminal and on the outside of the Locomotive. When an Emergency Stop mushroom push button is actuated (pushed-in) the Emergency Stop function is activated which forces the Locomotive to a fail-safe condition. The fail-safe condition includes the following actions: locomotive throttle is cutback to idle, locomotive brakes are fully applied, and generator field is opened. If Train Line Brakes are implemented in the system, the Brake Pipe will be dumped and the Train Line Brakes will be at maximum braking effort. In summary, an Emergency Stop command will "dynamite" the train.

In addition to an operator initiated Emergency Stop command, the Remote system can initiate an Emergency Stop under the following conditions:

6. Terminal keyswitch turned off.
7. Terminal battery dead
8. Loss of communication link for more than 4 seconds.
9. Terminal Tilt timeout
10. Any Programmed Controller monitored engine status fault:
 - ◆ Low Main Reservoir Pressure
 - ◆ Low Engine Lube Oil Pressure
 - ◆ High Engine Temperature

After the cause of the Emergency Stop is corrected the operator can restart the system from the Terminal by pressing the Horn button to re-establish the communication link, and then release Train Line brakes with the toggle switch.

Emergency Stopping

Locomotives and Trains DO NOT stop quickly. It is imperative to anticipate stops well in advance. A good rule-of-thumb is to operate at speeds that will allow for controlled stops. And keep in mind, although obvious, the more cars the longer the stopping distances. Stopping short is easy to correct, however, overshooting a stop can be very hazardous. Get accustomed to the remote control system before operating in the production setting where unfamiliarity with the system can be hazardous.

For an Emergency situation the operator has the following options:

5. Activate emergency stop by **pushing the red Emergency-Stop** mushroom push button on the left side of the terminal. This action will inhibit all other command functions and immediately command full Locomotive and Train Line Brakes.
6. **Turn power off to the Terminal** by turning the keylock switch to the off position. This action will apply full Locomotive and Train Line Brakes within four seconds.
(Note: The Controller does not consider the loss-of-communications an operator initiated Emergency-Stop command.)

Once the Controller has received an Emergency Stop command from the Terminal, the Terminal MUST BE turned OFF for at least five seconds in order to allow the Controller to clear the Emergency Stop condition. After the Emergency Stop is cleared, as indicated by the Communication Link Status LED on the Controller CPU Card, the Operator can restart the Terminal and re-establish the communication link between Terminal and Controller.

It would be a good idea to experiment with Emergency Braking in an area where you have plenty of room to get the feel of how far it takes to stop under various conditions.

General Operation Procedures

Throttle, Locomotive Brake and Brake Release Operation

The Throttle/Brake lever has fourteen (14) detent positions. Starting with the lever all the way back (toward the battery) there are five (5) positions of brake, one "idle" position, then eight (8) positions of throttle (note that only the first 7 throttle positions are used. The 7th and 8th positions both command full throttle). The "idle" position is indicated by a raised marker on the terminal case, and marks the boundary between brake and throttle positions. In the "idle" position, no throttle or locomotive brakes are commanded, so this position may be used for coasting. From the "idle" position, locomotive brakes are progressively applied by moving the lever back toward the battery, or throttle is progressively advanced by moving the lever forward.

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/RESET button is pressed AND released, within 10 more seconds, the alarm will turn off and the E_STOP command will not be sent.

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/RESET 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).

Operator Alert Bypass

The Operator Alert function can be momentarily bypassed by holding full locomotive brake – maintaining the Brake lever in the maximum brake position (lever all the way back toward the battery).

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 full locomotive brake – maintaining the Brake lever in the maximum brake position (lever all the way back toward the battery).

Man Down Alarm Operation

While communications are active, if a “tilt” condition exists for more than 60 seconds, the “Man Down Alarm” will be triggered. When this happens, the locomotive horn will sound continuously. This occurs even if tilt bypass is active.

If the “tilt” condition doesn’t result in an E-STOP (i.e. tilt bypass is active), then the alarm can be reset by returning the terminal to an upright position within 60 seconds.

To reset the alarm if the “tilt” condition does result in an E-STOP however, the operator must return the terminal to an upright position, then wait a minimum of 5 seconds and THEN re-initialize communications by pressing the Horn button. This must all occur within 60 seconds or the “Man Down Alarm” will be triggered.

Once the horn sounds, the only way to turn it off is to remove the key from the Terminal, and use it to reset the alarm inside the cab of the locomotive.

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.

This operation does NOT trigger the “Man Down” alarm.

Directional Change Operation

The system will not allow a directional change unless locomotive brakes are fully applied. 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 are released the terminal will not allow a direction change until locomotive brakes have been fully 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 the operator to command full locomotive brakes.

Train Line Brake Operation

The Train Line Brakes are operated using the switch labeled RELEASE-LAP-APPLY. When the switch is placed in the RELEASE position, Train Line Brakes are commanded for full pressure, which places the brakes in a fully released state. When the switch is moved to the LAP position, a minimum of 6 lbs. of differential pressure is applied, engaging a minimum amount of brakes. When the switch is held in the APPLY position, pressure is bled off, progressively engaging more brakes, for as long as the switch is held in this position. When the switch is released from the APPLY position, it moves to the LAP position, and the last applied pressure is held.

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 are at a "Maintain" rate, the "Active" rate is immediately activated to restore fast operator response.

Emergency Operations

For an Emergency situation the operator has the following options:

1. Activate emergency stop by **pushing the red Emergency-Stop mushroom push button** on the left side of the terminal. This action will inhibit all other command functions and immediately command full Locomotive and Train Line Brakes.
2. **Turn power off to the Terminal** by turning the keylock switch to the off position. This action will apply full Locomotive and Train Line Brakes within four seconds. (Note: The Controller does not consider the loss-of-communications an operator initiated Emergency-Stop command.)

Once the Controller has received an Emergency Stop command from the Terminal, the Terminal MUST BE turned OFF for at least five seconds in order to allow the Controller to clear the Emergency Stop condition. After the Emergency Stop is cleared, as indicated by the Communication Link Status LED on the Controller CPU Card, the Operator can restart the Terminal and re-establish the communication link between Terminal and Controller.

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. An important antenna placement requirement is, 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

Radio Module

The Communication Card consists of the necessary interface circuitry for the Radio Module. The Radio Module is a Synthesized UHF Receiver specifically designed for radio telemetry applications.

RF Channel Configuration

The RF channel frequency is pre-set at the factory based on customer site channel availability coordinated by Application Engineering.

Communication Card Diagnostics

The Communication Card provides 4-LED indicators for troubleshooting the communication RF link. Please refer to Figure 6 Communication and Processor Card LED Indicators on page 29 for LED location and Table 3 on page 30 for functional description.

Processor Card

System Address Configuration

The System address is established by Application Engineering to provide system operational security. The System Address is pre-set at the factory by means of DIP Switch SW1 on the Processor Card (Figure 4 on page 13).

System Address setup

The System Address is pre-set at the factory or by Field Service personnel, and should not require re-configuration by the end user. However, when determined and under the direction of Control Chief Engineering or Product Service there are situations when the end user may need to re-configure the System Address. For Processor Card System Address re-configuration please refer to the discussion below and **Error! Reference source not found. Error! Bookmark not defined.** for reference.

The 4-bit System Address is set by switch positions 1, 2, 3, and 4 of the Processor Card

DIP Switch, SW1. The switch settings must match the 4-bit address assigned by Application Engineering and recorded in the ADDRESS block of the Terminal Layout print. To setup the Processor Card for the assigned System Address the DIP switches must be set according to [Table 2 SW1 System Address Table on page 28](#). (To date the Terminal System Address is NOT field re-configurable.)

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.

Diagnostic Mode Setup

The Diagnostic Mode is selected by SW1 DIP switch positions 5, 6, 7, and 8. To date, the only diagnostic mode available is Operational Mode. Operational Mode is selected when switch positions 5, 6, 7, and 8 are in the OFF or "0" position states. Please refer to [Figure 5 on page 28](#) for further reference.

Operational Mode Diagnostics

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 display shows the last active error code. Please refer to [Figure 6 on page 29](#) for LED position definitions and [Table 4 on page 30](#) for LED functional definitions. The Operational Diagnostic Codes are defined in [Table 5 on page 31](#) and [Table 6 on page 31](#) of this document.

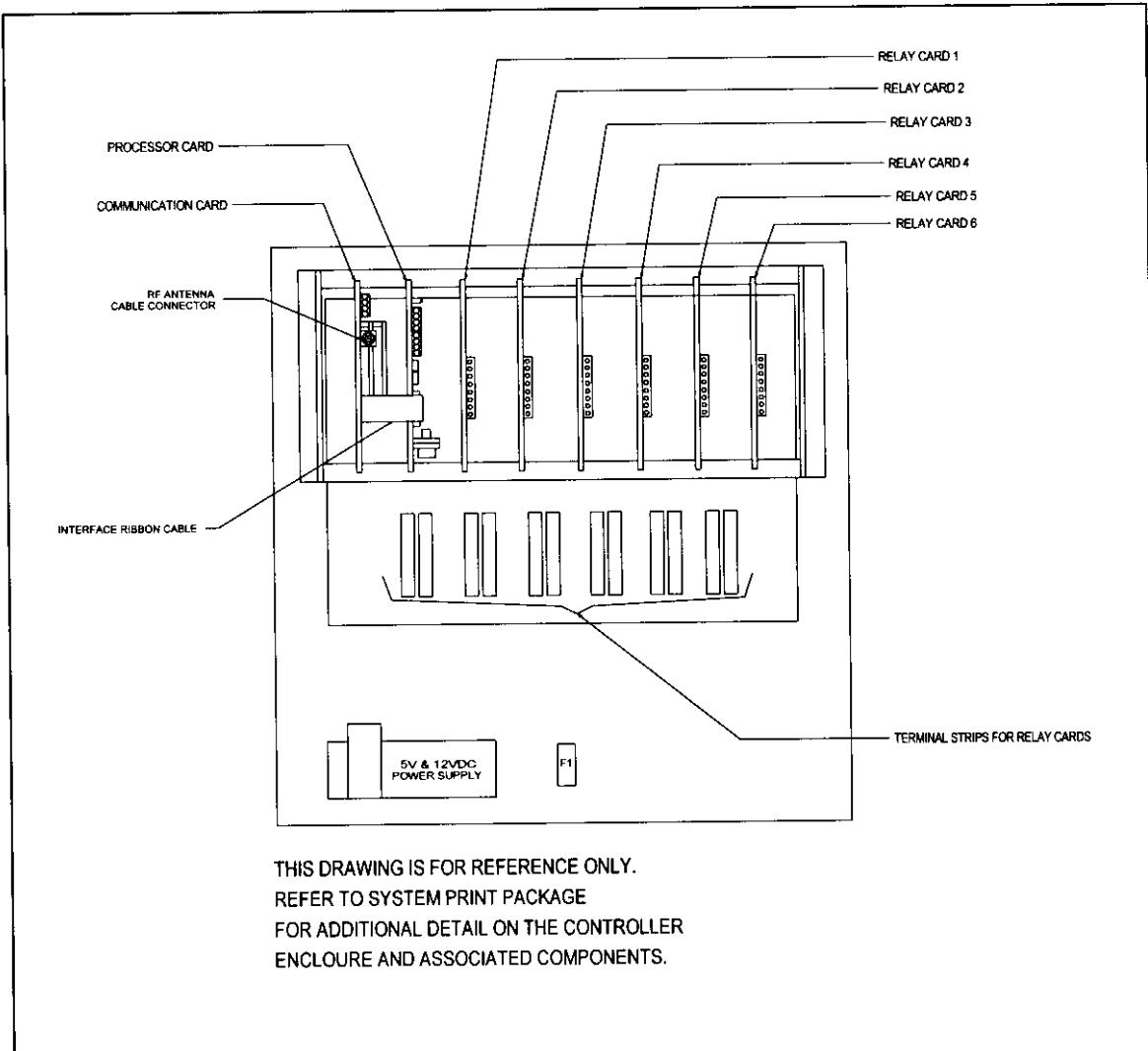
Figure 3 Programmed Controller Enclosure Layout

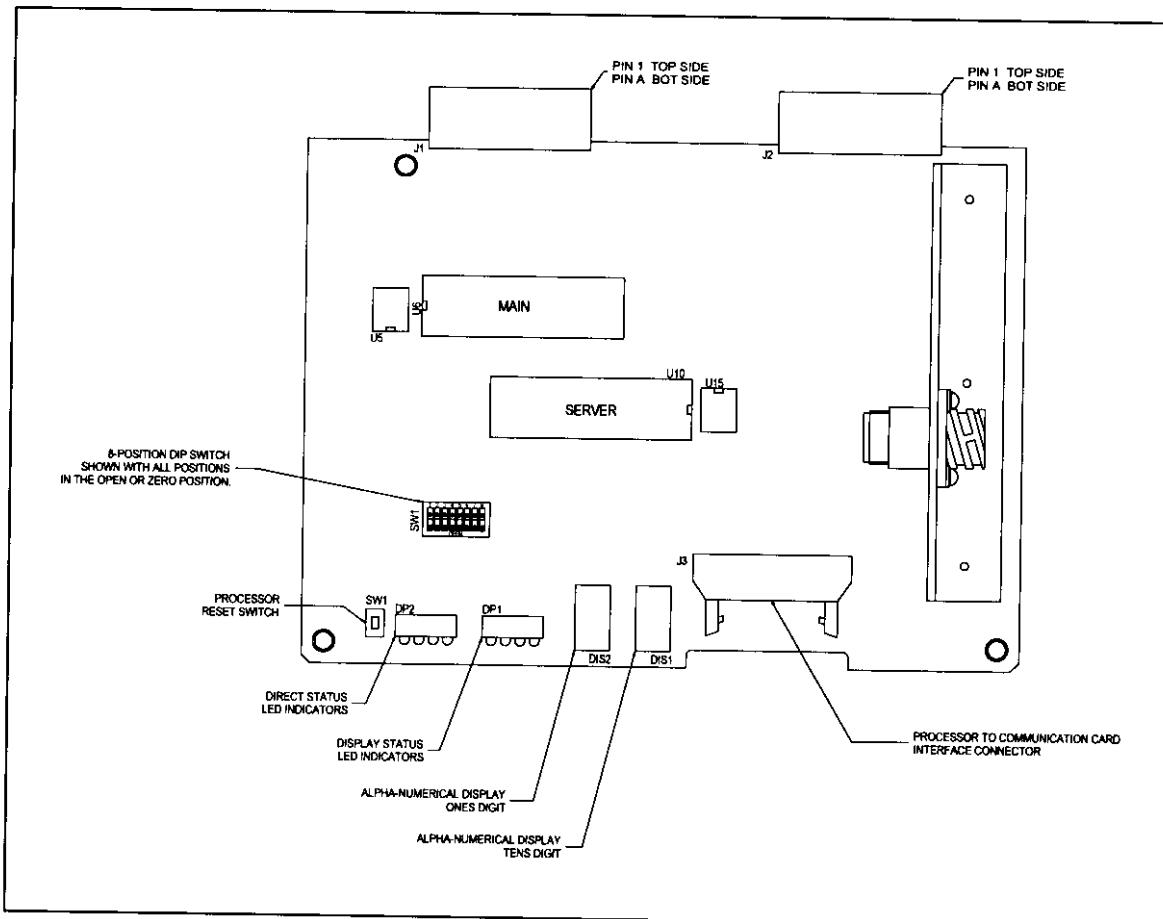
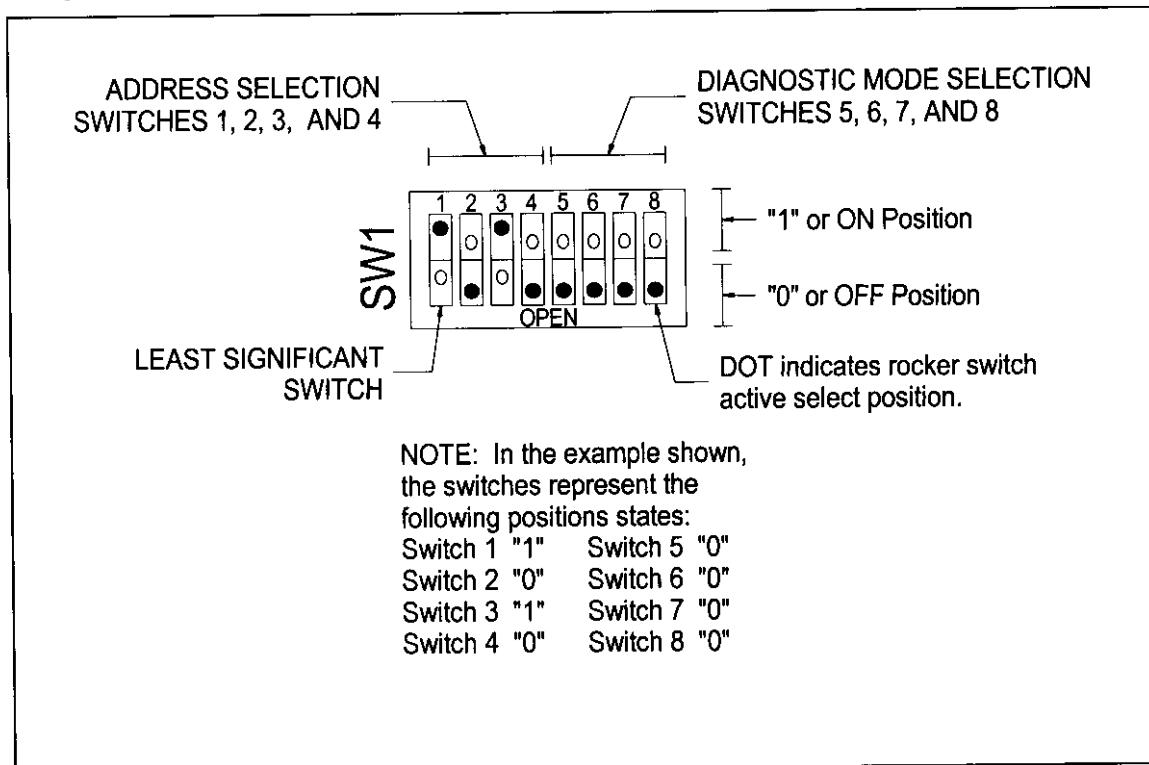
Figure 4 Processor Card Layout – TOP VIEW

Figure 5 Processor Card Configuration Settings via DIP Switch SW1**Table 2 SW1 System Address Table**

System Address		SW1 Switch Position States for 4-bit System Address								
Binary	Hex	"1"	"2"	"3"	"4"	"5"	"6"	"7"	"8"	
0000	0	0	0	0	0	0	0	0	0	
0001	1	1	0	0	0	0	0	0	0	
0010	2	0	1	0	0	0	0	0	0	
0011	3	1	1	0	0	0	0	0	0	
0100	4	0	0	1	0	0	0	0	0	
0101	5	1	0	1	0	0	0	0	0	
0110	6	0	1	1	0	0	0	0	0	
0111	7	1	1	1	0	0	0	0	0	
1000	8	0	0	0	1	0	0	0	0	
1001	9	1	0	0	1	0	0	0	0	
1010	A	0	1	0	1	0	0	0	0	
1011	B	1	1	0	1	0	0	0	0	
1100	C	0	0	1	1	0	0	0	0	
1101	D	1	0	1	1	0	0	0	0	
1110	E	0	1	1	1	0	0	0	0	
1111	F	1	1	1	1	0	0	0	0	

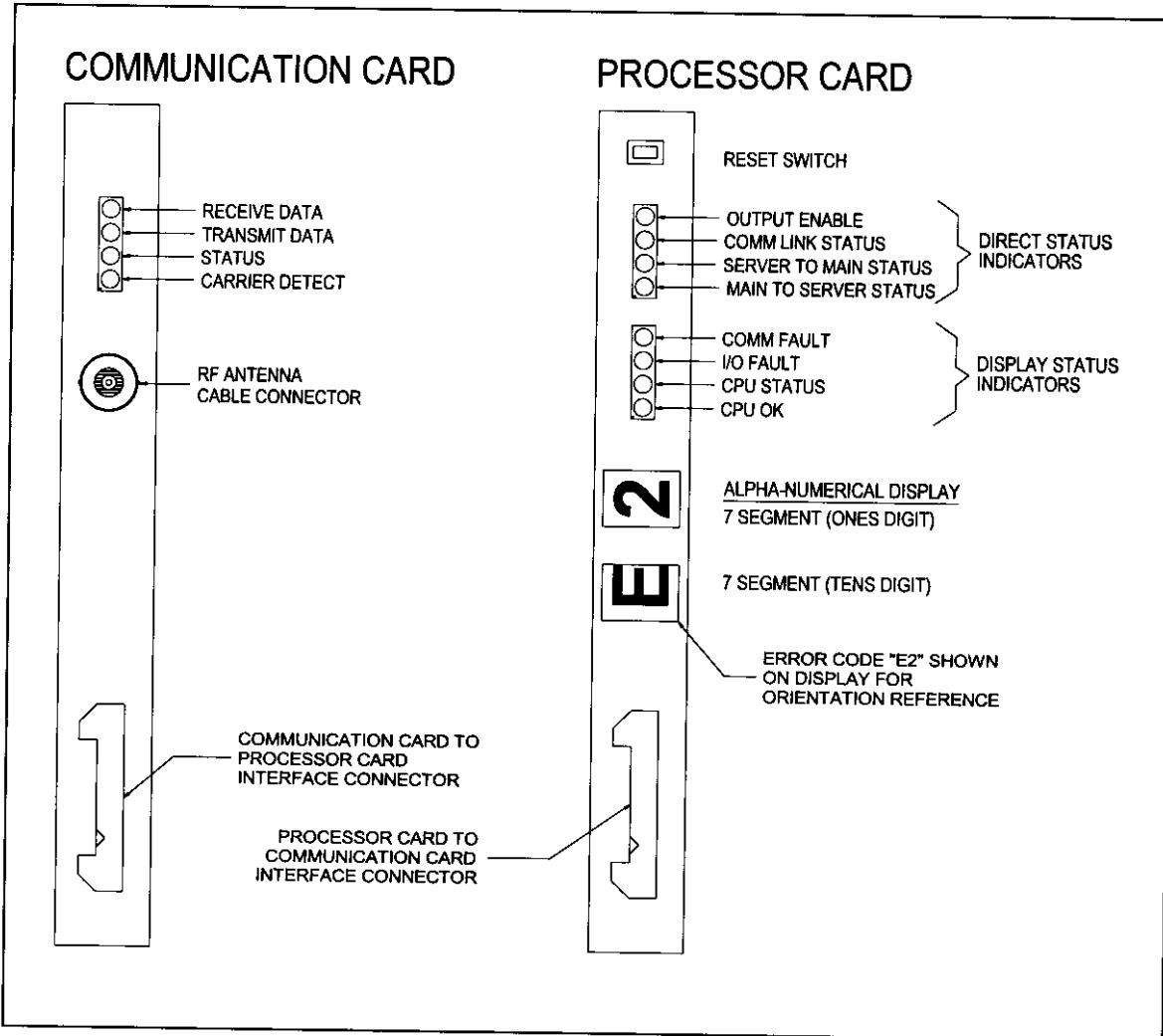
Figure 6 Communication and Processor Card LED Indicators

Table 3 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 4 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 5 Train Chief Controller CPU Card Diagnostic Codes

Table 6 Train Chief Controller CPU Card Diagnostic Codes (Continued)

Comments	DIS1	DIS2	Tens Digit	Ones Digit	CPU Lockup – Requires Operator Reset to Clear.	Not Used	Not Used
			E	9			
			E	8			
			E	7			
			E	6			
			E	5			
			E	4			
			E	3			
			E	2			
			E	1			
			E	0			

Diagnostic Code Definition

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 – SOH/Address Error:

StartOfHeader / Address Error. Could be an indication of interference or on the "fringe" of range or another Terminal is attempting to send data on the same carrier frequency.

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 is address zero. Address zero is not allowed, the program will lockup and further operation will be inhibited. To clear this error set DIP Switches 1-4 to the correct system address and press the reset button on the CPU card.

Pneumatic System

The pneumatic cabinet contains the valves, regulators and pressure switches employed in the control of the pneumatic functions on the engine with pneumatic throttles. Each throttle valve utilizes an associated regulator which is adjusted for optimum throttle performance under normal working conditions. In conjunction with the five speed throttle control valves, a throttle transfer valve is used to select throttle control from either manual cab control or remote control. With electric throttle, intermediate relays are used to provide the required steps of throttle sequencing.

Braking is obtained by controlling five solenoid valves and regulators in a manner to increase or decrease the brake effort. Each step of brake is individually adjusted to provide a smooth brake application under normal use. A separate solenoid valve is used as an to control emergency stop brake application. This valve as well as fifth step of brake is normally energized to release the brakes. Removal of power from either of these valves will apply the brakes in an emergency (full applied) manner and simultaneously retard the throttle.

The pneumatic cabinet also contains the auxiliary function valves for operating the horn, bell, sanders and Train Line Brakes.

In addition to the solenoid control valves, the pneumatic cabinet contains pressure switches to sense the Main Reservoir Pressure, Brake Pressure, and Throttle Pressure. Main Reservoir pressure switch energizes when enough air is available in the Main Reservoir to operate the engine safely. Should an air leak occur significant enough to causes this switch to deactivate, the main control relay "ES" would be de-energized, causing the throttle to be reduced to idle and the brakes to be applied to the preset Emergency Brake pressure.

The Brake pressure switch is used to interlock the throttle and direction select circuit so that there can be no direction change without enough brake pressure to ensure the locomotive is stopped and the throttle is at idle. (This will prevent "plugging" and subsequent damage to the traction motors.)

The solenoid valves have indicator lights to show when power is applied and the valves can be manually shifted for test purposes.

Pressure Gages are provided in the pneumatic Cabinet to aid with setup and troubleshooting.

Programmed Controller – Options

Man Down Alarm

Wheel Slip Signal Input To Control Throttle Reduction

Event Logging

Operation Events
Errors
Impact
Other

Software Upgrade Procedures

Introduction

Occasionally, the end user may have changes in operational requirements, which impact the functional operation of the TCRCS. Functional changes can generally be achieved by way of a software upgrade, which can be accomplished by qualified maintenance personnel on site. The end user simple contacts Control Chief Application Engineering and describes the required functional changes for their system. Upon review of the requested Operational changes Application Engineering will determine if the changes can be achieved via a Software upgrade or if other measures are needed, and the required costs for the upgrade service.

Once Application Engineering has determined a software upgrade will fulfil the functional operation change the appropriate upgrade kit will be sent to the customer. Included in the kit will be upgrade instructions, any special tools for chip extraction, and the upgraded firmware to be installed.

Terminal Software Upgrade Procedure

Provided by Application Engineering upon review of existing system and application.

Programmed Controller Software Upgrade Procedure

Provided by Application Engineering upon review of existing system and application.

Application Variants

Introduction

The Train Chief Locomotive Remote Control system is designed for integration into a Short Line Locomotive control system. The objective of this integration is to enhance the productivity of a Short Line Locomotive, while maintaining safety and reliability. Although the system is specific to Short Line Locomotive Applications, nevertheless, it provides the flexibility to cover the range of application scenarios in the Short Line Locomotive arena. With the wide range of Short Line Locomotive operations, each one being unique, how can a Remote Control System provide the required flexibility to meet all the unique requirements of the various operations? Hence, the objective of this section, to provide application variant examples as a guideline for selecting and using the TCLRCS in a particular Short Line operation. The following examples will show general application implementation in three application variants. These examples demonstrate how the flexibility of the TCLRCS can be easily configured to satisfy the functional and operational requirements of the remote control system.

The following sections will discuss each Application Variant, designated by a Type Number, and its configuration and operation. As application variants are developed they will be added to this section and referenced by a Type Number.

Type 01

This application variant is primarily distinguished by the standard configuration of the Throttle/Brake Control Lever. As described in the section, the standard Throttle/Brake Control lever consists of a "V-lever" with fore and aft pads, and incorporates a Spring-Return-To-Center multi-position switch. When the operator releases the control lever the integral return-to-center-spring of the multi-position switch will bring the control lever to its idle or off command. This return-to-center-spring feature acts as an integrated Deadman control, and facilities one-hand operation by the operator.

While he is commanding locomotive movement, he must maintain the throttle command by holding the control lever at a throttle step. If he lets go of the control lever, the lever will return to its center position and the Terminal will initiate the internal Deadman timer. Once the Deadman Timer expires the terminal will send the deadman command to the locomotive controller for Locomotive brakes to be commanded ON.

Control Lever with Spring-Return-To-Center (integrated Deadman control)

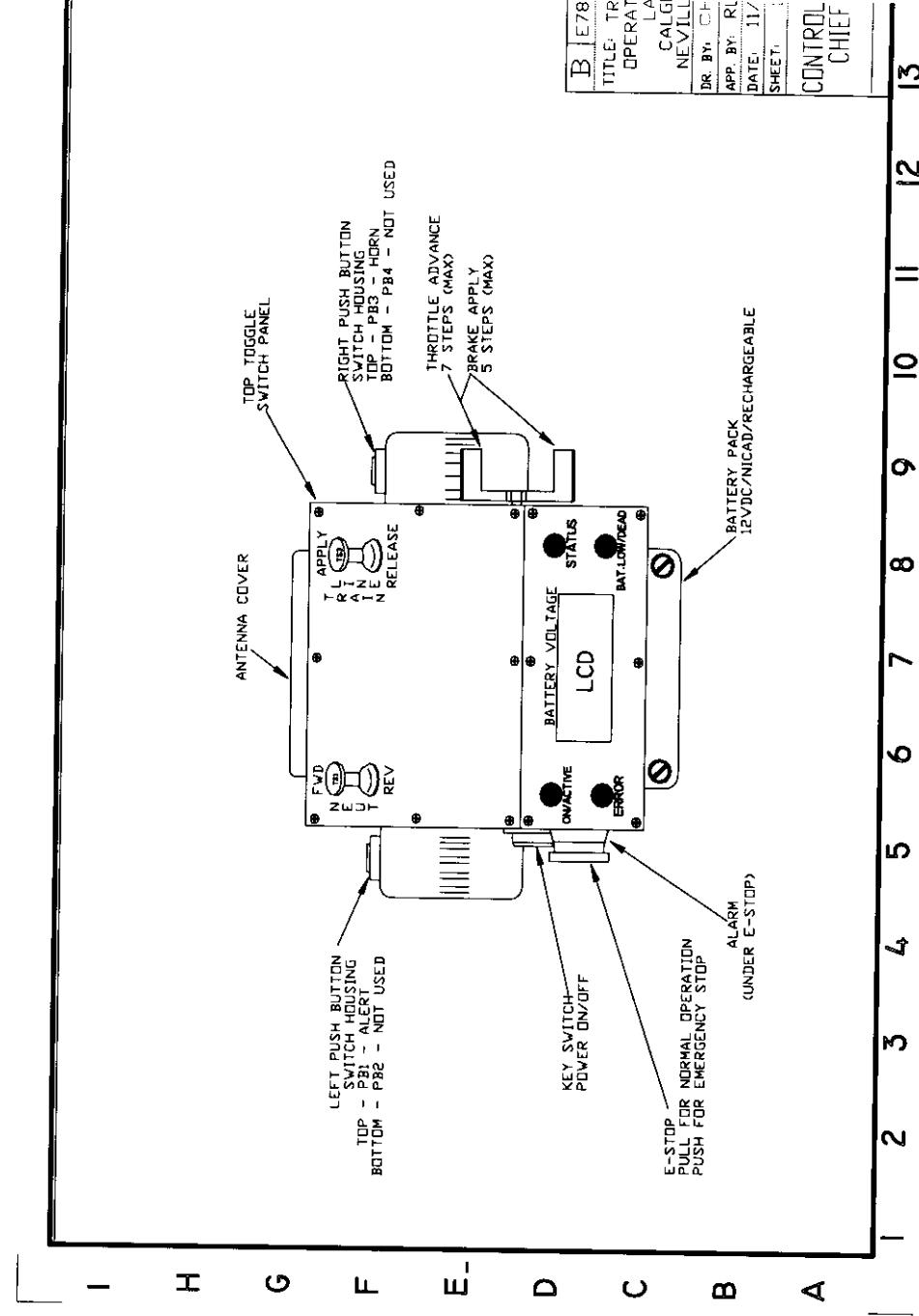
Applications that require one-hand operation with a built-in safety or deadman may find this base variant configuration suitable to their operation.

With the lever is in its center or idle position, Throttle and Independent Locomotive Brake functions are commanded off. Additionally, the center (for standard configurations) or idle (for optional configurations) position may also be used to determine other operational functions to be acted on by the Terminal, i.e., Deadman.

The ergonomic design of the standard control lever facilitates the convenient operation of Throttle and Locomotive Independent Brake functions on a single control lever. To increase Locomotive Throttle (upon completion of start-up procedures), the operator simply places his thumb on the forward lever pad and pushes the lever away from him to command an increase in engine Rpm's. To reduce Rpm's the operator simply reduces thumb pressure on the forward pad to the next lower step position or releases (meaning "hands off" of) the lever to allow it to return to center position. Similarly, to command Locomotive Independent Brake the operator places his thumb on the aft lever pad and pushes the lever towards him to increase the application of Locomotive brake pressure. To decrease the Locomotive brake application the operator reduces thumb pressure on the lever to the next brake step position or releases the lever and it will return to center position.

Intra-Plant Switching. The movement of cars from one place to another within the yards of a plant or industry.

Figure 7 Type 01 Terminal Layout

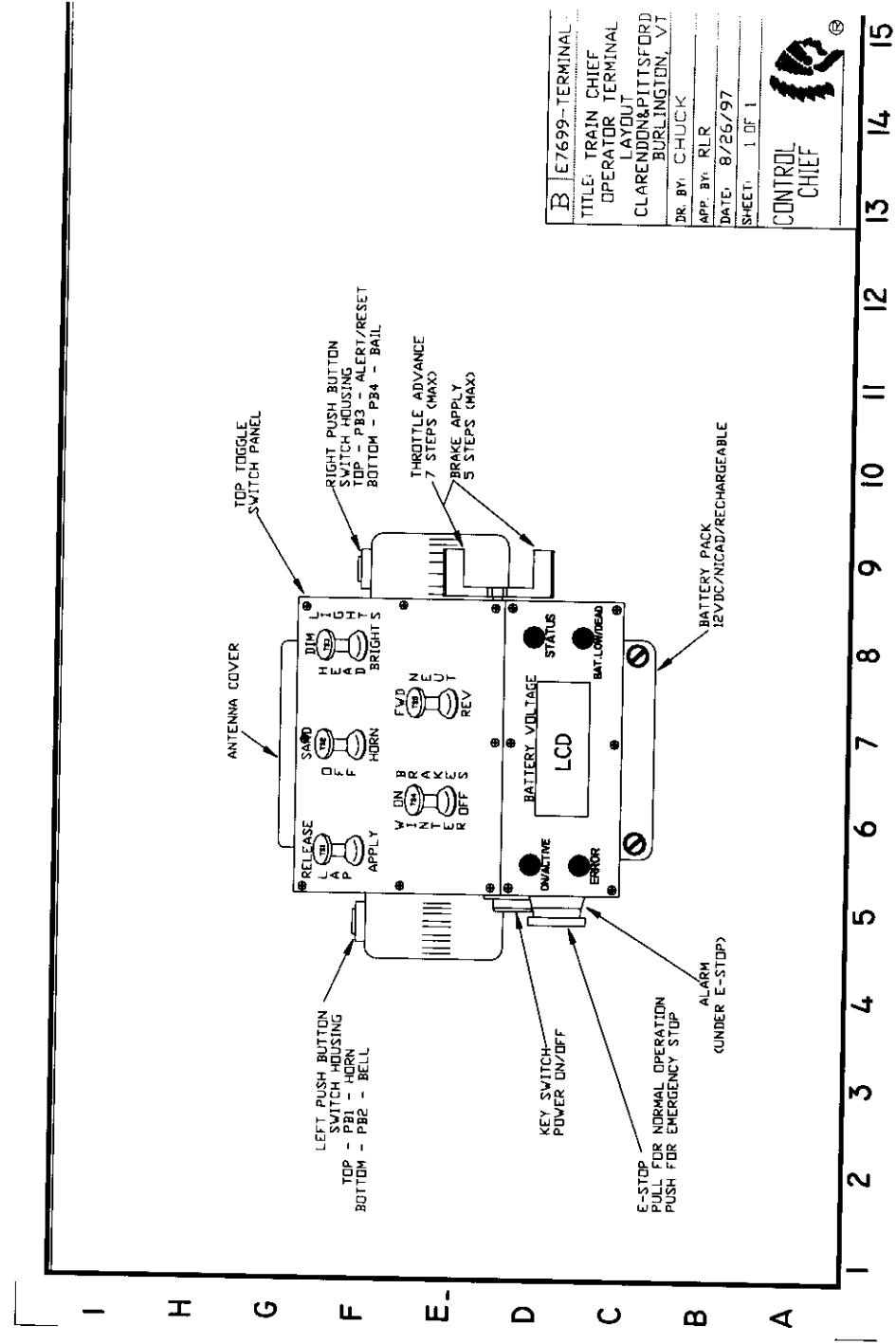


Type 02

Control Lever without Spring-Return-To-Center

For applications where operators are moving trains from terminal to terminal may find this configuration suitable to their needs. With the spring-return-to-center feature eliminated in the Control Lever an operator can set the desired throttle step and not have to hold the lever for long periods at a time. However, in the interest of safety to insure the operator is aware of his situation around him an operator alert safety feature will be implemented. Intra-Terminal Switching. The movement of cars from one place to another within the limits of a terminal on the same transportation line.

Figure 8 Type 02 Terminal Layout



Type 03

For applications using Track Mobile systems Variant 03 provides a starting base with which to start to build a system.

A track mobile system operates slightly differently then a typical short line locomotive. Hence, the use of Variant Type to distinguish it from the rest. Usually, Track mobiles will utilize a different component and operation terminology.

Track Mobile. (Track Car – Any equipment operated on track, such as motor car, hand car, trailer, or other unit not on standard railcar trucks.)

Train Chief Remote Control System

Operational Briefing

Figure 9 Type 03 Terminal Layout

