



INSTALLATION & SERVICE

TRAIN SENTINEL SYSTEM

February 2011 (Revised June 2014)

DOCUMENT NO. OBE-00-11-04
VERSION A.1

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REVISION HISTORY

Rev.	Date	Author	Description
A	2/2011	DLW	Initial release
A.1	06/2014	TP	Change to Siemens Branding

1.0 INTRODUCTION

1.1 SYSTEM CONCEPT

Train Sentinel® is a non-vital component of the Train Control (TC) solution; a Positive Train Control (PTC) system designed to provide a cost-effective, reliable and safer means to operate trains within a railroad network. The primary operational components of the Train Sentinel® System are the CAD—ACT Dispatcher Control System, the Train Sentinel® locomotive subsystem, and GPS technology.

Major functions performed by Train Sentinel® Systems are:

- electronic delivery, monitoring and enforcement of Track Warrant and Bulletins
- wayside status monitoring and enforcement, including switches and signals
- speed limit monitoring and enforcement (i.e., civil and restricted speed).

The Sentinel System’s subsystem modules covered by this manual are:

- The Control Module (90315)
- The Head of Train (HOT) Module (90325)
- The Brake Interface Module (BIM) (90336)
- The Display Unit (90320)



CONTROL



HOT



BIM



DISPLAY

Figure 1-1 Sentinel Subsystem Components

1.2 DEFINITIONS, ACRONYMS, AND ABBREVIATIONS

The following definitions, acronyms and abbreviations apply specifically to this document, although they may have other meanings in another context.

Active Track Warrant: This is a Track Warrant that has been confirmed by both the Locomotive Crew and the Dispatcher.

Directional Warrant: Term applied to movement authority with the intent for the train to travel from one location to another. A Directional Warrant implies a desired destination.

Dispatch System: Provides Track Warrants and other forms of control instructions to the Locomotive Subsystem and train crew to coordinate train operation and permissions within controlled territory.

EOT System: A system that is mounted at the end of the train that monitors brake pipe pressure, motion, and other parameters, and sends this information to the head of the train. It also can receive information from the head of the train to control the release of air from the brake pipe to invoke emergency brake applications.

False Stop: Any penalty application or train stoppage caused by a PTC due to a hardware or software fault or due to an improper decision made by the PTC system.

Forms (e.g., Form A & Form B): Forms contain information on temporary conditions which affect safe train or engine movement as well as maximum permissible speeds at specific locations or regions.

GPS System: A system of satellites which emit signals and data used to provide global position data to the Locomotive Subsystem.

Head End Speed Restriction: A type of speed restriction that is applicable only to the head end locomotives of a train. In freight applications, the need of this type of restriction is generally due to the weight of the locomotives or the tractive effort of the locomotives on the track. Other uses may be due to specific operating rule requirements.

Locomotive Brake System: A brake system that the Locomotive Subsystem interfaces with to apply penalty brake application with can be either a full service and/or an emergency brake rate.

Locomotive Crew: Personnel that operate a train and interface with the Locomotive Subsystem.

Locomotive Speed System: A system that measures the current speed of the locomotive and provides the data to the Locomotive Subsystem. The locomotive speed can be provided by an axle tachometer, GPS Satellites, Accelerometers, or etc.

Locomotive Subsystem: A system that enforces movement authorities and train handling instructions such as maximum authorized speed. The system interfaces with the Locomotive

Crew and Dispatch System. The Locomotive Subsystem will request a penalty brake application to stop the locomotive if the Locomotive Crew exceeds the displayed speed limits.

Maintainer: A role that will install, configure and repair the Locomotive Subsystem on the Locomotive.

Movement Authority: The permission to occupy and use a specific section of controlled track. This does not include track within yard limits or outside controlled territory. The term is also synonymous with “Track Warrant”, “License”, and other terms depending upon the railroad in question. Movement Authorities are generally issued to trains and track repair equipment, but may be issued to individuals working on the railroad right of way under certain circumstances.

NAK: Negative Acknowledgment

Relative Stopping Distance: Is the calculated distance traveled by a moving train from when a full service brake rate is first applied to when the speed of the train is at 0 mph.

Roadway Worker: A person whose work typically involves repair, construction, or maintenance of track, ties, switches, or other devices directly associated with the rail or roadbed. As such, Roadway Workers generally communicate with dispatch personnel and trains as per operational rules when the work involves fouling controlled track or work within the proximity of controlled track. Typically Roadway Workers use a Form B restriction for protection within controlled territory, and said Form B must be planned and instantiated the day prior to the planned work.

System Tests: Tests ran on the Locomotive Subsystem to ensure the hardware is operating correctly, and software has not been corrupted.

Track and Time: This is a form of Track Warrant issued to trains which provides specific territorial limits and the planned time at which the warrant should be cleared. The expiration of time does not remove the territorial authority limits; rather it is an indication of non-compliance with the instructions.

Track Bulletin: A notice containing temporary track information, speed restrictions, or other conditions, necessary for safe operation of trains. Some examples are a Form A or Form B.

Track Warrant: A Track Warrant is a permission to use main line track, and is provided by the Dispatch System. Track warrants are only issued to trains. A train may be one locomotive.

Track Warrant Request: This is a message issued by the train crew via the PTC system which informs the dispatcher and dispatch system that a train desires to obtain a track warrant and enter controlled territory.

Wayside Status System: A system that reports the signal and switch/point states, broken rail status, avalanche status or other aperture status from the wayside to the Dispatch System and/or Locomotive Subsystem.

Work Between Warrant: A type of Track Warrant where the intent is for a train or track equipment to circulate or work between specified limits. A Work Between Warrant may be joint, where more than one train or track equipment vehicle may occupy the same territorial limits.

Yard Movement Authority: The Yard MA or Yard License is a specialized set of instructions generated internally by the PTC system which allows the train to move within the confines of a yard or industry track with oversight by the PTC system. The Yard MA is not generated by, or communicated to, the dispatching system; nor is it permission to occupy, or encroach upon, controlled territory.

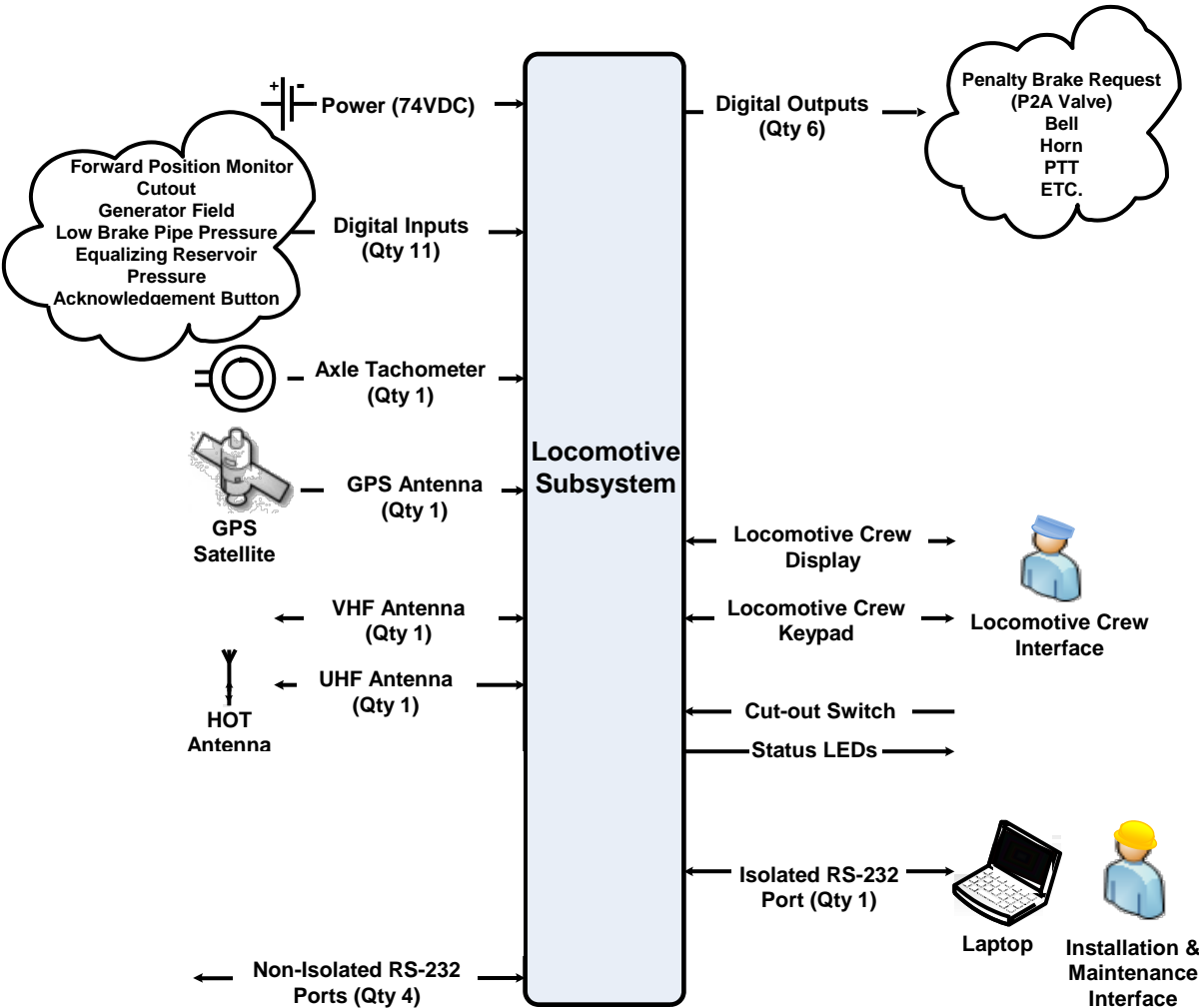
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2.0 SYSTEM OVERVIEW

2.1 LOCOMOTIVE SUBSYSTEM CONTEXT

Train Sentinel® uses GPS and speed sensors to locate the train relative to an on-board track database. The track database includes layout information, grades, curvature, milepost references, signal locations, speed limits, and highway crossings. Train Sentinel® equipment continuously monitors train speed and location against the speed limits and movement authorities. By predicting the train braking distance, the system warns the crew of potential safe movement violations. If no action is taken, the locomotive brakes are activated.

The figure below shows the physical external interfaces of the Locomotive Subsystem.



2.2 MODULE PARTS LIST

Siemens P/N	Description
9000-90336-0001	Brake Interface Module (BIM)
9000-90325-0001	Head of Train (HOT)
9000-90315-0001	Control Module
9000-90320-0001	Display

NOTE

NOTE

All Siemens Industry, Inc. Rail Automation documents are available on the following web site: railautomation.com. Use the Download Center button to search for the desired document.

2.3 CABLES AND ANTENNA PARTS LIST

Siemens P/N	Description
9000-26735-0001	TS Cable Ext. Radio 25 ft.
9000-26736-0001	TS Cable Output 25 ft.
9000-26737-0001	TS Cable Input 25 ft.
9000-26738-0001	TS Cable HOT Input 25 ft.
9000-26739-000X	TS Cable 12 VDC
9000-26740-000X	TS Cable Ethernet
9000-26741-0001	TS Cable 12 VDC Display
9000-26748-0001	BIM Cable Power and Comm.
9000-26749-0001	BIM Cable P2A
9000-26750-0001	BIM Cable Remote Trail 25 ft.
Z927-00374-0000	TS GPS Receiver, Antenna & 25 ft. Cable

3.0 INSTALLATION

3.1 SYSTEM COMPONENT CONNECTION BLOCK DIAGRAM

The figure below shows the subsystem components and how they interconnect.

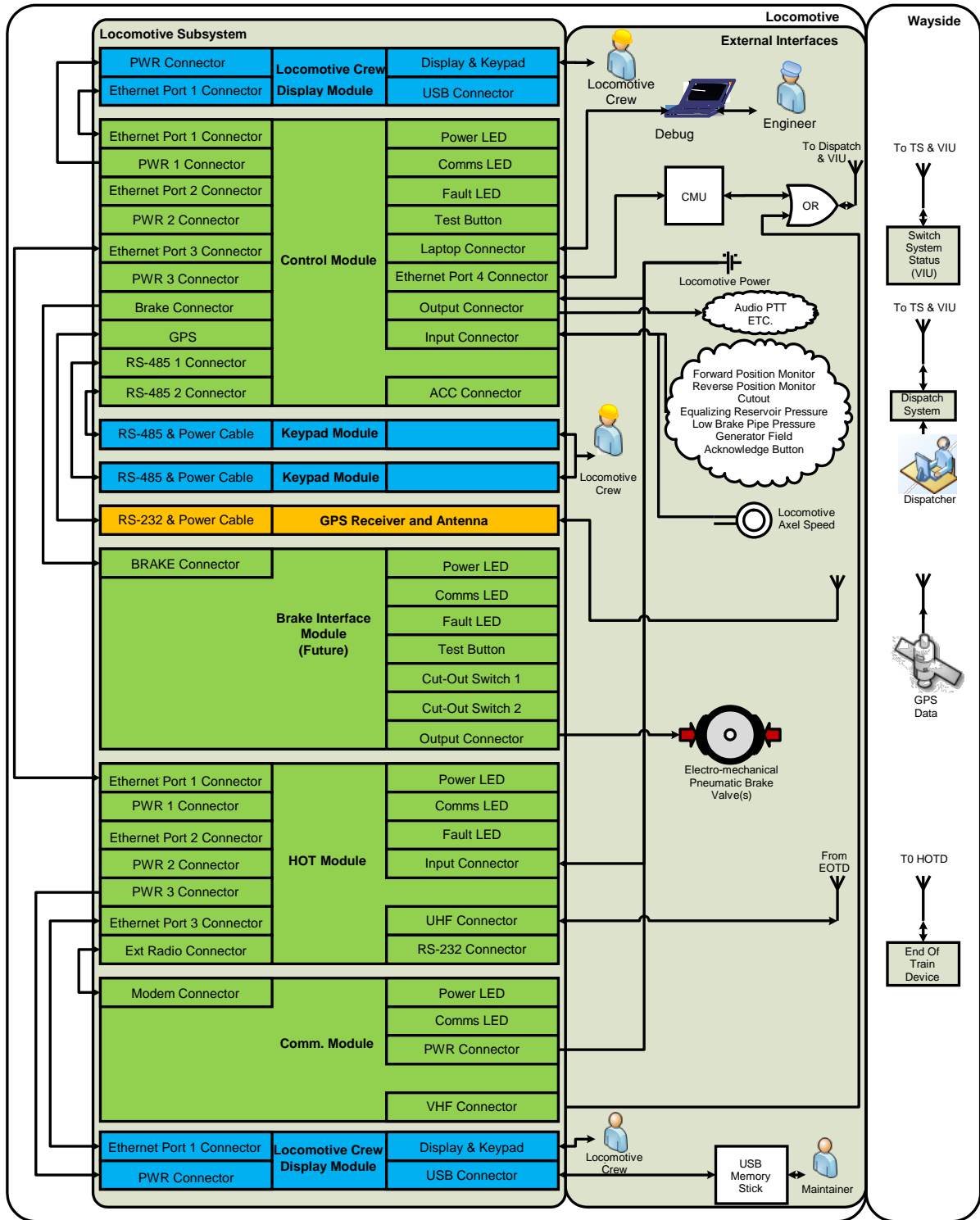


Figure 3-1 Locomotive Subsystem Connection Block Diagram

3.2 TYPICAL ON-BOARD MODULE INTERCONNECTION DIAGRAM

The following diagram illustrates a typical Train Sentinel® equipment configuration in the locomotive. The rack assembly is designed to be installed in the locomotive LSI equipment rack. The touch-screen display(s) and optional keypad(s) are installed in the crew cab.

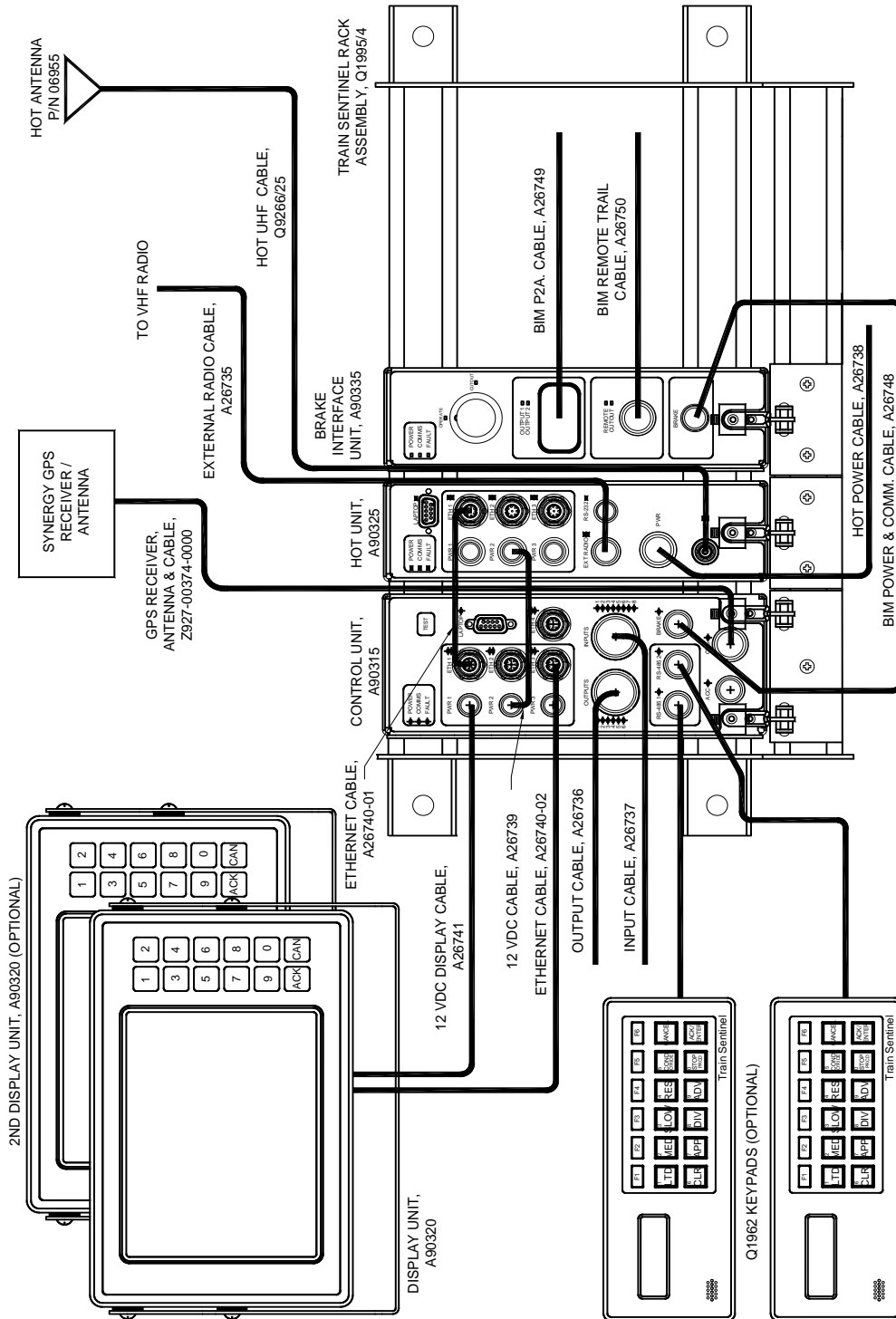


Figure 3-2 Typical On-Board Equipment Configuration

**WARNING**

THE POSSIBILITY OF A MINOR SHOCK EXISTS WHEN CONNECTING TRAIN SENTINEL® TO 74-VOLT LOCOMOTIVE BATTERY POWER.

3.2.1 Locomotive Display(s)

The display unit(s) display necessary operating information to the crew including train status, commands, consist information, authorities, restrictions, and topographic information. The display has a sub-screen to indicate the status of the GPS system, the current status of the locomotive/train speed coupled with a track warrant pictorial showing where the locomotive/train is in relation to existing speed and authority limits. Displays are presented in both text and graphics. The display shows the relative stopping distance, in feet, from the present location to the stopping point based on the relative deceleration. An audible warning is contained within the display assembly to alert the operator should the train approach the authority limit or attempt to exceed the boundary condition of the brake/stopping profile.

3.2.2 Train Integrity Monitoring

Train integrity is monitored by an end of train (EOT) device, which monitors the brake pipe pressure and GPS position of the end of the train. The EOT communicates with the Train Sentinel® Head of Train (HOT) module via a VHF radio. Separation of train consist is determined by loss of radio or inconsistency of reported information. Train integrity status is reported to the locomotive crew.

3.2.3 System Failure and Cut-Out

In the event of any failure compromising safe operation, locomotive operation is halted through penalty brake application and a message is sent to the dispatcher giving notification of the event. Train Sentinel® will continue to operate under loss of communications until the limit of current authority is reached.

The engineer may take manual control of the locomotive by activation of the cut-out switch on the Brake Interface Module. However, when the engineer does so, a message is transmitted to the dispatcher advising that a manual locomotive is operating within the Train Sentinel® equipped subdivision. The “failed and/or cut out” locomotive is uniquely identified to the dispatcher via the dispatch system. The locomotive engineer will be required to contact the dispatcher for approval to cut out PTC because some failures may be of a nature that when cut out, no transmission will occur.

3.3 MOUNTING THE SYSTEM MODULES

The modules are mounted on the locomotive LSI equipment rack using the Sentinel Rack Assembly Q1995/4, and secured with a locking swivel nut at the bottom of each module.

The figure below shows a drawing of the mounted modules, along with the standard cable and connector designations.

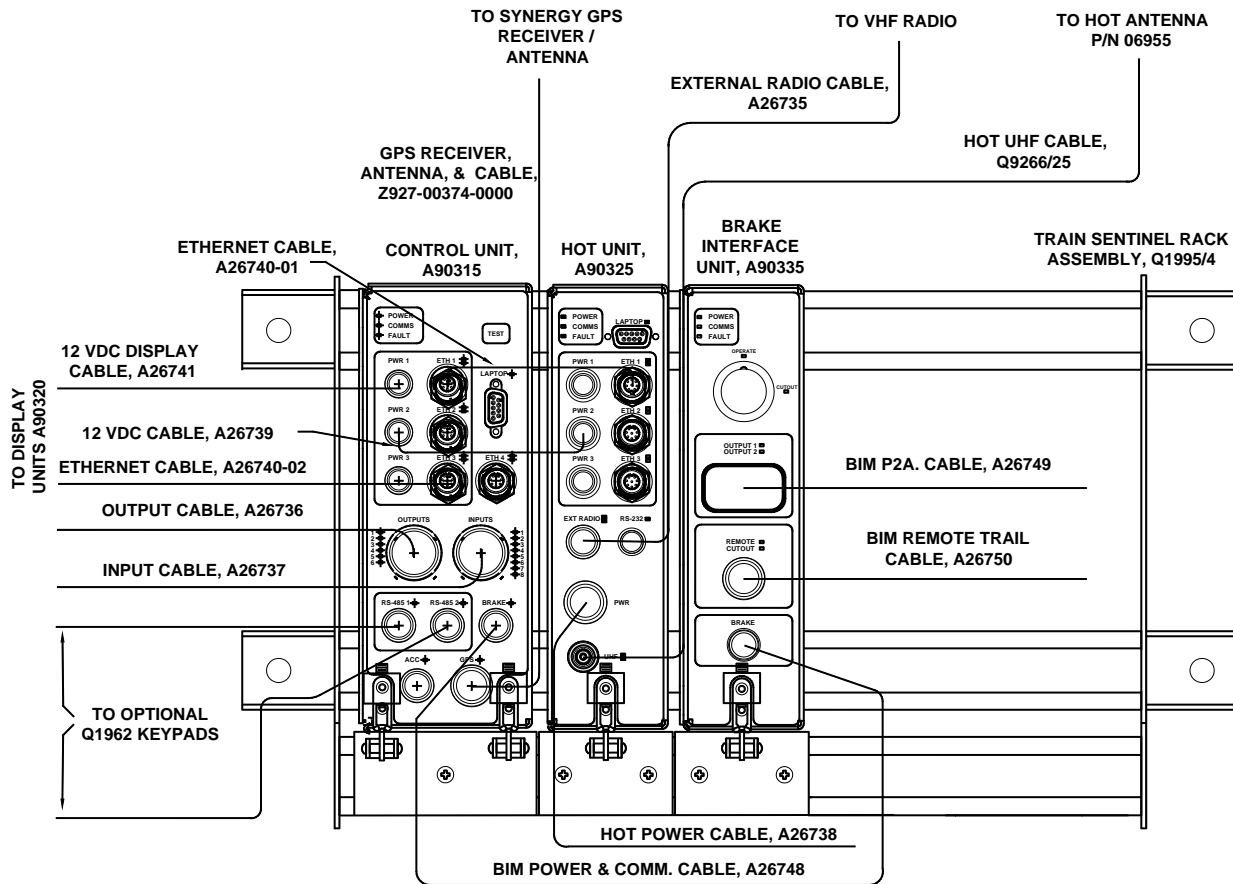


Figure 3-3 Sentinel Modules Mounted on Cab Rack Assembly

The following figure is an example of how the Sentinel modules are mounted and secured in the system rack.



Figure 3-4 Example of Sentinel Modules Mounted in Rack Assembly

⚠ WARNING

WARNING

SPECIAL CARE NEEDS TO BE TAKEN TO ENSURE THAT 74 VDC IS NOT SHORTED TO THE PENALTY ELECTRO-MECHANICAL PNEUMATIC VALVE (e.g., P2A) PREVENTING THE TRAIN SENTINEL® SYSTEM FROM REQUESTING A PENALTY BRAKE APPLICATION. SPECIFICALLY, DO NOT ALLOW +74 VDC TO SHORT TO PIN 5 (OUT1P) AND PIN 8 (OUT2P), AND 74 VDC GND TO SHORT TO PIN 6 (OUT1N) AND PIN 7 (OUT2N) ON THE BRAKE INTERFACE UNIT OUTPUT CONNECTOR.

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4.0 SOFTWARE CONFIGURATION

4.1 HARDWARE REQUIRED

1. PC/laptop with a serial port
2. A straight-through serial cable with a DB9 Male and a DB9 Female connector (assuming the PC has a DB9 Male connector).

4.2 SOFTWARE REQUIRED

1. Windows XP operating system
2. Sentinel.exe program

4.3 RUNNING THE SENTINEL.EXE PROGRAM



WARNING

CONFIRM THAT ALL CONFIGURATION PARAMETERS ARE IN COMPLIANCE WITH THE RAILROAD OPERATING RULES AND PROCEDURES PRIOR TO THE LOCOMOTIVE ENTERING INTO REVENUE SERVICE.

1. Connect the PC/laptop to the Train Sentinel® system Control Module's Laptop port using the appropriate serial cable.
2. Start the Sentinel.exe program.
3. Select Communications -> Settings...
 - a. Select the correct Port per your PC/laptop
 - b. Set the Baud Rate to 56k
 - c. Set the Data Bits to 8
 - d. Set the Parity to None
 - e. Set the Stop Bits to 1
 - f. Set the Flow to None
 - g. Click OK
4. Select Communications -> Connect Serially.
 - a. Confirm **** Serial Port Opened **** is displayed on the screen
5. Select Settings -> System Configuration.
 - a. Under Braking Data
 - i. The following parameters should be set per railroad operating rules and procedures:
 1. Additional Dist (default is 328 ft)
 2. Delay (sec) (default is 0)
 - ii. The remaining parameters are set by a received train consist message.

- b. Under General Configuration set the following parameters:
 - i. The following parameters are determined by the specific locomotive and time zone:
 - 1. Locomotive ID
 - 2. Wheel Size
 - 3. Time Zone Offset
 - ii. The remaining parameters should be set per railroad operating rules and procedures:
 - 1. Train Id (set via dispatch message)
 - 2. Speed Average (default is 3 samples)
 - 3. Restricted Speed (default is 20 MPH)
 - 4. Signal ACK Speed (default is 20 MPH)
 - 5. Creep Speed (default is 10 MPH)
 - 6. Overspeed Timer (default is 25 sec.)
 - 7. Min Horn Speed (default 10 MPH)
 - 8. Display Option (default 0)
 - 9. Accel Filter (default 3)
 - 10. Maximum Speed (determined by train length in train consist message)
 - 11. MCC Loco ID (default blank)
 - 12. Form A (default 260)
 - 13. Form B (default 0)
 - 14. Hysteresis Threshold (default 20)
 - 15. Hysteresis (default 5)
- c. Under Global Settings set the following parameters:
 - i. Check the following:
 - 1. Enable End Of Train Control
 - 2. Use Axle Drive for Speed
 - 3. Departure Test Req'd
 - ii. The following is determined by the railroad:
 - 1. Single Pendant System (If the system has only one LCD display check this box)
 - 2. Show ZULU Time
 - 3. Show AM/PM Time
 - 4. Uses 250 Pulse Pickup (If the locomotive has a 250 Pulse Axle Tachometer check this box)
 - iii. The remaining parameters are not typically used or checked.
- d. The Active Low Inputs section is determined by the specific locomotive hardware configuration.
- e. Please select the appropriate Owner ID.
- f. When complete click OK.

4.4 INSTALLING THE APPLICATION IMAGE

This section applies to the **Control**, **HOT** and **Display** modules only. To install the application software proceed as follows:

1. Turn off the target hardware, if currently turned on.
2. Connect the target hardware module's Serial Port to the PC's RS-232 Serial Port.
3. Open the Tera Term window application and connect it to that PC's corresponding COM port.
4. Turn on the target hardware.
5. On the Tera Term window, check if the following appears:
System Starting - enter 222 for bootloader menu...
6. Within ~5-7 seconds, type 222 in the Tera Term window.
7. The following bootloader menu will appear:

```
Bootloader Menu Version 3.8
=====
 1 - Upload Program Image
 2 - Display Image Info

d - Display MFG data
s - Set Serial Number
a - Auto set MAC addresses (using serial number)
m - Manual set MAC addresses

x - Erase entire NAND flash
y - Erase entire DATAFLASH flash

r - Reset system

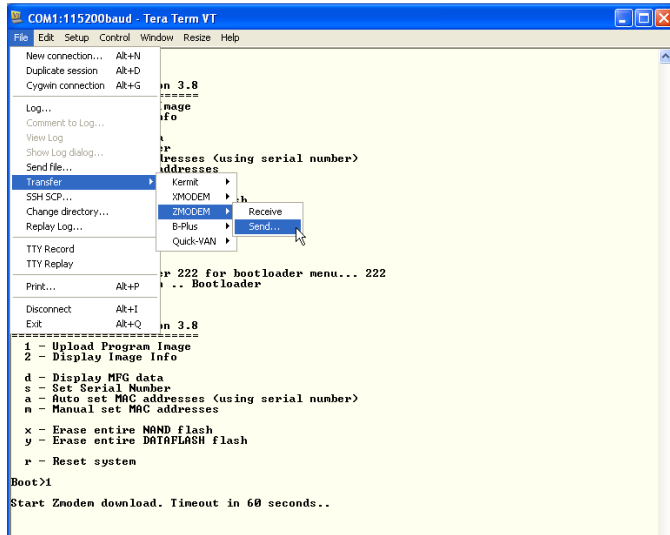
Boot>
```

[Note that the version number of the bootloader (Bootloader Menu Version 3.8) depends on the last loaded Bootloader image.]

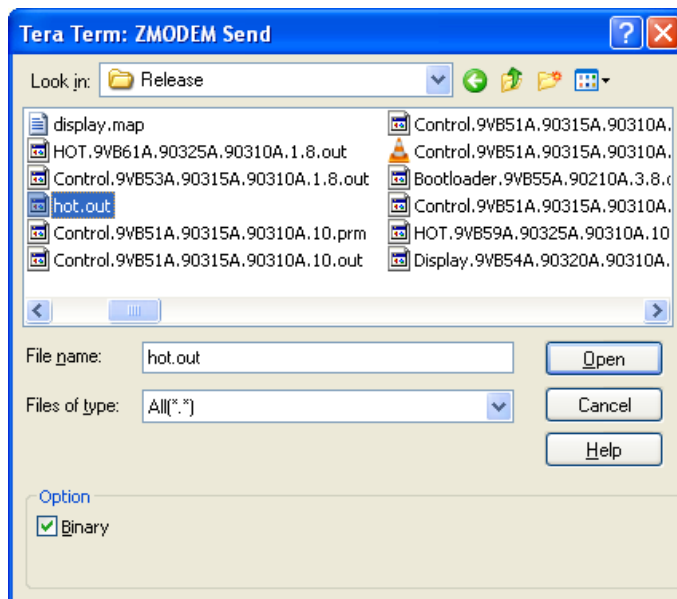
8. At the Boot prompt, type 1 to initiate a zmodem upload of the Application Image file.
Boot>1

Start Zmodem download. Timeout in 60 seconds.

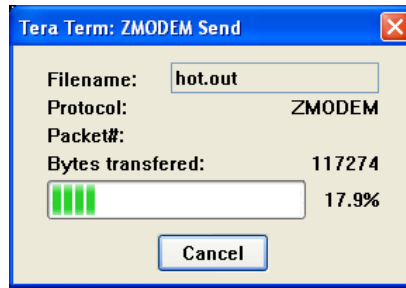
- On the Tera Term window, start the zmodem download. (File -> Transfer -> ZMODEM -> Send ...)



- Browse and select the Application Image that needs to be downloaded.



- Select Open.
- The following zmodem download dialog appears.



13. When complete, the Tera Term window will indicate that the file was received and that the application is being installed. Below is a sample text:

```
Boot>1
```

```
Start Zmodem download. Timeout in 60 seconds..
Received File with 0x9FD48 (654664) bytes
  Verifying Application Image .. Successful
  Erasing Application Image space in Nandflash, Address 0x0 Size
    0x400000 .. Successful
  Writing Application Image to Nandflash at Address 0x0 Size
    0x9FD48 .. Successful
  Part Number: HOT:90325:9VB61-1.8
  FileType=0xB4B44B4B FileCrc=0xA02344CB FileSize=0x9FD48
  FileVersion=1.8 HdrRevision=0x2
  HdrCrc=0x403D393B CompileDateTime=09/27/10 08:54:31
```

14. Verify the FileType, FileCrc, FileVersion in the above output.
15. Verify the software load.
- Type **2** at the boot prompt, to 'Display Image Info'.
 - Verify the file information for the Bootloader (FLASH Image), Application and Master Fpga.

```
Boot>2
```

```
**** Bootloader Info ****
RAM Image
  Part Number: Bootloader::9VB55-3.8
  FileType=0xB25A55A5 FileCrc=0x1F1A76A0 FileSize=0xFFA8
  FileVersion=3.8 HdrRevision=0x2
  HdrCrc=0x2F2AEA0A CompileDateTime=09/27/10 08:47:36

FLASH Image
  Part Number: Bootloader::9VB55-3.8
  FileType=0xB25A55A5 FileCrc=0x1F1A76A0 FileSize=0xFFA8
  FileVersion=3.8 HdrRevision=0x2
  HdrCrc=0x2F2AEA0A CompileDateTime=09/27/10 08:47:36

**** Application Info ****
  Part Number: HOT:90325:9VB61-1.8
  FileType=0xB4B44B4B FileCrc=0xA02344CB FileSize=0x9FD48
  FileVersion=1.8 HdrRevision=0x2
  HdrCrc=0x403D393B CompileDateTime=09/27/10 08:54:31

**** Fpga Info ****
  FPGA Version=0x0001
```

16. Turn off the target hardware.

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5.0 TESTING THE TRAIN SENTINEL® SYSTEM

This section provides instructions for functionally testing the Sentinel system to verify its operation. To test the system, proceed as follows:

1. Verify the Train Sentinel® system is installed and appears to be operational.
 - a. Verify each of the system modules is powered on.
2. Verify the system has a valid GPS position, is on the track map, and has a valid milepost indication.
 - a. Verify in the upper right hand corner of the Display Unit that there is an icon of a satellite.
 - b. Verify there is a valid milepost number
 - c. Verify the locomotive is placed at that milepost on the track display
3. Perform communications tests with the VHF and HOT systems.
 - a. Using the function keys, press F1 System -> F1 Test -> F2 Comms -> F2 RF Test to test the VHF communications link to the Dispatch System.
 - b. Using the function keys, press F2 HOTD -> F5 Test to test the HOT system.
 - c. Verify the HOTD test passed by the HOTD Comm test has passed on the Display unit.
4. Exercise the trail mode functions.
 - a. Activate the pneumatic brake on the locomotive to release the air from the Equalizing Reservoir.
 - b. Verify on the Display Unit that it displays Trail Mode and the P2A remains energized.
 - c. Recharge the pneumatic brake system.
5. Exercise the primary cutout switch.
 - a. On the Brake Interface Module (BIM), set the local cutout switch to the “CUTOUT” position.
 - b. Verify on the Display Unit that it displays System Cutout: Ctrl Switch, and the P2A remains energized.
6. Perform a departure test. Verify the P2A operation.
 - a. Using the function keys, press F1 System -> F1 Test -> F4 Depart -> F1 P2A -> F3 Yes to test the P2A
 - b. Verify the Penalty Valve Test reports Passed on the Display Unit.
7. Move the locomotive and ensure the axle drive is operating properly.
 - a. Disconnect the GPS cable from the Control Module. This is removing the second speed sensor input.
 - b. Operate the train to 10 MPH.
 - c. Verify the Display Unit is displaying 10 MPH in the upper right hand corner.
 - d. Reconnect the GPS cable to the Control Module.
8. Receive a Movement Authority that allows the train to traverse through a communicating switch.
 - a. Have the Dispatch system send a Train Consist message to the Train Sentinel system.
 - b. Press F6 Back to clear the screen

- c. Have the Dispatch system send a Movement Authority through a communicating switch.
 - d. Press F1 Confirm to confirm the Movement Authority
 - e. Press F6 Ok to clear the Warrant Read Screen
 - f. Press F6 Back to clear the Dispatch Message
 - g. Verify the background of the territory the Movement Authority covers is now white. It was gray prior to confirming the Movement Authority.
9. When the switch is within range verify the correct alignment and locked indication is shown.
 - a. Operate the train toward the communicating switch.
 - b. Verify on approach to the communicating switch the system displays the switch milepost and that it is “NORMAL” and “LOCKED”.
10. Verify the train may pass at track speed and verify the physical alignment of the switch.
 - a. Continue to operate the train through the communicating switch.
 - b. Verify the communicating switch is in the correct position (i.e., NORMAL).
 - c. Verify the locomotive can traverse through the switch at civil speed by inspecting the Display Unit.
11. Repeat steps 8 & 9. Slow the train to restricted speed.
12. When within visual range of the switch, disconnect the Ext. Radio cable from the HOT Module.
13. Upon approach, verify the maximum authorized speed reduces to Restricted Speed and the alignment indication transitions to “Bad Alignment”.
14. Reconnect the Ext. Radio cable to the HOT Module to allow the receipt of Dispatch System messages.
15. Repeat steps 8 & 9. Disconnect the VHF communications system prior to the switch being in-range (2 miles).
16. Verify the alignment is shown as “Bad Alignment”.
17. Transit the switch at restricted speed and verify the restricted speed is enforced by the PTC system.
18. Record the results.

6.0 DOWNLOADING SYSTEM LOGS

To download system logs from Train Sentinel system place a USB memory stick into the USB port on the side of the Display Unit.

Press F1 System -> F3 Setup -> F5 USB -> F1 To USB -> F1 Logs to start downloading logs to the USB memory stick. See the Display Unit for status.

NOTE**NOTE**

This may take a few minutes due to the size and quantity of the log files. Please be patient.

When complete the Display Unit will disable the USB LED and display “Copy Logs to USB complete”.

To view the system logs, plug the USB stick into a PC USB port and traverse to the \\Siemens\Sentinel\Log directory. There you will see the log files.

NOTE**NOTE**

The PC will need a program installed on it to uncompress the .gz file(s). For example PeaZip found at www.peazip.org will uncompress the .gz file creating a readable .log file.

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7.0 MODULE CONNECTOR DESCRIPTIONS & SPECIFICATIONS

7.1 CONTROL MODULE A90315

The Control Module is the primary decision maker of the Locomotive Subsystem. There is typically one Control Module per Locomotive Subsystem. It gets its power from the locomotive and supplies power to the Display Unit, Keypads, and HOT Module (when necessary). It also contains the majority of the external and internal interfaces.

The following pages contain details for each connector on the module.



Figure 7-1 Control Module A90315

7.1.1 ACC Connector

Front face of pin inserts is illustrated in the following figure.

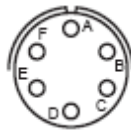


Figure 7-2 ACC Connector

Table 7-1 ACC Connector Pin Out

Gender:		Female
Manufacturer:		Amphenol
Part Number:		71-570122-06S¹ (PT02A-10-6S)
Mating Connector Part Number:		PT06A-10-6P (SR)
Pin Identification	Symbol	Description
A	TXD (RS-232)	Transmit line for the spare RS-232 port.
B	RXD (RS-232)	Receive line for the spare RS-232 port.
C	GND (RS-232)	Ground line for the spare RS-232 port.
D	CANH (CAN)	High signal for the spare CAN port.
E	CANL (CAN)	Low signal for the spare CAN port.
F	GND (CAN)	Ground signal for the spare CAN port.

¹ This part number is for a Box Mounting Receptacle (PT02) with PCB Contacts. The following part number in the parenthesis is the exact part except with solder cups.

7.1.2 RS-232

Table 7-2 RS-232 Interface Characteristics

Item Description	Value
Input / Output	I/O
Connector Quantity	1
Link Active Status LED	Flashing Green is active
Physical Layer	RS-232
Baud Rate	1200 - 115200 ²
Data Link Layer	ISO 11898
Application Layer	Qpacket

7.1.3 CAN BUS Interface

Table 7-3 CAN BUS Interface Characteristics

Item Description	Value
Input / Output	I/O
Connector Quantity	1
Link Active Status LED	Flashing Green is active
Physical Layer	ISO 11898-2
Data Link Layer	ISO 11898
Application Layer	Qpacket

² The interface will only support the following industry standard baud rates; 1200, 4800, 9600, 19200, 38400, 57600, and 115200.

7.1.4 Brake Connector

Front face of pin inserts is illustrated in the following figure.

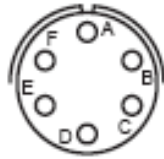


Figure 7-3 Brake Connector

Table 7-4 Brake Connector Pin Out

Gender:		Female
Manufacturer:		Amphenol
Part Number:		71-570122-06S³ (PT02A-10-6S)
Mating Connector Part Number:		PT06A-10-6P (SR)
Pin Identification	Symbol	Description
A	+12VDC	12 Volt supply for the Brake Interface Module.
B	GND	12 Volt return for the Brake Interface Module.
C	CLKP	The positive clock line to the Brake Interface Module.
D	CLKN	The negative clock line to the Brake Interface Module.
E	DATP	The positive data line to the Brake Interface Module.
F	DATN	The negative data line to the Brake Interface Module.

³ This part number is for a Box Mounting Receptacle (PT02) with PCB Contacts. The following part number in the parenthesis is the exact part except with solder cups.

7.1.5 12 Volt Supply

Table 7-5 12 Volt Supply Interface Characteristics

Item Description	Value
Input / Output	O
Connector Quantity	1
Voltage	12.5 VDC
Nominal Amperage	3.5 A

7.1.6 Synchronous RS-485

Table 7-6 Synchronous RS-485 Interface Characteristics

Item Description	Value
Input / Output	O
Connector Quantity	1
Link Active Status LED	Flashing Green is active
Physical Layer	RS-485

7.1.7 Ethernet Connector

Front face of pin inserts is illustrated in the following figure.

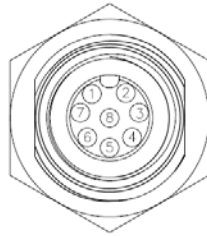


Figure 7-4 Ethernet Connector

Table 7-7 Ethernet Connector Pin Out

Gender: Female		
Manufacturer: Tyco		
Part Number: 1838892-4		
Mating Connector Part Number: 1838277-4		
Pin Identification	Symbol	Description
1	No Connect	NA
2	No Connect	NA
3	No Connect	NA
4	TXN	Negative transmit line
5	RXP	Positive receive line
6	TXP	Positive transmit line
7	No Connect	NA
8	RXN	Negative receive line

Table 7-8 Ethernet Interface Characteristics

Item Description	Value
Input / Output	I/O
Connector Quantity	4
Link Active Status LED	Solid Green is Link Active at 10/100, Off is Link Inactive
Link Speed Status LED	Flashing Yellow is 10/100Mb Activity, Off is no Activity
Physical Layer	10/100BASE-T
Data Link Layer	Ethernet
Network Layer	IP
Transport Layer	TCP, UDP and etc.
Session Layer	Class D
Presentation Layer	EMP
Application Layer	Qpacket, FTP, & Ping

7.1.8 General Control Module LED Interface

Table 7-9 General Control Module LED Interface

LED Label	LED Color
POWER	Steady Green is On
COMMS	Flashing Yellow is activity
FAULT	Steady Red is system fault detected

7.1.9 GPS Connector

Front face of pin inserts is illustrated in the following figure.

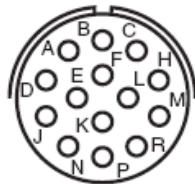


Figure 7-5 GPS Connector

Table 7-10 GPS Connector Pin Out

Gender:		Female
Manufacturer:		Amphenol
Part Number:		PT02A-12-14S
Mating Connector Part Number:		PT06A-12-14P (SR)
Pin Identification	Symbol	Description
A	+12VDC	12 Volt supply to the GPS receiver
B	GND	Ground
C	TXD0-	Transmit line for port 0 minus
D	RXD0-	Receive line for port 0 minus
E	TXD1-	Transmit line for port 1 minus
F	RXD1-	Receive line for port 1 minus
H	PPS-	Pulse Per Second minus
J	TXD0+	Transmit line for port 0 plus
K	RXD0+	Receive line for port 0 plus
L	TXD1+	Transmit line for port 1 plus
M	RXD1+	Receive line for port 1 plus
N	PPS+	Pulse Per Second plus
P	GND	Ground
R	+5VDC	5 Volt supply to the GPS receiver

Table 7-11 GPS Interface Characteristic

Item Description	Value
Input / Output	I/O
Connector Quantity	1
Link Active Status LED	Flashing Green is Active
Physical Layer	RS-232
Baud Rate	1200 - 115200 ⁴
Data Link Layer	NMEA 1083
Application Layer	NMEA 1083

7.1.10 Input Connector

Front face of pin inserts is illustrated in the following figure.

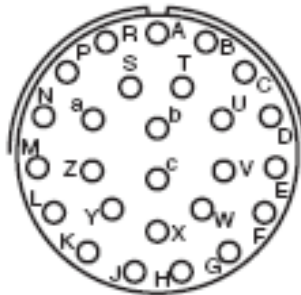


Figure 7-6 Input Connector

⁴ The interface will only support the following industry standard baud rates; 1200, 4800, 9600, 19200, 38400, 57600, and 115200.

Table 7-12 Input Connector Pin Out

Gender:		Male
Manufacturer:		Amphenol
Part Number:		71-533725-26P⁵ (PT02A-16-26P)
Mating Connector Part Number:		PT06A-16-26S (SR)
Pin Identification	Symbol	Description
A	In 1 Positive	Positive line for digital input number 1.
B	In 1 Negative	Negative line for digital input number 1.
C	In 2 Positive	Positive line for digital input number 2.
D	In 2 Negative	Negative line for digital input number 2.
E	In 3 Positive	Positive line for digital input number 3.
F	In 3 Negative	Negative line for digital input number 3.
G	In 4 Positive	Positive line for digital input number 4.
H	In 4 Negative	Negative line for digital input number 4.
J	In 5 Positive	Positive line for digital input number 5.
K	In 5 Negative	Negative line for digital input number 5.
L	In 6 Positive	Positive line for digital input number 6.
M	In 6 Negative	Negative line for digital input number 6.
N	In 7 Positive	Positive line for digital input number 7.
P	In 7 Negative	Negative line for digital input number 7.
R	In 8 Positive	Positive line for digital input number 8.
S	In 8 Negative	Negative line for digital input number 8.
T	No Connect	NA

⁵ This part number is for a Box Mounting Receptacle (PT02) with PCB Contacts. The following part number in the parenthesis is the exact part except with solder cups.

Pin Identification	Symbol	Description
U	No Connect	NA
V	No Connect	NA
W	250 Pole Positive	Positive line for the 250 pulse pole axle tachometer input.
X	250 Pole Negative	Negative line for the 250 pulse pole axle tachometer input.
Y	20/60 Pole Positive	Positive line for the 20/60 pulse pole axle tachometer input.
Z	20/60 Pole Negative	Negative line for the 20/60 pulse pole axle tachometer input.
a	No Connect	NA
b	No Connect	NA
c	No Connect	NA

7.1.11 Digital Inputs

Table 7-13 Digital Input Interface Characteristics

Item Description	Value
Input / Output	Input
Interface Quantity	8
Status LEDs	Green is Energized
Voltage	0 or 74 VDC

7.1.12 20/60 Pole Axle Tachometer Input

Table 7-14 20/60 Pole Axle Tachometer Interface Characteristics

Item Description	Value
Input / Output	Input
Interface Quantity	1

7.1.13 250 Pole Axle Tachometer Input

Table 7-15 60P Pole Axle Tachometer Interface Characteristics

Item Description	Value
Input / Output	Input
Interface Quantity	1

7.1.14 Laptop Connector

The Laptop Connector is wired as a DCE (Data Circuit-Terminating Equipment).

The front face of the socket is illustrated in the following figure.

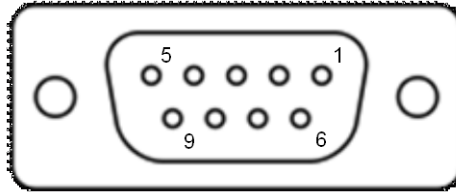


Figure 7-7 Laptop Connector

Table 7-16 Laptop Connector Pin Out

Gender:		Female
Manufacturer:		Tyco
Part Number:		5747090-2
Mating Connector Part Number:		749808-8
Pin Identification	Symbol	Description
1	No Connect	NA
2	TXD	Transmit line for the Laptop port.
3	RXD	Receive line for the Laptop port.
4	DEBUG RXD	Receive line for the Debug port.
5	GND	Ground
6	DEBUG TXD	Transmit line for the Debug port.
7	No Connect	NA
8	No Connect	NA
9	No Connect	NA

7.1.15 Laptop Port

Table 7-17 Laptop Port Interface Characteristics

Item Description	Value
Input / Output	I/O
Connector Quantity	1
Link Active Status LED	Flashing Green is Active
Physical Layer	RS-232
Baud Rate	1200 - 115200 ⁶
Application Layer	Qpacket

7.1.16 Debug Port

Table 7-18 Debug Port Interface Characteristics

Item Description	Value
Input / Output	I/O
Connector Quantity	1
Link Active Status LED	Flashing Green is Active
Physical Layer	RS-232
Baud Rate	1200 - 115200 ⁷
Application Layer	Terminal - ASCII

⁶ The interface will only support the following industry standard baud rates; 1200, 4800, 9600, 19200, 38400, 57600, and 115200.

⁷ The interface will only support the following industry standard baud rates; 1200, 4800, 9600, 19200, 38400, 57600, and 115200.

7.1.17 Output Connector

Front face of pin inserts is illustrated in the following figure.

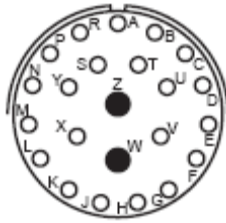


Figure 7-8 Output Connector

Table 7-19 Output Connector Pin Out

Gender:		Male
Manufacturer:		Amphenol
Part Number:		71-533725-99P⁸ (PT02A-16-99)
Mating Connector Part Number:		PT06A-16-99S (SR)
Pin Identification	Symbol	Description
A	Out 5 Positive	Output number 5, positive terminal.
B	Out 5 Negative	Output number 5, negative terminal.
C	No Connect	NA
D	Out 6 Negative	Output number 6, negative terminal.
E	Out 6 Positive	Output number 6, positive terminal.
F	No Connect	NA
G	Out 4 Negative	Output number 4, negative terminal.
H	+74VDC	74 VDC supply.
J	74VDC GND	74 Volt DC return.
K	Out 3 Negative	Output number 3, negative terminal.
L	Out 3 Positive	Output number 3, positive terminal.
M	No connect	NA
N	Out 1 Positive	Output number 1, positive terminal.

⁸ This part number is for a Box Mounting Receptacle (PT02) with PCB Contacts. The following part number in the parenthesis is the exact part except with solder cups.

P	Out 1 Negative	Output number 1, negative terminal.
R	No Connect	NA
S	Out 2 Negative	Output number 2, negative terminal.
T	Out 2 Positive	Output number 2, positive terminal.
U	No Connect	NA
V	Out 4 Positive	Output number 4, positive terminal.
W	+74VDC	74 Volt DC supply
X	No Connect	NA
Y	No Connect	NA
Z	74VDC GND	74 Volt DC return

7.1.18 Digital Outputs

Table 7-20 Digital Output Interface Characteristics

Item Description	Value
Input / Output	Output
Connector Quantity	1
Status LEDs	Green is Energized
Output Type	Open-Collector
Voltage	74 VDC

7.1.19 System Input Power

Table 7-21 System Input Power Interface Characteristics

Item Description	Value
Input / Output	Input
Connector Quantity	1
Voltage	74 VDC

7.1.20 Power Connectors

Front face of pin inserts is illustrated in the following figure.



Figure 7-9 Power Connector

Table 7-22 Power Connector Pin Out

Gender:		Female
Manufacturer:		Amphenol
Part Number:		71-570121-02S⁹ (PT02A-8-2S)
Mating Connector Part Number:		PT06A-8-2P (SR)
Pin Identification	Symbol	Description
A	+12VDC	12 Volt supply.
B	GND	12 Volt return.

⁹ This part number is for a Box Mounting Receptacle (PT02) with PCB Contacts. The following part number in the parenthesis is the exact part except with solder cups.

Table 7-23 Power Connector Interface Characteristics

Item Description	Value
Input / Output	Output
Connector Quantity	3
Voltage	12.5 VDC
Nominal Amperage	3.5 Amp

7.1.21 RS-485 Connectors

Front face of pin inserts is illustrated in the following figure.



Figure 7-10 RS-485 Connector¹⁰

¹⁰ The following table information is compliant with existing Train Sentinel Keypads. On the Rev. 1 (i.e., prototype) of the Control Module Pin A is +12, Pin B is GND, Pin C is 485A, and Pin D is 485B.

Table 7-24 RS-485 Connector Pin Out

Gender:		Female
Manufacturer:		Amphenol
Part Number:		71-570122-05S¹¹ (PT02A-10-5S)
Mating Connector Part Number:		PT06A-10-5P (SR)
Pin Identification	Symbol	Description
A	RS-485A	Master RS-485A data bus. Also known as DATA (A)-.
B	RS-485B	Master RS-485B data bus. Also known as DATA (B)+.
C	+12VDC	12 Volt source
D	GND	Ground
E	GND	Ground

Table 7-25 RS-485 Interface Characteristics

Item Description	Value
Input / Output	I/O
Connector Quantity	2 ¹²
Link Active Status LED	Flashing Green is Active
Physical Layer	RS-485
Baud Rate	1200 - 115200 ¹³
Application Layer	Qpacket

¹¹ This part number is for a Box Mounting Receptacle (PT02) with PCB Contacts. The following part number in the parenthesis is the exact part except with solder cups.

¹² There are two connectors connected to one RS-485 port.

¹³ The interface will only support the following industry standard baud rates; 1200, 4800, 9600, 19200, 38400, 57600, and 115200.

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7.2 HEAT OF TRAIN (HOT) MODULE A90325

The HOT Module is tasked with the control and operation of the End of Train Device (EOT). Because it can operate as a stand-alone device, the HOT Module utilizes dual independent power sources. The HOT Module receives power from the PTC Control Module and from an independent power connection to the locomotive. It is recommended that the primary PTC power supply and the alternate HOT Module power supply utilize independent circuit breakers. It also provides a communications gateway via the Ext. Radio Connector when engaging in long-range data communications utilizing an external voice-band radio.

The following pages contain details for each connector on the module.



Figure 7-11 HOT Module A90325

7.2.1 Ethernet Connector(s)

Front face of pin inserts is illustrated in the following figure.

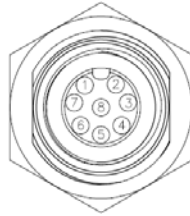


Figure 7-12 Ethernet Connector

Table 7-26 Ethernet Connector Pin Out

Gender: Female		
Manufacturer: Tyco		
Part Number: 1838892-4		
Mating Connector Part Number: 1838277-4		
Pin Identification	Symbol	Description
1	No Connect	NA
2	No Connect	NA
3	No Connect	NA
4	TXN	Negative transmit line
5	RXP	Positive receive line
6	TXP	Positive transmit line
7	No Connect	NA
8	RXN	Negative receive line

7.2.2 External Radio Connector

Front face of pin inserts is illustrated in the following figure.

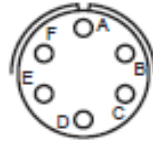


Figure 7-13 External Radio Connector¹⁴

Table 7-27 External Radio Connector Pin Out

Gender:		Male
Manufacturer:		Amphenol
Part Number:		71-570121-06S¹⁵ (PT06A-10-6S)
Mating Connector Part Number:		PT06A-10-6P (SR)
Pin Identification	Symbol	Description
A	+12 VDC	12 V source.
B	GND	The return line for the radio interface.
C	TX_AUDIO	Audio transmission line (HOT output).
D	RX_AUDIO	Audio receive line (HOT input).
E	PTT	Push To Talk line (HOT output).
F	Carrier Detect	Radio Modem has detected the carrier frequency (HOT input).

¹⁴ In the Panama system the External Radio Connector is connected to a VHF 160 MHz radio using FSK at 1200 Baud. There are no start and stop bits.

¹⁵ This part number is for a Box Mounting Receptacle (PT02) with PCB Contacts. The following part number in the parenthesis is the exact part except with solder cups.

7.2.2.1 +12 Volt Supply Interface

Table 7-28 12 Volt Supply Interface Characteristics

Item Description	Value
Input / Output	Output
Connector Quantity	1
Voltage	12.5 VDC
Amperage	See Control Module. (Supplied via Control Module)

7.2.2.2 Transmit Audio Interface

Table 7-29 Transmit Audio Interface Characteristics

Item Description	Value
Input / Output	Output
Connector Quantity	1
Voltage	16 VDC Max
Modulation	FFSK
Baud Rate	1200
Modulating Freq. (Space/Mark)	1800 Hz / 1200 Hz

7.2.2.3 Receive Audio Interface

Table 7-30 Receive Audio Interface Characteristics

Item Description	Value
Input / Output	Input
Connector Quantity	1
Voltage	16 VDC Max
Modulation	FFSK
Baud Rate	1200
Modulating Freq. (Space/Mark)	1800 Hz / 1200 Hz

7.2.2.4 PTT Interface

Table 7-31 PTT Interface Characteristics

Item Description	Value
Input / Output	Output
Connector Quantity	1
Voltage	0 and 12 VDC
Active State	0 VDC

7.2.2.5 Carrier Detect Interface

Table 7-32 Carrier Detect Interface Characteristics

Item Description	Value
Input / Output	Input
Connector Quantity	1
Voltage	0 and 12 VDC
Active State	0 VDC

7.2.3 General HOT Module LED Interface

Table 7-33 General HOT Module LED Interface

LED Label	LED Color
POWER	Steady Green is On
COMMS	Flashing Yellow is activity
FAULT	Steady Red is system fault detected

7.2.4 Input Connector

Front face of pin inserts is illustrated in the following figure.

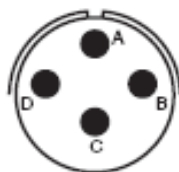


Figure 7-14 Input Connector

Table 7-34 Input Connector Pin Out

Gender:		Male
Manufacturer:		Amphenol
Part Number:		71-570123-04P¹⁶ (PT02A-12-4P)
Mating Connector Part Number:		PT06A-12-4S (SR)
Pin Identification	Symbol	Description
A	+74VDC	74 VDC power line (HOT Power Interface).
B	74VDC GND	74 VDC return line (HOT Power Interface).
C	In 1 Positive	Positive line for digital input number 1.
D	In 1 Negative	Negative line for digital input number 1.

7.2.5 HOT Power Interface

Table 7-35 HOT Power Interface Characteristics

Item Description	Value
Input / Output	Input
Connector Quantity	1
Voltage	+74 VDC

¹⁶ This part number is for a Box Mounting Receptacle (PT02) with PCB Contacts. The following part number in the parenthesis is the exact part except with solder cups.

7.2.5.1 Digital Input

Table 7-36 Digital Input Interface Characteristics

Item Description	Value
Input / Output	Input
Connector Quantity	1
Voltage	0 and 74 VDC

7.2.6 Laptop Connector

The Laptop Connector is wired as a DCE (Data Circuit-Terminating Equipment). Front face of socket illustrated in the following figure.

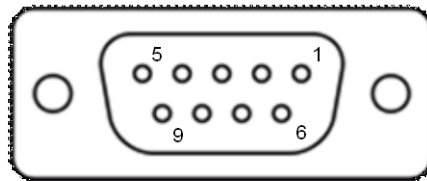


Figure 7-15 Laptop Connector

Table 7-37 Laptop Connector Pin Out

Gender:		Female
Manufacturer:		Tyco
Part Number:		5747090-2
Mating Connector Part Number:		749808-8
Pin Identification	Symbol	Description
1	No Connect	NA
2	TXD	Transmit line for the Laptop port.
3	RXD	Receive line for the Laptop port.
4	DEBUG RXD	Receive line for the Debug port.
5	GND	Ground
6	DEBUG TXD	Transmit line for the Debug port
7	No Connect	NA
8	No Connect	NA
9	No Connect	NA

7.2.6.1 Laptop Port

Table 7-38 Laptop Port Interface Characteristics

Item Description	Value
Input / Output	I/O
Connector Quantity	1
Link Active Status LED	Flashing Green is Active
Physical Layer	RS-232
Baud Rate	1200 - 115200 ¹⁷
Application Layer	Qpacket

¹⁷ The interface will only support the following industry standard baud rates; 1200, 4800, 9600, 19200, 38400, 57600, and 115200.

7.2.6.2 Debug Port

Table 7-39 Debug Port Interface Characteristics

Item Description	Value
Input / Output	I/O
Connector Quantity	1
Link Active Status LED	Flashing Green is Active
Physical Layer	RS-232
Baud Rate	1200 - 115200 ¹⁸
Application Layer	Terminal - ASCII

7.2.7 Power Connectors

Front face of pin inserts is illustrated in the following figure.



Figure 7-16 Power Connector

¹⁸ The interface will only support the following industry standard baud rates; 1200, 4800, 9600, 19200, 38400, 57600, and 115200.

Table 7-40 Power Connector Pin Out

Gender:		Female
Manufacturer:		Amphenol
Part Number:		71-570121-02S¹⁹ (PT02A-8-2S)
Mating Connector Part Number:		PT06A-8-2P (SR)
Pin Identification	Symbol	Description
A	+12VDC	12 Volt supply.
B	GND	12 Volt return.

Table 7-41 Power Connector Interface Characteristics

Item Description	Value
Input / Output	Output
Connector Quantity	3
Voltage	12.5 VDC
Amperage	See Control Module

7.2.8 RS-232 Connector

Front face of pin inserts is illustrated in the following figure.

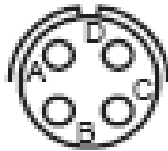


Figure 7-17 RS-232 Connector

¹⁹ This part number is for a Box Mounting Receptacle (PT02) with PCB Contacts. The following part number in the parenthesis is the exact part except with solder cups.

Table 7-42 RS-232 Connector Pin Out

Gender:		Female
Manufacturer:		Amphenol
Part Number:		71-570121-04S²⁰ (PT02A-8-4S)
Mating Connector Part Number:		PT06A-8-4P (SR)
Pin Identification	Symbol	Description
A	No Connect	NA
B	COM	Common for both transmit and receive lines.
C	TX	Transmit line.
D	RX	Receive line.

Table 7-43 RS-232 Interface Characteristics

Item Description	Value
Input / Output	I/O
Connector Quantity	1
Physical Layer	RS-232
Data Link Layer	ISO 11898
Application Layer	Qpacket

²⁰ This part number is for a Box Mounting Receptacle (PT02) with PCB Contacts. The following part number in the parenthesis is the exact part except with solder cups.

7.2.9 UHF – HOT Connector



Figure 7-18 UHF – HOT Connector

Table 7-44 UHF – HOT Connector Pin Out

Gender:		Female (N-Type)
Pin Identification	Symbol	Description
1	UHF	UHF signal line
Shield	GND	UHF signal return

Table 7-45 UHF – HOT Connector Interface Characteristics

Item Description	Value
Input / Output	I/O
Connector Quantity	1
Receive Carrier Frequency	457.9375 MHz (i.e., UHF)
Transmit Carrier Frequency	452.9375 MHz
Power	10 watts Max.
Modulation	FFSK
Baud Rate	1200 \pm 0.5%
Modulating Freq. (Space/Mark)	1800 Hz \pm 0.5% / 1200 Hz \pm 0.5%

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7.3 BRAKE INTERFACE MODULE (BIM) A90335

The Brake Interface Module controls the electro-mechanical Pneumatic Brake Valve 'P2A' directly, or it can provide a discrete digital output to the newer electro-mechanical brake systems deployed by New York Air Brake and others.

The following pages contain details for each connector on the module.



Figure 7-19 Brake Interface Module A90335

7.3.1 Brake Connector

Front face of pin inserts is illustrated in the following figure.

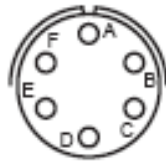


Figure 7-20 Brake Connector

Table 7-46 Brake Connector Pin Out

Gender:		Female
Manufacturer:		Amphenol
Part Number:		71-570122-06S²¹ (PT02A-10-6S)
Mating Connector Part Number:		PT06A-10-6P (SR)
Pin Identification	Symbol	Description
A	+12VDC	12 Volt supply for the Brake Interface Module.
B	GND	12 Volt return for the Brake Interface Module.
C	CLKP	The positive clock line to the Brake Interface Module.
D	CLKN	The negative clock line to the Brake Interface Module.
E	DATP	The positive data line to the Brake Interface Module.
F	DATN	The negative data line to the Brake Interface Module.

²¹ This part number is for a Box Mounting Receptacle (PT02) with PCB Contacts. The following part number in the parenthesis is the exact part except with solder cups.

7.3.1.1 12 Volt Supply

Table 7-47 12 Volt Supply Interface Characteristics

Item Description	Value
Input / Output	O
Connector Quantity	1
Voltage	12 VDC

7.3.2 Asynchronous RS-485

Table 7-48 Asynchronous RS-485 Interface Characteristics

Item Description	Value
Input / Output	O
Connector Quantity	1
Link Active Status LED	Flashing Green is active
Physical Layer	RS-485

7.3.3 General Brake Interface Module LED Interface

Table 7-49 General Brake Interface Module LED Interface

LED Label	LED Color
POWER	Steady Green is On
COMMS	Flashing Yellow is activity
FAULT	Steady Red is system fault detected

7.3.4 Output Connector



WARNING

SPECIAL CARE NEEDS TO BE TAKEN TO ENSURE THAT 74 VDC IS NOT SHORTED TO THE PENALTY ELECTRO-MECHANICAL PNEUMATIC VALVE (e.g., P2A) PREVENTING THE TRAIN SENTINEL® SYSTEM FROM REQUESTING A PENALTY BRAKE APPLICATION. SPECIFICALLY, DO NOT ALLOW +74 VDC TO SHORT TO PIN 5 (OUT1P) AND PIN 8 (OUT2P), AND 74 VDC GND TO SHORT TO PIN 6 (OUT1N) AND PIN 7 (OUT2N) ON THE BRAKE INTERFACE MODLE OUTPUT CONNECTOR.

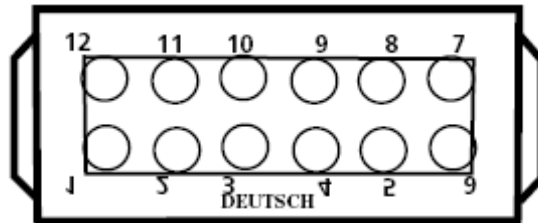


Figure 7-21 Output Connector

Table 7-50 Output Connector Pin Out

Gender: Male Manufacturer: Deutsch Part Number: DT04-12PA-LE05 Mating Connector Part Number: DT06-12SA, W12S, 0462-201-16141 (Qty 8), & 114017 (Qty 4)		
Pin Identification	Symbol	Description
1	BR1P	74VDC Positive Input for Output 1
2	BR1N	74 VDC Negative Return for Output 1
3	No Connect	NA
4	No Connect	NA
5	OUT1P	P2A Positive Valve Drive 1
6	OUT1N	P2A Negative Valve Return 1

7	OUT2N	P2A Negative Valve Return 2
8	OUT2P	P2A Positive Valve Drive 2
9	No Connect	NA
10	No Connect	NA
11	BR2N	74VDC Negative Return for Output 2
12	BR2P	74VDC Positive Input for Output 2

7.3.5 P2A Outputs

Table 7-51 P2A Output Interface Characteristics

Item Description	Value
Input / Output	Output
Connector Quantity	1
Status LEDs	Green is Energized
Voltage	74 VDC

7.3.6 P2A Output Source

Table 7-52 P2A Output Source Interface Characteristics

Item Description	Value
Input / Output	Input
Connector Quantity	1
Voltage	74 VDC

7.3.7 Remote/Cutout Connector

Front face of pin inserts is illustrated in the following figure.

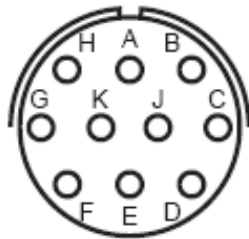


Figure 7-22 Remote/Cutout Connector

Table 7-53 Remote/Cutout Connector Pin Out

Gender:		Female
Manufacturer:		Amphenol
Part Number:		71-570121-10S²² (PT02A-12-10S)
Mating Connector Part Number:		PT06A-12-10P (SR)
Pin Identification	Symbol	Description
A	NO1	Input 1 Normally Open
B	NC1	Input 1 Normally Closed
C	GND	Ground
D	NO2	Input 2 Normally Open
E	NC2	Input 2 Normally Closed
F	GND	Ground
G	NO3	Input 3 Normally Open
H	NC3	Input 3 Normally Closed
J	GND	Ground
K	No Connection	NA

²² This part number is for a Box Mounting Receptacle (PT02) with PCB Contacts. The following part number in the parenthesis is the exact part except with solder cups.

7.3.8 Remote Input(s)

Table 7-54 Remote Input(s) Interface Characteristics

Item Description	Value
Input / Output	Input
Connector Quantity	1
Status LEDs	Lit Green is Remote active; otherwise Remote is inactive. Yellow is Reserved.

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7.4 DISPLAY MODULE A90320

The Locomotive Crew Display picks up the messages being broadcasted across the Internal Ethernet network. This is the primary display to the Locomotive Crew. This display also includes a speaker to create an audible alert. An alert is activated to warn the Locomotive Crew that an over speed condition has occurred. The speaker is also activated when a key on the Keypad Module has been activated.

The Locomotive Subsystem supports two Locomotive Crew Displays, one for the operator and the other for the conductor.

The following pages contain details for each connector on the module.

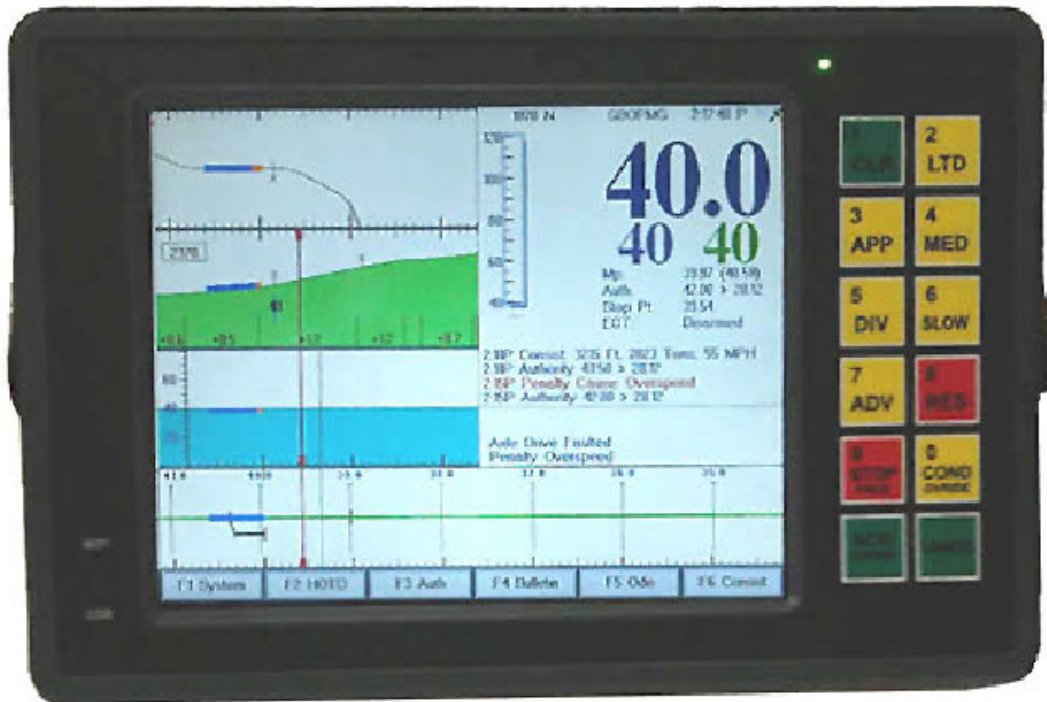


Figure 7-23 Display Module A90320

Table 7-55 Display Specifications

Item Description	Value
Input / Output	I/O
Quantity	2 (max)
Speaker	Yes
Buttons	0-9, Enter, & Cancel

7.4.1 Ethernet Connector

Front face of pin inserts is illustrated in the following figure.

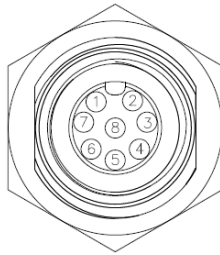


Figure 7-24 Ethernet Connector

Table 7-56 Ethernet Connector Pin Out

Gender: Female		
Manufacturer: Tyco		
Part Number: 1838892-4		
Mating Connector Part Number: 1838277-4		
Pin Identification	Symbol	Description
1	No Connect	NA
2	No Connect	NA
3	No Connect	NA
4	TXN	Negative transmit line
5	RXP	Positive receive line
6	TXP	Positive transmit line
7	No Connect	NA
8	RXN	Negative receive line

7.4.2 Power Connector

Front face of pin inserts is illustrated in the following figure.

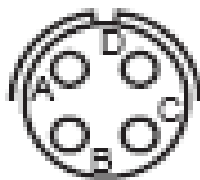


Figure 7-25 Power Connector

Table 7-57 Power Connector Pin Out

Gender: Female		
Manufacturer: Amphenol		
Part Number: 71-570121-04S ²³ (PT02A-8-4S)		
Mating Connector Part Number: PT06A-8-4P (SR)		
Pin Identification	Symbol	Description
A	12VDC	12VDC supply
B	COM	Common for 12VDC, transmit and receive lines.
C	TX	Laptop Port transmit line.
D	RX	Laptop Port receive line.

²³ This part number is for a Box Mounting Receptacle (PT02) with PCB Contacts. The following part number in the parenthesis is the exact part except with solder cups.

7.4.2.1 12 VDC Port

Table 7-58 12 VDC Interface Characteristics

Item Description	Value
Input / Output	Output
Connector Quantity	1
Voltage	13.5 VDC

7.4.2.2 Laptop Port

Table 7-59 Laptop Port Interface Characteristics

Item Description	Value
Input / Output	I/O
Connector Quantity	1
Physical Layer	RS-232
Baud Rate	1200 - 115200 ²⁴
Data Link Layer	ISO 11898
Application Layer	Qpacket

²⁴ The interface will only support the following industry standard baud rates; 1200, 4800, 9600, 19200, 38400, 57600, and 115200.

7.4.3 USB Connector

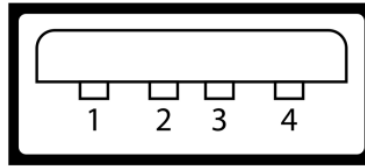


Figure 7-26 USB Connector

Table 7-60 USB Connector Pin Out

Gender:		Type A Receptacle
Mating Connector Part Number:		Type A Plug
Pin Identification	Symbol	Description
1	5VDC	5 volt supply.
2	DATA-	Data minus.
3	DATA+	Data plus.
4	GND	Ground

Table 7-61 USB Interface Characteristics

Item Description	Value
Input / Output	I/O
Connector Quantity	1
Protocol	2.0 Host

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7.5 KEYPAD/DISPLAY INTERFACE Q1962

The Keypad Module includes 18 push buttons, a 16 character – 2 row display, and a speaker. Six of the 18 push buttons are Function keys. The application specific function for these buttons is displayed on the bottom of the Locomotive Crew Display.

This small dot matrix display and speaker is for back up if the Locomotive Crew Display and/or speaker were to fail.

The Locomotive Subsystem supports two Keypad Modules that connect to the system via the two RS-485 connectors on the Control Module.

The following pages contain details for each connector on the module.



Figure 7-27 Keypad/Display Specifications

Table 7-62 Keypad/Display Specifications

Item Description	Value
Input / Output	Input / Output
Quantity	2 Max.
Display Size	2 rows of 16 characters
Speaker	Yes
Buttons	F1-F6, 0-9, Enter, & Cancel

7.5.1 Keypad/Display Connector

Front face of pin inserts is illustrated in the following figure.

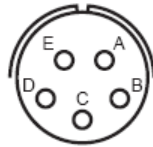


Figure 7-28 Keypad/Display Connector

Table 7-63 Keypad/Display Connector Pin Out

Gender:		Female
Manufacturer:		Amphenol
Part Number:		71-570121-10S²⁵ (PT02A-10-5S)PT06A-10-5P (SR)
Mating Connector Part Number:		
Pin Identification	Symbol	Description
A	RS-485-A	RS485 signal A
B	RS-485-B	RS485 signal B
C	+12VDC	12VDC Source
D	GND	Ground
E	SHIELD	Cable Shield

Table 7-64 RS Interface Characteristics

Item Description	Value
Input / Output	I/O
Connector Quantity	2
Physical Layer	RS-485
Baud Rate	1200 - 115200 ²⁶

²⁵ This part number is for a Box Mounting Receptacle (PT02) with PCB Contacts. The following part number in the parenthesis is the exact part except with solder cups.

²⁶ The interface will only support the following industry standard baud rates; 1200, 4800, 9600, 19200, 38400, 57600, and 115200.

NOTES

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