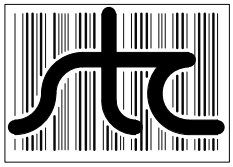


EUD-2005041-00

Solar-Powered SmallTalk System User's Guide for BNSF

Because products evolve and system configurations change, this manual may not be an exact representation of the products and systems that you are using.

STC assumes no responsibility for errors or omissions in this document. Nor does STC make any commitment to update the information contained herein.

Product and company names mentioned herein are trademarks or registered trademarks of their respective owners.

CAUTION

Contact with electrically active parts could result in sparks, burns, and electric shock. Because of this, you should avoid all electrical hazards when installing, wiring, operating, maintaining, and using the SmallTalk system. Failure to do so could result in damage to the equipment or serious injury to you.

STC's web site is www.southern-tech.com

their email address is email@southern-tech.com

their fax number is 423-499-0045

their telephone number is 423-892-3029

Contents

This section lists the headings of this guide in sequential order with their page references.

Chapter 1 — Introduction

This chapter summarizes the purpose of this guide, describes the solar-powered SmallTalk system, and lists the components of the system. It tells how to comment on this guide and how to order more copies of this guide. And, it also covers the cautions and disclaimers of which the customer should be aware.

1.1 Purpose of This Guide

The technical staff at Southern Technologies Corporation (STC) created the solar-powered SmallTalk system. This system can support different types of detectors. This guide describes the system that supports dragging-equipment, bridge-failure, shifted-load (aka wide-load), and high-water detectors.

This solar-powered SmallTalk system monitors specific trackside detectors and reports specific problems found during monitoring. Some parts of the system, such as the track circuit, are installed on railroad tracks. Other parts of the system, such as the SmallTalk module, are installed near the tracks.

The system is firmware driven. Internal firmware can be changed to meet the unique needs of a given railroad. This guide is for those who purchase, install, maintain, troubleshoot, manage, or use the described system at BNSF.

1.2 System Description

The solar-powered SmallTalk system can be configured in one of three ways.

- Bridge-failure detector with track circuit only.
- High-water detector with track circuit only.
- Dragging-equipment detector (DED) and one or two optional shifted-load detectors with transducer and optional track circuit.

For bridge-failure detection, the system checks railway bridges for alignment problems that could cause derailments or severe damage to trains.

For high-water detection, the system constantly monitors the water level for problems that have the potential of impacting train traffic.

For dragging-equipment detection, the system checks passing trains for dragging equipment that could cause derailments or severe damage. When shifted-load detectors are installed, it also checks passing trains for cars that have overhanging loads.

During train passage, the solar-powered SmallTalk system:

- Examines the signals from the detectors, any transducers, and any track circuits.
- Determines if an alarm condition exists.
- Determines the defect position (that is, axle count), if applicable.
- Announces any alarm condition in a humanlike voice via the RF transmitter.

When no train is present, the solar-powered SmallTalk system:

- Monitors any installed dragging-equipment detector for any malfunction (such as, for a stuck dragger).
- Monitors any installed shifted-load detector for any malfunction (such as, for a blocked sensor).
- Monitors any installed bridge-failure detector for any indication of bridge misalignment.
- Monitors any installed high-water detector for any indication of unacceptable water height.
- Notifies the next train, when such a malfunction or misalignment exists.

When the system detects a defect, it informs the crew of the affected train. This is done by a voice transmission over an assigned radio channel. Firmware generates the voice from previously digitized human speech. It tells the crew:

- The site of the reporting detector, which is reported as a milepost
- A warning that a defect has been detected, as the train is passing over the site
- The axle number upon which the defect was detected and the type of defect found, after the train has left the site

When no defect is detected, the voice tells the crew that no defects were found. The results of train scans are also stored for later use. With this stored data, the system can create formatted reports for you. To get them at the site, all you need is a computer.

The system runs well in the harsh environments found along right of ways. With adequate sun-energy reaching the solar panel, it runs over a temperature range of -40ºF to +160ºF (-40ºC to +71ºC). It runs unattended, carrying out all tasks without human intervention.

1.3 System Components

The solar-powered SmallTalk system consists of:

- Solar Package
- Electronics Package
- Track Hardware

The Solar Package consists of:

- Solar panel, generating 75 watts of power
- Tower in two sections
- Three anti-climb panels
- Base plate
- Ground rod
- Concrete footer

The Electronics Package consists of:

- Enclosure
- SmallTalk module, which contains a SmallTalk board
- Expansion board
- Hold-off interface
- Regulator panel
- Battery
- Surge Suppression panel
- Coaxial Surge Protector
- RF transmitter

For bridge-failure detection, the Track Hardware consists of:

- One switch-closure-type bridge-failure detector per track.
- One track circuit per track, each indicates train presence on the track it was installed.

For high-water detection, the Track Hardware consists of:

- One switch-closure-type high-water detector per track.
- One track circuit per track, each indicates train presence on the track it was installed.

For dragging-equipment detection, the Track Hardware consists of:

- One switch-closure-type dragging-equipment detector per track.
- One or two optional switch-closure-type shifted-load detectors per track.
- One transducer per track, each counts axles on the track it was installed; each may also indicate train presence.
- One optional track circuit per track, each indicates train presence on the track it was installed.

STC provides the Solar Package, the Electronics Package, and any transducers. BNSF provides the RF transmitter, any dragging-equipment detectors, any bridge-failure detectors, any high-water detectors, any shifted-load detectors, and any track circuits.

1.4 Cautions

Do not try to install any part of the solar-powered SmallTalk system until you have read and understood the information in this guide.

Do not install the tower near any type of power line. Be sure the tower is out of falling range of any overhead wires, including the lead to any building. Once installed, do not climb the tower. Failure to follow these instructions could result in injury or death.

While exposed to light, the solar panel generates DC electricity. Contact with electrically active parts could result in sparks, burns, and electric shock. Therefore, do not install the panel where flammable gases or vapors are present. Do not touch any unshielded wire coming from the panel. Do not let two unshielded wires touch. Work only under dry conditions. In sum, avoid all electrical hazards when installing, wiring, operating, and maintaining the solar panel and other electrical parts of the solar-powered SmallTalk system. Failure to follow these instructions could result in injury or death.

1.5 Disclaimers

The correct use of this guide, the environmental conditions at the time of installation, and the method of installation itself is beyond the control of STC. So too is the correct use and maintenance of all or part of the solar-powered SmallTalk system. Therefore, the installer, user, and maintainer assume the risk of any injury that might occur during installation, use, and maintenance of all or part of the solar-powered SmallTalk system. STC assumes no risk, liability, or responsibility for errors or omissions on the part of these people.

1.6 How to Comment on This Guide

We want to hear from you. Tell us what you like or don't like about this guide. Send your comments to:

Southern Technologies Corporation
Technical Publications Department
6145 Preservation Drive
Chattanooga, Tennessee 37416-3638
USA

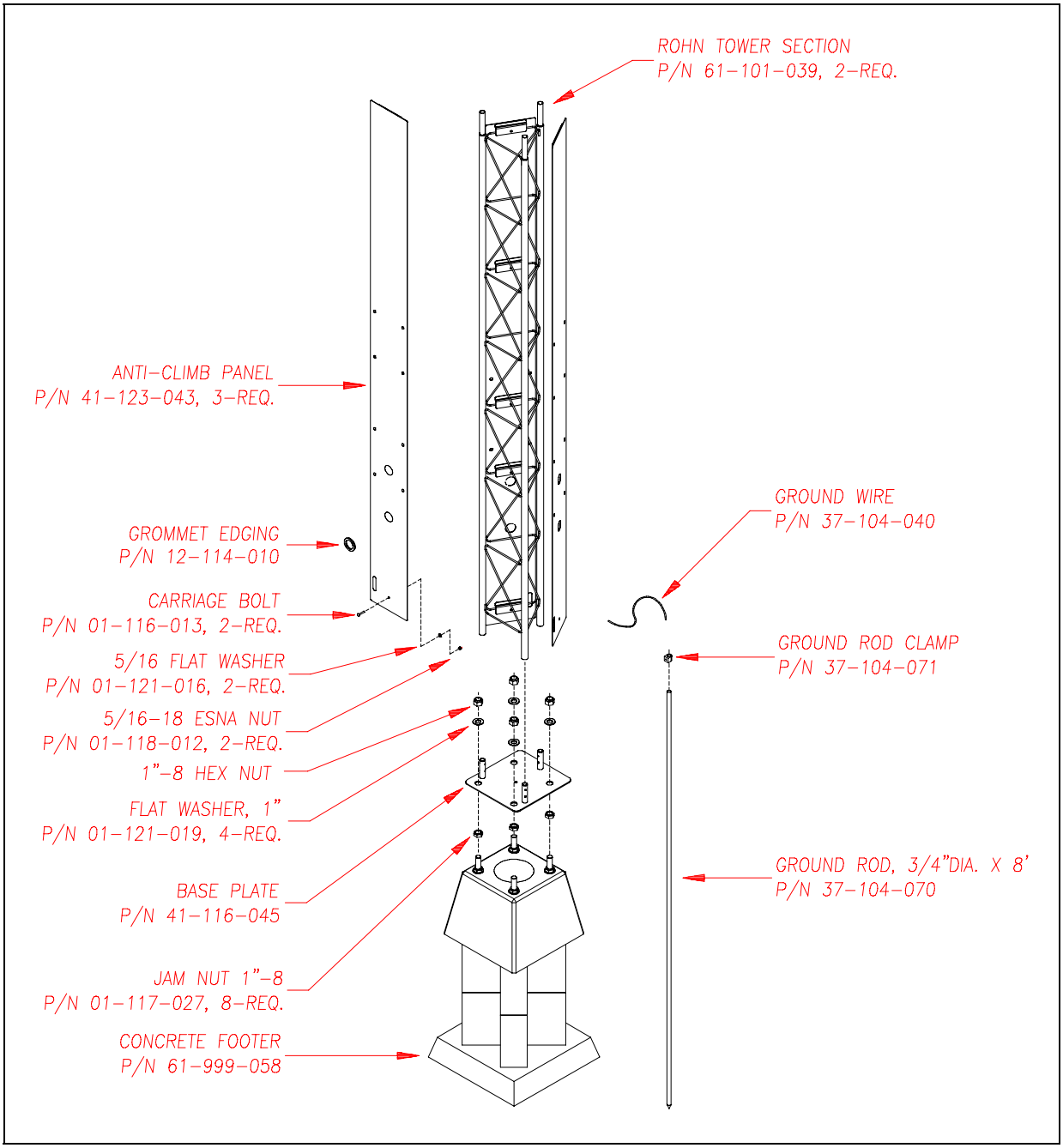
All comments become the property of STC and won't be returned.

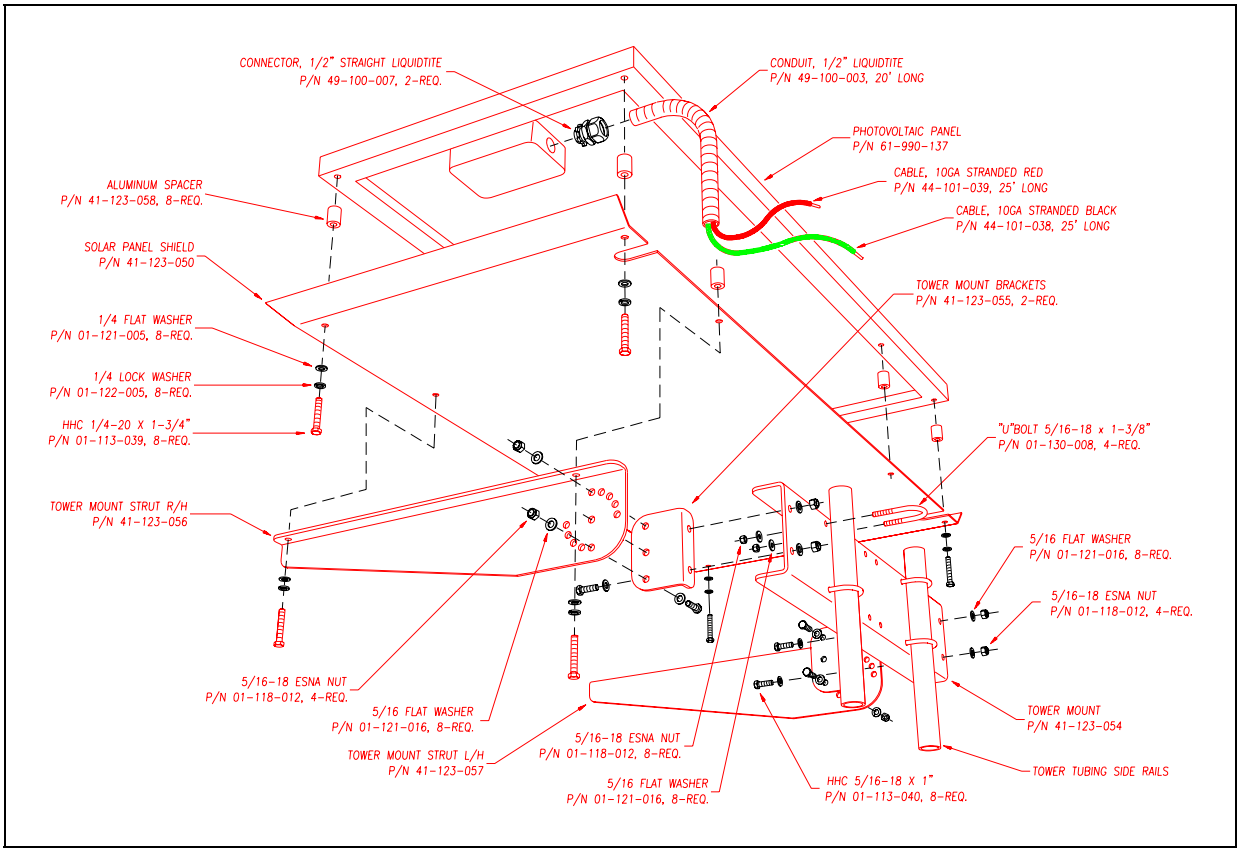
1.7 How to Order More Copies of This Guide

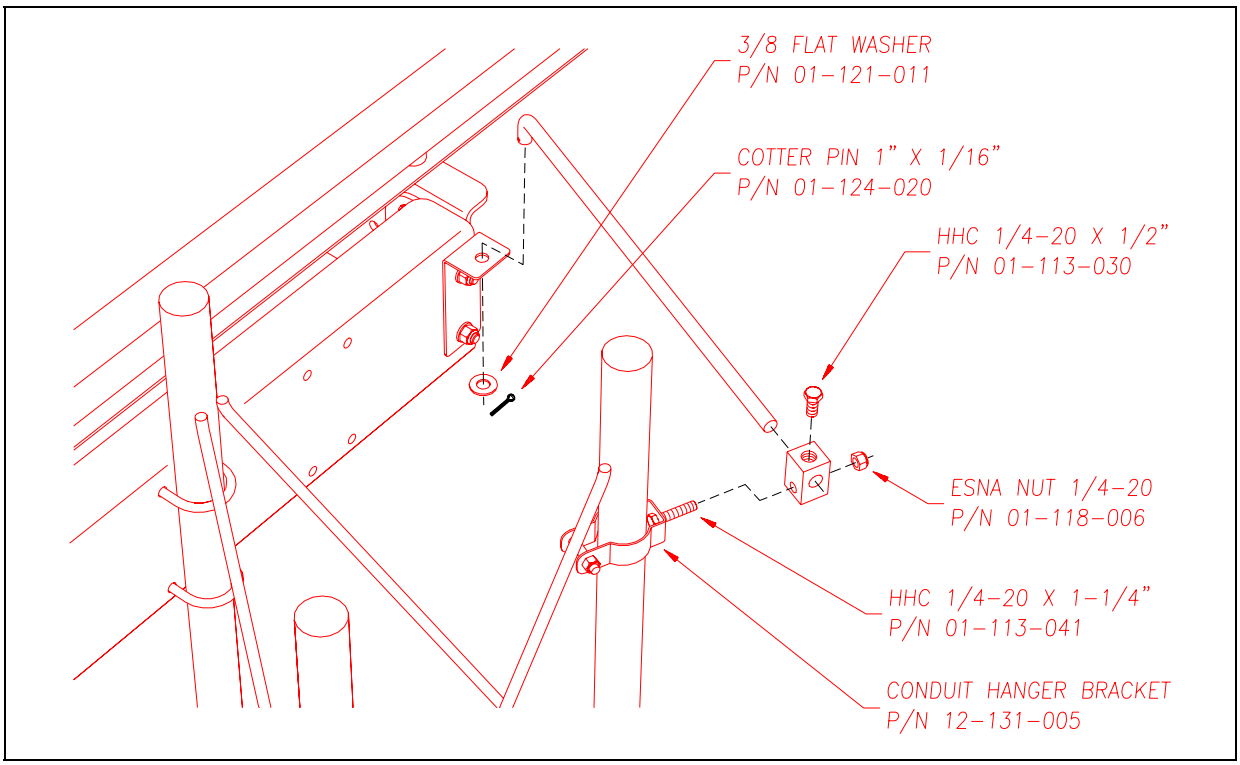
When placing an order for more copies of this guide, refer to the order number shown on the cover of this guide. To request pricing and delivery, call 423-892-3029, fax 423-499-0045, or send email to email@southern-tech.com. Electronic copies of this guide are also available.

Chapter 2 — Parts of Solar Package

This chapter shows the parts of the Solar Package, with their respective part numbers.




CONNECTOR, 1/2" STRAIGHT LIQUIDTITE
P/N 49-100-007, 2-REQ.
CONDUIT, 1/2" LIQUIDTITE
P/N 49-100-003, 20' LONG
PHOTOVOLTAIC PANEL
P/N 61-990-137
CABLE, 10GA STRANDED RED
P/N 44-101-039, 25' LONG
CABLE, 10GA STRANDED BLACK
P/N 44-101-038, 25' LONG
ALUMINUM SPACER
P/N 41-123-058, 8-REQ.
SOLAR PANEL SHIELD
P/N 41-123-050
TOWER MOUNT BRACKETS
P/N 41-123-055, 2-REQ.
1/4 FLAT WASHER
P/N 01-121-005, 8-REQ.
1/4 LOCK WASHER
P/N 01-122-005, 8-REQ.
HHC 1/4-20 X 1-3/4"
P/N 01-113-039, 8-REQ.
"U"BOLT 5/16-18 x 1-3/8"
P/N 01-130-008, 4-REQ.
TOWER MOUNT STRUT R/H
P/N 41-123-056
5/16 FLAT WASHER
P/N 01-121-016, 8-REQ.
5/16-18 ESNA NUT
P/N 01-118-012, 4-REQ.
5/16-18 ESNA NUT
P/N 01-118-012, 4-REQ.
5/16 FLAT WASHER
P/N 01-121-016, 8-REQ.
TOWER MOUNT STRUT L/H
P/N 41-123-057
5/16-18 ESNA NUT
P/N 01-118-012, 8-REQ.
TOWER MOUNT
P/N 41-123-054
5/16 FLAT WASHER
P/N 01-121-016, 8-REQ.
HHC 5/16-18 X 1"
P/N 01-113-040, 8-REQ.
TOWER TUBING SIDE RAILS

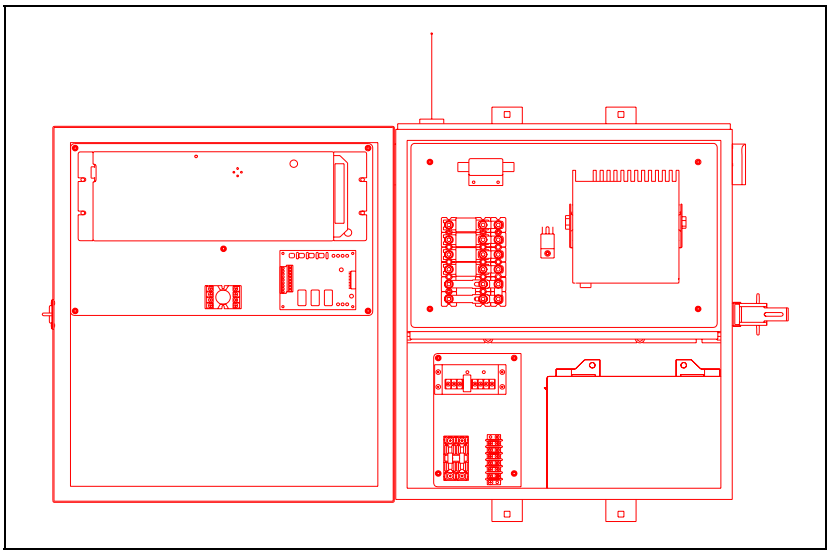

3/8 FLAT WASHER
P/N 01-121-011
COTTER PIN 1" X 1/16"
P/N 01-124-020
HHC 1/4-20 X 1/2"
P/N 01-113-030
ESNA NUT 1/4-20
P/N 01-118-006
HHC 1/4-20 X 1-1/4"
P/N 01-113-041
CONDUIT HANGER BRACKET
P/N 12-131-005

Chapter 3 — Parts of Electronics Package

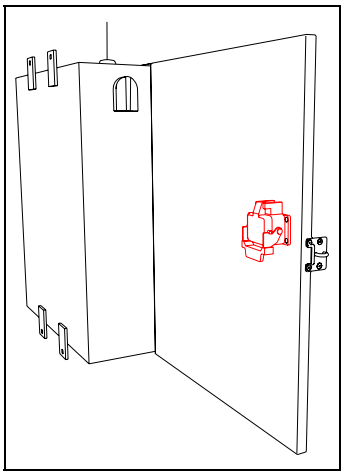
This chapter describes the key components in the Electronics Package. And, where appropriate, it shows the parts of the Electronics Package, with their respective part numbers.

3.1 Enclosure

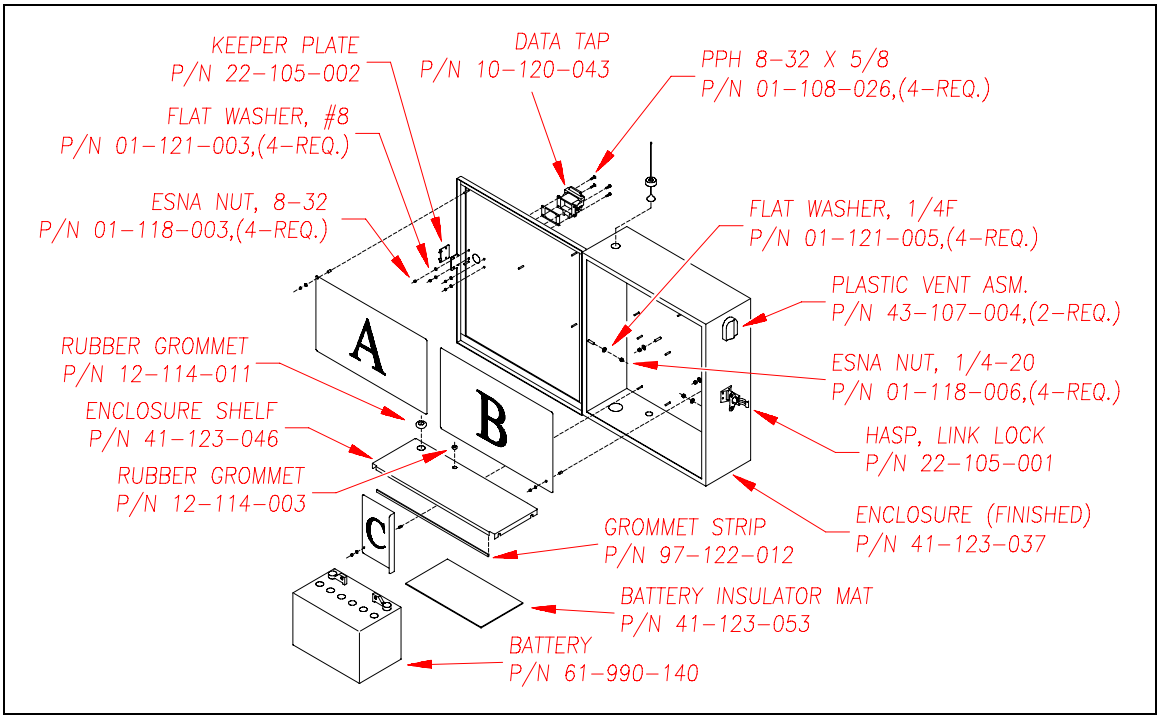
The figure below shows the front of an assembled enclosure.



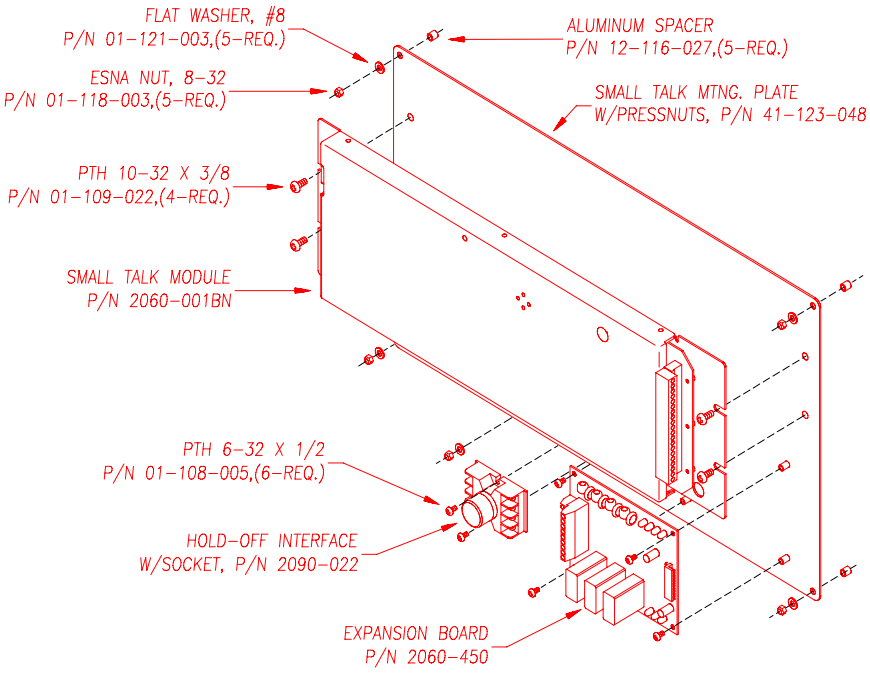
The figure below shows the back of an assembled enclosure.



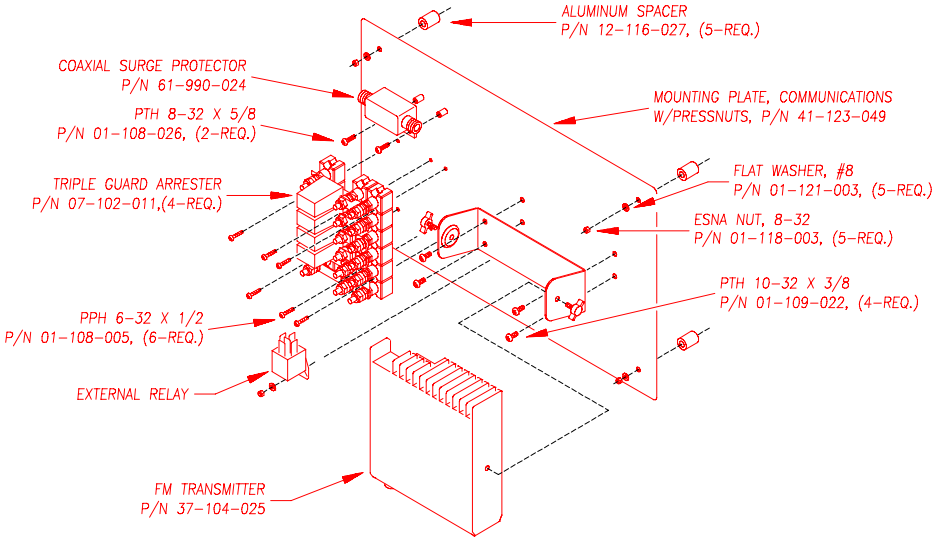
The figures below show the parts of an enclosure.



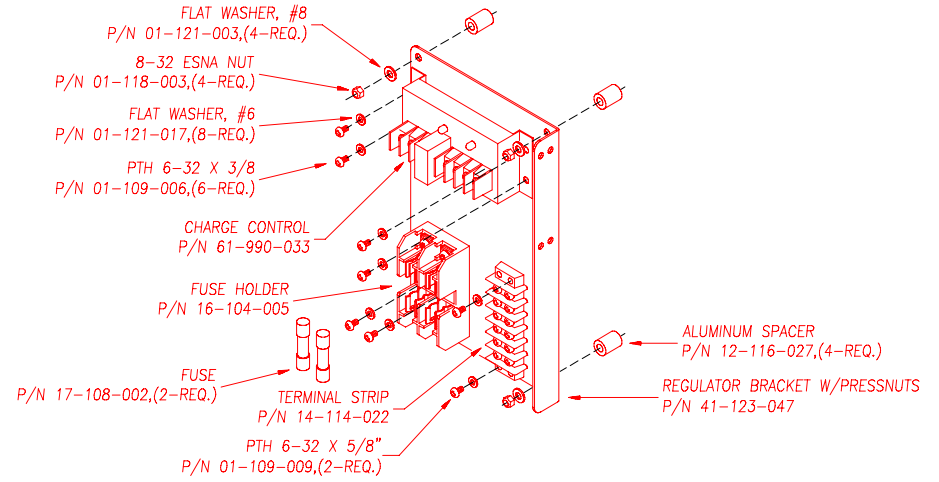
A ⇨



B ⇨

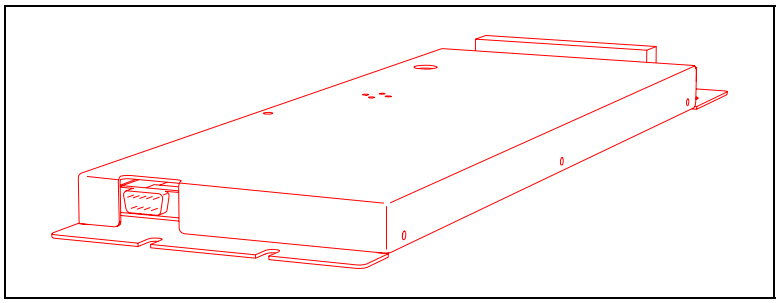

ALUMINUM SPACER
P/N 12-116-027, (5-REQ.)
COAXIAL SURGE PROTECTOR
P/N 61-990-024
PTH 8-32 X 5/8
P/N 01-108-026, (2-REQ.)
MOUNTING PLATE, COMMUNICATIONS
W/PRESSNUTS, P/N 41-123-049
TRIPLE GUARD ARRESTER
P/N 07-102-011,(4-REQ.)
FLAT WASHER, #8
P/N 01-121-003, (5-REQ.)
ESNA NUT, 8-32
P/N 01-118-003, (5-REQ.)
PTH 10-32 X 3/8
P/N 01-109-022, (4-REQ.)
PPH 6-32 X 1/2
P/N 01-108-005, (6-REQ.)
EXTERNAL RELAY
FM TRANSMITTER
P/N 37-104-025

C ⇨

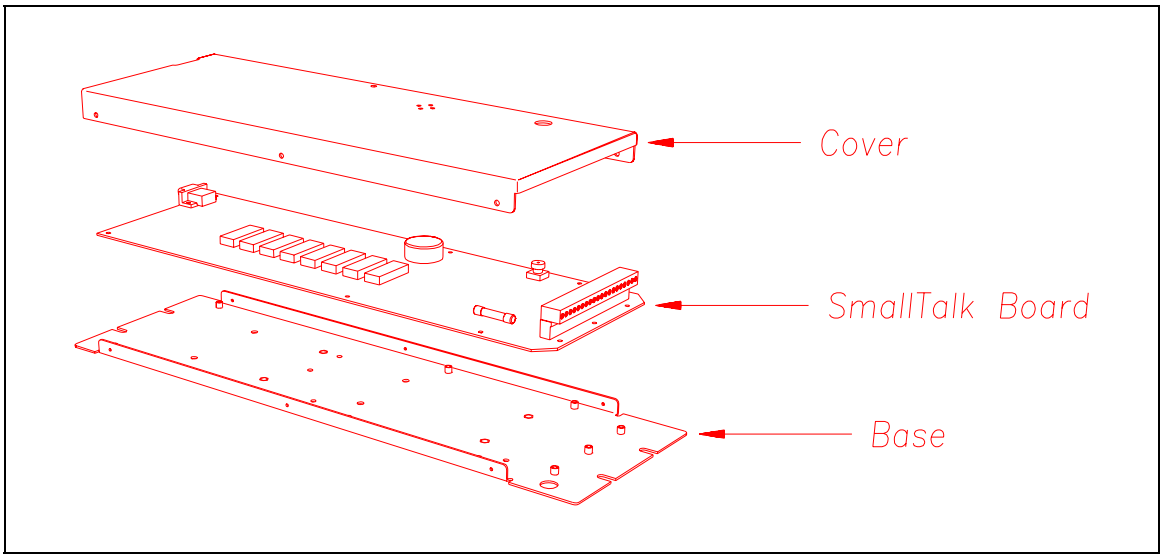

FLAT WASHER, #8
P/N 01-121-003,(4-REQ.)
8-32 ESNA NUT
P/N 01-118-003,(4-REQ.)
FLAT WASHER, #6
P/N 01-121-017,(8-REQ.)
PTH 6-32 X 3/8
P/N 01-109-006,(6-REQ.)
CHARGE CONTROL
P/N 61-990-033
FUSE HOLDER
P/N 16-104-005
ALUMINUM SPACER
P/N 12-116-027,(4-REQ.)
FUSE
P/N 17-108-002,(2-REQ.)
TERMINAL STRIP
P/N 14-114-022
REGULATOR BRACKET W/PRESSNUTS
P/N 41-123-047
PTH 6-32 X 5/8"
P/N 01-109-009,(2-REQ.)

3.2 SmallTalk Module

The figure below shows an assembled SmallTalk module.



The figure below shows the major parts of a SmallTalk module.



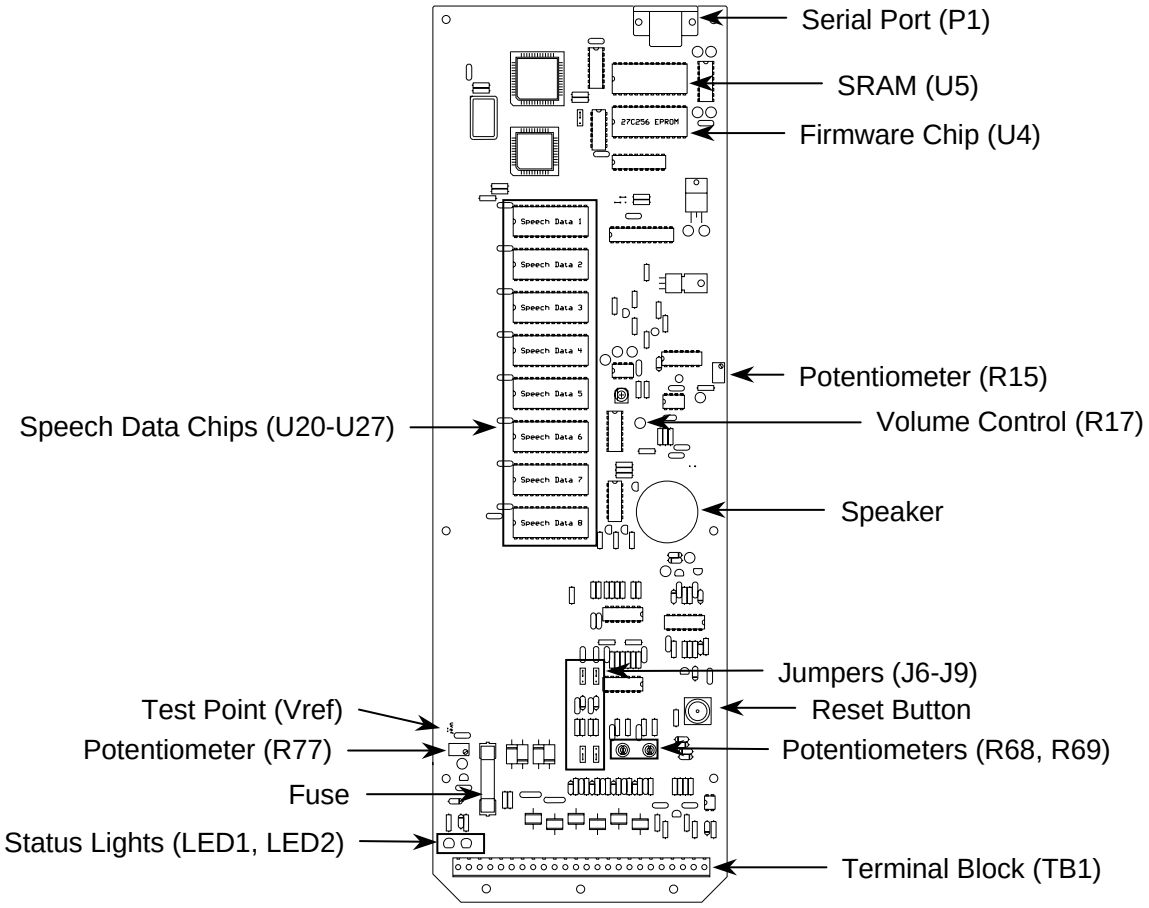
3.3 SmallTalk Board

The SmallTalk board has:

- Two channels for accepting input from two tracks at the same time.
- A speaker for verifying system operation.
- Sixteen kilobytes of nonvolatile static random-access memory (SRAM) for storing data on trains scanned, alarms found, and detector malfunctions found.
- An RS232 serial communications port for retrieving the stored data, setting up the system, and testing the operation of the track hardware.
- A terminal block for connecting the track hardware, the RF transmitter, and the power supply.

Newer SmallTalk boards are shown in this guide. They are similar to the older ones, except for a few minor changes. The older ones have a 20-terminal block on them. The newer ones have a 24-terminal block, on which the four additional terminals currently aren't being used by BNSF. Terminals 1-20 on both boards are wired the same. Also, the newer boards have two status LEDs on them, where the older ones had one.

The figure below shows a SmallTalk board with some key components highlighted. These components are the ones you use to install and maintain the SmallTalk system.

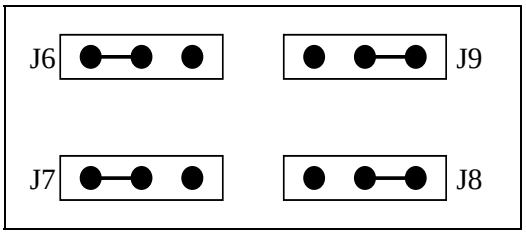


3.3.1 Speech Data Chips (U20-U27)

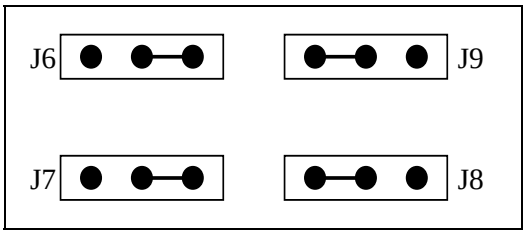
The eight sockets, labeled U20 through U27, are for 27C512, 27C256, or equivalent EPROMs. (Currently, BNSF only uses the first seven sockets.) These 64-kilobyte chips contain the digitized words and phrases used for voice announcements. If it becomes necessary to replace one or more of these chips, see ***Chapter 11 - Replacing Chips***.

3.3.2 Jumpers (J6-J9)

The four jumper blocks (J6-J9) are used to configure the SmallTalk system for the type of transducer used. For STC transducers, set the jumpers as:



For non-STC transducers, set the jumpers as:



3.3.3 Test Point (Vref)

Test point Vref is the reference voltage for the microprocessor's on-board analog-to-digital converter (ADC). This voltage should be +5 VDC.

3.3.4 Potentiometer (R77)

Potentiometer R77 adjusts the reference voltage for the microprocessor's on-board ADC. Use this potentiometer to make the voltage, at test point Vref, +5 VDC. Turn R77 clockwise to increase the voltage. Turn it counterclockwise to decrease the voltage.

3.3.5 Fuse

On the SmallTalk board is a 3AG glass-body fast-acting fuse. This 1/4-ampere fuse protects the rest of the board from excessive DC. Whenever possible, before replacing a blown fuse, locate and correct the problem that caused the fuse to blow.

3.3.6 Serial Port (P1)

The serial communications port (P1) connects the SmallTalk system to the serial port on the outside of the enclosure. From this external serial port, you can connect a computer. Thus, P1 is used indirectly to retrieve the stored data, setup the SmallTalk board, and test the operation of the track hardware.

The table below shows which signals are present at both ports.

PIN Number	I/O	PIN Function
2	I	Receive data (Rxd)
3	O	Transmit data (Txd)
5	--	Signal ground (Gnd)

3.3.7 SRAM (U5)

In socket U5 is 16 kilobytes of nonvolatile SRAM that stores data on trains scanned, alarms found, and detector malfunctions found.

3.3.8 Firmware Chip (U4)

In socket U4, the firmware is in a single 27C256 (or equivalent) EPROM. If it becomes necessary to replace this chip, see ***Chapter 11 - Replacing Chips***.

3.3.9 Potentiometer (R15)

Potentiometer R15 (aka Xmit Audio) adjusts the audio level to the RF transmitter. R15 doesn't affect the audio level of the on-board speaker. Turn R15 clockwise to increase the audio level. Turn it counterclockwise to decrease the audio level.

3.3.10 Volume Control (R17)

The volume control (R17) adjusts the volume of the on-board speaker. It doesn't affect the audio level of the voice radio. Turn R17 clockwise to increase the volume. Turn it counterclockwise to decrease the volume. Turning R17 all the way to the left turns the on-board speaker volume all the way down. This results in not hearing anything from the on-board speaker.

3.3.11 On-Board Speaker

The on-board speaker aids in verifying the operation of the system. If R17 hasn't been turned all the way to the left, all announcements broadcast over the voice radio is heard through this speaker.

3.3.12 Reset Button

The black reset button causes a hardware reset of the board, which has the same effect as if power was turned off and back on. You can use it to recover from an apparent microprocessor malfunction. You can also use it to mimic a system startup. Pressing it doesn't reset any other part of the system. Train data isn't lost.

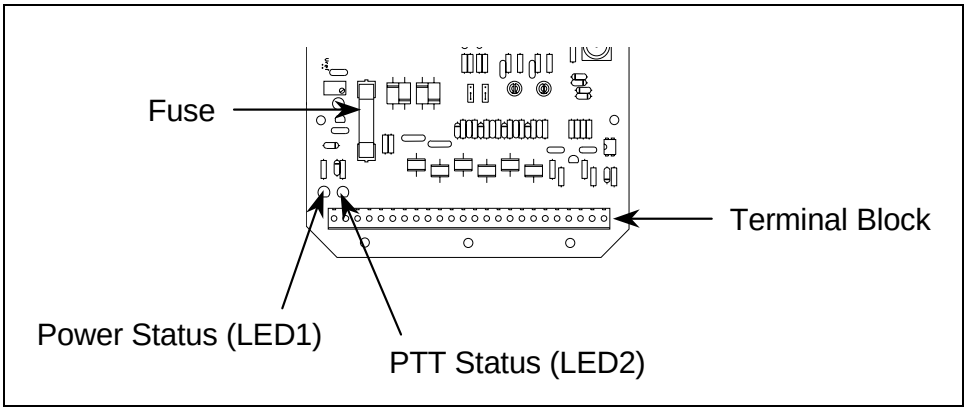
3.3.13 Potentiometers (R68, R69)

Potentiometers R68 and R69 adjust transducer loading. R68 adjusts transducer A (on track1), which is attached to terminals 7 and 8 on TB1. R69 adjusts transducer B (on track2), which is attached to terminals 9 and 10.

When the system is configured for STC transducers, potentiometers R68 and R69 dampen the transducer inputs. They are preset from the factory at 80 ohms, which works well for most applications. To verify this setting, disconnect the transducer and measure across the transducer input with an ohmmeter. This would be terminals 7 and 8 for transducer A or terminals 9 and 10 for transducer B. Adjust R68 for transducer A or R69 for transducer B until the ohmmeter indicates 80 ohms. Reconnect the transducer wires to the terminal block when finished with the adjustment. You may improve axle counts by adjusting these potentiometers to other than 80 ohms. If you get extra axle counts, try a lower value. If you are missing axles, try a higher value. Raise or lower the resistance in 10-ohm increments. Turn either potentiometer clockwise to increase loading resistance. Turn either counterclockwise to decrease loading resistance.

3.3.14 Status Lights (LED1, LED2)

The green LED1 stays lit as long as the system is powered up. If this LED isn't lit, it probably indicates that the SmallTalk board isn't powered or that the on-board fuse is blown.

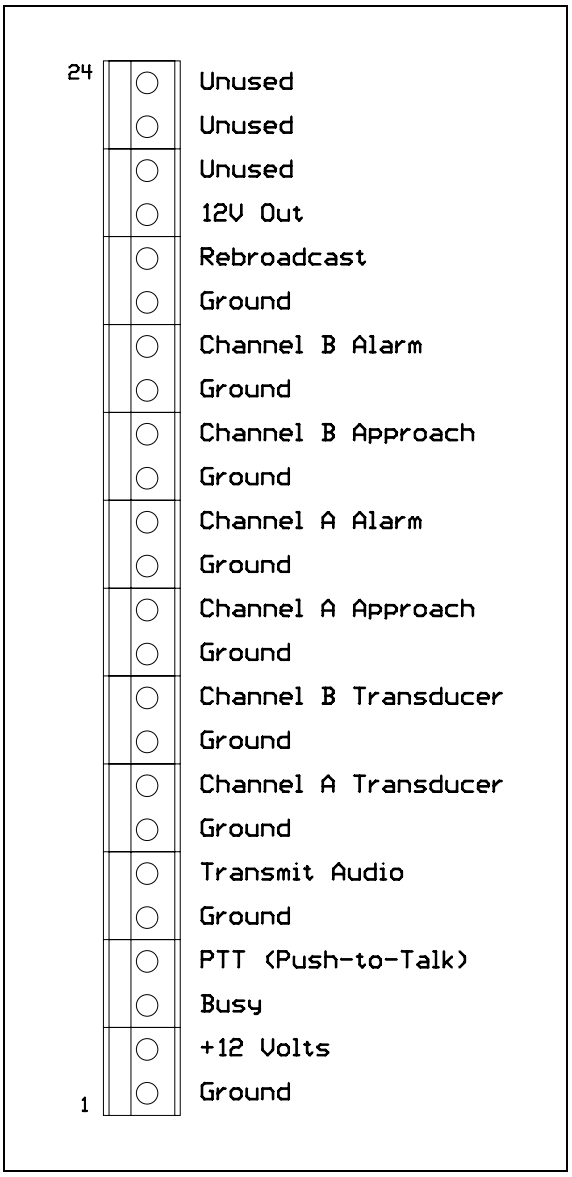


The green LED2 stays lit while the voice radio is sending messages.

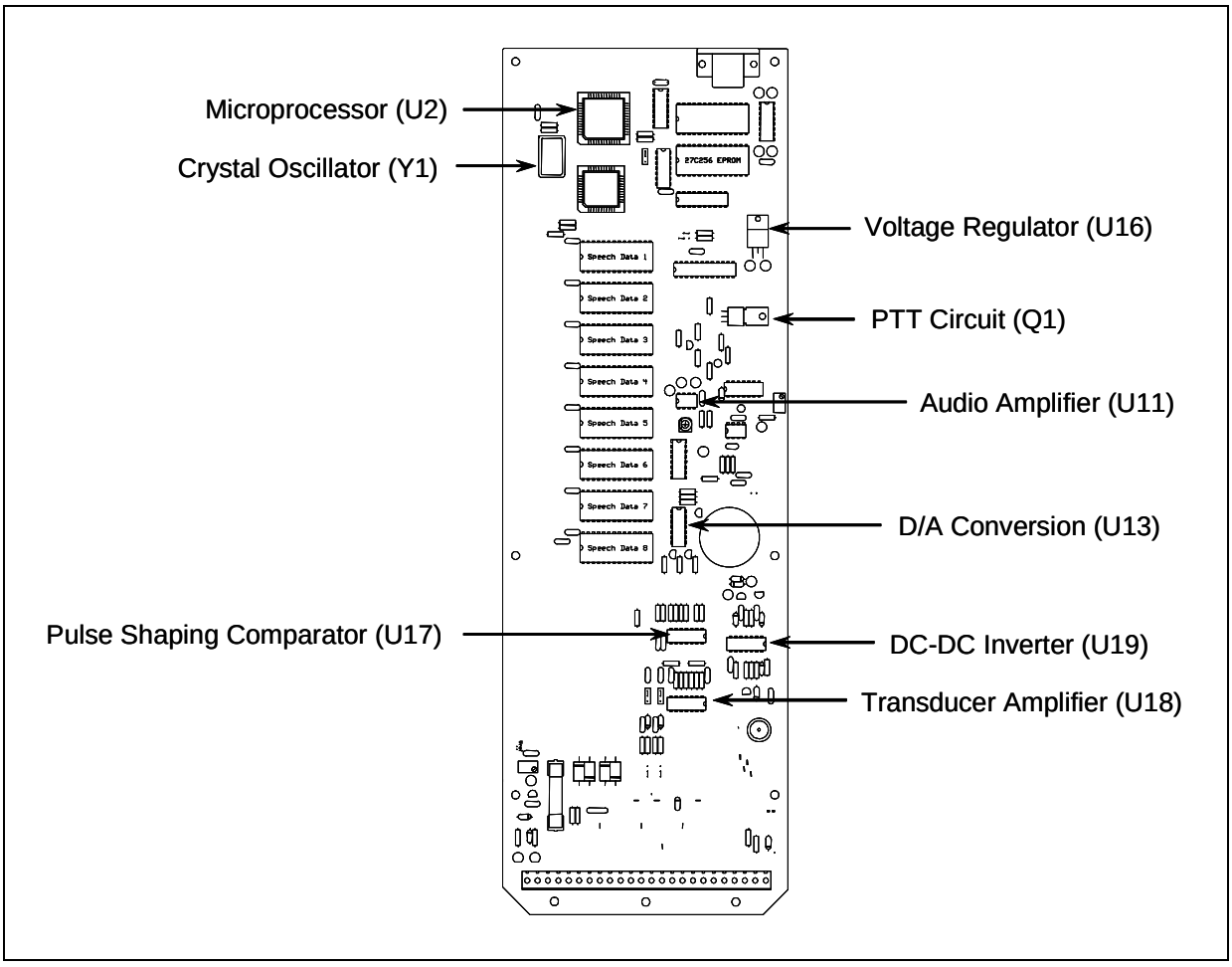
3.3.15 Terminal Block (TB1)

The 24-position terminal block (TB1) connects the SmallTalk board to the track hardware, the RF transmitter, and the power supply.

The figure below shows what is wired to each terminal.



The figure below shows a SmallTalk board with more key components highlighted. Knowledge of these components isn't required to install and maintain the SmallTalk system. However, this knowledge completes your understanding of the board.



3.3.16 Microprocessor (U2)

The microprocessor (U2) retrieves and executes the firmware stored in the EPROM chip (U4). The microprocessor accesses memory through its data bus and address bus. The data bus supplies both data and the lower eight bits of the address. The address bus supplies the upper eight bits. An address latch (U3) captures the lower address byte.

Besides the single 16-kilobyte EPROM chip (U4), there is a 16-kilobyte nonvolatile SRAM chip (U5), which is used primarily for train data storage. A chip select is generated by (U8) to select either the EPROM chip (U4) or the SRAM chip (U5). Among other things, the microprocessor also scans trackside inputs, activates the push-to-talk (PTT) circuit, and generates speech. An I/O chip (U6) addresses the speech data chips (U20-U27).

3.3.17 Crystal Oscillator (Y1)

The crystal oscillator (Y1) provides an eight-megahertz clock signal that is divided by the microprocessor to a two-megahertz signal present on pin 5 of the microprocessor. All system timing is based on this signal.

3.3.18 Pulse-Shaping Comparator (U17)

The pulse-shaping comparator (U17) provides squaring of transducer input signals. Any input to U17 greater than 0.65 volts is translated to +5 VDC for the microprocessor. Any input less than 0.65 volts is translated to 0 VDC for the microprocessor.

3.3.19 Voltage Regulator (U16)

The voltage regulator (U16) provides a fixed five-volt supply to the entire board. A separate eight-volt regulator (U28) provides a reference voltage for the microprocessor's on-board ADC. This reference voltage can be adjusted with potentiometer R77 and should be set to five volts at the test point labeled Vref.

3.3.20 PTT Circuit (Q1)

The PTT circuit (Q1) provides an open-collector output for operating the PTT circuit of the voice radio. It is activated by output PD3 from the microprocessor. C13, R28, and U9 keep the PTT on for about one second after the end of the audio.

3.3.21 Audio Amplifier (U11)

The audio amplifier (U11) drives the on-board speaker. The volume of the output is controlled by R17.

3.3.22 D/A Converter (U13)

The D/A converter (U13) translates the digital speech samples from the speech data chips to an analog voltage. That analog voltage is supplied through an analog gate (U14) to an audio filter (U12). This filter helps eliminate some switching noise inherent during speech generation.

3.3.23 DC-DC Inverter (U19)

U19 is a package of four NAND gates. Along with C22, R36, Q3, and Q4, three of the NAND gates form a DC-DC inverter circuit that generates a negative voltage from the 12-volt supply. The audio filter (U12) circuit needs this negative voltage for speech generation. Along with transistor Q4, one of the NAND gates on U19 performs a power-on-reset function. This ensures that the microprocessor's reset line is held low until all power supply voltages have stabilized. (Pressing the reset button also activates this circuit.)

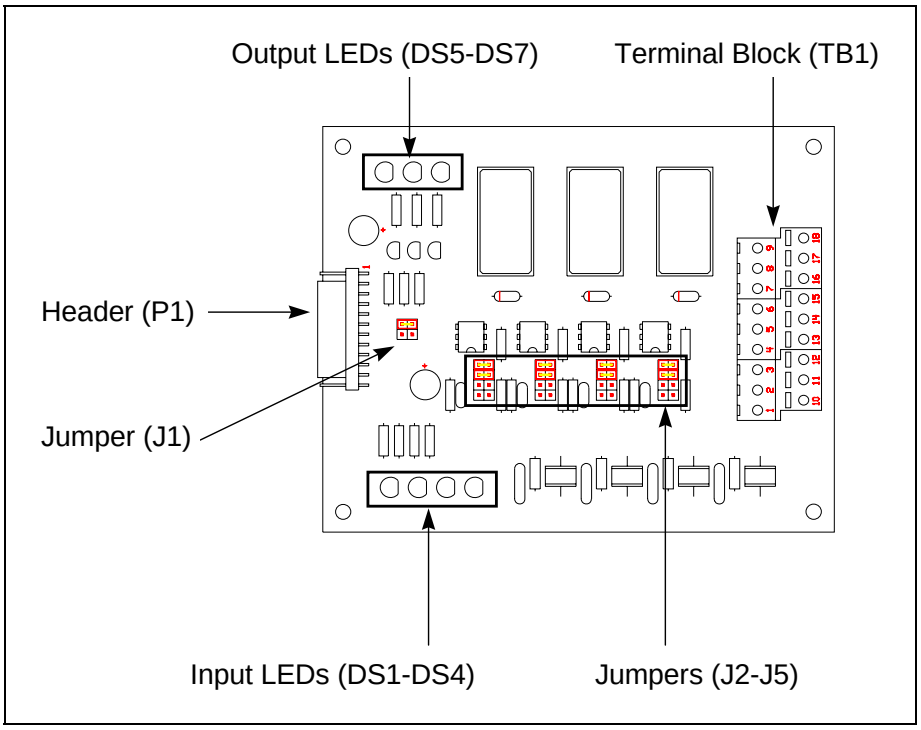
3.3.24 Transducer Amplifier (U18)

The transducer amplifier (U18) amplifies the transducer signals to levels usable by the microprocessor. The amplifier has a gain of about 22, which is required for the transducers manufactured by STC. Jumpers are provided (J7 and J8 for channel A; J6 and J9 for channel B) to bypass the amplifiers for transducers that have higher outputs.

3.4 Expansion Board

The Expansion board provides access to some additional inputs to and outputs from the SmallTalk processor. Up to three relay outputs and four optical-isolator inputs are made available.

The figure below shows an Expansion board.



3.4.1 Input LEDs (DS1-DS4)

The Input LEDs DS1 through DS4 indicate the status of inputs IN1 through IN4. If an input is active, its corresponding LED is lit.

3.4.2 Output LEDs (DS5-DS7)

The Output LEDs DS5 through DS7 indicate the status of outputs OUT1 through OUT3. If an output relay is energized, its corresponding LED is lit. OUT1 is used to control +12 VDC to the RF transmitter. Therefore, the RF transmitter will only be powered when the OUT1 LED is lit.

3.4.3 Jumper (J1)

Input IN1 and output OUT3 share the same I/O line. When J1 has a shorting jumper across pins 1 and 2, OUT3 is connected to the control line. When J1 has a shorting jumper across pins 3 and 4, IN1 is connected to the control line. IN1 and OUT3 cannot both be used at the same time. OUT3 is enabled at the factory.

3.4.4 Jumpers (J2-J5)

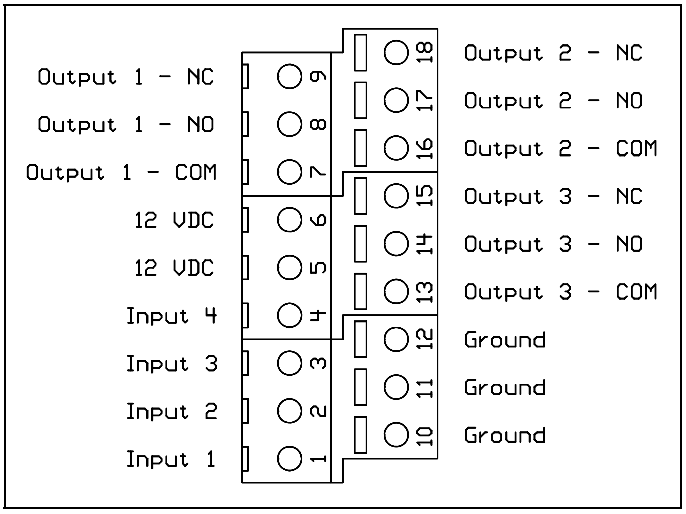
Jumpers J2 through J5 determine whether inputs IN1 through IN4 are active high or active low. With shorting jumpers across pins 1 and 2 and pins 3 and 4, the inputs are active low. This means the input terminal must be connected to ground to make the input active. With shorting jumpers across pins 5 and 6 and pins 7 and 8, the inputs are active high. This means that a positive voltage of approximately 12 VDC must be applied to the input terminal to make the input active. These inputs are set active high at the factory.

3.4.5 Header (P1)

The 12-pin header socket physically connects the Expansion board to the SmallTalk board. It carries the TTL-level (5V) signals that are used for the Expansion board inputs and outputs. This cable is already wired and connected at the factory. No additional wiring is needed.

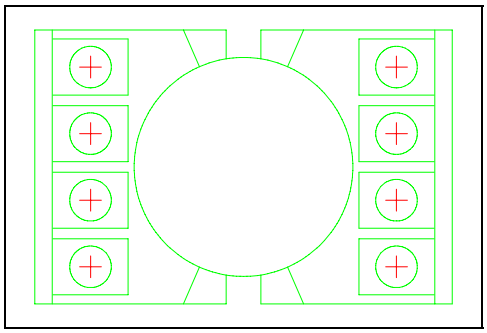
3.4.6 Terminal Block (TB1)

The 18-position terminal block (TB1) connects the Expansion board to the hold-off interface, the external relay, and the Regulator panel.



3.5 Hold-Off Interface

The hold-off interface (aka squelch interface) is an optically coupled device that connects the squelch-detect signal from the RF transmitter to terminal 3 of the SmallTalk board. This device changes the active-high signal that the transmitter sends into the active-low signal that the solar-powered SmallTalk system requires. This device is wired at the factory. No additional wiring is needed.

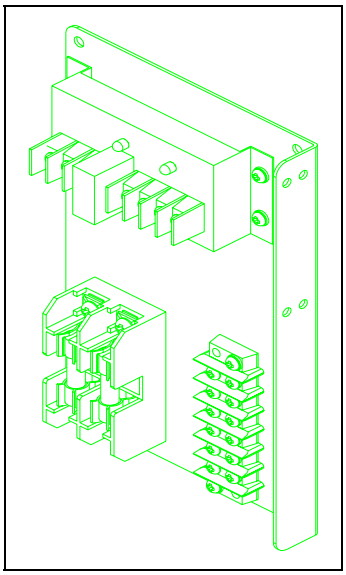


The hold-off interface is mounted below the SmallTalk board and to the left of the Expansion board.

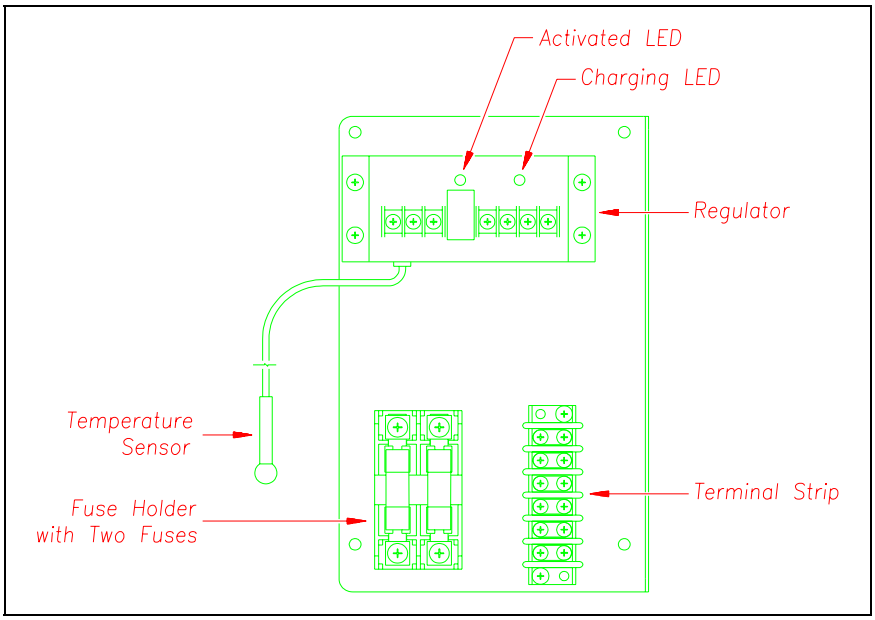
To power the RF transmitter when no train is present, jumper terminals 7 and 8 on the hold-off interface socket. This should be done carefully since terminal 7 is connected to the battery. Terminal 7 shouldn't be connected to the enclosure or to any terminal other than 8.

3.6 Regulator Panel

The figure below shows an assembled Regulator panel.



The figure below shows the major parts of a Regulator panel. The location and connection of the temperature sensor on your regulator might be different.



3.6.1 Regulator

The regulator (also called the automatic sequencing charger) is a solid-state battery charge controller. It starts charging when the battery voltage drops below 13.5 VDC and stops charging when the battery voltage reaches 14.3 VDC. It provides overcharge protection to the solar-powered SmallTalk system's battery and reverse leakage protection, which prevents battery discharge through the solar panels at night.

3.6.1.1 Temperature Sensor

From the regulator, at the end of a 10-foot cable is a sensor that attaches to the battery. This sensor is used to adjust the charging thresholds according to battery temperature. The charge set-point will be higher in cold weather and lower in hot weather. The regulator won't function with a missing or damaged sensor.

3.6.1.2 Activated LED

On the regulator, the Activated LED is lit when the battery voltage drops below 11.5 VDC. When lit, power is cut to the rest of the system. The battery charges. When the battery voltage exceeds 11.5 VDC, the light goes out and power is restored to the whole system.

3.6.1.3 Charging LED

On the regulator, the Charging LED is lit when there is voltage from the solar panel and the battery is charging. When the battery is at a low state of charge, the LED is lit continuously. When the battery is at a high state of charge (that is, when it is close to full charge), the LED alternates between being lit and not being lit.

3.6.2 Fuses

There are two 10-ampere fuses on the Regulator panel. They protect the whole system from excessive DC. They should be removed when attaching the solar panel and the battery to the system.

3.6.3 Terminal Strip

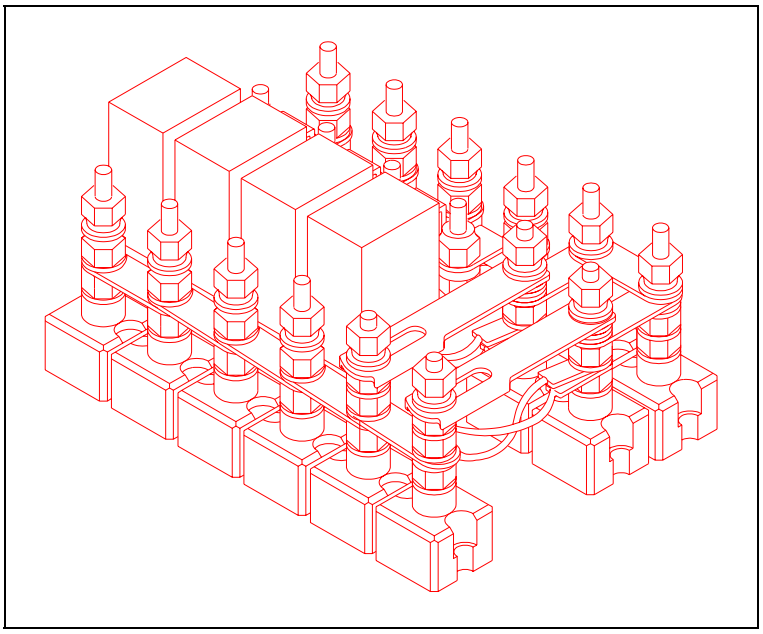
The 12-position terminal strip connects the Regulator panel to the solar panel, the battery, the SmallTalk board, and the Expansion board.

3.7 Battery

The solar-powered SmallTalk system uses a 12-volt 92-ampere-hour maintenance-free, deep-cycle battery. The use of a smaller battery reduces the amount of time that the system can operate after solar power is removed. The use of a larger battery or more than one battery may exceed the charging capacity of the system and could result in its failure.

3.8 Surge Suppression Panel

The figure below shows the front of an assembled Surge Suppression panel.



3.8.1 Triple-Guard Arresters

On the Surge Suppression panel are four triple-guard arresters. They protect the transducer inputs, the dragging-equipment inputs, and bridge-failure inputs from surges in voltage.

3.8.2 Terminals

On the Surge Suppression panel are 12 terminals that are used to:

- Attach the wire from the earth ground
- Attach the wires from the transducers, if used
- Attach the wires from the dragging-equipment detectors, if used
- Attach the wires from the bridge-failure detectors, if used

3.9 Coaxial Surge Protector

The Coaxial Surge Protector is an arrester that protects the RF transmitter from surges in voltage (such as from a lightning strike) through the antenna. This bidirectional arrester is inline between the antenna and the RF transmitter.

3.10 RF Transmitter

The solar-powered SmallTalk system uses a transceiver that is provided by BNSF and wired to the system by STC.

The C and NO terminals of OUT1 (on the Expansion board) are used to control power to the RF transmitter. To conserve power, the transmitter is only turned on when a train is present. To power the transmitter when no train is present, jumper terminals 7 and 8 on the hold-off interface socket. This should be done carefully since terminal 7 is connected to the battery. Terminal 7 shouldn't be connected to the enclosure or to any terminal other than 8.

The SmallTalk system has:

- Adjustable low-level audio output
- PTT output driver
- Busy input
- Rebroadcast input

You can adjust the RF transmitter's audio level with potentiometer R15, which is also labeled Xmit Audio on the SmallTalk board. Adjustment is from 0 to 2.5V peak-to-peak. Turning R15 doesn't affect the audio level of the on-board speaker.

The PTT output driver is an open collector NPN transistor. It can pull an external relay to ground when the talker is active. It can also control the RF transmitter directly when the RF transmitter can be controlled with an active low signal.

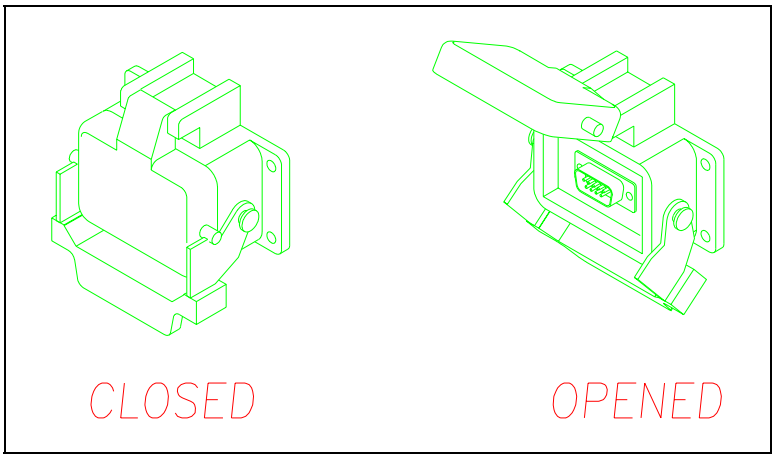
A busy input allows an announcement to be delayed. This input is an active low input. If it is held low, the SmallTalk board waits until the busy input is released (returned high) before attempting to talk. If it isn't released in 20 seconds, the board makes its announcement anyway. If the RF transmitter channel is busy, a carrier detect (or similar signal from the RF transmitter) attached to the busy input delays the announcement. Jumper J3 provides an alternate means of using the busy input by connecting it to the PTT circuit. This lets two SmallTalk systems be connected to the same RF transmitter without both trying to talk at the same time.

The rebroadcast input is an active low input. When held low it causes the most recent post-train announcement for each channel to be repeated. After each train, the rebroadcast input is enabled for the amount of time entered with the Rebroadcast Timeout option of the Setup Options menu. ***Chapter 10 - Serial Communications*** tells how to do this.

3.11 Data Tap and External Serial Port

On the outside of the enclosure is a weatherproof box, called a data tap. Inside this box is a serial port. From this port, you can connect a computer. Doing so lets you retrieve the stored data, setup the SmallTalk board, and test the operation of the track hardware.

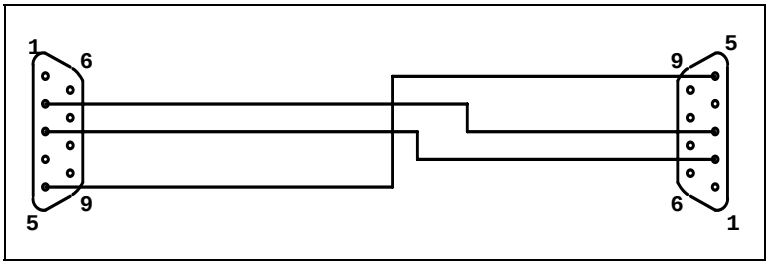
The figure below shows the serial port and its weatherproof box.



The table below lists which signals are present at the port.

PIN Number	I/O	PIN Function
2	I	Receive data (Rxd)
3	O	Transmit data (Txd)
5	--	Signal ground (Gnd)

To access the SmallTalk system through the serial port, you need a communications program, such as ProComm or Windows Terminal. Communications parameters should be set at eight data bits, one stop bit, no parity, and Xon/Xoff flow control. The baud rate is fixed at 9600 baud. A three-wire cable is required and should be wired as shown below.



Only pins 2, 3, and 5 need to be connected for proper operation. However, a standard 9-pin-to-9-pin null-modem serial cable can be used, and one is shipped with each solar-powered SmallTalk system.

Chapter 4 — Parts of Track Hardware

The SmallTalk system can be configured in one of three ways.

- Bridge-failure detector with track circuit only.
- High-water detector with track circuit only.
- Dragging-equipment detector (DED) and one or two optional shifted-load detectors with transducer and optional track circuit.

For bridge-failure detection, the Track Hardware consists of:

- One switch-closure-type bridge-failure detector per track.
- One track circuit per track, each indicates train presence on the track it was installed.

For high-water detection, the Track Hardware consists of:

- One switch-closure-type high-water detector per track.
- One track circuit per track, each indicates train presence on the track it was installed.

For dragging-equipment detection, the Track Hardware consists of:

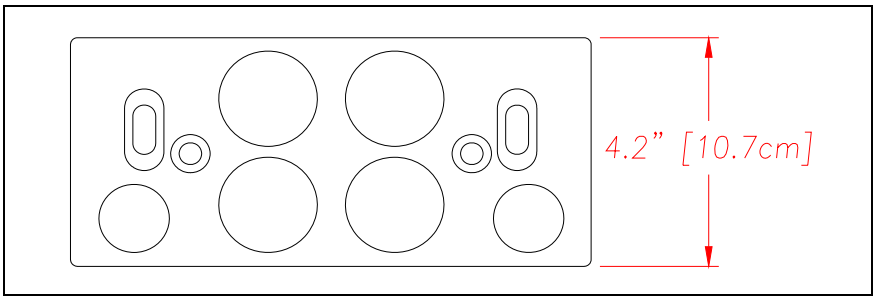
- One switch-closure-type dragging-equipment detector per track.
- One or two optional switch-closure-type shifted-load detectors per track.
- One transducer per track, each counts axles on the track it was installed; each may also indicate train presence.
- One optional track circuit per track, each indicates train presence on the track it was installed.

STC provides the transducers, if used. BNSF provides any dragging-equipment detectors, any bridge-failure detectors, any high-water detectors, any shifted-load detectors, and any track circuits. This chapter shows the parts of the transducer, with their respective part numbers.

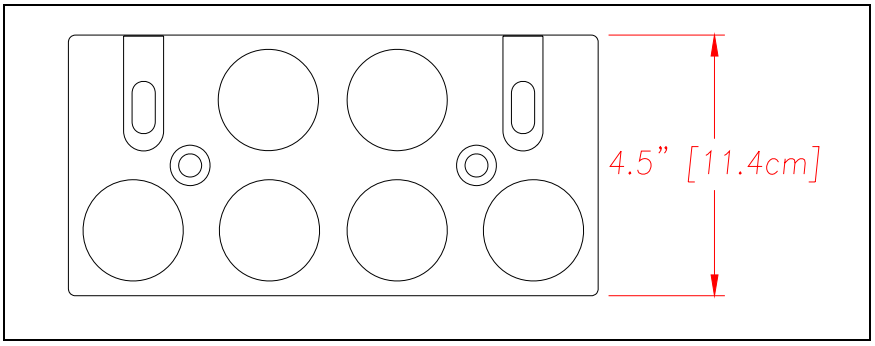
STC transducers consist of a horseshoe magnet with a tightly wound coil, encapsulated in a rigid epoxy potting compound. Each transducer is mounted 1-9/16 inches (3.97 centimeters) below the top of the rail. As the wheels of a railcar pass over the transducer, the wheel flange disturbs the flux field of the magnet, causing the output of a sinusoidal waveform of varying amplitude. The depth of the flange and the speed at which the wheel is moving determines amplitude.

One of two mounting plates is packaged with each transducer. The smaller one, which is labeled 112LB-130LB, is used with lighter rails. The larger one, which is labeled 131LB-141LB, is used with heavier rails. Normally, the smaller plate is sent.

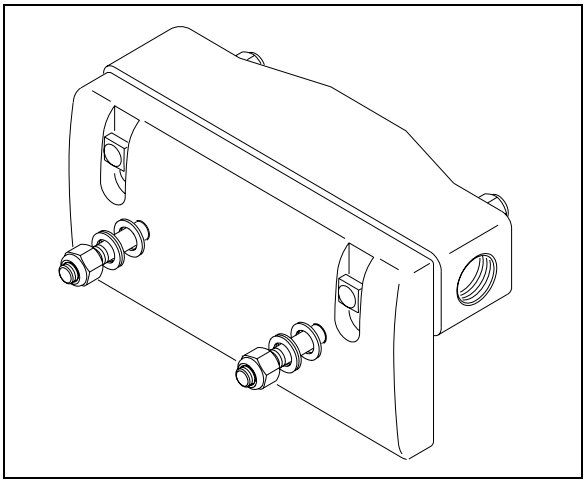
If your rail size is 115 or 122 pounds per yard, you would use the smaller mounting plate (2100-554) that looks like this. This plate usually ships with your transducers.



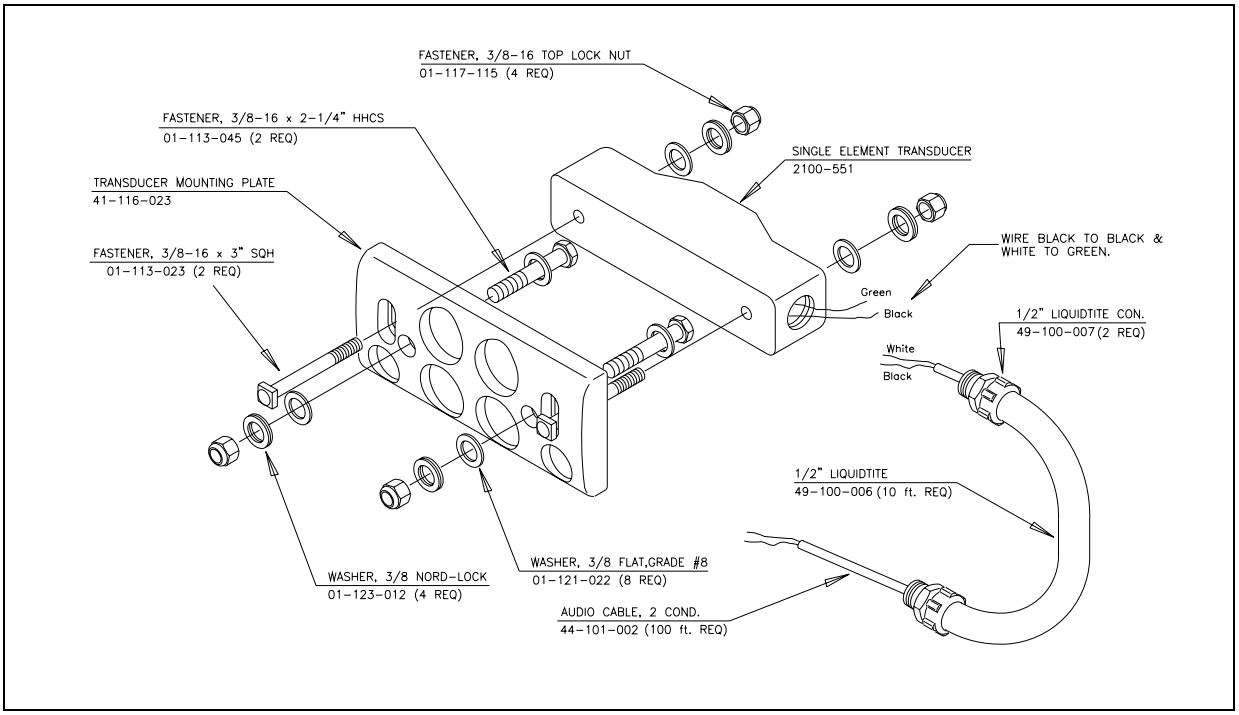
If your rail size is 132, 136, or 141 pounds per yard, you would use the larger mounting plate (2100-552) that looks like this.



The figure below shows an assembled transducer with the larger mounting plate.

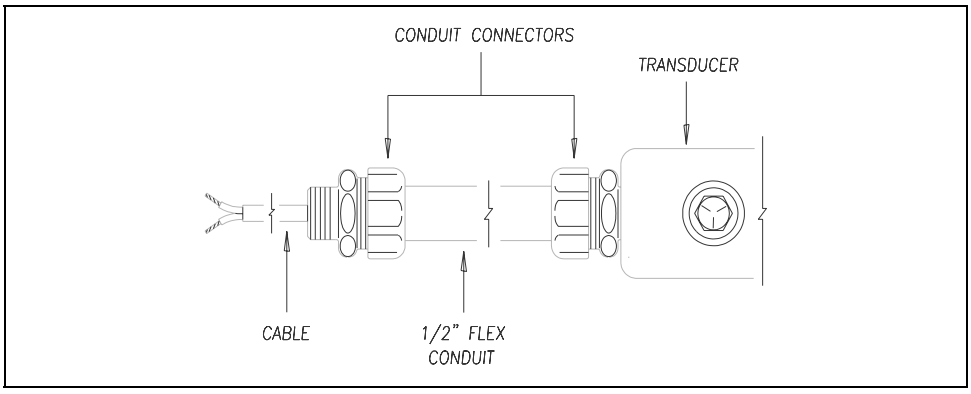


The figure below shows the parts of a transducer with the smaller mounting plate.



One end of the transducer cable comes attached to the transducer. The other end has two wires sticking out of the conduit. These wires are white and black.

The figure below shows a transducer cable.



Chapter 5 — Preparation

The preparation phase starts with selecting the site. It ends with identifying the installation tools. Care taken during this phase can result in reduced maintenance and improved performance of the solar-powered SmallTalk system.

This chapter covers what needs to be done before installation begins. Contained herein is time-tested advice. It's well worth following.

5.1 Selecting a Site

Locate the site:

- On level, well-drained ground
- In an area that is away from power lines
- In an area that is away from a track switch and a side track
- In an area that is free of any shading throughout the day

5.2 Collecting Information

Before installing the solar-powered SmallTalk system:

- Find out the declination of the site. This information is needed to adjust magnetic north to true north.
- Find out the latitude of the site. This information is needed to calculate the tilt angle of the solar panel.

5.3 Receiving Your System

The solar-powered SmallTalk system is shipped in one crate. The contents of this crate are specific to the site and are detailed on the packing list. When the crate arrives at the site, immediately check it for exterior damage. If there is any, notify STC.

5.4 Returning Damaged or Defective Hardware

Return any damaged or defective hardware to STC for repair or replacement. You don't need a return authorization number. You don't need to make a phone call first. Just ship it to:

Southern Technologies Corporation
Repair Department
6145 Preservation Drive
Chattanooga, Tennessee 37416-3638
USA

With the returned hardware, include:

- Written explanation of the hardware damage or defect.
- Name and phone number of the person who can answer questions about the hardware.
- Complete address of where the hardware is to be returned.

5.5 Getting Help with the Installation

If a part is missing or if you have problems installing a part, contact STC.

By phone, you can reach STC at 423-892-3029, Monday through Friday, from 8:00 a.m. until 5:00 p.m. Eastern time. After business hours, a machine answers the calls. These calls are returned promptly the next business day. By fax, you can reach STC at 423-499-0045. The fax machine can receive faxes at all times. Faxes are replied to as soon as possible, normally within one working day. By email, you can reach STC at email@southern-tech.com. Email is replied to as soon as possible, normally within one working day.

5.6 Identifying the Installation Tools

Besides the tools needed to install signal cases, underground cables, and power services, you need the following ones to install your solar-powered SmallTalk system.

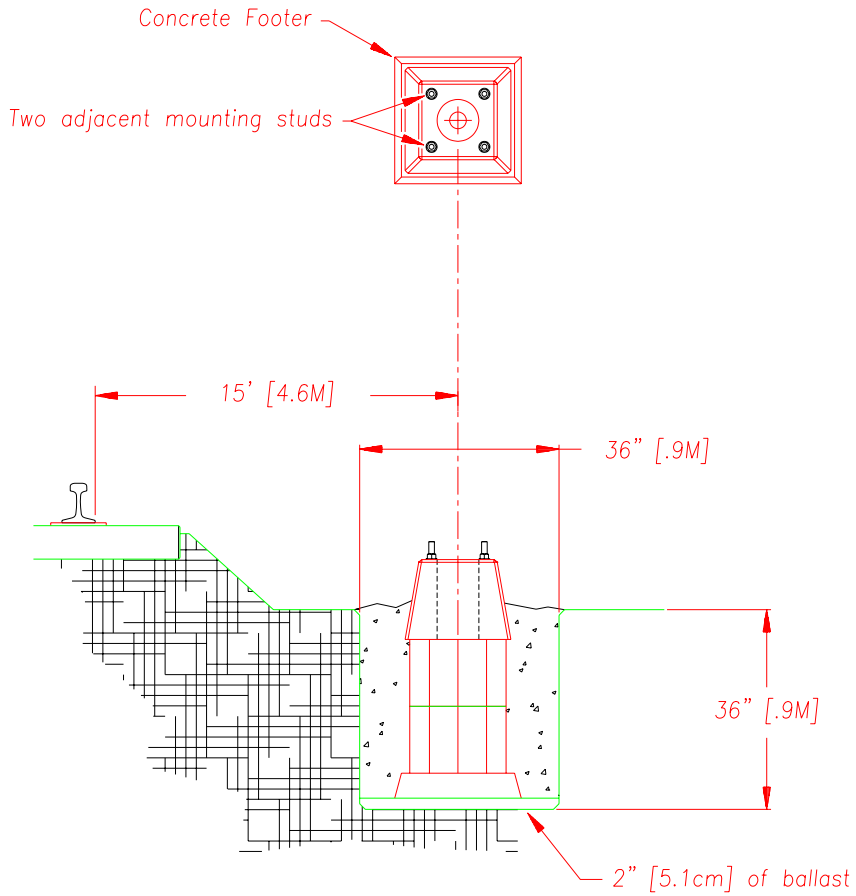
- Track drill with 3/8-inch bit
- 3/8-inch transfer punch or center punch
- Carpenters level
- #2 Phillips head screwdriver
- 1/8-inch flathead screwdriver
- 25-foot or longer tape measure
- Multimeter, reading at least 110-120 VAC, 0-50 VDC, and 0-1 megohm
- Combination 9/16-inch open-end box wrench

Chapter 6 — Installation

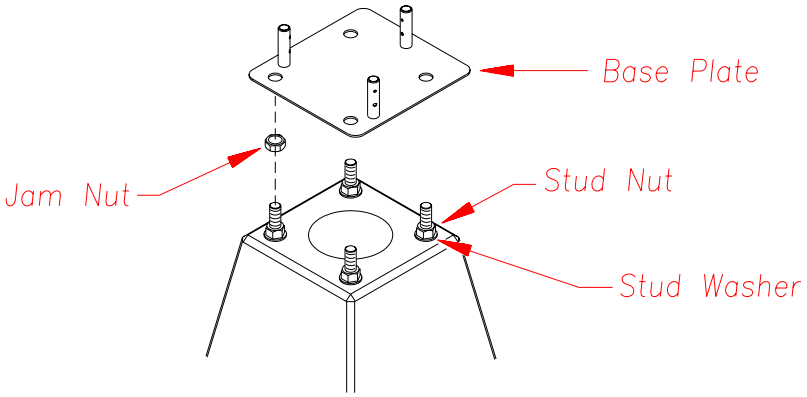
This chapter tells how to install the components of the Solar Package, Electronics Package, and Track Hardware. (Detector installation isn't covered in this document. Refer to the directions that came with the detector.)

6.1 Solar Package

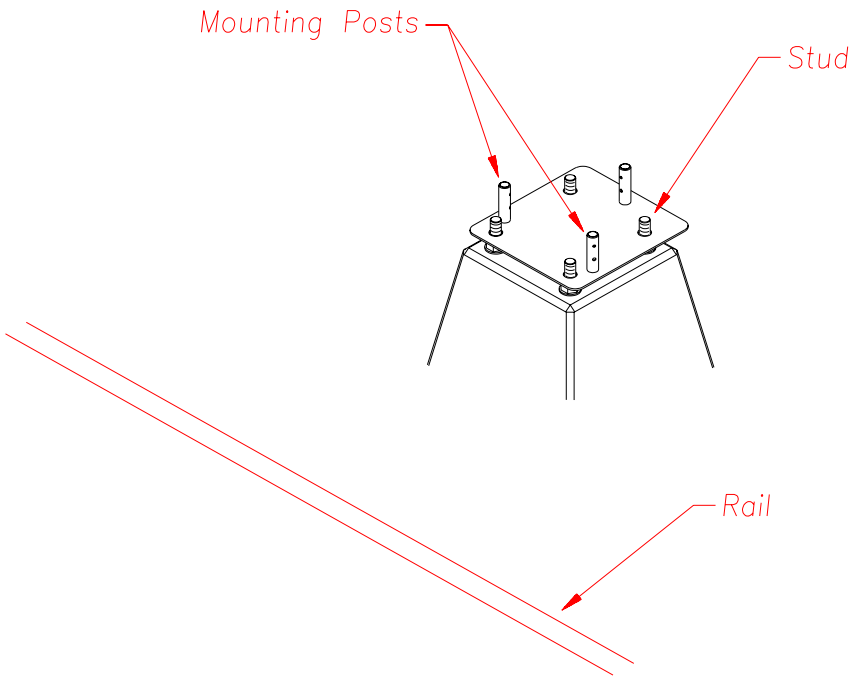
1. Using the dimensions below, dig a hole and add ballast. Lower concrete footer into hole, rotating it until two adjacent studs are parallel to the track. Install the footer so that it's plumb and its center is 15 or more feet from the edge of the nearest rail.



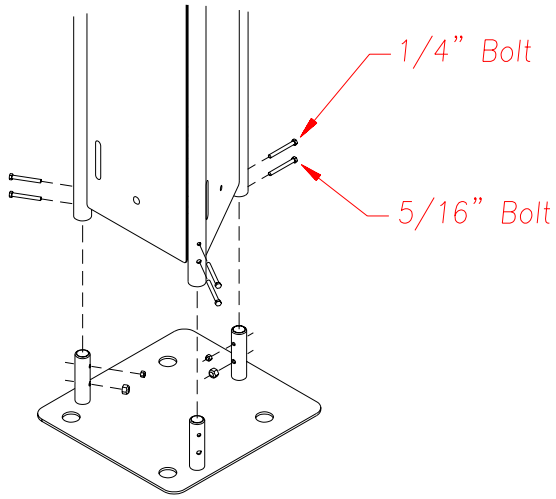
2. Install a 1-inch jam nut on each footer stud. Screw each jam nut until it touches the stud nut.



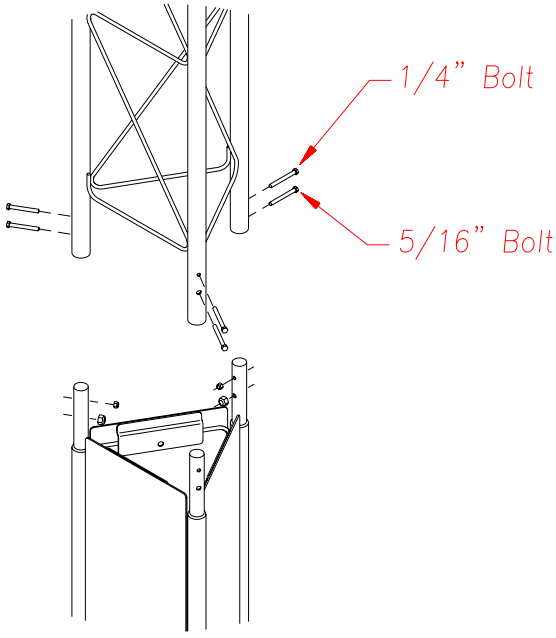
3. Lower the base plate onto the footer. Make the side of the base plate, with the two mounting posts, parallel to the rails. Level the base plate by adjusting the jam nuts. Remove the base plate from the footer.



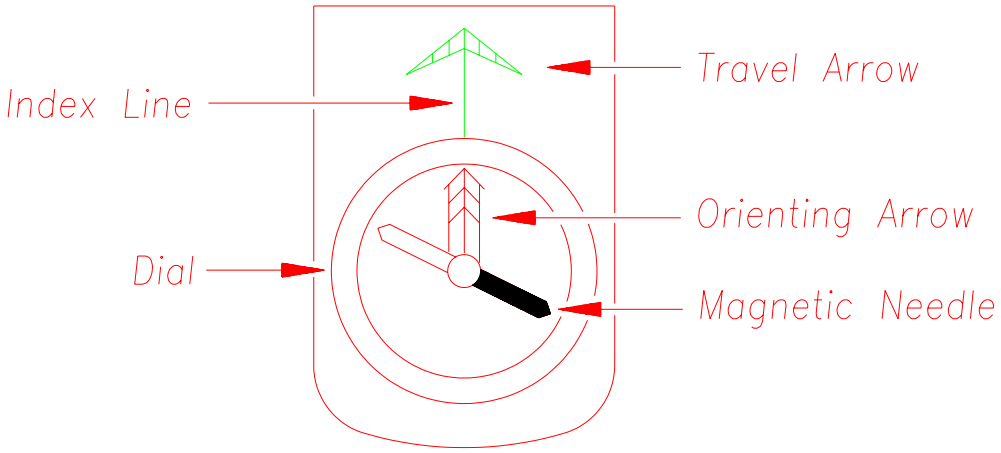
4. Using the supplied six bolts and nuts, secure the base plate to the lower tower section.



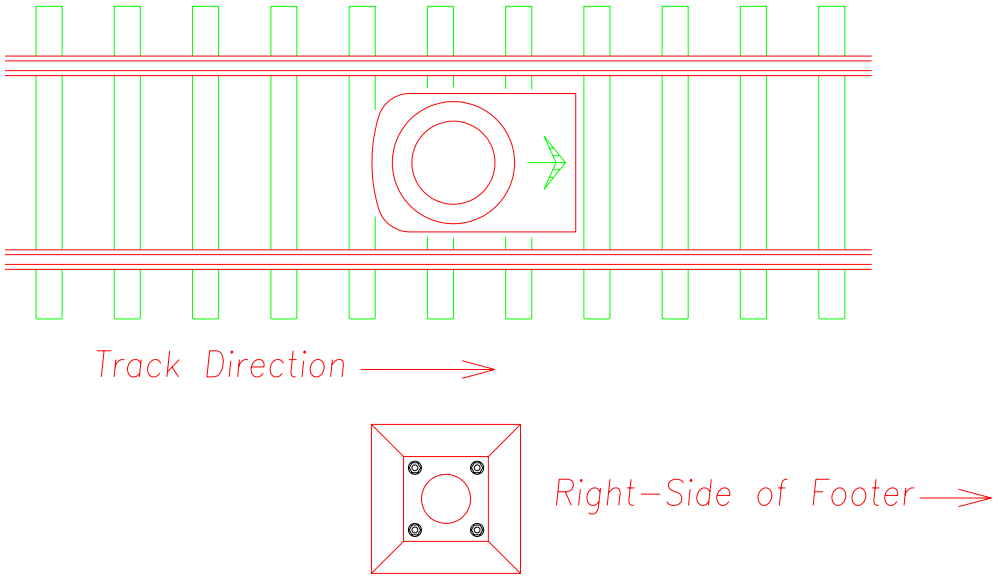
5. Using the supplied six bolts and nuts, secure the upper tower section to the lower tower section.



6. Familiarize yourself with the major parts of your supplied compass.

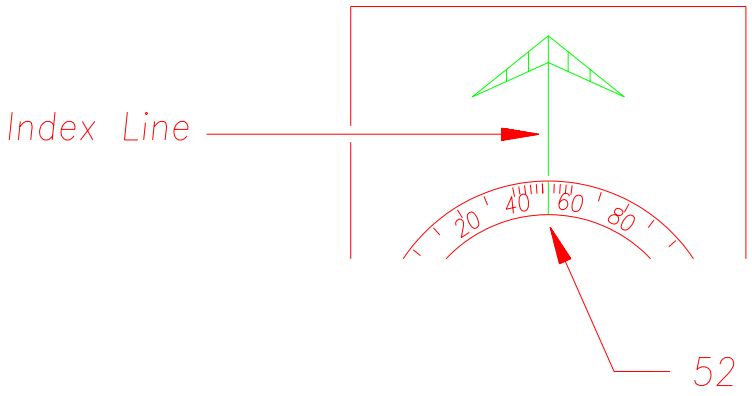


7. Facing in the direction of the track, hold the compass with the travel arrow in front of you. Be sure the compass is at least four feet from any ferrous metal. Keeping the travel arrow in front of you, rotate the blue dial until the red orienting arrow is directly under the white part of the magnetic needle.



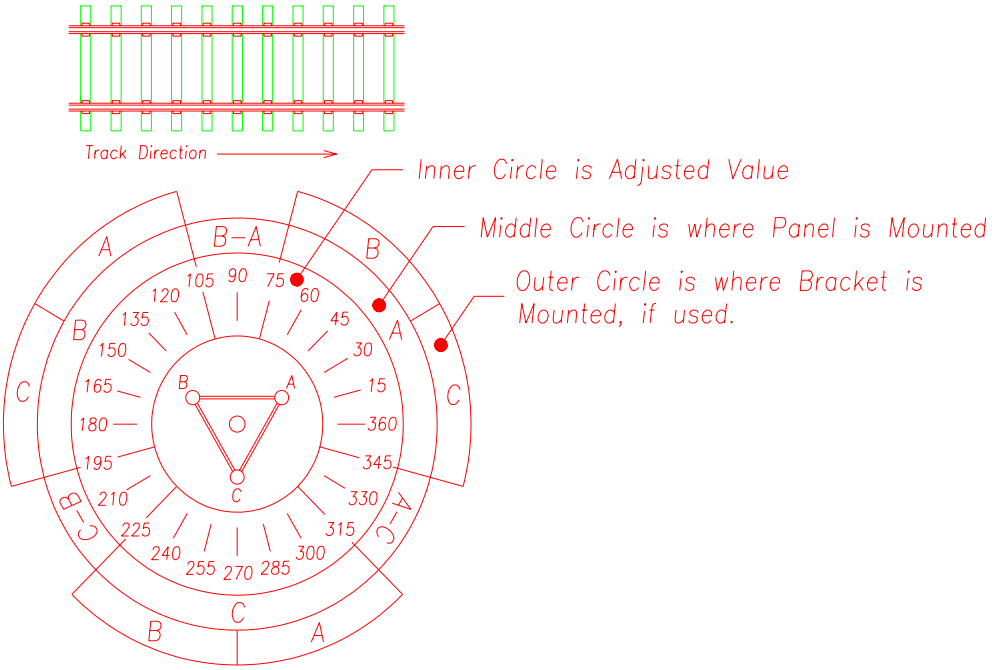
8. "Add" your local declination adjustment to the value pointed to by the index line of your compass. Write this value down for later reference.

For example, if the site is in Maine, your declination might be -21. If your compass reading were 52, the adjusted value would be 31. The drawing below shows a compass reading of 52.



9. Looking at the figure below, find the adjusted value, which you calculated in the prior step. Moving from the inner circle to the outer circle, find the leg of the tower on which the solar panel will be mounted and the leg of the tower on which the bracket will be mounted.

For example, if your adjusted value is 44, the panel is mounted on leg-A and the bracket is mounted to leg-B. If your adjusted value is 330, no bracket is used. Instead, the panel is mounted only on leg-A and leg-C.

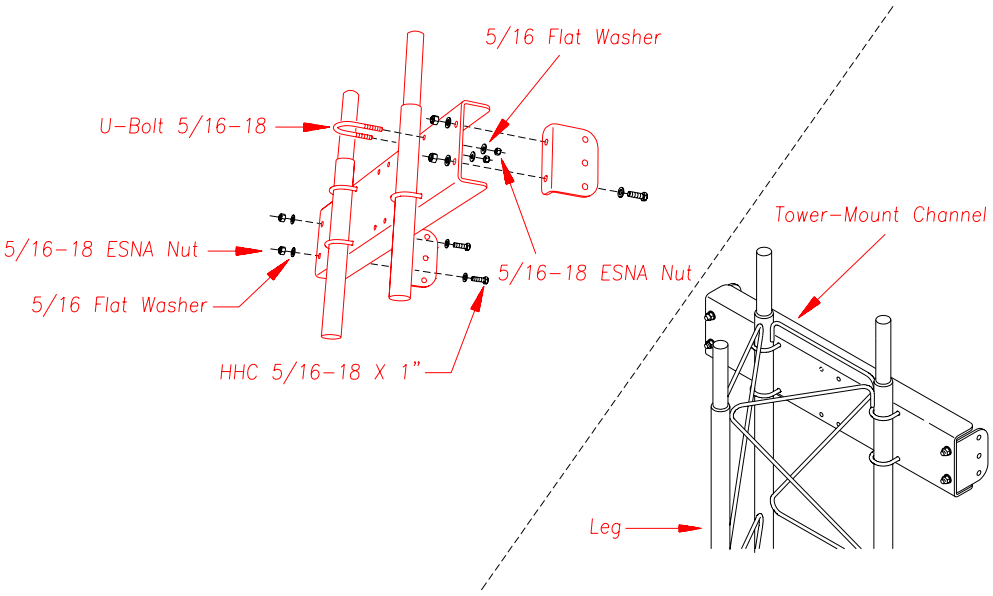


10. If your adjusted value is 75 through 105, 195 through 225, or 315 through 345, go to step **11**.

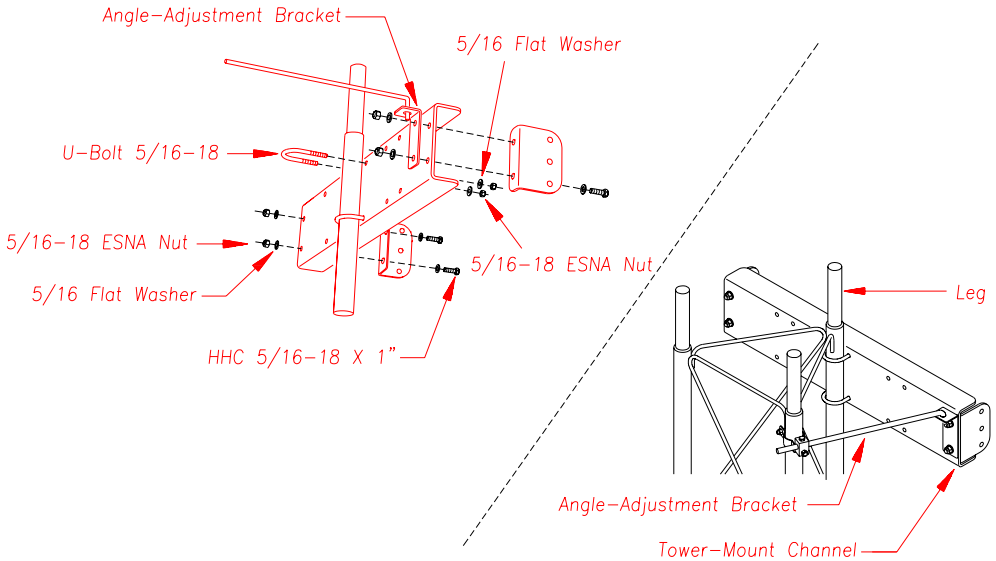
If your adjusted value is 1 through 30, 106 through 150, 226 through 270, or 346 through 360, go to step **12**.

If your adjusted value is 31 through 74, 151 through 194, or 271 through 314, go to step **14**.

11. If your adjusted value is 75 through 105, 195 through 225, or 315 through 345, install the tower-mount channel as shown below. After tightening all the nuts, go to step **16**.



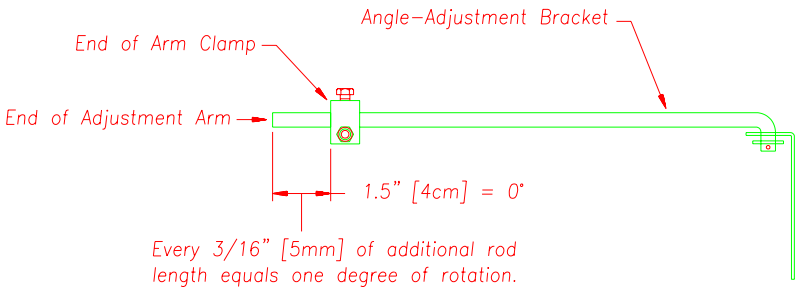
12. If your adjusted value is 1 through 30, 106 through 150, 226 through 270, or 346 through 360, install the tower-mount channel and angle-adjustment bracket as shown below. Tighten the four nuts holding the two U-bolts just enough to hold the channel in place, but not too tight to keep it from moving.



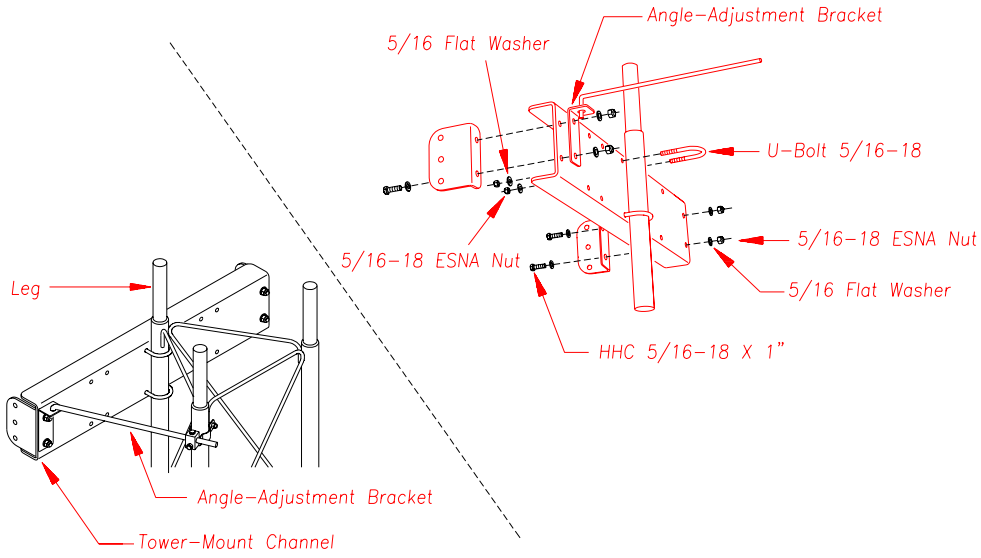
13. Calculate the degrees of rotation as follows:

- If your adjusted value is 1 through 30, subtract 1 from it.
- If your adjusted value is 106 through 150, subtract 106 from it.
- If your adjusted value is 226 through 270, subtract 226 from it.
- If your adjusted value is 346 through 360, subtract 346 from it.

Multiply the degrees of rotation you just calculated by 0.1875. Add 1.5 to this value. The result is the number of inches from the end of the adjustment arm to the end of the arm clamp. Move the arm clamp until this measurement is achieved. After tightening the nuts that hold the U-bolts and the arm clamp in place, go to step **16**.



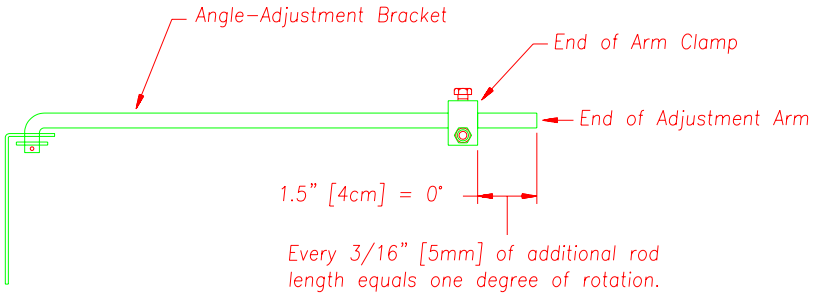
14. If your adjusted value is 31 through 74, 151 through 194, or 271 through 314, install the tower-mount channel and angle-adjustment bracket as shown below. Tighten the four nuts holding the two U-bolts just enough to hold the channel in place, but not too tight to keep it from moving.



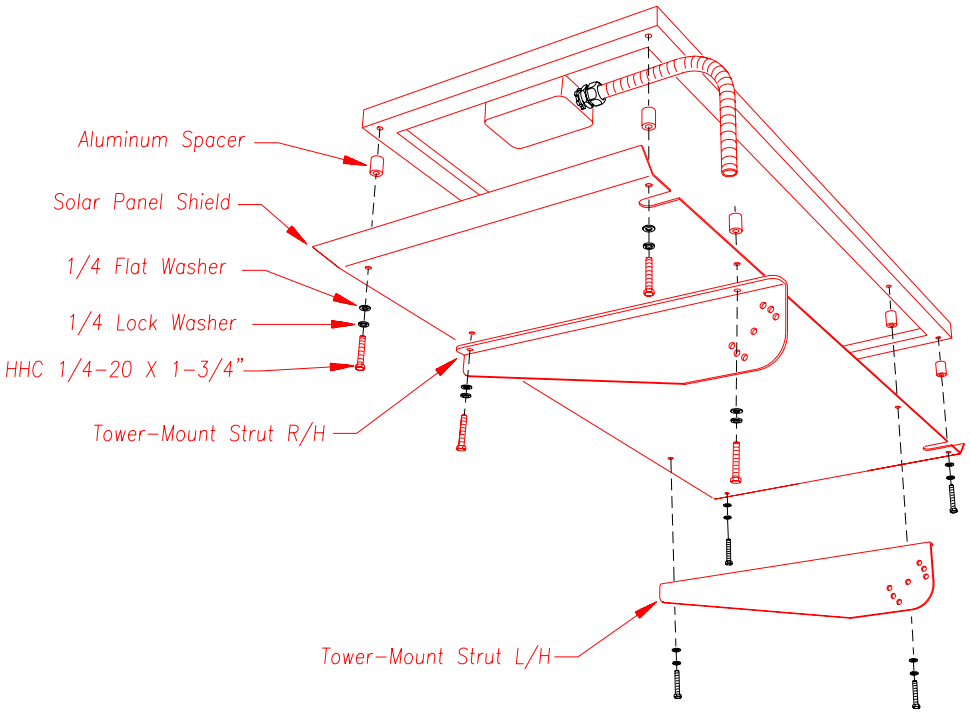
15. Calculate the degrees of rotation as follows:

- If your adjusted value is 31 through 74, subtract 31 from it.
- If your adjusted value is 151 through 194, subtract 151 from it.
- If your adjusted value is 271 through 314, subtract 271 from it.

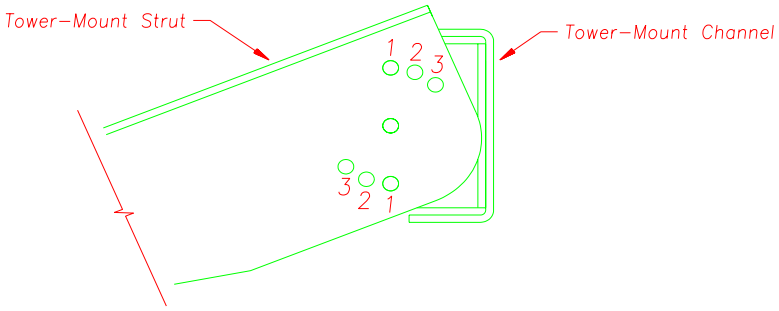
Multiply the degrees of rotation you just calculated by 0.1875. Add 1.5 to this value. The result is the number of inches from the end of the adjustment arm to the end of the arm clamp. Move the arm clamp until this measurement is achieved. Tighten the nuts that hold the U-bolts and the arm clamp in place.



16. Assemble the solar panel as shown below.

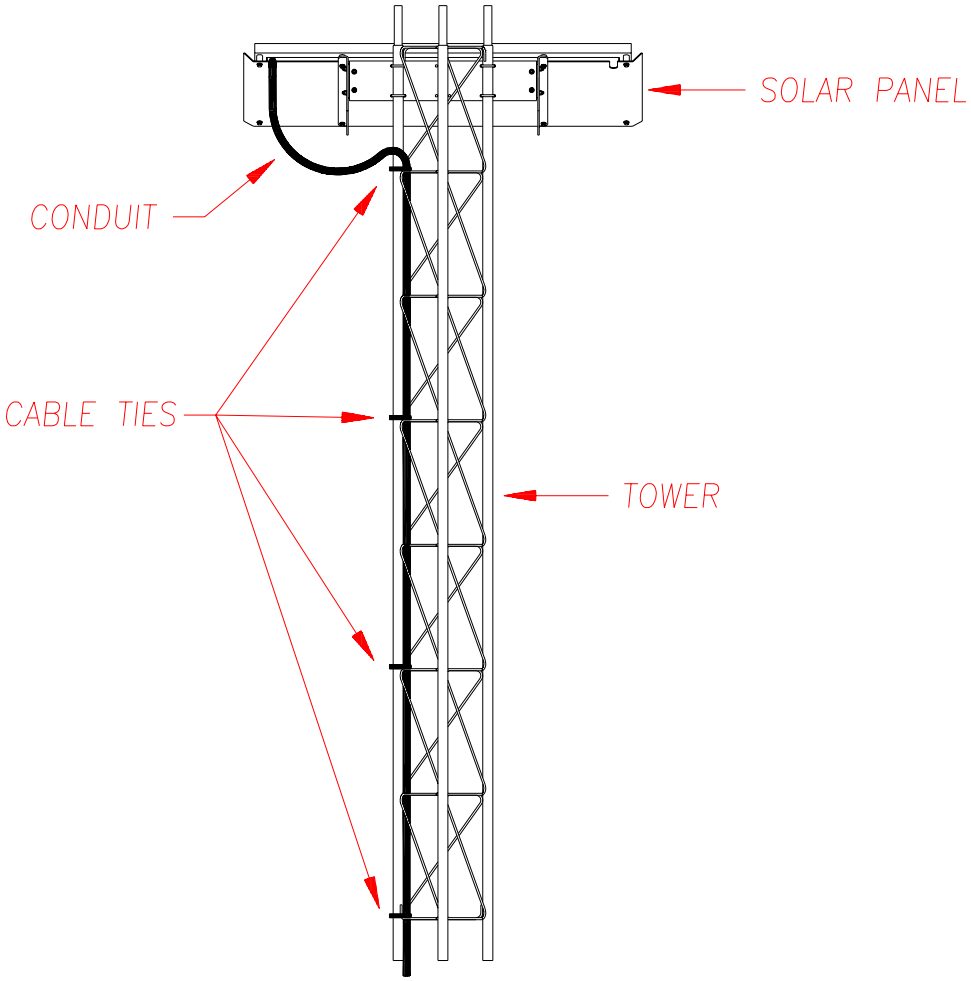


17. Calculate the tilt correction by adding 20 degrees to the site latitude. Using the results of this calculation, attach the solar panel to the tower-mount channel as shown below.



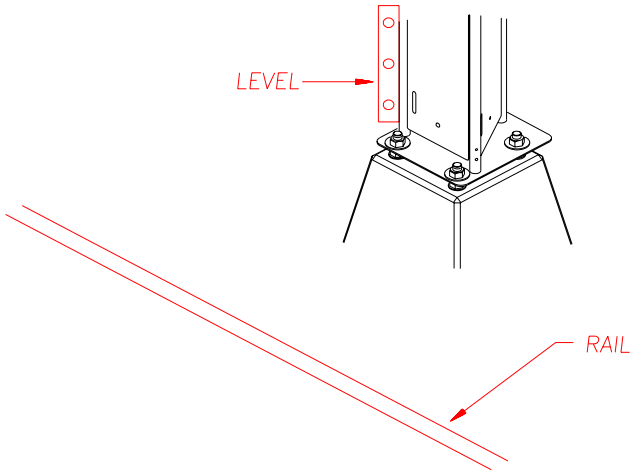
If tilt correction is 33 or less degrees, use holes labeled 1
If tilt correction is 34-56 degrees, use holes labeled 2
If tilt correction is 57 or more degrees, use holes labeled 3

18. Be sure that the conduit from the solar panel is inside the tower. With cable ties, attach conduit to the tower as shown below.

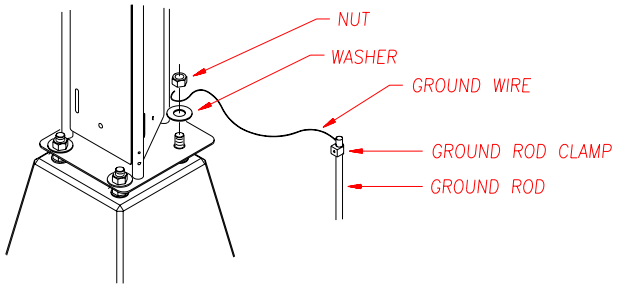


In the next chapter, you will attach the two wires (from the solar panel) to the appropriate terminals on the Regulator panel.

19. Carefully upend the tower. Attach the base plate (with attached tower) to the concrete footer. Be sure that the side of the base plate, with the two mounting posts, is parallel to the rails. Be sure the solar panel is facing due south. Plumb the tower by adjusting the jam nuts on the footer.



20. On the side of the tower, drive the 8-foot (2.4-meter) rod into the ground, attach the rod clamp to the rod, and the ground wire to the clamp. Looping the ground wire, attach it to one of the studs on the footer, between the top washer and the top nut. Tighten the nut.



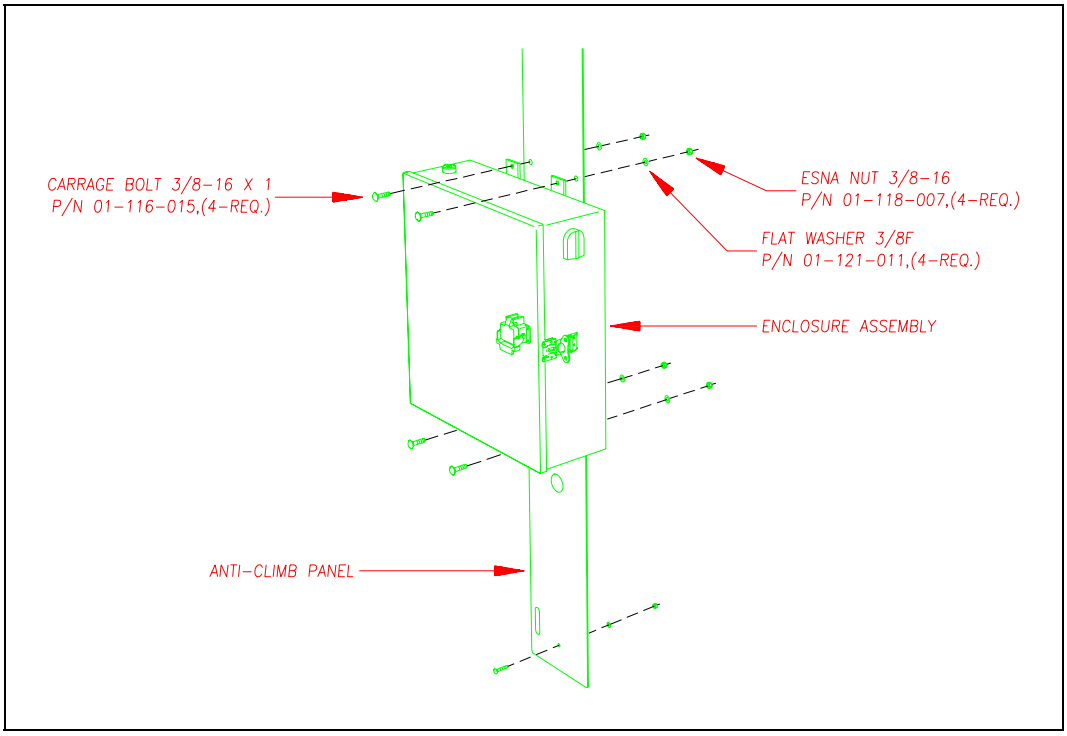
You're done installing the Solar Package. If installed correctly, the tower should be level, grounded, and attached to the footer. The solar panel should be tilted to the correct angle and facing due south.

While exposed to light, the solar panel generates DC electricity. Therefore, before connecting the wires from the solar panel to the Regulator panel, be sure that unauthorized persons cannot access the wires. Also, until connecting the wires, secure the end of the conduit in such a way that it points toward the ground.

6.2 Electronics Package

To install the enclosure onto the anti-climb panel that is facing the track:

1. If the anti-climb panel that is facing the track isn't properly attached to the tower, do so before going to the next step.
2. If not already done, remove one of the other anti-climb panels.
3. Store the panel and its attachment bolt in a safe place until you replace them.
4. As shown in the figure below, attach the enclosure to the anti-climb panel that is facing the track.



5. Using a 3/8-inch wrench, tighten each nut.
6. Replace the removed panel and secure it to the tower.
7. Using the supplied split-bolt connector and ground wire, attach the ground terminal on the bottom of the enclosure to the ground wire coming from the ground rod.

6.3 Track Hardware

Transducers are used with dragging-equipment detectors and shifted-load detectors. They aren't used with bridge-failure detectors and high-water detectors. To install a transducer:

1 Be sure you have on hand all the parts for one transducer per track.

2 Be sure you have on hand a center punch, a track drill, a 3/8-inch bit, a combination 9/16-inch open-end box wrench, and a 10-foot or longer tape measure.

3 Separate the nylon transducer body from the aluminum mounting plate.

4 Store the transducer parts in a safe place until you use them.

5 Determine where you'll install the transducer.

You can install a transducer on either rail. You should install it within 10 feet of the dragging-equipment detector.

6 At the site of installation, with the arrow (on the plate) pointing up, place the mounting plate against the gauge side of the rail.

7 Hold the mounting plate against the rail and as high against the crown as possible.

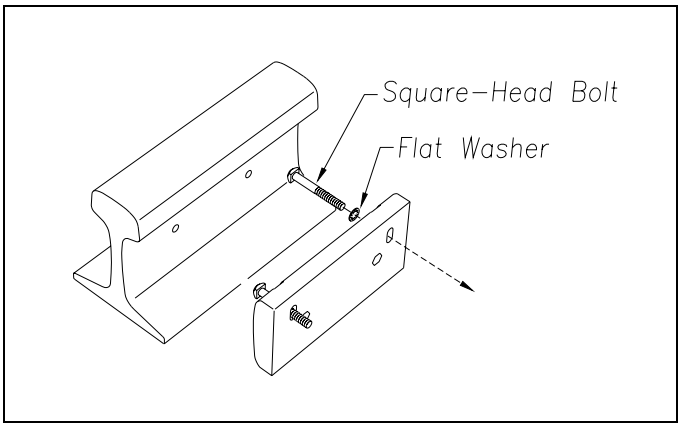
8 Using a center punch and the hex-head bolt holes as your guide, mark the two places on the rail where you'll later drill holes.

9 Remove the mounting plate.

10 Using a 3/8-inch (9.5-millimeter) bit, drill the two holes.

11 Place one flat washer on each square-head bolt.

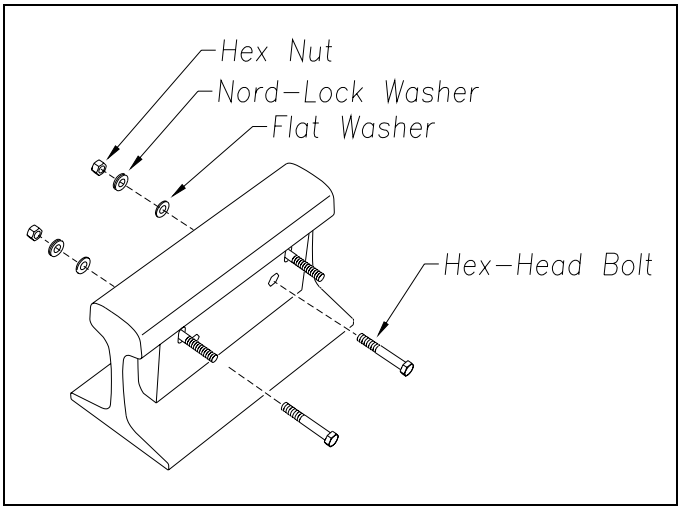
12 Insert the two square-head bolts with flat washers into the slotted holes of the mounting plate.



13 With the arrow on the plate pointing up and the heads of the bolts against the gauge side of the rail, align the hex-head bolt holes in the plate with the drilled holes in the rail.

14 Insert the two hex-head bolts through the aligned holes.

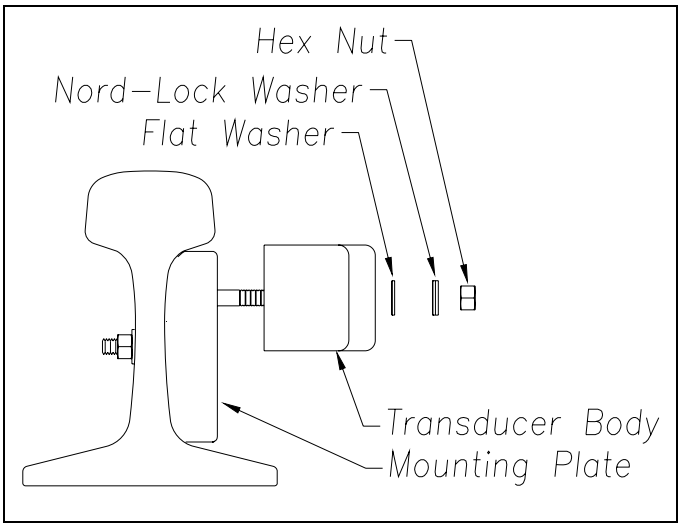
15 Loosely place the flat washers, Nord-Lock washers, and hex nuts onto the hex-head bolts.



16 Tighten each nut with a 9/16-inch wrench to a torque of 10 to 12 foot-pounds.

17 With the transducer body's magnetic side up (that is, with the arrow on the transducer body pointing up), slide it onto the square-head bolts.

18 Loosely place the flat washers, Nord-Lock washers, and hex nuts onto the square-head bolts.



19 By sliding it up and down, adjust the transducer body to the proper height.

The installed transducer body should be level and 1-5/8 inches (4.13 centimeters) below the top of the rail. This can be done by using a straightedge and a ruler.

20 Tighten each nut with a 9/16-inch wrench to a torque of 8 to 10 foot-pounds.

The transducer body is now attached to the mounting plate.

21 If this is a single-track site, label the two-wire end of the cable **TRNSDCR**.

22 If this is a double-track site, label the two-wire end of the cable **TRNSDCR-TRACK1** or **TRNSDCR-TRACK2**, whichever is appropriate.

23 Extend the transducer cable to the enclosure.

In the next chapter, you will attach the two wires (from the cable) to the appropriate terminals on the Surge Suppression panel.

24 If this is a double-track site, repeat steps **1** through **23** on the second track.

To install a track circuit:

1 Following the directions that came with your track circuit, mount both track-wire connectors.

Mount one connector on each rail, directly opposite each other. Mount them within five feet of the dragging-equipment detector.

2 Attach wires to the track-wire connectors.

Wires should be as short as practical. They should be 9 AWG (or larger) insulated copper wire. Total wire resistance shouldn't exceed 0.2 ohm.

3 If this is a single-track site, label the end of the wires that aren't attached to the track-wire connectors **TC**.

4 If this is a double-track site, label the end of the wires that aren't attached to the track-wire connectors **TC-TRACK1** or **TC-TRACK2**, whichever is appropriate.

5 Extend the wires to the enclosure.

In the next chapter, you will attach the two wires to the appropriate terminals on the SmallTalk board.

6 If this is a double-track site, repeat steps **1** through **5** on the second track.

Chapter 7 — Wiring

At the factory, most enclosure components have been installed and wired. All that remains is connecting some cables and installing some subcomponents. This chapter tells how to install the battery, install the antenna, and connect the wires from the track hardware, battery, and solar panel.

7.1 First Things

To improve your margin of safety and to protect the system's electronics:

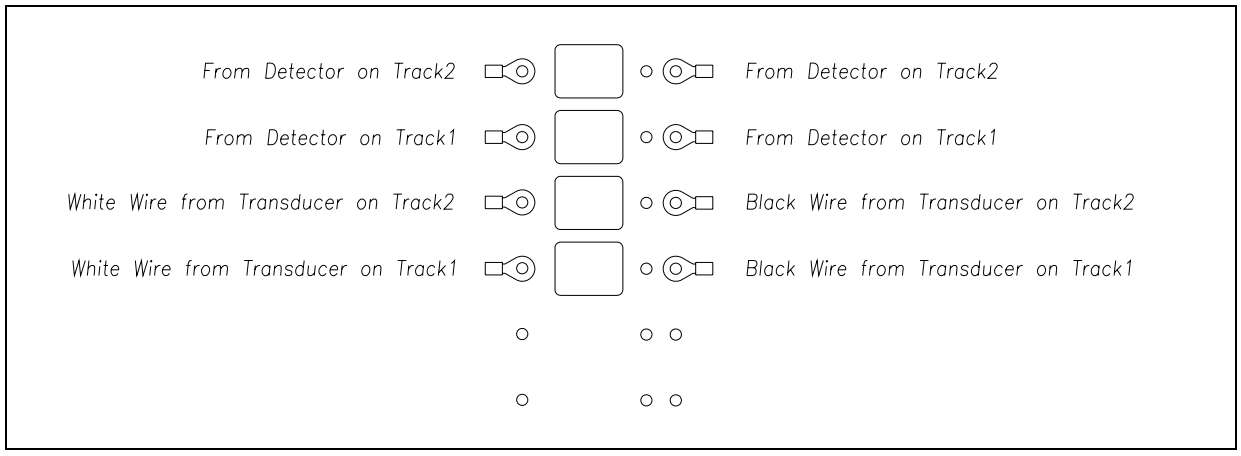
1. If the tower hasn't been attached to a properly installed ground rod, do so before proceeding.
2. If the ground bus on the enclosure hasn't been attached to the ground wire from the properly installed ground rod, do so before proceeding.
3. If two fuses are installed on the lower left front of the Regulator panel, remove them.
4. Store the fuses in a safe place until you replace them.

   You'll replace them at the end of this chapter.

7.2 Transducers

Transducers are only used with dragging-equipment detectors and shifted-load detectors. If you are installing bridge-failure detectors or high-water detectors, skip this section and go to ***7.3 Dragging-Equipment, Bridge-Failure, High-Water Detectors***.

The figure below shows where the ring terminals (from the transducers and detectors) fasten to the Surge Suppression panel.



To connect the transducers to the Surge Suppression panel:

1 Be sure you have installed all the transducers onto the tracks.

2 Be sure you have on hand a wire stripper, a 1/2-inch nut driver, and a pliers-type crimping tool.

3 If they're installed, remove both 10-ampere fuses from the lower left front of the Regulator panel.

4 Through the leftmost hole in the bottom of the enclosure and then through the leftmost hole in the shelf inside the enclosure, thread the wires from the transducers.

5 Using a wire stripper, remove 1/4 inches of insulation from the end of each transducer wire.

6 If a transducer isn't installed on track1, go to step **11**.

7 Crimp a ring terminal to the end of the black wire from the transducer on track1.

8 Fasten this ring terminal to the right side of the fourth triple-guard arrester.

There already is a black wire attached here. It goes to the SmallTalk board.

9 Crimp a ring terminal to the end of the white wire from the transducer on track1.

10 Fasten this ring terminal to the left side of the same arrester.

There already is a white wire attached here. It goes to the SmallTalk board.

11 If a transducer isn't installed on track2, go to step **16**.

12 Crimp a ring terminal to the end of the black wire from the transducer on track2.

13 Fasten this ring terminal to the right side of the third triple-guard arrester.

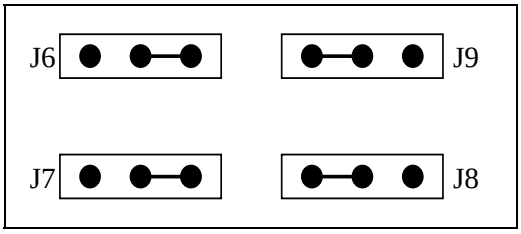
14 Crimp a ring terminal to the end of the white wire from the transducer on track2.

15 Fasten this ring terminal to the left side of the same arrester.

16 If you are using STC transducers, skip the next step.

Most installations use STC transducers. Therefore, jumpers J6, J7, J8, and J9 on the SmallTalk board are set at the factory for these transducers.

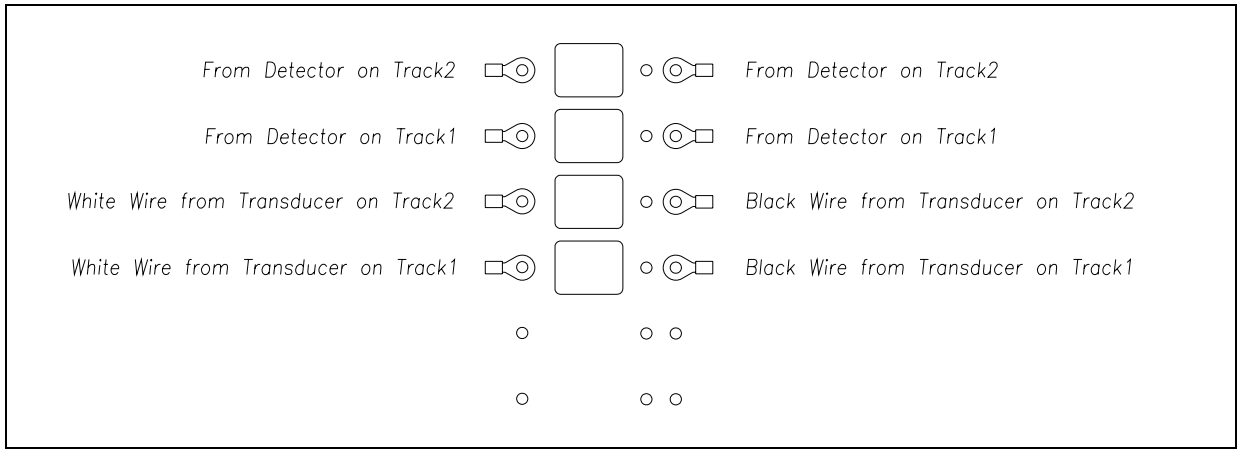
17 If you are using non-STC transducers, set jumpers J6, J7, J8, and J9 on the SmallTalk board as follows:



7.3 Dragging-Equipment, Bridge-Failure, High-Water Detectors

Either dragging-equipment detectors or bridge-failure detectors or high-water detectors are connected to the SmallTalk board via the Surge Suppression panel. No two of them can be connected at the same time.

The figure below shows where the ring terminals (from the transducers and detectors) fasten to the Surge Suppression panel.



To connect the dragging-equipment detectors, bridge-failure detectors, or high-water detectors to the Surge Suppression panel:

1 Be sure you have installed all the detectors onto the tracks.

2 Be sure you have on hand a wire stripper, a 1/2-inch nut driver, and a pliers-type crimping tool.

3 If they're installed, remove both 10-ampere fuses from the lower left front of the Regulator panel.

4 Through the leftmost hole in the bottom of the enclosure and then through the leftmost hole in the shelf inside the enclosure, thread the wires from the detectors.

5 Using a wire stripper, remove 1/4 inches of insulation from the end of each detector wire.

6 If a detector isn't installed on track1, go to step **11**.

7 Crimp a ring terminal to the end of one wire from the detector on track1.

8 Fasten this ring terminal to the left side of the second triple-guard arrester.

9 Crimp a ring terminal to the end of the other wire from the detector on track1.

10 Fasten this ring terminal to the right side of the same arrester.

11 If a detector isn't installed on track2, skip all the steps below.

12 Crimp a ring terminal to the end of one wire from the detector on track2.

13 Fasten this ring terminal to the left side of the first triple-guard arrester.

14 Crimp a ring terminal to the end of the other wire from the detector on track2.

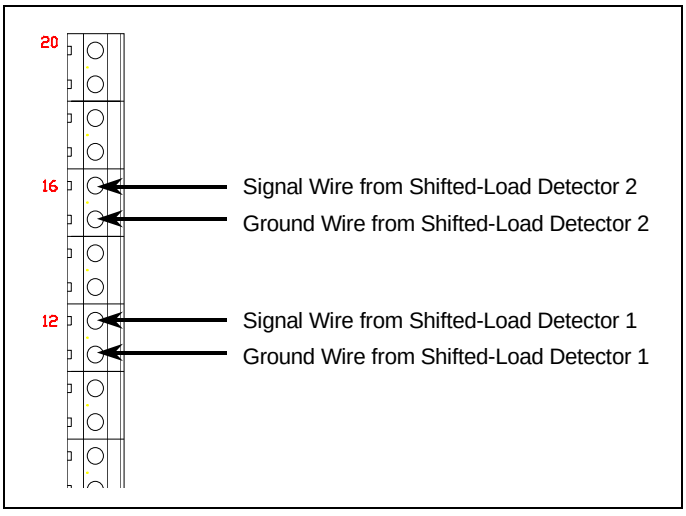
15 Fasten this ring terminal to the right side of the same arrester.

7.4 Shifted-Load Detectors, Track Circuits

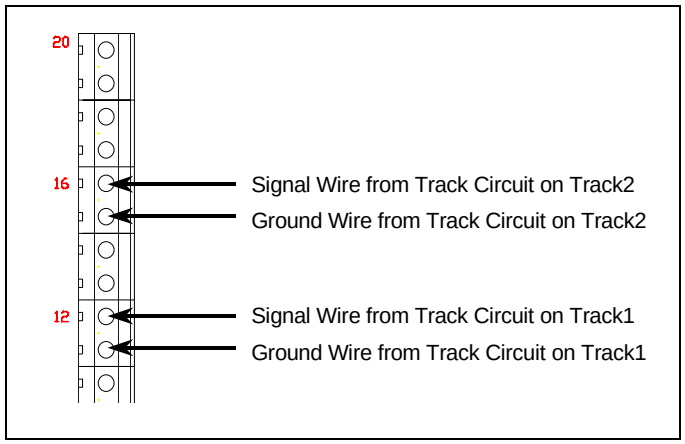
At some sites, either shifted-load detectors or track circuits are connected to the SmallTalk board. Both can't be connected at the same time. At other sites, neither is connected.

If neither shifted-load detectors nor track circuits are used, terminals 11, 12, 15, and 16 on terminal block TB1 (on the SmallTalk board) aren't used. In this case, you need to set the Shifted-Load option (of the Setup Options menu) to Not Used and the System Activation option to Transducer.

If shifted-load detectors are used, the Shifted-Load option is set to either Single or Double. When set to Single, terminals 11 and 12 are channel A's shifted-load inputs for rail1. Terminals 15 and 16 are channel A's shifted-load inputs for rail2. The system sets the System Activation option to Transducer. Channel B isn't used. When set to Double, terminals 11 and 12 are channel A's shifted-load inputs. Terminals 15 and 16 are channel B's shifted-load inputs. The system sets the System Activation option to Transducer. The figure below shows where the wires from the shifted-load detectors fasten to the SmallTalk board.



If track circuits are used, terminals 11 and 12 are channel A's approach inputs. Terminals 15 and 16 are channel B's approach inputs. In this case, you need to set the Shifted-Load option to Not Used and the System Activation option to Approach. The figure below shows where the wires from the track circuits fasten to the SmallTalk board.



To connect the shifted-load detectors to the SmallTalk board:

1 If your site doesn't use shifted-load detectors, skip all the steps below.

2 Be sure you have installed all the shifted-load detectors onto the tracks.

3 Be sure you have on hand a wire stripper and a 1/8-inch flathead screwdriver.

4 If they're installed, remove both 10-ampere fuses from the lower left front of the Regulator panel.

5 Through the leftmost hole in the bottom of the enclosure and then through the leftmost hole in the shelf inside the enclosure, thread the wires from the shifted-load detectors.

6 Using a wire stripper, remove 1/4 inches of insulation from the end of each shifted-load detector wire.

At the factory, jumper wires were installed on the approach inputs (on the SmallTalk board). Remove these wires only when you are installing shifted-load detectors or track-circuit wires in their place.

7 If the Shifted-Load option is set to Double, go to step **23**.

The next step is only done when the Shifted-Load option is set to Single.

Terminals 11 and 12 on terminal block TB1 (on the SmallTalk board) are channel A's shifted-load inputs for rail1. Terminals 15 and 16 are channel A's shifted-load inputs for rail2.

8 If a shifted-load detector isn't installed for rail1, go to step **15**.

9 Turn the screws at terminals 11 and 12 counterclockwise five complete turns.

10 Remove the jumper wire connecting terminals 11 and 12.

11 Insert the end of ground wire from the shifted-load detector (for rail1) into terminal 11.

12 Turn the screw clockwise until the wire is held in place.

13 Insert the end of signal wire from the shifted-load detector (for rail1) into terminal 12.

14 Turn the screw clockwise until the wire is held in place.

15 If a shifted-load detector isn't installed for rail2, skip all the steps below.

16 Turn the screws at terminals 15 and 16 counterclockwise five complete turns.

17 Remove the jumper wire connecting terminals 15 and 16.

18 Insert the end of ground wire from the shifted-load detector (for rail2) into terminal 15.

19 Turn the screw clockwise until the wire is held in place.

20 Insert the end of signal wire from the shifted-load detector (for rail2) into terminal 16.

21 Turn the screw clockwise until the wire is held in place.

22 Skip all the steps below.

The next step is only done when the Shifted-Load option is set to Double.

Terminals 11 and 12 on terminal block TB1 (on the SmallTalk board) are channel A's shifted-load inputs. Terminals 15 and 16 are channel B's shifted-load inputs.

23 If a shifted-load detector isn't installed on track1 (channel A), go to step **30**.

24 Turn the screws at terminals 11 and 12 counterclockwise five complete turns.

25 Remove the jumper wire connecting terminals 11 and 12.

26 Insert the end of ground wire from the shifted-load detector (on track1) into terminal 11.

27 Turn the screw clockwise until the wire is held in place.

28 Insert the end of signal wire from the shifted-load detector (on track1) into terminal 12.

29 Turn the screw clockwise until the wire is held in place.

30 If a shifted-load detector isn't installed on track2 (channel B), skip all the steps below.

31 Turn the screws at terminals 15 and 16 counterclockwise five complete turns.

32 Remove the jumper wire connecting terminals 15 and 16.

33 Insert the end of ground wire from the shifted-load detector (on track2) into terminal 15.

34 Turn the screw clockwise until the wire is held in place.

35 Insert the end of signal wire from the shifted-load detector (on track2) into terminal 16.

36 Turn the screw clockwise until the wire is held in place.

To connect the track circuits to the SmallTalk board:

1 If your site doesn't use track circuits, skip all the steps below.

2 Be sure you have installed all the track circuits onto the tracks.

3 Be sure you have on hand a wire stripper and a 1/8-inch flathead screwdriver.

4 If they're installed, remove both 10-ampere fuses from the lower left front of the Regulator panel.

5 Through the leftmost hole in the bottom of the enclosure and then through the leftmost hole in the shelf inside the enclosure, thread the wires from the track circuits.

6 Using a wire stripper, remove 1/4 inches of insulation from the end of each track-circuit wire.

At the factory, jumper wires were installed on the approach inputs (on the SmallTalk board). Remove these wires only when you are installing shifted-load detectors or track-circuit wires in their place.

7 If a track circuit isn't installed on track1, go to step **14**.

8 Turn the screws at terminals 11 and 12 on terminal block TB1 (on the SmallTalk board) counterclockwise five complete turns.

9 Remove the jumper wire connecting terminals 11 and 12.

10 Insert the end of ground wire from the track circuit (on track1) into terminal 11.

11 Turn the screw clockwise until the wire is held in place.

12 Insert the end of signal wire from the track circuit (on track1) into terminal 12.

13 Turn the screw clockwise until the wire is held in place.

14 If a track circuit isn't installed on track2, skip all the steps below.

15 Turn the screws at terminals 15 and 16 on terminal block TB1 (on the SmallTalk board) counterclockwise five complete turns.

16 Remove the jumper wire connecting terminals 15 and 16.

17 Insert the end of ground wire from the track circuit (on track2) into terminal 15.

18 Turn the screw clockwise until the wire is held in place.

19 Insert the end of signal wire from the track circuit (on track2) into terminal 16.

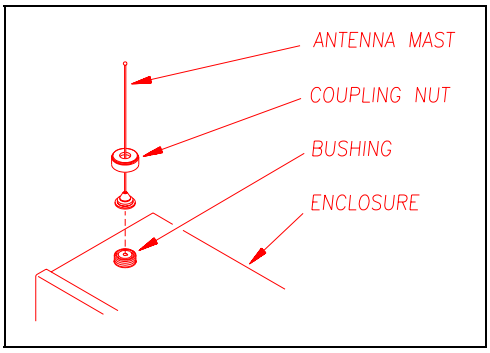
20 Turn the screw clockwise until the wire is held in place.

7.5 Antenna

To install the antenna mast:

1 Remove the coupling nut.

2 Slide antenna mast through coupling nut.



3 Place mast-nut combination over bushing.

4 Tighten coupling nut in place.

7.6 Battery

WARNING

Battery posts, terminals, and related accessories contain lead and lead components, chemicals known to the State of California to cause cancer, birth defects, or other reproductive harm. So, as a minimum, wash your hands after handling the batteries.

To install the battery and connect it to the SmallTalk system:

1. Be sure you have on hand a 1/2-inch nut driver.
2. If they're installed, remove both 10-ampere fuses from the lower left front of the Regulator panel.
3. With the battery terminals to the back of the enclosure, place the battery on the mat in the lower-right corner of the enclosure.

   A black wire and a red wire are attached to the terminal strip on the Regulator panel. Each wire is about a foot long.
4. Connect the red wire to the positive side of the battery.
5. Connect the black wire to the negative side of the battery.

   Do <u>not</u> reverse wiring connections. Doing so may harm the system.

WARNING

In operation, batteries generate and release flammable hydrogen gas, which, if ignited by burning cigarette, naked flame, or spark, may cause battery explosion with dispersion of casing fragments and corrosive liquid electrolyte. So, carefully follow manufacturer's instructions for installation and service. Keep all sources of gas ignition away from the batteries and do <u>not</u> allow metallic articles to contact the negative and positive terminals of a battery at the same time.

7.7 Temperature Sensor

Each temperature sensor has a 10-foot cable. In some regulators, this cable is hardwired directly to the interior circuitry of the regulator. In other regulators, this cable has a plug at one end and is plugged into the regulator.

To install the temperature sensor:

1. Run the temperature sensor to the battery.
2. Using the supplied foam square, attach and cover the temperature sensor halfway up the side of the battery.
3. If the cable of the temperature sensor has a plug at one end, be sure that it is firmly attached to the regulator.

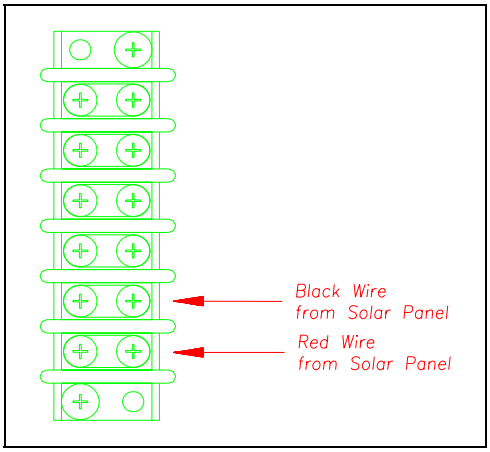
7.8 Solar Panel

WARNING

Do <u>not</u> touch any unshielded wire coming from the solar panel. Do <u>not</u> let two unshielded wires touch. Do <u>not</u> let any unshielded wire touch the enclosure or tower. Do <u>not</u> reverse wiring connections. Doing so may harm you, the system, or both.

To connect the solar panel to the SmallTalk system:

1. Be sure you have on hand a wire stripper, a #2 Phillips head screwdriver, and a pliers-type crimping tool.
2. If they're installed, remove both 10-ampere fuses from the lower left front of the Regulator panel.
3. Using a wire stripper, remove 1/2 inches of insulation from the end of each solar panel wire.
4. Crimp a spade terminal to the end of each wire from the solar panel.
5. As shown in the figure below, attach the solar panel to the terminal strip on the Regulator panel.

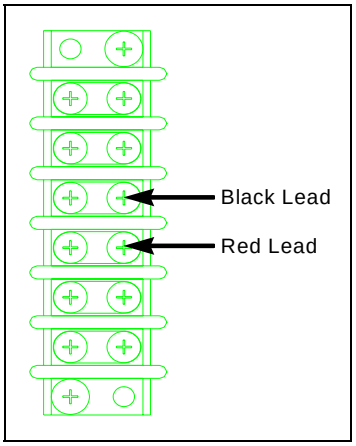


7.9 Final Checks

To check the electrical integrity of the system and then power up the system:

1. Be sure you have on hand a multimeter.
2. To verify that the battery is installed correctly and that it is generating voltage:
   a. Switch the multimeter to the DC volts scale.

b On the terminal strip on the Regulator panel, place the leads as shown below, checking for a positive reading of about +12 VDC.



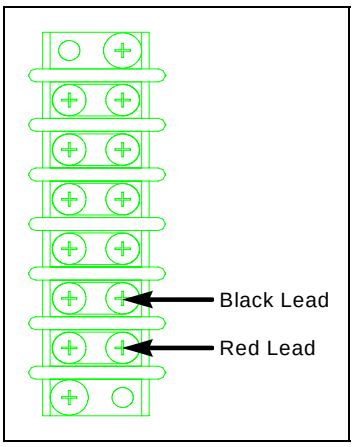
c If the reading isn't positive or voltage isn't displayed, fix this problem before proceeding.

The next step should be done when sun-energy is reaching the solar panel.

3 To verify that the solar panel is installed correctly and that it is generating voltage:

a Switch the multimeter to the DC volts scale.

b On the terminal strip on the Regulator panel, place the leads as shown below, checking for a positive reading of at least +17 VDC.



c If the reading isn't positive or voltage isn't displayed, fix this problem before proceeding.

The next step should generate an announcement through the on-board speaker.

4 While listening to the speaker (on the SmallTalk board), replace the 10-ampere fuses (on the Regulator panel).

Replace the fuse on the left first.

5 If you don't hear a startup announcement coming from the speaker, call STC for help in isolating the problem.

Chapter 8 — System Operation

This chapter describes the operation of a SmallTalk system. Covered are the board operation, train detection, axle counting, alarm detection, data storage, and speech generation.

8.1 Board Operation

The SmallTalk board controls the operation of the entire SmallTalk system. It scans the track hardware and generates the required speech. On this board are the speech patterns and the hardware to generate signals for RF transmitter control and the vocabulary needed for announcements. The board also contains signal-conditioning circuitry and lightning-protection circuitry for all the track connections. A terminal block (TB1) is provided for connections to the track hardware, the RF transmitter, and the power supply.

8.2 Train Approach Detection

The track circuits, if used, are wired directly to the SmallTalk board. The transducers, if used, are wired via the Surge Suppression panel. On the SmallTalk board, terminals 11 and 12 on terminal block TB1 are channel A's approach inputs. Terminals 15 and 16 are channel B's approach inputs. Terminals 7 and 8 are channel A's transducer inputs. Terminals 9 and 10 are channel B's transducer inputs.

On the Setup Options menu, option8 is the System Activation option. Selecting this option lets you select if you want the SmallTalk system to be activated by the approach inputs or by the transducer pulses.

When "Transducer" is selected, any positive going pulse greater than 30 millivolts at a transducer input causes the SmallTalk board to start scanning the alarm input for that channel. Train scanning continues as long as transducer pulses occur at intervals less than 10 seconds. Any period of 10 seconds or greater without a transducer pulse being detected is considered the end of the train. In order for the board to recognize a train, at least four transducer pulses must be counted. Any train with an axle count of two or three is logged as a test train. Any train with an axle count of one is ignored.

When "Approach" is selected and the Set Alarm Type option of the Main menu is set to "DED/Shifted load," any condition causing an open circuit at an approach input causes the SmallTalk board to start scanning the alarm input and the transducer input for that channel. Train scanning continues as long as the open circuit exists. When the open circuit no longer exists, that condition is considered the end of the train. As with transducer activation, the board must count at least four transducer pulses to recognize a valid train.

When “Approach” is selected and the Set Alarm Type option of the Main menu is set to “Bridge Alignment” or “High Water,” train presence is indicated by an open circuit at the approach input for at least three seconds. The transducer inputs aren’t used for bridge-failure detectors and high-water detectors. When train presence is detected, an arrival message is broadcast. For bridge failure, this message is either “No Defects” or “Bridge Failure Detected” depending on the status of the alarm input. For high water, it is either “No High Water” or “High Water.”

For double-track installations, while one channel is active, the SmallTalk board continues to scan the approach inputs for the other channel. If it becomes active, the alarm inputs for both channels will be scanned. In other words, both channels may be active at the same time.

8.3 Axle Counting

Any positive going pulse greater than 30 millivolts at the transducer inputs causes the axle count to be incremented. The transducer inputs must return to less than 30 millivolts between axle pulses. Any alarm occurring during an axle pulse is announced (at the end of the train) as being near that axle. Any alarm occurring between axle pulses is announced as being near the previous axle.

8.4 Dragging-Equipment Detection

The dragging-equipment detectors are wired to the Surge Suppression panel, which, in turn, are wired to the SmallTalk board. Terminals 13 and 14 on terminal block TB1 (on the SmallTalk board) are channel A’s dragging-equipment inputs. Terminals 17 and 18 are channel B’s dragging-equipment inputs.

While a train is passing the site, any condition causing an open circuit at the dragging-equipment inputs causes an alarm to be activated. For the first alarm, either a dragging-equipment alarm or a shifted-load alarm, the SmallTalk board transmits a real-time message announcing that a defect was detected. Additional alarms are logged and announced after the train has passed the site.

When an alarm occurs, another alarm isn’t allowed until the alarm contacts have closed and reopened and at least three axles have been counted since the previous alarm. Doing this stops multiple alarms being generated by one contact opening. After the train has passed, any alarms are announced in the order they occurred along with the axle count at which they occurred. If the number of alarms detected exceeds the maximum number of alarms, “Excessive Alarms” is added to the post-train announcement. (***Chapter 9 - Radio Announcements*** describes this message.) If the alarm contacts open while a train is passing the site and if they remain open, there will only be one alarm at the axle where the contacts first opened.

If no alarms are detected and Talk on Defects mode is selected, there is no post-train announcement. If no alarms are detected and Talk on Defects mode isn’t selected, a “No Defects” announcement is made. If both channels are active at the same time, the announcements for both tracks are buffered and announced in the order they occur.

8.5 Bridge-Failure Detection

When the Set Alarm Type option of the Main menu is set to Bridge Alignment, terminals 13, 14, 17, and 18 serve as bridge-failure inputs. While a train is passing the site, any condition causing an open circuit at these bridge-failure inputs causes an alarm to be activated. The SmallTalk board transmits a message announcing that a bridge failure was detected. (***Chapter 9 – Radio Announcements*** describes this message.) Only one bridge-failure alarm is allowed per train. If the alarm input is inactive when the train enters the site but becomes active while the train is passing, a "No Defects" message is broadcast at the beginning of the train and the "Bridge Failure Detected" message is broadcast when the alarm occurs. No end-of-train message (aka post-train announcement) is broadcast in bridge-alignment mode.

8.6 High-Water Detection

When the Set Alarm Type option of the Main menu is set to High Water, terminals 13, 14, 17, and 18 serve as high-water inputs. While a train is passing the site, any condition causing an open circuit at these high-water inputs causes an alarm to be activated. The SmallTalk board transmits a message announcing that a high-water condition was detected. (***Chapter 9 – Radio Announcements*** describes this message.) Only one high-water alarm is allowed per train. If the alarm input is inactive when the train enters the site but becomes active while the train is passing, a "No High Water" message is broadcast at the beginning of the train and the "High Water" message is broadcast when the alarm occurs. No end-of-train message is broadcast in high-water mode.

8.7 Shifted-Load Detection

Shifted-load detectors, if used, are wired directly to the SmallTalk board. When the Shifted-Load option (of the Setup Options menu) is set to Double, terminals 11 and 12 on terminal block TB1 (on the SmallTalk board) are channel A's shifted-load inputs. Terminals 15 and 16 are channel B's shifted-load inputs. When the Shifted-Load option is set to Single, terminals 11 and 12 are channel A's shifted-load inputs for rail1. Terminals 15 and 16 are channel A's shifted-load inputs for rail2.

While a train is passing, any condition causing an open circuit at the shifted-load inputs causes an alarm to be activated. For the first alarm, either a shifted-load alarm or a dragging-equipment alarm, the SmallTalk board transmits a real-time message announcing that a defect was detected. New alarms are logged and announced after the train has passed.

When an alarm occurs, another alarm isn't allowed until the alarm contacts have closed and reopened and at least three axles have been counted since the previous alarm. Doing this stops multiple alarms being generated by one contact opening. After the train has passed, any alarms are announced in the order they occurred along with the axle count at which they occurred. If the number of alarms detected exceeds the maximum number of alarms, "Excessive Alarms" is added to the post-train announcement. (***Chapter 9 - Radio Announcements*** describes this message.) If the alarm contacts open while a train is passing the site and if they remain open, there will only be one alarm at the axle where the contacts first opened.

If no alarms are detected and the Talk on Defects mode is selected, there is no post-train announcement. If the Talk on Defects mode isn't selected, a "No Defects" announcement is made (if there are no alarms). If both channels are active at the same time, the announcements for both tracks are buffered and announced in the order they occur.

8.8 Advance Alarm Detection

The firmware allows alarms before the first transducer pulse even when no track circuit is used. The Advance Alarm Time option of the Setup Options menu determines the amount of time before the first transducer pulse (when Transducer is selected with the System Activation option of the Setup Options menu) to allow alarms. This option is also used to determine if a stuck dragger or blocked sensor has occurred when no train is present.

If the System Activation option of the Setup Options menu is set to Transducer, the SmallTalk system continuously monitors the alarm inputs even if no train is present. When an alarm input is activated, an internal timer starts counting down from the value set up as the Advance Alarm Time. If a transducer pulse occurs before the timer reaches zero, a dragging-equipment alarm is stored and announced as being near the first axle. If the timer reaches zero before any transducer pulses occur, no alarm is announced.

If the System Activation option is set to Approach, no alarms are allowed before the approach input becomes active. Any alarm that occurs after the approach input becomes active, but before the first transducer pulse, is stored and announced as a dragging-equipment alarm near the first axle.

8.9 Stuck Dragger Detection

During train passage, a Stuck Dragger condition occurs when the dragging-equipment contacts open and remain open for five axles or more. The dragging-equipment alarm, at which the contacts first opened, is stored and announced, but no new dragging-equipment alarms are recognized while the Stuck Dragger condition exists. If the dragging-equipment alarm contacts close and remain closed for eight axles, the stuck dragger is considered cleared and the SmallTalk board returns to normal operation. After the stuck dragger clears, any dragging-equipment alarms that occur are stored and announced until the maximum number of alarms is reached. Any time a Stuck Dragger condition exists during train passage, whether it later clears or not, "Integrity Failure" is added to the post-train announcement.

While no train is present, a Stuck Dragger condition occurs when a dragging-equipment input becomes active and stays active for a period longer than the value set up as the Advance Alarm Time. If a train passes the SmallTalk system while the Stuck Dragger condition exists, no dragging-equipment alarms are allowed. An "Integrity Failure" announcement is made at the end of the train. (***Chapter 9 - Radio Announcements*** describes this message.) If the dragging-equipment input becomes inactive for a period longer than the value set as the Advance Alarm Time, the stuck dragger clears and the system returns to normal operation. It is possible for a Stuck Dragger condition to exist when a train enters a site and then clear during train passage (the alarm contacts are closed for eight axles or more). In this case, any dragging-equipment alarms that occur after the stuck dragger clears are stored and announced, but "Integrity Failure" is still added to the post-train announcement.

8.10 Blocked Sensor Detection

While no train is present, a Blocked Sensor condition occurs when a shifted-load input becomes active and stays active for a period longer than the value set up as the Advance Alarm Time. If a train passes the SmallTalk system while the Blocked Sensor condition exists, no shifted-load alarms are allowed. An "Integrity Failure" announcement is made at the end of the train. (***Chapter 9 - Radio Announcements*** describes this message.) If the shifted-load input becomes inactive for a period longer than the value set as the Advance Alarm Time, the blocked sensor clears and the system returns to normal operation.

8.11 Train Data Storage

Train data is stored in a directory in nonvolatile SRAM on the SmallTalk board. This directory is organized as a circular buffer. In this scheme, data is added to the directory until the directory is full. Once full, the oldest data in the directory is overwritten as new data is recorded.

The number of trains actually stored depends on how many alarms have been stored with them. For example, if all the trains had the maximum of nine alarms, only 80 trains would be stored. If none of them had alarms, 582 trains would be stored.

For each train, the time, date, total axles (if transducers were installed), and status are saved. The status field can be blank, which indicates that no defects or malfunctions were found. Or, it can contain these words.

- Bridge Failure, which indicates that a bridge-failure alarm was detected
- DED Clear, which indicates that a Stuck Dragger condition cleared during train passage
- DED Stuck (PT), which indicates that a Stuck Dragger condition occurred before train arrival
- DED Stuck, which indicates that a Stuck Dragger condition occurred during train passage
- Dragging Equipment, which indicates a dragging-equipment alarm was detected
- Excessive Alarms, which indicates that the maximum number of alarms was exceeded
- Shifted Load, which indicates a shifted-load alarm was detected
- SL Blocked, which indicates that a (shifted-load) Blocked Sensor condition occurred
- Test Train, which indicates a train with an axle count of two or three
- High Water, which indicates that a high-water alarm was detected

For each alarm that occurs during train passage, the time, date, and axle count (if transducers were installed) at which the alarm first occurred are saved. If the number of alarms during one train exceeds the maximum number of alarms, data is stored only for the alarms up to and including the maximum number. For double-track installations, separate directories are maintained for each track.

If it becomes necessary, you can clear the train data buffers with the Clear Train Data Buffer option of the Main menu. ***Chapter 10 - Serial Communications*** tells how to do this.

8.12 Speech Generation

The SmallTalk board not only controls train scanning but also generates the phrases to be spoken. All the needed vocabulary is stored in EPROM as digitized phrases. The information stored is the binary equivalent of the digitized voltage samples taken at a nine-kilohertz rate while the desired phrase was being spoken. The microprocessor has in its memory the specific memory locations of all digitized phrases. Generating audible speech is achieved by converting each of the stored digital samples to analog voltages at the same rate that they were digitized. The net effect is a machine that converts a series of codes from the microprocessor to human speech with the correct phonics and tempo. ***Chapter 9 - Radio Announcements*** describes the message formats and the announcement criteria.

Chapter 9 — Radio Announcements

This chapter describes radio announcements, which consist of predefined spoken messages with each message triggered by a particular event or set of events. Covered are the message formats and the announcement criteria.

9.1 Startup Announcements

Startup announcements are given when:

- SmallTalk system is powered up.
- Reset button (on the SmallTalk board) is pressed.

The format of this announcement is:

B-N-S-F Detector
Milepost (mile)
(track1 indicator)
(message1)
(track2 indicator)
(message2)

For example, if the alarm contacts are closed, the announcement is like this.

B-N-S-F Detector
Milepost 3-1-6 Point 5
North Track
No Defects
South Track
No Defects

If the alarm contacts are opened, the announcement is like this.

B-N-S-F Detector
Milepost 3-1-6 Point 5
North Track
Integrity Failure

9.2 Arrival Announcements

There are no arrival announcements when the Set Alarm Type option of the Main menu is set to DED/Shifted load. There are arrival announcements when the Set Alarm Type option is set to Bridge Alignment or High Water.

9.2.1 Bridge Alignment

While the Set Alarm Type option of the Main menu is set to Bridge Alignment, if the track circuit is active for three seconds, an arrival message is broadcast. This message is either "No Defects" or "Bridge Failure Detected" depending on the status of the alarm input.

If the alarm input is inactive (low) when the train enters the site, the format of this announcement is:

B-N-S-F Detector
Milepost (mile)
(track indicator)
No Defects
Repeat
No Defects

For example, if the alarm contacts are closed when the train enters the site, the announcement is like this.

B-N-S-F Detector
Milepost 6-4-2 Point 8
East Track
No Defects
Repeat
No Defects

If the alarm input is active (high) when the train enters the site, the format of this announcement is:

B-N-S-F Detector
Milepost (mile)
(track indicator)
Bridge Failure Detected
Stop Your Train
(5-second pause)
B-N-S-F Detector
Milepost (mile)
(track indicator)
Bridge Failure Detected
Stop Your Train

If the alarm input is inactive when the train enters the site but becomes active while the train is passing, the “No Defects” message is broadcast at the beginning of the train and the “Bridge Failure Detected” message is broadcast when the alarm occurs. No post-train (aka end-of-train) announcement is made.

9.2.2 High Water

While the Set Alarm Type option of the Main menu is set to Bridge Alignment, if the track circuit is active for three seconds, an arrival message is broadcast. This message is either “No High Water” or “High Water” depending on the status of the alarm input.

If the alarm input is inactive (low) when the train enters the site, the format of this announcement is:

B-N-S-F Detector
Milepost (mile)
(track indicator)
No High Water
Repeat
No High Water

For example, if the alarm contacts are closed when the train enters the site, the announcement is like this.

B-N-S-F Detector
Milepost 6-4-2 Point 8
East Track
No High Water
Repeat
No High Water

If the alarm input is active (high) when the train enters the site, the format of this announcement is:

B-N-S-F Detector
Milepost (mile)
(track indicator)
High Water
Stop Your Train
(5-second pause)
B-N-S-F Detector
Milepost (mile)
(track indicator)
High Water
Stop Your Train

If the alarm input is inactive when the train enters the site but becomes active while the train is passing, the “No High Water” message is broadcast at the beginning of the train and the “High Water” message is broadcast when the alarm occurs. No post-train announcement is made.

9.3 Real-Time Announcements

Real-time announcements, if any, are given as the train is passing over the site and only when the first alarm condition is found.

When the Set Alarm Type option of the Main menu is set to DED/Shifted load, the format of this announcement is:

B-N-S-F Detector
Milepost (mile)
(track indicator)
You Have a Defect [Near Axle (axle)]

For example, the announcement is like this.

B-N-S-F Detector
Milepost 3-1-6 Point 5
North Track
You Have a Defect Near Axle 4-8

This message is announced only for the first alarm. The axle number isn’t automatically announced. If you want it to be announced, use the Announce Axles Real-Time option of the Setup Options menu. (***Chapter 10 - Serial Communications*** tells how to do this.)

When the Set Alarm Type option of the Main menu is set to Bridge Alignment, the format of this announcement is:

B-N-S-F Detector
Milepost (mile)
(track indicator)
Bridge Failure Detected
Stop Your Train
(5-second pause)
B-N-S-F Detector
Milepost (mile)
(track indicator)
Bridge Failure Detected
Stop Your Train

9.4 Post-Train Announcements

No end-of-train messages are broadcast when the Set Alarm Type option of the Main menu is set to Bridge Alignment. They are only broadcast when the Set Alarm Type option is set to DED/Shifted load.

Post-train (aka end-of-train) announcements, if any, are given after the train has left the site. The format of this announcement is:

B-N-S-F Detector
Milepost (mile)
(track indicator)
(message)

If you want to add the words “Detector Out” to the end of a post-train announcement, use the Announce Detector Out option of the Setup Options menu. (***Chapter 10 - Serial Communications*** tells how to do this.) Here’s an example.

B-N-S-F Detector
Milepost 5-6-7 Point 8
North Track
No Defects
Detector Out

To select the amount of time the last post-train announcement is available for rebroadcast, use the Rebroadcast Timeout option of the Setup Options menu. ***Chapter 10 - Serial Communications*** tells how to do this. The train crew makes the actual request for rebroadcast. The repeated announcement has the word “rebroadcast” at the beginning and ending of the message. Here’s an example.

Rebroadcast
B-N-S-F Detector
Milepost 5-6-7 Point 8
North Track
No Defects
Rebroadcast

9.4.1 No Defects Found

For a “train” passing the site with an axle count of two or three, the announcement is like this.

B-N-S-F Detector
Milepost 3-1-6 Point 5
North Track
System Working

For a train passing the site with an axle count greater than three and without defects, the announcement is like this.

B-N-S-F Detector
Milepost 3-1-6 Point 5
North Track
No Defects

On the Setup Options menu, option10 is the Repeat No Defects option. Selecting this option lets you select if you want “No Defects” to be announced twice as part of the post-train announcement. If no is selected, the message isn’t repeated. If yes is selected, the message is repeated. Here’s an example.

B-N-S-F Detector
Milepost 3-1-6 Point 5
North Track
No Defects
Repeat
No Defects

On the Setup Options menu, option4 is the Talk on Defect Only option. Selecting this option lets you select if you want announcements to be made for trains having no alarms and no integrity failures. If yes is selected, there is no post-train announcement for a train without defects. If no is selected, one of the above post-train announcements is made.

9.4.2 Defects Found

For a train passing the site with an axle count greater than three and with eight dragging-equipment alarms, the announcement is like this.

B-N-S-F Detector
Milepost 3-1-6 Point 5
North Track
First Dragging Equipment Near Axle 9
Second Dragging Equipment Near Axle 1-4
Third Dragging Equipment Near Axle 2-2
-
-
-
Eighth Dragging Equipment Near Axle 1-0-1

When double-track shifted-load is selected, for a train passing the site with an axle count greater than three and with two shifted-load alarms, the announcement is like this.

B-N-S-F Detector
Milepost 1-2-5 point 6
North Track
First Wide Load Near Axle 3-4
Second Wide Load Near Axle 4-8

When single-track shifted-load is selected, for a train passing the site with an axle count greater than three and with two shifted-load alarms, the announcement is like this.

B-N-S-F Detector
Milepost 3-7-9 point 9
North Track
First Wide Load East Rail Near Axle 4-4
Second Wide Load West Rail Near Axle 5-8

Announcements start with the axle where the first alarm was discovered and continue until all alarms are announced or the maximum number of alarms is exceeded. The labels “first,” “second,” “third,” and so forth are applied separately to dragging-equipment alarms and shifted-load alarms. If there is only one dragging-equipment alarm, “First” is omitted from the announcement. The same is true of a single shifted-load alarm.

If the maximum number of alarms is exceeded, the alarm announcement is followed by “Excessive Alarms.” Maximum number of alarms is calculated by adding all dragging-equipment and all shifted-load alarms.

For a train passing the site with a stuck dragger or blocked sensor, the announcement is like this.

B-N-S-F Detector
Milepost 3-1-6 point 5
North Track
Integrity Failure

If a stuck dragger occurs during train passage, alarms that occur before the stuck dragger or after the stuck dragger clears are announced, as for example:

B-N-S-F Detector
Milepost 3-1-6 point 5
North Track
First Dragging Equipment Near Axle 9
Second Dragging Equipment Near Axle 2-2
Integrity Failure

If the maximum number of alarms is exceeded and a stuck dragger or a blocked sensor has occurred, the alarms are announced followed by “Excessive Alarms” followed by “Integrity Failure.”

For any train with a defect or integrity failure, the post-train announcement is repeated after five seconds.

Chapter 10 — Serial Communications

This chapter describes the Serial Communications Interface for the SmallTalk system. It covers how to set the system parameters and how to display stored train data. These functions are available only when both channels are inactive. In other words, no serial input is processed during train passage.

To access the SmallTalk system:

1 Be sure your computer has appropriate communications software installed.

2 Be sure your communications software is set to use full duplex.

The system doesn't pause when the screen is filled. Because of this, you need to use your communications software to open a LOG file and save the information in it. When your session is over, you may then view the recorded information with an editor or print it with a printer.

3 On your computer, open a LOG file.

4 Connect your computer to the RS232 connector on the outside of the enclosure.

If **[Esc]** is pressed, the mileposts, date, and time appear above the Main menu. Besides that information, if the reset button (on the SmallTalk board) is pressed or if the power to the system is cycled, the firmware version and current configuration appear.

5 To get less information with the Main menu, press **[Esc]**.

The Main menu and other information appear. The contents of your screen will be different.

```
BNSF Milepost 0123.4x
Time: 09:56:08  Date: 07/17/05

The following commands are available:
-------------------------------------
[1] - Display Train Data for Channel A
[2] - Display Train Data for Channel B
[3] - Set System Parameters
[4] - Enter Test Mode
[5] - Generate Test Tone
[6] - Clear Train Data Buffer
[7] - Rebroadcast Summary for Channel A
[8] - Rebroadcast Summary for Channel B
[9] - Set Alarm Type - DED/Shifted load
```

6 To get more information with the Main menu, press the reset button.

The Main menu and other information appear. The contents of your screen will be different.

```
Southern Technologies Corporation
SmallTalk  Ver 04A1  November 5, 2004

BNSF Milepost 0123.4x
Time: 09:56:08  Date: 07/17/05

Channel A currently = North Track
Channel B currently = South Track
Talk on Defect Only = No
Announce Detector Out = No
Maximum Alarms = 2
System Activation = Transducer
Advance Alarm Time = 10
Repeat No Defects = No
Rebroadcast Timeout = 5
Announce Total Axles = Yes
Announce Axles Real-time = Yes
Shifted Load = Not Used

The following commands are available:
-------------------------------------
[1] - Display Train Data for Channel A
[2] - Display Train Data for Channel B
[3] - Set System Parameters
[4] - Enter Test Mode
[5] - Generate Test Tone
[6] - Clear Train Data Buffer
[7] - Rebroadcast Summary for Channel A
[8] - Rebroadcast Summary for Channel B
[9] - Set Alarm Type - DED/Shifted load
```

7 Press the digit that corresponds to the desired option.

For example, if you want to generate a test tone, press **[5]**.

8 Repeat step **7** until you are done.

9 When done, close the LOG file.

10.1 Display Train Data for Channel A

On the Main menu, option1 is the Display Train Data for Channel A option. To select this option, press **[1]**. Doing so produces a report of the train data stored for channel A.

When the Set Alarm Type option of the Main menu is set to DED/Shifted load, the report looks like this. The contents of your report will be different.

```
For the following report, pressing `H' will pause printing
Any other key will resume printing.
Press ESC to end printing.

Train Summary for North Track
Train       Time        Date      Axles      Status
-------------------------------------------------------------
   5      17:42:22    06/02/05    212
          17:43:00    06/02/05     41     Dragging Equipment
          17:43:00    06/02/05     82     Dragging Equipment
                                          Excessive Alarms

   4      16:31:05    06/02/05    180     DED Stuck  DED Clear
          15:30:30    06/02/05     66     Dragging Equipment

   3      16:00:03    06/02/05    258     DED Stuck (PT)

   2      15:35:22    06/02/05    218
          15:36:00    06/02/05     41     Dragging Equipment

   1      14:52:00    06/02/05    172

End of Data
```

On the sample report above, five trains passed the site. None had a shifted-load alarm.

The first train passed the site at 2:52 p.m. on 2 June 2005. The SmallTalk board counted 172 total axles for this train and detected no alarms or malfunctions. A train with no defects or malfunctions has nothing printed in the Status column.

If a Stuck Dragger condition occurs before train passage, DED Stuck (PT) is printed in the Status column (as in train number 3 above).

If a Stuck Dragger condition occurs during train passage, DED Stuck is printed in the Status column of the first line and any alarms that occurred are printed. If a stuck dragger clears during train passage, DED Clear is also printed in the Status column (as in train number 4 above).

Each alarm that occurs on a train is printed on separate line beneath the first line along with the axle count at which it occurred. Dragging Equipment is printed in the Status column. If the maximum number of alarms is exceeded, Excessive Alarms is printed in the Status column of the last line (as in train number 5 above). A blank line is printed between trains.

To cancel a printout before “End of Data” appears, press **[Esc]**. To display the Main menu after “End of Data” appears, press **[Esc]**.

Below is another sample of that report. Again, the contents of your report will be different.

```
For the following report, pressing `H' will pause printing
Any other key will resume printing.
Press ESC to end printing.

Train Summary for North Track
Train       Time        Date      Axles      Status
-------------------------------------------------------------
   3      00:06:04    02/17/05     68
          00:06:11    02/17/05     17       Shifted Load
          00:06:24    02/17/05     49       Shifted Load

   2      00:02:44    02/17/05     53
          00:02:48    02/17/05     10       Shifted Load
          00:02:58    02/17/05     30       Shifted Load

   1      00:00:43    02/17/05     57
          00:00:48    02/17/05     12       Shifted Load
          00:00:59    02/17/05     41       Shifted Load
End of Data
```

On the sample report above, three trains passed a double-track site. Each had a shifted-load alarm. If this were a single-track site, the sample report looks something like this.

```
For the following report, pressing `H' will pause printing
Any other key will resume printing.
Press ESC to end printing.

Train Summary for North Track
Train       Time        Date      Axles      Status
-------------------------------------------------------------
   3      00:06:04    02/17/05     68
          00:06:11    02/17/05     17       Shifted Load Side 1
          00:06:24    02/17/05     49       Shifted Load Side 2

   2      00:02:44    02/17/05     53
          00:02:48    02/17/05     10       Shifted Load Side 1
          00:02:58    02/17/05     30       Shifted Load Side 2

   1      00:00:43    02/17/05     57
          00:00:48    02/17/05     12       Shifted Load Side 1
          00:00:59    02/17/05     41       Shifted Load Side 2
End of Data
```

When the Set Alarm Type option of the Main menu is set to Bridge Alignment, no axle count is shown and only one alarm is shown per train. Here's a sample of that report. The contents of your report will be different.

```
For the following report, pressing `H' will pause printing
Any other key will resume printing.
Press ESC to end printing.

Train Summary for North Track
Train       Time        Date      Axles      Status
-------------------------------------------------------------
   3      11:03:17    01/30/05
          11:03:38    01/30/05              Bridge Failure

   2      11:01:12    01/30/05
          11:01:12    01/30/05              Bridge Failure

   1      10:59:34    01/30/05

End of Data
```

On the sample report above, the first train had no defects. The second train had a bridge failure detected at train arrival which is indicated by the arrival and alarm times being identical. The third train had a bridge failure detected during train passage which is indicated by the alarm time being later than arrival time.

10.2 Display Train Data for Channel B

On the Main menu, option2 is the Display Train Data for Channel B option. To select this option, press **[2]**. Doing so produces a report of the train data stored for channel B. This report is in the same format as the one outlined for channel A above.

When the Set Alarm Type option of the Main menu is set to DED/Shifted load, the report looks like this. The contents of your report will be different.

```
For the following report, pressing `H' will pause printing
Any other key will resume printing.
Press ESC to end printing.

Train Summary for South Track
Train       Time        Date      Axles      Status
-------------------------------------------------------------
End of Data
```

On the sample report, no trains passed the site. To cancel a printout before "End of Data" appears, press **[Esc]**. To display the Main menu after "End of Data" appears, press **[Esc]**.

Below is another sample of that report. Again, the contents of your report will be different.

```
For the following report, pressing `H' will pause printing
Any other key will resume printing.
Press ESC to end printing.

Train Summary for South Track
Train       Time        Date      Axles      Status
-----------------------------------------------------------------
   4      20:06:04    04/04/05    112
          20:06:11    04/04/05     27       Shifted Load
          20:06:24    04/04/05     59       Shifted Load

   3      14:02:44    04/04/05     53
          14:02:48    04/04/05     14       Shifted Load
          14:02:58    04/04/05     30       Shifted Load

   2      12:35:22    04/04/05    118
          12:36:00    04/04/05     85       Dragging Equipment

   1      01:00:43    04/04/05     57
          01:00:48    04/04/05     12       Shifted Load
          01:00:59    04/04/05     41       Shifted Load
End of Data
```

On the sample report above, four trains passed a double-track site. Three had shifted-load alarms. One had a dragging-equipment alarm. If this were a single-track site, the sample report would look something like this.

```
For the following report, pressing `H' will pause printing
Any other key will resume printing.
Press ESC to end printing.

Train Summary for Not Used
Train       Time        Date      Axles      Status
-----------------------------------------------------------------
End of Data
```

10.3 Set System Parameters

On the Main menu, option3 is the Set System Parameters option. To select this option, press **[3]**. Doing so displays the Setup Options menu and other information.

When the Set Alarm Type option of the Main menu is set to DED/Shifted load, the screen that contains the Setup Options menu looks like this. The contents of your screen will be different.

```
Setup Options                          Current Setting
---------------                        -----------------
[1] - Channel A Track Designator ..... North Track
[2] - Channel B Track Designator ..... Not Used
[3] - Time and Date .................. Time: 04:04:15  Date: 04/04/05
[4] - Talk on Defect Only ............ No
[5] - Announce Detector Out .......... No
[6] - Maximum Alarms ................. 3
[7] - Milepost ....................... 0159.0X
[8] - System Activation .............. Transducer
[9] - Advance Alarm Time ............. 10
[A] - Repeat No Defects .............. No
[B] - Rebroadcast Timeout ............ 10
[C] - Announce Total Axles ........... Yes
[D] - Announce Axles Real-time ....... Yes
[E] - Shifted Load ................... Single Track
[F] - Channel A Rail Designator....... North Rail
[G] - Channel B Rail Designator....... South Rail
[0] - Exit
```

When the Set Alarm Type option of the Main menu is set to Bridge Alignment, the screen that contains the Setup Options menu looks like this. The contents of your screen will be different.

```
Setup Options                          Current Setting
---------------                        -----------------
[1] - Channel A Track Designator ..... North Track
[2] - Channel B Track Designator ..... Not Used
[3] - Time and Date .................. Time: 04:04:15  Date: 04/04/05
[4] - Talk on Defect Only ............ No
[5] - Announce Detector Out .......... No
[6] - Maximum Alarms ................. 3
[7] - Milepost ....................... 0159.0X
[8] - System Activation .............. Approach
[9] - Advance Alarm Time ............. 10
[A] - Repeat No Defects .............. No
[B] - Rebroadcast Timeout ............ 10
[C] - Announce Total Axles ........... Yes
[D] - Announce Axles Real-time ....... Yes
[E] - Shifted Load ................... Not Used
[0] - Exit
```

On the left of the above screens is the option number followed by its name. For example, the Milepost option is option7. On the right are the current settings of the options. For example, the current setting of the Milepost option is 0159.0X.

All options, except **[1]**, **[2]**, **[E]**, **[F]**, and **[G]**, affect both tracks of a double-track installation. Options **[F]** and **[G]** only appear when option **[E]** is Single Track.

10.3.1 Channel A Track Designator

On the Setup Options menu, option1 is the Channel A Track Designator option. To select this option, press **[1]**. Doing so displays a list of track designations from which to choose.

```
Channel A currently = North Track
Choose New Track Designation or Press ESC to exit:
[0] - None
[1] - North
[2] - South
[3] - East
[4] - West
[5] - Main 1
[6] - Main 2
[7] - Main 3
[8] - Middle
[9] - Not Used
```

Press the digit that corresponds to the desired track designation. For example, if you want to select west, press **[4]**. To have no designation announced for the track connected to the channel A inputs, press **[0]**. To cause channel A not to be scanned and announcements not to be made for that track, press **[9]**. To exit without making any changes, press **[Esc]**. After pressing either a digit or **[Esc]**, the Setup Options menu reappears.

10.3.2 Channel B Track Designator

On the Setup Options menu, option2 is the Channel B Track Designator option. To select this option, press **[2]**. Doing so presents a choice of track designations for channel B in the same format as channel A above.

```
Channel B currently = South Track
Choose New Track Designation or Press ESC to exit:
[0] - None
[1] - North
[2] - South
[3] - East
[4] - West
[5] - Main 1
[6] - Main 2
[7] - Main 3
[8] - Middle
[9] - Not Used
```

Press the digit that corresponds to the desired track designation. For example, if you want to select east, press **[3]**. To have no designation announced for the track connected to the channel B inputs, press **[0]**. To cause channel B not to be scanned and announcements not to be made for that track, press **[9]**. To exit without making any changes, press **[Esc]**. After pressing either a digit or **[Esc]**, the Setup Options menu reappears.

10.3.3 Time and Date

On the Setup Options menu, option3 is the Time and Date option. To select this option, press **[3]**. Doing so displays the current time and date with a prompt for a new time.

```
Time: 09:56:08  Date: 03/17/05
Enter Time  HHMMSS  (Press ESC to exit)
```

Enter the time with no spaces between digits. Entry format is **hhmmss**, where **hh** is hours, **mm** is minutes, and **ss** is seconds. Time is in 24-hour format, where 8 a.m. is 08:00, noon is 12:00, 8 p.m. is 20:00, and midnight is 00:00. Thus, for 26 seconds past 3:49 p.m., enter **154926**. To exit without changing the time, press **[Esc]**. After either typing six digits or pressing **[Esc]**, the SmallTalk board prompts for the date as shown below:

```
Enter Date  MMDDYY  (Press ESC to exit)
```

Enter the date with no spaces between digits. Entry format is **mmddyy**, where **mm** is the month, **dd** is the day, and **yy** is the year. For days, months, or years from 1 through 9, enter leading zeros. Thus, for 7 April 2005, enter **040705**. To exit without changing the date, press **[Esc]**. After either typing six digits or pressing **[Esc]**, the Setup Options menu reappears.

10.3.4 Talk on Defect Only

On the Setup Options menu, option4 is the Talk on Defect Only option. To select this option, press **[4]**. Doing so lets you select if you want announcements to be made for trains having no alarms and no integrity failures. (This option is only meaningful when dragging-equipment detectors are installed. When bridge-failure detectors or high-water detectors are installed, selecting this option won't have any effect on the system.)

```
Talk on Defect Only = No
Select New Setting or Press ESC to exit:
(Y) - Yes
(N) - No
```

To cause the SmallTalk board to make a "No Defects" announcement to the train crew when the train has no alarms or integrity failures, press **[N]**. To prevent announcements for trains having no alarms or integrity failures, press **[Y]**. To exit without making any changes, press **[Esc]**. After pressing **[Y]**, **[N]**, or **[Esc]**, the Setup Options menu reappears.

10.3.5 Announce Detector Out

On the Setup Options menu, option5 is the Announce Detector Out option. To select this option, press **[5]**. Doing so lets you select if you want to add the words "Detector Out" to the end of each post-train announcement.

```
Announce Detector Out = No
Select New Setting or Press ESC to exit:
(Y) - Yes
(N) - No
```

To cause the SmallTalk board to add "Detector Out" to the end of the last announcement when no more messages are waiting in the speech buffer, press **[Y]**. To prevent the "Detector Out" announcement, press **[N]**. To exit without making any changes, press **[Esc]**. After pressing **[Y]**, **[N]**, or **[Esc]**, the Setup Options menu reappears.

10.3.6 Set Maximum Alarms

On the Setup Options menu, option6 is the Set Maximum Alarms option. To select this option, press **[6]**. Doing so lets you set the number of alarms the SmallTalk board allows during each train's passage. (This option is only meaningful when dragging-equipment detectors are installed. When bridge-failure detectors or high-water detectors are installed, selecting this option won't have any effect on the system.)

```
Maximum Alarms = 3
Select New Setting (1 - 9) or Press ESC to exit:
```

Press a digit from **1** to **9** to set the maximum number of alarms. If a train has more than the maximum number of alarms, the message "Inspect Remainder of Train" is added to the post-train announcement. The alarms, up to and including the maximum, are announced with the axle number at which they occurred. (***Chapter 9 - Radio Announcements*** describes this message.) To exit without making any changes, press **[Esc]**. After pressing either a digit or **[Esc]**, the Setup Options menu reappears.

10.3.7 Milepost

On the Setup Options menu, option7 is the Milepost option. To select this option, press **[7]**. Doing so displays the current milepost (that is announced with each message) with a prompt for a new one.

```
BNSF Milepost 0123.4x
Enter new Milepost as 5 digits (-----.-) then the optional character.
The optional character may be X, Y, Z, or SPACE (if not used).
Press ESC to exit without changing the Milepost.
```

Enter the milepost with no spaces between characters. Entry format is **nnnn.nx**, where **n** is a digit 0 through 9 and **x** is a space or a letter X through Z. If the desired milepost has less than five digits, enter leading zeros. If the desired milepost is an integer, enter a trailing zero. Thus, for milepost 87, enter **00870**. The system automatically inserts the decimal point. After the last digit, you may enter an X, Y, or Z. If no letter is desired, press the spacebar. To exit without changing the milepost, press **[Esc]**. After either typing in six characters or pressing **[Esc]**, the Setup Options menu reappears.

10.3.8 System Activation

On the Setup Options menu, option8 is the System Activation option. To select this option, press **[8]**. Doing so, when the Set Alarm Type option of the Main menu is set to DED/Shifted load, lets you select if you want the SmallTalk system to be activated by the approach inputs or by the transducer pulses.

```
System Activation = Transducer
Select New Setting or Press ESC to exit:
(1) - Transducer
(2) - Approach
```

Pressing **[1]** causes the SmallTalk board to ignore the approach inputs and activate the system on transducer pulses. This should be used at sites where a track circuit isn't present. Pressing **[2]** causes the board to use the approach inputs for system activation. The transducer inputs are still used to determine axle count and speed, but the board scans for trains only when an approach input is active. This should be used at sites where a track circuit is present. To exit without making any changes, press **[Esc]**. After pressing **[1]**, **[2]**, or **[Esc]**, the Setup Options menu reappears.

Selecting option8, when the Set Alarm Type option of the Main menu is set to Bridge Alignment or High Water, generates this message.

```
This parameter can not be changed while Bridge Alignment is enabled.
```

10.3.9 Advance Alarm Time

On the Setup Options menu, option9 is the Advance Alarm Time option. To select this option, press **[9]**. Doing so lets you set the Advance Alarm Time.

```
Advance Alarm Time = 10
Enter New Value (01 - 99) seconds
(or Press ESC to exit)
```

Enter a two-digit value representing the amount of time (in seconds) to allow alarms before the first transducer pulse. This option is also used to determine if a stuck dragger or blocked sensor has occurred when no train is present. The Advance Alarm Time may be set from 1 second to 99 seconds, but for values less than ten, enter a leading zero. To exit without changing the time, press **[Esc]**. After either typing two digits or pressing **[Esc]**, the Setup Options menu reappears.

10.3.10 Repeat No Defects

On the Setup Options menu, option10 is the Repeat No Defects option. To select this option, press **[A]**. Doing so lets you select if you want “No Defects” to be announced twice as part of the post-train announcement.

```
Repeat No Defects = Yes
Select New Setting or Press ESC to exit:
(Y) - Yes
(N) - No
```

To cause the SmallTalk board to say “No Defects, Repeat, No Defects” as part of the post-train announcement for trains having no alarms or integrity failures, press **[Y]**. To cause the board to say “No Defects” only once, press **[N]**. To exit without making any changes, press **[Esc]**. After pressing **[Y]**, **[N]**, or **[Esc]**, the Setup Options menu reappears.

10.3.11 Rebroadcast Timeout

On the Setup Options menu, option11 is the Rebroadcast Timeout option. To select this option, press **[B]**. Doing so lets you set the number of minutes a crew has to request a rebroadcast of the last post-train announcement.

```
Rebroadcast Timeout = 5
Enter New Value (01 - 99) minutes
or 00 to always allow Rebroadcast
(or Press ESC to exit)
```

Enter a two-digit value. If you enter a value from 01 through 99, the value is the number of minutes that a crew has to request a repeat of the last post-train announcement. If you enter 00, the last post-train announcement is always available for rebroadcast. The repeated announcement has the word “rebroadcast” at the beginning and ending of the message. To exit without changing the time, press **[Esc]**. After either typing two digits or pressing **[Esc]**, the Setup Options menu reappears.

On solar-powered systems, the RF transmitter must be powered to listen for a rebroadcast request. Therefore, the RF transmitter remains on after each train for the amount of time specified by the Rebroadcast Timeout option of the Setup Options menu. To conserve power, this parameter should be kept as small as possible, but shouldn’t be set to zero.

10.3.12 Announce Total Axles

On the Setup Options menu, option12 is the Announce Total Axles option. To select this option, press **[C]**. Doing so lets you select if you want to announce total axles at the end of each post-train announcement. (Axles are only announced when transducers are installed. When transducers aren't installed, selecting this option won't have any effect on the system.)

```
Announce Total Axles = No
Select New Setting or Press ESC to exit:
(Y) - Yes
(N) - No
```

To cause the SmallTalk board to announce total axles at the end of each post-train announcement, press **[Y]**. Total axles aren't announced for test trains. To prevent total axles from being announced, press **[N]**. To exit without making any changes, press **[Esc]**. After pressing **[Y]**, **[N]**, or **[Esc]**, the Setup Options menu reappears.

10.3.13 Announce Axles Real-Time

On the Setup Options menu, option13 is the Announce Axles Real-Time option. To select this option, press **[D]**. Doing so lets you select if you want to announce the axle count with the real-time alarm announcement. (Axles are only announced when transducers are installed. When transducers aren't installed, selecting this option won't have any effect on the system.)

```
Announce Axles Real-time = No
Select New Setting or Press ESC to exit:
(Y) - Yes
(N) - No
```

To cause the SmallTalk board to announce the axle count with the real-time alarm announcement, press **[Y]**. To prevent the axle count from being announced, press **[N]**. To exit without making any changes, press **[Esc]**. After pressing **[Y]**, **[N]**, or **[Esc]**, the Setup Options menu reappears.

10.3.14 Shifted Load

On the Setup Options menu, option14 is the Shifted-Load option. To select this option, press **[E]**. Doing so, when the Set Alarm Type option is set to DED/Shifted load, lets you select if you want to select the Approach inputs as shifted-load inputs. Three choices are available.

```
Shifted Load = Double Track
Use the Approach inputs as Shifted Load inputs?
Select New Setting or Press ESC to exit:
(1) - Not Used
(2) - Double Track
(3) - Single Track
```

Pressing **[1]** disables the shifted-load function. The approach input may be used for a track circuit or it goes unused.

Pressing **[2]** allows shifted-load alarms in double-track mode. In this mode, the approach input for each channel can be used as a shifted-load input for that channel. No rail indication is provided for the shifted-load alarms. In this mode, System Activation is forced to Transducer and can't be changed. If a track has more than one shifted-load detector, they can be connected in series to the shifted-load input for that track.

Pressing **[3]** allows shifted-load alarms in single-track mode. In this mode, channel B isn't used. Both Approach inputs can be used as shifted-load inputs for channel A. Two options are added to the Setup Options menu, channel A and channel B rail designations. These options allow each shifted-load input to be associated with a rail designation that is announced as part of the shifted-load alarm.

To exit without making any changes, press **[Esc]**. After pressing **[1]**, **[2]**, **[3]**, or **[Esc]**, the Setup Options menu reappears.

If you pressed **[1]** or **[Esc]**, you get no warning. If you pressed **[2]**, you get this warning.

```
WARNING: System Activation will be set to Transducer.
```

If you pressed **[3]**, you get this warning.

```
WARNING: System Activation will be set to Transducer.
         Channel B will be set to Not Used.
```

Selecting option14, when the Set Alarm Type option of the Main menu is set to Bridge Alignment or High Water, generates this message.

```
This parameter can not be changed while Bridge Alignment is enabled.
```

10.3.15 Channel A Rail Designator

On the Setup Options menu, option15 is the Channel A Rail Designator option. (This option only appears if the Shifted-Load option is set to Single Track.) To select this option, press **[F]**. Doing so lets you select the rail designation for channel A. Six choices are available.

```
Channel A Rail currently = North Rail
Choose New Rail Designation or Press ESC to exit:
(1) - North
(2) - South
(3) - East
(4) - West
(5) - Side 1
(6) - Side 2
```

Press the digit that corresponds to the desired rail designation. For example, if you want to select east, press **[3]**. To exit without making any changes, press **[Esc]**. After pressing either a digit or **[Esc]**, the Setup Options menu reappears.

10.3.16 Channel B Rail Designator

On the Setup Options menu, option16 is the Channel B Rail Designator option. (This option only appears if the Shifted-Load option is set to Single Track.) To select this option, press **[G]**. Doing so lets you select the rail designation for channel B. Six choices are available.

```
Channel B Rail currently = South Rail
Choose New Rail Designation or Press ESC to exit:
(1) - North
(2) - South
(3) - East
(4) - West
(5) - Side 1
(6) - Side 2
```

Press the digit that corresponds to the desired rail designation. For example, if you want to select east, press **[3]**. To exit without making any changes, press **[Esc]**. After pressing either a digit or **[Esc]**, the Setup Options menu reappears.

10.3.17 Exit

On the Setup Options menu, option0 is the Exit option. To select this option, press **[0]**. Doing so returns you to the Main menu.

10.4 Enter Test Mode

On the Main menu, option4 is the Enter Test Mode option. To select this option, press **[4]**. Doing so allows you to verify the proper operation of all detectors and transducers at a given site.

```
              Press ESC to exit
---- Channel A ----       ---- Channel B ----
 Approach    Alarm         Approach    Alarm
  ----        ----          ----        ----
```

The header labels the columns for each track (Channel A and Channel B) and the inputs for each track (Approach and Alarm). The next line shows the initial status of each input. Four dashes mean that an input isn't active (that is, the contacts aren't open). A new status line is added to this screen every time one or more input changes (that is, every time an alarm or approach contact opens or closes). For example, if the dragging-equipment alarm contact on channel A opens and then closes, the screen is updated as shown below.

```
              Press ESC to exit
---- Channel A ----       ---- Channel B ----
 Approach    Alarm         Approach    Alarm
  ----        ----          ----        ----
  ----        open          ----        ----
  ----        ----          ----        ----
```

The second and third lines verify that the alarm contact on channel A was activated and then returned to its normal state. For the same action, if no update was made to the display or if the third line wasn't displayed upon the dragging-equipment detector returning to its normal state, the dragging-equipment detector on channel A wouldn't be operating properly.

Transducer operation can be verified by activating either transducer. If the transducer is operating properly, the display is updated with the message Transducer Active as follows:

```
              Press ESC to exit
---- Channel A ----       ---- Channel B ----
 Approach    Alarm         Approach    Alarm
  ----        ----          ----        ----
  ----        open          ----        ----
  ----        ----          ----        ----
>>> Transducer Active <<<
```

The SmallTalk board then temporarily leaves the test mode and begins scanning for a train. If four or less transducer pulses are detected, the board determines that no train was present, and returns to test mode after a 10-second timeout. Once the board has returned to test mode, the other transducer's operation may be verified.

The SmallTalk board exits test mode when you press **[ESC]** or when no activity occurs through the serial port for 30 minutes.

10.5 Generate Test Tone

On the Main menu, option5 is the Generate Test Tone option. To select this option, press **[5]**. Doing so allows you to adjust the audio level to the RF transmitter. Pressing **[5]** causes the SmallTalk board to activate the PTT for the RF transmitter and output a 1000-hertz tone through the transmit audio line. At the same time, the following appears.

```
Now generating test tone...
Press [Esc] to exit
```

Press **[Esc]** to stop the test tone and release the PTT. The test tone continues for five minutes if there is no activity through the serial port.

10.6 Clear Train Data Buffer

On the Main menu, option6 is the Clear Train Data Buffer option. To select this option, press **[6]**. Doing so allows you to clear the train data in nonvolatile SRAM.

```
All Train Data will be erased...
Press [Y]es to continue
Press [N]o or any other key to exit
```

Press **[Shift][Y]** to clear all train data out of memory. If any other key is pressed or five minutes elapses without a key being pressed, the system returns to the Main menu without erasing any train data.

10.7 Rebroadcast Summary for Channel A

On the Main menu, option7 is the Rebroadcast Summary for Channel A option. To select this option, press **[7]**. Doing so produces a report of the last 25 rebroadcast events stored for channel A. Below is a sample of that report. The contents of your report will be different.

```
For the following report, pressing 'H' will pause printing
Any other key will resume printing.

Rebroadcast Summary for North Track
Event       Time        Date                  Action
-------------------------------------------------------------
  27      16:21:45    10/05/05                 Yes
          16:19:38    10/05/05  (Last Train)
                          •
                          •
                          •
   3      16:17:19    10/05/05                 No
          16:14:31    10/05/05  (Last Train)

End of Data
```

The first line of each rebroadcast record lists the time and date of the rebroadcast request along with the action taken ("yes" for "a rebroadcast was made"; "no" for "no rebroadcast was made"). The second line of each record lists the time and date of the last train recorded on that channel. Each rebroadcast has an event number, which ranges from 1 to 255.

10.8 Rebroadcast Summary for Channel B

On the Main menu, option8 is the Rebroadcast Summary for Channel B option. To select this option, press **[8]**. Doing so produces a report of the last 25 rebroadcast events stored for channel B. Below is a sample of that report. The contents of your report will be different.

```
For the following report, pressing 'H' will pause printing
Any other key will resume printing.

Rebroadcast Summary for South Track
Event       Time        Date                  Action
-------------------------------------------------------------
  27      16:21:45    10/05/05                 Yes
          16:19:38    10/05/05  (Last Train)
                          •
                          •
                          •
   3      16:17:19    10/05/05                 No
          16:14:31    10/05/05  (Last Train)

End of Data
```

The first line of each rebroadcast record lists the time and date of the rebroadcast request along with the action taken ("yes" for "a rebroadcast was made"; "no" for "no rebroadcast was made"). The second line of each record lists the time and date of the last train recorded on that channel. Each rebroadcast has an event number, which ranges from 1 to 255.

10.9 Set Alarm Type

On the Main menu, option9 is the Set Alarm Type option. To select this option, press **[9]**. Doing so lets you select the type of defect the SmallTalk system will detect and announce.

```
Alarm Type = DED / Shifted load
Select New Setting or Press ESC to exit:
(1) - DED / Shifted load
(2) - Bridge Alignment
(3) - High Water
```

Pressing **[1]** causes the SmallTalk board to operate as a dragging-equipment and shifted-load detector. This setting allows both transducer and approach activation (depending on the System Activation setting). Dragging-equipment alarms and wide-load alarms will be announced.

Pressing **[2]** causes the SmallTalk board to operate as a bridge-failure detector. This setting uses approach activation for train presence (the transducer inputs aren't used) and announces only bridge-failure alarms. When Bridge Alignment is selected, the System Activation parameter is forced to "Approach" and the Shifted Load parameter is forced to "Not Used." These options can't be changed while the Set Alarm Type option is set to Bridge Alignment. Also, these parameters will have no effect while in bridge-alignment mode: Talk On Defect Only, Maximum Alarms, Announce Total Axles, Announce Axles Real-Time.

Pressing **[3]** causes the SmallTalk board to operate as a high-water detector. This setting uses approach activation for train presence (the transducer inputs aren't used) and announces only high-water alarms. When High Water is selected, the System Activation parameter is forced to "Approach" and the Shifted Load parameter is forced to "Not Used." These options can't be changed while the Set Alarm Type option is set to High Water. Also, these parameters will have no effect while in high-water mode: Talk On Defect Only, Maximum Alarms, Announce Total Axles, Announce Axles Real-Time.

To exit without making any changes, press **[Esc]**. After pressing **[1]**, **[2]**, **[3]**, or **[Esc]**, the Main menu reappears.

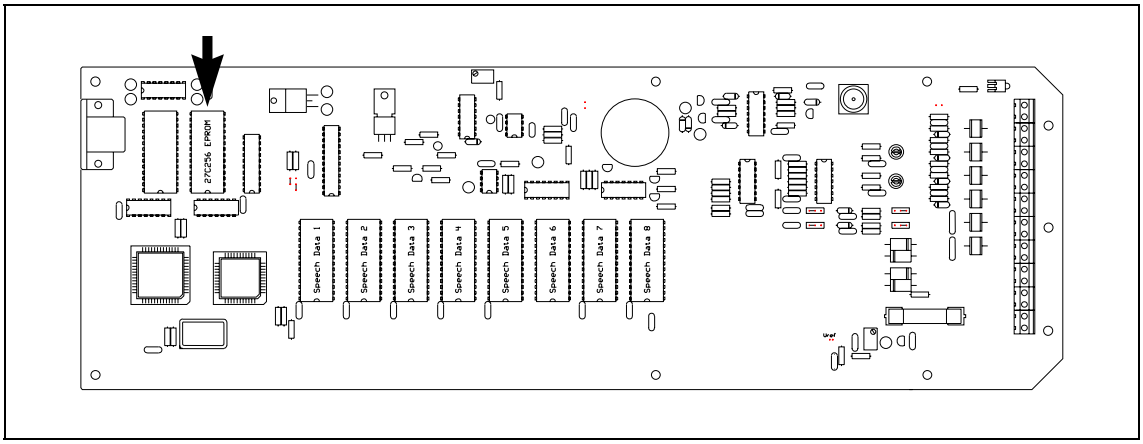
Chapter 11 — Replacing Chips

This chapter tells how to replace the firmware chip and the speech data chips.

11.1 Replacing the Firmware Chip

On the SmallTalk board, the firmware is in a 27C256 (or equivalent) EPROM.

The figure below shows the location of the firmware chip.



To replace the firmware chip:

1. Be sure you have on hand a chip removal tool (or small flathead screwdriver) and a #2 Phillips head screwdriver.
2. Remove power to the SmallTalk board.

   When the on-board green LED isn't lit, the board is powered down.
3. Using a #2 Phillips head screwdriver, remove the six screws that hold the cover to the base.
4. Store the screws and cover in a safe place until you replace them.
5. Using a chip removal tool or small flathead screwdriver, lift the EPROM from U4 by prying gently, one end at a time, until the leads are free of the socket.

6 To insert the new EPROM in U4:

   a Orient the notch on the chip to the notch on the socket.

   Putting the chip in backwards or bending one or more of the pins may damage the SmallTalk system.

   b Line up the pins with the socket contacts.

   c Press in the EPROM with a firm rocking motion.

7 Replace the cover.

8 Using a #2 Phillips head screwdriver, replace the six screws that hold the cover to the base.

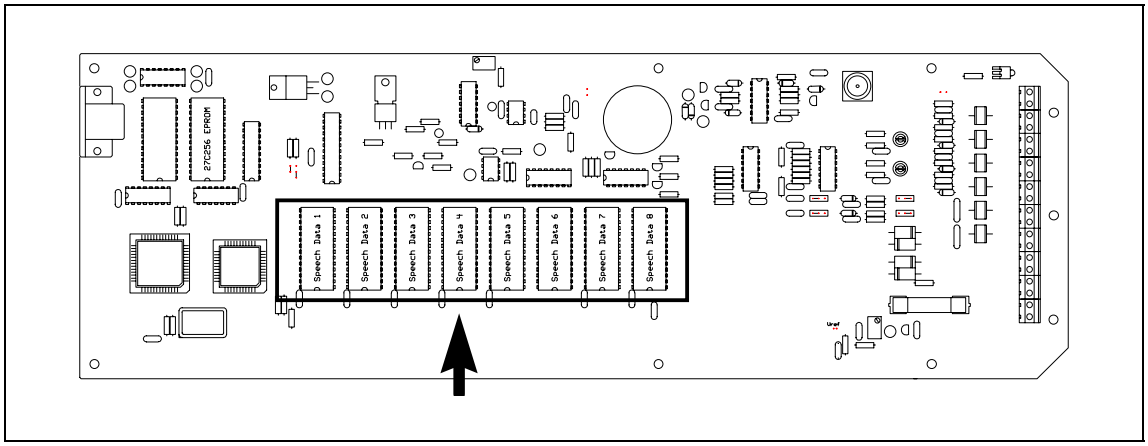
9 Return power to the SmallTalk board.

   When the on-board green LED is lit, the board is powered up.

11.2 Replacing the Speech Data Chips

On the SmallTalk board, the eight sockets, labeled U20 through U27, are for 27C512 (or equivalent) EPROMs. (Currently, BNSF only uses the first seven sockets.) These chips contain the digitized words and phrases required for voice announcements.

The figure below shows the location of the speech data chips.



To replace one or more of the speech data chips:

1 Be sure you have on hand a chip removal tool (or small flathead screwdriver) and a #2 Phillips head screwdriver.

2 Remove power to the SmallTalk board.

When the on-board green LED isn't lit, the board is powered down.

3 Using a #2 Phillips head screwdriver, remove the six screws that hold the cover to the base.

4 Store the screws and cover in a safe place until you replace them.

If you're replacing all the speech data chips, start with the chip in U20, replacing one chip at a time, until you replace the last chip. (On top of the chip that goes into U20 is the wording "SPEECH DATA 1," on top of the chip that goes into U21 is the wording "SPEECH DATA 2," and so on.)

5 Using a chip removal tool or small flathead screwdriver, lift the EPROM from its socket by prying gently, one end at a time, until the leads are free of the socket.

6 To insert the new EPROM in its socket:

a Orient the notch on the chip to the notch on the socket.

Putting the chip in backwards or bending one or more of the pins may damage the SmallTalk system.

b Line up the pins with the socket contacts.

c Press in the EPROM with a firm rocking motion.

7 Repeat steps **5** and **6** until all the speech data chips that are to be replaced are replaced.

8 Replace the cover.

9 Using a #2 Phillips head screwdriver, replace the six screws that hold the cover to the base.

10 Return power to the SmallTalk board.

When the on-board green LED is lit, the board is powered up.

Chapter 12 — Customer Service

At STC, the customer is number one. STC is committed to products that work and customers that are satisfied. Nothing less is acceptable. This chapter tells how to get answers for questions, fixes for problems, and parts for spares.

12.1 Reaching STC

You can reach STC by mail, telephone, fax, and email. By mail, you can reach STC at:

Southern Technologies Corporation
6145 Preservation Drive
Chattanooga, Tennessee 37416-3638
USA

Mail and shipments are replied to as soon as possible, normally within one working day. Equipment repair may take longer.

By telephone, you can reach STC at 423-892-3029, Monday through Friday, from 8:00 a.m. until 5:00 p.m. Eastern time. After business hours, a machine answers the calls. These calls are returned promptly the next business day. By fax, you can reach STC at 423-499-0045. The fax machine can receive faxes at all times. Faxes are replied to as soon as possible, normally within one working day. By email, you can reach STC at email@southern-tech.com. Email is replied to as soon as possible, normally within one working day.

12.2 Returning Equipment for Repair

Return any defective or malfunctioning equipment to STC for repair or replacement. You don't need a return authorization number. You don't even need to make a phone call first. Just ship it directly to the **Repair Department** at the address above.

With the returned equipment, include:

- Complete address where the equipment is to be returned.
- Name and phone number of person who should be contacted to answer questions about the equipment.
- Written explanation of the equipment defect or malfunction.
- Any reports or other data that would help in diagnosing the problem.
- If out of warranty, Purchase Order Number for the order or credit card number (to be charged) with its expiration date.

12.3 Reporting Problems or Suggestions

If you have any problems, suggestions, or questions related to STC equipment, phone the **Engineering Department** at the phone number above. When calling, state the equipment about which you are calling. Your call will then be directed to the right person.

12.4 Ordering Spare Parts

If you need any spare parts to support STC equipment, phone or fax the **Sales Department** at the phone numbers above.

When calling, state that you are calling to order parts. Your call will then be directed to the right person. When placing the order, reference the STC part numbers listed in this guide. However, if you don't have the part numbers, the sales staff can get them for you and provide you with current pricing and availability.

When faxing, include:

- Purchase Order Number for the order or credit card number (to be charged) with its expiration date.
- Complete address where the parts are to be shipped.
- Complete address where the invoice is to be mailed.
- Name and phone number of the person who should be contacted to answer questions about the order.
- Your fax number, if available.
- For each item ordered, part number, complete description, and quantity needed.

12.5 Checking on Shipments and Orders

If you need to check on the status of any shipment or order, phone or fax the **Sales Department** at the phone numbers above.

When calling, state that you are checking the status of a shipment or order. Your call will then be directed to the right person. Have your Purchase Order Number ready when you call. However, if you don't have the order number, the sales staff can get it for you and provide you with the status of the shipment or order.

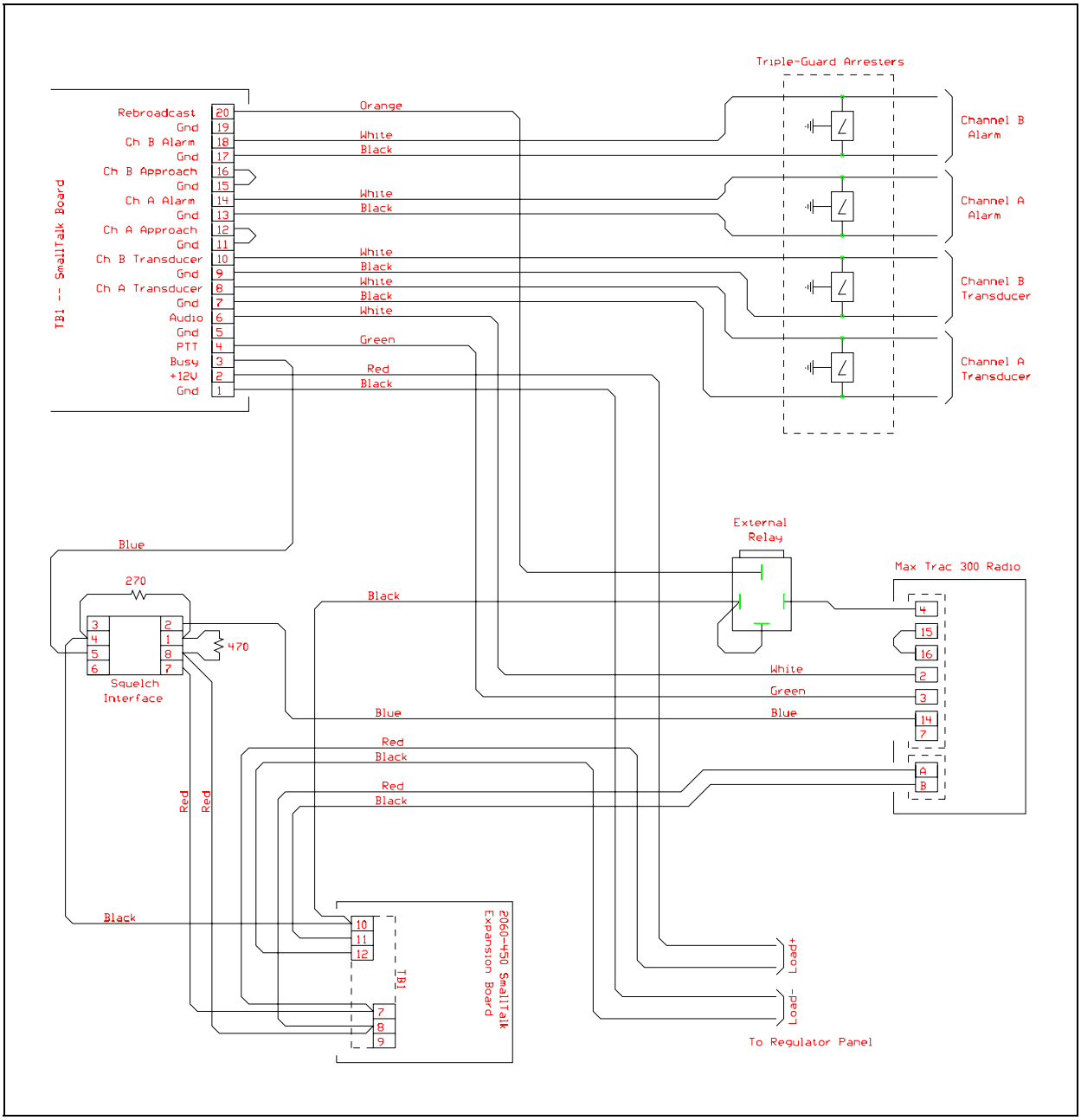
When faxing, include:

- Purchase Order Number for the shipment or order being checked.
- Name and phone number of the person who should be contacted after the order status is checked.
- Your fax number, if available.

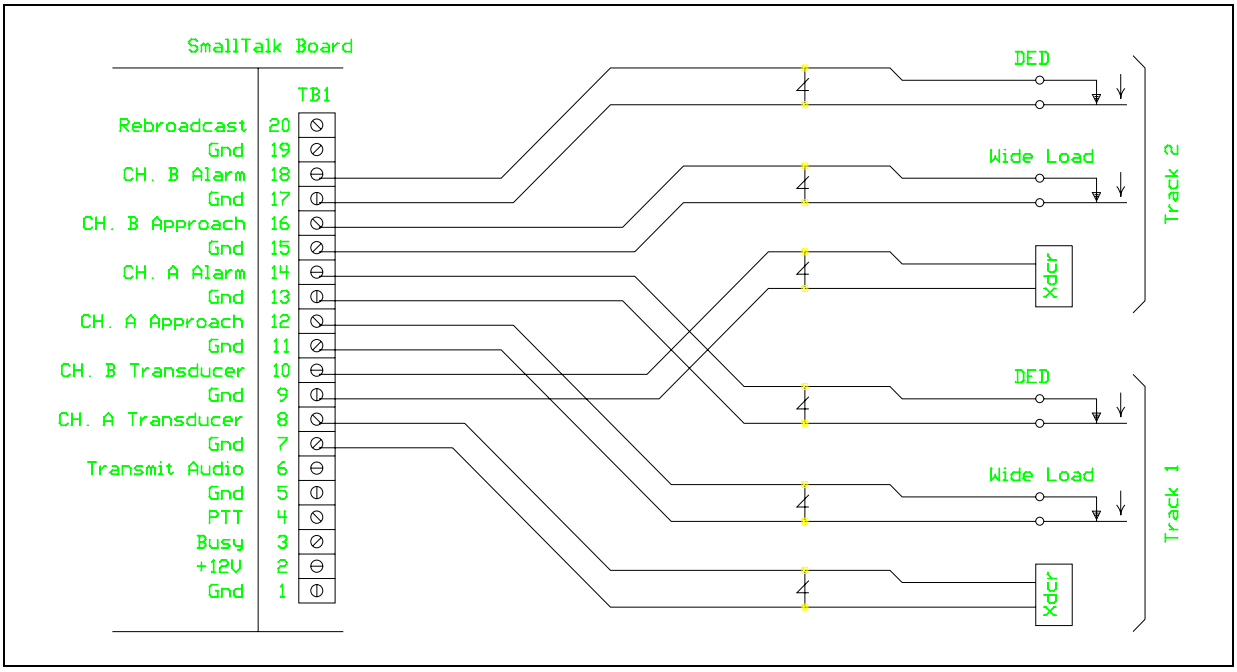
Appendix A — Wiring Diagrams

This appendix shows the wiring connections between the major components of the solar-powered SmallTalk system. Other wiring diagrams appear in ***Chapter 7 - Wiring***.

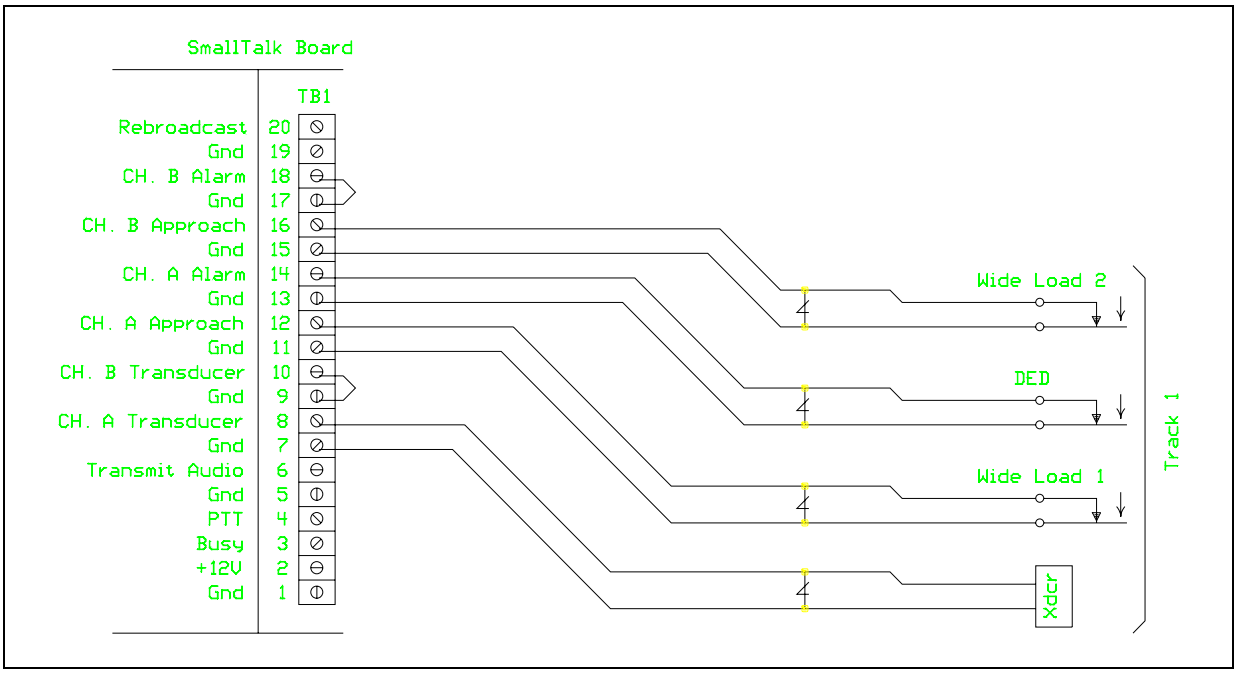
The drawing below shows wiring inside the enclosure.



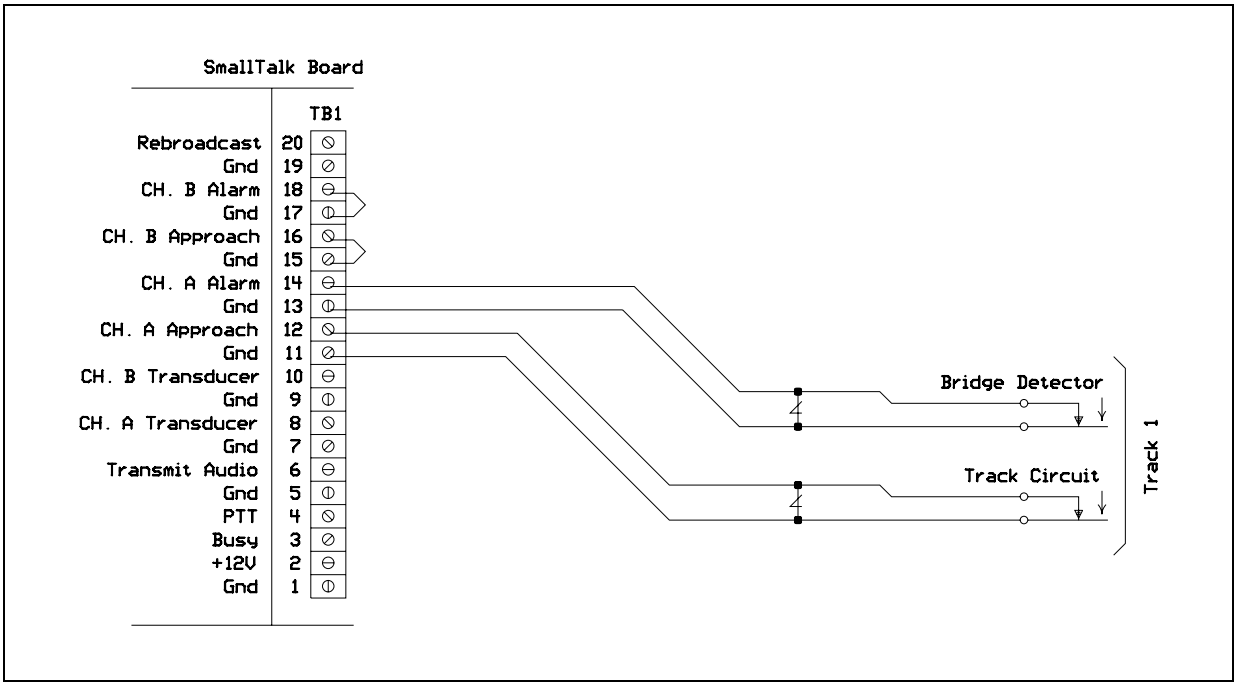
The drawing below shows the wiring for a double track with installed shifted-load detectors.



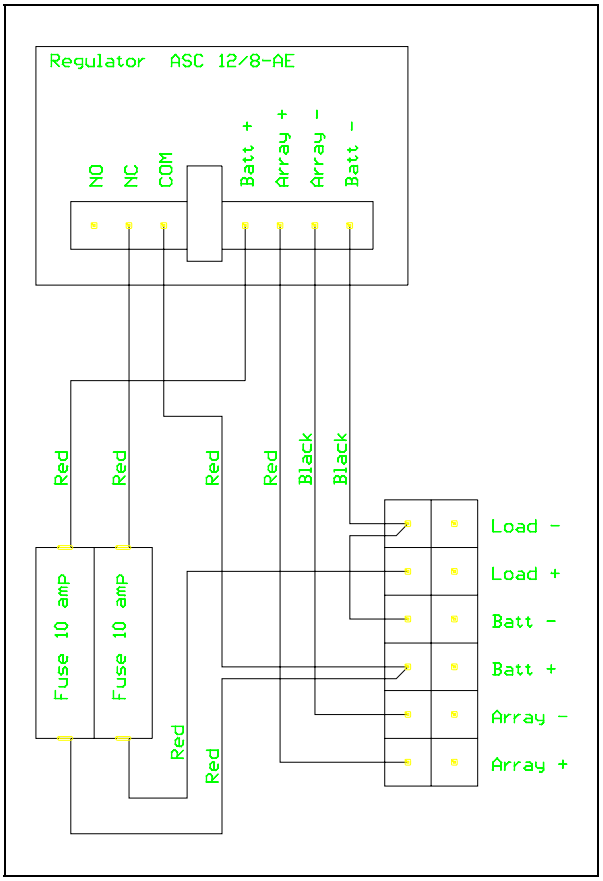
The drawing below shows the wiring for a single track with installed shifted-load detectors.



The drawing below shows the wiring for a single track with installed bridge-failure detectors.



The drawing below shows the wiring on the Regulator panel.



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