



INSTRUCTION & INSTALLATION

MICROPROCESSOR BASED MOTION SENSOR MODELS 2000 AND 2000S2

JULY 2007 (REVISED JULY 2014)

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VERSION B.1

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FCC RULES COMPLIANCE

The equipment covered in this manual has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his/her own expense.

DOCUMENT HISTORY

Version	Release Date	Details of Change
A	October 1997	Initial release
B	July 2006	<p>Added 80224 Processor Software Enhancement (CSB 1-01), Added A80170 Relay Adapter Module (CSB 1-05), Added Wiring Instructions for Six-Wire and Four-Wire External Track Circuit Equipment (CSB 3-06 B.01), deleted reference to Module Part Nos. 80212 & 80213, and added reference to Module Part No. 80115. Specifically:</p> <p><u>Global Changes throughout document:</u></p> <ul style="list-style-type: none"> • Replaced reference to AAR with AREMA • Where applicable, removed the word “crossing protection” and substituted “crossing warning signals” in its place <p>Paragraph 1.4</p> <ul style="list-style-type: none"> • Added new section titled “MS 2000 SYSTEMS THAT SHARE TRACK WIRES WITH EXTERNAL TRACK CIRCUIT EQUIPMENT.” Two pages of information (1-8 & 1-9) taken from CSB 3-06 B.01. Change to CSB: deleted “DAX, Prime Prediction offset, or” from the first paragraph; under 6-wire Connections the word “must” was deleted and the words “may” and “Receiver or” were added; under 4-wire Connections, the referenced figure was changed from “8-8” to “1-1”; under Note the word “case” was deleted and replaced by “chassis” and added Figure 1-2. <p>Paragraph 2.2</p> <ul style="list-style-type: none"> • Added Note that regarding Software Version 9V126-01F and Steps 27 – 31. • Added Steps 27 – 31. <p>Paragraph 2.3</p> <ul style="list-style-type: none"> • Added Steps 27 – 31 to Table 2-10 Extended Application Programming Procedures. • Added Note 1 to Table 2-10 Extended Application Programming Procedures. <p>Paragraph 3.4.4</p> <ul style="list-style-type: none"> • Changed Title of paragraph, changed prior Paragraph 3.4.4 to 3.4.4.1 Island Adjustment (80011) – Track 1 and Track 2, and Added paragraph 3.4.4.2 IPI Adjustment (80211) – Track 1 and Track 2. <p>Paragraph 4.2</p> <ul style="list-style-type: none"> • Added default values to sections 4.2.2 through 4.2.8. <p>Paragraph 4.5</p>

		<ul style="list-style-type: none"> • Removed reference to Module Part Nos. 80212 and 80213 from Table 4-1 and added Part No. 80115 to same table. <p>Paragraph 5.1.1</p> <ul style="list-style-type: none"> • Removed reference to Module Part Nos. 80212 and 80213 from Table 5-1 • Added Part No. 80115 to Table 5-1 <p>Paragraph 5.1.2</p> <ul style="list-style-type: none"> • Removed reference to Module Part No. 80212. <p>Paragraph 5.1.3</p> <ul style="list-style-type: none"> • Added and made changes to the Warning concerning the Relay Drive Module, 80013/80213. <p>Paragraph 5.1.4</p> <ul style="list-style-type: none"> • Added downloading software instructions. <p>Paragraph 5.1.5</p> <ul style="list-style-type: none"> • Added Part No. 80115 to paragraph title. <p>Paragraph 5.1.6</p> <ul style="list-style-type: none"> • Added identification of expanded memory modules to Control Interface Assembly, 80020. <p>Paragraph 5.1.7</p> <ul style="list-style-type: none"> • Added identification of expanded memory modules to Control Interface Assembly, 80029. <p>Paragraph 5.1.9</p> <ul style="list-style-type: none"> • Added Relay Adapter Module, A80170 information and installation paragraph, per Safetran Bulletin CSB 1-05, and photograph of the A80170. <p>Figure 5.3</p> <ul style="list-style-type: none"> • Added Module Part No. 80115 to Tables 5-2, 5-3, & 5-4. • Deleted Module Part Nos. 80212 and 80213 from Table 5-2. <p>Figure 5.10</p> <ul style="list-style-type: none"> • Added new default settings to Function Mode Menu Structure. <p>Paragraph 5.20.1</p>
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		<ul style="list-style-type: none"> • Added two WARNINGS regarding External Track Circuit Equipment and Island Modules. <p>Paragraph 5.20.9</p> <ul style="list-style-type: none"> • Added Note that delineates the applicability of paragraphs 5.20.9 through 2.50.13. • Added Low EZ Detection Menu. <p>Paragraph 5.20.10</p> <ul style="list-style-type: none"> • Added Low EZ Detection Timer Menu <p>Paragraph 5.20.11</p> <ul style="list-style-type: none"> • Added Positive Start EZ Level Menu <p>Paragraph 5.20.12</p> <ul style="list-style-type: none"> • Added Positive Start Timeout Menu <p>Paragraph 5.20.13</p> <ul style="list-style-type: none"> • Added Set AT Operation Out Menu <p>Paragraph 5.20.14</p> <ul style="list-style-type: none"> • Changed Paragraph 5.20.9 Set to Default to Paragraph 5.20.14. <p>Paragraph 5.21</p> <ul style="list-style-type: none"> • Added default values for Low EZ Detection, Low EZ Detection Timer, Positive Start, Positive Start Timeout, and Set AT Operation Out to Table 5-7. <p>Figure 5-12</p> <ul style="list-style-type: none"> • Changed 2000 MS Application History Card Front Side from old version dated 7-22-97 to current version dated 07-11-07. <p>Figure 5-13</p> <ul style="list-style-type: none"> • Changed 2000 MS Application History Card Back Side from old version dated 7-22-97 to current version dated 07-11-07. <p>Figure 5-14</p> <ul style="list-style-type: none"> • Removed reference to Module Part Nos. 80212 and 80213. <p>Paragraph 6.0</p> <ul style="list-style-type: none"> • Added reference to Module Part No. 80115. <p>Paragraph 6.1</p>
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		<ul style="list-style-type: none"> • Added missing tab stop to Step 3a. <p>Paragraph 6.7</p> <ul style="list-style-type: none"> • Added reference to Module Part No. 80115. <p>Paragraph 7.1</p> <ul style="list-style-type: none"> • Added two WARNINGS regarding External Track Circuit Equipment and Island Modules. <p>Paragraph 7.6</p> <ul style="list-style-type: none"> • Changed WARNING to more accurately describe tightening jumpers on shunt. <p>Paragraph 7.8</p> <ul style="list-style-type: none"> • Changed WARNING to more accurately describe tightening jumpers on shunt. <p>Paragraph 7.13</p> <ul style="list-style-type: none"> • Added WARNING to limit distance of cable used on Insulated Joint Bypass Coupler. <p>Paragraph 7.13.1</p> <ul style="list-style-type: none"> • Changed Tuning Procedures for the Insulated Joint Bypass Coupler. • Changed the WARNING to reflect gold nuts on unused terminals must be removed. <p>Paragraph 7.13.2</p> <ul style="list-style-type: none"> • Changed the WARNING to reflect gold nuts on unused terminals must be removed. <p>Paragraph 7.14</p> <ul style="list-style-type: none"> • Added WARNING regarding how tracks are taken out of service. <p>Paragraph 7.14.2</p> <ul style="list-style-type: none"> • Added two WARNING statements regarding retuning a Track to Service. <p>Paragraph 7.21</p> <ul style="list-style-type: none"> • Added two WARNINGS regarding External Track Circuit Equipment and Island Modules. <p>Paragraph 7.22</p>
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		<ul style="list-style-type: none"> Added NOTE that information in paragraph 7.22 applies only when there are two track cards located in the same physical box. <p>Figure 8-5 (Sheet 1 of 2)</p> <ul style="list-style-type: none"> Added WARNING regarding External Auxiliary Equipment in six-wire connections. <p>Figure 8-7</p> <ul style="list-style-type: none"> Added A80170 Relay Adapter Module to pins 11 and 12 of 2000MS terminal output board and warning per Safetran Bulletin CSB 1-05 and changed warning to reflect information from Paragraph 5.1.3. <p>Figure 8-8</p> <ul style="list-style-type: none"> Changed title to “Proper MS 2000 Four-wire and Six-wire Connections Using Auxiliary Track Circuit Equipment on MS 2000 Operating in the Bidirectional Simulation Mode”. <p>History Card, Front and Back</p> <p>Changed 2000 MS Application History Card from old version dated 7-22-97 to current version dated 07-11-07.</p>
B.1	July 2014	Rebrand for Siemens

NOTES, CAUTIONS, AND WARNINGS

Throughout this manual, notes, cautions, and warnings are frequently used to direct the reader's attention to specific information. Use of the three terms is defined as follows:

WARNING

WARNING

INDICATES A POTENTIALLY HAZARDOUS SITUATION WHICH, IF NOT AVOIDED, COULD RESULT IN DEATH OR SERIOUS INJURY. WARNINGS ALWAYS TAKE PRECEDENCE OVER NOTES, CAUTIONS, AND ALL OTHER INFORMATION.

CAUTION

CAUTION

REFERS TO PROPER PROCEDURES OR PRACTICES WHICH IF NOT STRICTLY OBSERVED, COULD RESULT IN A POTENTIALLY HAZARDOUS SITUATION AND/OR POSSIBLE DAMAGE TO EQUIPMENT. CAUTIONS TAKE PRECEDENCE OVER NOTES AND ALL OTHER INFORMATION, EXCEPT WARNINGS.

NOTE

NOTE

Generally used to highlight certain information relating to the topic under discussion.

If there are any questions, contact Siemens Industry Inc., Rail Automation Application Engineering.

ELECTROSTATIC DISCHARGE (ESD) PRECAUTIONS

Static electricity can damage electronic circuitry, particularly low voltage components such as the integrated circuits commonly used throughout the electronics industry. Therefore, procedures have been adopted industry-wide which make it possible to avoid the sometimes invisible damage caused by electrostatic discharge (ESD) during the handling, shipping, and storage of electronic modules and components. Siemens Industry, Inc., Rail Automation has instituted these practices at its manufacturing facility and encourages its customers to adopt them as well to lessen the likelihood of equipment damage in the field due to ESD. Some of the basic protective practices include the following:

- Ground yourself before touching card cages, assemblies, modules, or components.
- Remove power from card cages and assemblies before removing or installing modules.
- Remove circuit boards (modules) from card cages by the ejector lever only. If an ejector lever is not provided, grasp the edge of the circuit board but avoid touching circuit traces or components.
- Handle circuit boards by the edges only.
- Never physically touch circuit board or connector contact fingers or allow these fingers to come in contact with an insulator (e.g., plastic, rubber, etc.).
- When not in use, place circuit boards in approved static-shielding bags, contact fingers first. Remove circuit boards from static-shielding bags by grasping the ejector lever or the edge of the board only. Each bag should include a caution label on the outside indicating static-sensitive contents.
- Cover workbench surfaces used for repair of electronic equipment with static dissipative workbench matting.
- Use integrated circuit extractor/insertion tools designed to remove and install electrostatic-sensitive integrated circuit devices such as PROM's (OK Industries, Inc., Model EX-2 Extractor and Model MOS-40 Insertion (or equivalent) are highly recommended).
- Utilize only anti-static cushioning material in equipment shipping and storage containers.

For information concerning ESD material applications, please contact the Technical Support Staff at 1-800-793-7233. ESD Awareness Classes and additional ESD product information are also available through the Technical Support Staff.

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GLOSSARY

DAX:	<u>Downstream Adjacent Crossing</u> - A prediction indication for a remote GCP located somewhere other than the equipment feed point.
ED:	<u>Enhanced Detection</u> – A system to improve train shunting detection under very poor track ballast (EX) conditions.
EX:	Track Ballast Conditions – The relative indicator of track ballast conditions where: 100 = ideal ballast conditions 85 = nominal ballast conditions 50 = poor ballast conditions
EZ:	<u>Main receiver level</u> – The relative indicator of track circuit operational efficiency, where the maximum value for an unoccupied track is 100.
GCP:	<u>Grade Crossing Predictor</u> – A railroad crossing monitor system that activates crossing protection devices when an approaching train is detected.
Island Circuit:	A short track circuit (up to 350 feet) that extends for limited distances on both sides of a highway crossing.
IPI:	<u>Intelligent Processor Island</u> – A microprocessor based, multi-frequency, modulated short-range track occupancy detector module.
LAN:	<u>Local Area Network</u> - A limited network where the data transfer medium is generally wires or cable.
MS:	<u>Motion Sensor</u> – A railroad crossing monitor system that activates crossing protection equipment when the movement of an approaching train is detected.
RS232:	EIA interface standard between DTE and DCE, employing serial binary data interchange.
SEA/R:	<u>Safetran Event Analyzer Recorder</u> – A non-vital stand-alone system designed to provided continuous real-time general purpose status monitoring and event recording for a wide range of functions associated with railroad wayside and grade crossing installations.
Track Ballast:	The relative DC-resistance of a track circuit.
UAX:	<u>Upstream Adjacent Crossing</u>

SECTION I

INTRODUCTION

1.0 GENERAL INFORMATION

This manual provides installation information and detailed operating instructions for Models 2000 and 2000S2 Microprocessor-based Motion Sensors (2000 MS). The information is essential to proper system operation and problem diagnosis. It is strongly recommended that each system operator/maintainer become familiar with the information provided herein before attempting to program, calibrate, or troubleshoot the 2000 MS system. This manual is divided as follows:

- SECTION I **INTRODUCTION** - Contains a brief overview of system operation plus equipment specifications.
- SECTION II **SYSTEM APPLICATION PROGRAMMING** - Provides step-by-step system programming instructions.
- SECTION III **SYSTEM CALIBRATION** - Provides step-by-step instructions for system calibration (required following programming) and operational checks to be performed immediately prior to placing the system into operation.
- SECTION IV **DIAGNOSTICS** - Includes procedures for utilizing the self-diagnostic capabilities of the 2000 MS. Diagnostic message code listings are also provided.
- SECTION V **PRIMARY EQUIPMENT FAMILIARIZATION; KEYBOARD AND MENU DESCRIPTIONS** - Provides a brief description of the two 2000 MS cases and plug-in modules, including indicators and controls, plus a simplified system block diagram. Also describes the functions, displays, and menus associated with each key on the keyboard/-display assembly.
- SECTION VI **DATA RECORDER** - Describes system operations associated with optional Data Recorder Module, 80015 or 80255.
- SECTION VII **AUXILIARY EQUIPMENT FAMILIARIZATION** - Provides a brief description of the auxiliary equipment available for use in conjunction with the 2000 MS system. Also provided are installation and adjustment procedures for this equipment and typical application drawings.
- SECTION VIII **TYPICAL APPLICATION DRAWINGS** – A variety of general 2000 MS applications are illustrated.

1.1 DESCRIPTION

The Model 2000 Motion Sensor is available in two configurations: a non-redundant system (Model 2000) and a redundant system (Model 2000S2). The **non-redundant system** is designed for two-track installations and provides independent programming of transmit frequencies for track 1 (T1) and track 2 (T2). The **redundant system** is designed for use in single-track installations and consists of two identical module sets plus a transfer module with one module set serving as the primary system and the other as the backup. In the event of a system failure, control automatically switches to the backup system. The 2000 MS operates from battery power to ensure continued operation in the event of AC power failure.

With the exception of the processor module, the 2000 MS is equipped with the same standard modules used in Safetran's Model 3000 Family of Grade Crossing Predictors. The processor module used in the 2000 MS is equipped with special poor shunting detection software (called 'enhanced detection') to ensure proper operation in the event of a reduction in train traffic, or when the rails have become coated with foreign substances. In cases where train traffic is minimal in dark territory and excessive rust build-up on the rails does not allow shunting to occur, an additional 6 to 8 VDC on the track (with insulated joints at each approach end) is applied at the crossing to enhance the shunting and allow the 2000 enhanced detection to function properly.

Spotty poor shunting can occur virtually anywhere from numerous causes but generally occurs due to light track usage, light cars, and/or during transit operation. A lack of any shunting generally occurs in dark territory where no DC or AC track circuits exist and where few trains per week are run.

The Safetran Shunting Enhancer Panel, 80049, provides a very simple and cost effective solution for improving shunting in dark territory by providing a nominal 6 VDC that is isolated from the battery and is applied to the track at the crossing to break down the film on the rails. Only two insulated joints are required to confine the 6 volts on the track: one at each end of the motion sensor approach. The application of DC voltage with overlapping approaches from two or more crossings is also very easy to implement without any additional insulated joints. Narrow band termination shunts are required whenever the 6 VDC is applied. The 6 VDC is generated from the 110 VAC transformer when AC is present and automatically switches to a 12 volt DC to DC converter when AC is off. The presence of this 6 volts is checked by the 2000 UAX input. The 80049 can be rack, wall or shelf mounted.

The 2000 MS features simplified programming and system calibration that requires only a single automated setup procedure. The 2000 MS is also programmable to operate from a remote location. Both the Enable and UAX input terminals are available for more complex applications. In addition, remote six track wire operation is also available via front panel AREMA terminals.

Table 1-1. 2000 MS Basic Model Options

MS Model	Part Number	One-Track Operation	Two-Track Operation	Internal Automatic Transfer
2000	80080	Yes	Yes*	No
2000S2	80090	Yes	No	Yes

*Programmable for independent frequencies

1.2 OPERATIONAL OVERVIEW

The 2000 MS is a microprocessor-controlled system that is designed to reliably detect the motion of an approaching train and to activate the crossing warning equipment when the speed of the train exceeds the minimum motion sensitivity of the 2000 MS.

Operation of the 2000 MS is based on the maximum impedance of an unoccupied track circuit. This is determined by the location of the termination shunts and the rate of change in the impedance resulting from the physical location of a train as it moves within the track circuit. The 2000 MS applies a constant current AC signal to the track and measures the level of the resulting voltage. The level varies with approach track impedance, which also varies with the distance of the train from the crossing. The rate of change is sensed by the 2000 MS, which then activates the crossing warning equipment provided the speed of the approaching train exceeds the minimum motion sensitivity.

A shunt is connected across the rails to terminate the 2000 MS approach circuit. This device presents a low impedance at the 2000 MS operating frequency and may consist of a wire connected between the rails (hardwire shunt) when no other signals (AC or DC) are present on the rails, or when non-coded DC track circuits only are present, a wideband shunt may be used. A narrow-band shunt is used when other AC signals are present. Insulated joints in DC coded track can be coupled using Tunable Insulated Joint Bypass Couplers, 62785-f.

The 2000 MS will respond to the approaching motion of a train and cause the crossing warning equipment to operate within 4 seconds. When the train has cleared the crossing, the 2000 MS no longer senses approaching motion and the crossing warning signal system recovers.

When a train stops before reaching the crossing, or reverses direction and backs away from the crossing, the 2000 MS system will recover after a short (programmable) time-out as approaching motion is no longer detected. When the train resumes forward motion toward the crossing, the 2000 MS system is activated and remains in operation until the train has cleared the crossing.

The required track length becomes an integral part of the 2000 MS system and is a function of maximum train speed, warning time desired, plus an additional 4-second system response time. The 4-second interval enables the crossing warning signal equipment to activate and ensures adequate warning time when a maximum speed train enters the 2000 MS approach. At this point,

the track circuit is terminated by a shunt across the rails. The track distance from the feed point to the shunt is the approach distance. Under normal conditions, the impedance of this section of track is a constant value. However, a train entering the approach shunts the track and reduces the impedance and, therefore, the effective length of the track circuit. This, in turn, causes a voltage reduction in the track signal.

The 2000 MS receiver circuits are also transformer-coupled to the track through wires connected to the rails, usually on the opposite side of the crossing from the transmitter feed points. The length of track between the two sets of feed points defines the island circuit. The receiver senses the voltage level across the track impedance and the level changes as the effective impedance of the track changes with the position of the train in the approach.

When a train is moving toward the crossing the receiver circuits detect the decreasing voltage. This is then processed as a rate of change of the track voltage, which is also a measure of train speed. When a train approaches near the crossing at 1 mile-per-hour or faster, the processor module detects the train movement and activates the crossing warning signal equipment. Self-check modulation occurs every 3 seconds and verifies proper operation of the motion-processing circuits.

The crossing warning signal equipment recovers when the receiver circuits sense any of the following conditions:

- (1) A decreasing change of less than 1 mile-per-hour
- (2) A zero rate of change indicating an unoccupied track or a train stopped within the approach but not yet within the island circuit
- (3) An increasing rate of change caused by a train moving away from the crossing

Operating parameters are programmable via a detachable keyboard and liquid crystal display. Self-check circuits in the 2000 MS test the unit at specific intervals, ensuring safe operation. Module status LED indicators plus diagnostic messages, which are displayed on the liquid crystal display, combine to permit rapid troubleshooting.

An island circuit is a short (up to 350 feet) track circuit that enables the 2000 MS to provide warning signals for limited distances on both sides of a highway crossing. The 2000 MS island circuit is established and controlled by a high-frequency island module that contains separate transmitter and receiver circuits. The length of the island circuit is established by the location of the track connections on either side of the crossing. A train located at any point within the island circuit will activate the 2000 MS. The island frequency may be selected from a number of available frequencies ranging from 2.14 kHz to 20.2 kHz.

1.3 SYSTEM SPECIFICATIONS

Input Power

Voltage	9.0-16.5 VDC; 12 VDC nominal
Current	Single-track system - 1.50 amps Two-track system - 2.3 amps Optional modules up to 0.65 amp each Maximum current – 2.95 amps
Transmitter Output Current	250 mA nominal on medium power; up to 500 mA on high power; varies with frequency
Program Selection	Keystroke entry via keyboard/display - Program is displayed by LCD readout
Frequencies Available	Frequencies can be programmed between 45 and 999 Hz in 1 Hz increments. Independent frequencies can be programmed for track 1 and track 2 (Model 2000 only).
Frequency Stability	±0.01 percent
Island Frequencies Available	4.0, 4.9, 5.9, 7.1, 8.3, 10.0, 11.5, 13.2, 15.2, 17.5, or 20.2 kHz (fixed - determined by individual Island Modules, 80011/-80211). In addition to the 11 frequencies listed above, the 80211 island module also provides 2.14, 2.53, and 3.24 kHz.
Island Circuit Length	Determined by island track wire connections - 120 feet (36 meters) minimum to 350 feet (106 meters) maximum
Relay Drive Outputs	400 to 1,000-ohm load
Surge Protection	Built-in surge protection for track and battery connections. Requires only primary arresters and equalizers.
Diagnostics and Monitoring	Accomplished via two-line, 16-character, alphanumeric, liquid crystal display. Diagnostic information, application programming and train move data plus internal voltages are displayed.
Mounting	The 2000 MS can be wall, rack, or shelf mounted. All track, power, and slaving connections use standard AREMA terminals.

SYSTEM SPECIFICATIONS (continued)

Dimensions	Models 2000 and 2000S2: 23 inches (58.4 cm) wide 11.34 inches (28.8 cm) deep 14.36 inches (36.5 cm) high
Weight	Model 2000 (all modules in place) 22 pounds (9.9 kg) (approximate) Model 2000S2 (all modules in place) 30 pounds (13.6 kg) (approximate)
Temperature Range	-40 °F to +160 °F (-40 °C to 71 °C)
Operating Distance	Tables 1-2 and 1-3 indicate minimum and maximum bidirectional and unidirectional approach lengths, respectively, for each standard Safetran 2000 MS operating frequency with ballast resistances of 2, 4, and 6 ohms per 1,000 feet. Maximum operating distances for any given frequency are governed by ballast resistance conditions, increasing with higher ballast and decreasing with lower ballast. Minimum approach distances are determined by available system gain. The minimum approach distance figures indicate the shortest approach distance over which a given frequency will operate.

Table 1-2. Ballast Resistance vs. Approach Length by Frequency, Bidirectional Applications

2000 MS Operating Frequency (Hz)	Bidirectional Approach Length (Feet)					
	2 Ohms/1,000 Feet Distributed Ballast		4 Ohms/1,000 Feet Distributed Ballast		6 Ohms/1,000 Feet Distributed Ballast	
	Minimum*	Maximum	Minimum*	Maximum	Minimum*	Maximum
86	1,000	5,100	1,000	7,600	1,000	9,280
114	750	4,300	750	6,100	750	7,448
156	600	3,750	600	5,200	600	6,349
211	475	3,200	475	4,500	475	5,494
285	400	2,800	400	3,900	400	4,762
348	400	2,500	400	3,400	400	4,151
430	400	2,200	400	3,100	400	3,785
525	400	2,050	400	2,900	400	3,541
645	400	1,850	400	2,600	400	3,175
790	400	1,650	400	2,300	400	2,808
970	400	1,475	400	2,025	400	2,472

*Based on use of hardwire or wideband shunts

Table 1-3. Ballast Resistance vs. Approach Length by Frequency, Unidirectional Applications

2000 MS Operating Frequency (Hz)	Unidirectional Approach Length (Feet)					
	2 Ohms/1,000 Feet Distributed Ballast		4 Ohms/1,000 Feet Distributed Ballast		6 Ohms/1,000 Feet Distributed Ballast	
	Minimum*	Maximum	Minimum*	Maximum	Minimum*	Maximum
86	700	4,200	700	5,900	700	7,080
114	525	3,700	525	5,300	525	6,360
156	420	3,200	420	4,600	420	5,520
211	400	2,650	400	3,900	400	4,680
285	400	2,150	400	3,300	400	3,960
348	400	1,850	400	2,850	400	3,420
430	400	1,650	400	2,500	400	3,000
525	400	1,450	400	2,150	400	2,580
645	400	1,250	400	1,850	400	2,220
790	400	1,075	400	1,550	400	1,860
970	400	1,000	400	1,425	400	1,710

*Based on use of hardwire or wideband shunts

1.4 2000 MS SYSTEMS THAT SHARE TRACK WIRES WITH EXTERNAL TRACK CIRCUIT EQUIPMENT.

When any external track circuit equipment or auxiliary track circuit equipment shares track wires with a MS track circuit that does not have an active internal island for that track circuit or output, such as a Remote MS 2000, then the track circuit equipment must be connected in one of two ways:

- The external track circuit equipment or auxiliary track circuit equipment may be connected across the receiver wires directly,
or
- When connected to the Transmitter/Check Receiver wires, the external track circuit equipment or auxiliary track circuit equipment must be connected as identified in the following:

6 WIRE CONNECTIONS

The external equipment must be connected to the Receiver or to the Check Receiver wires only (see Figure 1-2).



WARNING

FOR 6 WIRE CONNECTIONS, DO NOT CONNECT ANY EXTERNAL TRACK CIRCUIT EQUIPMENT ACROSS THE TRANSMITTER WIRES.

4 WIRE CONNECTIONS

The Check Channel Receiver wires may connect either to the Transmitter wires at the same point or prior to connecting to the other track circuit equipment (see Figures 1-1 & 1-2).

NOTE

NOTE

MS 2000 four wire systems have the Check Receiver tied to the Transmitter in the GCP chassis.

The Check Channel Receiver wires may connect to the external track circuit equipment prior to connecting to the transmitter track wires (see Figures 1-1 & 1-2)



WARNING

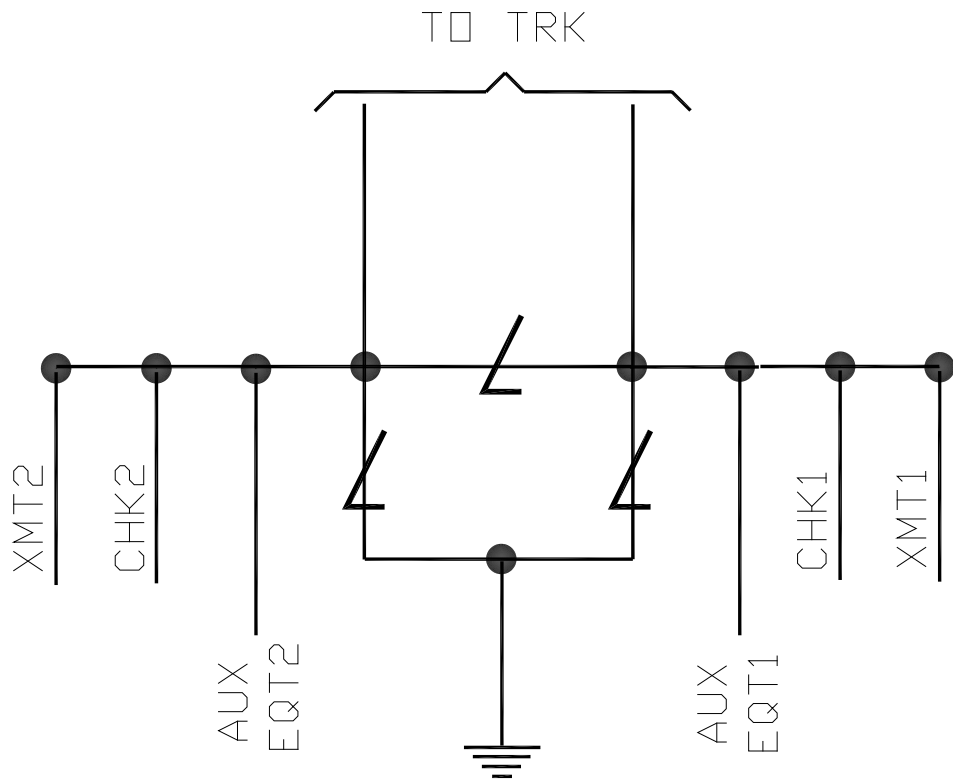
DO NOT CONNECT ANY EXTERNAL TRACK CIRCUIT EQUIPMENT ACROSS THE TRANSMITTER PRIOR TO CONNECTING IT TO THE CHECK CHANNEL RECEIVER WIRES.

External track circuit equipment includes, but is not limited to, 80049 DC Exciter Panels, Electronic Coded Track, AFO Track circuits, Track batteries or relays, surge suppressors (not including air gap arresters) or Bidirectional Simulation Couplers.



WARNING

CONNECTIONS MUST BE ARRANGED SO THAT AN OPEN WIRE OR OPEN CONNECTION WILL NOT RESULT IN THE TRANSMITTER WIRES BEING CONNECTED TO THE AUXILIARY TRACK CIRCUIT EQUIPMENT UNLESS THE CHECK RECEIVER IS ALSO CONNECTED (REFER TO FIGURES 1-1 & 1-2).



2KF1-1
07-30-07

Figure 1-1. Proper Connection of Track Wires

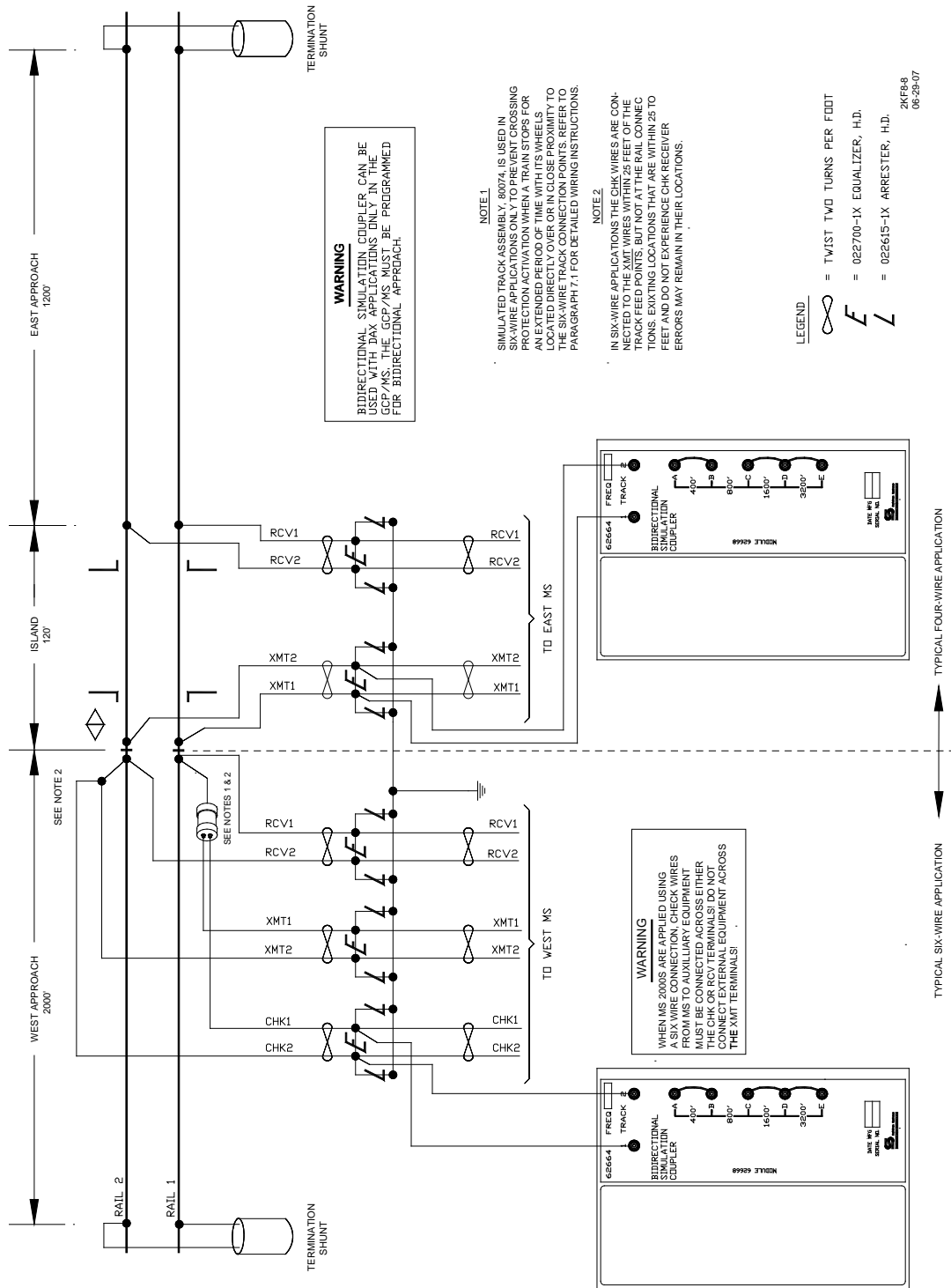


Figure 1-2. Proper MS 2000 Four-wire and Six-wire Connections Using Auxiliary Track Circuit Equipment on MS 2000 Operating in the Bidirectional Simulation Mode

SECTION II SYSTEM APPLICATION PROGRAMMING

2.0 GENERAL

This section provides step-by-step application programming instructions for the 2000 MS System. Included at the end of this section (paragraph 2.3) are condensed programming procedures that are provided as a reference for system users who are familiar with the general programming procedure but require occasional prompting during programming. The procedures contained herein apply to initial programming as well as reprogramming of the 2000 MS. Follow the steps in the order listed and perform all that are necessary for the specific application. See Section IV for descriptions of the programming menu items.

When power is initially applied to the system, the following displays appear in sequence:

MODEL 2000
MOTION SENSOR

NOTE

NOTE

The software version indicated below as XXX represents the revision level.

SOFTWARE VERSION
9V126-XXX

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SYSTEM TEST
.....

When the system status message indicated below is displayed, the system is ready for programming (EZ and EX values shown are example values only; actual values may vary). *ED* will appear only when the unit has switched to the enhanced shunting detection operating mode due to poor shunting conditions. When the train has left the MS approaches the *ED* will disappear.

STATUS T1	*ED*
EZ: 100	EX: 87

The 2000 MS provides two application programming modes: Program and Function. The Program Mode is the primary programming mode for system application parameters. An extended programming mode (Function Mode) is provided for programming additional parameters. Each of

these modes is menu driven to simplify operator interface when programming the system according to specific application requirements.

NOTE**NOTE**

Application information to be programmed into the Program and Function menus should first be entered on the 2000 MS Application History Card, which can then be used as a reference during programming. The order in which the information is listed on the card corresponds to the order in which the information is requested in the Program and Function menus.

The Program and Function menus are selected by pressing the corresponding key on the 2000 MS keyboard/display assembly. When a menu is selected, each item in that menu can be viewed by using the down arrow key (↓) to scroll through the menu. The menu is continuous in that it starts over at the beginning when the end of the menu is reached. During programming, enter the information requested and then press the down arrow key (↓) to proceed to the next menu item. The up arrow key (↑) can be used to scroll through the menu in reverse order.

If, while programming, a keyboard entry is not made within 90 seconds of the last keyboard entry, the system automatically reverts to the Status Mode (paragraph 5.1) and the initial Status Mode display appears. If this occurs, reselect the programming mode by pressing the appropriate key (PROGRAM or FUNCTION), scroll to the menu item where programming was interrupted, and proceed as before.

NOTE**NOTE**

While reprogramming an operational system and the message Enter Password appears on the display, enter the proper four-digit password and press the ENTER key to continue.

Each menu contains a number of system application parameters that require specific inputs for each track controlled by the system. This specific input requirement is identified by T1 (for track 1) or T2 (for track 2) appearing in the application parameter display. Systems programmed for a single track will accept data inputs for track 1 only (T1 displayed). For two-track systems, enter the track 1 data when T1 appears on the display, press the TRACK 2 key to select the T2 display (T1 in the display changes to T2), and enter the track 2 data. Press the TRACK 1 key to return to the track 1 display (T1 replaces T2 in the display).

NOTE

NOTE
 Pressing the TRACK 2 key when the system is programmed for one track causes the following message to appear on the display for 2 seconds.

ONLY ONE TRACK
 IS SELECTED

While making numerical data entries during programming and incorrect digits are entered but the ENTER key has not yet been pressed, press the CLEAR key to return to the original value displayed. The correct digits may then be entered.

2.1 MAKING PROGRAM CHANGES

Program changes can be made on in-service 2000 Motion Sensors **when no train is present in the approach**. To make a program change, perform the following:

- Select the proper programming menu (see 2.2 SYSTEM PROGRAMMING)
- Scroll to the menu item to be changed
- Enter the new parameter value
- Record the new value in the proper location on the 2000 MS Application History Card

NOTE

NOTE
 If any of the program changes listed in Table 2-1 are made, system recalibration is required (go to Section III in this manual).

Table 2-1. Programming Changes Requiring System Recalibration

Program Change	Setup For Calibration
Increased Number of Tracks from 1 to 2	Required for Track 2 Only
MS Frequency	Required For Changed Track Only
Unidirectional to Bidirectional or Bidirectional to Unidirectional	Required For Changed Track Only
Transmit Level Changed from Medium to Maximum or Maximum to Medium	Required For Changed Track Only
Ballast Compensation Value	Required For Changed Track Only

2.2 SYSTEM PROGRAMMING

If any of conditions (a) through (c) listed below apply, the relay drive may be inhibited and the following message will flash on the display every 10 seconds:

SET TO DEFAULT REQUIRED

- (a) It is an initial installation.
- (b) The Processor Module (80224) has been replaced with another containing a different software revision level.
- (c) The Keyboard/display Interface Assembly (80020 or 80029) has been replaced (includes attached keyboard display interface module (80017 or 80153)).

The system's application parameters must be initialized to default values before performing application programming. To initialize the application parameters, proceed with programming Step 1. However, if none of the conditions listed below apply, skip Step 1 and start at Step 2 to begin application programming.

2.2.1 Set To Default

Step 1 Press the FUNCTION key. The following message is displayed:

T1 REMOTE UNIT OPERATION: OFF

Step 1a Press the up arrow key (↑) once. The following message is displayed:

SET TO DEFAULT

Step 1b Press the NEW DATA key. The following message is displayed:

SET TO DEFAULT PRESS ENTER

Step 1c Press the ENTER key. The system must now be completely programmed starting with Step 2. The following message may appear intermittently, indicating the system requires calibration (refer to section VI):

SETUP T1 AND T2 REQUIRED

The following message is displayed when installation of default parameters is complete.

NOTE**NOTE**

The word COMPLETE will momentarily appear in the following display after 2 seconds.

```
SET TO DEFAULT
COMPLETE
```

2.2.2 Application Programming

NOTE**NOTE**

The value/parameter messages displayed in the following steps indicate the system default settings. If the current data displayed is correct, do not press the NEW DATA key but simply press the down arrow key (↓) step.

Step 2 Press the PROGRAM key. The following message is displayed:

```
PROGRAM NUMBER
OF TRACKS      2
```

Step 2a Press the NEW DATA key.

Step 2b Enter the number of tracks (1 or 2) which are monitored by the system.

Step 2c Press the ENTER key.

Step 3 Press the down arrow key (↓) once. The following message is displayed:

```
PROGRAM T1
FREQUENCY:    790
```

Step 3a Press the NEW DATA key.

Step 3b Enter the frequency of the transceiver module(s) (45 to 999 Hz).

Step 3c Press the ENTER key.

Step 4 Press the down arrow key (↓) once. The following message is displayed:

PROGRAM T1 UNIDIRECTIONAL

Step 4a Press the NEW DATA key. The system application for the track indicated toggles between unidirectional and bidirectional each time the NEW DATA key is pressed.

Step 4b Press the ENTER key when the desired application is displayed.

Step 4c If two tracks were selected in step 2b, press the TRACK 2 key and repeat steps 4a and 4b for track 2. Press the TRACK 1 key.

Step 5 Press the down arrow key (↓) once. The following message is displayed:

PROGRAM T1	XMIT
LEVEL:	MEDIUM

Step 5a Press the NEW DATA key. The transceiver transmit level for the track indicated toggles between Medium and Maximum each time the NEW DATA key is pressed.

Step 5b Press the ENTER key when the desired transmit level is displayed.

Step 5c If two tracks were selected in step 2b, press the TRACK 2 key and repeat steps 5a and 5b for track 2. Press the TRACK 1 key.

Step 6 Press the down arrow key (↓) once. The following message is displayed:

PROGRAM T1	
APPROACH:	3000

Step 6a Press the NEW DATA key.

Step 6b Enter the approach distance for the track indicated (0000 to 9999) (value is in feet).

Step 6c Press the ENTER key.

Step 6d If two tracks were selected in step 2b, press the TRACK 2 key and repeat steps 6a, 6b, and 6c for track 2. Press the TRACK 1 key.

Step 7 Press the down arrow key (↓) once. The following message is displayed:

PROGRAM	UAX1
PICKUP DELAY:	25

Step 7a Press the NEW DATA key.

Step 7b Enter the pickup delay time (0 (off) to 500 seconds) for UAX 1.

WARNING

WARNING
WHEN THE UAX FEATURE IS OFF (0 IS ENTERED), THE FRONT PANEL UAX TERMINALS HAVE NO CONTROL OVER MS RELAY DRIVE.

Step 7c Press the ENTER key.

Step 8 Press the down arrow key (↓) once. The following message is displayed:

PROGRAM	ENA/UAX2
PICKUP DELAY:	25

Step 8a Press the NEW DATA key.

Step 8b Enter the pickup delay time (0 (ENA) to 500 seconds) for UAX 2.

NOTE

NOTE
When the UAX2 feature is ENA (0 is entered), the front panel ENA terminals continue to operate as conventional ENA terminals for cascading motion sensor outputs.

Step 8c Press the ENTER key.

Step 9 Press the down arrow key (↓) once. The following message is displayed:

PROGRAM	SLAVING
MASTER	

Step 9a Press the NEW DATA key.

Step 9b Select the slaving status for the 2000 MS case (Master or Slave). The display toggles between Master and Slave each time the NEW DATA key is pressed.

Step 9c Press the ENTER key.

Step 10 Press the down arrow key (↓) once. One of the following messages will be displayed, depending upon the current status of the password feature:

PROGRAM PASSWORD DISABLED	or	PROGRAM PASSWORD ENABLED
------------------------------	----	-----------------------------

NOTE

NOTE
To leave the password feature in its current status, proceed to step 11. To enable the password feature, proceed as directed in steps 10a through 10e. To change the current password code, proceed as directed in steps 10g through 10p. To disable the password feature, proceed as directed in steps 10r through 10u.

2.2.3 Enable Password

Step 10a Press the NEW DATA key. The following message is displayed:

ENTER NEW PASSWORD: ■

Step 10b Enter the new four-digit password.

Step 10c Press the ENTER key. The following message is displayed:

CONFIRM NEW PASSWORD: ■

Step 10d Re-enter the new password.

Step 10e Press the ENTER key. The following message is displayed, indicating the password feature is enabled and the password is installed:

PROGRAM PASSWORD ENABLED

Step 10f Proceed to step 11.

2.2.4 Change Password

Step 10g Press the NEW DATA key. The following message is displayed:

ENTER OLD PASSWORD: ■

Step 10h Enter existing four-digit password.

Step 10j Press the ENTER key. The following message is displayed:

ENTER NEW PASSWORD: ■

Step 10k Enter new four-digit password.

Step 10m Press the ENTER key. The following message is displayed:

CONFIRM NEW PASSWORD: ■

Step 10n Re-enter the new password.

Step 10p Press the ENTER key. The following message is displayed, indicating the new password is installed:

PROGRAM PASSWORD ENABLED

Step 10q Proceed to step 11.

2.2.5 Disable Password

Step 10r Press the NEW DATA key. The following message is displayed:

ENTER OLD PASSWORD: ■

Step 10s Enter the current four-digit password.

Step 10t Press the ENTER key. The following message is displayed:

ENTER NEW PASSWORD: ■

Step 10u Press the CLEAR key. The following message is displayed, indicating the password feature is disabled:

PROGRAM PASSWORD DISABLED ■
--

2.2.6 Data Recorder Programming

Step 11 Press the down arrow key (↓) once. One of the following messages is displayed, depending upon the current data recorder status:

PROGRAM RECORDER NOT INSTALLED	or	PROGRAM RECORDER INSTALLED
-----------------------------------	----	-------------------------------

If the data recorder option is to be used, program the system for recorder Installed (steps 11a and 11b) and then perform programming steps 12 through 18b as required.

If the data recorder option is not to be used, program the system for recorder Not Installed (steps 11a and 11b) and then proceed to step 19 for extended application programming.

Step 11a Press the NEW DATA key. The recorder option status toggles between Not Installed and Installed each time the NEW DATA key is pressed.

Step 11b Press the ENTER key when the desired recorder option status is displayed.

NOTE

NOTE

Perform steps 12 through 15c to set the RS232C interface port parameters to enable the 2000 MS to communicate with an external PC or printer, which can be connected to the data recorder module (80015) via a 9-pin RS232C connector located on the front edge of the module. Refer to the applicable PC software or printer manufacturer's manual to determine the appropriate values to enter. Steps 12 through 15c may be performed at a future date prior to downloading recorded data to a PC or printing.

Step 12 Press the down arrow key (↓) once. The following message is displayed:

PROGRAM	RS-232-C
BAUD RATE:	9600

Step 12a Press the NEW DATA key.

Step 12b Use the up (↑) or down (↓) arrow keys to display the PC/printer baud rate (300, 1200, 2400, 4800, or 9600). The default value is 9600.

Step 12c Press the ENTER key.

Step 13 Press the down arrow key (↓) once. The following message is displayed:

PROGRAM	RS-232-C
DATA BITS:	8

Step 13a Press the NEW DATA key.

Step 13b Use the up (↑) or down (↓) arrow keys to display the number of data bits for the PC/printer (7 or 8). The default value is 8.

Step 13c Press the ENTER key.

Step 14 Press the down arrow key (↓) once. The following message is displayed:

PROGRAM	RS-232-C
STOP BITS:	1

Step 14a Press the NEW DATA key.

Step 14b Use the up (↑) and down (↓) arrow keys to display the number of stop bits for the PC/printer (1 or 2). The default value is 1.

Step 14c Press the ENTER key.

Step 15 Press the down arrow key (↓) once. The following message is displayed:

PROGRAM	RS-232-C
PARITY:	NONE

Step 15a Press the NEW DATA key.

Step 15b Use the up (↑) and down (↓) arrow keys to display the type of parity used by the PC/printer (none, odd, even, mark, or space).

Step 15c Press the ENTER key.

Step 16 Press the down arrow key (↓) until the date display message (similar to that shown below) appears.

PROGRAM	DATE
FRI	21 FEB 1997

Step 16a Press the NEW DATA key. The cursor appears at the first digit of the day-of-the-month entry.

Step 16b Enter the day of the month. The entry must consist of two digits (01, 12, 27, etc.). When the second digit is entered, the cursor moves to the first letter of the month entry.

Step 16c Use the up (↑) and down (↓) arrow keys to display the desired month entry.

Step 16d Press the NEW DATA key. The cursor appears at the first digit of the year entry.

Step 16e Enter all four digits for the year entry (1997, 1998, etc.). As the last digit is entered, the applicable day of the week is automatically displayed and the cursor moves to the first letter of the day-of-the-week entry. Review all time entries and change any if necessary.

Step 16f Press the ENTER key.

Step 17 Press the down arrow key (↓) once. A time display message similar to that shown below appears. Time is displayed in hours:minutes:seconds (hh:mm:ss) format.

PROGRAM	TIME
11:25:43	(24 HR)

Step 17a Press the NEW DATA key. The cursor appears at the first digit of the hours entry.

Step 17b Enter the hours. The entry must consist of two digits (01, 02, etc.). When the second digit is entered, the cursor moves to the first digit of the minutes entry.

NOTE

NOTE

If 24-hour (military) time format is used, enter the hours in the same format (e.g. 01, 12, 18, 21, etc.).

Step 17c Enter the minutes. The entry must consist of two digits (e.g. 01,12, 21, etc.). When the second digit is entered, the cursor moves to the first digit of the seconds entry.

NOTE**NOTE**

To ensure precise time setting, it may be helpful to set the minutes entry approximately two minutes ahead of the actual time to allow sufficient time to complete steps 17d and 17e below. When the entered minutes time arrives, step 17f can be performed.

Step 17d Enter the seconds. The entry must consist of two digits (e.g. 01, 12, 21, etc.). When the second digit is entered, the cursor moves to the first character of the time format (AM, PM, 24-Hour) entry.

Step 17e Use the up (↑) and down (↓) arrow keys to display the desired time format entry. When using 24-hour (military) format, follow the time entry with 24 Hr. When using standard 12-hour format, follow the time entry with AM or PM, whichever is appropriate.

Step 17f Press the ENTER key at the exact second when real time coincides with the time entered on the display. Verify that the seconds portion of the display is now incrementing.

Step 18 Press the down arrow key (↓) once. The daylight savings time message shown at the top of the following page is displayed.

PROGRAM DAYLIGHT	
SAVINGS:	ON

Step 18a Press the NEW DATA key. Each time the NEW DATA key is pressed, the entry toggles between OFF and ON. If daylight savings time is to be used, select ON and the recorder will change the time setting automatically at the beginning (2:00 a.m. on the first Sunday in April) and end (2:00 a.m. on the last Sunday in October) of the daylight savings time period. If daylight savings time is not to be used, select OFF.

Step 18b Press the ENTER key.

2.2.7 Extended Application Programming

Step 19 Press the FUNCTION key. The following message is displayed:

T1 REMOTE UNIT	
OPERATION:	OFF



WARNING

WHEN REMOTE OPERATION IS PROGRAMMED “ON” AND AN ISLAND MODULE IS USED ON THE SAME TRACK (T1 OR T2), THE ISLAND (WHEN DEENERGIZED) WILL NOT CAUSE THE MS RELAY DRIVE TO DEENERGIZE. WHEN USED AT A REMOTE LOCATION, THE ISLAND MODULE IS USED FOR ENHANCED DETECTION REMOTE OPERATION LOGIC AND THUS WILL NOT CONTROL THE RELAY DRIVE OUTPUT AS IT NORMALLY DOES AT A CROSSING.

Press the NEW DATA key. When a remote 2000 MS is operating on track 1 (T1) or track 2 (T2), the display for the associated track should be set to ON. Each time the NEW DATA key is pressed, the display toggles between OFF and ON. The default is OFF.

Step 19a Press the ENTER key.

Step 19b If two tracks were selected in step 2b, press the TRACK 2 key and repeat steps 19 and 19a for track 2. Press the TRACK 1 key.

Step 20 Press the down arrow key (↓) once. The following message is displayed:

PICKUP DELAY	
PRIME:	15

Step 20a Press the NEW DATA key.

Step 20b Enter the length of time from the point at which motion ceases in the approach until the gates pick up (8 to 500 seconds).

Step 20c Press the ENTER key.

Step 21 Press the down arrow key (↓) once. The following message is displayed:

COMPENSATION	
VALUE T1:	XXXX

Step 21a Press the NEW DATA key.

Step 21b Enter the compensation value for the track indicated (1000 to 2000).

⚠ WARNING

WARNING

THE DEFAULT VALUE IS AUTOMATICALLY CALCULATED BY THE 2000 MS SYSTEM. DO NOT CHANGE THIS VALUE WITHOUT PROPER INSTRUCTIONS.

Step 21c Press the ENTER key.

Step 21d If the system is programmed for two tracks, press the TRACK 2 key and repeat steps 21a, 21b, and 21c for track 2. Press the TRACK 1 key.

Step 22 Press the down arrow key (↓) once. The following message is displayed:

T1 ENHANCED	
DETECTION:	OFF

⚠ WARNING

WARNING

WHEN ENHANCED DETECTION IS DESIRED AND PROGRAMMED “ON” AND TRAIN TRAFFIC IS MINIMAL ESPECIALLY IN DARK TERRITORY, RUST BUILD-UP ON THE RAILS MAY NOT ALLOW ANY TRACK SHUNTING TO OCCUR. SHOULD THIS HAPPEN, THE MS ENHANCED DETECTION WILL NOT DETECT NON/MINIMAL SHUNTING TRAIN MOVEMENTS. THE UNIT MUST DETECT SHUNTING IN ORDER TO SENSE TRAIN MOVEMENT.

NOTE**NOTE**

Train shunting in dark territory can be easily improved similar to style C circuits (but without the need of as many insulated joints) by the application at the crossing of DC voltage onto the track (along with one insulated joint at each approach end). This DC voltage will improve train shunting and allow the 2000 Enhanced Detection software to function properly.

Spotty poor shunting can occur virtually anywhere from numerous causes but generally occurs due to light track usage, light cars, and/or during transit operation. A lack of any shunting generally occurs in dark territory where no DC or AC track circuits exist and where few trains per week are run.

The Safetran Shunting Enhancer Panel, 80049, provides a very simple and cost effective solution for improving shunting in dark territory by providing a nominal 6 VDC that is isolated from the battery and is applied to the track at the crossing to break down the film on the rails. Only two insulated joints are required to confine the 6 volts on the track: one at each end of the motion sensor approach. The application of DC voltage with overlapping approaches from two or more crossings is also very easy to implement without any additional insulated joints. Narrow band termination shunts are required whenever the 6 VDC is applied.

In cases where train traffic is minimal in dark territory and excessive rust build-up on the rails does not allow shunting to occur, an additional 6 to 8 VDC on the track (with insulated joints at each approach end) is applied by the 80049 unit at the crossing to enhance the shunting and allow the 2000 enhanced detection to function properly.

Step 22a Press the NEW DATA key. The ED operating mode for track 1 toggles between ON and OFF each time the NEW DATA key is pressed.

Step 22b Press the ENTER key when the desired mode is displayed.

Step 22c If track 2 is also selected in step 2b, press the TRACK 2 key and repeat steps 22a and 22b for track 2. Press the TRACK 1 key.

Step 23 Press the down arrow key (↓) once. If enhanced detection is programmed ON the following message is displayed:

BACK TO BACK	
T1 AND T2:	NO

Step 23a Press the NEW DATA key. The back-to-back display toggles between NO and YES each time the NEW DATA key is pressed. Select YES when two unidirectional units are in the same 2000 MS case and the associated approaches are located on opposite sides of the same pair of insulated joints.

Step 23b Press the ENTER key when the applicable condition is displayed.

Step 24 Press the down arrow key (↓) once. If enhanced detection is programmed ON the following message is displayed:

STATION STOP	
TIMER T1:	10

WARNING

WARNING

WHEN THE STATION STOP TIMER IS PROGRAMMED TO OTHER THAN THE DEFAULT VALUE OF 10 SECONDS, THERE MUST NOT BE ANY TRAIN MOVES APPROACHING THE CROSSING WITHIN THE TIME A TRAIN LEAVES THE ISLAND AT THE CROSSING AND THE PROGRAMMED TIME OF THE STATION STOP TIMER. THE TIMER CAN BE PROGRAMMED UP TO A MAXIMUM OF 120 SECONDS (TWO MINUTES).

NOTE

NOTE

The station stop timer should normally be left at the default value of 10 seconds. The timer is initiated automatically after a train leaves the island circuit and operates in conjunction with enhanced detection logic. If there is a station stop after the train passes the crossing, the timer can be programmed up to 120 seconds to prevent tail rings due to poor shunting after the train has stopped and then leaves the station. This timer is only active if Enhanced Detection is programmed "ON".

Step 24a Press the NEW DATA key. This entry is used when a passenger station platform is located within the 2000 MS approach and the value entered on the numeric keypad establishes the time interval (in seconds) during which the internal loss-of-shunt timer is inhibited. Valid entries are 10 to 120.

Step 24b Press the ENTER key when the desired time interval is displayed.

Step 24c If track 2 is also selected in step 2b, press the TRACK 2 key and repeat steps 24a and 24b for track 2. Press the TRACK 1 key.

Step 25 Press the down arrow key (↓) once. The following message is displayed:

NUMBER OF TRACK	
WIRES T1:	4

Step 25a Press the NEW DATA key.

Step 25b Enter the number of track wires for the track indicated (4 or 6).

Step 25c Press the ENTER key.

Step 25d If the system is programmed for two tracks, press the TRACK 2 key and repeat steps 25a, 25b, and 25c for track 2. Press the TRACK 1 key.

Step 26 Press the down arrow key (↓) once. The following message is displayed:

T1 LOW EX ADJUSTMENT: 0

Step 26a Press the NEW DATA key.

Step 26b Enter the Low EX Adjustment value (0 to 5).

Step 26c Press the ENTER key.

Step 26d If the system is programmed for two tracks, press the TRACK 2 key and repeat steps 26a, 26b, and 26c for track 2. Press the TRACK 1 key.

NOTE

NOTE

Steps 27 through 31 below apply only if Software Version 9V126-01F or later has been installed on the MS 2000.

Step 27 Press the down arrow key (↓) once. The following message is displayed:

LOW EZ DETECTION EZ=70 T1:OFF

Step 27a Press the NEW DATA key. The back-to-back display toggles between NO and YES each time the NEW DATA key is pressed. Select YES when notice of detection of a significant reduction of EZ is desired.

Step 27b Press the ENTER key.

Step 27c If the system is programmed for two tracks, press the TRACK 2 key and repeat steps 27a, 26b, and 26c for track 2. Press the TRACK 1 key

Step 28 Press the down arrow key (↓) once. If low EZ detection is programmed ON the following message is displayed:

LOW EZ DETECTION	
TIMER T1:	10

Step 28a Press the NEW DATA key.

Step 28b Enter the Low EZ Detection value (2 to 99). The EZ detection timer delay is generally programmed for a time interval longer than trains would normally remain in the MS approach.

Step 28c Press the ENTER key.

Step 28d If the system is programmed for two tracks, press the TRACK 2 key and repeat steps 28a, 28b, and 28c for track 2. Press the TRACK 1 key.

Step 29 Press the down arrow key (↓) once. The following message is displayed:

POSITIVE START	
EZ LEVEL T1:	OFF

Step 29a Press the NEW DATA key.

Step 29b Enter the Positive Start value (1 to 100). This immediately activates the crossing when EZ is less than the programmed Positive Start EZ Level. There is no 4-second reaction delay time. Once Positive Start occurs, the crossing is continuously activated until either the train clears the island circuit, the EZ value rises to a number 5 greater than the programmed positive start EZ level, or the Positive Start timer has exceeded the programmed timer delay of 1 to 99 minutes. A new Positive Start sequence may be initiated once EZ exceeds the programmed Positive Start EZ level by 5.

Step 29c Press the ENTER key.

Step 29d If the system is programmed for two tracks, press the TRACK 2 key and repeat steps 29a, 29b, and 29c for track 2. Press the TRACK 1 key.

Step 30 Press the down arrow key (↓) once. If positive start EZ level is programmed ON the following message is displayed:

POSITIVE START TIMEOUT T1: NONE

Step 30a Press the NEW DATA key.

Step 30b Enter the Positive Start Timeout value (1 to 99). This selectable value allows a continuous positive start to either not time out (None = 0) or to timeout after the programmed delay.

Step 30c Press the ENTER key.

Step 30d If the system is programmed for two tracks, press the TRACK 2 key and repeat steps 30a, 30b, and 30c for track 2. Press the TRACK 1 key.

Step 31 Press the down arrow key (↓) once. The following message is displayed:

SET AT OPERATION OUT: NORMAL

Step 31a Press the NEW DATA key. The display toggles between Normal and Diagnostic each time the NEW DATA key is pressed. When programmed to NORMAL, the AT terminal operates as a standard output used for redundant operation by two separate 2000 units wired to an 80069 Automatic Transfer Unit. When programmed to DIAGNOSTIC, the AT terminal functions as an error indicator and therefore will not support automatic transfer operation. While programmed to DIAGNOSTIC, the AT terminal provides a constant 256 Hz AC signal output. When an error is detected, the AT terminal output changes to a DC level. A 2000 S2 or D2 redundant unit must have the AT terminal programmed to NORMAL.



CAUTION

THE **SET AT OPERATION OUT** OPTION SHOULD ONLY BE USED IN NON-REDUNDANT 2000 CASES.

Step 31c Press the ENTER key.

Step 31d If the system is programmed for two tracks, press the TRACK 2 key and repeat steps 31a, 31b, and 31c for track 2. Press the TRACK 1 key.

This completes the system application programming. Before the system can be placed into operation, system calibration must be performed. Proceed to Section III, System Calibration.

2.3 CONDENSED PROGRAMMING PROCEDURES

The condensed programming procedures that follow are provided as a reference for system users who are familiar with the general programming procedure but require occasional prompting during system programming. The step numbers listed in the condensed procedures correspond with the step numbers in paragraph 2.2 SYSTEM PROGRAMMING.

NOTE

NOTE

Refer to the 2000 MS Application History Card (which should have been completed prior to programming) for the values to be entered during programming.

If any of conditions (a) through (c) listed below apply, the relay drive may be inhibited and the following message will flash on the display every 10 seconds:

<p>SET TO DEFAULT REQUIRED</p>

The system must be programmed to Set To Default parameters to initialize the database before performing application programming. To initialize the database, proceed with programming Step 1. However, if none of the conditions listed below apply, skip Step 1 and start at Step 2 to begin application programming.

- (a) It is an initial installation.
- (b) The Processor Module (80224) has been replaced with another containing a different software revision level.
- (c) The Keyboard/display Interface Assembly (80020 or 80029) has been replaced (includes attached keyboard display interface module (80017 or 80153)).

NOTE

NOTE
 During the following procedures, if the message shown below appears when the NEW DATA key is pressed, enter the proper four-digit password and then press the ENTER key to continue.

ENTER
 PASSWORD ■

The condensed programming procedures are provided in the following tables:

Table 2-2. Set To Default Programming Procedures

Step No.	Key Pressed	Resulting Display	Data Entry Key Sequence	Comments
1	FUNCTION	T1 REMOTE UNIT OPERATION: OFF	Go to step 1a	
1a	Up Arrow (one time)	SET TO DEFAULT	Go to step 1b	
1b	NEW DATA	SET TO DEFAULT PRESS ENTER	Go to step 1c	
1c	ENTER	SETUP T1 AND T2 REQUIRED then SET TO DEFAULT COMPLETE		Setup message displayed intermittently. Indicates system calibration (section VI) is required. Displayed when installation of default parameters is complete. The word COMPLETE momentarily appears after 2 seconds. The system must now be completely reprogrammed and recalibrated.

Table 2-3. Application Programming Procedures

Step No.	Key Pressed	Resulting Display	Data Entry Key Sequence	Comments
2	PROGRAM	PROGRAM NUMBER OF TRACKS: 2	a. NEW DATA b. (1 or 2) c. ENTER	Default value is 2.
3	Down Arrow (one time)	PROGRAM T1 FREQUENCY: 790	a. NEW DATA b. (45 to 999) c. ENTER	Default value is 790 Hz. If programmed for two tracks, press the TRACK 2 key and repeat step for track 2. Press the TRACK 1 key.

Continued on next page

Table 2-3 (Continued)

Step No.	Key Pressed	Resulting Display	Data Entry Key Sequence	Comments
4	Down Arrow (one time)	PROGRAM T1 UNIDIRECTIONAL	a. NEW DATA b. ENTER	System application for indicated track toggles between Unidirectional and Bidirectional each time the NEW DATA key is pressed. Default is Unidirectional. If programmed for two tracks, press the TRACK 2 key and repeat step for track 2. Press the TRACK 1 key.
5	Down Arrow (one time)	PROGRAM T1 XMIT LEVEL: MEDIUM	a. NEW DATA b. ENTER	Transceiver transmit level for the track indicated toggles between Medium and Maximum each time the NEW DATA key is pressed. Default is Medium. If programmed for two tracks, press the TRACK 2 key and repeat step for track 2. Press the TRACK 1 key.
6	Down Arrow (one time)	PROGRAM T1 APPROACH: 3000	a. NEW DATA b. (0000 to 9999) c. ENTER	Default is 3000. If programmed for two tracks, press the TRACK 2 key and repeat step for track 2. Press TRACK 1 key.
7	Down Arrow (one time)	PROGRAM UAX1 PICKUP DELAY: 25	a. NEW DATA b. (0 (off) to 500) c. ENTER	The default is 25 seconds. <u>WARNING</u> WHEN THE UAX FEATURE IS OFF (0 IS ENTERED), THE FRONT PANEL UAX TERMINALS HAVE NO CONTROL OVER MS RELAY DRIVE.
8	Down Arrow (one time)	PROGRAM ENA/UAX2 PICKUP DELAY: 25	a. NEW DATA b. (0 (ENA) to 500) c. ENTER	When the UAX2 feature is off (0 is entered) the front panel ENA/UAX2 terminals continue to operate as conventional ENA terminals for cascading 2000 MS outputs. Default is 25 seconds.
9	Down Arrow (One Time)	PROGRAM SLAVING MASTER	a. NEW DATA b. (Use NEW DATA key to select Master or Slave) c. ENTER	Default is Master.

Continued on next page after Note

NOTE

NOTE

If the password is to be enabled or disabled, perform steps 10 through 10u as required; otherwise, press the down arrow key (↓) and go directly to Step 11.

Table 2-3 (Concluded)

Step No.	Key Pressed	Resulting Display	Data Entry Key Sequence	Comments
10	Down Arrow (One Time)	PROGRAM PASSWORD DISABLED Or PROGRAM PASSWORD ENABLED Determined by current password status		Default is Disabled. To leave the password feature in the current status, proceed to step 11. To enable the password feature, perform steps 10a through 10e. To change the current password, perform steps 10g through 10p. To disable the password feature, perform steps 10r through 10u.

Table 2-4. Enable Password Programming Procedures

Step No.	Key Pressed	Resulting Display	Data Entry Key Sequence	Comments
10a	NEW DATA	ENTER NEW PASSWORD: ■	Enter four-digit password, then proceed to step 10c.	
10c	ENTER	CONFIRM NEW PASSWORD: ■	Re-enter four-digit password, then proceed to step 10e.	
10e	ENTER	PROGRAM PASSWORD ENABLED		Password feature enabled and pass-word is installed. Proceed to step 11.

Table 2-5. Change Password Programming Procedures

Step No.	Key Pressed	Resulting Display	Data Entry Key Sequence	Comments
10g	NEW DATA	ENTER OLD PASSWORD: ■	Enter old four-digit password, then proceed to step 10j.	To change the current password, perform steps 10g through 10p.
10j	ENTER	ENTER NEW PASSWORD: ■	Enter new four-digit password, then proceed to step 10m.	
10m	ENTER	CONFIRM NEW PASSWORD: ■	Re-enter the new four-digit password, then proceed to step 10p.	
10p	ENTER	PROGRAM PASSWORD ENABLED		The new password is installed. Proceed to step 11.

Table 2-6. Disable Password Programming Procedures

Step No.	Key Pressed	Resulting Display	Data Entry Key Sequence	Comments
10r	NEW DATA	ENTER OLD PASSWORD: ■	Enter current four-digit password, then proceed to step 10t.	To disable the password feature, perform steps 10r, 10s, and 10t.
10t	ENTER	ENTER NEW PASSWORD: ■	Enter no number, but proceed to step 10u.	
10u	CLEAR	PROGRAM PASSWORD DISABLED		The password feature is now disabled. Proceed to step 11.

NOTE**NOTE**

Steps 11 through 18b apply to the data recorder module (80015). Perform these steps as required.

Table 2-7. Data Recorder Programming Procedures

Step No.	Key Pressed	Resulting Display	Data Entry Key Sequence	Comments
11	Down Arrow (one time)	PROGRAM RECORDER NOT INSTALLED or PROGRAM RECORDER INSTALLED Determined by the current data recorder status	(See comments) a. NEW DATA b. ENTER	If the data recorder module (80015) <u>is not</u> installed, proceed to step 19 for extended programming. If the data recorder <u>is</u> installed but the recorder feature has not yet been enabled, proceed as directed in steps 11 through 18b. Data recorder status toggles between Installed and Not Installed each time the NEW DATA key is pressed. Default is Not Installed.

NOTE

NOTE
Steps 12 through 15c apply to an external PC or printer connected to the 2000 MS. Refer to the PC software or printer manufacturer's instruction manual to determine the values to enter in each step. If a PC or printer is not connected but the data recorder module (80015) is installed, proceed as directed in steps 16, 17, and 18.

Table 2-8. Programming For An External Pc Or Printer

Step No.	Key Pressed	Resulting Display	Data Entry Key Sequence	Comments
12	Down Arrow (one time)	PROGRAM RS-232-C BAUD RATE: 9600	a. NEW DATA b. (300 to 9600) c. ENTER	Default value is 9600.
13	Down Arrow (one time)	PROGRAM RS-232-C DATA BITS: 8	a. NEW DATA b. (7 or 8) c. ENTER	Default value is 8.
14	Down Arrow (one time)	PROGRAM RS-232-C STOP BITS: 1	a. NEW DATA b. (1 or 2) c. ENTER	Default value is 1.
15	Down Arrow (one time)	PROGRAM RS-232-C PARITY: NONE	a. NEW DATA b. (Use arrow keys to select None, Odd, Even, Mark, or Space.) c. ENTER	Default value is NONE.

Table 2-9. Date And Time Programming Procedures

Step No.	Key Pressed	Resulting Display	Data Entry Key Sequence	Comments
16	Down Arrow (one time)	PROGRAM DATE FRI 21 FEB 1997 (Example)	a. NEW DATA b. (Enter date.) c. ENTER	Enter day of the month first (must be two digits). Use arrow keys to select month. Enter all four digits of the year.
17	Down Arrow (one time)	PROGRAM TIME 11:25:43 (24 HR) (Example)	a. NEW DATA b. (Enter current time of day.) c. ENTER	For 24-hour (military) format, follow the time entry with (24 Hr). For standard 12-hour format, follow the time entry with AM or PM, whichever applies.
18	Down Arrow (one time)	PROGRAM DAYLIGHT SAVINGS: ON	a. NEW DATA b. ENTER	Entry toggles between ON and OFF each time the NEW DATA key is pressed. Default is ON.

Table 2-10. Extended Application Programming Procedures

Step No.	Key Pressed	Resulting Display	Data Entry Key Sequence	Comments
19	Down Arrow (one time)	T1 REMOTE UNIT OPERATION: OFF	(See comments) a. NEW DATA b. ENTER	When a 2000 MS is operating remotely on track 1 (T1), the display for the associated track (T1) should be set to ON. Each time the NEW DATA key is pressed, the display toggles between OFF and ON. Default is OFF.
20	Down Arrow (one time)	PICKUP DELAY PRIME: 15	a. NEW DATA b. (8 to 500) c. ENTER	Default is 15 seconds.
21	Down Arrow (one time)	COMPENSATION VALUE T1: XXXX	a. NEW DATA b. (1000 to 2000) c. ENTER	Default value is automatically calculated by the 2000 MS system. If programmed for two tracks, press the TRACK 2 key and repeat step for track 2. Press the TRACK 1 key. WARNING DO NOT CHANGE THIS VALUE WITHOUT PROPER INSTRUCTIONS.

Continued on next page

Table 2-10 (Continued)

Step No.	Key Pressed	Resulting Display	Data Entry Key Sequence	Comments
22	Down Arrow (one time)	T1 ENHANCED DETECTION: OFF	a. NEW DATA b. ENTER	Default is OFF. Display toggles between ON and OFF each time the NEW DATA key is pressed. If programmed for two tracks, press the TRACK 2 key and repeat step for track 2. Press the TRACK 1 key.
23	Down Arrow (one time)	BACK TO BACK T1 AND T2: NO (Only if ED is programmed "ON")	a. NEW DATA b. ENTER	Default is NO. Display toggles between NO and YES each time the NEW DATA key is pressed.
24	Down Arrow (one time)	STATION STOP TIMER T1: 10 (Only if ED is programmed "ON")	a. NEW DATA b. (10 to 120) c. ENTER	Default is 10 seconds. If programmed for two tracks, press the TRACK 2 key and repeat step for track 2. Press the TRACK 1 key.
25	Down Arrow (one time)	NUMBER OF TRACK WIRES T1: 4	a. NEW DATA b. (4 or 6) c. ENTER	Default is 4. If programmed for two tracks, press the TRACK 2 key and repeat step for track 2. Press the TRACK 1 key.
26	Down Arrow (one time)	T1 LOW EX ADJUSTMENT: 0	a. NEW DATA b. (0 to 5) c. ENTER	Default is 0. If programmed for two tracks, press the TRACK 2 key and repeat step for track 2. Press the TRACK 1 key.
27 (1)	Down Arrow (one time)	LOW EZ DETECTION EZ=70 T1:OFF	a. NEW DATA b. ENTER	Default is OFF. Display toggles between ON and OFF each time the NEW DATA key is pressed. If programmed for two tracks, press the TRACK 2 key and repeat step for track 2. Press the TRACK 1 key.
28	Down Arrow (one time)	LOW EZ DETECTION TIMER T1: 10	a. NEW DATA b. (2 to 99) c. ENTER	Default is 10 minutes. If programmed for two tracks, press the TRACK 2 key and repeat step for track 2. Press the TRACK 1 key.
29	Down Arrow (one time)	POSITIVE START EZ LEVEL T1: OFF	a. NEW DATA b. (12 to 99) c. ENTER	Default is 10 minutes. If programmed for two tracks, press the TRACK 2 key and repeat step for track 2. Press the TRACK 1 key.

Continued on next page

Table 2-10 (Concluded)

Step No.	Key Pressed	Resulting Display	Data Entry Key Sequence	Comments
30	Down Arrow (one time)	POSITIVE START TIMEOUT T1: NONE	a. NEW DATA b. (1 to 99) c. ENTER	Default is NONE. If programmed for two tracks, press the TRACK 2 key and repeat step for track 2. Press the TRACK 1 key.
31	Down Arrow (one time)	SET AT OPERATION OUT: NORMAL	a. NEW DATA b. ENTER	Default is OFF. Display toggles between ON and OFF each time the NEW DATA key is pressed. <u>WARNING</u> THE SET AT OPERATION OUT OPTION SHOULD ONLY BE USED IN NON-REDUNDANT 2000 CASES.

1 – Steps 27 through 31 are applicable only for those locations where software version 9V126-01F have been installed in the 2000 MS.

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SECTION III

SYSTEM CALIBRATION

3.0 GENERAL

Calibration of the 2000 MS is an extremely simple and reliable microprocessor-controlled operation consisting primarily of one automated setup procedure that is set up for calibration. User interface is kept to a minimum, requiring only occasional inputs via the keyboard/display assembly. No meters or external test equipment are required for field calibration.

As a safeguard against improper system operation, the 2000 MS software inhibits system relay drive output if the setup for calibration procedure is required but has not yet been performed. As an indication that a setup procedure must be performed, a reminder message is flashed on the keyboard/display assembly when the unit is in either Program or Status Mode.

The reminder message for the calibration setup procedure is in the form of one of the following displays (depending upon the number of tracks programmed for the system and the parameter changed):

SETUP T1 AND T2 REQUIRED

SETUP T1 REQUIRED

SETUP T2 REQUIRED

Before proceeding with system calibration, ensure the insulated joint bypass couplers and termination shunts are installed where required and properly adjusted.

3.1 SYSTEM PROGRAMMING REQUIREMENTS

For initial system installations, program the system according to the procedure provided in Section II, System Application Programming. Begin programming with Step 1 (Set To Default) and completely program all parameters listed in the Program and Function menus for both track 1 and track 2 (if applicable) according to the railroad application instructions.

If the system was previously programmed, ensure that system programming corresponds to the railroad application instructions for track 1 and track 2 (if applicable) by reviewing all Program and Function menu items. Refer to the 2000 MS Application History Card or railroad installation drawing for the correct programming entries.

3.2 SET TO DEFAULT, REPROGRAMMING, AND RECALIBRATION REQUIREMENTS

Set to default, reprogramming, and recalibration must be performed if either of the following conditions exist:

- The Processor Module (80224) has been replaced with another containing a different software revision level.
- The Keyboard/display Interface Assembly (80020 or 80029) has been replaced (includes attached keyboard display interface module (80017 or 80153)).

If either of the above conditions have occurred, relay drive will be inhibited and the following message will be flashed on the display every 10 seconds.

SET TO DEFAULT
REQUIRED

NOTE

NOTE

For complete instructions on set to default, programming, and reprogramming, refer to Section II, Paragraph 2.2, System Programming.

3.3 RECALIBRATION REQUIREMENTS FOR IN-SERVICE 2000 MOTION SENSORS

Tables 3-1, 3-2, and 3-3 list the recalibration and reprogramming requirements that must be performed following the replacement of any modules, programming changes, or changes to existing track equipment.

3.3.1 Recalibration/Reprogramming Requirements Due to Module Replacement

Table 3-1 on the following page indicates recalibration, reprogramming, and adjustment requirements when any of the modules listed are replaced. For example, when an island module (80011) is replaced, island adjustment is required only for the track associated with the island module; no other setup or adjustment procedures are required. However, whenever a processor module (80224) is replaced with another processor module with a different software revision level, the system must be set to the default parameters and reprogrammed before performing setup for calibration.

3.3.2 Recalibration/Reprogramming Requirements Due to Programming Changes

Table 3-2 indicates the recalibration requirements resulting from any of the indicated programming changes. For example, if the number of tracks in the installation is increased from one to two, setup for calibration must be performed for track 2 only.

3.3.3 Recalibration/Reprogramming Requirements Due to Track Equipment Changes

Table 3-3 indicates the recalibration island adjustments required when any of the changes listed are made to existing track equipment.

Table 3-1. Recalibration/Reprogramming Requirements Due to Module Replacement

Module/Assembly Replacement Requiring Recalibration		Setup for Calibration Required	Island Adjustment Required	Set to Default and Reprogramming Required
80011/80211	Island	No	Yes (for track associated with 80011/80211 only)	No
80012	Transceiver	Yes (for track associated with 80012/80212 only)	No	No
80013	Relay Drive	No	No	No
80224	Processor	No	No	No
80224	Processor (with new software level)*	Yes (Both tracks)	No	Yes (Both tracks)
80015/80115	Data Recorder	No	No	No
80020	Control Interface Assembly*	Yes (Both tracks)	No	Yes (Both tracks)
80069/80028	Switch Over	Yes (Both tracks)	Yes (Both tracks)	No

*When a new software level is added or the control interface assembly is replaced, first set the system to the default parameters and then perform complete reprogramming and recalibration.

Table 3-2. Recalibration/Reprogramming Requirements Due to Programming Changes

Programming Changes Requiring Recalibration	Setup for Calibration Required
Increased Number of Tracks From 1 to 2	Yes (For track 2 only)
MS Frequency Changed	Yes (Only for the track that was changed)
Application Changed From: Unidirectional to Bidirectional Or Bidirectional to Unidirectional	Yes (Only for the track that was changed)
Transmit Level Changed From: Medium to Maximum Or Maximum to Medium	Yes (Only for the track that was changed)
Approach Length Changed	Yes (Only for the track that was changed)
Ballast Compensation Value Changed	Yes (Only for the track that was changed)

Table 3-3. Recalibration/Reprogramming Requirements Due to Track Equipment Changes

Track Equipment Changes Requiring Recalibration	Setup For Calibration Required	Island Adjustment Required
Termination Shunts Changed or Moved to New Location*	Yes	No
Termination Shunts of other Frequencies Added, Removed from, or Moved within 2000 MS Approach(es)	Yes	No
Wideband Insulated Joint Couplers (8A076 or 8A077) Replaced in 2000 MS Approach(es)	Yes	No
Tuned Insulated Joint Couplers (62785-f) Replaced in 2000 MS Approach(es)	Yes	No
2000 MS Track Wire(s) Replaced	Yes	Yes

*Approach length in the Program menu must be changed to reflect the new approach length.

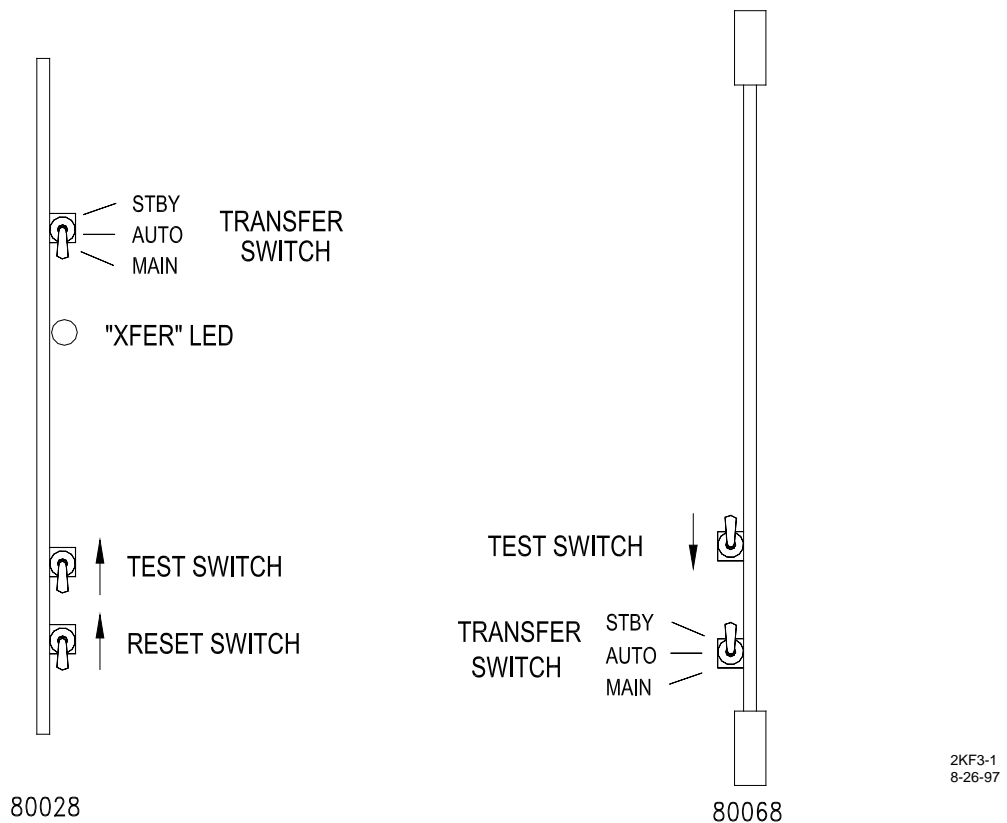


Figure 3-1. Transfer Switch Location on 80068/80028 Modules

3.4 CALIBRATION PROCEDURE

Perform the following steps to calibrate the 2000 MS.

NOTE

NOTE

When the 2000 MS is calibrated under poor ballast conditions, it may require recalibration when the ballast conditions improve.

3.4.1 Automatic Switch Over Systems Only (Main Unit)

Step 1 When the unit is a Model 2000S2 (dual system with switch over), or when two Model 2000 Motion Sensors are operated in conjunction with an external automatic transfer timer unit (80069), set the STBY/AUTO/MAIN transfer switch located on the associated transfer timer module to the MAIN position (see applicable diagram in Figure 3-1 for switch location).

3.4.2 Setup For Calibration - Track 1 And Track 2

Step 2 Press the TRACK 1 key.

Step 2a Press and hold the SETUP key. The following message is displayed when setup has been selected:

```

SETUP T1 FOR
CALIBRATION
  
```

Release the SETUP key.

NOTE

NOTE

If used, cab signal (60 or 100 Hz) should be turned off during the following calibration step.

Step 2b Press the ENTER key. The following message is displayed while setup is in progress:

```

SETUP T1
IN PROGRESS      2
  
```

Setup requires approximately 70 seconds to complete. The number at the right end of the lower display line increases to 6 as setup progresses. Once automatic setup has begun, pressing any key on the keyboard will abort the setup procedure. When setup is complete, the following message is displayed for approximately 2 seconds:

```

SETUP T1
COMPLETE
  
```

A status display similar to that shown on the following page will appear. The EZ and EX values displayed are calibrated values. The EZ value should be between 98 and 102 while EX should be between 50 and 100. If the EX value is 40 or lower (possibly even a negative value), phasing of the MS track wires may be incorrect. Verify the track wiring then repeat steps 2 through 2b before continuing.

STATUS T1	
EZ: 100	EX: 87

3.4.3 Setup For Calibration - Track 2 (Model 2000 Ms Only)

Step 3 When the 2000 MS is programmed for two tracks, press the TRACK 2 key and repeat steps 2a and 2b. Note that T2 will replace T1 on the display.

3.4.4 Island Adjustment

3.4.4.1 Island Module 80011 Adjustment - Track 1 and Track 2

If the 2000 MS includes one or two island modules (80011), perform the following island circuit adjustment procedure for track 1 first (leftmost 80011 module in the case) then for track 2, if applicable.

Step 4 Determine the island frequency of the track circuit to be adjusted.

Step 4a Temporarily install a **hardwire** shunt at the distance beyond the island receiver rail connections specified in the chart below for the corresponding island frequency.

Island Frequency (kHz)	Shunt Distance (Feet)
4.0	10.5
4.9	9.0
5.9	7.5
7.1	6.5
8.3	6.0
10.0	5.0
11.5	4.5
13.2	4.0
15.2	3.5
17.5	3.0
20.2	3.0

Step 4b

Adjust the ADJ (island gain) potentiometer located on the front edge of the island module (80011) CW until the island module STATUS LED indicator illuminates, then slowly adjust the potentiometer counter-clockwise until the indicator just extinguishes (refer to Figure 3-2).

NOTE**NOTE**

At some installations, the STATUS LED indicator may not illuminate even when the island gain potentiometer is adjusted to the full clockwise position. However, this condition is satisfactory provided the indicator illuminates when the hardware shunt (installed in Step 4a) is removed from the rails.

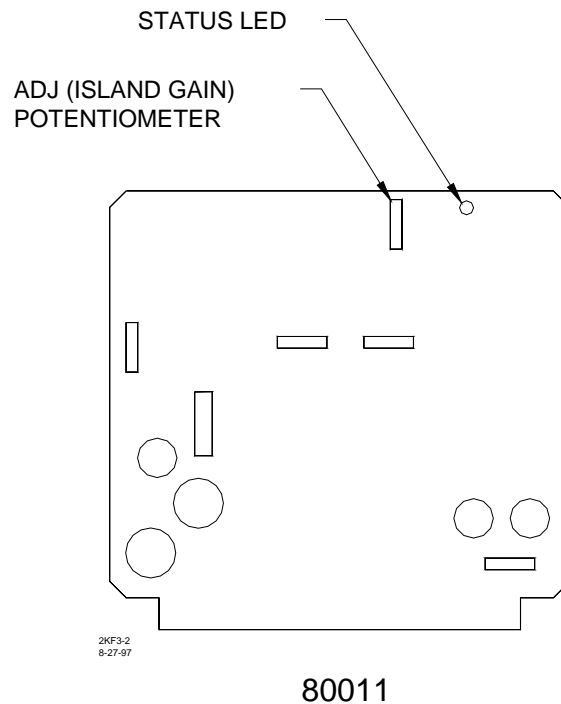


Figure 3-2. Location of ADJ (Island Gain) Potentiometer

Step 5

Remove the hardware shunt installed in Step 4a from the rails.

NOTE**NOTE**

At installations where poor island shunting is encountered or expected, an adjustment procedure using 0.25 ohm shunting sensitivity can be used. When using the 0.25 ohm procedure, the shunt distances indicated in the chart in Step 4a must be doubled for each island frequency. For example, the shunt installation distance beyond the island receiver rail connections for a 4.0 kHz island circuit is 21 feet. It should be noted that a reduction in maximum island operating distance could result from low ballast.

3.4.4.2 80211 IPI Adjustment – Track 1 and Track 2

Step 4 (IPI) Cycle GCP case power and note the software version of the IPI module.

NOTE

NOTE
The software version is identified on the IPI display for approximately 5 seconds at power up.

Step 4a (IPI) Set the 3000 GCP case **POWER** switch to the **OFF** position.

Step 4b (IPI) Remove the Intelligent Processor Island (IPI) module (80211) from the case.

Step 4c (IPI) Select the desired IPI operating frequency by installing the provided shorting block across the appropriate pair of frequency selection pins on the 16-position header (see figure 3-3).

Step 4d (IPI) If the software version noted in step 4 (IPI) is A01D or earlier, proceed to step 4f (IPI).

Step 4e (IPI) On modules running software version A01E or later set the pick up delay time for the IPI module as required using the A and B header positions (see figure 3-3). Refer to table 3-4 for proper jumper placement.

NOTE

NOTE
Modules running software version A01E and later are supplied with two pickup delay time selection jumpers.

Table 3-4. Pickup Delay Jumper Placement

Install Jumper In these Header Positions	Pickup Delay Time Added (seconds)
A & B	0
A	2
B	4
no jumper on A or B	6

Step 4f (IPI) Reinstall the IPI module in the case.

Step 5 (IPI) Set the 3000 GCP case **POWER** switch to the **ON** position.

NOTE

NOTE
Make sure that power is applied to the IPI module for a minimum of 20 seconds before proceeding to step 5.8 (IPI).

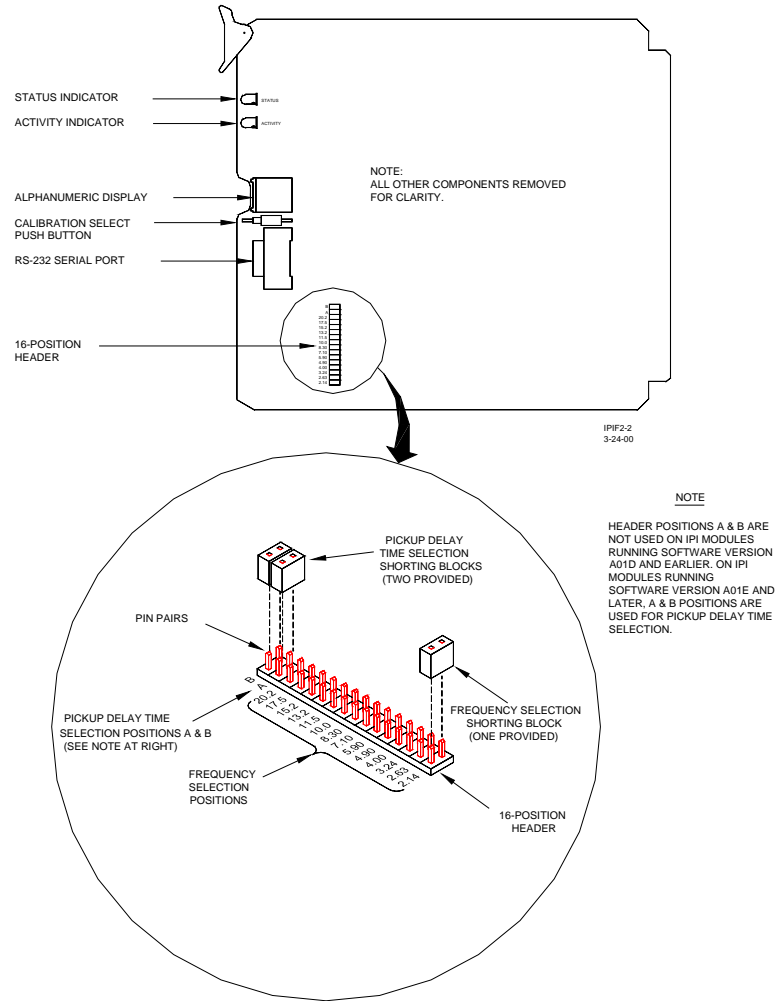


Figure 3-3. Jumper Positions on IPI 16-Position Header

NOTE

NOTE
Only one frequency selection jumper is allowed. A missing frequency jumper, or two or more frequency jumpers, render an invalid selection.

Step 5a (IPI) Temporarily install a **hardwire** shunt at the appropriate distance beyond the receiver rail connections as specified in table 3-56.

NOTE

NOTE
The island circuit shunting sensitivity chart below provides shunt distance values for shunting sensitivities of 0.12 and 0.3 ohm plus 0.4 and 0.5 ohm for areas where poor shunting is a problem.

Table 3-5. IPI Shunt Distance

Island Frequency (kHz)	0.12 ohm Sensitivity Shunt Distance (Feet)	0.3 ohm Sensitivity Shunt Distance (Feet)	0.4 ohm Sensitivity Shunt Distance (Feet)	0.5 ohm Sensitivity Shunt Distance (Feet)
2.14	20.0	50	67	84
2.63	17.0	43	58	72
3.24	13.0	33	44	55
4.0	10.5	27	36	45
4.9	9.0	23	31	39
5.9	7.5	19	26	32
7.1	6.5	17	23	29
8.3	6.0	15	20	25
10.0	5.0	13	18	22
11.5	4.5	12	16	20
13.2	4.0	10	14	17
15.2	3.5	9	12	15
17.5	3.0	8	11	14
20.2	3.0	8	11	14

NOTE

NOTE
For all installations where poor shunting has been experienced or is anticipated, a 4-second pickup delay jumper setting and 0.3 ohm shunting sensitivity calibration are recommended.

Step 5b (IPI) Press and hold the IPI calibration select push button for 2 seconds until **REL** (release) appears on the display. Immediately release the push button and then momentarily press it again within 2 seconds.

The automated calibration process starts and **CAL*** appears on the display.

NOTE**NOTE**

1. The IPI module remains in the automatic Calibration mode for approximately 20 seconds. During this time, the display indicates **CAL*** for 6 seconds, **DONE** momentarily, **BOOT** for 9 seconds, and then the software revision level is displayed for 5 seconds. When the calibration process is complete, the IPI operating frequency is displayed (alternates with pickup delay setting when running A01E and later software versions).
2. If **FAIL** appears on the display, the calibration process did not complete. Should this happen, cycle the GCP power and then repeat step 5.9 (IPI). If **FAIL** appears again, replace the IPI module.

Step 5c (IPI) Once the calibration cycle is complete and the IPI operating frequency (and pickup delay setting if applicable) appears on the display, verify the following:

- IPI operating frequency is correct
- pickup delay setting is correct (if applicable)
- IPI Status indicator is off
- IPI relay drive voltage is 0 VDC

Step 5d (IPI) Remove the hardwire shunt installed in step 5a (IPI) and then verify the following:

- IPI STATUS indicator is lit
- IPI relay drive voltage is more than 10 VDC

Step 5e (IPI) Place a 0.06-ohm shunt across the track at the receiver track wires.

Step 5f (IPI) Verify that the shunt causes the island to deenergize and the crossing to activate.

Step 5g (IPI) Remove the shunt installed in step 5e (IPI) and place it across the transmitter track wires.

Step 5f (IPI) Verify that the shunt causes the island to deenergize and the crossing to activate.

Step 5g (IPI) Remove the 0.06-ohm shunt installed in step 5g (IPI).

3.4.5 Automatic Switch Over Systems (Standby Unit)

Step 6 With 2000S2 models (dual system with switch-over), or if two 2000 Motion Sensors are operating in conjunction with an automatic transfer timer unit (80069), set the STBY/AUTO/MAIN transfer switch on the associated transfer timer module (80028 or 80068) to the STBY (standby) position (see Figure 3-1 for switch locations) and repeat steps 2 through 5 for the standby unit.

3.4.6 DAX Setting On Transfer Timer Module (80028)

Step 7 With 2000S2 models (dual system with switch-over), set the case POWER switch to the OFF position and remove the transfer timer module 80028 from the case.

Step 7a On the 80028 transfer timer module, set all four controls on DIP switch S1 to the DAX NOT USED position (labeled to right of switch) (Figure 3-3).

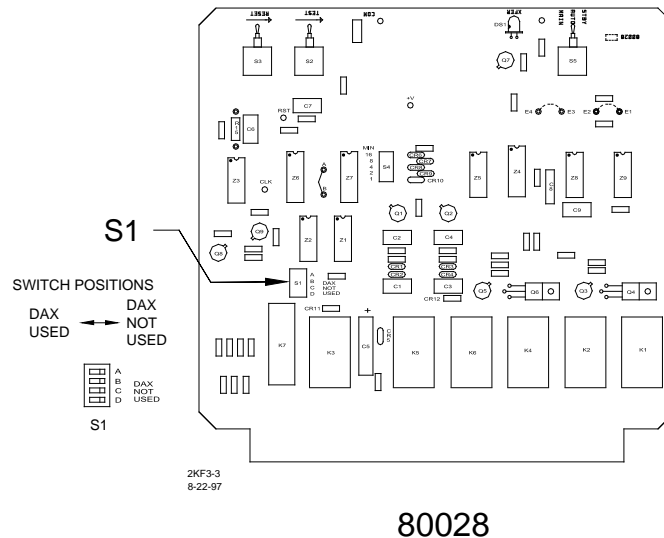


Figure 3-4. Location of DAX Selection DIP Switches S1 (80028)

Step 7b Return the transfer timer module to its original position in the case and set the POWER switch to the ON position.

3.4.7 Automatic Switch Over Test Model 2000s2 And Model 2000 Motion Sensors Operating In Conjunction With External Automatic Transfer Timer Unit, 80069

Step 8 On the automatic transfer timer module (80028 or 80068), set the STBY/AUTO/-MAIN transfer switch to the AUTO (center) position (see Figure 3-4 for location).

Step 8a Momentarily press the RESET switch to the up position until the XFER LED on the 80028 module or the NO XFER WHEN LIT LED indicator on the 80069 unit (whichever is applicable) is lighted. (See Figure 3-5 for LED locations.)

Step 8b On the automatic transfer timer module, press and hold the TEST switch in the TEST position (see Figure 3-4 for location). Transfer to the standby module set should occur within 4 seconds, verifying that the timer is operational.

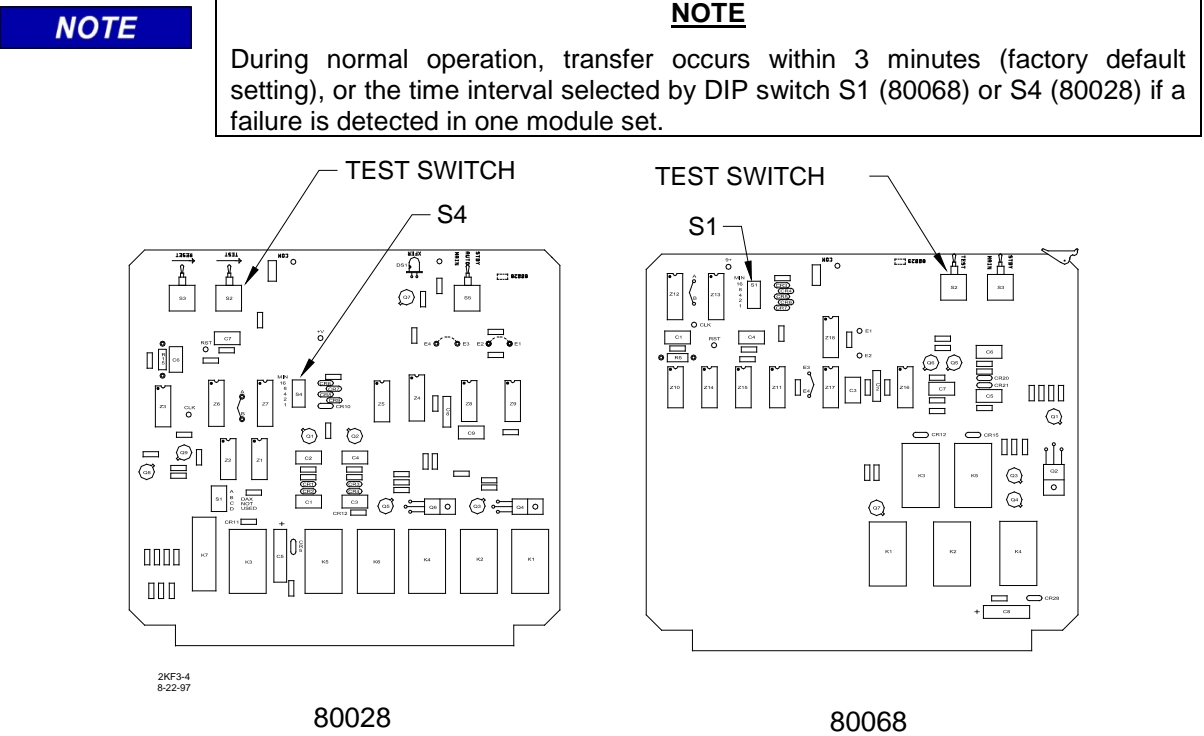


Figure 3-5. Location of TEST Switches and DIP Switches S4 (80028) and S1 (80068)

Step 8c

On the automatic transfer timer module (80028), set the RESET switch to the RESET (up) position or, where applicable, on the automatic transfer timer unit (80069), then momentarily press the RESET push button (see Figure 3-5 for switch and push button locations). Verify that the main 2000 MS module set is operating and the XFER LED indicator on the 80028 module or the NO XFER WHEN LIT LED indicator on the 80069 unit (whichever is applicable) is illuminated. The unit is now ready to perform the transfer function in the event a module failure is detected.

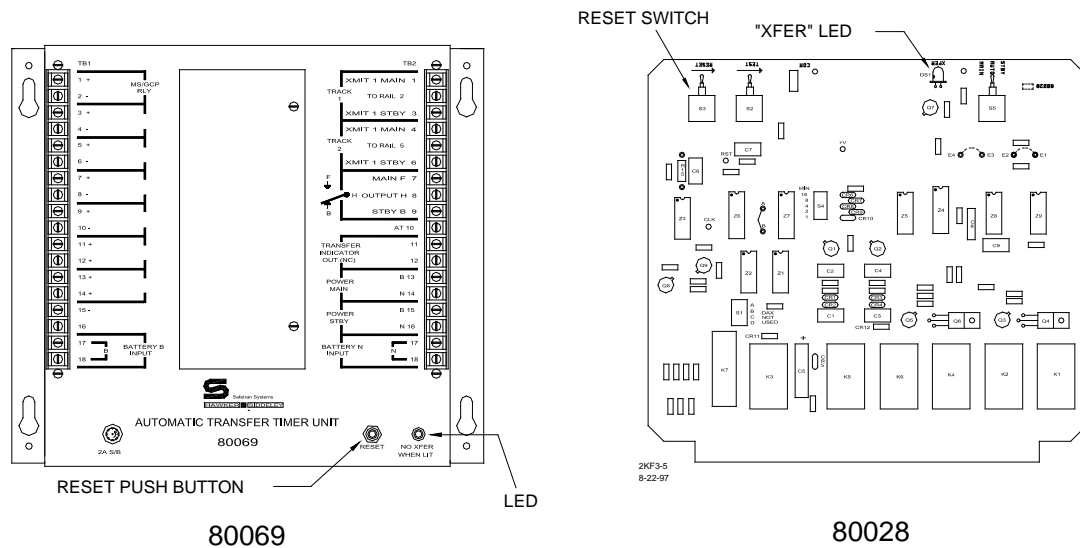


Figure 3-6. Reset Switch and Transfer Indicator Locations

3.5 OPERATIONAL CHECKS

Following system calibration, and prior to placing the system in service, perform the operational checks described in the following procedure.

3.5.1 UAX Checkout

Step 1 When the 2000 MS is programmed for UAX (value other than 0 entered in the Program menu for UAX1 pickup delay time), momentarily remove the wire connected to TB2-9 (+UAX) and verify that the crossing warning immediately activates.



WARNING

WHEN THE UAX FEATURE IS OFF (NO TIME ENTERED), THE UAX TERMINALS ON THE 2000 MS FRONT PANEL HAVE NO CONTROL OVER MS RELAY DRIVE.

Step 1a Return the wire removed in step 1 to the +UAX terminal and verify that the crossing warning signal continues to operate for the length of time programmed for the UAX pickup delay.

Step 1b Check the line circuit that controls the UAX terminals by de-energizing the line circuit at the far end and verifying that the UAX de-energizes when the line circuit is de-energized.

Step 1c When the 2000 MS is programmed for UAX2 (value other than 0 entered in the Program menu for UAX2 pickup delay), momentarily remove the wire connected to TB1-7 (ENA) and verify that the crossing warning signal immediately activates.

Step 1d Return the wire removed in step 1c to the ENA terminal and verify that the crossing warning signal continues to operate for the length of time programmed for the UAX2 pickup delay.

Step 1e Check the line circuit that controls the ENA terminal by de-energizing the line circuit at the far end and verifying that the UAX2 de-energizes when the line circuit is de-energized.

3.5.2 Operational Performance Checks

System operational performance must be verified by observing system operation and the change in EZ during inbound train moves on each approach. Proceed with the operational checks below:

Step 2 Press the STATUS key. The following display appears (actual EZ and EX values may vary):

STATUS T1	
EZ: 100	EX: 87

Step 2a Select track 1 or track 2 display as applicable.

Step 2b The EZ value for a good shunting track must begin to decrease from the no-train value (ideally 100) as an incoming train passes the termination shunt and should decrease smoothly to zero (0) as the train arrives at the crossing. For bidirectional installations, the value should increase as the train leaves the crossing and continue increasing smoothly until the last car passes the termination shunt.

WARNING

WARNING

IF A RAPID CHANGE OCCURS IN THE VALUE OF EZ AT ANY TIME WHILE THE TRAIN IS MOVING WITHIN THE TERMINATION SHUNTS, TRACK DISCONTINUITY CAUSED BY A HIGH RESISTANCE BOND OR A DEFECTIVE COUPLER IS INDICATED. LOCATE AND CORRECT THE PROBLEM IMMEDIATELY.

NOTE

NOTE

In some bidirectional applications, approaches are of different lengths and a simulated track is placed in one approach circuit to make the approaches appear electrically equal. In this application, there is a normal and acceptable decrease in EZ as a train just enters the MS approach when passing a set of insulated joints.

Step 2c In applications where poor shunting is expected, ensure the Enhanced Detection mode has been programmed "ON" (Function menu), the island calibration is adjusted for poor shunting, and adequate warning times are verified.

**WARNING**

ENSURE INBOUND TRAIN SHUNTING IS ADEQUATE FOR 2000 ENHANCED DETECTION OPERATION BY VERIFYING THAT EZ IS CONSISTANTLY VARYING (CHANGING) ON INBOUND TRAINS THROUGHOUT THE MS APPROACH CIRCUIT AND EZ IS CONSISTANTLY LESS THAN 25 WHEN THE HEAD END OF EACH TRAIN ARRIVES APPROXIMATELY 50 FEET PRIOR TO THE MS TRACK WIRES AT THE CROSSING. ALSO VERIFY THAT THE ISLAND LED DOES NOT LIGHT OR BLINK AS TRAINS RUN THROUGH THE ISLAND CIRCUIT. IF THERE IS ANY QUESTION REGARDING THE SHUNTING CHARACTERISTICS AT AN INSTALLATION, CONTACT SIEMENS INDUSTRY, INC. ENGINEERING.

If the 6-volt DC Shunting Enhancer Panel, 80049, is used to improve wheel-to-rail shunting, verify that there is a minimum of 5.0 volts DC on the track with no train present. Remove AC power from the panel and verify that a minimum of 4.5 volts DC is still present on the track. Restore AC power to the panel.

Step 2d Verify proper warning times on speed limit train moves, including all remote 2000 MS units. This completes vital calibration of the 2000 MS.

3.5.3 Clearing Recorded Diagnostic Messages From Memory

During programming, calibration, or normal system operation, any diagnostic messages generated by the system are stored in memory. The messages are identified by four-digit codes cross-referenced in Table 4-2 in Section IV of this manual. To view the recorded messages, first press the ERROR (diagnostic) key and then use the arrow keys to scroll through the messages.

Following system installation or maintenance, it is frequently desirable to clear the portion of memory where these messages are stored prior to leaving the crossing site. This ensures a fresh start with no old data contained in memory. Clearing this portion of memory also resets the HZ (highest EZ value recorded) and LX (lowest EX value recorded) values in memory to the present values of EZ and EX. To clear the recorded messages from memory and reset the HZ and LX values, proceed as follows:

Step 3 Press the SYSTEM RESET key. The following message is displayed:

SYSTEM RESET

Step 3a Press and hold the SYSTEM RESET key for approximately 3 seconds. The following message is displayed:

PRESS ENTER TO CLEAR ERRORS

Release the SYSTEM RESET key.

Step 3b Press the ENTER key. When memory is clear, the following message is displayed:

ERROR	< 0 >
-------	-------

3.5.4 Clearing Train Move History From Memory

During normal operation, the system records certain parameters relating to train moves within the track section monitored by the 2000 MS. The recorded train move data is stored in memory and can be viewed by pressing the HISTORY key on the keyboard.

To clear all recorded train move data from memory, perform the following:

Step 4 Press the SYSTEM RESET key. The following message is displayed:

SYSTEM RESET

Step 4a Press and hold the SYSTEM RESET key for approximately 3 seconds. The following message is displayed.

PRESS ENTER TO CLEAR ERRORS

Release the SYSTEM RESET key.

Step 4b Press the down arrow key (↓) once. The following message is displayed:

PRESS ENTER TO CLEAR HISTORY

Step 4c Press the ENTER key. The following message is displayed, indicating all events in memory have been cleared:

HISTORY	< 0>
---------	------

3.6 DATA RECORDER MODULE SETUP

For systems equipped with the optional data recorder module (80015), use the following procedure to set the date and time.

NOTE

NOTE

Ensure that the data recorder option was installed in step 11 of the programming procedure (Section II) before continuing with this procedure.

Step 1 Verify that the STATUS and LO BATT LEDs on the data recorder module are illuminated steady (see Figure 3-6 for LED locations).

NOTE

NOTE

If the LO BATT LED is flashing, replace the memory retention battery on the data recorder module. See Section VI, paragraph 6.9 for the battery replacement procedure.

Steps 2 through 4b correspond to steps 16 through 18b, respectively, in the programming procedure (Section II). If the parameters affected by these steps were previously programmed, perform steps 2 through 4b to verify correct date and time.

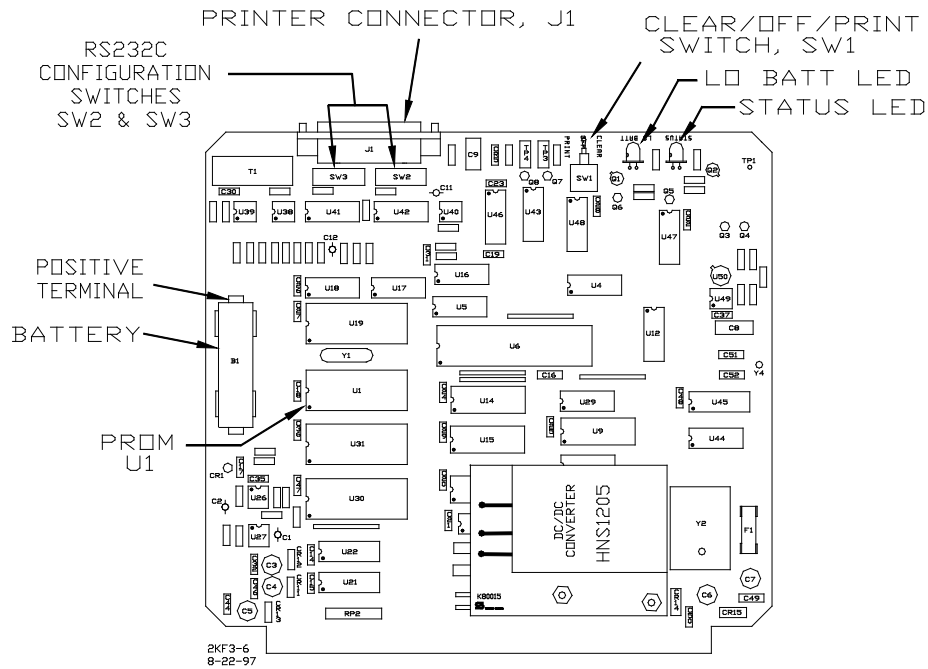
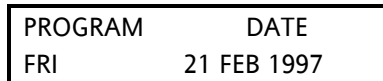


Figure 3-7. Data Recorder Module Component Locations

Step 2 Press the PROGRAM key and then use the up arrow key (↑) to scroll through the Program menu until the date display similar to that shown below appears.



Step 2a Press the NEW DATA key. The cursor appears at the first digit of the day-of-the-month entry.

Step 2b Enter the day of the month. The entry must consist of two digits (e.g., 01, 09, 12, etc.). When the second digit is entered, the cursor moves to the first letter of the month entry.

Step 2c Use the arrow keys to display the desired month entry.

Step 2d Press the NEW DATA key. The cursor appears at the first digit of the year entry.

Step 2e Enter all four digits of the year entry (e.g., 1997). As the last digit is entered, the day-of-the-week is automatically displayed. Review all entries and change as necessary.

Step 2f Press the ENTER key.

Step 3 Press the down arrow key (↓) once. A time display similar to that shown below appears. Time is in the hours:minutes:seconds (hh:mm:ss) format as shown below.

PROGRAM	TIME
11:25:43	(24 HR)

Step 3a Press the NEW DATA key. The cursor appears at the first digit of the hours entry.

Step 3b Enter hours. The entry must consist of two digits (e.g., 01, 12, etc.). When the second digit is entered, the cursor moves to the first digit of the minutes entry.

NOTE

NOTE

When 24-hour (military) time format is used, ensure that hours are entered in the correct format (e.g., 01, 12, 18, 21, etc.).

Step 3c Enter minutes. The entry must consist of two digits (e.g., 01, 22, 56, etc.). When the second digit is entered, the cursor moves to the first digit of the seconds entry.

NOTE

NOTE

To ensure accurate timing, set the minutes entry 2 minutes ahead of the actual time to allow sufficient time for Steps 3d and 3e below. Then, as the entered time arrives, perform Step 3f.

Step 3d Enter seconds. The entry must consist of two digits (e.g., 01, 12, 21, etc.). When the second digit is entered, the cursor moves to the first character of the time format (AM, PM, 24-HR).

Step 3e Use the arrow keys to display the desired time format entry. When using 24-hour (military) format, follow the time entry with (24 HR). When using standard 12-hour format, follow the time entry with AM or PM, whichever is appropriate.

Step 3f Press the ENTER key at the exact instant when the actual time coincides with the time entered on the display. Verify that the seconds portion of the display is now advancing.

Step 4 Press the down arrow key (↓) once. The following daylight savings display will appear:

PROGRAM DAYLIGHT SAVINGS:	ON
---------------------------	----

Step 4a Press the NEW DATA key. Each time the NEW DATA key is pressed, the entry toggles between OFF and ON. When daylight savings time is used, select ON and the recording will change the time setting automatically at the beginning (2:00 a.m. on the first Sunday in April) and end (2:00 a.m. on the last Sunday in October) of the daylight savings time period. Otherwise, select OFF.

Step 4b Press the ENTER key.

Step 5 To clear the data recorder memory, press and hold the CLEAR/OFF/PRINT switch (Figure 3-6) in the CLEAR position for approximately 5 seconds until the LO BATT LED indicator begins to flash. Release the switch. The recorder memory is now clear.

NOTE**NOTE**

Data recorder memory should be cleared at initial installation by performing this step immediately prior to placing the system in operation.

3.7 DATA RECORDER OPERATIONAL CHECKS

With the data recorder module (80015) installed and the system programmed (Section II, steps 11 and 16 through 18b), perform the following operational checks to verify proper data recorder operation prior to placing the 2000 MS into service. For either downloading recorded data to a computer file or printing recorded data, refer to paragraphs 6.3 or 6.4 in Section VI.

3.7.1 Verify Correct Time And Date

Step 1 Press the SYSTEM STATUS key.

Step 1a Use the up arrow key (↑) to scroll through the Status menu until the time/date display similar to the following appears.

STATUS	11:23:46A
FRI	21 FEB 1997

Step 1b Verify that the time and date appearing on the display are correct.

3.7.2 Verify Event Recording Operation

Step 2 Press the EVENT key. A display similar to that shown below appears. Note the value in the upper right corner (17 in the following example).

EVENTS	< 17 >
START PRINT:	1

DIAGNOSTICS

- Step 2a Observe one or more train moves.
- Step 2b Press the EVENT key. Verify that the number in the upper right corner of the display has advanced (note the new value).
- Step 2c If any of the 16 external inputs to the data recorder are used, activate one of the inputs at the interface panel by momentarily removing and then restoring the input. (Removing and restoring an input constitutes two input changes.)
- Step 2d Press the EVENT key. Verify that the number in the upper right corner of the display has advanced by 2.
- Step 2e Repeat steps 2c and 2d for each of the external inputs being used.
- Step 2f To clear the data recorder memory, press and hold the CLEAR/OFF/PRINT switch on the data recorder module (Figure 3-6) in the CLEAR position for approximately 5 seconds until the LO BATT LED on the module begins to flash. Release the switch. The recorder memory is now clear.

SECTION IV

DIAGNOSTICS

4.0 GENERAL

The advanced self-diagnostic capabilities of the 2000 MS software provide the system maintainer with three simple but effective diagnostic tools: Status Mode, Error (diagnostic) Mode, and History Mode. Maintainer interface with these modes is accomplished via a keyboard/display control unit (80019) that attaches to the front of the 2000 MS case.

The **Status Mode** enables the maintainer to monitor vital system parameters such as track ballast conditions, receiver signal levels, and critical voltage levels.

The **Error Mode** provides a visual indication in the form of diagnostic messages of abnormal internal and external system status. (External status includes track conditions that vary greatly from accepted levels while internal status can include memory and processor-related problems.)

The **History Mode** provides a record of warning times for the 20 most recent train moves (events) on a single-track system (10 per track if two tracks are monitored). Each of these modes is described in some detail in the paragraphs that follow. Also provided are diagnostic message code reference tables.

In addition to the three diagnostic modes, the system provides the maintainer with further diagnostic input through the use of status LED indicators located on each of the modules installed in the 2000 MS case. The function of each of these indicators is described in paragraph 4.5.

4.1 STATUS MODE

The Status Mode permits the maintainer to monitor track ballast conditions (EX), main receiver signal levels (EZ), transceiver voltage and current levels, and the outputs of the ± 5 , ± 8 , and ± 15 -volt power supplies.

When power is initially applied to the 2000 MS, or following a system reset, the unit executes a system test and initialization routine. When the routine is completed, an initial Status Mode display similar to the following appears:

STATUS T1			
EZ:	100	EX:	87

The Status Mode is the system default mode and the initial Status Mode display is the default display. When the 2000 MS is operating in any mode (i.e., Status, Error, or History) and no

keyboard entries are made within 90 seconds, the display automatically defaults to the display above.

When the enhanced track shunting detection (ED) operating mode is enabled and poor shunting conditions are detected, *ED* will be displayed as shown below. The *ED* indication will remain on the display for the duration of the train move until the train leaves the approach.

STATUS T1	*ED*
EZ: 100	EX: 87

4.2 VIEWING STATUS MODE MENU ENTRIES

The Status Mode is selected by pressing the SYSTEM STATUS key. When the initial Status Mode display appears, additional system parameters can be viewed by using the arrow keys to scroll through the Status Mode menu. The menu is continuous in that it starts over at the beginning when the end of the menu is reached. The Status Mode menu is depicted in flowchart format in Figure 5-8.

The system parameters described in the following paragraphs are presented in the order in which they appear in the Status Mode menu when scrolling with the down arrow key (↓). The values appearing in each of these parameter displays are updated every 1/2 second.

If the system is programmed for two tracks, pressing the TRACK 2 key causes similar information for track 2 to be displayed. Pressing the TRACK 1 key returns to the track 1 display.

4.2.1 Current Status of EZ and EX

A typical initial Status Mode display is shown below that indicates the current level of each of the parameters shown for the track indicated.

STATUS T1
EZ: 100 EX: 87

EZ = Main receiver level where: 100 = Unoccupied track

EX = Indication of track conditions where: 100 = Ideal track
85 = Nominal conditions
50 = Poor ballast

4.2.2 EX at Highest EZ

The display shown below indicates the highest EZ value recorded (HZ) for the track indicated and the value of EX when HZ was last updated. Due to the nature of the parameter, there is no default value for this item.

STATUS T1 MEMORY	
HZ: 145	EX: 45

4.2.3 EZ at Lowest EX

The following display indicates the value of EZ when the lowest value of EX (LX) was recorded for the track indicated. Due to the nature of the parameter, there is no default value for this item.

STATUS T1 MEMORY	
EZ: 95	LX: 62

4.2.4 Transmit Current

The following display indicates the transmitter current (in amperes) for the indicated track. It is updated every 1/2 second. Due to the nature of the parameter, there is no default value for this item.

STATUS T1	XMIT
CURRENT:	0.251 A

4.2.5 Transmit Voltage

The following display indicates the transmitter voltage (in volts) for the track indicated. It is updated every 1/2 second. The voltage varies for different motion sensor frequencies and track lengths, so due to the nature of the parameter, there is no default value for this item.

STATUS T1	
VOLTAGE:	1.32 V

4.2.6 ± 5 Volt Power Supply Status

The following display indicates the output voltage levels of the plus and minus 5-volt power supplies. It is updated every 1/2 second. Default settings are from 4.75 to 5.25 VDC.

STATUS	5 VOLT
+5.02	-5.01

4.2.7 ±8 Volt Power Supply Status

The following display indicates the output voltage levels of the plus and minus 8-volt power supplies for the track (transceiver) indicated. It is updated every 1/2 second. Default settings are from 7.2 to 8.8 VDC.

STATUS T1	8 VOLT
+8.26	-8.24

4.2.8 Power Supply Status

The following display indicates the output voltage levels of the plus and minus 15-volt power supplies. It is updated every 1/2 second. Default settings are from 14.1 to 15.9 VDC.

STATUS	15 VOLT
+14.7	-14.6

4.2.9 Time/Date Display with Data Recorder Module Installed

If the data recorder option is installed and selected, the following status display is selectable:

STATUS	11:23:46A FRI
21 FEB 1997	

The display indicates the current time and date. Time is shown in 12-hour format as hh:mm:ss followed by A (AM) or P (PM) or by a space in 24-hour format.

4.3 ERROR MODE

The Error (diagnostic) Mode provides a visual indication of previous or present conditions (both internal and external). Diagnostic messages indicating external system status are recorded when track conditions vary greatly from established levels while internal status messages can indicate memory and processor errors.

Select the Error Mode by pressing the ERROR key. If no diagnostic messages have been recorded, the following display will appear:

ERROR	< 0 >
-------	-------

If one or more messages have been recorded, the initial Error Mode display indicates the most recent diagnostic message recorded. A typical Error Mode display is shown as follows:

ERROR	9112 < 3 >
T2 GAIN CHECK	

The four-digit number immediately following the word Error is a code corresponding to a specific diagnostic message. The value enclosed by the bracket symbols (<X>) indicates the number of messages recorded. Use the up (↑) and down (↓) arrow keys to view the other recorded messages. Each time an arrow key is pressed, the number in the bracket will increment or decrement, and the four-digit code corresponding to the associated diagnostic message will be displayed. A brief statement describing the diagnosed problem appears in the second row of the display. Table 4-2 at the end of this section lists the four-digit diagnostic message codes and provides a brief description of each message.

To determine if an “ERROR” situation indicated on the display by a four-digit diagnostic message code is current and has not been corrected, perform the following system error reset to clear the error memory. Any ERROR codes remaining after memory is cleared indicate current active error situations.

NOTE**NOTE**

Clearing this portion of memory will also reset the HZ (highest EZ value recorded) and LX (lowest EX value recorded) values to the present values of EZ and EX.

To clear the recorded messages from memory and reset the HZ and LX values, perform the following:

Step 1 Press the SYSTEM RESET key. The following message will be displayed:

SYSTEM RESET

Step 2 Press and hold the SYSTEM RESET key for approximately 3 seconds. The following message will be displayed:

PRESS ENTER TO
CLEAR ERRORS

Release the SYSTEM RESET key.

Step 3 Press the ENTER key. When memory is clear, the following message is displayed provided that all error situations have been corrected. However, any current active error situation(s) will be indicated by the appropriate diagnostic message code(s) as follows:

ERROR < 0 >

4.4 HISTORY MODE

The History Mode provides a record of warning times for the 20 most recent train moves on a single track (10 train moves per track when two tracks are monitored).

Each train move is assigned a number (1 to 10 or 1 to 20, depending on the number of tracks monitored). Train move number 1 is the oldest and the highest number is the most recent. When the number of train moves exceeds 10 (20), the next train move recorded is assigned the highest number (10 or 20), all previously recorded train moves drop to the next lowest number, and the oldest recorded train move is removed from the record. Performing a system reset, clearing the history, or removing power from the equipment for an extended period of time, clears that portion of memory containing the train move records.

To view the train move records, select the History Mode by pressing the HISTORY key. The initial history display identifies the track for which the train moves were recorded, the number of train moves recorded (in the brackets <X>), and warning times.

HISTORY T1	<12>
WARNING TIME:	35

To view the recorded train moves for track 2, press the TRACK 2 key. Press the TRACK 1 key to return to the track 1 display.

The up (↑) and down (↓) arrow keys are used to select the train move number (indicated on the display) for which the warning times will be displayed. Each time one of these keys is pressed, the train move number in the brackets increments or decrements, depending on the key pressed.

4.5 MODULE-MOUNTED STATUS INDICATORS

Each module installed in the 2000 MS case (except the 80028 transfer timer) contains a status LED indicator located on the front edge of the module near the top. A glance at these normally-lighted indicators will quickly lead the maintainer to a malfunctioning module. In addition, certain modules are equipped with a second LED indicator (located immediately below the status LED) which indicates the status of a vital system function directly associated with the module. These indicators are under direct control of the microprocessor and are identified in Table 4-1.

Table 4-1. Module-Mounted Status Indicators

Module Part No.	Indicator Nomenclature	Indication
80011/80211	STATUS	Lighted steady = island relay drive present Extinguished = no island relay drive
80012	STA	Lighted steady = module operational Flashing = problem on module or associated track or wires
	PRD	Motion indicator. Normally lighted. Extinguished when inbound motion is detected
80013	STA	Lighted steady = module operational Flashing = problem on module
80224	STA	Lighted steady = module operational Flashing = problem on module
	ACT	Activity indicator. Flashes when processor is operational and program is running; extinguished if processor fails
	SERVICE	Flashes when the SERVICE REQUEST push button on the module is pressed and when the network is accessed.
80015 / 80115	STATUS	Lighted steady = module operational Flashing = problem on module
	LO BATT	On-board battery status indicator. Lighted steady when battery level is normal. Flashes when battery is low or dead
80020	N/A	Status LED. Mounted on keyboard interface printed circuit board (80017) and extends through panel above control interface assembly. Lighted steady = assembly operational Flashing = problem on keyboard interface printed circuit
80028 (2000S2)	XFER	Transfer indicator. Normally lighted. Extinguished when a main-to-standby 2000 MS transfer has occurred since the RESET switch was last pressed.

4.6 TROUBLESHOOTING

Field troubleshooting can be easily accomplished by following the TROUBLESHOOTING CHART located at the back of this manual. The chart provides an orderly means of first determining whether the track (track wires, couplers, termination shunts, bonds) or the 2000 MS unit has a problem or failure. Secondly, if the 2000 MS is determined to be the source of the failure, the chart indicates which module to change out. Additional troubleshooting information is provided in the following paragraphs.

4.6.1 High Signal Detection (Open Track)

An open track generally causes a high signal condition (error code 9015 or 9016, EZ in excess of 115). This can be caused by open termination shunts, defective insulated joint couplers, or

open/high resistance bonds. See the following paragraphs for specific troubleshooting information.

4.6.1.1 Defective Termination Shunts

There are three types of termination shunts: hardwire, wideband, and narrow-band (NBS). To test the termination shunt, place a hardwire shunt across the termination and note the change in EZ.

- If termination is hardwire, no EZ change should occur.
- If termination is wideband, a change of no more than ± 2 should occur.
- If termination is NBS, a decrease in EZ of up to 30 can occur depending upon frequency and approach length. Lower frequencies and shorter approaches produce greater change. If an increase in EZ is noted, then the NBS is defective.

4.6.1.2 Defective Couplers

There are two types of insulated joint couplers: wideband and Tunable Insulated Joint Couplers (TIJC). The couplers can be field tested for proper operation as follows:

1. Connect a hardwire shunt on the crossing side of the joint coupler and note the EZ value.
2. Move the hardwire shunt to the termination side of the joint coupler and note the EZ value.
3. Remove the hardwire shunt. Note the difference in EZ values between steps 1 and 2.
 - If the coupler is a wideband shunt, a difference in EZ of no more than ± 2 should occur or the wideband shunt is defective.
 - If the coupler is a TIJC (located in the outer half of the approach), the EZ difference should be no more than ± 3 or the TIJC is mis-tuned or defective.

4.6.1.3 Open Or High Resistance Bond, Broken Rail

When EZ is unstable or in high signal, it can be the result of varying bond resistance or intermittent open track due to bad bonds or broken rail. If bonding is suspected, the approaches should be walked and the bonds checked for integrity.

4.6.2 Low EX

4.6.2.1 At New Installations

If a low EX condition is occurring at a cutover of a new installation, check for the following:

- Bad bonds
- Defective insulated joint couplers
- Missing battery choke in approaches
- Defective gauge rods or switch rods
- Open termination shunt
- Improper application of other frequency NBS in the approaches.

4.6.2.2 At In-service Installations

If track conditions are extremely wet (possibly salted crossing) at an in-service crossing and a low EX condition is presently occurring (EX below 39), then perform the Low EX Test procedure provided below to determine if the low EX threshold can be reduced below 39.

- **Low EX Test**

1. With EX in failure (below 39), connect a hardwire shunt at the termination shunt of the longest approach and note the EZ value.
2. Move the hardwire shunt in to the 90% point of the approach and note the EZ value.
3. The EZ value at the 90% point must be at least 5 less than the EZ value at the termination shunt to allow safe adjustment of the EX threshold below 39.

- **Low EX Adjustment**

This adjustment must be initially made at low ballast when EZ is less than 39 and the “Low EX Test” provided above has been passed (EZ changes a minimum of 5). **IF IT IS NOT - DO NOT PROCEED!**

1. Press the STATUS key and note the value of EX (must be between 34 and 39 to be valid).
2. If EX is between 34 and 39 (inclusive), subtract the EX value from 39 (remainder should be between 0 and 5). Note this value.
3. Press the FUNCTION key and then press the up arrow key (↑) twice. Verify that LOW EX ADJUSTMENT is displayed.
4. Press the NEW DATA key.
5. Enter the value (remainder) noted in step 2.
6. Press the ENTER key. Verify that the value entered remains on the display.
7. Enter the low EX adjustment value on the 2000 MS Application History Card for track(s) affected.

Table 4-2. Diagnostic Message Code Reference

Code	Text Displayed	Description	Possible Cause
1100	ROM	ROM Checksum Error	80224 Processor Module
1200	RAM	RAM Read/Write Error	80224 Processor Module
1300	NOVRAM	NOVRAM Checksum Error	80020/80029 Keyboard/Display Interface Module
1400	ROM	ROM Checksum Error (System Reset)	80224 Processor Module

Continued on next page

Table 4-2 continued

Code	Text Displayed	Description	Possible Cause
1500	RAM	RAM Read/Write Error (System Reset)	80224 Processor Module
1600	NOVRAM	NOVRAM Checksum Error (System Reset)	80020/80029 Keyboard/Display Interface Module
4000	ENA INPUT	ENA Input Error	80013 Relay Drive Module
4001	UAX INPUT	UAX Input Error	80013 Relay Drive Module
4002	T1 ISLAND INPUT	Island Relay Drive 1 Input Error	80013 Relay Drive Module
4003	T2 ISLAND INPUT	Island Relay Drive 2 Input Error	80013 Relay Drive Module
4102	MS OUTPUT	MS Relay Drive Output Error	80013 Relay Drive Module
4105	AT OUTPUT	Approach Track Output Error	80013 Relay Drive Module
5001	DATA RECORDER	Data Recorder Not Responding	80015 Data Recorder Module
5002	DATA RECORDER	Incorrect Data Transmission	80015 Data Recorder Module
5003	RECORDER ROM	Recorder ROM Checksum Error	80015 Data Recorder Module
5004	RECORDER RAM	Recorder RAM Checksum Error	80015 Data Recorder Module
8001	-5 VOLT SUPPLY	- 5 Volt Power Out of Range	80013 Relay Drive Module
8002	+5 VOLT SUPPLY	+5 Volt Power Out of Range	80013 Relay Drive Module
8003	T1 -8V SUPPLY	Track 1 -8 Volt Power Out of Range	80012 Transceiver Module (left)
8004	T1 +8V SUPPLY	Track 1 +8 Volt Power Out of Range	80012 Transceiver Module (left)
8005	T2 -8V SUPPLY	Track 2 -8 Volt Power Out of Range	80012 Transceiver Module (right)
8006	T2 +8V SUPPLY	Track 2 +8 Volt Power Out of Range	80012 Transceiver Module (right)
8007	-15 VOLT SUPPLY	-15 Volt Power Supply Out of Range	80013 Relay Drive Module
8008	+15 VOLT SUPPLY	+15 Volt Power Supply Out of Range	80013 Relay Drive Module
8113	T1 XMIT CURRENT	Track 1 Transmit Current Low	80012 Transceiver Module (left), transmit track wires
8114	T1 XMIT CURRENT	Track 1 Transmit Current High	80012 Transceiver Module (left)
8117	T2 XMIT CURRENT	Track 2 Transmit Current Low	80012 Transceiver Module (right), transmit track wires
8118	T2 XMIT CURRENT	Track 2 Transmit Current High	80012 Transceiver Module (right)
8200	FREQUENCY	Processor Frequency Out of Range	80224 Processor Module
8201	T1 FREQUENCY	Track 1 Frequency Out of Range	80012 Transceiver Module (left)
8202	T2 FREQUENCY	Track 2 Frequency Out of Range	80012 Transceiver Module (right)
8300	T1 SELF-CHECK	Track 1 Self-check Not Successful	80012 Transceiver Module (left)
8301	T2 SELF-CHECK	Track 2 Self-check Not Successful	80012 Transceiver Module (right)
9011	T1 LOW EX	Track 1 EX Under Low Limit	Low Ballast
9012	T1 HIGH EX	Track 1 EX Over High Limit	80012 Transceiver Module (left)

Continued on next page

Table 4-2 Concluded

Code	Text Displayed	Description	Possible Cause
9013	T2 LOW EX	Track 2 EX Under Low Limit	Low Ballast
9014	T2 HIGH EX	Track 2 EX Over High Limit	80012 Transceiver Module (right)
9015	T1 HIGH EZ	Track 1 EZ Over High Limit	Bond, termination, tunable insulated joint bypass couplers, or connections
9016	T2 HIGH EZ	Track 2 EZ Over High Limit	Bond, termination or tunable insulated joint bypass couplers, or connections
9021	T1 CHECK CHANNEL	Track 1 Channel 2 EZ Over High Limit	80012 Transceiver Module (left), transmit track wires
9022	T2 CHECK CHANNEL	Track 2 Channel 2 EZ Over High Limit	80012 Transceiver Module (right), transmit track wires
9031	T1 LOW EX *ADJ*	Track 1 EX Under Low Adjustment	Low Ballast
9032	T1 ADJ LOW EX	Track 1 EX Under 39	Low Ballast
9033	T2 LOW EX *ADJ*	Track 2 EX Under Low Adjustment	Low Ballast
9034	T2 ADJ LOW EX	Track 2 EX Under 39	Low Ballast
9111	T1 GAIN CHECK	Track 1 Channel 2 Out of Range	Bond Within Island, Receiver Connection, track wires
9112	T2 GAIN CHECK	Track 2 Channel 2 Out of Range	Bond Within Island, Receiver Connection, track wires
9115	T1 EX PROCESS	Track 1 EX Process Error	High Resistance Bond
9116	T2 EX PROCESS	Track 2 EX Process Error	High Resistance Bond
9400	T1 ENHANCED DET	Track 1 Switched to *ED* Mode	Poor Track Shunting Conditions on Track 1
9401	T2 ENHANCED DET	Track 2 Switched to *ED* Mode	Poor Track Shunting Conditions on Track 2

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SECTION V

PRIMARY EQUIPMENT FAMILIARIZATION; KEYBOARD AND MENU DESCRIPTIONS

5.0 GENERAL DESCRIPTION

Each 2000 MS is housed in a gray powder coat, aluminum case assembly containing a back-plane-mounted motherboard (see Figures 5-1 and 5-2). The motherboard provides connectors to accommodate a maximum of seven plug-in-type printed circuit modules in the Model 2000 and 11 modules (includes one Transfer Timer Module, 80028) in the Model 2000S2. Refer to Table 5-1 for complete system module/assembly requirements.

All external wiring connections to the 2000 MS case are accomplished via standard AREMA terminals arranged in horizontal rows across the front panel of the case. Indicators (LEDs) located on the front panel of each 2000 MS case and on each plug-in module provide a visual indication of module operating status plus various system functions. The functions of each AREMA terminal and LED indicator, as well as any switches and connectors located on the case and modules, are described in the following paragraphs.

5.1 PLUG-IN PRINTED CIRCUIT MODULES

Each plug-in module used in the 2000 MS is 8 inches (20.3 cm) high by 8.9 inches (22.6 cm) wide and is equipped with a dual 43-pin connector on one edge which plugs into a corresponding edge connector on the motherboard. An ejector lever is mounted on the top corner of each module (except transfer timer module 80028) to facilitate removal from the case. Each ejector lever is stamped with the module part number. See Table 5-1 for system module requirements.

NOTE

NOTE

The following module descriptions refer to the modules comprising a single module set (2000 MS). The two module sets housed in the Model 2000S2 case must be identical except as noted in Table 5-1.

5.1.1 Island Module, 80011-f/80211

Each island module consists of separate transmitter and receiver circuits. The 11 frequencies provided by the 80011 island module range from 4.0 to 20.2 kHz. In addition to the same 11 frequencies provided by the 80011 module, the 80211 island module also supplies frequencies of 2.14, 2.53, and 3.24 kHz. The transmitter circuits are transformer-coupled to the front panel XMT 1 and XMT 2 terminals, which are then connected by a pair of wires to the 2000 MS transmit feed points on the rails, providing a path for both the motion sensor and island transmitter signals.

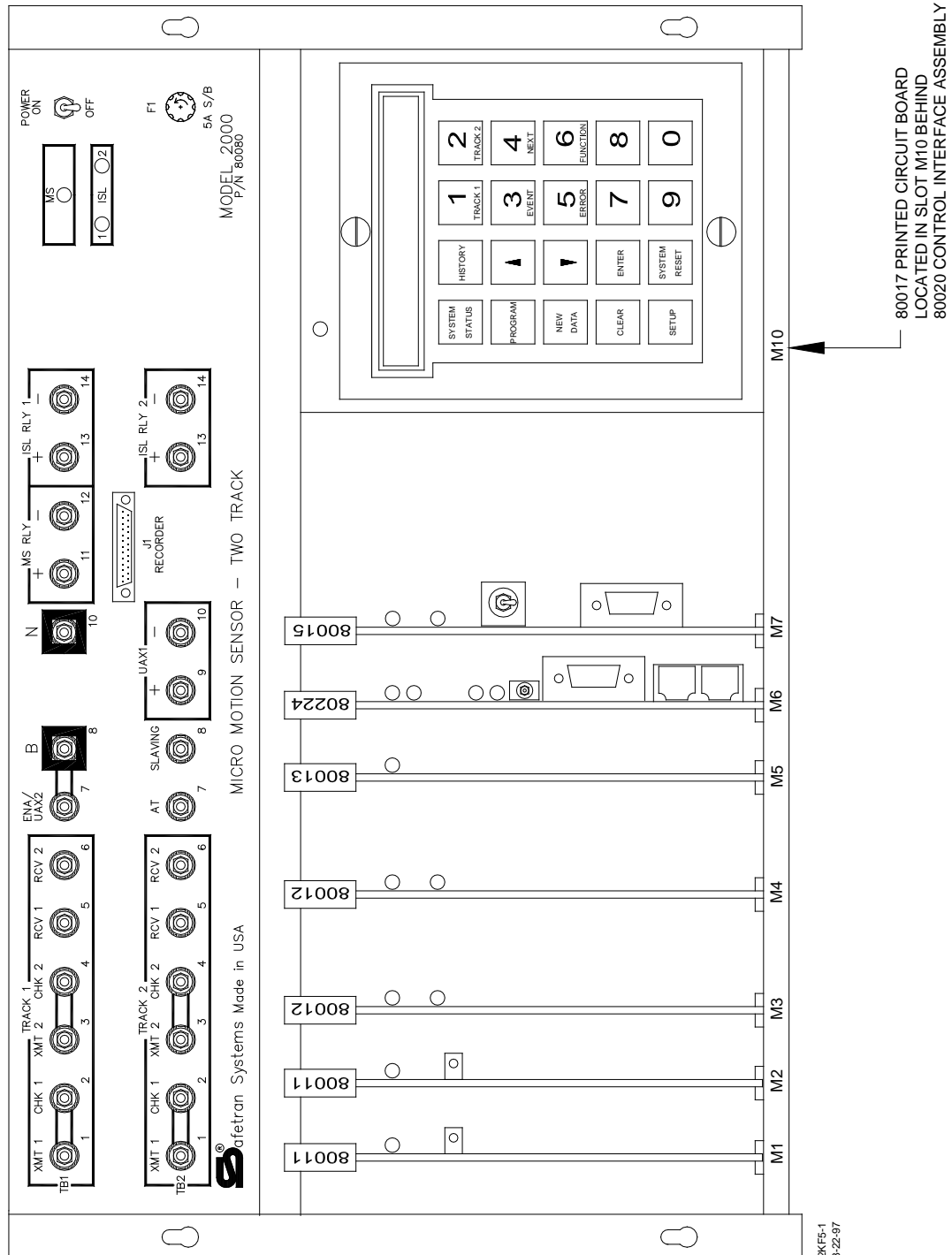


Figure 5-1. Model 2000 Motion Sensor with all Optional Modules Installed, Front View

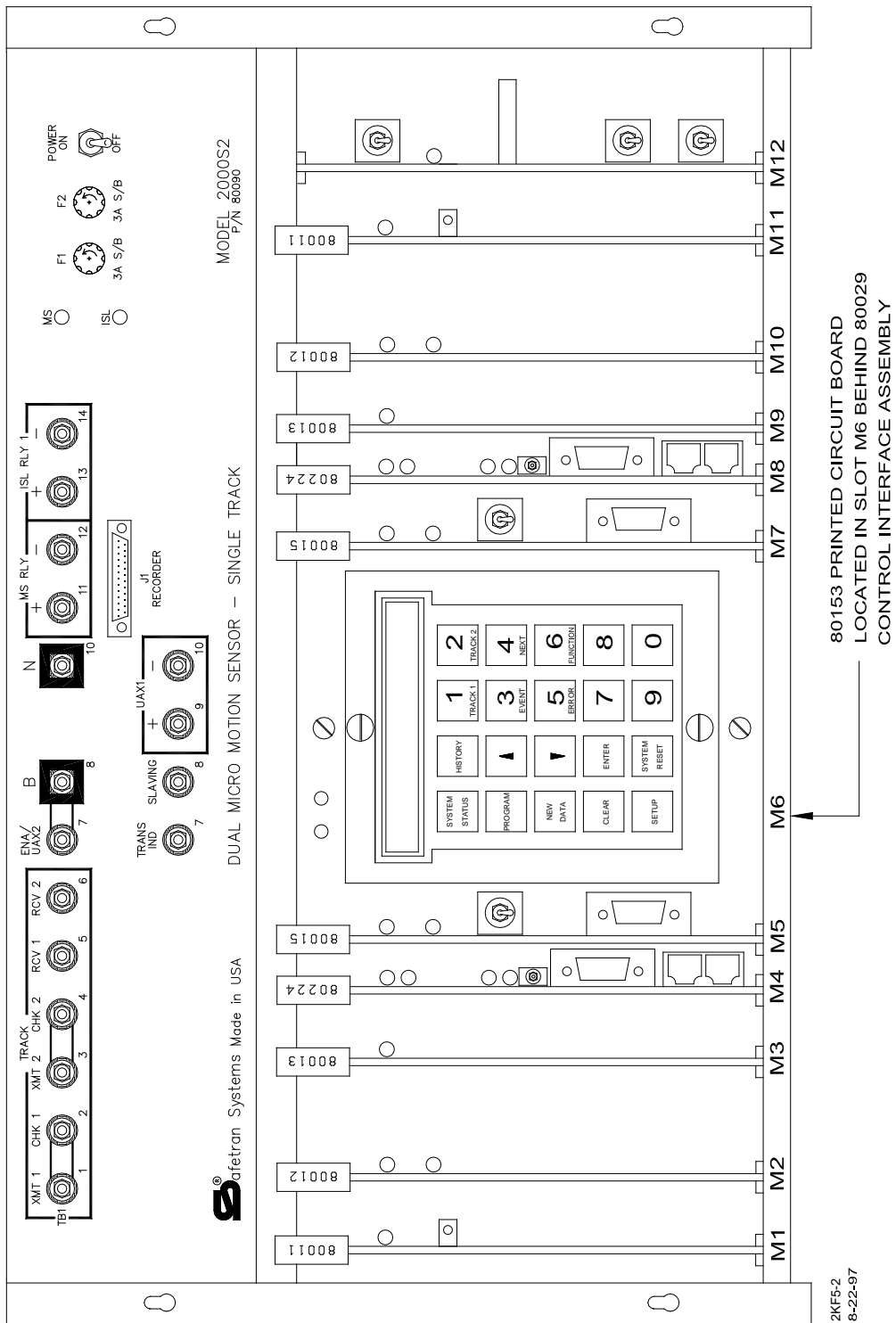


Figure 5-2. Model 2000S2 Motion Sensor with all Optional Modules Installed, Front View

Table 5-1. System Module/Assembly Requirements

Module	Part No.	Module Slot Assignments ¹	
		Model 2000 (P/N 80080)	Model 2000S2 (P/N 80090)
Island (1 or 2) (Optional)	80011/ 80211	M1 (Track 1) M2 (Track 2)	M1 and M11 ²
Transceiver (Minimum 1)	80012	M3 (Track 1) M4 (Track 2)	M2 and M10 ²
Relay Drive	80013	M5	M3 And M9
Processor	80224	M6	M4 And M8
Data Recorder (Optional)	80015 / 80115	M7	M5 And M7
Keyboard/Display Control Unit	80019	M10 ³	M6 ³
Control Interface Assembly (Includes Keyboard Interface Printed Circuit Board, 80017)	80020	M10 ³	N/A
Control Interface Assembly (Includes Keyboard Interface Printed Circuit Board, 80153)	80029	N/A	M6 ³
Transfer Timer	80028	N/A	M12

1. Module slots are numbered from left to right as viewed from the front of the case.
2. Corresponding modules in the left and right halves of the case should be the same frequency.
3. Plugs into control interface assembly (80020/80029).

The island receiver circuits are transformer-coupled to the TRACK RCV 1 and RCV 2 terminals on the front panel. The output voltage from the island relay drive output is connected to the island relay drive terminals on the front panel. When a train reaches the island circuit, the island relay drive signal ceases, ensuring the voltage continues to be removed from the ISL RLY terminals. When the last car clears the island circuit, the transmitter signal returns to normal, activating the receiver and allowing the crossing warning signal to recover.

5.1.2 Transceiver Module, 80012

The basic 2000 MS system includes a single transceiver module. However, a second identical transceiver module can be added to enable a single system to operate with two unidirectional approaches, two bidirectional approaches, or one unidirectional and one bidirectional approach. When two transceiver modules are used, the 2000 MS can be programmed for different operating frequencies for track 1 and track 2. High power transmitter drive is also a standard feature and minimizes the requirement for a high-current transmitter coupler. The transceiver module contains transmitter and receiver transformers, transmitter driver, receiver filters, amplitude and zero-crossing detectors, plus digitally controlled gain and attenuator circuits.

5.1.3 Relay Drive Module, 80013

A single relay drive module is required for each system. The relay drive module contains a relay driver circuit, analog-to-digital converters, system power supply (DC-to-DC converter), plus island, UAX1, and ENA/UAX2 isolation circuits.



WARNING

WHEN A 2000 MS IS APPLIED SO THE UAX, ISL RLY, MS/GCP CONTROL AND/OR ENA INPUT ON A SINGLE 3000 GCP AND/OR 2000 MS UNIT IS DIRECTLY DRIVEN BY (NO RELAY ISOLATION) THE GCP RLY (3000 GCP) AND/OR MS RLY (2000 MS) OUTPUT OF ANOTHER UNIT, THE SAFETRAN RELAY ADAPTER MODULE A80170 MUST BE USED PER SAFETRAN BULLETIN CSB 1-05. REFER TO PARAGRAPH 5.1.9 FOR INFORMATION AND INSTALLATION INSTRUCTIONS ON THE RELAY ADAPTER MODULE A80170.

5.1.4 Processor Module, 80224 (Equipped with 9V126-01F Software)

Each basic system requires a single processor module containing the microprocessor, memory (including both RAM and ROM), and a digitally-controlled frequency generator. The operating program for the 2000 MS is contained in flash memory devices located on the processor module. This permits operational features to be enhanced by simply downloading new software. New software revisions may be installed using a laptop computer and a Safetran provided compact disc.

5.1.5 Data Recorder Module, 80015/80115

The optional data recorder module allows information concerning train moves and system status messages to be stored for future use. The module contains a microprocessor, onboard memory (RAM and ROM), plus a real-time clock. A long-life lithium battery provides backup power in the event of failure of the primary power source. An RS232C interface is provided for local access to stored information via a personal computer (PC) or portable printer.

A basic system will retain train history information for a maximum of 20 moves without the data recorder module. However, only warning time and speed for each move is stored (not date and time). When two transceiver modules are used, a maximum of 10 moves will be retained for each track circuit (T1 and T2). With the data recorder module installed, event capacity is increased to approximately 3,000 events, including the date and time for each event. Refer to Section VI, Data Recorder, for additional information.

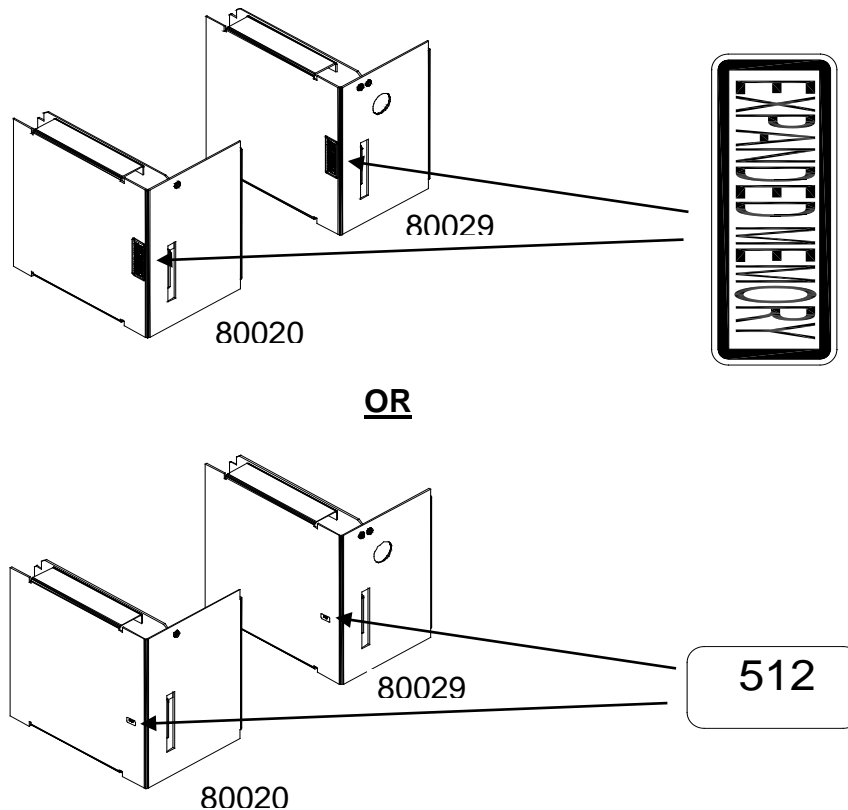
5.1.6 Control Interface Assembly, 80020

The control interface assembly (80020) contains the keyboard interface printed circuit board (80017) and is part of the basic 2000 MS system. The unit is installed in the right end (slot M10 in the 80080 case) and provides the interface between the detachable Keyboard/Display Control Unit, 80019 and the 2000 MS data bus. The presence of expanded NOVRAM memory modules is indicated by the presence of an **Expanded Memory** or a **512** sticker placed at the edge of the assembly as shown in the figure below.

5.1.7 Control Interface Assembly, 80029

The control interface assembly (80029) contains the keyboard interface printed circuit board (80153). The unit is installed in the center of the card cage (slot M6 in the 80090 case) and provides the interface between the detachable keyboard/display control unit (80019) and the 2000 MS data bus in each half of the card cage.

Control signals from the transfer timer module (80028) are applied to tri-stated switching circuits on the keyboard interface printed circuit board (80153) to determine which half of the card cage is interfaced to the keyboard. The presence of expanded NOVRAM memory modules is indicated by the presence of an **Expanded Memory** or a **512** sticker placed at the edge of the assembly as shown in the figure below.



5.1.8 Transfer Timer, 80028 (Model 2000S2 Only)

The far right card slot (M12) contains the transfer timer module (80028). If the main 2000 MS circuits (located in the left half of the case) fail, the relays and associated control circuits on the transfer timer module provide switch over from the main motion sensor circuits to identical standby circuits (located in the right half of the case). A switch-over interval ranging from 1 to 31 minutes in 1-minute increments is selectable on the module. Programming is generally not required, however, since the unit is set at the factory for the recommended delay of 3 minutes. During the switch-over period, the crossing warning signal equipment (gates, lights, bells, etc.) is enabled. In the event the standby circuits fail following switch-over, circuits on the transfer timer module will continue to search for an operational motion sensor system.

The switch-over interval is programmable via DIP switch S4 located on the transfer timer module (see Figure 5-3). The five S4 segments correspond to the binary values printed on the module adjacent to S4. To select a value, the corresponding switch lever(s) is/are pressed down (ON) as shown.

The transfer timer module is also used with Safetran's Model 3000 Family of GCPs to control switch over of GCP DAX circuits. However, when the module is used in a 2000 MS, all four sections of DIP switch S1 (labeled A, B, C, and D) must be set to the DAX NOT USED position (see Figure 5-3). For a description of the remaining switches shown in Figure 5-3, see Table 5-3.

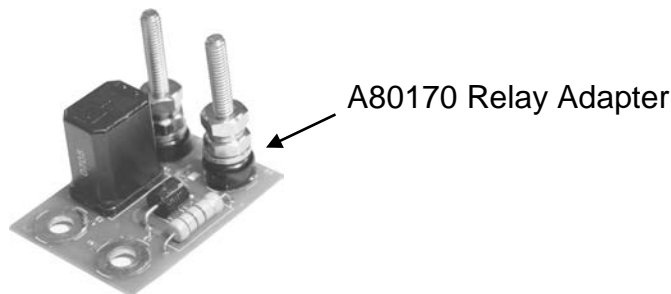
5.1.9 Relay Adapter Module, A80170

Relay Adapter Module (Safetran P/N 8000-80170-001) (see photo below) must be installed in all existing and future applications where a 2000 MS will be used to directly drive (no relay isolation) any UAX, ISL RLY, MS/GCP CONTROL and/or ENA input on a single 3000 GCP and/or 2000 MS unit by the GCP RLY (3000 GCP) and/or MS RLY (2000 MS) output of another unit. The Relay Adapter Module A80170 is installed externally to the 2000MS unit and can be wired into the system as shown in Figure 8-7.

NOTE

NOTE

The Relay Adapter Module is not required where vital relays are used as an interface between the UAX, ISL RLY, MS/GCP CONTROL and/or ENA inputs of one unit and the GCP RLY (3000GCP) or MS RLY (2000MS) output of another unit.



Perform the following steps to install the Relay Adapter Module on a 2000 MS Unit:

1. Remove all wires from terminal 11 on the front panel, including any event recorder wires (terminal 11 = MS RLY (+)).
2. Connect all wires removed in step 1 to the OUT (+) terminal on the A80170 Relay Adapter Module.
3. Remove all wires from terminal 12 on the front panel, including any event recorder wires (terminal 12 = MS RLY (-)).
4. Connect all wires removed in step 3 to the OUT (-) terminal on the A80170 Relay Adapter Module.
5. Slide the mounting holes at the base of the A80170 Module onto terminals 11 and 12 of the 2000MS unit. Fasten the A80170 Module securely using appropriate AREMA-compliant hardware.
6. When installation of the A80170 module is complete, test UAX, ISL RLY, MC/GCP CONTROL and/or ENA circuits per railroad policies and procedures.

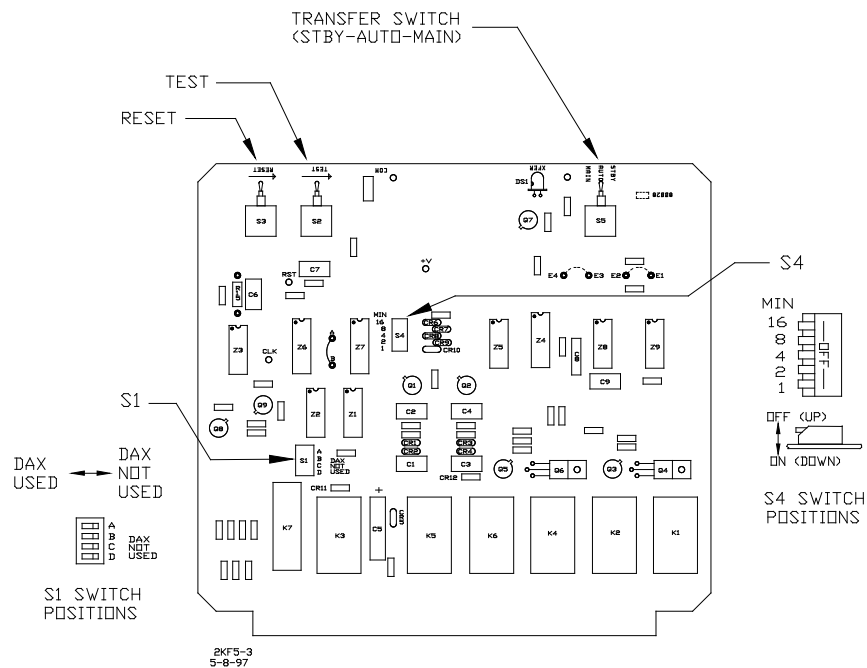


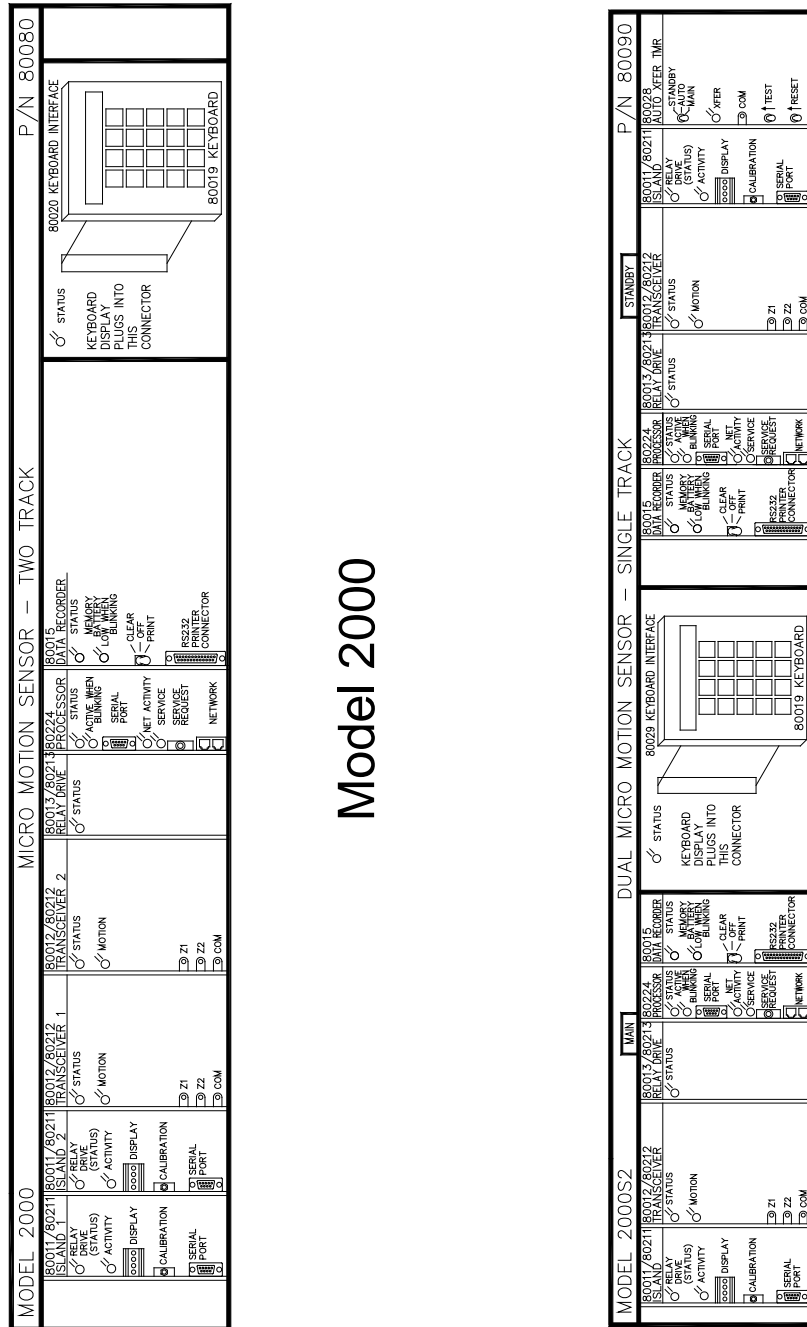
Figure 5-3. Switch Locations on Transfer Timer Module, 80028

5.2 MODULE INDICATORS, CONTROLS, SWITCHES, TEST JACKS, AND CONNECTORS

Refer to the module locator guides in Figure 5-4 for the location of each LED status indicator, control, switch, test jack, and connector described in Tables 5-2 (status indicators), 5-3 (control and switches), and 5-4 (test jacks and connectors).

5.3 FRONT PANEL TERMINALS, INDICATORS, AND CONTROLS

Models 2000 and 2000S2 MS front panel terminals, indicators, and controls, are shown in Figures 5-1 and 5-2, respectively, and are described in Table 5-2.



Model 2000

Model 2000S2

Figure 5-4. Models 2000 and 2000S2 MS Module Locator Guides

Table 5-2. Module Mounted LED Status Indicators

Module	Nomenclature	Indication
80011 (see Section III)	STATUS	Lighted steady = island relay drive present Extinguished = no island relay drive
80012	STATUS	Lighted steady = module operational Flashing = problem on module or track
	MOTION	Motion indicator. Normally lighted; extinguished when inbound motion is detected
80013	STATUS	Lighted steady = module operational Flashing = problem on module
80015 / 80115	STATUS	Lighted steady = module operational Flashing = problem on module
	LOW BATTERY	On-board battery status indicator. Lighted steady when on-board lithium battery voltage is normal; flashes when battery is low
80020	n/a	Status LED. Mounted on keyboard interface printed circuit board (80017) and extends through panel above control interface assembly. Lighted steady = assembly operational Flashing = problem on keyboard interface printed circuit board
80028 (2000S2 only)	XFER	Transfer indicator. Normally lighted; extinguishes when main-to-standby GCP transfer occurs
80211	RELAY DRIVE (STATUS)	Lighted steady = island relay drive present Extinguished = no island relay drive
	ACTIVITY	Lighted steady = system being initialized or system calibration Flashing = module operational
80224	STATUS	Lighted steady = module operational Flashing = problem on module
	ACTIVITY	Activity indicator. Flashes when processor operational and pro-gram running; extinguished if processor fails or lighted steady
	NET ACTIVITY	Flashes to indicate activity on the network (future use)
	SERVICE	Flashes when the SERVICE REQUEST pushbutton on module is pressed and when network is accessed (future use).

Table 5-3. Module Mounted Controls and Switches

Module	Nomenclature	Function
80011	ADJ	A potentiometer for island circuit adjustment during system calibration (see Section III).
80015 / 80115	CLEAR-OFF- PRINT	A switch that controls data recorder module memory clear and print functions.
80028 (2000S2 Only)	STANDBY- AUTO -MAIN	A switch that selects standby/main operating system or automatic transfer mode.
	TEST	A switch that, when pressed, forces automatic transfer from main to standby module set.
	RESET	Following transfer, press switch to return to main module set.
80211	CALIBRATION	A pushbutton switch that, when pressed, automatically adjusts the island circuit shunting threshold level.
80224	SERVICE REQUEST	A switch that, when pressed, accesses the network (future use).

Table 5-4. Module Mounted Test Jacks and Connectors

Module	Nomenclature	Function
80011 (see Section III)	+7	+7 VDC test jack
	+4	+4 VDC test jack
	MOD	Modulation test jack. Measures -5 VDC when modulation is detected.
	ENV	Envelope test jack. Voltage from +1 to -5 VDC with -3 VDC at minimum detection threshold and -5 VDC at saturation.
	COM	Signal common test jack
80012	Z1	Analog approximation (not linearized) of EZ value on main channel as displayed on 80019 display. Approximately 10 VDC when no train is present; 0 VDC with a train in the island circuit
	Z2	Analog equivalent of check channel
	COM	Signal common test jack
80015 / 80115	RS232 PRINTER CONNECTOR	RS232 printer connector
80028	COM	Signal common test jack
80211	DISPLAY	Four-character alphanumeric display indicates island frequency
	SERIAL PORT	RS232 serial port used for system diagnostics and upgrading of onboard firmware
80224	SERIAL PORT	RS232 serial port used for system diagnostics and upgrading of onboard firmware
	NETWORK	Dual RJ11 connectors. For use with Echelon bus

Table 5-5. Model 2000 MS Front Panel Terminals, Indicators, and Controls

Terminal/- Indicator/ Control	Nomenclature	Function
TB1-1	TRACK 1 XMT 1	MS track 1 transmitter output to track
TB1-2	TRACK 1 CHK 1	MS check receiver input from track 1
TB1-3	TRACK 1 XMT 2	MS track 1 transmitter output to track
TB1-4	TRACK 1 CHK 2	MS check receiver input from track 1
TB1-5	TRACK 1 RCV 1	MS track 1 receiver input from track
TB1-6	TRACK 1 RCV 2	MS track 1 receiver input from track
TB1-7	ENA/UAX2	Used to cascade the relay drive output (XR circuit) from another 2000 MS. Voltage level at this terminal must be greater than +5 VDC. Normally connected to TB1-8 (B) when not in cascade operation. The ENA/UAX2 terminal also provides the functions of a second UAX input to the motion sensor. It may also remain a conventional ENA function when programmed for zero time when cascading motion sensor outputs. A 25-second ENA/UAX2 default time is provided.
TB1-8	B	Battery B input to 2000 MS case
TB1-10	N	Battery N input to 2000 MS case
TB1-11	MS RLY +	Positive (+) 2000 MS relay drive output. Drives relays of 400 to 1,000 ohms.
TB1-12	MS RLY -	Negative (-) 2000 MS relay drive output. Drives relays of 400 to 1,000 ohms.
TB1-13	ISL RLY 1 +	Positive (+) island 1 relay drive output. May be used to drive external island relay of 400 to 1,000 ohms, where desired.
TB1-14	ISL RLY 1 -	Negative (-) island 1 relay drive output. May be used to drive external island relay of 400 to 1,000 ohms, where desired.
TB2-1	TRACK 2 XMT 1	MS track 2 transmitter output to track
TB2-2	TRACK 2 CHK 1	MS check receiver input from track 2
TB2-3	TRACK 2 XMT 2	MS track 2 transmitter output to track
TB2-4	TRACK 2 CHK 2	MS check receiver input from track 2
TB2-5	TRACK 2 RCV 1	MS track 2 receiver input from track
TB2-6	TRACK 2 RCV 2	MS track 2 receiver input from track
TB2-7	AT	Signal output used in automatic transfer applications. Connects to AT terminal on automatic transfer timer unit (80069) to indicate to the timer unit that MS has detected a train. No connection if not used
TB2-8	SLAVING	Connects to SLAVING terminal on other 2000 MS when units are frequency slaved. Both motion sensors must be programmed for proper slave status. No connection if not used

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Table 5-5 (Concluded)

Terminal/- Indicator/ Control	Nomenclature	Function
TB2-4	TRACK 2 CHK 2	MS check receiver input from track 2
TB2-5	TRACK 2 RCV 1	MS track 2 receiver input from track
TB2-6	TRACK 2 RCV 2	MS track 2 receiver input from track
TB2-7	AT	Signal output used in automatic transfer applications. Connects to AT terminal on automatic transfer timer unit (80069) to indicate to the timer unit that MS has detected a train. No connection if not used
TB2-8	SLAVING	Connects to SLAVING terminal on other 2000 MS when units are frequency slaved. Both motion sensors must be programmed for proper slave status. No connection if not used
TB2-9	UAX1 +	Positive (+) input to 2000 MS from UAX (upstream adjacent crossing). Motion sensor must be programmed for use. Upon pickup, will cancel any UAX1 time remaining as the train leaves the island circuit of track 1. The pickup delay time is a programmable entry with 25 seconds as the default. No connection if not used
TB2-10	UAX1 -	Negative (-) input to 2000 MS from UAX (upstream adjacent crossing). Motion sensor must be programmed for use. No connection if not used
TB2-13	ISL RLY 2 +	Positive (+) island 2 relay drive output. May be used to drive external island relay of 400 to 1,000 ohms, where desired
TB2-14	ISL RLY 2 -	Negative (-) island 1 relay drive output. May be used to drive external island relay of 400 to 1,000 ohms, where desired
LED	MS	2000 MS relay drive indicator. Lights when relay drive is present
LED	ISL 1	Island 1 relay drive indicator. Lights when relay drive is present
LED	ISL 2	Island 2 relay drive indicator. Lights when relay drive is present
Switch	POWER ON/OFF	Controls main power to 2000 MS circuits
Fuse	F1 5A S/B	Main power fuse. 5 ampere, slow-blow, 3 AG

Table 5-6. Model 2000S2 MS Front Panel Terminals, Indicators, and Controls

Terminal/- Indicator/ Control	Nomenclature	Function
TB1-1	TRACK XMT 1	MS transmitter output to track
TB1-2	TRACK CHK 1	MS check receiver input from track
TB1-3	TRACK XMT 2	MS transmitter output to track
TB1-4	TRACK CHK 2	MS check receiver input from track
TB1-5	TRACK RCV 1	MS receiver input from track
TB1-6	TRACK RCV 2	MS receiver input from track
TB1-7	ENA/UAX2	Used to cascade the relay drive output (XR circuit) from another 2000 MS. Voltage level at this terminal must be greater than +5 VDC. Normally connected to TB1-8 (B) when not in cascade operation. The ENA/UAX2 terminal also provides the functions of a second UAX input to the motion sensor. It may also remain a conventional ENA function when programmed for zero time when cascading MS outputs. A 25-second ENA/UAX2 default time is provided.
TB1-8	B	Battery B input to 2000 MS case
TB1-10	N	Battery N input to 2000 MS case
TB1-11	MS RLY +	Positive (+) 2000 MS relay drive output. Drives relays of 400 to 1,000 ohms.
TB1-12	MS RLY -	Negative (-) 2000 MS relay drive output. Drives relays of 400 to 1,000 ohms.
TB1-13	ISL RLY +	Positive (+) island relay drive output. May be used to drive external island relay of 400 to 1,000 ohms.
TB1-14	ISL RLY -	Negative (-) island relay drive output. May be used to drive external island relay of 400 to 1,000 ohms.
TB2-7	TRANS IND	Automatic transfer indication output. Terminal is at +12 VDC when main system is on-line. Terminal drops to 0 VDC when unit switches to standby system. No connection if not used
TB2-8	SLAVING	Connects to SLAVING terminal on another 2000 MS when units are frequency slaved. Both motion sensors must be programmed for proper slave status. No connection if not used

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Table 5-6 Concluded

Terminal/- Indicator/ Control	Nomenclature	Function
TB2-9	UAX1 +	Positive (+) input to 2000 MS from UAX (upstream adjacent crossing). Motion sensor must be programmed for use. Will cancel any UAX1 time remaining as the train leaves the island circuit. The pickup delay time is a programmable entry with 25 seconds as the default. No connection if not used
TB2-10	UAX1 -	Negative (-) input to 2000 MS from UAX (upstream adjacent crossing). Motion sensor must be programmed for use. No connection if not used
RS232 Connector	J1 RECORDER	Connector for data recorder interface assembly (80025) 25-line interface cable
LED	MS	2000 MS relay drive indicator. Lights when relay drive is present
LED	ISL	Island relay drive indicator. Lights when relay drive is present
Fuse	F1 3A S/B	Power fuse for main (left) module set, 3 ampere, slow-blow, 3 AG
Fuse	F2 3A S/B	Power fuse for standby (right) module set, 3 ampere, slow-blow, 3 AG
Switch	POWER ON/OFF	Controls main power to 2000 MS circuits

5.4 KEYBOARD/DISPLAY CONTROL UNIT, 80019

The following descriptions are provided for general information only. For specific programming/operating procedures, refer to the following sections as required:

- Section II, System Application Programming
- Section III, System Calibration
- Section IV, Diagnostics

The keys on the keyboard are divided into two groups by function: **major mode keys** and **support keys**. The major mode keys are the PROGRAM, FUNCTION, HISTORY, ERROR, SYSTEM STATUS, SETUP, and SYSTEM RESET keys. The remaining keys perform support functions in conjunction with all or certain of the major mode keys.

In the key descriptions that begin in paragraph 5.5, the key is highlighted in the illustration and its primary function(s) is described first. If a menu is associated with the function, the items contained in that menu and the associated displays are then described in the order in which they appear when scrolling down the menu using the down arrow key (↓) on the keyboard. For the

larger menus, a flowchart is included which provides an overall view of the menu and the relationships of the individual items with that menu.

The keyboard/display control unit attaches to an edge connector on the keyboard interface printed circuit board (80017) via an opening in the front of the control interface assembly (80020) and serves as the communications interface between the user and the system. Programming the system for specific applications is accomplished through simple keystrokes. The liquid crystal display enables the user to view diagnostic information, application programming entries, and train move data.

5.4.1 Keyboard

The one-piece membrane keyboard (Figure 5-5) contains 20 embossed keys arranged in four vertical columns of five keys each.

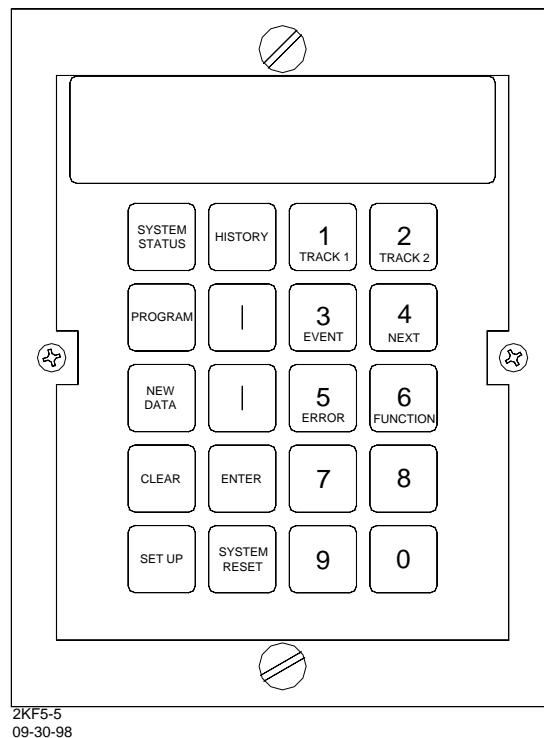


Figure 5-5. 2000 MS Keyboard/Display

5.4.2 Liquid Crystal Display

The liquid crystal, alphanumeric display consists of two rows, each containing 16 character positions. All programmed parameters, system power supply voltages, and recorded data are viewed on the display. Figure 5-6 illustrates typical displays for each of the various keyboard selected operating modes. The display viewing angle can be changed to permit easier viewing when the 2000 MS is mounted at or below eye level. Switch S1 (see Figure 5-7) located on the

keyboard interface printed circuit board provides viewing angle control. With S1 in the down position, the display is best viewed from a position where the line of sight is perpendicular to the display (eye level). By setting S1 to the up position, the display is easier to read when viewed from above at an angle of approximately 45 degrees from horizontal. The control interface assembly (80020) must be removed from the 2000 MS case to gain access to switch S1.

Initial System Display:	MODEL 2000 MOTION SENSOR	History Mode Display:	HISTORY T1 <08> WARNING TIME: 30
Program Mode Display:	PROGRAM NUMBER OF TRACKS: 2	Reset Mode Display:	SYSTEM RESET
Function Mode Display:	T1 REMOTE UNIT OPERATION: OFF	Setup Mode Display:	SETUP T1
Status Mode Display:	STATUS T1 EZ: 100 EX: 87	Diagnostic Mode Display:	ERROR 9112 <02> T2 GAIN CHECK

(example only)

Figure 5-6. Typical Display Indications for Operating Modes

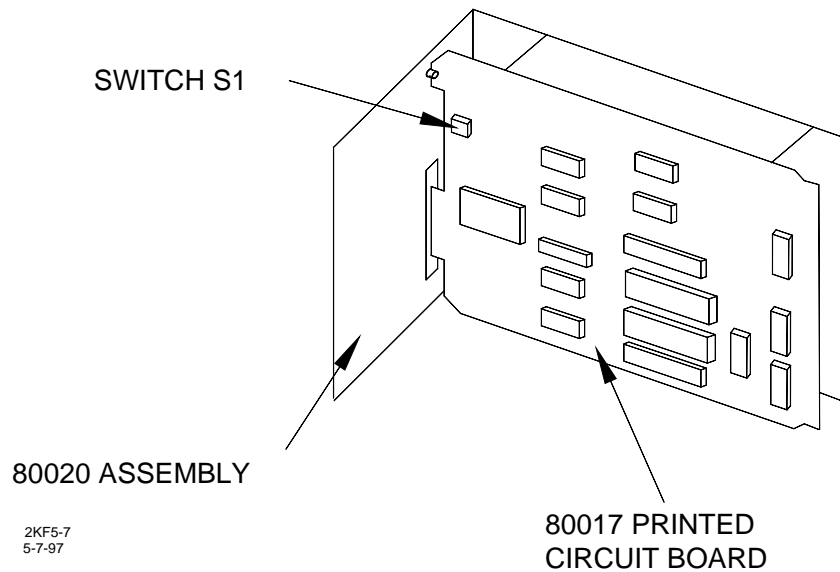
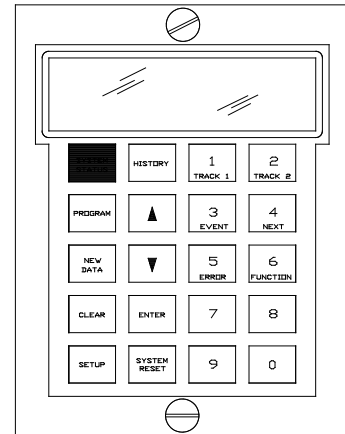


Figure 5-7. Location of Display Viewing Angle Switch, S1

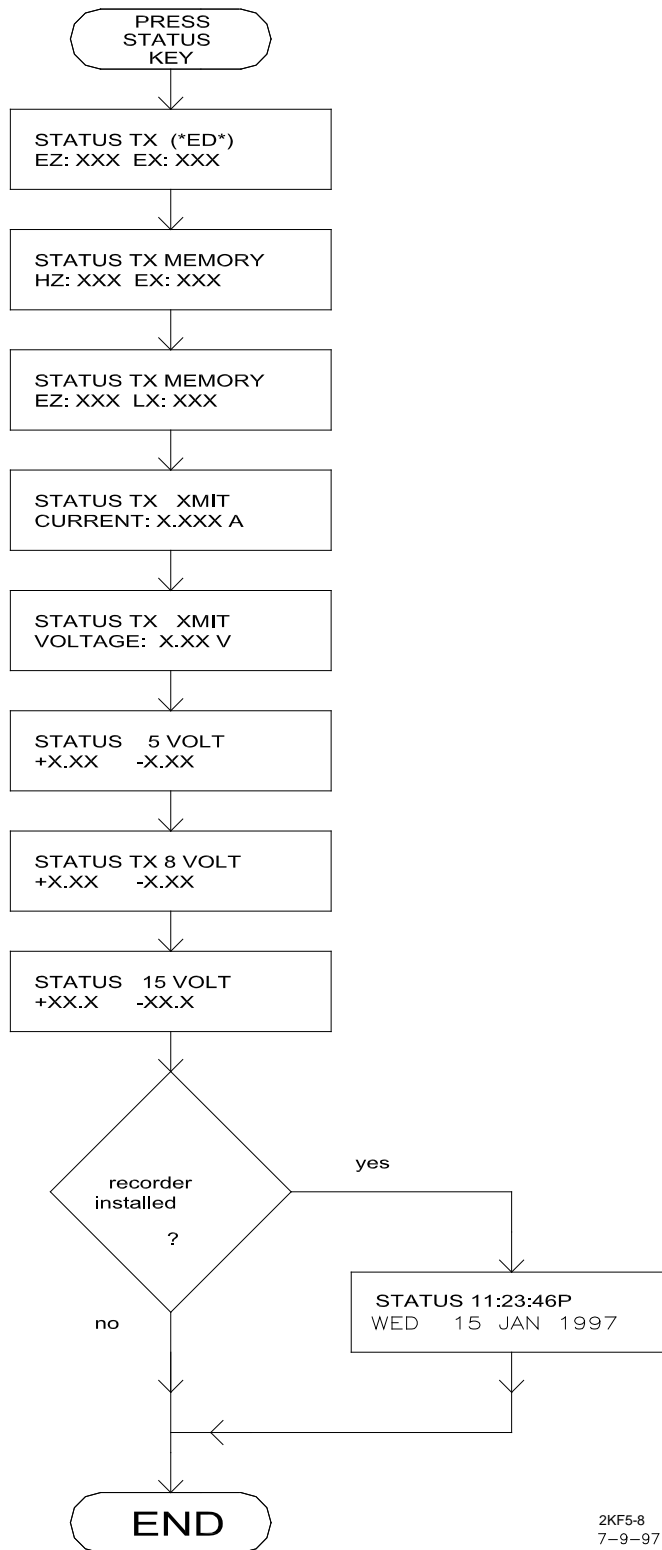
5.5 SYSTEM STATUS KEY

Press the SYSTEM STATUS key to select the Status Mode menu. The Status Mode displays indicate the current levels or values of selected system operating parameters such as receiver signal levels (EZ), track ballast conditions (EX), transmitter voltage and current levels to the track, and the outputs of the ± 5 , ± 8 , and ± 15 -volt power supplies. This is a monitor mode only.

When the 2000 MS is operating in any mode other than the Status Mode (e.g., Program, History, etc.), and no keyboard entries are made within 90 seconds of the last keyboard entry, the system automatically reverts to the Status Mode and the initial Status Mode display (see paragraph 5.5.1).



The Status Mode displays are arranged in a menu format that is continuous and starts over at the beginning when the end of the menu is reached. The Status Mode menu is shown in flowchart format in Figure 5-8.



2KF5-8
7-9-97

Figure 5-8. Status Mode Menu Structure

When a Model 2000 MS is programmed for two tracks, certain Status Mode menu items will provide a separate display for each track. A T1 or T2 appearing in the display indicates the track to which the information applies. When T1 is displayed, pressing the TRACK 2 key causes similar information for track 2 to be displayed. Pressing the TRACK 1 key returns to the track 1 display.

5.5.1 Current Status of EZ And EX

This is the initial Status Mode display which appears when power is applied to the 2000 MS, following 90 seconds of keyboard inactivity, or whenever the SYSTEM STATUS key is pressed (T1 indicates track 1 status information).

STATUS T1			
EZ:	100	EX:	87

When *ED* is displayed it indicates the system has automatically switched to the enhanced track shunting detection (ED) operating mode. The initial Status Mode display indicates current EZ and EX levels for the track indicated.

EZ = Track receiver signal level where:

- 100 = No train
- 0 = Train in island

EX = Track ballast conditions where:

- 100 = Ideal
- 85 = Nominal
- 50 = Poor

5.5.2 EX at Highest EZ

STATUS T1		MEMORY	
HZ:	145	EX:	45

Indicates the highest EZ value recorded (Hz) for the track indicated and the EX value when that EZ value occurred (since the system was last reset).

5.5.3 EZ at Lowest EX

STATUS T1		MEMORY	
EZ:	95	LX:	62

Indicates the EZ value when the lowest EX (LX) value was recorded for the track indicated (since the system was last reset).

5.5.4 Transmit Current

STATUS T1	XMIT
CURRENT:	0.251 A

Indicates 2000 MS transmit current (amperes) to the track indicated.

5.5.5 Transmit Voltage

STATUS T1	XMIT
VOLTAGE:	1.32 V

Indicates 2000 MS transmit voltage (volts) to the track indicated. The voltage varies for different motion sensor frequencies and track lengths.

5.5.6 ±5 Volt Power Supply Status

STATUS	5 VOLT
+5.02	-5.01

Indicates +5 and -5 volt power supply output levels. Should be 4.75 to 5.25 VDC.

5.5.7 ±8 Volt Power Supply Status

STATUS T1	8 VOLT
+7.99	-8.01

Indicates +8 and -8 volt power supply outputs for track indicated. Should be 7.2 to 8.8 VDC.

5.5.8 ±15 Volt Power Supply Status

STATUS	15 VOLT
+14.7	-14.6

Indicates +15 and -15 volt power supply output levels. Should be 14.1 to 15.9 VDC.

5.5.9 Time/Date Display With Data Recorder Module Installed

If the data recorder module (80015) is installed, the following status display will appear.

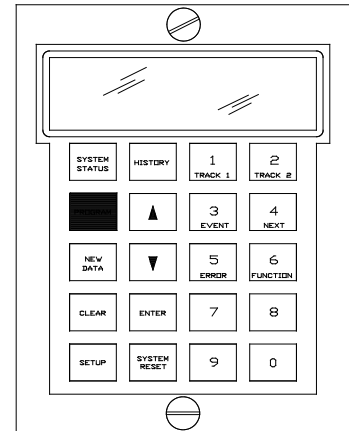
STATUS	11:23:46A
MON	23 DEC 1996

The current time and date, according to the data recorder, can be verified by checking this display. Time is in hours-minutes-seconds (hh:mm:ss) format followed by A (AM) or P (PM) in 12-hour format or by a space in 24-hour format.

5.6 PROGRAM KEY

Press the PROGRAM key to select the Program Mode menu. The Program Mode is the primary programming mode for system application parameters (frequency, transmit level, etc.). To simplify operator interface with the system during programming operations, the Program Mode is menu driven.

The Program Mode displays are arranged in a continuous menu format that starts over at the beginning when the end of the menu is reached. The Program Mode menu is depicted in flowchart format in Figure 5-9.



If a 2000 MS is programmed for two tracks, some Program Mode menu items can be programmed differently for each track. A T1 or T2 appearing in the display indicates the track to which the information applies. When T1 is displayed, pressing the TRACK 2 key causes similar information for track 2 to be displayed. Pressing the TRACK 1 key returns to the track 1 display.

NOTE

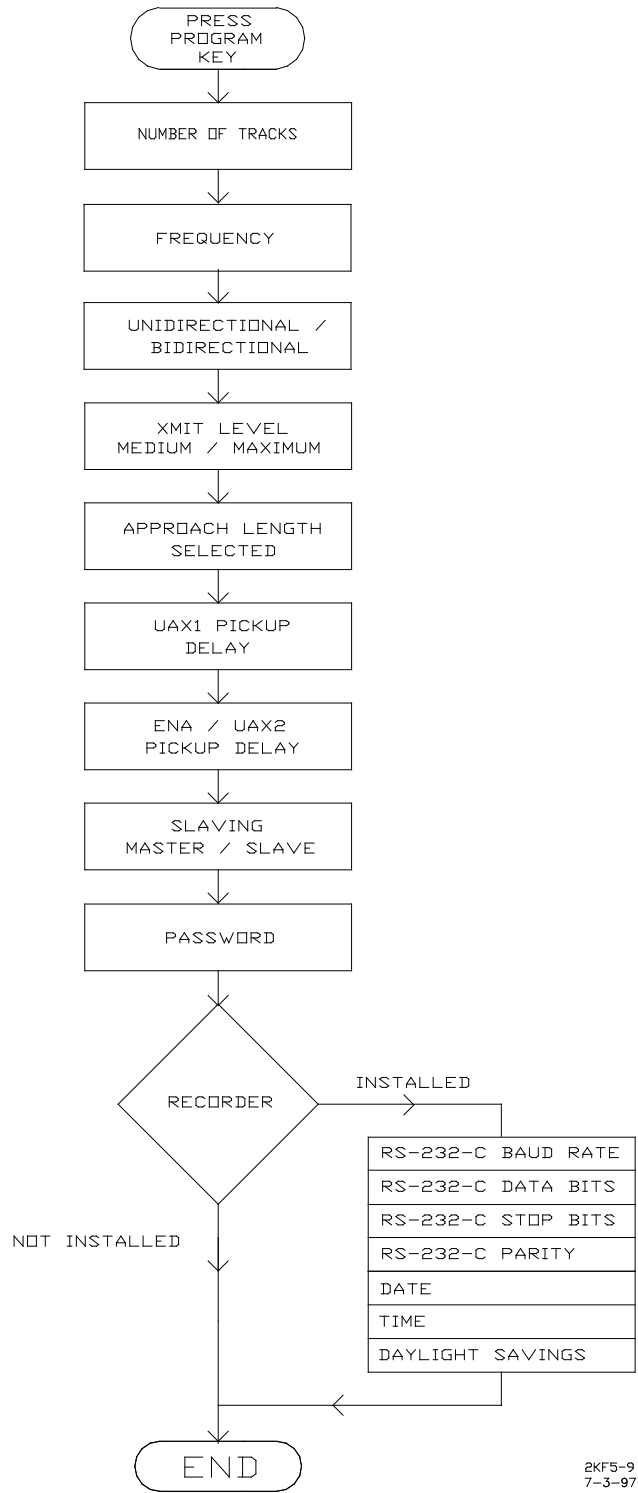
NOTE

Information programmed via the Program Mode should first be entered on the 2000 MS Application History Card (see sample in Figure 5-12). The card (located at the back of this manual) should remain with the equipment at all times and should reflect the current programmed status of the system. The order in which the information is listed on the card coincides with the order in which the information is requested in the Program Mode menu.

NOTE

NOTE

The following Program Mode menu items can be viewed at any time by selecting the Program Mode and scrolling through the menu. However, if the password feature is enabled, the four-digit password code must be entered into the system via the keyboard before any program changes can be made.



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Figure 5-9. Program Mode Menu Structure

5.6.1 Number of Tracks

PROGRAM	NUMBER
OF TRACKS	2

This is the initial Program Mode display which appears when the PROGRAM key is pressed. The item requested is the first system application parameter in the menu. The information requested is the number of operational transceiver modules (80012/80212) contained in the 2000 MS case. The value to enter is either 1 or 2, whichever applies. For a Model 2000S2, enter 1.

5.6.2 Frequency

PROGRAM T1	
FREQUENCY:	790

The transmitter frequency for the transceiver module(s) (80012/80212) is requested. If two 80012/80212 modules are installed in a two-track Model 2000 MS, either the same or different frequencies may be entered for each track. In a dual Model 2000S2 MS, the same frequency operates for both main and standby operation. The range of values is from 45 to 999 Hz in 1-Hz increments.

5.6.3 Unidirectional/Bidirectional

PROGRAM T1	
UNIDIRECTIONAL	

The system application for each track is requested. Select BIDIRECTIONAL or UNIDIRECTIONAL.



WARNING

MODEL 2000 MOTION SENSORS THAT OPERATE IN A SIMULATED BIDIRECTIONAL APPLICATION MUST BE PROGRAMMED FOR BIDIRECTIONAL.

5.6.4 Xmit Level

PROGRAM T1	XMIT
LEVEL:	MEDIUM

Select the transmit level for each track (transceiver) in use. Valid level selections are MAXIMUM and MEDIUM with MEDIUM generally used for most applications. However, in high track noise environments or very short approaches, MAXIMUM is recommended.

5.6.5 Approach (Distance)

PROGRAM T1	
APPROACH:	3000

For bidirectional applications, enter the actual distance (in feet) measured from the feed wires on the side of the street which is closest to the termination shunt in the longest physical approach. Disregard an approach in which a “dummy track load” (inductance) is used to simulate a longer approach. For unidirectional applications, enter the actual distance (in feet) from the receiver track wires to the termination shunt.

5.6.6 UAX Pickup Delay

The 2000 MS can be programmed to accommodate two separate UAX inputs. The UAX1 terminals are referenced to T1 while the ENA/UAX2 is referenced to T2 for timeout purposes. However, when the ENA is programmed for zero time, the ENA terminal (positive control input) functions as an enable input for cascading relay drives from two separate units. When the ENA terminal input is not used, the ENA terminal must be strapped to battery B to enable operation of MS relay drive.

PROGRAM	UAX1
PICKUP DELAY:	OFF

PROGRAM	ENA/UAX2
PICKUP DELAY:	ENA

When both UAX inputs are used (controlled from remote units), select the desired UAX pickup delay time (generally 25 seconds). Valid selections are from 1 to 500 seconds. When the UAX1 input is not used, select 0 (zero) seconds. This produces an OFF indication on the 2000 MS display and strapping of the UAX1 terminals to battery is not required.

PROGRAM	UAX1
PICKUP DELAY:	25

WARNING

WARNING

WHEN THE UAX FEATURE FOR UAX1 IS OFF (ZERO TIME ENTERED), THE FRONT PANEL UAX1 TERMINALS HAVE NO CONTROL OVER MS RELAY DRIVE.

NOTE

NOTE

When UAX1 and/or ENA/UAX2 is programmed between 1 and 500 and a nominal 12 volts is removed from either UAX terminal, the MS relay drive is immediately deenergized. When 12 volts is reapplied to both the UAX1 and/or ENA/UAX2 terminals, the MS relay drive energizes after the applicable UAX pickup delay time has elapsed (providing no other condition keeps the MS relay drive deenergized).

5.6.7 Slaving Master/Slave

NOTE

NOTE

The master/slave function can be used to slave 2000 Motion Sensors to other 2000 Motion Sensors and 3000 MS/GCPs only, not to Model 585/590s, 660, and 600 MS/GCPs, etc.

The master/slave function is used when two or more 2000 MS cases are to use the same operating frequency. The 2000 MS designated as the master supplies a synchronizing frequency to the other 2000 motion sensors (slaves) at the location. When only one 2000 MS is used at a crossing, it must be programmed as a master. If two or more 2000 motion sensors are used at a location but each at a different frequency, then each unit must be programmed as a master.

PROGRAM	SLAVING
MASTER	

NOTE

NOTE

A wire must be installed between the front panel SLAVING terminal (TB2-8) and the corresponding SLAVING terminal (TB2-8) on each slave 2000 MS operating at the same frequency.

Select the motion sensor frequency slaving status for the 2000 MS case; either master or slave. The entry made in this programming item in each unit determines whether the SLAVING terminal is an output (master unit) or an input (slave unit).

5.6.8 Password Disabled/Enabled

A user-selectable, four-digit password provides warning signal from changes to the application programming. The password feature can be enabled (installed) at the time of installation or any time thereafter if the need arises via this menu item. This menu item is also used to change or disable the password at any time, providing the correct password is entered first.

PROGRAM	PASSWORD
DISABLED	

When the password feature is enabled, the correct four-digit password must be entered via the keyboard/display unit before any changes to application parameters (in the Program and Function Mode menus) can be made. However, the application program parameters can be viewed at any time without entering the password. For specific procedures relating to the password feature, refer to the applicable paragraphs in Section II.

5.6.9 Recorder Not Installed/Installed

The data recorder module (80015) is an optional item in the 2000 MS. This menu item is used to disable (Not Installed) or enable (Installed) the recorder function. When the recorder function is disabled (Not Installed), this is the last item from the Program Mode menu to be displayed.

PROGRAM RECORDER NOT INSTALLED

When the data recorder module is installed in the 2000 MS case, the entry for this menu item must be changed to Installed to enable the data recorder.

NOTE

NOTE

When the data recorder function is enabled (installed), additional menu items appear in the Program menu. The first four items relate to an external PC or printer which can be connected to the data recorder module via a 9-pin RS232C connector on the front edge of the module. Consult the PC software or printer manufacturer's documentation to determine the values for the four entries.

5.6.10 RS232C Baud Rate

Enter the PC/printer baud rate. Valid baud rates are 300, 1200, 2400, 4800, or 9600. The default value is 9600.

PROGRAM	RS-232-C
BAUD RATE:	9600

5.6.11 RS232C Data Bits

Enter the number of data bits (data length) for the PC/printer being used. Valid entries are 7 or 8 with 8 as the default.

PROGRAM	RS-232-C
DATA BITS:	8

5.6.12 RS232C Stop Bits

Enter the number of stop bits for the PC/printer being used. Valid entries are 1 or 2 with 1 as the default.

PROGRAM	RS-232-C
STOP BITS:	1

5.6.13 RS232C Parity

Enter the type of parity used by the PC/printer. Valid entries are None, Odd, Even, Mark, and Space with None as the default.

PROGRAM	RS-232-C
PARITY:	NONE

5.6.14 Date

Enter the current day and date in the format shown in the following example.

PROGRAM	DATE
MON	23 DEC 1996

5.6.15 Time

Enter the current time in hours-minutes-seconds (hh:mm:ss) format as shown in the example at the top of the following page. When using the 24-hour (military) format, follow the time entry with (24 HR). When using the standard 12-hour format, follow the time entry with AM or PM, whichever is appropriate.

PROGRAM	TIME
11:25:43	(24 HR)

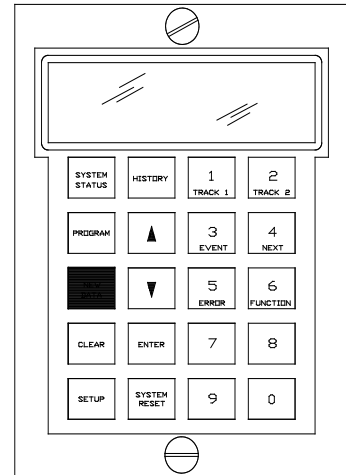
5.6.16 Daylight Savings Time

PROGRAM	DAYLIGHT
SAVINGS:	ON

Select ON to enable the data recorder to change the time setting automatically at the beginning (2:00 a.m. on the first Sunday in April) and end (2:00 a.m. on the last Sunday in October) of the daylight savings time period. Select OFF if the system will be operating on standard time only.

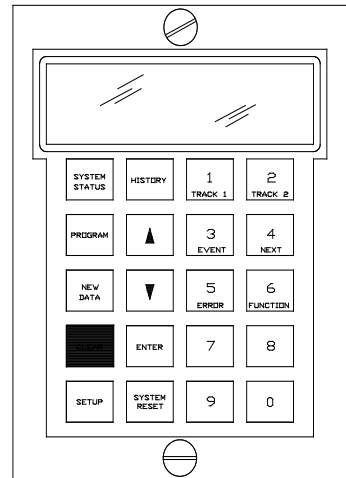
5.7 NEW DATA KEY

The NEW DATA key is a support key that must be pressed just prior to entering a new value when changing system operating parameters in the Program, Setup, or Function Modes. The NEW DATA key performs a similar function in the Event Mode and in the approach and linearization setup procedures.



5.8 CLEAR KEY

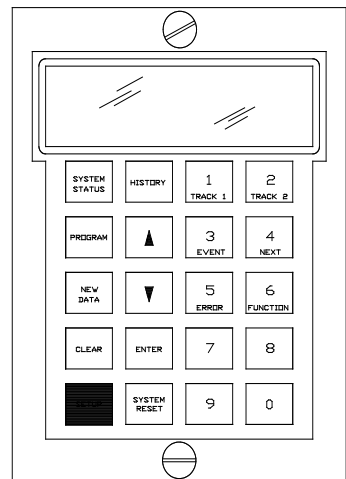
The CLEAR key is a support key that is used to clear (delete) incorrect data entries. When changing system operating parameters in either the Program or Function Mode, if an incorrect data entry is made but the ENTER key has not yet been pressed, the CLEAR key can be pressed to remove the new data and return to the previous value. The CLEAR key is also used when disabling the password function.



5.9 SETUP KEY

Press and hold the SETUP key for a minimum of 3 seconds to select the Setup Menu. The Setup Menu accesses the system calibration procedure.

Whenever the Setup Menu is selected, the following display appears:



This display identifies the Setup For Calibration procedure. The procedure is described in the following paragraphs.

5.9.1 Setup For Calibration Procedure

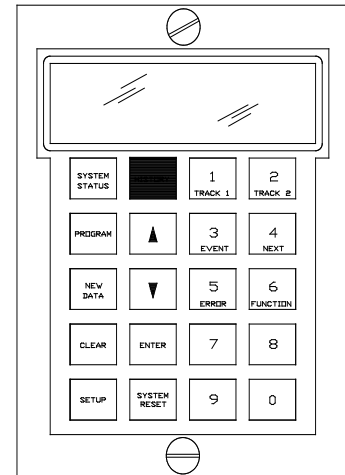
The Setup For Calibration procedure must be performed at initial installation, when the system is returned to default parameters, or whenever any of the items listed in the Setup for Calibration column of Tables 3-1, 3-2, or 3-3 occur. This includes module replacement, programming changes, and changes to existing track equipment.

5.10 HISTORY KEY

Press the HISTORY key to select the History Mode. The History Mode provides a record of warning times of the previous 20 train moves (events) on a single track (10 train moves per track when two tracks are monitored).

The initial history display (see sample below) identifies the track on which the move(s) were recorded, the number of events recorded (in angled brackets < >), and the warning time (in seconds) for the last event recorded.

HISTORY T1	<10>
WARNING TIME:	46

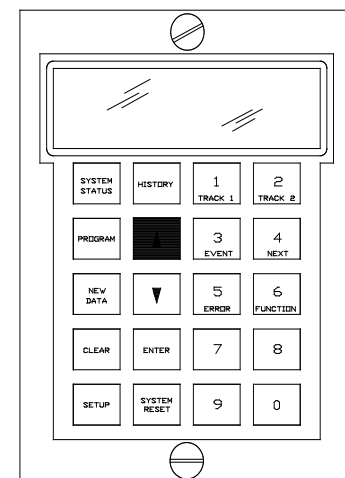


The events occurring on track 2 can be viewed by pressing the TRACK 2 key.

The up (↑) and down (↓) arrow keys are used to select the train move number (as indicated on the display) for which the warning times will be displayed. Each time one of the keys is pressed, the train move number in the angled brackets increments or decrements (depending upon the key that is pressed).

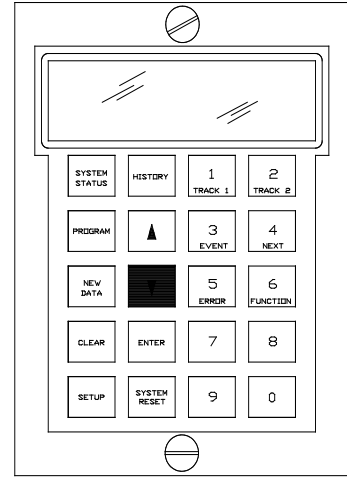
5.11 UP ARROW KEY (↑)

The up arrow key (↑) is used in the System Status, Program, and Function Modes to scroll up a menu (reverse order) and in the Error and History Modes to scroll through a list of recorded entries in descending order.



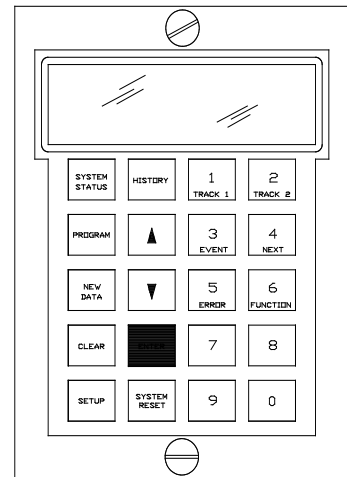
5.12 DOWN ARROW KEY (⇩)

The down arrow key (⇩) is used in the System Status, Program, and Function Modes to scroll down a menu (normal order) and in the Error and History Modes to scroll through a list of recorded entries in ascending order.



5.13 ENTER KEY

When operating in the Program and Function (extended programming) Modes, press the ENTER key following a data entry to enter that data in the program. In the Setup and System Reset Modes, the ENTER key is used to select a function such as Calibration Setup or to clear errors, respectively.

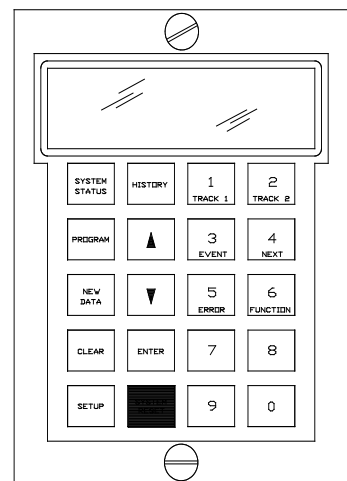


5.14 SYSTEM RESET KEY

The SYSTEM RESET key selects a menu which consists of three functions: Clear Errors (diagnostic messages), Clear History, and Reset System. These functions are identified by menu entries in the Reset menu. When the RESET key is pressed and held for a minimum of 3 seconds, the following display appears:

PRESS ENTER TO
CLEAR ERRORS

This display indicates the Clear Mode is selected and identifies the clear errors (diagnostic messages) function, which is the first function in the Reset Mode menu.



The clear errors (diagnostic messages) function permits the operator to clear all system diagnostic messages from system memory which were recorded during system programming, calibration, or normal operation. These messages are described further in Section VII, Diagnostics. The Clear Errors function also resets the HZ and LX memories.

The display shown below identifies the clear history function.

PRESS ENTER TO
CLEAR HISTORY

The reset system function clears both the error and history portions of memory simultaneously and will cause the crossing to operate for approximately 30 seconds. The system reset does not affect the levels established by the Setup Mode or system programming. The display shown at the top of the following page identifies the system reset function.

PRESS ENTER TO
RESET SYSTEM

NOTE

NOTE

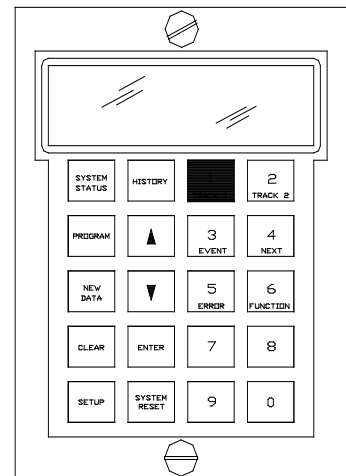
If the EZ value is less than 3 and power to the 2000 MS is interrupted (when changing out a module, for example), or a system error occurs, relay drive will not recover until the EZ value becomes greater than 3. However, if a train in the approach is the cause of the low EZ value, this condition can be manually overridden by maintenance personnel performing a system reset.

5.15 TRACK 1 KEY (1)

The TRACK 1 key is used while in the Program, Function, System Status, Setup, and History Modes to select a display for track 1. The T1 indicates a track 1 display.

STATUS T1
EZ: 100 EX: 87

The dual-function TRACK 1 key is also used to enter the digit 1 for numerical data entries.

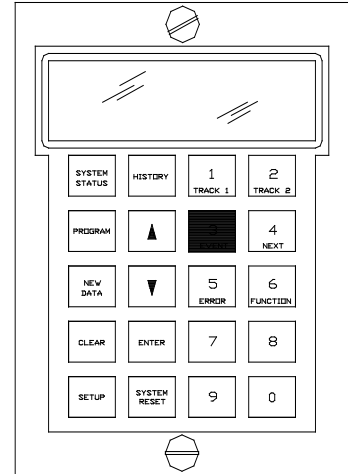


5.16 EVENT KEY (3)

The EVENT key is used when the data recorder module (80015) is installed to select an event number other than 1 (default value) as the starting point for a file download to a PC or a hard copy printout. In the sample Events display below, the number shown in brackets (<27>) indicates the total number of events recorded. The number in the lower right corner indicates the event number where the printout will begin.

EVENTS	<27>
START POINT:	1

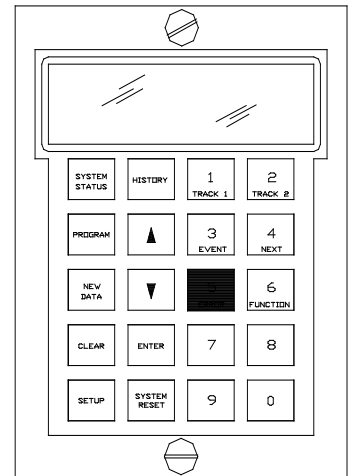
The dual-function EVENT key is also used to enter the digit 3 for numerical data entries.



5.17 ERROR KEY (5)

Press the ERROR (diagnostic) key to select the Diagnostic Mode. The Diagnostic Mode provides a visual indication of the 10 most recent diagnostic messages recorded by the system. These messages are identified by four-digit codes and are cross-referenced in Table 4-2.

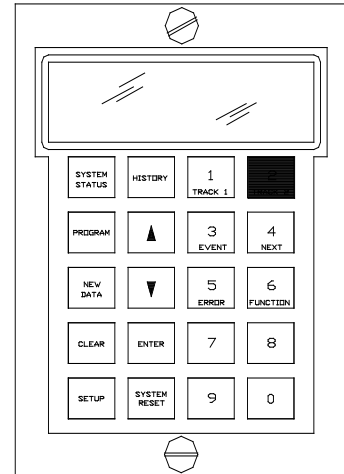
The ERROR (diagnostic) key is a dual-function key and is used to enter the digit 5 for numerical data entries.



5.18 TRACK 2 KEY (2)

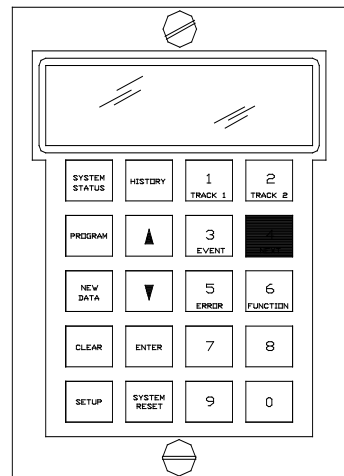
The TRACK 2 key is also a dual-function key that is used to enter the digit 2 for numerical data entries. In addition, when the keyboard assembly is installed in a 2000 MS two-track system, and while in the Program, Function, System Status, Setup, and History Modes, permits selection of a display for track 2. The T2 indicates a track 2 display.

STATUS T2			
EZ:	100	EX:	87



5.19 NEXT KEY (4)

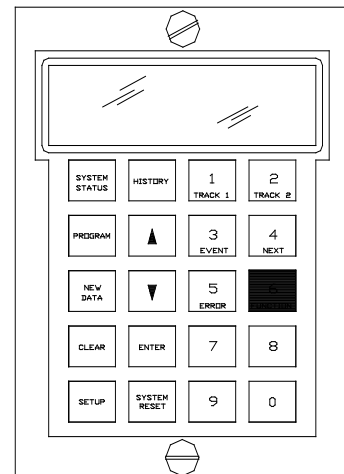
The NEXT key is used to enter the digit 4 for numerical data entries only.



5.20 FUNCTION KEY (6)

Press the FUNCTION key to select the Function (extended programming) Mode. The Function Mode is an extension of the Program Mode and permits adjustment system parameters to compensate for track conditions or system application requirements. To simplify operator interface with the system during programming operations, the Function Mode is menu driven.

The Function Mode displays are arranged in a menu format that is continuous and starts over at the beginning when the end of the menu is reached. The Function Mode menu is depicted in flowchart format in Figure 5-10.



NOTE**NOTE**

Information programmed via the Function Mode should first be entered on the 2000 MS Application History Card (Figure 5-12). The card should remain with the equipment at all times and should reflect the current programmed status of the system. The order in which the information is listed on the card corresponds with the order in which the information is requested in the Function Mode menu.

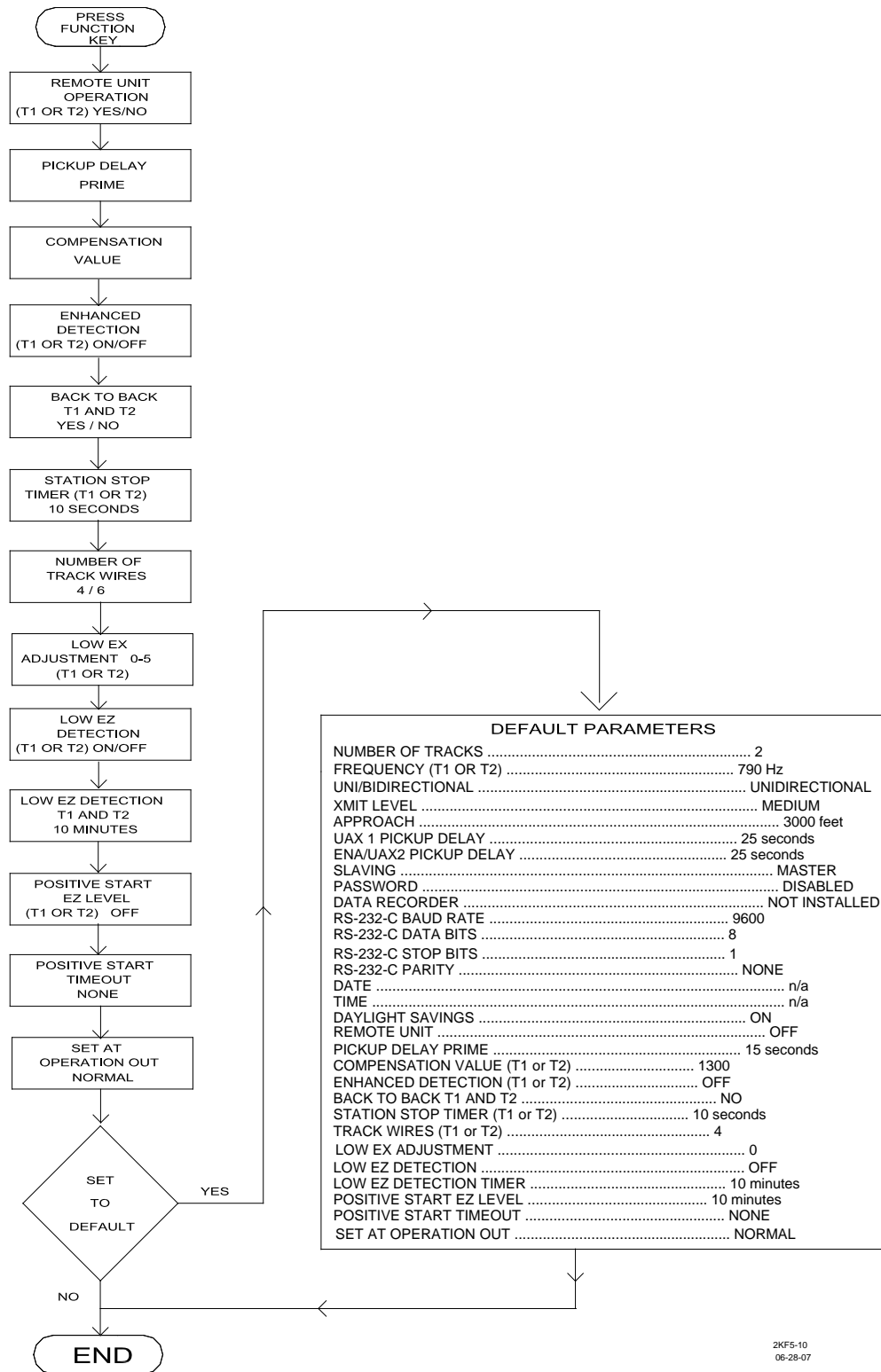
When a 2000 MS two track system is programmed for two tracks, certain Function Mode menu items can be programmed differently for each track. A T1 or T2 appearing in the display indicates the track to which the information applies. When T1 is displayed, pressing the TRACK 2 key causes similar information to be displayed for track 2. Pressing the TRACK 1 key returns to the track 1 display.

The FUNCTION key is a dual-function key which is used to enter the digit 6 for numerical data entries.

NOTE**NOTE**

The following Function Mode menu items can be viewed at any time by selecting the Function Mode and scrolling through the menu. However, if the password feature is enabled, the password must be entered before any program changes can be made.

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Figure 5-10. Function Mode Menu Structure

5.20.1 Remote Unit Operation (T1 And T2)

The Remote Unit Operation is the first menu item in the Function Mode menu. When a 2000 MS is applied as a remote unit, the display for the associated track (T1 or T2) should be set to ON. Each time the NEW DATA key is pressed, the display toggles between OFF and ON. The default is OFF.

T1 REMOTE UNIT OPERATION: OFF
--

WARNING

WARNING

WHEN REMOTE OPERATION IS PROGRAMMED “ON” AND AN ISLAND MODULE IS USED ON THE SAME TRACK (T1 OR T2), THE ISLAND (WHEN DEENERGIZED) WILL NOT CAUSE THE MS RELAY DRIVE TO DEENERGIZE. WHEN USED AT A REMOTE LOCATION, THE ISLAND MODULE IS USED FOR ENHANCED DETECTION REMOTE OPERATION LOGIC AND THUS WILL NOT CONTROL THE RELAY DRIVE OUTPUT AS IT NORMALLY DOES AT A CROSSING.

WARNING

WARNING

WHEN REMOTE UNIT OPERATION IS USED, ANY EXTERNAL TRACK CIRCUIT EQUIPMENT OR AUXILIARY TRACK CIRCUIT EQUIPMENT SHALL BE CONNECTED TO THE MS 2000 TRACK WIRES IN ACCORDANCE WITH SECTION 1.4

5.20.2 Pickup Delay Prime

Enter the time interval (seconds) beginning from when the 2000 MS recovers and relay drive returns. Valid entries range from 8 to 500 seconds.

PICKUP DELAY PRIME: 15

NOTE

NOTE

The default value is 15 seconds and, generally, is not changed; however, a longer pickup delay (up to 45 seconds) can be used if required (e.g., transit station stops, poor shunting, etc.).

When a train stops in a 2000 MS approach, actual prime pickup delay time is determined by the time that has been programmed.

5.20.3 Compensation Value

The compensation value is a correction factor used to fine tune the system for unusual ballast loads on the track. This value is selected automatically to maintain a stable EZ value over changing ballast conditions. The EZ value can be monitored using the Status Mode (see Section IV, Diagnostics). The valid range of entries is 1000 to 2000; however, 1300 is generally used.

COMPENSATION VALUE T1: XXXX



WARNING
THIS VALUE IS SELECTED AUTOMATICALLY BY THE SYSTEM ANY TIME THE FREQUENCY IS CHANGED. THE VALUE CAN BE CHANGED MANUALLY VIA THIS MENU ITEM BUT SHOULD NOT BE CHANGED UNLESS SPECIFICALLY INSTRUCTED BY SAFETRAN TO DO SO. IF THE VALUE IS CHANGED, SET UP FOR CALIBRATION MUST BE PERFORMED.

5.20.4 Enhanced Detection, T1/T2

This programming step selects the enhanced detection (ED) operating mode. Each time the NEW DATA key is pressed, the display toggles between OFF and ON. The default is OFF.

T1 ENHANCED DETECTION: OFF

For a 2000 MS two-track installation, this operating parameter must be set for each track (T1 and T2). When On has been selected for a track and the system has switched to the ED operating mode due to poor shunting conditions, the system status message *ED* is displayed until the train leaves the approach.



WARNING
WHEN ENHANCED DETECTION IS DESIRED AND PROGRAMMED “ON” AND TRAIN TRAFFIC IS MINIMAL ESPECIALLY IN DARK TERRITORY, RUST BUILD-UP ON THE RAILS MAY NOT ALLOW ANY TRACK SHUNTING TO OCCUR. SHOULD THIS HAPPEN, THE MS ENHANCED DETECTION WILL NOT DETECT NON/MINIMAL SHUNTING TRAIN MOVEMENTS. THE UNIT <u>MUST</u> DETECT SHUNTING IN ORDER TO SENSE TRAIN MOVEMENT.

NOTE**NOTE**

Train shunting in dark territory can be easily improved similar to style C circuits (but without the need of as many insulated joints) by the application at the crossing of DC voltage onto the track (along with one insulated joint at each approach end). This DC voltage will improve train shunting and allow the 2000 Enhanced Detection software to function properly.

Spotty poor shunting can occur virtually anywhere from numerous causes but generally occurs due to light track usage, light cars, and/or during transit operation. A lack of any shunting generally occurs in dark territory where no DC or AC track circuits exist and where few trains per week are run.

The Safetran Shunting Enhancer Panel, 80049, provides a very simple and cost effective solution for improving shunting in dark territory by providing a nominal 6 VDC that is isolated from the battery and is applied to the track at the crossing to break down the film on the rails. Only two insulated joints are required to confine the 6 volts on the track: one at each end of the motion sensor approach. The application of DC voltage with overlapping approaches from two or more crossings is also very easy to implement without any additional insulated joints. Narrow band termination shunts are required whenever the 6 VDC is applied.

When this mode is enabled and poor shunting conditions are detected, the system switches to the ED operating mode and *ED* appears in the upper right corner of the display (see example below). The *ED* indication remains on the display for the duration of the train move (until the train leaves the track circuit).

STATUS T1	*ED*
EZ: 100	EX: 87

NOTE**NOTE**

The EZ and EX values shown in the sample status message above are for example only; actual values may differ.

5.20.5 Back to Back T1 and T2

This programming step appears only when the ED operating mode has been selected (paragraph 5.20.4 above) and selects the back-to-back operating mode. The display toggles between NO and YES each time the NEW DATA key is pressed. YES is selected when two unidirectional units and the associated approaches are located on opposite sides of the same pair of insulated joints. The default is NO.

BACK TO BACK
T1 AND T2: NO

5.20.6 Station Stop Timer

This programming step appears only when the ED operating mode has been selected (see paragraph 5.20.4). When a passenger station stop is located in an outbound 2000 MS approach, and the enhanced detection feature is ON, the station stop timer is generally programmed for a longer time interval than the train would normally remain stopped. For example, if a passenger train normally remains stopped for 60 seconds, program the timer for approximately 90 seconds. The time interval is entered on the numeric keypad and the maximum delay is 120 seconds. The default value is 10 seconds. For a two-track 2000 MS installation, this operating parameter may also be set for each track (T1 and T2).

STATION STOP	
TIMER T1:	10



WARNING

WHEN THE STATION STOP TIMER IS PROGRAMMED TO A TIME OTHER THAN 10 SECONDS (MINIMUM VALUE), THERE MUST NOT BE ANY TRAIN MOVES APPROACHING THE CROSSING BETWEEN THE TIME A TRAIN LEAVES THE ISLAND AT THE CROSSING AND THE PROGRAMMED TIME OF THE STATION STOP TIMER ELAPSES (TIMER CAN BE PROGRAMMED TO RUN FOR UP TO A MAXIMUM OF 120 SECONDS (2 MINUTES)).

NOTE

NOTE

The Station Stop Timer should normally be left at the default setting of 10 seconds. The timer is initiated automatically after a train leaves the island circuit and operates in conjunction with the enhanced detection logic. If the train makes a station stop after passing the crossing, the timer can be programmed for up to 120 seconds to prevent tail rings after the train has stopped and then departs from the station. This timer is active only if Enhanced Detection is programmed "ON".

5.20.7 Number of Track Wires

This programming step selects either a four or six track wire configuration used at an installation. For a Model 2000 MS two-track installation, each track (T1 and T2) must be programmed for either four track wire or six track wire operation. Enter either a 4 or a 6 when programming. The default value is 4.

NUMBER OF TRACK	
WIRES T1:	4

The number of track wires selected for track 2 can be viewed by pressing the TRACK 2 key.

5.20.8 Low EX Adjustment

The EX value is a numerical indication of track ballast conditions relative to the leakage resistance between the rails. As ballast resistance decreases, the leakage increases. Leakage resistance can be affected by the presence of water, mud, salt, or other contaminants that are deposited in the track ballast. High concentrations of these contaminants in a localized area (e.g., at a crossing), results in a lump-loading (high leakage between rails) condition.

When ballast is clean, and of the right makeup (no iron content, dry, clean, etc.), an EX value of 100 is possible and is considered “perfect”. Normally, the EX value falls in the range from 70 up to 100. When contamination or lump loading occurs, the EX value can approach the 2000 MS EX operating threshold of 39. At these low EX levels, the operation of the MS can be affected.

The Low EX Adjustment programming step allows the low EX operating threshold to be lowered below the preset value (39) and thus allow the MS to operate under extremely poor ballast conditions. The adjustment value is entered on the numeric keypad and the maximum adjustment is 5 (lowers the threshold from 39 to 34). The default value is 0. For a two-track installation, this operating parameter should be set for each track (T1 and T2) as needed.

T1 LOW EX ADJUSTMENT: 0

WARNING

WARNING

DO NOT ARBITRARILY REDUCE THE EX OPERATING THRESHOLD. IMPROPER ADJUSTMENT MAY CAUSE SHORT OR NO WARNING TIME.

BEFORE REDUCING THE THRESHOLD, THOROUGHLY TEST THE BALLAST AT THE LOCATION TO DETERMINE WHETHER OR NOT CONDITIONS PERMIT THE THRESHOLD REDUCTION. (SEE SECTION IV DIAGNOSTICS FOR BALLAST TEST.)

When the Low EX Adjustment parameter is set to a value other than 0 (zero), an asterisk (*) appears next to the EX value in the initial Status Mode display (paragraph 4.1.1) as shown below.

STATUS T1 EZ: 100 EX: * 87

NOTE

NOTE

The expanded functionality described below is available only on those Advanced 80020 or 80029 Control Interface Modules that contain expanded NOVRAM memory. To identify expanded memory modules, an **EXPANDED MEMORY** or a **512** sticker has been placed at the edge of each assembly as described in paragraphs 5.1.6 and 5.1.7 and shown in the figure below paragraph 5.1.7. If an early spare control interface module from a 3000 GCP is installed in a 2000 MS, then these new features will not be available. If this should happen, the motion sensor will prompt the user by displaying the message “is not available”.

NOTE**NOTE**

Paragraphs 5.20.9 through 5.20.13 below apply only if Software Version 9V126-01F or later has been installed on the MS 2000.

5.20.9 Low EZ Detection

This option, when enabled, detects a significant reduction of EZ. The EZ signal may reduce for various reasons including a false shunt. Low EZ detection occurs when EZ is constantly less than 70 for a period of time exceeding the Low EZ Detection Timer value. Once Low EZ detection occurs, the crossing is continuously activated until EZ rises to 75 or above.

Each time the **NEW DATA** key is pressed, the display toggles between **OFF** and **ON**. The default is **OFF**. For a two-track installation, Low EZ Detection may be programmed for each track independently (**T1** and **T2**).

LOW EZ DETECTION	
EZ=70	T1:OFF

5.20.10 Low EZ Detection Timer

This programming step appears only when the Low EZ Detection option is enabled. The EZ detection timer delay is generally programmed for a time interval longer than trains would normally remain in the MS approach. The selectable timer delay values are from **2** to **99** minutes. The default is **10**. For a two-track installation, Low EZ Detection Timer may be programmed for each track independently (**T1** and **T2**).

LOW EZ DETECTION	
TIMER T1:	10

5.20.11 Positive Start EZ Level

This option, when enabled, immediately activates the crossing when EZ is less than the programmed Positive Start EZ Level. There is no 4-second reaction delay time. Once Positive Start occurs, the crossing is continuously activated until either the train clears the island circuit, the EZ value rises to a number 5 greater than the programmed positive start EZ level, or the Positive Start timer has exceeded the programmed timer delay of 1 to 99 minutes. A new Positive Start sequence may be initiated once EZ exceeds the programmed Positive Start EZ level by 5.

The default is **OFF (OFF =0)**. EZ level may be set to any value between **1** and **100**. For a two-track installation, Positive Start may be programmed for each track independently (**T1** and **T2**).

POSITIVE START EZ LEVEL T1: OFF

5.20.12 Positive Start Timeout

This programming step appears only when the Positive Start EZ Level option is enabled. The selectable timeout value allows a continuous positive start to either not time out (**NONE = 0**) or to timeout after a programmed delay time of **1** to **99** minutes. The default value is **NONE** (no timeout). For a two-track installation, Positive Start Timeout may be programmed for each track independently (**T1** and **T2**).

POSITIVE START TIMEOUT T1: NONE

5.20.13 Set AT Operation Out

This option can configure the **AT** terminal output for specialized applications. This new option cannot be used in S2 or D2 redundant 2000 systems. This option has two selections: **NORMAL** and **DIAGNOSTIC**. The display toggles between **NORMAL** and **DIAGNOSTIC** each time the **NEW DATA** key is pressed. The default is **NORMAL**.

When programmed to **NORMAL**, the **AT** terminal operates as a standard output used for redundant operation by two separate 2000 units wired to an 80069 Automatic Transfer Unit. When programmed to **DIAGNOSTIC**, the **AT** terminal functions as an error indicator and therefore will not support automatic transfer operation. While programmed to **DIAGNOSTIC**, the **AT** terminal provides a constant 256 Hz AC signal output. When an error is detected, the **AT** terminal output changes to a DC level. A 2000 S2 or D2 redundant unit must have the **AT** terminal programmed to **NORMAL**. The SET AT Operation Out option should only be used in non-redundant 2000 cases.

SET AT OPERATION OUT: NORMAL

5.20.14 Set to Default

When initially installed and power is applied, the system must be initialized by installing a set of default parameters (see Table 5-7) via this function prior to system programming. The default parameters are automatically installed in the system when the SET TO DEFAULT function in the Function Mode menu is enabled.

SET TO DEFAULT

Once a system is operational, it is normally not necessary to return to the default values. However, **if any of the hardware changes listed below are made, it is necessary to return to the default parameters and then reprogram and recalibrate the system.**

- The Control Interface Assembly (80020/80029) have been replaced (including attached printed circuit board (80017/80153) (see Figure 5-11).
- The Processor Module (80224) has been replaced with another containing a different software level.
- The software on the Processor Module (80224) has been replaced with a different software revision level.
- The entire 2000 MS case, including all associated modules, has been moved to another location.

5.21 NUMBER KEYS (0 AND 1 THROUGH 9)

These keys are used for entering numerical data. Keys 1 through 6 are dual-function keys and are also described elsewhere under the assigned function.

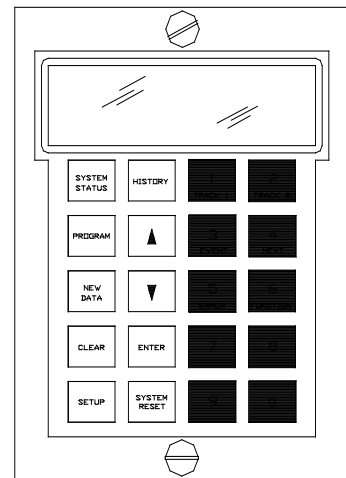
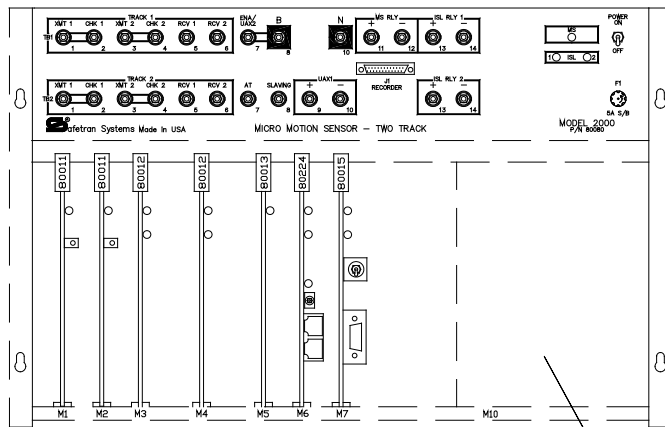


Table 5-7. System Default Parameters

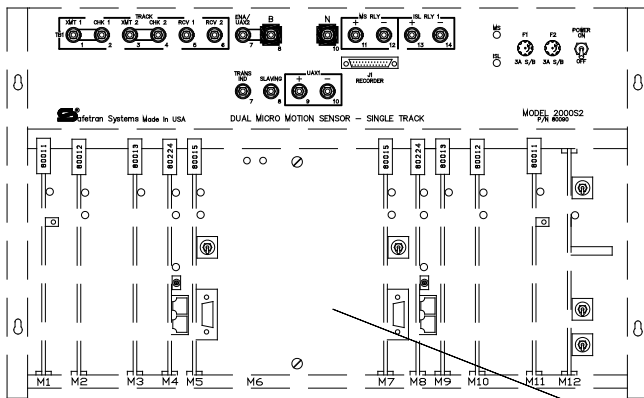
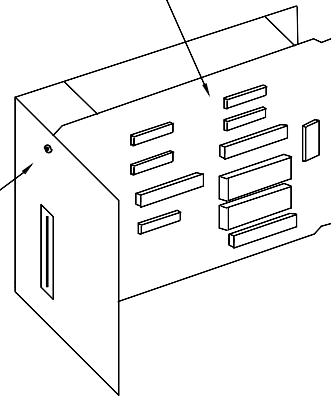
Parameter	Default Value	Reference Paragraph
Number of Tracks	2	5.6.1
Frequency	790 Hz	5.6.2
Unidirectional/Bidirectional	Unidirectional	5.6.3
Xmit Level	Medium	5.6.4
Approach (Distance)	3000 Feet	5.6.5
UAX Pickup Delay	25 Seconds	5.6.6
Slaving Master/Slave	Master	5.6.7
Password Disabled/Enabled	Disabled	5.6.8
Data Recorder	Not Installed	5.6.9
RS232C Baud Rate	9600	5.6.10
RS232C Data Bits	8	5.6.11
RS232C Stop Bits	1	5.6.12
RS232C Parity	None	5.6.13
Date	None	5.6.14
Time	None	5.6.15
Daylight Savings Time	On	5.6.16
Remote Unit Operation	Off	5.20.1
Pickup Delay Prime	15 Seconds	5.20.2
Compensation Value	Set by System Frequency	5.20.3
Enhanced Detection	Off	5.20.4
Back to Back T1 and T2	No	5.20.5
Station Stop Timer	10 Seconds	5.20.6
Number of Track Wires	4	5.20.7
Low EX Adjustment	0	5.20.8
Low EZ Detection	Off	5.20.9
Low EZ Detection Timer	10 minutes	5.20.10
Positive Start	Off	5.20.11
Positive Start Timeout	None	5.20.12
Set AT Operation Out	Normal	5.20.13



MODEL 2000 MS

80017 PRINTED CIRCUIT BOARD LOCATED BEHIND PANEL

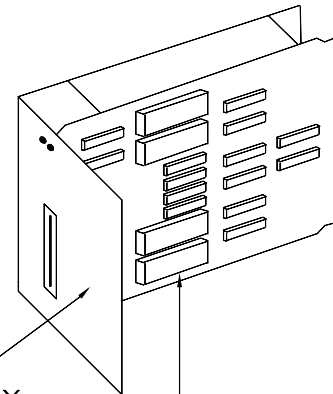
80020 ASSEMBLY



MODEL 2000S2 MS

80029 ASSEMBLY

80153 PRINTED CIRCUIT BOARD LOCATED BEHIND PANEL



2KF5-11
8-19-97

Figure 5-11. Location of Keyboard/Display Interface Assembly (80020) with Keyboard/Display Control Unit (80019) Removed

2000 MS APPLICATION HISTORY CARD

Equipment: 2000 2000S2 Date Installed: _____
 Unit/Serial No.: _____ Crossing No.: _____ Island Frequency: T1: _____ kHz T2: _____ kHz

PROGRAMMING HISTORY

<input type="checkbox"/> Press PROGRAM key	Initial Programmed Value Date:	Program Change Date:	Program Change Date:
NUMBER OF TRACKS (Transceiver Modules)	1 <input type="checkbox"/> 2 <input type="checkbox"/>	1 <input type="checkbox"/> 2 <input type="checkbox"/>	1 <input type="checkbox"/> 2 <input type="checkbox"/>
FREQUENCY	T1: _____ Hz T2: _____ Hz	_____ Hz _____ Hz	_____ Hz _____ Hz
UNIDIRECTIONAL/BIDIRECTIONAL	T1: UNI <input type="checkbox"/> BI <input type="checkbox"/> T2: UNI <input type="checkbox"/> BI <input type="checkbox"/>	UNI <input type="checkbox"/> BI <input type="checkbox"/> UNI <input type="checkbox"/> BI <input type="checkbox"/>	UNI <input type="checkbox"/> BI <input type="checkbox"/> UNI <input type="checkbox"/> BI <input type="checkbox"/>
XMIT LEVEL	T1: MAX <input type="checkbox"/> MED <input type="checkbox"/> T2: MAX <input type="checkbox"/> MED <input type="checkbox"/>	MAX <input type="checkbox"/> MED <input type="checkbox"/> MAX <input type="checkbox"/> MED <input type="checkbox"/>	MAX <input type="checkbox"/> MED <input type="checkbox"/> MAX <input type="checkbox"/> MED <input type="checkbox"/>
APPROACH DISTANCE → SELECTED	T1: _____ Ft. T2: _____ Ft.	_____ Ft. _____ Ft.	_____ Ft. _____ Ft.
UAX1 PICKUP DELAY (UAX) (0 = OFF)	_____ Sec.	_____ Sec.	_____ Sec.
ENA/UAX2 DELAY (0 = ENA)	_____ Sec.	_____ Sec.	_____ Sec.
SLAVING MASTER/SLAVE	MASTER <input type="checkbox"/> SLAVE <input type="checkbox"/>	MASTER <input type="checkbox"/> SLAVE <input type="checkbox"/>	MASTER <input type="checkbox"/> SLAVE <input type="checkbox"/>
PASSWORD ENABLED	DISABLED <input type="checkbox"/> ENABLED <input type="checkbox"/>	DISABLED <input type="checkbox"/> ENABLED <input type="checkbox"/>	DISABLED <input type="checkbox"/> ENABLED <input type="checkbox"/>
RECORDER INSTALLED	NOT INSTALLED <input type="checkbox"/> INSTALLED <input type="checkbox"/>	NOT INSTALLED <input type="checkbox"/> INSTALLED <input type="checkbox"/>	NOT INSTALLED <input type="checkbox"/> INSTALLED <input type="checkbox"/>
	EXTERNAL NODE # _____	EXTERNAL NODE # _____	EXTERNAL NODE # _____
RS-232-C BAUD RATE	_____ bps	_____ bps	_____ bps
RS-232-C DATA BITS	7 <input type="checkbox"/> 8 <input type="checkbox"/>	7 <input type="checkbox"/> 8 <input type="checkbox"/>	7 <input type="checkbox"/> 8 <input type="checkbox"/>
RS-232-C STOP BITS	1 <input type="checkbox"/> 2 <input type="checkbox"/>	1 <input type="checkbox"/> 2 <input type="checkbox"/>	1 <input type="checkbox"/> 2 <input type="checkbox"/>
RS-232-C PARITY	NONE <input type="checkbox"/> ODD <input type="checkbox"/> EVEN <input type="checkbox"/> SPACE <input type="checkbox"/> MARK <input type="checkbox"/>	NONE <input type="checkbox"/> ODD <input type="checkbox"/> EVEN <input type="checkbox"/> SPACE <input type="checkbox"/> MARK <input type="checkbox"/>	NONE <input type="checkbox"/> ODD <input type="checkbox"/> EVEN <input type="checkbox"/> SPACE <input type="checkbox"/> MARK <input type="checkbox"/>
DATE (e.g., THU 03 APR 1997)	_____	_____	_____
TIME (e.g., 11:25:43 AM)	_____	_____	_____
DAYLIGHT SAVINGS	ON <input type="checkbox"/> OFF <input type="checkbox"/>	ON <input type="checkbox"/> OFF <input type="checkbox"/>	ON <input type="checkbox"/> OFF <input type="checkbox"/>

EXPANDED PROGRAMMING HISTORY (Function Mode)

<input type="checkbox"/> Press FUNCTION key	Initial Programmed Value Date:	Program Change Date:	Program Change Date:
REMOTE UNIT OPERATION	T1: ON <input type="checkbox"/> OFF <input type="checkbox"/> T2: ON <input type="checkbox"/> OFF <input type="checkbox"/>	ON <input type="checkbox"/> OFF <input type="checkbox"/> ON <input type="checkbox"/> OFF <input type="checkbox"/>	ON <input type="checkbox"/> OFF <input type="checkbox"/> ON <input type="checkbox"/> OFF <input type="checkbox"/>
PICKUP DELAY PRIME	_____ Sec.	_____ Sec.	_____ Sec.
COMPENSATION VALUE	T1: _____ T2: _____	_____ _____	_____ _____
ENHANCED DETECTION (ED)	T1: ON <input type="checkbox"/> OFF <input type="checkbox"/> T2: ON <input type="checkbox"/> OFF <input type="checkbox"/>	ON <input type="checkbox"/> OFF <input type="checkbox"/> ON <input type="checkbox"/> OFF <input type="checkbox"/>	ON <input type="checkbox"/> OFF <input type="checkbox"/> ON <input type="checkbox"/> OFF <input type="checkbox"/>
BACK TO BACK T1 AND T2	NO <input type="checkbox"/> YES <input type="checkbox"/>	NO <input type="checkbox"/> YES <input type="checkbox"/>	NO <input type="checkbox"/> YES <input type="checkbox"/>
STATION STOP TIMER	T1: _____ Sec. (When ED is on) T2: _____ Sec.	_____ Sec. _____ Sec.	_____ Sec. _____ Sec.
NUMBER OF TRACK WIRES	T1: 4 <input type="checkbox"/> 6 <input type="checkbox"/> T2: 4 <input type="checkbox"/> 6 <input type="checkbox"/>	4 <input type="checkbox"/> 6 <input type="checkbox"/> 4 <input type="checkbox"/> 6 <input type="checkbox"/>	4 <input type="checkbox"/> 6 <input type="checkbox"/> 4 <input type="checkbox"/> 6 <input type="checkbox"/>
LOW EX ADJUSTMENT	T1: _____ T2: _____	_____ _____	_____ _____
LOW EZ DETECTION	T1: ON <input type="checkbox"/> OFF <input type="checkbox"/> T2: ON <input type="checkbox"/> OFF <input type="checkbox"/>	ON <input type="checkbox"/> OFF <input type="checkbox"/> ON <input type="checkbox"/> OFF <input type="checkbox"/>	ON <input type="checkbox"/> OFF <input type="checkbox"/> ON <input type="checkbox"/> OFF <input type="checkbox"/>
LOW EZ DETECTION TIMER	T1: _____ Min. (When low EZ detection is on) T2: _____ Min.	_____ Min. _____ Min.	_____ Min. _____ Min.
POSITIVE START (0 = OFF)	T1: _____ EZ (Enter EZ value) T2: _____ EZ	_____ EZ _____ EZ	_____ EZ _____ EZ
POSITIVE START TIMEOUT (0 = NONE)	T1: _____ Min. (When positive start is on) T2: _____ Min.	_____ Min. _____ Min.	_____ Min. _____ Min.
SET AT OPERATION OUT	NORMAL <input type="checkbox"/> DIAGNOSTIC <input type="checkbox"/>	NORMAL <input type="checkbox"/> DIAGNOSTIC <input type="checkbox"/>	NORMAL <input type="checkbox"/> DIAGNOSTIC <input type="checkbox"/>

HISTCARD
07-11-07

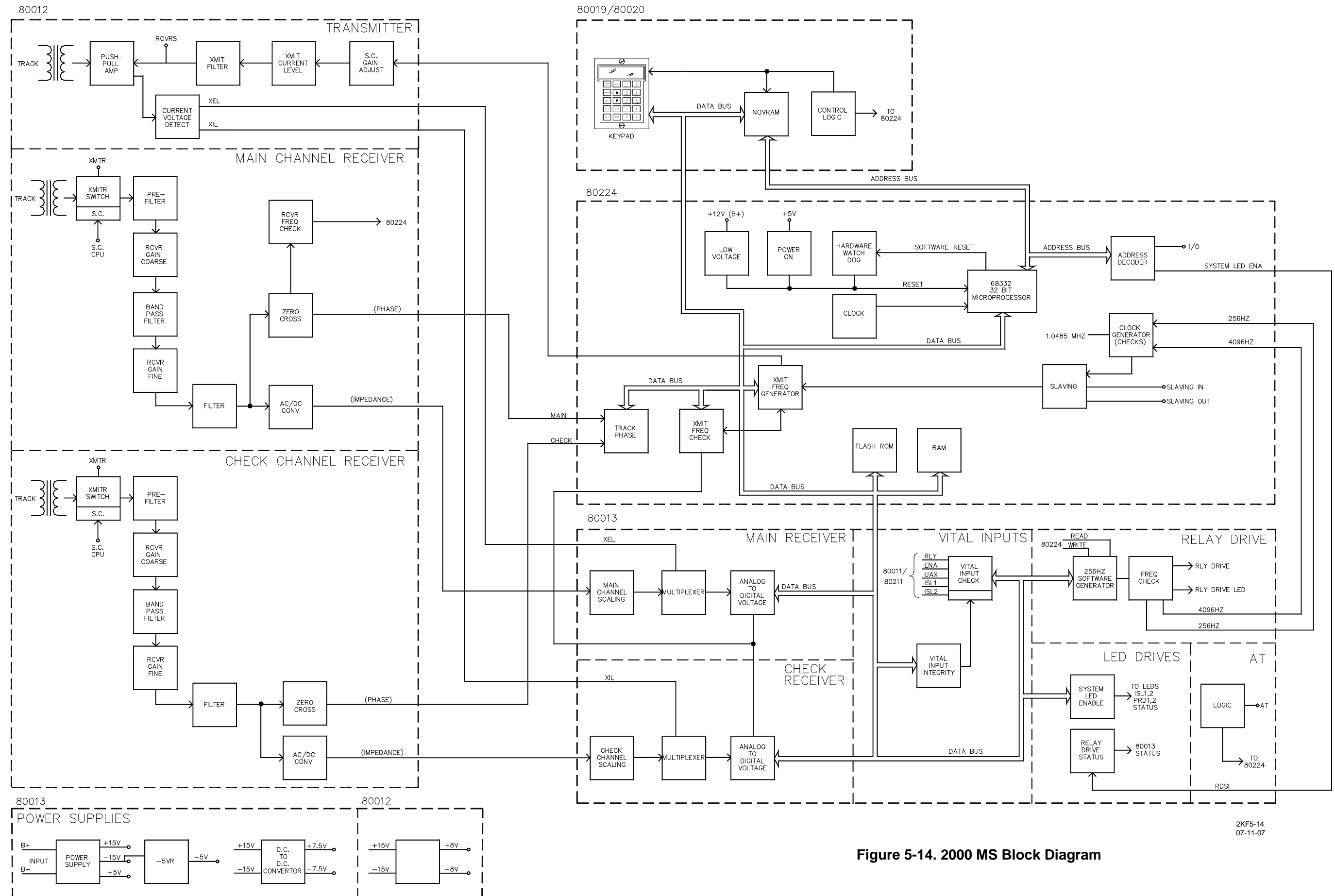
Figure 5-12. 2000 MS Application History Card (Front)

CALIBRATION HISTORY

EZ/EX VALUES (TRACK UNOCCUPIED)			
TRACK		EZ	EX
EAST/NORTH	TRACK 1		
WEST/SOUTH	TRACK 1		
EAST/NORTH	TRACK 2		
WEST/SOUTH	TRACK 2		

HISTCARDBACK
07-11-07

Figure 5-13. 2000 MS Application History Card (Back)



2KF5-14
07-11-07

Figure 5-14. 2000 MS Block Diagram

SECTION VI

DATA RECORDER

6.0 GENERAL

The optional data recorder module (80015/80115) is a solid-state data-recording device that maintains event records, including date and time of occurrence, for several types of events, both internal and external to the 2000 MS. In addition to train speeds, these events include input changes that occur on any of the 16 external channels. The external channels are monitored through a data recorder interface assembly (80025) via the RECORDER connector J1 located on the 2000 MS front panel. Also recorded are 2000 MS error (diagnostic) messages, MS power on/off and system reset indications, as well as track calibration indications. Refer to Paragraph 6.5, PC File/Printout Format for a description of each type of event.

On-board data memory consists of 64k bytes of RAM with battery backup. Approximate memory capacity is 3,000 events. When memory becomes full, the oldest data is overwritten by the newest data and the next oldest event remaining in memory then becomes event number 1. STATUS and LO BATT LEDs located on the front edge of the module (see Figure 6-1) are normally lighted steady, indicating the module is functioning properly and the on-board battery has sufficient charge to protect the stored data. When the battery voltage is low, the LO BATT LED begins to flash, indicating the battery should be replaced. Multifunction CLEAR/OFF/PRINT toggle switch SW1, also located on the front edge of the module, controls the memory clear (CLEAR position is momentary) and memory file download/print functions.

NOTE**NOTE**

With the data recorder installed in the 2000 MS and enabled in the Program menu, data recording begins when power is applied to the 2000 MS. Data can be recorded with CLEAR/OFF/PRINT switch SW1 set to either the OFF or PRINT position.

A 25-pin RS232C serial connector located on the front edge of the module provides a temporary interface between the module and an external PC/laptop, modem, or serial data printer. For a permanent installation, a modem can be connected to MODEM connector J2 on the data recorder interface assembly (80025) to supply recorded data to a remote PC/laptop or printer via the 2000 MS front panel RECORDER connector J1. System programming and on-board DIP switches allow the on-board data recorder I/O circuits to be configured to accommodate a wide variety of PC/laptops, modems, and printers.

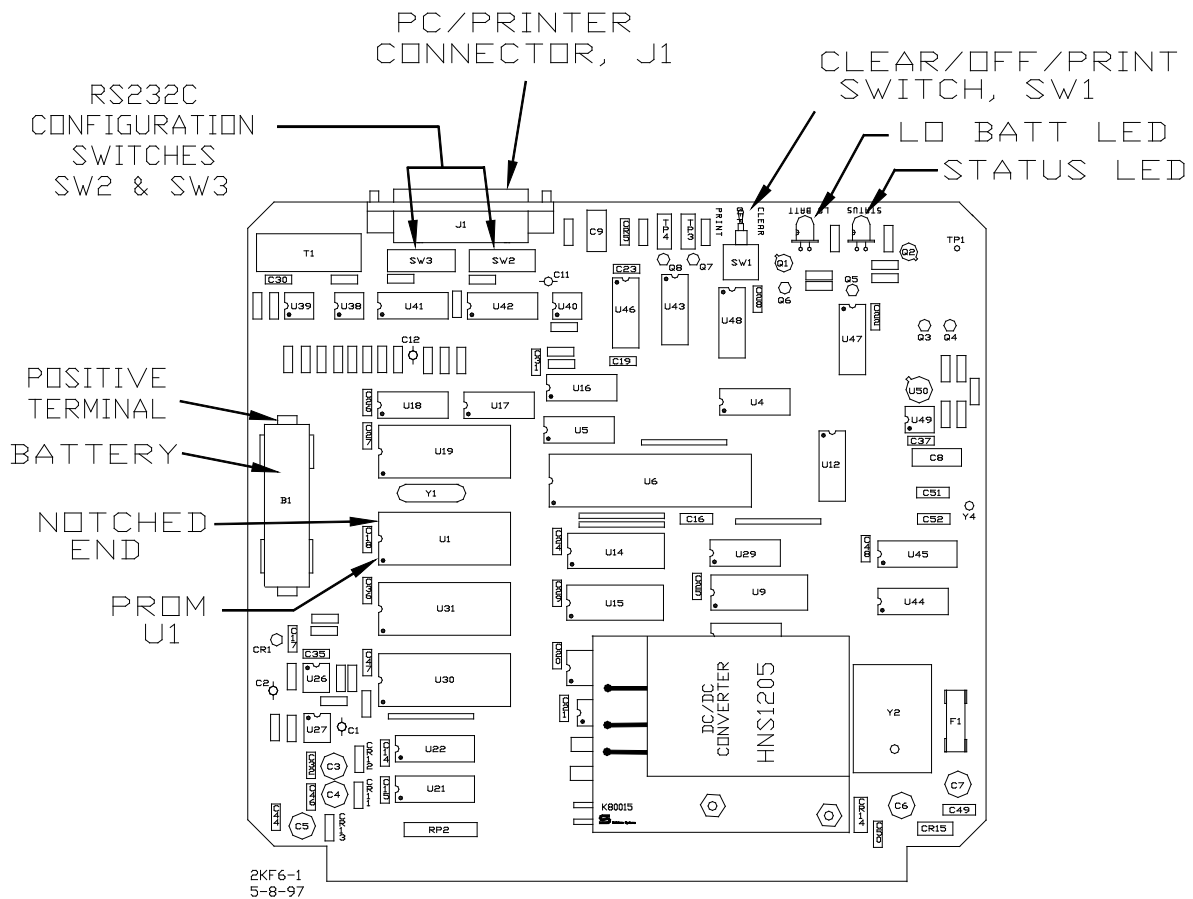


Figure 6-1. Data Recorder Module, 80015

6.1 DATA RECORDER PROGRAMMING

With the data recorder module installed in the 2000 MS, the system must be programmed to enable the recorder and to set the correct date and time. Computer/printer parameters associated with downloading the recorder's memory contents to a file or printing it can be programmed at the time of installation or any time prior to initiating the memory downloading or printing process. The recorder programming procedure is also included in Section II, System Application Programming.

NOTE	NOTE The following programming steps 2 through 9b correspond to steps 11 through 18b in section II.
-------------	---

Step 1 Press the PROGRAM key.

Step 2 Press the down arrow key (↓) once. One of the following messages is displayed depending on the current data recorder status:

PROGRAM RECORDER NOT INSTALLED

PROGRAM RECORDER INSTALLED

If the data recorder option is to be used, program the system for recorder Installed (steps 2a and 2b below) and then perform programming steps 3 through 9b below as required. If the data recorder option is not to be used, program the system for recorder Not Installed (steps 2a and 2b below) and then proceed to step 19 in section II for extended application programming.

Step 2a Press the NEW DATA key. The recorder option status toggles between Installed and Not Installed each time the NEW DATA key is pressed.

Step 2b Press the ENTER key when Installed is displayed.

NOTE

NOTE

Perform steps 3 through 6c below to set the RS232C parameters to enable the 2000 MS to communicate with an external PC/laptop or printer connected to the data recorder module (80015) via the connector on the front edge of the module. Refer to Paragraph 6.3, Downloading Recorded Data To A Computer File, (or other applicable PC software instructions) or to the printer manufacturer's manual to determine the appropriate values to enter. Steps 3 through 6c may be performed at a future date prior to memory downloading or printing.

Step 3 Press the down arrow key (↓) once. The following message is displayed:

PROGRAM	RS-232-C
BAUD RATE:	9600

Step 3a Press the NEW DATA key.

Step 3b Use the up (↑) or down (↓) arrow keys to display the PC/laptop, modem, or printer baud rate (300, 1200, 2400, 4800, or 9600). The default is 9600. If the memory contents will be downloaded to a PC/laptop computer file, set the baud rate to 9600.

Step 3c Press the ENTER key.

Step 4 Press the down arrow key (↓) once. The following message is displayed:

PROGRAM	RS-232-C
DATA BITS:	8

Step 4a Press the NEW DATA key.

Step 4b Use the up (↑) or down (↓) arrow keys to display the number of data bits for the PC/laptop, modem, or printer (7 or 8). The default is 8. If the memory contents will be downloaded to a PC/laptop computer file, set the data bits to 8.

Step 4c Press the ENTER key.

Step 5 Press the down arrow key (↓) once. The following message is displayed:

PROGRAM	RS-232-C
STOP BITS:	1

Step 5a Press the NEW DATA key.

Step 5b Use the up (↑) and down (↓) arrow keys to display the number of stop bits for the PC/laptop, modem, or printer (1 or 2). The default is 1. If the memory contents will be downloaded to a PC/laptop computer file, set the number of stop bits to 1.

Step 5c Press the ENTER key.

Step 6 Press the down arrow key (↓) once. The following message is displayed:

PROGRAM	RS-232-C
PARITY:	NONE

Step 6a Press the NEW DATA key.

Step 6b Use the up (↑) and down (↓) arrow keys to display the type of parity used by the PC/laptop, modem, or printer (none, odd, even, mark, or space). The default is None.

Step 6c Press the ENTER key.

Step 7 Press the down arrow key (↓) until the date display message similar to that shown below appears.

PROGRAM	DATE
FRI	21 FEB 1997

Step 7a Press the NEW DATA key. The cursor appears at the first digit of the day-of-the-month entry.

Step 7b Enter the day of the month. The entry must consist of two digits (e.g., 01, 12). When the second digit is entered, the cursor moves to the first letter of the month entry.

Step 7c Use the up (↑) and down (↓) arrow keys to display the desired month entry.

Step 7d Press the NEW DATA key. The cursor appears at the first digit of the year entry.

Step 7e Enter all four digits for the year entry (e.g., 1997). As the last digit is entered, the appropriate day-of-the-week is automatically displayed. Review all time entries and change any if necessary.

Step 7f Press the ENTER key.

Step 8 Press the down arrow key (↓) once. A time display message similar to that shown below appears. Time is displayed in hours:minutes:seconds (hh:mm:ss) format.

PROGRAM	TIME
11:25:43	(24 HR)

Step 8a Press the NEW DATA key. The cursor appears at the first digit of the hours entry.

Step 8b Enter the hours. The entry must consist of two digits (e.g., 01, 12). When the second digit is entered, the cursor moves to the first digit of the minutes entry.

NOTE**NOTE**

If 24-hour (military) time format is used, enter the hours in the same format (e.g., 01, 12, 23).

Step 8c Enter the minutes. The entry must consist of two digits (e.g., 01, 22, 56). When the second digit is entered, the cursor moves to the first digit of the seconds entry.

NOTE**NOTE**

To ensure precise time setting, it may be helpful to set the minutes entry approximately two minutes ahead of the actual time to allow sufficient time to complete steps 8d and 8e. Then, when the entered minutes time arrives, step 8f can be performed.

Step 8d Enter the seconds. The entry must consist of two digits (e.g., 01, 22, 56). When the second digit is entered, the cursor moves to the first character of the time format (AM, PM, 24-hour) entry.

Step 8e Use the up (↑) and down (↓) arrow keys to display the desired time format entry. When using 24-hour (military) format, follow the time entry with 24 HR. When using standard 12-hour format, follow the time entry with AM or PM, whichever is appropriate.

Step 8f Press the ENTER key at the exact second when real time coincides with the time entered on the display. Verify that the seconds portion of the display is now advancing.

Step 9 Press the down arrow key (↓) once. The daylight savings time message shown below is displayed.

PROGRAM DAYLIGHT SAVINGS: ON

Step 9a Press the NEW DATA key. Each time the NEW DATA key is pressed, the entry toggles between Off and On. If daylight savings time is to be used, select On and the recorder will change the time setting automatically at the beginning (2:00 a.m. on the first Sunday in April) and end (2:00 a.m. on the last Sunday in October) of the daylight savings time period. If daylight savings time is not to be used, select Off.

Step 9b Press the ENTER key.

6.2 CLEARING DATA RECORDER MEMORY

Once the data recorder is enabled (Installed status) and configured, it may be desirable to clear the recorder memory before leaving the crossing site. To clear the memory, press and hold CLEAR/OFF/PRINT switch SW1 on the data recorder module (Figure 8-1) in the CLEAR position for approximately 5 seconds until the LO BATT LED begins to flash. Release the switch. Memory is now clear. This procedure may be performed at any time, **but it is required at initial installation prior to placing the equipment in service and when the on-board battery is replaced.**

6.3 DOWNLOADING RECORDED DATA TO A COMPUTER FILE

The following procedures enables downloading of data recorder memory contents to a PC/laptop using the Microsoft® Windows® or Windows® 95/98 Terminal applications.

- A number of other widely used software programs are available that can be used to accomplish the same task.
- When using another program, refer to the documentation supplied with the software package for applicable instructions.

6.3.1 Microsoft® Windows® Application Procedure

Step 1 Connect an appropriate interface cable (see paragraph 9.1.10) between PC/printer connector J1 on the front edge of the data recorder module (figure 6-1) and an available serial port on the PC/laptop (normally COM1 or COM2).

Step 2 Apply power to the PC/laptop.

Step 3 Type **WIN** at the DOS prompt (**C:\>WIN**).

Step 4 Press the **ENTER** key.

The Windows™ screen displays.

Step 5 If the Windows™ Accessories group is not already open, select the Accessories group.

Step 6 From the Accessories group select the **Terminal** application.



Terminal

Step 7 From the Terminal application menu bar select **Settings**.

Step 8 From the **Settings** menu select **Communications**.

The dialog box shown in figure 6-2 displays.

Step 9 From the **Communications** dialog box, select the connector first (normally **COM1** or **COM2**; however, either **COM3** or **COM4** may also be used if available) and then select the following parameters:

Baud Rate: 9600
Data Bits: 8
Stop Bits: 1
Parity: None
Flow Control: Xon/Xoff

NOTE

NOTE

The above settings must be the same as those set for the data recorder module in paragraph 6.1.1, steps 3.2 through 6.2.

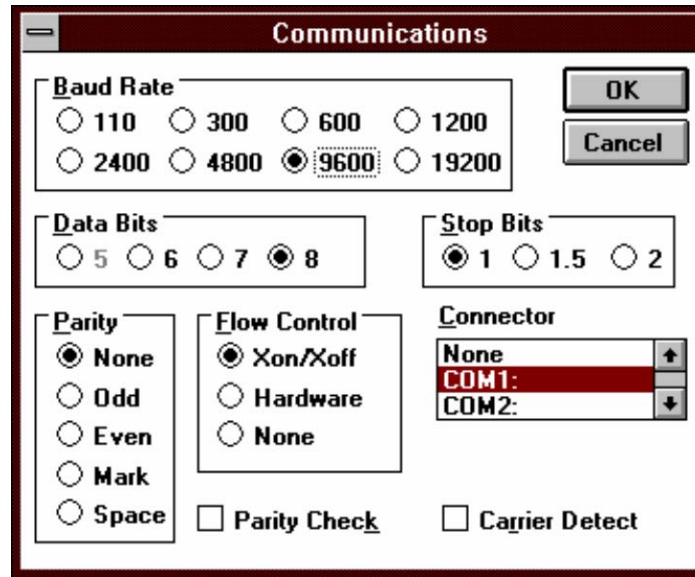


Figure 6-2. Windows™ Terminal Communications Dialog Box

Step 10

From the **Communications** dialog box, select the connector first (normally **COM1** or **COM2**; however, either **COM3** or **COM4** may also be used if available) and then select the following parameters:

Baud Rate: 9600
 Data Bits: 8
Stop Bits: 1
 Parity: None
Flow Control: Xon/Xoff

NOTE

NOTE
 The above settings must be the same as those set for the data recorder module in paragraph 9.1.1, steps 3.2 through 6.2.

Step 11

Within the **Communications** dialog box click on the **OK** button.

Step 12

From the Terminal application menu bar select the **Transfers** menu.

Step 13 From the **Transfers** menu select **Receive Text File**.

The dialog box shown in figure 6-3 displays.

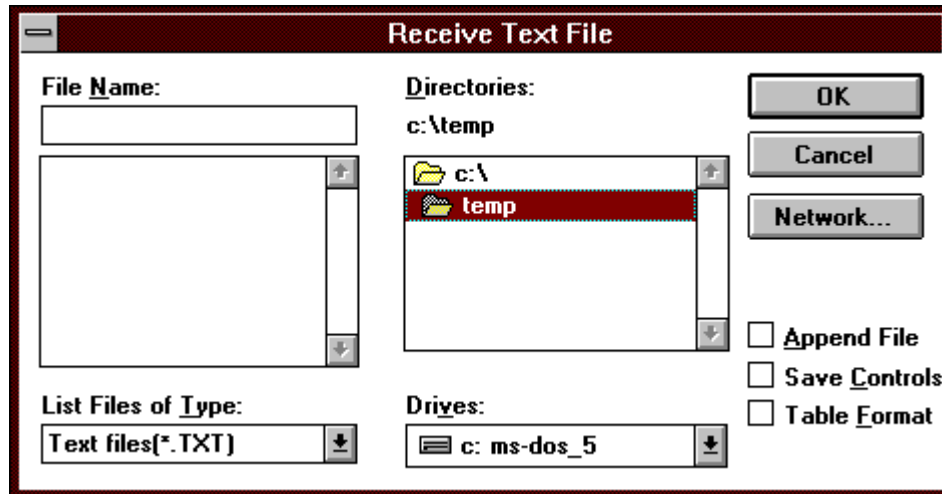


Figure 6-3. Receive Text File Dialog Box

Step 14 In the **File Name** text box enter the name of the destination file where the data recorder contents are to be copied.

Always include the directory path in the file name (e.g., **C:\TEMP\filename.TXT**) or set the directory path in the **Directories** list box.

Step 15 Click on the **OK** button.

Step 16 On the 3000 GCP keypad, press the **PROGRAM** key.

Step 17 Use the up arrow key (▲) on the 3000 GCP keypad to scroll through the Program menu to the data recorder RS-232-C parameters and set or verify the parameters as follows:

Parity: None
Stop Bits: 1
Data Bits: 8
Baud Rate: 9600

Step 18 On the data recorder module, set **CLEAR/OFF/PRINT** switch SW1 to the **PRINT** position.

The download process begins. The recorded data appears on the computer display as it is being downloaded.

The download process may be controlled from the keyboard as follows:

- To **interrupt (pause)** the downloading process at any time, press and hold the **Ctrl** key on the PC/laptop keyboard and then press the letter **S** key.
- To **resume** the downloading process following a pause, press and hold the **Ctrl** key on the PC/laptop keyboard and then press the letter **Q** key.
- To **abort** the downloading process, press and hold the **Ctrl** key on the PC/laptop keyboard and then press the letter **C** key.
- To **start** the downloading process at the beginning (event number 1 or specified start print event) after the downloading process has been aborted, momentarily press the **ENTER** key on the PC/laptop keyboard.

Step 19 When file downloading has been completed, select the **STOP** button located in the lower left corner of the display to save the file.

Step 20 On the data recorder module, set **CLEAR/OFF/PRINT** switch SW1 to the **OFF** position.

The file can now be printed out any time a hard copy is needed.

6.3.2 Microsoft® Windows® 95/98 HyperTerminal Application Procedure

Step 1 Connect an appropriate interface cable (see paragraph 9.1.10) between PC/printer connector J1 on the front edge of the data recorder module (figure 6-1) and an available serial port on the PC/laptop (normally COM1 or COM2).

Step 2 Apply power to the PC/laptop and start Windows® 95/98 by typing **WIN** at the DOS prompt (**C:\>WIN**).

Step 3 Click on the **Start** button in the taskbar at the bottom of the screen.

The **Windows 95** start menu displays.

Step 4 Place the cursor over **Programs** in the start menu.

A list of program folders displays.

Step 5 Place the cursor over **Accessories**.

A list of programs within the **Accessories** folder displays.

Step 6 Click on **HyperTerminal** within the displayed list.

The **HyperTerminal** window displays.



Hypertrm.exe

Step 7 From the window select the **HyperTerminal** application.

The **New Connection – HyperTerminal** window, figure 6-4, displays.

- The **Connection Description** dialog box appears within the window.

Step 8 In the **Name:** box, type a name for the connection.

Step 9 From the **Icon:** box, select an icon for the connection.

Step 10 Click on the dialog box **OK** button.

The **Connection Description** dialog box closes and is replaced by the **Phone Number** dialog box, figure 6-5.

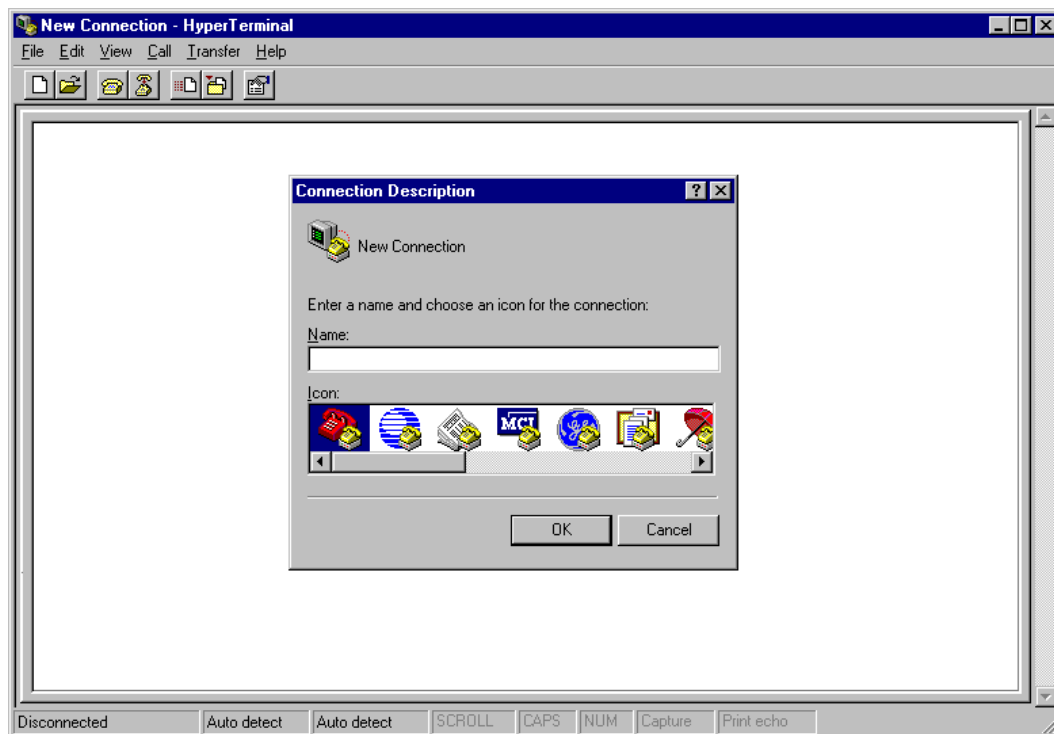


Figure 6-4. New Connection - HyperTerminal Window



Figure 6-5. Phone Number Dialog Box

Step 11 From the **Connect using:** drop down box, select the PC/laptop serial port.

Step 12 Click on the **Phone Number** dialog box **OK** button.

The **Phone Number** dialog box closes and is replaced by the **COM1 Properties** dialog box, figure 6-6.

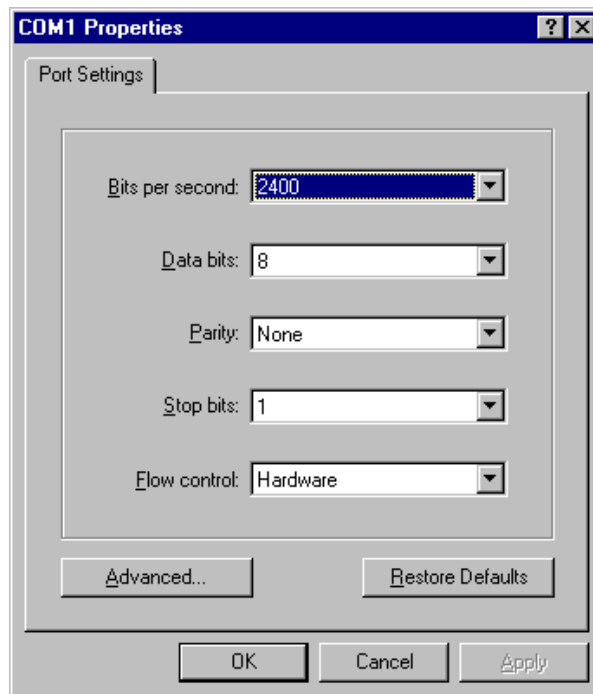


Figure 6-6. COM1 Properties Dialog Box

Step13 From the **Port settings** drop-down boxes, select the following parameters:

Baud Rate: 9600
Data Bits: 8
Parity: None
Stop Bits: 1
Flow Control: Xon/Xoff

NOTE**NOTE**

The above settings must be the same as those set for the data recorder module in paragraph 6.1, steps 3b through 6b.

Step 14 From the **COM1 Properties** dialog box click on the **OK** button.

The **COM1 Properties** dialog box closes.

Step 15 On the 3000 GCP keypad, press the **PROGRAM** key.

Step 16 Use the up arrow key (▲) on the 3000 GCP keypad to scroll through the Program menu to the data recorder RS-232-C parameters and set or verify the parameters as follows:

Parity: None
Stop Bits: 1
Data Bits: 8
Baud Rate: 9600

Step 17 From the **Transfer** menu select **Capture text...**

The **Capture Text** dialog box, figure 6-7, displays.

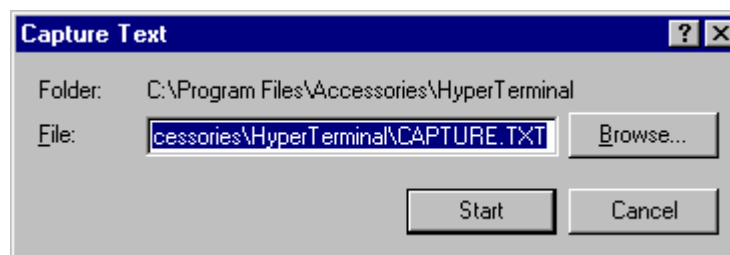


Figure 6-7. Capture Text Dialog Box

Step 18 In the **File** text box enter the name of the destination file where the data recorder contents are to be captured.

- The file name must include the directory path (e.g., **C:\TEMP\filename.TXT**).

Step 19 From the **Capture Text** dialog box click on the **Start** button.

Step 20 On the data recorder module, set **CLEAR/OFF/PRINT** switch SW1 to the **PRINT** position.

The download process begins.

- The recorded data appears within the **HyperTerminal** window as it is being downloaded (see figure 6-8).

```

1-15-99 - HyperTerminal
File Edit View Call Transfer Help
SAFETRAN SYSTEMS CORPORATION
Software Version 8V993-A02B-2
15-JAN-1999 03:47 PM
Number of Events Recorded = 104
DATE    TIME    - INPUT CHANNELS -      - - - - SPEEDS - - - -
MM/DD  HH:MM:SS  1-----8  9-----16  WT  DET  AVG  ISL      STATUS
-----
12/15  08:52:27A  -----  -----  37  41  47  48  T1 Train Move
12/15  08:54:00A  -----  -----  ---  ---  ---  ---  T2 ENHANCED DET
12/15  08:56:10A  -----  -----  ---  ---  ---  ---  T2 NORMAL MODE
12/15  08:57:12A  -----  -----  ---  ---  ---  ---  T2 ENHANCED DET
12/15  09:05:06A  -----  -----  ---  ---  ---  ---  T2 NORMAL MODE
12/15  09:05:48A  -----  -----  35  48  48  49  T1 Train Move
12/15  10:01:42A  -----  -----  ---  ---  ---  ---  Power Off
12/21  10:43:07A  -----  -----  ---  ---  ---  ---  Power On
12/21  10:43:08A  -----  -----  ---  ---  ---  ---  Power Off
12/21  03:49:31P  -----  -----  ---  ---  ---  ---  Power On
12/21  03:56:31P  -----  -----  ---  ---  ---  ---  T2 ENHANCED DET

```

Figure 6-8. Data Recorder Download Display

The download process may be controlled from the keyboard as follows:

- To **interrupt (pause)** the downloading process at any time, press and hold the **Ctrl** key on the PC/laptop keyboard and then press the letter **S** key.
- To **resume** the downloading process following a pause, press and hold the **Ctrl** key on the PC/laptop keyboard and then press the letter **Q** key.
- To **abort** the downloading process, press and hold the **Ctrl** key on the PC/laptop keyboard and then press the letter **C** key.
- To **start** the downloading process at the beginning (event number 1 or specified start print event) after the downloading process has been aborted, momentarily press the **Enter** key on the PC/laptop keyboard.

Step 21 When file downloading is completed, set the **CLEAR/OFF/PRINT** switch SW1 on the data recorder module to the **OFF** position.

Step 22 From the **File** menu select **Exit**.

The **HyperTerminal** dialog box, figure 6-9, appears within the **HyperTerminal** window.

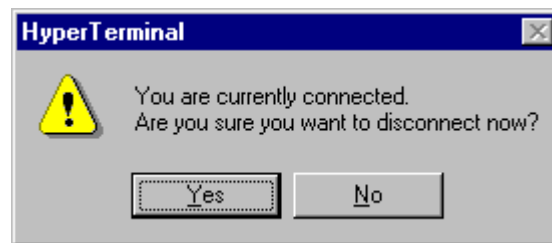


Figure 6-9. HyperTerminal Disconnect Dialog Box

Step 23 Click on the **Yes** button.

The **HyperTerminal** dialog box, figure 6-10, displays within the **HyperTerminal** window.

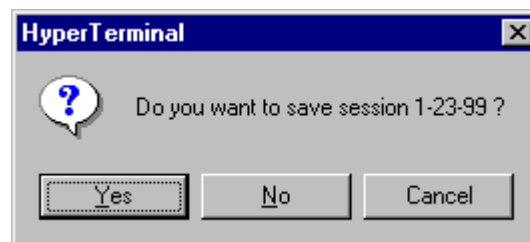


Figure 6-10. HyperTerminal Save Session Dialog Box

Step 24 Click on the **Yes** button.

The dialog box and the **HyperTerminal** window close. The file can now be printed out any time a hard copy is needed.

6.4 PRINTING RECORDED DATA

The data recorder memory contents are printed beginning with the earliest recorded (oldest) data in memory (event number 1) and ending with the last event recorded prior to initiating the print function. Memory contents can be printed from beginning to end, or the print can be started at a designated event number. Printing is controlled from the data recorder module using CLEAR/OFF/PRINT switch SW1. The print function can also be controlled from the printer if it is equipped with a keyboard. Printer interface requirements and printing procedures are described in the paragraphs that follow.

6.4.1 Printer Compatibility

To obtain a hard-copy printout of the data recorder memory contents, the data recorder module must be connected to a suitable printer via RS232C serial PC/printer connector J1 located on the front edge of the module. Generally, any 80-column serial printer can be used. The data recorder module will support Xon/Xoff protocol.

Before printing, ensure that the data recorder module is programmed for compatibility with the printer being used. Refer to the printer manufacturer's instruction manual and program the data recorder module baud rate, number of data bits, number of stop bits, and parity accordingly (see paragraph 6.1, steps 3 through 6c for programming instructions).

6.4.2 Printing Procedure

Perform the following steps to print the memory contents of the data recorder module.

6.4.2.1 Selecting A Specific Event For Printout

Step 1 When a printout is initiated, the first event printed is event number 1 (oldest data). If a large number of events have been recorded, the printout can be quite lengthy. However, it is possible to begin the printout at any point other than event number 1 and review events of specific interest while reducing the length of the printout. To select an alternate starting point (event number) for the printout, proceed as directed in steps 1a through 1d; otherwise, proceed to step 2.

Step 1a Press the EVENT key. A display similar to that shown below appears.

EVENTS	< 27>
START PRINT:	1

NOTE

NOTE

The number appearing in brackets indicates the total number of events recorded. The 1 in the lower right corner indicates the event number where the print will start (event number 1 is the oldest event in memory and is the default start point).

Step 1b Press the NEW DATA key.

Step 1c Enter the event number where the printout is to begin (the number should not exceed the total number of events recorded). The number entered will appear in the lower right corner of the display.

Step 1d Press the ENTER key.

NOTE**NOTE**

After the ENTER key is pressed, do not press any other key on the 2000 MS keyboard/display assembly until printing has started. If the Events display is replaced by any other display, the event number where the printout will begin reverts to 1.

6.4.2.2 Printing

Step 2 On the data recorder module, set CLEAR/OFF/PRINT switch SW1 to the OFF position (if not already in this position).

Step 3 Apply power to the printer.

Step 4 Set CLEAR/OFF/PRINT switch SW1 to the PRINT position. The printer should begin printing the memory contents. Refer to paragraph 6.5 for a description of the printout format.

NOTE**NOTE**

Printing will continue until the last event recorded in memory prior to beginning the print function is printed. Events recorded after the print function is started are stored in memory but are not printed. The print function must be stopped and started again to print newly recorded data.

The print function can be stopped (aborted) at any time by setting CLEAR/OFF/PRINT switch SW1 to the OFF position. Returning the switch to the PRINT position restarts the printout at the beginning (event number 1 or designated event number start point).

Step 5 When printing is complete, set CLEAR/OFF/PRINT switch SW1 to the OFF position.

6.4.3 Print Control Option

When using a printer equipped with a keyboard, the data recorder print function can be controlled from the printer after CLEAR/OFF/PRINT switch SW1 on the data recorder module has been set to the PRINT position. To control the printout from the printer keyboard, perform the following steps.

Step 1 To interrupt the print function at any time (**pause**), press and hold the CONTROL key on the printer keyboard while pressing the letter S key.

Step 2 To **resume** the printout following a pause (step 1), press and hold the CONTROL key on the printer keyboard while pressing the letter Q key.

Step 3 To **abort** the printout, press and hold the CONTROL key while pressing the C key.

Step 4 To **start** the printout at the beginning (event number 1 or specified start point) after the print function has been aborted, momentarily press the RETURN key on the printer keyboard.

6.5 PC FILE/PRINTOUT FORMAT

A hard copy printout provides a permanent record of several types of events, both internal and external to the 2000 MS, which are recorded and stored by the data recorder module. These events include train move data, input changes on the 16 external channel inputs, MS error (diagnostic) messages, and MS power on/off, system reset, and track calibration indications.

The printout format (Figure 6-11) consists of an identification header followed by column headings identifying the data fields. Below the column headings are lines of data; one or two lines for each recorded event.

Safetran Systems Corporation appears in the first line of the header followed by the data recorder module software version. The date and time the printout was generated appears next in the following format: Day of the month/month/year/time/AM or PM. Below this is a statement indicating the total number of events that have been recorded between the time memory was last cleared and the date and time of the printout. If an event number other than 1 is designated as the start point for the printout, a statement identifying that event number appears below the statement indicating the number of events recorded.

SAFETRAN SYSTEMS CORPORATION								
Software Version 8V993-01C								
13-JUL-1997 04:01 PM								
Number of Events Recorded = 1568								
Start Print Event = 1562								
DATE	TIME	INPUT CHANNELS			--- SPEEDS ---			
MM/DD	HH:MM:SS	1-----8	9-----16	WT	DET	AVG	ISL	STATUS
07/12								-
07/12	02:21:15A	1--4--78	-012-4-6	---	---	---	---	T1 Train Move
07/12	02:22:57A	12-4--78	-012-4-6	---	---	---	---	Input Change
07/13	02:34:12A	12-4--78	-012-4-6	---	---	---	---	Input Change
07/13	10:27:15A	12-4--78	-012-4-6	---	---	---	---	Power Off
07/13	10:40:22A	12-4--78	-012-4-6	---	---	---	---	Power On
07/13	10:59:18A	12-4--78	-012-4-6	---	---	---	---	T1 Calibration
	11:01:49A	12-4--78	-012-4-6	---	---	---	---	System Reset

Figure 6-11. Typical Data Recorder Printout

Data lines are printed in chronological order beginning with the oldest event recorded in memory (event number 1), or with a designated event number (see paragraph 6.4.2), and ends with the last event recorded before the printout was initiated.

The DATE data field appears in each data line and indicates the month and day (MM/DD) the event was recorded.

The TIME data field indicates the hour, minute, and second (HH:MM:SS) the event was recorded. Also indicated after the seconds entry is A for AM or P for PM when the standard time format is used; or blank when the 24-hour (military) time format is used.

The INPUT CHANNELS fields indicate the current status of external input channels 1 through 8 and 9 through 16. These data fields appear in each data line regardless of whether an input change has occurred. For all data lines where no input change has occurred, the last recorded input states are indicated. If an input state has changed, the data line is labeled as an input change in the last data field (Status) and the new channel input states are shown. A high (energized) state on an input is indicated by the presence of the channel number in the corresponding channel column of the data field (second digit of the channel number shown for two-digit numbers). A low (de-energized) input state is indicated by a dash in the channel column.

The WT data field represents the Warning Time value.

The SPEEDS data fields (detected speed, average speed, and island speed) are not used.

The STATUS data field indicates the type of event for which the data was recorded. Table 6-1 indicates the six types of events recorded, their corresponding entry in the Status data field, and a brief description of the event.

Table 6-1. Data Recorder Printout Status Message Descriptions

Event Type	Status Data Field Entry	Event Description
Train Move	T1 Train Move or T2 Train Move	Train move on track 1 Train move on track 2
Input Change	Input Change	Input change (active to inactive or inactive to active) occurred on one or more of the 16 external channel inputs.
Error (Diagnostic) Message Generated	Error (followed by four-digit message code and a brief description in the second line)	Error (diagnostic) message identified by four-digit code has been recorded. See Table 4-2 for message descriptions for each code.
Power Applied to 2000 MS	Power On	Indicates 2000 MS POWER switch was set to the ON position.
Power Removed From 2000 MS	Power Off	Indicates 2000 MS POWER switch was set to the OFF position.
Calibration Procedure Performed	T1 Calibration or T2 Calibration	Setup For Calibration procedure performed on track 1 Setup For Calibration procedure performed on track 2
System Reset	System Reset	Complete system reset has been performed.

6.6 REFERENCE INFORMATION FOR SERIAL PORT CONFIGURATION

Electronic devices such as PC/laptops, modems, and printers equipped with RS232C serial interface connectors (ports) operate either as data terminal equipment (DTE) or data communications equipment (DCE). The difference lies in the serial connector pin assignments (see Table 6-2).

Table 6-2. Data Recorder Module RS232C Connector (J1) Pin Assignments

Pin	Signal – DTE Mode ¹	Signal - DCE Mode ²
1	Ground	Ground
2	Transmit Data (TxD)	Receive Data (RxD)
3	Receive Data (RxD)	Transmit Data (TxD)
4	Request To Send (RTS)	Request To Send (RTS)
5	Clear To Send (CTS)	Clear To Send (CTS)
6	Data Set Ready (DSR)	Data Set Ready (DSR)
7	Ground	Ground
8	Data Carrier Detect (DCD)	Data Carrier Detect (DCD)
20	Data Terminal Ready (DTR)	Data Terminal Ready (DTR)

¹Serial port configured for modem communications

²Serial port configured for PC/laptop and printer communications

To enable the data recorder module (80015) to communicate with any of these external devices over a standard pin-to-pin serial cable (no pins swapped), the operating modes (DTE or DCE) for the two devices must be opposite. Since the majority of these serial devices generally operate in the DCE mode, the data recorder module is shipped from the factory with the RS232C PC/printer serial port (J1) configured in the DCE mode. A pair of double-pole rocker switches (SW2 and SW3) are provided on the data recorder module (refer to Figure 6-1) to control the module operating mode (DCE or DTE) by switching pin assignments of connector J1 as illustrated in Figure 6-12.

NOTE

NOTE

Both sections of rocker switches (SW2 and SW3) should be set to the same positions. The rocker positions are toward connector J1 for DCE mode and away from the connector for DTE mode.

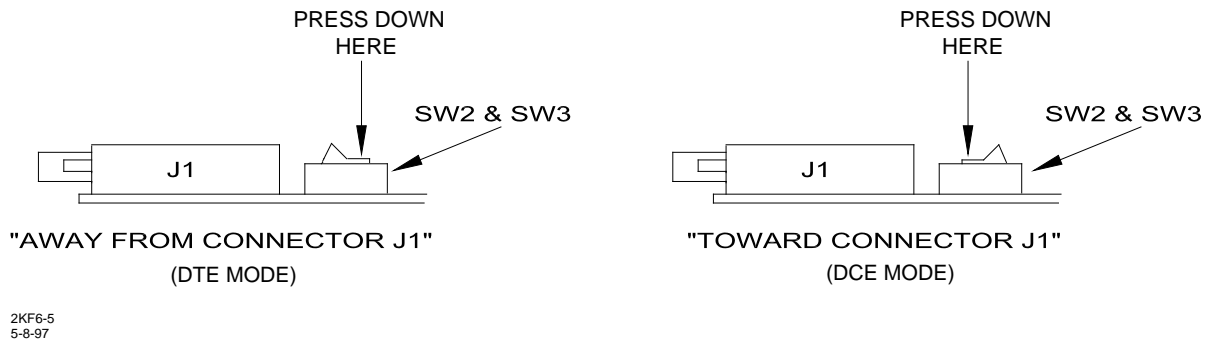


Figure 6-12. SW2 and SW3 Switches for Selecting DTE or DCE Modes

6.7 DATA RECORDER MODULE (80015/80115) SPECIFICATIONS

Power:

Voltage	9.5-15 VDC
Current	150 mA
Battery	Lithium, BCX-72-AA, 3.9V, P/N 3B64 (A fresh battery will support 64k bytes of RAM for a minimum of 5 years.)

Data Inputs:

(Internal)	Via 2000 MS 8-bit data/access bus
(External)	1 to 16 channels (parallel) via interface assembly (80025) and 2000 MS front panel RECORDER connector J1

Input Resistance 5k ohms (opto-isolator interfaces on 80025 assembly)

Input Voltage 8-36 VDC (opto-isolator interfaces on 80025 assembly)

Signal Persistence 0.500 milliseconds (minimum)

Memory Capacity: 64k bytes of data; approximate capacity = 3,000 events

Time Base:

Resolution	1 second
Stability	Accurate to within 30 seconds per year
Signature	Time and date recorded with each event or change of input state

Date:

Day/month/year (in printout header)
Month/day (for each data line printed)

Operating Temperature: -40 °F to +160 °F (-40 °C to +71 °C)

Dimensions:

Data Recorder Module (80015)	8.00 inches (20.32 cm) wide 8.875 inches (22.54 cm) long
Interface Assembly (80025), 16 Channel	1.875 inches (4.76 cm) high 9.375 inches (23.81 cm) wide 8.375 inches (21.27 cm) deep

Weight: 1 pound (0.45 kg) (approximate) (each unit)

6.8 PROM REPLACEMENT (FIRMWARE UPGRADE)

The versatility of microprocessor-controlled equipment permits operational features to be enhanced by simply installing upgraded firmware (system operating program stored in a hardware device). On the data recorder module (80015), the operating program is contained in a PROM device (U1 on Figure 8-1). Perform the procedure in the following paragraphs to replace the PROM.

6.8.1 Guidelines for Handling Modules and PROMs

Before proceeding with any software upgrade, the following guidelines concerning proper handling of static-sensitive electronic devices should be reviewed to ensure that the PROM internal circuits are not accidentally damaged by high static voltages or electrostatic fields.

1. Except when necessary, avoid touching the PROM leads.
2. Use of integrated circuit extractor/insertion tools designed to remove and install electrostatic-sensitive PROMs (OK Industries, Inc., Model EX-2 Extractor and Model MOs-40 Inserter, or equivalent) is highly recommended.
3. When replacing a PROM, be certain to lay the module on the electrostatic bag provided, not directly on the work surface. The bag will protect the pins extending from the solder side of the module from the work surface and prevent possible damage to the PROM or module.
4. Following removal from a module, old PROMs should be inserted into the conductive foam material supplied with the upgrade PROMs and returned to Safetran Systems, California for subsequent reprogramming.



CAUTION

ALL UPGRADE PROMS SHOULD REMAIN IN CONDUCTIVE FOAM MATERIAL UNTIL INSTALLATION ON THE MODULE.

6.8.2 PROM Replacement Procedure

- Step 1 Set the POWER switch on the 2000 MS case to the OFF position.
- Step 2 Remove the data recorder module (80015) from the 2000 MS case.
- Step 3 Refer to Figure 6-1 and locate PROM U1. Note the location of the notched end of the PROM and, using an extractor tool, carefully remove U1 from the socket.
- Step 4 Install the upgraded PROM in the U1 socket with the notched end of the PROM in the same position as noted in step 3 above (ensures proper pin 1 orientation).
- Step 5 Install the data recorder module in the proper card slot in the 2000 MS case. Ensure that the module is fully seated in the edge connector.
- Step 6 Set the POWER switch on the 2000 MS case to the ON position.
- Step 7 Press and hold CLEAR/OFF/PRINT switch SW1 on the data recorder module in the CLEAR position for approximately 5 seconds until the LO BATT LED on the module begins to flash. Release the switch.
- Step 8 Connect a PC/laptop or printer to the RS232C PC/printer serial connector (J1) on the data recorder module.

NOTE**NOTE**

If a PC/laptop/printer was not previously used with the data recorder module, or if a different device is to be used, verify that the device is compatible with the data recorder module and that the system is programmed as described in paragraph 6.1.

- Step 9 Apply power to the PC/laptop or printer.
- Step 10 Set/verify that CLEAR/OFF/PRINT switch SW1 on the data recorder module is set to the OFF position.
- Step 11 Set CLEAR/OFF/PRINT switch SW1 to the PRINT position. The PC/laptop or printer should begin displaying or producing the file/printout header and data lines for any data recorded since the data recorder memory was last cleared. Verify that the file/printout is the same format as shown in Figure 6-4.
- Step 12 When file downloading or printing is complete, set CLEAR/OFF/PRINT switch SW1 to the OFF position.

6.9 BATTERY REPLACEMENT

The on-board lithium battery is provided to retain the data recorder memory contents in the event the battery supply to the 2000 MS is interrupted. If the LO BATT LED on the front edge of the module (see Figure 6-1) begins to flash, the battery voltage is low and the battery must be replaced. Perform the following steps to replace the battery.

NOTE

NOTE

If the battery fails or is removed from the data recorder module and power is removed from the 2000 MS case, or if the data recorder module is removed from its slot in the 2000 MS case, all data in memory will be lost.

- Step 1 Set the POWER switch on the 2000 MS to the OFF position.
- Step 2 Remove the data recorder module (80015) from the 2000 MS case.
- Step 3 Locate the battery (see Figure 6-1). Note the location of the battery positive terminal and carefully remove the battery from the holder.
- Step 4 Install the fresh battery with the positive terminal toward the front edge of the module as noted in step 3 above.
- Step 5 Return the data recorder module to its original position in the 2000 MS case (step 2). Ensure that the module is fully seated in the edge connector.
- Step 6 Set the POWER switch on the 2000 MS case to the ON position.
- Step 7 On the data recorder module, press and hold CLEAR/OFF/PRINT switch SW1 to the CLEAR position for approximately 5 seconds until the LO BATT LED on the front edge of the module begins to flash. Release the switch.
- Step 8 Refer to paragraph 6.1, steps 7 through 9b and reprogram the date and time.

6.10 INTERFACE CABLES

Table 6-3 lists a number of typical interface cable configurations required to download recorded data to a PC/laptop or to print the information. Recorded data can be downloaded directly via RS232C PC/printer serial connector J1 on the data recorder module (80015) or from MODEM connector J2 on the data recorder interface assembly (80025) via RECORDER connector J1 on the 2000 MS front panel.

Table 6-3. Interface Cable Configurations

Application	Connector/Pin Connections	Comments
PC/printer connector J1 on the data recorder module (80015) to a PC/laptop or modem	DB-25 to DB-25. Straight through wiring (pins 1-1, 2-2, 3-3, etc.)	25-pin male to 25-pin female. For PC/laptop connection, configuration switches SW2 and SW3 on the data recorder module must be set toward PC/printer connector J1. For modem connection, SW2 and SW3 must be set away from J1 (see paragraph 6.6).
PC/printer connector J1 on the data recorder module (80015) to a modem or to a Texas Instruments, Silent 700 printer	DB-25 to DB-25. Straight through wiring (pins 1-1, 2-2, 3-3, etc.)	25-pin male to 25-pin male. For modem connection, configuration switches SW2 and SW3 on the data recorder module must be set away from PC/printer connector J1. For printer connection, switches SW2 and SW3 must be set toward J1 (see paragraph 6.6).
PC/printer connector J1 on the data recorder module (80015) to a PC/lap-top or modem	DB-25M to DB-9F 8 ----- 1 3 ----- 2 2 ----- 3 20 ----- 4 7 ----- 5 6 ----- 6 4 ----- 7 5 ----- 8 22 ----- 9	25-pin male to 9-pin female. For PC/laptop applications, configuration switches SW2 and SW3 on the data recorder module must be set toward PC/printer connector J1. For modem applications, SW2 and SW3 must be set away from J1 (see paragraph 6.6)

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SECTION VII

AUXILIARY EQUIPMENT FAMILIARIZATION

7.0 GENERAL

The equipment described in this section can be used with the 2000 MS. Where applicable, installation and adjustment information is provided. The following equipment is covered:

<u>Paragraph</u>	<u>Equipment Covered</u>	<u>Page</u>
7.1	Bidirectional Simulation Coupler, 62664-Mf	7-2
7.2	Automatic Transfer Timer Unit, 80069	7-7
7.3	Data Recorder Interface Assembly, 80025	7-12
7.4	Solid-state Vital AND-Gate, 90975	7-15
7.5	Narrow-band Shunt, 62775-f	7-18
7.6	Multifrequency Narrow-band Shunt, 62775-XXXX	7-20
7.7	Narrow-band Shunt, 62780-f	7-23
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7.1 **BIDIRECTIONAL SIMULATION COUPLER, 62664-MF**

WARNING

WARNING

WHEN REMOTE OPERATION IS PROGRAMMED “ON” AND AN ISLAND MODULE IS USED ON THE SAME TRACK (T1 OR T2), THE ISLAND (WHEN DEENERGIZED) WILL NOT CAUSE THE MS RELAY DRIVE TO DEENERGIZE. WHEN USED AT A REMOTE LOCATION, THE ISLAND MODULE IS USED FOR ENHANCED DETECTION REMOTE OPERATION LOGIC AND THUS WILL NOT CONTROL THE RELAY DRIVE OUTPUT AS IT NORMALLY DOES AT A CROSSING.

WARNING

WARNING

WHEN REMOTE UNIT OPERATION IS USED, ANY EXTERNAL TRACK CIRCUIT EQUIPMENT OR AUXILIARY TRACK CIRCUIT EQUIPMENT SHALL BE CONNECTED TO THE MS 2000 TRACK WIRES IN ACCORDANCE WITH SECTION 1.4

Low ballast resistance effectively reduces approach distances to a greater degree in unidirectional 2000 MS installations than in bidirectional installations. However, a technique referred to as bidirectional simulation can be applied to a unidirectional installation to obtain the operating benefits of a bidirectional application.

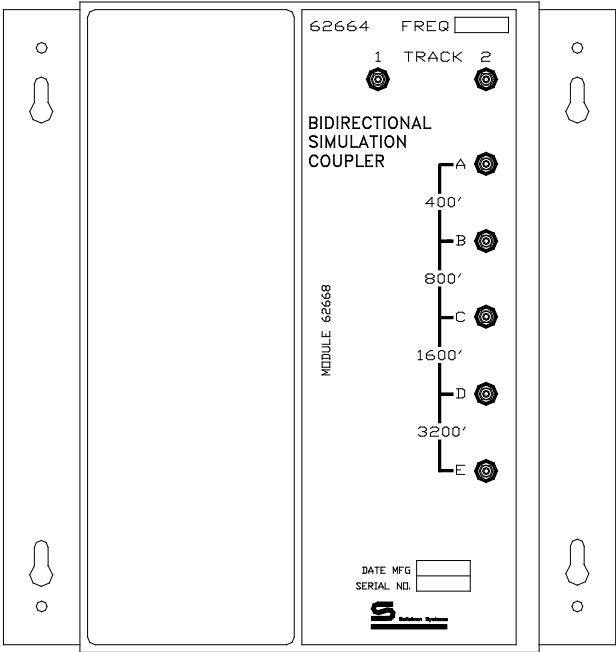
In a simulated bidirectional configuration, a narrow-band shunt is connected in series with an adjustable inductor. The combination is then connected in parallel across the track connections so that the circuit is electrically equal to that of the actual track approach circuit. To the 2000 MS, both approach circuits appear equal in length, even though one of the circuits consists of the shunt and inductor, which are located in the instrument housing/bungalow.

Bidirectional Simulation Coupler, 62664-Mf, (Figure 7-1) is a convenient, compact, shelf- or backboard-mounted unit containing both a narrow-band shunt of the same frequency as the 2000 MS and an adjustable inductor (simulated track).

NOTE

NOTE

The bidirectional simulation coupler (62664) cannot be used as a termination shunt.



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7-15-97

Figure 7-1. Bidirectional Simulation Coupler, 62664-Mf

The bidirectional simulation coupler is housed in a brushed aluminum case containing a single plug-in-type printed circuit board and four toroid-wound inductors, each of which simulate a specific track length. The inductors are wired in series with taps provided that enable strapping of front panel terminals for selecting approach distances to closely match the actual track approach ranging from 400 to 6,000 feet as shown in Table 7-1.

Table 7-1. Approach Distance Selection Strapping

Distance(Feet)	Strap Terminals	Distance(Feet)	Strap Terminals
400	B-C, C-D, D-E	3,600	B-C, C-D
800	A-B, C-D, D-E	4,000	A-B, C-D
1,200	C-D, D-E	4,400	C-D
1,600	A-B, B-C, D-E	4,800	A-B, B-C
2,000	B-C, D-E	5,200	B-C
2,400	A-B, D-E	5,600	A-B
2,800	D-E	6,000	No Straps
3,200	A-B, B-C, C-D		

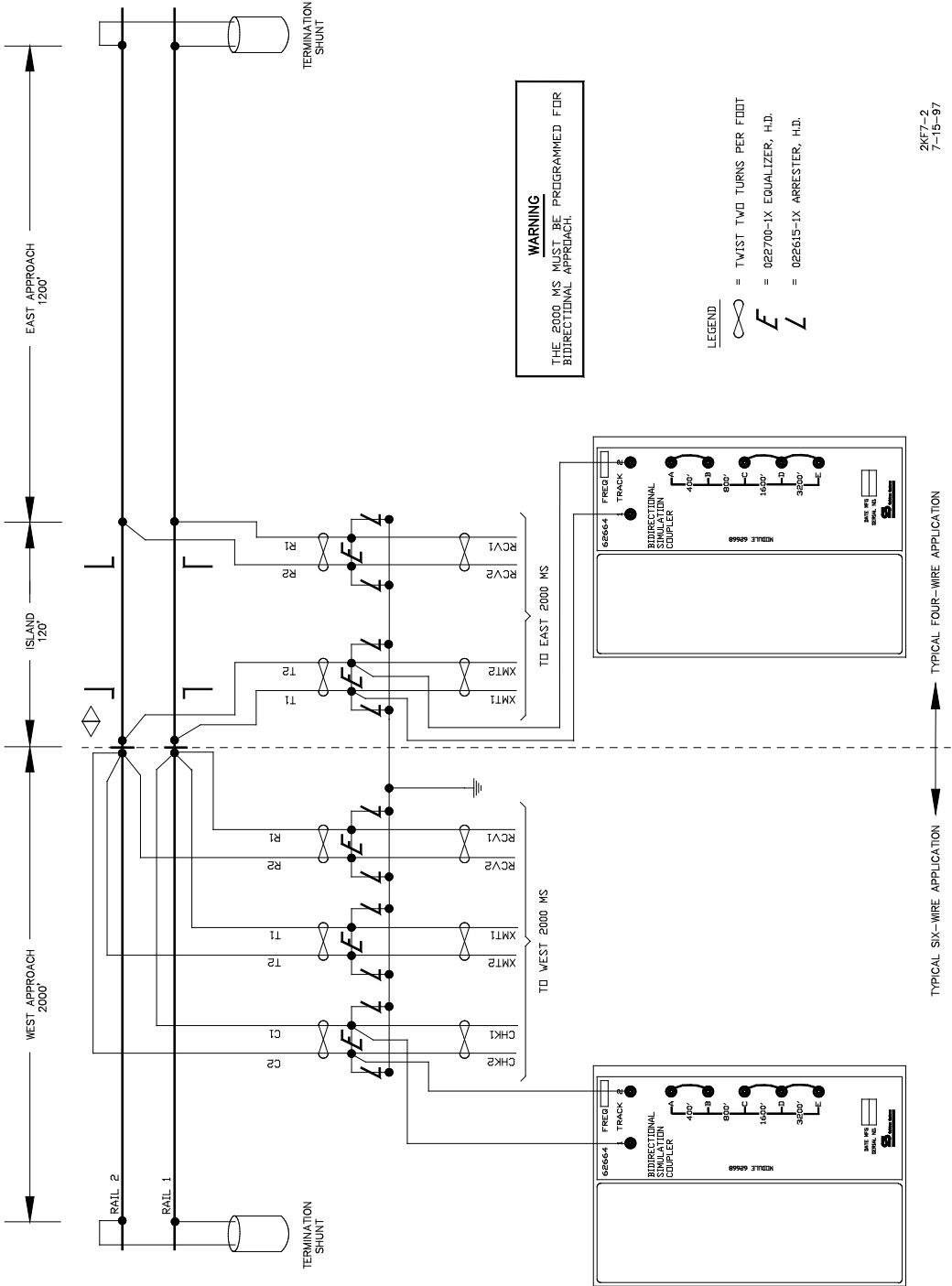
Mounting dimensions for the bidirectional simulation coupler are provided in Figure 7-3. Specifications for the bidirectional simulation coupler are as follows:

Environmental	-40 °F to +160 °F (-40 °C to +71 °C)
Dimensions	8.75 inches (22.2 cm) high 8.50 inches (21.6 cm) wide 9.25 inches (23.5 cm) deep
Weight	5 pounds (2.27 kg) (approximate)
Adjustment Range	400 to 6,000 feet (122m to 1.8 km) (must be within ±10% of actual approach distance)
Loading Effect	Loading effects of the internal narrow-band shunt are equivalent to that of the 62775 narrow-band shunt.



WARNING

WHEN A UNIDIRECTIONAL 2000 MS IS CONNECTED IN A SIX-WIRE CONFIGURATION (TWO RECEIVER WIRES, TWO TRANSMIT WIRES, AND TWO CHECK WIRES) AS SHOWN IN FIGURE 7-2, THE BIDIRECTIONAL SIMULATION COUPLER MUST BE CONNECTED TO THE CHECK (CHK) WIRES, NOT TO THE TRANSMIT (XMT) WIRES. IF THE COUPLER IS CONNECTED TO THE TRANSMIT WIRES, AN OPEN TRANSMITTER TRACK WIRE CANNOT BE DETECTED AND CAN, THEREFORE, ADVERSELY AFFECT MOTION SENSOR OPERATION. HOWEVER, IN STANDARD FOUR-WIRE SIMULATED BIDIRECTIONAL INSTALLATIONS, IT IS PERMISSIBLE TO CONNECT THE COUPLER TO THE TWO TRANSMITTER TRACK LEADS AS SHOWN.



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7-15-97

Figure 7-2. Typical Unidirectional 2000 MS Installation with Bidirectional Simulation Applied to East Approach

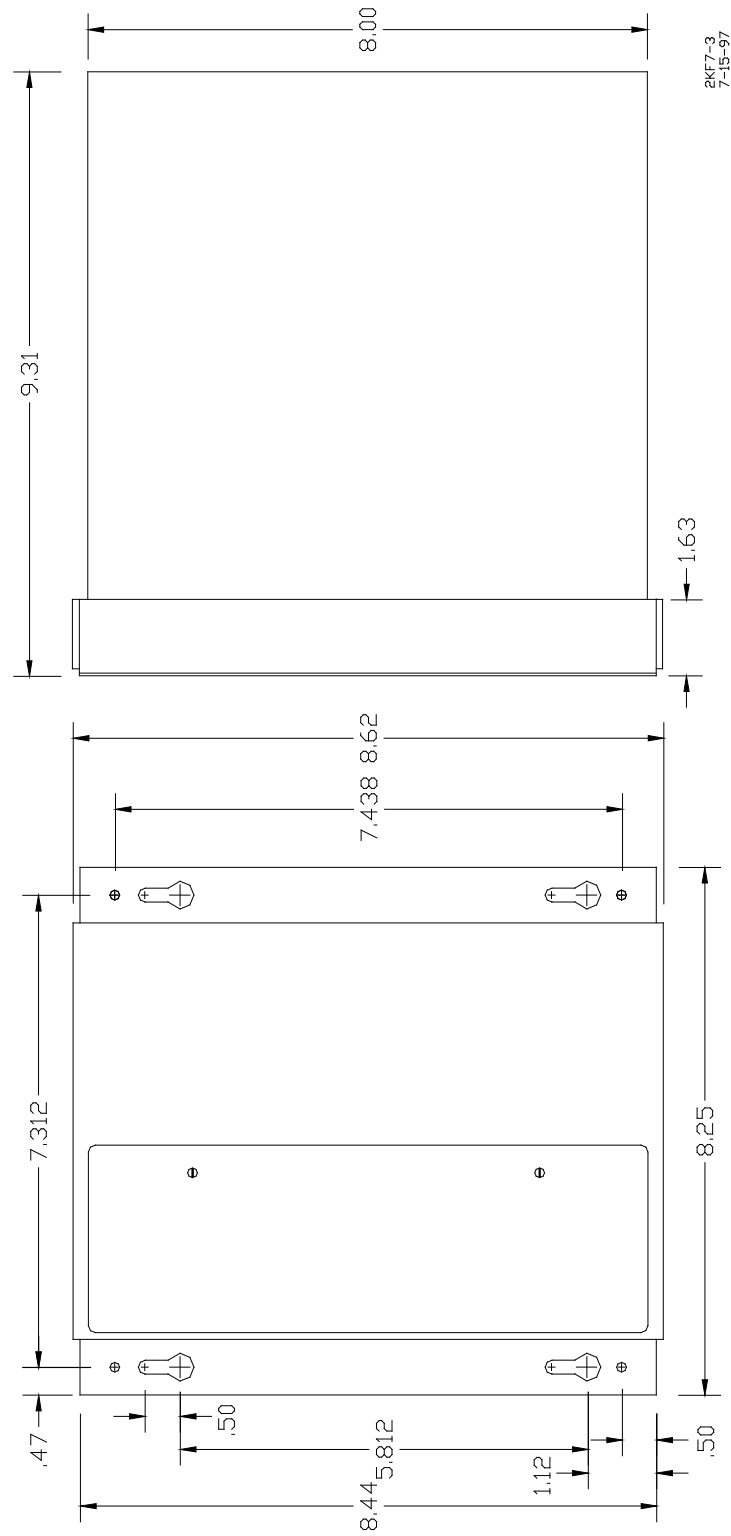
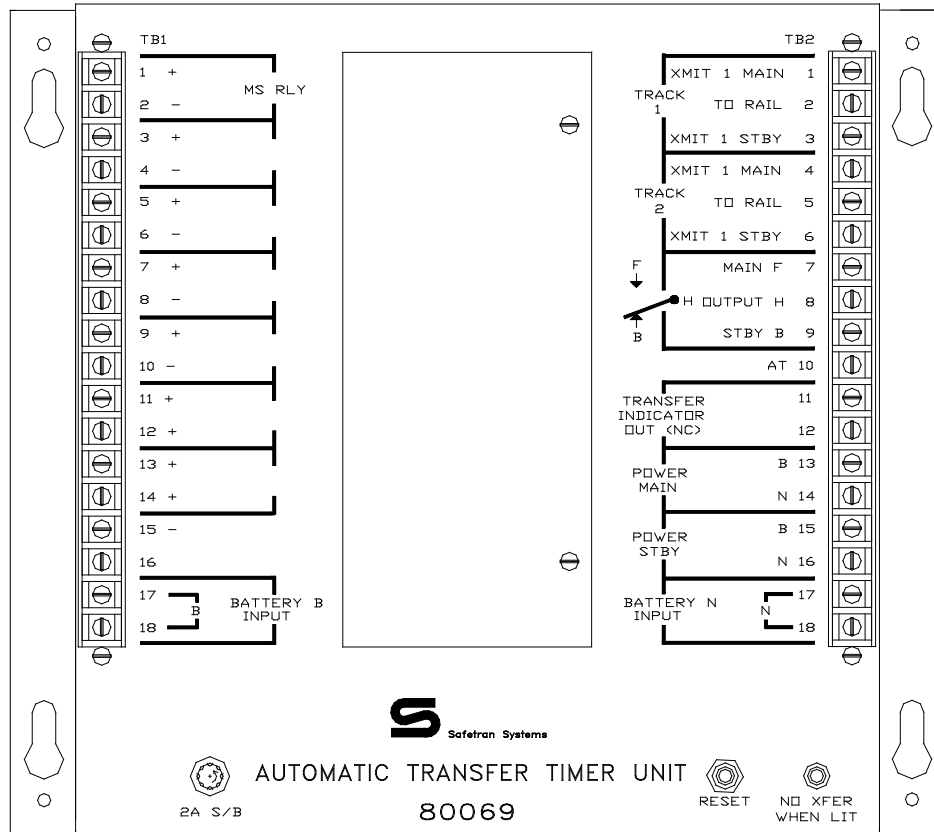


Figure 7-3. Bidirectional Simulation Coupler Assembly Mounting Dimensions

7.2 AUTOMATIC TRANSFER TIMER UNIT, 80069

The automatic transfer timer unit (Figure 7-4) is connected to two Model 2000 Motion Sensors and, in the event of a failure of the primary (main) unit, operation is automatically transferred to the standby (backup) unit within a pre-established time period. The transfer interval is field programmable from 1 to 31 minutes in 1-minute increments. When shipped from the factory, the unit is normally programmed for a 3-minute transfer interval. The automatic transfer timer will continue to switch between the two motion sensors in an effort to select an operational unit.

The field programmable transfer interval is selected via DIP switch S1 located on the 80068 module (Figure 7-5). The five segments of S1 correspond to the binary values printed on the 80068 circuit board adjacent to S1. To select a value, press the corresponding switch lever(s) to the down (ON) position as indicated in Figure 7-5.



2KFIG7-4
6-19-97

Figure 7-4. Automatic Transfer Timer Unit, 80069

The automatic transfer timer unit is also equipped with an LED indicator and a number of switches that are used primarily for calibration and test purposes. Each of the devices is described in Table 7-2.

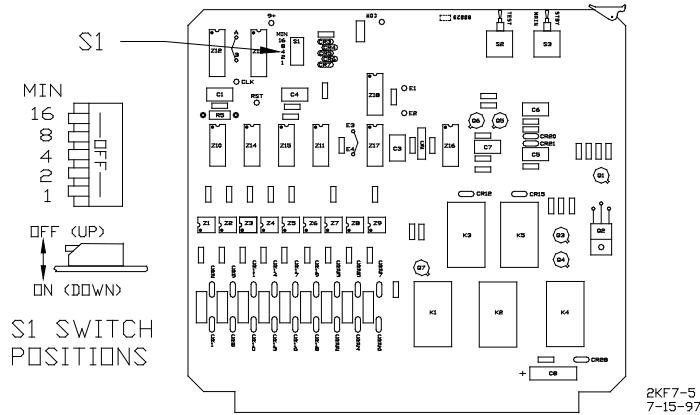


Figure 7-5. Transfer Interval Select Switch (S1) Location

Table 7-2. Automatic Transfer Timer Unit Controls and Indicators

Device and Location	Nomenclature	Function
Switch (80068 Module)	STBY-AUTO-MAIN	Selects standby/main operating system or automatic transfer mode
Switch (80068 Module)	TEST	When pressed, causes an automatic transfer from main to standby 2000 MS
Switch (80069 Case)	RESET	Following transfer from main to standby 2000 MS, press to return to main MS. Also resets LED
LED (80069 Case)	NO XFER WHEN LIT	Transfer indicator. Normally lighted; extinguishes when main to standby MS transfer occurs.

Figure 7-6 illustrates a typical single track, bidirectional application using the automatic transfer timer unit with two Model 2000 Motion Sensors. Table 7-3 lists the front panel terminals and their 2000 MS connections. The automatic transfer timer unit is housed in an aluminum case designed for shelf or backboard mounting. The mounting dimensions for the unit are provided in Figure 7-7.

Table 7-3. Automatic Transfer Timer Unit Terminal Connections

Terminal	Nomenclature	Connection
TB1-1	+ MS RLY	Positive terminal of 2000 MS relay or + MS RLY terminal (TB1-11) on main 2000 MS
TB1-2	- MS RLY	Negative terminal of 2000 MS relay or - MS RLY terminal (TB1-12) on main 2000 MS

Continued on next page

Table 7-3 Concluded

Terminal	Nomenclature	Connection
TB1-3 through TB1-15	None	Not used
TB1-17	BATTERY B INPUT	Positive 2000 MS battery supply as needed for 80069 connections
TB1-18	BATTERY B INPUT	Connect to positive 2000 MS battery terminal
TB2-1	TRACK 1 XMIT 1 MAIN	TRACK 1, XMT 1 terminal (TB1-1) on main 2000 MS
TB2-2	TRACK 1 TO RAIL	Connect as XMT 1 wire to rail on track 1
TB2-3	TRACK 1 XMIT 1 STBY	TRACK 1, XMT 1 terminal (TB1-1) on standby 2000 MS
TB2-4	TRACK 2 XMIT 1 MAIN	TRACK 2, XMT 1 terminal (TB2-1) on main 2000 MS
TB2-5	TRACK 2 TO RAIL	Connect as XMT 1 wire to rail on track 2
TB2-6	TRACK 2 XMIT 1 STBY	TRACK 2, XMT 1 terminal (TB2-1) on standby 2000 MS
TB2-7	MAIN B	Spare relay contact (back)
TB2-8	OUTPUT H	Spare relay contact (heel)
TB2-9	STBY F	Spare relay contact (front)
TB2-10	AT	AT (automatic transfer) terminal (TB2-7) on both main and standby 2000 motion sensors
TB2-11	TRANSFER INDICATOR OUT (NC)	Output for external transfer indication such as POE light on enclosure
TB2-12	TRANSFER INDICATOR OUT (NC)	Output for external transfer indication such as POE light on enclosure
TB2-13	POWER MAIN B	Positive battery supply. Connect to battery terminal (TB1-8) on main 2000 MS
TB2-14	POWER MAIN N	Negative battery supply. Connect to battery terminal (TB1-10) on main 2000 MS
TB2-15	POWER STBY B	Positive battery supply. Connect to battery terminal (TB1-8) on standby 2000 MS
TB2-16	POWER STBY N	Negative battery supply. Connect to battery terminal (TB1-10) on standby 2000 MS
TB1-17	BATTERY N INPUT	Negative 2000 MS battery supply as needed for 80069 connections
TB2-18	BATTERY N INPUT	Connect to negative 2000 MS battery terminal (N12)

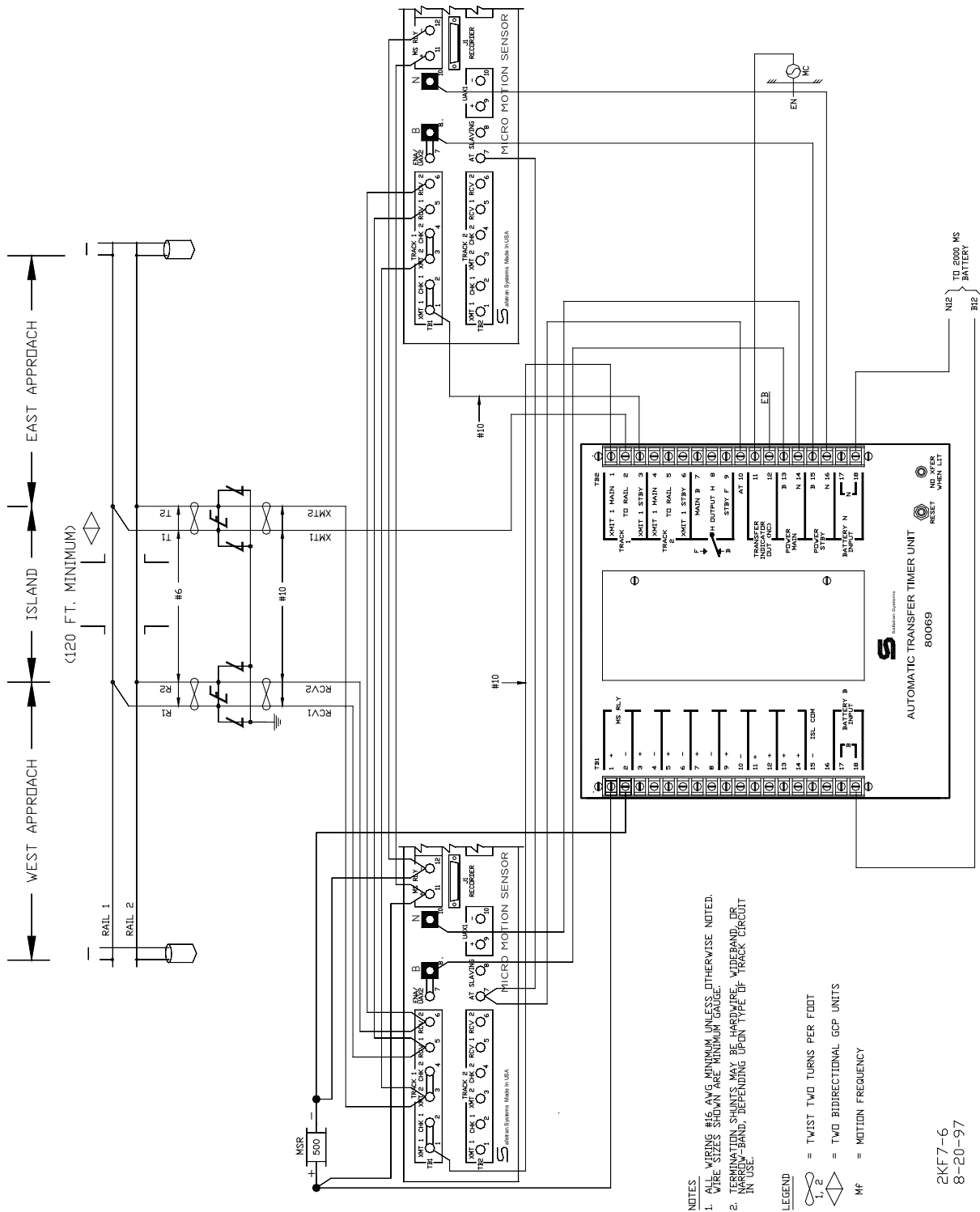


Figure 7-6. Typical Single Track, Bidirectional Application with Automatic Transfer Timer Unit and Two 2000 Motion Sensors

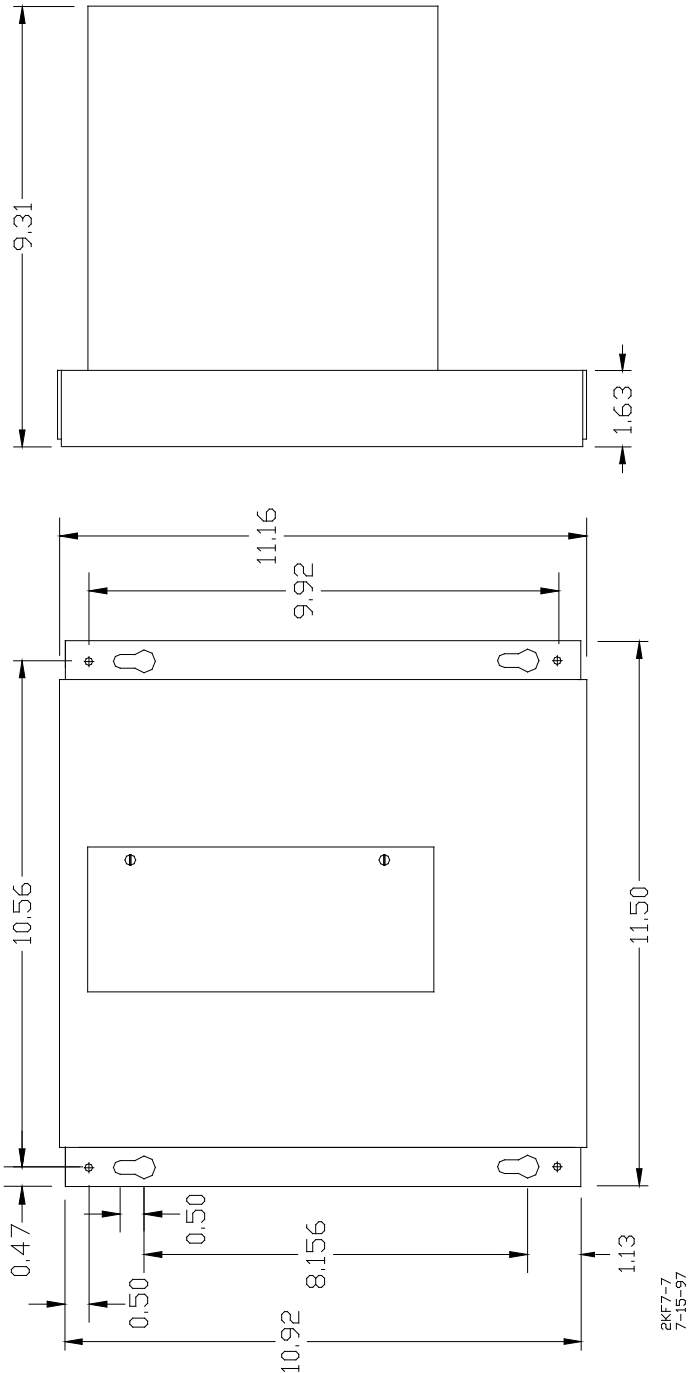


Figure 7-7. Automatic Transfer Timer Unit Mounting Dimensions

Specifications for the automatic transfer timer unit are as follows:

Environmental	-40 °F to +160 °F (-40 °C to +71 °C)
Dimensions	9.31 inches (23.6 cm) high 11.50 inches (29.2 cm) wide 11.16 inches (28.3 cm) deep
Weight	4.75 pounds (2.15 kg) (approximate)

7.3 DATA RECORDER INTERFACE ASSEMBLY, 80025

The Data Recorder Interface Assembly, 80025 (Figure 7-8), enables the data recorder module (80015) to monitor and record changes of input states on 16 channels external to the 2000 MS. The data recorder interface assembly interfaces with the data recorder via a 25-line cable (supplied with the unit) which is connected between connector J1 (RECORDER) on the 2000 MS front panel and connector J1 (RECORDER) on the data recorder interface assembly. Pin assignments for connector J1 on the data recorder interface assembly are provided in Table 7-4.

Recorded data which is stored in memory on the data recorder module (80015) can be accessed or monitored from a remote location via an external modem connected to MODEM connector J2 on the data recorder interface assembly. Refer to Section VI, Data Recorder, for information concerning interconnecting cables and modem use.

All 16 inputs on the data recorder interface assembly are electrically isolated from each other and from ground by optical isolators, allowing direct connection to vital circuits. Input changes must typically consist of voltage level changes similar to those produced by relay contact closures (i.e., low-to-high and high-to-low). Each channel input from a monitored signal circuit consists of two wires attached to screw terminals on the data recorder interface assembly. See Figure 7-9 for data recorder interface assembly mounting dimensions.

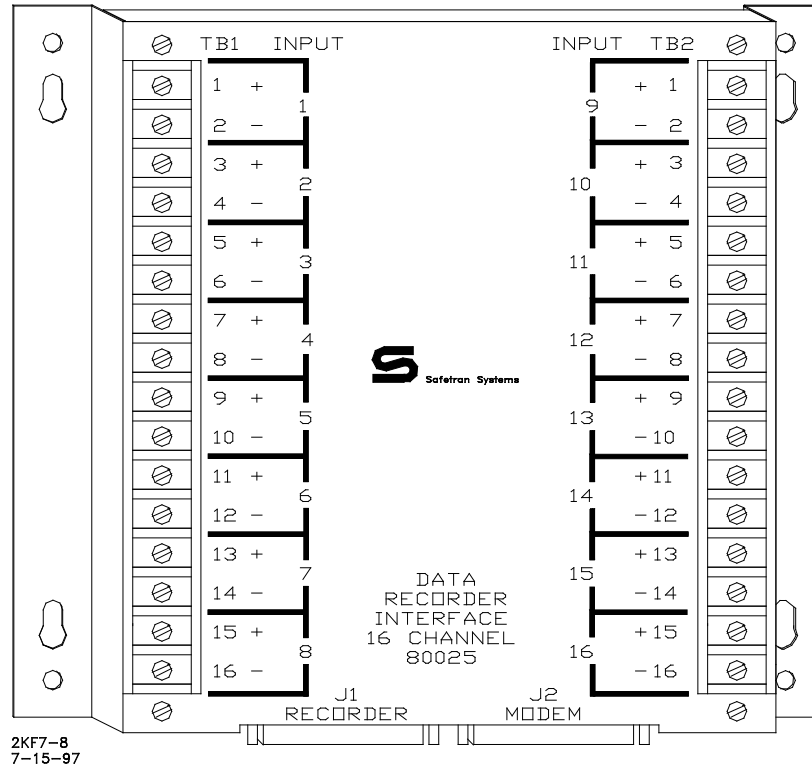


Figure 7-8. Data Recorder Interface Assembly, 80025

Table 7-4. Data Recorder Interface Assembly Connector J1 Pin Assignments

Pin	Signal	Pin	Signal
1	Ground	14	Channel 16
2	Transmit Data (TxD)	15	Channel 15
3	Receive Data (RxD)	16	Channel 14
4	Request To Send (RTS)	17	Channel 13
5	Clear To Send (CTS)	18	Channel 12
6	Data Set Ready (DSR)	19	Channel 11
7	Ground	20	Data Terminal Ready (DTR)
8	Data Carrier Detect (DCD)	21	Channel 10
9	Channel 9	22	Channel 1
10	Channel 2	23	Channel 3
11	Channel 4	24	Channel 5
12	Channel 6	25	Channel 7
13	Channel 8		

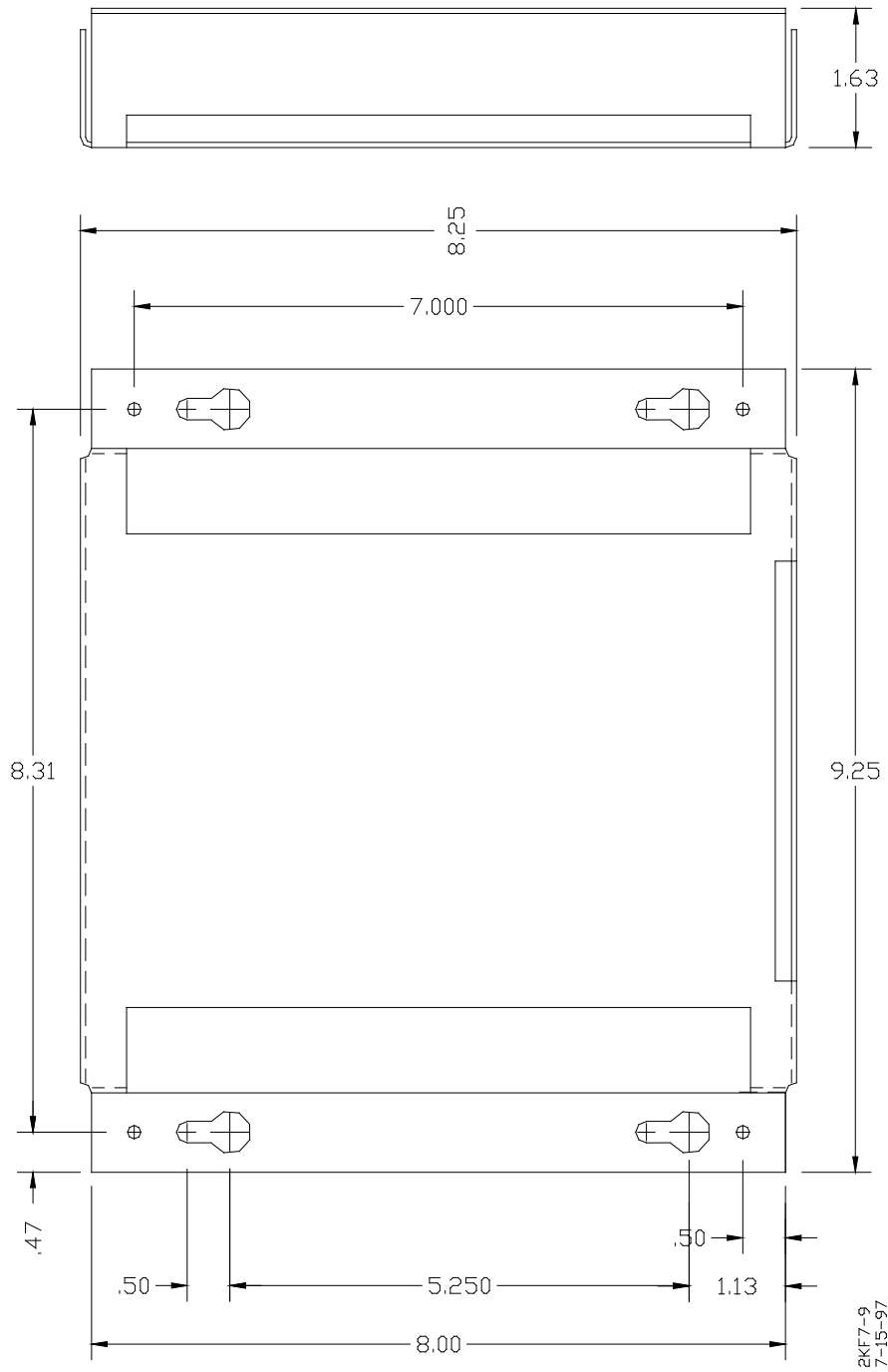


Figure 7-9. Data Recorder Interface Assembly Mounting Dimensions

Specifications for the data recorder interface assembly are as follows:

Channel Inputs

Number of Inputs	16
Input Resistance	5k ohms
Input Voltage	8 to 36 VDC
Terminal Screw Size	No. 6

Dimensions	1.88 inches (4.8 cm) high (with terminals)
	9.25 inches (23.5 cm) wide
	8.25 inches (21.0 cm) deep

Weight	1 pound (0.45 kg)
--------	-------------------

7.4 SOLID-STATE VITAL AND-GATE, 90975

Solid-state Vital AND-Gate, 90975 (Figure 7-10), is a logic device that combines two inputs to produce a single output. The AND-gate is energized only when both inputs are energized. The inputs and outputs are electrically isolated from battery (B and N) within the unit.



Figure 7-10. Solid-state Vital AND-Gate, 90975

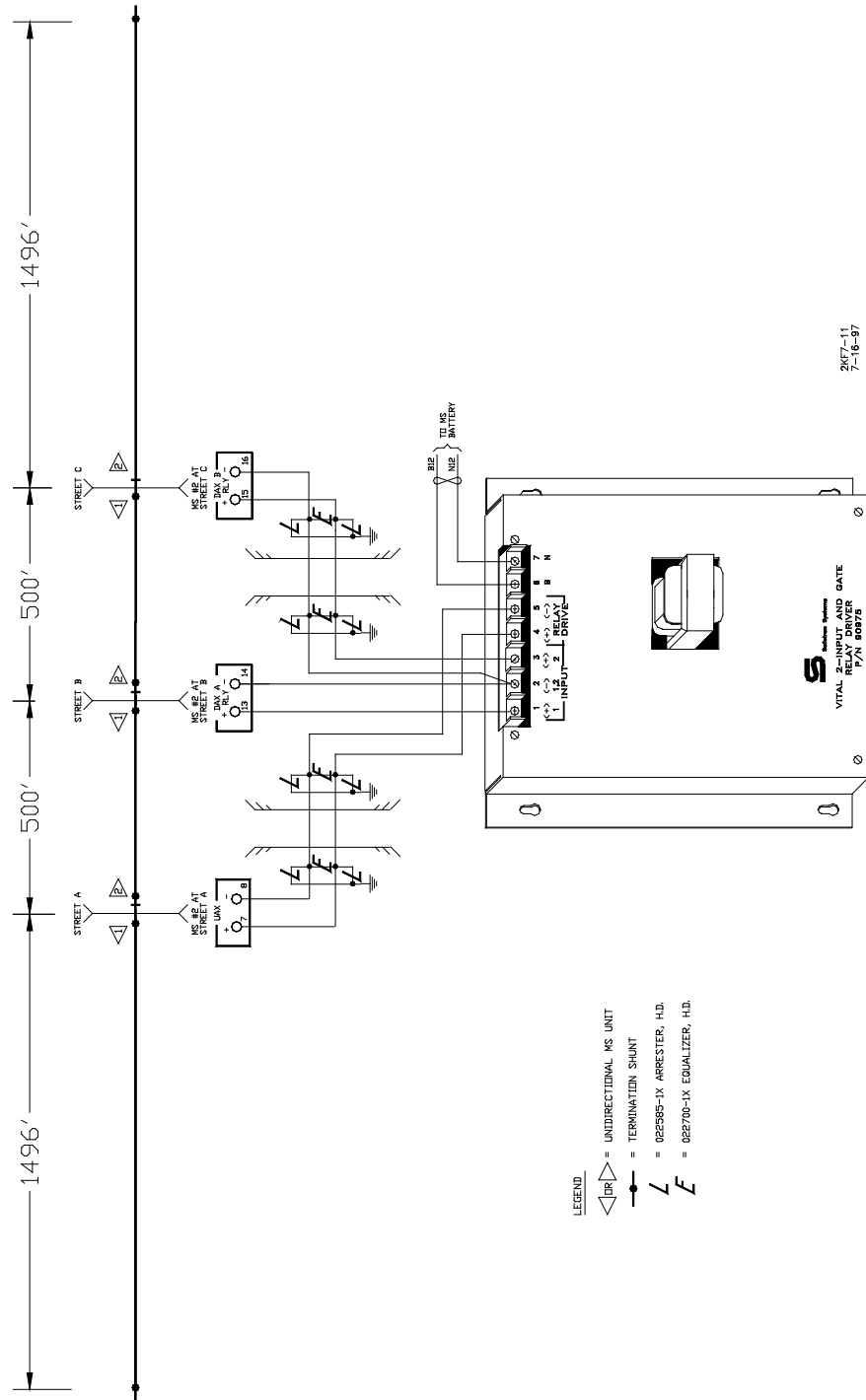


Figure 7-11. Typical Vital AND-Gate Application

The solid-state vital AND-gate is designed for use in applications such as cascading outputs from two separate devices into the single input of a third device. The vital AND-gate minimizes the need for external relays which are normally used to accomplish this function. The unit is housed in a brushed aluminum case that can be installed in any convenient location within a wayside enclosure. A typical application using the vital AND-gate with the 2000 MS is illustrated in Figure 7-11. See Figure 7-12 for assembly mounting dimensions for the solid-state vital AND-gate.

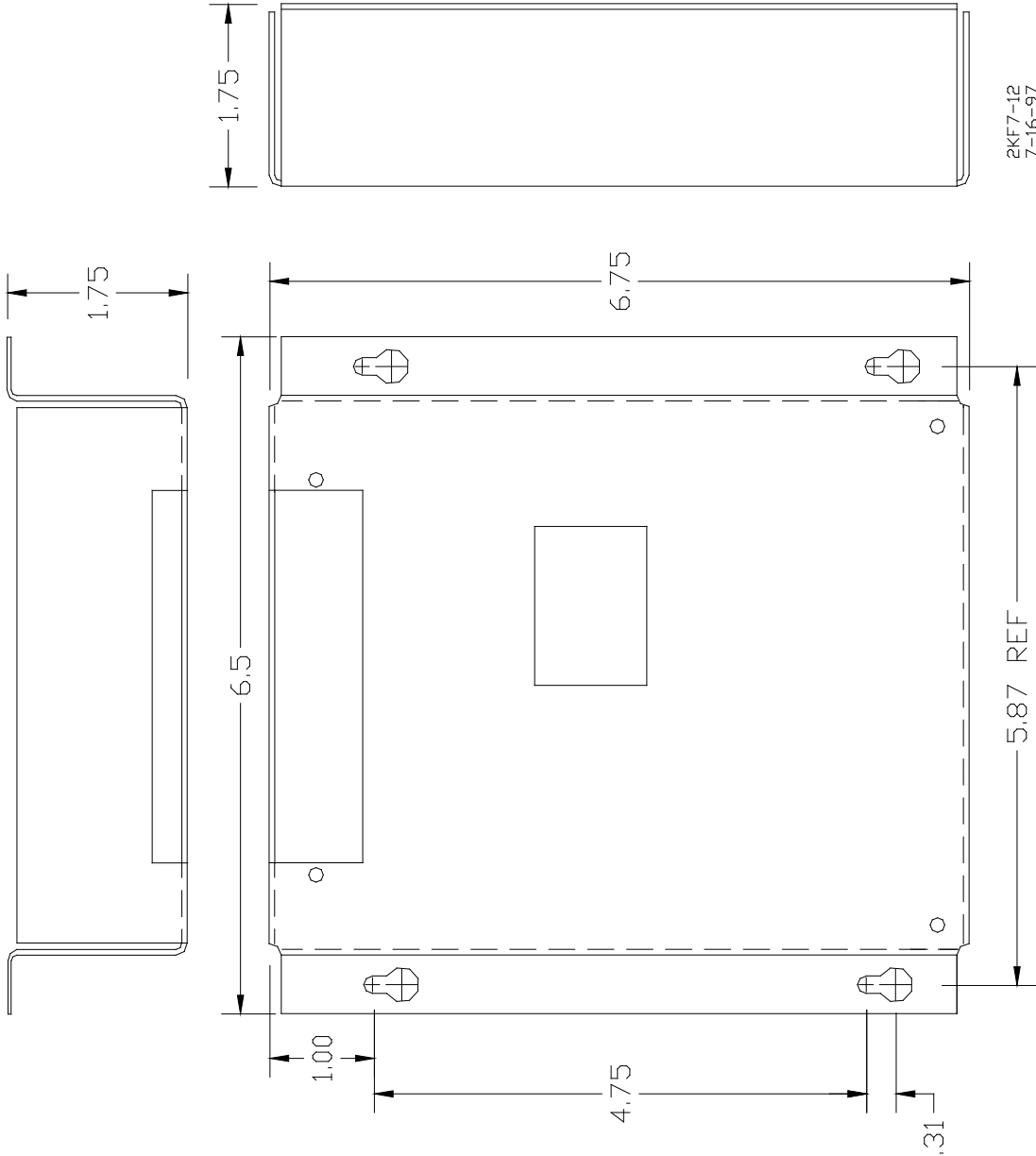


Figure 7-12. Solid-state Vital AND-Gate Assembly Mounting Dimensions

Specifications for the solid-state vital AND-gate are as follows:

Power Input	
Voltage	9 to 16.5 VDC
Current	200 mA
Output	12 VDC (nominal); will drive 200 to 1,000-ohm loads
Control Inputs	7 to 18 VDC (1,000-ohm input resistance)
Input/Output Protection	Floating (optically isolated and transformer coupled; surge protected)
Dimensions	6.25 inches (15.9 cm) high 6.25 inches (15.9 cm) wide 2.50 inches (6.4 cm) deep
Weight	1 pound (0.5 kg) (approximate)

7.5 NARROW-BAND SHUNT, 62775-F

The 62775-f narrow-band termination shunt (Figure 7-13) is designed for use in areas where other AC frequencies or DC coded track circuits are present, but only the 2000 MS frequency should be terminated. The shunt requires no special tuning and is generally preferred for most applications.

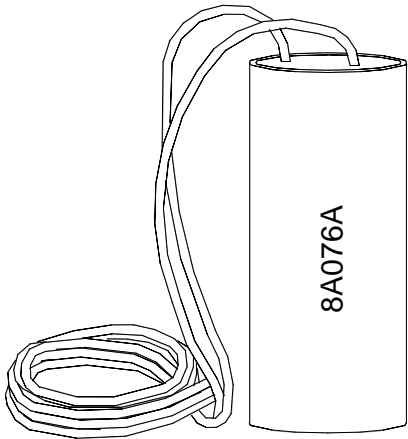


WARNING

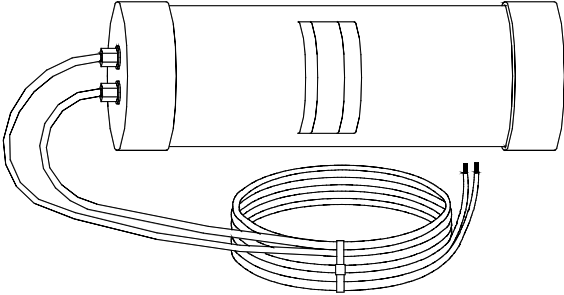
WARNING

THE 62775-F SHUNT MUST NOT BE USED ANYWHERE WITHIN A MODEL 300 OR 400 GCP APPROACH; NARROW-BAND SHUNT 62780-F IS RECOMMENDED FOR THESE APPLICATIONS.

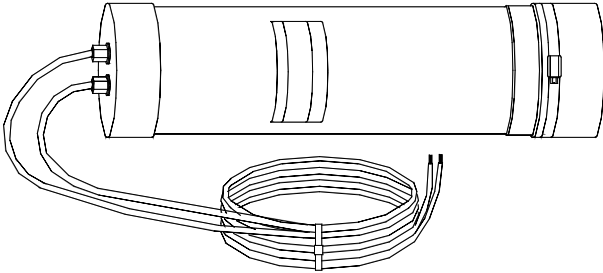
The narrow-band shunt (62775-f) is housed in a hermetically-sealed, cylindrical case with a pair of 10-foot leads extending from one end. The shunt should be connected as close as possible to the rails. To afford maximum protection from physical damage, the shunt should be encased in a protective enclosure or buried (either vertically or horizontally) at an appropriate depth. It is not necessary to bury the shunt below the frost line. The shunt is available in any fixed frequency (Hz) listed in the chart on page 7-20. Safetran frequencies are shown in **boldface** type.



Wideband Shunt, 8A076A



Narrow-band Shunt,
62775-5 and 62780-F



Multifrequency Narrow-band Shunt,
62775 and 62780-XXXX

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7-16-97

Figure 7-13. Safetran Narrow-band and Wideband Termination Shunts

NOTE

NOTE

The shunt is shipped with no factory jumpers installed and is, therefore, electrically open and will not load any frequency on the track. Install jumpers for the desired frequency before placing the unit in service.

WARNING

WARNING

THE CORRECT FREQUENCY MUST BE VERIFIED FOR THE SHUNT LOCATION. ALL NUTS ON ALL FREQUENCY JUMPERS MUST THEN BE CAREFULLY TIGHTENED. INSTALL A SECOND NUT TO SECURELY LOCK THE ASSEMBLY.

The shunt should be connected as close as possible to the rails. To afford maximum protection from physical damage, the shunt should be encased in a protective enclosure or buried (either vertically or horizontally) at an appropriate depth (see paragraph 7.18). It is not necessary to bury the shunt below the frost line.

Specifications for the 62775-XXXX multifrequency narrow-band shunt are as follows:

Dimensions	22 inches (55.9 cm) long 5 inches (12.7 cm) in diameter
Weight	10 pounds (4.54 kg) (approximate)
Frequencies	See Table 7-5
Leads	10 feet (3 m); number 6 AWG, stranded, black PVC

Table 7-5. Multifrequency Narrow-band Shunt, 62775 Frequency Selection Jumpers

Shunt Part Number	Frequency (Hz)	Jumper Shunt Terminals
62775-1543	156	A-F, G-C, C-D, D-E, E-F
	211	A-G, G-C, C-D, D-E
	285	B-C, C-D, D-G,
	348	B-C, C-D
	430	B-C

Continued on next page

Table 7-5 Concluded

Shunt Part Number	Frequency (Hz)	Jumper Shunt Terminals
62775-2132*	211	A-F, G-C, C-D, D-E, E-F
	267	B-G, G-C, C-D, D-E
	285	B-C, C-D, D-G
	313	B-C, C-D
	326	B-C
62775-2152	211	A-F, G-C, C-D, D-E, E-F
	285	B-C, C-D, D-E, E-G
	348	B-C, C-D, D-G
	430	B-C, C-D
	525	B-C
62775-3448*	348	A-B, B-C, C-D, D-E, E-F, F-G
	389	A-B, B-C, C-D, D-E, E-F
	392	A-B, B-C, C-D, D-E
	430	A-B, B-C, C-D
	452	A-B, B-C
	483.5	A-B
62775-3497	348	A-B, B-C, C-D, D-E, E-F, F-G
	430	A-B, B-C, C-D, D-E, E-F
	525	A-B, B-C, C-D, D-E
	645	A-B, B-C, C-D
	790	A-B, B-C
	970	A-B
62775-5274*	522	A-B, B-C, C-D, D-E, E-F, F-G
	525	A-B, B-C, C-D, D-E, E-F
	560	A-B, B-C, C-D, D-E
	645	A-B, B-C, C-D
	669.9	A-B, B-C
	746.8	A-B
62775-7910*	790	A-B, B-C, C-D, D-E, E-F, F-G
	816	A-B, B-C, C-D, D-E, E-F
	832.5	A-B, B-C, C-D, D-E
	970	A-B, B-C, C-D
	979	A-B, B-C
	1034	A-B
62775-8621	86	A-F, G-D, D-E, E-F
	114	B-G, G-D, D-E
	156	C-D, D-G
	211	C-D

*Available for special applications only

7.7 NARROW-BAND SHUNT, 62780-F

Like the 62775 narrow-band termination shunt (paragraph 7.5), the 62780 narrow-band shunt (Figure 7-13) is designed for use in areas where other AC frequencies or DC coded track circuits are present, but only the 2000 MS frequency should be terminated. However, the 62780 shunt produces less loading effect on adjacent frequencies (10 ohms reactance) than the 62775 shunt and, therefore, can be used in territories with overlapping Model 300 and Model 400 GCP approaches. The 62780 narrow-band shunt is compatible with all Safetran motion sensors and GCPs and is available in any one of 26 frequencies ranging from 86 Hz to 979 Hz as shown in the chart below. Safetran frequencies are shown in **boldface** type.

86	211	430	645	970
100	267	452	686	979
114	285	522	753	
151	326	525	790	
156	348	560	816	
210	392	630	881	

The 62780 narrow-band shunt is housed in a hermetically-sealed, cylindrical case with a pair of 10-foot leads extending from one end. The shunt should be connected as close as possible to the rails. To afford maximum protection from physical damage, the shunt should be encased in a protective enclosure or buried (either vertically or horizontally) at an appropriate depth (see paragraph 7-18). It is not necessary to bury the shunt below the frost line.

Specifications for the 62780-F narrow-band shunt are as follows:

Dimensions	14.125 inches (35.9 cm) long 4.125 inches (10.5 cm) in diameter
Weight	7 pounds (3.18 kg) (approximate)
Frequencies	See chart above
Leads	10 feet (3 m); number 6 AWG, stranded, black PVC

7.8 MULTIFREQUENCY NARROW-BAND SHUNT, 62780-XXXX

Multifrequency Narrow-band Shunt, 62780-XXXX (Figure 7-13), produces less loading effect on adjacent frequencies (10 ohms reactance) than the 62775-XXXX shunt (paragraph 7.6) and, therefore, can be used in territories with overlapping Model 300 and Model 400 GCP approaches. The 62780 shunt is compatible with all Safetran GCPs and motion sensors. The 62780 narrow-band shunt is available in four multifrequency versions for terminating all 11 standard Safetran operating frequencies plus a number of Harmon frequencies as well (Table 7-6).

The multifrequency narrow-band shunt (62780) is housed in a hermetically-sealed, cylindrical case with a pair of 10-foot leads extending from one end and seven standard AREMA terminals from the opposite end of the case. The terminals are labeled A through G and are jumpered to select the desired shunt frequency. Terminal jumper hardware is supplied with each multifrequency shunt and a label located inside the removable end cap identifies the terminal jumpering for each frequency. The pliable end cap covering the terminal end of the shunt is secured in place by a sturdy stainless steel clamp for protection against moisture.

NOTE

NOTE

The multifrequency narrow-band shunt is shipped with no factory jumpers installed and is, therefore, electrically open and does not load any frequency on the track. Install jumpers for the desired frequency before placing the unit in service.

WARNING

WARNING

THE CORRECT FREQUENCY MUST BE VERIFIED FOR THE SHUNT LOCATION. ALL NUTS ON ALL FREQUENCY JUMPERS MUST THEN BE CAREFULLY TIGHTENED. INSTALL A SECOND NUT TO SECURELY LOCK THE ASSEMBLY.

Table 7-6. Multifrequency Narrow-band Shunt, 62780 Frequency Selection Jumpers

Shunt Part Number	Frequency (Hz)	Jumper Shunt Terminals
62780-1543	156	A-F, G-C, C-D, D-E, E-F
	211	A-G, G-C, C-D, D-E
	285	B-C, D-G, C-D
	348	B-C, C-D
	430	B-C
62780-2152*	211	A-F, G-C, C-D, D-E, E-F
	285	B-C, C-D, D-E, C-G
	348	B-C, C-D, D-G
	430	B-C, C-D
	525	B-C
62780-5297	525	A-B, B-C, C-D, D-E
	645	A-B, B-C, C-D
	790	A-B, B-C
	970	A-B
62780-8621	86	A-F, G-D, D-E, E-F
	114	B-G, G-D, D-E
	156	C-D, D-G
	211	C-D

*Available for special applications only

The shunt should be connected as close as possible to the rails. To afford maximum protection from physical damage, the shunt should be encased in a protective enclosure or buried (either

vertically or horizontally) at an appropriate depth (see paragraph 7.18). It is not necessary to bury the shunt below the frost line.

Specifications for the 62780-XXXX multifrequency narrow-band shunt are as follows:

Dimensions	22 inches (55.9 cm) long 5 inches (12.7 cm) in diameter
Weight	10 pounds (4.54 kg) (approximate)
Frequencies	See Table 7-6
Leads	10 feet (3 m); number 6 AWG, stranded, black PVC

7.9 WIDEBAND SHUNT, 8A076A

Wideband Shunt, 8A076A (Figure 7-13), provides an effective short circuit to AC but presents an open circuit to DC. The shunt may be used as a termination shunt where no other frequencies (other than the 2000 MS) are present. The shunt may also be used to bypass existing insulated joints required for DC signaling purposes within the track circuit.



WARNING

WARNING

THE 8A076A WIDEBAND SHUNT MUST NOT BE USED TO BYPASS INSULATED JOINTS IN DC CODED TRACK CIRCUITS OR WHERE AC OR CODED AC CIRCUITS EXIST.

The wideband shunt is housed in a hermetically-sealed, cylindrical case with a pair of 10-foot leads extending from one end. The shunt should be connected as close as possible to the rails. To afford maximum protection from physical damage, the shunt should be encased in a protective enclosure or buried (either vertically or horizontally) at an appropriate depth (see paragraph 7.18). It is not necessary to bury the shunt below the frost line.

Specifications for the wideband shunt are as follows:

Dimensions	7.5 inches (19.1 cm) long 3.35 inches (8.5 cm) in diameter
Weight	7 pounds (3.18 kg) (approximate)
Leads	10 feet (3 m); number 6 AWG, stranded, black PVC

7.10 SIMULATED TRACK INDUCTOR, 8V617 (USED WITH MULTIFREQUENCY SHUNTS)

In bidirectional motion sensor and grade crossing predictor installations, insulated joints located in one approach frequently prevent both termination shunts from being installed at approximately equal distances from the 2000 MS feed point as required. When Safetran's multifrequency narrow-band shunts (62775/62780) are used to terminate the approaches, Simulated Track Inductor, 8V617 (Figure 7-15), may be used along with the shunt in the shorter approach to compensate for the reduced distance (Figure 7-14).

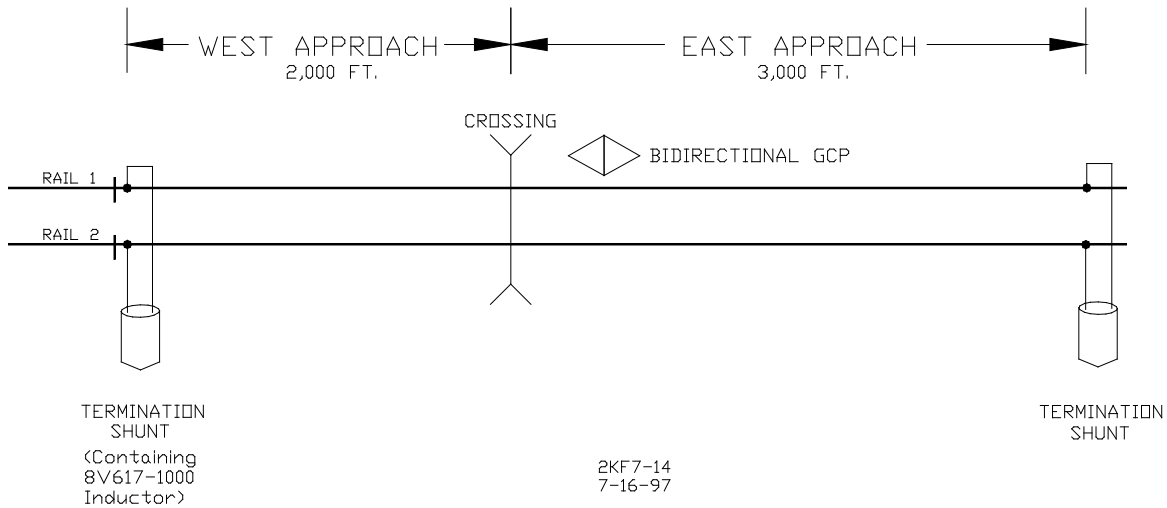


Figure 7-14. Simulated Track Inductor used with Termination Shunt

The inductor consists of an insulated, toroid-wound coil with a pair of 4-inch number 18 AWG stranded wire leads with 1/4-inch ring terminals attached. The inductor is supplied in 21 configurations to simulate track lengths ranging from 200 to 4,000 feet in 200-foot increments plus 4,400 feet. Each inductor is identified with the basic part number followed by a dash number indicating the simulated distance in feet as listed in Table 7-8.

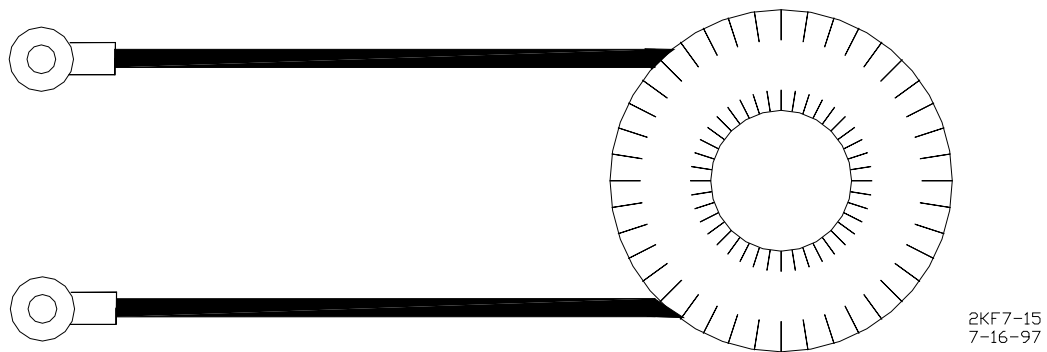


Figure 7-15. Simulated Track Inductor, 8V617

Table 7-7. Simulated Track Inductor Part Number Listing

Basic Part No.	Dash Number = Distance (Feet)		
8V617	-0200	-1600	-3000
	-0400	-1800	-3200
	-0600	-2000	-3400
	-0800	-2200	-3600
	-1000	-2400	-3800
	-1200	-2600	-4000
	-1400	-2800	-4400

Use the following procedure to install the inductor in the narrow-band shunt.

1. After determining the shunt frequency and compensating distance required, loosen the clamp and remove the end cap from the shunt to gain access to the frequency-selection terminals. Refer to the small chart inside the end cap for terminal strapping information.

NOTE**NOTE**

If the chart is missing or illegible, refer to Table 7-5 (62775) or 7-6 (62780) in this section.

WARNING**WARNING**

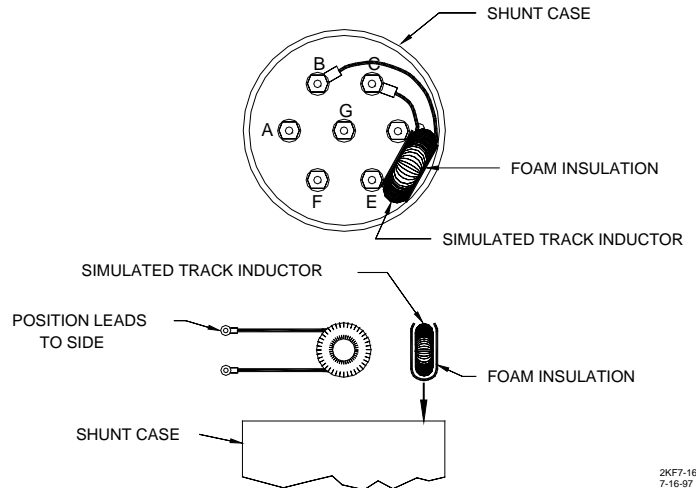
BEFORE INSTALLING, VERIFY THE 8V617 INDUCTOR IS THE CORRECT DISTANCE VALUE FOR THE APPLICATION.

2. Refer to Table 7-8 and note the inductor mounting terminals for the applicable shunt and frequency. Remove the nuts, washers, and shorting link from the shunt terminals indicated. Discard the shorting link and install the inductor in its place by connecting the inductor leads to the two terminals. Install the washers and nuts and tighten securely.

WARNING**WARNING**

ENSURE THE INDUCTOR IS WRAPPED IN FOAM INSULATION FOR PROTECTION.

3. Wrap the inductor in the foam insulation (included with the inductor) as shown in Figure 7-16 and carefully insert into the shunt housing between the terminals and case at the approximate location shown. Position the inductor with the leads extending horizontally toward the side (not upward) to prevent interference with the shunt end cap.
4. Return the end cap to its original position on the shunt and tighten the clamp securely



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Figure 7-16. Typical Installation of 8V617 in 62775/62780 Shunt

Specifications for the 8V617 simulated track inductor are as follows:

Diameter	1.875 inches (4.76 cm)
Thickness	0.875 inches (2.22 cm)
Weight	5 ounces (141.75 grams)

Table 7-8. Simulated Track Inductor, 8V617, Mounting Terminals

Narrow-band Shunt Part No.	Frequency (Hz)	Remove Shorting Link And Connect Inductor Leads Between Shunt Terminals
62775/62780-1543	156	A and F
	211	A and G
	285	B and C
	348	B and C
	430	B and C
62775-2132*	211	A and F
	267	B and G
	285	B and C
	313	B and C
	326	B and C
62775/62780-2152*	211	A and F
	285	B and C
	348	B and C
	430	B and C
	525	B and C

Continued on next page

Table 7-8 Concluded

Narrow-band Shunt Part No.	Frequency (Hz)	Remove Shorting Link And Connect Inductor Leads Between Shunt Terminals
62775-3448*	348	A and B
	389	A and B
	392	A and B
	430	A and B
	452	A and B
	483.5	A and B
62775-3497	348	A and B
	430	A and B
	525	A and B
	645	A and B
	790	A and B
	970	A and B
62775-5274*	522	A and B
	525	A and B
	560	A and B
	645	A and B
	669.9	A and B
	746.8	A and B
62780-5297	525	A and B
	645	A and B
	790	A and B
	970	A and B
62775-7910*	790	A and B
	816	A and B
	832.5	A and B
	970	A and B
	979	A and B
	1034	A and B
62775/62780-8621	86	A and F
	114	B and G
	156	C and D
	211	C and D

*Available for special applications only

7.11 ADJUSTABLE INDUCTOR ASSEMBLY, 8A398-6

Insulated joints located in one approach frequently prevent both termination shunts from being installed at approximately equal distances from the 2000 MS feed point as required. When Safetran’s single-frequency narrow-band shunts (62775-f/62780-f are used to terminate these

approaches, Adjustable Inductor Assembly, 8A398-6 (Figure 7-19), may be used along with the shunt in the shorter approach to compensate for the reduced distance (Figure 7-17).

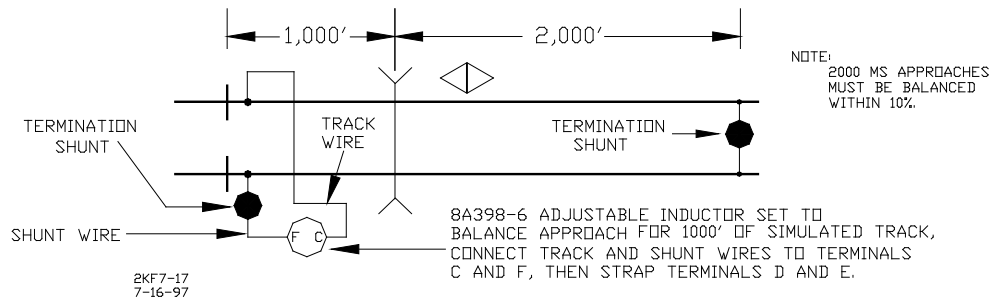


Figure 7-17. Adjustable Inductor used with Termination Shunt

The inductor assembly consists of a 3-inch diameter ABS plastic enclosure with mounting brackets at the base. Seven AREMA terminals extend from the top of the assembly and accommodate connections to six inductors which are connected in series and housed within the sealed unit.

Refer to Table 7-9 and locate the desired simulated track length (column 1). Then read across the table to determine which inductors (indicated by terminal pairs in column 2) are required to simulate that length. Next, connect the track wire and the shunt wire (Figure 7-17) to the two terminals indicated in column 2. Finally, install a strap between the terminal pairs indicated in column 3 to short any inductors located between the track and shunt wire connecting terminals (Figure 7-18) which are not required for the desired length. For example, if the required simulated track length is 1,000 feet, the track and shunt wires are connected to terminals C and F. A strap is then installed between terminals D and E to short the 400-foot inductor and remove it from the series circuit.

Track lengths are selectable in 50-foot increments ranging from 50 to 3,150 feet. Specifications for the 8A398-6 adjustable inductor assembly are as follows:

- Diameter 3.375 inches (8.57 cm)
- Height 9 inches (22.86 cm) (to top of AREMA terminals)
- Weight 5 pounds, 12 ounces (2.59 kg)

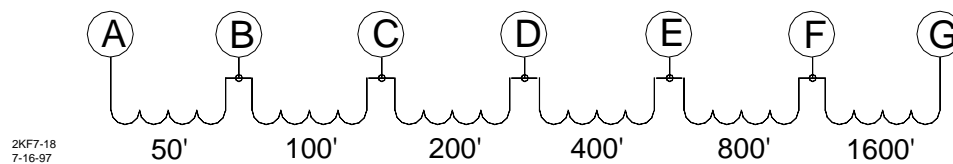


Figure 7-18. 8A398 Adjustable Inductor Schematic

Table 7-9. Adjustable Inductor Assembly, 8A398-6, Terminal Connections

Column 1	Column 2	Column 3	Column 1	Column 2	Column 3
Simulated Track Length (Feet)	Connect Track And Shunt Wires To These Terminals	Connect Shorting Strap(s) Between These Terminals	Simulated Track Length (Feet)	Connect Track And Shunt Wires To These Terminals	Connect Shorting Strap(s) Between These Terminals
50	A-B		1650	A-G	B-C, C-D, D-E, & E-F
100	B-C		1700	B-G	C-D, D-E, E-F
150	A-C		1750	A-G	D-E, E-F
200	C-D		1800	C-G	B-C, D-E, E-F
250	A-D	B-C	1850	A-G	D-E, E-F
300	B-D		1900	B-G	D-E, E-F
350	A-D		1950	A-G	E-F
400	D-E		2000	D-G	B-C, C-D, E-F
450	A-E	B-C, C-D	2050	A-G	C-D, E-F
500	B-E	C-D	2100	B-G	C-D, E-F
550	A-E	C-D	2150	A-G	E-F
600	C-E		2200	C-G	B-C, E-F
650	A-E	B-C	2250	A-G	E-F
700	B-E		2300	B-G	E-F
750	A-E		2350	A-G	
800	E-F		2400	E-G	B-C, C-D, D-E
850	A-F	B-C, C-D, D-E	2450	A-G	C-D, D-E
900	B-F	C-D, D-E	2500	B-G	C-D, D-E
950	A-F	C-D, D-E	2550	A-G	D-E
1000	C-F	D-E	2600	C-G	B-C, D-E
1050	A-F	B-C, D-E	2650	A-G	D-E
1100	B-F	D-E	2700	B-G	D-E
1150	A-F	D-E	2750	A-G	
1200	D-F		2800	D-G	B-C, C-D, D-E
1250	A-F	B-C, C-D	2850	A-G	C-D
1300	B-F	C-D	2900	B-G	C-D
1350	A-F	C-D	2950	A-G	
1400	C-F		3000	C-G	B-C
1450	A-F	B-C	3050	A-G	
1500	B-F		3100	B-G	
1550	A-F		3150	A-G	
1600	F-G				

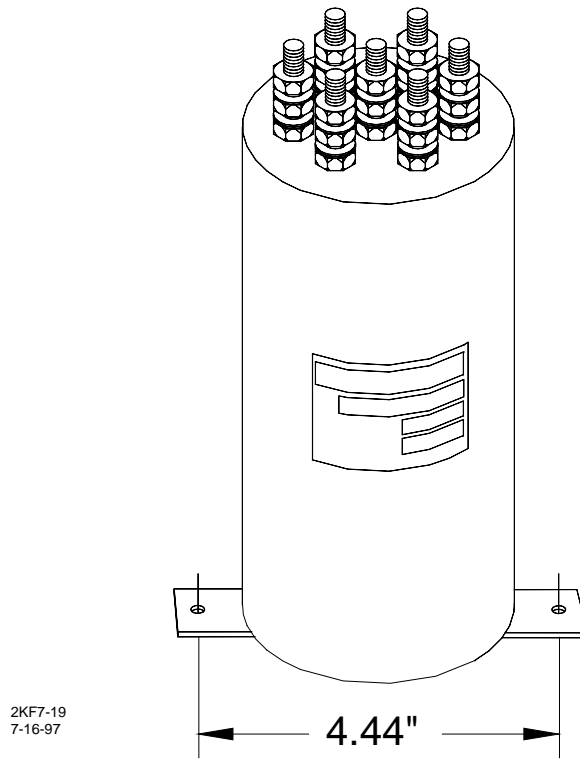


Figure 7-19. Adjustable Inductor Assembly, 8A398-6

7.12 TRACK CIRCUIT ISOLATION DEVICES

Several types of track circuit isolation devices are available for both DC and AC coded track applications. Since there are a number of variations in DC coded track such as relay type and associated operating current, decoding method, current and voltage transmitted and received, track circuit length, transmit and receive code polarity, DC code frequency, pulse width, etc., the recommendations presented in the following paragraphs are general in nature and no attempt has been made to cover all applications. Also, as additional field experience is gained, improved or changed application methods may result. If there are any questions concerning these recommendations or applications, contact Safetran Technical Support for assistance.

The following discussions are grouped by coded track circuit type. Battery chokes and code isolation devices described here are designed for mounting inside a weatherproof enclosure.

7.12.1 Steady Energy DC Track Circuits

All DC track circuits with batteries located within a 2000 MS approach, or less than 2,000 feet beyond the approach termination, should be equipped with a battery choke. However, if the track connections for the DC track circuit are 2,000 feet or more beyond the motion sensor approach termination shunt, a battery choke is not required (Figure 7-21).

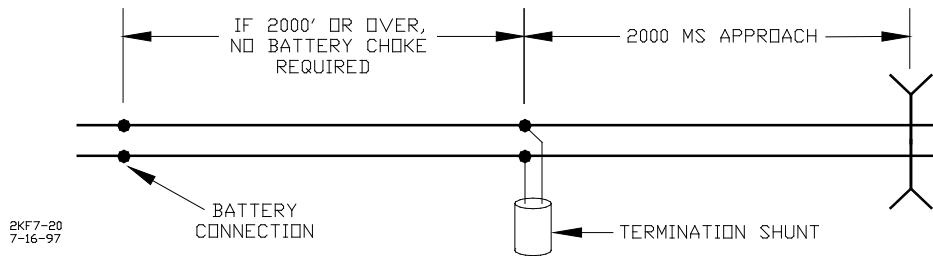


Figure 7-20. Battery Choke Requirements

Either of the following battery chokes may be used: part number 8A065A or 62648 (see limitations in the following paragraphs).

Operation of long DC track circuits with very low ballast conditions may be affected by the DC resistance (DCR) of the 8A065A battery choke (DCR of 8A065A is 0.40 ohm). Such track circuits should use the 62648 battery choke, which has a DCR of 0.10 ohm. However, in applications where the choke is located within a Model 300 or Model 400 GCP approach, the 8A065A battery choke must be used.

The 62648 and 8A065A battery chokes each consist of a large inductance coil with two top-mounted AREMA terminals and a mounting base (see Figure 7-22).

When a rectified track circuit is used and the 2000 MS is operating at 114 Hz, an 8A076A wideband shunt (paragraph 7.9) should also be used along with the battery choke to minimize 120 Hz ripple. Figure 7-21 illustrates this application.

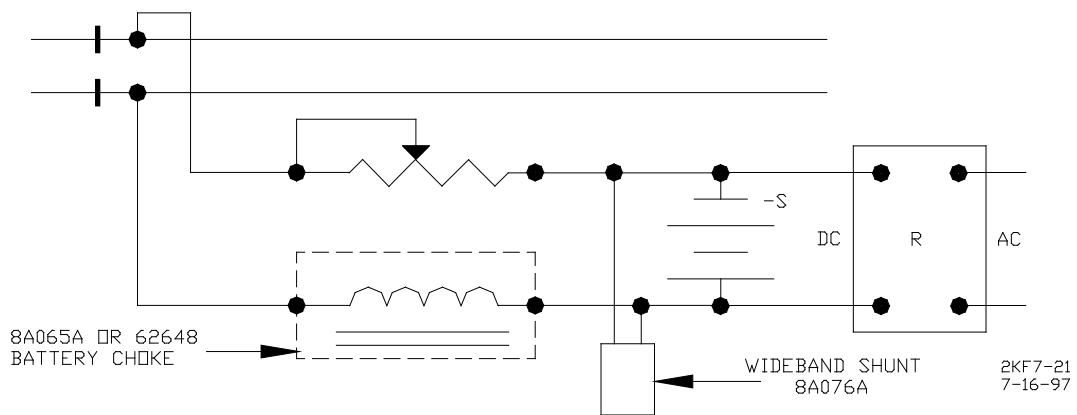
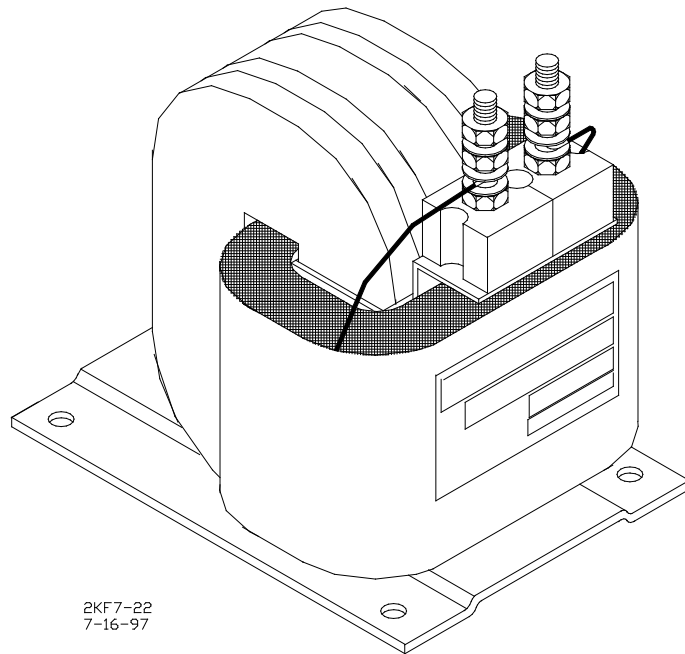
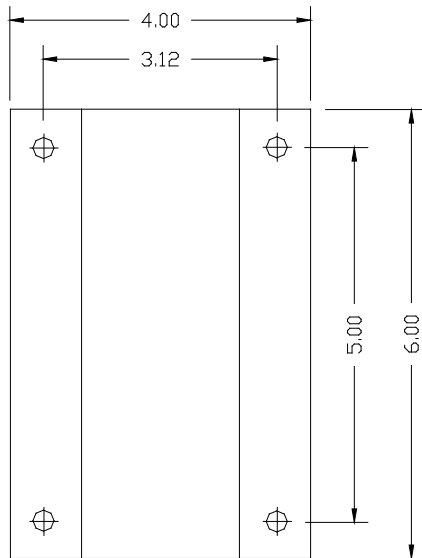


Figure 7-21. Wideband Shunt used with Battery Choke

Specifications for the 62648 and 8A065A battery chokes are as follows:

Dimensions

4.5 inches (11.43 cm) wide
 5.0 inches (12.70 cm) deep
 8.5 inches (21.59 cm) high
 (to top of terminal studs)



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Weight

17 pounds (7.72 kg) (approximate)

Figure 7-22. 62648/8A065A Battery Choke with Mounting Dimensions

7.12.2 Electro Code Electronic Coded System

Model 2000 MS frequencies of 86 Hz and above can normally be used with Electro Code. All frequencies of 211 Hz and lower require use of maximum current track drive. In certain instances, 285 Hz may also require maximum current.

For frequencies of 211 Hz and lower, an Electro Code track filter (TF-freq) may be required. As with any coded track system, the lower the Electro Code transmit level, the less interference with 2000 MS units.

7.12.3 Relay Coded DC Track

Most relay coded DC track installations require use of DC code isolation units such as the 6A342-1 (Figure 7-24). A code isolation unit is a special battery choke that aids in preventing coded track battery and track relays from causing high interference with the 2000 MS.

NOTE

NOTE
The correct model of code isolation unit for the type of DC coded track circuit used must be installed as instructed in the 2000 MS Application Guidelines.

WARNING

WARNING
VERIFY PROPER CODE SYSTEM OPERATION FOLLOWING INSTALLATION OF THE ISOLATION UNIT.

The 6A342-1 DC code isolation unit is used in most single polarity code systems while the 6A342-3 unit is used in GRS Trakode (dual polarity) relay systems.

All wiring to terminals 1 and 2 on the isolation units should be number 6 AWG. This significantly reduces current losses to the track relay during low track ballast conditions. Frequencies below 211 Hz require maximum current. Specifications for the 6A342 battery chokes are as follows:

Dimensions	5.0 inches (12.7 cm) wide
	9.0 inches (22.8 cm) deep
	5.75 inches (14.6 cm) high

Weight	15 pounds (6.8 kg) (approximate)
--------	----------------------------------

Various applications for the track isolation units are discussed in the paragraphs that follow.

7.12.3.1 Single Polarity Systems (Fixed Polarity)

The 6A342-1 code isolation unit can be used in most single (fixed) polarity code systems. A single polarity code system must have the same received and transmitted polarities to use this code isolation unit. Most rate code systems (75, 120, 180 ppm) are of this type. Figure 7-23 illustrates a typical 6A342-1 code isolation unit installation in a single polarity code system.

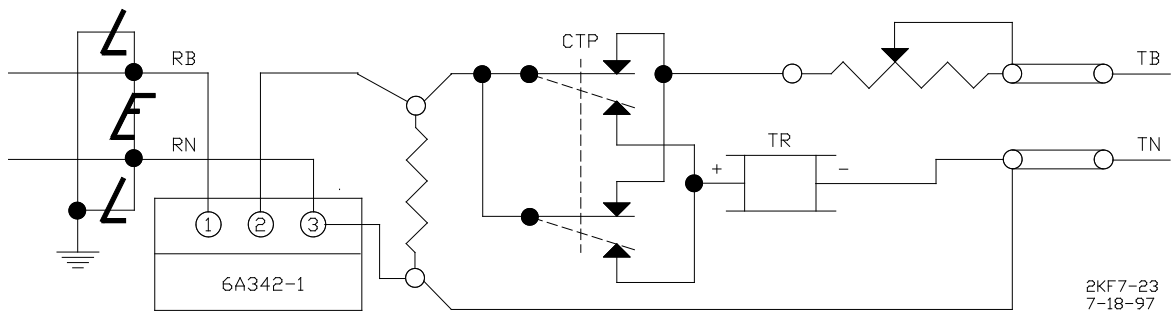


Figure 7-23. Code Isolation Unit in a Single Polarity Code System

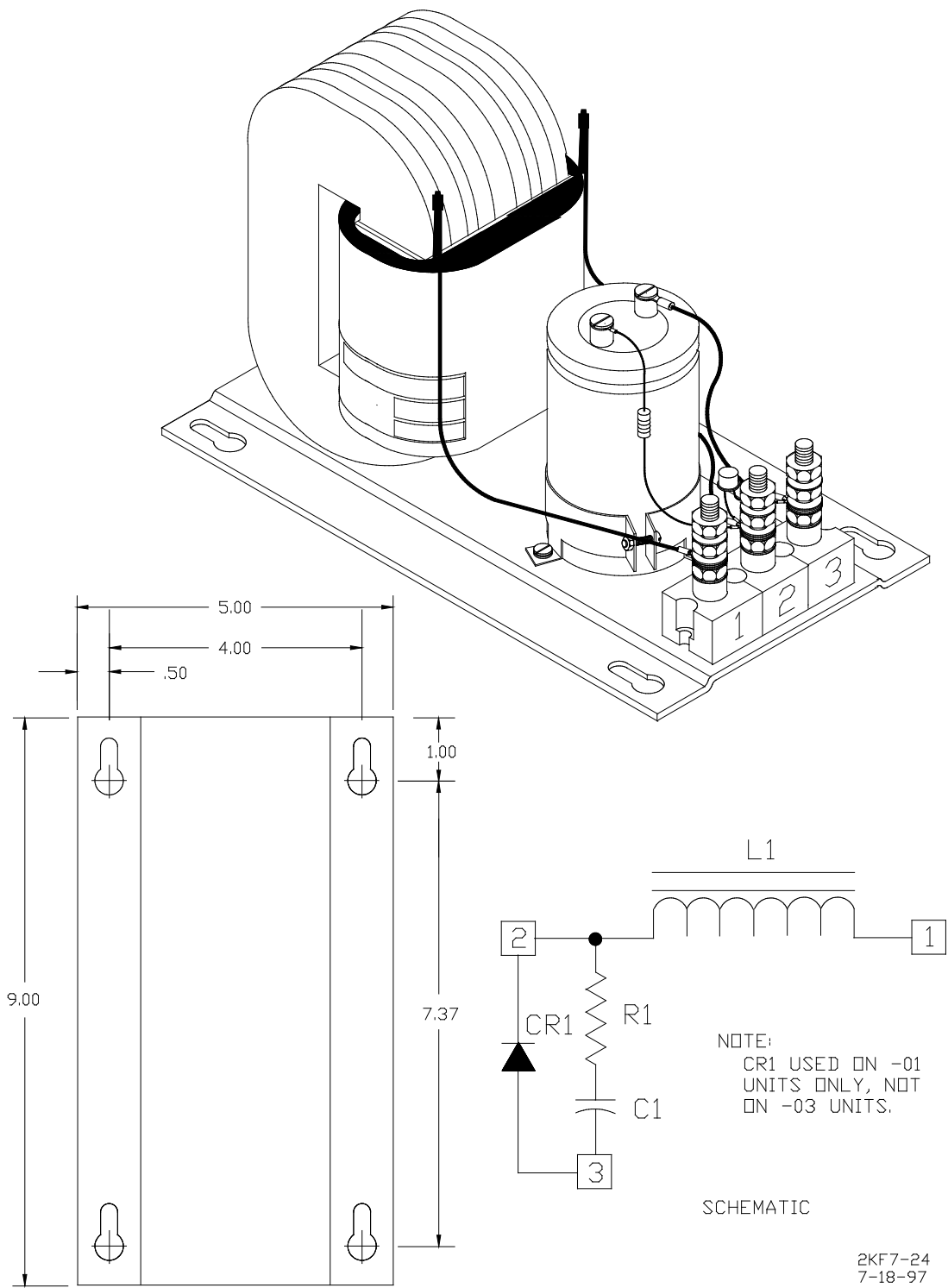


Figure 7-24. DC Code Isolation Unit, 6A342, with Mounting Dimensions

7.12.3.2 GRS Trakode (Dual Polarity) Systems

Figure 7-25 illustrates the 6A342-3 code isolation unit installed in a GRS Trakode system. To install the unit as shown, a transfer delay (TD) relay must be used. Do not install any code isolation circuit in GRS Trakode without use of the TD relay.

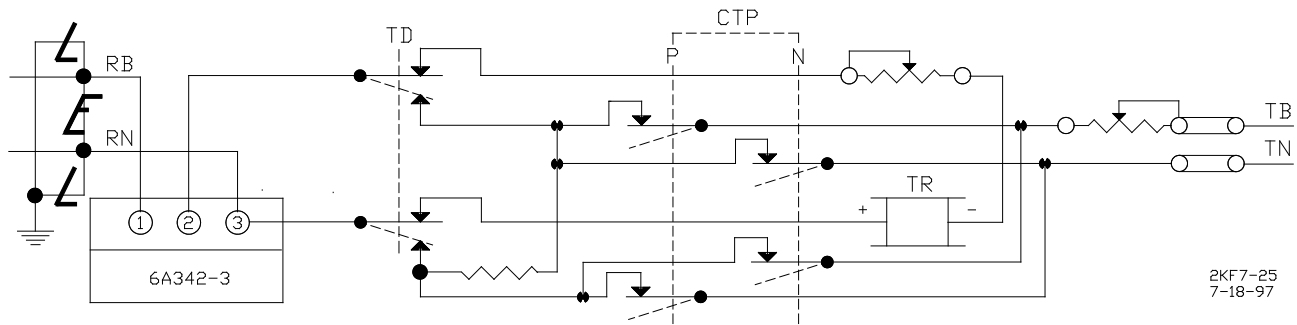


Figure 7-25. Code Isolation Unit Installed in a GRS Trakode System

7.12.3.3 Dual Polarity (Polar) Coded Track Systems Other Than GRS Trakode

A dual polarity system is one in which the received code polarity is opposite that of the transmitted code. The 6A342-3 code isolation unit can be used in a dual polarity system, however, two 6A342-3 units must be specifically placed at each end of the circuit for proper filtering. The application will depend upon the track circuit configuration. Contact Safetran Technical Support for assistance in dual polarity code systems.

7.12.4 Cab Signal AC

Application of 2000 MS systems in cab territory using 60 Hz AC Code Isolation Unit, 8A466-3, or 100 Hz Isolation Unit, 8A471-100, is shown in Figure 7-26. For other installations, contact Safetran Technical Support for assistance.

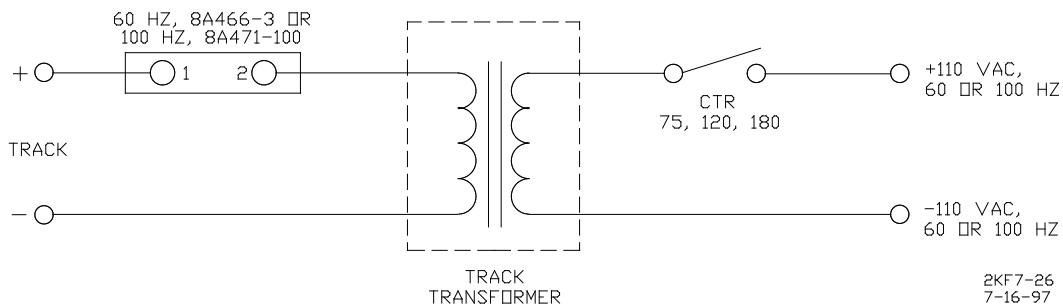


Figure 7-26. Isolation Units used in Cab Territory

Specifications for the 8A466-3 and 8A471-100 AC code isolation units are as follows:

8A466-3

Dimensions	10.15 inches (25.8 cm) wide 11.78 inches (29.9 cm) deep 7.62 inches (19.3 cm) high
Weight	26 pounds (11.8 kg) (approximate)

8A471-100

Dimensions	5.0 inches (12.7 cm) wide 9.4 inches (23.8 cm) deep 9.0 inches (22.8 cm) high
Weight	5 pounds (2.3 kg) (approximate)

7.13 TUNABLE INSULATED JOINT BYPASS COUPLER, 62785-F

The 62785-f coupler is designed to replace the earlier fixed-frequency 62531-f and 62631-f insulated joint bypass couplers and **must** be used in all 2000 MS applications; not the 62531-f and 62631-f couplers.



WARNING

WARNING

INSULATED JOINT BYPASS COUPLERS, 62531-F AND 62631-F, MUST NOT BE USED WITH THE 2000 MS; USE THE 62785-F COUPLER INSTEAD.



WARNING

WARNING

THE COUPLER MUST BE CONNECTED TO THE INSULATED JOINTS IT IS COUPLING USING ONLY THE 10 FOOT LENGTH OF CABLE ATTACHED TO THE COUPLER.

The 62785-f coupler is field tuned to pass the 2000 MS operating frequency (f) around insulated joints in DC or coded DC track circuits. Field tuning of the coupler enables precise frequency adjustment for track and joint parameters. The 62785-f coupler is available in standard Safetran frequencies of 114 Hz through 970 Hz.

The coupler is housed in a hermetically-sealed, 6-inch diameter case 2 inches larger in diameter than the 62531-f and 62631-f couplers. A pair of 10-foot, number 6 AWG leads extend from one end and nine AREMA terminals extend from the other (see Figure 7-27). Five of the terminals

(labeled A through E) are equipped with special gold AREMA nuts that are used to tune the coupler.

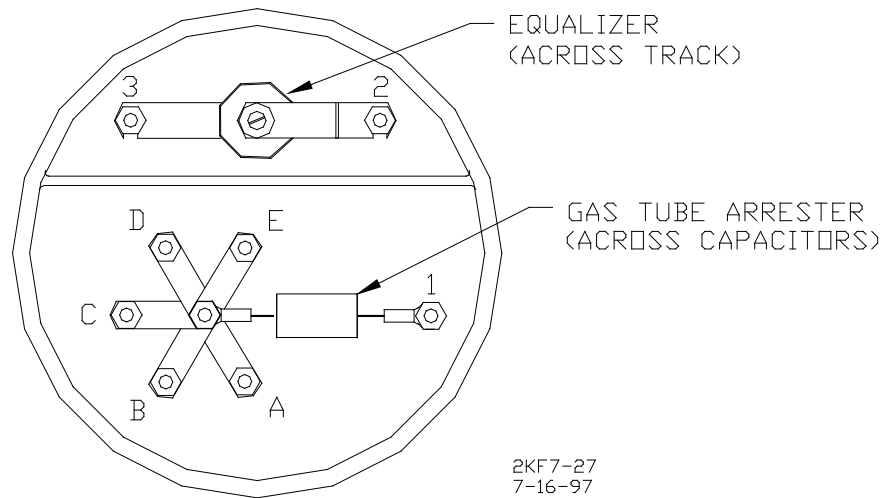


Figure 7-27. Terminal Identification, 62785-f Tunable Insulated Joint Bypass Coupler

When tuning the coupler, tighten the gold nut on terminal E down first. Then, with a hardwire shunt placed across the tracks, first on one side of the coupler and then on the other, tighten one or more of the remaining nuts in sequence to obtain the minimum change in EZ value across the joint. Tightening the nut on terminal E will produce maximum change in EZ value and tightening the nut on terminal A will produce minimum change.

When adjustment is complete, tighten a second (standard) AREMA nut on each of the terminals to lock the gold adjusting nuts firmly in position. Connect an equalizer and a gas tube for capacitor protection to the remaining AREMA terminals to provide complete surge protection. Secure a pliable end cap in place over the terminal end of the coupler with the stainless steel clamp to provide protection against moisture and dust.

The coupler should be connected as close as possible to the rails and, to afford maximum protection from physical damage, be encased in a protective enclosure or buried (either vertically or horizontally) at an appropriate depth. It is not necessary to bury the coupler below the frost line.

7.13.1 Field Tuning Procedure

There are two different tuning procedures to tune the Tunable Insulated Joint Bypass Coupler depending on where the coupler(s) is/are located in the approach. Use the procedure outlined in Section 7.13.1.1 primarily. Use the procedure outlined in Section 7.13.1.2 as an alternate. Refer to Figure 7-28 when performing either of the following tuning procedures.

NOTE

NOTE
Multiple couplers often require the procedures in Section 7.13.1.2 for proper setup.

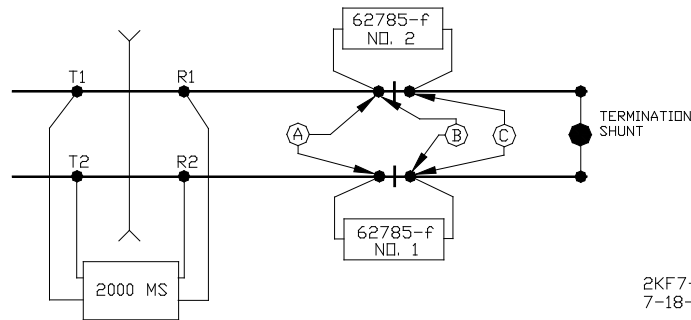
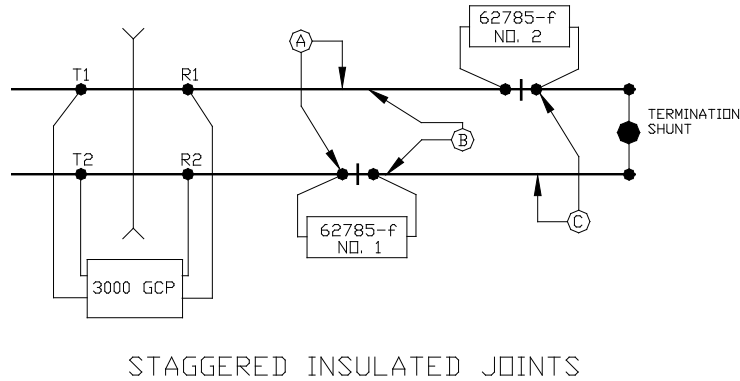


Figure 7-28. Typical Installation Diagrams using the 62785-f Coupler

7.13.1.1 Tuning Procedure #1 for Couplers

1. Tighten the gold nut securely on terminal E of each coupler.
2. Calibrate the 2000 MS EZ value to 100.
3. Place a hardwire test shunt across the track at location A (refer to Figure 7-28).
4. **Make a note of the EZ value** on the 2000 MS display.
5. Move the test shunt to location B.
6. Tune the Tunable Insulated Joint Bypass Coupler **#1** to the same EZ value noted in Step 4.
7. Move the test shunt to location C.

8. Tune the Tunable Insulated Joint Bypass Coupler **#2** to the same EZ value noted in Step 4.
9. Remove the test shunt and tighten a standard AREMA nut against each gold nut to ensure all nuts are securely locked in position.

⚠ WARNING

WARNING

ENSURE THAT A STANDARD AREMA NUT IS TIGHTENED SECURELY AGAINST EACH GOLD NUT ON TERMINALS A THROUGH E. TERMINALS THAT ARE NOT USED FOR TUNING THE COUPLER MUST HAVE THEIR GOLD NUTS REMOVED.

10. Completely recalibrate the 2000 MS and perform all the operational checks while observing the smooth change in the EZ value across the couplers during a train move.

7.13.1.2 Tuning Procedure #2 for Couplers

1. Tighten the gold nut securely on terminal E of each coupler.
2. Calibrate the 2000 MS EZ value to 100.
3. Place a hardwire test shunt across the track at location A (refer to Figure 7-28).
4. **Make a note of the EZ and EX values** on the 2000 MS display.
5. Move the test shunt to location B.
6. Tune the Tunable Insulated Joint Bypass Coupler **#1 EX** value to above 75. The **EZ** value may be as much as 8 points above the value noted in Step 4.
7. Move the test shunt to location C.
8. Tune the Tunable Insulated Joint Bypass Coupler **#2** so the **EX** value stays above 75. The **EZ** value may be as much as 16 points above the value note in Step 4.
9. Remove the test shunt and tighten a standard AREMA nut against each gold nut to ensure all nuts are securely locked in position.

⚠ WARNING

WARNING

ENSURE THAT A STANDARD AREMA NUT IS TIGHTENED SECURELY AGAINST EACH GOLD NUT ON TERMINALS A THROUGH E. TERMINALS THAT ARE NOT USED FOR TUNING THE COUPLER MUST HAVE THEIR GOLD NUTS REMOVED.

10. Completely recalibrate the 2000 MS and perform all the operational checks while observing the relatively smooth change in the EZ value across the couplers during a train move.

Specifications for the 62785-f Tunable Insulated Joint Bypass Coupler are as follows:

Dimensions	18 inches (45 cm) long 6 inches (15 cm) diameter
Weight	12 pounds (5.45 kg) (approximate)
Leads	10 feet (3 m); number 6 AWG, stranded, black PVC
Surge Suppressor Part Numbers	Equalizer, 022700-21X, Safetran No. Z803-00052-0001 Gas Tube Arrester, Safetran No. Z803-00053-0001

7.14 TAKING A TRACK OUT OF SERVICE USING SIMULATED TRACK ASSEMBLY, 80071



WARNING

THE RAILROAD PROCEDURES GOVERNING HOW TO TAKE A TRACK OUT OF SERVICE WILL BE FOLLOWED. THE INSTRUCTIONS IN THIS SECTION MAY BE FOLLOWED ONLY IF ALLOWED BY THE RAILROAD.

Track 1 (or track 2 in the Model 2000 MS) can be temporarily removed from service by installing Simulated Track Assembly, 80071, between the applicable track 1 or track 2 transmitter output terminals (XMT 1 and XMT 2) on the front panel of the 2000 MS case. The simulated track assembly (Figure 7-29) consists of a plastic housing containing a special simulated track inductor. A pair of 10-foot, number 10 AWG, stranded leads with yellow insulation and AREMA lugs extend from one end of the housing. The bright yellow leads permit an out-of-service track condition to be easily identified.

7.14.1 Instructions For Taking a Track Out of Service

Perform the following steps to temporarily take track 1 or track 2 out of service.



WARNING

VERIFY THAT THE PROPER 2000 MS TRACK (T1 OR T2) IS BEING TAKEN OUT OF SERVICE.

WARNING**WARNING**

INSTALLATION OF THE SIMULATED TRACK ASSEMBLY MAY AFFECT WARNING TIMES AT OTHER NEARBY OPERATING CROSSINGS. THIS CAN OCCUR WHEN APPROACHES OF THE NEARBY CROSSINGS OVERLAP THE ISLAND CIRCUIT OF THE CROSSING WHICH IS BEING TAKEN OUT OF SERVICE.

1. Verify that no train moves are occurring on the track and that all normally-energized relay drives are energized before continuing.
2. Install the two leads (Figure 7-29) of the simulated track assembly (80071) on the associated transmitter output terminals for the track that is being taken out of service (TB1-1 and TB1-3 or TB2-1 and TB2-3).

NOTE**NOTE**

When connecting the two simulated track assembly leads, place one lug on the appropriate transmitter output terminal and tighten the AREMA nut securely. While installing the second lead, hold the lug firmly on the other terminal while tightening the nut to ensure a solid electrical connection. If a solid electrical connection is not achieved when connecting the second lead of the simulated track assembly, apparent motion may be sensed or an error condition may be produced, de-energizing one or more relay drives. If this occurs, disconnect one lead of the simulated track assembly, wait for all relay drives to recover, and then repeat step 2.

The applicable track circuit is now out of service; however, the island circuit remains operational.

AUXILIARY EQUIPMENT FAMILIARIZATION

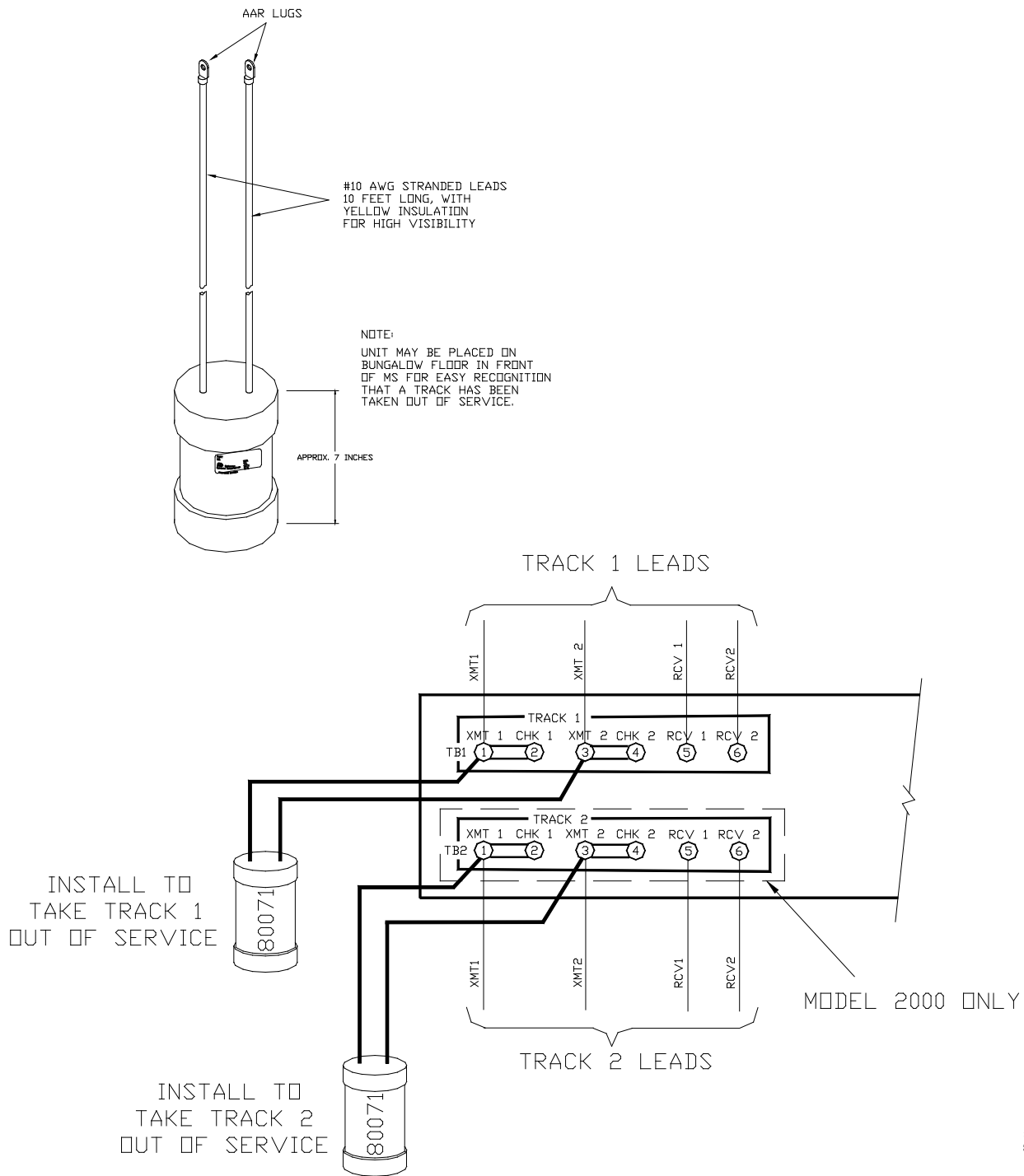


Figure 7-29. Simulated Track Inductor Assembly, 80071

7.14.2 Returning a Track to Service



WARNING

REQUIRED OPERATIONAL TESTS SHALL BE PERFORMED IN ACCORDANCE WITH RAILROAD PROCEDURES WHEN RESTORING TRACKS TO SERVICE.



WARNING

WHEN RESTORING TRACK CIRCUITS TO SERVICE, VERIFY THAT THE EZ AND EX ARE IN THE EXPECTED RANGE OF VALUES.

To return track 1 or track 2 to service, disconnect the simulated track assembly (step 2). With no trains operating in the approaches, verify that the track EZ value has returned to its nominal level. In addition, ensure that all other railroad instructions and procedures for returning a track to service are followed.

7.15 SLAVING UNIT, 80065

When two Model 2000 Motion Sensors are frequency slaved in a master/slave configuration, and the two units are powered from separate batteries, a special slaving unit must be used to isolate the two batteries. Without the isolation provided by the slaving unit, a grounded battery would be reflected in both sets of 2000 MS operating batteries. The slaving unit prevents this interaction from occurring. When the two 2000 motion sensors are operated from the same battery, the slaving unit is not required.

The slaving unit consists of a 3-inch diameter by 5-inch long ABS plastic enclosure with mounting brackets at the base. Four AREMA terminals extend from the top of the assembly and accommodate connections to separate windings of an isolation transformer housed within the hermetically sealed enclosure. The terminals are connected between the battery N (TB1-8) and SLAVING (TB2-6) terminals on the master 2000 MS and the same pair of terminals on the slave unit as shown in Figure 7-30.

Specifications for the 80065 slaving unit are as follows:

Diameter	3.5 inches (8.9 cm)
Height	7.625 inches (19.37 cm) (to top of AREMA terminals)
Weight	2 pounds (0.91 kg) (approximate)

7.16 SIX-WIRE SIMULATED TRACK BURIAL ASSEMBLY, 80074

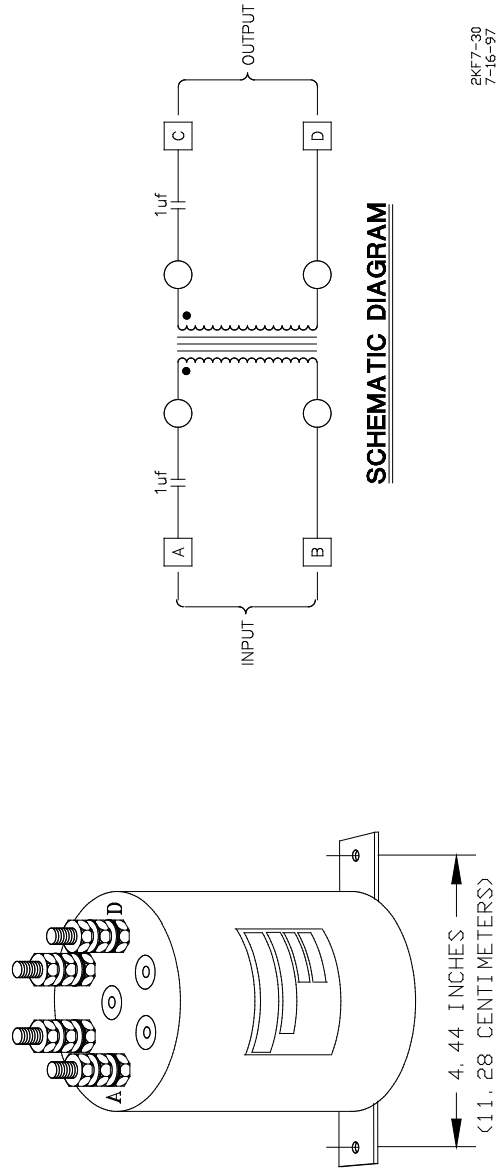
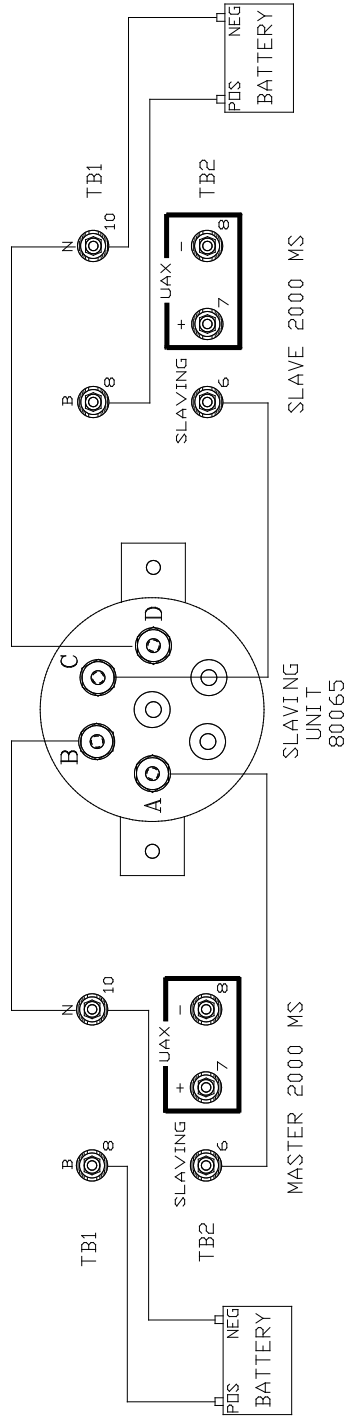
The six-wire simulated track burial assembly (80074) is used in six track wire applications only and ensures proper operation of the 2000 MS self check circuits if a train stops at or very near the track wire feed points. The unit is connected between the transmit and check channel receiver track wires and the associated rail as shown in Figure 7-31 and buried beside the tracks. The length of the single number 6 AWG lead from the simulated track burial assembly to the track feed point should not exceed 25 feet. Existing locations that are between 25 and 50 feet and do not experience CHK receiver errors may remain at their location.

⚠ WARNING**WARNING**

WHEN REMOTE OPERATION IS PROGRAMMED “ON” AND AN ISLAND MODULE IS USED ON THE SAME TRACK (T1 OR T2), THE ISLAND (WHEN DEENERGIZED) WILL NOT CAUSE THE MS RELAY DRIVE TO DEENERGIZE. WHEN USED AT A REMOTE LOCATION, THE ISLAND MODULE IS USED FOR ENHANCED DETECTION REMOTE OPERATION LOGIC AND THUS WILL NOT CONTROL THE RELAY DRIVE OUTPUT AS IT NORMALLY DOES AT A CROSSING.

⚠ WARNING**WARNING**

BEFORE INSTALLING, VERIFY THE 8V617 INDUCTOR IS THE CORRECT WHEN REMOTE UNIT OPERATION IS USED, ANY EXTERNAL TRACK CIRCUIT EQUIPMENT OR AUXILIARY TRACK CIRCUIT EQUIPMENT SHALL BE CONNECTED TO THE MS 2000 TRACK WIRES IN ACCORDANCE WITH SECTION 1.4



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Figure 7-30. Slaving Unit, 80065

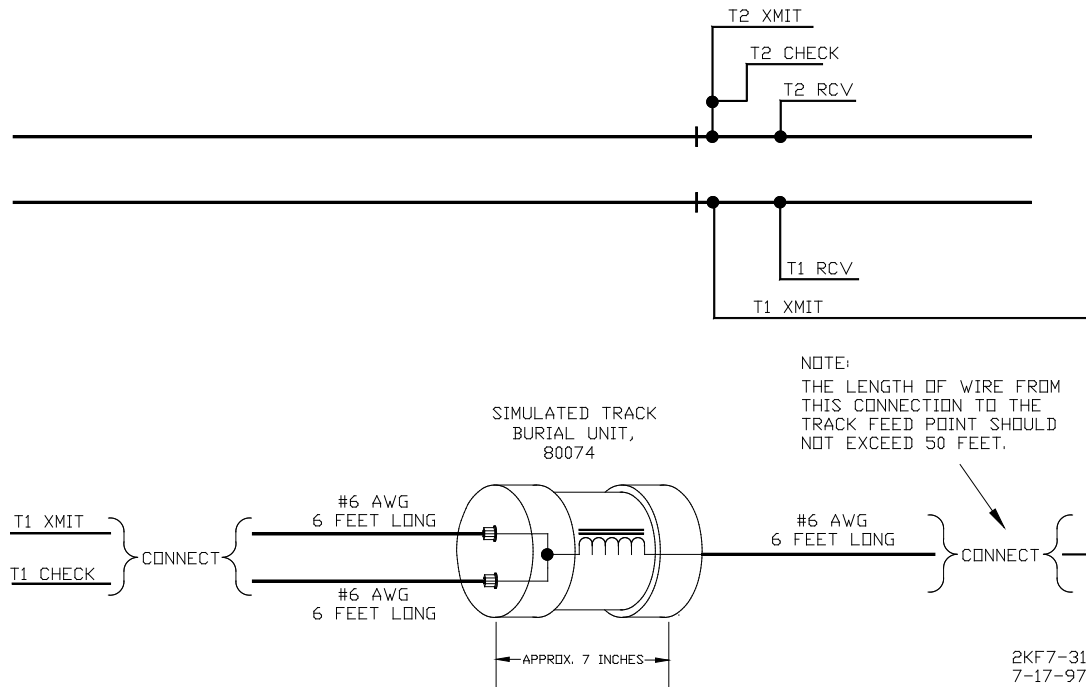


Figure 7-31. Six-wire Simulated Track Burial Assembly, 80074

7.17 EXTENDER MODULE, 80021

The extender module (80021) is 8 inches (20.3 cm) high by 8.9 inches (22.6 cm) wide and is equipped with a dual 43-pin connector on one edge which plugs into a corresponding edge connector on the 2000 MS motherboard. The extender module can be used with all 2000 MS plug-in modules and is primarily a troubleshooting device which permits access to a module installed in the 2000 MS case for test purposes. The extender module plugs into the case connector on the motherboard and the module under test is then plugged into the extender module. Test terminals are provided for each connector pin. The module cannot be used with any other equipment.

7.18 MS/GCP TERMINATION SHUNT BURIAL KIT, A62776

The MS/GCP termination shunt burial kit (A62776) is designed to protect narrow-band termination shunts that are normally buried in the space between adjacent railroad ties. The kit consists of a 26-inch length of 6-inch diameter black PVC tubing and a 7 x 24-inch, 1/4-inch thick steel plate. One end of the tubing is fitted with a pliable rubber cap that is secured in place by an adjustable stainless steel clamp. Two 5/8-inch diameter holes located near the capped end of the tube accommodate the shunt leads.

The enclosure is normally buried in a vertical position between the ties. The termination shunt is lowered into the enclosure and the two leads routed through the holes in the enclosure wall and connected to the rails using standard procedures. The cap is then secured over the top of the enclosure using the stainless steel clamp. The steel plate is centered over the buried enclosure/shunt and securely fastened to each tie using the two 1/4 x 3-inch lag bolts provided.

Specifications for the shunt kit assemblies are as follows:

Dimensions:

Enclosure (PVC)	24 inches (60.9 cm) long (without end cap) 6 inches (15.2 cm) in diameter (inside)
Cover Plate (Steel)	24 inches (60.9 cm) long 7 inches (17.8 cm) wide 0.25 inch (0.6 cm) thick

Weight:

Enclosure	5 pounds (2.3 kg)
Cover Plate	12 pounds (5.4 kg)

7.19 SURGE PANELS, 80026

The 80026 surge panel is available in a variety of configurations to meet specific customer requirements. Each panel is equipped with the appropriate combination of equalizers and arresters to provide the necessary protection for battery and/or track circuits. The -01, -02, and -22 units are designed for wall mounting while the remaining panels are designed for standard 24-inch rack mounting. For additional surge protection requirements and/or custom designed surge panels, contact Safetran Technical Support. Refer to Table 7-10 for specific surge panel applications.

Table 7-10. 80026-XX Surge Panel Applications

Surge Panel Part Number	Type/Number Of Circuits Protected	Mounting Requirements	Notes
80026-01	Battery, 1; Track, 1	Wall mount only	
80026-02	Track, 1	Wall mount only	Use with -01 panel for second track
80026-22	Track, 1	Wall mount only	Use for six-wire applications
80026-31	Battery, 1; Track, 1	Rack mount	
80026-32	Battery, 1; Track, 1	Rack mount	Use with -31 panel for second track and second battery
80026-33	Battery, 1	Rack mount	Used with -31 panel for second track
80026-34	Track, 1	Rack mount	Used with -31 panel for second track

Continued on next page

Table 7-10 Concluded

Surge Panel Part Number	Type/Number Of Circuits Protected	Mounting Requirements	Notes
80026-35	Track, 2	Rack mount	
80026-36	Track, 1	Rack mount	Used with -31 panel for second track. Used with six-wire applications for transmit, receive, and check receive lead protection
80026-37	Battery, 1	Rack mount	
80026-38	Track, 2	Rack mount	Used with -37 panel. Used in applications with six wires on one track and four on the other
80026-39	Battery, 4; Battery input/output line protection for two DAX or two UAX circuits	Rack mount	Normally used with second battery when line circuit protection is required
80026-41	110 VAC (Includes four 15-amp resettable circuit breakers and one 15-amp GFCI duplex output)	Rack mount	Used primarily when 20-amp solid-state crossing controller (91070A) is used in conjunction with 2000 MS
80026-41A	110 VAC (Includes three 15-amp and one 25-amp resettable circuit breakers and one 15-amp GFCI duplex outlet)	Rack mount	Used primarily when 40-amp solid-state crossing controller (91075A) is used in conjunction with 2000 MS
80026-50	Input/output circuits, 4	Rack mount	Generally used for UAX input

Surge panel nomenclature and mounting dimensions are provided in the following chart.

Surge Panel	Figure Number	Surge Panel	Figure Number
80026-01	7-26	80026-36	7-29
80026-02	7-26	80026-37	7-30
80026-22	7-26	80026-38	7-30
80026-31	7-27	80026-39	7-31
80026-32	7-27	80026-41	7-31
80026-33	7-28	80026-41A	7-31
80026-34	7-28	80026-50	7-32
80026-35	7-29		

7.20 AUXILIARY EQUIPMENT PANELS

A number of auxiliary equipment panels are available for use with the 2000 MS. The panels are designed for standard 24-inch rack mounting and will accommodate a variety of auxiliary equipment as described in the following paragraphs.

7.20.1 Rectifier Panel Assembly, 80033

Rectifier Panel Assembly, 80033, is equipped with equalizers and arresters to provide surge protection on the B(+) and N(-) connections to the battery and the 2000 MS. Mounting holes are also provided for Exide Rail Battery Charger, Model ERBC 12/20M. See Figure 7-39 for mounting dimensions.

7.20.2 Sentry Data Recorder Panel Assembly, 91041

Sentry Data Recorder Panel Assembly, 91041, provides a convenient rack mounting location for a single sentry data recorder (91010). See Figure 7-40 for mounting dimensions.

7.20.3 Cable Termination Panel Assembly, 91042

Cable Termination Panel Assembly, 91042, is a universal mounting panel which can be ordered with from 1 to 19 pairs of strapped AREMA terminals. See Figure 7-41 for mounting dimensions.

7.20.4 Data Recorder Interface And Vital AND-Gate Driver Panel Assembly, 91043

Data Recorder Interface And Vital AND-Gate Driver Panel Assembly, 91043, provides mounting holes to accommodate a single vital AND-gate driver (90975), two 80025 16-channel data recorder interface assemblies (80025), or two 24-channel data recorder interface assemblies (80035). See Figure 7-42 for mounting dimensions.

7.20.5 Vital AND-Gate Driver Panel Assembly, 91044

Vital AND-Gate Driver Panel Assembly, 91044, provides mounting holes to accommodate from one to three vital AND-gate driver assemblies (90975). See Figure 7-43 for mounting dimensions.

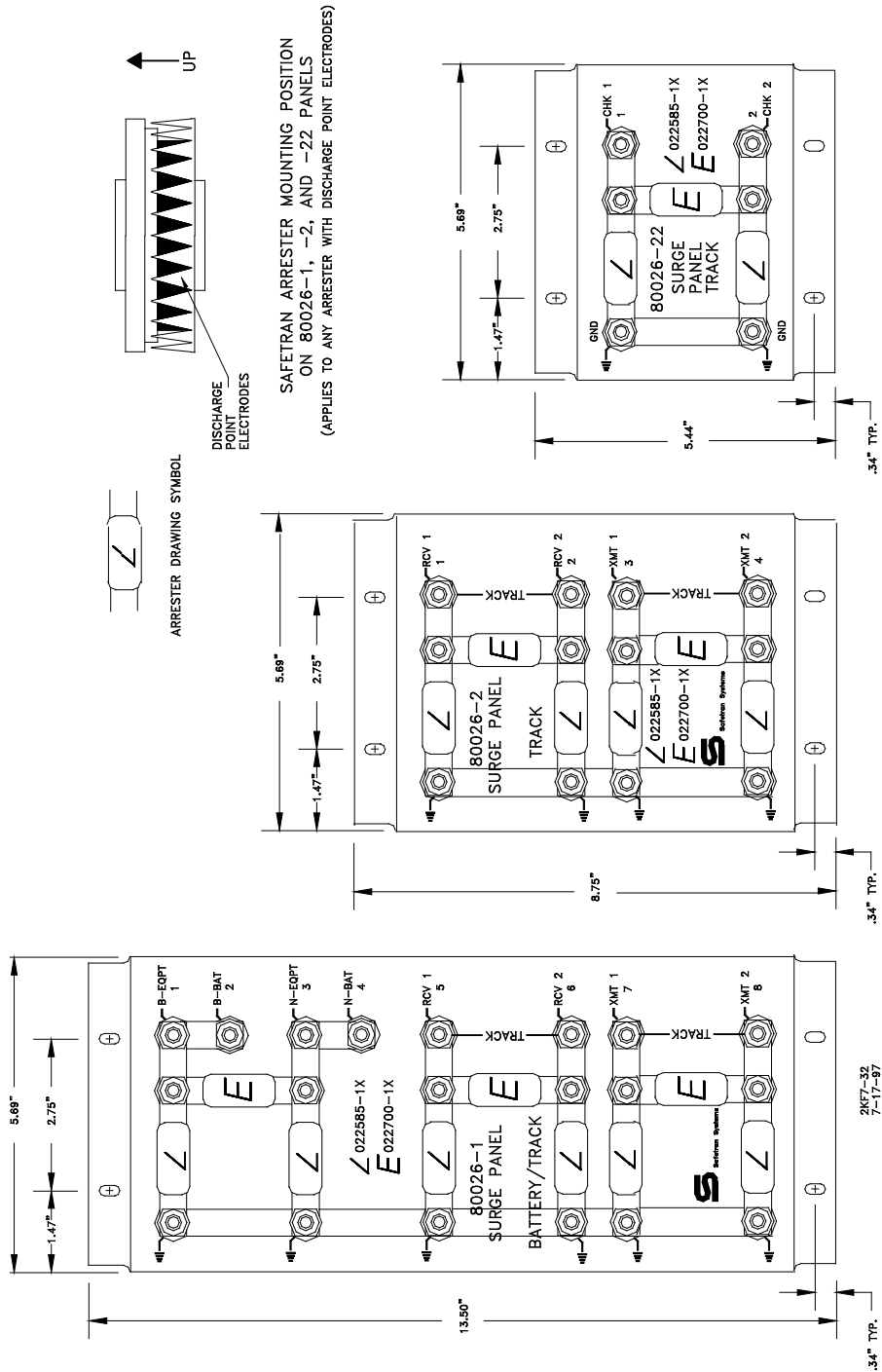


Figure 7-32. Surge Panels, 80026-01, -02, and -22

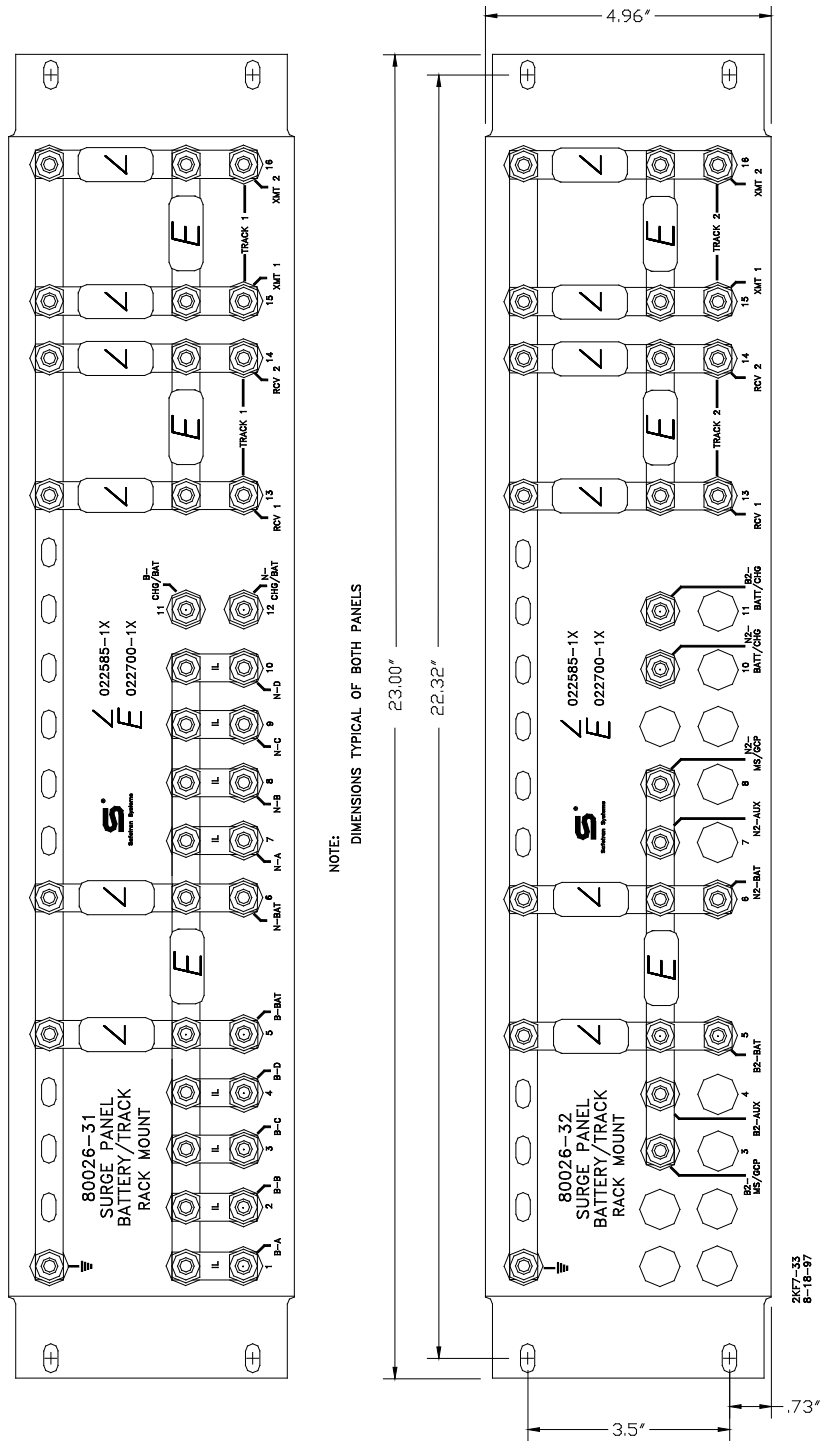


Figure 7-33. Surge Panels, 80026-31 and -32

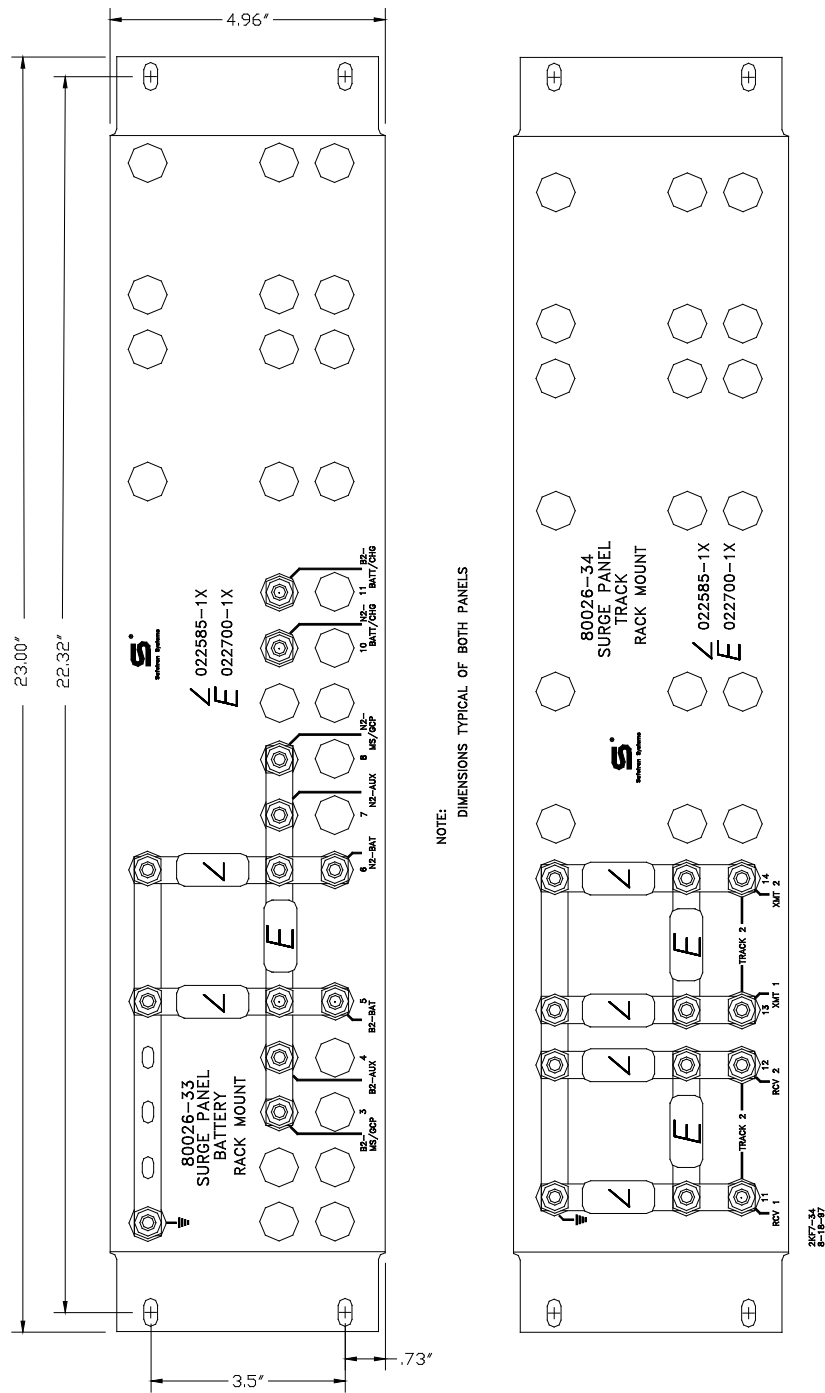


Figure 7-34. Surge Panels, 80026-33 and -34

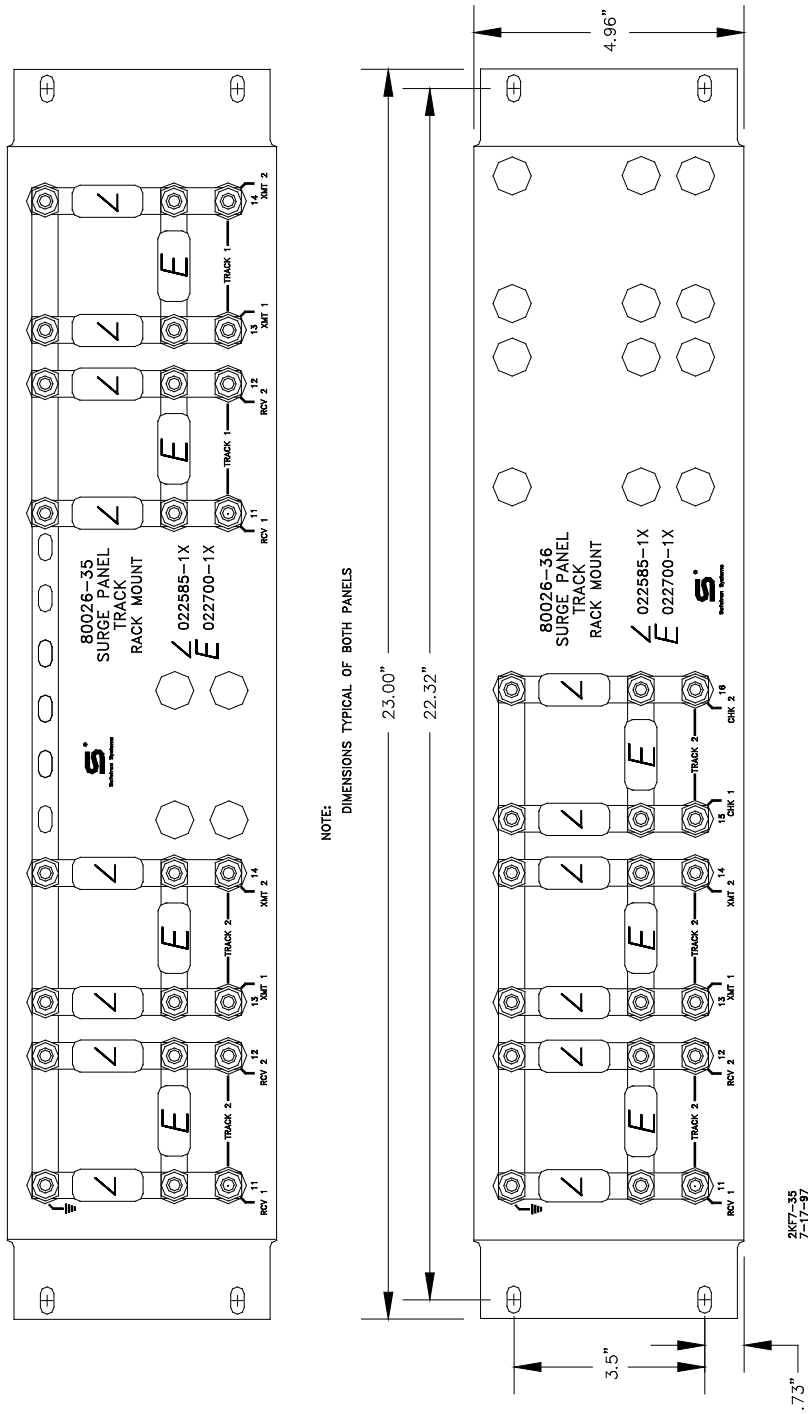


Figure 7-35. Surge Panels, 80026-35 and -36

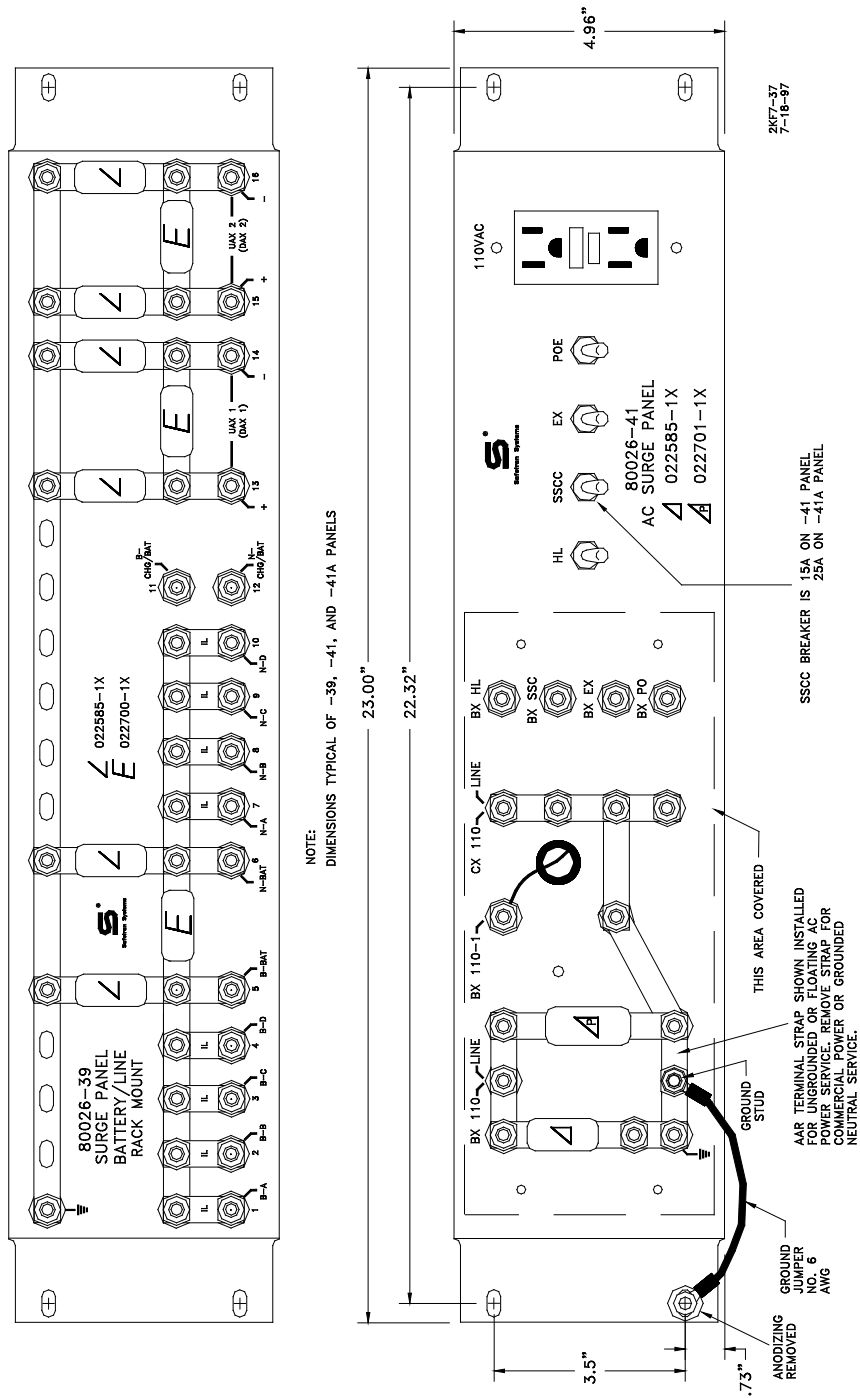


Figure 7-37. Surge Panels, 80026-39, -41, and -41A

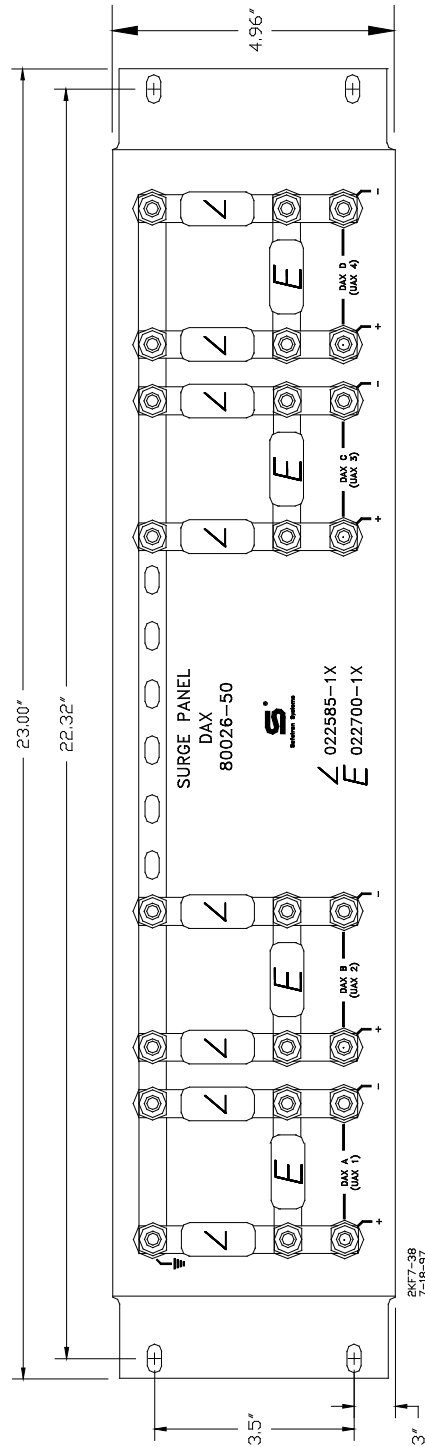


Figure 7-38. Surge Panel, 80026-50

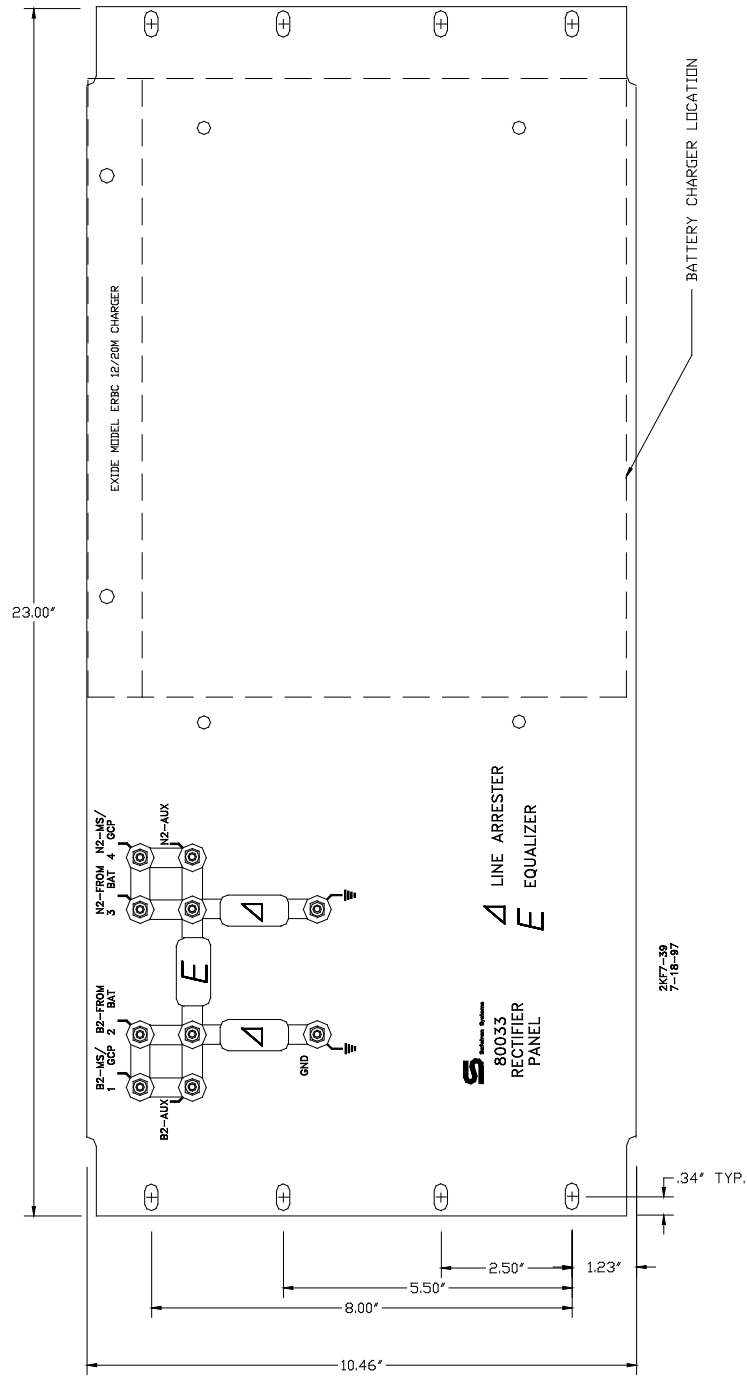


Figure 7-39. Rectifier Panel Assembly, 80033

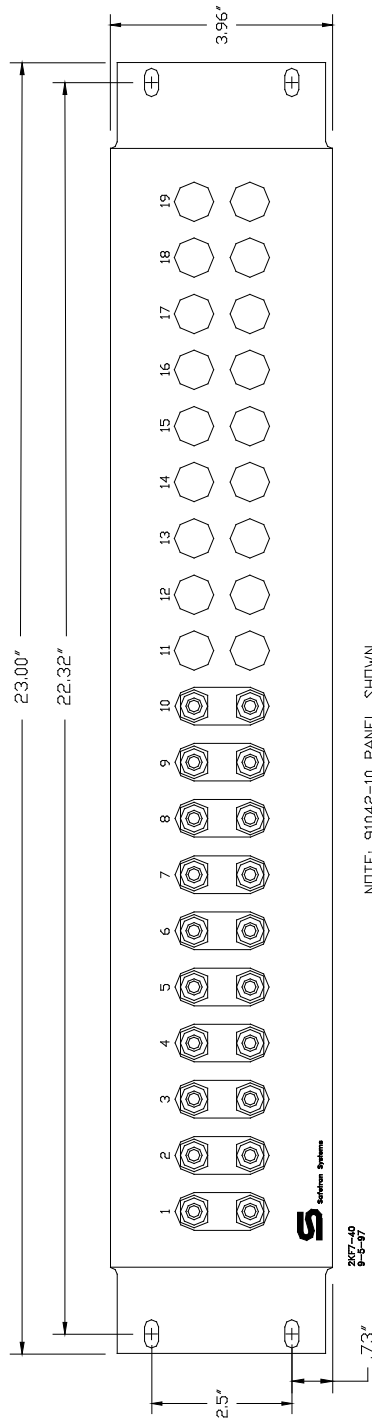


Figure 7-40. Cable Termination Panel Assembly, 91042

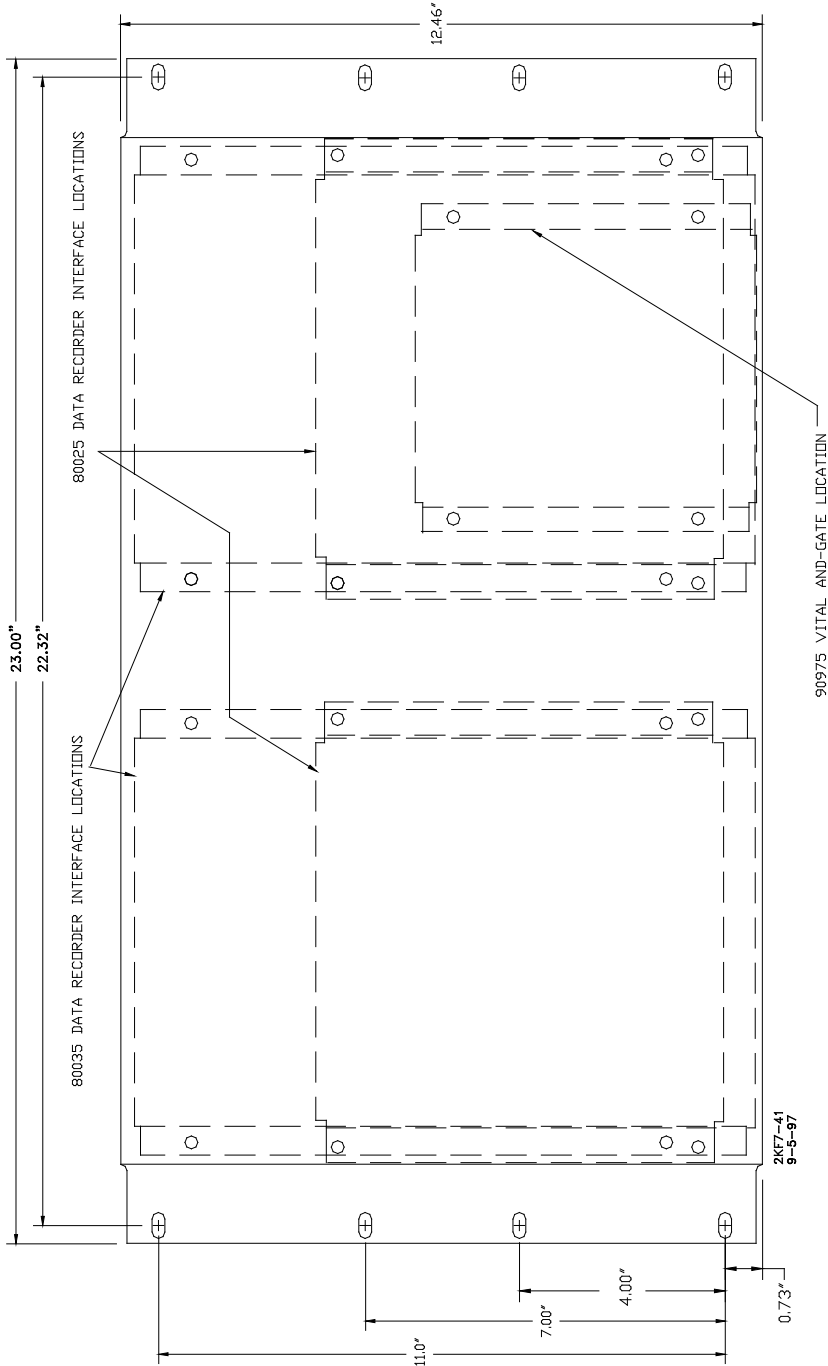


Figure 7-41. Data Recorder Interface and Vital AND-Gate Driver Panel Assembly, 91043

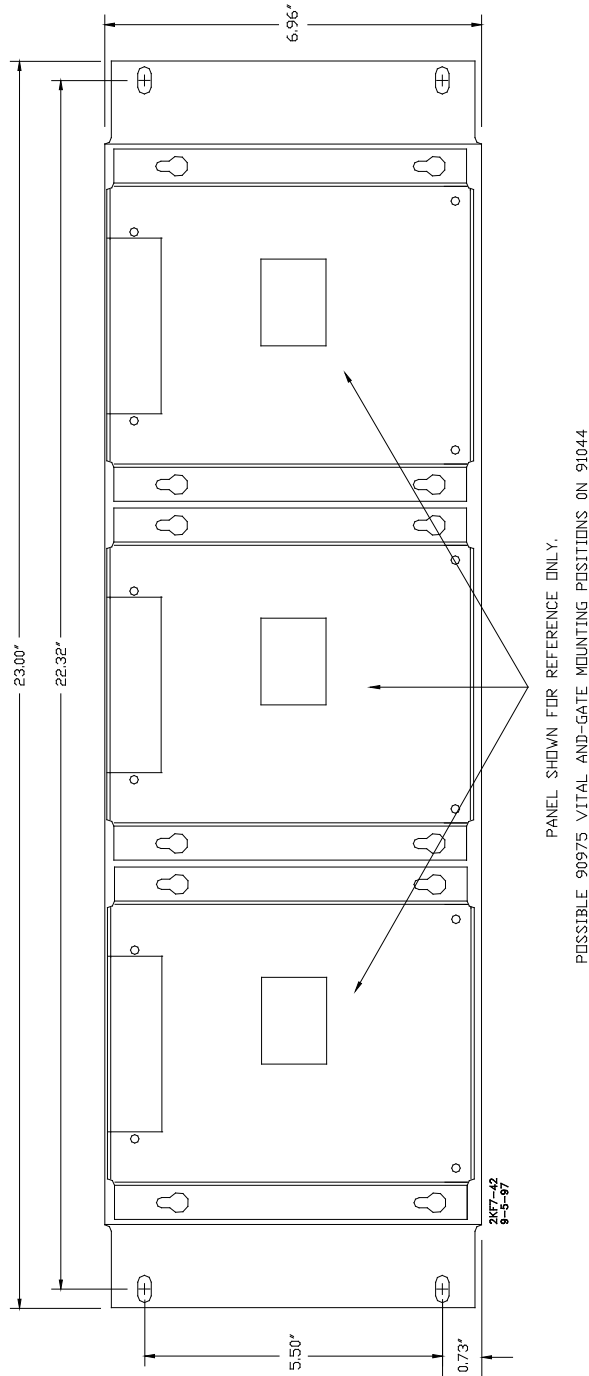


Figure 7-42. Vital AND-Gate Driver Panel Assembly, 91044

7.21 TRACK LEADS

In most installations where a 2000 MS is operating in a single track circuit, four track leads are used to connect the 2000 MS to the track: transmitter leads on one side of the crossing and receiver leads on the other. Transmitter and receiver track lead connections that run from the instrument house to the rails are to be twisted number 6 AWG, or larger if needed. In unidirectional or simulated bidirectional installations, the transmitter leads are to be located adjacent to the insulated joints. Since the transmitter leads should be as short as possible, the leads should be connected to the rails on the same side of the crossing as the instrument housing.

Within the instrument housing, all wires carrying transmit and receive signals are to be number 10 AWG or larger. Leads connecting the transmitter to the rails are not to exceed the maximum lengths specified in Table 7-11. The lengths of the wire runs inside the instrument housing should be as short as possible. Generally, total track lead length should be limited to 500 feet. This includes the length of both the transmitter and receiver pairs. Each pair of wires should be twisted at least two turns per foot. When an island circuit is used, the 2000 MS transmitter pair should be separated to the maximum extent possible from the receiver pair, both below ground and within the instrument housing.

WARNING

WARNING

WHEN REMOTE UNIT OPERATION IS USED, ANY EXTERNAL TRACK CIRCUIT EQUIPMENT OR AUXILIARY TRACK CIRCUIT EQUIPMENT SHALL BE CONNECTED TO THE MS 2000 TRACK WIRES IN ACCORDANCE WITH SECTION 1.4

NOTE

NOTE

When individual track lead lengths exceed the distances specified in Table 7-11, a six-wire application should be considered.

Table 7-11. Maximum Transmit Wire Lengths (Four-Wire Applications)

Standard Safetran MS Frequency (Hz)	Maximum Transmit Lead Length (Feet)
86	100
114	125
156	150
211	200
285-970	250

For six-wire hookups, the minimum recommended wire size is number 6 AWG with a maximum distance of 3,500 feet from the 2000 MS to the remote track wire feed points. Refer to the notes regarding six-wire hookups on Tables 7-12 and 7-13.

NOTE

NOTE
When splicing track connections, welded splices should be used. Use of Kearney connectors should be avoided.

7.22 MINIMUM APPROACH LENGTH VS. FREQUENCY

NOTE

NOTE
The information contained in Paragraph 7.22 below pertains only in cases where there are two track cards located in the same physical box.

The shortest approach distance at which a low-frequency 2000 MS will provide reliable operation is generally a function of the 2000 MS operating frequency plus the gauge and length of the copper transmit wires connected to the rails. When a low-frequency 2000 MS is controlling both a main track and a short siding track as illustrated in Figure 7-44, the shortest permissible approach distance at the installation is indicated in Tables 7-12 and 7-13. The minimum approach distances given are based upon 2000 MS operating frequency versus the transmit wire type and length for bidirectional and unidirectional installations.

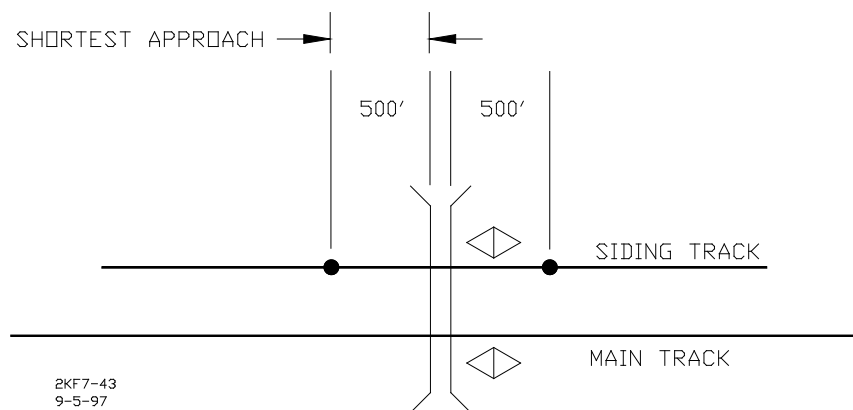


Figure 7-43. Minimum Approach Distances

The length indicated as the shortest approach is equal to 70 percent of the distance shown for a bidirectional installation, with a minimum for both of 400 feet. For example, Tables 7-12 and 7-13 indicate that, for the lower 2000 MS operating frequencies, the shortest approach distance is obtained by using a six-wire connection to the rails. The next shortest distance requires doubling of each transmit wire (two number 6 AWG copper wires in parallel for each transmit wire) or single number 4 AWG copper wires. Refer to the tables to determine the appropriate transmit wire gauge and length for the applicable minimum approach distances.

Table 7-12. Minimum Bidirectional Approach Length vs. Frequency

2000 MS Transmit Frequency (Hz)	Minimum Approach Length (Feet)				
	Transmit Wire Length (No. 6 Copper)				
	Six- Wire Connec- tion*	100 Feet Double (Or 1 No. 4)	100 Feet	150 Feet	200 Feet
86	1000	1000	1350	-----	-----
114	750	800	1150	-----	-----
156	600	700	1000	1150	1350
211	475	600	850	1000	1150
285	400	550	750	850	1000
348	400	500	700	800	850
430	400	500	650	750	750
525	400	500	600	700	700
645	400	500	550	650	650
790	400	500	500	600	600
970	400	500	475	550	550

* When an island frequency is transmitted on the same leads as the 2000 MS operating frequency in a six-wire hookup, maximum transmit wire length is 250 feet.

Table 7-13. Minimum Unidirectional Approach Length vs. Frequency

2000 MS Transmit Frequency (Hz)	Minimum Approach Length (Feet)				
	Transmit Wire Length (No. 6 Copper)				
	Six- Wire Conne- ction*	100 Feet Double (or 1 No. 4)	100 Feet	150 Feet	200 Feet
86	700	700	945	-----	-----
114	525	560	805	-----	-----
156	420	490	700	805	945
211	400	420	595	700	805
285	400	400	525	595	700
348	400	400	490	560	595
430	400	400	455	525	525
525	400	400	420	490	490
645	400	400	400	455	455
790	400	400	400	420	420
970	400	400	400	400	400

* When an island frequency is transmitted on the same leads as the 2000 MS operating frequency in a six-wire hookup, maximum transmit wire length is 250 feet.

Installations containing an approach that does not meet the minimum distance restrictions specified in Tables 7-12 and 7-13 will frequently exhibit a 30-second over-ring condition at the crossing. This is caused by a T1 or T2 gain check error, which is indicated by a 9111 or 9112 error message being generated by the 2000 MS.

SECTION VIII

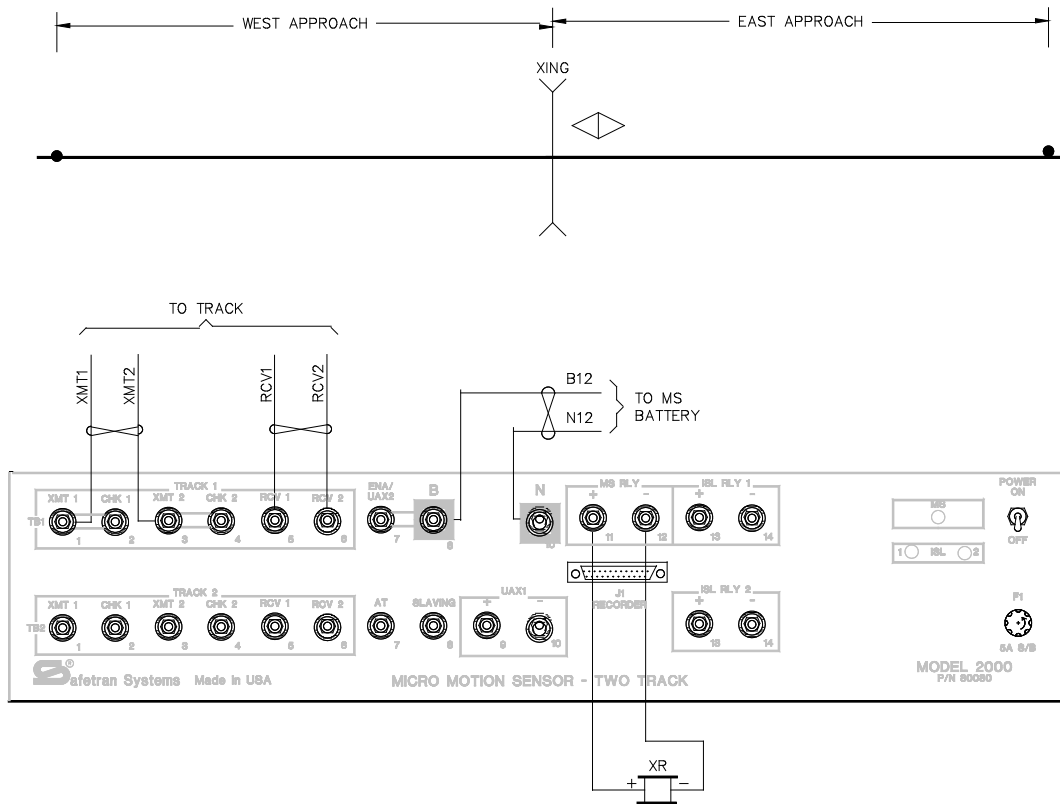
TYPICAL APPLICATION DRAWINGS

8.0 TYPICAL APPLICATION DRAWINGS

The following Figures illustrate a variety of typical 2000 MS applications. Also included are equipment wiring and mounting diagrams.

<u>Figure No.</u>	<u>Title</u>
8-1	Typical 2000 MS Bidirectional Application, One Track
8-2	Typical 2000 MS Bidirectional Application, Two Tracks
8-3	Typical 2000 MS Unidirectional Application, One Track
8-4	Typical 2000MS Track Connections, Unidirectional Application, Two Tracks
8-5	Typical 2000 MS Bidirectional Application, Unidirectional Unit with Remote Feed Point, One Track (Six-Wire)
8-6	Typical 2000 MS Bidirectional Application with External Automatic Transfer, One Track
8-7	Typical 2000 MS Unidirectional Application with Frequency Slaving and Cascaded Relay Drives, Two Tracks
8-8	Proper MS 2000 Four-wire and Six-wire Connections Using Auxiliary Track Circuit Equipment on MS 2000 Operating in the Bidirectional Simulation Mode
8-9	Recommended Surge Suppression Wiring for 2000 MS
8-10	Models 2000/2000S2 MS Mounting Dimensions
8-11	DC Shunting Enhancer Panel, 80049, Typical Application with Overlapping Track Circuits

TYPICAL APPLICATION DRAWINGS



NOTES

1. ALL WIRING #16 AWG MINIMUM UNLESS OTHERWISE NOTED. WIRE SIZES SHOWN ARE MINIMUM GAUGE.
2. TERMINATION SHUNTS MAY BE HARDWIRE, WIDEBAND, OR NARROW-BAND, DEPENDING UPON TYPE OF TRACK CIRCUIT IN USE.
3. SEE SHEET 2 FOR MS-TO-TRACK WIRING.
4. SEE FIGURE 8-9 FOR MS BATTERY CONNECTIONS AND CHARGING CIRCUIT.
5. EACH APPROACH DISTANCE TO BE MEASURED FROM THE TRACK WIRE CONNECTION (ON THE SIDE OF THE STREET CLOSEST TO THE SHUNT) TO THE SHUNT WIRE CONNECTIONS.

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WARNING

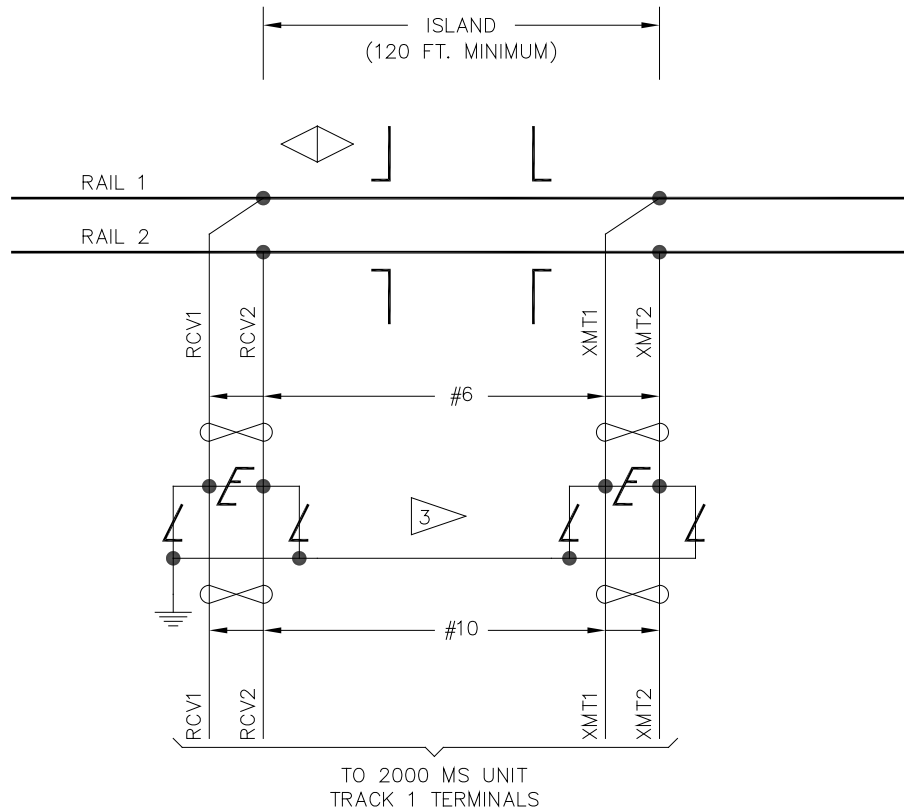
APPROACH DISTANCES MUST PROVIDE A MINIMUM OPERATING TIME PLUS 4 SECONDS SYSTEM RESPONSE TIME FOR MAXIMUM TRAIN SPEED.

NEVER WIRE WRAP AROUND RELAY FRONT CONTACTS BETWEEN MS RLY (+) TB1-11 AND ENA/UAX2 (+) TB1-7.

LEGEND

- = TWIST TWO TURNS PER FOOT
- = BIDIRECTIONAL MS UNIT
- = TERMINATION SHUNT

Figure 8-1. Typical 2000 MS Bidirectional Application, One Track (Sheet 1 of 2)



NOTES

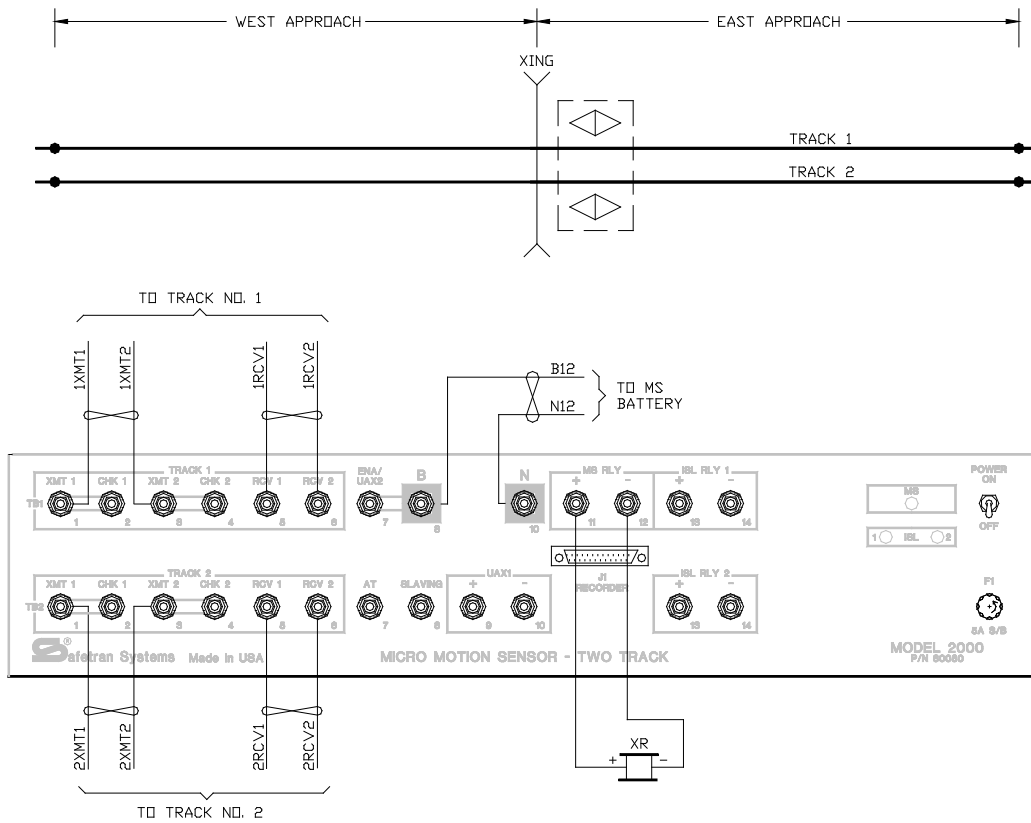
1. ALL WIRING #16 AWG MINIMUM UNLESS OTHERWISE NOTED. WIRE SIZES SHOWN ARE MINIMUM GAUGE.
2. SEE PARAGRAPH 7.21 FOR DETAILED MS-TO-TRACK WIRING INFORMATION.
3. ARRESTERS AND EQUALIZERS MOUNTED ON SURGE PANELS (80026-XX). SEE PARAGRAPH 7.19 FOR DETAILS.

LEGEND

- ∞ = TWIST TWO TURNS PER FOOT
- E = 022700-1X EQUALIZER, H.D.
- L = 022585-1X ARRESTER, H.D.
- ◇ = BIDIRECTIONAL 2000 MS UNIT

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Figure 8-1. Typical 2000 MS Bidirectional Application, One Track (Sheet 2 of 2)



NOTES

1. ALL WIRING #16 AWG MINIMUM UNLESS OTHERWISE NOTED. WIRE SIZES SHOWN ARE MINIMUM GAUGE.
2. TERMINATION SHUNTS MAY BE HARDWIRE, WIDEBAND, OR NARROW-BAND, DEPENDING UPON TYPE OF TRACK CIRCUIT IN USE.
3. SEE SHEET 2 FOR MS-TO-TRACK WIRING.
4. SEE FIGURE 8-9 FOR MS BATTERY CONNECTIONS AND CHARGING CIRCUIT.
5. EACH APPROACH DISTANCE TO BE MEASURED FROM THE TRACK WIRE CONNECTION (ON THE SIDE OF THE STREET CLOSEST TO THE SHUNT) TO THE SHUNT WIRE CONNECTIONS.

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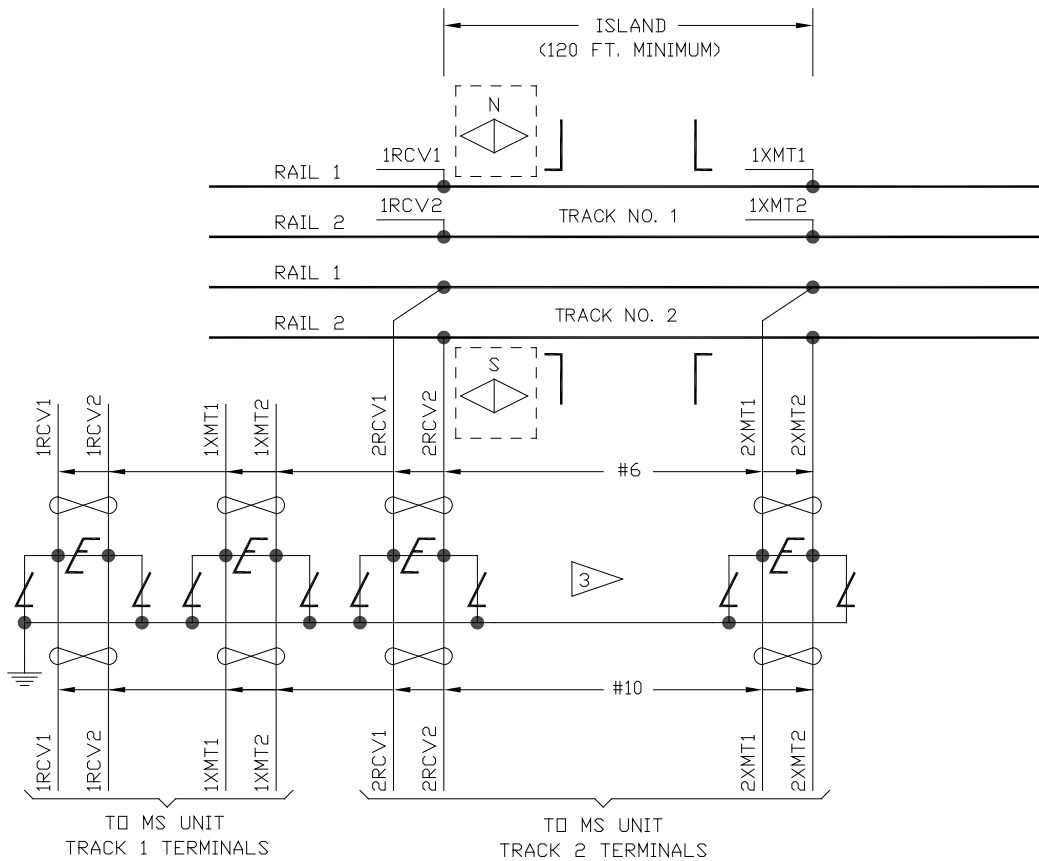
WARNING

APPROACH DISTANCES MUST PROVIDE A MINIMUM OPERATING TIME PLUS 4 SECONDS SYSTEM RESPONSE TIME FOR MAXIMUM TRAIN SPEED.
NEVER WIRE WRAP AROUND RELAY FRONT CONTACTS BETWEEN MS RLY (+) TB1-11 AND ENA/UAUX2 (+) TB1-7.

LEGEND

- = TWIST TWO TURNS PER FOOT
- = BIDIRECTIONAL MS UNIT
- = TERMINATION SHUNT





Figure 8-2. Typical 2000 MS Bidirectional Application, Two Tracks (Sheet 1 of 2)



NOTES

1. ALL WIRING #16 AWG MINIMUM UNLESS OTHERWISE NOTED. WIRE SIZES SHOWN ARE MINIMUM GAUGE.
2. SEE PARAGRAPH 7.21 FOR MS-TO-TRACK WIRING INFORMATION.
3. ARRESTERS AND EQUALIZERS MOUNTED ON SURGE PANELS (80026-XX). SEE PARAGRAPH 7.19 FOR DETAILS.

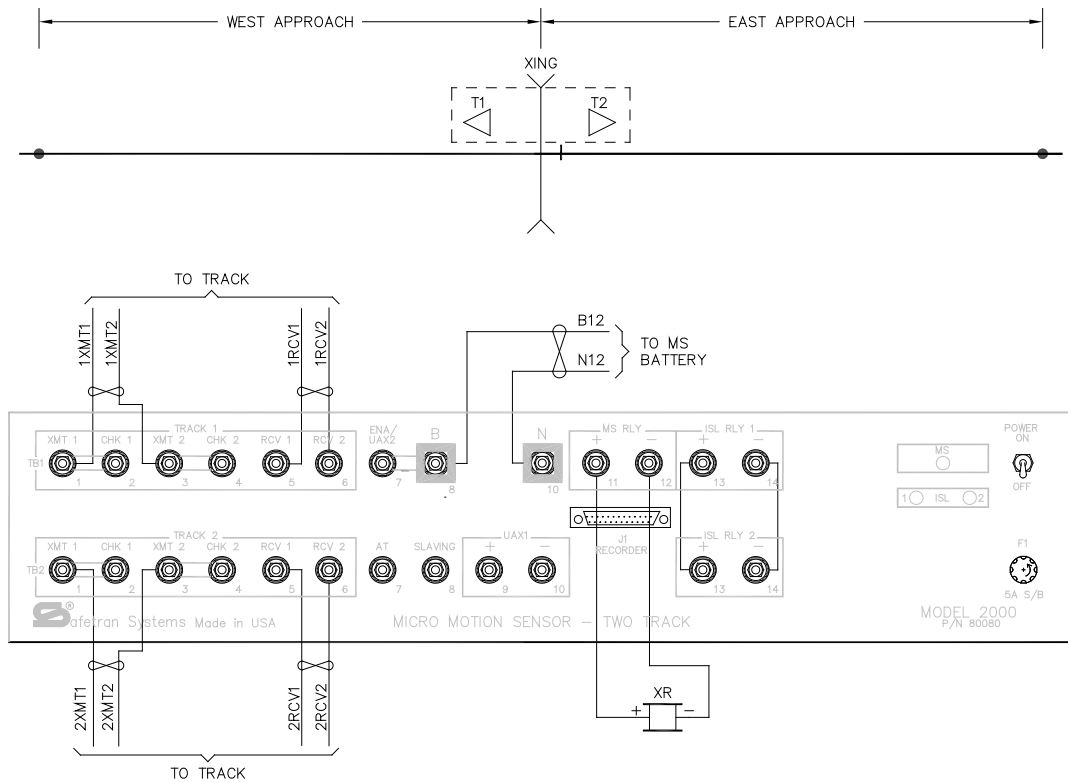
LEGEND

-  = TWIST TWO TURNS PER FOOT
-  = 022700-1X EQUALIZER, H.D.
-  = 022585-1X ARRESTER, H.D.
-  = BIDIRECTIONAL MS UNIT

2KF8-2B
8-20-97

Figure 8-2. Typical 2000 MS Bidirectional Application, Two Tracks (Sheet 2 of 2)

TYPICAL APPLICATION DRAWINGS



NOTES

1. ALL WIRING #16 AWG MINIMUM UNLESS OTHERWISE NOTED. WIRE SIZES SHOWN ARE MINIMUM GAUGE.
2. TERMINATION SHUNTS MAY BE HARDWIRE, WIDEBAND, OR NARROW-BAND, DEPENDING UPON TYPE OF TRACK CIRCUIT IN USE.
3. SEE SHEET 2 FOR MS-TO-TRACK WIRING.
4. SEE FIGURE 8-9 FOR MS BATTERY CONNECTIONS AND CHARGING CIRCUIT.
5. EACH APPROACH DISTANCE TO BE MEASURED FROM THE TRACK WIRE CONNECTION (ON THE SIDE OF THE STREET CLOSEST TO THE SHUNT) TO THE SHUNT WIRE CONNECTIONS.

2KF8-3A
9-5-97

WARNING

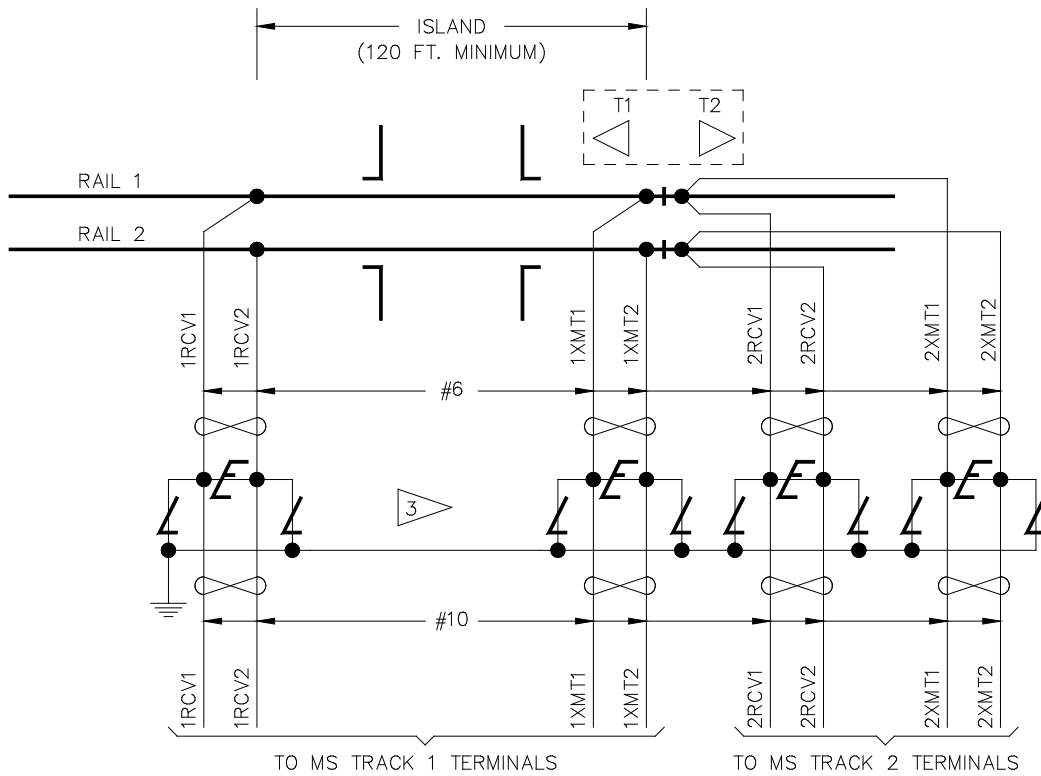
APPROACH DISTANCES MUST PROVIDE A MINIMUM OPERATING TIME PLUS 4 SECONDS SYSTEM RESPONSE TIME FOR MAXIMUM TRAIN SPEED.

NEVER WIRE WRAP AROUND RELAY FRONT CONTACTS BETWEEN MS RLY (+) TB1-11 AND ENA/UAX2 (+) TB1-7.

LEGEND

- = TWIST TWO TURNS PER FOOT
- = UNIDIRECTIONAL MS UNIT
- = TERMINATION SHUNT
- = 2 UNITS - 1 BOX

Figure 8-3. Typical 2000 MS Unidirectional Application, One Track (Sheet 1 of 2)



NOTES

1. ALL WIRING #16 AWG MINIMUM UNLESS OTHERWISE NOTED. WIRE SIZES SHOWN ARE MINIMUM GAUGE.
2. SEE PARAGRAPH 7.21 FOR MS-TO-TRACK WIRING INFORMATION.
3. ARRESTERS AND EQUALIZERS MOUNTED ON SURGE PANELS (80026-XX). SEE PARAGRAPH 7.19 FOR DETAILS.

LEGEND

- = TWIST TWO TURNS PER FOOT
- = 022700-1X EQUALIZER, H.D.
- = 022585-1X ARRESTER, H.D.
- OR = UNIDIRECTIONAL MS UNIT

2KF8-3B
8-20-97

Figure 8-3. Typical 2000 MS Unidirectional Application, One Track (Sheet 2 of 2)

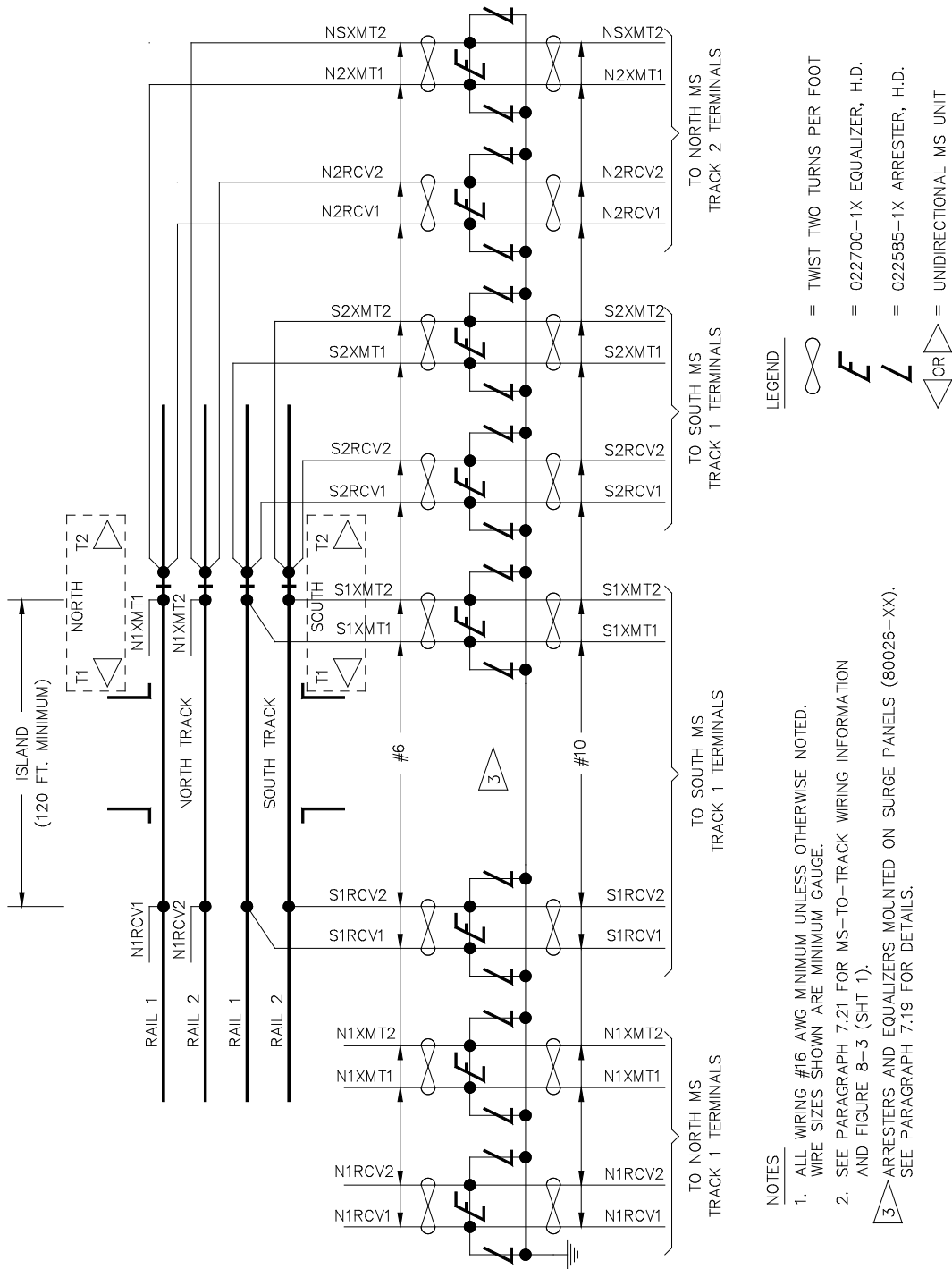
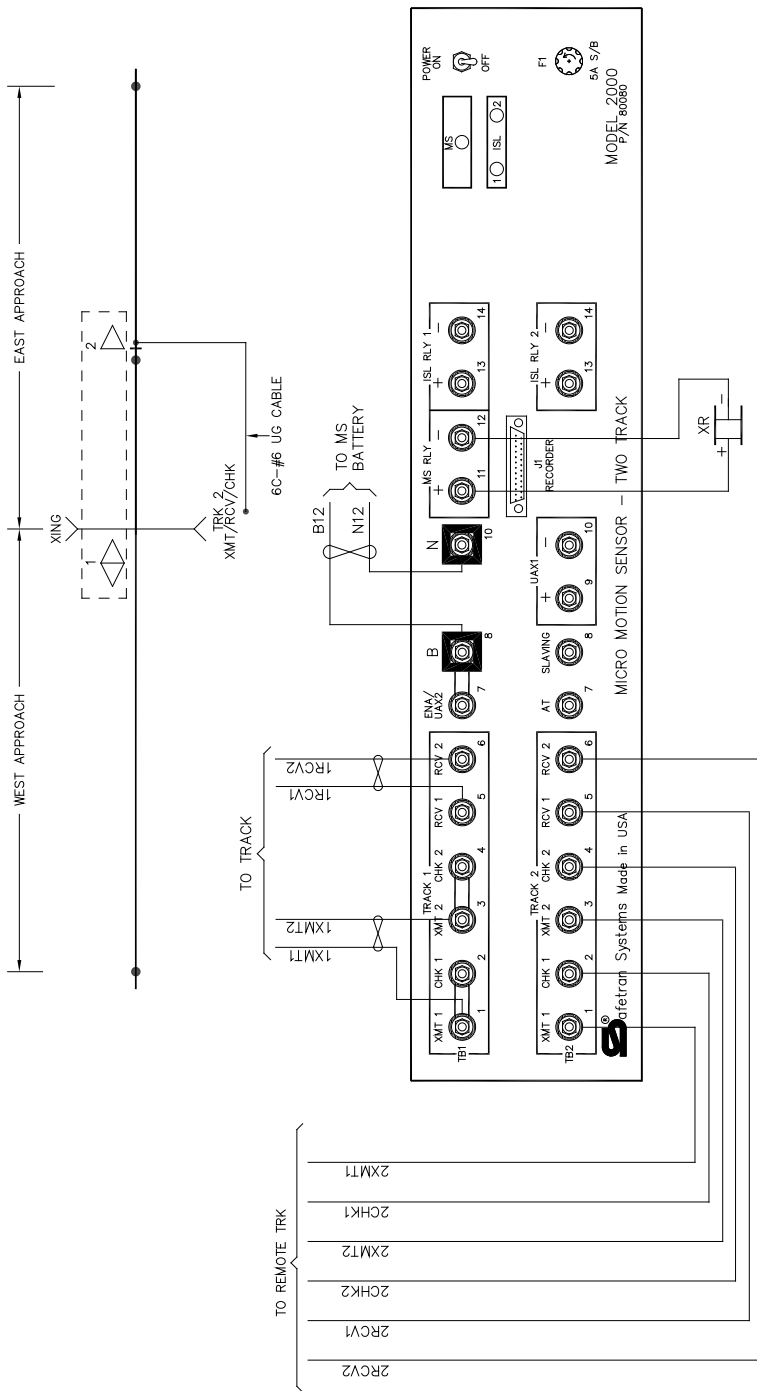


Figure 8-4. Typical 2000 MS Track Connections, Unidirectional Application, Two Tracks



LEGEND

- = TWIST TWO TURNS PER FOOT
- = BIDIRECTIONAL MS UNIT
- = UNIDIRECTIONAL MS UNIT
- = TERMINATION SHUNT
- Mf = MOTION FREQUENCY

WARNING

WHEN MS 2000S ARE APPLIED USING A SIX WIRE CONNECTION, CHECK WIRES FROM MS TO AUXILIARY EQUIPMENT MUST BE CONNECTED ACROSS EITHER THE CHK OR RCV TERMINALS. DO NOT CONNECT EXTERNAL EQUIPMENT ACROSS THE XMT TERMINALS!

2K78-5A
8-23-97

- NOTES**
1. ALL WIRING #16 AWG MINIMUM UNLESS OTHERWISE NOTED. WIRE SIZES SHOWN ARE MINIMUM GAUGE.
 2. TERMINATION SHUNTS MAY BE HARDWIRE, WIDEBAND, OR NARROW-BAND, DEPENDING UPON TYPE OF TRACK CIRCUIT IN USE.
 3. SEE SHEET 2 FOR MS-TO-TRACK WIRING.
 4. SEE FIGURE 8-9 FOR MS BATTERY CONNECTIONS AND CHARGING CIRCUIT.
 5. OFFSET DISTANCES TO BE MEASURED FROM INSULATED JOINTS TO THE APPROACH SIDE OF STREET

Figure 8-5. Typical 2000 MS Bidirectional Application, Unidirectional Unit with Remote Feed Point, One Track (Six-Wire) (Sheet 1 of 2)

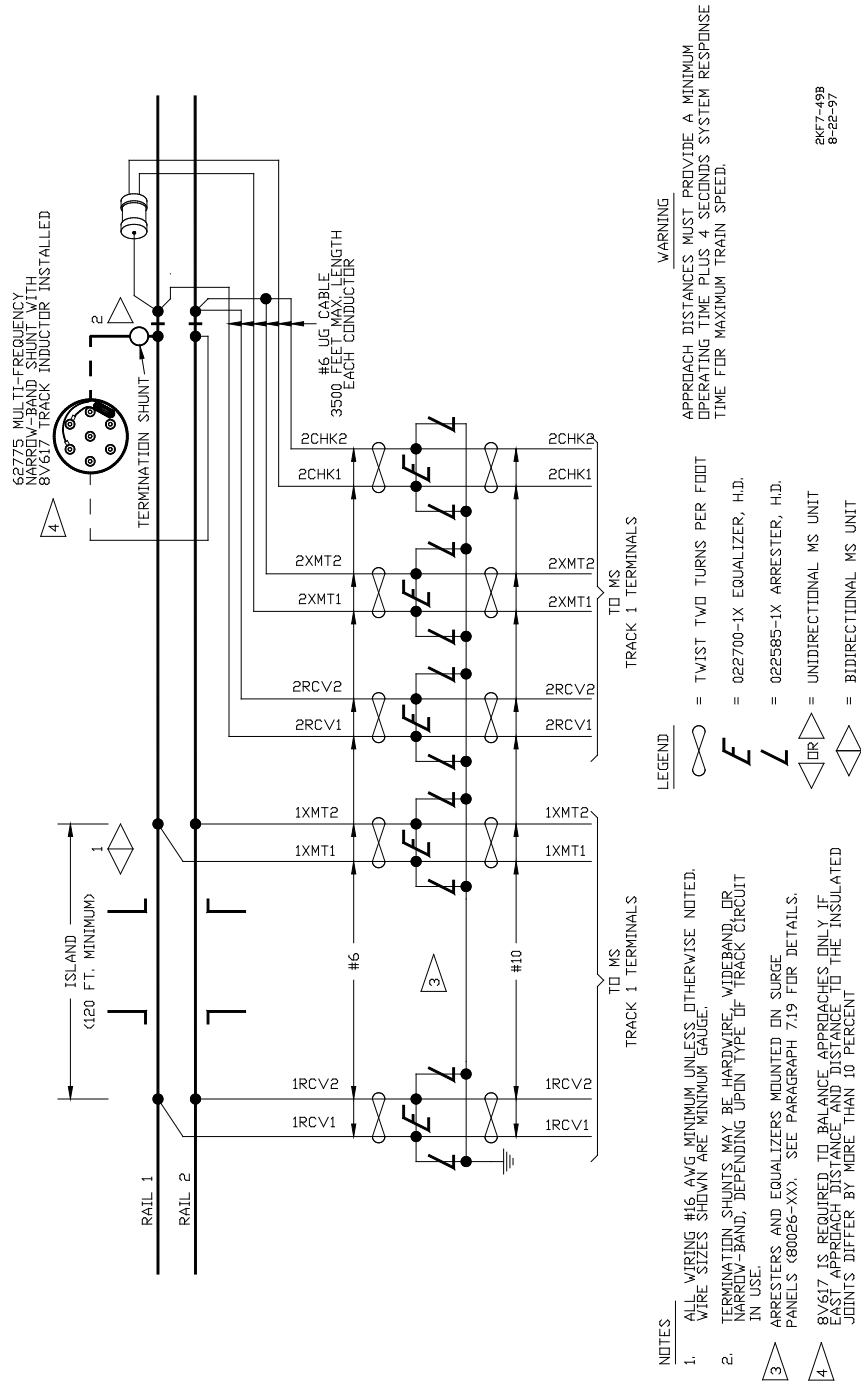


Figure 8-5. Typical 2000 MS Bidirectional Application, Unidirectional Unit with Remote Feed Point, One Track (Six-Wire) (Sheet 2 of 2)

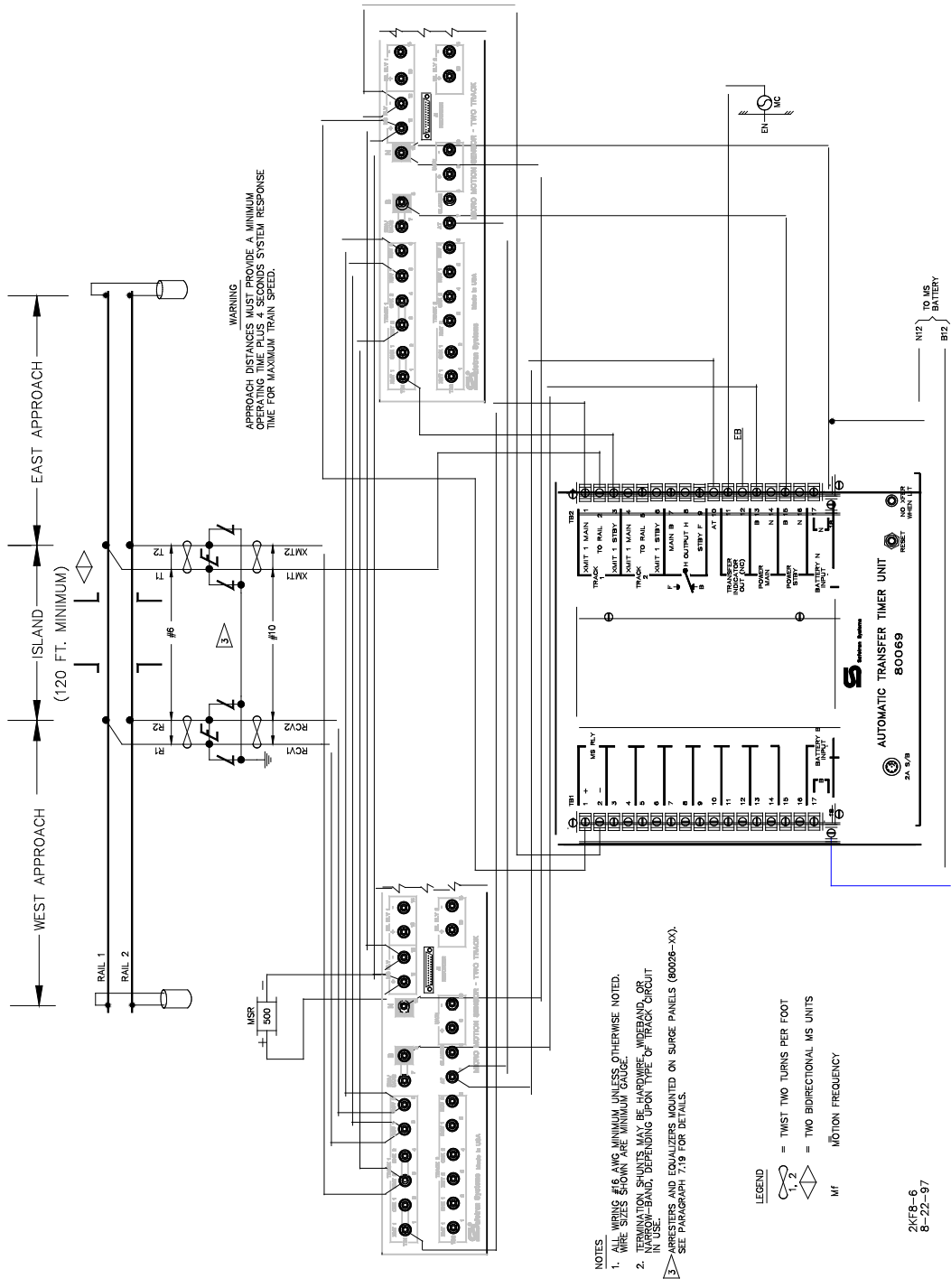


Figure 8-6. Typical 2000 MS Bidirectional Application with External Automatic Transfer, One Track

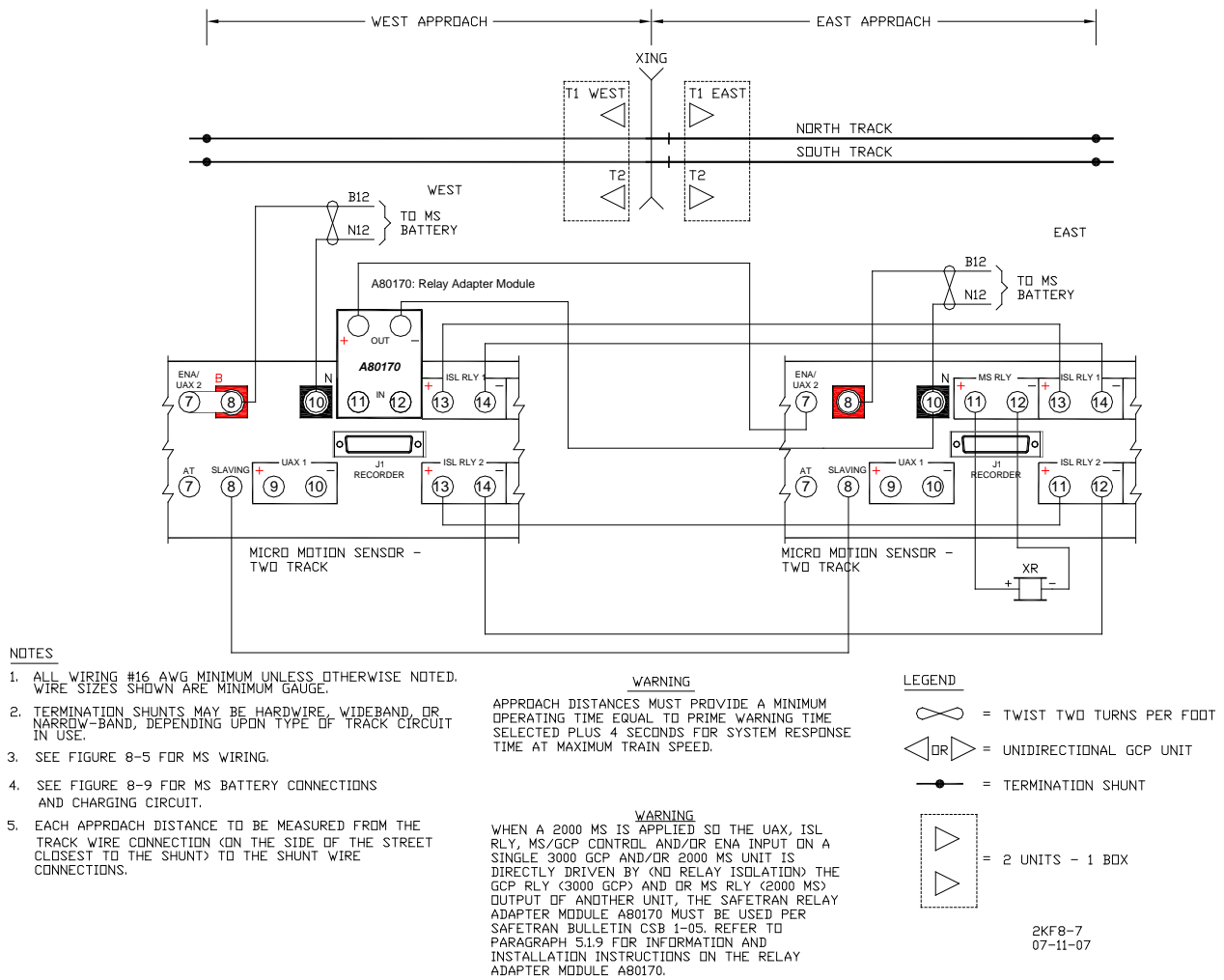


Figure 8-7. Typical 2000 MS Unidirectional Application with Frequency Slaving and Cascaded Relay Drives, Two Tracks

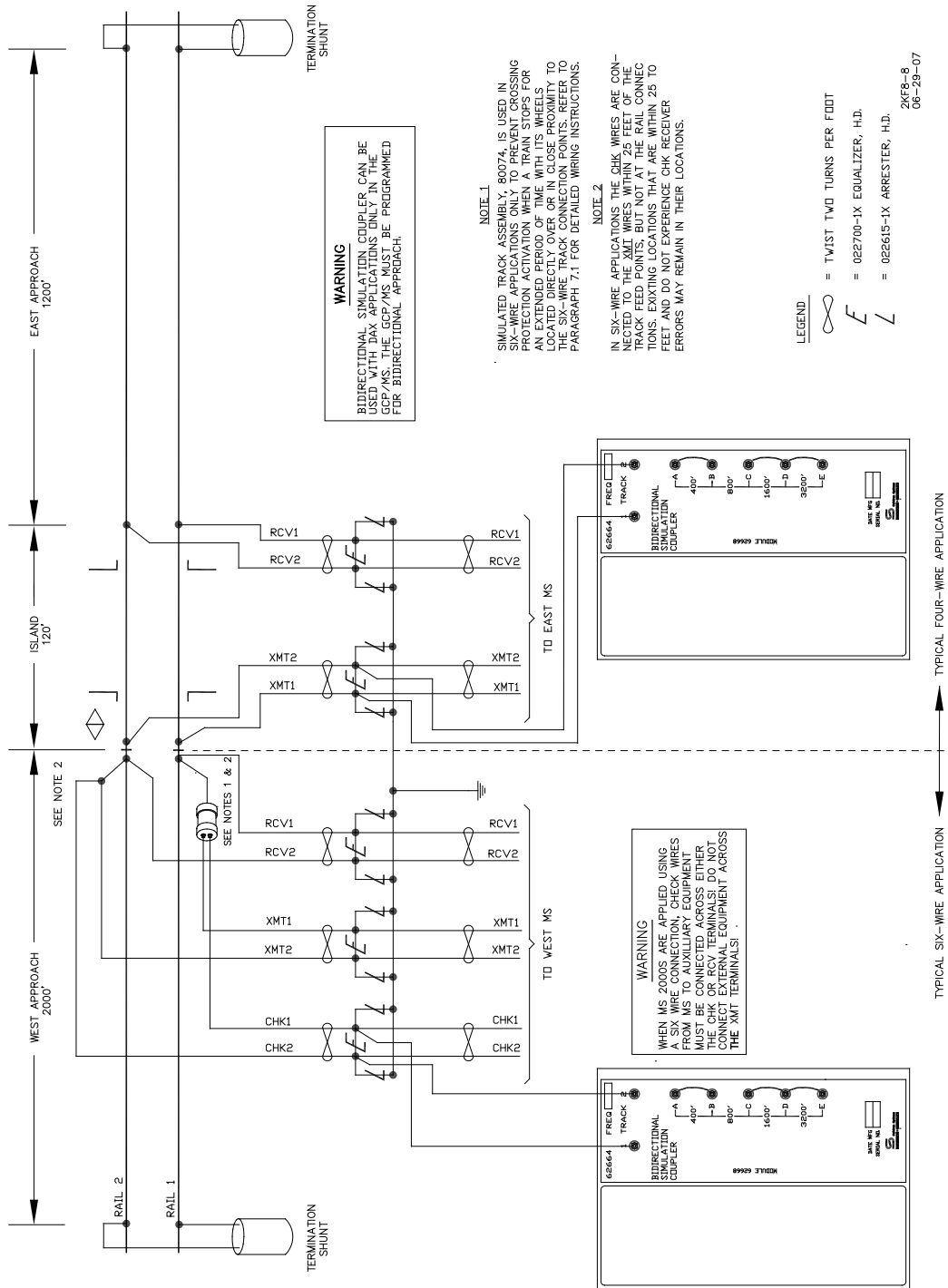
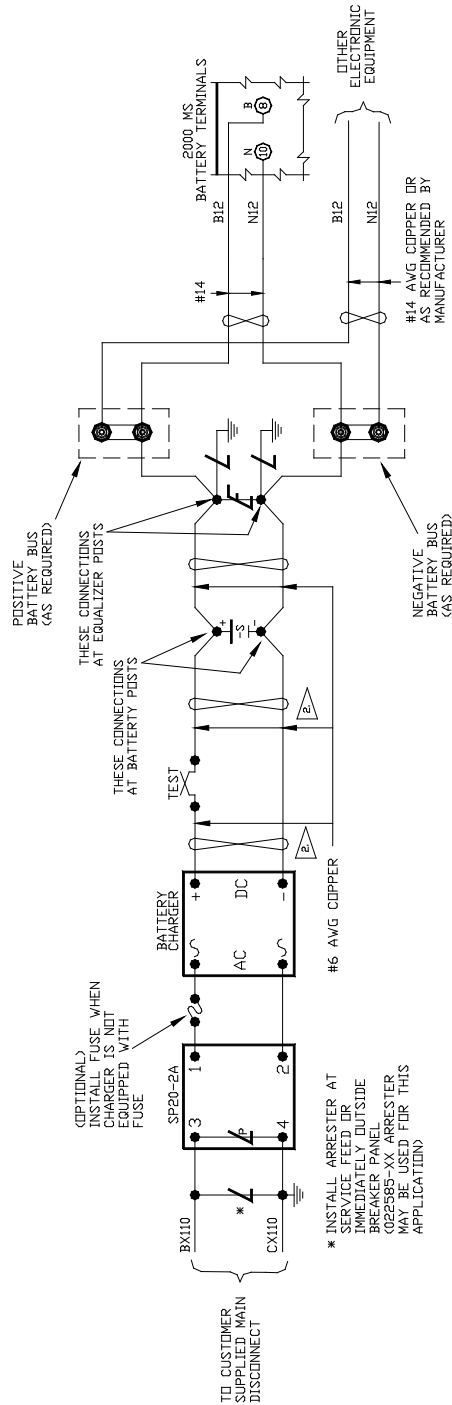


Figure 8-8. Proper MS 2000 Four-wire and Six-wire Connections Using Auxiliary Track Circuit Equipment on MS 2000 Operating in the Bidirectional Simulation Mode



RECOMMENDED INSTALLATION AND WIRING OF SURGE PROTECTION UNITS FOR A BATTERY CHARGING CIRCUIT USING THE LOW IMPEDANCE OF THE BATTERY FOR SURGE SUPPRESSION.

- LEGEND
- = TWIST TWO TURNS PER FOOT
 - = 022700-1X EQUALIZER, H.D.
 - = 022701-1X ARRESTER, AC POWER LINE
 - = 022585-1X ARRESTER, H.D.

NOTES

1. WIRE SIZES SHOWN ARE MINIMUM GAUGE.
2. TWISTED WHEN LENGTH IS 10 FEET OR OVER, OR CHARGING WIRES CANNOT BE SEPARATED FROM LOAD WIRING BY 1 INCH OR MORE.

8KFB-9
8-22-97

Figure 8-9. Recommended Surge Suppression Wiring for 2000 MS

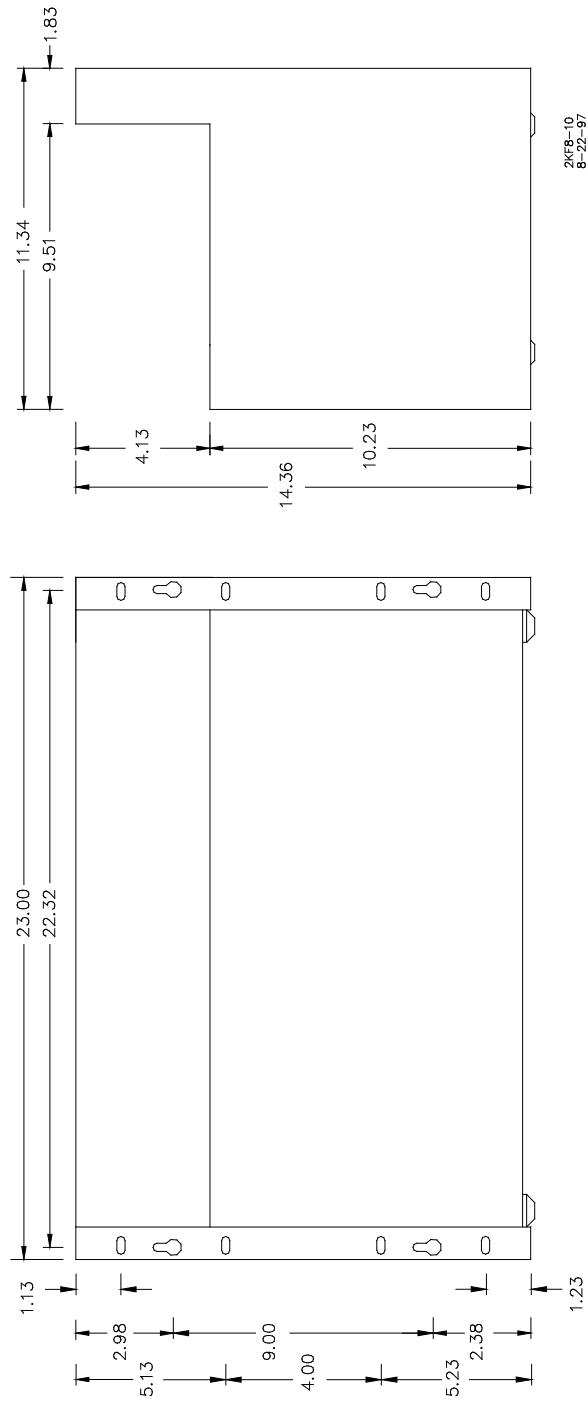


Figure 8-10. Models 2000/2000S2 Mounting Dimensions

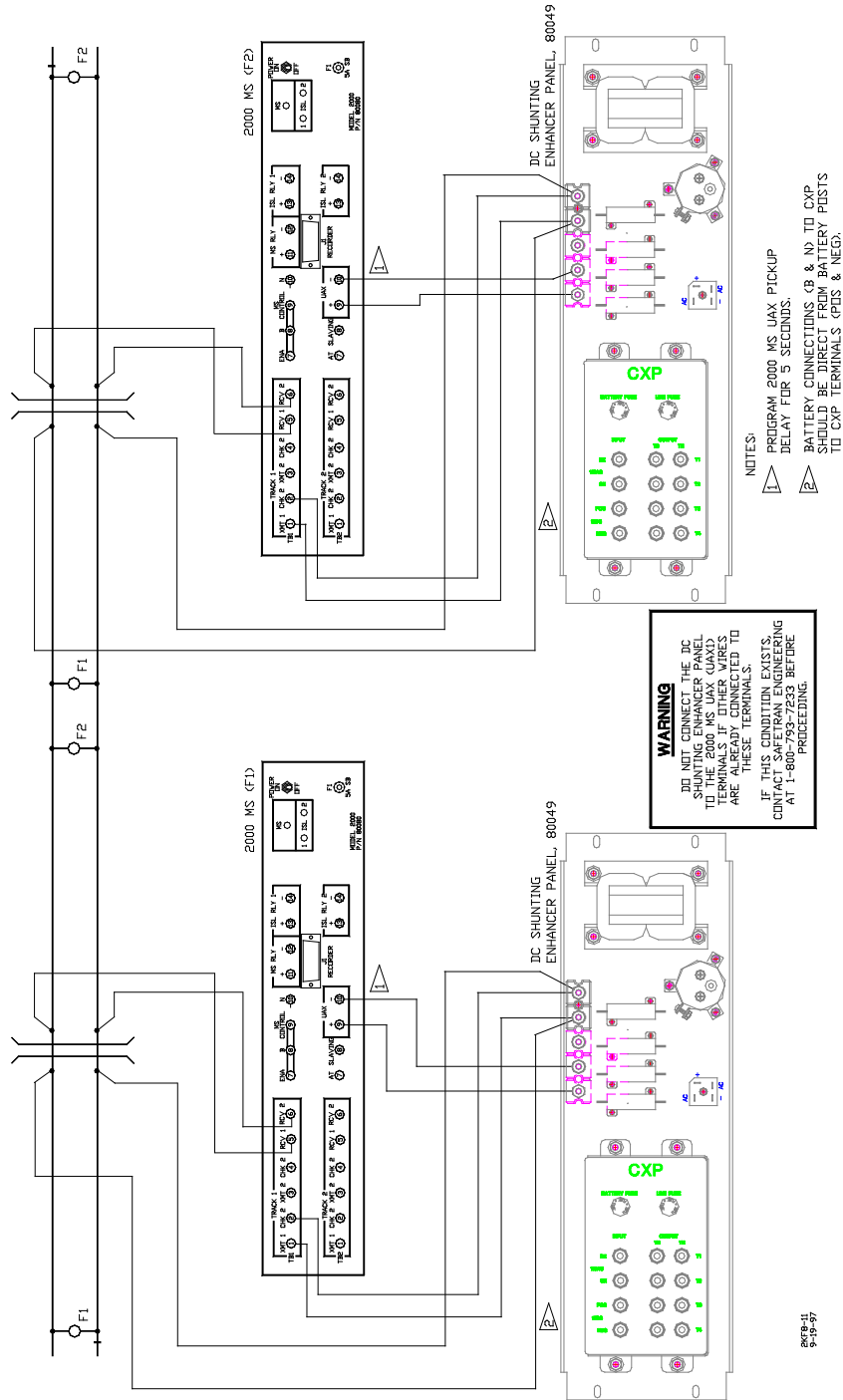
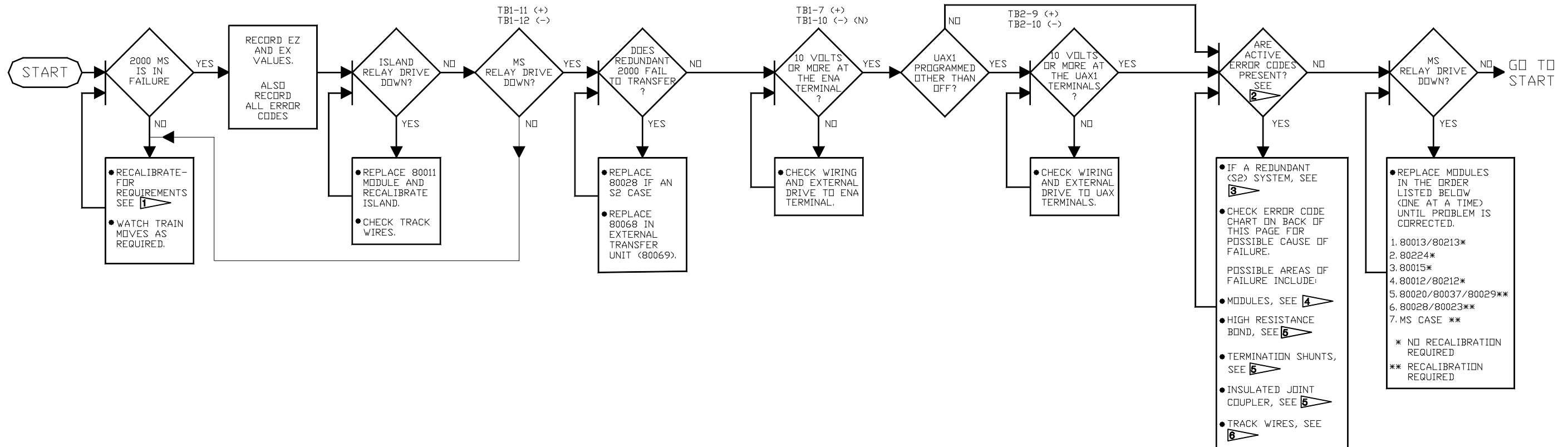


Figure 8-11. DC Shunting Enhancer Panel, 80049, Typical Application with Overlapping Track Circuits



1

See Recalibration/Reprogramming Requirement Charts on the back of this page.

2

To determine if there are current active error codes, proceed as follows:

1. Press and hold SYSTEM RESET key for approximately 3 seconds until the following message is displayed.

PRESS ENTER TO CLEAR ERRORS

2. Press the ENTER key.

Note:

Any error codes that remain after the above steps are performed are active and current. Look up the error code number(s) in the Error Code Chart on the back of this page to determine possible cause.

3

If a redundant (S2) system, then switch to the standby unit and see if the identical failure is present. If it is, the problem is generally track related.

4

See Error Code Chart on the back of this page.

5

High resistance bonds, insulated joint couplers/track connections, or termination shunts/track connections can produce the following error codes:

Error Code	Text Displayed	Track Affected
9015	T1 HIGH EZ	T1
9016	T2 HIGH EZ	T2

6

Possible increased track wire resistance or track connections can produce the following error codes:

Error Code	Text Displayed	Track Affected
8113	T1 XMIT CURRENT	T1
8117	T2 XMIT CURRENT	T2
9111	T1 GAIN CHECK	T1
9112	T2 GAIN CHECK	T2
9021	T1 CHECK CHANNEL	T1
9022	T2 CHECK CHANNEL	T2

2000 MS TROUBLESHOOTING CHART

Recalibration/Reprogramming Requirements Due to Module Replacement

	Module/Assembly Replacement Requiring Recalibration	Setup For Calibration Required	Island Adjustment Required	Set To Default and Reprogramming Required
80011	Island	No	Yes (For track associated with 80011 only)	No
80012	Transceiver	Yes (For track associated with 80012 only)	No	No
80013	Relay Drive	No	No	No
80224	Processor	No	No	No
80224	Processor (With new software level)*	Yes (Both tracks)	No	Yes (Both tracks)
80015/ 80115	Data Recorder	No	No	No
80020, 80029	Control Inter-face Assembly*	Yes (Both tracks)	No	Yes (Both tracks)
80028, 80068	Switch Over	Yes (Both tracks)	Yes (Both tracks)	No

*When a new software level is added or the control interface assembly is replaced, first set the system to the default parameters and then perform complete reprogramming and recalibration.

Recalibration/Reprogramming Requirements Due to Programming Changes

Programming Changes Requiring Recalibration	Setup For Calibration Required
Increased Number of Tracks From 1 to 2	Yes (For track 2 only)
MS Frequency Changed	Yes (Only for the track that was changed)
Application Changed From: Unidirectional to Bidirectional or Bidirectional to Unidirectional	Yes (Only for the track that was changed)
Transmit Level Changed From: Medium to Maximum or Maximum to Medium	Yes (Only for the track that was changed)
Ballast Compensation Value Changed	Yes (Only for the track that was changed)

Recalibration/Reprogramming Requirements Due to Track Equipment Changes

Track Equipment Changes Requiring Recalibration	Setup For Calibration Required	Island Adjustment Required
Termination Shunts Changed or Moved to New Location	Yes	No
Termination Shunts of Other Frequencies Added, Removed From, or Moved Within 2000 MS Approach(es)	Yes	No
Wideband Insulated Joint Couplers (8A076 or 8A077) Replaced in 2000 MS Approach(es)	Yes	No
Tuned Insulated Joint Couplers (62785-f) Replaced in 2000 MS Approach(es)	Yes	No
2000 MS Track Wire(s) Replaced	Yes	Yes

DIAGNOSTIC MESSAGE CODE CHART

Code	Text Displayed	Description	Possible Cause
1100	ROM	ROM Checksum Error	80224 Processor Module
1200	RAM	RAM Read/Write Error	80224 Processor Module
1300	NOVRAM	NOVRAM Checksum Error	80020/80029 Keyboard/Display Interface Module
1400	ROM	ROM Checksum Error (System Reset)	80224 Processor Module
1500	RAM	RAM Read/Write Error (System Reset)	80224 Processor Module
1600	NOVRAM	NOVRAM Checksum Error (System Reset)	80020/80029 Keyboard/Display Interface Module
4000	ENA INPUT	ENA Input Error	80013 Relay Drive Module
4001	UAX INPUT	UAX Input Error	80013 Relay Drive Module
4002	T1 ISLAND INPUT	Island Relay Drive 1 Input Error	80013 Relay Drive Module
4003	T2 ISLAND INPUT	Island Relay Drive 2 Input Error	80013 Relay Drive Module
4102	MS OUTPUT	MS Relay Drive Output Error	80013 Relay Drive Module
4105	AT OUTPUT	Approach Track Output Error	80013 Relay Drive Module
5001	DATA RECORDER	Data Recorder Not Responding	80015 Data Recorder Module
5002	DATA RECORDER	Incorrect Data Transmission	80015 Data Recorder Module
5003	RECORDER ROM	Recorder ROM Checksum Error	80015 Data Recorder Module
5004	RECORDER RAM	Recorder RAM Checksum Error	80015 Data Recorder Module
8001	-5 VOLT SUPPLY	- 5 Volt Power Out of Range	80013 Relay Drive Module
8002	+5 VOLT SUPPLY	+5 Volt Power Out of Range	80013 Relay Drive Module
8003	T1 -8V SUPPLY	Track 1 -8 Volt Power Out of Range	80012 Transceiver Module (left)
8004	T1 +8V SUPPLY	Track 1 +8 Volt Power Out of Range	80012 Transceiver Module (left)
8005	T2 -8V SUPPLY	Track 2 -8 Volt Power Out of Range	80012 Transceiver Module (right)
8006	T2 +8V SUPPLY	Track 2 +8 Volt Power Out of Range	80012 Transceiver Module (right)
8007	-15 VOLT SUPPLY	-15 Volt Power Supply Out of Range	80013 Relay Drive Module
8008	+15 VOLT SUPPLY	+15 Volt Power Supply Out of Range	80013 Relay Drive Module
8113	T1 XMIT CURRENT	Track 1 Transmit Current Low	80012 Transceiver Module (left), transmit track wires
8114	T1 XMIT CURRENT	Track 1 Transmit Current High	80012 Transceiver Module (left)
8117	T2 XMIT CURRENT	Track 2 Transmit Current Low	80012 Transceiver Module (right), transmit track wires
8118	T2 XMIT CURRENT	Track 2 Transmit Current High	80012 Transceiver Module (right)
8200	FREQUENCY	Processor Frequency Out of Range	80224 Processor Module
8201	T1 FREQUENCY	Track 1 Frequency Out of Range	80012 Transceiver Module (left)
8202	T2 FREQUENCY	Track 2 Frequency Out of Range	80012 Transceiver Module (right)
8300	T1 SELF-CHECK	Track 1 Self-check Not Successful	80012 Transceiver Module (left)
8301	T2 SELF-CHECK	Track 2 Self-check Not Successful	80012 Transceiver Module (right)
9011	T1 LOW EX	Track 1 EX Under Low Limit	Low Ballast
9012	T1 HIGH EX	Track 1 EX Over High Limit	80012 Transceiver Module (left)
9013	T2 LOW EX	Track 2 EX Under Low Limit	Low Ballast
9014	T2 HIGH EX	Track 2 EX Over High Limit	80012 Transceiver Module (right)
9015	T1 HIGH EZ	Track 1 EZ Over High Limit	Bond, Termination, tunable insulated joint bypass couplers, or connections
9016	T2 HIGH EZ	Track 2 EZ Over High Limit	Bond, Termination, tunable insulated joint bypass couplers, or connections
9021	T1 CHECK CHANNEL	Track 1 Channel 2 EZ Over High Limit	80012 Transceiver Module (left), transmit track wires
9022	T2 CHECK CHANNEL	Track 2 Channel 2 EZ Over High Limit	80012 Transceiver Module (right), transmit track wires
9031	T1 LOW EX *ADJ*	Track 1 EX Under Low Adjustment	Low Ballast
9032	T1 ADJ LOW EX	Track 1 EX Under 39	Low Ballast
9033	T2 LOW EX *ADJ*	Track 2 EX Under Low Adjustment	Low Ballast
9034	T2 ADJ LOW EX	Track 2 EX Under 39	Low Ballast
9111	T1 GAIN CHECK	Track 1 Channel 2 Out of Range	Bond Within Island, Receiver Connection, track wires
9112	T2 GAIN CHECK	Track 2 Channel 2 Out of Range	Bond Within Island, Receiver Connection, track wires
9115	T1 EX PROCESS	Track 1 EX Process Error	High Resistance Bond
9116	T2 EX PROCESS	Track 2 EX Process Error	High Resistance Bond
9400	T1 ENHANCED DET	Track 1 Switched to *ED* Mode	Poor Track Shunting Conditions on Track 1
9401	T2 ENHANCED DET	Track 2 Switched to *ED* Mode	Poor Track Shunting Conditions on Track 2

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2000 MS APPLICATION HISTORY CARD

Equipment: 2000 2000S2

Date Installed: _____

Unit/Serial No.: _____ Crossing No.: _____ Island Frequency: T1: _____ kHz T2: _____ kHz

PROGRAMMING HISTORY

■ Press PROGRAM key	Initial Programmed Value Date:	Program Change Date:	Program Change Date:
NUMBER OF TRACKS (Transceiver Modules)	1 <input type="checkbox"/> 2 <input type="checkbox"/>	1 <input type="checkbox"/> 2 <input type="checkbox"/>	1 <input type="checkbox"/> 2 <input type="checkbox"/>
FREQUENCY	T1: _____ Hz T2: _____ Hz	_____ Hz _____ Hz	_____ Hz _____ Hz
UNIDIRECTIONAL/BIDIRECTIONAL	T1: UNI <input type="checkbox"/> BI <input type="checkbox"/> T2: UNI <input type="checkbox"/> BI <input type="checkbox"/>	UNI <input type="checkbox"/> BI <input type="checkbox"/> UNI <input type="checkbox"/> BI <input type="checkbox"/>	UNI <input type="checkbox"/> BI <input type="checkbox"/> UNI <input type="checkbox"/> BI <input type="checkbox"/>
TXMIT LEVEL	T1: MAX <input type="checkbox"/> MED <input type="checkbox"/> T2: MAX <input type="checkbox"/> MED <input type="checkbox"/>	MAX <input type="checkbox"/> MED <input type="checkbox"/> MAX <input type="checkbox"/> MED <input type="checkbox"/>	MAX <input type="checkbox"/> MED <input type="checkbox"/> MAX <input type="checkbox"/> MED <input type="checkbox"/>
APPROACH DISTANCE → SELECTED	T1: _____ Ft. T2: _____ Ft.	_____ Ft. _____ Ft.	_____ Ft. _____ Ft.
UAX1 PICKUP DELAY (UAX) (0 = OFF)	_____ Sec.	_____ Sec.	_____ Sec.
ENA/UAX2 DELAY (0 = ENA)	_____ Sec.	_____ Sec.	_____ Sec.
SLAVING MASTER/SLAVE	MASTER <input type="checkbox"/> SLAVE <input type="checkbox"/>	MASTER <input type="checkbox"/> SLAVE <input type="checkbox"/>	MASTER <input type="checkbox"/> SLAVE <input type="checkbox"/>
PASSWORD ENABLED	DISABLED <input type="checkbox"/> ENABLED <input type="checkbox"/>	DISABLED <input type="checkbox"/> ENABLED <input type="checkbox"/>	DISABLED <input type="checkbox"/> ENABLED <input type="checkbox"/>
RECORDER INSTALLED	NOT INSTALLED <input type="checkbox"/> INSTALLED <input type="checkbox"/> EXTERNAL NODE # _____	NOT INSTALLED <input type="checkbox"/> INSTALLED <input type="checkbox"/> EXTERNAL NODE # _____	NOT INSTALLED <input type="checkbox"/> INSTALLED <input type="checkbox"/> EXTERNAL NODE # _____
RS-232-C BAUD RATE	_____ bps	_____ bps	_____ bps
RS-232-C DATA BITS	7 <input type="checkbox"/> 8 <input type="checkbox"/>	7 <input type="checkbox"/> 8 <input type="checkbox"/>	7 <input type="checkbox"/> 8 <input type="checkbox"/>
RS-232-C STOP BITS	1 <input type="checkbox"/> 2 <input type="checkbox"/>	1 <input type="checkbox"/> 2 <input type="checkbox"/>	1 <input type="checkbox"/> 2 <input type="checkbox"/>
RS-232-C PARITY	NONE <input type="checkbox"/> ODD <input type="checkbox"/> EVEN <input type="checkbox"/> SPACE <input type="checkbox"/> MARK <input type="checkbox"/>	NONE <input type="checkbox"/> ODD <input type="checkbox"/> EVEN <input type="checkbox"/> SPACE <input type="checkbox"/> MARK <input type="checkbox"/>	NONE <input type="checkbox"/> ODD <input type="checkbox"/> EVEN <input type="checkbox"/> SPACE <input type="checkbox"/> MARK <input type="checkbox"/>
DATE (e.g., THU 03 APR 1997)	_____	_____	_____
TIME (e.g., 11:25:43 AM)	_____	_____	_____
DAYLIGHT SAVINGS	ON <input type="checkbox"/> OFF <input type="checkbox"/>	ON <input type="checkbox"/> OFF <input type="checkbox"/>	ON <input type="checkbox"/> OFF <input type="checkbox"/>

EXPANDED PROGRAMMING HISTORY (Function Mode)

■ Press FUNCTION key	Initial Programmed Value Date:	Program Change Date:	Program Change Date:
REMOTE UNIT OPERATION	T1: ON <input type="checkbox"/> OFF <input type="checkbox"/> T2: ON <input type="checkbox"/> OFF <input type="checkbox"/>	ON <input type="checkbox"/> OFF <input type="checkbox"/> ON <input type="checkbox"/> OFF <input type="checkbox"/>	ON <input type="checkbox"/> OFF <input type="checkbox"/> ON <input type="checkbox"/> OFF <input type="checkbox"/>
PICKUP DELAY PRIME	_____ Sec.	_____ Sec.	_____ Sec.
COMPENSATION VALUE	T1: _____ T2: _____	_____ _____	_____ _____
ENHANCED DETECTION (ED)	T1: ON <input type="checkbox"/> OFF <input type="checkbox"/> T2: ON <input type="checkbox"/> OFF <input type="checkbox"/>	ON <input type="checkbox"/> OFF <input type="checkbox"/> ON <input type="checkbox"/> OFF <input type="checkbox"/>	ON <input type="checkbox"/> OFF <input type="checkbox"/> ON <input type="checkbox"/> OFF <input type="checkbox"/>
BACK TO BACK T1 AND T2	NO <input type="checkbox"/> YES <input type="checkbox"/>	NO <input type="checkbox"/> YES <input type="checkbox"/>	NO <input type="checkbox"/> YES <input type="checkbox"/>
STATION STOP TIMER	T1: _____ Sec. T2: _____ Sec.	_____ Sec. _____ Sec.	_____ Sec. _____ Sec.
NUMBER OF TRACK WIRES	T1: 4 <input type="checkbox"/> 6 <input type="checkbox"/> T2: 4 <input type="checkbox"/> 6 <input type="checkbox"/>	4 <input type="checkbox"/> 6 <input type="checkbox"/> 4 <input type="checkbox"/> 6 <input type="checkbox"/>	4 <input type="checkbox"/> 6 <input type="checkbox"/> 4 <input type="checkbox"/> 6 <input type="checkbox"/>
LOW EX ADJUSTMENT	T1: _____ T2: _____	_____ _____	_____ _____
LOW EZ DETECTION	T1: ON <input type="checkbox"/> OFF <input type="checkbox"/> T2: ON <input type="checkbox"/> OFF <input type="checkbox"/>	ON <input type="checkbox"/> OFF <input type="checkbox"/> ON <input type="checkbox"/> OFF <input type="checkbox"/>	ON <input type="checkbox"/> OFF <input type="checkbox"/> ON <input type="checkbox"/> OFF <input type="checkbox"/>
LOW EZ DETECTION TIMER	T1: _____ Min. T2: _____ Min.	_____ Min. _____ Min.	_____ Min. _____ Min.
POSITIVE START (0 = OFF)	T1: _____ EZ T2: _____ EZ	_____ EZ _____ EZ	_____ EZ _____ EZ
POSITIVE START TIMEOUT (0 = NONE)	T1: _____ Min. T2: _____ Min.	_____ Min. _____ Min.	_____ Min. _____ Min.
SET AT OPERATION OUT	NORMAL <input type="checkbox"/> DIAGNOSTIC <input type="checkbox"/>	NORMAL <input type="checkbox"/> DIAGNOSTIC <input type="checkbox"/>	NORMAL <input type="checkbox"/> DIAGNOSTIC <input type="checkbox"/>

HISTCARD
07-11-07

CALIBRATION HISTORY

EZ/EX VALUES (TRACK UNOCCUPIED)			
TRACK		EZ	EX
EAST/NORTH	TRACK 1		
WEST/SOUTH	TRACK 1		
EAST/NORTH	TRACK 2		
WEST/SOUTH	TRACK 2		

HISTCARDBACK
07-11-07