

**USER MANUAL
FOR
AATC SPREAD SPECTRUM RADIO**

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SCOPE

This User Manual describes the Harmon Advanced Automatic Train Control (AATC) Spread Spectrum Radio (SSR) portion of the AATC Radio Set (RS), its installation, and conditions of usage.

APPLICABLE DOCUMENTS

The following Government regulations form a part of this User Manual to the extent specified herein. In the event of a conflict between the regulations referenced herein and the contents of this manual, the regulations shall be considered a superseding requirement.

Title 29, Code of Federal
Regulations, Chapter XVII
Part 1910, Subpart G, I, & L

Occupational Safety and Health Standards

Title 47, Code of Federal
Regulations, Part 15,
Subpart C

Federal Communication Commission Rules

Advanced Automatic Train Control Spread Spectrum Radio (AATC-SSR) DESCRIPTION

AATC-SSR Definition

The AATC-SSR is a multi-functional digital data transmitter-receiver used for digital data communication and range measurement. The AATC-SSR with suitable antenna and mounting/installation kits is a Radio Set (RS) and can be used in a variety of rail vehicle and wayside configurations. The AATC-SSR is identical in all RS configurations. Only the differences in the mounting and installation kit (Antenna, Product Identification Module (PIM), and mounting) define a specific RS configuration and its use. The Product Identification Module is a serial electrically erasable programmable read only memory (EEPROM) which provides the radio with its configuration type i.e. vehicle, or wayside radio. The AATC-SSR is designed specifically for the railroad environment and requires professional installation and operation.

AATC-SSR Operation

The AATC-SSR provides for data exchange between RSs, between the AATC-SSR and a Train Controller, and between the AATC-SSR and a Station Computer. The AATC-SSR has serial interface capability to a Global Positioning System (GPS) Receiver and the Radio Test Set (RTS), a specialized test equipment.

The AATC-SSR operation is controlled by firmware (embedded software). The AATC-SSR hardware, in combination with this firmware, is designed for operation in a communications network of similar AATC-SSRs to perform train control or other similar applications. A network can contain as few as two AATC-SSRs or as many as several hundred AATC-SSRs. The firmware is specifically designed to support networks of AATC-SSRs spread out along railways or tunnels, where multiple radio frequency (RF) links may need to be cascaded to provide communications from a source to a remote destination. Highly reliable communications is provided through a variety of techniques including spread spectrum and redundant RF channels.

Using the RF communications signals, the AATC-SSRs cooperatively measure the range between pairs of AATC-SSRs. The range measurements are reported to a control station, which is connected to one of the AATC-SSRs in a network, and the Control Station can use these ranges to establish and track the locations of AATC-SSR equipped vehicles.

The AATC-SSR operates in the 2400 MHz to 2483.5 MHz frequency band. Its transmit center frequency can be controlled to be anywhere from 2423.75 MHz to 2462.75 MHz in 1 MHz steps. The AATC-SSRs share the RF band using a combination of time division, frequency division, and code division multiple access techniques. The communications network structure is managed by a control station computer, which assigns time and frequency resources to each of the AATC-SSRs.

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The AATC-SSR consists of three major functional modules and the external interfaces shown in **Figure 1**.

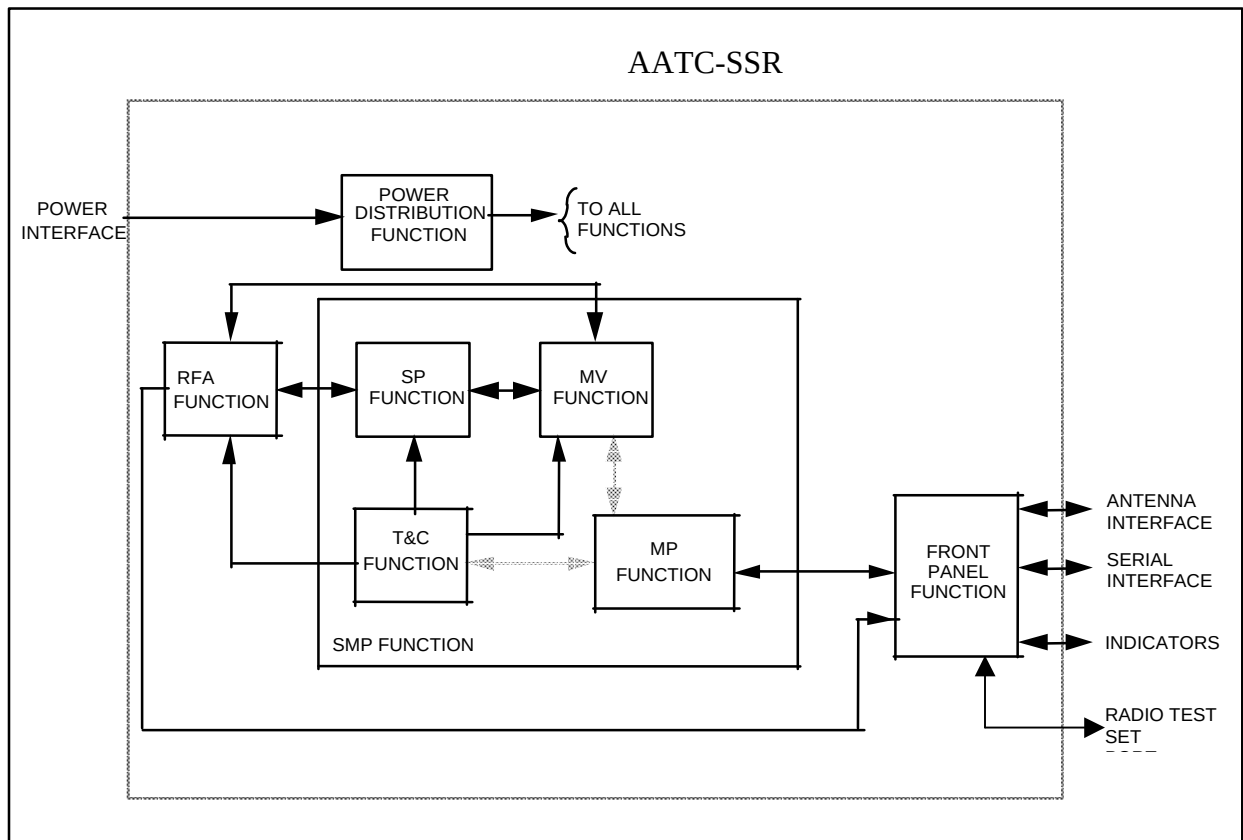


Figure 1 AATC-SSR Block Diagram

External Physical Interfaces

The AATC-SSR implements the following interfaces, shown in **Figure 1**. The Power Interface is located on the rear of the unit while the all other interfaces are located on the front of the AATC-SSR. The operator interface allows the operator to monitor operation of the AATC-SSR. The remaining interfaces are external connections for the Antenna, Serial Interface (GPS Receiver, Train Controller or Station Computer), Radio Test Set, and Power.

Operator Interface

The AATC-SSR provides the operator with the following indicators visible from either the top or front of the AATC-SSR:

Power

The POWER indicator is a green LED which provides the operator with an indication that proper power is applied to the AATC-SSR.

Fault

The FAULT indicator is a red LED which provides the operator with an indication that the AATC-SSR's firmware has encountered a failure and is not ready for operation. This indicator is momentarily turned on during power –up.

Mode

The MODE indicator is a yellow LED. The indicator provides the following indications:

In Power Up mode, during the operational checks, the indicator will be ON. Otherwise, the indicator will, under firmware control, blink ON and OFF in accordance with the following ratios:

Net Acquisition	7 ON/ 1 OFF
Time Sync	3 ON/ 1 OFF
Time Stabilized	1 ON/ 1 OFF
A Assignment Received	1 ON/ 3 OFF
B Assignment Received	1 ON/ 7 OFF
Both Assignments Received	1 ON/ 15 OFF

The minimum on or off period is nominally 0.5 seconds.

Serial Interface

The Serial Interface shall include the following types of interface:

- a) An RS 232 full duplex link for interfacing the AATC-SSR and GPS Receiver.
- b) An RS 485 full duplex link for interfacing the AATC-SSR and Train Controller.
- c) An RS 485 full duplex link for interfacing the AATC-SSR and Station Computer..
- d) A TTL level signal interface for receiving the GPS 1 PPS timing signal.
- e) A TTL level signal interface for the PIM

The 37-pin Serial Interface connector (J1), an Amphenol part number 10-565991-006 or equivalent, is located on the Front Panel.

Antenna Interface

The Antenna interface allows the connection of the required external antenna. The Antenna connector (J3) is located on the front of the AATC-SSR and is a 50 Ohm, type N female connector. Note: This radio must be professionally installed with the appropriate antenna.

Power Interface

The unit requires an attached primary power source (power adapter) for operation. The physical interface consists of an externally accessible power connector. The unit converts the input direct current (DC) power to those voltages required by unit electronics.

Power Input

The AATC-SSR is designed to operate with input power between 21.5VDC and 40VDC. The power input is isolated by at least 1500 VDC between the input terminals and ground or any set of output terminals

Normal Power Consumption

The total AATC-SSR power consumption is less than 22 watts average when the unit is operating normally over the input voltage range.

Peak Current Demand

Under all operating conditions, including input line voltage variation, the current consumed is less than 1.0 Amperes averaged over 1.0 second or longer.

Overvoltage Protection

The power supply shall be capable of withstanding, without damage or abnormal operation, transient surges applied across the input terminals of the supply. The surge levels and durations are defined below for a 100 Ohm source impedance

Amplitude (kV)	Duration (μ s)
+/- 5.5	0.1
+/- 4.0	1.0
+/- 3.0	5.0
+/- 1.5	50.0
+/- 0.8	100.0

Power Connections

The power connector (J4), an Amphenol 10-565991-003 or equivalent, is located at the rear of the AATC-SSR. The pin connections are as follows:

<u>Function</u>	<u>Pin Number</u>
+VIN	L
-VIN	M

INSTALLATION

Note: This radio must be professionally installed.

Physical

Refer to the appropriate installation drawing for physical installation.

Cable Connections

Refer to the appropriate installation drawing for the cable connections.

CAUTION

THIS EQUIPMENT MUST BE PROFESSIONALLY INSTALLED ACCORDING TO THE INSTALLATION DRAWINGS.

CONDITIONS OF USE

Potential RF Interference

INSTRUCTION TO THE USER

This equipment has been tested and found to comply with the limits for a class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and the receiver
- Consult the manufacturer for help.

In order to maintain compliance with FCC regulations, proper cables must be used with this equipment. Operation with non-approved equipment or improper cables is likely to result in interference to radio and TV reception. The user is cautioned that changes and modifications made to the equipment without the approval of the manufacturer could void the user's authority to operate this equipment.