
Westhold
Corporation.

**Race Management System
Instruction Manual**

Westhold Corporation General Warranty

Modules and other equipment ("Goods") purchased from Westhold Corporation are warranted against defects in materials and workmanship under normal use for a period of three years from the date of purchase. In the event of product failure due to defects in materials or workmanship, the customer may return the defective product to Westhold Corporation for repair or replacement. The customer is responsible for all shipping charges associated with shipping the Goods back to Westhold Corporation. Westhold Corporation pays shipping charges associated with the return of Goods back to the customer. As Westhold Corporation will not be responsible for damages incurred during any incoming shipment, it is recommended that the customer insure their shipment through their carrier.

Westhold Corporation shall, at its sole option, repair or replace the Goods. Repair or replacement of Goods is Westhold Corporation's sole obligation and the customer's exclusive remedy for all claims of defects. If that remedy is adjudicated insufficient, Westhold Corporation shall refund the customer's paid price for the Goods and have no other liability to the customer.

Westhold Corporation's software, if included with Goods, is sold as is, and this warranty is inapplicable to such software.

This warranty does not cover and Westhold Corporation will not be liable for, any damage or failure caused by misuse, abuse, acts of God, accidents, electrical irregularity, or other causes beyond Westhold Corporation's control, or claim by other than the original purchaser. This warranty is void if Westhold Corporation, in its sole discretion, determines that there has been any:

1. Tampering, signs of tampering, alteration, modification, or other indications or abuse.
2. Application of power outside of the voltage level and polarity specified in the data sheet or user's manual.
3. Repair or attempt to repair by anyone other than a Westhold Corporation authorized technician.

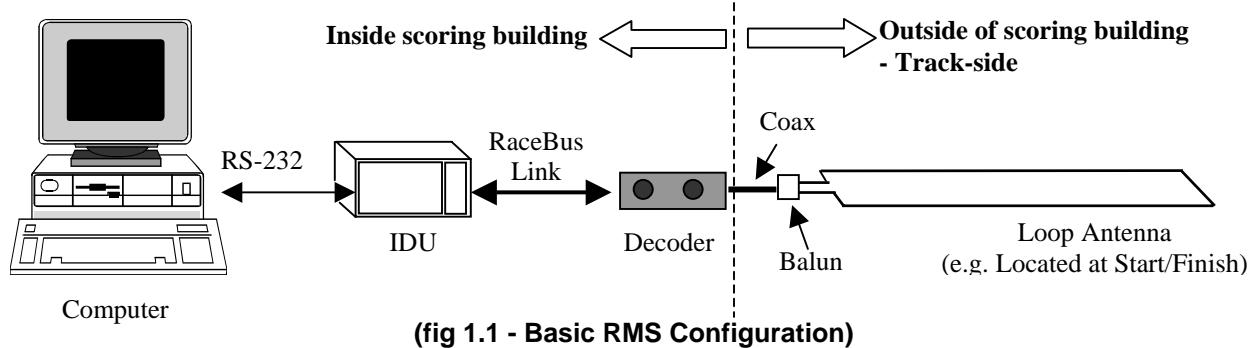
This is our entire warranty and is given in lieu of all other possible warranties, either express or implied, including warranties of merchantability and of fitness for a particular purpose. By accepting delivery of the Goods, Purchaser/User waives all other possible warranties, except those specifically given.

IN NO EVENT SHALL WESTHOLD CORPORATION BE LIABLE FOR ANY CONSEQUENTIAL, INCIDENTAL, INDIRECT, SPECIAL OR PUNITIVE DAMAGES ARISING OUT OF OR RELATING IN ANY WAY TO ANY DEFECT IN OR FAILURE OF OR INABILITY TO USE THE GOODS, INCLUDING BUT NOT LIMITED TO, CLAIMS BASED UPON LOSS OF USE, LOSS OF TIME, INCONVENIENCE, COMMERCIAL LOSS, LOST PROFITS, REVENUE OR SAVINGS, LOST GOODWILL, ENVIRONMENTAL DAMAGE, INCREASED EXPENSES OF OPERATION, COST OF REPLACEMENT GOODS, OR CLAIMS OF THE CUSTOMER OR CUSTOMER'S CUSTOMERS, WHETHER OR NOT BASED ON CONTRACT, TORT (INCLUDING NEGLIGENCE AND STRICT LIABILITY) OR OTHERWISE. WESTHOLD CORPORATION's MAXIMUM LIABILITY UNDER THIS WARRANTY SHALL NOT EXCEED THE PAID PRICE FOR THE GOODS UPON WHICH SUCH LIABILITY IS BASED AND ALL SUCH LIABILITY SHALL TERMINATE NO LATER THAN ONE YEAR FROM THE DATE OF DELIVERY OF THE GOODS.

Note: Westhold Corporation's Goods are sold for resale or for commercial purposes, and are thus not covered under the Magnuson-Moss Warranty Act.

1. Introduction

The Westhold RMS-3 is a sophisticated multi-component system used for the timing, scoring and management of motor sports racing events. The RMS-3 consists of electronic hardware and PC based MS-Windows® software. A basic hardware setup includes a computer, Interface Data Unit (IDU), Decoder, Loop Antenna, and transmitters. See fig. 1.1

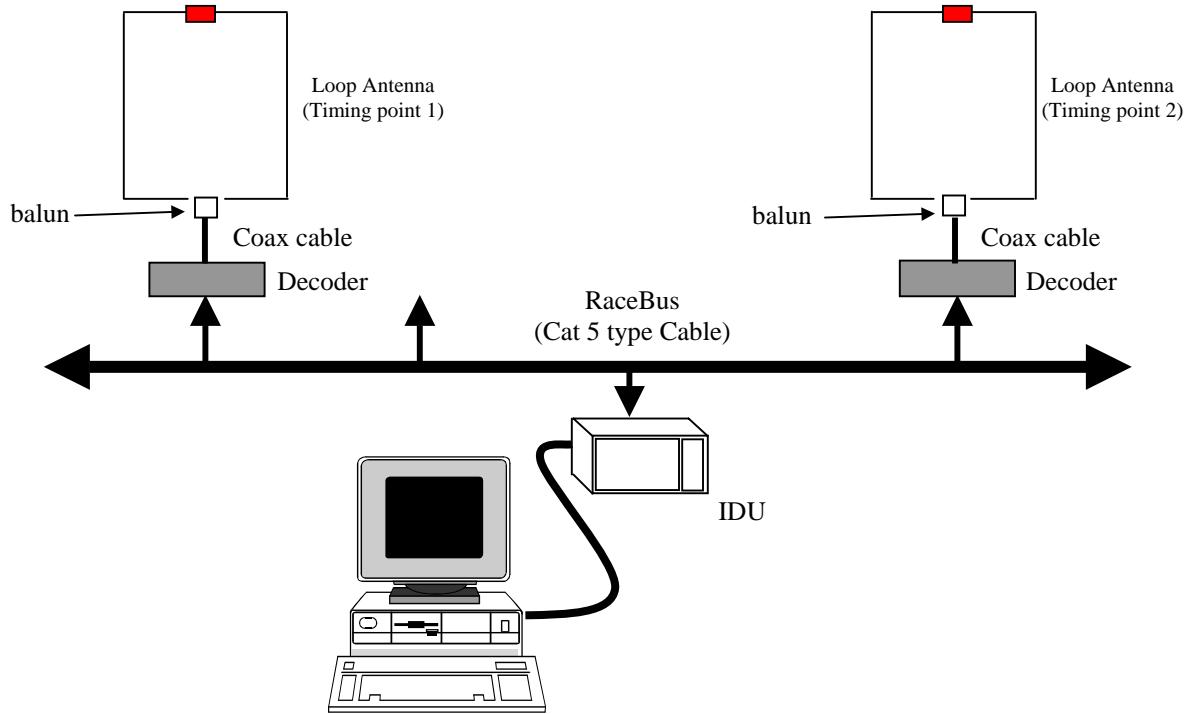


Each transmitter transmits a unique identification number. When a transmitter crosses a Loop Antenna, a Decoder reads this number and determines the crossing time of the transmitter. The Decoder sends this information to the IDU via the digital RaceBus network link. The IDU compiles all of the information and sends it to the computer over a serial link for final analysis and storage. Data can then be sent from the computer to other devices such as scoreboards, driver results printers, hand-held controllers and third party devices.

The Interface Data Unit (IDU) acts as the central data management junction between the computer, Decoder, and additional devices. It coordinates both incoming and outgoing signals to and from the computer, synchronizing data for the entire system. The IDU intelligently organizes and filters data for the PC. This frees the PC from handling all the overhead of managing the RaceBus network and allows the overall system to maintain reliable real-time operation. Only a single IDU is needed per system. Each IDU can handle dozens of Decoders.

The Decoder is a receiver system that processes the raw signals picked up by the Loop Antenna. Its job is to convert the raw signals into digital information that can then be transmitted via the RaceBus to the IDU. Multiple Decoders may be attached to the RaceBus to cover multiple timing points for information such as split times (see fig. 1.2) or pit row activity. Decoders may also be attached to each other in a daisy-chained configuration to cover wide tracks. See fig 1.3.

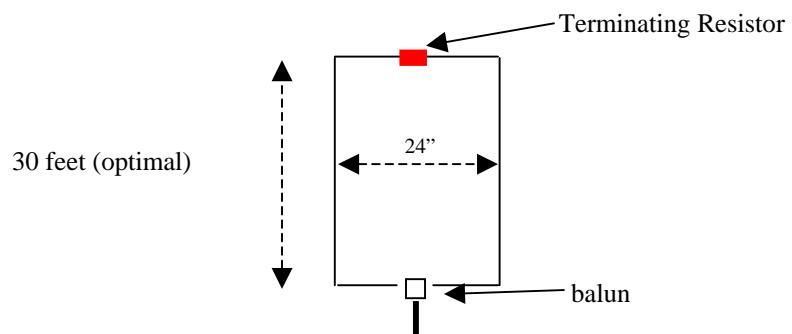
Each Decoder stores what are known as hit records. Hit records describe the crossing of transmitters over the Loop Antennas. Each record consists of a transmitter identification number, the crossing time as well as a few other pieces of information such as transmitter battery status. The Decoder is capable of storing 65,000 hit records and capable of determining a crossing time with spatial accuracy typically between 2-3 inches. Under normal operation, the PC would upload this data and process it as the transmitters cross the Loop Antennas. However, in the event of a computer failure for example, the Decoders would still contain the information necessary to recreate a race.



(fig 1.2 - Multiple Timing Point Configuration)

A Loop Antenna is simply insulated electrical wire with a terminating resistor on the side of the loop furthest from the connection to the Decoder. They are buried beneath the surface of the track and are 24 inches (approx. 60 cm) wide and can be of varying length to cover the width of the track. See fig 1.4. The optimal length is approximately 30 feet. However, the length may be longer with the tradeoff being detection height of the transmitters with respect to the antenna. In other words, the longer the antenna, the less detection height achieved.

The ends of the Loop Antenna connect to what is called a balun. It is a device that connects the Loop Antenna to a RG58 (50 ohm) coax cable. The balun device matches the impedance between the Loop Antenna section and the coax. It is necessary to have a balun device for optimal performance. Without it the impedance mismatches can result in reduced detection height and possibly intermittent and unpredictable behavior.



(fig. 1.4 - Loop Antenna Dimensions)

Physically, the RaceBus is standard 4 pair (8 wire) network (Category 5) cabling found at many computer stores. The RaceBus network architecture allows multiple devices, called Appliances, to be attached to the network. For instance, the IDU and Decoder are both RaceBus Appliances. Scoreboards, results monitors, results printers and other third party Appliances may also be attached to the RaceBus. However, it is **NOT** possible to hook computer network equipment to the RaceBus. Doing so may result in damaged equipment.

WARNING: Do not hook computer network equipment to the RaceBus cabling! Doing so may damage your equipment.

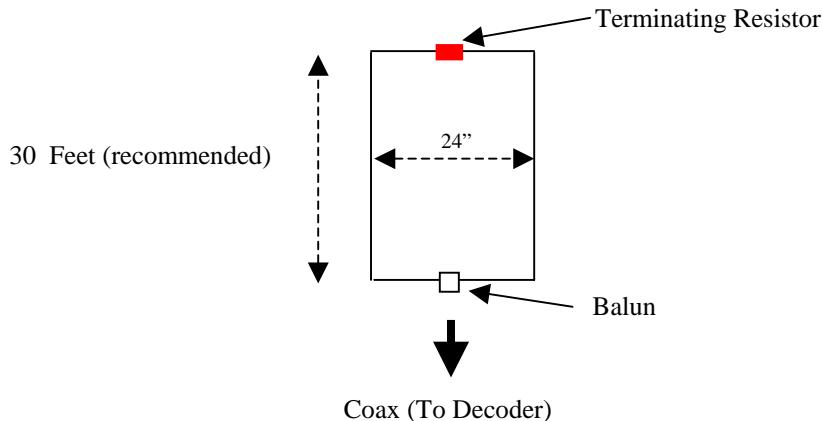
2. Installation and Usage

2.0 General Notes

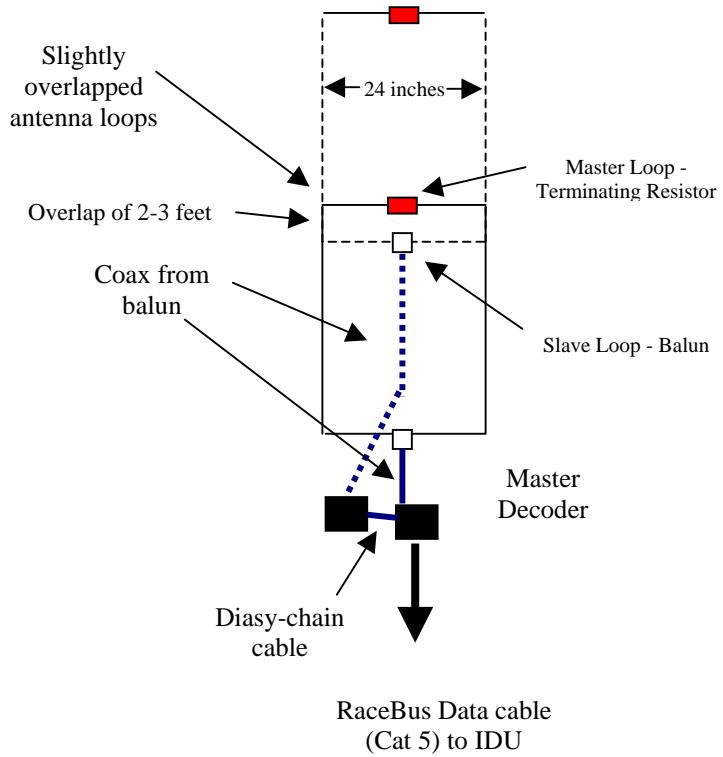
The first step in an installation is to carefully plan where each piece of the system will reside. The plan must take into account the limitations of the system. Some of these limitations are fixed. Others are variable and dependent upon the track environment.

2.1 Antenna Installation

There are two methods for setting up the antenna; the single loop and multi-loop methods. See the figures 2.1 and 2.2 below for the single and two loop setups. All loops should be about 24 inches wide with the resistor centered at the end of the loops. For multi-loop antennas each loop should overlap the adjacent loop about 2-3 feet.



(fig 2.1.1 – Single loop)



(fig 2.1.2 – Multi-loop)

Antenna loops are simply insulated copper electrical wire with a resistor soldered to the end of the loop. If you prefer to make loops yourself or have a special need, the wire can be purchased at most hardware stores while the resistor (450 ohm optimal) is available at many electronic stores. The wire may be stranded or solid core. A typical gauge of wire used is AWG 20. Smaller or larger gauges may be used. There are certain trade-offs to using smaller or larger gauges. For example, a smaller gauge is generally less durable, but is often more flexible and easier to manipulate.

Recommended:

Wire Type: Stranded core.

Resistor: Use approximately 450 ohms. Some deviation from this number is ok. Using a 400 ohm or 500 ohm resistor will not significantly affect the performance.

Heat shrink tubing: We suggest using heat shrink to encase the resistor and any exposed wire. This will keep moisture from seeping into the wire and eating away the copper.

To install the antenna loop, cut a groove approximately $\frac{1}{4}$ inch (6-8 mm) wide and $\frac{1}{2}$ inch (12-13 mm) deep in the track with the dimensions show below. See fig. 2.1.1. Depending on the wire gauge the groove dimensions should be adjusted accordingly. For dirt tracks, place the antenna

loops in plastic PVC sprinkler pipes. Make sure the pipes are sealed such that water will not enter the pipes.

There is no fixed depth to bury the antenna for dirt tracks. This is variable depending on the track. Environmental factors such as metal content in the soil can reduce detection distance and therefore the antenna cannot be buried as deeply as soil without metal content. The general rule of thumb is to bury the antenna only as deep as necessary to keep the antenna from being damaged, yet maintaining maximum detection distance between the antenna and the transmitter on the vehicle. Generally keeping the antenna burial depth to less than 18 inches is recommended. This typically is deep enough so cars and graders do not harm the antenna, but still maintaining good detection distance.

Connect the ends of the Loop Antenna to the balun device. There are two screw terminals on the device for the antenna wire. A BNC connector is on the opposite end of the balun. Connect the coax cable to the BNC connector. The other end of the coax cable will then connect to the BNC connector on the back of the Decoder.

2.2 Decoder

Decoders (Fig 2.2.1) may be connected to the system in two different manners—the standard configuration and the daisy-chain configuration. In the standard configuration the Decoder connects directly to the RaceBus. In the daisy-chain configuration one Decoder connects to the tail end of another. The combined chain acts as a single Decoder. The daisy-chain configuration is used when multiple loops are used to cover the width of a track.

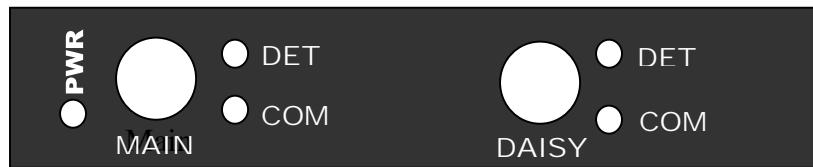


Fig. 2.2.1 - Decoder

The Decoder has 5 LED indicators. When the Decoder is properly hooked up to the IDU and the IDU is powered on, the power indicator LED (PWR) will turn on to indicate the unit is receiving power from the IDU. The communication (COM) LED on the Main port will also turn on. If there is a daisy-chain Decoder hooked to the unit the communication LED on the Daisy port will also turn on. Each daisy-chain device will also have LEDs that indicate the same things as the primary Decoder in the chain.

Note that when a transmitter is within detection distance of the antenna loop and Decoder, the detection LED (DET) will turn on.

Each Decoder has two circular connectors. One end is labeled “Main” and the other is labeled “Daisy.” Connect one end of the cat-5 cable with the circular connector to the Decoder. Connect the RJ-45 end to one of the ports on the back of the IDU. If daisy-chained Decoders (multi-loop) are required, connect the “Main” side of each subsequent Decoder in the chain to the “Daisy-chain” end of the previous Decoder.

2.3 Interface Data Unit:

The IDU comes with a power cord and an RS-232 serial port connector. Plug the male side of the RS-232 cord into the female connector on the IDU. Note that some older models have 2 RS-232 ports. Take the other end of the RS-232 cord and plug that into the proper connector on the computer that will run the system. Plug the power cord into the appropriate place on the IDU and plug the other end into the appropriate wall outlet. Note that the IDU does not need a special transformer to switch between 120V and 220V. The IDU has an intelligent auto-sensing power supply.

The back of the IDU has 4 RJ-45 network connectors. This is used for the RaceBus connections. All the RJ-45 ports are exactly the same. The multiple connectors are for user convenience. Power to RaceBus appliances is supplied by the IDU. Note that there is a limit to the number of appliances each IDU port may support power-wise. For example, each IDU port can currently power 2 Decoders. However if the appliances have their own power supply, the RaceBus system may support up to 32 devices total.

2.4 Transmitters

The transmitter is easy to install, operate and maintain. The lightweight and compact transmitter operates using an internal non-removable battery. Each transmitter has a unique identification code that is printed on the outside of the transmitter case. There are two LEDs, one green and one red on the transmitters. When the transmitters are fully charged and operational they will operate for 7 days. The green LED will blink rapidly every 3 seconds. The number of rapid blinks indicates the number of days of charge left before the transmitter will shut off. When the transmitter is on the last day, it will begin to blink the red LED once every 3 seconds.

Transmitters are mounted on vehicles using one of two types of holders. One type of holder is a plastic holder with two wings for bolting to a vehicle. The other type is a nylon fabric pouch variety with wings for bolting to a vehicle. 9 volt transmitters do not need holders and can be mounted directly to vehicles via their mounting ears. Be sure to securely fasten the transmitter to the vehicle before use. Unsecured transmitters can be hazardous if they fall on the track.

The best possible orientation of the transmitter is shown below with the label side of the transmitter facing the ground Fig 2.4.3. **It is important that the transmitter has no metal or**

carbon fiber between it and the track surface. Metal and carbon fiber will block the signal emanating from the transmitter and the Decoder will not be able to pick up crossing transmitters.

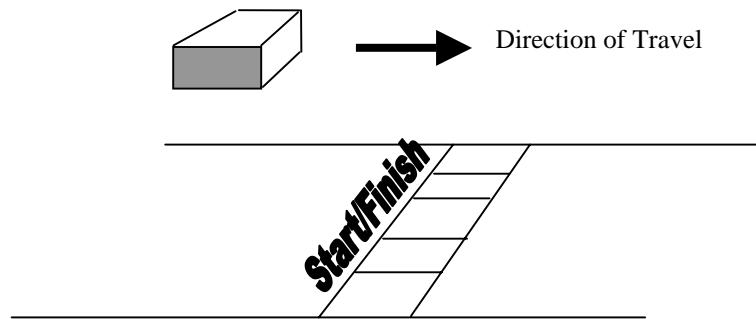
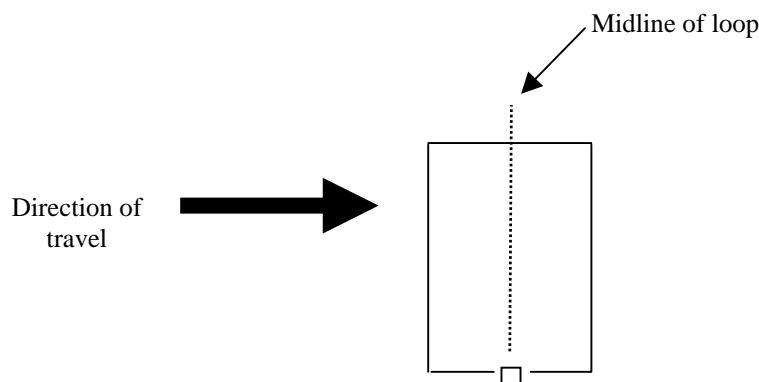


Fig 2.4.3

3. Specifications

The RMS is capable of detecting transmitter crossings over the middle of a Loop Antenna with a spatial accuracy of typically 2-3 inches and a resolution of better than one ten-thousandths of a second. For a transmitter traveling at 200 miles per hour, that translates into sub-millisecond accuracy.



(fig. 3.1 – Direction of travel)

System Specifications:

Specification	
# Transmitter Ids	> 1,000,000
Max Speed	200+ mph
Track Width	100+ feet (30 feet per Loop Antenna-Decoder Pair optimal)
Spatial Accuracy	2-3 inches typical
Timing Resolution	better than 0.0001 sec
Max Transmitter Height	Vehicle and track dependent (24-48 inches typical)

Component Specifications:

IDU (Interface Data Unit)	
Dimensions	11" x 8" x 2.5" (~22 x 16 x 8 cm)
Interface to PC	RS232
Power Supply	Universal AC (90 – 260V) auto detect or 12V DC
Multiple Decoders	Yes

Decoder	
Dimensions	6" x 4.5" x 1" (~15.25 x 11.5 x 2.5 cm)
Timer Stability	Up to 0.5 ppm
Humidity	90% Relative
Power Supply	RaceBus Supplied or Battery
Memory Capacity	65,000 Detections
Coax from Loop Antenna to Decoder	300 feet depending on conditions
Cable from IDU to Decoder	Twisted Pair Cables • 100-150 feet (Depends on number of Decoders)

Transmitter - Rechargeable	TXLI Model
Dimensions	Approx. 3" x 2" x 1" (~7.6 x 5.1 x 2.5cm)
Weight	Approx. 4.9oz (125grams)
Temp Range	32-122°F (0-50°C)
Battery Life	7 Days on full charge
Operational Indicator	LED
Low Battery Indicator	LED
Humidity	90% Relative

Transmitter - Hardwire	TXDP Model
Dimensions	Approx. 3" x 2" x 1" (~7.6 x 5.1 x 2.5cm)
Weight	Approx. 4.3oz (122grams)
Temp Range	32-122°F (0-50°C)
Voltage	+14 V > voltage > +9 V
Current	< 30 millamps
Operational Indicator	LEDs
Humidity	90% Relative

4. FCC Notices

RMS-3 Interface Data Unit and Track-Side Decoder FCC Declarations:

FEDERAL COMMUNICATIONS COMMISSION RADIO AND TELEVISION INTERFERENCE STATEMENT FOR A CLASS 'B' DEVICE

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 interference to radio or television reception, which can be determined by turning the equipment off and then on, the user is encouraged to try to correct the interference by one of more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver
- Connect the equipment into a different outlet so that the equipment and receiver are on different branch circuits.
- Consult the dealer or an experienced radio/TV technician for help.

This device complies with Part 15, of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received including interference that may cause undesired operation.

Changes or modifications not expressly approved by **Westhold Corporation** could void the user's authority to operate the equipment.

TXLI RMS Rechargeable Transmitter FCC Declaration:

FEDERAL COMMUNICATIONS COMMISSION RADIO AND TELEVISION INTERFERENCE STATEMENT

Changes or modifications not expressly approved by **Westhold Corporation** could void the user's authority to operate the equipment.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received including interference that may cause undesired operation.

FCC ID: NKBTXLI-01

TXDP RMS Hardwire Transmitter FCC Declaration:

**FEDERAL COMMUNICATIONS COMMISSION RADIO AND TELEVISION
INTERFERENCE STATEMENT**

Changes or modifications not expressly approved by ***Westhold Corporation*** could void the user's authority to operate the equipment.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received including interference that may cause undesired operation.

FCC ID: NKBTXDP-01