

INTELLIGENT

SMART



# WHEELTIME ELITE USER MANUAL

EDITION 1.2

## Declaration of Conformity

FCC ID: WBF-70400

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.

This equipment complies with FCC RF radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with a minimum distance of 25 centimetres between the radiator and your body and must not be co-located with any other antenna or transmitter.

To ensure the safety of users, the FCC has established criteria for the amount of radio frequency energy various products may produce depending on their intended usages. This product has been tested and found to comply with the FCC's exposure criteria.

The fast charger should only be attached and powered only when the Reader is turned off and all external cables are removed. During operation the mains power filter may be used, but not the fast charger.

Any changes or modifications not expressly approved by Times-7 could void the user's authority to operate this equipment.

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New Zealand Patent Numbers 556602, 556603 and 556604 and other patents pending.

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# FOR YOUR SAFETY



## Switch on safely

Do not switch on the system where radio frequency transmission is prohibited or when it may cause interference or danger.



## Road safety comes first

Obey all local laws. Always be considerate of other road users when using the system on public roads.



## Interference

All radio frequency devices may be susceptible to interference which could affect performance.



## Use sensibly

Use only in the normal setup as explained in the system documentation.



## Qualified service

Only qualified personnel may modify or repair the system.



## Enhancements and batteries

Use only approved enhancements, accessories and batteries. Do not connect incompatible products.



## Water resistance

The system is water resistant, not waterproof. Keep it dry.



## Back-up copies

Remember to make back-up copies or keep a written record of all important information stored in the Delta.



## Connecting to other devices

When connecting to any other device, read its user guide for detailed safety instructions. Do not connect incompatible products.



# INTRODUCTION

**Congratulations on your ownership of WheelTime – the world’s most advanced passive UHF RFID system designed specifically for timing cycle races.**

Cycling has traditionally been difficult to time electronically as speed, pelotons, and bicycles themselves all provide challenges to the

technologies available. WheelTime has overcome these barriers to deliver a reliable and accurate timing system for your cycling event. This user manual will help you to set up the WheelTime system to achieve optimum performance under most conditions.

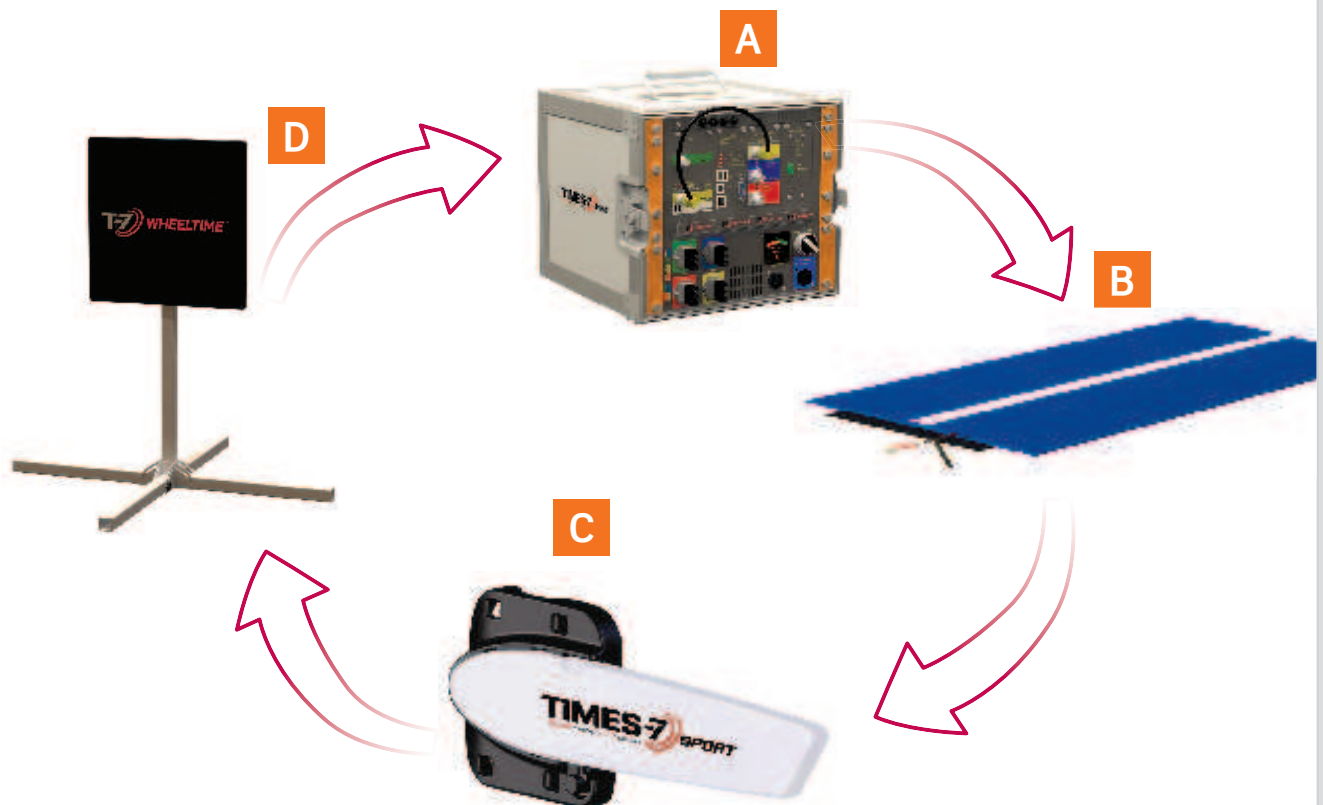
## 01 PRODUCT DESCRIPTION

### Overview

In simple terms, the WheelTime system is comprised of a Reader **A**, Transmit Antenna Mats **B**, an RFID tag (WheelTag) **C**, and a Roadside Antenna **D**.

The signal sent by the Reader to the Transmit Antenna Mats activates the WheelTag mounted on the fork of a bicycle in the WheelTag Holder. The WheelTag then communicates its unique ID back to the Reader through the Roadside Antenna. The time that the unique ID is received provides each cyclist with the time they crossed the line.

FIGURE 1.1: *WheelTime System Overview*



## Components

There are a number of standard components that must be used for the WheelTime system to operate

(refer to the table below). Additionally, there are a number of accessories to complement or protect the standard system.

### WheelTime Component List

	Item	Quantity
REQUIRED	Reader	1
	Roadside Antenna and Stand	2
	Roadside Antenna Cable 6.0m	1
	Roadside Antenna Cable 15.0m	1
	Set of 6 Transmit Antenna Mats	1
	Connection Hub	1
	Control Loom	1
	External Battery Power Cable	1
	Field Strength Meter	1
	Terminators	5
	WheelTag	1 per rider
	WheelTag Holder	1 per rider
	Sportscore Event Timing Software	1
RECOMMENDED	Fast Charger	1
	Chute Antenna and Stand	2
	Chute Antenna Cable 4.0m	2
	Registration Reader	1
OPTIONAL	External Beeper	1
	Rain Cover	1
	Sandbags	1 per stand



## Reader

### The Reader contains the components that:

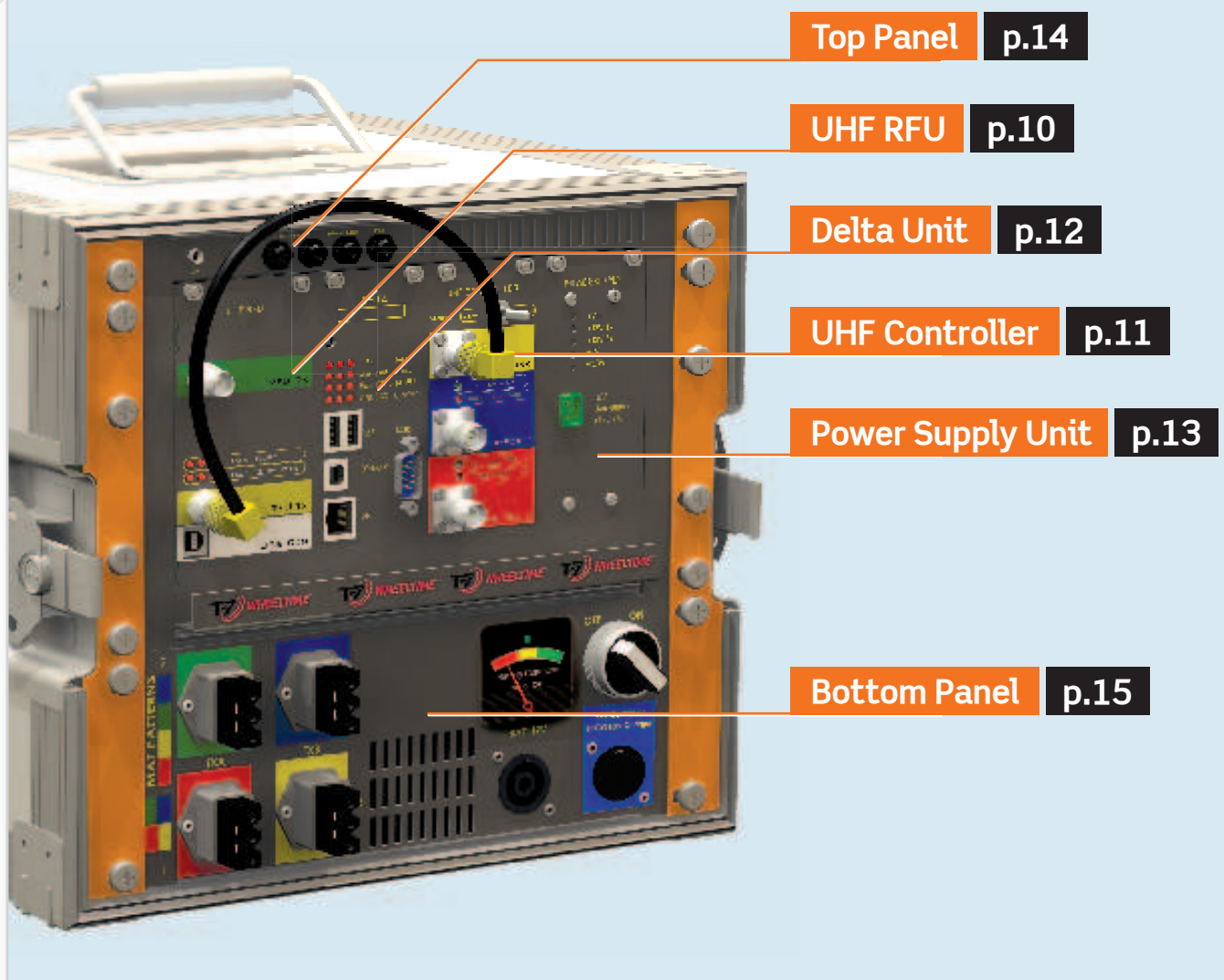
- Supply and manage the power for the WheelTime system
- Generate the transmission of the signal to the WheelTag through the Transmit Antenna Mats
- Receives the signal from the WheelTag through the Roadside and Chute antennas
- Provides a backup for the data collected
- Filters and forwards the tag data to a computer

The Reader is packaged in a Rugged Road Aluminium Case. Dimensions: 285mm H x 325mm W x 370mm L (11.2in H x 12.8in W x 14.6in L).

All fixings are in aluminium or stainless steel to minimise corrosion over time.

**Note:** The power is supplied by an internal sealed lead acid battery.

FIGURE 1.2: Reader



## UHF RFU

The UHF RFU generates the RF transmission pilot frequency, receives the RF signals, and determines the identities of each WheelTag as it passes over the Transmit Antenna Mats. The WheelTag identity, with associated timestamps, is streamed to the Delta, and is also available through a USB port on the front of the RFU. The RFU also emits a low level beep, and an LED flash on the front panel, every time that a tag is read.

The visible parts of the UHF RFU, as pictured in Figure 1.3, are:

**A RFU Rx** This connector receives the RF signals from Port RX-1 of the Connection Hub.

**B RFU Tx** This connector provides the RF pilot frequency from the UHF RFU to the UHF Controller.

**C PWR** This LED should be illuminated when the Reader is switched on to show that the UHF RFU is also turned on.

**D FAULT** Should not be illuminated. It is illuminated only when the USB ground and the Reader ground are different by over 50 Volts.

**E IACT** This LED is not used.

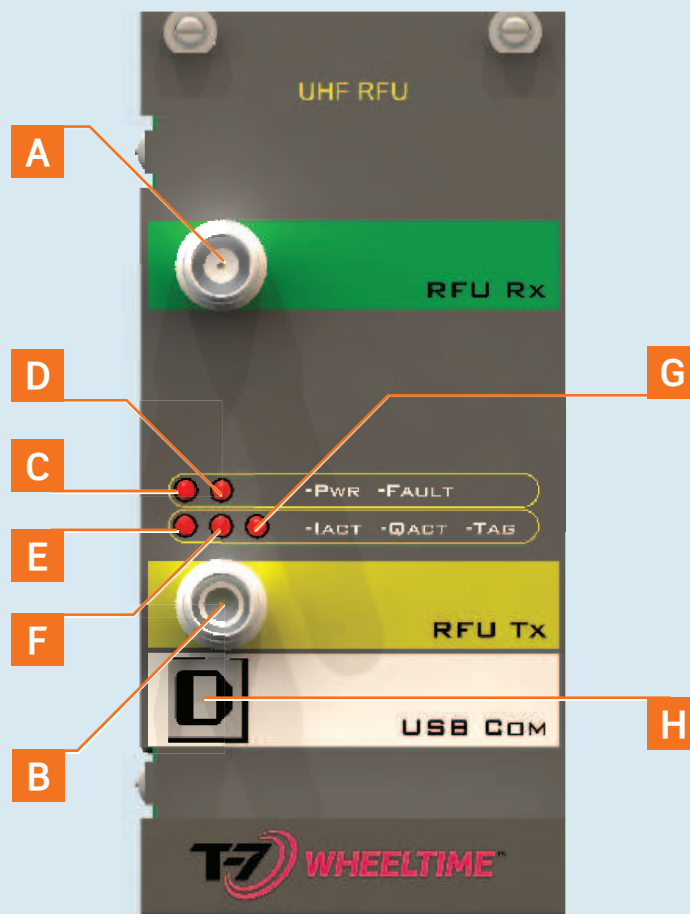
**F QACT** This LED is not used.

**G TAG** Should be illuminated whenever a WheelTag is detected.

**H USB COM** This connector provides a serial data stream containing all tags read. The stream is not filtered in any way, therefore a single tag may be reported numerous times in quick succession. The serial port settings are 115kbps, 8 bits, 1 stop bit, 1 start bit, no handshaking, no parity.

**RFU Internal Beeper** This sound indicator should make an audible beep whenever a WheelTag is detected.

FIGURE 1.3: UHF RFU



## UHF Controller

The UHF Controller manages the transmit signals to the Transmit Antenna Mats. It uses the RF pilot frequency from the RFU, and generates the RF transmission signals for the Transmit Antenna Mats (which are distributed through the Connection Hub). The form of the transmission signals is adjusted according to the operator's selection of start mode or finish mode. The UHF Controller has one green LED for each TX-Port, to indicate the correct generation of the RF signals. It also has one red LED for each TX-Port, to indicate the incorrect connection of the Connection Hub and/or the Transmit Antenna Mats.

The visible parts of the UHF Controller, as pictured in Figure 1.4, are:

**A Start Finish** This switch allows the operator to operate the UHF Controller in either start mode or finish mode. Start mode should be used when bicycles are congested such as at the start of an event.

**B TX-Link** This connector receives the RF pilot frequency from the UHF RFU.

**C TX-1 Power OK** This LED should be illuminated when the Reader is switched on to show that the UHF Controller is providing RF power out on TX-Port1. This LED may appear to be on continuously, or to be blinking (the blinking is particularly noticeable in start mode).

**D TX-1 Connection Fault** This LED should not be illuminated. It is illuminated only when the Connection Hub and/or Transmit Antenna Mats are not correctly connected to TX-Port1.

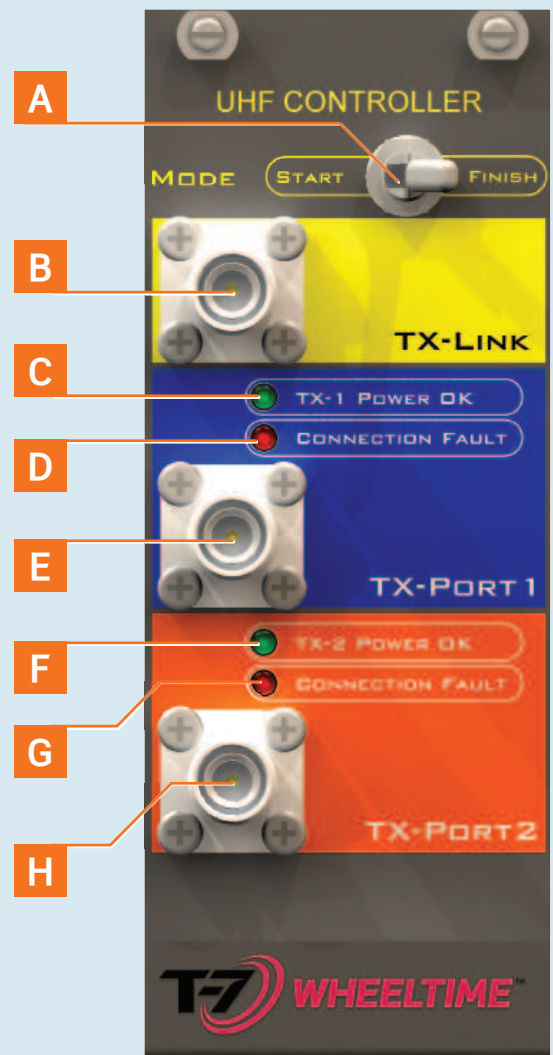
**E TX-Port1** This connector provides the RF signal from the UHF Controller and connects to the Connection Hub. A current limited 12V power supply is also provided through this connector, to allow the Connection Hub to illuminate its diagnostic LEDs.

**F TX-2 Power OK** This LED should be illuminated when the Reader is switched on to show that the UHF Controller is providing RF power out on TX-Port2. This LED may appear to be on continuously, or to be blinking (the blinking is particularly noticeable in start mode).

**G TX-2 Connection Fault** This LED should not be illuminated. It is illuminated only when the Connection Hub and/or Transmit Antenna Mats are not correctly connected to TX-Port2.

**H TX-Port2** This connector provides the RF signal from the UHF Controller, and connects to the Connection Hub. A current limited 12V power supply is provided through this connector, to allow the Connection Hub to illuminate its diagnostic LEDs.

FIGURE 1.4: UHF Controller



## Delta Unit

The Delta unit gets data from the UHF RFU and stores it on its internal flash drive. The streaming data is also available in real time during the race from the Ethernet port. After the race the complete data file can be copied from the Delta to a computer via the Ethernet port using an Ethernet Cross-Over Cable.

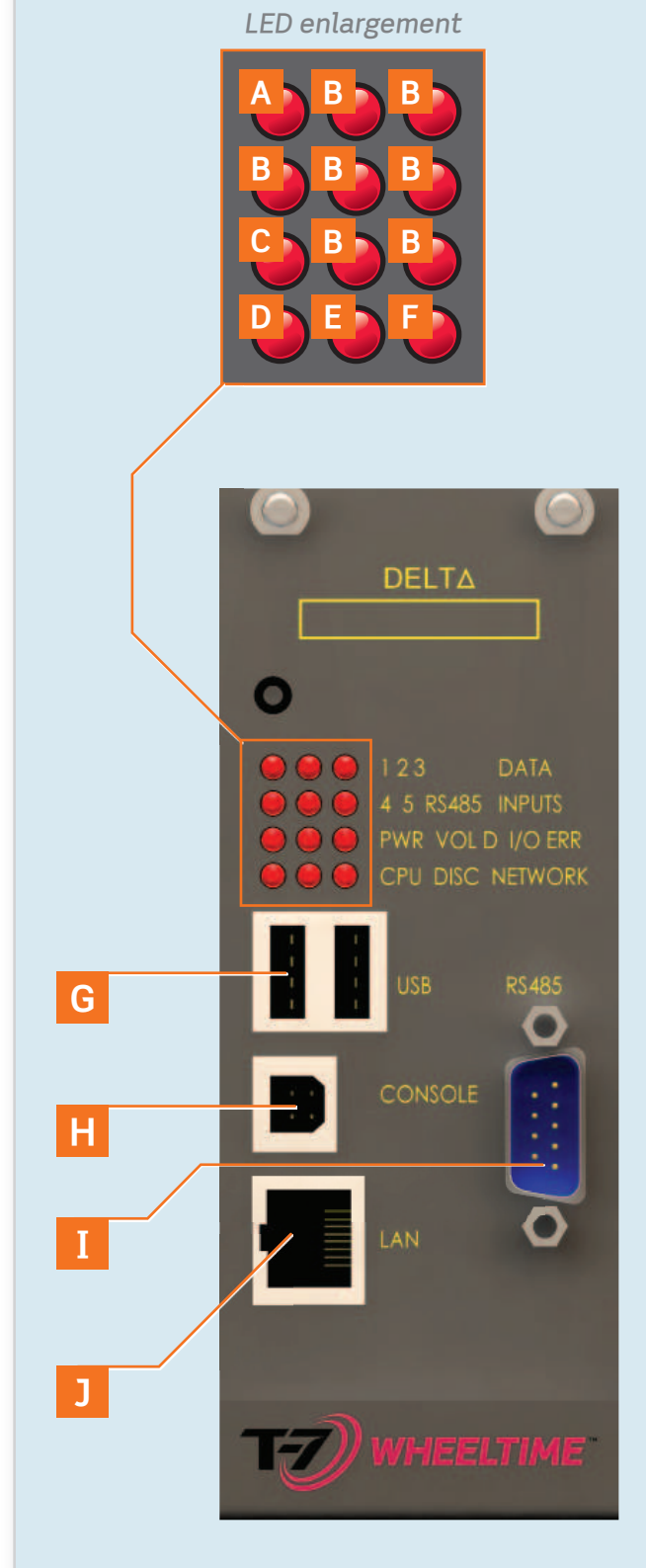
After switching off the Reader, the Delta will still run for two minutes to ensure that the onboard computer has shut down correctly.

The visible parts of the Delta Unit, as pictured in Figure 1.5, are:

- A Data from the UHF RFU** This LED shows when data is received from the UHF RFU to the Delta unit. The most common type of data received is the identity of a WheelTag.
- B Spare Indicators** These LEDs are not used in the WheelTime system.
- C Delta Unit Powered Indicator** This LED should be illuminated when the Reader is switched on to show that the Delta unit is powered.
- D CPU Activity Indicator** This LED shows that the microprocessor is operating. When operating correctly the CPU indicator will flash at approximately one second intervals.
- E Flash Disc Activity Indicator** This LED flashes when data is stored on the flash disc.
- F Network Activity Indicator** This LED shows that the Reader is transmitting tag data on the Ethernet port.
- G USB Port** The USB port is to only be used with appropriate hardware.
- H Console Port** This console port must not be used. It is to be used by qualified staff only.
- I Data Input Port** This port is used to store data from a Lite reader by the RS485 line.
- J LAN** This ethernet communication port is to network the Reader. It enables data transfer and Reader setup.

**Note:** It is recommend the Reader is turned on a minimum of 5 minutes before the first cyclist is seen. The Delta requires 1½ to 2 minutes to startup.

FIGURE 1.5: Delta Unit



No WheelTag reads will be stored during the startup process.

## Power Supply Unit

The Power Supply Unit manages the power supply of the Reader and its components.

### Battery specifications:

When the battery reaches a pre-set discharge voltage (approx 11.2 volts) the Reader will sound an alarm alerting the operator that an external battery or a filtered power supply is needed. This will continue to beep until the voltage reaches 12.2 volts. The operator has approximately 15 minutes to add a secondary power supply before the Reader shuts down to prevent damage occurring to its internal battery.

If external batteries are plugged in with incorrect polarity, beeps will be emitted by the Reader and the external battery will not connect.

The visible parts of the Power Supply Unit, as pictured in Figure 1.6, are:

### Power supply indicators:

These indicators correspond to each voltage used in the Reader. When the Reader is turned on, all should be illuminated.

**A +Vin** This indicates that the power supply unit is receiving 12V power from either the internal battery or an external source.

**B +12V TX** This indicates that the 12V supply to the UHF Controller is functioning correctly.

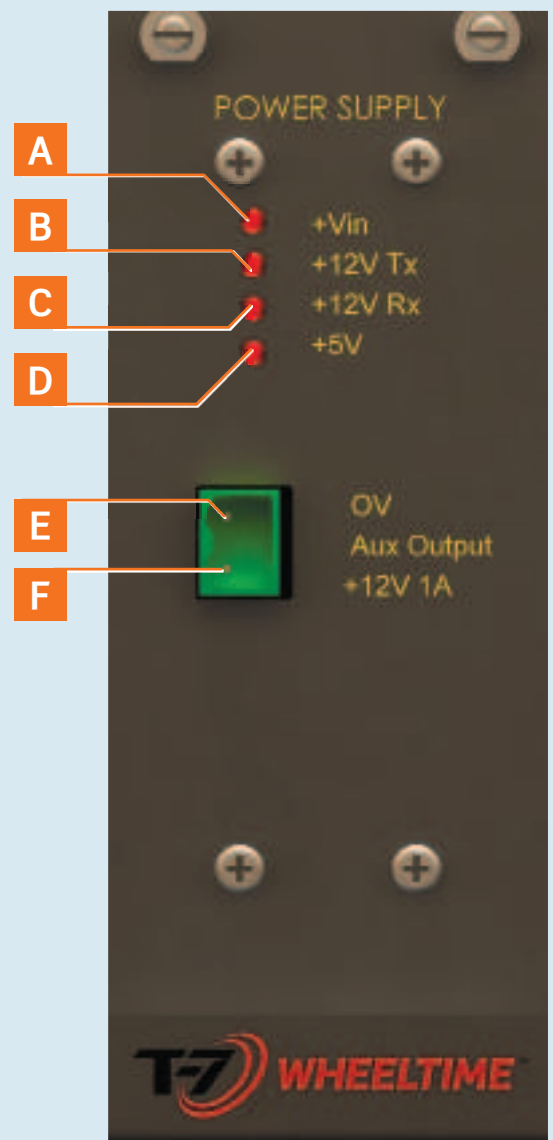
**C +12V RX** This indicates that the 12V supply to the UHF RFU is functioning correctly.

**D +5V** This indicates that the 5V supply to the Delta is functioning correctly.

### Auxiliary output:

There is a two pin power supply output (+12V 1A) that can be used to power a WiFi converter or a GPRS module for example. The upper pin is 0V **E**, and the lower pin is +12V **F**.

FIGURE 1.6: Power Supply Unit

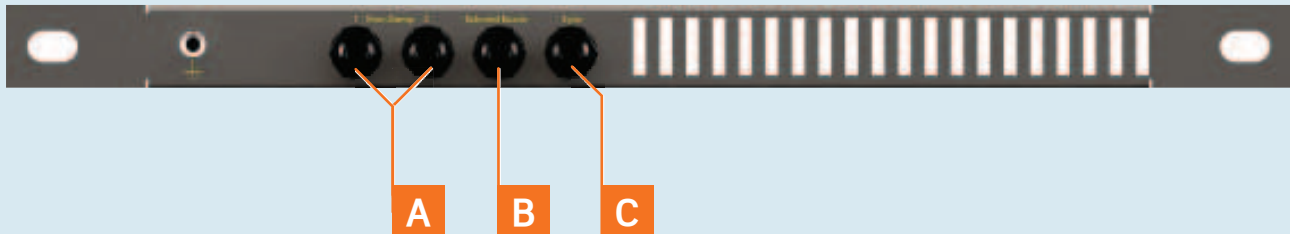




## Top Panel Unit

The visible parts of the Top Panel Unit, as pictured in Figure 1.7, are:

FIGURE 1.7: *Top Panel Unit*

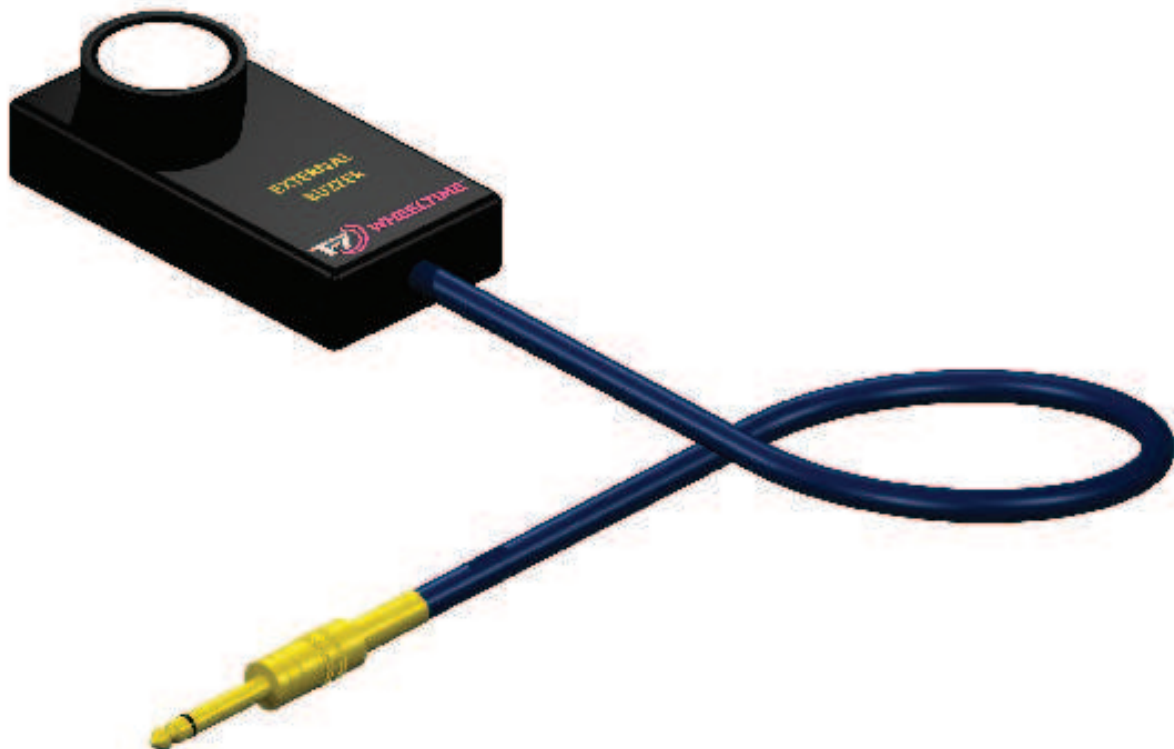


**A Time Stamp 1 & 2** There are two timestamp input connectors. They are in parallel. They use clean input contacts to connect external switches such as an acoustic coupler for a start gun, or an external switch. The action related to these inputs is to add a time and a date stamp into the data flow of the Reader.

**B External Loud Beeper** This connector allows a 12V DC loud beeper to be connected in order to allow the competitors, and WheelTime operators, to hear when they are detected. It is an optional accessory as pictured in Figure 1.8.

**C Synchronisation** Reserved for future use.

FIGURE 1.8: *External Beeper*



## Bottom Panel Unit

The Bottom Panel Unit houses the internal battery, access to the battery and the On/Off switch.

The visible parts of the Bottom Panel Unit, as pictured in Figure 1.9, are:

**A Reader On/Off switch** This is a rotary switch that switches on all units in the Reader.

**B Voltmeter** This displays the internal battery voltage. When red the internal battery needs to be charged before use. When orange the internal battery needs charging. When green there is sufficient energy in the internal battery to operate the Reader.

**C 12V battery sockets** There are 2 external battery input sockets. This allows adding an AC power supply unit or an external 12V battery that can be hot swapped without loss of data capture, or used to plug in a battery charger.

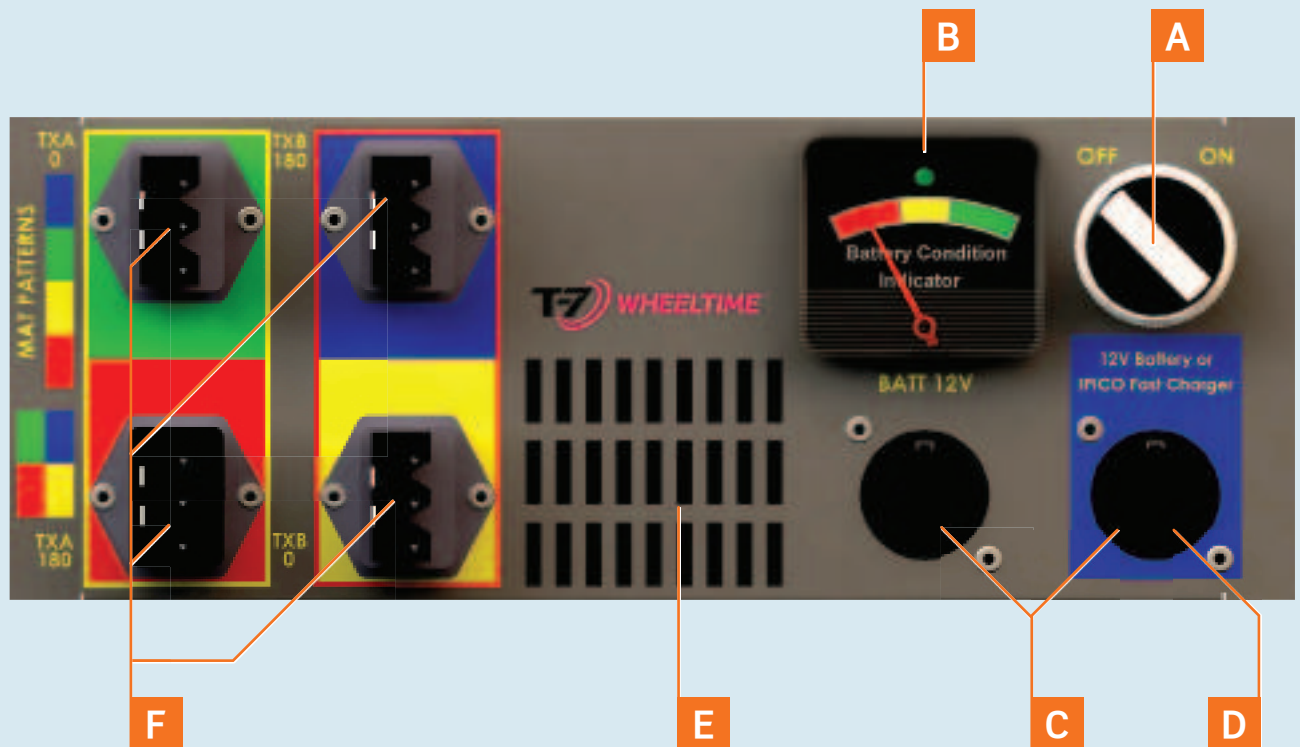
External batteries can be any 12V battery (automotive etc).

**D Fast charger socket** This battery socket allows an approved fast battery charger to be connected to the Reader.

**E Venting holes** These holes provide for circulation of air inside the Reader to cool it when it is used in high temperature environments.

**F TXA/TXB sockets** These sockets are not used in the WheelTime system.

FIGURE 1.9: Bottom Panel Unit



## Transmit Antenna Mats

The Transmit Antenna Mats transmit RF signals generated by the UHF Controller to the WheelTags.

One set of Transmit Antenna Mats is made up of six individual mats (pictured in Figure 1.10) defined by the length of the cable as detailed in the table beside. Each mat is 1.22m long and can be used individually or attached to another mat.

### Transmit Antenna Mat Set

Transmit Antenna Mat	Cable Length (m)	Cable Colour Code
Mat 1	2.62	Red
Mat 2	3.84	Green/Yellow
Mat 3	5.06	White
Mat 4	6.28	Grey
Mat 5	7.50	Brown
Mat 6	8.72	Yellow

FIGURE 1.10: *Transmit Antenna Mat*





## Connection Hub

The Connection Hub distributes RF signals throughout the WheelTime system. It connects all WheelTime Transmit Antenna Mats to the Reader. On one side, all six Transmit Antenna Mats are connected. On the other side the three cables of the Control Loom connect to the Reader, and two further Antenna Cables connect to the Roadside Antennas. The Connection Hub has one green LED for each of the six Transmit Antenna Mats to indicate the correct presence of the RF signals from the Reader. It also has one red LED for each of the six Transmit Antenna Mats to indicate the incorrect connection of the Transmit Antenna Mats to the Connection Hub.

The visible parts of the Connection Hub, as pictured in Figure 1.11, are:

**A TX-1 Connector** This connector receives the RF signal from the UHF Controller, and is used to power Transmit Antenna Mats 1, 3, and 5. The 12V power supply for illuminating the LEDs for mats 1, 3, and 5 is provided through this connector.

**B TX-2 Connector** This connector receives the RF signal from the UHF Controller, and is used to power Transmit Antenna Mats 2, 4, and 6. The 12V power supply for illuminating the LEDs for mats 2, 4, and 6 is provided through this connector.

**C RX-1 Connector** This connector provides the received RF signal to the UHF RFU. The Connection Hub constructs this signal by combining the signals from the ports ANT-1 and ANT-2.

**D ANT-1 Connector** This connector receives RF signal from a Roadside Antenna. The Connection Hub forwards this signal to the UHF RFU through the RX-1 Connector.

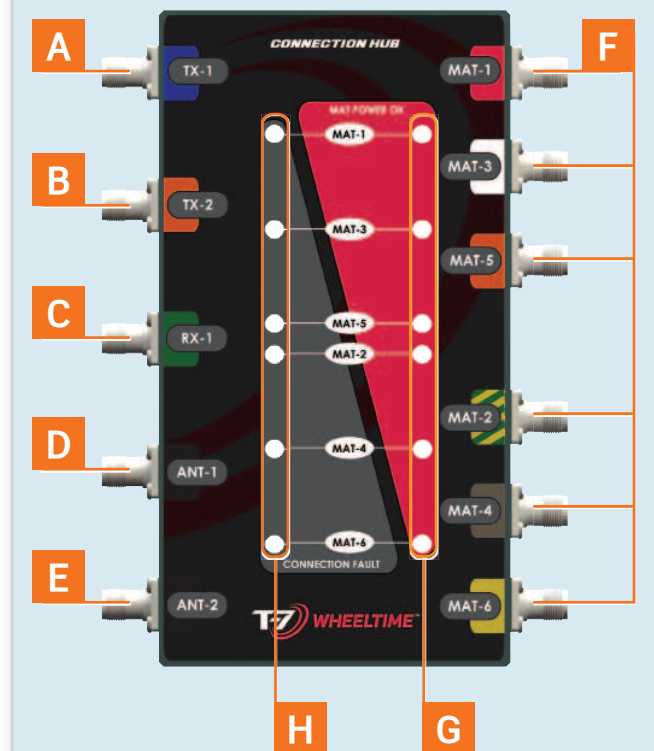
**E ANT-2 Connector** This connector receives RF signal from a . The Connection Hub forwards this signal to the UHF RFU through the RX-1 Connector.

**F MAT-n Connectors** The six connectors (Mat-1 to Mat-6) provide RF signal to the six Transmit Antenna Mats.

**G Mat Power OK** The six green LED indicators should be illuminated when the Reader is switched on to show that RF power is being provided to each of the six Transmit Antenna Mats. This LED may appear to be on continuously, or to be blinking (the blinking is particularly noticeable in start mode).

**H Mat Connection Fault** The six red LED indicators should not be illuminated. They are illuminated only when the Transmit Antenna Mats are not correctly connected to the Connection Hub, or there is a fault in the Transmit Antenna Mat.

FIGURE 1.11: Connection Hub



## Roadside Antenna

The Roadside Antennas receive RF signals from the WheelTags when they are activated by the Transmit Antenna Mats. These RF signals are then sent to the Connection Hub, and from there to the UHF RFU.

**Note:** There is one connector on the back of a Roadside Antenna.

FIGURE 1.12: Roadside Antenna and Stand



## Chute Antenna

The Chute Antennas receive RF signals from the WheelTags when they are activated by the Transmit Antenna Mats. These RF signals are then sent to the Connection Hub, and from there to the UHF RFU. Note that the Chute Antenna and the Roadside Antenna have different receive capabilities and are designed to be used together.

**Note:** There are two connectors on the back of a Chute Antenna.

FIGURE 1.13: Chute Antenna and Stand

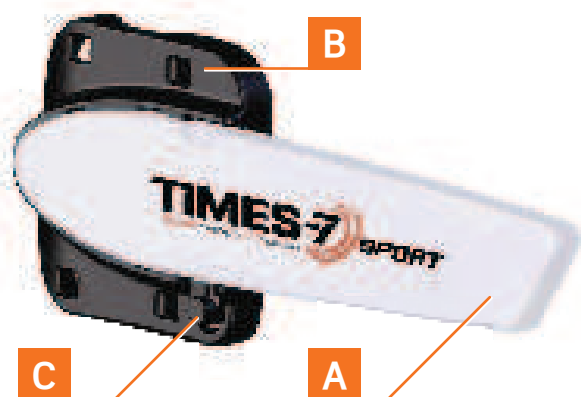


## WheelTag and Holder

The WheelTag is the item that uniquely identifies each competitor. The black Holder affixes to the front fork of the bicycle, and the WheelTag mounts in the Holder. The WheelTag is energized and activated by the RF signal from the Transmit Antenna Mats, and is read by the Roadside Antennas.

The WheelTag **A** can be released from the Holder **B** by pushing the quick release button **C**. This feature enables the WheelTag to be passed quickly between relay riders or to be easily moved to another bicycle with a Holder already affixed.

FIGURE 1.14: WheelTag and Holder



## Registration Reader

The **Registration Reader** is a compact unit for close proximity reading of WheelTags, that replaces the Connection Hub, Roadside Antennas, and Transmit Antenna Mats. The Registration Reader is for use in an indoor environment, for example for registering tags into a database, or for performing quick functional checks on WheelTags.

The Registration Reader connects to the Reader using the Control Loom.

The visible parts of the Registration Reader, as pictured in Figure 1.15, are:

**A RX-1 Connector** This connector provides the received RF signal to the UHF RFU. The Registration Reader receives this signal directly from the WheelTags.

**B TX-2 Connector** This connector receives the RF signal from the UHF Controller. This is not used by the Registration Reader, but should be connected in order to correctly terminate the UHF Controller RF outputs.

**C TX-1 Connector** This connector receives the RF signal from the UHF Controller, and is used to power the Registration Reader.

FIGURE 1.15 *Registration Reader*



## Control Loom

The **Control Loom** carries the RF signal from the UHF Controller to the Connection Hub or Registration Reader and from the Connection Hub to the UHF RFU.

The visible parts of the Control Loom, as pictured in Figure 1.16, are:

**A RX ANT** This cable carries the RF signal from the RX-1 connection on the Connection

Hub or the Registration Reader to the RFU Rx connection on the UHF RFU.

**B TX-2 Port** This cable carries the RF signal from the TX-Port2 connection on the UHF Controller to the TX-2 connection on the Connection Hub or the Registration Reader.

**C TX-1 Port** This cable carries the RF signal from the TX-Port1 connection on the UHF Controller to the TX-1 connection on the Connection Hub or the Registration Reader.

FIGURE 1.16 *Control Loom*



## Field Strength Meter

The Field Strength Meter measures the strength of the RF field produced by the Transmit Antenna Mats. To operate the Field Strength Meter, it should be held so that it is pointing in the same direction that a cyclist would travel, and the power button should be pressed continuously. When the RF field is detected with sufficient strength to operate a WheelTag in race conditions, the 'Acceptable' LED on the Field Strength Meter will be illuminated. The remaining two LEDs will illuminate as the field becomes even stronger. The best assessment of the RF field strength is made directly above the Transmit Antenna Mats, at the same height at which the WheelTag mounts onto the bicycle fork.

When operating the Field Strength Meter, keep your hands away from the top left corner of the meter, as this is where the sensitive RF receive antenna is located.

The visible parts of the Field Strength Meter, as pictured in Figure 1.17, are:

**A ON (Power Button)** Press and hold this button to operate the Field Strength Meter.

**B Power** The Power LED should be illuminated when the ON (power button) is pressed to show that the Field Strength Meter is operating.

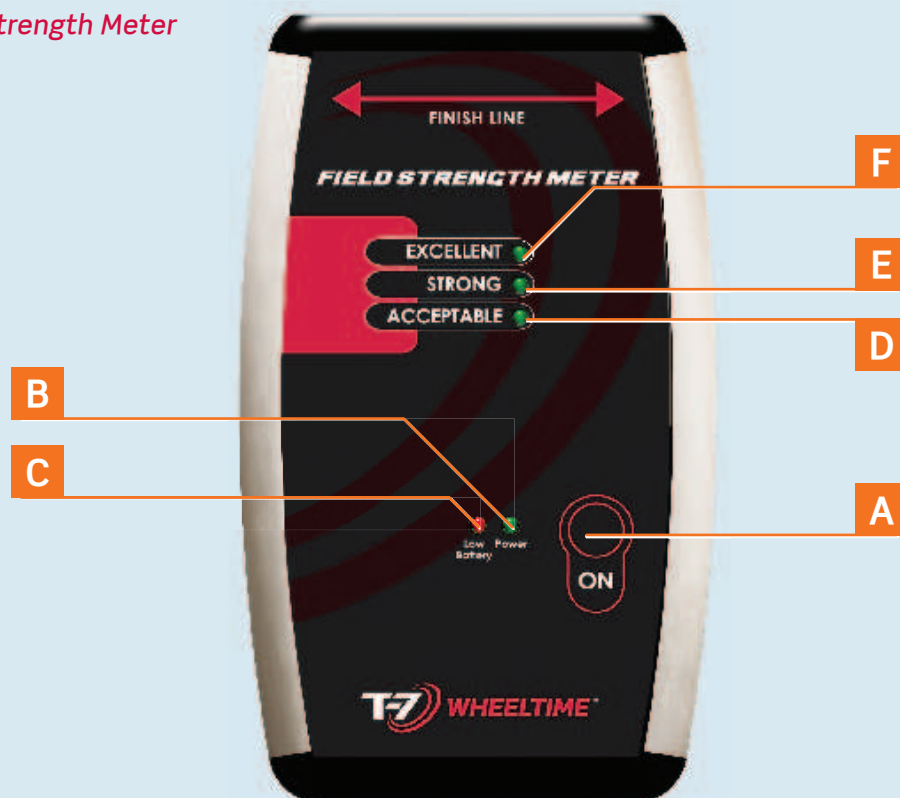
**C Low Battery** The Low Battery LED should not be illuminated. It will be illuminated when the 9V battery is running low. When this LED is illuminated it is time to replace the 9V battery.

**D Acceptable** The Acceptable LED will be illuminated when the Field Strength Meter is held inside an RF field in the correct orientation. This LED indicates that the RF field is sufficiently strong to activate and detect WheelTags (at the location and orientation where the meter is held).

**E Strong** The Strong LED will be illuminated when the power of the RF field is 60% (2dB) higher than the power level required to activate the Acceptable LED.

**F Excellent** The Excellent LED will be illuminated when the power of the RF field is 2.5 times (4dB) higher than the power level required to activate the Acceptable LED.

FIGURE 1.17 *Field Strength Meter*



# 02 INSTALLATION GUIDE

**This section outlines the procedure for setting up the standard WheelTime system configuration and confirming it is operating correctly.**

## System Deployment

As shown in Figures 2.1 and 2.2, the WheelTime system is deployed with the 6 Transmit Antenna Mats defining the finish line (or the start line, split timing point, etc.) in order from number 1 through to number 6. Transmit Antenna Mat number 1 is closest to the side of the road where the Reader will be located. The mats are joined using the Velcro strips on the end of each mat. The cables from the Transmit Antenna Mats are placed in a cable duct in the mats to ensure they are protected. The Transmit Antenna Mat cables are all numbered and colour coded. These are connected to the corresponding connector on the Connection Hub. Note that the connection must be tight to guarantee maximum transmission.

The Roadside Antennas are placed 2 metres forward and one metre to the side of the edge of Transmit Antenna Mats 1 and 6 in the direction the cyclists will travel. Both need to be vertical and are to be angled to point towards the centre of the finish line to ensure all WheelTags are captured. The Antenna 1 cable is connected to the Roadside Antenna closest to the Reader. The Antenna 2 cable is connected to the far side Roadside Antenna and is run through the cable duct of the

Transmit Antenna Mats for protection. The two cables are then connected to the corresponding Ant-1 and Ant-2 connectors on the Connection Hub. Note that the connection must be tight to guarantee maximum reception.

The lid of the Reader needs to be removed to enable the cables to be connected. Check the RF Link cable is correctly attached to the RFU TX and TX-LINK connectors on the Reader. The Control Loom then needs to be connected to the UHF RFU, UHF Controller, and the Connection Hub. Each cable is labelled and colour coded to assist in attaching the cables correctly. Note that the connections must be tight to guarantee maximum transmission and reception.

An external battery or AC power source can be connected to either of the Batt 12V sockets on the Reader. This will extend the running time of the Reader.

An external beeper can be plugged into the external beeper socket of the Reader to provide an audible signal of a WheelTag being read.

A computer running the event management software, SportScore, can be connected to the LAN port of the Delta using an Ethernet cross-over cable, or via an Ethernet switch or hub with a standard Ethernet cable.

Once the system is connected it can be turned on and its operation tested. A beep will sound 2 seconds after the system is switched on.

FIGURE 2.1

## Standard System Configuration

## Overall Layout

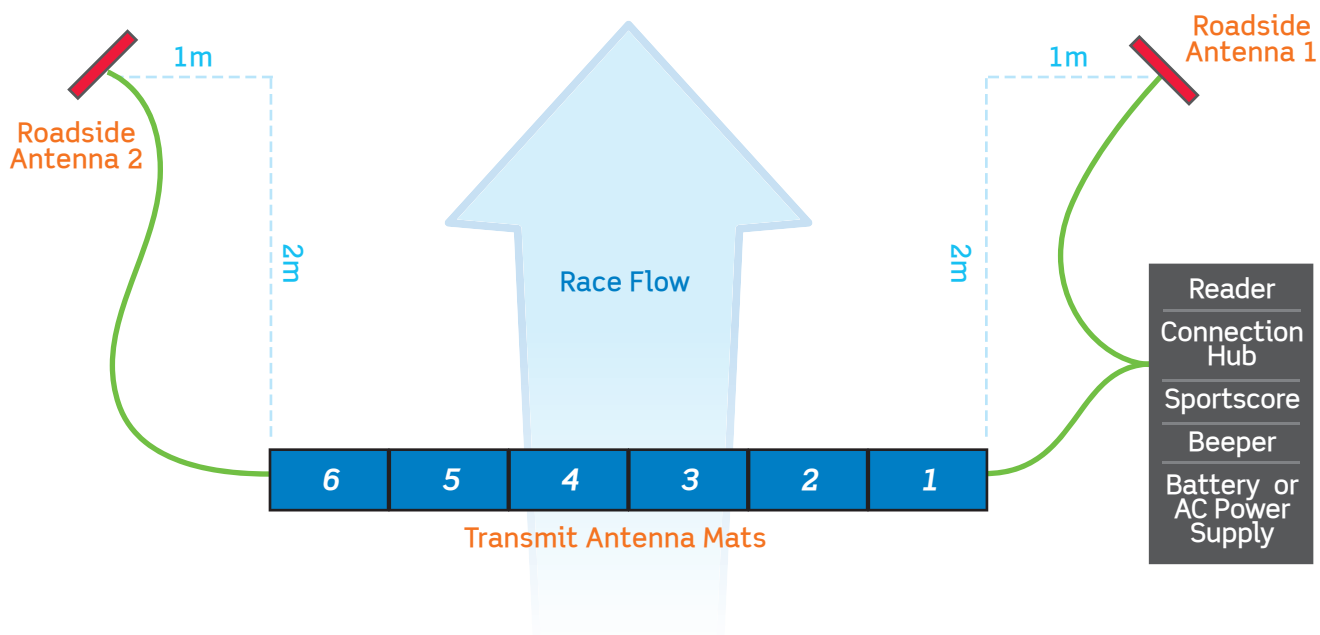
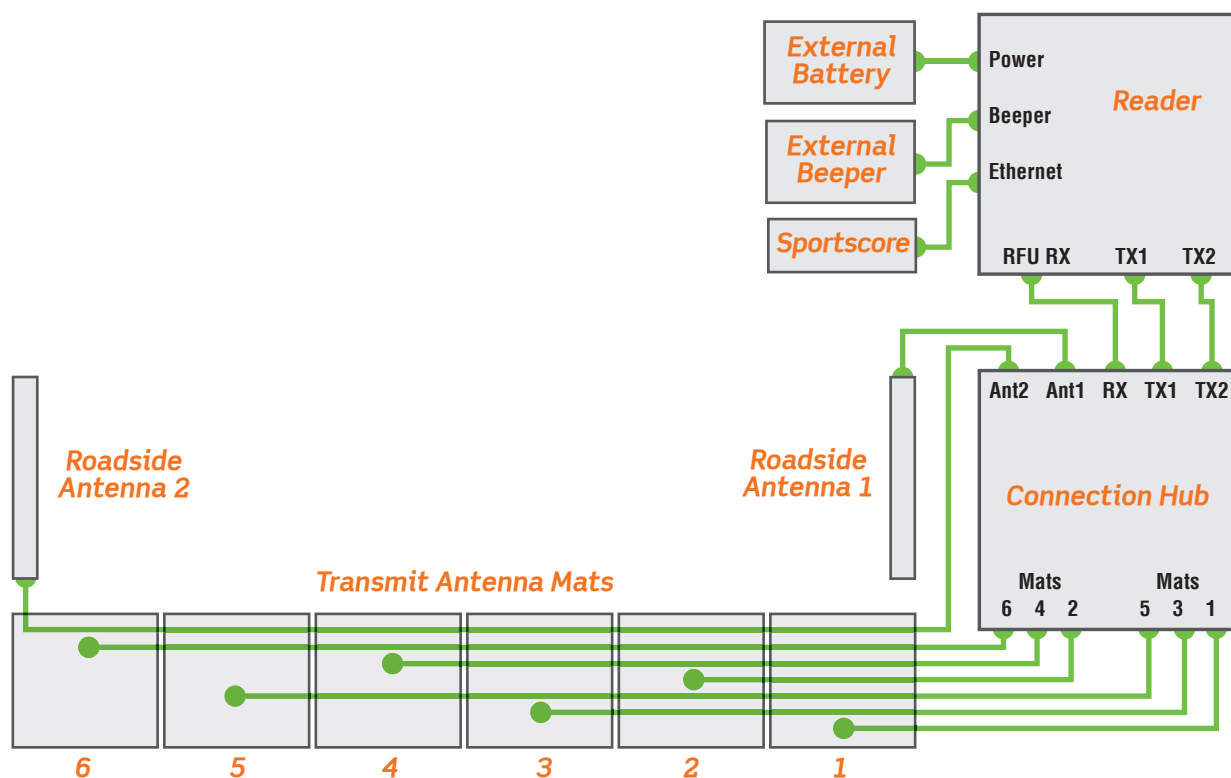


FIGURE 2.2

## Standard System Configuration

## Wiring Diagram





## System Operation

Two minutes after the WheelTime Elite Reader has been turned on the diagnostic lights need to be checked. **Note:** The Reader will not capture tags while it is starting up.

The table below shows the normal state of the diagnostic lights after a successful startup:

Component	Light Label	On/Off
UHF RFU	PWR	On
	FAULT	Off
	IACT	Off
	QACT	Off
	TAG	Pulsed*
Delta	PWR	On
	2 DATA	Off
	3 DATA	Off
	4 DATA	Off
	5 DATA	Off
	RS485	Off
	I/O ERR	Off
	1 DATA	Pulsed*
	VOL D	Pulsed*
	CPU	Pulsed*
	DISC	Pulsed*
	NETWORK	Pulsed*
UHF Controller	TX-1 POWER	On
	TX-2 POWER	On
	CONNECTION FAULT	Off
	CONNECTION FAULT	Off
Power Supply	+Vin	On
	+12V TX	On
	+12V Rx	On
	+5 V	On
Bottom Panel	BATT VOLTS	>12.0V
	or green after >12V	

Component	Light Label	On/Off
Connection Hub	MAT POWER OK MAT-1	On
	MAT POWER OK MAT-2	On
	MAT POWER OK MAT-3	On
	MAT POWER OK MAT-4	On
	MAT POWER OK MAT-5	On
	MAT POWER OK MAT-6	On
	CONNECTION FAULT MAT-1	Off
	CONNECTION FAULT MAT-2	Off
	CONNECTION FAULT MAT-3	Off
	CONNECTION FAULT MAT-4	Off
	CONNECTION FAULT MAT-5	Off
	CONNECTION FAULT MAT-6	Off

\* A 'pulsed' LED light is illuminated when a WheelTag is read, or when other activity is occurring, otherwise it is off.

The WheelTime system uses the six Transmit Antenna Mats as a transmitting RF source, and the Roadside Antennas as receiving antennas. The six Transmit Antenna Mats provide a curtain of RF energy which energises the WheelTags as they pass through the curtain (i.e. as the WheelTag passes over the finish line). The performance of the RF curtain can be measured using a Field Strength Meter. The meter should be moved across each of the Transmit Antenna Mats to ensure that each mat is transmitting an acceptable level of RF energy.

The WheelTag transmits its unique identifier code once it has been energised by the Transmit Antenna Mats. This signal is then received by the Roadside Antenna and the time it is received is saved in the Delta.

To check the Roadside Antennas are working, a WheelTag is moved along the mat with the constant buzzing of the beeper indicating that the system is transmitting and receiving the RF energy. Each antenna can be tested individually by disconnecting the other antenna.

The WheelTime system has two modes of operation, named 'Start' and 'Finish' which is controlled with a toggle switch on the front of the Reader (on the UHF Controller). 'Start' mode is used for situations with highly congested riders, whilst 'Finish' mode is used in all other situations.

## WheelTag Attachment

**A WheelTag Holder is firmly attached to the bicycle's front left fork, using plastic cable ties. The WheelTag easily locks into the Holder retained by a push-button release lever.**

**Note:** the performance of the WheelTag is optimised when the longer edge of the Tag is at the top as shown in Figure 2.3.

If the WheelTag is mounted too high on the fork, the rim of the wheel will adversely impact the performance of the WheelTag. The WheelTag should not be modified in any way. Certain materials if stuck on the WheelTag will adversely effect its identification by the WheelTime system.

FIGURE 2.3: *WheelTag and Holder Fitting Instructions*



- Remove double-sided tape backing on back of the Holder.
- Position black Holder on FRONT LEFT FORK, 4 fingers (80mm) below rim.
- Pull cable ties TIGHT. Ensure Holder remains flush to fork.

**Note:** If you are in a team event all members must have a Holder on their bike.

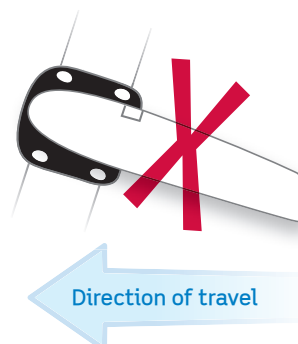
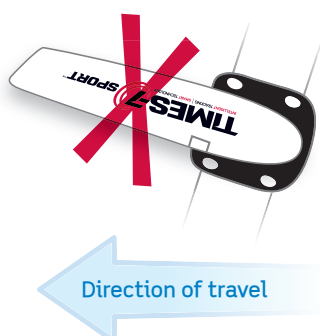


- Slide WheelTag into Holder until it clicks.
- Print must be the right way up with the longer edge of the Tag at the top (see below).
- Give WheelTag a gentle tug to ensure it is secure.
- To remove the WheelTag, press release button and slide tag out.



**WheelTag correctly attached**

- ✓ Holder secure
- ✓ WheelTag secure
- ✓ On left front fork
- ✓ Placed 4 fingers (80mm) below wheel rim.





## Precautions for Use

- ❗ Where possible the Reader and mats should be placed at a distance of at least 10m from other electromagnetic field generating equipment such as fan motors, audio equipment etc.
- ❗ The system must always be switched on with the six Transmit Antenna Mats connected or with terminators in their place.
- ❗ Do not use handheld radios or cellular phones within 20m as they may interfere with the WheelTime system.
- ❗ Do not place two WheelTime systems within 100m of each other.
- ❗ When deploying the system, obey road rules at all times and follow good safety protocols. It is strongly recommended the Reader is set up on the verge of the road.



# 03 CONFIGURATION GUIDE

WheelTime can be deployed in a number of alternate configurations outside of the standard installation defined in section 2. The alternate configurations are described in this section.

## Narrow Chute Configuration

When the start or finish of a bike race is conducted in a narrow chute (where it is difficult or impossible to locate side antenna 1m back from the end of the line of Transmit Antenna Mats), the WheelTime system may be deployed in the narrow chute configuration, using the Chute Add-on Equipment (refer Figure 3.1 and 3.2). The Chute Add-on Equipment consists of two extra Narrow Chute

Antenna, and two 4m cables to connect them into the WheelTime system. This configuration can also be used when it is impossible to not have spectators stand in front of the antennas.

## Alternate finish line configuration (narrow chute)

If the finish line area in which the WheelTime system is deployed is particularly narrow, it is possible to reconfigure the pattern of the Transmit Antenna Mats as shown in Figure 3.3.

**Note:** the terminators are required to be fitted to the MAT-X connectors of the Connection Hub when no Transmit Antenna Mat is connected.

FIGURE 3.1 **Narrow Chute Overall Layout**

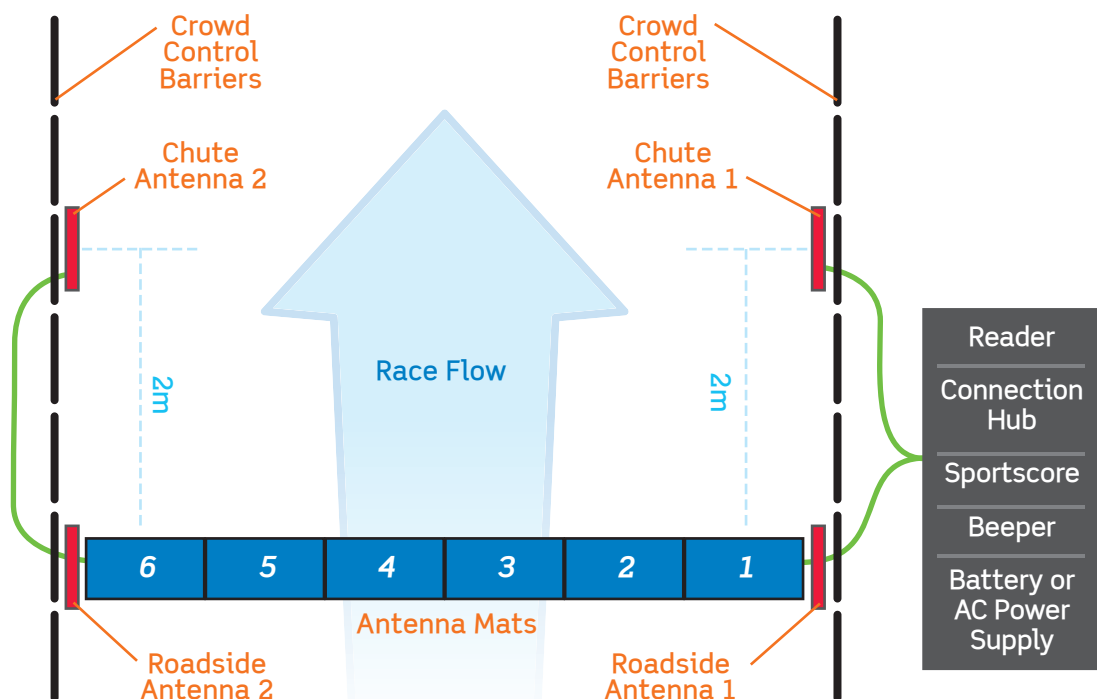


FIGURE 3.2 **Narrow Chute** Wiring Diagram

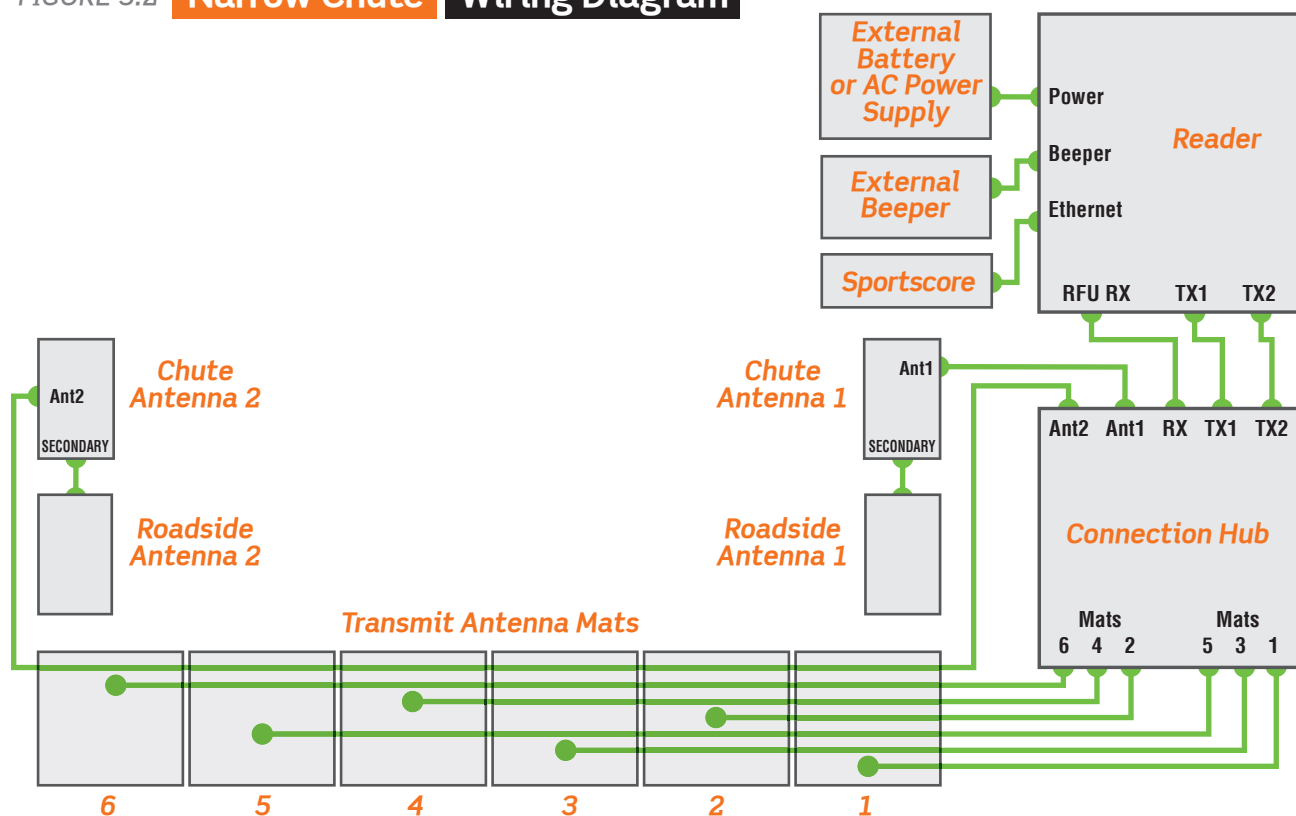
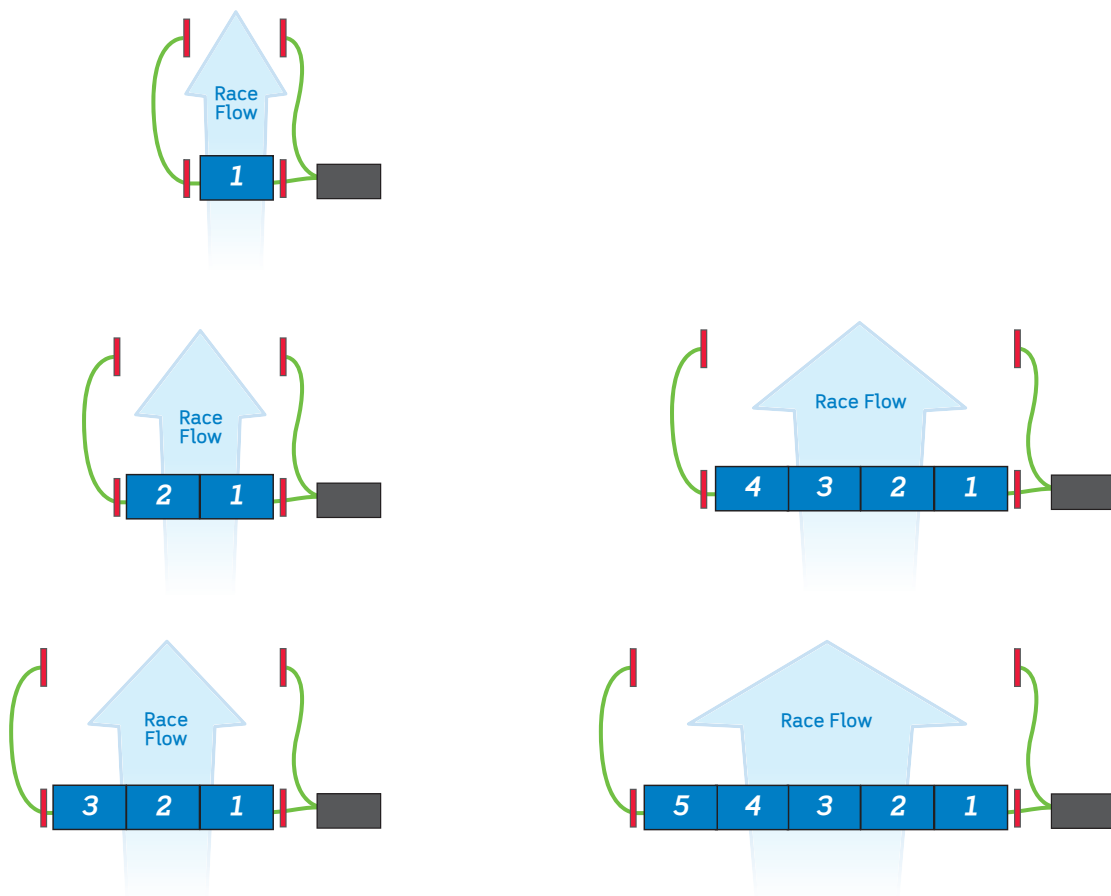


FIGURE 3.3 **Narrow Chute** Alternative Configurations



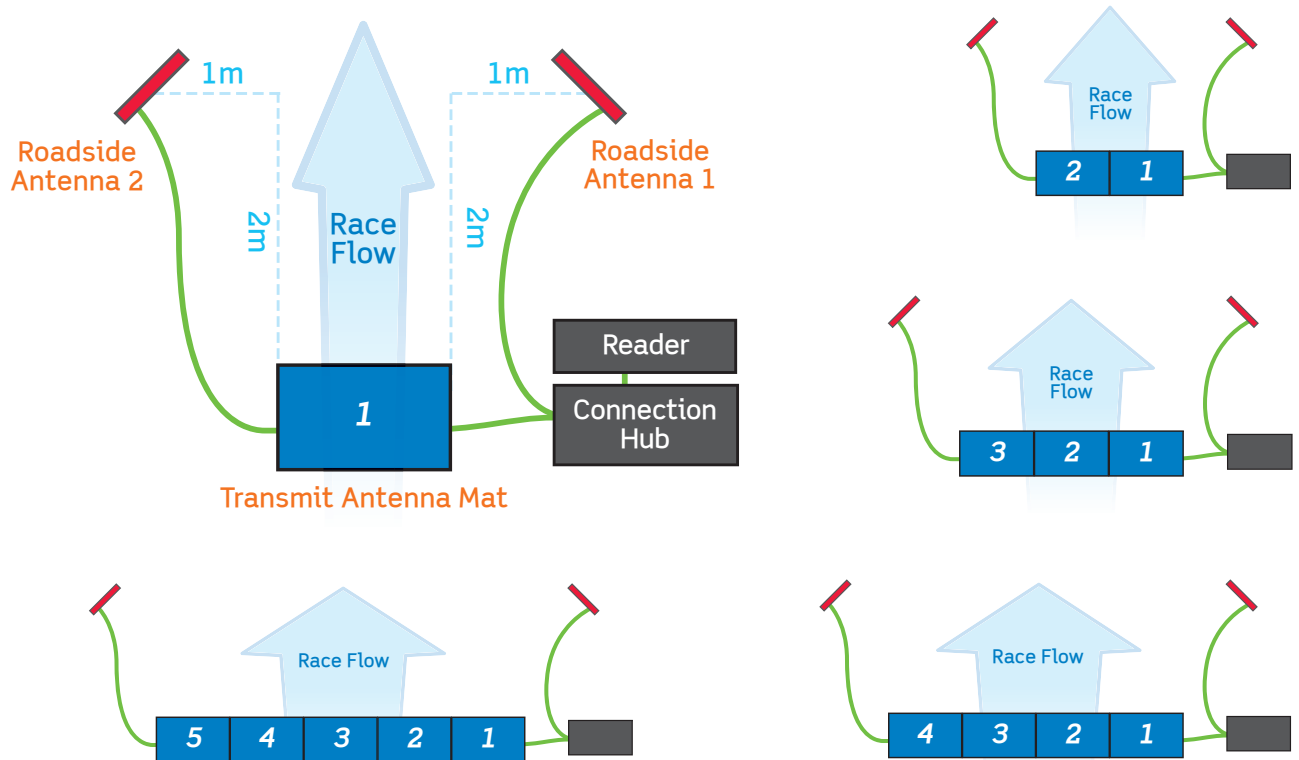
## Two Roadside Antenna

In all configurations shown in this section, the wiring diagram is the same as shown in Figure 2.2, except that where a Transmit Antenna Mat is omitted, a terminator should be connected to the Connection Hub in place of that mat.

FIGURE 3.4

### Two Roadside Antenna

### Alternative Configurations



## One Roadside Antenna

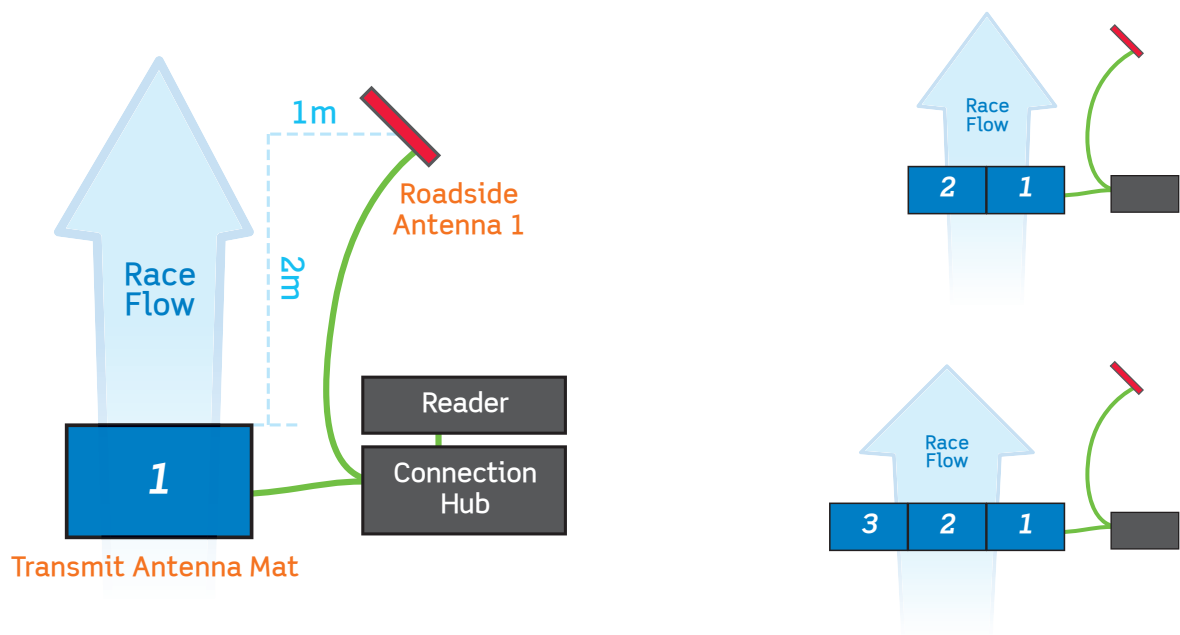
The WheelTime system can also be set up to operate with one Roadside Antenna. If only one Roadside Antenna is used the antenna should be plugged directly into the RFU connector on the UHF RFU.

In all configurations shown in Figure 3.5, the wiring diagram of the transmit section of the WheelTime

system is the same as shown in Figure 2.2, except that where a Transmit Antenna Mat is omitted, a terminator should be connected to the Connection Hub in place of that mat.

**Note:** the single Roadside Antenna configurations are not recommended for a setup with more than 3 Transmit Antenna Mats in a row.

FIGURE 3.5 One Roadside Antenna Alternative Configurations



## One Roadside Antenna & One Chute Antenna

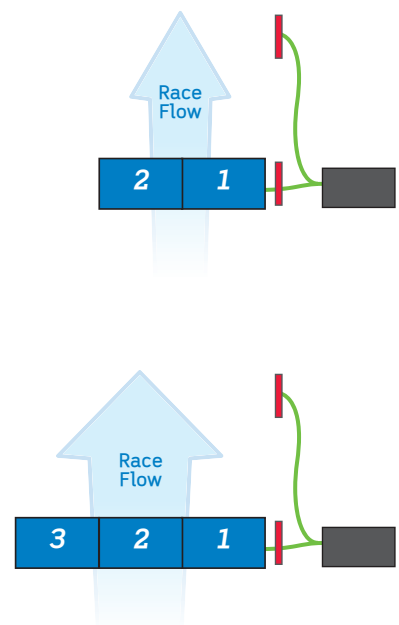
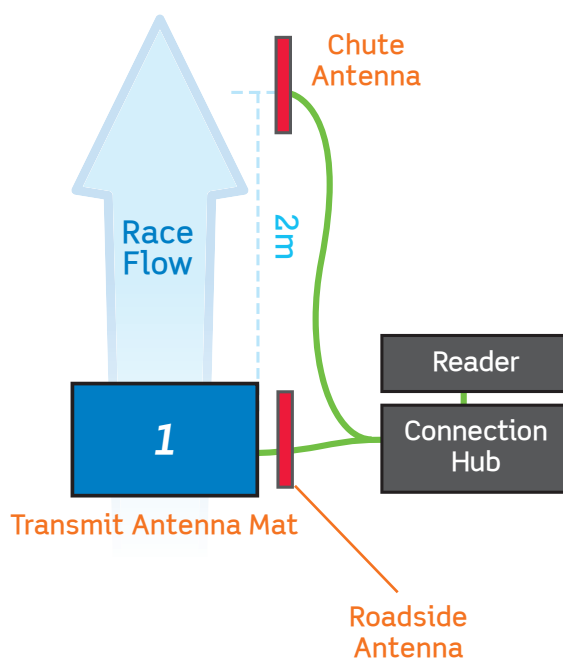
**In a narrow chute the WheelTime System can also be set up to operate with one Chute Antenna and one Roadside Antenna.**

In all configurations in Figure 3.6, the wiring diagram of the transmit section of the WheelTime

system is the same as shown in Figure 3.2 except that where a Transmit Antenna Mat is omitted, a terminator should be connected to the Connection Hub in place of that mat.

**Note:** the single Roadside and Chute Antenna Configuration are not recommended for a setup with more than 3 Transmit Antenna Mats in a row.

**FIGURE 3.6** One Roadside Antenna & One Chute Antenna  
Alternative Configurations







# 04 ALARMS & NOTIFICATIONS

There are a number of alarms or notifications that the system will raise when a part of the system is not performing as designed.

Equipment	Alarm or Notification	Explanation and Corrective Actions
<b>Field Strength Meter</b>	Power LED	This LED is normally on (when the ON button is pressed and held down). It indicates that the Field Strength Meter is turned on. If it is not illuminated, replace the battery in the Field Strength Meter.
	The Low Battery LED is illuminated	The 9V battery inside the Field Strength Meter is running low. Replace the battery.
	Acceptable LED	This LED indicates that the RF power (at the present location and orientation of the meter) is sufficiently strong to activate and detect a WheelTag in race conditions.
	Strong LED	This LED indicates that the RF power (at the present location and orientation of the meter) is 60% (2dB) higher than the power level required to activate the Acceptable LED.
	Excellent LED	This LED indicates that the RF power (at the present location and orientation of the meter) is 2.5 times (4dB) higher than the power level required to activate the Acceptable LED.
<b>Reader</b>	Digital Voltmeter	<p>Note that some models of the Reader have digital voltmeters, while other models have analogue voltmeters.</p> <p>The digital voltmeter indicates the actual voltage of the internal battery. Nominally this is 12V, but fully charged batteries may show 12.5V or even higher.</p>
	Analogue Voltmeter	<p>Note that some models of the Reader have digital voltmeters, while other models have analogue voltmeters.</p> <p>The analogue voltmeter indicates whether the power supply voltage is high, low, or in between.</p>
	Audio Alarm (Battery)	<p>This is caused by either of two separate circumstances:</p> <ol style="list-style-type: none"> <li>1 - The power supply voltage is low (below 11.1V), or</li> <li>2 - An external battery is connected with reverse polarity.</li> </ol> <p>If the alarm started when an external battery was connected, then check the polarity of the battery connection.</p> <p>Otherwise, apply a battery charger or other external source of 12V power to the Reader.</p> <p>Note that once this alarm has started due to a low battery condition, the alarm will continue to sound until the power supply reaches a level of 12.2V. Alternatively the Reader can be manually turned off and on again to reset this alarm.</p> <p><b>Warning:</b> The Reader will take at least 4 mins to complete the reboot process. You cannot capture tag data during this time.</p>

Continued next page...

Equipment	Alarm or Notification	Explanation and Corrective Actions
Reader	Flashing Digital Voltmeter (flashing on and off every few seconds)	<p>This is caused by an extremely low power supply voltage (below 10.2V).</p> <p>In this condition the Reader will not be powered (other than the voltmeter). To correct this situation, apply a battery charger or other external source of 12V power to the Reader.</p> <p>Note that in this condition, power will not be restored to the Reader until the power supply reaches a level of 11.25V. Alternatively the Reader can be manually turned off and on again to reset this alarm.</p>
	Reader has no functionality except for the analogue power meter and a low power audio alarm	<p>This is caused by an extremely low power supply voltage (below 10.2V).</p> <p>In this condition the Reader will not be powered (other than the voltmeter). To correct this situation, apply a battery charger or other external source of 12V power to the Reader.</p> <p>Note that in this condition, power will not be restored to the Reader until the power supply reaches a level of 11.25V. Alternatively the Reader can be manually turned off and on again to reset this alarm.</p>
Power Supply	+Vin	This LED is normally on. It indicates that the power supply unit is receiving 12V power from either the internal battery or an external source.
	+12V TX	This LED is normally on. It indicates that the 12V supply to the UHF Controller is functioning correctly.
	+12V RX	This LED is normally on. It indicates that the 12V supply to the UHF RFU is functioning correctly.
	+5V	This LED is normally on. It indicates that the 5V supply to the Delta is functioning correctly.
RFU	PWR	This LED is normally on. It indicates that the 12V supply to the UHF RFU is functioning correctly.
	Fault	This LED is normally off. When illuminated it indicates a power supply fault whereby the ground pin of the USB port and the ground of the Reader are separated by over 50 Volts. This is a rare but serious fault.
	IACT	This LED is reserved for future use.
	QACT	This LED is reserved for future use.
	TAG	This LED is normally off but it flashes on whenever a WheelTag is detected by the UHF RFU. This LED may (or may not) also briefly activate approximately every 2 or 3 minutes.
	Beeper	This beeper is normally off but it emits a beep whenever a WheelTag is detected by the UHF RFU.

Continued next page...

Equipment	Alarm or Notification	Explanation and Corrective Actions
<b>UHF Controller</b>	TX-1 Power OK	This LED is normally on. It indicates that the RF Power transmitted from the UHF Controller on TX-Port1 is operating correctly.
	TX-1 Connection Fault	This LED is normally off. When illuminated it indicates that either the Connection Hub is not connected to the UHF Controller TX-Port1, or Transmit Antenna Mats 1, 3, and/or 5 are not connected to the Connection Hub, or a terminator is not connected to the Connection Hub.
	TX-2 Power OK	This LED is normally on. It indicates that the RF Power transmitted from the UHF Controller on TX-Port2 is operating correctly.
	TX-2 Connection Fault	This LED is normally off. When illuminated it indicates that either the Connection Hub is not connected to the UHF Controller TX-Port2, or Transmit Antenna Mats 2, 4, and/or 6 are not connected to the Connection Hub, or a terminator is not connected to the Connection Hub.
<b>Connection Hub</b>	Mat Power OK - Mat 1 - Mat 2 - Mat 3 - Mat 4 - Mat 5 - Mat 6	These LEDs are normally on. They indicate that the RF Power is being transmitted correctly to the corresponding Transmit Antenna Mat.
	Connection Fault - Mat 1 - Mat 2 - Mat 3 - Mat 4 - Mat 5 - Mat 6	These LEDs are normally off. When illuminated they indicate that the corresponding Transmit Antenna Mat or terminator is not connected to the Connection Hub, or that there is a fault in the Transmit Antenna Mat.
<b>Delta during startup</b>	Data Input LEDS 1-5	A slow cycling through these LEDs (about 5 seconds for each LED) indicates that the Delta is performing a built-in self test as part of its startup procedure.

Continued next page...

Equipment	Alarm or Notification	Explanation and Corrective Actions
<b>Delta</b>	Data Input 1	This LED indicates that there is serial traffic activity occurring between the UHF RFU and the Delta. The most common cause of this serial traffic is the detection of a WheelTag by the UHF RFU.
	Data Input 2	This LED is normally off and is reserved for future use.
	Data Input 3	This LED is normally off and is reserved for future use.
	Data Input 4	This LED is normally off and is reserved for future use.
	Data Input 5	This LED is normally off and is reserved for future use.
	RS485	This LED indicates that there is activity on the RS485 port.
	PWR	This LED is normally on. It indicates that the Delta is powered correctly.
	Vol D	This LED indicates that the Delta has Volatile Data stored, that is not yet written into non-volatile storage (the flash disc). This LED should not remain on for extended periods of time.
	IO ERR	This LED is normally off. When illuminated it indicates that an I/O error has occurred.
	CPU	This LED indicates that there is CPU activity.
	DISC	This LED indicates that there is flash disc activity.
	NETWORK	This LED indicates that there is tag data being transmitted on the LAN Port.
	LAN Port, Upper LED	This LED indicates that a computer (or other Ethernet device) is correctly connected to the LAN port.
	LAN Port, Lower LED	This LED indicates that there is activity on the LAN Port.
<b>External Beeper</b>	Beeper	This beeper is normally off but it emits a loud beep whenever a WheelTag is detected by the UHF RFU. This beeper may (or may not) also briefly activate approximately every 2 or 3 minutes.
<b>Fast Charger</b>	Green LED	<p>After reaching approximately 80% charge, the Green LED will turn off, but you should leave batteries connected until they are used to ensure the battery is fully charged.</p> <p>To check that battery is fully charged, turn AC power off for about 30 seconds then turn back on. The LED should light momentarily then go off.</p> <p>This battery charger may be left connected to a fully charged battery indefinitely as overcharging is impossible.</p>

# 05 CARE & MAINTENANCE PROCEDURES

## Battery Management

### Precaution of use

- Fully charge the battery before the first use.
- Fully charge the battery within 24 hours of use.
- The battery should be fully charged every 2 months in the case when it is not used, otherwise the battery can be permanently damaged.
- If the internal battery has not been regularly charged the AAA NiMh backup batteries in the Delta may go flat.

### Usual charge cycle

- The charge cycle with a fast charger is approximately 3 hours.
- The charge cycle with the AC power supply / charger is approximately 9 hours.

## Care Guidelines

**The following suggestions will help keep your WheelTime system in top condition.**

- Keep the system dry. Precipitation, humidity and all types of liquids or moisture can contain minerals that will corrode electronic circuits. If your system does get wet, allow the system to dry completely before using it.
- Do not use or store the device in dusty, dirty areas. Its connectors and electronic components can be damaged.
- Do not store the system in hot areas. High temperatures can shorten the life of electronic devices, damage batteries, and warp or melt certain plastics.

- Do not store the system in cold areas. Moisture can form inside the system and damage electronic circuit boards.
- Do not attempt to open the system other than as instructed in this manual.
- Do not drop, knock, or shake components of the system. Rough handling can break internal circuit boards and fine mechanics.
- Do not use harsh chemicals, cleaning solvents, or strong detergents to clean any parts of the system.
- Do not paint or apply adhesive labels to any parts of the system. Both can clog the moving parts, and prevent proper operation.
- Use only the supplied or approved antennas. Unauthorised antennas, modifications, or attachments could damage the system and may violate regulations governing radio devices.
- If any part of the system is not working properly, contact your nearest authorised service facility for service.

## Regular Maintenance

- Clean the Roadside Antenna covers with a wet soapy cloth.
- Clean the Transmit Antenna Mat covers with a wet soapy cloth.
- Clean the WheelTag surface with a wet soapy cloth.
- Check cables and connectors are not damaged.



# 06 TROUBLESHOOTING

Fault	Possible Cause	Explanation and corrective actions
RF power is low (as measured by field strength meter)	Water on connections	Dry the connectors before making a connection, possibly by blowing air into the connector.
	Excessive water on Transmit Antenna Mats	Sweep excess water off the Transmit Antenna Mats.
	Connectors not tight enough	Tighten all RF connectors until they are firm (hand tight).
RF power is low (as measured by field strength meter), or is missing on some Transmit Antenna Mats	Cables damaged	Replace the faulty Transmit Antenna Mat.
Slightly low read rates, either with fast riders, or with congested riders	Start mode/finish mode incorrect	Use start mode for highly congested groups of riders. Otherwise, use finish mode. If in doubt, use finish mode.
	Object or person in front of Roadside Antenna	Move object or person from in front of Roadside Antenna. Alternatively, deploy the Chute Antenna.
	WheelTag Modified	Remove any adhesive covers or labels from the WheelTag
Fault light illuminated on the UHF RFU	Ground differential problem	<p>This is a rare but serious fault. This means that there is a problem with the internal power supply system in the Reader, or a problem between the power supply provided through the USB port on the front of the RFU, and the power supply provided to the Reader. Steps to try to resolve this problem are:</p> <ol style="list-style-type: none"> <li>1 - To ensure that the computer connected to the USB port uses either an isolated power supply, or the same power source as the Reader.</li> <li>2 - Disconnect all devices from the USB port on the RFU.</li> </ol> <p>If these steps fail to resolve the problem and the fault LED continues to illuminate, contact your local authorised distributor.</p>
TAG LED on the RFU and beeper repeatedly activates with a 50% duty cycle, even when no WheelTag is present	Incorrect settings inside the UHF RFU	<p>This is the UHF RFU heartbeat pulse. The UHF RFU needs to be reconfigured to use this LED as a Tag Detection LED. This fault is an inconvenience but does not prohibit the WheelTime system from working - it only affects the audio visual indications of a tag being read.</p> <p><b>Contact your authorised local distributor!</b></p>

Continued next page...

Fault	Possible Cause	Explanation and corrective actions
The tag detection datastream is not present on the USB port of the UHF RFU (but the Delta is receiving the datastream)	The wiring on the PCB is incorrect	<b>Contact your authorised local distributor!</b>
	Incorrect serial port settings used on the computer	The serial port settings on the computer may be incorrect. The correct serial port settings are 115kbps, 8 bits, 1 stop bit, 1 start bit, no handshaking, no parity.  <b>Contact your authorised local distributor!</b>
The computer is plugged into the USB port of the UHF RFU but no serial port is recognised	Computer is missing the required USB drivers	The correct drivers may not be on the computer.  Download drivers from <a href="http://www.times-7sport.com">www.times-7sport.com</a>
The green LEDs on the UHF Controller are not illuminated	RF Power is too low, or is off	This means that RF power is not coming out from the UHF Controller. Steps to try to resolve this problem are:  1 - Ensure that the UHF RFU is operating normally, and that the link cable is connected from the UHF RFU Tx port to the UHF Controller.  2 - Connect the connection hub to the UHF Controller.  3 - Ensure that the UHF RFU is operating normally and that its power LED is illuminated.
One green LED on the UHF controller is illuminated, and the other is not	RF power is too low	The UHF Controller has an internal calibration problem in either the RF output power or in the sensitivity of the LED. Check the RF power coming from all 6 Transmit Antenna Mats - if this is OK then this problem is confined to the LED itself and the system will operate as normal. If the power is reduced on mats 1, 3, and 5, or mats 2, 4, and 6 (for TX-Port 1 or TX-Port 2 respectively) then the UHF Controller requires recalibration.  <b>Contact your authorised local distributor!</b>
One or two red LEDs on the UHF Controller are illuminated	RF signal path is disconnected or faulty	There is a connection fault with either the Connection Hub, or with the antennas (or terminators) connected to the Connection Hub. Steps to try to resolve this problem are:  1 - Ensure that all connectors are firmly tightened on the UHF Controller, and on the Connection Hub.  2 - Use the diagnostic LEDs on the Connection Hub as an indicator of where the fault may lie. Green LEDs illuminated on the Connection Hub indicate that the connection from the UHF Controller to the Connection Hub is OK, red LEDs illuminated on the Connection Hub indicate a connection fault between the Connection Hub and the Transmit Antenna Mat.

Continued next page...



Fault	Possible Cause	Explanation and corrective actions
Three or six green LEDs on the Connection Hub are not illuminated	RF signal path is disconnected or faulty	<p>This means that RF power is not reaching the Connection Hub from the UHF Controller. Steps to try to resolve this problem are:</p> <ol style="list-style-type: none"> <li>1 - Ensure that the UHF Controller is operating normally.</li> <li>2 - Ensure that the Control Loom is connected from the UHF Controller to the Connection Hub and that the connectors are firmly tightened.</li> <li>3 - Ensure that the Transmit Antenna Mats are connected to the connection hub and connectors are firmly tightened.</li> </ol>
One or two green LEDs on the Connection Hub are not illuminated and others are illuminated, and no red LEDs on the Connection Hub are illuminated	RF power to some Transmit Antenna Mats is too low	<p>The Connection Hub has an internal calibration problem in the sensitivity of the LEDs. Check the RF power coming from all 6 Transmit Antenna Mats - if this is OK then the system will operate as normal. The Connection Hub LEDs require recalibration.</p> <p><b>Contact your authorised local distributor!</b></p>
One or more red LEDs on the Connection Hub are illuminated	Transmit Antenna Mat is disconnected or faulty	<p>There is a connection fault between the Connection Hub, and the antennas (or terminators) connected to the Connection Hub. Steps to try to resolve this problem are:</p> <ol style="list-style-type: none"> <li>1 - Ensure that all connectors are firmly tightened on the Connection Hub.</li> <li>2 - Temporarily swap the connections of two Transmit Antenna Mats, to see if the fault is in the Transmit Antenna Mat or in the LED calibration in the Connection Hub.</li> <li>3 - If the Connection Hub has an internal calibration problem in the sensitivity of the LEDs then check the RF power coming from all 6 Transmit Antenna Mats - if this is OK then the system will operate as normal. The Connection Hub LEDs require recalibration.</li> </ol> <p><b>Contact your authorised local distributor!</b></p>

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Fault	Possible Cause	Explanation and corrective actions
The Field Strength Meter shows no RF signal (no LEDs turn on). The Power LED is off	Field Strength Meter is faulty or has a flat battery	The Power button on the Field Strength Meter must be continuously held down for the Field Strength Meter to function. If the Power LED is off when the power button is pressed, then replace the 9V battery inside the Field Strength Meter.
The Field Strength Meter shows no RF signal (no LEDs turn on). The Power LED is on	RF field is too low or is off, or the field strength meter is shielded from the RF field	<p>This condition indicates that the Field Strength Meter is not receiving the RF field.</p> <p>Steps to try to resolve this problem are:</p> <ol style="list-style-type: none"> <li>1 - Ensure that the Field Strength Meter is within the RF field (directly above the Transmit Antenna Mats).</li> <li>2 - Ensure that no obstacles are between the Field Strength Meter and the Transmit Antenna Mats. In particular ensure that the operators hand is not holding the top left corner of the Field Strength Meter (the top left corner contains the sensitive RF receive antenna).</li> <li>3 - Ensure that the Field Strength Meter is correctly oriented, it should be held lying flat, pointed in the direction in which the cyclists travel. If necessary, experiment with different orientations to observe the effect that poor orientation has on the Field Strength Meter readings.</li> </ol>
The Delta doesn't turn on	The NiMh batteries on the Delta are flat	Remove the Delta from the Reader and remove and recharge the AAA batteries or replace them with new NiMH batteries.
Computer cannot connect to Delta	IP address incorrect	The IP Address should be set as per Webmin. Refer to the Webmin manual.
	Ethernet cable incorrect	<p>Ensure using an Ethernet cross-over cable when connecting directly from computer to Delta.</p> <p>If using a hub or router between the Reader and the computer, ensure using a standard Ethernet cable.</p>
	No instant information when Reader started	It takes up to 2 minutes for the Delta to start up.

# 07 SPECIFICATIONS

## Operating frequency range:

- 864.1-867.9 MHz (New Zealand)
- 920.1-925.9 MHz (Australia, USA)

## Reader consumption:

- 3.3 Amps

## External power supply:

- 12V DC

## Internal Battery:

- Characteristics: 12V, 17Ah, 6kg
- Time life: 4 years
- Autonomy: 2.5h when fully charged
- Charge time: 9h with 12V DC/ 6Amps charger.  
3h with Ipico Fast Charger.

## Weights:

- WheelTime Reader: 18kg (40lbs)
- Transmit Antenna Mats: 9kg (20lbs)
- Roadside Antenna and Stand: 3kg (7lbs)

## Reader Dimensions:

- 285mm H x 325mm W x 370mm L  
(11.2in H x 12.8in W x 14.6in L).

## Operating Environment:

- Operating temperature range (mats and Reader): -10°C to +60°C (14°F to 140°F).
- Reader to be sheltered from direct rainfall and direct sunlight.

## IP protection:

- Reader open: IP21
- Reader closed: IP54
- Transmit Antenna Mats: IP66
- Connection Hub: IP66
- Roadside Antenna: IP66

## Warranty:

- 1 year



# 08 CONTACT DETAILS

## WheelTime Technical Assistance:

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