USER'S REFERENCE.

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1. SAFETY AND REGULATIONS

1.1. General Safety Responsibilities

This unit has been designed and tested in accordance with applicable Rules&Regulations and has left the manufacturer's plant in condition, fully complying with safety standards.

To maintain this condition and to ensure safe operation, the user must observe all instructions and warnings given in this operating manual.

Applicable local and national safety regulations and rules for the prevention of accidents must be observed in all work performed.

1.2. FCC/IC Statement

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

This device complies with Part 15 of the FCC Rules and with Industry Canada license-exempt RSS standard(s). 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 radio transmitter has been approved by Industry Canada to operate with the antenna types listed below with the maximum permissible gain indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device:

LAIRD-RD2458 3 dBi Gain @ 2.4GHz

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

1.3. Warnings and Cautions

The following alerts are used in this manual:

- WARNINGS alert users of potentially dangerous situations.
- CAUTIONS alert users of potential equipment damage.

Warnings and cautions are indicated by:

- the text WARNING or CAUTION,
- a description explaining the hazard and how to avoid it,
- an icon: 

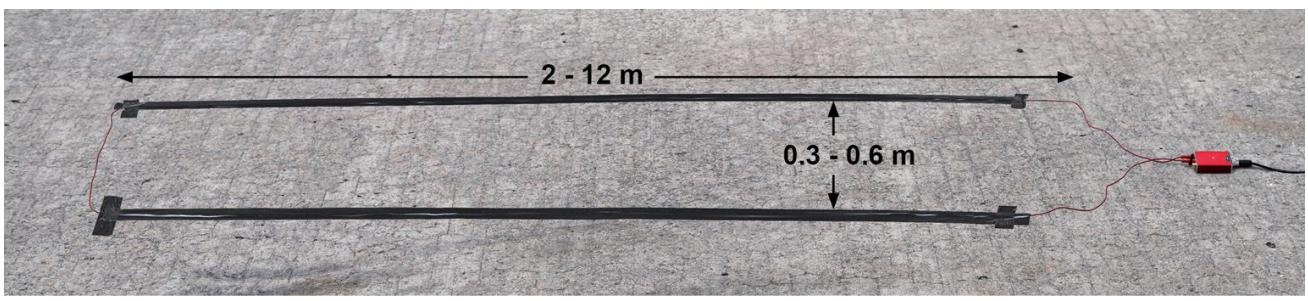
2. ACTIVE LOOP SETUP

Most of the time the transponder is sleeping, but when in close proximity to a race result loop, the 125kHz signal from the loop will wake up the transponder. It starts analyzing the 125kHz signal and if it stems from a race result loop, it will turn on its microcontroller which analyzes the signal strength from the loop, calculates the time when it crossed the center of the loop, and transmits this information on a 2.4GHz channel to the decoder. When the decoder acknowledges that the data has been received, the transponder goes back to sleep.

2.1. Setting up the Cable Loop

In most cases the cable loop will be laid on the ground and either taped down with duct tape or covered by a mat. Make sure that the loop forms a rectangle with 30 – 60 cm width. If you require higher precision, the loop should be narrower, and greater care must be taken to set up the loop precisely. Note that 0.01 second means only 5cm distance at 70km/h. So when fixing the loop a few centimeters askew, this will have a negative effect on precision.

A wider loop, on the other hand, will result in higher read height but less precision.



2.2. Loop Power

In the *Active Extension* menu (only visible when an Active Extension is connected) the loop power can be set, i.e., how much power the decoder sends through the loop. Higher loop power results in higher read height above the loop, but less precision.

Depending on the type of sport, choose the appropriate value. For example for cycling (high precision needed, transponder fixed on the bike and thus close to the loop) choose a low value like 25%. However, if participants wear the transponder on the wrist and can finish with their arms raised, choose a high loop power like 75% or 100%.

Depending on what materials happen to be underground at the timing point, the maximal read height with 100% loop power is 2-2.5 meters. Metal in the ground will reduce the read height.

Note that the read height is independent from the loop length. The system automatically determines the length of the loop and adapts the real power on the loop accordingly, so that the same percentage value should always result in roughly the same read height.

2.3. Channel ID setup

The back channel from the transponder to the decoder operates on 2.4GHz which is a worldwide public band also used for many purposes, such as WiFi. Within this band, the active system can use 8 different frequency channels. When the loop activates the transponder, it also encodes the channel ID on the loop signal so that the transponder knows on which channel the decoder is listening for the reply from the transponder.

By default, the Channel ID is set to *auto*. In this case, the system performs a channel survey when turned on and selects the channel used the least in order to avoid interferences between the active system and other devices. Note that

- even if a channel is heavily used by WiFi there would still be sufficient gaps to operate the active system on the same channel.
- Auto mode will usually select channel 1 because this channel is not used by WiFi and is often completely free.

If necessary, a different channel can be selected on the main decoder. The system will first perform a channel survey and then show the channels and their qualities.

2.4. Loop ID Setup

When activating a transponder, the loop also transmits a loop ID. When transmitting the detection back to the decoder, the transponder will also transmit this loop ID. This way, several active systems can run on the same channel: decoders within an area will 'hear' the detections from all loops but only process those from transponders that have been activated by their own loop.

Similar to the channel ID, the loop ID can be set in the menu of the main decoder but normally runs in an *auto* mode: every Active Extension sends out a status beacon every second on 2.4GHz. When turning on a decoder with auto loop mode, it will listen a few seconds for the signals from the other decoders and then select an unused loop ID.

The auto loop mode is easy to use and fool-proof, but it may make sense to assign fixed loop IDs so that you immediately know which loop ID belongs to which decoder. Make sure not to assign a loop ID twice – otherwise you will receive the detections on both decoders (when running on the same channel).

2.5. Possible Loop Issues

The Active Extension monitors the status of the loop constantly and can report the following loop issues which will be shown in the display of the decoder:

Loop Error: The loop is not connected anymore or has been cut. This error will be signaled by the decoder with a long beep sound.

Loop Limit: The system cannot provide enough power for the selected loop power. Either the cable is too long or too thin.

Overflow: Transponders are being detected faster than they can be transmitted from the Active Extension to the main decoder (~50 per second).
The Active Extension has an internal buffer for 1000 detections. Should this buffer be full detections will get lost and the decoder will show the *Overflow* error.

3. ACTIVE LOOPBOX

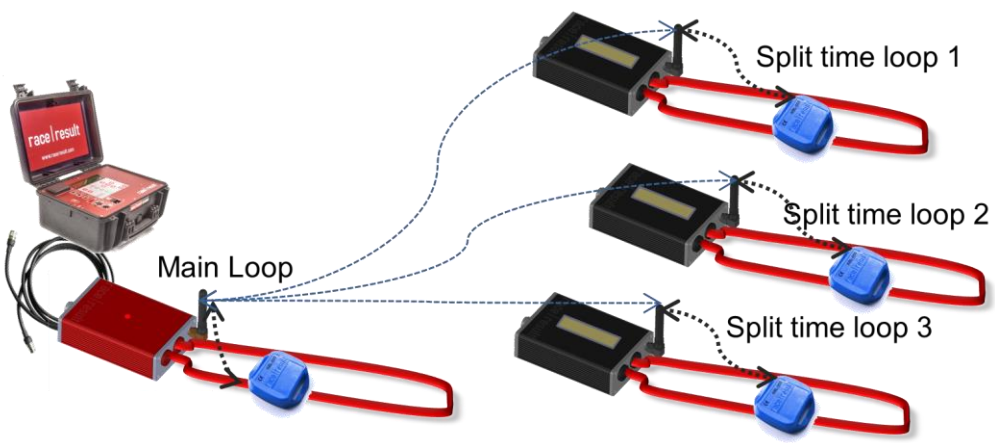
The *LoopBox* is an additional stand-alone device which activates the active transponder, but does not process the data of the transponders.

There are two use cases:

3.1. Repeater Mode

In this mode, the LoopBox activates the transponder, receives its data and sends (repeats) it to an Active Extension.

This is an easy way to realize several timing points within an area, e.g. a triathlon finish, transition in and transition out. The maximum distance between LoopBox and Active Extension can be up to 300m depending on conditions.



Note that the LoopBox has an internal buffer for 1000 detections. Even if the connection between LoopBox and Active Extension is interrupted, the detections will not be lost: once the connection recovered, the LoopBox will transmit the buffered detections. Thanks to the precise internal clock of the LoopBox, the detection time will still be correct and precise.

For the communication between LoopBox and Active Extension please note:

- LoopBox and Active Extension need to run on the same channel (see chapter 2.3 and chapter 3.3). It is recommended that you select a fixed channel on the main decoder instead of using the *auto* mode.
- The Active Extension that shall receive the detections from the LoopBox(es) must have loop ID 1. This way the LoopBoxes know where to send the data even if several Active Extensions are present.

3.2. Store Mode

This mode only works with the ActivePro transponder!

In this mode, the ActivePro transponder will be activated by the LoopBox, but instead of transmitting the detection data, it will start its internal clock and thus know the time since it had been activated. This internal clock runs for a maximum of 24 hours (activations will be deleted afterwards) and a maximum of 64 detections can be saved.

When being activated by a real active system, the transponder will transmit not only the new detection but also all stored detections. For example for a MTB downhill race, a LoopBox at the start could activate the transponder, and at the finish two detections will be received: start time and finish time.

The LoopBox is a very easy way to make sure athletes have passed several check points: Simply put a LoopBox at every check point and at the finish the transponder will transmit the detections from all the check points.

Note that the internal clock of the ActivePro transponder is only as precise as the clock on your wrist. It can have deviations of up to 5 seconds per day. High deviations between different chips may occur when they are being used with very different environmental temperatures.

At the same time note that a deviation of 5 seconds per day, equals a deviation of only 0.03 seconds in 10 minutes.

3.3. Configuring the LoopBox

The LoopBox can be configured by pressing the button for 2 seconds. The first of the four settings (loop ID, channel ID, loop power, store/repeat mode) will start blinking and can be changed by pressing the button again. By pressing the button again for 2 seconds, the setting will be confirmed and the next setting can be changed.

To use the repeater mode, proceed as follows:

1. Set the loop ID of the main active system to 1 (see chapter 2) and select a channel ID (see chapter 2.3).
2. Set the loop ID of the LoopBox to a value not used yet.
3. Set the channel ID to the same channel as used by the main active system.
4. Make sure the LoopBox mode is set to *Repeat* (instead of *Store).*

To use the store mode, proceed as follows:

1. Set the loop ID of the LoopBox to a value not used yet (in order to identify detections from this LoopBox).
2. Make sure the LoopBox mode is set to *Store* (instead of *Repeat*).

3.4. How to Receive LoopBox Data using race result 11

When using one or more LoopBoxes, the detections from several timing points will be received through the one and only main race result System with Active Extension and thus come into the Transponder Module through one connection.

Probably, detections from a certain loop shall be assigned to a certain timing point (*location*) in the software. Therefore, several connections to the race result System can be created, each using a different loop ID / channel ID filter. Then, for each connection, different settings can be set.

3.5. LoopBox Time

Note that the LoopBox and the ActivePro transponder do have an internal clock, but do not need to have the precise time. They simply tell the Active Extension how much time has elapsed since the detection occurred. The Active Extension will then calculate the detection time by subtracting this offset from its current time.

3.6. Power connection

The LoopBox will be shipped with a 12V AC/DC power adapter and an additional DC plug. If you do not have a reliable power supply for the LoopBox, you can easily use the additional DC plug to connect a battery.

As the LoopBox needs a maximum of 100mA, a small 2Ah battery will last for a day.

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APPENDIX 2: SPECIFICATIONS

Safety & Conditions	
Protection Class **with cable/antenna screwed on**	IP67 -waterproof-
Safety Norm	EN60950
Regulatory Conformity	CE, RoHS, FCC
Temperature	-30°C to 70°C
Dimensions **Weight**	27x65x97mm 170g

Power & Battery	
AC Power Supply **Loop Box**	110V-230V, 50-60Hz (2A fuse)
Loop Box	10V-15V, 100mA (at 100% loop power)
Battery Life Decoder with Active Extension	approx. 24 hours

2.4GHz RF & Loop Specification	
Transponder 2.4GHz **Channel Frequencies** **(Worldwide Compliance)**	1: 2480 MHz 5: 2415 MHz 2: 2405 MHz 6: 2460 MHz 3: 2425 MHz 7: 2435 MHz 4: 2475 MHz 8: 2450 MHz
2.4GHz TX Power	3dBm
Loop Frequency & Data	125kHz Data-Packet = Loop ID + channel Packet rate: 150Hz OOK-modulation, manchester encoded 16bit anti-false-wakeup pattern
Loop Power	100% = 200mA RMS regulated peak current
Loop Cable & Length	5m-25m, >0,5mm², standard 4mm banana plugs
Data Cables	5m (standard), 15m, 20m
Read Range **25% Loop Power** **100% Loop Power**	 60cm (2ft) 2m (6ft)
Detection Rate **Read Rate**	100% 250 chips/second burst for 4 seconds 50 chips/second continuously
Internal Data Buffer	1000 passings
Clock Stability	24/1000th second per day 0.28ppm TCXO calibrated to Rubidium Frequency Standard

	traceable to NIST
Prewarn Data Delay	100ms (from entering the loop field)
Max Passing Data Delay	250ms (after loop center)
Repetitive Passing rate over Loop	1 per Second

Active Transponders	Active	ActivePro
Loop Detection Antenna	1D	3D
Maximum Speed	75 km/h (45mph)	150 km/h (90mph)
Timing Accuracy	2/10th second	1/100th second
Passings Storage	-	64 passings up to 24 hours +/- 7/100th per hour (+/- 20ppm)
Expected Battery Life	7 years	6 years
Guaranteed Battery Life	4 years & 100.000 passings	
Battery Indicator	temperature compensated battery status data in passing	
Dimensions **Weight**	36x40x9mm 16.8g	
Housing	IP69 TPE molded case, sealed with PU compound 100% salt water proof	
Temperature	-40°C to +70°C	
Shock Resistance	>1000G	

Tray	
Dimensions	522x297x12mm
Weight	approx. 1kg (including 50 transponders)
Material	4mm rugged PE (UV-Stabilized)
Features	Stackable, with numbering 1-50 / 51-100