



KAHA
SCIENCES

RAT TELEMETRY

User Manual

Contact Information

Kaha Sciences is an ADInstruments NZ Limited brand

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For complete product instructions, general insights and surgical recommendations, visit adinstruments.com and access our free online support www.adinstruments.com/support/kaha.

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To all users;

We pride ourselves on helping you achieve excellent results. If you have any questions related to the operation of your system, please contact us at adi.to/support.

ADInstruments Disclaimer & Warranty for Kaha Sciences Products

Background

Kaha Sciences is a brand owned and operated by ADInstruments NZ Limited. (“ADInstruments”)

Responsibilities

The Purchaser and any others using any ADInstruments product or solution agree to use it in a reasonable manner for purposes for which it is suited, and agree to take responsibility for their actions and the results of their actions. If problems arise with an ADInstruments product, ADInstruments will make all reasonable efforts to rectify them. This service may incur a charge, depending on the nature of the problems, and is subject to the other conditions in this Disclaimer and Warranty.

Disclaimer

Except as specified below, ADInstruments makes no warranties, express or implied, and specifically disclaims any warranty of the products’ fitness for a particular purpose. The Kaha Science Products supplied by ADInstruments are intended for use in teaching and research applications and environments. Products supplied by ADInstruments are NOT intended to be used as medical devices or in medical environments. That is, no product supplied by ADInstruments is intended to be used to diagnose, treat, or monitor a person. Furthermore no product is intended for the prevention, curing or alleviation of disease, injury or handicap.

Warranty

Rat Telemeter Warranty

ADInstruments comprehensive telemeter warranty guarantees that telemeters will be free from defects in materials and workmanship for sixty (60) days after the date of implantation **provided that** implantation occurs within six months of the date of shipment/purchase of the rat telemeter and that upon implantation the telemeter is registered at adi.to/telemeter-register.

In order to activate this warranty, registration of all rat telemeters is compulsory upon first implantation. Registration must occur within six (6) months from the date of shipment/purchase.

Mouse Telemeter Warranty

ADInstruments warrants that at the time of sale and shipment to the original purchaser, Kaha Sciences mouse telemeters shall be free from defects in material and workmanship for 90 days from the date of shipment.

Telemetry Hardware Warranty

ADInstruments warrants that at the time of sale to the original Purchaser, the telemetry hardware (excluding telemeters – see above) shall be free from defects in materials and workmanship for a period of one (1) year from its date of shipment to the original purchaser. Should the hardware become damaged after expiration of the one-year warranty, ADInstruments will accept the product for evaluation with a signed RMA (return material authorization) and at a cost of USD100. If repairs are required, ADInstruments will provide a detailed quote and lead time, and will not commence the repair work until the customer has approved the quote. As part of ADInstruments continued commitment to customer support, free online, phone and email support in the use of all telemetry equipment is available beyond all warranty periods.

Defects

If there is a defect in a Kaha Sciences Product (other than telemeters which cannot be repaired), as Purchaser’s sole remedy hereunder, ADInstruments will repair or replace the equipment as appropriate, and the duration of the warranty shall be extended by the length of time needed for repair or replacement. To obtain service under this warranty, the Purchaser must notify the nearest ADInstruments office, or Authorized Representative, of the defect before the warranty expires. The ADInstruments or Representative office will advise the Purchaser of the nearest service center address to which the Purchaser must ship the defective product at his or her own expense. The product should be packed safely, preferably in its original packaging. ADInstruments will pay return shipping costs.

General Limitations

ADInstruments products are produced to high standards, and should perform as described in the supplied documentation. There is a limited hardware warranty, and technical support is provided for all ADInstruments products. Nevertheless, since ADInstruments products could be affected by external factors (for instance, the computer system on which they run and other hardware and/or software provided by third parties), absolute performance and reliability of products and the overall solution cannot be guaranteed. No warranty, either expressed or implied or statutory, other than that expressly contained in this Warranty and Disclaimer, is made in respect to ADInstruments products or software, third party products or software, the overall solution or otherwise. The Purchaser therefore assumes all risks as to the performance and reliability of the products, the software, the solution and the results gained using them. ADInstruments neither assumes nor authorizes any person to assume on its behalf any liability in connection with the sale, installation, service or use of its products. ADInstruments shall not be held responsible for special, consequential or punitive damages of any kind arising out of sale, installation service or use of its products.

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FCC Compliance

Telemeter (5 series)

The devices comply 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.

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

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.
- Changes or modifications not expressly approved by ADInstruments could void the user's authority to operate the equipment.

TR190 Configurator

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.

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

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

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

TR181 SmartPad

The Wireless Power Transfer System is FCC Part 18 Compliant

Note: This equipment has been tested and found to comply with part 18 of the FCC limits for non-consumer equipment. These limits are designed to provide reasonable protection against harmful interference in an industrial installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Note: There is no required maintenance of this device from a FCC compliance perspective.

The 2.4GHz Data Transmitter is FCC Part 15 Compliant

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.

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

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

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

Introduction

This User Manual contains information to help in the correct installation and basic use of the Kaha rat telemetry system. It is **strongly recommended that you visit our online Knowledge Centre** for more detailed information and to view instructional videos showing telemeter implantation, explanation and recommendations for cleaning and care for your whole system. www.adinstruments.com/support/kaha.

All Kaha telemeters use a unique patented inductive power transfer system for power and battery recharging, making it ideal for long-term recordings in rats 175 grams and over.

Please note that if your system has been customized in any way, parts of this manual may not apply to your system. Due to continual product improvement, your system may look slightly different to the images and graphics contained in this manual. If you have any questions, please contact us at adi.to/support.

Telemetry System Key Features

High Accuracy

Provides long term digital wireless recording of physiological data with high frequency sampling (sampling at 2 kHz), resulting in high data quality and signal integrity.

24/7 Uninterrupted Recording

Data can be collected 24 hours a day while the animal is on the SmartPad, with no need to replace batteries.

High Versatility

Telemeters send data wirelessly from within the animal to the SmartPad, which is then converted to analog signals that can be recorded by any PowerLab and LabChart data acquisition system. LanChart software provides a great range of recording and analysis options.

Low Cost of Ownership

Telemeters are rechargeable, hence removing the need and the cost to replace the battery of the telemeter, or even purchasing replacement telemeters. Telemeters can potentially be cleaned, resterilized and reused with great user care.

Efficient Simple Housing

Animal cages can be next to each other in one location for simultaneous data collection from multiple animals. No specialized cages or shielding are required as each telemeter operates digitally using one of 40 independent frequencies with no interference to recordings.

Global Service & Support

ADInstruments prides itself on being responsive to our customers' current and future needs. We have experienced engineers and scientists on staff to provide professional, expert, timely support and advice.

Telemetry Setup Overview



A rat telemetry setup consists of three main components, which are the rat telemeter, the SmartPad and the Configurator System. Therefore, a typical telemetry setup for each animal will require one telemeter of your choice and one SmartPad. The measured data by a telemeter is collected by its corresponding SmartPad that is set to the same Channel (communication frequency) as the telemeter. Data collected by the SmartPad is then recorded by a PowerLab and LabChart data acquisition system via BNC-BNC cables. Each laboratory setup will just require one Configurator in order to configure all your telemetry equipment.

Telemetry Components

The Telemeter

The telemeter is a fully implantable precision electronic device that is designed to measure specific physiological signals within an animal. Its electronics is safely contained within a biocompatible and water impermeable Liquid Crystal Polymer (LCP) material, while its extending leads can be placed at suitable measurement sites of interest within the animal. Several types and variations of telemeters are available. All telemeters are individually packaged, shipped in Safe Mode (inactive mode) and on the same Channel "Setup". Therefore, each telemeter will need to be activated and configured to the same Channel (frequency) to its designated SmartPad prior to implantation.



Please note: Depending on the model, your telemeter may look slightly different to images throughout this manual; however, all telemeter models have the same basic construction and operation. When handling the telemeter, care must be taken not to damage the telemeter body, catheter or lead wires, because the telemeters are non-repairable. You can read the Telemeter Care and Handling section for more information (page 44).

The SmartPad

The SmartPad acts both as a universal inductive telemeter recharging platform and a data receiving station for any paired Kaha rat telemeter. Each SmartPad is supplied with three 4m BNC-BNC cables to connect to a PowerLab and LabChart data acquisition system.



Please note: For the safe and normal operation of the SmartPad it needs to be placed on a flat non-metallic surface. There must not be any metal or another SmartPad within 10-15 cm of any SmartPad and we recommend at least a minimum of 40 cm separating distance above or below another SmartPad (page 15).

The Configurator System

The Configurator System includes both the Configurator (TR190) hardware and ConfigSoft software (inside a USB drive). Together they are used to wirelessly control telemeters and SmartPads allowing the user to:

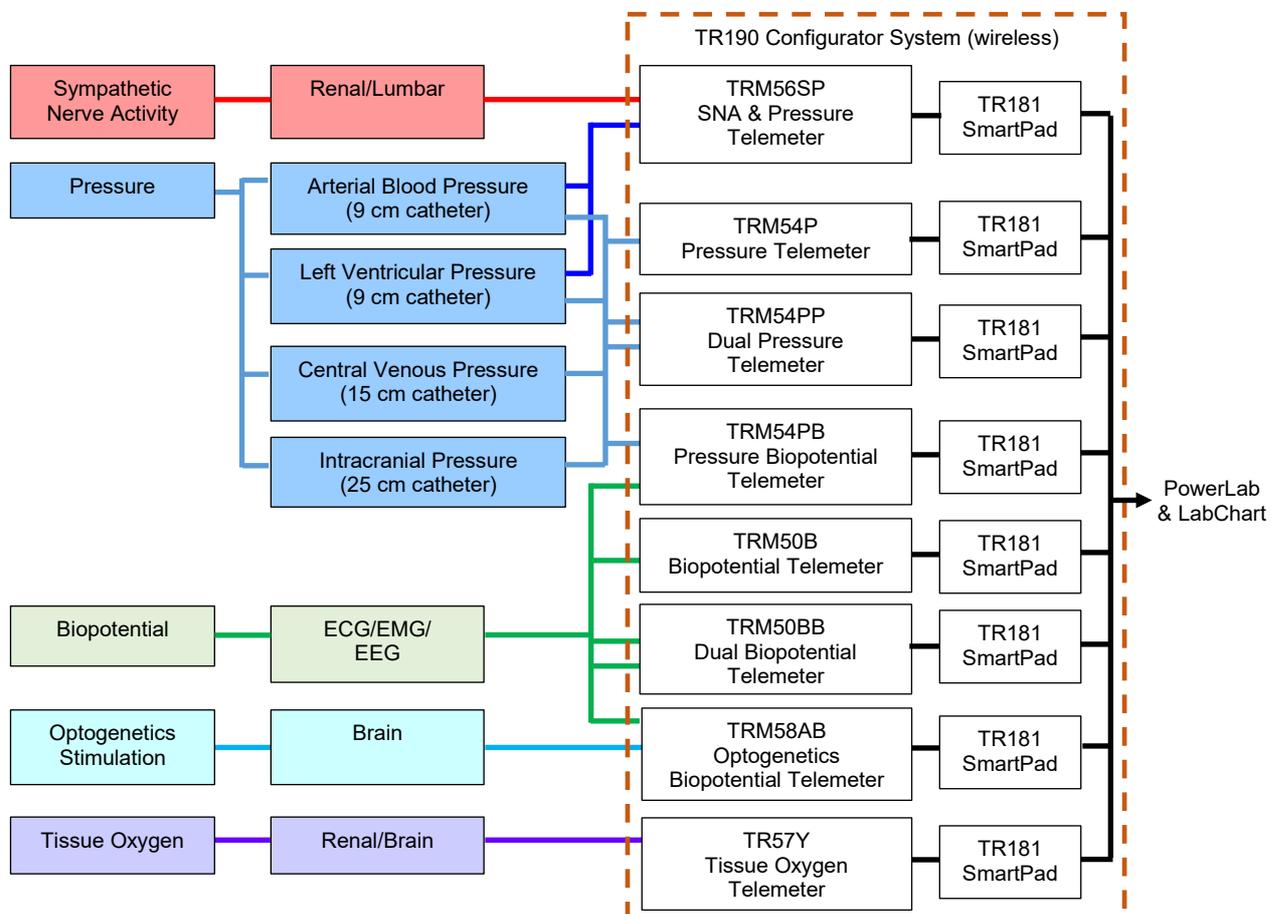


- Change/configure the Channel (referred by this manual and ConfigSoft software as the communication frequency) of a telemeter and SmartPad.
- Run and provide diagnostic information about telemeters (such as battery charge) and SmartPad performance.
- Place telemeters into Safe Mode, power-down to conserve battery power when away from a SmartPad or when being stored.
- Turn the SmartPad charging field on/off.
- Enable/disable Cohousing on applicable SmartPads

As mentioned, previously **ONLY** a single Configurator System is required to control all telemetry systems in a laboratory. In addition, it can also be used interchangeably between a Kaha rat and mouse telemetry system. The Configurator System is not required for data acquisition. **Contact adi.to/support for any further assistance.**

IMPORTANT: The ConfigSoft software supplied on the USB drive must be installed on a computer before connecting the Configurator hardware to the computer. It requires Windows 7, 8 or 10 (USB 2.0 or 3.0).

Rat (>175g) Telemeter Types and Measurements Overview



Quick Start for Rat Telemetry

1) Installing ConfigSoft

1. Ensure system is either Windows 7, 8 or 10 (USB 2.0 or 3.0).
2. Insert the USB drive and open the ConfigSoft folder. There are two separate installers 32 bit and 64 bit. Please install the version compatible with your system. Open the appropriate folder and run setup.exe
3. Internet connection is necessary to access and install any drivers not already installed.

2) Configurator and SmartPad Setup

1. Attach aerial to rear of the Configurator.
2. Connect Configurator to computer via USB cable.
3. Place and position each SmartPad as recommended, which is on a flat non-metallic surface, away from any metal or other SmartPad for at least 10-15 cm, at least a minimum of 40 cm separating distance above or below another SmartPad (page 15).
4. Plug in each SmartPad to the appropriate power supply. Light on front will turn on (initially solid orange).
5. Connect SmartPads to a suitable PowerLab and LabChart data acquisition system using its BNC outputs. Each SmartPad has three analog BNC outputs, which automatically corresponds to the signals of the telemeter that will be paired later on.

Model #	Output 1	Output 2	Output 3
TRM54P	Pressure	Unused	Temperature
TRM54PB	Pressure	Biopotential	Temperature
TRM54PP	Pressure	Pressure	Temperature
TR50B	Unused	Biopotential	Temperature
TR50BB	Biopotential 1 (yellow & green)	Biopotential 2 (black & red)	Temperature
TRM56SP	Pressure	SNA original	Temperature
TR57Y	Oxygen	Unused	Temperature

3) Telemeter Setup

1. Telemeters do not need to be removed from their sterile packaging.
2. Place only one telemeter on the SmartPad (ensure any other telemeters are 2 meters away).
3. The SmartPad will turn the telemeter on and into Active Mode and it will start transmitting data.

A green LED on the front of the SmartPad indicates that it has identified a telemeter on the same Channel that it is on. All telemeters and SmartPads are shipped on the same Channel allocation "Setup". An orange LED indicates no telemeter could be found on that Channel. **ONLY** activate and pair one telemeter with a SmartPad at any one time.

4) Pairing Telemeters and SmartPads via Configurator System

All telemeters and SmartPads are initially configured to Channel "Setup". For data collection, select and pair each telemeter and SmartPad to one of 40 channels using the Configurator and ConfigSoft software.

After changing channels, remove the telemeter from the SmartPad and place into Safe Mode using ConfigSoft. Keep telemeters that are in Safe Mode at least 1m away from any SmartPad or they will turn back on.

5) Implant Telemeters

Telemeters are normally shipped sterile and ready to implant. Surgical instructional videos, guides and techniques are available online at: www.adinstruments.com/support/kaha.

6) Acquiring Data

After successful surgical recovery, place the animal cage with the animal on the corresponding SmartPad. When the animal is placed on the SmartPad, and SmartPad charging field is enabled, the telemeter will be automatically activated and data transmission will occur. Continuous data collection and simultaneous charging is now possible (the Configurator is not required for data acquisition).

7) Telemeter Care and Storage

Telemeters are precision electronic devices and cannot be refurbished if damaged. Always store telemeters in original packaging. Use ConfigSoft to place telemeters into Safe Mode (page 28) for storage or when animals are away from the SmartPad for extended periods. Always fully charge the battery prior to storage and check battery level at least every 2 months.

8) Further Questions and Support

If you have any additional questions and require further support, please contact your nearest ADInstruments representative or submit an inquiry via our website at <https://www.adinstruments.com/contact/technical-support>

The Telemeter

Overview

Telemeters have a biocompatible and water impermeable Liquid Crystal Polymer (LCP) material body that safely encases and protects their electronics, as previously mentioned. This body also has two suture tabs to help securing it during implantation. Each telemeter also has its unique serial number engraved on it that is used for identification during later configuration and diagnostics.



Telemeter Packaging and Channel

All telemeters are shipped sterile in a sterile sealed packaging (right) to be ready for implantation. The telemeter model and serial number are printed on the outside label of the transparent protective plastic case within the packaging, which also allow the serial number on the actual telemeter to be also visible. They are also factory set to Safe Mode and Channel “Setup” and thus, **MUST** be activated or turned on and configured to one of 40 communication Channels corresponding to its SmartPad before use. Each telemeter should have a different communication Channel when multiple telemeters are simultaneously used. When configuring multiple telemeters, we recommend you only turn on and configure the channel of one telemeter at any one time. There is no need to remove the telemeter from its sterile packaging to either turning it on or changing the channel until actual implantation.



Please note:

- It is highly recommended to write down the telemeter serial number and Channel setting before implanting the telemeter.
- Any other devices on the same Channel can interfere with the telemeter and/or SmartPad communication. Please check that only one telemeter and one SmartPad are on each Channel.
- Communication Channels of the current telemeters and SmartPads use similar frequencies as legacy Telemetry Research devices (telemeters, receivers or wireless power chargers) so these may also cause interference.

Telemeter Modes

Each telemeter has two modes, which is Safe Mode (inactive and does not send any data) and Active Mode (sends data measured from its sensor leads).

Safe Mode

All telemeters are shipped in Safe Mode, which has an extremely low current drain. This is the recommended mode for when a telemeter is being stored or if it is not being used to record data from an animal while still implanted, such as moving the animal away from a SmartPad in the non-recording phase of an experiment, for a longer period than the battery charge.

To place a telemeter into Safe Mode:

1. The telemeter needs to be at least 1m away from any active SmartPad.
2. Use the Configurator System to place the telemeter into Safe Mode (page 28).
3. Take care not to allow the telemeter to come within 1m of any active SmartPad or the telemeter will be activated by the field of the SmartPad and will enter Active Mode. This will happen regardless of which Channel the SmartPad is configured to.

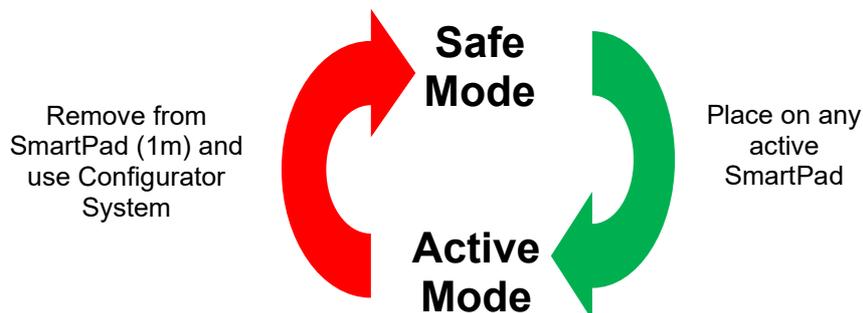
Please note: Telemeters can be activated (turned on) by the charging field of any SmartPad (even if it is set to a different Channel). It is important to keep telemeters at least 1m away from all SmartPads until you are ready to activate them one by one.

Active Mode

The telemeter must be in Active Mode to transmit data to its corresponding SmartPad. To change the telemeter from Safe Mode to Active Mode:

1. a) Non-implanted telemeter - place the telemeter (it can be still in its sterile packaging for new telemeters) on an active SmartPad. This will automatically switch the telemeter into Active Mode, which is now sending data and consuming battery power.
1. b) Implanted telemeter (inside the animal) - place the appropriate animal cage with the animal on an active SmartPad. This will automatically switch the telemeter into Active Mode, which is now sending data and consuming battery power.
2. If the SmartPad is configured to the same Channel as the telemeter, the Status light on the front of the SmartPad will be **green**.

The relationship between Safe Mode and Active Mode can be illustrated as below.

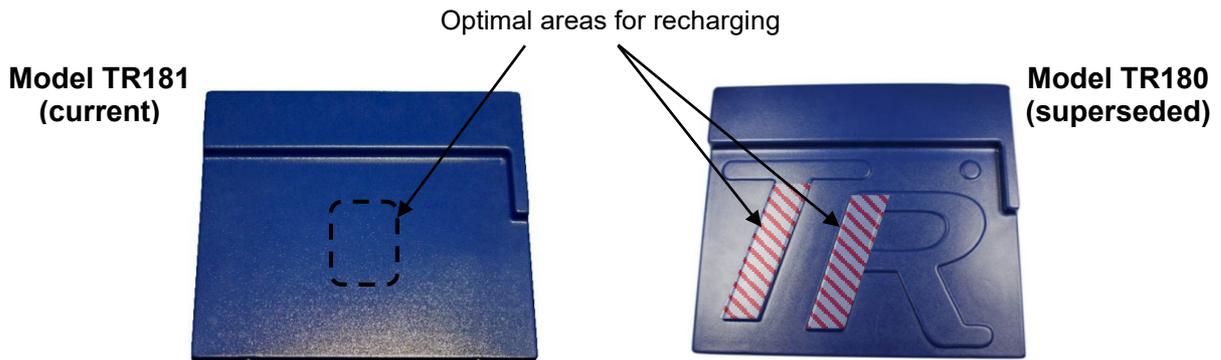


Telemeter Battery and Recharging

Telemeters are designed to be recharged either before implantation or when implanted inside an animal. It is recommended to have the telemeters fully charged (90-100%) before implantation or if they are to be stored for any length of time.

Recharging Telemeters Before Implantation

To efficiently charge a new telemeter before implantation, we recommend placing the telemeter, while is still in its sterile packaging, onto the optimal charging areas of the SmartPad as indicated (page 13). Check the battery level using the diagnostics of the Configurator System. If a telemeter is being reused (after proper cleaning), place the telemeter so that it lies flat in a container of water or normal saline (0.9% NaCl) and with the main body of the telemeter parallel to the top surface of the SmartPad in the indicated areas. Full charging may take a minimum of 5 hours, depending of the initial charge status. For the best estimate of the battery charge level remove the telemeter from the SmartPad and use the diagnostics section of ConfigSoft to determine the battery level. For maximum battery capacity, we recommend charging the telemeter for a further hour after the battery level reaches 90-100%.



The dashed area printed on the surface of TR181 SmartPad provides the best location/power for recharging, while anywhere on the two areas shaded on the picture of the TR180 SmartPad will provide the best location for recharging. When using either model of SmartPad, it is important that the SmartPad and telemeter are paired (set to the same Channel).

Please note: ONLY recharge explanted telemeter individually on separate SmartPads. DO NOT recharge explanted telemeters on SmartPads enabled for Cohousing.

Recharging Implanted Telemeters and Temperature

For effective recharging within the animal, the telemeter body must lie parallel to the SmartPad when the animal is mobile. The telemeter body must be implanted within the abdominal cavity and attached to the abdominal muscle wall using the suture tabs. Charging will not be effective if the telemeter is placed on the side or back of the animal.

All telemeters record temperature. When collecting temperature data from the telemeter at the same time as charging, temperature output from the SmartPad is updated once every two hours (page 17). Continuous temperature measurement is available if the SmartPad charging field is disabled.

Please note: Turning the SmartPad charging field off will mean that the telemeter battery will not be recharged.

If monitoring is not taking place for any length of time it is recommended that the telemeters be fully charged and placed in Safe Mode to protect battery life (damage to the telemeter can occur if left in a fully discharged state).

Long Term Storage

Always fully charge your telemeter before storing. We recommend that the battery level of rat telemeters be checked regularly (at least every 2-3 months) while in storage. To do this, activate the telemeter by placing it on an active SmartPad. Move the telemeter 1m away from the SmartPad after turning it on and run telemeter diagnostics (page 34) in ConfigSoft software of the Configurator System. Recharge the telemeter if the battery is not fully charged (90-100%). When it is fully charged, put the telemeter back into Safe Mode before returning to storage. Make sure to keep it at least 1m away from any active SmartPad to prevent it from accidentally turning back on.

Please note: Care must always be taken not to damage the telemeter body, catheter or lead wires as they cannot be repaired. You can read the Telemeter Care and Handling section for more information (page 44).

SmartPad

Overview

The current model of SmartPad is the TR181, which has superseded the TR180. While the TR180 is still being supported, its support is gradually limited with time. Both units operate to power and receive signals from any of our 5 series telemeters with the TR181 having an additional built-in fan. Visually the TR181 can be easily distinguished from the TR180 by the front and rear air vents (see TR181 figures below). The model number can also be found on the front label above the status light.

Model TR181 (with built-in fan)

Front

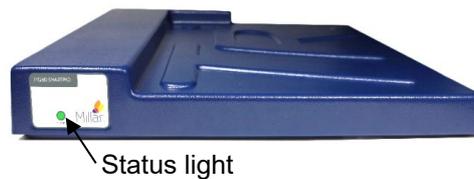


Rear

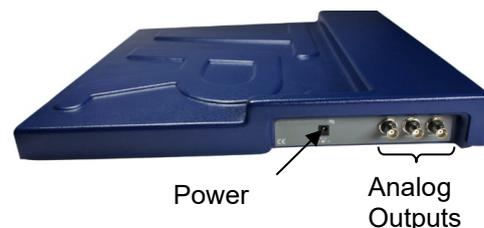


Model TR180 (superseded)

Front



Rear



IMPORTANT:

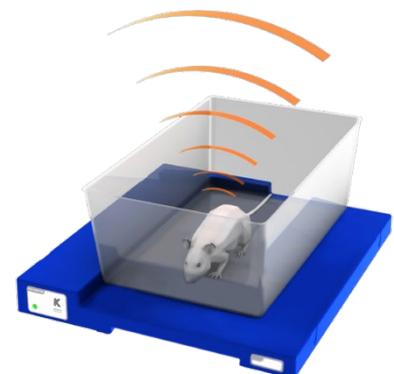
- The TR181 uses a different power supply to the TR180. The TR181 will not work with a TR180 power supply.
- Connect only the supplied and labelled TR181 Power Supply to the power socket at the rear of the TR181 SmartPad. *Using any other Power Supply will invalidate the warranty and may damage the SmartPad.*
- DO NOT obstruct the air vents at the front or rear of the TR181.

SmartPad Optimization

Cage Positioning on SmartPad

The SmartPad is designed to supply power and charge rat telemeters while they are implanted in the animal. For the most efficient charging, place the cage on the SmartPad so that it is against the raised edges in the rear left-hand corner.

To protect the telemeter battery, the SmartPad automatically controls the strength of the charging field using information from the telemeter. It is important that telemeters are only placed on SmartPads set to the same Channel otherwise over or under charging may damage the battery.



**Place cage against the edge.
Do not place SmartPad on metal shelving!**

SmartPad Shelving Setup

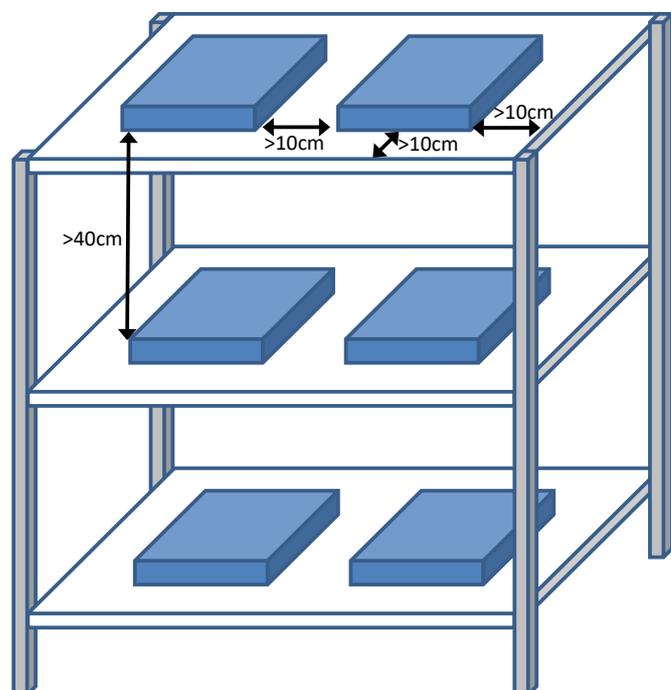
The SmartPad charges the telemeter using an electromagnetic field generated above and below the SmartPad. For this reason, it is important that a SmartPad is **NOT** placed on a metal surface or above or below other SmartPads (unless 40 cm apart). If the SmartPad is to be used near metal, for data collection only, then the charging field must be disabled using the Configurator System.

When initially setting up a laboratory with multiple SmartPads, it is recommended that only **ONE** SmartPad is turned on at a time and the Channel (communication frequency) configured as described below. The recommended setup of multiple SmartPads in a laboratory is detailed below. Please note the distances from other SmartPads and metal objects.

Please note:

- *Active SmartPads cannot be stacked directly on top of each other*
- *With the field disabled, the telemeter will not recharge and recording time will be limited to ~4 hours depending on the telemeter model.*

Plastic shelving is recommended for your SmartPads. Multiple SmartPads should be arranged so that there is more than 10 cm horizontal and 40 cm vertical separation between them. If using shelving that has metal supports or framing, then the SmartPads must be >10cm away from these as well (don't forget to check the underside of the shelves for metal supports). There should also be more than 10 cm separation between the top of a metal cage lid and the SmartPad on the shelf above.



If metal shelves are used, while the charging field is enabled, the SmartPad needs to be raised at least 10 cm from the shelf surface but you must maintain a vertical separation of at least 40 cm between SmartPads.

If your SmartPad shows a **solid red light**, then you need to separate your SmartPads further (vertically and horizontally) and/or move them further away from any metal brackets, supports, cables or power packs. Reset the SmartPad by disconnecting and reconnecting the power. If the problem continues, please contact adi.to/support.

All SmartPads are shipped set to Channel "Setup". Before using a SmartPad with a telemeter you need to configure and pair each SmartPad to the same Channel as the telemeter to be used (there are 40 Channels available). It is important that only one SmartPad is used on any Channel to prevent signal interference.

1. Connect the supplied power supply to the SmartPad.
2. The Status light will be Orange.
3. Use the Configurator System to select a Channel to match the telemeter being used.
4. The Status light will change to Green when SmartPad and telemeter Channel are matched.

SmartPad Status Lights

Depending on the firmware version and the model number of your SmartPad, the SmartPad status lights have different meanings which are summarized in the table below. Information regarding the details of your SmartPad can be accessed in the SmartPad diagnostics of ConfigSoft software.

Legend: 1° = Primary and 2° = Secondary.

Status light	SmartPad firmware v3.2 or later**			SmartPad TR181 firmware v2.5 or earlier			SmartPad TR180 firmware v2.0 or earlier		
	Communicating with telemeter	Charging field enabled	Cohousing enabled	Communicating with telemeter	Charging field enabled	Cohousing enabled	Communicating with telemeter	Charging field enabled	Cohousing enabled
Solid Green	✓	✓	✗	✓	✓	—	✓	✓	—
<i>Slow Flashing Green (1s on/1s off)</i>	✓	✗	✗	✓	✗	—	—	—	—
<i>2 Fast Green Flashes-Pause</i>	✓	✓	1°	—	—	—	—	—	—
<i>3 Fast Green Flashes-Pause</i>	✓	✗	2°	—	—	—	—	—	—
Solid Orange	✗	✓	✗	✗	✓	—	✗	✓	—
<i>Slow Flashing Orange (1s on/1s off)</i>	✗	✗	✗	✗	✗	—	Diagnostic mode		
<i>2 Fast Orange Flashes-Pause</i>	✗	✓	1°	—	—	—	—	—	—
<i>3 Fast Orange Flashes-Pause</i>	✗	✗	2°	—	—	—	—	—	—
Solid Red	High current detected Charging field disabled			High current detected Charging field disabled			High current detected Charging field disabled		
<i>Flashing Red</i>	Diagnostic mode			Diagnostic mode			—	—	—

** Firmware version can be found by running SmartPad Diagnostics in ConfigSoft

* When the status light is solid red, data output will continue from the telemeter and SmartPad, however the charging field is disabled i.e. no power or battery charging is occurring. **Cause:** may be due to the SmartPad being placed too close to a metal surface or to another SmartPad. Move the SmartPad away from any metal and then reset by disconnecting and reconnecting the power. The status light of the older TR180 may also show red if used with the power supply from the TR181. Please make sure to use the correct power supply for your SmartPad.

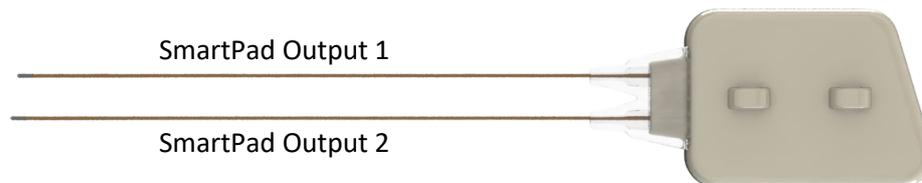
* For easy reference a copy of this table is included in ConfigSoft.

Analog Outputs

After pairing the SmartPad/telemeter Channels, the SmartPad automatically detects the type of telemeter it is communicating with and the analog outputs on the SmartPad are automatically configured to the following signal outputs. The SmartPad analog outputs are low pass filtered at 1 kHz.

Telemeter model	Output 1	Output 2	Output 3
TRM54P	Pressure	Unused	Temperature
TRM54PB	Pressure	Biopotential Red(+)/Black(-)	Temperature
TRM54PP	Pressure	Pressure	Temperature
TR50BB	Biopotential 1 Yellow(+)/Green(-)	Biopotential 2 Red(+)/Black(-)	Temperature
TR50B	Unused	Biopotential Red(+)/Black(-)	Temperature
TR57Y	Oxygen	Unused	Temperature
TRM56SP	Pressure	SNA	Temperature

Generally, it is easy to differentiate the leads of each telemeter. However, in the case of TRM54PP Dual Pressure Telemeter, the pressure sensor located on the shorter lead of the telemeter case corresponds to Output 1 of the SmartPad as indicated in the image below.



Charging Field

The SmartPad charging field is turned off for 30 minutes every two hours to allow an accurate update of body temperature (except during Cohousing). The TR181 status light will flash green (communicating with a telemeter) or orange (not communicating with a telemeter) during this time. It is important to note that if the status light of a TR181 SmartPad is flashing green or orange, the field is off, therefore it will not be able to activate (turn on) a telemeter in this mode. (Note: The TR180 also turns off the field for 30 minutes every 2 hours to update the temperature output, however there is no change in the status light to show this). This automatic temperature measurement cycling does not significantly affect recharging of the telemeter battery or data collection and can be reset by turning the power to the SmartPad off, and then on again.

The charging field of the SmartPad can also be disabled manually using ConfigSoft. If the field is turned off manually the **ONLY** way to turn it back on is using ConfigSoft. The charging field option in the "SmartPad" tab allows the user to enable (turn on) or disable (turn off) the charging field of the SmartPad. By default, when the SmartPad is powered the charging field will be turned on. Turning the charging field off may be useful if recording from an animal while it is in an experimental chamber, running wheel, water maze etc. where the SmartPad will be near metal. The telemeter battery will not charge when placed on a SmartPad with the field disabled, so data collection will only be possible for approximately 4 continuous hours (telemeter model dependent). After this time, the telemeter will need to be placed on a SmartPad with the field enabled for a minimum of 5 hours.

Configurator System

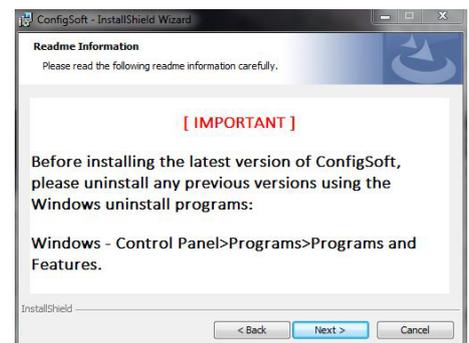
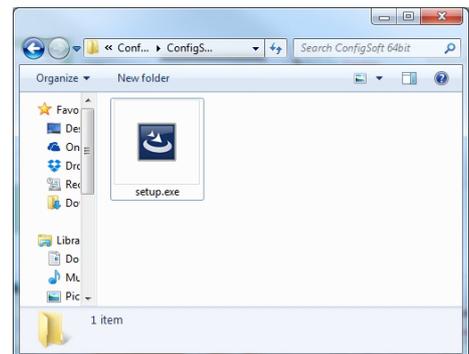
Configurator Software (ConfigSoft) Installation

The software requirements either Windows 7, 8 or 10 to operate and can be used with USB 2 and 3 ports. There are two separate installers on the supplied USB, each for different computer operating system. The version compatible with your system should be installed. Internet connection is necessary to access and install any drivers not already installed.

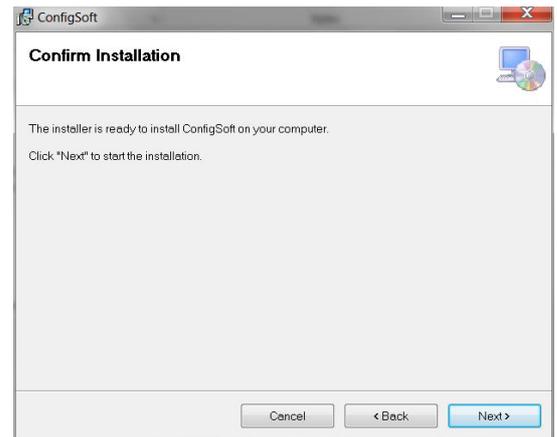


Please note: ConfigSoft must be installed on the computer before connecting the Configurator hardware. Any existing versions of ConfigSoft must be uninstalled prior to installation.

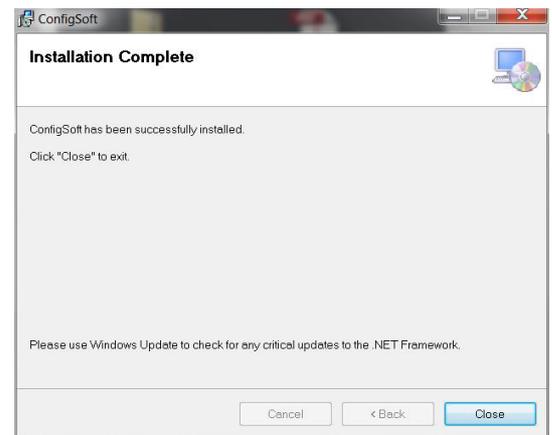
1. Connect the supplied USB drive containing ConfigSoft to your computer.
2. Open the folder “ConfigSoft 32 bit” or “ConfigSoft 64 bit” according to your Windows Operating System.
3. Double click on “Setup.exe” to start the installation.
4. Once the welcome screen appears, follow the instructions for installation.
5. If reinstalling or upgrading the ConfigSoft it is important that any previous versions of ConfigSoft be first removed. If you need to remove the program, follow the instructions in this dialog to remove old versions. When ready click Next.



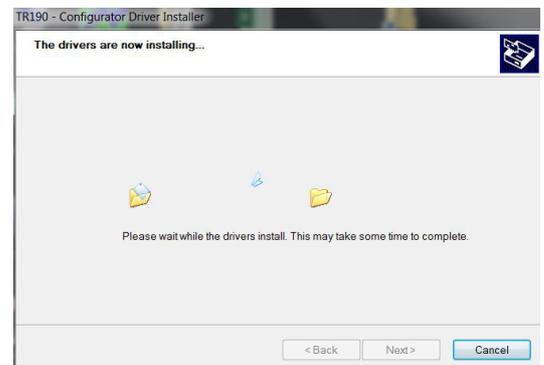
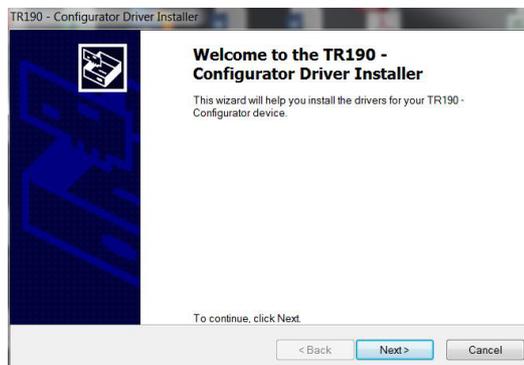
6. Confirm installation. Click Next.



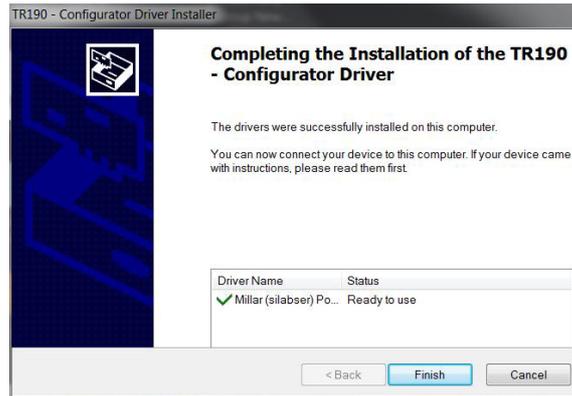
7. After the installation has been completed, Click Close.



8. The following window will automatically appear to install the driver for the TR190 Configurator if it is not already located on the computer. Click Next.



9. After successful installation of the TR190 Driver, Click Finish.



10. Installation of ConfigSoft and the TR190 Configurator drivers has been completed.

11. The Configurator hardware can now be connected. If there are any issues with the installation of ConfigSoft or the TR190 Configurator driver, please contact adi.to/support.

Configurator Hardware Connections

Front



Status light

Rear



Antenna
connection

USB port
connection

1. Attach the antenna to the rear of the Configurator.
2. After installation of ConfigSoft, connect the Configurator to the computer using the supplied USB cable. The status light on the front of the Configurator should glow **red** or **green** indicating that it is receiving power from the computer.

The status light on the front panel of the Configurator indicates the following information:

Off	Not connected, USB cable unplugged Configurator is off
Red	Configurator is receiving power but not communicating with computer
Green	Configurator is communicating with the computer

3. The computer will install any additional drivers and the status light should glow **green** indicating that the system is operational. If there are any problems, please contact adi.to/support.
4. The Configurator System is now ready for use with all your telemeters and SmartPads.

Configurator Software - Overview

ConfigSoft software can be either be launched from either the

- Desktop icon
- OR
- Start>Programs>Kaha Telemetry>ConfigSoft



From the main menu the user has access to several options:

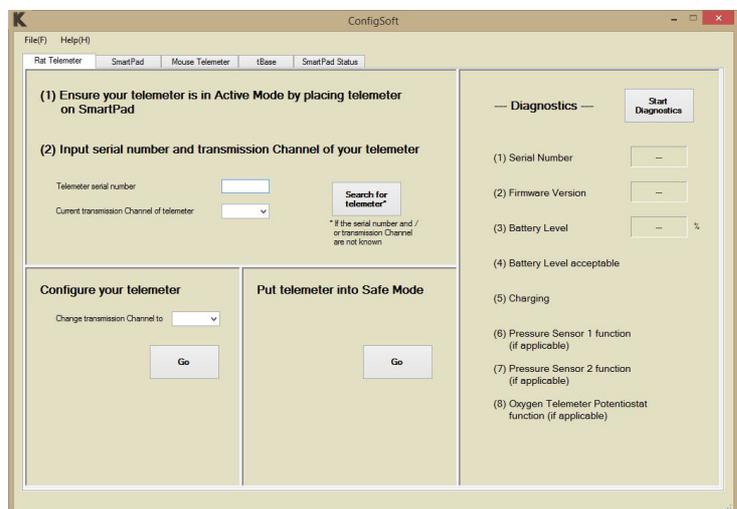
1. Rat Telemeter.
2. SmartPad.
3. Mouse Telemeter (not required for the rat telemetry system).
4. tBase (not required for the rat telemetry system).
5. Link to the Kaha Knowledge Centre (if connected to the internet), which will have a link to www.adinstruments.com/support/kaha.

After selecting an option, ConfigSoft will switch to another presentation dialog with the options as tabs and including another additional tab (SmartPad Status).

Rat Telemeter

This tab allows you to:

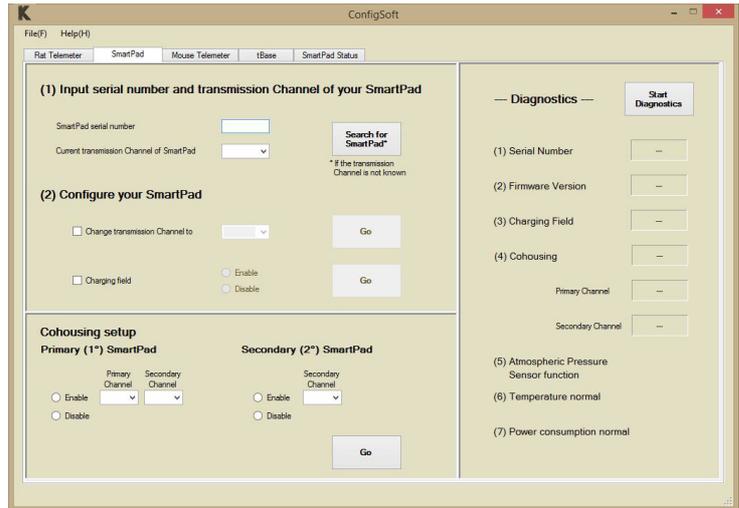
- Search and detect nearby KAHA rat telemeters.
- Configuring the transmission Channel of the detected KAHA rat telemeter.
- Run diagnostics on the KAHA rat telemeter.
- Placing activated rat telemeters into Safe Mode.



SmartPad

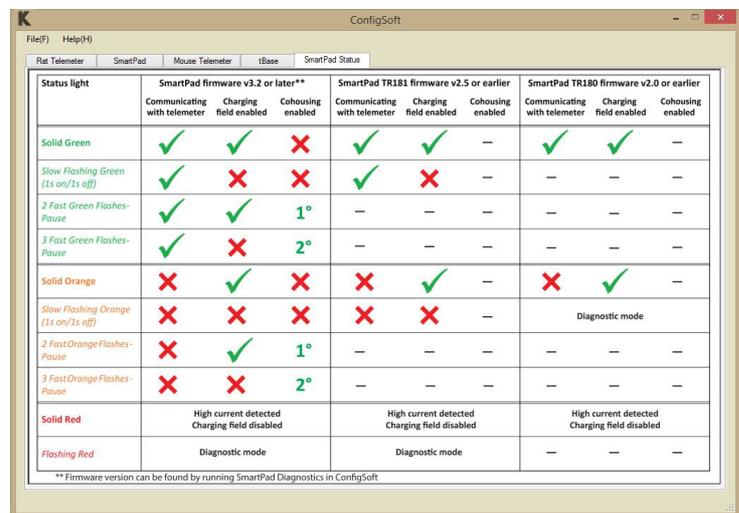
This tab allows you to:

- Search and detect nearby SmartPads. You will need to first input the serial number of the SmartPad.
- Configuring the transmission Channel of the detected SmartPad.
- Run diagnostics on the SmartPad.
- Enable or disable the charging field of the SmartPad.
- Setup Cohousing recording.



SmartPad Status

This tab provides you a copy of a SmartPad's status light colours and their corresponding indication.



Status light	SmartPad firmware v3.2 or later**			SmartPad TR181 firmware v2.5 or earlier			SmartPad TR180 firmware v2.0 or earlier		
	Communicating with telemeter	Charging field enabled	Cohousing enabled	Communicating with telemeter	Charging field enabled	Cohousing enabled	Communicating with telemeter	Charging field enabled	Cohousing enabled
Solid Green	✓	✓	✗	✓	✓	—	✓	✓	—
Slow Flashing Green (1s on/1s off)	✓	✗	✗	✓	✗	—	—	—	—
2 Fast Green Flashes-Pause	✓	✓	1°	—	—	—	—	—	—
3 Fast Green Flashes-Pause	✓	✗	2°	—	—	—	—	—	—
Solid Orange	✗	✓	✗	✗	✓	—	✗	✓	—
Slow Flashing Orange (1s on/1s off)	✗	✗	✗	✗	✗	—	Diagnostic mode		
2 Fast Orange Flashes-Pause	✗	✓	1°	—	—	—	—	—	—
3 Fast Orange Flashes-Pause	✗	✗	2°	—	—	—	—	—	—
Solid Red	High current detected Charging field disabled			High current detected Charging field disabled			High current detected Charging field disabled		
Flashing Red	Diagnostic mode			Diagnostic mode			—	—	—

** Firmware version can be found by running SmartPad Diagnostics in ConfigSoft

Setting Up the System

Pairing a SmartPad and Telemeter

Before implanting a telemeter into an animal, a SmartPad and telemeter need to have their Channels paired. Please ensure that only **one** SmartPad and **one** telemeter are configured and paired at any one time. All SmartPads and telemeters are shipped on Channel “**Setup**” as default and will need to be changed to one of the 40 available Channels.

Please note: When pairing a telemeter/SmartPad make sure any other SmartPads (on the same Channel) are turned off until needed and any other telemeters (on the same Channel) are in Safe Mode and remain at least 2m away from any active SmartPad.

1. Turn on the SmartPad by connecting it to its power supply (Status light should be **orange**).



Insert power plug here



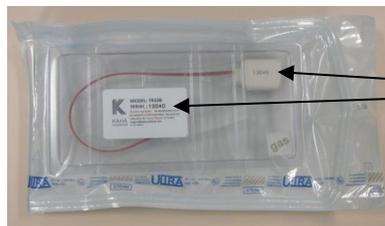
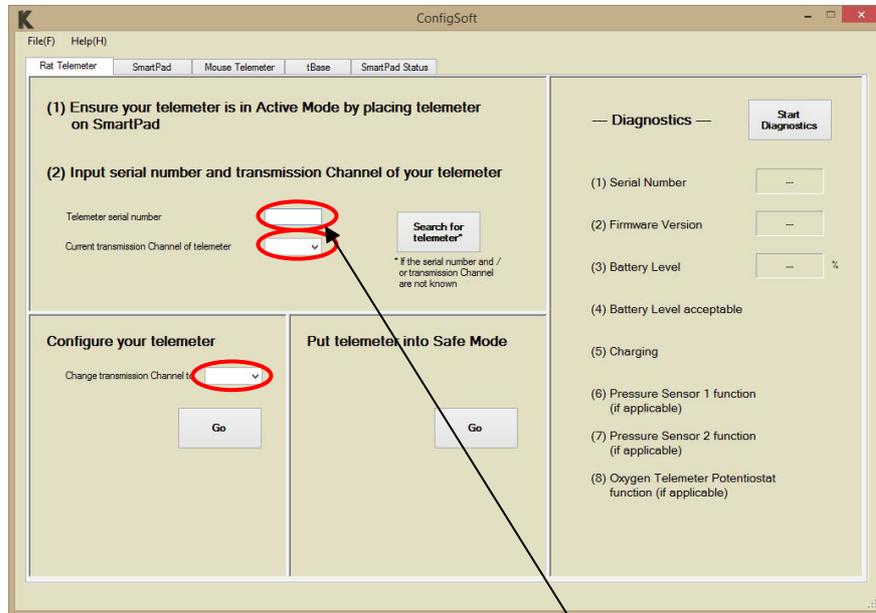
2. Place a telemeter (in its sterile packaging) on the SmartPad. This will automatically turn the telemeter into Active Mode (data transmission active).



3. If the Status light on the front of the SmartPad glows **green** this indicates that the telemeter and SmartPad are on the same Channel. This will be the case when first setting up as the SmartPad and Telemeter will both be on the Setup Channel.
4. If the SmartPad Status remains orange the SmartPad and/or telemeter need to have their Channels changed/paired using the Configurator System.

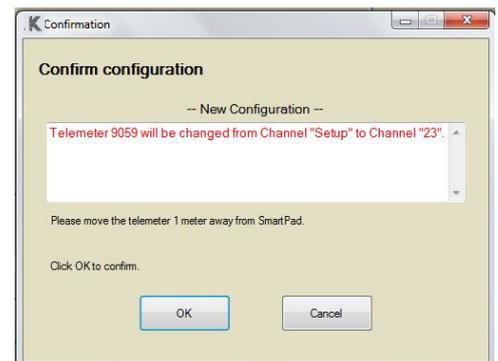
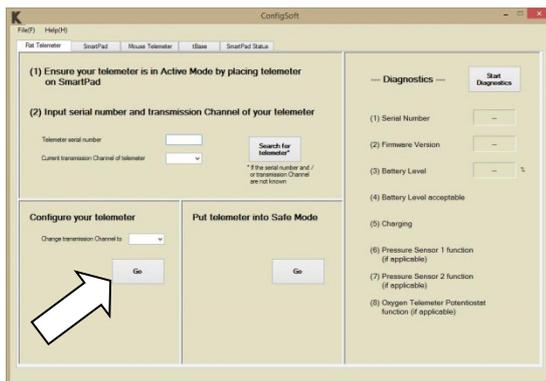
Changing Telemeter Channel

1. After activating, remove the telemeter from the SmartPad and place it 1 metre away from the SmartPad.
2. Open ConfigSoft
3. Click on “Rat Telemeter” button (or “Rat Telemeter” tab if ConfigSoft is already open).

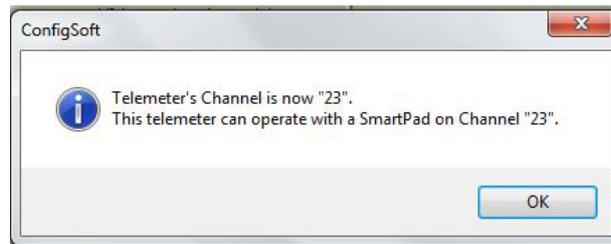


Telemeter
serial number

4. Enter the serial number of the telemeter. The number is on the label on the outside of the telemeter packaging and on the telemeter itself.
5. Select or enter the current Channel number of the telemeter (first use: Channel will be on “Setup”). If you do not know the Channel click the “Search for Telemeter” button and the Configurator will search for all active telemeters and list their serial number and Channel number.
6. To change the Channel number, select or enter the new Channel number in “Configure your Telemeter” section.
7. Click Go to activate the new Channel.



8. Click OK to confirm the choice.

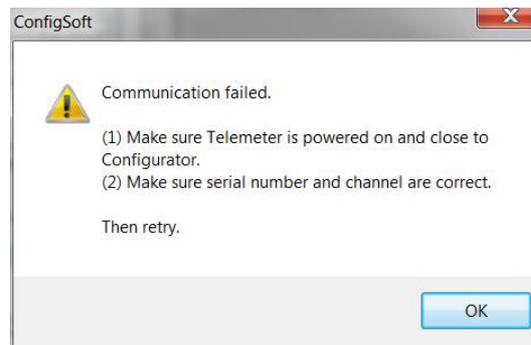


9. A message confirming the new telemeter Channel number should appear. To make it easier for the future, record the telemeter Serial number and Channel number for all telemeter configurations.

Once an active telemeter and SmartPad are paired the SmartPad status light will be green. If the status light is orange, proceed to the next section to change the SmartPad to the correct Channel.

Failed Telemeter Communication with Configurator System

If the Configurator cannot communicate with the telemeter an error message may appear.

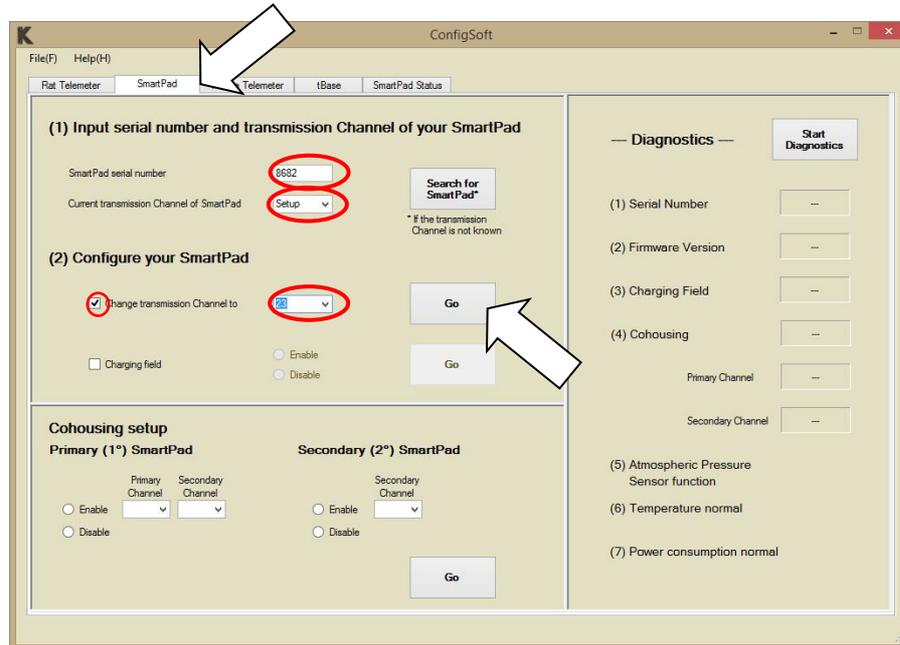


Solution: Click OK and do the following, then try again.

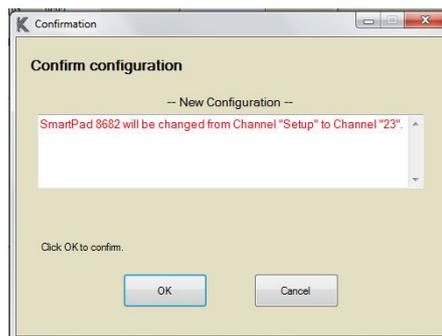
- Check that you have entered the correct telemeter Serial number.
- Check that you have entered the correct telemeter Channel number.
- Move the telemeter closer to the Configurator.
- Check the telemeter is not on an active SmartPad.
- Move any other telemeters away.
- Turn off any other telemeters or any SmartPads that are on the same Channel as the telemeter.

Changing SmartPad Channel

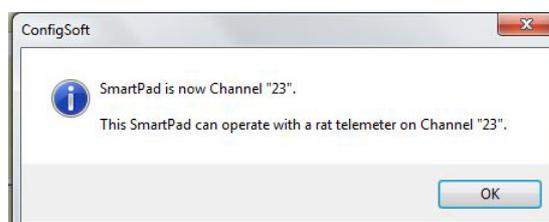
1. To change the SmartPad Channel and pair this with a telemeter, click on the “SmartPad” Tab in ConfigSoft.



2. Enter the serial number of the SmartPad (found on the front and rear of the SmartPad).
3. Enter current Channel number of the SmartPad (first use: Channel “Setup”). If you do not know the Channel number click the “Search for SmartPad” and the Configurator will search and report the Channel frequency.
4. In the “Configure your SmartPad” enter or select a new Channel number for the SmartPad (should be same as telemeter being used).
5. Ensure “Change transmission channel to” is checked.
6. Click Go to activate the new Channel.
7. Click OK to confirm your choice.



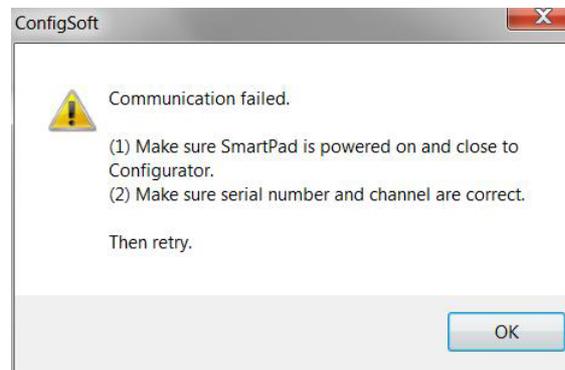
8. A message confirming that the SmartPad Channel has been changed will appear. Record the SmartPad serial number and new Channel number for future reference.



9. If using a telemeter on the same Channel the SmartPad Status light should change to green. The telemeter and SmartPad are now on the same Channel, paired, and able to communicate for data collection and transmission.

Failed SmartPad Communication with Configurator System

If the Configurator cannot communicate with the SmartPad the following error message may appear.



Solution: Click OK and perform the following, then retry:

- Check that the light on the front of the SmartPad is either orange or green.
- Check that you entered the correct Serial and/or Channel numbers.
- Move SmartPad closer to Configurator.
- Turn off any other SmartPads or any telemeters on the same Channel.

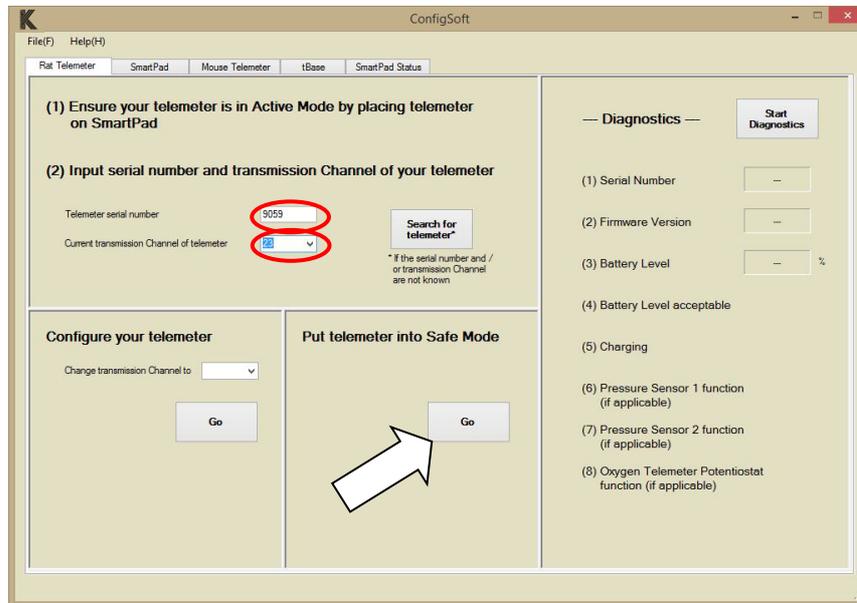
Please note: The telemeter is now in Active Mode and sending data. The battery life in this mode is continuous if on a SmartPad, if charging field is enabled, or ~4 hours if the charging field is disabled (dependent on telemeter type and charge status). If data collection is not required immediately, we recommend you remove the telemeter from the SmartPad and place it into Safe Mode using the Configurator System.

Repeat the above process for each of the SmartPads and telemeters to configure each pair to a different Channel.

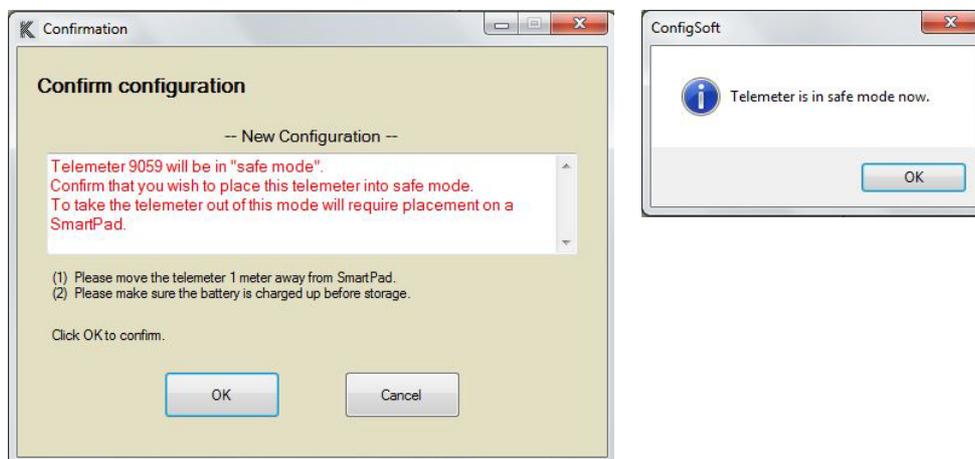
Your telemetry system is now configured and ready for use.

Placing a Telemeter into Safe Mode

1. Connect Configurator to the computer with ConfigSoft loaded.
2. Start ConfigSoft and click on the “Rat Telemeter” button.
3. Make sure the telemeter is 1m away from an active SmartPad.
4. Enter the telemeter Serial and Channel numbers (if unknown use the Search for Telemeter function).
5. In the “Put Telemeter into Safe Mode” Press Go.



6. Click OK to confirm.



7. The telemeter is now in Safe Mode. Make sure the telemeter does not come within 1m of any active SmartPad or the telemeter may become Active again.

Cohousing

Cohousing allows two rats, each implanted with one telemeter, to be housed together in one cage, or one rat (>350g) implanted with two telemeters. In both cases, the two telemeters must be set to different channels and two SmartPads are still required to collect data. The cage containing the animal/s is placed on top of the Primary (1°) SmartPad which charges both telemeters and acquires data from one telemeter. The Secondary (2°) SmartPad acquires data from the second telemeter.

Please note: To avoid telemeter damage, it is important that two telemeters are only used on a SmartPad that has been configured for Cohousing with both the correct telemeter Channels configured. Using two telemeters on a normal SmartPad or with the wrong Channels configured may damage your telemeters.

The Configurator system is required to setup the SmartPads for cohousing, assigning a Primary (1°) SmartPad and a Secondary (2°) SmartPad. **Both the Primary and Secondary SmartPads are required to be enabled and configured for Cohousing.**



Kaha SmartPads (firmware versions 3.2 or later) can be configured for Cohousing. The table below summarizes the SmartPad and Configurator serial numbers that either are already Cohousing enabled or can be upgraded. All existing and new 5 series telemeters can be used for Cohousing. For more information about Cohousing or hardware upgrades contact adi.to/support.

	Upgradeable	Already Cohousing enabled
TR181 SmartPad	All	Serial numbers 10050 and above
TR180 SmartPad	Serial numbers 5444 and above	
TR190 Configurator	All	Serial numbers 9788 and above

When Cohousing is enabled the

1. Primary SmartPad:

- Monitors the battery level and recharges two implanted telemeters set on the Primary and Secondary Channels.
- Collects data from the telemeter on the Primary Channel
- Temperature output is disabled.

2. Secondary SmartPad:
 - Collects data from the telemeter on the Secondary Channel.
 - The Secondary SmartPad will have the charging field automatically disabled.
 - Temperature output is disabled.

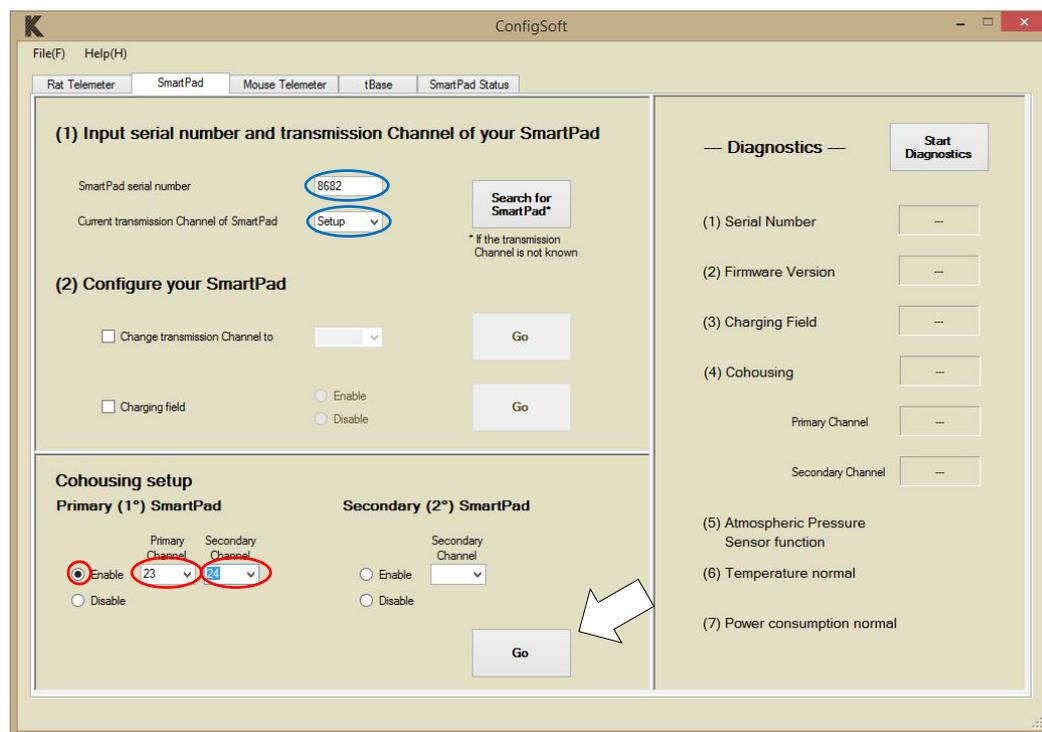
Please note: Telemeters must firstly be setup with the same Channels to be assigned to the Primary and Secondary SmartPads.

Enabling Cohousing

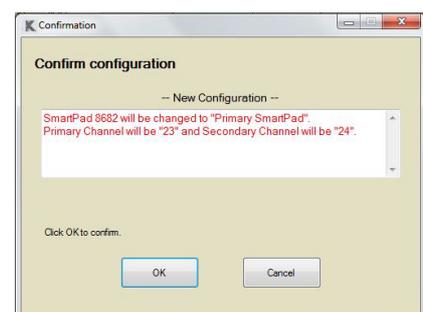
When setting up for Cohousing, both Primary (1°) and Secondary (2°) SmartPads need to be enabled.

Primary SmartPad

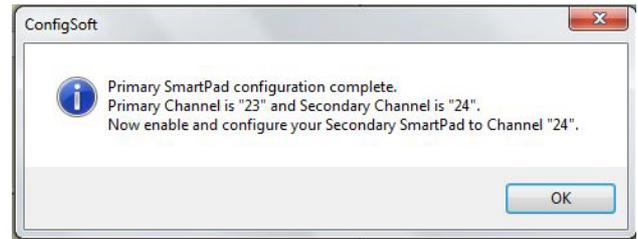
1. Click on the SmartPad tab of ConfigSoft.
2. Enter the serial number of the intended Primary SmartPad and its current Channel.
3. In the “Cohousing Setup” section, under “Primary (1°) SmartPad”, click the “Enable” button and enter in the currently configured Channels of the intended Primary and Secondary SmartPads (these will be the same channels to be used by the telemeters).



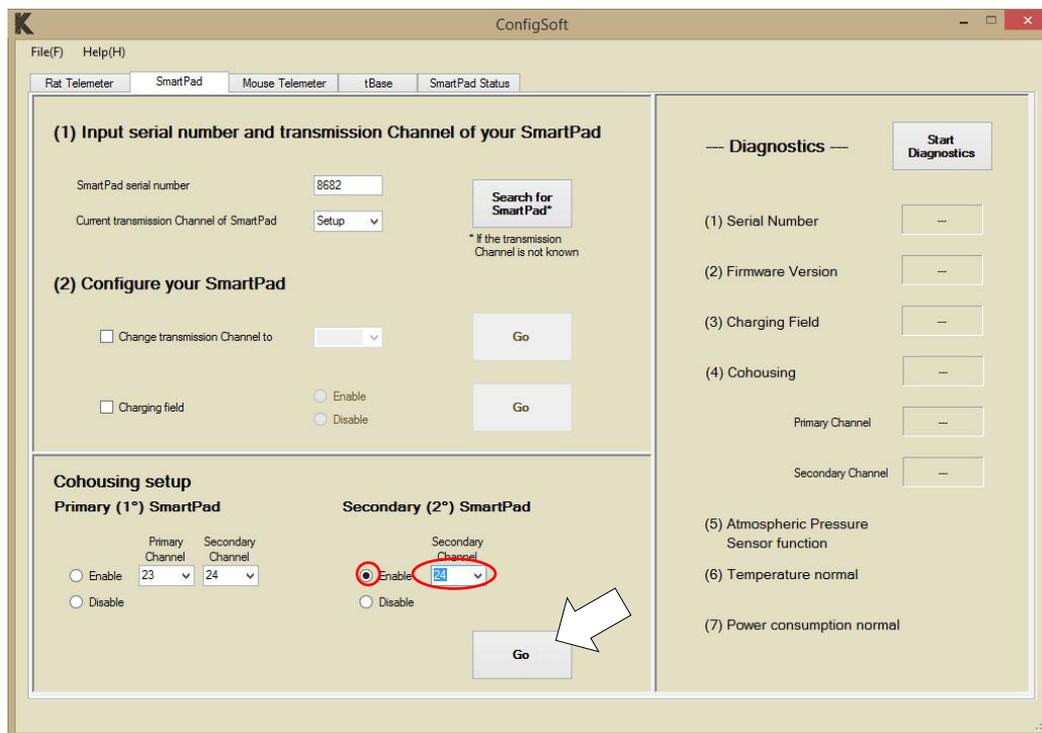
4. Press “Go”
5. Click OK to confirm configuration.



- A message confirming that the Cohousing Primary SmartPad has been enabled will appear. Record the Primary and Secondary Channels for future reference. You will also be asked to configure the Secondary SmartPad to a Secondary Channel and enable Secondary Cohousing.



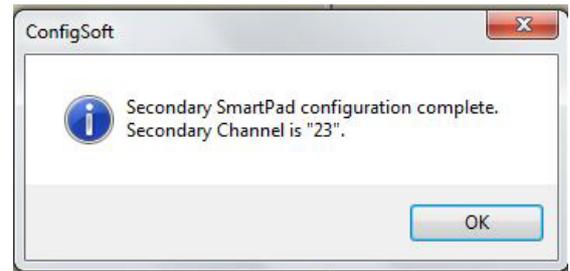
- Enter the serial number and configured Secondary Channel of the intended Secondary SmartPad.
- In the “Cohousing Setup” panel, under “Secondary (2°) SmartPad”, select “Enable” and enter the Secondary Channel number. **NOTE: This *must* match the Secondary Channel number in the confirmation message after enabling Cohousing for the Primary SmartPad. If a different Secondary Channel is to be used the Primary SmartPad will need to be reconfigured.**



- Click “Go”.
- Click OK to confirm



11. A message confirming that the Secondary SmartPad Cohousing has been enabled will appear. Click Ok. Configuration for the Primary and Secondary Cohousing SmartPads is now complete and the system is now set up for collecting Cohousing data.

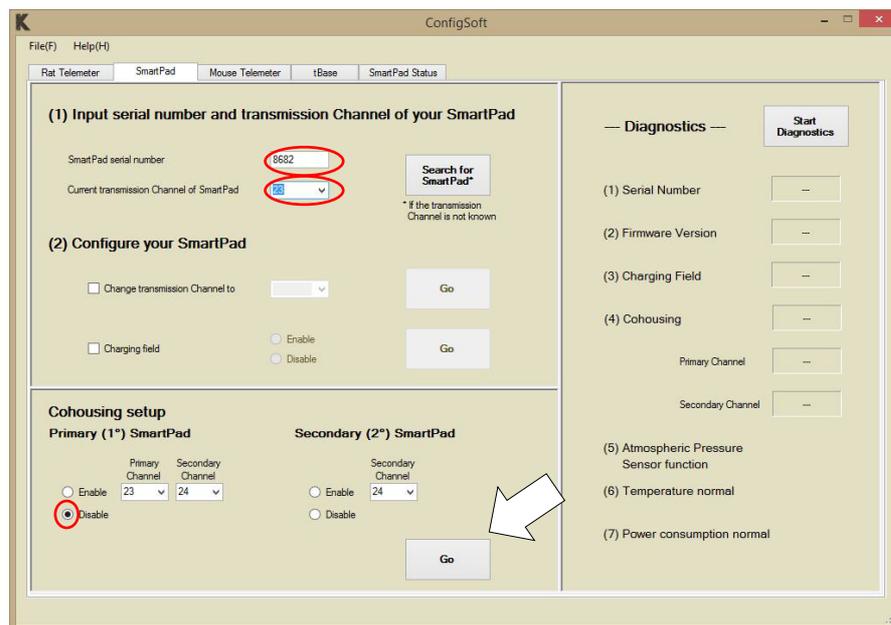


Please Note: If Cohousing has been enabled on a SmartPad, this will be indicated by the SmartPad status light. Please see SmartPad Status Lights for more details. Explanted telemeters should only be individually recharged on SmartPads in the normal operating mode.

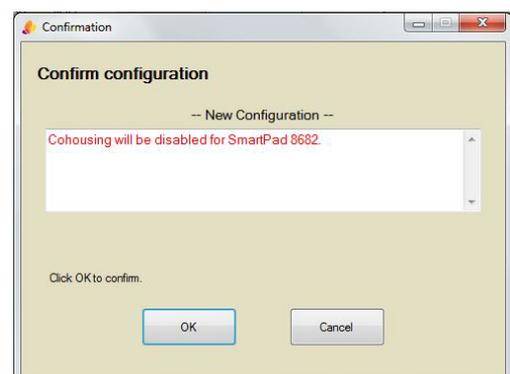
Disabling Cohousing

Before they are returned to normal single housing operation or before the SmartPads are used for recharging explanted telemeters, Cohousing must be disabled on both the Primary and Secondary SmartPads using the Configurator System.

1. In the SmartPad tab, enter the serial number and Channel of the Primary SmartPad.
2. In the “Cohousing Setup” panel, under “Primary (1°) SmartPad”, select “Disable” and click “Go”.



3. Click OK to confirm disabling Cohousing.



4. A message confirming Cohousing has been disabled will appear.

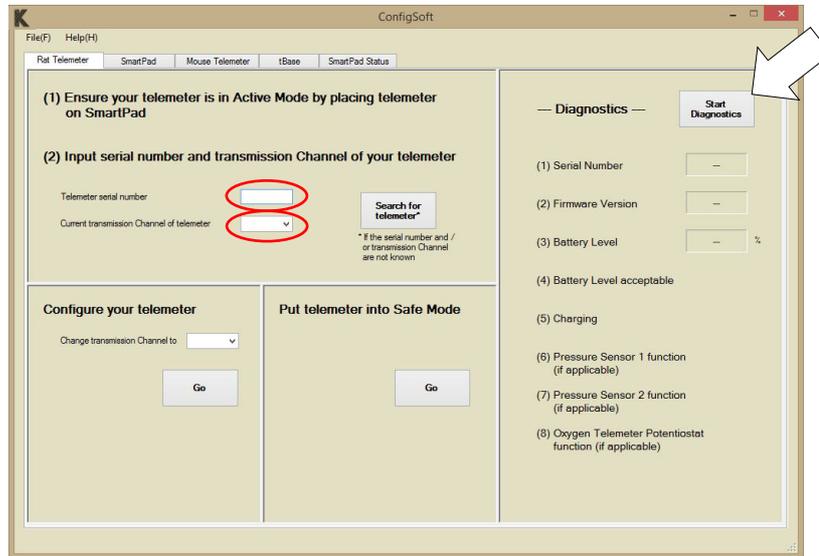


5. For the Secondary SmartPad enter the serial number and Channel.
6. In the “Cohousing Setup” panel, under “Secondary (2°) SmartPad”, select “Disable” and click “Go”
7. Click OK to confirm disabling Cohousing.
8. A message confirming Cohousing has been disabled will appear. Cohousing will now be disabled for both the Primary and Secondary SmartPads and they will resume their normal function.

Diagnostics

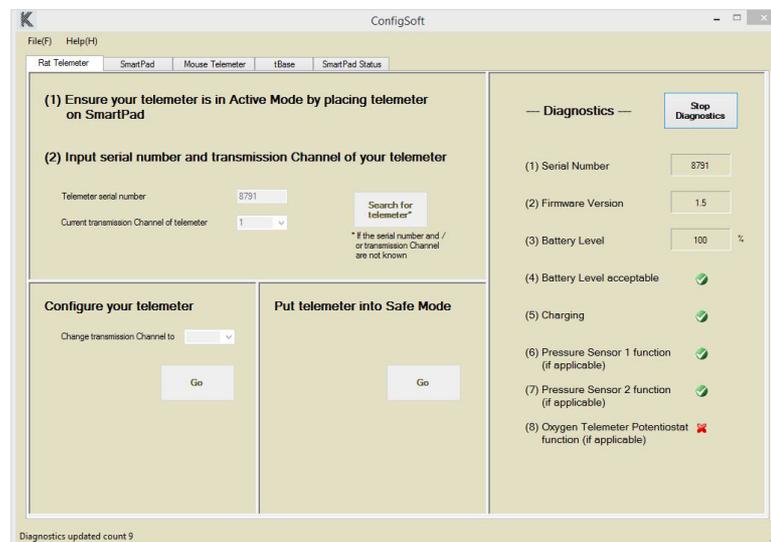
Telemeter Diagnostics

Using the Configurator System, the user can investigate the status of the telemeter. To run diagnostics, enter the serial and Channel numbers of the telemeter and click “Start Diagnostics”. In diagnostic mode the telemeter will continue to transmit data.



After clicking on the Start Diagnostics you will be asked if you want to save a log file. This can be useful to monitor the telemeter over a period of time or if you are asked to send information to support staff at Kaha. The log file and display are both updated every 10 s. A count of the updates is shown in the bottom left hand corner of the window. If you choose to save a log file you will not be able to stop the diagnostics for at least 2 minutes. ConfigSoft will ask you to confirm the name and location for the log file. The default filename includes the telemeter serial number and the date and time the diagnostics was started e.g. RTx5574_log_2013_5_9_16_11.txt

Please Note: Depending on the telemeter you have the **X** may appear if the telemeter does not have that function i.e. oxygen telemeters will have **X** for the pressure sensor.



Battery Level

✓ = the battery is more than 20% charged.

✗ = the battery is low, and the telemeter needs to be recharged. If the telemeter is not placed on an active SmartPad it will automatically enter Safe Mode.

Note: The battery level reported during diagnostics may be artificially high while the telemeter is charging. For an accurate battery level, remove the telemeter from the SmartPad for 1 minute before noting the battery level.

Charging

✓ = the telemeter detects a charging field from a SmartPad and charging is occurring.

✗ = the telemeter cannot detect a charging field from a SmartPad and is not charging. A telemeter will continue to run off its battery for approximately 4 hours (if fully charged).

Troubleshooting Charging: there are a number of possible situations for a ✗ next to Charging:

- 1) The Charging field of the SmartPad has been disabled using the Configurator System.
- 2) The telemeter is not within 5 cm of the charging surface of a SmartPad.
- 3) The SmartPad has temporarily turned the scheduled charging field off for a temperature update.
- 4) The telemeter is in an area of the SmartPad with low field strength or not be parallel to the SmartPad surface therefore in the wrong orientation to receive the charging field efficiently.

Pressure Sensor Function

This only applies to telemeters with pressure sensors e.g. TRM54P, TRM54PB, etc

✓ = the pressure sensor is functioning normally.

✗ = a problem has been detected with the pressure sensor, please contact your distributor or adi.to/support.

Oxygen Telemeter Potentiostat

✓ = the oxygen sensor is functioning normally.

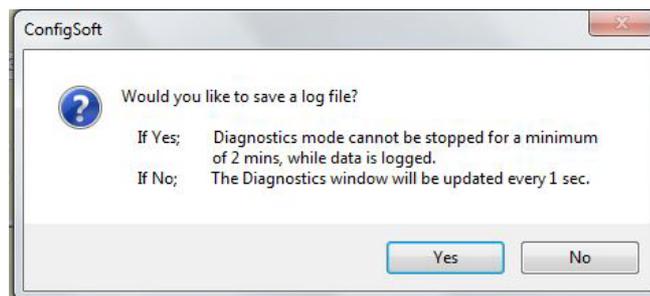
✗ = a problem has been detected with the oxygen sensor.

For any other issues or questions please contact adi.to/support for further assistance.

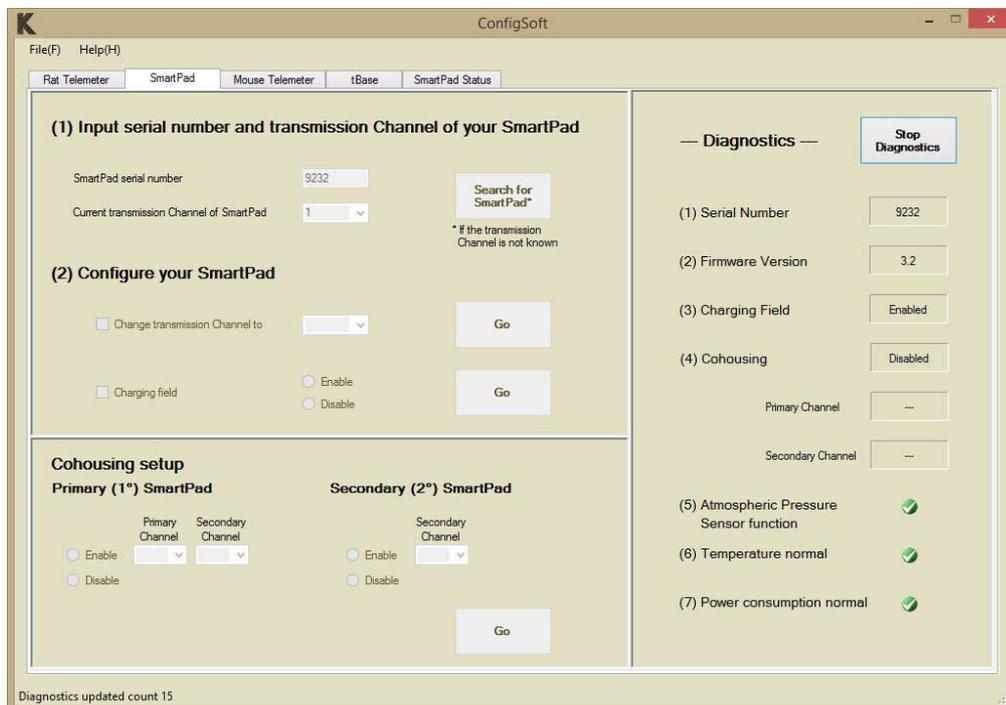
SmartPad Diagnostics

Using the Configurator System, the user can investigate the status of their SmartPad. To run diagnostics, enter the serial and Channel numbers of your SmartPad and press the “Start Diagnostics” button. **Please note:** *you cannot record data from your telemeter using a SmartPad that is in diagnostics mode (a saw tooth pattern is outputted from the SmartPad analog outputs).*

Press OK to continue. You will be asked if you wish to save a log file. This can be useful to monitor the SmartPad over a period of time or if you are asked to send information to support staff at Kaha. The log file and display are both updated every 10 s. A count of the updates is shown in the bottom left hand corner of the window. If you choose to save a log file you will not be able to stop the diagnostics for at least 5 minutes. ConfigSoft will ask you to confirm the name and location for the log file. The default filename includes the SmartPad serial number and the date and time the diagnostics was started e.g. Sp6096_log_2013_5_9_16_48.txt.



The SmartPad will now be in diagnostics mode and the Status light on the front will flash red (TR181) or orange (TR180) depending on the SmartPad model.



Atmospheric Pressure Sensor Function

- ✓ = the atmospheric pressure sensor is functioning normally.
- ✗ = a problem has been detected with the SmartPad atmospheric pressure sensor. This can be caused by a brief loss of communication with the SmartPad. If it occurs frequently or continues for more than 30s please contact adi.to/support.

Temperature Normal

- ✓ = the temperature of the SmartPad is at acceptable levels.
- ✗ = the temperature is above acceptable limits. Please contact adi.to/support.

Power Consumption Normal

- ✓ = SmartPad power consumption is normal.
- ✗ = Excess power consumption has been detected. The Status light on the front of SmartPad will be red. This cause may be that the SmartPad is too close to a metal surface or another SmartPad. The SmartPad will continue receiving and outputting data but the charging field will have been turned off. To correct the situation, unplug the SmartPad and try moving the SmartPad away from any metal surfaces and other SmartPads, re-plug in the power cable to reset the SmartPad. If the problem continues please contact adi.to/support.

Cohousing

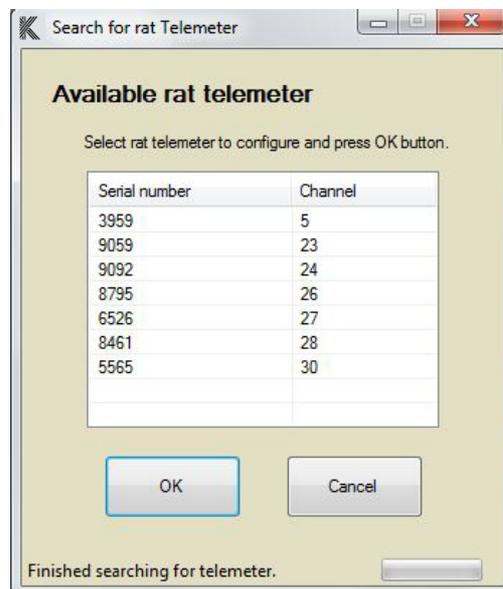
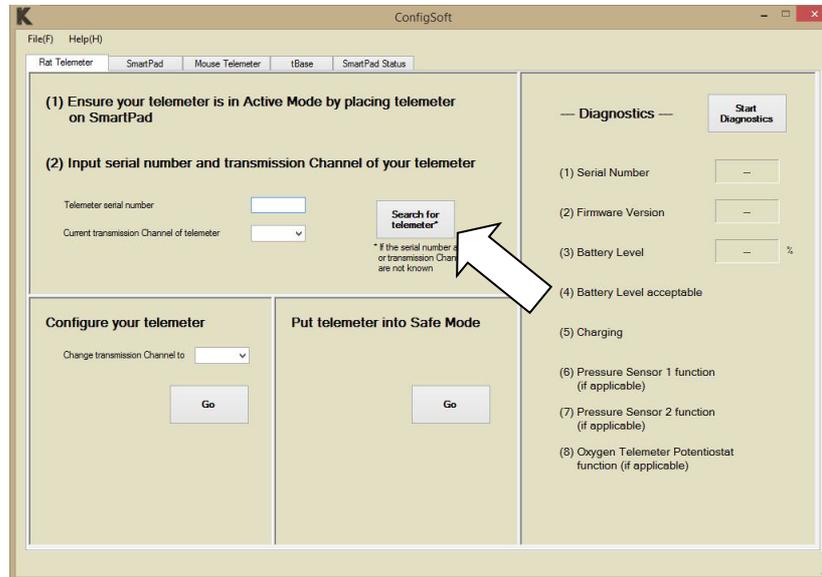
This box indicates whether Cohousing has been enabled.

Disabled	Cohousing is disabled, or not available with this SmartPad
Primary	Primary Cohousing is enabled. The Primary and Secondary Channels will also be displayed.
Secondary	Secondary Cohousing is enabled. The Secondary Channel will be displayed.

General Troubleshooting

What if I do not know the Channel setting of the telemeter?

With the telemeter in Active Mode press the “Search for Telemeter” button in the “Rat Telemeter” tab of ConfigSoft. The Configurator will search through each of the available Channels and report any telemeters which are in Active Mode and within range and report the serial number and Channel.



What if I do not know the serial number of a telemeter already implanted in an animal?

It is always best to record the telemeter serial number and Channel at the time of surgery, however if you do not know the Channel or the serial number of the telemeter, make sure the telemeter is active (place the animal on a SmartPad) and use the “Search for Telemeter” button in the “Rat Telemeter” tab of ConfigSoft. The Configurator will search through each of the Channels and report any telemeters active and within range. You may need to go through a process of elimination by turning telemeters off and on to determine which telemeter is in which animal.

The Search for Telemeter function does not find the telemeter. What do I do now?

There are 4 possible explanations:

1. The telemeter is in Safe Mode
2. The battery of the telemeter is discharged (and the telemeter has switched to Safe Mode)
3. The telemeter is too far away from the Configurator
4. The telemeter has been configured to the same Channel as another telemeter

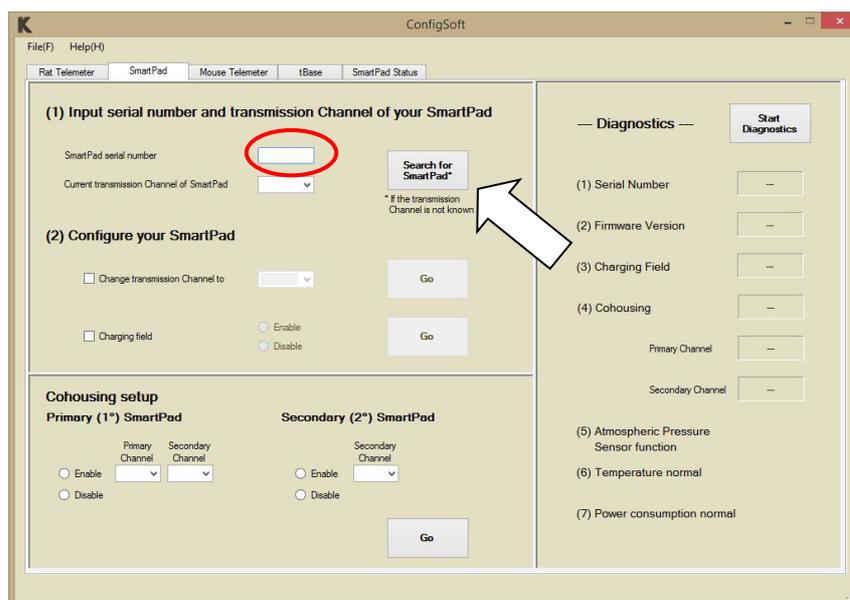
Solutions

1. Move the telemeter closer to the Configurator and run the search again.
2. Place the telemeter on a SmartPad (with an active charging field) in the area as indicated on page 13. Run the search again.
3. Try turning other telemeters to Safe Mode or move other telemeters to another room (>5 m away) and run the search again.

Now that the telemeter has been found check the battery level (see Telemeter Diagnostics section). If the battery level is below 30% the telemeter needs to be charged before the Channel can be changed. Place the telemeter on a SmartPad with the same Channel and leave it to fully charge (90-100%), overnight is recommended.

What if I do not know the Channel setting of a SmartPad?

Go to the “SmartPad” tab in ConfigSoft. With the SmartPad turned on, enter the serial number (found on the front or rear), press the “Search for SmartPad” button. The Channel will appear in a table.



Calibration Values

Calibration & Offset Testing

During factory calibration, we attempt to ensure the environment is as similar as possible to what the telemeter will experience when implanted in an animal. Users who wish to follow or check the offset either pre- or post-implantation need to precisely set the environment for the offset test as detailed below.

Please Note: Telemeters should remain immersed throughout the testing procedure. If your telemeter has biopotential or SNA lead wires these also need to be submerged during the testing procedure to prevent ambient noise affecting the pressure signals.

Key factors that need to be controlled are;

1. **Hydration;** Telemeters should be soaked for a minimum of 48 hours prior to offset check. It is important to ensure that, when checking the offset, the sensor tip is no more than 5 mm under the water so as to avoid a head of pressure effect.
2. **Turn on time;** On the bench, all telemeters have a signal settling period when first switched on. In order to correctly account for this “turn-on effect”, telemeters should be in Active Mode on a SmartPad for a minimum of FOUR (4) hours prior to checking the offset pressure.
3. **Telemeter Temperature;** Telemeters should be at 38°C for a minimum of 30 min prior to recording values.
4. **Light;** Light will affect the sensor and so the telemeters need to be in the dark.

If testing at the time of explant this process can be simplified:

1. The telemeter can be removed from the animal whilst still in Active Mode, put immediately in a Tergazyme solution and placed on the SmartPad.
2. Once cleaned, it can be placed in warm water at 38°C for 30 minutes in the dark. The output voltage obtained from the SmartPad at this zero-pressure level should be close to 1.0 V.

Telemeters are all factory calibrated using tightly controlled conditions as listed above. Under these conditions the voltage analog output from the SmartPad corresponds to the following pressures:

1V = 0 mmHg
2V = 100 mmHg

Biopotential

Prior to shipping, all telemeters are calibrated so that the voltage analog output from the SmartPad corresponds to the following voltages:

0V = -2 mV
2V = 0 mV
4V = 2 mV

Oxygen

Prior to shipping, all telemeters are calibrated so that the voltage analog output from the SmartPad corresponds to the following voltages:

1V = 0 nA
2V = -200 nA

Calibration coefficients will also be supplied with the carbon paste electrodes which will need to be used in calculating the correct oxygen concentration.

SNA

Prior to shipping, all telemeters are calibrated so that the voltage analog output from the SmartPad corresponds to the following voltages:

$$0V = -60 \mu V$$

$$2V = 0 \mu V$$

$$4V = 60 \mu V$$

**SmartPad outputs have a low pass filter of 1 kHz. Additional filtering, rectification and signal integration can be performed using a data acquisition system.

Temperature

Prior to shipping, all telemeters are calibrated so that the voltage analog output from the receiver corresponds to the following temperatures:

$$0V = 0^{\circ}C$$

$$1V = 20^{\circ}C$$

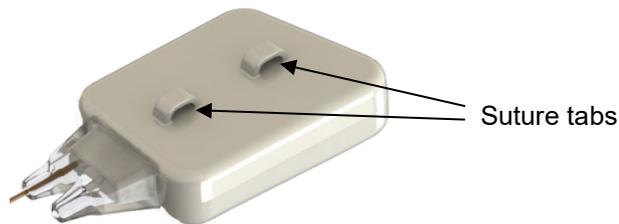
Under normal operation (SmartPad charging field enabled), temperature output is updated every 2 hours. For continuous updates of the temperature output use the Configurator system to disable the SmartPad charging field. **Please Note: The telemeter will not be charged when the SmartPad charging field is turned off.

Usage and Maintenance

Positioning the Telemeter during Surgery

Charging and Signal Maximization

For best charging performance, the telemeter must be implanted within the abdominal cavity and parallel to the SmartPad. Securing the telemeter to the abdominal wall using the suture tabs places it in the best position and orientation for recharging and signal communication. Never secure the telemeter by suturing around the pressure catheter or lead wires. With the telemeter body in the abdomen, the pressure catheter can be inserted into the abdominal aorta for arterial pressure measurement and/or lead wires tunneled subcutaneously to a recording site. More information and extensive surgical videos are available online at www.adinstruments.com/support/kaha.



Use of the Suture Tabs

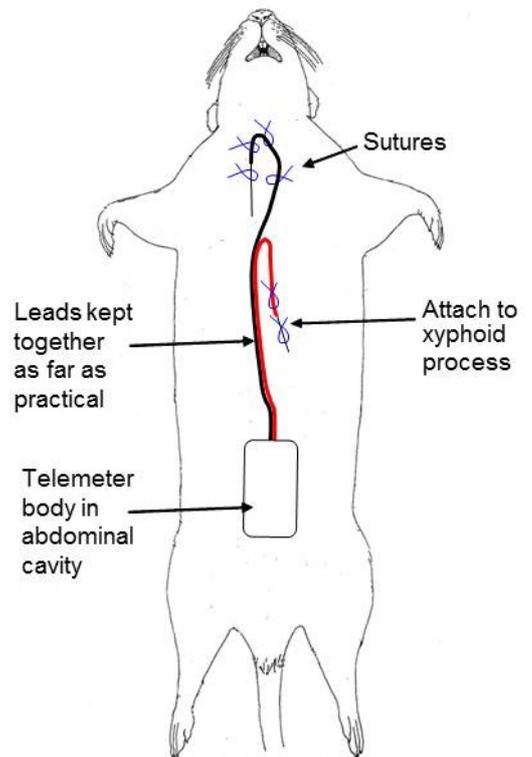
All telemeters are equipped with two suture tabs. The suture tabs must be used to secure the telemeter in the correct position within the abdominal cavity. If your telemeter has silicone suture tabs, particular care should be taken not to damage the suture tabs during either implantation or explantation of the telemeter.

Biopotential Telemeter

Biopotential Lead Separation

Depending on the model, telemeters may be supplied with bipolar lead wires that are suited to ECG data collection. The bipolar lead wires are supplied connected down their entire length. While separation of the ends is required to allow appropriate placement, we recommend that the lead wires be kept together and run alongside one another for as far as practical. This will reduce electrical noise in recorded biopotential signals. A free length of no more than 3-4 cm is recommended for each lead. It is not recommended that sutures be placed around the leads other than at the point of contact with the tissue as this may provide a stress point on the leads and cause them to break. More information and surgical videos are available online at www.adinstruments.com/support/kaha.

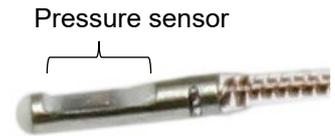
In the example placement of lead wires for ECG on the right, the positive lead wire (red or yellow) is placed on the xiphoid process, while the negative lead wire (black or green) is placed between the sternocleidomastoid muscles.



Example placement of lead wires for recording of high quality ECG

Pressure Telemeter (Pressure Sensor)

Telemeter models that include pressure measurement are fitted with a Millar Mikro-Tip® solid state pressure sensor. The sensor is at the end of the catheter allowing highly accurate measurement of pressure signals directly where the tip is located. The sensing tip should be handled carefully. Never lift the telemeter by the tip, pierce the tip with a sharp object, handle the tip with forceps or hit the tip against a hard surface.

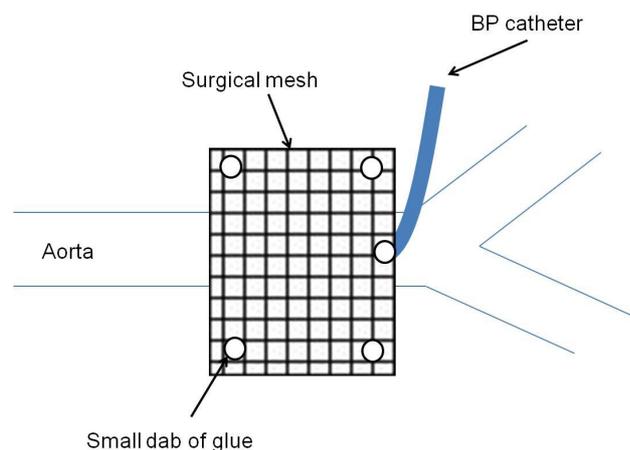


Telemeters with pressure catheters are shipped sterile and dry, when implanted there will be an equilibration period and the pressure values recorded in the first 48 hours after surgery may have an offset of up to 20 mmHg. Before making any recordings from the implanted telemeter it is also important that the telemeter has been turned on for a minimum of FOUR (4) hours

Mesh for BP Catheter Implantation

Tissue adhesive can detach from tissue after a period of time allowing the pressure catheter to pull out of the vessel. To avoid this, we recommend the use of a small piece of surgical mesh at the time of implantation. Scar tissue will grow into the mesh fabric holding the catheter in place and reducing reliance on the glue itself.

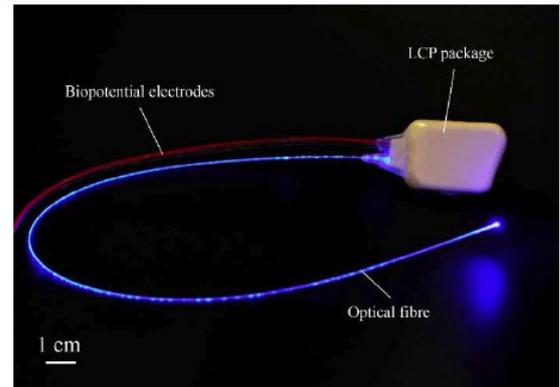
1. Insert catheter into the vessel and use the smallest amount of glue to hold the catheter in place and to stop any blood leakage (see surgical videos online at www.adinstruments.com/support/kaha)
2. Dry the surrounding area using swab sticks.
3. Cut a small square of surgical mesh (5 x 5 mm).
4. Place the mesh over the aorta and catheter.
5. Glue the mesh to the catheter and use small amounts of glue to attach the mesh to the surrounding tissue. Take care not to put too much glue on the vessel or blood flow may be restricted when it dries. It is important to ensure that the mesh is properly glued to the catheter. You should not be able to gently lift the mesh away from the catheter once the glue has dried.



Optogenetics Telemeter

The Optogenetics Biopotential telemeter (TR58AB) consists of a blue (460 nm) led light source and optical fiber for light delivery (35 cm), and biopotential leads (25 cm) for the recording of EEG, EMG or ECG.

The telemeter can be used with the TR190 Configurator and TR181 SmartPads (but **NOT** compatible with any TR180 SmartPads). Some SmartPads and Configurators will require a firmware upgrade before they will work with the Optogenetics telemeters.



	Optogenetics compatible	Upgradeable*
TR181 SmartPad	Serial numbers 13537 and above	All
TR190 Configurator	Serial numbers 12305 and above	All
ConfigSoft	v4.2.0.0 or above	All**
TR180 SmartPad	Not compatible	Not upgradeable

*Contact adi.to/support or your nearest representative.

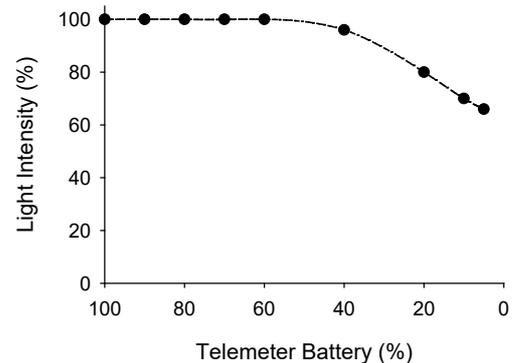
**If using ConfigSoft v3.0, or earlier, you will need to upgrade to v4.2.0.0 or above.

Optogenetics Telemeter Light Properties

The light emitted from the fiber tip of the Optogenetics Telemeter is designed to activate opsins that respond to wavelengths of ~460nm e.g. Channel rhodopsin 2. The amount of light emitted is controlled by the Light Intensity parameter set in ConfigSoft (see page 45). The 100% setting will provide full power which will be at least 48mW/mm² at the tip. The exact maximum light intensity varies slightly between individual telemeters and is provided on the telemeter packaging.

The light at the tip may also be affected by:

1. Sharp bends in the optical fiber – a minimum bend radius of 5mm is recommended to avoid damage to the fiber. Light reduction caused by a bend radius of 5mm is ~4%.
2. Telemeter battery level – Consistent light output should be expected when the telemeter battery level is >40%.
 - a. If the telemeter is being used on the SmartPad, with the wireless power field enabled, then it can be expected that the battery will remain well above 40% and light output will be consistent.
 - b. When the telemeter is used off the SmartPad, and therefore running off the battery, the battery level can be monitored using ConfigSoft's Telemeter Diagnostics.
 - c. The time for the battery to discharge to ~40% will depend on the light stimulation pattern chosen. E.g. for a light pattern with a 20% duty cycle and maximum light intensity (100%) it is expected that it will take ~2.4 hours before the battery reaches 40%.



IMPORTANT:

- Please do not look directly at the emitted light or direct it into the eyes of others when the LED is enabled.
- Please do not bring the active fiber tip close to your eye or the eyes of others.

Optogenetics Parameter Setup

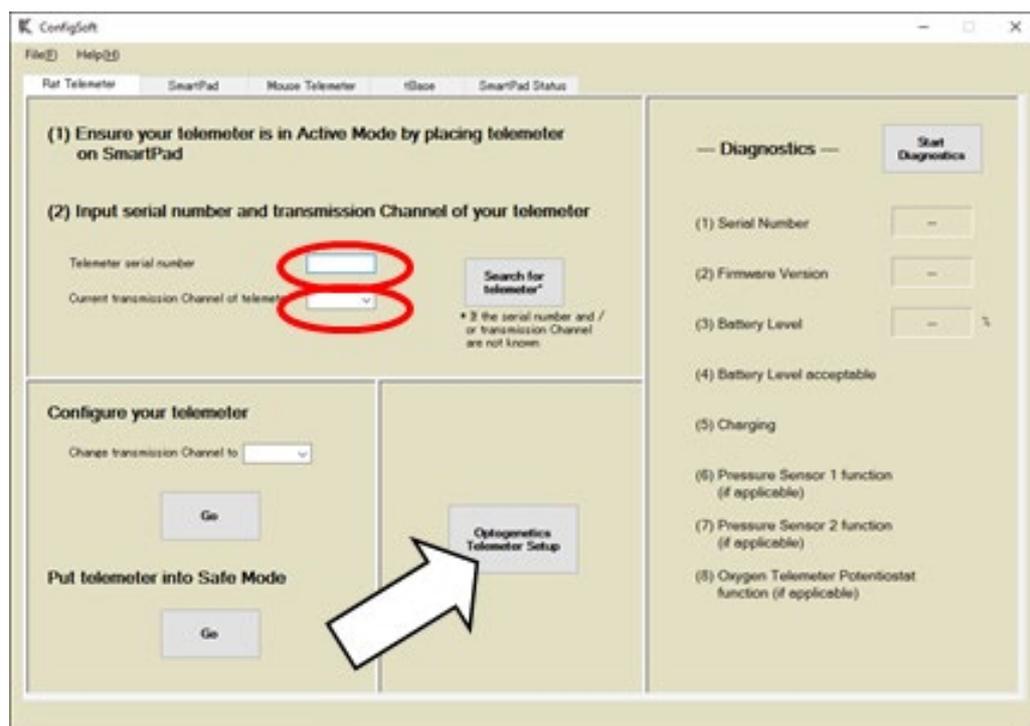
The optogenetics parameters are stored on the telemeter. The factory default parameters are shown in the table on the next page. The parameters can be configured in the Rat Telemeter tab in ConfigSoft by pressing the 'Optogenetics Telemeter Setup' button.

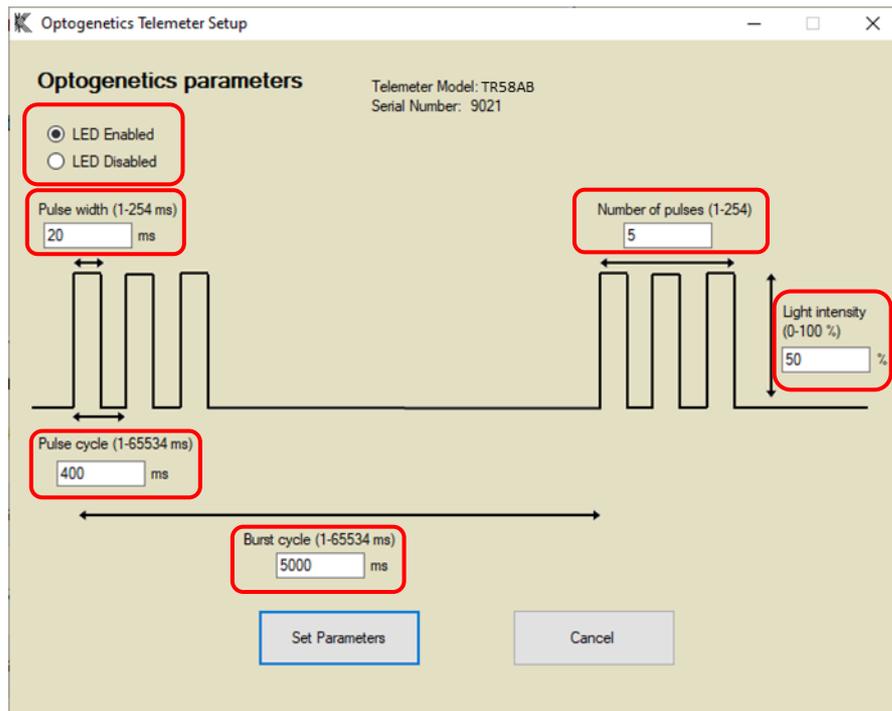
Optogenetics functions are available in versions of ConfigSoft v4.2.0.0 or above. If this button is not visible in your version of ConfigSoft, an updated version can be downloaded from ADInstruments' website:

<https://www.adinstruments.com/support/downloads/windows/configsoft>

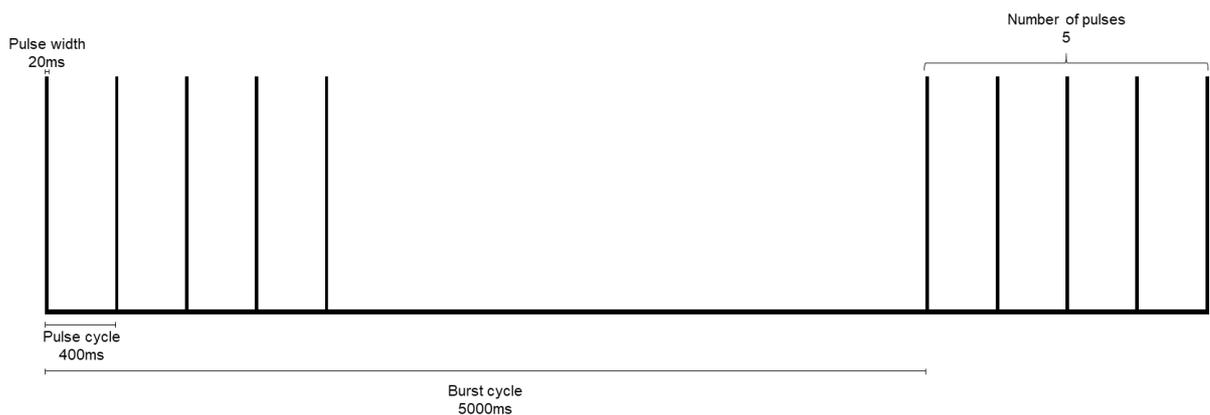
To set the optogenetics parameters:

1. Enter the telemeter serial number and Channel.
2. Press 'Optogenetics Telemeter Setup.'
3. The Optogenetics Telemeter Setup window will appear and be populated with the current optogenetics parameters loaded on the telemeter. If the LED is enabled, the LED on the telemeter will be flashing according to the parameters set. **Note:** The Optogenetics Telemeter Setup window will not appear if an Optogenetics telemeter with the entered serial number cannot be found on the chosen Channel.





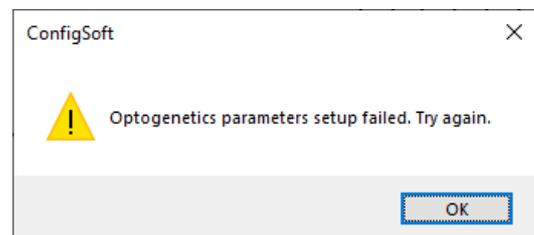
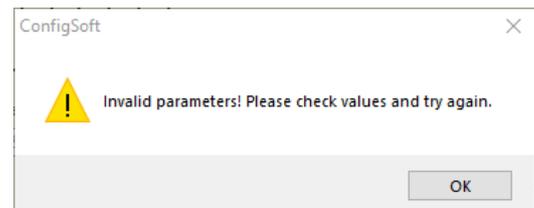
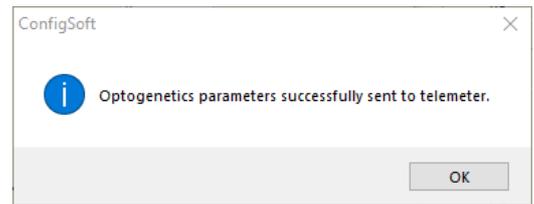
For example: the parameter settings above would result in the following light stimulation pattern at 50% light intensity.



- Change parameters by clicking on the parameter and entering the new value. Descriptions and default factory settings of the parameters are listed in the table below.

Parameter	Description	Factory Default
LED Enable/Disable	Enable or disable LED	Enabled
Pulse width	Set the pulse width (On time) of LED (1 - 254 ms)	100 ms
Pulse cycle	Set the pulse cycle of LED (1 - 65534 ms)	200 ms
Number of pulses	Set the number of LED pulses in each burst (1 - 254)	3
Light Intensity	Set the Light Intensity (up to 100%)	100
Burst cycle	Set the time between the start of each stimulation burst (1 – 65534 ms)	1200 ms

5. Press Set Parameters button to send the updated parameters to the telemeter. Pressing the Cancel button on Optogenetics Telemeter Setup window closes the Optogenetics Telemeter Setup form without sending any commands to the telemeter.
6. If the parameters are sent/received successfully to the telemeter a confirmation window will appear and clicking OK closes the Setup window.
7. If invalid parameters are set, such as the pulse width being longer than the pulse cycle, the window below will appear, check that parameters are valid before sending the parameters again.
8. If the parameters were not successfully sent/received by the configurator/telemeter an error message will appear and the parameters will need to be sent again.



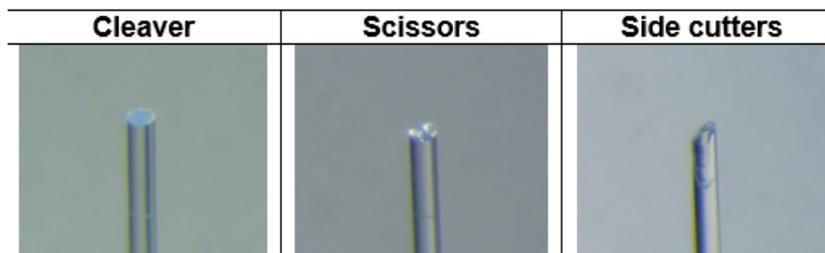
Reusing the Optogenetics Telemeter

Like the other rat telemeters, the Optogenetics telemeter is designed to be reused. The general telemeter explanation, cleaning and sterilisation instructions on page [49](#) should be followed along with the following recommendations.

If dental cement is used to secure the fiber in place, the fiber will need to be cut where it exits the dental cement. Solvents such as acetone are not suitable for removing dental cement from the fiber as they may damage the fiber cladding and affect light propagation.

Before sterilisation, the fiber should be prepared for reimplantation:

1. Strip the cladding from the fiber using a TRSTR-1 Fiber Optic Stripper (103-S, 250 um).
2. Use a fiber cleaving tool to trim the glass fiber and give a clean perpendicular cut. Cutting the fiber with scissors or a scalpel blade will not achieve a clean cut and will cause light scattering. Using the TRCLV-1 Fiber Optic Field Cleaver (900um Buffer/250um Coated) is highly recommended



Telemeter Care and Handling

Telemeters with Pressure Sensors

The telemeter pressure catheter (if fitted) is shipped with foam around the catheter tip to protect the sensor area. The catheter tip should be kept in the open area of the foam and should always be stored in its original packaging between uses.

Proper handling of the telemeter and pressure catheter is very important to avoid damage and extend the telemeter life. **Take care not to damage the telemeter body, pressure catheter or lead wires as they are non-repairable.** It is highly recommended that users view the online videos on handling the telemeters during implantation, explantation and cleaning www.adinstruments.com/support/kaha.

Please note: If handling the pressure catheter using forceps, the forceps' tips should always be padded using soft tubing (e.g. silicon). This will protect the wires inside the catheter from being crushed.



Use and Handling Tips

- Inspect the catheter (using a microscope) for damage (cracking, kinks, etc.) before each use.
- Clean the telemeter and sensor and lead wires immediately after each use (see Cleaning Instructions).
- Do not touch the pressure sensor area with sharp objects. Do not make sharp bends in the catheter.
- Do not apply direct pressure to the pressure sensor area with instruments such as forceps or tweezers.
- When handling the catheter with either fingertips or surgical instruments, always handle the catheter 5-10 mm proximal to the sensor area. The sensor area contains very fine wires which may be damaged or broken if the catheter is gripped too close to the sensor or too tightly, be GENTLE.
- Always know the location of the catheter tip.
- Do not place heavy objects or metal instruments on top of the catheter or telemeter.
- Take care not to cut the catheter during surgery or when removing the telemeter from the animal.

	DO:	DO NOT:
Pressure Sensor	Clean immediately after use	Do NOT clean with stiff-bristled brush Do NOT clean with high pressure water jet
	Protect sensor tip when not in use	Do NOT tap the sensor against a hard surface Do NOT apply excessive force to the sensor tip Do NOT expose to excessive pressure
Catheter Body	Clean immediately after use	Do NOT cut, crease, knot, fold, kink, or crush with forceps or clamps of any kind
After removal from animal	Keep catheter and sensor wet until cleaned	Do NOT expose to alcohol, cresols, phenols, mercury compounds, hypochlorites, acetone, peroxide, silicone chlorine, xylenes, trichloroethylene, or freon
	Clean thoroughly with approved enzymatic cleanser immediately	Do NOT use ultrasonic cleaner
Disinfection or Sterilization	Dry catheter before sterilizing with ethylene oxide	Do NOT autoclave, irradiate (gamma/ebeam), plasma, peroxide or formaldehyde vapor solutions
	Use a recommended cleaning agent	Do NOT use Sporox or Cidex PA solutions

Telemeter Removal and Preparation for Reuse

With care, the rat telemeters are designed to be reused. After implantation for a long period of time it is possible to find connective tissue around the catheter, lead wires and telemeter body. When removing the telemeter take care to avoid damaging the catheter, lead wires or telemeter body. Never use a scalpel to cut tissue from around or above the telemeter as it could damage the telemeter. When detaching the telemeter body from the muscle, take great care to only cut the sutures holding it in place. It may be necessary to first clear attached tissue from the area so that the suture thread can be visualized. Extreme care should also be taken not to damage the pressure catheter and sensor tip during telemeter removal.

The telemeter should be soaked in cleaning detergent (see below) immediately after removal. After soaking and using a microscope, the sensing tip should be **gently** wiped with a soft cotton gauze pad or swab sticks to remove any remaining film or deposits. As always care must be taken not to damage the sensing tip.

Cleaning

1. After removing the telemeter from the animal, immediately soak it in a beaker or dish filled with fresh saline or distilled water. Keep soaking until you are ready to continue cleaning; **DO NOT** allow it to dry.
2. Soak the whole telemeter in a recommended enzymatic cleaning solution (listed below). This is essential to prevent protein build-up on the pressure sensor. Without the use of an enzymatic cleaner, a protein film will form that can result in pressure signal drift.

Type	Trade Name	Manufacturer	Active Ingredient	Soak Time/Temp
Enzymatic Detergent	Enzol [®] (in UK: Cidezyme [®])	Advanced Sterilization Products (J&J)	Propylene Glycol	15 mins / room temperature
	Endozine [®]	Ruhoff Corporation	Propylene Glycol	15 mins / room temperature
	Terg-A-Zyme [®]	Alconox	Sodium Dodecylbenzene	15 mins / room temperature

3. After soaking (recommended times), gently wipe the sensing tip under a microscope with a soft cotton gauze pad or swab sticks to remove any remaining film or deposits. Care must be taken not to damage the sensing tip.
4. After soaking and wiping, thoroughly rinse the telemeter with fresh distilled water or saline.
5. After rinsing is complete, gently dry the catheter as follows:
 - Fold a soft tissue or kim wipe
 - Use gentle stroking to dry the catheter tip.
 - **Do not** pull the catheter tip through a folded tissue.
 - **Do not** allow the catheter to air dry on a tray, table, or countertop.
6. After the cleaning and drying procedure is finished:
 - Protect the sensor area on the catheter tip by carefully placing it in the foam that came with the telemeter.
 - Return the telemeter to its original plastic tray.
 - Slide the tray inside the box and now store the telemeter in a cool, dry place until the next use.

IMPORTANT: Delays in rinsing a telemeter after removal will reduce cleaning effectiveness! Examine the pressure sensor active surface (diaphragm) for blood or materials not removed by cleaning. A dirty sensor may cause baseline drift when used the next time.

Cleaning Agents

An enzymatic detergent can help in removing biological tissue from the catheter and telemeter body (e.g. Terg-A-Zyme®). These are generally available from most hospital supply companies and are generally labeled for use on fabrics or surgical equipment/instruments. The purpose of the detergent is to remove blood, serum proteins, and tissue debris from the surface of the telemeter. It is important to note that any product that has a **SURFACTANT CANNOT** be used with any pressure telemeters.

We recommend Terg-A-Zyme which is an enzyme-active powdered detergent made by Alconox, Inc. To make a 1% solution, mix 10 grams of powder with 1 Litre of cold or warm water. Allow the telemeter to soak for a minimum of 15 minutes and a maximum of 24 hours in the solution. Rinse thoroughly, preferably with running water. Terg-A-Zyme is not a sterilant. Telemeters must be sterilized before re-implantation. Please see following section for more information.

Please Note: If checking the offset/calibration of the telemeter, the conditions listed under Calibration Values must be replicated, i.e. clean, hydrated, turned on for 4 hours, at 38°C and in the dark.

Sterilization

Preventing infection is very important in collecting quality recordings of normal physiology and animal survival. It is important to make sure the telemeter is sterile before implantation. All telemeters are shipped sterilized using Ethylene Oxide gas sterilization and can be implanted without further sterilizing as long as the sterile pouch is intact. Once opened or in preparing for reuse, use one of the methods below to sterilize your telemeter.

IMPORTANT:

- Under no circumstances should the telemeter be autoclaved or subjected to temperatures over 60°C as this will damage the telemeter.
- Do not use alcohol as a sterilizing agent. This will damage the telemeter.
- Do not sterilize by radiation (gamma or e-beam), plasma, peroxide or formaldehyde vapor solutions.
- Carbon paste electrodes should not be sterilized, in particular the electrodes of Tissue Oxygen telemeters. Please see www.adinstruments.com/support/kaha for access to online recommendations.

Disinfection/Sterilization

1. The telemeter must be cleaned, rinsed and dried before disinfection or sterilization. Soil, debris, proteins, and water can interfere with the effectiveness of the following procedure. Note that some disinfectants have a limited usable life after activation or opening the container, failure to take notice of the warnings can prevent the effectiveness of the disinfection process.
2. Prepare the disinfectant according to the manufacturer's instructions.
3. Soak the telemeter in the disinfectant at the temperature and time intervals listed.
4. Rinse the telemeter well in sterile pyrogen-free water (or sterile saline) before implantation. A minimum of three separate rinses is recommended. Do not reuse any of the water used for rinsing since it will be contaminated with the disinfectant.

IMPORTANT: Use only the listed recommended cleaners and disinfectants for the times/temperatures indicated.

Chemical Sterilants

Available from most hospital supply companies, chemical sterilants are considered cold sterilants and should be used for the sterilization of heat sensitive medical equipment such as Kaha telemeters. When used properly, chemical sterilants will destroy all viable forms of microbial life.

Glutaraldehyde may be used to sterilize the telemeters. Glutaraldehyde must be diluted to 2% before use. Check your local chemical supply company for availability. Do not use glutaraldehyde solutions containing surfactants (i.e. do **not** use Cidex 7, Cidex Plus 28 Day or Metrocide 28).

Rinse with Sterile Saline

The telemeter should always be washed in sterile saline before implantation to remove all traces of the sterilant. Use it to temporarily store (< 24 hours) the telemeter aseptically until surgical implantation.

Ethylene Oxide Gas Sterilization

These sterilizers operate at a low temperature of 55°C and use chemicals as the sterilant. Items are packed and dry at the end of the sterilizing cycle. Telemeters are suitable for Ethylene Oxide sterilization as long as they are not subjected to temperatures above 60°C.

Customers are liable for product replacement if the recommended cleaning and sterilization products and instructions are not used or followed. If there are any questions about a chemical or procedure, please contact adi.to/support.

WARNING: Some examples of chemicals that will cause damage to telemeters include, but are not limited to: alcohols, phenols, iodophors, and hypochlorite. Please confirm with adi.to/support before using any product other than the approved products list below.

Type	Trade Name	Manufacturer	Active Ingredient	Soak Time / Temperature
High-level disinfectant	Cidex Activated Dialdehyde Solution	Advanced Sterilization Products (J&J)	Glutaraldehyde	1-2 hours / 25°C (77°F)
	Cidex® OPA	Advanced Sterilization Products (J&J)	Orthophthalaldehyde	16-30 mins / 20°C (68°F)
	MetriCide®	Metrex	Glutaraldehyde	1-2 hours / 25°C (77°F)

Products with similar names are available but may not be suitable. Please use only products specified or contact adi.to/support for any other questions.

Technical Specifications

SmartPad Technical Specifications

SmartPad Model	TR181	TR180
SmartPad functions	Contains ambient pressure monitor, outputs standard analog voltage compatible with any data acquisition system (BNC), recharges the telemeter battery, has a built-in fan for optimal temperature operation.	Contains ambient pressure monitor, outputs standard analog voltage compatible with any data acquisition system (BNC), recharges the telemeter battery.
Weight	2.8 kg	2.5 kg
Dimensions	400(w) x 450(d) x 75(h) mm	400(w) x 450(d) x 60(h) mm
Cage platform dimensions	295(w) x 425(d) mm	295(w) x 425(d) mm
Power input	100-240 V, 50-60 Hz	100-240 V, 50-60 Hz
Max Power draw	50W	40W
Temperature Operating Range	10 to 40 degrees Celsius	10 to 40 degrees Celsius
Output Connectors	BNC x 3	BNC x 3
Output Voltage Range	0 to 4V	0 to 4V
Low Pass filtering on signal outputs	Cut off frequency = 1000 Hz	Cut off frequency = 1000 Hz

Telemeter Technical Specifications

The technical specifications in the table below are for the Kaha 5 series telemeters. Some specifications may not be relevant depending on the model of the telemeter.

Temperature operating range	8 to 41 degrees Celsius
Sampling frequency	2000 Hz
Low Pass filtering by SmartPad	Cut off frequency = 1000 Hz
Transmission range	Up to 5 m (range may vary depending on laboratory configuration)
Transmitted signal	Fully digital at 2.4 GHz
Channels	40 transmission frequencies are available, user set
Minimum animal weight	175 g
Outer material	Liquid Crystal Polymer (LCP)
Weight	~13.5 g
Dimensions	31.5 x 24 x 11 mm
Battery life	Continuous on SmartPad. If the telemeter/animal is away from the SmartPad field (or the SmartPad field is turned off) battery operation time is ~4 hrs.
Recharge time	Minimum 3 hours
On-off mechanism	Activation (On) via the SmartPad field and deactivation (Safe Mode) using Configurator System.
Calibration	No user intervention required (calibration values stored within each telemeter).
Analog output calibration values	Pressure: 1V output = 0mmHg, 2V output = 100 mmHg Biopotential: 2V output = 0mV input, 4V output = 2 mV input SNA: 2V output = 0 μ V input, 4V output = 60 μ V input Oxygen: 1V output = 0nA, 2V output = -200nA Temperature: 0V output = 0°C, 1V output = 20°C

Pressure Telemeter Technical Specifications

Pressure sensor accuracy	± 2 mmHg
Pressure sensor drift	<4 mmHg per month
Pressure sensor Frequency response	DC to 500 Hz (-3 dB)
Standard pressure catheter dimensions	Distal tip; 660 μ m OD (2Fr), Catheter; 500 μ m (1.5Fr), length 9 cm
Pressure sensor range	-40 to 300 mmHg @ atm of 760 mmHg (720 to 1060 mmHg absolute pressure)
Ambient pressure range	650 to 800 mmHg
Maximum operating altitude	1300 m

Biopotential Telemeter Technical Specifications

Biopotential Input range	± 2 mV
Biopotential Resolution	12 bit A/D
Biopotential High pass characteristics	AC coupled, single pole, -3dB point at 0.7 Hz
Biopotential lead wires	25cm length, coiled stainless steel
Biopotential lead wire diameter	1 mm

SNA Telemeter Technical Specifications

SNA Input range	± 60 μ V
SNA High pass filter	-3dB point at 1.5 Hz
SNA Input impedance	500 kOhms at 1000 Hz
SNA lead wires	Multi-stranded stainless steel (length 25cm)
SNA lead wire diameter	0.15 mm (wire only)

Tissue Oxygen Telemeter Technical Specifications

Potentiostat type	Voltage controlled current source
Set potential	-0.65V (-650mV)
Potentiostat current measurement range	0 to -600nA
Potentiostat resolution	12-bit A/D
Potentiostat lead wires	Coiled stainless steel (~28 cm)
Potentiostat lead wire diameter	1 mm

Optogenetics Telemeter Technical Specifications

Optical fiber length	35 cm
Optical fiber diameter	200 μ m core (500 μ m with cladding and coating)
Optical fiber material	Pure Silica core/ TECS Hard Cladding/ Tefzel coating
Minimum bend radius	5mm (breakpoint radius <3mm)
Light wavelength	460 nm (blue)
Light power (max)	≥ 1.0 mW
Light intensity (max)	≥ 30 mW/mm ²
Light intensity stability	Stable when telemeter battery >40%. Allows use off SmartPad for ~2.4 hours at 20% duty cycle at 100% light intensity. See page 44
Battery life	2 – 4 hours, depending on on-time and intensity of the light pulses

Frequently Asked Questions.....

Battery and recharging

Would the animal be harmed by staying in the SmartPad charging field?

There are no known biological effects of the inductive field. Studies have shown that a field strength much higher than the Kaha SmartPad have no effect. The level of magnetic field is quite low and remains useable only ~5 cm above the SmartPad.

Telemeter

How many animals can be monitored at one time?

Each telemeter sends its signal on one of 40 unique transmission Channels. Therefore, up to 40 telemeters and animals within close proximity, the Channels are independent and will not interfere with each other. If you need to have more animals in close proximity, contact Kaha to discuss a customized solution.

Is there any interference between telemeters?

No. As long as each telemeter is set to use a different Channel they use a separate transmission frequency. No shielding is required between multiple cages and SmartPads in a single room. The transmission frequency is in the 2.4 GHz band.

What is the life expectancy of the telemeters?

The telemeters are designed for the implantation in the abdomen. As this is a relatively hostile environment, users should not expect the same life time as for bench top based laboratory items. However, with appropriate care during implantation and explantation and dependent on the length of time of implantation, depending on the length of time the telemeters are used in individual animals, users should expect to reuse the telemeters a number of times.

SmartPad questions

Why does my SmartPad keep showing a red light and my telemeter goes flat?

A red light on your SmartPad suggests that the SmartPad has automatically disabled the charging field due to detection of a high current. In this mode data output will continue but battery charging is not occurring. **Cause:** may be due to the SmartPad being placed too close to a metal surface or to another SmartPad. Move the SmartPad away from any metal and then reset by disconnecting and reconnecting the power.

I need to record from my animal while it is near metal. How can I do this?

Use the Configurator System to disable the charging field of the SmartPad. Remember that the telemeter will run off battery power and therefore data can be collected for approximately 4 hours if fully charged.

Further questions?

Kaha is proud to offer unlimited technical support and advice to all its customers. Register to access our free online Knowledge Centre (www.adinstruments.com/support/kaha) for surgical recommendations and **hardware troubleshooting** advice. If you have any further questions, our team of engineers and physiologists can advise on specific applications and equipment configurations. Please do not hesitate to contact us at support@kahasciences.com.

