EXERGEN

TemporalScanner

Accurate Temperature with a Gentle Forehead Scan

TAT-5000S-RS232-QR IFU
Mindray

The TemporalScanner is an infrared thermometer designed for accurate, completely non-invasive temperature assessment by scanning the temporal artery (TA).

Temperature is measured by gently stroking the TemporalScanner across the forehead, and includes a momentary touch of the probe to the neck area behind the ear lobe, to account for any cooling of the forehead as a result of diaphoresis. The patented arterial heat balance technology (AHB™) automatically measures the temperature of the skin surface over the artery and the ambient temperature. It samples these readings some 1000 times a second, ultimately recording the highest temperature measured (peak) during the course of the measurement. The TemporalScanner emits nothing - it only senses the natural thermal radiation emitted from the skin.

It has been clinically proven in premier university hospitals to be more accurate than ear thermometry, and better tolerated than rectal thermometry, and is supported by more than 50 peer-reviewed published studies covering all ages from premature infants to geriatrics in all clinical care areas. It is a superior method for patient and clinician alike.

A 40-page compendium on Temporal Artery Temperature Assessment is available at www.exergen.com/medical/PDFs/tempassess.pdf, and a complete list of peer-reviewed published clinical studies is available at www.exergen.com/c. Complete multilanguage information on clinical use, instruction manuals, and training is available at www.exergen.com/s, which includes links to a specialized clinical site http://www.exergen.com/tathermometry/index.htm.

The link to www.exergen.com/s appears on the front label of the instrument as a scannable "QR" symbol for easy linking to the site.

exergen.com/s

Important Safety Instructions

READ ALL INSTRUCTIONS BEFORE USING

Intended Use: The Exergen TemporalScanner is a handheld infrared thermometer used by medical professionals for the intermittent measurement of human body temperature of people of all ages, by scanning the forehead skin over the temporal artery. Intended users are physicians, nurses, and nursing assistants at all levels who normally provide patient care. The thermometer provides a peak temperature reading from plural readings during the step of scanning. Electronic circuitry processes the measured peak temperature to provide a temperature display based on a model of heat balance relative to a detected arterial temperature, the electronic circuitry computing an internal temperature of the body as a function of ambient temperature (Ta) and sensed surface temperature. Training materials that are supplementary to this instruction manual are available at www.exergen.com/s, and recommended for first time users.

TAT-5000S Series thermometers are used by medical professionals in clinical environments. Such medical professionals include physicians, nurses, nurses' aides, patient care technicians, and others who are trained to take the temperature of patients. Clinical environments include areas where medical professionals are providing medical services for patients, including hospitals, outpatient clinics, primary care offices, and other settings where temperature is taken as part of patient care. Clinical environments include Emergency Medical Services environments.

Additionally, the TAT-5000S series thermometers are not for use aboard aircraft or near High Frequency Surgical Equipment or Radio Frequency shielded rooms, such as MRI (Magnetic Resonance Imaging) areas.

When using the product basic safety precautions should always be followed, including the following:

- Use this product only for its intended use as described in this manual.
- Do not take temperature over scar tissue, open sores or abrasions.
- The operating environmental temperature range for this product is 60 to 104°F (15.5 to 40°C).
- Always store this thermometer in a clean, dry place where it will not become excessively cold (-4°F/-20°C), or hot (122°F/50°C) or humid (max RH 93% non-condensing, at 50 to 106 kPa).
- The thermometer is not shockproof. Do not drop it or expose it to electrical shocks.
- Do not Autoclave. Please note cleaning and sterilizing procedures in this manual.
- Do not use this thermometer if it is not working properly, if it has been exposed to temperature extremes, damaged, been subject to electrical shocks or immersed in water.
- There are no parts that you can service yourself except for the battery, which you should replace when low by following the instructions in this manual. For service, repair, or adjustments, return your thermometer to Exergen. Warning: no modification of this equipment is allowed.
- Never drop or insert any object into any opening, unless stated in this manual.
- If your thermometer is not used regularly, remove the battery to prevent possible damage due to chemical leakage.

- Follow the battery manufacturer's recommendations or your hospital policy for the disposal of used batteries.
- Not suitable for use in the presence of flammable anesthetic mixtures.
- Communication cables for the TAT-5000S that are field replaceable are specific to the model and patient monitor. Only compatible cables may be used, to maintain compliance of the TAT-5000S thermometers with requirements for Emissions and Immunity.
- If the device fails to operate as described above, see the FAQ section of this manual. Additionally, ensure that you are not in the presence of electromagnetic disturbances.
- If you have any additional questions regarding use or care of the thermometer, please see www.exergen.com or call customer service at 617-923-9900.

WARNING: Use of this equipment adjacent to or stacked with other equipment (other than TAT-5000S compatible patient monitors) should be avoided because it could result in improper operation. If such use is necessary, this equipment and the other equipment should be observed to verify that they are operating normally.

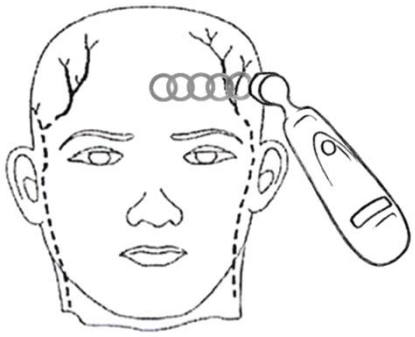
WARNING: Use of accessories, transducers and cables other than those specified or provided by the manufacturer of this equipment could result in increased electromagnetic emissions or decreased electromagnetic immunity of this equipment and result in improper operation.

WARNING: Portable RF communications equipment (including peripherals such as antenna cables and external antennas) should be used no closer than 30 cm (12 inches) to any part of the TAT-5000S thermometer, including cables specified by the manufacturer. Otherwise, degradation of the performance of this equipment could result.

SAVE THESE INSTRUCTIONS.

Introduction to Temporal Artery Thermometry

Temporal artery thermometry (TAT) is a completely new method of temperature assessment, using infrared technology to detect the heat naturally emitting from the skin surface. In addition, and of key importance, this method incorporates a patented arterial heat balance system to automatically account for the effects of ambient temperature on the skin.



This method of temperature assessment has been shown to improve results and reduce costs by non-invasively measuring body temperature with a degree of clinical accuracy unachievable with any other thermometry method.

Before Using, Familiarize Yourself with the Instrument

- **To Scan:** Depress the red button. The instrument will continually scan for the highest temperature (peak) as long as the button is depressed.

- Clicking: Each fast click indicates a rise to a higher temperature, similar to a radar detector. Slow clicking indicates that the instrument is still scanning, but not finding any higher temperature.

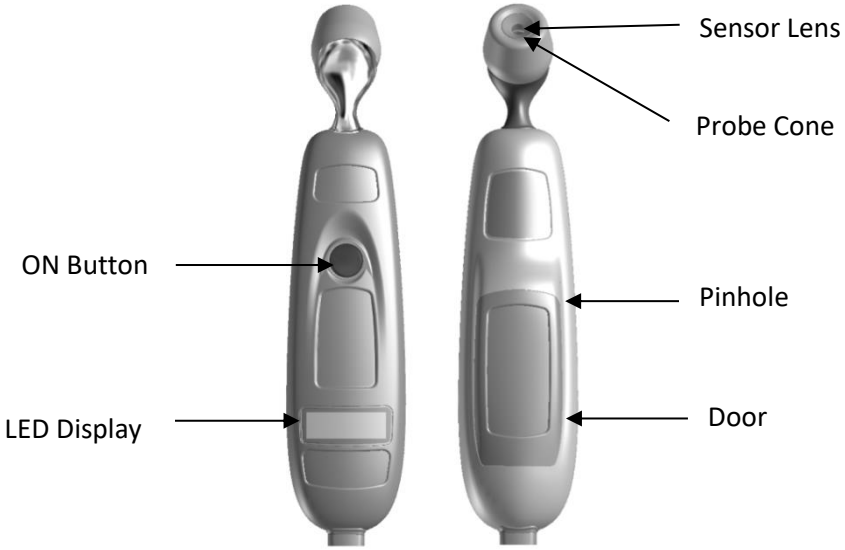
- To Retain or Lock Reading: The reading will remain on the display for 30 seconds after button is released. If measuring room temperature, the temperature will remain on the display for only 5 seconds.

- To *Restart*: Depress the button to restart. It is not necessary to wait until the display is clear, the thermometer will immediately begin a new scan each time the button is depressed.

Alternate sites when temporal artery or behind ear are unavailable:

- Femoral artery: slowly slide the probe across groin.
- Lateral thoracic artery: slowly scan side-to-side in the area ~midway between the axilla and the nipple.

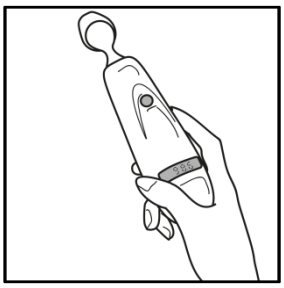
Let the instrument acclimatize for at least 10 minutes in the area in which it will be used.



2-Step Infant Temperature Measurement

Step 1

Place probe flush on center of forehead and depress button. Keeping button depressed, slowly slide probe mid-line across forehead to the hair line.



Step 2

Release button remove from head and read.

How to improve the accuracy of your measurements on infants

The preferred site is the temporal artery area. Unless visibly diaphoretic, one measurement here is typically all that is required

If the temporal artery is covered, then the area behind the ear, if exposed, can be an alternate site.

Measure straight across the forehead and not down side of face.

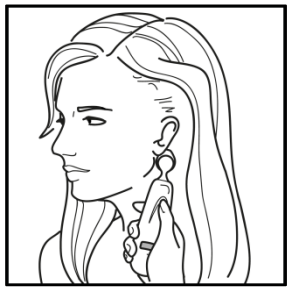
At mid-line, the temporal artery is about 2 mm below the surface, but can go deeply below the surface on the side of the face.

Brush the hair aside if covering the area to be measured. Measurement site must be exposed.

3-Step Adult Temperature Measurement

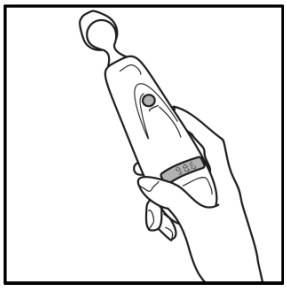
Step 1

Slide across forehead.
Place probe flush on center of forehead and depress button. Keeping button depressed slowly slide probe mid-line across forehead to the hair line.



Step 2

Slide behind ear.
Keeping button depressed, lift probe from forehead, touch behind ear halfway down the mastoid process and slide down to the soft depression behind the earlobe.



Step 3

Release button and read.

How to improve the accuracy of your measurements on adults

Measure only the up-side on a patient in a lateral position. The down-side will be insulated preventing the heat from dissipating, resulting in falsely high readings.

Think of a sweatband.
Measure straight across the forehead and not down the side of the face. At mid-line, the temporal artery is about 2 mm below the surface, but can go deeply below the surface on the side of the face.

Measure exposed skin.

Brush the hair and bangs aside if covering the area to be measured.

Minimum measuring time : 2 seconds.
Minimum time between successive measurements : 30 seconds

FAQs

How does the temperature from a temporal scanner relate to core temperature?

Temporal artery temperature is considered a core temperature because it has been demonstrated as accurate as the temperature measured by a pulmonary artery and esophageal catheter, and as accurate as a rectal temperature on a stable patient. Rule of thumb: Rectal temperature is about 1°F (0.5°C) higher than an oral temperature and 2°F (1°C) higher than an axillary temperature. It will be easy to remember if you think of core temperature as a rectal temperature, and apply the same protocol you would use for a rectal temperature.

If your thermometer is marked Arterial/Oral and has a serial number beginning with "O" (standard model start with "A"), it is programmed to compute the normal average cooling effect at the mouth, and automatically reduces the higher arterial temperature by that amount. This calibration allows the hospital to maintain existing protocols for fever workups based on oral temperature, and results in a reading consistent with the 98.6°F (37°C) mean normal oral temperature, in the range of 96.6 - 99.5°F (35.9 - 37.5°C) you now see.

What should I do if I get an abnormally high or low reading, how do I confirm my reading?

- Repeat the reading with the same Temporal Scanner; a correct reading will be reproducible.
- Repeat the reading with another Temporal Scanner. Two Temporal Scanners with the same reading will confirm the reading.
- Sequential readings on the same patient in rapid succession will cool the skin; it is best to wait about 30 seconds for the skin to recover from the cold probe.

Possible causes of abnormal readings.

Type of abnormal Temperature	Possible cause	Helpful hint
Abnormally low Temperature	Dirty Lens	Clean lens of scanner every two weeks.
	Releasing the button before finished	Release the button after finished measuring.
	Measuring when an ice pack or wet compress is on the forehead	Remove ice pack or wet compress, wait 2 minutes, and re-take temperature.
	Measuring a completely diaphoretic patient	Complete diaphoresis includes diaphoresis of area behind the ear and suggests that the temperature is rapidly dropping. Use an alternative method of temperature measurement in these cases until the patient is dry and the temporal artery measurement can be repeated.
	Improperly scanning down the side of the face	Scan straight across forehead. The temporal artery is closest to skin in that area.
Abnormally high temperature	Anything covering the area to be measured would insulate and prevent heat from dissipating, resulting in false high readings.	Confirm measurement site has not recently been in contact with heat insulators such as hats, blankets, and hair. Scan the area not covered or wait about 30 seconds for the previously covered area to equilibrate to the environment.

DISPLAY DIAGNOSTICS CHART

The following chart summarizes the conditions that may occur while the Temporal*Scanner* is in use, and the associated indications:

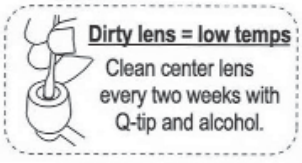
Condition	Display	Range
High Target	HI	>110 ºF (43 ºC)
Low Target	LO	<61 ºF (16 ºC)
High Ambient	HI A	>104 ºF (40 ºC)
Low Ambient	LO A	<60 ºF (16 ºC)
Low Battery	bAtt	
No or Very Low Battery	blank display	
Processing Error	Err	Restart. Return to Exergen for repair if error message persists.
Scanning (Normal Operation)	- - - -	

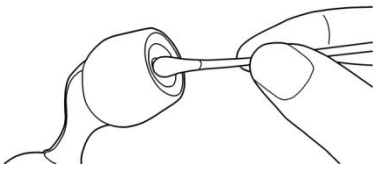
Care and Maintenance

- **Handling:** The Temporal*Scanner* is designed and built to industrial durability standards in order to provide long and trouble-free service. However, it is also a high precision optical instrument, and should be accorded the same degree of care in handling as you would provide other precision optical instruments, such as cameras or otoscopes.

- **Cleaning the case:** The TemporalScanner case can be wiped down using a cloth dampened with 70% isopropyl alcohol. The industrial grade housing and design of the electronic components allow for completely safe cleaning with 70% isopropyl alcohol but should not be immersed in fluid or autoclaved.

- **Cleaning the sensor lens:** With normal use, the only maintenance required is to keep the lens on the end of the probe clean. It is made of special mirror-like, silicon infrared-transmitting material. However, dirt, greasy films or moisture on the lens will interfere with the passage of infrared heat and affect the accuracy of the instrument. Regularly clean the lens with a cotton swab dipped in alcohol in accordance with the instruction label on the instrument (see below). Use only light force for cleaning, to avoid damaging the lens. Water can be used to remove any residual film left by the alcohol. Do not use bleach or other cleaning solutions on the sensor lens.





Sterilization: Sterilization is not recommended for cabled versions of the Temporal*Scanner*.

DO NOT SUBMERSE THE THERMOMETER IN ANY CLEANING SOLUTION.

- **Calibration:** Factory calibration data is installed via a computer which communicates with the Temporal*Scanner's* microprocessor. The instrument automatically self-calibrates each time it is turned on using this data, and will never require recalibration. If readings are not correct, the instrument should be returned for repair.

- **Battery:** A standard alkaline 9V battery provides approximately 15,000 readings. ** To replace, insert the end of a bent paper clip into the pinhole on the side of the unit to release the battery compartment door. Disconnect the old battery and replace with a new one in the same location. Replace the cover. Use only high quality alkaline batteries.

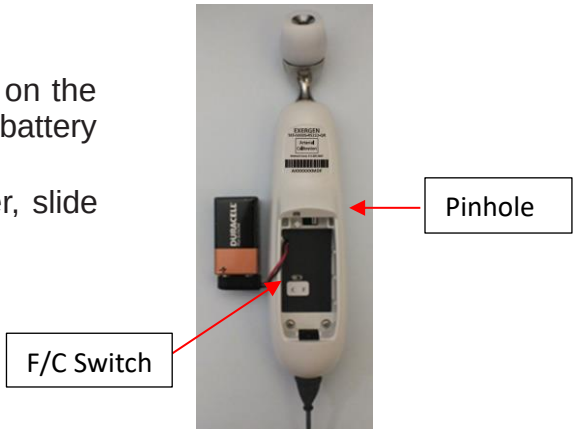
** Approximate number of readings when scanning for 5 seconds and reading the temperature display for 3 seconds before turning thermometer off.

Instructions for Fahrenheit or Celsius Conversion

The Temporal*Scanner* can be used in either °F or °C. To convert from one scale to the other, the only tools necessary are a paper clip and the tip of a small screwdriver.

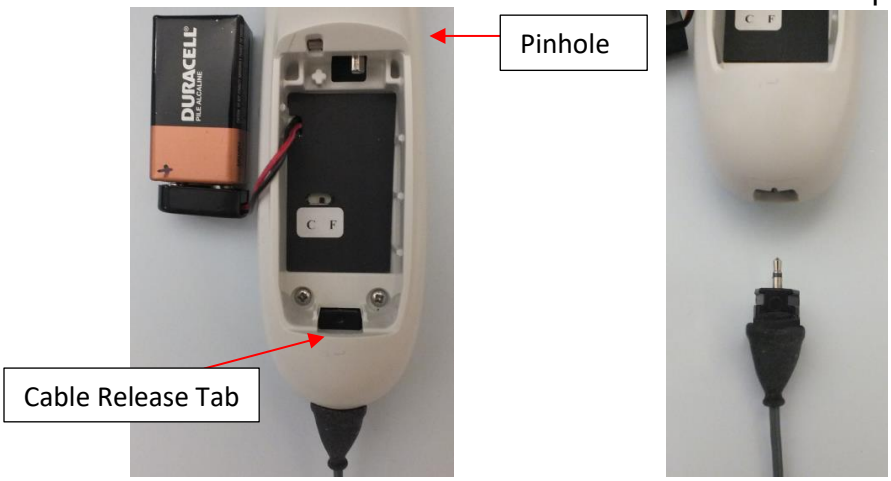
For °F/°C Conversion:

- Insert the end of a bent paper clip into the pinhole on the side to release and remove the cover. Remove the battery from the compartment.
- Locate the switch, and with the tip of a screwdriver, slide left or right to the opposite position.
- Remove the screwdriver.
- Replace cover.



Cable Replacement (TAT-5000S-RS232-QR only)

- Disconnect the scanner cable from the monitor's communication port.
- Insert the end of a bent paper clip into the pinhole on the side to release and remove the cover. Remove the battery from the compartment.
- Locate the cable release tab, and with the tip of a screwdriver in the small round depression in the tab, push the tab down.
- Pull the cable out.
- Replace with new cable - push the cable in until it clicks.
- Put the battery back into the compartment and replace the cover.
- Reconnect the scanner cable to the monitor's communication port.



Repair

If repair is required, contact Exergen at (617) 923-9900 or rma@exergen.com for a Return Materials Authorization (RMA) Number.

- Mark the RMA number on the outside of your package and packing slips.
- Include a description of the fault if possible.
- Send the instrument freight/postage prepaid to:

  Exergen Corporation
  400 Pleasant Street
  Watertown, MA 02472
  USA

- Include the address the instrument should be returned to. The instrument will be returned freight/postage prepaid.

Part Numbers

Exergen p/n	Description
124237-AF-MR	TAT-5000S-RS232-QR, Arterial, Deg F
134203	Disposable Caps, box of 1000
129462	Sheaths , box of 250

Guidance and Manufacturer's Declaration-Electromagnetic Emissions		
The infrared forehead thermometer model TAT-5000S series is intended for use in the electromagnetic environment specified below. The user of the TAT-5000S series should assure that it is used in such an environment.		
Emissions test	**Compliance**	**Electromagnetic environment-guidance**
RF emissions CISPR 11	Group 1	The TAT-5000S series thermometer uses no RF energy therefore any emissions are unlikely to cause any interference in nearby electronic equipment
RF emissions CISPR 11	Class B	The TAT-5000S series thermometer is suitable for use by a healthcare professional in a typical health care environment.
Harmonic emissions	Not applicable	
Voltage fluctuations	Not applicable	

Guidance and manufacturer's declaration-electromagnetic immunity			
The TAT-5000S series thermometer is intended for use in the electromagnetic environment specified below. The user of the TAT-5000S series should assure that it is used in such an environment.			
Immunity test	**IEC 60601 test level**	**Compliance level**	**Electromagnetic environment-guidance**
Conducted RF IEC 61000-4-6	3Vrms 150 kHz to 80 MHz	3Vrms	Portable and mobile RF communications equipment should be used no closer to any part of the TAT-5000S series including cables if applicable, than the recommended separation distance calculated from the equation applicable to the frequency of the transmitter. **Recommended separation distance** $d=1,2*P^{1/2}$ $d=1,2*P^{1/2}$ 80 MHz to 800MHz $d=1,2*P^{1/2}$ 800MHz to 2,5 GHz Where P is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer and d is the recommended separation distance in meters(m). Field strength from the fixer RF transmitters, as determined by an electromagnetic site survey, a. should be less than the compliance level in each frequency range and b. interference may occur in the vicinity of equipment with the following symbol: 
Radiated RF IEC 61000-4-3	10V/m 80 MHz to 2,7 GHz	10V/m	
Note 1 At 80MHz and 800MHz, the higher range applies. Note 2 These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects, and people.			

a. Field strengths from fixed transmitter, such as base stations for radio (cellular/cordless) telephones and land mobile radios, amateur radio, AM and FM radio broadcast and TV broadcast cannot be predicted theoretically with accuracy. To assess the electromagnetic environment due to fixed RF transmitters, an electromagnetic site survey should be considered. If the measured field strengths in the location in which the TAT-5000S series thermometer is used exceeds the applicable RF compliance level above, the TAT-5000S series thermometer should be observed to verify normal operation. If abnormal performance is observed, additional measures may be necessary, such as reorienting or relocating the TAT-5000S.
b. Over the frequency range 150 kHz to 80 MHz, field strengths should be less than 3V/m.
c. Portable and mobile RF communications equipment can affect performance.
d. ESD compliance has been verified by testing. UL Report Number R11965326-TAT5000S-EMC.

Guidance and Manufacturer's Declaration-Electromagnetic Immunity (cont)			
The TAT-5000S series thermometer is intended for use in the electromagnetic environment specified below. The user of the TAT-5000S series should assure that it is used in such an environment.			
Immunity test	**IEC 60601 test level**	**Compliance level**	**Electromagnetic environment-guidance**
Electrostatic discharge (ESD) IEC61000-4-2	8kV contact 15kV air	8kV contact 15kV air	Floors should be wood, concrete or ceramic tile. If floors are covered with synthetic material, the relative humidity should be at least 30%.
Electrical fast transient/ burst IEC 61000-4-4	2kV for power supply lines 1kV for input output lines	Not applicable	Mains power quality should be that of a typical health care environment.
Surge IEC 61000-4-5	1kV line(s) to line(s) 2kVline(s) to earth	Not applicable	Mains power quality should be that of a typical health care environment.
Interruptions and voltage variations on power supply Input lines IEC 61000-4-11	<5% UT (>95% dip in UT) for 0,5 cycle 40% UT (60% dip in UT) for 5 cycles 70% UT (30% dip in UT) for 25 cycles < 5% UT (>95% dip in UT) for5 sec.	Not applicable	Mains power is not applicable. The TAT-5000S series is powered by battery and battery only.
Power frequency (50/60 Hz) magnetic field IEC 61000-4-8	30A/m	30A/m	Power frequency magnetic fields should be at the level characteristic of a typical location in a typical health care environment.
Note UT is the a.c. mains voltage prior to the application of the test level			

Recommended separation distances between portable and mobile RF communication equipment and the TAT-5000S Series			
The TAT-5000S series forehead thermometer is intended for use in an electromagnetic environment in which radiated RF disturbances are controlled or the user of the TAT-5000S series thermometer can help prevent electromagnetic interference by maintaining a minimum distance between portable and mobile RF communications equipment (transmitters) and the TAT-5000S series thermometer as recommended below, according to the maximum output power of the communications equipment.			
Rated maximum output power of transmitter (W)	**Separation distance according to frequency of transmitter m**		
	150 KHz to 80 MHz $d=1,2\ P^{1/2}$	**80 MHz to 800 MHz $d=1,2\ P^{1/2}$**	**800 MHz to 2,5 GHz $d=2,3\ P^{1/2}$**
0,01	0,12	0,12	0,23
0,1	0,38	0,38	0,73
1	1,2	1,2	2,3
10	3,8	3,8	7,3
100	12	12	23
For transmitters rated at a maximum output power not listed above, the recommended separation distance d in meters (m) can be estimated using the equation applicable to the frequency of the transmitter, where P is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer. Note 1 At 80 MHz and 800 MHz the separation distance for the higher frequency range applies. Note 2 These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.			

Specification	TAT-5000S-RS232
Clinical Accuracy	± 0.2°F or 0.1°C Per ASTM E1112
Temperature Range	61 to 110°F (16 to 43°C) ***
Arterial Heat Balance Range for Body Temperature *	94 to 110°F (34.5 to 43°C)
Operating Environment	60 to 104°F (16 to 40°C)
Resolution	0.1° F or C
Response Time	~0.04 seconds
Time Displayed On Screen	30 seconds
Size	Instrument : 7.9" X 1.8" X 1.6" Cable : 32" retracted
Weight	0.7 lb
EMI and RFI Protection	Stainless steel enclosure on upper part inside of casing
Storage Conditions	-4 to 122°F (-20 to 50°C)
Display Type and Size	Large bright LED's
Construction Method	• Industrial duty impact resistant casing • Chemically resistant casing and lens • Hermetically sealed sensing system • Stainless steel probe
Warranty	Thermometer : Lifetime; Cable : 5 years

*Automatically applied when temperature is within normal body temperature range, otherwise reads surface temperature.

** Approximate number of readings when scanning for 5 seconds and reading the temperature display for 3 seconds before turning thermometer off.

*** 16 C rounded up from 15.5 C.

Laboratory accuracy outside physiological range is +/-0.3 °C (0.5 °F).

	Symbol for Manufacturer		Do not throw this device away in the trash, contact Exergen Corp. for disposal and recycling instructions.
	Attention, Consult Accompanying Documents	IPX0	Ordinary Equipment
	Consult Instructions for Use		"On" (only for part of Equipment)
	Degree of Protection Against Electrical Shock Defibrillation-Proof Type BF Applied Part, Battery Operated		MEDICAL ELECTRICAL EQUIPMENT ANSI/AAMI/ES60601-1: 2005/(R)2012 3rd Edition including Amendment 1; CAN/CSA-C22.2 No. 60601.1: 2014; IEC 60601-1-6; ISO 80601-2-56: Particular Requirements For Basic Safety and Essential Performance of Clinical Thermometers For Body Temperature Measurement

The CLINICAL THERMOMETER is an ADJUSTED MODE CLINICAL THERMOMETER. Correction method is proprietary. Laboratory testing protocol for laboratory accuracy available upon request.

EC REP

EMERGO EUROPE
Westervoortsedijk 60
6827 AT Arnhem
The Netherlands

CE
1434

Verification Testing

All Exergen infrared thermometers are designed to permanently maintain their accuracy and normally recalibration is not required unless the thermometer has been physically damaged or experiences component failure. In the unlikely event recalibration might be required, the thermometer must be returned to Exergen for the procedure.

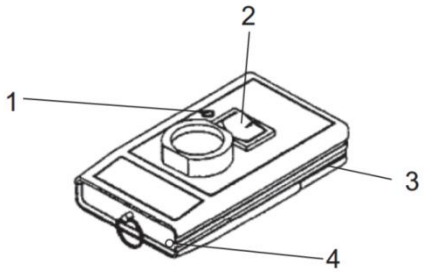
However, calibration can be verified in the lab or clinical units quite easily using a device known as a portable blackbody. A portable blackbody is a reference heat generator (Figure 1), which is a self-contained device providing a stable reference target temperature in the clinical temperature range.

The device is then used to verify the calibration of any Exergen thermometer in question, or for quality checks done on a routine basis. The verifier operates with either a 9-volt power supply plugged directly into any 120 VAC wall receptacle, allowing extended use in the laboratory, or it can be completely powered by a 9-volt battery for portable use on the nursing floors.

There are two ways to use the portable blackbody to verify the calibration accuracy of the thermometer in question, either (1) with a certified master reference infrared thermometer, or (2) by using two identical thermometers as a reference against the one in question.

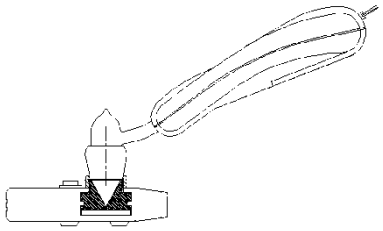
Using the Portable Blackbody

1. Turn on the verifier device, using either a 9-volt battery or the power supply. Make sure the red LED is illuminated.
2. Allow device ~5 minutes for warm-up and stabilization time.
3. Allow certified master or the two reference thermometers and the instrument to be tested to acclimate in the same ambient temperature for at least 10 minutes.
4. For all instruments, make sure the lens at the tip of the probe is clean. To clean, use an alcohol prep or a swab dipped in alcohol, followed by a damp wipe with water to remove any residue.
5. Alternately insert the reference instrument(s) and the instrument being verified into the aperture opening, comparing the readings.



Portable Blackbody Calibration Verifier

1. Power On LED
2. ON/OFF Switch
3. Battery Compartment
4. Power Supply Jack



Using a Certified Master Reference Thermometer in a Portable Blackbody to Verify Calibration
Figure 1

- Accuracy Limits: Comparison between the reference instrument(s) and the instrument being verified should be within ±0.4 ºF (0.2 ºC) for acceptable limits. If not, repeat the process. In the event they still differ by more than the acceptable limits, call Exergen for repair or replacement of the failed instrument.

Verifier Specifications:

Power Source	9-volt battery, or 9-volt power supply.
Battery Life	Approximately 1 hour continuous use.
Low Voltage Indicator	Red LED shuts off when battery voltage drops below lower threshold ~5 volts.
Temperature Range	97-104 ºF (36-40 ºC)
Cleaning	Wipe down with alcohol. Do not immerse.

Generic Exergen Binary Serial Protocol, Version One

The Data Packet Format

Byte	Label	Description
Byte 1	Start Byte	The value of this byte is 0x01 (ASCII SOH char).
Bytes 2-3	Firmware Version	A binary value. (currently 7952, or so.)
Byte 4	Protocol Version	A binary value. (currently 0x01)
Byte 5	Reference	"A" (0x41) indicates an arterial temperature reference. "O" (0x4F) indicates an oral temperature reference.
Byte 6	Status Byte	bit 0 : Fahrenheit flag bit 1 : Internal Error bit 2 : Battery Low Error bit 3 : Fatal Battery Error bit 4 : High Target Error bit 5 : Low Target Error bit 6 : High Ambient Error bit 7 : Low Ambient Error A value of 0xFF for the status byte is special, indicating that this packet should be ignored. While the Fahrenheit flag (bit 0) and the Battery Low Error flag (bit 2) can be expected to be set in any combination, only one of the bits 1:3-7 can be set in a given packet. All errors in the Status correspond to errors shown on the display. The Low Battery Error is the only error state that also gives a valid temperature reading.
Bytes 7-8	Display Temperature	This value represents the digits displayed, ignoring the decimal point. The decimal point is always in the tenths location, so this is effectively the displayed temperature times ten. (e.g., 989 for a display of 98.9) If the reading is in degrees Fahrenheit any (non-nul) value less than 600 or more than 1100 is unpossible, and if the device is set to Celsius output any (non-nul) value less than 155 or more than 433 is also unpossible.[1] These two bytes should both be nul (0x00) if there is any error other than Battery Low.
Bytes 9-12	Serial Number	This is a little funky, and is the serial number stored in a floating point (!) format. Note that this is *not* the standard IEEE representation of a 32 bit floating point number. The format of this number is described as: M0 (MSB) M1 M2 (LSB) EXP S.MMMMMMM MMMMMMMM MMMMMMMM EEEEEEEE S represents the sign bit; 0 is positive, 1 is negative. M represents a bit in the Mantissa, which has an implied 1 as its most significant bit. E represents a bit in the exponent, which has a bias of +127.
Bytes 13-30	Reserved	These bytes may change at will, ignore them.
Byte 31	Checksum	The checksum is such that the sum of all characters in bytes 1 through 32, modulo 256 is equal to 0.
Byte 32	Newline/LF	This is the ASCII newline/line feed character (0x0A).

[1] "Unpossible" is a perfectly cromulent word.

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Further details of formats and examples

TAT devices using this protocol only transmit and do not receive data. The serial port settings are 9600 baud, eight bits, no parity, one stop bit, and no handshaking. The data packet is sent after the display temperature for the unit is determined, which is very shortly after the button is released. All data is transmitted most significant byte first.

The bytes of data in a 32 bit floating point format are transmitted M0 first, followed by M1, M2, and lastly EXP. For reference, here are a few examples of floating point representations of numbers:

M0	M1	M2	EXP	Value
0x00	0x00	0x00	0x00	0
0xC0	0x00	0x00	0x7F	-1.5
0x8F	0x5C	0x29	0x7B	-0.07
0x40	0x00	0x00	0x80	3
0x08	0x93	0x33	0x87	273.15

Also for reference, here is an example of an entire valid packet:

0x01	0x1f	0x11	0x01	0x41	0x01	0x02	0xd8	0x60	0x00	0x00	0x84	0x03	0x67	0x0e	0x
0x13	0xec	0x3d	0x87	0x01	0x84	0x45	0x78	0x65	0x72	0x67	0x65	0x6e	0x20	0x36	0x

In this example, the firmware version number of the device is 7953 (0x1f11), the device is in Fahrenheit mode and there were no errors, the displayed temperature is 72.8 degrees (0x02d8), the serial number is fifty-six, and the reference measurement site is arterial (0x41).

Recommended guidelines for implementations

Verifying valid packets

To ensure the correctness of a received packet, software should enforce the singular correct values for the start byte, the protocol version, the checksum, and the final newline (bytes 1, 4, 31, and 32). Furthermore, there are limits on the permissible values for the displayed temperature and the temperature reference site (bytes 5, 7, and 8). It is suggested that these bytes also be verified to have permissible values, as indicated in the description of these bytes in the data packet format table. Enforcing particular values for the firmware version number is *not* recommended, so that any future TAT devices manufactured with updated firmware can interface with the software, so long as the protocol version has not changed.

For those extra-paranoid users, it is possible that a portion of the reserved bytes (bytes 13-30) may be unused and stuffed with constant values, for a given version of firmware. These bytes are subject to change without notice in any future revisions of the firmware. These bytes should only be enforced in conjunction with particular values of firmware version, and after consultation with Exergen. Any implementations attempting to verify these reserved bytes should be mindful of correct operation with future firmware versions, and not try to verify the reserved bytes if the firmware version number differs from the expected known value(s).

Timeout mechanism

Enforcing a minimum allowable time between received serial bytes in a packet is encouraged. The TAT device will send serial bytes in quick succession, therefore any large delay between received bytes can be interpreted as an error, and the bytes received prior to the delay discarded. Once transmission of a packet of data has started, the delay between the end of one byte's stop bits, and the beginning of the start bit of the next byte of data should be well below one millisecond, until all 32 bytes of the packet have been sent.

Recovery in the event of detected errors

Software needs to be able to recover from a break condition and any framing errors on the serial line.

In the event of a detected error while verifying the received packet, it is suggested that the software drop the first received byte and attempt to verify the next 32 bytes received as a valid packet. This will ensure that any glitches on the serial line (due to startup transients, electrostatic discharges, plugging or unplugging devices, or whatnot) do not cause the software to reject any valid packets sent subsequently to said glitches.

Pinout

Signal	QR Plug End of Cable	Cable	Hirose Connector End of Cable
Ground	sleeve	Black	Pin 1
RS232 Signal	pin	Red	Pin 4

Disposable Covers:

Disposable (Resposable) covers, meaning they can be used once and discarded, or reused on the same patient, are available for all levels of cross-contamination protection should they be preferred for certain patient populations, and are still very cost effective. These options include disposable caps and full instrument sheaths, the sheaths being mainly used for isolation patients.

- Using the Disposable (Resposable) Caps:



1. Apply cap by pushing onto the probe head with fingers.
2. Remove cap by pushing edge forward with thumb.
3. Caps may be reused on the same patient.

- Using the Full Instrument Sheaths:

1. Insert instrument into sheath bottom end first.
    - If instrument is on a cable, insert probe end first and twist sheath at neck with fingers to assure film is smooth over probe lens.
2. Wrap additional film around probe neck.
    - Film should be smooth over probe lens.
3. Slide additional film under fingers while using.

Disposable (Resposable) Covers can be discarded in normal trash.

The operator is responsible for checking the compatibility of the thermometer, probe cover, and monitoring equipment. Incompatible components can result in degraded performance.