How the Wahl Thermal Imager Works

Thermal Imaging is a technique for creating an image of a scene based on the invisible thermal radiation emitted from an object. Using this technology, thermal images of faults in mechanical or electrical plant can be displayed.

Thermal imaging can be used in any process where the temperature of the object gives an indication of its state not visible to the eye. For example, a loose electrical connection or a worn bearing will heat up. These defects can be seen with a thermal imager as a 'hot spot'.

The ability to measure the temperature of an overheating component enables the operator to determine the seriousness of the fault, and take corrective action before costly breakdown occurs.

Condition monitoring / preventive maintenance:

Manufacturing companies invest large sums on installing and maintaining automated production and processing equipment. Delivery schedules and profits can be seriously affected by machine downtime and the identification of impending equipment problems can result in lower maintenance costs and reduced production losses.

Wahl has developed affordable radiometric hand held thermal imagers that can be used to identify unusual hot spots that could signify the imminent failure of bearings, faulty switchgear and other critical parts. Preventative maintenance can then take place before complete breakdown and
associated further damage occurs. The portability of the device means that it can be used to monitor a large number of machines within a production facility. The output display for the imager is provided by a Compaq iPAQ palmtop computer; alternatively the unit can be operated using the users own PC.

Wahl also supplys an online thermal imager that is both small and light enabling integration into new process equipment and retrofitting to existing equipment. These units are capable of being networked in a multisensor process environment.

Applications:

- Electrical switchgear
- All types of manufacturing production equipment
- Mail and package sorting lines
- Process control equipment
- PCB production testing
- Nondestructive testing
- Robotics
- Security and surveillance
- Factory automation

Wahl's New Heat Spy® Thermal Imager HOT SPOT FINDER!

Wahl's easy to use, low cost Heat Spy Imager has the same ability as the expensive thermal imaging cameras to find the hottest spot or area of the target, and tell you the temperature of it.

What makes the Wahl Heat Spy Imager different from the competitors? You can locate and point to the hot spot with the built in laser.

Just scan the target area and find the hottest spot on the screen. Place the hottest spot of your target on the center of the screen indicated by the circle. It will also indicate the temperature of that spot. Then, simply press the laser button, and the laser will point to the hot spot on your target, corresponding to where it appears on the center of the screen. You can then take a thermal picture and store it in the Pocket PC. With the optional digital camera you also have the ability to take a digital picture, and store it for reporting purposes if needed.

Ergonomically designed, flexible and easy to use, this affordable imager can be used in a variety of applications. Choose from two optional handles which easily accommodate the thermal imaging camera, pocket pc, and even an optional digital camera and light. Combined together, they work as a processor, display unit and storage device.

Frequently Asked Questions

What is the maximum distance the Wahl Imager can see?

The Wahl Imagers use a fixed focus lens, therefore the Imager's field of view **(FOV)** increases as the distance from the scene increases.

For the Imager to make an accurate temperature measurement, the 'hot spot' being imaged must cover a whole pixel. The pixel size is directly related to the FOV size. This is illustrated in the Field of View slides, which can be found under the 'Technical Information' section of the Wahl Thermal Imager CD.

Example:

If a standard 20 degree Wahl imager is used to look at a scene 5 metres away, it will accurately be able to measure 'hot spots', which are larger than 11cm that cover a pixel.

What is the "Spectral Response" of the Imager?

Thermal imaging cameras measure infrared radiation emitted from the surface of objects. This radiation has to travel through the atmosphere from the object to the detector in the camera. The atmosphere will however only transmit the infrared radiation at certain wavelengths, these being between 3 to 5 microns and between 8 to 14 microns. For many technical reasons the 8 to 14 micron band is preferable, and that is why the detector in the Wahl camera (and most other thermal imaging cameras used in Industry for predictive maintenance applications) operate in this region.

What is a thermal imager's temperature sensitivity?

Sensitivity is the minimum resolvable difference between two temperatures. For example a Thermal Imaging device with a sensitivity of 0.5 degrees Celsius will be able to detect two points that have temperatures different by 0.5 degrees Celsius. If the two points had a temperature difference of less than 0.5 degrees Celsius, the device would not be able to detect the difference and would detect them as being at the same temperature.

Example:

The following example shows two bodies (each body is represented by a yellow box) at different temperatures viewed by a Thermal Imager with a sensitivity of $0.5^{o}C$

The Thermal Imager can see that the two bodies are at different temperatures.

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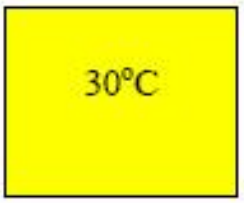
The Thermal Imager can **not** see that the two bodies are at different temperatures, because the temperature difference is less than the Imagers sensitivity of $0.5^{o}C$.

What is a thermal imager's accuracy?

Accuracy is a measure of how accurately a specific device can make a temperature measurement. For example a device with an accuracy of +/- 1 degree Celsius will make temperature readings which could be 1 degree higher or 1 degree lower than the actual temperature.

Example:

The following example shows a body that is being viewed by a Thermal Imager with an accuracy of +/- 1^{o}C.



The Thermal Imager will give a temperature reading anywhere from 29^{o}C to 31^{o}C.

What is the "integration" used on Wahl's Imager's?

The pixel integration can be changed to enhance the temperature sensitivity. An integration value of 10 means that 10 temperature readings will be taken by the camera, and then the 'averaged' value will be used in the image displayed on the screen. The 'averaging' done by the imager consists of complex mathematical calculations. As an 'average' value is used the imager's sensitivity is improved.

You will notice when using a high integration value e.g. 10, the image appears to update slowly when moving the camera around. This is due to the fact that 10 measurements are being taken to produce the 1 averaged value used in the produced image.

What is emissivity?

Emissivity is the fraction of the radiant emittance of a black body produced by an object at a specific temperature. Emissivity is a ratio (i.e. a fraction of radiant emittance of a black body), so it is not expressed with any units.
This is a very simplified explanation of emissivity. More information can be found in text books and on the Wahl related training course.

What is a Black Body?

A Black Body is a perfect emitting surface i.e. emissivity = 1. These surfaces do not reflect, they absorb all incident energy and re-emit it as infrared energy. In practice all materials have an emissivity of less than 1.

What is a Pyroelectric detector?

A Pyroelectric detector converts the changes in incoming infrared radiation into electrical signals. This conversion is similar to a capacitive function. Therefore the Pyroelectric detector needs to see a modulated signal.

What is a “rotating disk modulator”?

The "rotating disk modulator" is a disk with a cut out section that rotates in front of the detector, causing the image to be 'modulated'. The purpose of this is so that the camera can continually see changes in temperature in real time of an 'external scene'.

What is the “imaging optics”?

The "imaging optics" is the lens that you see on the front of the camera. The lens focuses the 'external scene' and images it onto the detector inside the camera.

What is the imager’s “frame rate”?

The frame rate is the number of frames seen per a second. So a frame rate of 8Hz means that 8 frames are captured every second. A frame is a single 'picture' seen by the camera.

HSI 1000 Universal Thermal Imager

Is it possible to manually adjust the HSI 1000 temperature and sensitivity range?

The temperature range and sensitivity can be adjusted manually or automatically. It is not possible to make manual adjustment when set in ‘auto' mode. You must first toggle the 'auto' button off at the bottom of the 'Pocket PC' screen. You then need to press on the center of the 'Menu' button, which will make a flashing red outline box around one of the measurement pixels (SP1 or SP2) or around the temperature range box. If you keep pressing the menu button the red outline box will cycle between the measurement pixels and the temperature range box. With the red outline box around the temperature range box you can make manual adjustments. By pressing left and right you can adjust the temperature range, pressing up and down you can adjust the sensitivity. Once you have made your manual adjustments, click on the middle of the menu button again to move the red outline box off the manual adjust temperature bar

Why is it necessary to turn on the HSI1000 unit for a period of time before using it for accurate temperature measurement?

When the HSI1000 Thermal Imager is initially turned on, the internal IR detector may be at a different temperature to the surrounding environment. It can take up to 30 minutes after switching the HSI3000 on before it stablizes at the same temperature as the surounding envirnment.

Does Wahl supply the cables for connecting to a PC and Pocket PC?

An RS232 cable is supplied with the HSI 1000 for connecting the imager to a PC.

Wahl does not supply the RS232 serial synchronising cable for Pocket PCs because every brand requires a different connector at the Pocket PC end. Customers have the flexibility to decide which Pocket PC they want to use, and then need to acquire the appropriate RS232 sync cable. A list of recommended Pocket PCs and cables can be obtained by calling Wahl Customer Service.

Can the batteries in the HSI 1000 imager be recharged?

The HSI 1000 Imager itself is not setup for direct recharging of the batteries. The HSI 1000 can be operated from mains power by using the mains lead, power supply and connector which are supplied as standard with the HSI 1000.

The HSI 1000 can be operated by 4 standard AA size batteries, these can be rechargeable batteries. The batteries can then be taken out of the imager and recharged in an appropriate charger.

What software is included with the HSI 1000?

The software was developed by software engineers. There are two software applications included on a CD-Rom with the HSI 1000, one for the Pocket PC and one for the PC. The Pocket PC software creates a color image of the viewed scene clearly showing any hot spots. There are two cursors that can be moved around the screen, which give temperature measurements for the selected element. Snapshot images can be taken and stored in the Pocket PCs memory, and then transferred to a PC. The software also features an 'auto-gain' function, which automatically adjusts the temperature range and sensitivity to give the best viewable image.

The PC software has 10 temperature measurement cursors; the software allows you to plot a graph of the temperature over time for these cursors. It is possible to copy images to paste into reports created in Word or other applications.

Is there more than one temperature range for the HSI 1000?

The HSI 1000 has two temperature ranges that can be selected, a 'standard' range and an 'extended' range. Either temperature range will give the correct temperature measurement in the top right hand corner of the screen, but the standard temperature range will not display the color image above 2000C. When measuring temperatures above 2000C, you need to select the 'extended' range from the 'Tools' menu. The extended temperature range will measure up to 3000C