

Courtesy of the Town of Okotoks

# **DIY** Home Energy Assessment Kit



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# **The Do-it-yourself** Home Energy Assessment Kit

#### **Energy Efficiency**

Improving the energy efficiency of your building can save money on utility costs, decrease your impact on the environment and create more comfortable interior conditions.

Climate change, caused by greenhouse gas emitted from burning fossil fuels, is one of the biggest problems facing human kind in the 21st century. In Okotoks, electricity and natural gas used to power our homes contributes to 127,046 tonnes of CO2 emissions a year. This is equal to a third of all the carbon dioxide emitted in Okotoks every year!<sup>1</sup>

Okotoks is a leader in developing and promoting sustainable building strategies as well as renewable energy resources. You can help address climate change and realize great benefits in the process by making your building as energy-efficient as possible! The greenest resource available to us is the energy we save through efficiency. We can all take part in the solution.



By making energy efficient upgrades to your building, you will:

#### **Save Money**

Many buildings see a reduction in energy bills.

#### **Add Comfort**

Eliminating drafts, keeping surfaces warmer and balancing air circulation creates a cozier space.

#### Make a healthier home

A tighter building with good ventilation provides improved indoor air quality.

### **Reduce ecological impact**

Reduced energy consumption results in a more eco-friendly home.



<sup>1</sup>Town of Okotoks, Greenhouse Gas Inventory Baseline, 2019

Book an EnerGuide energy efficiency home evaluation to receive an EnerGuide rating for your home, and an energy efficiency report to help you make decisions about completing retrofits. Learn more at okotoks.ca/energykit

### **Professional Inspections and Evaluations**

A professional energy evaluations comes with a fee; however it provides the benefit of a building performance expert's experience and judgment. Be sure you hire an independent evaluator that doesn't represent a specific product or system. Professional tools, including test equipment for air leakage and thermal imaging camera scans, allow you to 'see' energy losses in new ways. For example:

**Thermal Imaging** measures surface temperatures using infrared cameras and creates a visual image of heat loss. The cameras detect radiation in the infrared range of the electromagnetic spectrum.

Typically, warmer surfaces appear brighter and cooler surfaces appear darker. The images can reveal where walls, ceilings or floors are inadequately insulated or where windows and doors aren't well sealed.

While this kit provides a thermal camera for your use, interpreting the images can be somewhat difficult. There is no substitute for the expert eye of a professional. A **blower door test** depressurizes the building with a large fan and then measures airflow into the interior space, which measures overall air leakage of the entire structure. The test can also determine the location of leaks.

A **duct pressure test** identifies areas and location of leaks in the duct system. A related 'balance' test of the heating ducts determines if the right amount of air is flowing to each room for comfort and efficiency. Other tests confirm combustion safety and ventilation fan flows.

Heat pumps and A/C commissioning

are a set of tests that confirm the systems have the correct air flow and refrigerant charge. Equipment may have been sized using only rules of thumb, which can mean poor performance and durability.





What's in your kit?	5
Thermal Camera	7
Temperature Reader and Thermal Cards	17
Energy Monitor and LED Lightbulb	24
Radon Monitor	33

### Appendices:

A.	Paybacks	44
B.	Thermal Camera Manual	46
C.	Insulation Options	68
D.	Energy Monitor Manual	72
E.	Tricklestar Energy Monitor Manual	74
F.	Temperature Reader Manual	84
G.	Radon Monitor Manual	88





### Temperature Reader and Thermal Cards

Use these tools to check if your fridge/ freezer is too cold and if your hot water heater is too hot. Keeping your appliances at the right temperature can save you a lot of money on your energy bill. See page **17**.



### **FLIR C5 Thermal Imaging Camera**

Use the thermal camera to see heat loss in buildings and identify sources of energy loss. See page **9**.



**Radon Monitor** 

Use the radon monitor to measure radon levels in your home

See page 37.



### **Energy Monitor & LED Lightbulb**

Use the Kill-A-Watt meter to measure energy use of appliances. Use the LED Lightbulb along with the Kill-A-Watt Meter and a lamp to measure the difference in energy consumption between types of light bulbs.

See page 27.







# Thermal **Camera**



# What it's for

We often think of insulation as the primary means to create an energy-efficient building enclosure.

However, like a sweater with a windbreaker, insulation must work with an air barrier to be effective.

The air barrier prevents the movement of air between the interior and the exterior (or unheated spaces). Where there are gaps in the air barrier, air leakage occurs. Cold air from the outside enters the building and warm air from the interior escapes. Since warm air rises, a heated building in winter acts like a big chimney. As the warm air rises and escapes through ceiling penetrations, cold air is pulled in from the basement, garage, or crawl space. This cold air can bring dust or pollutants with it, and lower the



Any penetration in the building shell will result in air leakage. Along with doors and windows, obvious places where cold outside air enters a home are access points for heating ducts, water pipes, sewer stacks, wiring, lighting fixtures, electrical switches and outlets, chimneys, ventilation fans, attic hatches, fireplaces, and pet doors.

Air leakage can be responsible for up to one-third of a building's heating cost<sup>2</sup>.

The thermal camera can be used to see heat loss in buildings and identify sources of energy loss.

Thermal imaging is a useful tool when inspecting the air tightness of your building in areas prone to air leakage, such as chimneys, attics, wall vents, badly sealed doorways and windows, and walls with missing insulation.





# How it works

### Wait for appropriate weather

A thermal camera shows the heat flow through parts of a building, so using it in temperatures over 20°C will not yield any results, as the indoor and outdoor temperatures will be relatively similar.

To be able to see significant signs of energy leakage, the difference between the indoor and outdoor temperatures should be at least 10°C for several hours before you begin the inspection.

The best time for an inspection is early mornings, before the sun has had a chance to increase the outside temperature or warm up any surfaces of your building.

Even in wintertime, heating of exterior surfaces from sun exposure can skew the results of your inspection.

Wind speeds are another consideration, with optimal conditions for a thermography test being under 13 km/h.

If you want to be extra thorough, move furniture and pictures away from the exterior walls 12 hours before the inspection, just in case they are covering any existing draft areas. Make sure to close all exterior doors, windows, and fireplace flues.





Heat leaks are made visible in this thermal image of a poorly insulated brick house. The warm chimney flue on the the gable end shows up as a vertical red stripe.<sup>3</sup>

### Using the thermal camera

For technical instructions on how to operate the included FLIR C5 Thermal Camera, please see Appendix B.

Photo credit: Tom Barbour - Thermal Image UK - http://www. thermalimageuk.com





This image shows studs as vertical stripes, becauase they are thermal bridges and leak more heat than the insulation between the studs.<sup>4</sup>



The horizontal stripe in this image is an uninsulated rim joist.<sup>5</sup>



This thermal image shows which stud bays have no insulation.<sup>6</sup>



### Start on the outside of the building

The first place to inspect is the exterior of the building. This will show you any thermal bridges, such as studs or poorly insulated rim joints. The thermal bridges of your building are areas that transfer heat at significantly higher rates than the surrounding material, which results in a reduction of the overall thermal insulation of your building.

The vertical studs leak more heat than the insulation between the studs, and should be visible through the thermal camera. If they are not visible, either the weather conditions are not appropriate for an inspection, or the building is well constructed with materials meant to minimize thermal bridging.

If your walls were built with rigid foam insulation, the wall framing will not be visible. Inspect the outside of your building for anomalies and insulation voids, such as uninsulated stud bays, or places where blown-in insulation has settled and left the top of each stud bay empty. Stud bays with hot-air ductwork will also be visible.

Take extra care with low-sloping roofs! When the sun shines, these roof surfaces and the roof insulation heat up. After sunset, any damp insulation from roof leaks, cools at a much slower rate than dry insulation and will appear as warm spots at night. You can use this technique to identify leaky areas of your roof, but when inspecting for energy efficiency make sure that the surfaces being inspected are dry.

surfaces being inspected are dry. <sup>46</sup> Photo credit: Gerard Brady - Infrared New England http://www.infrarednewengland.com <sup>5</sup> Photo credit: Chuck Evans - http://homecert.com

### Continue inside the building

Scan the inside surfaces of the building for anomalies. This works best if you create negative pressure in the building prior to the inspection. You can do this by turning off all combustion appliances, such as the water heater and furnace, and turning on all exhaust fans and your dryer on a no-heat setting.

This will force air out of the building, lowering the pressure inside and the higher outside air pressure will flow into the building through cracks and openings. The colder outside air will cool the surfaces it comes in contact with as it enters the building, making these surfaces visible through the thermal camera.

According to "Guidelines for Thermographic Inspections of Buildings," a standard produced by RESNET, "The thermal image for air leakage will appear as 'fingers' or 'streaking' showing as dark when cold air is observed and lighter colors when warm air is viewed.

The thermal images will produce irregular shapes with uneven boundaries and large temperature variations. These air leakage sites are often at joints, junctions or penetrations in the enclosure. There is often a temperature gradient within a finger or streaking area.

Take care to discriminate between thermal bridging sites and thermal bypass or air leakage sites. Thermal bridging sites will not change size or shape during the inspection."



A thermal image of the interior of a timber-frame home shows air leaks at the eaves.<sup>7</sup>



The horizontal stripe in this image is an uninsulated rim joist.<sup>8</sup>



This thermal image shows heat leaking into an attic.<sup>9</sup>

<sup>78</sup> Photo credit: Gerarg Brady - Infrared New England http://www.infrarednewengland.com
<sup>9</sup> Photo credit: David Valley - Massachusetts Infrared http://www.massinfrared.com



### Places to focus on

There are a number of areas in your building that are more likely to be leaking air. Be sure to check these surfaces when conducting your inspection:

### Windows

Along weather stripping, where the frame meets the wall, or inside the window where the glass meets the frame.

### Doors

Along weather stripping and door threshold.

### **Electrical outlets and light switches**

Sometimes these are not insulated. Focus on the outlets located on exterior facing walls.

### Fireplace

A burning fireplace /open fireplace is the least efficient way to heat your space as 85-90 % of the fire's heat escapes up the chimney with the smoke<sup>10</sup>. Even when not in use, a fireplace can be a big cause of heat loss if the damper does not seal well. The damper is the metal plate in the chimney above the fire box used to regulate the draft. Dampers should be kept closed when the fireplace is not in use. A damper should have a tight seal when closed.

### Attic

Identify all of the items that penetrate the ceiling, chimney, pipes, recessed lights, wires, and check for gaps around them. If there is insulation, pull it away to get a clear view. Chimneys and soil stacks can often be the most serious air leaks in a home. Note whether the attic



hatch has good weather stripping.

### **Exhaust fans**

Where fan housing meets drywall or plaster.

### **Recessed lights**

These are notorious for air leakage. Note whether they are 'Air Loc' models and/or rated for insulation contact. Rated fixtures should have a sticker on the inside that says "IC".

### **Pipe and wire penetrations**

Where sinks are located along exterior walls, or adjacent to unheated spaces, look under the sink. Gaps are often left in the wall where pipes and wires pass through.

# Joints between different types of construction

This includes brick chimneys to wood walls, vertical joints where foundations step up, and where roof beams meet drywall or trim.

### Basement

A common area of air leakage is where the wood frame of the house rests upon the foundation. Outside air can be drawn in under the mud sill, the horizontal board that forms the base of the wood frame. Another leaky area is at the rim (or band) joist. The rim joist forms the perimeter of the floor framing above and the floor joists butt into it, creating multiple cavities along the length of the wall and many opportunities for air leakage.

> 10 Sustainable Energy Authority of Ireland. How efficient are open fires and fuel-effect fires? http://www.seai.ie/Powe\_of\_ One/FAQ/Home%20Heating/How\_efficient\_are\_open\_fires\_ and fuel-effect\_fires.html

# **Next Steps**

Once you've identified where air leakage is occurring, you'll want to seal off these gaps. Depending on location, you can seal air leaks with caulk, sealant or spray foam. Apply caulk where you need a flexible seal at narrow joints, use weather stripping where two surfaces move against each other and choose spray foam for irregular shaped gaps because it will expand to fit any opening. Before sealing gaps, it is always a good idea to consult a renovation guide or an expert to make sure you are not negatively affecting the ventilation of your home.

### Windows

Weather strip around the window sash (the sash is the part that moves) and apply caulk between the window frame and trim, and between the trim and the wall. Plastic film interior window sealing kits can be easily installed to add another insulating layer on windows.

### Doors

Install weather stripping at the tops and sides and a sweep at the base of the door. Install a door threshold if one doesn't already exist and caulk or replace those that leak.

### **Electrical outlets and light switches**

Install foam or rubber gaskets behind the outlet and switch plate covers on all exterior walls. For additional insulation insert child safety outlet caps in unused plug-ins.

# Joints between different types of construction

Use caulk or spray foam to seal leaks.

### **Exhaust fans, pipes and wires** Seal all gaps with spray foam. **Fireplace and duct penetrations** A fire-rated sealant needs to be used to fill large gaps in the attic or basement next to a brick chimney, or ductwork. If the gap is large, first install fitted sheet metal or cement board pieces to cover the opening and then seal the joints.

### **Recessed lights**

These should not be caulked or foamed tight unless they are IC rated because they could overheat. If there is space, a box can be built using 3.5cm (1 inch) rigid foam insulation leaving a 10-15cm (4-6 inch) air space around the light. Seal the box at all joints and at the back of the ceiling material. The best solution is to replace the light with a new IC 'Air Loc' model. These come with a gasket that seals the light fixture where it meets the drywall, minimizing air leakage.

(Continued on next page)





### **Fireplace**

If the culprit of energy loss is a damper with a loose seal, a professional mason can repair this for you. You can also install tight-fitting glass doors to increase the overall efficiency of an existing fireplace, or consider installing one or more fireplace devices such as a flue top damper, air vents, heat exchangers and/or fireplace insert. In some cases an ash cleanout passage can be modified to bring outside air to the fire. Some people make a decorative panel with foam insulation on the back to fit snugly in the opening when not in use. If your fireplace is no longer used, you may wish to engage a chimney repair service to permanently seal off the chimney.

You can increase the levels of insulation in any or all parts of your home by hiring a professional or doing the work yourself. If you choose to do it yourself, make sure to get all the necessary information in how-toguides and be certain that you are well informed on proper insulation techniques. Make sure to seal leaks before you insulate as sealing is more effective than installing insulation.

For descriptions of common insulation options see Appendix C.

For a detailed air leakage control guide refer to the publication 'Keeping the Heat In', available online at

Okotoks.ca/EnergyKit.



# Temperature **Reader** and Thermal Cards



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BLUE -th TAN - th BLACK	e temperature is more than that num e temperature is less than that num within the RED SQUARE .
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danger of	at to save money, and lessen the If tap water scalds.

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Freezer Refrigerator				
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	5'F 39'F -15'C IDEAL 4'C			
	O'F TEMP 36'F			
	-18°C 2°C			
	-5°F Too 32°F -21°C Cool 0°C			

#### SAVE ENERGY and stay safe with ecofitt

to test the temperature of your hot rater, hold the black strip (on the other ide) in the running hot water stream or 15 seconds and adjust your hot vater heater accordingly. Our tester is température de votre eau

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# What is it for?

### **Fridge and Freezer**

Your fridge and freezer use a lot of energy. Just think, they are using energy 24 hours a day to keep your food cold. Want to know how much energy your fridge uses? If you still have the original documents that came with your fridge, find the Energy Guide label. You can also find the fridge's model number by looking for the label on back of the unit or behind the kick plate on the lower front. You can look up the model number on the manufacturer's website to find the Energy Guide information.

The Energy Guide label tells you the fridge's estimated annual energy use in kilowatt hours (kWh). Multiply the kWh by the electricity rate on your bill to see how much this energy costs you per year.

### Ex. 2,000 kWh/year x 0.07 dollars/kWh = \$140 dollars a year

What about the amount of carbon emissions generated to run your fridge for a year? Multiply the Energy Guide kWh by 0.08 kg (carbon intensity of the Alberta grid is 800g CO2E/kWh) <sup>11</sup>.

### *Ex. 2,000 kWh/year x 0.08 kg CO2E/ kWh = 160 kg CO2E/year*

Keep in mind that these energy and carbon costs are only accurate if you're running your fridge at the recommended temperature. A fridge

<sup>11</sup>Town of Okotoks, Greenhouse Gas Inventory Baseline. 2019.

<sup>12</sup> Edison International, 9 Ways to Make Your Refrigerator More Efficient, 2016.



running  $5^{\circ}$ C degrees colder than it needs to can use up to 25% more energy <sup>12</sup>.

Use the Temperature Reader to make sure your fridge and freezer are at the ideal temperature to use less energy while keeping your food cold.

# How it works

### Fridge: Ideal temperature 2 to 4°C (36 to 39°F)

- Open the fridge. Find the temperature control unit. Make a note of the current fridge temperature setting.
  - Some refrigerators have digital thermometers and some have temperature dials that go from "cold to coldest"
  - b. Using the temperature reader in the DIY Kit can ensure that you're getting an accurate reading of your fridge's temperature
- 2. Pick a few items of food or liquid that have been in the fridge for more than 24 hours. Make sure they're in different locations within

**\*Safety note:** Do not point the temperature reader laser near anyone's eyes or off reflective surfaces. Do not let children handle the temperature reader.

the fridge (ex. Door, top shelf, drawer).

- 3. Press the trigger on the temperature reader and point the laser at the first item. The temperature will appear on the temperature reader's screen. Record the location of the item and the temperature.
- 4. Repeat step 3 with different items in your fridge.
- 5. If the temperatures are all higher than 2 to 4°C, turn your fridge's temperature down. If the temperatures are all lower than 2 to 4°C, turn your fridge's temperature up.
- Wait 24 hours, and record the temperatures again to ensure that you've adjusted your fridge correctly. Repeat steps 1 to 5 until you have achieved a fridge temperature within the 2 to 4°C range.

### Freezer: Ideal temperature -15 to -18°C (5 to 0°F)

- Find the temperature control unit. Make a note of the current freezer temperature setting.
- 2. Pick a few items of food or liquid that have been in the freezer for more than 24 hours. Make sure they're in different locations

within the freezer.

- Press the trigger on the temperature reader and point the laser at the first item. The temperature will appear on the temperature reader's screen. Record the location of the item and the temperature.
- 4. Repeat step 3 with different items in your freezer.
- If the temperatures are all higher than -15 to -18°C, turn your freezer's temperature down. If the temperatures are all lower than -15 to -18°C, turn your freezer's temperature up.
- Wait 24 hours, and record the temperatures again to ensure that you've adjusted your freezer correctly. Repeat steps 1 to 5 until you have achieved a freezer temperature within the -15 to -18°C range.

# How to Use the Refrigerator & Freezer Temperature Card:

- 1. Place card in the fridge or freezer, wait 15 minutes
- 2. Leave the card in the fridge/ freezer while reading the temperature.
- 3. Return the card to the DIY Kit after you've gotten your temperature reading!

# Next Steps

Now your fridge and freezer are running at the most efficient temperatures, that's great! Follow these tips to make your fridge and freezer even more efficient to save more on your electricity bill. <sup>13</sup>

- Clean the condenser coils once a year. Unplug the fridge and use a brush or vacuum to clean the coils underneath. This could improve the unit's efficiency by 30%.
- When ice on the walls of the fridge or freezer is thicker than ¼ inch (6cm), manually defrost the unit.
- Keep your home thermostat set to around 20°C. The hotter your home, the harder your fridge has to work to cool down which wastes more energy.

- Make sure there are a few centimeters of space between the back of your fridge and the wall to allow for good air circulation.
- To check if your seals are damaged (which could be wasting a lot of energy) close a \$5 bill in the door seal. If you can move the bill easily, consider replacing the seals.







<sup>13</sup> Edison International, 9 Ways to Make Your Refrigerator More Efficient, 2016.



### **Hot Water Heater**

Is your hot water heater turned up too high? If your water is too hot you are wasting energy and increasing the risk of tap water scalds – ouch!

On average, every Canadian uses about 75 Litres of hot water a day. All this hot water accounts for around 19% of all the energy used in your home!

If your hot water heater has a thermostat, you can turn it down to 120°F. The default setting of most hot water heaters is 130 to 140°F which is way too hot for human skin. By turning it down 10°F you could save 3-5% on your total water heating costs. Here's how you can make sure that your hot water heater is as efficient as it can be.

(Continued on next page)

## How it works

**\*Safety note:** Do not point the temperature reader laser near anyone's eye or off reflective surfaces. Do not let children handle the temperature reader.

### Hot Water Heater: Ideal Temperature 49 to 54°C (120 to 130°F)

- Do not use any hot water for at least 1 hour before completing this test.
- 2. Find the tap that's closest to the hot water heater. Turn on the tap to the hottest setting and allow the water to run for at least 1 minute.
  - a. Collect the water you run in a large pot and use it to boil pasta or water your plants later

of water. The water temperature will appear on the screen of the Temperature Reader.

- Record the temperature on the Temperature Reader's screen. Adjust your Hot Water Heater (increase temperature if below 49 to 54°C, decrease temperature if above 49 to 54°C)
- After adjusting hot water heater temperature settings wait 24 hours and then repeat steps 1 through 4 until a temperature between 49 to 54°C is achieved.

3. Using caution, fill a cup with the hot water. Set the cup down and point the Temperature Reader's laser into the centre of the cup



### How to Use the Hot Water Gauge Card:

- 1. Run the tap closest to the hot water heater for 3-5 minutes on the hottest setting
- 2. Use caution to fill up a glass with hot water and insert the end of the card into the water
- 3. Return the card to the DIY Kit after you've gotten your temperature reading!

# **Next Steps**

Your hot water heating bill can make up to 12% of your utility bills. Now that your hot water heater is set to the right temperature you've taken a big step in reducing your bill. Follow these tips to save the even more! <sup>14</sup>

- Use cold water for laundry
- Reduce your time in the shower, and remember to turn the faucet off when you're brushing your teeth
- Install low-flow shower heads and faucets
- Get your hot water heater a jacket! Newer hot water heaters

are usually insulated well. If you have an older model that's warm to the touch you could save 7-16% of your heating costs by insulating it with a pre-cut blanket or jacket

 Insulate the first few meters of hot and cold water pipes that are connected to the water heater

# Before









<sup>14</sup> US Department of Energy, 15 Ways to Save on Your Water Heating Bill, 2009











# What it's for

This Energy Monitor measures how much electricity a piece of equipment uses. With the help of an Energy Monitor you can:

- Determine the cost of running a piece of equipment
- Determine an appliance's most efficient setting
- Compare equipment with and get more information on efficient ENERGY STAR models
- Determine if and how much energy a piece of equipment uses when it is not in active use ("phantom power")
- Determine what portion of overall electric use a piece of equipment represents

Use the LED lightbulb included in the kit to test how the electricity usage of your lighting equipment changes when the lightbulbs you currently use (incandescent or compact fluorescent (CFL)) are replaced with a high efficiency LED bulb.



### Instructions for the Energy Monitor:



### Plug it in

Press the "Energy" button until kWh appears beside the numbers. You will see "Day" at the bottom of the screen. This is how many kWh your appliance uses per day. Select "Energy"

For smaller appliances, press the "Energy" button until Watt appears beside the numbers. The meter will display how many watts of energy the appliance is using.





### **Get your Results**

- Press the "Cost" button. This screen shows the cost in dollars per hour of appliance usage based on the current average electricity rates. Press "Cost" again to see how much it costs to run this appliance for a "Day", "Month", or "Year".
- Press the "CO2" button. This screen shows how many kilograms of CO2 per hour are being emitted through electricity generation in order to power this appliance. Press "CO2" again to see the amount of CO2 emissions that are generated to run this appliance for a "Day", "Month", or "Year".
- Press the "Energy Count" button to see the energy usage, cost, or CO2 emissions during the use of any appliance. For example, if you would like to see the amount of energy used to toast a bagel. Press the "Energy" button, turn on the toaster, then press the "Energy Count" button. You will be able to see the accumulated energy used to power the toaster. The "Energy Count" function can be used in any of the energy, cost, or CO2 functions.







Once you have conducted all of your measurements and have seen the energy used by your appliances, consider the following:







Do any of your appliances use significant energy when not in active use or powered off? Unplug these when not using them. If you have a number of appliances that are usually used as a group (TV, DVD players, sound and gaming systems), plug all of these into a power bar that has an off switch. This way you can make sure none of these appliances are drawing phantom power when they are not in active use by switching off the entire power bar.

2

What is the most efficient setting for an appliance? Use this setting whenever possible to use less energy.

(Continued on next page)





What appliances are the highest energy users? It may be worthwhile to look into the potential savings of replacing these appliances with newer, more energy efficient ones, especially if they are getting to the end of their lifecycle. Now that you know how much energy your current appliances use, you can compare these values to advertised energy ratings when making future purchases. When getting rid of old appliances, remember to recycle your electronics when possible, or to dispose of them responsibly.

Are your lighting appliances currently using more energy than they would with high efficiency LED lightbulbs? If so, switch to LED lightbulbs when buying your next bulb replacements! Remember to take your old bulbs to the Okotoks Eco Centre so that they can be properly disposed of.







www.okotoks.ca/energykit

3
## www.okotoks.ca/energykit

# Radon Monitor









## What is radon?

Radon is a radioactive gas that is produced naturally by the breakdown of uranium in the ground. Since radon can't be seen, smelled, or tasted, it can enter buildings undetected. Within the outdoor environment, radon is diluted and therefore not a concern, however within an indoor space, radon can build up to high levels. High levels of radon can become a significant risk to human health over extended periods of exposure.

Radon can enter your building any place where the building touches the soil and there is an opening.

Radon exposure increases the risk of developing lung cancer and is the second leading cause of lung cancer after smoking<sup>15</sup>. The risk level depends on several factors; the level of radon in the building and the length of exposure to radon.

The amount of radon in your building will depend on many factors including:

- the amount of uranium in the ground
- the number of entry points into your building
- how well your building is ventilated

Common entry points include:

- cracks in foundation walls and floor slabs
- construction joints
- gaps around service pipes
- support posts
- window casements
- floor drains
- sumps or cavities inside walls



## **Testing for radon**

Health Canada recommends that longterm testing is completed during the heating season (in our climate, no later than the beginning of February).

During the non-heating season in summer, windows and doors are open more often and for longer periods of time and the test runs the risk of a false negative. Additionally, the ground is no longer frozen, which also leads to seasonally lower radon levels being measured within a building.

While testing in the summer months can lead to lower radon readings, Health Canada suggests testing in the summer months over not testing at all. If you test out of the heating season and your numbers come back high – it's an indication that the building likely has high average levels. If the numbers are low, then the second test (Health Canada recommends every two years) should be completed during the heating season. If the radon level within a building is above the Canadian guideline of 200 becquerels (Bq)/ metre<sup>3</sup>, mitigation action is required.

The higher the radon level in a building the increased immediacy of action required. A certified radon mitigation professional can help provide you with the most effective radon reduction solution.

## How to use the radon monitor

This device provides long term readings, seven day short term and one day short term readings. To reset the device and clear all of the stored data press the reset button (located on the back of the device). This device should be placed with the display face up. The longer you leave the device running the more accurate the average exposure reading will be. Health Canada recommends a test duration of at least 91 days. A shorter test is for information purposes only. Longer term tests can be found at local hardware stores or at okotoks.ca/energykit

### (Refer to Appendix G for details)

To conduct your radon test, follow these steps:

- 1. Place monitor in lowest level of the home off of the floor.
- 2. Turn unit over and lightly press "Reset" button with a paperclip or pen.
- 3. Wait up to 24 hours for the first radon reading.
- 4. The readings will continue to average over the duration of the test.



www.okotoks.ca/energykit

## **Radon monitor placement**

For the most accurate results follow the placement recommendations from Health Canada listed below. The purpose is to test locations where you commonly breathe air. The placement of the radon meter should be:

- In the lowest level of your home that you occupy for four or more hours a day
- Not in the kitchen, bathroom,laundry or closet
- Min. 50 cm from an exterior wall
- Min. 40 cm from an interior wall
- Min. 80 200 cm above the floor

- Min. 20 cm space around the device
- Minimum 50 cm from the ceiling
- Out of direct sunlight and not in areas of high humidity
- In a location where it will not be disturbed
- Out of direct air drafts

## **Mitigation Measures**

The most popular mitigation solution is active sub-slab depressurization. Through this method, a venting pipe is installed through the foundation floor and is piped to the outside via a fan, drawing radon from under the building and venting the gas outside before it enters the building.

This method can reduce radon levels in a building by more than  $90\%^{16}$ . Increased ventilation and sealing of radon entry points can also help reduce radon levels, but these solutions may not be as effective as sub-slab depressurization.

See Radon Reduction Guide for Canadians for more information on reducing radon in your home at www.hc-sc.gc.ca/ewh-semt/pubs/radiation/radon\_canadians-canadiens/index-eng.php

Results (Bq/m³)	Equivalent Dental X-rays / person / year	Action Levels and Averages
200	360	Health Canada action level
148	266	USA Environmental Protection Agency action level
100	180	World Health Organization action level
42	76	Average indoor levels
10	18	Average outdoor levels



<sup>16</sup> Government of Canada. Testing your home for radon. 2015. www.canada.ca/en/health-canada/services/radon/ testing-your-home-radon.html



Appendix A - Paybacks	44
Appendix B - Thermal camera manual	46
Appendix C - Insulation options	68
Appendix D - Energy Monitor manual	74
Appendix E - Temperature reader manual	84
Appendix F - Radon monitor manual	88



## Appendix A: Paybacks

Payback is an estimate of how long it will take to save enough energy to pay for the cost of a conservation measure. A payback calculation will help you decide which upgrades to prioritize. Sealing up air leaks and duct-sealing are low cost measures and usually come in first place for payback. Insulation, especially in walls or basements that have none, is an excellent investment.

When looking at how much an investment may save, consider the source of information. Someone selling a product may overestimate the savings of that product or miss lower cost measures. Information from your local utility or engaging the services of a professional can help you with unbiased information.

We recommend doing those improvements first that cost the least and save the most energy. The following list of energy conservation measures are arranged in the order of their payback:

### Energy Measures that Save a Lot and Have Little or No Cost

- Keep your home at or below 20°C.
- Lower heating thermostat to 15°C at night and when home is unoccupied.
- Close fireplace damper when fireplace is not in use.
- Replace furnace air filters regularly.
- Lower water heater thermostats to the minimum of 60°C.
- Insulate electric based hot water pipes and install heat trap fittings at flex connections. Insulate the first five feet of cold line.
- Regularly check and adjust the temperature of fridge and freezer to ensure they aren't too cold.
- Install low flow efficient showerheads and faucet aerators.
- Install gaskets behind electric outlets and switch plates on exterior walls.
- Insert safety caps in unused outlets for additional insulation.
- Seal air leaks to attic and crawl space with spray foam.
- Caulk and weather-strip windows, doors, cracks and holes.
- Dust baseboard and wall heaters.

### Energy Measures with an Estimated One to Two-Year Payback

- Install do-it-yourself insulating shrink film window kits.
- Tune up heating and cooling equipment.
- Insulate and air seal rim joist area in basement.

### Energy Measures with an Estimated Two to Five-Year Payback

- Insulate walls in a heated basement, and the rim joist of an unheated basement or crawl space.
- Install attic insulation to achieve a minimum R-38.
- Install underfloor insulation to achieve a minimum R-30.
- Install fireplace modifications such as glass doors, flue top damper and outside combustion air.
- Install do-it-yourself insulated window shades or shutters.
- Install wall insulation in un-insulated exterior walls.
- Install do-it-yourself solar hot water preheat.

### Energy Measures with an Estimated Payback of More Than Five Years

- Install commercial storm windows.
- Replace existing single-pane windows with new double, or even triple-pane, windows.
- Replace older furnace or boiler with a 90 per cent+ condensing unit.
- Install programmable thermostats.
- Have a blower door test conducted to assist with air sealing.
- Install do-it-yourself plastic storm windows.
- Repair fireplace damper seal.
- Install LED bulbs in all fixtures.
- Install dimmer switches, photocells, timers and motion detectors.
- Install do-it-yourself insulated panel.
- Install a fireplace insert into an existing fireplace.
- Install an energy efficient hot water tank or tankless hot water heater.
- Replace conventional oil furnace burner with a new flame retention burner.
- Install active solar hot water system.



## **Appendix B: Thermal Camera Manual**



### Important note

Before operating the device, you must read, understand, and follow all instructions, warnings, cautions, and legal disclaimers.

### Důležitá poznámka

Před použitím zařízení si přečtěte veškeré pokyny, upozornění, varování a vyvázání se ze záruky, ujistěte se, že jim rozumíte, a řiďte se jimi.

#### Vigtig meddelelse

Før du betjener enheden, skal du du læse, forstå og følge alle anvisninger, advarsler, sikkerhedsforanstaltninger og ansvarsfraskrivelser.

#### Wichtiger Hinweis

Bevor Sie das Gerät in Betrieb nehmen, lesen, verstehen und befolgen Sie unbedingt alle Anweisungen, Warnungen, Vorsichtshinweise und Haftungsausschlüsse

#### Σημαντική σημείωση

Πριν από τη λειτουργία της συσκευής, πρέπει να διαβάσετε, να κατανοήσετε και να ακολουθήσετε όλες τις οδηγίες, προειδοποιήσεις, προφυλάξεις και νομικές αποποιήσεις.

#### Nota importante

Antes de usar el dispositivo, debe leer, comprender y seguir toda la información sobre instrucciones, advertencias, precauciones y renuncias de responsabilidad.

#### Tärkeä huomautus

Ennen laitteen käyttämistä on luettava ja ymmärrettävä kaikki ohjeet, vakavat varoitukset, varoitukset ja lakitiedotteet sekä noudatettava niitä.

#### **Remarque importante**

Avant d'utiliser l'appareil, vous devez lire, comprendre et suivre l'ensemble des instructions, avertissements, mises en garde et clauses légales de non-responsabilité.

### Fontos megjegyzés

Az eszköz használata előtt figyelmesen olvassa el és tartsa be az összes utasítást, figyelmeztetést, óvintézkedést és jogi nyilatkozatot.

#### Nota importante

Prima di utilizzare il dispositivo, è importante leggere, capire e seguire tutte le istruzioni, avvertenze, precauzioni ed esclusioni di responsabilità legali.

#### 重要な注意

デバイスをご使用になる前に、あらゆる指示、警告、注意事項、および免責条項をお読み頂き、その内容を理解して従ってくだ さい。

### 중요한 참고 사항

장치를 작동하기 전에 반드시 다음의 사용 설명서와 경고, 주의사항, 법적 책임제한을 읽고 이해하며 따라야 합니다.

### Viktig

Før du bruker enheten, må du lese, forstå og følge instruksjoner, advarsler og informasjon om ansvarsfraskrivelse.

#### Belangrijke opmerking

Zorg ervoor dat u, voordat u het apparaat gaat gebruiken, alle instructies, waarschuwingen en juridische informatie hebt doorgelezen en begrepen, en dat u deze opvolgt en in acht neemt.

#### Ważna uwaga

Przed rozpoczęciem korzystania z urządzenia należy koniecznie zapoznać się z wszystkimi instrukcjami, ostrzeżeniami, przestrogami i uwagami prawnymi. Należy zawsze postępować zgodnie z zaleceniami tam zawartymi.

#### Nota importante

Antes de utilizar o dispositivo, deverá proceder à leitura e compreensão de todos os avisos, precauções, instruções e isenções de responsabilidade legal e assegurar-se do seu cumprimento.

#### Важное примечание

До того, как пользоваться устройством, вам необходимо прочитать и понять все предупреждения, предостережения и юридические ограничения ответственности и следовать им.

### Viktig information

Innan du använder enheten måste du läsa, förstå och följa alla anvisningar, varningar, försiktighetsåtgärder och ansvarsfriskrivningar.

### Önemli not

Cihazı çalıştırmadan önce tüm talimatları, uyarıları, ikazları ve yasal açıklamaları okumalı, anlamalı ve bunlara uymalısınız.

#### 重要注意事项

在操作设备之前,您必须阅读、理解并遵循所有说明、警告、注意事项和法律免责声明。

重要注意事項

操作裝置之前,您務必閱讀、了解並遵循所有說明、警告、注意事項與法律免責聲明。

### **Table of contents**

1	Discla	Disclaimers		
	1.1	Legal disclaimer1		
	1.2	U.S. Government Regulations1		
	1.3	Patents1		
	1.4	Quality assurance1		
	1.5	Third-party licenses1		
	1.6	Usage statistics1		
	1.7	Copyright1		
2	Safety	nformation2		
	2.1	Accessing regulatory information3		
3	Notice	e to user		
	3.1	Calibration4		
	3.2	Accuracy		
	3.3	Disposal of electronic waste		
	3.4	Training		
	3.5	Documentation updates		
	3.6	Important note about this manual4		
	3.7	Note about authoritative versions5		
4	Custo	er help6		
	4.1	General6		
	4.2	Submitting a question		
	4.3	Downloads6		
5	Quick	tart guide7		
6	Camer	overview		
	6.1	View from the front8		
	6.2	View from the rear8		
	6.3	Screen elements9		
		6.3.1 General9		
		6.3.2 Menu system9		
		6.3.3 Status icons		
		6.3.4 Swipe-down menu10		
7	Achiev	ng a good thermal image11		
	7.1	To keep in mind		
	7.2	Temperature scale		
		7.2.1 Example 1		
		7.2.2 Example 2		
		7.2.3 Manually adjusting the temperature scale		
		7.2.4 Locking the temperature scale		
	7.0	7.2.5 Showing/hiding the temperature scale		
	7.3	Image modes 13		
	7.4	7.4.1 General 12		
		7.4.1 General		
		7.4.3 Aligning the thermal and visual images 13		
	75	Color nalettes 14		
8	Mogeu	ing temperatures		
0	8 1	Adding/removing measurement tools		
	82	Moving the spotmeter 15		
	8.3	Moving and resizing the box 15		
	8.4	Changing the measurement parameters 16		
		8.4.1 Setting measurement parameters		
		8.4.2 Recommended values		
9	Saving	and working with images		
5	9.1	Saving an image 17		
	0.1	ouring un inlage		

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iii

### Table of contents

	9.2	About image files
	9.3	Adding a note
	9.4	Editing a saved image
10	Unioa	ding images
	10.1	Connecting to Wi-Ei 19
	10.2	Pairing with ELIB Ignite 19
	10.3	Automatic unload 19
	10.0	Manual unload 19
	10.1	10.4.1 Unloading an image 19
		10.4.2 Uploading multiple images 20
		10.4.3 Uploading a folder 20
	10.5	FLIB lanite 20
	10.5	10.5.1 View images 20
		10.5.2 Organize in folders 20
		10.5.3 Search 20
		10.5.4 Download images 20
		10.5.5 Share results 20
11	WORKI	ng with the image gallery21
	11.1	Opening a saved image
	11.2	Creating a new folder
	11.3	Renaming a folder
	11.4	Changing the active folder
	11.5	Moving files between folders
	11.6	Deleting a folder
	11.7	Deleting an image
	11.8	Deleting multiple images
	11.9	Deleting all images
12	Handl	ing the camera24
	12.1	Charging the battery
	12.2	Turning on and turning off the camera
	12.3	Using the camera lamp
	12.3 12.4	Using the camera lamp
	12.3 12.4	Using the camera lamp
	12.3 12.4 12.5	Using the camera lamp
	12.3 12.4 12.5 12.6	Using the camera lamp
	12.3 12.4 12.5 12.6 12.7	Using the camera lamp
	12.3 12.4 12.5 12.6 12.7	Using the camera lamp
	12.3 12.4 12.5 12.6 12.7	Using the camera lamp
13	12.3 12.4 12.5 12.6 12.7 Came	Using the camera lamp
13	12.3 12.4 12.5 12.6 12.7 <b>Came</b> 13.1	Using the camera lamp
13	12.3 12.4 12.5 12.6 12.7 <b>Came</b> 13.1 13.2	Using the camera lamp
13	12.3 12.4 12.5 12.6 12.7 <b>Came</b> 13.1 13.2 13.3	Using the camera lamp       24         Moving files via USB cable       24         12.4.1 Related topics       24         Bluetooth connection       24         Non-uniformity correction       25         Cleaning the camera       25         12.7.1 Camera housing, cables, and other items       25         12.7.2 Infrared lens       25         ra settings       27         Connections       27         Connections       27         Camera temperature range       27
13	12.3 12.4 12.5 12.6 12.7 <b>Came</b> 13.1 13.2 13.3 13.4	Using the camera lamp       24         Moving files via USB cable       24         12.4.1 Related topics       24         Bluetooth connection       24         Non-uniformity correction       25         Cleaning the camera       25         12.7.1 Camera housing, cables, and other items       25         ra settings       27         Measurement parameters       27         Camera temperature range       27         Save options & storage       27
13	12.3 12.4 12.5 12.6 12.7 <b>Came</b> 13.1 13.2 13.3 13.4 13.5	Using the camera lamp       24         Moving files via USB cable       24         12.4.1 Related topics       24         Bluetooth connection       24         Non-uniformity correction       25         Cleaning the camera       25         12.7.1 Camera housing, cables, and other items       25         12.7.2 Infrared lens       25         ra settings       27         Measurement parameters       27         Camera temperature range       27         Save options & storage       27         Accounts       27
13	12.3 12.4 12.5 12.6 12.7 <b>Came</b> 13.1 13.2 13.3 13.4 13.5 13.6	Using the camera lamp       24         Moving files via USB cable.       24         12.4.1 Related topics       24         Bluetooth connection       24         Non-uniformity correction.       25         Cleaning the camera       25         12.7.1 Camera housing, cables, and other items       25         12.7.2 Infrared lens       25         ra settings       27         Connections       27         Camera temperature range       27         Save options & storage       27         Accounts       27         Device settings       27         Accounts       27         Device settings       27
13	12.3 12.4 12.5 12.6 12.7 <b>Came</b> 13.1 13.2 13.3 13.4 13.5 13.6 <b>Updat</b>	Using the camera lamp       24         Moving files via USB cable       24         12.4.1 Related topics       24         Bluetooth connection       24         Non-uniformity correction       24         Scleaning the camera       25         12.7.1 Camera housing, cables, and other items       25         ra settings       27         Measurement parameters       27         Camera temperature range       27         Save options & storage       27         Accounts       27         Device settings       28         sing the camera       29
13	12.3 12.4 12.5 12.6 12.7 <b>Came</b> 13.1 13.2 13.3 13.4 13.5 13.6 <b>Updat</b> 14.1	Using the camera lamp       24         Moving files via USB cable       24         12.4.1 Related topics       24         Bluetooth connection       24         Non-uniformity correction       25         Cleaning the camera       25         12.7.1 Camera housing, cables, and other items       25         ra settings       27         Measurement parameters       27         Camera temperature range       27         Save options & storage       27         Device settings       28         ing the camera       29         Updating the camera online       29
13	12.3 12.4 12.5 12.6 12.7 <b>Came</b> 13.1 13.2 13.3 13.4 13.5 13.6 <b>Updat</b> 14.1 14.2	Using the camera lamp       24         Moving files via USB cable       24         12.4.1 Related topics       24         Bluetooth connection       24         Non-uniformity correction       25         Cleaning the camera       25         12.7.1 Camera housing, cables, and other items       25         12.7.2 Infrared lens       25         ra settings       27         Measurement parameters       27         Camera temperature range       27         Save options & storage       27         Accounts       27         Device settings       28         ing the camera online       29         Updating the camera online       29         Updating the camera online       29         Updating the camera online       29
13 14 15	12.3 12.4 12.5 12.6 12.7 <b>Camee</b> 13.1 13.2 13.3 13.4 13.5 13.6 <b>Updat</b> 14.1 14.2 <b>Mecha</b>	Using the camera lamp       24         Moving files via USB cable.       24         12.4.1 Related topics       24         Bluetooth connection       24         Non-uniformity correction       25         Cleaning the camera       25         12.7.1 Camera housing, cables, and other items       25         12.7.2 Infrared lens       25         ra settings       27         Connections       27         Camera housing, cables, and other items       27         Acsurement parameters       27         Save options & storage       27         Accounts       27         Device settings       28         updating the camera online       29         Updating the camera online       29         updating the camera via USB cable       29         anical drawings       30
13 14 15 16	12.3 12.4 12.5 12.6 12.7 <b>Camee</b> 13.1 13.2 13.3 13.4 13.5 13.6 <b>Updat</b> 14.1 14.2 <b>Mecha</b> <b>CE De</b>	Using the camera lamp       24         Moving files via USB cable       24         12.4.1 Related topics       24         Bluetooth connection       24         Non-uniformity correction       24         Ite tooth connection       24         Non-uniformity correction       25         12.7.1 Camera housing, cables, and other items       25         12.7.2 Infrared lens       25         ra settings       27         Connections       27         Camera temperature range       27         Save options & storage       27         Device settings       28         ing the camera       29         Updating the camera online       29         Updating the camera via USB cable       29         anical drawings       30         claration of conformity       30
13 14 15 16 17	12.3 12.4 12.5 12.6 12.7 <b>Came</b> 13.1 13.2 13.3 13.4 13.5 13.6 <b>Updat</b> 14.1 14.2 <b>Mecha</b> <b>CE Dec</b> <b>About</b>	Using the camera lamp       24         Moving files via USB cable       24         12.4.1 Related topics       24         Bluetooth connection       24         Non-uniformity correction       24         String the camera       25         12.7.1 Camera housing, cables, and other items       25         12.7.2 Infrared lens       27         Measurement parameters       27         Camera temperature range       27         Save options & storage       27         Device settings       28         ting the camera       29         Updating the camera online       29         Updating the camera via USB cable       29         anical drawings       30         relaration of conformity       32         FLIR Systems       34
13 14 15 16 17	12.3 12.4 12.5 12.6 12.7 <b>Came</b> 13.1 13.2 13.3 13.4 13.5 13.6 <b>Updat</b> 14.1 14.2 <b>Mech:</b> <b>CE De</b> <b>About</b> 17.1	Using the camera lamp       24         Moving files via USB cable       24         12.4.1 Related topics       24         Bluetooth connection       24         Non-uniformity correction       25         Cleaning the camera       25         12.7.1 Camera housing, cables, and other items       25         12.7.2 Infrared lens       27         Connections       27         Connections       27         Camera housing, cables, and other items       25         12.7.2 Infrared lens       27         Connections       27         Camera temperature range       27         Camera temperature range       27         Device settings       28         ting the camera       29         Updating the camera via USB cable       29         updating the camera via USB cable       29         anical drawings       30         claration of conformity       32         :       FLIR Systems         More than lust an infrared camera       35
13 14 15 16 17	12.3 12.4 12.5 12.6 12.7 <b>Came</b> 13.1 13.2 13.3 13.4 13.5 13.6 <b>Updat</b> 14.1 14.2 <b>Mecha</b> <b>CE De</b> <b>About</b> 17.1 17.2	Using the camera lamp       24         Moving files via USB cable.       24         12.4.1 Related topics       24         Bluetooth connection       24         Non-uniformity correction       25         Cleaning the camera       25         12.7.1 Camera housing, cables, and other items       25         12.7.2 Infrared lens       25         ra settings       27         Connections       27         Camera temperature range       27         Accounts       27         Device settings       27         Updating the camera online       29         Updating the camera online       29         updating the camera via USB cable       29         anical drawings       30         relaration of conformity       32         : FLIR Systems       34         More than just an infrared camera       35         Sharing our knowledge       35

v

1

### Disclaimers

### 1.1 Legal disclaimer

For warranty terms, refer to https://www.flir.com/warranty.

### 1.2 U.S. Government Regulations

This product may be subject to U.S. Export Regulations. Send any inquiries to exportquestions@flir.com.

### 1.3 Patents

This product is protected by patents, design patents, patents pending, or design patents pending. Refer to the FLIR Systems' patent registry:

https://www.flir.com/patentnotices

### 1.4 Quality assurance

The Quality Management System under which these products are developed and manufactured has been certified in accordance with the ISO 9001 standard.

FLIR Systems is committed to a policy of continuous development; therefore we reserve the right to make changes and improvements on any of the products without prior notice.

### 1.5 Third-party licenses

Information about third-party licenses is available in the user interface of the product.

### 1.6 Usage statistics

FLIR Systems reserves the right to gather anonymous usage statistics to help maintain and improve the quality of our software and services.

### 1.7 Copyright

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1

### Safety information

#### WARNING

#### Applicability: Class B digital devices.

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.

#### 

#### Applicability: Digital devices subject to 15.19/RSS-GEN.

NOTICE: This device complies with Part 15 of the FCC Rules and with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions:

- 1. this device may not cause harmful interference, and
- this device must accept any interference received, including interference that may cause undesired operation.

#### 

Applicability: Digital devices subject to 15.21.

NOTICE: Changes or modifications made to this equipment not expressly approved by FLIR Systems may void the FCC authorization to operate this equipment.

#### 

Applicability: Digital devices subject to 2.1091/2.1093/KDB 447498/RSS-102.

Radiofrequency radiation exposure Information: For body worn operation, this device has been tested touched to the phantom and meets FCC RF exposure guidelines. Nevertheless, the device should be used in such a manner that the potential for human contact during normal operation is minimized.

### VARNING

This device is granted pursuant to the Japanese Radio Law (電波法) and the Japanese Telecommunications Business Law (電気通信事業法). This device should not be modified (otherwise the granted designation number will become invalid)

### VARNING

Do not disassemble or do a modification to the battery. The battery contains safety and protection devices which, if damage occurs, can cause the battery to become hot, or cause an explosion or an ignition.

#### WARNING

Make sure that you read all applicable MSDS (Material Safety Data Sheets) and warning labels on containers before you use a liquid. The liquids can be dangerous. Injury to persons can occur.

### CAUTION

Do not point the infrared camera (with or without the lens cover) at strong energy sources, for example, devices that cause laser radiation, or the sun. This can have an unwanted effect on the accuracy of the camera. It can also cause damage to the detector in the camera.

#### Safety information

### CAUTION

Do not use the camera in temperatures more than +50°C (+122°F), unless other information is specified in the user documentation or technical data. High temperatures can cause damage to the camera.

### CAUTION

Do not attach the batteries directly to a car's cigarette lighter socket, unless FLIR Systems supplies a specific adapter to connect the batteries to a cigarette lighter socket. Damage to the batteries can occur.

#### 

Do not use the battery if, when you use, charge, or put the battery in storage, there is an unusual smell from the battery, the battery feels hot, changes color, changes shape, or is in an unusual condition. Speak with your sales office if one or more of these problems occurs. Damage to the battery and injury to persons can occur.

#### 

The temperature range through which you can charge the battery is  $\pm 0^{\circ}$ C to  $+35^{\circ}$ C ( $+32^{\circ}$ F to  $+95^{\circ}$ F), except for the Korean market where the approved range is  $+10^{\circ}$ C to  $+35^{\circ}$ C ( $+50^{\circ}$ F to  $+95^{\circ}$ F). If you charge the battery at temperatures out of this range, it can cause the battery to become hot or to break. It can also decrease the performance or the life cycle of the battery.

### CAUTION

The temperature range through which you can remove the electrical power from the battery is  $-10^{\circ}$ C to  $+50^{\circ}$ C (+14<sup>o</sup>F to +122<sup>o</sup>F), unless other information is specified in the user documentation or technical data. If you operate the battery out of this temperature range, it can decrease the performance or the life cycle of the battery.

#### I CAUTION

Do not apply solvents or equivalent liquids to the camera, the cables, or other items. Damage to the battery and injury to persons can occur.

#### 

Be careful when you clean the infrared lens. The lens has an anti-reflective coating which is easily damaged. Damage to the infrared lens can occur.

#### 

Do not use too much force to clean the infrared lens. This can cause damage to the anti-reflective coating.

#### 

The 5 GHz band is only allowed for indoor use in Japan and Canada.

### 2.1 Accessing regulatory information

To access the regulatory information available in the camera, tap O (Settings) > Device settings > Camera information > Regulatory.

### Notice to user

### 3.1 Calibration

We recommend that you send in the camera for calibration once a year. Contact your local sales office for instructions on where to send the camera.

### 3.2 Accuracy

For very accurate results, we recommend that you wait 5 minutes after you have started the camera before measuring a temperature.

### 3.3 Disposal of electronic waste

Electrical and electronic equipment (EEE) contains materials, components and substances that may be hazardous and present a risk to human health and the environment when waste electrical and electronic equipment (WEEE) is not handled correctly.

Equipment marked with the below crossed-out wheeled bin is electrical and electronic equipment. The crossed-out wheeled bin symbol indicates that waste electrical and electronic equipment should not be discarded together with unseparated household waste, but must be collected separately.

For this purpose all local authorities have established collection schemes under which residents can dispose waste electrical and electronic equipment at a recycling centre or other collection points, or WEEE will be collected directly from households. More detailed information is available from the technical administration of the relevant local authority.



### 3.4 Training

For training resources and courses, go to http://www.flir.com/support-center/training.

### 3.5 Documentation updates

Our manuals are updated several times per year, and we also issue product-critical notifications of changes on a regular basis.

To access the latest manuals, translations of manuals, and notifications, go to the Download tab at:

http://support.flir.com

In the download area you will also find the latest releases of manuals for our other products, as well as manuals for our historical and obsolete products.

### 3.6 Important note about this manual

FLIR Systems issues generic manuals that cover several cameras within a model line.

This means that this manual may contain descriptions and explanations that do not apply to your particular camera model.

### 3.7 Note about authoritative versions

The authoritative version of this publication is English. In the event of divergences due to translation errors, the English text has precedence.

Any late changes are first implemented in English.

### **Customer help**

### 4.1 General

For customer help, visit:

http://support.flir.com

### 4.2 Submitting a question

To submit a question to the customer help team, you must be a registered user. It only takes a few minutes to register online. If you only want to search the knowledgebase for existing questions and answers, you do not need to be a registered user.

When you want to submit a question, make sure that you have the following information to hand:

- · The camera model
- · The camera serial number
- The communication protocol, or method, between the camera and your device (e.g., SD card reader, HDMI, Ethernet, USB, or FireWire)
- Device type (PC/Mac/iPhone/iPad/Android device, etc.)
- Version of any programs from FLIR Systems
- Full name, publication number, and revision number of the manual

### 4.3 Downloads

On the customer help site you can also download the following, when applicable for the product:

- · Firmware updates for your infrared camera.
- Program updates for your PC/Mac software.
- Freeware and evaluation versions of PC/Mac software.
- · User documentation for current, obsolete, and historical products.
- · Mechanical drawings (in \*.dxf and \*.pdf format).
- · CAD data models (in \*.stp format).
- Application examples.
- · Technical datasheets.

### **Quick start guide**

- 1. Push the On/off button () to turn on the camera.
- Follow the instructions on the camera screen to select the language, units, date and time formats, etc.
- 3. You can easily set up the camera to upload images for storage online.

To enable upload of images, you need to connect your camera to a FLIR Ignite account. Use a computer or other device with internet access and follow the instructions on the camera screen.

- To enable automatic upload of images, select <sup>(C)</sup>/<sub>(Settings)</sub> > Save options & storage > Auto upload = On.
- 5. To save an image, push the Save button.
- If automatic upload is enabled, new images will automatically be uploaded to your FLIR Ignite account when the camera is connected to the internet.

You can also upload images manually or move images from the camera using the USB cable.

7. To access your FLIR Ignite account, go to https://ignite.flir.com.

### 6.1 View from the front



- 1. Camera lamp.
- 2. Infrared lens.
- 3. Visual camera lens.
- 4. Lanyard attachment point.

### 6.2 View from the rear



- 5. USB-C connector.
- 6. Camera screen.
- 7. On/off button.
- 8. Save button.
- 9. Tripod mount.

### 6.3 Screen elements

### 

- 1. Result table.
- 2. Status icons.
- 3. Live view button.
- 4. Gallery button.
- 5. Settings button.
- 6. Menu button.
- 7. Spotmeter.
- 8. Temperature scale.

### 6.3.2 Menu system

To display the menu system, tap the menu button



- 1. Main menu toolbar.
- 2. Submenu toolbar.

### 6.3.3 Status icons

ū	Battery status indicator.	
	<ul> <li>When the battery status is 20–100%, the indicator is white.</li> <li>When the battery is charging, the indicator is green.</li> <li>When the battery status is below 20%, the indicator is red.</li> </ul>	
	The remaining storage capacity of the camera memory is below 100 MB.	

58

6

#### Camera overview

#### 6.3.4 Swipe-down menu

To open the swipe-down menu, place your finger at the top of the screen and swipe down.



- 1. Battery status indicator.
- 2. Control buttons:
  - Wi-Fi button: Tap to enable/disable Wi-Fi. See also section 10.1 Connecting to Wi-Fi, page 19.
  - Bluetooth button: Tap to enable/disable Bluetooth. See also section 12.5 Bluetooth connection, page 24.
  - Upload button: Tap to enable/disable automatic upload of images. See also section 10.3 Automatic upload, page 19.
  - · Lamp button: Tap to turn on/off the camera lamp.
- 3. Screen brightness slider: Used to control the brightness of the screen.
- 4. Camera memory indicator.
- 5. The FLIR Ignite user account that the camera is paired with. For more information, see section 10.2 *Pairing with FLIR Ignite*, page 19.

10

### Achieving a good thermal image

These are the functions and settings you need to experiment with to achieve a good thermal image:

- · Adjusting the temperature scale.
- · Selecting a suitable temperature range.
- Selecting a suitable image mode.
- · Changing the color palette.

### 7.1 To keep in mind

- A thermal camera has a resolution limit. This depends on the size of the detector, the lens, and the distance to the target. Use the center of the spot tool as a guide to the minimum possible object size, and get closer if necessary. Make sure to stay away from dangerous areas and live electrical components.
- Be careful when holding the camera perpendicular to the target. Be observant of reflections, especially at low emissivities—you, the camera, or the surroundings may become the main source of reflection.
- Select a zone of high emissivity, e.g., an area with a matte surface, to perform a measurement.
- Blank objects, i.e., those with low emissivities, may appear warm or cold in the camera, because they mainly reflect the environment.
- · Avoid direct sunlight on the details that you are inspecting.
- Various types of faults, e.g., those in a building's construction, may result in the same type of thermal pattern.
- Correctly analyzing an infrared image requires professional knowledge about the application.

### 7.2 Temperature scale

An infrared image can be adjusted automatically or manually.

In automatic mode, the camera continuously adjusts the level and span for the best image presentation. The temperature scale on the screen shows the upper and lower temperatures of the current span.

In manual mode, you can adjust the temperature scale to values close to the temperature of a specific object in the image. This will make it possible to detect anomalies and smaller temperature differences in the part of the image of interest.

#### 7.2.1 Example 1

Here are two infrared images of a building. In the left image, which is auto-adjusted, the large temperature span between the clear sky and the heated building makes a correct analysis difficult. You can analyze the building in more detail if you change the temperature scale to values close to the temperature of the building.



#### Achieving a good thermal image

#### 7.2.2 Example 2

Here are two infrared images of an isolator in a power line. To make it easier to analyze the temperature variations in the isolator, the temperature scale in the right image has been changed to values close to the temperature of the isolator.



### 7.2.3 Manually adjusting the temperature scale

### 1. Tap the menu button

- 2. Tap *Temperature scale* 1 and then tap *Manual* 6. This displays a wheel next to the temperature scale.
- To enhance the details of a certain point of interest in the image, tap that point on the screen. The image will be auto-adjusted based on the thermal content of the area around the tapped point.
- 4. To change the level, scroll the wheel up/down.
- 5. To change the span, do the following:
  - 5.1. Tap the temperature limit you want to keep unchanged. This locks the limit.
  - 5.2. Scroll the wheel up/down to change the value of the other temperature limit.

#### 7.2.4 Locking the temperature scale

You can lock the temperature scale.

- · To lock the temperature scale, tap the upper and the lower temperature limits.
- · To unlock the temperature scale, tap the temperature limits again.

#### Note

- When a temperature limit (upper and/or lower) is locked, the auto-adjust by touch function is disabled.
- · If you switch to automatic mode, the temperature scale will automatically unlock.

A typical situation where you would lock the temperature scale is when looking for temperature anomalies in two items with a similar design or construction.

For example, you have two cables, and you suspect that one is overheated. With the camera in automatic mode, direct the camera toward the cable that has a normal temperature. Then activate the manual mode and lock the temperature scale.

When you direct the camera, with the temperature scale locked, toward the suspected overheated cable, that cable will appear in a *lighter* color in the thermal image if its temperature is *higher* than the first cable.

If you instead use the automatic mode, the color for the two items might appear the same despite their temperature being different.

#### 7.2.5 Showing/hiding the temperature scale

In some situations, you may want to hide the temperature scale for a better view.

61

<sup>#</sup>T810539; r. AD/68933/69002; en-US

#### Achieving a good thermal image

- Tap the Settings button <sup>O</sup>
- 2. Tap Device settings > Show temperature scale.
- 3. Show/hide the temperature scale by toggling the Show temperature scale switch.

### 7.3 Temperature range

The camera is calibrated for different temperature ranges. For accurate temperature measurements, you must change the *Camera temperature range* setting to suit the expected temperature of the object you are inspecting.

Note For more information, see section , page .

To change the temperature range, do the following:

- Tap the Settings button <sup>O</sup>.
- 2. Tap Camera temperature range.
- 3. Select the appropriate temperature range.

### 7.4 Image modes

### 7.4.1 General

The camera can capture thermal and visual images at the same time. By choosing the image mode, you select which type of image to display on the screen.

The camera supports the following image modes:

- Thermal MSX (Multi Spectral Dynamic Imaging): An infrared image where the edges
  of the objects are enhanced with visual image details is displayed.
- Thermal: An infrared image is displayed.
- Digital camera: The visual image captured by the digital camera is displayed.
- · Picture in picture: An infrared image frame is displayed on top of the visual image.

#### Note

- For the *Thermal MSX*, *Thermal*, and *Picture in picture* image modes, all thermal and visual information is stored when an image is saved. This means that you can edit the image later, in the camera image gallery or in a FLIR Thermography software, and select any of the image modes.
- For the *Digital camera* image mode, a digital image is stored when an image is saved. However, no thermal information is stored.
- You can choose to turn off the digital camera. This can, for example, be required in re-

stricted areas. Select  $\bigotimes$  (Settings) > Save options & storage > Digital camera = Off. When the digital camera is off, only the image mode *Thermal* is enabled.

#### 7.4.2 Changing the image mode

To change the image mode, do the following:

- 1. Tap the menu button
- 2. Tap Image mode
- 3. Tap the image mode you want to use.

### 7.4.3 Aligning the thermal and visual images

In Thermal MSX and Picture in picture modes, the camera displays a combination of thermal and visual images. When looking at an object close up or far away, you may need to adjust the distance setting in the camera to align the thermal and visual images.

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To align the thermal and visual images, do the following:

- Tap the screen. This displays a box with a distance in the upper right corner.
   Tap the distance box. This displays a slider.
- 3. Use the slider to adjust the distance.

#### 7.5 **Color palettes**

You can change the color palette that the camera uses to display different temperatures. Changing the palette can make it easier to analyze an image.

To change the color palette, do the following:

- 1. Tap the menu button
- 2. Tap Color 灯 .
- 3. Tap the palette you want to use.

### Measuring temperatures

You can measure a temperature using a spotmeter or a box. The measured temperatures are displayed in the result table on the screen.

- With a spotmeter, the camera measures the temperature at the position of the spotmeter.
- With a box, the camera detects the hottest/coldest spot within the box area and measures its temperature.



**Note** For accurate temperature measurements, you may need to change the measurement parameters. See section 8.4 *Changing the measurement parameters*, page 16.

### 8.1 Adding/removing measurement tools

- 1. Tap the menu button
- 2. Tap Measurement .
- 3. Do one or more of the following:
  - Tap  $\stackrel{-}{\hookrightarrow}$  to add/remove a spotmeter.
  - Tap 🔄 to add/remove a hot spot box.
  - Tap to add/remove a cold spot box.

### 8.2 Moving the spotmeter

- 1. Tap the spotmeter. The tool is now displayed with a handle.
- 2. Tap and hold the spotmeter and drag it to a new position..

### 8.3 Moving and resizing the box

- 1. Tap one of the corners of the box. The tool is now displayed with handles.
- 2. To move the box, tap and hold the center handle and drag the box to a new position.
- To resize the box, tap and hold one of the corner handles and drag it to a new position.

### 8.4 Changing the measurement parameters

For accurate temperature measurements, it is important to use appropriate measurement parameters:

- Emissivity: The emissivity determines how much of the radiation originates from the object as opposed to being reflected by it.
- Reflected temperature: This parameter is used to compensate for the radiation from the surroundings reflected by the object into the camera.
- Relative humidity: The relative humidity of the air between the camera and the object
  of interest.
- Atmospheric temperature: The temperature of the air between the camera and the object of interest.
- · Distance: The distance between the camera and the object of interest.

Note During normal operation there is typically no need to change the default measurement parameters, see section 8.4.2 *Recommended values*, page 16.

#### 8.4.1 Setting measurement parameters

Emissivity is the most important measurement parameter to set correctly. If the Emissivity is set to a low value, the Reflected temperature also becomes important. The parameters Relative humidity, Atmospheric temperature, and Distance are relevant for longer distances.

To set the measurement parameters, do the following:

- 1. Tap the Settings button 🧐.
- 2. Tap Measurement parameters.
- 3. Tap the measurement parameter you want to change.
- 4. Select the appropriate parameter setting.

#### 8.4.2 Recommended values

If you are unsure about the measurement parameter values, the following are recommended:

Emissivity	0.95
Reflected temperature	20°C (69°F)
Relative humidity	50%
Atmospheric temperature	20°C (69°F)
Distance	1 m (3.3 ft.)

### Saving and working with images

### 9.1 Saving an image

To save an image, push the Save button at the top of the camera.

When you save an image, the camera stores the image file in the camera memory. You can also set up the camera to upload images for storage online, see section 10 Uploading images, page 19.

### 9.2 About image files

The saved image file includes all thermal and visual information. This means that you can open an image file, in the camera or in a FLIR Thermography software, and, for example, change the color palette, apply another image mode, and add measurement tools.

**Note** When the *Digital camera* image mode is selected, a high-resolution digital image is stored when an image is saved. However, no thermal information is stored.

#### 9.2.1 File-naming convention

The naming convention for image files is FLIRxxxx.jpg, where xxxx is a unique counter.

To reset the numbering of the image filenames, tap  $\stackrel{\{Q\}}{\bigcirc}$  (Settings) > Device settings > Reset options > Reset image counter... > Reset.

Note To prevent image files being overwritten, the new counter value will be based on the highest existing filename number in the camera memory. To ensure that the counter is reset to 0001, delete all images from the camera memory before resetting the counter.

### 9.3 Adding a note

To make reporting and post-processing more efficient, you can add notes with additional information, e.g., conditions and information about where an image is taken. The notes are added to the image file and can be viewed and edited in the camera or in a FLIR Thermography software.

You can set up the camera to display the note tool when an image has been saved. Se-

lect  $\{Q\}$  (Settings) > Save options & storage > Add note after saving = On.

You can also add notes to saved images in the image gallery, by doing the following:

- 1. Tap the Gallery button **•**.
- 2. Tap a folder and then tap an image.
- ....
- 3. Tap \*\*\* and then tap Note.
- 4. A soft keyboard is displayed, where you can enter text.
- 5. When completed, tap Done on the soft keyboard.
- To get the note stored online, make a manual upload of the image. See section 10.4 Manual upload.

### 9.4 Editing a saved image

- 1. Tap the Gallery button
- 2. Tap a folder and then tap an image.
- 3. Tap \*\*\* and then tap Edit. This opens the image in edit mode.

### Saving and working with images

- 4. Manual adjustment mode is now active. For adjustment instructions, see section 7.2.3 *Manually adjusting the temperature scale*, page 12.
- 5. Tap the menu button
  - To change the image mode, tap Image mode  $\textcircled{\hfill \label{eq:change}}$  .
  - To add a measurement tool, tap *Measurement*  $\dot{\Phi}$ .
  - To change the color palette, tap Color  $\P$  .
- To exit edit mode, tap .
   To get the edited image stored online, make a manual upload of the image. See section 10.4 Manual upload.

### **Uploading images**

You can set up the camera to upload images for storage online.

To enable upload of images, you need to connect the camera to a Wi-Fi network and pair the camera with a FLIR Ignite account.

If automatic upload is enabled, new images will automatically be uploaded to your FLIR Ignite account when the camera is connected to a Wi-Fi network. You can also upload images manually.

### 10.1 Connecting to Wi-Fi

- 1. Tap the Settings button 😳.
- 2. Tap Connections > Wi-Fi.
- 3. Make sure Wi-Fi is enabled by toggling the Wi-Fi switch.
- When Wi-Fi is enabled, a list of the available networks is displayed.
- 4. In the list, tap one of the networks.

Note Password-protected networks are indicated with a padlock icon, and for these you will need to enter a password the first time you connect to the network. After that the camera will connect automatically to the network. To disable the automatic connection, select the currently connected network and then select *Forget network*.

### 10.2 Pairing with FLIR Ignite

You can pair the camera as part of the initial setup of the camera. You can also pair the camera at any time via the *Settings* menu.

To pair the camera via the Settings menu, do the following:

- 1. Make sure the camera is connected to a Wi-Fi network.
- 2. Tap the Settings button 😳.
- 3. Tap Accounts.
- 4. Tap Pair.
- 5. Use a computer or other device with internet access and follow the instructions on the camera screen.

### 10.3 Automatic upload

You can set up the camera to automatically upload images to your FLIR Ignite account when the camera is connected to the internet.

To enable automatic upload of images, do the following:

- 1. Tap the Settings button 😳.
- 2. Tap Save options & storage > Auto upload.
- 3. Enable/disable automatic upload by toggling the Auto upload switch.

### 10.4 Manual upload

You can manually upload images to your FLIR Ignite account when the camera is connected to the internet.

### 10.4.1 Uploading an image

- 1. Make sure the camera is connected to a Wi-Fi network.
- 2. Tap the Gallery button .
- 3. Tap a folder and then tap an image.
- 4. Tap \*\*\* and then tap Upload.

#### 10.4.2 Uploading multiple images

- 1. Make sure the camera is connected to a Wi-Fi network.
- 2. Tap the Gallery button **•**.
- 3. Tap a folder.
- 4. Tap  $\stackrel{{\ensuremath{\boxtimes}}}{\longrightarrow}$  and then tap the images you want to upload.
- 5. Tap 4.

#### 10.4.3 Uploading a folder

- 1. Make sure the camera is connected to a Wi-Fi network.
- 2. Tap the Gallery button
- 3. Tap a folder.
- 4. Tap \*\*\* and then tap Upload.

# 10.5 FLIR Ignite

In FLIR Ignite, you can view, organize, search for, download, and share your uploaded images.

To access your FLIR Ignite account, go to https://ignite.flir.com.

#### 10.5.1 View images

In FLIR Ignite, you can view all images uploaded from your camera. You can see measurement functions in the image, read notes, zoom in to see more details, and switch between thermal and visual images.

#### 10.5.2 Organize in folders

Folders that you create in your camera will also be created in FLIR Ignite. Images saved in the folders on your camera will be uploaded to the corresponding folder in your FLIR Ignite Library.

To create a suitable structure for your thermal images, you can create additional folders in FLIR Ignite and move the folders created in your camera into those.

#### 10.5.3 Search

You can search among all your files and images uploaded to FLIR Ignite. It is possible to search on file names, folder names, and any notes added to the images.

#### 10.5.4 Download images

You can select one or more images for download to your computer, for example to analyze and create reports in a FLIR Thermography software. Folders and selections of multiple files are downloaded as .zip files.

#### 10.5.5 Share results

You can share results with colleagues and clients by generating a shared link. You can share individual images and entire folders. Shared links can be password protected and you can set an expiry date.

#T810539; r. AD/68933/69002; en-US

# Working with the image gallery

When you save an image, the camera stores the image file in the image gallery of the camera. You can open an image in the image gallery and, for example, change the color palette, apply another image mode, and add measurement tools.

The image gallery can include one or several folders. New images will be saved to the active folder. You can create new folders, rename a folder, change the active folder, move files between the folders, and delete folders.

# 11.1 Opening a saved image

- 1. Tap the Gallery button . This displays the Gallery with one or more folders.
- 2. Tap a folder.
- Tap the image you want to view. This displays thumbnails of the thermal and visual images and information about the image.
- 4. To view an image in full screen, tap └ .

To return to the thumbnail view, tap ----.

- To do changes to the image, tap \*\*\*. This displays a menu where you can do one or more of the following:
  - Upload the image. For more information, see section 10.4 *Manual upload*, page 19.
  - Edit the image. For more information, see section 9.4 *Editing a saved image*, page 17.
  - Move the image to another folder in the image gallery.
  - Add a note. For more information, see section 9.3 Adding a note, page 17.
  - Delete the image.

# 11.2 Creating a new folder

- 1. Tap the Gallery button
- 2. Tap +.
- 3. A soft keyboard is displayed, where you can enter the name of the new folder.
- 4. When completed, tap Done on the soft keyboard.
- 5. The new folder automatically becomes the active folder and appears at the top of the *Gallery*.

# 11.3 Renaming a folder

You can change the name of the folders in the image gallery. The active folder cannot be renamed.

To rename a folder, do the following:

- 1. Tap the Gallery button **•**.
- 2. Tap the folder to rename.
- 3. Tap \*\*\* and then tap Rename.
- 4. A soft keyboard is displayed, where you can enter the new name of the folder.
- 5. When completed, tap Done on the soft keyboard.

# 11.4 Changing the active folder

New images are saved to the active folder.

To change the active folder, do the following:

- 1. Tap the Gallery button .
- Tap the folder that new images should be saved to.
- 3. Tap \*\*\* and then tap Save new images to this folder.
- 4. The new active folder is now at the top of the Gallery.

# 11.5 Moving files between folders

- 1. Tap the Gallery button
- 2. Tap a folder
- 3. Tap I and then tap the images you want to move.
- 4. Tap  $\leftarrow$  and then tap the destination folder.

# 11.6 Deleting a folder

You can delete a folder in the image gallery. The active folder cannot be deleted.

To delete a folder, do the following:

- 1. Tap the Gallery button **•**.
- 2. Tap a folder.
- 3. Tap \*\*\* and then tap *Delete*. This displays a dialog box.
- 4. To delete the folder and the images, tap Delete.

# 11.7 Deleting an image

- 1. Tap the Gallery button **•**.
- 2. Tap a folder and then tap an image.
- 3. Tap \*\*\* and then tap Delete. This displays a dialog box.
- 4. To delete the image, tap Delete

# 11.8 Deleting multiple images

- 1. Tap the Gallery button .
- 2. Tap a folder
- 3. Tap  $\stackrel{{\ensuremath{\boxtimes}}}{\longrightarrow}$  and then tap the images you want to delete.
- 4. Tap  $\Box$  . This displays a dialog box.
- 5. To delete the selected images, tap Delete.

# 11.9 Deleting all images

You can delete all images from the camera memory.

To delete all images, do the following:

- Tap the Settings button <sup>(1)</sup>.
   Tap Save options & storage and then tap Delete all saved files.... This displays a dialog box.
- 3. To permanently delete all images, tap Delete.

# Handling the camera

# 12.1 Charging the battery

You can charge the battery by using a standard USB power adapter or by connecting the camera to a computer.

It is good practice to disconnect the camera from power when the battery is fully charged.

The battery status is displayed on the swipe-down menu, see section 6.3.4 *Swipe-down menu*, page 10.

# 12.2 Turning on and turning off the camera

- When the camera is off, push and hold the On/off button () for more than 1 second to turn on the camera.
- When the camera is on and in live mode, push and hold the On/off button 
   of or about 1 second until the screen goes black. This puts the camera in standby mode. From standby, the camera automatically turns off after 48 hours.
- When the camera is on, push and hold the On/off button I for more than 12 seconds to turn off the camera.

You can also set up the camera to enter standby mode after a period of inactivity. Select

(Settings) > Device settings > Auto power off.

#### 12.3 Using the camera lamp

You control the camera lamp on the swipe-down menu, see section 6.3.4 *Swipe-down menu*, page 10.

# 12.4 Moving files via USB cable

When you save an image, the file is stored in the internal camera memory. You can move the image files by connecting the camera to a computer using the USB cable. The file transfer is done using the Media Transfer Protocol (MTP).

Note To be able to access the camera file system from a Mac computer, you must first install an Android File Transfer application. For more information, go to https://www.android.com/filetransfer.

To move files to a computer via USB cable, do the following:

- 1. Turn on the camera.
- 2. Connect the camera to the computer using the USB cable.
- 3. Move the files to the computer using a drag-and-drop operation.

Note Moving a file using a drag-and-drop operation does not delete the file in the camera.

#### 12.4.1 Related topics

You can also set up the camera to upload images for storage online, see section 10 Uploading images, page 19.

# 12.5 Bluetooth connection

If supported by your mobile phone, you can share the phone's internet connection with the camera via Bluetooth. Before you can use the internet sharing connection, you need to pair the devices.

#T810539; r. AD/68933/69002; en-US

- 1. Tap the Settings button
- 2. Tap Connections > Bluetooth.
- 3. Make sure Bluetooth is enabled by toggling the Bluetooth switch.

**Note** On the mobile phone, you must also make sure that Bluetooth is enabled, that the phone is in discovery mode, and that Bluetooth tethering is enabled.

- 4. Tap Available devices.
- 5. Wait until a list of available Bluetooth devices is displayed.
- 6. In the list, tap your mobile phone to begin the pairing procedure.

#### 12.6 Non-uniformity correction

When the thermal camera displays Calibrating... it is performing what in thermography is called a "non-uniformity correction" (NUC). An NUC is an image correction carried out by the camera software to compensate for different sensitivities of detector elements and other optical and geometrical disturbances<sup>1</sup>

The camera performs the NUC automatically, for example at start-up and when the environment temperature changes.

To perform an NUC manually, tap and hold the 🕨 button.

#### 12.7 Cleaning the camera

#### 12.7.1 Camera housing, cables, and other items

#### 12.7.1.1 Liquids

- Use one of these liquids:
- Warm water
- · A weak detergent solution

#### 12.7.1.2 Equipment

A soft cloth

#### 12.7.1.3 Procedure

Follow this procedure:

- 1. Soak the cloth in the liquid.
- 2. Twist the cloth to remove excess liquid.
- 3. Clean the part with the cloth.

#### 

Do not apply solvents or similar liquids to the camera, the cables, or other items. This can cause damage.

#### 12.7.2 Infrared lens

#### 12.7.2.1 Liquids

Use one of these liquids:

- A commercial lens cleaning liquid with more than 30% isopropyl alcohol.
- 96% ethyl alcohol (C<sub>2</sub>H<sub>5</sub>OH).

Definition from the European standard EN 16714-3:2016, Non-destructive Testing—Thermographic Testing— Part 3: Terms and Definitions.

#### Handling the camera

#### 12.7.2.2 Equipment

Cotton wool

#### 

If you use a lens cleaning cloth it must be dry. Do not use a lens cleaning cloth with the liquids that are given in section 12.7.2.1 above. These liquids can cause material on the lens cleaning cloth to become lose. This material can have an unwanted effect on the surface of the lens.

#### 12.7.2.3 Procedure

Follow this procedure:

- 1. Soak the cotton wool in the liquid.
- 2. Twist the cotton wool to remove excess liquid.
- 3. Clean the lens one time only and discard the cotton wool.

#### 

Make sure that you read all applicable MSDS (Material Safety Data Sheets) and warning labels on containers before you use a liquid: the liquids can be dangerous.

#### CAUTION

Be careful when you clean the infrared lens. The lens has a delicate anti-reflective coating.
Do not clean the infrared lens too vigorously. This can damage the anti-reflective coating.

# **Camera settings**

The Settings menu includes the following:

- Measurement parameters.
- Connections.
- Camera temperature range.
- Save options & storage.
- Accounts.
- Device settings.

To display the Settings menu, tap the Settings button

#### 13.1 Measurement parameters

For accurate temperature measurements, it is important to use appropriate measurement parameters. The *Measurement parameters* submenu is used to set these parameters. For more information, see section 8.4 *Changing the measurement parameters*, page 16.

#### 13.2 Connections

- Wi-Fi: This setting defines Wi-Fi networks. For more information, see section 10.1 Connecting to Wi-Fi, page 19.
- Bluetooth: This setting defines Bluetooth connectivity. For more information, see section 12.5 Bluetooth connection, page 24.

#### 13.3 Camera temperature range

For accurate temperature measurements, you must change the *Camera temperature* range setting to suit the expected temperature of the object you are inspecting.

The unit (°C or °F) depends on the temperature unit setting, see section 13.6 Device settings, page 28.

#### 13.4 Save options & storage

- Auto upload: When this setting is on, new images will automatically be uploaded to your FLIR Ignite account when the camera is connected to the internet.
- Photo as separate JPEG: For the Thermal MSX, Thermal, and Picture in picture image modes, a visual image is always saved in the same JPEG file as the thermal image. Enabling this setting saves an extra low-resolution visual image as a separate JPEG file.
- Add note after saving: When this setting is on, the note tool will be displayed when an image has been saved.
- Digital camera: This setting is used to turn on/off the digital camera. Turning off the digital camera can for example be required in restricted areas and in confidential (e.g. doctor/patient) situations. When the digital camera is off, the images modes *Thermal* MSX and *Picture in picture* are disabled.
- Delete all saved files...: This displays a dialog box where you can choose to permanently delete all the saved files from the camera memory or to cancel the delete action.

### 13.5 Accounts

The Accounts dialog box is used to pair the camera with your FLIR Ignite account. For more information, see section 10 Uploading images, page 19.

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When the camera is paired, the Accounts dialog box displays the following information:

- · The FLIR Ignite account that the camera is paired with.
- The link to FLIR Ignite: https://ignite.flir.com
- The current storage capacity in your FLIR Ignite account.

# 13.6 Device settings

- Language, time & units: This submenu includes settings for a number of regional parameters:
  - Language.
  - Date & time.
  - Distance unit.
  - Temperature unit.
- Screen brightness: The screen brightness slider is used to control the brightness of the screen.

**Note** You can also control the screen brightness on the swipe-down menu. For more information, see section 6.3.4 *Swipe-down menu*, page 10.

- Auto power off: This setting defines the period of inactivity before the camera enters standby mode.
- Screen rotation: This setting defines if the orientation of the overlay graphics will change according to how you hold the camera.
- Show temperature scale: This setting is used to show/hide the temperature scale.
- Update: This dialog box is used to check for updates and install new firmware versions. The camera must be connected to the internet. For more information, see 14 Updating the camera, page 29.
- Product improvement program: This setting is used to help FLIR improve your camera. The camera can send anonymous information to FLIR about how it is used and, when something does not work as intended, notify FLIR about it.
- · Reset options: This submenu includes the following settings:
  - Reset default camera mode...: This setting will affect the image mode, color palette, measurement tools, and measurement parameters. Saved images will not be affected.
  - Reset device settings to factory default...: This setting will affect all camera settings, including regional settings, WI-Fi networks, and pairing with your FLIR Ignite account. Saved images will not be affected. The camera will be restarted and the start-up wizard will appear again.
  - Reset image counter...: This setting will reset the numbering of the image filenames. To prevent image files being overwritten, the new counter value will be based on the highest existing filename number in the camera memory.

**Note** When a reset option is selected, a dialog box is displayed with more information. You can choose to execute the reset action or to cancel.

 Camera information: This submenu displays information about the camera, regulatory information, and open-source license information. No changes can be made.

# Updating the camera

To take advantage of our latest camera firmware, it is important that you keep your camera updated.

When the camera is connected to the internet, you can check for updates and install new firmware versions online. You can also update the camera by connecting the camera to a computer using the USB cable.

## 14.1 Updating the camera online

- 1. Make sure the camera battery is fully charged.
- 2. Make sure the camera has Wi-Fi enabled and is connected to the internet.
- 3. To check for new firmware versions, tap O (Settings) > Device settings > Update.
- 4. To install a new firmware version, do the following:
  - 4.1. Tap Download to download the installation package.
  - 4.2. Tap Install to start the installation.
  - 4.3. When the installation is completed, the camera will automatically restart.

# 14.2 Updating the camera via USB cable

Note To be able to access the camera file system from a Mac computer, you must first install an Android File Transfer application. For more information, go to https://www.android.com/filetransfer.

- 1. Make sure the camera battery is fully charged.
- 2. Download the FLIR update .zip file and save it in a suitable location on your computer.
- 3. Unzip the .zip file. You should find an update package file ending in .fuf or .run in the zip archive.
- 4. Turn on the camera.
- 5. Connect the camera to the computer using the USB cable.
- 6. Open the folder Flir Camera > Images > doupdate.
- Copy the update package file (.fuf or .run) from your computer to the folder *doupdate* in the camera.
- 8. The update process starts automatically.

The camera is unavailable during the update. When the update is completed, the camera starts again.

Note Do not remove the USB cable until the update is completed.

# **Mechanical drawings**

[See next page]



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# **CE Declaration of conformity**

[See next page]



May 5, 2020 Täby, Sweden

AQ320383

#### CE Declaration of Conformity - EU Declaration of Conformity

Product: FLIR C5-series

Name and address of the manufacturer: FLIR Systems AB PO Box 7376 SE-187 15 Täby, Sweden

This declaration of conformity is issued under the sole responsibility of the manufacturer. The object of the declaration: FLIR C5 -series (Product Model Name FLIR-C8940). The object of the declaration described above is in conformity with the relevant Union harmonisation legislation:

Directives:				
Directive	2014/53/EU	Radio E	quipment Directive (RED)	
Directive:	2011/65/EU	RoHS and 2015/830/EU (Phtalates)		
Standards:				
EMC:	EN 55032:2015 v.2016-	02	Electromagnetic compatibility multimedia eq	
	EN 61000-4-8 v.2010-11	L	Power frequency magnetic field immunity test	
	ETSI EN 301489-1 v2.2.3	3	ERM – EMC for radio equipment	
	ETSI EN 301489-17 v3.2	.0	ERM – EMC Wideband data	
Radio:	ETSI EN 300 328 v2.2.2		Harmonized EN covering essential	
			requirements of the R&TTE Directive	
	ETSI EN 301 893 v.2.1.1		5GHz WLAN	
SAR:	EN 50566:2017		Compliance with 30MHz to 6GHz	
	EN 62209-2		Handheld and body-mounted devices	
	IEEE 1528-2013		Wireless communication devices	
Safety:	IEC/EN 62368-1:2014 (2 <sup>nd</sup> Ed) and Cor 1:2015 EN 62368-1:2014/AC:2015		nd Cor 1:2015 EN 62368-1:2014/AC:2015	
	/A11:2017		Audio/video, information tech equipment	
Restricted substances:	EN 50581:2012		Technical documentation	

FLIR Systems AB Quality Assurance

den Balton

Lea Dabiri Quality Manager

# About FLIR Systems

FLIR Systems was established in 1978 to pioneer the development of high-performance infrared imaging systems, and is the world leader in the design, manufacture, and marketing of thermal imaging systems for a wide variety of commercial, industrial, and government applications. Today, FLIR Systems embraces five major companies with outstanding achievements in infrared technology since 1958—the Swedish AGEMA Infrared Systems (formerly AGA Infrared Systems), the three United States companies Indigo Systems, FSI, and Inframetrics, and the French company Cedip.

Since 2007, FLIR Systems has acquired several companies with world-leading expertise:

- NEOS (2019)
- · Endeavor Robotics (2019)
- · Aeryon Labs (2019)
- Seapilot (2018)
- Acyclica (2018)
- Prox Dynamics (2016)
- Point Grey Research (2016)
- DVTEL (2015)
- DigitalOptics micro-optics business (2013)
- MARSS (2013)
- Traficon (2012)
- Aerius Photonics (2011)
- TackTick Marine Digital Instruments (2011)
- ICx Technologies (2010)
- Raymarine (2010)
- Directed Perception (2009)
- OmniTech Partners (2009)
- Salvador Imaging (2009)
   Ifara Tecnologías (2008)
- Ifara Tecnologías (2008)
- Extech Instruments (2007)



Figure 17.1 Patent documents from the early 1960s

FLIR Systems has three manufacturing plants in the United States (Portland, OR, Boston, MA, Santa Barbara, CA) and one in Sweden (Stockholm). Since 2007 there is also a manufacturing plant in Tallinn, Estonia. Direct sales offices in Belgium, Brazil, China,

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#### About FLIR Systems

France, Germany, Great Britain, Hong Kong, Italy, Japan, Korea, Sweden, and the USA —together with a worldwide network of agents and distributors—support our international customer base.

FLIR Systems is at the forefront of innovation in the infrared camera industry. We anticipate market demand by constantly improving our existing cameras and developing new ones. The company has set milestones in product design and development such as the introduction of the first battery-operated portable camera for industrial inspections, and the first uncooled infrared camera, to mention just two innovations.





1969: Thermovision Model 661. The camera weighed approximately 25 kg (56 lb), the oscilloscope 20 kg (44 lb), and the tripod 15 kg (33 lb). The operator also needed a 220 VAC generator set, and a 10 L (2.6 US gallon) jar with liquid nitrogen. To the left of the oscilloscope the Polaroid attachment (6 kg (13 lb)), can be seen.

2015: FLIR One, an accessory to iPhone and Android mobile phones. Weight: 36 g (1.3 oz.).

FLIR Systems manufactures all vital mechanical and electronic components of the camera systems itself. From detector design and manufacturing, to lenses and system electronics, to final testing and calibration, all production steps are carried out and supervised by our own engineers. The in-depth expertise of these infrared specialists ensures the accuracy and reliability of all vital components that are assembled into your infrared camera.

# 17.1 More than just an infrared camera

At FLIR Systems we recognize that our job is to go beyond just producing the best infrared camera systems. We are committed to enabling all users of our infrared camera systems to work more productively by providing them with the most powerful camerasoftware combination. Especially tailored software for predictive maintenance, R & D, and process monitoring is developed in-house. Most software is available in a wide variety of languages.

We support all our infrared cameras with a wide variety of accessories to adapt your equipment to the most demanding infrared applications.

# 17.2 Sharing our knowledge

Although our cameras are designed to be very user-friendly, there is a lot more to thermography than just knowing how to handle a camera. Therefore, FLIR Systems has founded the Infrared Training Center (ITC), a separate business unit, that provides certified training courses. Attending one of the ITC courses will give you a truly hands-on learning experience.

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The staff of the ITC are also there to provide you with any application support you may need in putting infrared theory into practice.

# 17.3 Supporting our customers

FLIR Systems operates a worldwide service network to keep your camera running at all times. If you discover a problem with your camera, local service centers have all the equipment and expertise to solve it within the shortest possible time. Therefore, there is no need to send your camera to the other side of the world or to talk to someone who does not speak your language.

Website http://www.flir.com

Customer support http://support.flir.com

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# **Appendix C - Insulation Options**



INSULATION	R-VALUE	WHAT IT LOOKS LIKE	COMMON APPLICATION
Fibreglass Batts	2X4 = R-11 2X6 = R-19* 2X10 = R-30 2.9-3.8/inch	Pink or yellow blankets. Can be unfaced, paper or plastic faced, or encapsulated for ease of installation.	Install in open wall, floor or ceiling cavities. Must be carefully installed avoiding gaps, voids or compression. Considered to have little or no negative impact on indoor environmental quality.
Cotton-fibre Batts	2X4 = R-13 2X6 = R-19-21 2x10 = R-30 3.0-3.7/inch	Light blue to dark blue fluffy cotton, made from blue jean manufacturing cut-offs.	Non-toxic. Non-irritating during installation. Easy to install and does not off gas. Can be used in place of other batt insulation products. A newer product not typically found in older homes.
Rockwool Batts	2X4 = R-13 2X6 = R-22 2x10 = R-33 2.8-3.7/inch	Dark gray or black batts with paper facing.	Gaining popularity in residential application, but most commonly used for industrial and commercial construction. Extraction and processing of mineral wool (a by- product of steel processing) may still be an environmental concern.
Fibreglass Loose Fill	2.2-2.7/inch (varies based on density)	Pink, yellow or white fluffy material that comes compressed in bags.	Good choice for blowing into attics. Important that contractor set blower correctly to establish correct thickness and density. Most now contains some recycled content, and some manufacturers have replaced the traditional-but-toxic phenol formaldehyde binder with other more benign alternatives – or no binder is used at all. Loose fill is associated with black mould and health hazards similar to those associated with asbestos such as lung disease.
Cellulose Loose Fill	3.0-3.7/inchl	Gray finely chopped up newspaper with fire retardant added - usually borate salts which inhibits mould and fungus.	Excellent choice for blowing into attic or closed wall cavities. Be sure to seal any air gaps first so dust does not blow into home. When spray applied this is quite dense and provides a good barrier against air infiltration from the outside. Due to the spray in nature of the installation, performance is less likely to suffer from installation errors.

INSULATION	R-VALUE	WHAT IT LOOKS LIKE	COMMON APPLICATION
Extruded Polystyrene (ExPS or XPS) Rigid Foam	5.0/inch	Blue or pink rigid board.	Waterproof. Excellent for exterior sealing or insulating basement walls. Can be applied directly to concrete. Must be protected from sunlight.
Expanded Polystyrene (EPS) Rigid foam	3.6-4.4/inch	Usually white - also known as 'bead board'	Low cost but not as sturdy or moisture resistant as ExPS. Must be protected from sunlight. Of the two main types of rigid polystyrene (XPS or EPS) EPS is more environmentally benign.
Rigid Polyisocyanurate	6.0-6.5/inch	Foam boards with foil facing. 4x8, 4x9 and 4x10 foot sheets.	Thermax or R-max are common trade names. Best R-value overall. Best choice for maximum insulation in a thin area such as rafters in a cathedral ceiling.
Low Density Spray Foam	3.8/inch	Yellowish, white foam that goes on wet and dries quickly. Expands as it is applied.	Excellent for sealing irregular gaps. Expands to fill the cavity, including the smallest cracks. Products range from those with a high content of toxic substances, to those that are water-blown and do not offgas, such as Includes "Icynene" and soy based foams.
High Density Spray Foam	6.5/inch	Yellowish, white foam that goes on wet and dries quickly. Expands as it is applied.	Excellent for sealing irregular gaps. Includes "Corbond" and urethane.

For more on selecting insulation materials, see the Canadian Passive House Institute at www.passivehouse.ca

# Appendix E: Energy Monitor Manual







The best way to save energy is to stop wasting i t

# **Table Of Content**

Contents	
Introduction	3
Installation / Setup	4
Electricity Rate	5
Carbon Emission Value	6
Modes	7
Energy Mode	8
Cost Mode	9
CO <sup>2</sup> Mode	10
Energy Count Mode	11
Countdown Timer Mode	12
Outlet Manual ON/OFF Switch	13
Product Warranty	14
Copyright and Disclaimer	15

The Energy Monitor helps you understand how much power your appliances u se. Once y ou understand this you can take steps to reduce your energy consumption – after all, it's difficult to manage what you can't measure!

The Energy Monitor also includes surge protection to ensure your appliance is protected against surges and voltage spikes whilst being measured



#### Installation / Energy Monitor Configuration Setup

#### Install Energy Monitor

The Energy Monitor tracks power consumption of individual home appliances.

1. Plug in the Energy Monitor to a powered AC outlet 2. Plug in an appliance into the Energy Monitor

#### Perform Energy Monitor Configuration Setup

The Energy Monitor is preset with a default rate (\$0.12/ KWH) and carbon emission value (0.49Kg/KWH). Both of these values can be changed.



R



#### Carbon Emission Value

emission rate setup page.

Carbon dioxide is emitted when producing electricity by burning coal & fossil fuel. This is referred to as a CO<sub>2</sub> footprint or carbon emission. The average carbon emission rate is 0.49Kg of carbon emission for every 1 KWH of electricity produced. This value can be changed depending upon your local electric utility and power source. Please contact your local utility for their carbon emission rate.



- 1. The default carbon emission rate is 0.49Kg per KWH. Press **v** (COST) or **a** (ENERGY) to adjust the electricity rate.
- 2. Press 📣 (CO<sub>2</sub> button) to confirm and exit the setup page.

#### Modes

There are 5 different modes:

- 1. Energy Mode
- 2. Cost Mode
- 3. CO2 Mode
- 4. Energy Count Mode
- 5. Countdown Timer Mode

#### Energy Mode

In Energy Mode, press ENERGY button to switch to different display of energy information. The Energy Monitor can display power consumption of an appliance in real time / day / month / year estimates.

Note: The Energy Monitor reads your appliance's energy usage continuously while your appliance is on and off, and calculates the estimated energy information based on real time and historical measurements. We recommend you leave the Energy Monitor measuring an appliance for several use cycles, to obtain a more accurate estimate.

### **Energy Mode**



#### Cost Mode

In Cost Mode, press COST to switch between different energy cost displays. The Energy Monitor can display real time / day / month / year estimates.



#### CO<sub>2</sub> Mode

In  $CO_2$  mode, press  $CO_2$  to switch to display of carbon emission data. The Energy Monitor can display carbon emission of the plug-in appliance in real time / daily / monthly / yearly estimates modes.



#### **Energy Count Mode**

Energy Count offers an easy way to find out how much total energy consumption or energy cost each time you use an appliance.



#### Countdown Timer Mode

Countdown Timer Mode supports a simple countdown timer function that allows you to set when the outlet is switched on or off within a 24 hour period.



## **Outlet Manual On/Off Switch**

The outlet can be switched on or off manually.



1. Press (TIMER) and (ENERGY) to switch outlet off or on.

Note: the countdown timer will be disabled when the outlet is manually switched.

# **Product Warranty**

TrickleStar warrants to the original purchaser of the TrickleStar Product for 1 year, that the Product shall be free of defects in design, assembly, material, or workmanship, and will repair or replace, at its option, any defective product free of charge. Email a warranty claim to us at warranty@tricklestar.com

Be prepared to provide the following information:

- Product part number of the product
- The date of the occurrence.
- · Where and when you purchased the product.
- · A copy of original receipt.

A Customer Service Representative will then instruct you on how to forward your product and receipt and how to proceed with your claim.

# **Copyright and Disclaimer**

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Disclaimer: TrickleStar reserves the right to change specifications or designs described in this manual without notice and without obligation. Any typographical, clerical or other error or omission in this document or other documents or information issued by TrickleStar shall be subject to correction without any liability on the part of TrickleStar without notice.





# Appendix F: Temperature Reader Manual



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SPECIFICATIONS     4       SAFET GUIDELINES     5-6       OUICK START NUSTIONS     7-12       MAINTENANCE     13       WARRANTY     14-15	Image: Section 1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.	Image: Solution of the second seco
If any parts are missing or damaged, or if you have any questions, please call 1-800-689-9928.	The function of the sector of	Anotoence of the first interview of the f
	Description	The formation of the addition of the addition of the addition, read current surface the propertices of high head addition of the addition, read current surface to the propertices of high head addition of the addition of th




## HOW IT WORKS

Infrared thermometer measures the surface temperature of an object. The unit's optics sense emitted, reflected and transmitted energy, which is collected and focused onto a detector.

The unit's electronics measure the transmitted energy, which is displayed on the unit. For increased ease and accuracy, the laser pointer makes aiming even more precise.

TEMPERATURE READER 057-4554-4 Mastercraft

### 0

- MODE button: Press MODE button for cycle options E-MAX-AVG-MIN-LAL-HAL mode B-AVG: Calculate the average of all measured data; A-MAX: Measure maximum current data; C-MIN: Measure minimum current data; 4
  - D-LAL: Low-temperature alarm. In LAL mode, press "9" "9" button to set alarm temperature. When the LCD displays "L" it means the measured result

E-HAL: High-temperature alarm. In HAL mode, press " $\theta^{n} = \theta^{n}$  button to set alarm temperature. When the LCD displays "H" it means the measured is less than the alarm temperature.

SNOITOUATENI TAATE NOIUD

- result exceeds the alarm temperature.
- (5) "0," button: In "Alarm temperature" and "Setting emissivity" mode use to adjust value down, or else, parse this button to select 'C, /F. (6) "2" button: Press for setting emissivity, and parses "0," "0," to adjust from 0.1-1.0. Press "e" button again to exit setting mode.
- (7) LCD ... " (8) Battlery door. When replacing batteries, please use the finger indents to pull open the battery door.

### Note:

are displayed in normal ambient temperature, it probably means the unit is broken. When "AL" is showing, ambient temperature is lower than 0°C (32°F). When "AH" is showing, ambient temperature is higher than 60°C (122°F). If the above codes

target, the closer the measuring distance. When accuracy is critical, make sure the target is all feature in the peak statismus measurements or the many measurement of t

.

Field of view: Make sure the target is larger than the unit's spot size. The smaller the

When taking measurement, point thermometer toward the object to be measured and hold the blue trigger. The object should be larger than the spot size calculated by the field of view diagram.

# Mastercraft

TEMPERATURE READER 057--4554-4

### ĉ

- Lens cleaning: Blow off lose particles using clean, compressed air. Gently brush .
  - remaining debris away with a moist cotton cloth. Case cleaning: Clean the case with a damp sponge/cloth and mild soap.

### Note:

- Do not use solvent to clean lens.
   Do not submerge the unit in water.

# DISPOSAL OF THIS ARTICLE

If you at some point intend to dispose of this article, please valuable materials, which can be recycled. Please do not keep in mind that many of its components consist of dispose of it in the garbage. Check with your local council for recycling facilities in your area. Dear Customer,











YTNAAAAW



0

(Figure 1)

G

Measured result

Emissivity G 0

onick 2.

E 0.95

(1) Press battery door clip, install battery correctly. Pull the trigger to see LCD display reading and battery toor. FC any stude after the builth is compression system will automatically adjust the beneature relating according to the ambert operating condition. And the register until the reading stabilizes. Then, release the trigger and the reading will pold for 10 seconds.



(1) Trigger: Press to turn on. Test result will display and hold automatically ("HOLD") for ten seconds. The reader will turn off automatically after not being used for 10 seconds. DIAGRAM DESCRIPTION

(2) Laser pointer button: Press to turn on laser pointer. Press again to turn if off. 3) Back ign/button: in "Amare impretance" and "Setting parsivity" mode, use this to adjust values up. In other modes, it turns on the back light. When the reader is on, press it to turn on the back light. Press it again to turn it off.

## TEMPERATURE READER 057-4554-4 Mastercraft

(Figure 3)

TEMPERATURE READER 057-4554-4

Mastercraft

(Figure 2)

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## 2

## (mproved) Applicable Emissivity for Various Material (For refe

Distance & spot size: As the distance from the object increases, the spot size of measuring area becomes larger.

•

F

D:S=8:1

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..... 8

Material	Emissivity	Material	Emissivity
Asphalt	0.90 to 0.98	Textile (black)	0.98
Beton	0.94	Human skin	0.98
Cement -	0.96	Soap bubble	0.75 to 0.80
Sand	0:00	Charcoal (powder)	0.96
Soil	0.92 to 0.96	Lacquer	0.80-0.95
Water	0.92 to 0.96	Lacquer (reluster)	0.97
Ice	0.96 to 0.98	Rubber (black)	0.94
Snow	0.83	Plastic	0.85-0.95
Glass	0.90 to 0.95	Timber	0.90
Ceramic	0.90 to 0.94	Paper	0.70-0.94
Marble	0.94	Chromic oxide	0.81
Gypsum	0.80 to 0.90	Copper oxide	0.78
Compo	0.89 to 0.91	Iron oxide	0.78 to 0.82
Brick	0.93 to 0.96	Stainless steel and aluminum	0.2-0.3



TEMPERATURE READER 057-4554-4

Mastercraft

4



TEMPERATURE READER 057-4554-4 Mastercraft

**Nastercraft** TEMPERATURE READER 057-4554-4

15

### **Appendix G: Radon Monitor Manual**





The menu options may differ from what is illustrated in this user guide.

### **KEY TO FIGURE**

- 1. Indicator for low battery level. The batteries need to be replaced when this is displayed
- 'LONG TERM AVERAGE'. Long term average measurement mode
- 3. Measured value
- 4. 'SHORT TERM AVERAGE'. Short term average measurement mode
- 5. Measurement period for short term average. Alternates between 1 and 7 days
- 6. Indicator for measurement. The unit is active when this is flashing.

- 7. Unit of measurement: pCi/
- 8. 'RESET'. Button for resetting. Used when a new measurement period starts. NOTE: Deletes all stored data from earlier measurement
- 9. 'MODE'. Button for information about the number of days measured since the previous resetting. Displayed on the screen, see section 5
- 10. Battery compartment for 3 x LR03, alkaline AAA batteries
- 11. Battery cover

### SAFETY

Contact the Town of Okotoks if the product requires service or repairs. The front or back cover must not be opened. Avoid subjecting the unit to shock, impact, pressure, vibrations, dust and moisture. Condensation can occur if the unit is moved from a location with high atmospheric humidity to a cold location. If condensation occurs, remove the batteries and leave the unit in a dry environment for 2 hours. The unit must not be exposed to direct sunlight for extended periods. The unit must be stored under dry conditions, if possible together with a desiccant such as silica gel.

Use only batteries of type LR3, alkaline AAA batteries. The batteris must not be exposed to fire or other extreme heat. The battery terminals must not be touched, and they must be kept free from dust, sand, liquids and other foreign objects.

#### CALIBRATION

We recommend that the unit is left on at all times. If the unit is turned off (by removing the batteries) for more than one year it should be recalibrated. The same applies if measurement takes place continuously for one year at values over 35pCi/L. In the event of continuous operation at lower radon values, recalibration will not be required for the first 10 years.

### **GETTING STARTED**

- Insert the supplied batteries. Measurement will start automatically after about 3 minutes. This is indicated by a flashing measurement indicator at the top right of the screen
- If the screen displays the error message 'Err' and a number: press the RESET button, remove the batteries and put them back in
- Position the unit in a living area (for example a bedroom or living room), and in a location that is representative of the air that is breathed in this room
- The unit should not be exposed to direct sunlight or electromagetic radiation; it should be postiioned lying flat at least 25 cm from the nearest wall, at least 50 cm above the floor, and at least 150 cm from the nearest door, window or ventilation device.
- To permit self-calibration, the unit should remain untouched for the first few minutes after start-up.

### HOW TO USE THE MONITOR

- The long term average (LONG TERM AVERAGE) is the average radon value over the last year (updated once every 24 hours.
- The short term average (SHORT TERM AVERAGE) alternates between showing the radon value over the last day (1 DAY – updated every hour) and over the last 7 days (7 DAYS – updated once every 24 hours)
- The long term average is used to identify any potential health risk. The short term average is
  used primarily to see the effect of measures to reduce the radon level for example by
  increasing the ventilation. The building can be diagnosed by taking measurements for one
  week in all living areas, such as living rooms and bedrooms. This should preferably be
  followed by long term measurement in the room which has the highest radon value. For
  long term measurement period and action level we recommend to follow the guidelines
  from the national radiation authority.
- The RESET button is used when the monitor is moved in order to take a new measurement. This deletes all stored radon data. Remember to note the previous measurement before using the RESET button.
- The MODE button is used to obtain information on how many days measurements have been taken since the monitor was started for the first tiem or since the RESET button was last depressed. This information is displayed on the lower half of the screen for 20 seconds, after which the screen reverts to the regular display.
- It is recommended that the monitor is activated continuously, and that the batteries are not removed. The batteries last for about 3 years, and they can be replaced without stored data being deleted.

#### DISPOSAL

The monitor and the batteries must not be disposed of as ordinary household waste. The materials used in the monitorcan be recycled. It is the user's environmental responsibility to ensure that electronic equipment and batteries are disposed of in accordance with national regulations. Users should contact the seller or their local authority for information about environmentally friendly waste disposal.

The Do-It-Yourself Home Energy Assessment Guide was originally created by the Seattle Department of Planning & Development's City Green Building Program and Seattle City Light. The Town of Okotoks acknowledges the City of Seattle for permission to revise these guides for use in Okotoks.

