EXERTHERM®
Power On. Peace Of Mind

WATCH OUR WEBINAR:

Webinar Q&As

CONTINUOUS THERMAL MONITORING WEBINAR

Measure Delta T:
The intelligent way to determine electrical faults

Webinar Q&As

Please explain EXERTHERM methodology to maintain safely the validity of type tested objects without disturbing them by installation of these sensors and wiring in MV system?

The Exertherm IR sensors are non-contact and therefore do not touch any existing connections or equipment, they must always be mounted outside of the minimum creepage and clearance distance. Therefore the validity of type test is maintained and does not require revalidation.

Is there any example, any application to fix the sensors on BOS or PV panels. Any Solar application example?

We haven't any examples of BOS or PV panel installations. These both would have switchgear and therefore would be the same method as any other LV or MV installation. The system is designed to protect connection points.

Is it possible to transmit the temperature data acquired by this sensor to the MES for analysis?

Yes, temperature data is available over industry standard protocol Modbus RS485 to further integrate into any client/host systems.

Which standard(s) are applicable for this application, e.g. how to place them, distance to measured object etc.

We recommend you follow the local/international regulations for minimum clearance and creepage distance for the voltage on which the switchgear is operating. Also, it should be in line with our IR sensor gain matrix.

Do the sensors need to be calibrated?

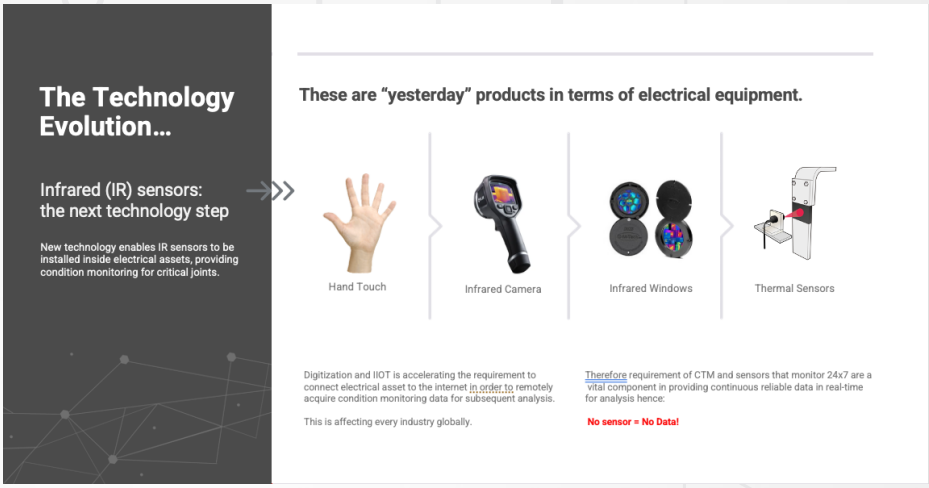
Once calibrated in the factory at manufacture, Exertherm sensors do not require further calibration for their entire life. These are lifetime calibrated. They are non-powered and therefore do not drift, hence do not require to be recalibrated.

What is the care strategy for these sensors?

The sensor must never be installed facing upwards as over time, dust can settle on the lens which affects the readings. As long as they are facing horizontal to downwards, they are good. The sensors are maintenance free.

How do you fix Delta-T limit values in prevention before a failure?

We recommend that you follow the NETA table to set the values for ΔT warning and critical alarms. This will enable you to be notified of alarm conditions prior to any issues causing a failure.



How is this system used, can it easily be integrated into existing safeguarding system or is it best to keep it autonomous?

Temperature data is available over industry standard protocol Modbus RS485, this makes it very simple to integrate into any system. At which point you can view readings, configure alarm thresholds and trend/log data if required. This can be built into an existing system for safeguarding or be kept autonomous. There is no need to keep it totally separate as it would form part of the power monitoring system and add valuable information to existing systems.

How easy is it to install Exertherm sensors into existing switchboards?

The Exertherm IR sensors are small and non-contact therefore very easy to retrofit by use of a set of mounting brackets. The cable sensors are very easy to install onto cables to monitor the terminations, these can be affixed onto the cables using cable ties. We can assist in the design and placement of sensors especially when it is your first time and have online free of charge training modules.

John mentioned the importance on load in setting the ΔT level. We have used Exertherm sensors setting a fixed (static) expected load. Could you further explain any experience where load data is coming from metering, so ΔT is recalculating based on?

If you have used LoadMap in the 'static' method then this allows you as you have seen to apply design load and maximum expected load values to give a new warning ΔT temperature level. If you wish to use in a 'dynamic' setup, then this would have LoadMap algorithms licensed to the EPMS system and then would require connections to actual power meters to obtain the live load data.This would allow continuous adjustment of the warning ΔT level based on actual loads. This has been used very succesfully in many sites and is very useful when loads can fluctuate from low to high over a period of time due to process changes etc.

What Is Delta T (ΔT) ?

- Delta T (ΔT) is the method of measuring the temperature difference between two points within an equipment or a connection and its ambient.
- Internationally recognized standard for Infrared thermography technology is to identify the level of defect by monitoring **Delta T (ΔT) temperature**.
- The IR.06-EM.SC sensor and the cable sensor have been specifically designed to provide 24x7 Thermal Monitoring of mission-critical electrical equipment by monitoring **an increase in heat over** ambient temperature - **Delta T (ΔT).**

What is your HMI?

The HMI we currently have is the ARM XL and is available for datacards, so IR and Cable sensors and gives LoadMap built in adjustment of Alarm limits along with indication of alarm both locally and remotely with dry relay contacts.

What are the biggest benefits to these vs PT1000s?

PT1000 sensor elements are a very low cost device which then require added electronics to obtain the temperature data. They would require onsite calibration to the electronics before they could be used to ensure they all read the same, they drift over time and would need annual calibration. They would also be contact, which gives type test certification issues and also then can become a potential arc path if contamination and moisture sticks to the cables. Exertherm IR sensors leave the factory calibrated for immediate use and are non-contact.

Have you seen much uptake of these for the data centre industry switchgear or busbar/busway etc?

Yes, huge number of our sensors are currently deployed in datacentres across electrical components such as Bus Ducts, LV/MV switchgear, MCCs, UPS, PDUs, and dry transformers. We are a preferred technology for some of the largest global Datacentres operators. Having the sensors installed enables safer working practice, early notification of issues and therefore reduces downtime and increases the uptime.

Would the overexcited max temp of the equipment be detected by the sensor? Like for a clamp.

If we are talking switchgear here, then if the equipment was at heavy load or max loads, the busbars would be warm and so would the local ambient within the switchgear, so Delta temperatures should be below the recommended alarm levels. If the switchgear was overloaded and the connection points become too hot, then yes the system would detect this and alarm.

How do we determine the alarm setpoint if using Delta T measurement? What is the criteria, is it depending on the busbar size, pass through current, etc?

No, this has nothing to do with busbar size or current. We always recommend to follow the NETA table to set the values for ΔT warning and critical alarms, which are globally accepted as being alarm levels suitable for detecting issues within switchgear.

How would you install the sensor if the main busbar system has phases installed one behind the other?

We will require some drawings or pictures to evaluate how best we can position the sensors. In most designs we do figure out a way to install the sensors upon evaluation of drawings and pictures. The sensors can be installed viewing the 'edge' of bars and also at up to 45 degree angles to view onto the face of the bar.

You said Low voltage connection for cables. Do you have solutions for MV cables for 12-36 KV switchgear?

This all depends on the type of cable termination and in most cases IR sensors are used, we require drawings/pictures to evaluate the feasibility of using the IR sensor.

Do you have any plans to integrate Exertherm with Eaton's energy Low Voltage Switchgear? Eaton has a configurator software to design the panel and it can generate BOM automatically.

This would be a future project and we do not see any reason this cannot be achieved relatively quickly. There could be many changes in the next 12 months or so.

How do the sensors communicate with the HMI and other sensors in the equipment?

The sensors connect to a Modbus datacard which linearise the sensor signals and converts it into temperature data which is available over Modbus RS485 and this is the protocol link between the datacard and HMI. The HMI has a Modbus TCP/IP data passthrough which allows further integration into client/host systems where other devices/equipment/sensors can connect to form a complete integrated system. The HMI cannot take data from other 'third party' sensors in the equipment.

I just want to confirm these sensors are hardwired and can they be integrated into any BMS system? Also, are they rated for the potential high temps within LV Switchgear?

Yes, these sensors are hardwired and connect to a datacard which transmits the data over industry standard protocol Modbus RS485 to integrate into any client/host/BMS systems where you can view readings, configure alarms and trend/log data if required. They are rated for the internal temperatues found within switchgear. We have carried out extensive enviromental testing on these units and they will operate at temperatures higher than the normal heat rise type test temperature found within switchgear.

Are there any environmental concerns that might affect the working of the sensors?

There are no enviromental concerns with the sensors located inside switchgear. They normally sit within the switchgear and are compatible with the maximum operating conditions specified for switchgear / switchboards per international standards. If extreme environmental conditions occur or exist then this can be a major threat to a switchgear/switchboard and is a much bigger problem on its own.

How far shall ambient sensor be from cable to measure real ambient temperature?

The connecting cable should be routed away from the back of the sensor, ensure that the ambient sensor is kept away from the cable being measured and that it is in the local/free ambient air and is kept at a minimum distance of 5cm (2") from the cable being monitored.

I would like to know if bus trunking can be monitored with 3 m or even less or more. Hope we can monitor the same.

Yes, we can monitor bus trunking and have a system specifically designed for this which is very modular and allows lengths of less than 3 metres or more to be monitored.

If the panel width is 600mm and the 4 or 3 phases are just 15-20 mm away in LV systems, how do we maximise the temp monitoring in such cases? Edge or different planes.

We can always figure out a best fit solution, there is extremely low possibility where we cannot physically fit into a switchgear due to design constraints. We require to see drawings/designs and can suggest possible locations to install. But yes, we can monitor on edge of the bars as well as the face.

Are there available tests for environmental testing (humidity, vibrations, EMC, etc.), to be shared with customers for demonstration?

Yes these can be provided upon specific request under NDAs.

The cable sensor has an ambient sensor on the "other end". How does the busbar sensor determine the ambient?

The IR sensor takes the target bus reading and the ambient sensor is internal, with these 2 values, the output is a Delta-T temperature.

The NETA table implies two scenarios to consider - rise above ambient OR difference between two similar points with similar loads. Please confirm my understanding.

Yes correct, the NETA Table 100.18 implies to 2 scenarios: which are looking for two completely different problems.
1. Temperature difference (ΔT) based on comparisons between similar components under similar loading. This is looking for imbalance of temperature when loads are balanced, example say a motor has a winding failure.
2. Temperature difference (ΔT) based upon comparisons between component and ambient air temperatures. This is looking for compromised or failing joints.

When your equipment is integrated inside some other equipment - A switchboard for example - from your perspective, how is the Ambient defined? Is it the temperature inside the switchboard or the outside/switch room temperature?

With all our sensors, the ambient is defined as the internal temperature local to the joints / bus bar connections. This is the important temperature to give a true Delta T value for a compromised joint. Whereas an external ambient is only used for a max heat rise in type testing.

What types of electrical faults are most commonly detected using Delta T measurements?

It helps identify a compromised connection/joint way ahead in time before a catastrophic failure occurs. There are many ways in which a joint can be compromised.
1. Electrical connections are subject to wear and tear over time.
2. Vulnerabilities due to environmental factors.
3. Mechanical stress.
4. Age - over time, the joints can become loose.
5. Poor installation by humans, loose connections or incorrect torque setting.
6. Overloading and current imbalance.

Are there any handbook or manual with installation and reading instructions? Is the DATA module installed in the SWG?

Yes the datacard is mounted on a DIN rail inside the LV controls compartment of the switchgear. The set of manuals are available to download during the course of online training.

Does the data module need power? 48V?

Yes it requires a 24VDC +/-10%, 0.4w per datacard power supply.

Can we access the previous webinars?

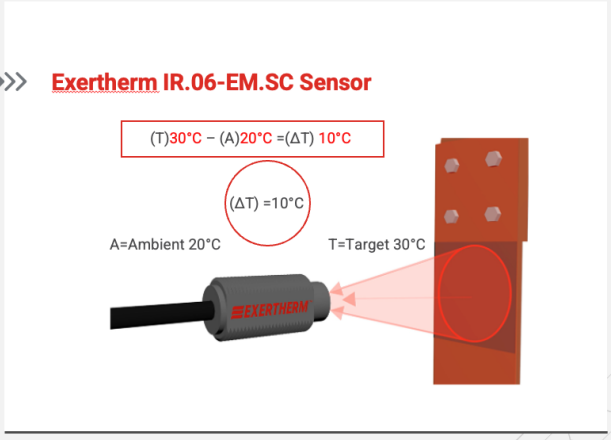
Yes, you can watch the previous webinars via our YouTube Channel - Exertherm https://www.youtube.com/@exertherm

What is the IP rating of the sensors?

IR SENSOR: Hermetically sealed (IP67)/NEMA 4X Rating.

How do Exertherm sensors calculate Delta T (ΔT)

→»» **Exertherm IR.06-EM.SC Sensor**



What is the right value of Delta-T to set for bus bars joints inside a HV Switchgear? What input data should be evaluated to provide a fair setting value?

This would relate back to the NETA table 100.18 to set the correct alarm level. When we say HV, there is always individual thoughts on what this refers to ie. Voltage levels. Exertherm sensors will operate in switchgear up to 38kV and is the same alarm setting as for LV switchgear. The reason we do not operate above 38kV is due to target size and clearance distance required, which stops the sensor operating accurately.

How do we usually set the alarm level of different seasons of the same equipment?

You should use the Delta-T method of measurement, that way you would not require to change alarm levels from day to night or season to season. Delta-T reading eliminates these temperature variances giving you a clear indication of a fault irrespective of external weather conditions/ambient.

Does the electromagnetic interference & temperature extremes affect the operation of sensors & data transmission? If yes, how?

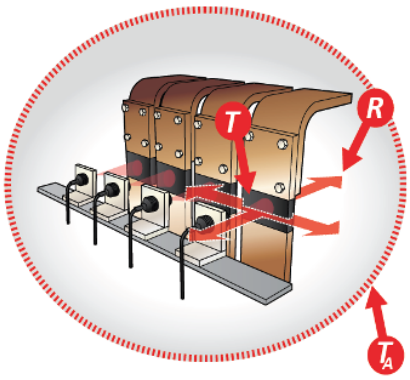
The IR sensors are Hermetically sealed (IP67)/NEMA 4X Rating and are very rugged/durable, we stipulate operating temperature at max 70DegC ambient - standard for most switchgears, however, we have tested the operation and found that they operate at even high temperatures around 100DegC. If your switchgear is operating at such extreme temperature then this can bring on a much bigger issue than the sensor failure itself.
The sensors are not affected by EMI/EMF.

Newton's law of cooling

"A body will raise its own temperature infinitely to dissipate the extra power due to the compromised conditions"

Power dissipated through any resistance *(R)* in an electrical system always flows to the ambient surroundings as heat.

It will infinitely heat to a level above local ambient sufficient to move the extra power away and into the surrounding ambient.



The heat flow quantity is proportional to the temperature difference between the electrical component *(T)* and its ambient temperature(T_A) (Newton's Law of cooling).

Since the dissipated power is only dependent on the current and resistance (R), the conductor temperature *(T)* will increase to whatever is necessary to dissipate the power as heat to the ambient (T_A).

Do you need periodic cleaning of sensors? Is the product third party certified like BV or INTERTEK?

Exertherm sensors are CE/UL certified and these are internationally accepted standard. The sensors if installed correctly, i.e. not facing upwards, are totally maintenance free. We have never had requirements for BV or INTERTEK. As these are generally installed within a piece of switchgear, then it is that item that would be certified.

Do you have documents that will prove that the sensors do not require calibration? Most customers requires this information.

Yes we have a lifetime calibration certificate which we share with our customers and a lifetime warranty document.

What's the accuracy of the sensor?

IR SENSOR accuracy is: +/-5% of the reading, so 5% at 1°C, 10°C or 40°C, and has a Repeatability of: 1°C (2°F). The Cable Sensor has an accuracy of:+/- 2% or 1°C (2°F) of nominal target value.

What is the mean time between failures on the Exertherm sensors themselves?

Exertherm IR Sensors: MTTF is 13,000 years and Exertherm Cable EM Sensors MTTF is: 3012 years.

How to use on low voltage busway system? Are there any suggestion on direct connections?

We do have a system specifically designed for busway systems. This is the busduct monitoring solution.

If the ambient temperature inside the switchgear rises (e.g., ambient is 70°C and the connection temperature is 75°C), resulting in a Delta-T of only 5°C, how can it be identified that the connection temperature of 75°C is high but won't trigger an alarm set for a ΔT of 10°C?

What we need to remember here is that connections inside a piece of switchgear are allowed as per the standards to have a max temp of 105°C or 115°C dependant on bar type and bolt type used. Therefore, if we say the connection temp is only 75°C and local ambient is 70°C then there is no problem. Also the other point to remember is that the ambient will never heat to the same level as the connection as we have airflow around the cabinet disipating the ambient air. To have this scenario would be a very hot climate or heavily loaded piece of equipment and the fact that the Delta is only 5° does show there is no issue at all.

While commissioning, what is the best practice to simulate temperature rising?

We offer an Exertherm verification device which allow you to verify IR sensor operation during commissioning. If the switchgear is deenergised and safe to touch, you can also place the palm of your hand infront of the sensor lens acting as a heat source if the ambient air temperature is lower than your body temperature. Alternatively, you can use a hot air gun from a distance to warm up the connection, just make sure you do not damage the sensor in the process.

What is a good distance to spot ratio for thermal imaging?

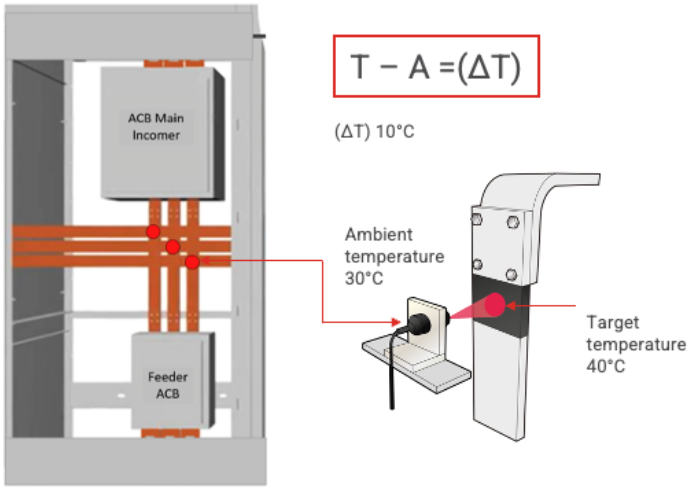
The IR spot ratio and diameter are not a factor to consider when choosing sensor placement as this is solely dependent on our IR sensor gain matrix which defines the min/max distance the IR sensor can be mounted depending on the busbar size and also adhering to minimum clearance and creepage distances.

How do we identify faulty contactors using the Delta-T method? What is the tolerance for contactors?

A faulty contactor would generate heat across its input and output terminals so we can monitor the IN or OUT connections from the contactor by using our MCC solution. If this was a larger contactor and you wish to use the IR sensor to measure the coil, then we are not sure what that alarm level would be required to be set to. We are not aware of any table etc that describes this. We have had good success through monitoring the In and Out terminations on the contactors to discover when a unit is faulty.

ABSOLUTE VS DELTA T

Delta T (ΔT)



Exertherm IR technology allows for the placement of compact, non-contact, non-powered, and lifetime calibrated sensors inside electrical enclosures, making it 'The Next Technology Step'.

This directly overcomes two major concerns with thermal imaging.

1. Exertherm sensors provide a direct and continuous view of critical joints/terminations, hence more accurate.

2. provide a Delta ΔT measurement from INSIDE the enclosure, therefore:

   - no temperature correlation is required,
   - eradicates the requirement for an additional ambient sensor
   - no calculation of the delta-T in the Front-end system.

Regarding the NEMA 5 drawable LV panel, how do we manage this to connect the power supply to the monitoring system?

The sensors itself do not require to be powered, they are non-powered. The datacard to which sensors connect sit in the LV controls compartment where they need 24VDC power.

If the sensor is faulty I would need to shut down my electrical equipment to replace it. What is the MTTF of the sensor ?

IR Sensors: 13,000 years and Cable EM Sensors: 3012 years.

Are Exertherm sensors third party certified? How do we know the accuracy of the Delta T?

IR SENSOR accuracy is: +/-5% of the reading, so 5% at 1°C, 10°C or 40°C, and has a Repeatability of: 1°C (2°F). The Cable Sensor has an accuarcy of:+/- 2% or 1°C (2°F) of nominal target value. The sensors have all been rigorously tested by the manufacturers to give this data.

Additional resources:

Future-Proof Electrical Assets With Continuous Thermal Monitoring

Download

Developing an IEEE Continuous Thermal Monitoring Standard and a Major Company's Protection of Their Electrical Assets

Download

CONTINUOUS THERMAL MONITORING
For Critical Electrical Assets

EXERTHERM® | Power On. Peace Of Mind