DX SERIES
Handheld Infrared Thermometers

User's Guide

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Chapter One - Welcome to Infrared Thermometry

1.1 Introduction

Exergen Corporation, the world's leading manufacturer of infrared temperature systems, presents the low cost DX Series™ of hand held infrared thermometers. These dual-purpose systems function as both NIST traceable temperature calibrators and thermal scanning devices. Make fast, accurate, and reliable temperature measurements using advanced non-contact IR technology.

Meet your company's product quality conformance needs with the DX's patented Automatic Emissivity Compensation System (AECS). In this mode, the unit will provide precision temperature measurements of spot targets, without knowing the target's emissivity value, and without errors caused by other sources of incident radiation. Since the DX is NIST traceable, it can function as a primary temperature calibrator for other temperature measuring devices, serving your corporate quality instrument calibration programs. Operate the DX in SCAN mode, for thermal scanning measurements over a range of target temperatures. Thermal Scanning is very useful in many applications such as evaluating insulation, monitoring machinery, and inspecting electrical equipment. Or the DX may be operated in the MAX mode where the highest temperature measured while monitoring is presented.

This manual provides complete instructions on how to operate and use your DX--to provide fast, accurate, reliable temperature measurements for your application needs.

1.2 Product Features

Designed for ease of use and measurement flexibility, the DX features:

*   Dual purpose, AECS as well as MAX and SCAN measurement modes
*   Measurement resolution to 0.1 °F or 0.1°C
*   Factory calibration for precise results
*   A 10 second display reading hold
*   Internal self test and error diagnostic codes to insure proper function

1.3 Models and Ordering Information

DX 501   -50 to 550°F (-45 to 287°C) Unit includes a 9 V DC Alkaline Battery and DX Instruction Manual. Also available with a Remote Sensor, RS232 Digital Output and an Analog Output.

DX 1001   0 to 1000°F (-18 to 538°C) Unit includes a 9 V DC Alkaline Battery and DX Instruction Manual. Also available with a Remote Sensor, RS232 Digital Output and an Analog Output.

DX 1201   0 to 1207°F (86 to 653°C) Unit includes a Remote Sensor, 9 V DC Alkaline Battery and DX Instruction Manual. Also available with an RS232 Digital Output and an Analog Output.

DX 1601 0 to 1600°F (86 to 871°C) Unit includes a
         Remote Sensor, 9 V DC Alkaline Battery and DX
         Instruction Manual. Also available with an RS232
         Digital Output and an Analog Output.

Chapter Two - Operation

2.1 DX Controls

MEASUREMENT
button

LED Display

Sensor Window

AECS Cup

Battery Cover
Screw
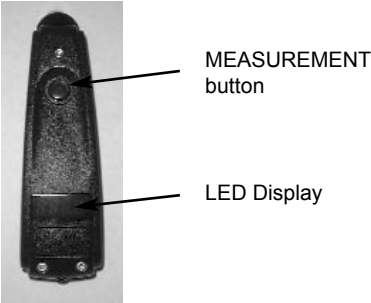
LED Display	Displays target temperature and diagnostic codes
Measurement button	To turn on and start temperature measurement
Nosepiece w/AECS cup	Automatic emissitivity compensation system nosepiece to contact target
Sensor window	Sensor viewing area for IR detector

2.2 To Change Display Measurement Units

The DX Models come from the factory displaying temperature in units of Fahrenheit. To display readings in units of Celsius, perform the following steps:

1. Remove the screw from the underside of the case.
2. Remove the cover, exposing the battery area.
3. Locate the push button switch as shown in the picture.
4. With the unit off (display is blank), push the push button in.
5. Holding the push button in, turn the unit on with the MEASUREMENT button.

The instrument now reads in °C instead of °F. To return to the original setting, simply repeat the process.

°F/°C Switch ⟵   ⟶ MAX/SCAN Switch
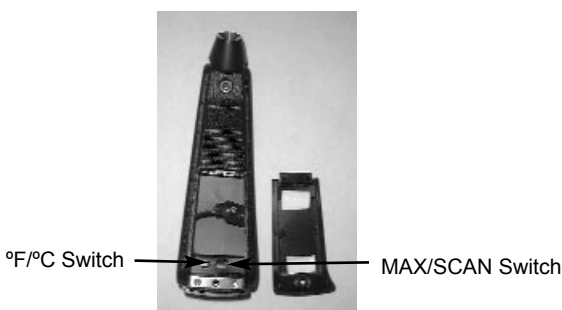
2.3 To Change Mode of Operation

The DX Models come from the factory operating in the MAX mode. To change to the SCAN mode perform the following steps:

1.   Remove the screw from the underside of the case.
2.   Remove the cover, exposing the battery area.
3.   Locate the slide switch as shown in the picture.
4.   Change the position of the slide switch from 1 to ON.

The unit will now operate in the SCAN mode. ON ➔ SCAN, 1 ➔ MAX.

2.4 Temperature Measurements

2.4.1 General Operation
<u>CAUTION</u>... SHOCK HAZARD
DO NOT TOUCH THE INSTRUMENT TO ELECTRICAL CONDUCTORS*

The DX™ measures temperature very quickly. To obtain an accurate measurement, it is only necessary to touch the surface for a fraction of a second.

For exact surface temperature measurements that are NIST traceable, use the following procedure:

1.   Press and hold the MEASURE button.
2.   The display will briefly show [8888].
3.   Touch the nosepiece to the target surface.
4.   The display may or may not change, but the "beeping" sound will indicate that measurements are being made.
5.   Record the temperature from the display.
6.   Release the MEASURE button. The last reading will remain locked on the display for 10 seconds after releasing the button.

If the target is electrical equipment, Exergen manufactures the Model E Microscanner instruments for safe andconvenient inspection of electrical equipment. Contact Exergen for more information on the Model E line of instruments and electrical inspection.   If the surface is metallic, be sure to mark it as described in the Measurement Tips section in Chapter Three.

2.4.2 Temperature Measurement of Moving Targets

To measure moving targets that are not possible to touch, use the following procedure:

1. Press and hold the MEASURE button.
2. The display will briefly show [8888].
3. Bring the nosepiece as close as possible to the target, preferably within 1/32 inch (1 mm). **
4. The display may or may not change, but the "beeping" sound will indicate that measurements are being made.
5. Record the temperature from the display.
6. Release the MEASURE button. The last reading will remain locked on the display for 10 seconds after releasing the button.

** If the surface is metallic, be sure to mark it as described in the Measurement Tips section in Chapter Three.

2.4.3 High Temperature Targets

When using the DX™ to measure high temperature targets, above 100 °F, quickly touch the target's surface -- one second is long enough to get an accurate reading.

Follow the procedures described above under 2.4.1 General Operation (see pg. 5). If the DX makes contact with a hot surface for an extended time (10 seconds or more) the target will conduct heat. Although this will not harm the unit, the indicated temperature may be a few degrees too high. Allow a few minutes between readings for the nosepiece to cool down and stabilize.

If the DX makes contact with a hot surface and an error message [HI] shows on the display remove the instrument from the object immediately.

2.5 MAX Mode Temperature Measurements

Use this measurement mode when making contact with the target or when the target is large. The DX is a wide-angle thermal scanner with a fixed emissivity of 0.9. The target's temperature is continuously displayed and updated 10 times per second for as long as you hold the MEASURE button down.

The DX displays the average temperature of everything within the sensor's field of view measurement area. The size of the measuring area depends on the distance of the device from the target. The DX has a 1:1 field of view, which means that this unit will measure a 1"diameter target area when the device is 1" from the target.

2.5.1 General Operation

For continuous temperature measurement of a target or for temperature measurement at a distance, use the following procedure.

1. Determine the appropriate measurement distance from your desired target. Best measurements are made when the DX is in contact with the target.
2. Make sure the MODE switch is on MAX.
3. Point the nosepiece at the target.
4. Press and hold the MEASURE button.

5. Record the temperature from the display.
6. Release the MEASURE button. The last reading will remain locked on the display for 10 seconds after releasing the button.

2.6 SCAN Mode Temperature Measurements

Use this measurement mode for thermal scanning of a target or when measuring targets located at a distance. The DX is a wide-angle thermal scanner with a fixed emissivity of 0.9. The target's temperature is continuously displayed and updated 10 times per second for as long as you hold the MEASURE button down.

The DX displays the average temperature of everything within the sensor's field of view measurement area. The size of the measuring area depends on the distance of the device from the target. The DX has a 1:1 field of view, which

means that this unit will measure a 1"diameter target area when the device is 1" from the target.

2.6.1 General Operation

For continuous temperature measurement of a target or for temperature measurement at a distance, use the following procedure.

1. Determine the appropriate measurement distance from your desired target.
2. Make sure the MODE switch is on SCAN.
3. Point the nosepiece at the target.
4. Press and hold the MEASURE button.
5. Record the temperature from the display.
6. Release the MEASURE button. The last reading will remain locked on the display for 10 seconds after releasing the button.

Chapter Three - Measurement Tips

3.1 Optimizing Target Area Measurements

When performing a continuous thermal scan of a target, or measuring a target located at a distance, proper target alignment will help assure accurate results. Since the DX's sensor measurement area is fixed at a field of view of 1 to 1, it is important to properly determine the best measuring distance from the target, to optimize the reading. A field of view of 1 to 1 means that the DX's viewing area is 1" diameter for 1" distance from target. Optimize optical alignment, so that the DX views only the target and does not overlap the measurement area. See Figure below for examples of proper optical alignment.

POOR   POOR   GOOD

3.2 Measuring Metallic Targets

In general, infrared thermometers can easily measure non-metallic surfaces because they emit most of their potential heat. Metallic surfaces, on the other hand, are poor emitters and require special treatment before infrared thermometers can accurately measure their temperature. Fortunately, that special treatment is simple and can be easily accomplished by marking the metallic surface you wish to measure with a non-metallic substance such as a solid paint marker. Other substances such as grease, oil, or tape may also be used. It is only necessary to mark an area slightly larger that the DX nosepiece, when operating in AECS mode. When operating in MAX or SCAN modes, mark the appropriate target area for the measuring distance from the target, based on a 1 to 1 Field of View.

3.3 Optimizing AESC Measurements for NIST Traceablity

If you look at the DX's nosepiece, you will see that it is really a small reflective cup with the sensor's window at its base. When the DX's nosepiece touches the surface of an object, that reflective cup automatically controls what the sensor sees by eliminating variables such as target emissivity and extraneous radiation. Patented by Exergen as the Automatic Emissivity Compensation System (AECS), this unique design ensures accurate readings every time. To optimize results, make sure that the nosepiece is flush with the target when possible, so that the reflective cone can complete trap out any light or incident radiation from the environment.

3.4 Measuring Transparent Materials

Although transparent materials pass visible light, many visibly transparent materials are opaque in the infrared and can be directly measured by the DX.

To test for infrared transparency, touch the DX to the target's surface and pass a heat source such as your hand or a penlight through the sensor's field of view on the other side of the material. If the DX responds to the heat source, the material is transparent in the infrared, and requires marking the surface for proper measurement. Mark the surface with an opaque non-metallic coating, such as paint or grease.

Alternatively, place a shiny metallic object, such as aluminum foil, behind the transparent material. The shiny metal will reflect the target's heat back to the DX.

3.5 Measuring Wet or Icy Surfaces

Wet or icy surfaces may interfere with the DX's readings. Water and other liquids are good targets, but evaporation lowers their surface temperatures.

Frost forms on a surface at the freezing point of water. Frozen foods or similar targets will form frost unless the environment is controlled. If frost forms, the DX will measure the temperature of the frost instead of the object's temperature.

Melting ice will read slightly higher than 32 °F (0°C) because the instrument actually measures the air condensing on the ice, a reaction that generates a small amount of

heat. As long as the ice is not melting, the DX will accurately read its temperature.

To make an accurate target measurement, remove any ice or moisture before measuring.

Chapter Four - Maintenance

The high-performance DX is a rugged and durable instrument, designed for long term performance reliability.

4.1 Battery Replacement

Open the instrument's cover to access the battery by loosening the screw on the back of the instrument. Remove the old battery and replace it with one fresh, 9 V alkaline battery. Align the battery contacts as indicated on the case.

4.2 Cleaning

The only maintenance required involves keeping the sensor window clean. This window, located at the base of the nosepiece's reflective cup, is made of a special crystal that passes infrared heat. Dirt, greasy films, or moisture on the window will interfere with the passage of infrared heat and affect the accuracy of the instrument.

If necessary, clean the sensor window and reflective cup with a cotton swab dipped in alcohol. Periodic cleaning is a good practice.

4.3 Storage

When not in use, store the DX in a container, to protect the unit from dirt and dust. Do not store the unit in areas of extreme heat, cold, or humidity. If not using the DX for a long period, remove the battery from the unit.

4.4 Calibration

The DX is factory calibrated under high quality standards. Because there are no mechanical adjustments, the instrument is able to maintain its calibration through vibration and normal use. No field calibration is necessary.

Chapter Five - Troubleshooting

5.1 Diagnostic Codes

The high-performance DX™ continuously monitors its ability to produce accurate temperature readings. If either the target's temperature or the unit's ambient temperature exceeds the operational limits, the display will default to an error message.

The battery voltage is also monitored. A low battery is indicated by a separate error code. The unit will continue to operate as long as accuracy can be assured. If the battery drops below 5.7 volts, the battery is considered "dead" and the display defaults to [----].

If the [E-##] or [Err] error messages are displayed, the unit will not function and must be returned to the factory for repair. (See section on Warranty for return instruction).

The following charts summarize the fault condition, and the associated indication.

High Target Temperature

Condition	Error Code	Measurement Fault	Remedy
Model DX 501	[HI]	Target >550°F (287 °C)	Use higher DX
Model DX 1001	[HI]	Target >1000 °F (538 °C)	Use higher DX
Model DX 1201	[HI]	Target >1207 °F (653 °C)	Use higher DX
Model DX 1601	[HI]	Target >1600 °F (871 °C)	Contact Exergen

Low Target Temperature

Condition	Error Code	Measurement Fault	Remedy
Model DX 501	[LO]	Target < -50 °F (-45 °C)	Contact Exergen
Model DX 1001	[LO]	Target <0 °F (-18 °C)	Use lower DX
Model DX 1201	[LO]	Target <186 °F (86 °C)	Use lower DX
Model DX 1601	[LO]	Target <186 °F (86 °C)	Use DX 501 or DX 1001

Other Errors

5.2

Condition	Error Code	Measurement Fault	Remedy
High Ambient Temperature	[HI A]	Ambient > 122 °F (50 °C)	Move to alternate location
Low Ambient Temperature	[LO A]	Ambient < 32 °F (0 °C)	Move to alternate location
Low Battery	[N/A]	Battery power low	Replace battery
Dead Battery	[----]	Dead battery	Replace battery
Processing Error	[E-##] or [Err}	Internal fault	Repeat measurement, if error remains, contact Exergen

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5.2 Troubleshooting Measurement Difficulties

If you experience measurement problems, review the following troubleshooting steps:

Is the sensor window clean?
Clean the sensor window and reflective cup and repeat the measurement.

Is the target's surface non-metallic?
Coat metallic surfaces with a non-metallic finish and repeat the measurement.

Is the target's surface transparent?
Coat transparent surfaces with an opaque non-metallic finish and repeat the measurement.

Alternatively, put a shiny metallic surface such as aluminum foil behind the transparent target and repeat the measurement.

Was the instrument's nosepiece in contact with the surface?
Touch the nosepiece flush to the target's surface and repeat the measurement.

If after applying all of the above solutions, the instrument's accuracy is still in question, contact Exergen for further help.

Chapter Six - DX™ Specifications

Target Temperature Range

DX 501   -50 to 550°F (-45 to 287°C)
DX 1001 0 to 1000°C (-18 to 538°C)
DX 1201 186 to 1207°F (86 to 653°C)
DX 1601 186 to 1600°F (86 to 871°C)

Linearity Error

DX 501   ± 1% of reading
DX 1001 ±3% of reading
DX 1201 ±3% of reading
DX 1601 ±3% of reading

Emissivity Error

±1% of max. difference between target temperature and instrument temperature when touching, for emissivity of 0.8 to 1.0

Minimum spot size diameter

Approx. 1/4" (6.4 mm)
Repeatability
± 0.1 °F/°C

NIST Traceablity

In AECS Mode

Display Resolution

0.1 °F or 0.1 °C

Display Update

10 times/second

Measurement Response Time

Approximately 0.1 seconds

Field of View

1:1 0.63" (15.9 mm) Diameter Spot Area in AECS Mode

Spectral Sensitivity

2 to 20 microns

Battery

One 9 volt

Battery Life

5000 readings (10 seconds each)

Instrument Ambient Temperature

Operating Range: 32 to 122°F (0 to 50°C)
Storage Range: -22 to 140°F (-30 to 60°C)*

Extended storage at temperature extremes will reduce battery life.

Chapter Seven - Warranty

Exergen warrants the DX to be free of defects in material and workmanship for a period of one year from the date of purchase, and will repair or replace the returned instrument at no charge during the period. No other warranties are implied.

If repair is required:

Contact the factory for a Return Material Authorization (RMA) Number. Mark the RMA number on both the shipping box and the packing slip. Include a description of the unit's problem. Ship the instrument prepaid. Exergen will return ship prepaid. After you have received an RMA Number, send to:

EXERGEN CORPORATION
Repair Department
RMA _____
51 Water Street
Watertown, MA 02472