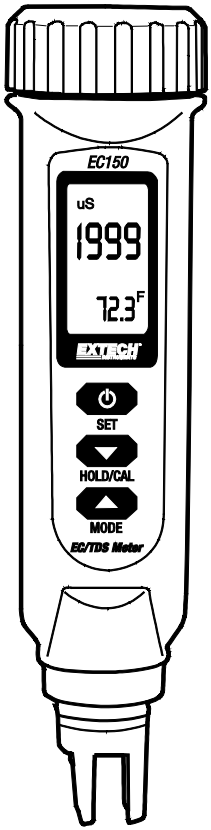
EXTECH

USER MANUAL

Conductivity and TDS Meter
Pen Style Water Quality Meter

Model EC150



Introduction

Congratulations on your purchase of the Extech Pen Style Water Quality instrument; the Model EC150 measures Conductivity and TDS (Total Dissolved Solids) plus Temperature. The instrument is housed in an IP65 Water-proof enclosure for safety. This instrument is shipped fully tested and calibrated and, with proper use, will provide years of reliable service.

Features

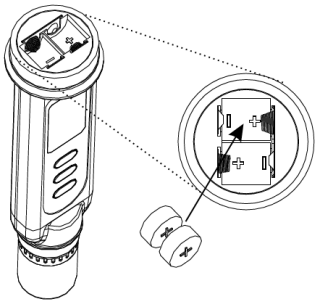
- Automatic and manual range
- Dual Display with ATC (automatic temperature control)
- Data hold for freezing displayed readings
- Low battery indicator
- Automatic power-off for maximum battery efficiency
- Switchable temperature units of measure (C/F)
- Multi-point and one-touch calibration
- Powered by four (4) LR44 batteries

Supplied Materials

- EC150 meter
- Four (4) LR44 button batteries
- User documentation

Battery Installation

The meter is shipped with the four (4) LR44 button batteries removed. The user must install the batteries before the meter can be used. Refer to accompanying diagram.



1. Unscrew the battery compartment cover (top of meter) in a counterclockwise direction, applying downward pressure. Please do not discard the black washer.
2. Install the four (4) LR44 button batteries, carefully orienting the batteries and observing polarity.
3. Replace the battery compartment cover.
4. Please remove the batteries while the meter is not in use for long periods.

Battery Safety

- Remove and immediately recycle or dispose of used batteries according to local regulations, keeping the batteries away from children. Do NOT dispose of batteries in household trash or incinerate.
- Even used batteries can cause severe injury or death.
- Call a local poison control center for treatment information.
- This unit contains four (4) LR44 lithium batteries.
- Non-rechargeable batteries are not to be recharged.
- Do not force discharge, recharge, disassemble, heat above 122ºF (50ºC), or incinerate. Doing so may result in injury due to venting, leakage, or explosion resulting in chemical burns.
- Ensure that the batteries are installed correctly according to correct polarity (+ and -).
- Do not mix old and new batteries, different brands or types of batteries, such as Alkaline, carbon-zinc, or rechargeable batteries.
- Always completely secure the battery compartment. If the battery compartment does not close securely, stop using the product, remove the batteries, keeping the batteries away from children.
- Remove and immediately recycle or dispose of batteries from equipment not used for an extended period of time, according to local regulations.

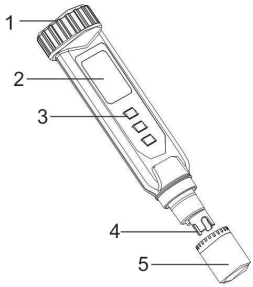
⚠ WARNING

- **INGESTION HAZARD** : This product contains a button cell or coin battery.
- **DEATH** or serious injury can occur if ingested.
- A swallowed button cell or coin battery can cause **Internal Chemical Burns in as little as 2 hours.**
- **KEEP** new and used batteries **OUT OF REACH of CHILDREN.**
- **Seek immediate medical attention** if a battery is suspected to be swallowed or inserted inside any part of the body.

Please do not dispose of this device or used batteries in household waste.

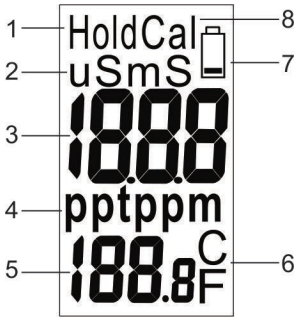
Meter Description

1. Battery Compartment
2. Display
3. Keypad
4. Electrode
5. Electrode protective cap



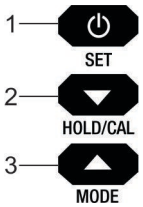
Display Description

1. Data Hold icon
2. Micro- and milli-Siemens units
3. Primary measurement reading
4. Parts per thousand / parts per million units
5. Temperature reading
6. Temperature units of measure
7. Battery strength indicator
8. Calibration icon



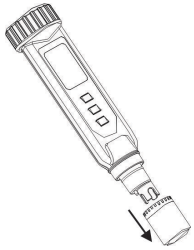
Keypad Description

1. Power ON-OFF and SET button
2. Down Arrow, Data Hold, and Calibration button
3. Up arrow and MODE Button



Operation

Getting Started



1. Remove the probe's protective cap (bottom of meter) by pulling the cap firmly downward, away from meter, until it releases (see diagram).
2. Press the power button ⏻ to power ON. The display will cycle through several icons (representing the current configuration of the meter) before stabilizing.
3. Long press the power button to power OFF.
4. The meter is powered by four (4) LR44 buttons batteries. If the meter will not switch ON, please check that fresh batteries are installed.

Automatic and Manual Ranging

There are two ranges available in each measurement mode (see Range table below). The meter defaults to the AUTO RANGE mode where the range is selected automatically to provide the best resolution and accuracy. However, MANUAL RANGE can be selected by long pressing the up-arrow button ▲. The display will briefly display the 'man' icon indicating that the meter is changing to the Manual Range mode and the next available range will be selected as indicated by the change in the units of measure icon.

	Conductivity	**TDS (Total Dissolved Solids)**
Range 1	0 to 1999 µS	0 to 1999 ppm
Range 2	0 to 19.99 mS	0 to 19.99 ppt

Measurement Preparations, Notes, and Considerations

- Accuracy is specified as a percentage of FULL SCALE, therefore using the lowest range will yield the best accuracy.
- The meter display will indicate E02 or E03 if the measured value is below (E02) or above (E03) the specified limits. If this occurs, please select another range as described in the Manual Range instructions above.
- Set the temperature coefficient. The factory default setting is 2.1% per ºC (this nominal value is correct for most applications). Refer to the Setup section for details on changing this setting. Also refer to Appendix D (Temperature effects) for more information.
- Set the normalization (reference) temperature. The factory default setting is 77ºF (25ºC) (this nominal value is correct for most applications). Refer to the Setup section and the Appendices for programming details and instructions on changing this setting.
- Rinse the probe with deionized or distilled water before use to remove impurities that may adhere to the electrode. When the meter has been idle for a long period, soak the electrode for at least 30 minutes before use.
- When dipping the probe into a sample solution, be sure to eliminate air bubbles trapped in the probe's slot by gently stirring.
- When taking a measurement, stir the probe gently in the sample to create a homogenous sample. Allow a few seconds for the probe and the sample to reach temperature equilibrium. Ideally, wait 15 minutes to achieve maximum accuracy and best temperature compensation.
- The unit of measure icon will flash on the display while stabilizing. When stabilization is achieved, the meter's icon will stop flashing.
- Press the HLD (HOLD) button to freeze a displayed reading. Press again to release the display.

TDS (Total Dissolved Solids) and Conductivity Measurements

1. Read the Measurement Preparation section above before continuing.
2. Use the MODE button to switch between the TDS and the Conductivity modes. In TDS mode the unit of measure is ppt (parts per thousand) or ppm (parts per million). In Conductivity mode the units of measure are µS or mS (micro- or milli-Siemens).
3. The TDS conversion factor is set to 0.50 at the factory. To change the setting, refer to the Setup section. Also refer to Appendix B (Conductivity-to-TDS Conversion Factors) and Appendix C (Calculating TDS Conversion Factors) for more information.
4. To switch from Auto Range mode (default) to Manual Range mode press and hold the up-arrow button for at least two seconds as described previously.

Post-Measurement Maintenance

After a measurement session:

- Rinse the electrode in de-ionized water and store dry.
- Affix the protective cap over the electrode when storing.
- If the unit is to be unused for a month or more, remove and store the batteries separately.

Automatic Power OFF (Sleep mode)

The meter will automatically switch OFF after 20 minutes of inactivity. To disable the Sleep Mode:

With the instrument switched off, long press the SET and HLD/CAL buttons until the '**n**' icon appears. Release the buttons and the meter will switch ON. The meter will now remain ON until manually switched OFF. Sleep Mode is reactivated when meter power is cycled.

Setup Mode

Parameter P1: Temperature Units, Ambient Temperature, and Temperature Coefficient settings

1. From the normal operating mode, long press the SET button until the '**P1.0** icon appears.
2. Short press the SET button, the '**C'** or '**F'** icon should now be flashing and the '**t.ut**' icon (abbreviation for temperature units) will be visible above the flashing unit.
3. Use the MODE key to select the desired unit of measure.
4. Short press the SET button to confirm the selection.
5. A temperature value will be flashing at the bottom of the display and the '**t.nr**' icon (normalization temperature i.e., reference temperature) will be visible above the flashing temperature. See Appendix D (Temperature Effects) for more information.
6. Use the MODE button to toggle between 68°F (20°C) and 77°F (25°C) (default is 77°F [25°C]).
7. Press the SET button to confirm the setting.
8. The temperature coefficient value should now be flashing on the bottom of the display with the '**t.Co**' icon visible above it.
9. Use the arrow buttons to select the coefficient temperature (default is 2.1°C).
10. Short press the SET button to confirm the selection.
11. The meter display should return to the **P1.0** starting point.
12. Long press the SET button to return to the normal operation mode or short press the MODE button to move to Parameter P2 (see below).

Parameter P2: TDS Conversion Factor

1. If continuing from Parameter P1, skip directly to step 2, below. If starting from the normal operating mode, long press the SET button until the '**Px**' icon appears (x = parameter number).
2. Use the MODE button to scroll to the P2 icon. '**tdS**' should appear above the P2.0 icon.
3. Short press the SET button. The current TDS factor setting should start flashing (0.50 is the default setting).
4. Use the arrow buttons to adjust the factor from 0.40 to 1.00.
5. Short press the SET button to confirm the change.
6. Long press the SET button to return to the normal operation mode or short press the MODE button to move to Parameter P3 (see below).

Parameter P3: Meter Reset

This parameter can be used to restore all settings to their factory default state.

1. If continuing from Parameter P2, skip directly to step 2, below. If starting from the normal operating mode, long press the SET button until the '**Px**' icon appears (x = parameter number).
2. Use the arrow buttons to scroll to the P3 icon if necessary. The '**rSt**' display icon should now be visible above the P3 icon.
3. Short press the SET button; a '**y**' or an '**n**' will be flashing.
4. Use the arrow buttons to select '**y**' for YES RESET or '**n**' for NO RESET.
5. Short press the SET button to confirm the setting.
6. Long press the SET button to return to the normal operation mode or short press the MODE button to move to Parameter P4 (see below).

Parameter P4: Calibration Review for Concentration Range 1 and 2

1. If continuing from Parameter P3, skip directly to step 2, below. If starting from the normal operating mode, long press the SET button until the '**Px**' icon appears (x = parameter number).
2. Use the MODE button to scroll to the P4.0 icon if necessary. The '**CAL**' display icon should be visible above the P4.0 icon.
3. Short press the SET button to view the current Range 1 Calibration Concentration. The P4.0 icon will switch to P4.1. If dashes (- - -) appear, this indicates that the meter has not been calibrated thus far.
4. Press the up-arrow button to move to the P4.2 display. The displayed value represents the Range 2 Calibration Concentration. If dashes appear, calibration has not been performed thus far.
5. Long press the SET button to return to P4.0. Short press the MODE button to move back to Parameter P1.
6. Long press the SET button to return to the normal operating mode.

Calibration

Calibration Preparation and Considerations

The user must first determine:

1. The best calibration schedule for the application.
2. The appropriate calibration standard for the application.

Calibration Schedule

- Calibration is necessary and should be performed regularly.
- If measuring in the mid-ranges, calibrate the meter at least once per month and soak the probe for 15 minutes before each use.
- If measuring in extreme temperature environments, or at the low end of the measurement range, calibrate the meter at least once per week.

Selecting a Calibration Standard

For best results, select a calibration standard closest to the expected sample value. Alternatively, use a calibration solution value that is approximately 2/3 of the expected full scale measurement range. For example, in the 1999µS range, use the 1413µS solution standard. Remember not to re-use calibration solutions; contaminants in the solution will affect the accuracy.

CONDUCTIVITY Calibration Procedure

1. Allow the probe to soak in de-ionized or distilled water for 30 minutes.
2. Select an appropriate conductivity calibration standard as discussed in previous section.
3. Pour the calibration solution into two clean containers to a height of 1.2 in. (3 cm).
4. Power the meter and select the Conductivity mode (µS) using the MODE button, if necessary.
5. Rinse the probe in one of the calibration solutions; gently stirring the probe.
6. Dip the probe into the second calibration solution. Tap the probe on the bottom of the container to remove air bubbles. Allow the probe to stabilize to the solution temperature (15 minutes).
7. Long press the HLD/CAL button. The conductivity value and the 'CAL' icon will flash.
8. Use the MODE or the HLD/CAL button to adjust the displayed conductivity value so that it matches the standard solution (normalized for the measured temperature). The conductivity reading can only be adjusted ±30% the detected value. If the displayed value differs from the standard > ±30%, the probe may need cleaning, or the meter may require replacing.

   For example: For a 10µS calibration standard, with a detected value of 19µS, the adjustable range would be ±5.7µS (19*30%). In this example the values differ > 30% limit.
9. When the CAL icon stops flashing, short press the SET button to confirm. The meter will return to the Conductivity measurement mode. If the CAL icon continues flashing, verify that the solutions are fresh and stable. Also, re-check that the value selected in step 8 is correct.
10. Repeat the procedure above for other ranges as required.

Note: When switching from measurement mode to calibration mode, the meter will display the factory default calibration value. This is normal and does not affect the user calibration.

Note: To exit the calibration mode without confirming the calibration, press and hold the SET button in Step 9 for at least 2 seconds. This will abort the calibration and revert to the previous calibration values.

TDS (Total Dissolved Solids) Calibration Procedure

TDS CALIBRATION OPTION 1

1. Allow the probe to soak in de-ionized or distilled water for 30 minutes.
2. Select an appropriate TDS calibration standard. The factory default TDS conversion factor setting is 0.50. To change this value, to better match the TDS factor of a particular calibration solution, refer to the Setup section. Also, refer to Appendix B (Conductivity-to-TDS Conversion Factors) and Appendix C (Calculating TDS Conversion Factors) for more information.
3. Pour the calibration solution into two clean containers to a height of 1.2 in. (3 cm).
4. Power the meter and select the TDS mode (ppm) using the MODE button, if necessary.
5. Rinse the probe in one of the calibration solution containers; gently stir the probe.
6. Dip the probe into the second calibration solution container. Tap the probe on the bottom of the container to remove air bubbles. Allow probe to stabilize to solution temperature (15 minutes).
7. Long press the HLD/CAL button. The TDS value and the '**CAL**' icon on the display will flash.
8. Use the MODE or the HLD/CAL button to adjust the displayed TDS value so that it matches the standard solution (normalized for the measured temperature). The TDS reading can only be adjusted ±30% of the detected value. If the displayed value differs from the calibration standard > ±30%, the probe may need cleaning, or the meter may require replacing.

   For example: For a 10ppm calibration standard, and a detected value of 19ppm, the adjustable range would be ±5.7ppm (19*30%). In this example the values differ > 30%.
9. When the CAL icon stops flashing, short press the SET button to confirm. The meter will return to the TDS measurement mode.

TDS CALIBRATION OPTION 2

TDS values are related to Conductivity; therefore, the meter can be calibrated using Conductivity standards (as described in the Conductivity Calibration section above). A conversion factor can then be applied.

1. Perform the Conductivity Calibration as described previously.
2. Select the Conductivity-to-TDS conversion factor in Setup mode, refer to the Setup section. Also, refer to Appendix B (Conductivity-to-TDS Conversion Factors) and Appendix C (Calculating TDS Conversion Factors) for more information.
3. Refer to the Setup section for instructions on programming the conversion factor.

Maintenance

- **Keep the electrode clean**. Between measurements, rinse the electrode with de-ionized water. If the electrode has been exposed to a solvent immiscible in water, clean it with a solvent miscible in water, e.g. Ethanol, and then rinse carefully with water.
- **Store the electrode carefully.** Before storage, rinse carefully in de-ionized water and store dry.

Troubleshooting

Power ON is attempted but there is no display

- Be sure to press the ON-OFF for at least 100mS to switch the meter ON.
- Check that batteries are positioned correctly, with correct polarity, making good contact.
- Remove and replace the existing batteries.
- Replace the existing batteries with fresh batteries.

Display switches OFF

- This is normal when with Auto Power OFF enabled (default).
- Check the batteries; Replace if necessary.

Air Bubbles adhered to Electrode

- Stir the solution with the electrode, dip at an oblique angle. Vertical dipping can cause air bubbles.
- Gently tap the bottom of the solution container while stirring the electrode in the solution.
- Air can be blown across the electrode before dipping it into the solution.

Error Codes

- Refer to the Table below for details on displayed error codes.

Code	Description	Suggestions
CONDUCTIVITY ERRORS		
-----	Measurement outside of range	In Manual Range mode, press and hold the up arrow for 2 seconds to change range or use the Auto Range mode.
E03	Conductivity is over-range	Check with a standard buffer solution. If problem persists, repair meter.
E04	Temperature error	
TDS ERRORS		
-----	Measurement outside of range	In Manual Range mode, press and hold the up arrow for 2 seconds to change range or use the Auto Range mode.
E04	Temperature error	
TEMPERATURE ERRORS		
E01	Temperature circuit damaged	Repair meter.
E02	Temperature value is below allowable range or Temperature circuit damage	Check again at room temperature. If error persists, repair meter.
E03	Temperature value is above allowable range or Temperature circuit damage	Check again at room temperature. If error persists, repair meter.

Appendix A: Factory Default Settings

Type	Parameter	Default	Notes
P1.1	Select °C/°F	°C	Temperature units
P1.2	Normalized Temperature (reference temperature)	25°C	Select 20°C or 25°C
P1.3	Temperature Coefficient	2.1% /°C	Adjust from 0.4 to 10%
P2.1	TDS Factor	0.50	Adjust from 0.40 to 1.00
P3.1	Revert to Factory Default settings	NO	Select YES to revert to default settings
P4.1	Review of previous Calibration data	-----	Calibration Data for Range 1
P4.2		-----	Calibration Data for Range 2

Appendix B: Conductivity to TDS Conversion Factors

Conductivity at 25°C	TDS KCl		TDS NaCl		TDS 442*	
	ppm	Factor	ppm	Factor	ppm	Factor
23 µS	11.6	0.5043	10.7	0.4652	14.74	0.6409
84 µS	40.38	0.4807	38.04	0.4529	50.5	0.6012
447 µS	225.6	0.5047	215.5	0.4822	300	0.6712
1413 µS	744.7	0.527	702.1	0.4969	1000	0.7078
1500 µS	757.1	0.5047	737.1	0.4914	1050	0.7
2070 µS	1045	0.5048	1041	0.5029	1500	0.7246
2764 µS	1382	0.5	1414.8	0.5119	2062.7	0.7463
8974 µS	5101	0.5685	4487	0.5	7608	0.8478
12,880 µS	7447	0.5782	7230	0.5613	11,367	0.8825
15,000 µS	8759	0.5839	8532	0.5688	13,455	0.897
80mS	52,168	0.6521	48,384	0.6048	79,688	0.9961

*442: 40% sodium sulfate, 40% sodium bicarbonate, and 20% chloride

Appendix C: Calculating TDS Conversion Factors

This meter can be calibrated using TDS calibration standard solutions. The calibration requires a TDS value at a standard temperature such as 77°F (25°C). Note that the TDS calibration can be performed using the *conductivity* calibration (detailed earlier in this user manual), using a conductivity-to-TDS conversion factor. To determine the Conductivity-to-TDS conversion factor, use the following formula:

Factor = Actual TDS / Actual Conductivity at 77°F (25°C)

Where the Actual TDS is the value per the solution bottle label or from a prepared buffer solution, using high purity water and precisely weighed salts. Actual Conductivity is the measured value obtained using a calibrated Conductivity/TDS/Temperature meter.

Both the Actual TDS and the Actual Conductivity values must be in the same magnitude of units. For example, if the TDS value is in ppm, the Conductivity value must be in µS; if the TDS value is in ppt, the Conductivity value must be in mS.

Check this by multiplying the conductivity reading by the factor in the above formula; the result is the TDS in ppm.

Refer to the Setup section of this User Manual for instructions on programming the TDS factor.

Appendix D: Temperature Effects

Conductivity measurements are temperature dependent, therefore if the temperature increases, the conductivity also increases. For example, if the conductivity measured in a 0.01 M KCL solution at 20°C is 1.273mS/cm, it would be 1.409 mS/cm at 25°C.

The reference temperature (normalization temperature) allows for the comparison of conductivity measurements obtained at different temperatures. The reference temperature is typically 68°F or 77°F (20°C or 25°C).

This meter measures the actual conductivity and temperature and then converts to the reference temperature using a temperature correction factor; the conductivity at the reference temperature is then displayed.

Linear Temperature Correction

This meter uses linear temperature correction. In moderate and highly conductive solutions, temperature correction can be based on a linear equation using a temperature coefficient. The coefficient is usually expressed as a conductivity variation (% /°C). Refer to the following formula:

$$KT_{ref} = \frac{100}{100 + \theta \times (T - T_{ref})} \times K_T$$

Where:

KT_{ref} = Conductivity at T*ref*

K_T = Conductivity at T

T_{ref} = Reference temperature

T = Sample temperature

θ = Temperature coefficient

Note: The correction is accurate within a limited temperature range near T1 and T2; the greater the difference between T and T*ref*, the higher the risk of error.

Calculating Temperature Coefficient (θ)

Measuring the conductivity of a sample at temperature T1 (close to T*ref*) and another temperature, T2, the temperature coefficient can be calculated using the following equation:

$$\theta = \frac{(KT2 - KT1) \times 100}{(T2 - T1) \times KT1}$$

T2 should be selected as a typical sample temperature and should vary approximately 10°C from T1. Typical temperature coefficients are provided below:

Acids: 1.0 – 1.6%/°C

Bases: 1.8 – 2.2%/°C

Salts: 2.2 – 3.0%/°C

Drinking water: 2.0%/°C

Ultrapure water: 5.2%/°C

Average temperature coefficients of standard electrolyte solutions are expressed as %/C of the conductivity value at 77°F (25°C).

Temperature Range (°C)	**KCl 1 M**	**KCl 0.1 M**	**KCl 0.01 M**	**Saturated NaCl**
15 – 25	1.725	1.863	1.882	1.981
15 – 25 – 35	1.730 (15 – 27°C)	1.906	1.937 (15 – 34°C)	2.041
25 - 35	1.762 (25 – 27°C)	1.978	1.997 (25 - 34°C)	2.101

Specifications

Measurement ranges	Conductivity: 0 to 1999µS and 0 to 19.99mS
	TDS: 0 to 1999ppm and 0 to 19.99ppt
Accuracy	Conductivity and TDS: 1% Full Scale ±1digit
Resolution	Conductivity: 1µS and 0.01mS
	TDS: 1ppm and 0.01ppt
Temperature Accuracy	±0.5°C
Temperature Resolution	0.1°C/°F
Calibration	One point calibration per range
Auto Power OFF	After 20 minutes of inactivity
Data Hold	Freezes displayed reading
Automatic Temperature Compensation (ATC): 32 to 122°F (0 to 50°C)	
Waterproof	IP65 rated
TDS Factor	Selectable from 0.40 to 1.00
Temperature Coefficient	Selectable from 0 to 4.0%/°C
Normalization Temperature	(Reference Temperature) Selectable: 20°C or 25°C
Status indicators	Dashes are displayed for out-of-range measurements, and a low battery icon appears when batteries require replacement
Power Supply	Four (4) LR44 'button' batteries
Dimensions	6.5 x 1.4 x 1.3 in. (165 x 35 x 32 mm)

Two-year Warranty

Teledyne FLIR warrants this Extech brand instrument *to be free of defects in parts and workmanship for* ***two years*** *from date of shipment. To view the full warranty text please visit:*
https://www.flir.com/support-center/warranty/instruments/extech-product-warranty/

Calibration and Repair Services

Teledyne FLIR offers calibration and repair services *for the Extech brand products we sell. We offer NIST traceable calibration for most of our products.*

Customer Support

Local Telephone Support List: *https://support.flir.com/contact*

Return Material Authorization (RMA): *https://customer.flir.com/Home*

Customer Service: *https://support.flir.com/ContactService*

Technical Support: *https://support.flir.com*

www.extech.com

This document does not contain export-controlled information.