Russell RL060C

User's Guide

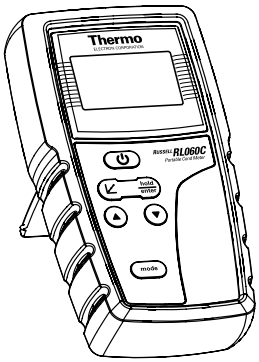

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Table of Contents

Chapter I
Introduction

Thank you for purchasing the Russell RL060C Portable Conductivity meter. These economy microprocessor-based handheld meters deliver up to ± 1% full-scale accuracy. It has a large custom LCD (Liquid Crystal Display) for clear and easy reading.

The RL060C measures Conductivity (µS/mS) and Temperature (°C). This sturdy meter measures up to 5 different ranges with auto-ranging capability that switches to appropriate measuring range automatically.

Your meter includes a conductivity electrode (cell constant K = 1.0) with built-in temperature sensor (Cat. No. 014005), 4 alkaline "AAA" batteries, instruction manual and warranty card.

Please read this manual thoroughly before operating your meter.

To order other accessories and calibration standard solutions, please refer to Section **Accessories** for more information.

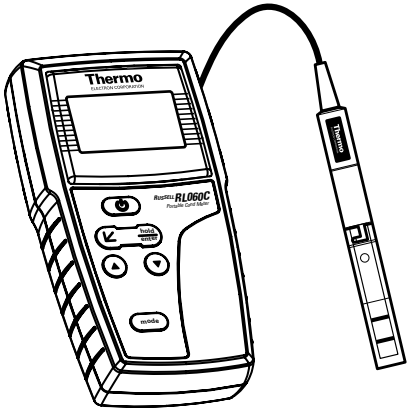


Figure 1: RL060C

Chapter II
Display & Keypad Functions

Display

The meter has a large custom LCD that consists of 4-digit segments and operation annunciators for µS/mS and °C (Temperature). Other annunciators include "HO" (when the HOLD function is activated) and "LO" (low battery condition).
See **Figure 2** below.

LCD and Customized Annunciators for RL060C meter

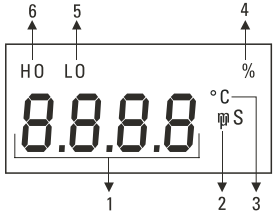


Figure 2: RL060C Display

1. Primary display
2. milli-Siemens/cm (mS) or micro-Siemens/cm (µS) indicator.
3. Temperature indicator
4. Percentage indicator for Temperature Coefficient.
5. Low battery indicator.
6. Hold (frozen) reading indicator.

Keypad

The conductivity meter has 6 keys on its splash-proof keypad; ⏻, 📈, hold enter and mode. Some buttons have several functions depending on its mode of operation.

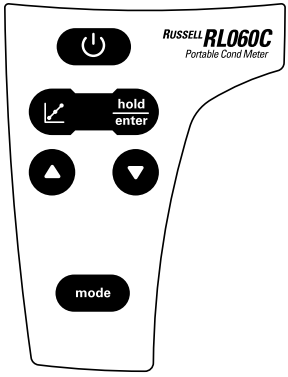


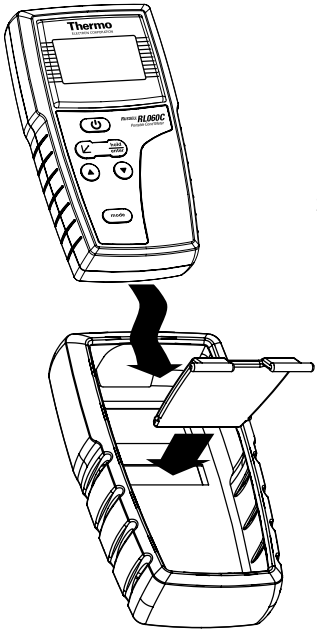
Figure 3: RL060C Keypad

⏻	• Powers on and shuts off the meter. Takes you directly into measurement mode when meter is switched on.
📈	• Enters into calibration mode for Conductivity and Temperature. • To abort calibration or setup mode without confirming any set value.
hold enter	• HOLD: Freezes the measured reading. To activate, press hold enter while in measurement mode. To release, press hold enter again. • ENTER: Press to confirm values in calibration mode, and to confirm selections in SETUP mode.
▲ ▼	• In CALIBRATION Mode: Press to scroll through calibration values. • In SETUP Mode: Press to scroll through the setup sub-group programs. • Press ▲ during conductivity measurement mode to activate manual ranging function. Each key press will move up higher conductivity range.
mode	• Selects measurement mode for conductivity and Temperature. • When pressed together with ⏻, it will take you into the SETUP mode. This allows you to customize meter preferences such as selecting an electrode's cell constant, normalization temperature, temperature coefficient factor, automatic (only conductivity) or manual calibration, single-point or multi-point calibrations, and to reset meter to factory default.

Chapter III
Preparation

Inserting & Removing Rubber Armor

(Armor on Cat. No. 5124002 only)

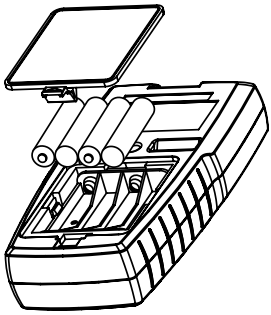


1. To remove the meter from rubber armor, push the bottom edges of the meter out until it is completely separated from the armor. Ensure that the cables of conductivity electrode or temperature probe are not connected.

2. To insert meter into rubber armor, slide in from the top of meter before pushing the bottom edges down and set it into position. Lift up the stand at the back of the meter for bench top applications if necessary.

Figure 4: RL060C Rubber Armor

Inserting the Batteries



The battery compartment is found at the back of instrument as shown. To open the battery compartment, push in the direction of the arrow and lift up the cover. Note the polarity of the battery before inserting it into position. Place the cover back and press down until it locks tight.

Figure 5:
Battery Compartment

Battery Replacement

A "LO" annunciator in the LCD alerts you when the battery power is running low. The replacement batteries are 4 alkaline "AAA".

Caution: *Power off the meter when changing battery.* ▲

Conductivity Electrode Information

The Russell RL060C hand-held meter is supplied with a conductivity electrode with a BNC connector. This conductivity electrode (Cat. No. 014005) comes with Stainless Steel rings, cell constant of K = 1.0, and a built-in temperature sensor for Automatic Temperature Compensation (ATC). Its specially designed Ultem-body housing has good chemical resistant properties. It provides fast temperature response and reduces air entrapment, which makes it easy to obtain accurate, stable readings.

The probe materials used which have good chemical durability include:

1. Polyetherimide (Ultem) – protective probe guard

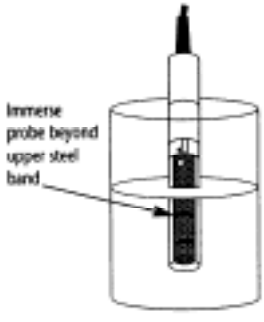
2. Polybutylterphalate (Valox) – sensor housing

3. Stainless Steel (SS 304) – 2 steel bands

Proper use of probe is essential to ensure that the optimum measurement is taken in a short time.

The removable protective plastic probe guard is meant for simple periodic maintenance and it must be kept intact during measurement and calibration.

Always immerse the probe beyond the upper steel band.



Note:

- *DO NOT remove the protective probe guard during measurement and calibration as it may affect your readings.* ▲
- *We recommend that you do not submerge the probe above the protective guard. You can submerge the cable for brief periods of time, but not continuously.* ▲

See Section ***Probe Care and Maintenance*** *for more information.* ▲

Figure 6: Conductivity Electrode

Connecting the Probe to Meter

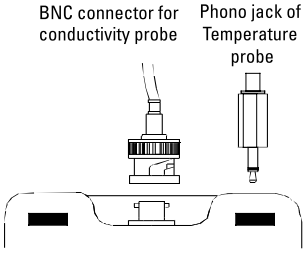


Figure 7: Meter Connections

1. To connect electrode into the meter, align the connector slots with the posts of the meter's socket and rotate the connector clockwise until it locks.

2. To remove, simply rotate the connector in anti-clockwise direction until it unlocks, and slide the connector off the socket.

3. Insert the mini phono jack of the temperature sensor into the socket on the meter as shown below.

4. Unplug the phono jack when not in use or when you want to measure conductivity without any temperature compensation. See **Manual Temperature Compensation**.

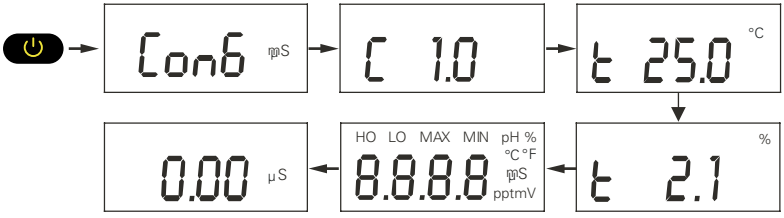
Caution: *Do not pull or force on the probe cord or the probe wires might disconnect.* ▲

Note: *Keep the connectors clean. Do not touch the connector with soiled hands.* ▲

Switching the Meter On

Press ⏻ to power up your meter.

It will then go through a series of displays, showing the various setup parameters.



Measurement Mode

1. The first screen shows [**Con6**].

2. Second screen shows [**C 1.0**] which is the conductivity cell constant, k. Default value is k=1.0. You can select different cell constants of 0.1, 1.0 or 10.0. Refer to **Advance Setup Functions** on Advanced Setup.

3. Third screen shows [**t 25.0 °C**] which is the Normalization Temperature. You can set Normalization Temperature at either 25 °C or 20 °C. Refer to section **Advance Setup Functions**. Default value is 25 °C.

4. Fourth screen shows [**t 2.1%**] which is the Temperature Coefficient. You can customize the meter with different Temperature Coefficient value from 0.0 to 3.0 %/°C from the Advance Setup mode. Default value is 2.1 %/°C.

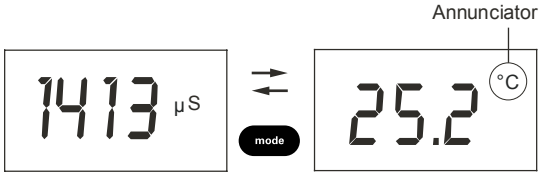
5. All LCD segments will light up for 2 seconds, and change into measurement mode.

6. You are now ready for conductivity measurement.

Change Conductivity to Temperature Measurement Mode

To switch between conductivity measurement mode and temperature measurement mode, simply press the mode.

The customized annunciator helps indicate the measurement parameter you are in.



Chapter IV
Calibration

Important Information on Meter Calibration

Your meter has five measuring ranges. You can calibrate one point in each of the measuring ranges (up to five points). If you are measuring values in more than one range, make sure to calibrate each of the ranges you are measuring.

The following table lists the corresponding conductivity ranges. You should calibrate each range using a solution that falls between the values in the "recommended calibration solution range" column

Conductivity Range	Recommended Calibration Solution Range
0.00 to 20.00 µS	6.00 to 17.00 µS
0.0 to 200.0 µS	60.0 to 170.0 µS
0 to 2000 µS	600 to 1700 µS
0.00 to 20.00 mS	6.00 to 17.00 mS
0.0 to 200.0 mS	60.0 to 170.0 mS

When you recalibrate your meter, old calibrations are replaced on a range basis. For example, if you previously calibrated your conductivity meter at 1413 µS in the 0 to 2000 µS range and you recalibrate at 1500 µS (also in the 0 to 2000 µS range), the meter will replace the old calibration data (1413 µS) in that range. The meter will retain all calibration data in other ranges.

To completely recalibrate your meter, or when you use a replacement probe, it is best to clear all calibration data. To erase all the old conductivity calibration data completely, see **Restore Factory Default Values**.

Preparing the Meter for Calibration

Before starting calibration, make sure you are in the correct measurement mode.

For best results, select a standard value close to the sample value you are measuring. Alternatively use a calibration solution value that is approximately 2/3 the full-scale value of the measurement range you plan to use. For example, in the 0 to 2000 µS conductivity range, use a 1413 µS solution for calibration.

Calibrate to all measurement ranges to ensure the highest accuracy throughout all measurement range. Note that RL060C will not accept calibration values that are less than 40 µS/cm. All new calibration values will automatically override existing data.

If you are measuring in solutions with conductivity lower than 100 µS/cm, calibrate the meter at least once a week to get good accuracy. If you are measuring in the mid ranges and you wash the probe in deionized water and store it dry, calibrate the meter once a month. If you take measurements at extreme temperatures, calibrate at least once a week.

Ensure that you use new conductivity standard solutions or sachets during calibration. Do not reuse standard solutions as it may be contaminated and affect the calibration and accuracy of measurements. Use fresh calibration solution each time you calibrate your meter. Store solutions in a dry and cool environment.

Always rinse the probe with either deionized water or rinse solution before and after each calibration/sample measurement to avoid cross-contamination. For details please refer to section **Probe Care and Maintenance**.

Note: *These meters are factory set to a temperature coefficient of 2.1% per °C. For most applications this will provide good results. To set the temperature coefficient to different value, see* ***Temperature Coefficient****. Also, see* ***Addendum 2 - Calculating Temperature Coefficient*** *to determine the appropriate temperature coefficient for your solution.* ▲

Note: *The factory default value for normalization temperature is 25 °C. If you need to normalize to a value other than 25 °C, see* ***Normalization Temperature****.* ▲

Selection of Automatic or Manual Calibration

This meter is capable of performing either automatic or manual calibration.

In the automatic calibration mode, the meter automatically detects and verifies the appropriate known calibration standards solutions being calibrated before accepting these particular calibration standards as one of its calibration values in a specific measurement range. This automatic calibration mode frees you from cumbersome calibration procedure.

The known calibration standards used for automatic calibration are:

Table 1
Conductivity Calibration Standards for Auto calibrations

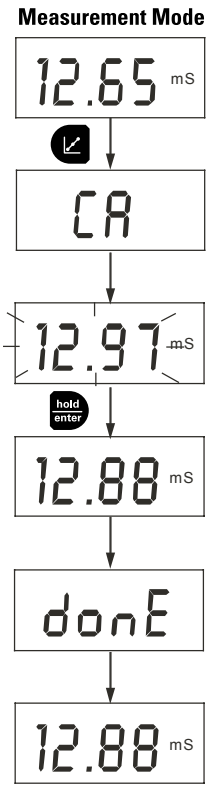
Meter	Normalization Temperature	Calibration Standards (Range)
RL060C	25 °C	1. 84 µS (for 0 – 200 µS/cm)
		2. 1413 µS (for 0 – 2000 µS/cm)
		3. 12.88 mS (for 0.00 – 20.00 mS/cm)
		4. 111.8 mS (for 0.0 – 200.0 mS/cm)
	20 °C	1. 76 µS (for 0 – 200 µS/cm)
		2. 1278 µS (for 0 – 2000 µS/cm)
		3. 11.67 mS (for 0.00 – 20.00 mS/cm)
		4. 102.1 mS (for 0.0 – 200.0 mS/cm)

In the manual calibration, non-standard calibration values can be used for calibration. You can manually input the appropriate values as your desired calibration standards in each specific range. This is useful when you have a customized calibration standard specifically unique for your application.

To select Automatic or Manual Calibration settings, refer to **Automatic Calibration** for more information.

Automatic Calibration

In the Automatic Calibration mode, the meter is capable of accepting either single-point or up to 4 points for multi-point calibration with maximum of 1 point per specific measurement range. For the known calibration standard values refer to **Table 1**.



1. If necessary, press mode to select conductivity mode.
2. Rinse the probe thoroughly with deionized water or a rinse solution, then rinse with a small amount of calibration standard.

Note: *For Automatic Calibration you must use one of the calibration standards listed in* ***Table 1***. ▲

3. Dip the probe into the calibration standard. Immerse the probe tip beyond the upper steel band (**see Figure 6**). Stir the probe gently to create a homogeneous sample. Allow time for the reading to stabilize.
4. Press ↙ to enter conductivity calibration mode. The [**CA**] indicator will appear for 1.5 seconds, and a value will appear flashing.

Note: *To exit calibration without confirmation, press* hold enter *again to go back to measurement mode.* ▲

5. Wait for the value to stabilize and press hold enter. The calibration standard value will appear for 3 seconds. If the calibration is successfully performed, a [**donE**] will be displayed for about 3 seconds, and the meter will returns to the measurement mode.

6. To perform the next point calibration in the multi-point calibration, repeat steps 1-5 until all points have been calibrated.

Important Notes:

1. *Meter allows a tolerance range of ±40% of its calibration standard. An error message "**Err 1**" will be displayed for 3 seconds if you attempt to calibrate with a solution whose value is outside the tolerance range.* ▲

   For instance: For 1413 µS conductivity calibration standard, 40% tolerance is from 848 µS to 1978 µS. ▲

2. *If the temperature (t °C) of the conductivity calibration solution is below 0 °C or above 50 °C (0 °C < t °C > 50 °C), an error message "**Err 2**" will be displayed when performing the auto calibration, and meter will return to measurement mode.* ▲

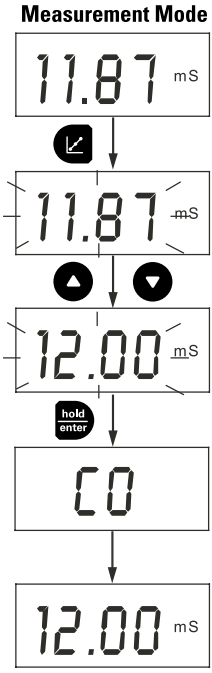
3. *All new calibration data will over-ride existing stored calibration data for each measuring range calibrated.* ▲

4. *It is important to use new conductivity calibration standards.* ▲

5. *Low conductivity standard solution (less than 20 µS /cm) cannot be obtained easily. Such low conductivity standard will be contaminated as soon as it is exposed to air, therefore you must exercise caution during calibration in the first measurement range (0.00 to 20.0 µS /cm).* ▲

Manual Calibration

In Manual Calibration mode, you can use customized conductivity calibration standards (specific to your own application) and calibrate the meter. The following example shows calibration sequence to 12.00 mS conductivity calibration standard.



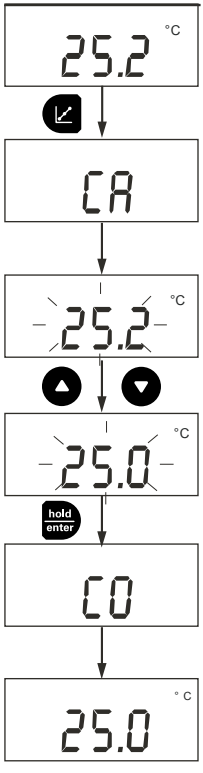
1. If necessary, press mode to select conductivity mode.
2. Rinse the probe thoroughly with deionized water or a rinse solution, then rinse with a small amount of calibration standard.
3. Dip the probe into the calibration standard. Immerse the probe tip beyond the upper steel band (**see Figure 6**). Stir the probe gently to create a homogeneous sample. Allow time for the reading to stabilize.
4. Press to enter conductivity calibration mode. The [**CA**] indicator will appear for 1.5 seconds, and a value will appear flashing.

Note: *To exit calibration without confirmation, press again to go back to measurement mode.* ▲

5. Wait for the value to stabilize and press or and adjust the value to the calibration standard used.
6. Press hold enter. The [**CO**] indicator will appear for 1.5 seconds, and the calibration is successfully performed. The meter returns to measurement mode.
7. To perform the next point calibration in the multi-point calibration for next range, repeat step 1-6 again until all points have been calibrated.

Temperature Calibration

The Conductivity electrode (Refer to **Accessories** section for order number) has a built-in temperature sensor for ATC. The temperature sensor is factory calibrated to the meter. Calibrate your sensor only if you suspect temperature errors that may have occurred over a long period of time or if you have a replacement probe.



1. Make sure that the phono jack (for temperature measurement) is properly connected to the meter. See **Figure 7**.
2. Switch on the meter and if necessary, press mode to select temperature measurement mode. See **Change Conductivity to Temperature Measurement Mode**.
3. Press to start the temperature calibration process.
4. Dip the probe into a solution with known temperature (for example, a temperature bath). Allow time for the temperature to stabilize.
5. Wait for the value to stabilize and press or and adjust the value to the solution temperature.
6. Press hold enter. The [**CO**] indicator will appear for 1.5 seconds, and the reading will stop flashing. The temperature calibration is successfully performed. The meter returns to measurement mode.

Note: *To exit calibration without confirmation, press again to go back to measurement mode.* ▲

Note: *You can offset the temperature reading up to ±5 °C from the original (default) reading.* ▲

Chapter V
Measurement

The RL060C meter is capable of taking measurements with automatic or manual temperature compensation.

With Automatic Temperature Compensation (ATC)

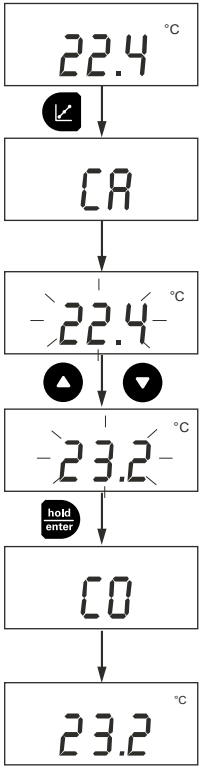
For ATC, make sure the phono jack of the probe (see **Figure 7**) is securely inserted.

The conductivity reading displayed will be compensated for according to the normalization temperature (20 °C or 25 °C) selected. See section **Normalization Temperature**.

Without ATC (Manual Temperature Compensation)

For manual temperature compensation, simply unplug the probe's phono jack (not BNC) from the meter.

To use manual temperature compensation, you need to enter the temperature value of your process into the meter. This is the value at which the reading will manually temperature compensates. You can select any temperature between 0 and 50 °C (32 to 122 °F). Default value is 25 °C.



1. Make sure that the phono jack (for temperature measurement) is disconnected from the meter. See **Figure 7**.
2. Switch on the meter and if necessary, press mode to select temperature measurement mode. See Section **Change Conductivity to Temperature Measurement Mode**.
3. Press to start temperature calibration process.
4. The "**CA**" will appear momentarily and a temperature value will start flashing.
5. Check the temperature of your sample using an accurate thermometer. Wait for the value to stabilize and press or and adjust the value to the reference thermometer used.
6. Press hold enter. The [**CO**] indicator will appear for 1.5 seconds, and the reading will stop flashing. The temperature calibration is successfully performed. The meter returns to measurement mode.

Taking Measurements

To take readings:

1. Rinse the probe with deionized or distilled water before use to remove any impurities adhering to the probe body. Shake or air dry. To avoid contamination or dilution of your sample, rinse probe with a small volume of your sample liquid.

2. Press  to switch on meter.

3. Dip the probe into the sample.

4. Allow time for the reading to stabilize. Note the reading on the display.

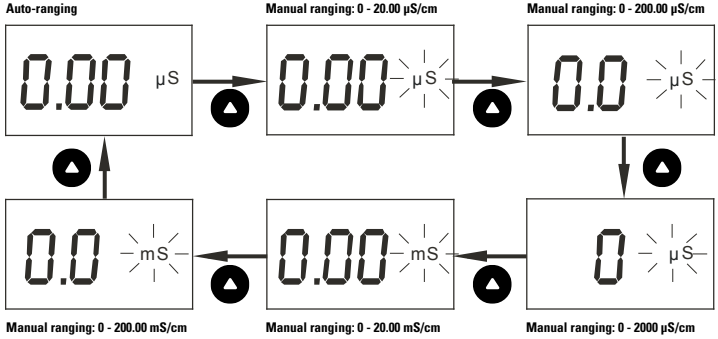
Note: *When dipping the probe into the sample, take care to ensure that the liquid level is above its upper steel band. Stir the probe gently in the sample to create a homogenous sample. See* ***Figure 6****.* ▲

Using Manual Ranging Function

By default your meter has auto-ranging ability and would automatically select the range in which your readings appear.

However, you may also manually select a specific range you want to measure. This is possible by simply pressing ▲ successively for each measurement range. The five ranges are:

Conductivity Range
0 – 20.00 µS/cm
0 – 200.0 µS/cm
0 – 2000 µS/cm
0 – 20.00 mS/cm
0 – 200.0 mS/cm

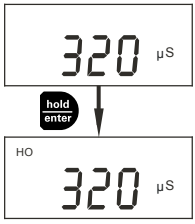


Note: *If the value of the solution you are measuring is higher than the range selected [**Or**] will appear on the primary display. Press ?? RANGE?? until the correct range is selected.* ▲

The meter resets to the Auto-ranging function once it is turned off. You will have reset the manual ranging function each time you turn the meter off. ▲

HOLD Function

This feature lets you freeze the display for a delayed observation. HOLD can be used any time in measurement mode.



1. To hold a measurement, press hold enter while in measurement mode. [**HO**] will appear on the display.
2. To release the held value, press hold enter again. Continue to take measurements.

Note: *This meter shuts off automatically after 20 minutes of non use. If the meter is shut off either automatically or manually, the HOLD value will be lost.* ▲

Chapter VI
Advance Setup Functions

Advanced Setup Overview

The advanced setup mode lets you customize your meter's preferences and defaults. To enter advanced setup mode:

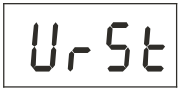
1. Make sure that the meter is switched-off.

2. Press ⏻ and mode simultaneously, holding both keys for 2 seconds. First release ⏻ first before releasing mode.

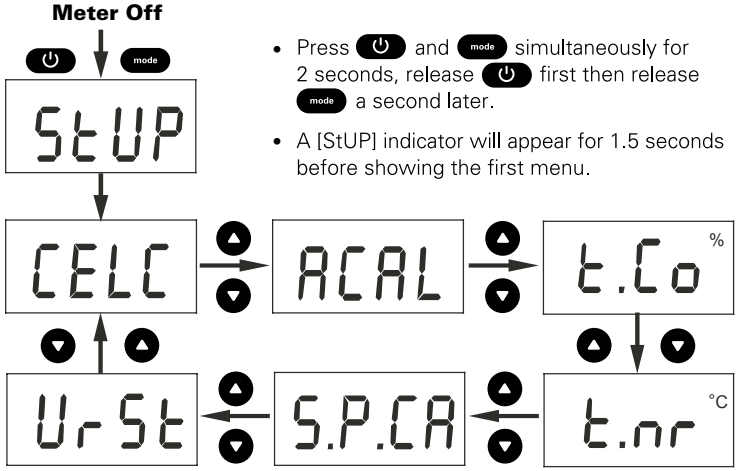
3. [**StUP**] indicator will appear momentarily and [**CELC**] will appear next.

4. An overviews of the Setup Menu as follows.

	• Enter Setup Page.
	• Select Cell Constant. Choice of k = 0.1, 1.0, and 10.0. • Default value is 1.0.
	• Select Automatic Calibration. "Yes" for auto calibration and "no" for manual calibration. • Default value is "Yes".
	• Adjust Temperature Coefficient value from 0.0 to 3.0 %/°C. • Default value is 2.1 %/°C.

	• Select Normalization Temperature. Choice of either 20 °C or 25 °C. • Default value is 25 °C.
	• Select Single Point Calibration. Choice of "Yes" or "No". • Default value is "Yes".
	• User re-set to factory defaults. Choice of "Yes" or "No". • Default value is "no".

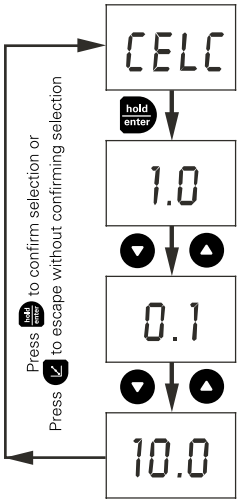
Overview of Advanced Setup



- Press ⏻ and mode simultaneously for 2 seconds, release ⏻ first then release mode a second later.
- A [StUP] indicator will appear for 1.5 seconds before showing the first menu.

Select Cell Constant

This meter lets you select a cell constant of K = 1.0, 10, or 0.1.



- Use a cell of K = 1.0 for midrange measurements
- Use a cell of K = 10 for high range measurements (above 20 mS).
- Use a cell of K = 0.1 for low range measurements (below 20 µS).

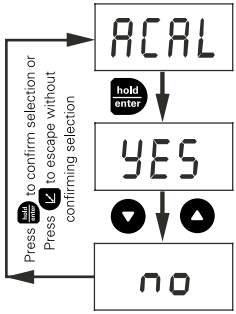
The cell included with your meter has a cell constant of K = 1.0.

1. Enter the advanced setup as described in Section **Advanced Setup Overview**.
2. Press ▲ or ▼ until [**CELC**] appears on the LCD. Press hold enter.
3. Press ▲ or ▼ to select either "1.0", "0.1" or "10.0". Ensure the cell constant selected corresponds with the conductivity electrode you are using.
4. Press hold enter to select. The meter will take you back to the menu, [**CELC**].
5. Press ▲ or ▼ to move to the next menu or press to exit to measurement mode.

Automatic Calibration

The automatic calibration allows you to quickly calibrate the meter to any of the four widely used conductivity calibration standards. For a list of calibration standards refer to **Table 1**, **Selection of Automatic or Manual Calibration**.

In the manual calibration mode, you can use your own customized conductivity calibration standard to calibrate this meter.

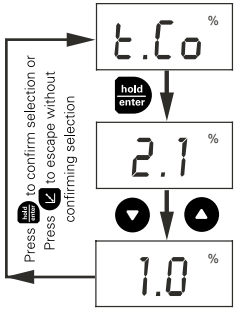


1. Enter the advanced setup as described in Section **Advanced Setup Overview**.
2. Press ▲ or ▼ until [**ACAL**] appears on the LCD. Press hold enter.
3. Press ▲ or ▼ to select either [**Yes**] or [**no**].
4. Press hold enter to select. The meter will take you back to the menu, [**ACAL**].
5. Press ▲ or ▼ to move to the next menu or press ↙ to exit to measurement mode.

Temperature Coefficient

The temperature coefficient is the amount of change in conductivity per degree of temperature; it is expressed in percent per °C. Entering the exact temperature coefficient of your solution lets you accurately compensate temperature for almost any solution. You can adjust 0.0 to 3.0 % per °C.

Meter default is 2.1% per °C.

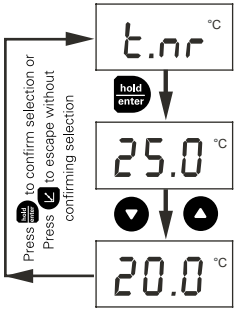


1. Enter the advanced setup as described in Section **Advanced Setup Overview**.
2. Press ▲ or ▼ until [**t.Co %**] appears on the LCD. Press hold enter.
3. Press ▲ or ▼ to select a value between 0.0 to 3.0.
4. Press hold enter to select. The meter will take you back to the menu, [**t.Co %**].
5. Pressor ▲ or ▼ to move to the next menu or press ↗ to exit to measurement mode.

Normalization Temperature

You can set the meter to normalize its conductivity measurements to a standard temperature of either 25 °C or 20 °C.

The default value is 25 °C.

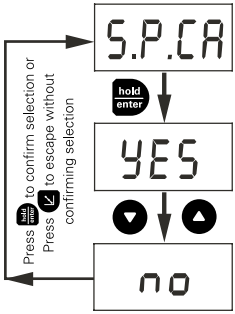


1. Enter the advanced setup as described in Section **Advanced Setup Overview**.
2. Press ▲ or ▼ until [**t.nr °C**] appears on the LCD. Press hold enter.
3. Press ▲ or ▼ to select either [**25.0 °C**] or [**20.0 °C**].
4. Press hold enter to select. The meter will take you back to the menu, [**t.nr °C**].
5. Press ▲ or ▼ to move to the next menu or press ↙ to exit to measurement mode.

Single-Point Calibration

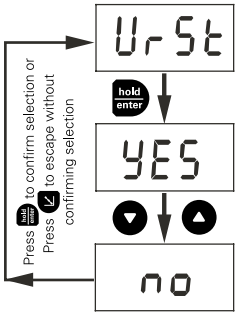
Single-point calibration refers to calibrating one conductivity value and uses it for the entire 5 conductivity ranges.

By selecting [no] to single-point calibration, you can perform calibration for each conductivity range.



1. Enter the advanced setup as described in Section **Advanced Setup Overview**.
2. Press ▲ or ▼ until [**S.P.CA**] appears on the LCD. Press hold enter.
3. Press ▲ or ▼ to select either [**Yes**] or [**no**].
4. Press hold enter to select. The meter will take you back to the menu, [**S.P.CA**].
5. Press ▲ or ▼ to move to the next menu or press ↙ to exit to measurement mode.

Restore Factory Default Values



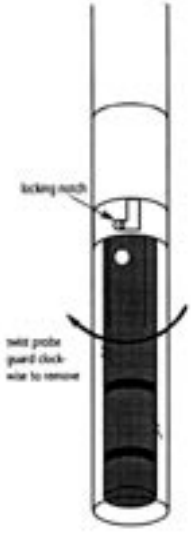
This function allows you to reset all parameters to factory default settings. This clears all calibration data and any other setup functions you might have changed.

Important: *Once activated the meter's settings and calibration data will be erased. Always exercise caution as meter reset* ***is not*** *reversible.* ▲

1. Enter the advanced setup as described in Section **Advanced Setup Overview**.
2. Press ▲ or ▼ until [**UrSt**] appears on the LCD. Press hold enter.
3. Press ▲ or ▼ to select either [**Yes**] or [**no**].
4. Press hold enter to select.
5. The meter will go back to measurement mode after the switch-on initialization as shown in Section **Switching the Meter On**.

Chapter VII
Probe and Maintenance

Keep the conductivity probe clean. Rinse the probe twice, and gently swirl it while you take readings. For best accuracy, soak a dry probe for at least 5 to 10 minutes or longer before calibration. Rinse the probe with deionized or tap water before storing. Never scratch the bands with a hard substance. Do not strike the probe against any hard surface.



Do not immerse the probe in oily solutions. Clean the electrode thoroughly by stirring it in a mild detergent bath or isopropyl alcohol. Wipe the probe with soft tissue paper. Rinse thoroughly in tap water and then in deionized water. Recalibrate the meter after cleaning the probe.

The conductivity probe (Cat. No. 014005) which is included with your meter features a removable probe guard to make cleaning easy.

To remove probe guard:

1. Grip probe guard and twist clockwise. The locking notch will release.

2. Slide probe guard off end of probe.

Note: *Remember to re-attach the probe guard prior to taking readings. Failure to do so could result in erroneous readings.* ▲

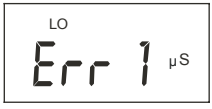
Chapter VIII
Troubleshooting Guide

Problem	Cause	Solution
Power on but no display	a. Batteries not in place	a. Check that batteries are in place and making good contact.
	b. Batteries not in correct polarity (+ and – position).	b. Re-insert batteries with correct polarity.
	c. Weak batteries	c. Replace batteries.
Unstable readings	a. Air bubbles in probe.	a. Tap probe to remove bubbles.
	b. Dirty probe.	b. Clean the probe and recalibrate.
	c. Probe not deep enough in sample.	c. Make sure sample entirely covers the probe sensors.
	d. External noise pickup or induction caused by nearby electric motor.	d. Move or switch off interfering motor.
	e. Broken probe.	e. Replace probe.
Slow response	a. Dirty / Oily probe.	a. Clean probe. See **Probe Care & Maintenance**.

Chapter IX
Error Messages

LCD Display	Indicates	Cause	Solution
"LO" indicator appears.	Low battery level.	Need new batteries or battery connection is bad.	Clean battery contacts. Replace batteries with fresh ones, noting polarity.
Err 1	Conductivity calibration error	Calibration point is outside the ± 40% window in the auto-calibration.	Check the value of the conductivity calibration solution. Switch to manual calibration mode and calibrate again. If message persists, return unit*.
Err. 2	Temperature calibration error.	Auto calibration is performed outside the temperature range (0 – 50 °C).	Check the temperature and make sure that it is within the acceptable range. If message persists, return unit*.
Err. 3	Conductivity calibration error.	Calibration point is within 10% of the measurement range in the manual calibration mode.	Check the value of the conductivity calibration solution. If message persists, return unit*.

* See Sections **Terms and Conditions**.



If an error message appears, switching off the meter and switching it on again may eliminate the error message. Refer to diagram on right.

If error persists, or the meter shows incorrect values, return the meter.

For a complete diagram of the display see section **Display**.

Chapter X
Specification

Specifications	Descriptions
Conductivity Range	0 to 20.00, 200.0, 2000 µS/cm; 0 to 20.00, 200.0 mS/cm
Resolution	0.01, 0.1, 1 µS/cm; 0.01, 0.1 mS/cm
Accuracy	±1% F.S.
Temperature Range	-10.0 to 110.0 °C
Resolution/Accuracy	0.1 °C / ± 0.5 for °C
Cell Constant	0.1, 1.0, 10.0 (selectable)
Temperature Compensation	Automatic/Manual (from 0 to 50 °C)
Temperature Coefficient	0.0 to 3.0% / °C
Normalization Temperature	20.0 °C and 25.0 °C (selectable)
Number of calibration points	5: Maximum 1 per range
Auto- & Manual-ranging	
HOLD Function	
Auto Power off	20 minutes after last key operation
Inputs	BNC for conductivity and phono jack for temperature
Display	Single Custom LCD
Power Requirements	4 'AAA' Batteries
Battery Life	> 100 hours
Dimension / Weight	Meter: 14 x 7 x 3.5 cm; 200 g

Chapter XI
Accessories

Replacement Meter and Meter accessories

Item	Cat. No.
RL060C portable conductivity meter complete with conductivity probe of k=1.0 **with rubber armor**	5124002
RL060C portable conductivity meter complete with conductivity probe of k=1.0 **without rubber armor**	5224003
3 ring SS, Ultem body Electrode with ATC & BNC plug, cell constant = 1.0 x 110 mm, 1m cable length	014005

Calibration Solutions

Cat. No.	Package	Description
011005	5 x 60 mL	111.9 mS/cm Conductivity Standard
011006	5 x 60 mL	12.9 mS/cm Conductivity / TDS Standard
011007	5 x 60 mL	1413 µS/cm Conductivity / TDS Standard
011008	5 x 60 mL	100 µS/cm Conductivity / TDS Standard
01100510	10 x 15 mL pouches	111.9 mS/cm Conductivity Standard
01100610	10 x 15 mL pouches	12.9 mS/cm Conductivity/TDS Standard
01100710	10 x 15 mL pouches	1413 µS/cm Conductivity/TDS Standard
01100810	10 x 15 mL pouches	100 µS/cm Conductivity/TDS Standard
01100910	10 x 15 mL pouches	147 mS/cm Conductivity Standard

Chapter XII
Conductivity Theory

Conductance is a quantity associated with the ability of primarily aqueous solutions to carry an electrical current, I, between two metallic electrodes when a voltage E is connected to them. Though water itself is a rather poor conductor of electricity, the presence of ions in the water increases its conductance considerably, the current being carried by the migration of the dissolved ions. This is a clear distinction from the conduction of current through metal, which results from electron transport.

The conductance of a solution is proportional to and a good, though non-specific indicator of the concentration of ionic species present, as well as their charge and mobility. It is intuitive that higher concentrations of ions in a liquid will conduct more current. Conductance derives from Ohms law, E = IR, and is defined as the reciprocal of the electrical resistance of a solution.

C = 1 / R

where C is conductance (siemens)
R is resistance (ohms)

One can combine Ohms law with the definition of conductance, and the resulting relationship is:

C = I / E

where I is current (amps)
E is potentials (volts)

In practice, conductivity measurements involve determining the current through a small portion of solution between two parallel electrode plates when an AC voltage is applied. Conductivity values are related to the conductance (and thus the resistance) of a solution by the physical dimensions --- area and length --- or the cell constant of the measuring electrode. If the dimensions of the electrodes are such that the area of the parallel plates is very large, it is reasonable that more ions can reside between the plates, and more current can be measured. The physical distance between the plates is also critical, as it effects the strength of the electric field between the plates.

If the plates are close and the electric field is strong, ions will reach the plates more quickly than if the plates are far apart and the electric field is weak. By using cells with defined plate areas and separation distances, it is possible to standardize or specify conductance measurements.

Thus derives the term specific conductance or conductivity.

The relationship between conductance and specific conductivity is:

Specific Conductivity, S.C. = (Conductance) (cell constant, k)
=siemens* cm/cm^2
= siemens/cm

Since the basic unit of electrical resistance is the ohm, and conductance is the reciprocal of resistance, the basic unit of conductance was originally designated a "mho" – ohm spelled backwards – however, this term has been replace by the term "siemen". Conductivity measurements are reported as Siemens/cm, since the value is measured between opposite faces of a cell of a known cubic configuration. With most aqueous solutions, conductivity quantities are most frequently measured in microSiemens per cm (µS/cm) or milliSiemens per cm (mS/cm).

The salinity value which ranges from 2 to 42 is a measure of all salts, not just sodium chloride. This scale was originally devised for seawater, and is based on seawater at 15 °C having a conductivity equivalent to that of a potassium chloride solution of a known concentration. This solution (0.44 molal) is defined as having a salinity of 35 ppt.

The total dissolved solids scale approximate the ppm TDS in surface waters by multiplying the conductivity of a sample by a factor, 0.66.

Some users prefer the use of resistivity units to describe their water, particularly where high purity water is involved. The unit most often used to describe resistivity is megohm-cm, which are simply the reciprocal of conductivity (µS/cm). The chart below shows the relationship between these units.

Conductivity, µS/cm	Resistivity, megohm-cm
0.056	18
0.1	10
1.0	1.0
2.5	0.4
10.0	0.1

Conductivity and Temperature

Conductivity in aqueous solutions reflects the concentration, mobility, and charge of the ions in solution. The conductivity of a solution will increase with increasing temperature, as many phenomena influencing conductivity such as solution viscosity are affected by temperature.

The relationship between conductivity and temperature is predictable and usually expressed as relative % change per degree centigrade. This temperature coefficient (% change per degree) depends on the composition of the solution being measured. However, for most medium range salt concentration in water, 2% per degree works well. Extremely pure water exhibits a temperature coefficient of 5.2%, and concentrated salt solutions about 1.5%.

Since temperature affects the conductivity measurement so profoundly, the usual practice is to reference the conductivity to some standard temperature. This is typical 25 °C, but the RL060C meters permit the choice of 20 °C or 25 °C in the advance setup menu.

Both meters permit you to enter the temperature coefficient which best suits your sample and use an ATC probe to automatically temperature compensate back to the chosen reference temperature.

Chapter XIII
Terms and Conditions

General

Seller hereby offers for sale to the buyer ("Buyer") the products herein (the "Products") on the express condition that Buyer agrees to accept and be bound by the terms and conditions set forth herein. Any provisions contained in any document issued by Buyer are expressly rejected and if the terms and conditions in this Agreement differ from the terms of Buyer's offer, this document shall be construed as a counter offer and shall not be effective as an acceptance of Buyer's document. Buyer's receipt of Products or Seller's commencement of the services provided hereunder will constitute Buyer's acceptance of this Agreement. This is the complete and exclusive statement of the contract between Seller and Buyer with respect to Buyer's purchase of the Products. No waiver, consent, modification, amendment or change of the terms contained herein shall be binding unless in writing and signed by Seller and Buyer. Seller's failure to object to terms contained in any subsequent communication from Buyer will not be a waiver or modification of the terms set forth herein. All orders are subject to acceptance in writing by an authorized representative of Seller.

Warranty

Thermo Electron warranty for Russell products covers failures due to manufacturer's workmanship or material defects from the date of purchase by the user. User should return the warranty card to Thermo Electron and retain proof of purchase. Warranty is void if product has been abused, misused, or repairs attempted by unauthorized persons.

Warranties herein are for product sold/installed by Thermo Electron or its authorized dealers.

Any product sold by a U.S. or Canadian distributor must be returned to Thermo Electron for any warranty work. Please contact our Technical Service department for further information. A Return Authorization Number must be obtained from Thermo Electron Technical Service before returning any product for in-warranty repair or replacement. In the event of failure within the warranty period, Thermo Electron will at Thermo Electron's option, repair or replace product not conforming to this warranty. There may be additional charges, including freight, for warranty service performed in some countries. For service, call Thermo Electron (or its authorized dealer outside the United States and Canada). Thermo Electron reserves the right to ask for proof of purchase, such as the original invoice or packing slip.

The following products are warranted to be free from defects in material and workmanship in the period listed below from the date of purchase from the user or from the date of shipment from Thermo Electron, whichever is earlier, provided use is in accordance with the operating limitations and maintenance procedures in the instruction manual and when not having been subjected to accident, alteration, misuse, abuse or breakage of electrodes:

Twenty-four months from date of purchase by the user (or thirty-six months from date of shipment from Thermo Electron)

All Russell RL060P and RL060C meters.

Six months from date of purchase by the user

Thermo Electron pH probes 9142BN, 9146BN, 9147BN; ATC probe 917004; conductivity probe 014005.

Warranty also includes failure for any reason (excluding breakage), except abuse, provided the electrode is not used in solutions containing silver, sulfide, perchlorate, or hydrofluoric acid; or in solutions more than one (1) Molar in strong acid or base at temperatures above 50 °C.

"Out-of-Box" Warranty - Should any of the following products fail to work when first used, contact Thermo Electron immediately for replacement.

THE WARRANTIES DESCRIBED ABOVE ARE EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES WHETHER STATUTORY, EXPRESS OR IMPLIED INCLUDING, BUT NOT LIMITED TO, ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE AND ALL WARRANTIES ARISING FROM THE COURSE OF DEALING OR USAGE OF TRADE. THE BUYER'S SOLE AND EXCLUSIVE REMEDY IS FOR REPAIR OR REPLACEMENT OF THE NON-CONFORMING PRODUCT OR PART THEREOF, OR REFUND OF THE PURCHASE PRICE, BUT IN NO EVENT SHALL THERMO ELECTRON (ITS CONTRACTORS AND SUPPLIERS OF ANY TIER) BE LIABLE TO THE BUYER OR ANY PERSON FOR ANY SPECIAL, INDIRECT, INCIDENTAL, OR CONSEQUENTIAL DAMAGES WHETHER THE CLAIMS ARE BASED IN CONTRACT, IN TORT (INCLUDING NEGLIGENCE), OR OTHERWISE WITH RESPECT TO OR ARISING OUT OF THE PRODUCT FURNISHED HEREUNDER. REPRESENTATION AND WARRANTIES MADE BY ANY PERSON, INCLUDING ITS AUTHORIZED DEALERS, REPRESENTATIVES AND EMPLOYEES OF THERMO ELECTRON WHICH ALTER OR ARE IN ADDITION TO THE TERMS OF THIS WARRANTY SHALL NOT BE BINDING UPON THERMO ELECTRON UNLESS IN WRITING AND SIGNED BY ONE OF ITS OFFICERS.

Limitation of Liability

NOTWITHSTANDING ANYTHING TO THE CONTRARY CONTAINED HEREIN, THE LIABILITY OF SELLER UNDER THESE TERMS AND CONDITIONS (WHETHER BY REASON OF BREACH OF CONTRACT, TORT, INDEMNIFICATION, OR OTHERWISE, BUT EXCLUDING LIABILITY OF SELLER FOR BREACH OF WARRANTY (THE SOLE REMEDY FOR WHICH SHALL BE AS PROVIDED UNDER SECTION 2 ABOVE)) SHALL NOT EXCEED AN AMOUNT EQUAL TO THE LESSER OF (A) THE TOTAL PURCHASE PRICE THERETOFORE PAID BY BUYER TO SELLER WITH RESPECT TO THE PRODUCT(S) GIVING RISE TO SUCH LIABILITY OR (B) ONE MILLION DOLLARS ($1,000,000). NOTWITHSTANDING ANYTHING TO THE CONTRARY CONTAINED HEREIN, IN NO EVENT SHALL SELLER BE LIABLE FOR ANY INDIRECT, SPECIAL, CONSEQUENTIAL OR INCIDENTAL DAMAGES (INCLUDING WITHOUT LIMITATION DAMAGES FOR LOSS OF USE OF FACILITIES OR EQUIPMENT, LOSS OF REVENUE, LOSS OF DATA, LOSS OF PROFITS OR LOSS OF GOODWILL), REGARDLESS OF WHETHER SELLER (A) HAS BEEN INFORMED OF THE POSSIBILITY OF SUCH DAMAGES OR (B) IS NEGLIGENT.

Miscellaneous

(a) The rights and obligations of the parties hereunder shall be governed by and construed in accordance with the laws of the Commonwealth of Massachusetts, without reference to its choice of law provisions. Each party hereby irrevocably consents to the exclusive jurisdiction of the state and federal courts located in Suffolk County, Massachusetts, in any action arising out of or relating to this Agreement and waives any other venue to which it may be entitled by domicile or otherwise. (b) In the event of any legal proceeding between the Seller and Buyer relating to this Agreement, neither party may claim the right to a trial by jury, and both parties waive any right they may have under applicable law or otherwise to a right to a trial by jury. Any action arising under this Agreement must be brought within one (1) year from the date that the cause of action arose.

Chapter XIV
Declaration of Conformity

Manufacturer: Thermo Electron Corporation

Address: 166 Cummings Center
Beverly, MA 01915
USA

The above named Manufacturer hereby declares that the product(s) described below conforms to the Standards and Directives listed below:

Conductivity RL060C portable meter

Directive / Standard

89/336/EEC Electromagnetic Compatibility (EMC) Directive

EMC essential requirements for measurement device:

EN 61326 : 1997
EN 55022
EN 61000-4-2/-3

These products have been manufactured in compliance with the provisions of the relevant Thermo Electron manufacturing and test documents and processes. Further, these documents and processes are recognized as complying with ISO 9001:2000 by QMI, listed as File #001911.

Place and date of issue:
Beverly, MA,
November 16, 2005

Robert Manning
Manager of Quality

Chapter XV
Assistance

After troubleshooting all components of your measurement system, contact The Technical Edge℠ for Orion products. Within the United States call 1.800.225.1480, outside the United States call 978.232.6000 or fax 978.232.6031. In Europe, the Middle East and Africa, contact your local authorized dealer. For the most current contact information, visit www.thermo.com/water or email info.water@thermo.com.

Chapter XVI
WEEE Compliance

This product is required to comply with the European Union's Waste Electrical & Electronic Equipment (WEEE) Directive 2002/96/EC . It is marked with the following symbol:

Thermo Electron has contracted with one or more recycling/disposal companies in each EU Member State and this product should be disposed of or recycled through them. Further information on Thermo Electron's compliance with these Directives, the recyclers in your country, and information on Thermo Electron products which may assist the detection of substances subject to the RoHS Directive are available at www.thermo.com/WEEERoHS.

Addendum 1
Calibration Tips

You only need one calibration for measurement throughout the entire range of the meter. If a range was not calibrated, the meter automatically detects the closest range calibrated and uses that calibration information. However, only the ranges that were calibrated have maximum accuracy.

If you are measuring in ranges near to or greater than 20 mS (10 ppt), or near to or lower than 100 µS (50 ppm), calibrate the meter at least once a week to get specified ±1% F.S. accuracy.

If you are measuring in the mid-ranges and you washed the probe in deionized water and stored it dry, calibrate the meter at least once a month.

Wet the probe for 10 minutes before calibrating or taking readings to saturate the probe surface and minimize drift. If you make measurements at extreme temperatures, calibrate the meter at least once a week.

You should only use the conductivity probe specified for these meters. These probes have a built-in temperature sensor. If you use a different probe without a temperature sensor, you must measure the solution temperature separately and manually enter the solution temperature. See **Manual Temperature Compensation**.

Addendum 2
Calculating Temperature Coefficients

To determine the temperature coefficient of your sample solution use this formula:

$$\mathbf{tc} = \frac{\mathbf{100 \times C_{T2} - C_{T1}}}{\mathbf{C_{T1}\,(T_2 - 25) - C_{T2}\,(T_1 - 25)}}$$

Where:

tc	= Temperature coefficient	**25**	= 25 °C
$\mathbf{C_{T1}}$	= Conductivity at Temp 1	$\mathbf{C_{T2}}$	= Conductivity at Temp 2
$\mathbf{T_1}$	= Temp 1	$\mathbf{T_2}$	= Temp 2

Note: *A controlled temperature water bath is ideal for this procedure.* ▲

1. Immerse the probe into a sample of your solution and adjust the temperature coefficient to 0% (that is, no compensation) by following instructions as described in Section **Temperature Coefficient**.

2. Wait for 5 minutes. Note $\mathbf{T_1}$ and $\mathbf{C_{T1}}$ (conductivity at $\mathbf{T_1}$).

3. Condition the sample solution and probe to a temperature ($\mathbf{T_2}$) that is about 5 °C to 10 °C different from $\mathbf{T_1}$, and note the conductivity reading $\mathbf{C_{T2}}$.

Note: Record your results for future reference. Ideally $\mathbf{T_1}$ and $\mathbf{T_2}$ should bracket your measurement temperature, and should not different by more than 5 °C. ▲

4. Calculate the temperature coefficient of your solution according to the formula shown above.

5. Enter the temperature coefficient you calculated into the meter. Refer to Section **Temperature Coefficient**.

The calculated temperature coefficient will not be applied to all the meter readings.

Thermo Electron Corporation

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Water Analysis Instruments

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