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FCC Notice

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

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

Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy, and if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
RF Exposure Information

This equipment complies with the FCC RF radiation requirements for uncontrolled environments. To maintain compliance with these requirements, the antenna and any radiating elements should be installed to ensure that a minimum separation distance of 20 cm is maintained from the general population.

Changes or modifications not expressly approved by the party responsible for compliance could void the users' authority to operate the equipment.

Professional Installation

In accordance with section 15.203 of the FCC rules and regulations, the Meter Interface Unit (MIU) must be professionally installed by trained meter installers. Changes or modifications not expressly approved by the party responsible for compliance void the user's authority to operate the equipment.

Industry Canada

The term "IC" before the radio certification number only signifies that Industry Canada technical specifications were met.

This Class B digital apparatus meets all requirements of the Canadian Interference Causing Equipment Regulations. Operation is subject to the following two conditions:

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

Cet appareil numérique de la classe B répond à toutes les exigences de l'interférence canadienne causant des règlements d'équipement. L'opération est sujette aux deux conditions suivantes: (1) ce dispositif peut ne pas causer l'interférence nocive, et (2) ce dispositif doit accepter n'importe quelle interférence reçue, y compris l'interférence qui peut causer l'opération peu désirée.
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Chapter 1: Product Description

This chapter provides a general description of the Neptune® E-CODER® R450™ register. The E-CODER)R450i is an integrated register containing both the E-CODER® and R450™ technologies in one register that collects meter data. It then transmits the data that a meter reader collects. A Neptune fixed network data collection system receives the data and stores it to download into the utility billing system for processing.

The E-CODER)R450i can be upgraded and configured. At the factory, serial numbers are programmed into the MIU and each MIU is given two unique serial numbers or identification numbers. Custom serial numbers are not available.

RF Protocol Error Detection

The RF protocol is comprised of a header, data packet, and an error detection mechanism that reduces the erroneous data.

Low Battery RF Emissions

The MIU does not produce out-of-band emissions under low battery conditions. The E-CODER)R450i is easy to install and requires a Federal Communications Commission (FCC) license to operate. For information on obtaining an FCC license, refer to “FCC Licensing,” in the R450™ System New Customer Guide.

Figure 1 – E-CODER®)R450™
This page intentionally left blank.
Chapter 2: Specifications

This chapter defines the specifications for the E-CODER®R450™.

Electrical Specifications

The following table defines the specifications for the E-CODER R450i.

Table 1 – E-CODER®R450™ Specifications

<table>
<thead>
<tr>
<th>Specification</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Environmental Conditions</strong></td>
<td></td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>–15º to 149ºF (–10º to +65ºC).</td>
</tr>
<tr>
<td>Storage Temperature</td>
<td>–40º to 158ºF (–40º to 70ºC).</td>
</tr>
<tr>
<td>Operating Humidity</td>
<td>100% submersible.</td>
</tr>
<tr>
<td><strong>Functional Specifications</strong></td>
<td></td>
</tr>
<tr>
<td>Register Reading</td>
<td>Three to nine digits.</td>
</tr>
<tr>
<td>MIU ID</td>
<td>Nine digits.</td>
</tr>
<tr>
<td><strong>Dimensions and Weight</strong></td>
<td></td>
</tr>
<tr>
<td>Dimensions</td>
<td>See &quot;Pit Antenna Dimensions&quot; on the next page</td>
</tr>
<tr>
<td>Weight</td>
<td>1.57 lbs. (712.14 grams).</td>
</tr>
</tbody>
</table>
Chapter 2: Specifications

Figure 2 – E-CODER®R450™ Dimensions

Figure 3 – Pit Antenna Dimensions
Chapter 3: General Installation Guidelines

This chapter defines the tools, materials, and general installation information for the E-CODER®R450™.

Tools and Materials

Tables 1 and 2 show the recommended tools and materials you may need to successfully install the E-CODER®R450™.

Some items may not apply to your specific installation, or the list may not contain all required tools or materials.

**Table 2 – Recommended Tools**

<table>
<thead>
<tr>
<th>Item</th>
<th>Description / Recommendation</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tool Kit</td>
<td>Tool Kit contains standard tools including:</td>
<td>Various installation procedures performed by the utility.</td>
</tr>
<tr>
<td></td>
<td>• Screwdrivers.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Hammer.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Pliers.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• 7/16 wrench.</td>
<td></td>
</tr>
<tr>
<td>Flashlight</td>
<td>Use for activating the LCD.</td>
<td>Activate the LCD.</td>
</tr>
<tr>
<td>Magnet</td>
<td>6 lb. force, part number 12287-001.</td>
<td>Activating the E-CODER®R450™.</td>
</tr>
<tr>
<td>Installation tool</td>
<td>Smartphone or cellular phone.</td>
<td>To receive emails.</td>
</tr>
</tbody>
</table>

**Table 3 – Recommended Materials**

<table>
<thead>
<tr>
<th>Item</th>
<th>Description / Recommendation</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture protection compound</td>
<td>Novagard® sealant, part number 96018-072.</td>
<td>Connecting the Pit antenna to the E-CODER®R450™.</td>
</tr>
<tr>
<td>Site work order</td>
<td>Documentation provided by your utility.</td>
<td>Receiving and recording information about the work site</td>
</tr>
<tr>
<td>Installation tool</td>
<td>Smartphone or cellular phone.</td>
<td>To receive emails</td>
</tr>
</tbody>
</table>
Safety and Preliminary Checks

Observe the following safety and preliminary checks before and during each installation:

- Verify that you are at the location specified on the Site Work Order.
- Verify that the site is safe for you and your equipment.
- Notify the customer of your presence, and tell the customer that you will need access to the water meter.
- If the Site Work Order does not have an MIU ID number on it, write the ID numbers of the E-CODER you are installing. If the Site Work Order already has an MIU ID number on it, verify that it matches the ID number on the MIU you are installing.
This chapter provides instructions for:

- Storing and unpacking the E-CODER® R450i™.
- Performing preliminary tests.
- Verifying materials.
- Selecting a site.
- Installing the unit.

Prior to Installation

This section defines how to unpack and store the E-CODER® R450i prior to installing it.

Inspecting the Unit

After receipt, inspect all shipping containers for damage, and inspect the contents of any damaged cartons prior to storing.

After completing the inspection, store the cartons in a clean, dry environment. The unit remains in sleep mode until it is exposed to light.

Unpacking

As with all precision electronic instruments, handle the E-CODER® R450i carefully; however, no additional special handling is required. When shipped, the assembly is lying on its side. You should lift the assembly out of the box by the meter main case.

After unpacking the E-CODER® R450i, inspect it for damage. If the E-CODER® R450i appears to be damaged or proves to be defective upon installation, notify your Neptune Territory Manager or Distributor. If one or more items require reshipment, use the original cardboard box and packing material.

Tools Needed

"Tools and Materials" on page 5 shows the recommended tools you need to successfully install the E-CODER® R450i.

Some items may not apply to your specific installation, or the list may not contain all required tools or materials.
Site Selection

Installation and operation in moderate temperatures increase reliability and product life. See “Environmental Conditions” on page 3.

Follow these guidelines when selecting a location for the E-CODER®R450:

- Install the unit in a vertical and upright position.
- Clear all obstructions from the installation location.

Always follow your company’s safety practices and installation guidelines when installing an E-CODER. Never install a unit during a lightning storm or under excessively wet conditions.

Installing the E-CODER®R450™

Follow the steps in this section to install the E-CODER®R450™.

New Meter Installation

Follow these steps to perform a new or retrofit meter installation.

1. Flush the service line prior to installation to remove debris in the line.
2. Place an electrical grounding strap on the service line, connecting the inlet and outlet service lines on either side of the meter setting.

You must install inlet and outlet meter valves and couplings / setters if they are not already present. Allow appropriate space in the line for the meter laying length and two coupling gaskets. Align the pipe ends so that the coupling and meter threads can engage without binding or cross-threading.

3. Before installing the meter, remove the thread protectors and spud caps. Be sure that no debris enters the meter during installation.

Use caution; the meter threads are sharp.

4. Place the coupling gaskets inside the coupling nuts and set the meter in the line. Position the meter horizontally with the register dial facing up. The direction of flow marked on the meter must agree with the direction of water flow.
5. Start the coupling nuts by hand then use a wrench and tighten sufficiently to prevent leakage. Be careful not to cross-thread the connections.
6. Open the meter outlet valve slowly.
7. Open a down stream faucet and run enough water to dissipate entrained air and flush the line. While the faucet is open, verify the meter is operating correctly.
8. Turn off the faucet and check the meter installation for leaks.
9. To activate the Liquid Crystal Display (LCD), use a small flashlight to activate the solar panel. The solar panel is located in the center of the faceplate. See "Activating and Testing the E-CODER®R450™" on page 11.

Retrofit Meter Installation

Follow these steps to perform a retrofit meter installation.
1. Use a punch / screwdriver and hammer to punch out the tamper-proof seal pin on the existing register head.
2. Twist the existing register counter-clockwise to remove it.
3. Twist the new E-CODER®R450i register head clockwise onto the meter body to install it.
4. Activate the E-CODER®R450i as described in "Activating and Testing the E-CODER®R450™" on page 11.
5. Test the E-CODER®R450i as described in "Activating and Testing the E-CODER®R450™" on page 11.
6. Snap the new tamper-proof seal pin to secure the register to the meter body.

Connecting the E-CODER®R450™ Antenna

Follow the steps in this section to connect the antenna to the E-CODER.
1. Insert the antenna cable and housing through the 1-3/4" hole in the meter pit lid.

Figure 4 – Insert the Antenna into the Pit Lid
2. Thread the locking nut onto the antenna, smooth end toward lid.

![Figure 5 – Locking Nut on Antenna](image)

3. Hand tighten the nut securely to the lid.

![Figure 6 – Secure the Locking Nut](image)

This figure shows a completed installation of the antenna.

![Figure 7 – Installation Complete](image)
This chapter defines how to read and test the E-CODER®R450™ to identify water leaks.

Activating the LCD Using the Solar Panel

Complete the following steps to activate and test the E-CODER.

1. Position the magnet over the magnetic area on the E-CODER, as shown, starting at the bottom of the register box bringing the magnet up toward the top.

   During the 30 seconds before the configuration transmission, the E-CODER®R450/™ acquires the strongest R450™ Data Collector (R450 DC) for that location.

   Figure 8 – Activating Using a Magnet

2. The E-CODER®R450/™ transmits its configuration packet to the collector approximately 30 seconds following the magnet swipe.

3. The E-CODER sends the register reading to the collector approximately 15 seconds following the configuration packet.
4. When the collector receives the configuration packet, the host sends an email or Short Message Service (SMS) confirmation to allow verification of proper installation and E-CODER(R450®)R450/i location. The following is an example of the email text.

```
Subject: 1224/G/-89/US 29/MIU Config

MIU RSSI..............Pass[-93]
Collector RSSI..............Pass[-89]
Register..............Valid Read
Collector..............US 29
Signal/Noise..............37
Noise..............126
MIU ID....................110001224

------------------------------------------
```

The subject line of the email provides a quick summary of the detailed information which is included. The following table provides a breakdown of the email highlights.

**Table 4 – Config Email Breakdown**

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1224</td>
<td>Last four digits of MIU ID.</td>
</tr>
<tr>
<td>G</td>
<td>Valid read. The three types of reads are:</td>
</tr>
<tr>
<td></td>
<td>• G – Valid read.</td>
</tr>
<tr>
<td></td>
<td>• B – Bad read.</td>
</tr>
<tr>
<td></td>
<td>• N – No register.</td>
</tr>
<tr>
<td>–89</td>
<td>R450 DC Received Signal Strength Indicator (RSSI).</td>
</tr>
<tr>
<td>US 29</td>
<td>Data Collector Name.</td>
</tr>
</tbody>
</table>

**RSSI Values and R450™ System Capabilities**

Signal Strength (RSSI values) is a key indicator of the R450 system health as well as the communication capabilities of the E-CODER(R450®)R450/i to and from the R450 DC.

These values are associated with the Uplink, the ability of the R450 DC to hear reading information from the E-CODER(R450®)R450/i, and Downlink, the ability of the E-CODER(R450®)R450/i to hear instructions from the R450 DC.
The E-CODER®R450/i Config Email provides feedback on the RSSI values between the E-CODER®R450/i and the collector following MIU activation. Depending on the RSSI values recorded, the system indicates the following values:

- Pass.
- Marginal.
- Fail.

RSSI values in the Pass range are required for both the Uplink and the Downlink to ensure full, two-way capabilities of the E-CODER®R450/i as part of the R450 System. For more information, see the next two tables.

**Table 5 – Collector RSSI Uplink**

<table>
<thead>
<tr>
<th>RSSI Description</th>
<th>RSSI Values</th>
<th>Result in Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pass</td>
<td>RSSI ≥ –105</td>
<td>Reliable daily readings and profile data.</td>
</tr>
<tr>
<td>Marginal</td>
<td>–115 &lt; + RSSI &lt; –105</td>
<td>Occasional missed daily readings and profile data.</td>
</tr>
<tr>
<td>Fail</td>
<td>RSSI &lt; –115</td>
<td>Poor readings performance.</td>
</tr>
</tbody>
</table>

**Table 6 – E-CODER®R450/i™ RSSI Downlink**

<table>
<thead>
<tr>
<th>RSSI Description</th>
<th>RSSI Values</th>
<th>Result in Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pass</td>
<td>RSSI ≥ –95</td>
<td>Full capability.</td>
</tr>
<tr>
<td>Marginal</td>
<td>–105 ≤ RSSI &lt; –95</td>
<td>Occasional two-way capability, not reliable.</td>
</tr>
<tr>
<td>Fail</td>
<td>RSSI &lt; –105</td>
<td>E-CODER®R450/i not capable of two-way communications.</td>
</tr>
</tbody>
</table>
Other Sample Configuration Emails

RSSI Validation Test Failed

If an E-CODER®R450/i fails the validation test for RSSI during the installation process, the system sends an email or SMS showing a Marginal or Failed RSSI value. In the following example email, note the Failed downlink value [-107] as well as the Marginal uplink value [-107].

Subject: 0042/G/-107/ Collector One/MIU Config
MIU <- Coll.......... Failed[-107]
Coll <- MIU.......... Marginal[-107]
Register............ Valid Read
Collector............... Collector One
Signal/Noise........... 23
Noise.................. 130
MIU id................ 110500042
=================================================================

Register Test Failed

If an E-CODER®R450/i fails the error-check test on the register read during the installation process, the system sends the following email. This indicates that there is a problem with the wiring to the register.

Subject: 1776/B/-117/Collector Four/MIU Config
MIU <- Coll.......... Failed[-109]
Coll <- MIU.......... Failed[-117]
Register............ Register Connectivity Problem
Collector............... Collector Four
Signal/Noise........... 13
Noise.................. 130
MIU id................ 110181776
=================================================================

Completing the Activation

Do one of the following:

- If a valid register connection and acceptable RSSI values are reported, then go to “Completing the E-CODER®R450/i™ Installation” on the facing page.
- If the E-CODER®R450/i does not report acceptable RSSI values, check the antenna.
- If the register connection is returned as invalid, then go to "Completing the E-CODER®R450/i™ Installation" on the facing page.
Completing the E-CODER® R450™ Installation

Before leaving the installation site, complete the following items in the checklist.

Table 7 – Installation Checklist

- ✔ Record the E-CODER® R450™ ID for each register.
- ✔ Verify that you have followed all requirements of this Installation and Maintenance Guide.
- ✔ Verify that you have recorded all required information.
- ✔ Clean up any installation debris.
- ✔ Verify that you have completed all requirements of the Site Work Order.
- ✔ Inform the customer that you have completed your work. If you were unable to finish, inform the customer when you will be back to complete the project.
Chapter 5: Activating and Testing the E-CODER® R450™

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Chapter 6: Maintenance and Troubleshooting

This chapter defines troubleshooting procedures for the E-CODER®)R450/™.

**Low RSSI: Tips and Techniques for New PIT MIU Installations**

Received Signal Strength Indicator (RSSI) is a measurement of the power present in received radio signal. Neptune® uses this measurement during the installation process to determine if a collector is strongly receiving for an E-CODER)R450i.

For details on the RSSI measurements, see the tables in “RSSI Values and R450™ System Capabilities” on page 12.

During the installation process, you receive an email with the RSSI value to determine if the location of the E-CODER)R450i is acceptable. If the RSSI value is either at the upper limit of the marginal range or is a failed RSSI, try these tips and techniques:

- Reorient the pit antenna.
- Check the antenna connection to the E-CODER)R450i.

**Low RSSI: Tips and Techniques for Existing Installations**

Refer to the following sections to troubleshoot low RSSI for existing Pit installations, for the E-CODER)R450i.

- Check the RSSI values and reorient the pit antenna.
- Check the antenna connection to the E-CODER)R450i.
- Replace the pit antenna.
- Replace the E-CODER)R450i, if necessary.

See the tables in "RSSI Values and R450™ System Capabilities" on page 12 for more information.
Chapter 6: Maintenance and Troubleshooting

Replacement Parts

The following table lists the available replacement parts for the E-CODER R450i.

Table 8 – Replacement Parts

<table>
<thead>
<tr>
<th>Part Name</th>
<th>Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dow® #4 compound (5.3oz tube)</td>
<td>96018-064.</td>
</tr>
<tr>
<td>Novagard® (4cc Packet)</td>
<td>96018-072.</td>
</tr>
<tr>
<td>Magnet</td>
<td>12287-001.</td>
</tr>
<tr>
<td>Antenna assembly</td>
<td>12926-000.</td>
</tr>
<tr>
<td>Black rubber washer</td>
<td>8340-054.</td>
</tr>
<tr>
<td>Lockwire screw</td>
<td>8460-015.</td>
</tr>
<tr>
<td>Seal pin</td>
<td>9106-001.</td>
</tr>
<tr>
<td>Lid, register</td>
<td>13199-003.</td>
</tr>
</tbody>
</table>

Contact Information

Within North America, Neptune Customer Support is available Monday through Friday, 7:00 A.M. to 5:00 P.M. Central Time, by telephone or email.

By Phone

To contact Neptune Customer Support by phone, complete the following steps.

1. Call (800) 647-4832.
2. Select one of the following options:
   - 1 if you have a Technical Support Personal Identification Number (PIN).
   - 2 if you do not have a Technical Support PIN.
3. Enter the six-digit PIN and press #.
4. Select one of the following options.
   - 2 for Technical Support.
   - 3 for maintenance contracts or renewals.
   - 4 for Return Material Authorization (RMA) for Canadian Accounts.

You are directed to the appropriate team of Customer Support Specialists. The specialists are dedicated to you until the issue is resolved to your satisfaction. When you call, be prepared to give the following information:
• Your name and utility or company name.
• A description of what occurred and what you were doing at the time.
• A description of any actions taken to correct the issue.

By Email

To contact Neptune Support by email, send your message to support@neptunetg.com.
Appendix A: E-CODER®R450™ Flags

Description of Flags

The tables in this appendix describe the volume represented by the eighth digit by meter size, and the flags used by the E-CODER®R450™.

Table 9 – Eighth Digit Resolution by Meter Size

<table>
<thead>
<tr>
<th>Register Size</th>
<th>Eighth Digit Resolution – Least Significant Digit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential (5/8” – 1” T-10)</td>
<td>1/10 Gallon or 1/100 Cubic foot.</td>
</tr>
<tr>
<td>Light Commercial and Industrial</td>
<td></td>
</tr>
<tr>
<td>(1-1/2&quot; and 2&quot; T-10; 1-1/2” – 4” HPT)</td>
<td>1 Gallon or 1/10 Cubic foot.</td>
</tr>
<tr>
<td>Large Commercial and Industrial</td>
<td></td>
</tr>
<tr>
<td>(6” – 12” HPT, HP III and TRU/FLO®)</td>
<td>10 Gallons or 1 Cubic foot.</td>
</tr>
<tr>
<td>Large Commercial and Industrial</td>
<td></td>
</tr>
<tr>
<td>(16” – 20” HPT)</td>
<td>100 Gallons or 10 Cubic feet.</td>
</tr>
</tbody>
</table>

Table 10 – E-CODER®R450™ Flags

Backflow Flag (Resets After 35 Days)

Based on reverse movement of the eighth digit. Eighth digit is variable based on the meter size.

| No backflow event | Eighth digit reversed less than one digit.                      |
| Minor backflow event | Eighth digit reversed more than one digit, up to 100 times the eighth digit. |
| Major backflow event | Eighth digit reversed greater than 100 times the eighth digit. |

Leak Status Flag (Resets After 35 Days)

Based on total amount of 15-minute periods recorded in the previous 24-hour period.

| Leak icon off | Eighth digit incremented less than 50 of the 96 days of 15-minute intervals. |
| Flashing leak icon | Eighth digit incremented in at least 50 of the 96 days of 15-minute intervals. |
| Solid leak icon | Eighth digit incremented in all of the 96 days 15-minute intervals. |

Consecutive Days with Zero Consumption Flag (Out of Rolling 35 Days)

Number of days the “leak status” was at a minimum value.
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Glossary

A

antenna (pit)
MIU antenna used for pit installations.

antenna (whip)
RF antenna that can be removed to upgrade to a through-the-lid antenna.

C

conical-shaped gasket
Cone-shaped rubber gasket on the antenna cable used to seal the cable at the top of the connector housing.

connector housing
Black plastic 1/4-turn connector used to waterproof the antenna cable connection to the pit MIU.

connector nut
Black plastic nut used to depress the conical-shaped gasket and seal antenna cable at the top of the connector housing.

F

flat rubber washer
Washer used to seal the antenna cable connector housing to the pit E-CODER® R450™.

L

light sensor
Component located under the recess that is used to activate the LCD. See Liquid Crystal Display.
Glossary

**Liquid Crystal Display (LCD)**
Component where the meter-reading and value-added icons are displayed.

**MIU**
Meter Interface Unit.

**register read time**
The default time is 15 minutes for all registers. Custom time is not available.

**seal pin**
Small, black plastic nail used to secure the E-CODER® R900™ to the meter.

**serial number**
Unique identification number given to each MIU at the factory. The default value is the last programmed, plus one. Custom serial numbers are not available.

**transmission time**
The time between MIU transmissions.
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