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Warning:

Extreme caution should be observed when using this product. Any work with energized meters can present the danger of electrical shock. Electric Utility specified procedures for setting and removing watthour meters should be followed and performed by qualified personnel. Safety precautions as described in the Handbook for Electricity Metering should also be followed.

Radian Research, Inc. assumes no liability for the failure to comply with existing applicable safety precautions as well as those listed in this warning statement.

1.0 Product Introduction

The RM-18 Portable Watthour Test System delivers the most effective method for field testing single-phase watthour billing meters. The RM-18 is in full compliance with ANSI C12 test criteria. The RM-18 is the only self-contained portable test system available that offers safe and simple operating procedures, complete data management and a true Radian reference standard. By incorporating a true Radian Research watthour reference standard within the RM-18 socket adapter, electric utility companies have the accuracy necessary for meeting today and tomorrow’s testing needs for both induction and solid state meters. The RM-18 is available in two models: the RM-18-01 and the RM-18-02. The two models and their respective testing capabilities are listed below:

<table>
<thead>
<tr>
<th>Meter Forms</th>
<th>Meter Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>RM-18-01</td>
<td>1S and 2S</td>
</tr>
<tr>
<td>RM-18-02</td>
<td>1S, 2S and 12S (Network Only)</td>
</tr>
</tbody>
</table>

Unless otherwise noted, information in this manual that pertains to both models will be labeled as RM-18. If information pertains to a specific model then it will be specified in the text (i.e. RM-18-01 or RM-18-02).
The RM-18 Portable Watthour Test System is the only portable test system to include a complete calibration report. That calibration report certifies the RM-18 measurement accuracy across the entire operating range. Typical accuracy of the RM-18 is +/- 0.05% with a worst case accuracy of +/- 0.10%. Both typical and maximum accuracy specifications include stability. The internal standard is NIST traceable through Radian’s metrology calibration laboratory. The internal watthour reference standard of the RM-18 provides the accuracy that the new single-phase, solid state meters require.

While the RM-18 testing capabilities include the testing of both induction and solid state single-phase meters. It also makes meter calibration in the field quick and easy with it’s automated current ranging. The RM-18 stores that last set of meter test results in the hand controller. This added convenience allows the operator to re-call and document the test results at the most opportune time. The weighted average of the meter under test is also calculated and displayed with the meter test results.
1.1 Additional features

The RM-18 hand controller operates from a 9 volt battery in the absence of the socket adapter. This battery support allows for changing meter test setups and viewing meter test results anytime, anywhere.

The RM-18 is as safe to use as it is simple. With all voltage and current connections contained within the socket adapter, personnel need only remove the meter, insert the socket adapter and re-install the meter. This process totally eliminates manual voltage and current connections. The RM-18 socket adapter features an interlock sensing mechanism which does not allow voltage to be present at the socket adapter jaws. For added safety, voltage is not present until the meter is set and the test initiated.

The RM-18 comes in a lightweight carrying case that accommodates all of the necessary testing accessories that any residential or light commercial billing meter would require.

The RM-18 uses nonvolatile memory to preserve both the last meter test result and last meter test setup without regard to power.

The time clock in the RM-18 hand controller has a basic accuracy of 30 seconds per month. The clock also has it’s own lithium battery for a 10 year operation in the absence of power.
2.0 Testing Methods

The RM-18 Portable Watthour Test System allows the operator to select the test method as either an automated or manual test. The RM-18 tests induction or solid state meters automatically when used with the Radian line of sensor pickups. The Radian RM-DS-ts and RM-1H-ts’s accuracy make one revolution tests a reality. When these accessories are used with the RM-18 test time is decreased and the meter technician’s efficiency increased.

Induction meters use the RM-DS-ts to sense disk rotations and convert the revolutions to pulses. These pulses are then recognized by the RM-18 hand controller and the accumulated watthours between each pulse is compared with reference to the internal watthour reference standard. For customer convenience Radian offers the RM-DS-ts in different mounting options.

For solid state meters the RM-1H-ts optical pickup is used to sense the infrared output pulse of the meter under test. That output pulse is then conditioned and acknowledged by the RM-18 hand controller. Watthours that are accumulated between each (equivalent) revolution are then calculated with reference to the internal reference standard.

For further testing flexibility, the RM-18 supports manual meter testing. Manual tests can be controlled directly from the RM-18 hand controller’s enter key. Or, the RM-1S Remote Reset Switch can be used via the Input port on the RM-18 hand controller.
3.0 Test Setups

A test setup can be created directly on the RM-18 hand controller through the Setup Test menu option. The RM-18 will display a test setup template in which the test parameters are defined. The last test setup defined becomes the default test setup. Radian allows the user to customize each meter test by selecting the test variable from a fixed list. Each fixed list contains a wide range of variables applicable to the various meter forms, meter Kh and meter TA. Those parameters are as follows:

**Test Setup** - [No user interface]

**Form** - The meter form of the meter to be tested.  [Fixed List]

**Kh** - Pulse constant for the meter under test.  [Fixed List]

**FL Amps** - Test amps to be used for the full load test.  [Fixed List]

**PF Amps** - Test amps to be used for the power factor test.  [Fixed List]

**LL Amps** - Test amps to be used for the light load test.  [Fixed List]

**FL Revs** - Number of revolutions to use for the full load test.

**PF Revs** - Number of revolutions to use for the power factor test.

**LL Revs** - Number of revolutions to use for the light load test.

**Pulses per Rev** - Number of pulses (or equivalent pulses) per revolution of the meter under test.

**Creep Mins** - Number of minutes to be used for the Creep test.
The RM-18 matches the most common Kh values with the appropriate meter forms to further simplify the use of the test system. When a meter form is selected, the Kh field will display one Kh value of the meter type. To scroll through the entire list of Kh values use the left and right arrow keys. See Figure 1.0 for the meter form and Kh value relationship.

<table>
<thead>
<tr>
<th>1S</th>
<th>2S</th>
<th>12S</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.8</td>
<td>3.6</td>
<td>7.2</td>
</tr>
<tr>
<td>3</td>
<td>6</td>
<td>7.272727</td>
</tr>
<tr>
<td>3.030303</td>
<td>7.2</td>
<td>14.4</td>
</tr>
<tr>
<td>3.125</td>
<td>12</td>
<td>28.8</td>
</tr>
<tr>
<td>3.6</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 1.0: Meter Forms and Pre-Set Kh Values

3.1 Auto-advance feature

The auto-advance feature eliminates the long down-time in waiting for the meter to position the disk flag at a convenient position to start a test. After one test point, the RM-18 applies the user defined full load current to the meter to rotate the disk at a faster speed to position the disk flag just in front of the Radian sensor pickup.

The RM-18 runs all of the selected test points consecutively by ranging the current between test points automatically. The last meter test result is automatically saved in the RM-18 hand controller. This meter test result can be viewed from the hand controller at any time. This allows the user to document the test results onto the test card at his convenience.
4.0 Theory of Operation

The RM-18 contains an actual internal reference standard that uses a Pulse Width Modulation (PWM) measurement approach. See Figure 2.0 for the block diagram. The input circuitry consists of potential input, a current input circuit consisting of dual current amplifiers, a watt converter, a current to frequency converter, pulse comparator and display output.

![Figure 2.0: RM-18 BLOCK DIAGRAM](image)

4.1 Potential Input Circuit

The autoranging potential input circuit senses potential input voltages from the meter service. This input can be zero to 300 VAC. The circuit consists of a toroid wound potential transformer with electronic compensation. This compensation can eliminate over 99% of the error present. The transformer is so accurate that it is not
a significant source of error regardless of the input level. The range selection is accomplished on the secondary side, with much greater accuracy and reliability that can be achieved with primary side switching. The potential input is taken from the service installation by setting the socket adapter into the meter installation socket. Voltage range is automatic and eliminates any possible operator error.

4.2 Current Input Circuit

The autoranging current input accepts a synthesized current in the range of 0.1 to 30 amperes. This circuitry isolates, ranges and scales the current to maintain an input current to the watt converter in the range of 1 to 5 milliamperes. The construction is of the toroidal type so there is not a problem with stray fields. Electronic compensation reduces errors to below measurement thresholds (0.0001%) at most operating currents, and to below 0.001% over the entire specified region.

4.3 Power Supply

The power supply voltage is derived from the service voltage and potential input. The power supply is able to operate efficiently in the range of zero to 300 VAC. The power supply has an overall efficiency of 70% which changes very little with input voltage. This high efficiency results in a very low power consumption. This, coupled with a typical temperature coefficient below 0.0003% per degree C, results in negligible warm-up drift. VA consumption varies between 5 and 30 VA depending on the service voltage and test current.

4.4 Watt Converter

The Watt Converter is of the pulse width modulation type. A pulse width modulation multiplier forms a product by producing a pulse train the height of which is proportional to one input and the width of which (duty cycle) is proportional to a second input. A filter performs an integration, producing an average value proportional to the product of the two inputs.
An often overlooked aspect of using pulse width modulation for power conversion is that the current axis (load dependent) is much more likely to be distorted than the potential axis (line dependent). In pulse width modulation the axis which determines the pulse height (the multiplexor axis) is much less sensitive to distortion. In the RM-18 this is the axis which senses the current input to minimize distortion sensitivity.

The watt converter has a voltage and current input (units of watts) and has a current output. Since input / output is watt / current which is equivalent to volts, a voltage reference is required to reference the watt converter. No other component within the watt converter has a significant effect upon the calibration.

### 4.5 Current To Frequency Converter

The Current to Frequency Converter (watthour circuit) converts the current output of the Watt Converter into a pulse train with each pulse proportional to watthours of energy. It is referenced by a highly advanced charge balance integrator which can produce a much higher frequency (two megahertz or 7 billion pulses per hour) than older converters limited to pulse rates of only 400 hertz or 1.5 million pulses per hour. The circuit delivers this degree of resolution without compromise of the accuracy, which is typically 0.05 %. The high resolution is an advantage in field testing because it permits the autoranging on the current axis which in turn allows closed link testing.

The current to frequency integrator works on the charge balance principle. This input current is proportional to watts. The input current over a period of time is proportional to watthours. The units of current multiplied by time is charge, so that the charge accumulated in a capacitor over a period of time is directly proportional to watthours. Quanta of charge are removed from the capacitor after they have accumulated for a fixed period of time. Each quanta of charge which is removed is directly proportional to ten microwatthours. The removal of charge is accomplished by injecting a current of known amplitude and known duration. The amplitude of current is determined by the ratio of an extremely precise voltage reference to an extremely precise resistor reference. The duration of the pulse is determined by one clock cycle of a crystal.
4.6 Pulse Comparator and Display Output

The Pulse Comparator accepts the pulse train from the current to frequency converter and counts it. The Pulse Comparator circuit is also counting pulses from the meter under test. The counter is controlled by the input to the RM-18 Hand Controller. This input is made with a Radian Sensor, RM-1S or the enter key located on the hand controller. The first pulse present at the input starts the counter while a programmable number of pulses (revolutions) are counted with the last pulse stopping the counter.

The RM-18 Hand Controller acts like a comparator by comparing the input pulses from the meter under test against the internal reference standard. The RM-18 will calculate the difference and display it on the hand controller LCD in % registration, % error or watthours.
5.0 Technical Specifications (RM-18-01 and RM-18-02)

5.1 Accuracy

At unity power factor: 0.05% typical, 0.10% maximum

At 0.5 lagging power factor: 0.05% typical, 0.10% maximum

All errors are in percent reading at any combination of the normal operating conditions. Note that stability is included within the maximum accuracy specification. *Power factor is referenced to Watthours and it is also assumed that voltage is the reference vector.

5.2 Normal Operating Conditions

Input voltage 60 - 300 VAC (Autoranging)
Input current 1-30 Amps
Power factor Unity and 0.5 lagging power factor
Relative humidity 0-95%
Frequency 48-62Hz
Orientation Any
Recalibration 365 days
Shock and vibration Any which is nondestructive
Normal operating range -20° to 70°C (-4° to 158° F)

5.3 Physical Description

Hand Controller 190 mm (7.5”) H
105 mm (4.0”) W
33 mm (1.25”) D approx.
<table>
<thead>
<tr>
<th>Technical Specifications</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Socket Adapter</td>
<td>178 mm (7.0”) W</td>
</tr>
<tr>
<td></td>
<td>178 mm(7.0”) D approx.</td>
</tr>
<tr>
<td>Influence Affecting Accuracy</td>
<td>None</td>
</tr>
<tr>
<td>Input Pickup Terminal</td>
<td>Lemo, 0.00001 pulse input for Radian RM-1H-ts or RM-DS-ts.</td>
</tr>
<tr>
<td>Input/Output Terminal</td>
<td>BNC, RM-1S Remote Reset Switch</td>
</tr>
<tr>
<td>Output Input/Output Terminal</td>
<td>BNC, 0.00001 pulse output value</td>
</tr>
<tr>
<td>RM-PCA Interface Port</td>
<td>Lemo, RM-PCA communications to RS-232 serial interface [Factory Use Only.]</td>
</tr>
</tbody>
</table>
6.0 RM-18 Hand Controller Conventions

Please refer to Figure 3 while reading the following text:

1 - LCD: Allows the contrast of the LCD to be adjusted by pressing and holding down the LCD key and using the Up or Down Arrow keys for increasing or decreasing the contrast. Releasing the LCD key returns the RM-18’s LCD to default contrast level.

2 - Cancel: When traversing menus on the RM-18 Hand Controller the Cancel key performs similar to the Escape key on most computers. Specifically, it backs the user out of the displayed menu leaving any parameters unchanged. The Cancel key is used to back out of sub-menus to reach the Main Menu. The Cancel key will also abort any test while in progress without saving the results.

3 - Enter: The Enter key serves as the primary selection key in the menu structure. To select a menu choice move the cursor to the desired selection and press Enter. The Enter key is also used to start and stop a manual test. The Enter key is also used to move the user up or into a menu saving any test parameter selected.

4 - Up and Down Arrow Keys: These keys control the vertical cursor movement for scrolling through menu items and results. If there are more than four menu items for four lines of result data an up or down movement is required for viewing purposes. An up or down arrow icon will appear in the upper right or lower right corner of the LCD. These icons direct the user to scroll in the appropriate direction.

5 - Left and Right Arrow and Yes/No Keys: These keys control the horizontal cursor movement within a keypad entry field to access the fixed lists. There are fixed lists for the meter forms, meter Kh and the test currents. The left and right arrow keys are also used to respond “Yes” and “No” respectively to menu prompts.

6. On /Off Keys: Turns the power to the RM-18 on and off. The RM-18 features a user defined time out interval. This allows the user to set the amount of time before the RM-18 will automatically shut off. This time out feature is not active when a test is in progress.

7. LCD Display: The RM-18 Hand Controller features a 16 character 4 line liquid crystal display.
Controller Conventions

Figure 3.0
7.0 Main Menu and Sub-Menu Structure

All menu items should be selected by using the up and down arrow keys to move the cursor to the desired menu option and pressing the enter key. Four menu items are visible at one time on the LCD. A down arrow icon will be displayed in the lower right corner of the LCD as an indication that there are additional menu items. The unseen menu items can be viewed by using the down arrow key to scroll down through the menu items. When the user is at the last menu item an up arrow icon will appear in the upper right corner of the LCD. This indicates that the user must move back up through the menu items using the up arrow key.

The Main Menu consists of the following:

1. Run Test
2. Show Result
3. Setup Test
4. Preferences

When a main menu item is selected the various sub-menu or sub-menus will be displayed. The sub-menus are as follows:

7.1 Run Test

Immediately initiates the RM-18 to run the test that is defined in the Setup Test menu. See Figure 4.0 for the factory default test and other test setup samples.
SAMPLE TEST CONFIGURATIONS

<table>
<thead>
<tr>
<th>Test Parameters</th>
<th>1S</th>
<th>2S</th>
<th>12S (Network)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Form</td>
<td>1S</td>
<td>2S</td>
<td>12S (Network)</td>
</tr>
<tr>
<td>Kh</td>
<td>1.8</td>
<td>7.2</td>
<td>14.4</td>
</tr>
<tr>
<td>Full Load Amps</td>
<td>15</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>Power Factor Amps</td>
<td>15</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>Light Load Amps</td>
<td>1.5</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Demand Amps</td>
<td>15</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>Full Load Revolutions</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Power Factor Revolutions</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Light Load Revolutions</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Creep Test Time Interval</td>
<td>0</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Pulses per Revolution</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

Figure 4.0

7.2 Show Result

Displays the test results of the last meter tested.

7.3 Setup Test

Displays the test setup template for the user to change the parameters. Defaults to the last test setup defined.

7.4 Preferences

1 PCA-Mode

Factory Use Only.
7.5 Results Display

Select the desired format for test result to be displayed and saved.

1. % Registration
2. % Error
3. Watthours

7.6 Results Digits

Sets the displayed result resolution. One, two or three places to the right of the decimal point.

1. One Digit
2. Two Digits
3. Three Digits

7.7 Test Method

Selecting Sensor Test allows the use of the Radian pickup sensor. When Sensor is selected the RM-18 will run a Pick Up test. The Pick Up test will rotate the disk at the defined full load current so the operator may properly align the sensing accessory. The RM-18 LCD will show flashing LCD segments that coincide with the sensing accessory's LEDs when proper alignment is achieved. For added convenience the hand controller will also “beep” at the meter disk flag when the disk sensor is properly aligned. Manual Test allows the RM-1S Remote Reset Switch or the RM-18’s enter key to start and stop the test. Factory default is Manual Test Mode.

1 Sensor Test
2 Manual Test
7.8  Calibration

Puts the RM-18 into the calibration and accuracy cross check mode. Or, allows the operator to view the test points that were previously ran. The RM-18 can easily be returned to the factory default calibration by selecting Original Cal. and confirming the adjustment.

1  View
2  Run As Found
3  Adjust Cal.
4  Original Cal.

7.9  Power Saver

Time allotted before the RM-18 automatically shuts off when in an idle mode. Time is user defined from 0 to 30 minutes. To disable the Power Saver enter a 0. Power saver does not shut the RM-18 down while in an active test sequence.

7.10  About

Includes information specific the RM-18. This information is downloaded from the factory and is not accessible to the user for changes.

[Information Line]

S/N: Of the RM-18 Hand Controller
SW Rev: xxx.xxx
FW Rev: xxx.xxx
Socket Adapter xxx.xxx
S/N Of the RM-18 Socket Adapter
Rev: Firmware and software
Cal: Date
8.0 Calculations

The % registration calculation for full load, power factor and light load is as follows:

Formula for Full Load, Power Factor and Light Load:

\[
\text{% Registration} = K \times (\text{# of pulses}) \times (\text{# of standard inputs}) \times (\text{display of standard}) \times (\text{# of meter elements}) \times 100
\]

where:

100 = used to convert to a percentage

K = constant, meter Kh

# of pulses = test duration in disk revolutions or pulses

# of standard inputs = this value is always 1 where the RM-18 is concerned

display of standard = Watthour reading from the RM-18 Socket Adapter (standard)

# of meter elements = the number of elements in the meter under test (The RM-18 knows how many elements when the form number is set in the Test Setup menu.)
Setup Test

9.0 To Setup a Test:

1. Turn the RM-18 Hand Controller on. From the main menu select Setup Test. Press the down arrow until the cursor is flashing next to "Setup Test: and then press Enter. The test setup template will be displayed on the RM-18 LCD.

2. The cursor will be flashing to the right of the meter form entry. Use the left and right arrow keys to scroll through the fixed list of meter forms that your RM-18 model supports. Note that the Kh values change according to the meter form selected.

3. Use the down arrow to move the cursor to the Kh field. Select the appropriate Kh value for the meter under test. Use the left and right arrow keys to select the available Kh values from the fixed list.

4. Arrow down and select the test current for the full load test. Use the left and right arrow keys to make the selection from the fixed list.

5. Arrow down and select the test current for the power factor test. Use the left and right arrow keys to make the selection from the fixed list.

6. Arrow down and select the test current for the light load test. Use the left and right arrow keys to make the selection from the fixed list.

7. Enter the number of meter disk revolutions or output pulses for the full load test. Use the left and right arrow keys to add and subtract revolutions. Enter 0 to skip the full load test.

8. Enter the number of meter disk revolutions or output pulses for the power factor test. Use the left and right arrow keys to add and subtract revolutions. Enter 0 to skip the power factor test.

9. Enter the number of meter disk revolutions or output pulses for the light load test. Use the left and right arrow keys to add and subtract revolutions. Enter 0 to skip the light load test.

10. Enter the creep test time interval. The RM-18 supports a 1 - 99 minute interval. To eliminate the creep test enter 0.
11. Enter the number of pulses per revolution for the meter under test. For induction meters use 1 pulse per revolution. For solid state meters enter their pulses per equivalent revolutions. All pulse per revolution values are listed on the meter under test’s nameplate.

15. Press enter to save the test setup.
10.0 Editing the Test Setup

1. From the main menu select Setup Test. Press the down arrow until the cursor is flashing next to "Setup Test" and then press Enter.

2. Once the Setup Test template is displayed use the up and down arrows to position the cursor on the parameter that is to be changed. Make the change or changes and press enter to save.

3. The RM-18 will immediately default back to the main menu.
### 11.0 Test Results

One meter test result is automatically saved in the RM-18 hand controller. This result can be viewed at any time through the RM-18 hand controller. When viewing the test result from the RM-18 use the up and down arrow keys to move in the respective direction through the test result data.

The RM-18 hand controller displays the meter test result in the order as shown below. This order will vary slightly as tests are personalized by omitting test points.

<table>
<thead>
<tr>
<th>LCD LINE</th>
<th>DATA</th>
</tr>
</thead>
<tbody>
<tr>
<td>FL %</td>
<td>xxx.xxx</td>
</tr>
<tr>
<td>PF %</td>
<td>xxx.xxx</td>
</tr>
<tr>
<td>LL %</td>
<td>xxx.xxx</td>
</tr>
<tr>
<td>CREEP</td>
<td>PASS / FAIL</td>
</tr>
<tr>
<td>FL WH</td>
<td>xx.xxxxx</td>
</tr>
<tr>
<td>PF WH</td>
<td>xx.xxxxx</td>
</tr>
<tr>
<td>LL WH</td>
<td>xx.xxxxx</td>
</tr>
</tbody>
</table>
12.0 In Service Test for Creep

The RM-18 supports an ANSI in-service test for creep. This test is required by ANSI if there is a 2% deviation between light load registration and full load registration. To accommodate various utility companies and meter testing services the RM-18 allows the operator to set the amount of time in which the meter under test will the test voltage applied with no current load present. The time interval is set in the setup test menu of the RM-18. The in-service creep test can be disabled in the meter test setup by entering a 0 for the time interval. Disabling the creep test eliminates it from the meter test result.

Once the test conditions for the creep test have been met, the RM-18’s LCD will display the amount of time defined in the test setup and start counting down. For further convenience, the RM-18 allows the operator to set the creep time interval in the test setup, but then decline to run the test if the 2% deviation is not present. This is done by answering “No” when the prompt appears.

If the meter under test makes one complete disk revolution within the prescribed amount of time the meter is considered to creep. The RM-18 will prompt the user to use the enter key to pass or the cancel key to fail the meter. The pass or fail status is then recorded in the results.
13.0 Running an Automated Meter Test

Equipment Needed:

- RM-18 Portable Watthour Test System
- RM-DS-ts Disk Sensor with Field Mount or with Suction mount
- 2S Meter (240V, TA 30, Kh=7.2)

Optional Equipment:

- RM-1H Optical Pickup for Infrared LED (for use with solid state meters)

Preliminary Setup:

- Verify the Preference menu for the following:
  - Desired results format and resolution.
  - Test Method is Sensor Test for use with the RM-DS-ts

Running the Test:

1. Note that before beginning a test, the RM-18 is intended for use by only properly trained personnel. Follow the Electric Utility Company guidelines and remove the meter to be tested from the meter socket. Reference the Handbook for Electricity Metering if necessary.

2. Insert the RM-18 socket adapter into the meter socket. Replace the socket cover or secure the RM-18 socket adapter clip to fit securely.

3. Insert the meter to be tested into the RM-18 socket adapter. Follow the appropriate Electric Utility Company guidelines for meter installation. If necessary, consult the Handbook for Electricity Metering.
4. Connect the RM-18 hand controller communication cable into the RM-18 socket adapter. The cable is hardwired directly into the hand controller in the port labeled “standard.” Be sure to identify the red dot located on the Lemo connector on the communications cable. This red dot must be properly aligned with the notch of the mating receptacle on the socket adapter. With the socket adapter installed in the meter socket, the mating receptacle is located at the seven o'clock position. Again, it is important to emphasize that proper alignment is critical for this connection. *Forcing an improper alignment may cause damage to the Lemo connector and to the mating receptacle.* When the test is finished disconnect the Lemo connector by pulling only the outer shell of the connector up gently until it stops. At this point pull the Lemo plug clear of the socket adapter connection.

5. Secure the RM-DS-ts onto the meter cover and insert the Lemo plug of the RM-DS-ts into the port of the hand controller labeled “pickup.” When the test is finished disconnect the Lemo connector by pulling only the outer shell of the connector up gently until it stops. At this point pull the Lemo plug clear of the hand controller input port.

6. Turn the RM-18 hand controller on with the ON key located on the hand controller. From the main menu select RUN TEST. See Section 7.0 for details on how to configure the test setup.

7. The RM-18 will start the test by displaying the service voltage and the internal temperature of the standard. Press enter to continue the test.

8. With Full Load current applied, align the RM-DS-ts so that it is triggering from the edge of the disk. The target beam of the RM-DS-ts should break the glass at an angle for the reflective circuitry to operate correctly. Note that there is one red and one green LED on the RM-DS-ts. When both red and green flash simultaneously it signifies that the device is operating at its optimum level. Verify that the RM-18 beeps and the LCD segments are flashing simultaneously with the red and green LEDs on the RM-DS-ts during each revolution. Each disk revolution will change the direction of the arrows on the LCD. This is for reference purposes only. Press enter to continue.
The gain adjustment screw on the RM-DS-ts can be used to adjust the signal strength. It is recommended that the supplied screw driver be used in order not to damage the adjustment screw. Note that in many cases once the gain adjustment has been set to optimum level, it may not be necessary to make further adjustments when testing each additional meter.

Instead of adjusting the gain setting try changing the positioning of the sensor assembly.

*Note: If testing a solid state meter the RM-1H-ts Optical Pickup for infrared LED would be used with or without the RM-OA Optical Adapter. See section 16.0 for details on these items.*

9. The RM-18 immediately ramps to the first test point.

10. When the first test point is finished the results are displayed briefly and the RM-18 ramps to the next test point. This process is repeated until the last test point is ran. At that time the RM-18 LCD display’s TEST COMPLETE. Press enter to continue.

11. The test results can be viewed from the Result menu.
14.0 Running a Manual Meter Test using the Enter Key or RM-1S Remote Reset Switch

Equipment Needed:

- RM-18 Portable Watthour Test System
- 2S Meter (240V, TA 30, Kh=7.2)

Optional Equipment:

- RM-1S Remote Reset Switch

Preliminary Setup:

- Verify the Preference menu for the following:
  - Desired results format and resolution.
  - Test Method is Manual Test.

Running the Test:

1. Note that before beginning a test, the RM-18 is intended for use by only properly trained personnel. Follow the Electric Utility Company guidelines and remove the meter to be tested from the meter socket. Reference the Handbook for Electricity Metering if necessary.

2. Insert the RM-18 socket adapter into the meter socket. Replace the socket cover or secure the RM-18 socket adapter clip to fit securely.

3. Insert the meter to be tested into the RM-18 socket adapter. Follow the appropriate Electric Utility Company guidelines for meter installation. If necessary, consult the Handbook for Electricity Metering.

4. Connect the RM-18 hand controller communication cable into the RM-18 socket adapter. The cable is hardwired directly into the hand controller in the port labeled “standard.” Be sure to identify the red dot located on the Lemo connector on the communications cable. This red dot must be properly aligned.
with the notch of the mating receptacle on the socket adapter. With the socket adapter installed in the meter socket, the mating receptacle is located at the seven o'clock position. Again, it is important to emphasize that proper alignment is critical for this connection. **Forcing an improper alignment may cause damage to the Lemo connector and to the mating receptacle.** When the test is finished disconnect the Lemo connector by pulling only the outer shell of the connector up gently until it stops. At this point pull the Lemo plug clear of the socket adapter connection.

5. If using the RM-1S Remote Reset Switch connect it to the “Input” port on the RM-18 Hand Controller. If using the enter key on the RM-18 Hand Controller continue on to step 6. Note that when in Manual Test mode the RM-18 will recognize pulses from both the input port (RM-1S) and the enter key.

6. Turn the RM-18 hand controller on with the ON key located on the hand controller. From the main menu select RUN TEST. See Section 7.0 for details on how to configure the test setup.

7. The RM-18 will start the test by displaying the service voltage and the internal temperature of the standard. Press enter to continue.

8. The RM-18 immediately ramps to the first test point. Establish a visual reference of the meter disk flag. This reference point is where the test is started and finished. After 2 to 3 seconds start the test by depressing the button on the RM-1S or RM-18 enter key.

9. After the desired number of revolutions have been completed depress the RM-1S button or the enter key on the hand controller to stop the test. The number of revolutions counted should be equivalent to the number of revolutions defined in the test setup.

10. When the first test point is finished the results are displayed and the RM-18 ramps to the next test point. After waiting 2 to 3 seconds start the next test point. This process is repeated until the last test point is ran. At that time the RM-18 LCD displays TEST COMPLETE. Press enter to continue.

11. The test result can be viewed from the Results menu.
15.0 Accuracy Certification and Calibration

The RM-18 accuracy can easily be tested, adjusted and viewed. This is done by externally connecting a RM-11 Primary Watthour Reference Standard to the pulse input of the RM-18 and comparing the two standards. The RM-TJ Test Jack interfaces the RM-18 with the RM-11 by seating into the socket adapter jaws of the RM-18 socket adapter. The RM-TJ current leads attach directly into the current inputs of the RM-11. Connect the potential jumper on the RM-TJ to the RM-11 and the RM-11 output to the input port of the RM-18 hand controller. Once these connections are made, the RM-18 can run either an as-found test or, actually adjust calibration to the factory defined calibration points. If the connection to the RM-11 is not correct the RM-18 will display the following error message: No pulses, Enter to continue.

Note: The RM-18 hand controller MUST have the 9 volt battery installed when running an as-found test or when adjusting calibration. This will prevent the powering down of the hand controller between voltage settings.

To run an as-found test select the Run As Found option from the Calibration menu. The RM-18 will automatically run through the test points prompting the user to change the voltage source when applicable. In this mode the RM-18 will produce as-found results only. No adjustments are made. To view the as found results select View from the Calibration menu.

Adjusting the calibration of the RM-18 should be done after viewing the as-found results. To adjust the calibration select Adjust Cal. from the Calibration menu. The calibration adjustment points are the same as the as found points that are factory defined. Once the calibration adjustment is complete the operator can run another as-found test and then view the change in calibration.

By selecting Original Cal. the RM-18 can be put back to the factory default calibration. This will undo any change in calibration that the customer has done.

Complete recertification and recalibration services are available from Radian’s NIST traceable metrology laboratory. Contact Radian Research or you local Radian Research Representative for details.
16.0 Test Accessories

16.1 RM-1S Remote Reset Switch

The RM-1S Remote Reset Switch is a normally closed push button switch. The RM-1S connects directly to the “Input” port on the RM-18 hand controller. The switch of the RM-1S is hermetically sealed to provide increased reliability during field use. The push-button has positive tactile feel to provide instantaneous feedback of the switch action.

![Figure 16.1 RM-1S Remote Reset Switch](image1)

16.2 RM-1H-ts Optical Pickup for infrared LED

The RM-1H-ts is used to sense the infrared pulses from the calibration LED of solid state meters. The pulses from the RM-1H are fed into the Pickup port of the RM-18 hand controller. When the RM-1H-ts is used with the RM-18 the testing of solid state meters is done automatically. The wide angular displacement of this sensor allows for fast, non-critical alignment. Also, automatic gain control circuitry of the RM-1H-ts assures operation in all ambient sunlight conditions. The RM-1H/v-ts is available for those solid state meters with a visible calibration LED.

![Figure 16.2 RM-1H-ts Optical Pickup for infrared LED](image2)
16.3 RM-OA Optical Adapter

The RM-OA Optical Adapter is used with solid state meters whose infrared calibration pulse is emitted from the optical communications port. The RM-OA magnetically couples to the communication port of solid state meters. The suction cup of the RM-1H-ts is attached to the clear polycarbonate cover of the RM-OA. The RM-OA incorporates a rare earth permanent magnet for exceptional holding power over the life of the product.

16.4 RM-TS Test Socket

The RM-TS Test Socket effectively interfaces the RM-18 to a potential source for testing purposes. The RM-TS connects voltage to the blades of the socket adapter portion of the RM-18. The RM-TS will generally be used in conjunction with the RM-TJ Test Jack.
16.5 RM-TJ Test Jack

The RM-TJ is the Test Jack Interface Assembly that allows direct connection of the RM-18 Socket Adapter to an RM-11 Primary Watthour Reference Standard. When in the calibration mode the RM-18 hand controller works as a comparator counting pulses of both the RM-18 socket adapter and the RM-11 Primary standard. The RM-TJ is necessary for performing an accuracy cross check or for adjusting calibration.

Figure 16.5 RM-TJ Test Jack

16.6 RM-DS-ts Meter Disk Sensor

The RM-DS-ts is a reflective pickup assembly used to sense the disk rotation of an induction type meter. The pulses generated by the RM-DS-ts are fed into the Pickup port on the RM-18 hand controller. With the RM-DS-ts and the RM-18 induction meter testing is fully automated with a high degree of accuracy compared to using the conventional push button or snap switch method. The RM-DS-ts is available in two different mounting options for increased flexibility.

Figure 16.6 RM-DS-ts Meter Disk Sensor
17.0 Service and Routine Maintenance

The RM-18 Portable Watthour Test System is virtually a maintenance free test system. The RM-18 Socket Adapter contains only surface mount components for improved reliability and ruggedness. Internally, there are fewer circuit board to circuit board connections. This greatly reduces problems associated with wiring and ill-fitting connections. The RM-18 hand controller power cord is field replaceable with the appropriate Radian part. Disassembly of the hand controller will reveal the power cord connector. Radian Research recommends keeping the RM-18 Test System in the padded carrying case when not in use. Other than routine surface cleaning and yearly calibration, no routine maintenance is required.
18.0 Cleaning

Cleaning of the RM-18 may be performed with a clean, dry lint-free cloth dampened slightly with a mild window cleaner. The area around the current blades and meter jaws should be buffed dry with another cloth which is completely clean and totally dry.
19.0 Warranty and Calibration Service

Radian Research warrants each of our products to be free from defects in material and workmanship. Our obligation under this warranty is to repair or replace any instrument or component therein which, within two years after shipment, proves to be defective upon examination. Radian will pay local domestic surface freight costs for return shipment of the product back to the customer.

In addition, all Radian Metronic Watthour Standards are warranted to be substantially stable in calibration over time. If within one year after factory calibration the standard does not meet its specifications, we will repair and recalibrate the unit at our cost. Our calibration records retain the value of each of the three reference elements to six decimal positions.

For a period of ten years, we warrant any fully autoranging reference standard from catastrophic failure caused by failure to range properly. This warranty is voided by disassembly of the unit beyond removal of the case for recalibration.

If warranty service is required, write or call your local Radian Research representative or contact our headquarters in Lafayette, Indiana. You will be given prompt assistance and shipping instructions.

Our optional five year extended warranty and calibration service is available on all Radian standards. Contact your local Radian Research representative or our headquarters for details.

Radian Research, Inc. maintains a complete state-of-the-art recalibration and repair facility in Lafayette, Indiana. Estimates for repairs are available by contacting our headquarters. All recalibrations, which are certified traceable to the National Institute of Standards and Technology are performed on the Radian RS-703A Automated Calibration System. The RS-703A Calibration System is referenced by Radian RM-11 Primary Standards with a short-term repeatability of 0.001% or better.