

Installation Instructions for Magnum DS Trip Unit Testing Using PACB Test Kit Style 87C0270G01

 **WARNING**

Do not attempt to install or perform maintenance on equipment while it is energized. Death or severe personal injury can result from contact with energized equipment. Always verify that no voltage is present before proceeding with the task and always follow generally accepted safety procedures. Eaton is not liable for the mis-application or mis-installation of its products.

 **IMPORTANT**

The user is cautioned to observe all of the recommendations, warnings and cautions relating to the safety of personnel and equipment, as well as all general and local health and safety laws, codes and procedures.

The recommendations and information contained herein are based on Eaton’s experience and judgement, but should not be considered to be all-inclusive or covering every application or circumstance which may arise. If any questions arise, contact Eaton for further information or instructions.

 **WARNING**

Do not test the trip unit while the breaker is in the “connected” position. Breaker must be racked to the “test” position, or removed from the switchgear cell.

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Section 1: Introduction

1.1 General Information

The PACB Trip Unit Test is used to test and verify the pickup levels and time delay settings of a breaker's trip unit. Scheduled testing of the circuit breaker's trip unit will help to ensure proper operation of the breaker and will lead to safer and more efficient performance.

Section 2: Test Kit / Breaker Information

2.1 Test Kit Information

2.1.1 Test Kit Controls

The following are the identifications and functions of the Test Kit controls. Any time these are referred to in the following portions of this publication they will be in **bold type** as shown in the following definitions.

Power — Turns power on and off to the Test Kit.

Phase Select — Permits checking of all phase input circuits. Can be pressed at any time prior to performing a test. Since all feed into a common pickup and timing circuit, it is only necessary to use one phase to test all the solid-state circuitry functions. Current is applied through the selected phase and returns to Test Kit via the neutral element. It is only necessary to use one circuit function (e.g., Long Delay) to verify that each phase (A, B and C) performs similarly. The **Phase Select** button is also used as an accelerator when scrolling through numerical entry fields and can be used to delete characters when entering the breaker name.

Test Select — Cycles the Test Kit through the steps of testing, including date input and the various tests. (See **Figures 6 and 7**).

Start — Begins testing of trip unit. Also used to proceed to next field when entering text data. (See **Figures 6 and 7**).

Cancel — When pressed, takes the test kit back to the beginning of the test sequence. Also used to move to previous field when entering text data. (See **Figures 6 and 7**). Pressing **Cancel** twice will take the Test Kit back to the main screen.

Up Arrow — Increments value.

Down Arrow — Decrements value.

2.1.2 Test Kit Breaker Cable

The Test Kit Breaker Cable is used to connect the Test Kit to the breaker's trip unit. The 14 pin Test Kit plug will not insert into the trip unit unless the Long Time Memory (LTM) jumper is in the inactive position, or it is removed. If it is in the active position (vertical), it must be removed or returned to the inactive position before the adapter connector can be inserted. See paragraph 2.2.2 for the explanation of this function.

2.1.3 Zone Interlock Shorting Plug

The Zone Interlock Shorting Plug (8779C02G06) is required when the breaker is removed from the switchgear cell for testing. The Shorting Plug must be installed on the breaker secondary contacts to defeat zone-interlock wiring (See **Figures 4 and 5**).

2.2 Circuit Breaker Information

2.2.1 Trip Unit Tolerance Bands

The Long Delay Pickup point is normally set in the Digitrip at 110% of the Long Delay Setting. The tolerance is $\pm 5\%$ of 110%.

Long Delay Times of the Trip Unit are top of band. The tolerance is $+0\% / -30\%$ of the Long Delay Time Setting.

Short Delay Pickup, Instantaneous, and Ground Fault Pickup values are mid-band, which have $\pm 10\%$ tolerance. Short Delay Time and Ground Time require curve for band tolerance.

2.2.2 Trip Unit Test Guidelines

Testing of the Trip Unit must be performed with the Trip Unit properly installed in the breaker.

The Long Time function has a memory circuit with a reset time of 36 times the Long Delay Time. The thermal memory jumper may need to be removed to disable the thermal memory. This jumper is shipped from the factory in the "active" position.

If a trip function LED on the Trip Unit is lit prior to a test, press the *Trip Reset* pushbutton on the Trip Unit.

When bench testing a breaker wired for zone interlock applications, shorting plug 8779C02G06 must be installed per **Figures 4 and 5**.

Section 3: Test Kit Setup

3.1 General Information

Place the Test Kit on a stable surface prior to testing. The handle can be rotated for ease of viewing and operation by pressing the buttons on the sides of the handle and rotating the handle to the desired angle (See **Figure 2**). When powering on, the test kit will run a self-diagnosis before displaying the Home Screen (See **Figure 6**).

3.2 Hardware Connections

Insert the power supply into a standard 120V outlet and plug the opposite end into the Test Kit. Plug the breaker cable into the test kit and insert the grooved end into the breaker trip unit. Check the long time memory jumper position before plugging connector into test port.

3.3 Storing Test Results

The PACB Test Kit is capable of storing data obtained from multiple tests on the included SD Card. These results can be downloaded to a computer via the communication cable included in the kit or by importing the data directly from the SD Card. This data is saved automatically to the test kit as each test is performed. Once the memory is full, the test kit automatically begins to write over the first test in memory. Because calibration data is also stored on the card, it is crucial to the operation of the PACB Test Kit that the information on the SD Card is never removed.

It is important to press the **Cancel** button twice after performing all tests on one trip unit before proceeding to the next trip unit so that a new breaker name can be entered.

3.4 Powering Up the Test Kit

Press **Power** on the Test Kit. Once the kit powers on, the self-diagnosis has been completed and the kit is ready to test the trip unit. Upon power up and following self-diagnosis, the Test Kit will display the Home Screen.

3.5 Setting the Date & Time

Figure 6 provides a flow diagram for this section. In order to modify the System Setting for the Test Kit, press the **Down Arrow** immediately after the Test Kit displays the Home Screen. The Home Screen will read "MTK1000 – Press START", followed by the date. Press **Start** to modify the date. Use the **Up Arrow** and **Down Arrow** to modify values in each selection and press **Test Select** to proceed. Once completed press **Cancel** to return to the Systems Configuration menu. Pressing **Cancel** once more will return the Test Kit to the Home Screen.

3.6 Communication Settings

Figure 7 provides a flow diagram for this section. In order to modify the System Setting for the Test Kit, press the **Down Arrow** immediately after the Test Kit displays the Home Screen. The Home Screen will read "MTK1000 – Press START", followed by the date. Once "System Settings → Date & Time" is displayed, press the **Up Arrow** to verify "Communications" is displayed. Press **Start** to modify these settings. Use the **Up Arrow** and **Down Arrow** to modify values in each selection and pressing **Test Select** to proceed. Once completed press **Cancel** to return to the Systems Configuration menu. Pressing **Cancel** once more will return the Test Kit to the Home Screen.

Section 4: Testing the Trip Unit

4.1 Legend

I_n = Rated Plug Value (must match Sensor Rating, I_s)

I_g = Ground Fault Current Pickup

I_t = Test Kit Trip Current

$I_{n/s} = I_n / I_s$

I_r = Long Delay Pickup Setting (Rated Current)

4.2 Entering Breaker Name

The PACB Test Kit is capable of storing test results as each test is performed. For this reason, it is important to label the breakers subject to test in the test kit memory. When prompted for breaker name on the display screen use the **Up Arrow** and **Down Arrow** to change the character and **Start** button to advance to the next character. The **Cancel** button can be pressed to move to the previous field. The Channel Select button, when pressed, performs the delete function. Once the entry is complete, press the **Test Select** button to proceed.

It is important to press the **Cancel** button twice to return to the Home Screen after performing all tests on one breaker before proceeding to the next breaker so that a new breaker name can be entered.

4.3 Setting the Plug Rating

In order for the test kit to correctly calculate current values, the plug rating of each trip unit must be stored into the test kit. When prompted, use the **Up Arrow** and **Down Arrow** to set the plug rating value and press the **Test Select** button.

4.4 Setting the Frequency

The PACB Test Kit is capable of providing voltages and currents at frequencies of 50 Hz and 60 Hz. In order to set this frequency, use the **Up Arrow** and **Down Arrow** to set the frequency and press the **Test Select** button.

4.5 Self Calibration

The PACB Test Kit contains a current transformer that is calibrated during the assembly process. During the self calibration procedure, the PACB Test Kit measures the current being injected into the test kit and modifies its program accordingly. This assures that variances in trip units will not affect the value for which each test is performed. It is important to complete the self calibration procedure each time a new trip unit is tested. During self calibration, it is likely the trip unit will tip. This is normal and will not affect the self calibration routine. Ensure that the trip unit is reset after the self calibration procedure is complete.

4.6 Proceeding Through Tests

The Long Delay Pickup Test must be completed prior to performing any other test as data stored in the Long Delay Pickup Test is used in later tests. In order to move through the various tests, the **Test Select** must be pressed to move to the proper test and press **Start** to begin the test. When the trip unit must be set to a certain setting for a test, the test kit screen will display these settings on the screen. Once the trip unit is set, press **Start** on the test kit to proceed.

4.7 Checking the Long Delay Pickup (L.D.P.U.)

This test must be performed prior to any other test. Press **Test Select** on the test kit until "LONG DELAY TEST" is displayed and press **Start**. The Short Delay Pickup Setting on the trip unit must be set to max and Instantaneous must be set to off. The test kit will display these settings prior to the test as a reminder. Set the Long Delay Pickup on the trip unit to the desired setting and make sure the trip unit is reset. Press **Start** to proceed once the trip unit has been set. In order to check the Long Delay Pickup of the trip unit, the test kit must begin generating current and forcing it into the trip unit. Once the test kit displays "Long Delay Trip Set", set the current value using the **Up Arrow** and **Down Arrow** to set the test kit " I_r " to a value below the Long Delay Time Pickup Setting and press the **Start** button. Once the **Start** button has been pressed, the test kit begins to generate current and force it into the trip unit. Begin to press the Up Arrow until the "Unit Status" LED on the trip unit begins to flash quickly. This should occur at the pickup current, (+15% / -0%). Once the current value is set so the LED continuously flashes quickly press the **Start** button. If the **Start** button is not pressed, the test will time out after 40 seconds. This value is the Long Delay Pickup Value.

NOTE: The rate of flashing will slow to normal when the current is lowered below the pickup setting.

4.8 Checking Long Delay Time (L.T.D)

The Long Delay Time test is performed after the Long Delay Pickup Test. Once verifying the Long Delay Pickup, press **Test Select**. The screen should read "LONG DELAY (at 6.0xlr). Use the **Up Arrow** and **Down Arrow** to set the test kit "T=" to match the Long Delay Time setting on the trip unit. The setting is input as milliseconds. Once the time delay setting on the test kit matches that of the trip unit, press the **Start** button. The test will run and if the trip unit trips in the allotted time, the test kit will display "LONG DELAY **COMPLETED**" and will list the current (I), Time Setting (S), and the actual clearing time (R). If no trip occurs and the background timer expires, the trip unit will display "LONG DELAY **FAIL**" and will list the current (I), Time Setting (S), and the failed clearing time (R). The Time (displayed as "R" on the test kit) should be less than the dial setting but no less than 70% of the setting. Pushing the **Start** button at this point will cause the test kit to return to the Long Time Pickup Test.

NOTE: Because the test kit only has discrete values for which it can inject current into the trip unit, it is likely that the value determined for the Long Time Pickup is slightly higher than the actual setting on the trip unit. In this case, the Long Delay Time value returned by the test kit will be slightly lower than the actual value one would obtain when testing at the actual Long Delay Pickup value. These differences are negligible, but could cause for a time return slightly below the allowable range.

4.9 Checking Short Delay Pickup (S.D.P.U) (If Applicable)

Prior to performing this test, the Long Delay Pickup test must be performed. Press **Test Select** on the test kit until "SHORT DELAY TEST" is displayed and press **Start**. Set the Short Delay Pickup on the trip unit to the desired setting and make sure the trip unit is reset. The Short Delay Time Setting on the trip unit must be set to minimum (0.1 sec), Instantaneous must be set to off, and the Long Delay Time should be set to the maximum. The test kit will display these settings prior to the test as a reminder. Press **Start** to proceed once the trip unit has been set. At this point use the **Up Arrow** and **Down Arrow** to match the setting "s=" on the test kit to the Short Delay Setting on the trip unit. Press **Start** and the test kit will automatically increase the current to determine the Short Delay Pickup. If the test is successful, the test kit will display "PICKUP CURRENT FOUND" and the current value.

4.10 Checking Short Delay Time (S.D.T) (If Applicable)

After the test kit determines the correct Short Delay Pickup press **Test Select** on the test kit. Set the Trip Unit to the desired Short Delay Time Setting and press **Reset** on the trip unit. It responses — those labeled with an asterisk (*) can not be tested with the Test Kit. Use the **Up Arrow** and **Down Arrow** to match setting (T) on the test kit to the Short Delay Time Setting and press **Start** on the test kit. The test will run and if the trip unit trips in the allotted time, the test kit will display "SHORT DELAY **COMPLETED**" and will list the current (I), Time Setting (S), and the actual clearing time (R). If no trip occurs and the background timer expires, the trip unit will display "SHORT DELAY **FAIL**" and will list the current (I), Time Setting (S), and the failed clearing time (R).

4.11 Checking Ground Pickup (If Trip Unit Is So Equipped)

Press **Test Select** on the test kit until "GROUND FAULT TEST" is displayed and press **Start**. Set the Ground Fault Pickup on the trip unit to the desired setting and make sure the trip unit is reset. Use the **Up Arrow** and **Down Arrow** to set the test kit "g=" to match the pickup setting on the trip unit. Press **Start** and the test kit will automatically increase the current to determine the Ground Fault Pickup. If the test is successful, the test kit will display "PICKUP CURRENT FOUND" and the current value. If no pickup current is detected, the test kit will display "NO PICKUP CURRENT FOUND".

4.12 Checking Ground Delay Time (If Trip Unit Is So Equipped)

NOTE: Zone Selective Interlocking essentially disables Ground Delay Time. This function is provided as a standard feature on all Magnum Trip Units. To test the Ground Delay Time when the breaker is removed beyond the test position in the switchgear, the zone interlock shorting plug must be utilized (see **Figures 4 and 5**). Without this, all Ground Delay Time values will be minimum.

After determining the Ground Pickup press **Test Select** on the test kit and reset the trip unit. Set the desired Ground Delay Time setting on the trip unit. It responses — those labeled with an asterisk (*) — can not be tested with the Test Kit. Use the **Up Arrow** and **Down Arrow** to set the time to match the Ground Delay Time setting on the trip unit. The setting is input as milliseconds. Once the time delay setting on the test kit matches that of the trip unit, press the **Start** button. The test will run and if the trip unit trips in the allotted time, the test kit will display "GROUND FAULT **COMPLETED**" and will list the current (I), Time Setting (S), and the actual clearing time (R). If no trip occurs and the background timer expires, the trip unit will display "GROUND FAULT **FAIL**" and will list the current (I), Time Setting (S), and the failed clearing time (R).

4.13 Checking Instantaneous (If Applicable)

Press **Test Select** on the test kit until "INSTANTANEOUS TEST" is displayed and press **Start**. On the trip unit, set the Long Delay Pickup and Time to maximum and set Short Delay Pickup to M1 setting. Set the desired Instantaneous Pickup on the trip unit and reset the trip unit. Use the **Up Arrow** and **Down Arrow** to set the test kit "i=" to match the pickup setting on the trip unit. Press **Start** and the test kit will automatically increase the current to determine the Instantaneous Pickup. If the test is successful, the test kit will display "PICKUP CURRENT FOUND" and the current value. If no pickup current is detected, the test kit will display "NO PICKUP CURRENT FOUND".

If the test kit successfully determines the Instantaneous setting of the trip unit, press **Test Select** on the test kit and reset the trip unit to test the Instantaneous trip time. Press **Start** and the test kit will return the Instantaneous trip time.

Section 5: Troubleshooting

Listed below are resolutions to common problems experienced with the PACB Test Kit. Please review this section prior to contacting Eaton with questions.

Trip Unit keeps indicating the wrong type of trip (i.e. Long Delay Trip when testing Short Delay Pickup).

Verify that the trip unit is set correctly as indicated on the Test Kit prior to starting the test and that the trip unit is reset prior to starting a test. Verify that the Zone Interlock plug is installed when the breaker is removed past the Test Position or is removed from the cell.

Measured values for a particular Trip Unit are not consistent with settings on the Trip Unit.

Press **Cancel** twice to reach the Home Screen. Proceed as normal and ensure that the Test Kit performs the self calibration procedure with the new Trip Unit. Verify that the thermal memory jumper is in the correct position or setting (see paragraph 2.2.2). Ensure that the SD Card provided from the factory is installed in the Test Kit and still has the original calibration data stored.

Trip Unit seems not to respond to input from the Test Kit.

Verify that the Trip Unit Cable is plugged correctly into the Trip Unit as well as the rear of the Test Kit.

Section 6: Figures



Figure 1. Complete Test Kit



Figure 2. Handle Positions



Figure 3. Trip Unit Faceplate Showing Test Port Connection

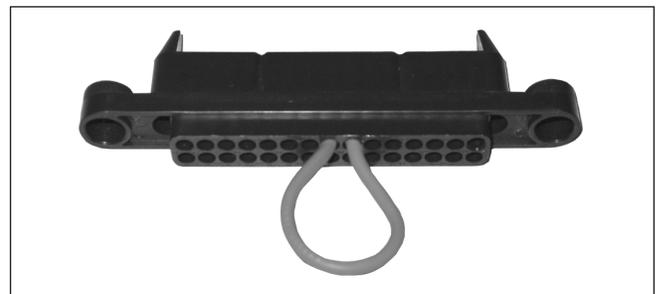


Figure 4. Zone Interlock Shorting Plug



Figure 5. Zone Interlock Shorting Plug Installed on Circuit Breaker

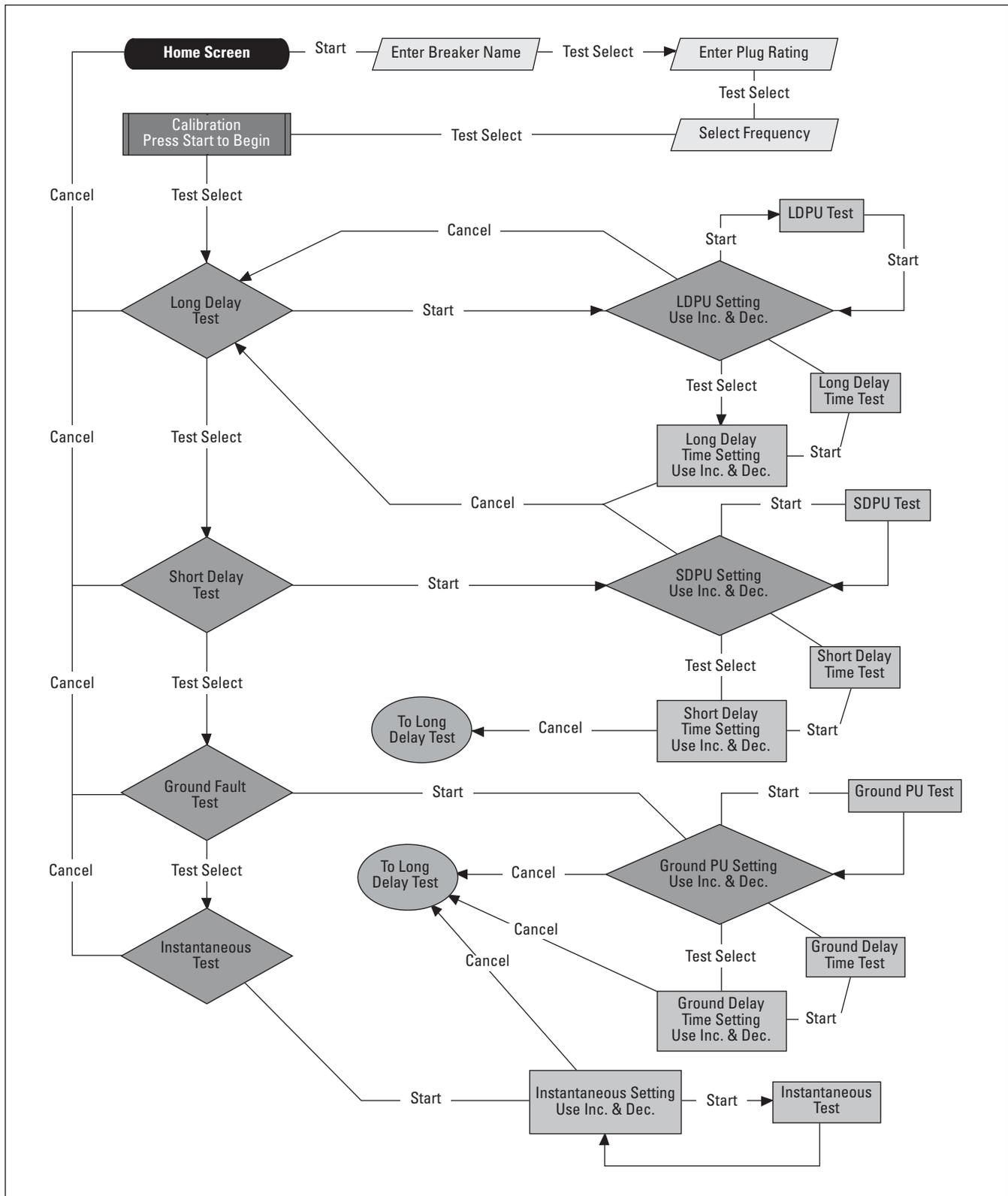


Figure 6. User Interface Flowchart

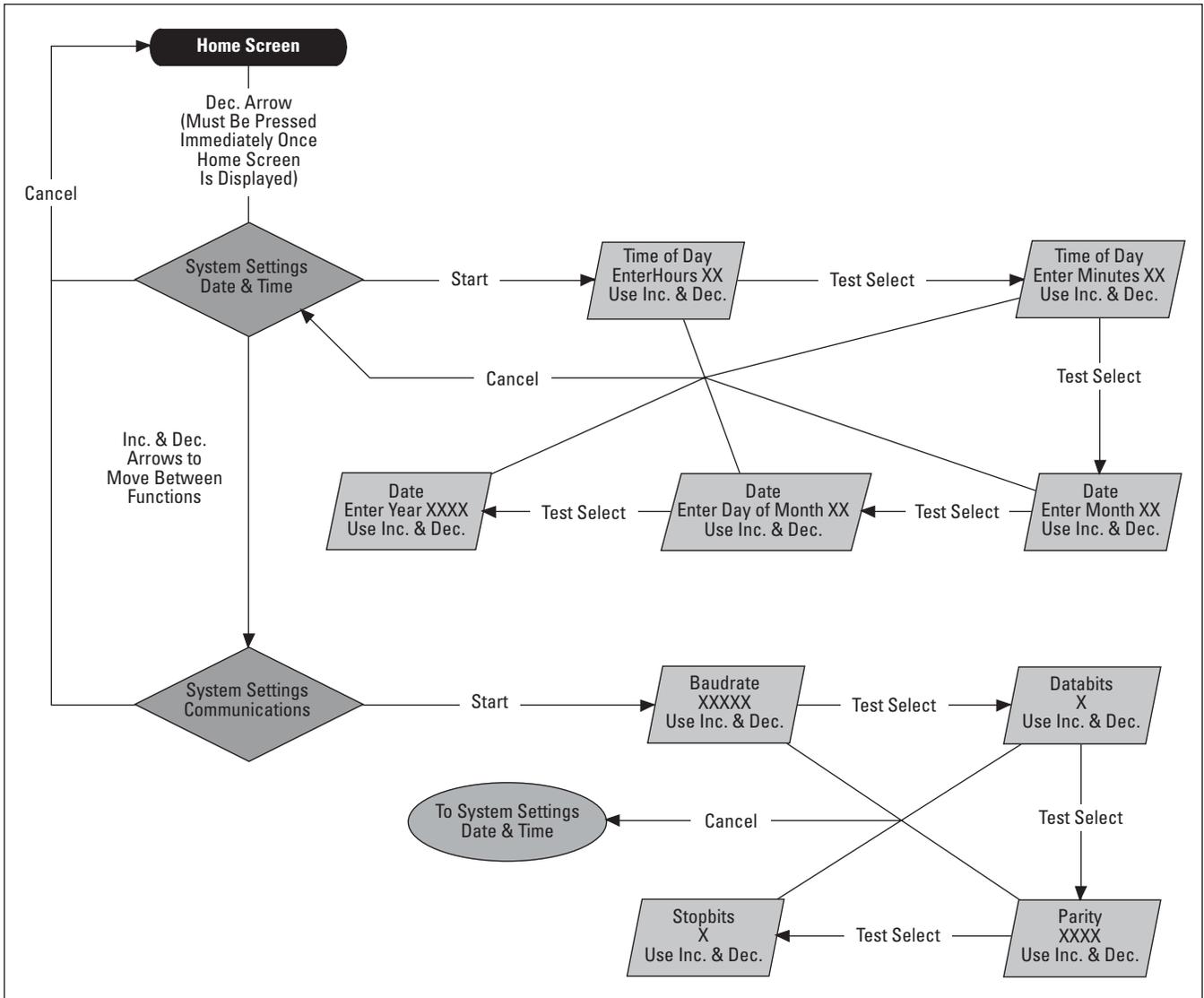


Figure 7. System Settings Flowchart

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