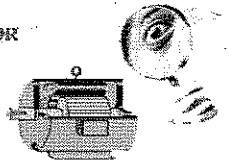


LOOKING FOR
TROUBLE?



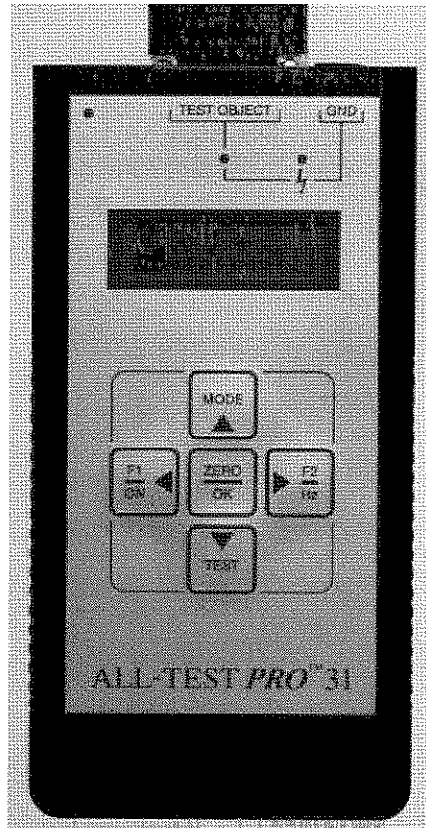
Yes... YOU WILL
FIND IT WILL.

THE ALL-TEST!

ALL-TEST PRO 31

USER MANUAL

ALL-TEST PRO™ 31



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Table of Contents

Table of Contents.....	1
Introduction.....	2
Safety	2
Instrument Warnings and Considerations.....	2
General Safety Considerations.....	3
ALL-TEST PRO 31 Kit Components.....	3
ALL-TEST PRO 31 Functions	4
Instrument.....	4
Instrument Screen 1: Impedance, Phase Angle and Frequency.....	5
Changing Test Frequency	5
Instrument Screen 2: I/F Test.....	6
Instrument Screen 3: Phase Balance Test.....	6
Instrument Screen 4 and 5: Rotor Test: Bar and Rotor Test.....	6
Instrument Screen 8: Insulation Resistance Test	7
Instrument Screen 9: EMI Testing.....	7
Instrument Charging Circuit.....	7
Test Procedures.....	8
Winding Test – Three Phase Motors	8
Rotor Test – Three Phase Motors – Bar and Auto Test.....	9
Bar Test.....	9
Auto Test.....	9
DC Motor Testing.....	9
Testing an Assembled DC Motor	9
Armature Testing	10
Data Interpretation	11
Three Phase Motor Windings	11
Induction Motor Rotors.....	12
Bar Analysis.....	12
Auto (Sine-Wave) Method.....	12
DC Motor Analysis.....	13
Tech Support and Information.....	14
Re-Setting Unit	14

Introduction

The ALL-TEST PRO™ 31 is designed to provide a simple method for troubleshooting, commissioning and quality assurance of electric motors and other wound equipment. The test method includes an expanded 500/1,000 Vdc, up to 500 MegOhm insulation to ground test, impedance test, and our patented phase angle and I/F tests for early winding fault detection. The power of the ALL-TEST PRO 31 includes an EMI test for detection of low-level EMI currents that can effect readings and may be the result of other faults within the motor circuit.

The light-weight, hand-held instrument can be used for immediate detection of winding shorts, insulation to ground faults, rotor faults, cable faults and more on AC/DC electric motors, transformers, coils, machine tool equipment, linear motors and much more. Testing can be performed at the motor connection box or from the disconnect or motor control center hundreds of feet away.

Safety

The ALL-TEST PRO™ 31 is a CE registered instrument. It is designed to test de-energized equipment safely and quickly. However, improper application of the ALL-TEST PRO 31 on live circuits is a danger to the user and will result in destruction of the testing circuit, requiring instrument replacement.

Instrument Warnings and Considerations

The following is a list of considerations for equipment life and accurate data collection:

- Ensure that all power has been removed from the circuit being tested, including static power stored in capacitors – Discharge all capacitors being tested.
- Attaching the ALL-TEST to live voltage will destroy the unit and void the warranty.
- Do not attempt to change the batteries. Contact your distributor or BJM Corp, ALL-TEST Pro Division at 860 399-5937 or via email, alltest@bjmcorp.com, to have the battery pack replaced.
- Do not open the instrument. Electrostatic charges may damage surface mount electronics. Please contact you vendor or BJM Corp for an authorized repair center.
- Use only the supplied charger for charging the instrument. It is an integral part of the charging circuit. Using the wrong charger will damage your instrument.

General Safety Considerations

Following are general safety considerations for using the ALL-TEST PRO 31 motor tester:

- The ALL-TEST PRO 31 is an off-line motor tester. All power and residual power must be disconnected. It provides a safe method of testing your electric motors.
- Follow all safety rules of your company and OSHA (or country equivalent) for off-line testing methods, including appropriate Personal Protective Equipment (PPE). Improper or unsafe operation of the equipment is the sole responsibility of the user.
- For MCA testing, the ALL-TEST PRO 31 sends out a low voltage, high frequency signal not harmful to the technician or electronic equipment (variable frequency drives and soft starts). However, electronic equipment and personnel must observe appropriate safety considerations (disconnect electronic equipment) when using the MegOhm test.

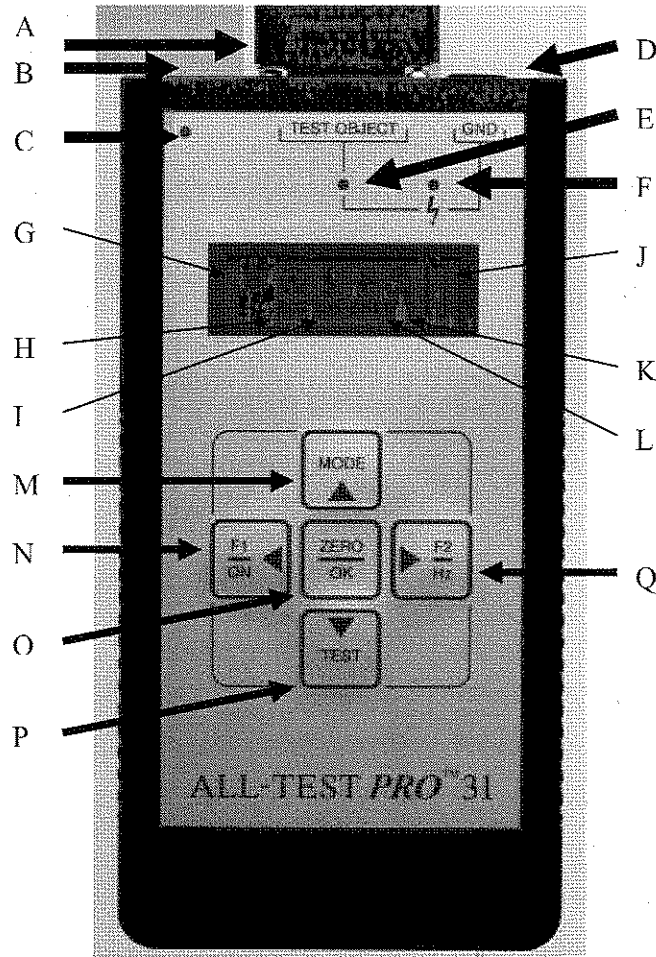
ALL-TEST PRO 31 Kit Components

The ALL-TEST PRO 31 kit contains all of the test components necessary to test most electrical machinery.

- ✓ ALL-TEST PRO 31 instrument
- ✓ Batteries (installed)
- ✓ Test leads
- ✓ Charger – 115 or 230 Volt
- ✓ Manual on CD Rom
- ✓ Carrying Pouch
- ✓ Reset Key

ALL-TEST PRO 31 Functions

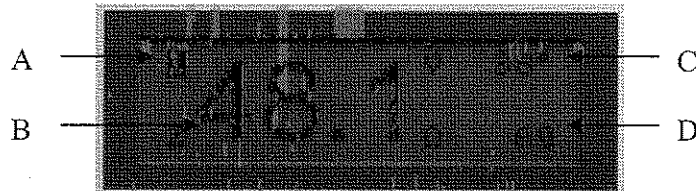
Instrument



- A. Test lead port
- B. Charger port
- C. Charging light – Indicates that the unit is charging
- D. Ground test lead port
- E. Test indicator light – Indicates that the unit is testing
- F. Insulation Test indicator light – Indicates that the unit is testing insulation resistance.
Caution – Applied voltage is 500 or 1,000 Volts DC.
- G. Impedance, Phase Angle (Fi), Current/Frequency (I/F) and Phase Balance test selection
- H. Rotor test selection
- I. Insulation to ground test selection
- J. Battery charge level indicator

- K. EMI test selection
- L. Turn instrument off selection
- M. Up direction and Main Menu button
- N. On and left direction (F1) button
- O. 'Zero' and Selection ('OK') button
- P. Down direction and Test button
- Q. Left (F2) and Frequency Select button

Instrument Screen 1: Impedance, Phase Angle and Frequency



1. From the main screen, use the right and left arrows (F1 and F2 buttons) to highlight the first selection, which is the image of an electric motor.
2. Press the OK button which will place you in Screen 1

The screen is indicated in the upper left (A). Screen 1 provides impedance (B) in Ohms, phase angle (C) in degrees and the test frequency (D) in Hz. The selections for test frequency are 25, 50, 60, 100, 200, 400 and 800 Hz.

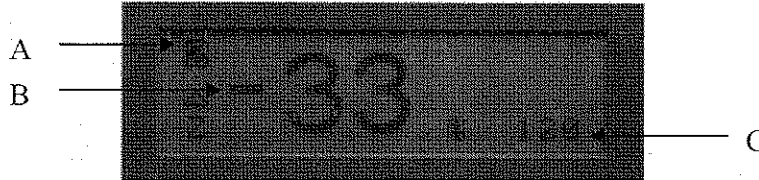
The data is presented in 'real time,' which means that if you move the motor shaft, your values will change slightly. You will also notice that if you change the test frequency (D), your impedance value will increase.

Changing Test Frequency

The test frequency can be changed in Screen 1. To increase or decrease the test frequency:

1. Press the right (F2) button and the Screen number indicator (A) should show an up/down arrow.
2. Press the up or down button to increase or decrease the test frequency. The Screen number (A) will re-appear.
3. To continue changing, repeat steps 1 and 2.

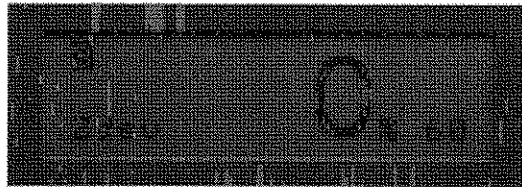
Instrument Screen 2: I/F Test



To view the I/F reading (B) on Screen 2 (A), press the Test button when you are in Screen 1. The I/F reading (B) will be displayed as well as the doubled frequency (C). To return to Screen 1, press the Test button.

Turning the motor shaft will change these test results.

Instrument Screen 3: Phase Balance Test



Screen 3 may be viewed, from either Screen 1 or Screen 2, by pressing the 'Zero/OK' button on the center of the key pad. This will display the relative % deviation of the impedance from the 'Zero' setting.

Uses for Screen 3 include determining phase unbalance and rotor testing. This result will change if the shaft is moved.

Instrument Screen 4 and 5: Rotor Test: Bar and Rotor Test



Screen 4, the **Bar Rotor Test**, can be viewed from the main menu by pressing the Rotor Test Selection. Turn the shaft of the motor several times (at least 4) while the instrument auto-ranges. A bar will appear across the bottom of the screen.

In a good rotor, the bar will extend completely from the left of the screen to the right side of the screen once for each pole of the motor (ie: 2-pole motor will extend twice, 4-pole four times, etc.). See Test Procedures section.

When the TEST button is pressed, the AUTO test function, which shows a Sine-Wave appears. See Test Procedures.

Instrument Screen 8: Insulation Resistance Test



Screen 8 is accessed from the main menu.

1. Select 'Ins' and press the 'Zero/OK' button. Three dashes will appear in the center of Screen 8.
2. Use the right button (F2) to change the insulation test voltage, displayed in the upper right corner, to the correct test voltage (500 or 1,000 Volts).
3. Press and hold the 'Test' button. The Insulation Test indicator will be lit during testing
 - a. If the display reads >500, then the insulation is greater than 500 MegOhms.
 - b. If the display reads some other value, hold down the 'Test' for 1 minute max and record the final reading.
 - c. If the display shows 0, then the motor is grounded.

Instrument Screen 9: EMI Testing

Screen 9 is accessed from the main menu.

1. Select 'EMI' and press the 'Zero/OK' button. A value will show with an mV in the lower right. Top right will display 'HI'. This is the highest level of EMI that the instrument is detecting.
2. Press the right button (F2). A value will show with an mV in the lower right. Top right will display 'LO'. This is the lowest level of EMI that the instrument is detecting.

At the time of drafting of this edition of the manual, research is underway to determine the maximum EMI values before test results are corrupted. In addition, research is being conducted into the application of this test in troubleshooting and trending electrical machinery condition.

Instrument Charging Circuit

The ALL-TEST PRO 31 Charger is specifically designed to be an integral part of the charging circuit. In order for the charger to operate correctly, connect the charger to the instrument, then plug in to the appropriate outlet. The AT31 will turn on and show a charging screen which will include the battery voltage and charging time. A light will show red while charging and green when charging is complete.

Test Procedures

Winding Test – Three Phase Motors

1. Clip the ground lead to an earth ground in motor control center, disconnect or connection box (Test Point).
2. Connect the red and black test clips from T1 to T2 (A-Phase to B-Phase).
3. Press the 'F1/ON' button.
4. In the menu, select the test selection with the motor icon (far left) using the F1 and F2 buttons, and press the 'Zero/OK' button. You will now be in Screen 1.
5. Select a test frequency where the impedance value displayed is above 1 Ohm and below 999 Ohms. Note the test frequency, impedance and phase angle readings.
6. Press the 'Test' button. You will be in Screen 2. Note the I/F test reading.
7. Press the 'Test' button and you should be in Screen 1.
8. Move one lead from T2 (B-Phase) to T3 (C-Phase) – You should now have a test lead on T1 and T3. Note the impedance and phase angle readings.
9. Repeat step 6 and 7.
10. Repeat steps 8 and 9 for T2 (B-Phase) to T3 (C-Phase).
11. Check your results

Note: If you are testing from the MCC or cannot move the motor shaft, skip steps 12 to 16 (Phase Balance).

12. before performing the phase balance test and move the test leads from T1 to T2.
13. In Screen 1, turn the motor shaft until you obtain the lowest impedance value on the display.
14. Press the 'Zero/OK' button. You will now be in Screen 3 and the value should be '0%'.
15. Move the test leads so that you have one on T1 and one on T3. Rotate the shaft until you obtain the lowest possible percentage unbalance and note it.
16. Move the test leads so that you have one on T2 and one on T3. Rotate the shaft until you obtain the lowest possible percentage unbalance and note it.

To Test Insulation to Ground:

17. Press the 'Mode' button to return to the main screen on the ALL-TEST PRO 31.
18. Press the F2 button until the INS selection is highlighted and press the 'Zero/OK' button.
19. Select the test voltage with the F2 button (500 or 1,000 V).
20. Press the test button for no more than 1 minute or until the result shows ">500." Note the result.
21. Press the 'Mode' button.
22. Use the F1 and F2 buttons to highlight PWR OFF in the main menu and press 'Zero/OK'
23. See the Data Interpretation section of this manual for data interpretation.

Rotor Test – Three Phase Motors – Bar and Auto Test

Bar Test

1. Turn the unit on using the 'F1/ON' button.
2. Use the F1 and F2 buttons to highlight the Rotor Test selection and press the 'ZERO/OK' button.
3. Turn the shaft until the bar appears at the bottom of the screen. The instrument has auto ranged for the motor.
4. Position the bar so that it lines up with the center line on the screen. Note the resulting percentage (should be close to '0.0' for a good rotor).
5. Turn the shaft until the bar reaches the far left. Note the resulting percentage.
6. Turn the shaft until the bar reaches the far right. Note the resulting percentage.
7. A good rotor should be within 1% of each other at the far right and far left. See data interpretation for a description of faults.

Auto Test

1. From the Bar Screen, press the TEST button.
2. A timed wave will appear on the test screen.
3. Rotate the shaft and view the sine wave. If you continue to rotate the shaft, the sine-wave will 'lock-in' showing the complete curve for review. Otherwise, pressing the F1 button will lock the view on the screen for your review.

DC Motor Testing

Testing an Assembled DC Motor

1. Clip the ground lead to an earth ground at the test point.
2. Test the fields if the DC motor is a compound or shunt motor:
 - a. Connect the test leads to motor leads F1 and F2.
 - b. Press the 'F1/ON' button.
 - c. In the menu, select the test selection with the motor icon (far left) using the instrument F1 and F2 buttons, and select the 'Zero/OK' button. You will now be in Screen 1.
 - d. Select a test frequency where the impedance value is above 1 Ohm and below 999 Ohms. Note the test frequency, impedance and phase angle readings.
 - e. Compare the results to a similar motor or to a baseline reading on the same motor and note any changes.
3. Connect the test leads to A1 and A2 (armature leads).

4. If the DC motor is a Series motor, perform the following:
 - a. Press the 'F1/ON' button.
 - b. In the menu, select the test selection with the motor icon (far left) using the instrument F1 and F2 buttons, and select the 'Zero/OK' button. You will now be in Screen 1.
5. Select a test frequency where the impedance value is above 1 Ohm and below 999 Ohms. Note the test frequency, impedance and phase angle readings.
6. Compare the results to a similar motor or to a baseline reading on the same motor and note any changes.
7. See Data Interpretation.

Armature Testing

1. Connect the test leads to the A1 and A2 armature leads.
2. Lift all but two of the DC motor brushes 90 degrees from each other.
3. Press the 'F1/ON' button.
4. In the menu, select the test selection with the motor icon (far left) using the instrument F1 and F2 buttons, and select the 'Zero/OK' button. You will now be in Screen 1.
5. Adjust the test frequency until you are between 1 and 999 Ohms of impedance.
6. Position the leading edge of one of the brushes at the edge of one rotor bar. Note the impedance and phase angle values.
7. Repeat step 6 until you have completed one full revolution.
8. If the impedance values are consistent and/or repeating, the armature is good. If not, there is a short.

Note: This test can also be performed using I/F (Screen 2) and % Deviation (Screen 3).

Data Interpretation

Three Phase Motor Windings

Data interpretation of three phase motor windings is very simple. The following tables are designed to assist you in understanding how to interpret data from your ALL-TEST PRO 31.

NOTE 1: It is important to remember that if a fault is found when testing from the motor control center, disconnect, or from a distance from the motor through cable, it is important that a confirmation test is performed at the motor connection box. ALL-TEST Pro Motor Circuit Analyzers will detect cable faults. If the reading is good at the motor, then the fault is in the cable; If the reading improves, but is still poor, at the motor, then there may be a fault in both the motor and cable; and, If the reading shows similar results at the motor, then the motor fault exists in the motor.

Note 2: In the case of wound rotor motors, synchronous motors and other motors that have windings in the rotor, if a fault is found, rotate the shaft any amount and retest. If the fault readings change, then the fault will most likely be found in the rotor windings.

Table 1: Three Phase Motor Test Results

Test	Limits	Description
Impedance	Special	This result can be used to trend the condition of a winding. If the overall readings decrease significantly, between tests, then the winding is degrading or contaminated.
Phase Angle (Fi)	+/- 1 point from average	Fi is a winding short indicator. A result of 35, 36, 37 degrees is OK, a result of 35, 32, 32 would be a fault (shorted winding).
Current/Frequency (I/F)	+/- 2 points from average	I/F is a winding short indicator. A result of -44, -45, -46 would be OK, -44, -46, -46 is borderline and -42 -45, -45 would be a fault (shorted winding)
Phase Balance	+/- 5%	Indicates winding unbalance which will result in current unbalance, motor heating and poor starting. It is recommended that this value remains under 3% with 5% indicating a fault.
Insulation Resistance	See Table 2 and 3	Indicates ground wall insulation failure or severe winding contamination.

Table 2: Insulation Resistance Voltage

Motor Voltage Rating	Insulation Test Voltage
< 600 Volts AC	500 V
600 to 6000 Volts AC	1,000 V

Table 3: Insulation Resistance Values (IEEE 43-2000)

Application	Pass/Fail Value
Insulation systems prior to 1974	> 1 Megohm + 1 MegOhm per kV rating of motor
Random Wound motors less than 600 V	> 5 MegOhms
DC Armatures and Form Wound motors over 600 V	> 100 MegOhms

Induction Motor Rotors

The ALL-TEST PRO 31 will quickly identify broken rotor bars by just rotating the motor shaft through several rotations to get a visual identification or by using just one rotation for a numerical identification.

As an AC induction motor is rotated through 360 degrees, a sine-wave (or repeating pattern) is generated once for each pole of the motor. Each method represented in this manual is used to identify this repeating pattern in different ways with deviation from the pattern identifying problems.

Bar Analysis

This visual method can identify eccentric rotors, rotor bar breaks and fractures:

- ✓ Broken Rotor Bar: The bar does not make it across the complete range shown on the screen for one or more repetition. The motor should be scheduled for repair or replace.
- ✓ Casting void or fractured bar: The bar hesitates while the rotor is being turned at a constant rate. If the motor is operating without problems, monitor. Else, if the motor is drawing high current, schedule for repair or replace.
- ✓ Eccentric Rotor: Lop-sided pattern. For example, on a four pole motor, the bar starts at the left but does not make it all the way to the right, then does not make it all the way to the left, but makes it all the way to the right; the fault will be an eccentric rotor.

Auto (Sine-Wave) Method

- ✓ Broken Rotor Bar: The tops (peaks) or bottoms (valleys) of at least one of the sine waves will show a flat spot or inconsistency with other parts of the sine wave.
- ✓ Casting void: The sides of at least one sine-wave will be flattened or indented.

DC Motor Analysis

DC field coil analysis is performed by using one of three methods:

- ✓ Trend – Trend the windings over time or compare to a past reading. The Fi and I/F readings should be within one digit from the baseline reading.
- ✓ Compare – Two similar DC motors (same manufacturer and model) can be compared to each other. The Fi and I/F readings should be within one digit of each other.
- ✓ Split the fields – Evenly split the fields and compare the test results. The Fi and I/F readings should be within one digit of each other.

The DC armature can be evaluated using one of three methods:

- ✓ Trend – the overall armature circuit reading is trended over time. The Fi and I/F should not change more than one digit.
- ✓ Compare – Compare the armature results from two similar DC motors (see above) to each other. The Fi and I/F readings should be within one digit of each other.
- ✓ Bar to bar testing – The test results should show as a repeating pattern.

Tech Support and Information

Technical support can be obtained by emailing or faxing your questions to Martindale Electric

email: sales@martindaleco.com

fax: 216-521-9476

Please put Attention: Alltest pro 31 tech support in your subject line

Martindale Electric
1375 Hird Ave
Cleveland, Ohio 44107

Ph: 216-521-8567

Fax: 216-521-9476

Web: www.martindaleco.com

Re-Setting Unit

Your ALL-TEST PRO 31 kit includes a special RESET KEY which plugs into the test lead port. Should your unit lock up in any screen, placing this key in the test lead port cancels all functions and returns you to the main screen.