



ALL-TEST Pro, LLC

MOTOR GENIE™



Table of Contents

I. Introduction	3
II. Safety	4
Instrument Warnings and Considerations	4
General Safety Considerations	4
Instrument Operation	5
Input Section	5
Display Section	6
Indicator Light Section	6
Display Screen	6
Keypad Section	8
Instrument Test Leads	8
IV. Testing a Three Phase Induction Squirrel Cage Motor	9
Operating Procedure 3-Phase Motors	9
Winding Test	9
Turn the Instrument On	10
Z/φ Test	10
Observe/Record the Test Data	10
Error Codes	11
Continue with Last Phase	13
Resistance Test	15
Phase Balance Test	17
Insulation Resistance Testing	20
Changing the Motor Test Frequency	22
V. Additional Functions and Features	23
Resetting the Unit	23
Firmware Version	23
VI. Charging the MOTOR GENIE™	24
VII. Data Interpretation Three Phase Motors	25
Data Interpretation Tables	25
Additional Data Interpretation Considerations Three Phase Motors	25
Test Location	26
Confirming Suspected Winding Shorts	26
Method 1: Rotor Compensation	26
Method 2: Variable Frequency Test	27
IV. Available Accessories for the MOTOR GENIE™	29
XI. Disclaimer, Copyright & Trademarks	31

I. Introduction

The light-weight, hand-held instrument can be used for immediate detection of winding shorts, insulation to ground faults, cable faults and more in low voltage 3 phase AC induction motors. Testing can be performed at the motor connection box or motor control center hundreds of feet away.

The MOTOR GENIE™ is designed to provide a simple test method for:

- troubleshooting faults
- commissioning new and rebuilt machines
- verifying quality assurance in electric motors

The patented tests performed for early winding fault detection:

- winding impedance test
- phase angle (Fi)
- current frequency response tests (I/F)

Phase to phase resistance: Unbalances in resistance are an indicator of loose connections, pitted contactors, cold solder joints, etc.

Insulation Resistance to ground: To prevent electrical shocks and to assure safety of personnel the MOTOR GENIE™ provides an insulation to ground test. The insulation resistance test provides either 500 or 1,000 V_{DC} to measure the insulation resistance up to 500 Meg-Ohm.






II. Safety

CAUTION: MOTOR GENIE™ is designed to test *de-energized equipment* safely and quickly. Improper application of this instrument on live circuits is a danger to the user and will result in the destruction of the testing circuit, requiring instrument replacement.

Instrument Warnings and Considerations




The MOTOR GENIE™ is a CE registered instrument.

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

-  **Ensure that all power is removed from the circuit under test, including static power stored in capacitors – Discharge all capacitors to be tested.**
-  **Attaching the MOTOR GENIE™ to live voltage will destroy the unit and void the warranty.**
-  Do not attempt to change the batteries. Contact your distributor of the MOTOR GENIE™, **ALL-TEST Pro, LLC** at 860-399-4222 or via email (support@alltestpro.com), to have the battery pack replaced.
-  Do not open the instrument. Electrostatic charges may damage surface mount electronics. Please contact your vendor or **ALL-TEST Pro, LLC** 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 MOTOR GENIE™ motor tester:

-  The MOTOR GENIE™ is a de-energized (off-line) motor tester. All power and residual power must be disconnected. It provides a safe method for testing your electric motors.
-  Follow all safety rules of your company and OSHA (or country equivalent) for de-energized testing methods, including appropriate Personal Protective Equipment (PPE). *Proper or safe operation of the equipment is the sole responsibility of the user.*
-  For MCA™ testing, the MOTOR GENIE™ sends out a low voltage, high frequency signal not harmful to the technician or most electronic equipment (variable frequency drives and soft starts). However, electronic equipment and personnel must observe appropriate safety considerations (disconnect electronic equipment) when performing the insulation to Ground resistance test (Meg-Ohm) test.

III. MOTOR GENIE™ Kit Components

Figure 1: MOTOR GENIE™ Kit



Parameter	Valid Test Range	Accuracy	Max Resolution	Repeatability
Resistance	0.1 ~ 250 Ω	± 3%	10 mΩ	± 2%
Insulation Resistance	0 ~ 100 MΩ	± 3%	0.01 MΩ	± 1%
	100 ~ 500 MΩ	± 5%		
Impedance	1 ~ 999 Ω	± 3%	10 mΩ	± 2%
Phase Angle (°)	15° ~ 90°	± 2°	1°	± 1°
I/F (%)	-50% ~ -15%	± 2 Digits	1 Digit	± 1 Digit

The MOTOR GENIE™ kit contains all of the necessary components necessary to test most electrical machinery:

- A. MOTOR GENIE™ instrument
- B. Batteries (installed)
- C. Test leads and clips
- D. Charger (115 or 230 Volt)
- E. Manual (CD)
- F. Carrying Pouch (Option)

Instrument Operation

The instrument is divided up into three working areas:

1. Input Section
2. Display Area
3. Keypad

Input Section

The input section provides all the external connections to the MOTOR GENIE™

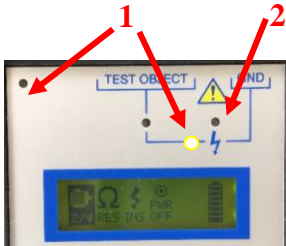
- A. Test lead port
- B. Charger port
- C. Ground test lead port for Insulation to Ground Measurements
- D. Reset Button



Display Section

The display section is divided into 2 sections:

1. Indicator Lights
2. Display Screen



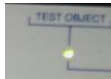
The Indicator Lights (section 1) informs the operator when an operation or test is being performed. The Display screen (section 2) allows the operator to select tests to be performed by the instrument.

Indicator Light Section

1. Charging light – Indicates that the unit is charging, light is illuminated **red** while charging, light is **green** when fully charged.



2. Test indicator light – Light is illuminated green when the unit is testing



3. Insulation Test indicator light – The light illuminates yellow when the instrument is testing insulation resistance. Caution – Applied voltage is 500 or 1,000 Volts DC.

Display Screen

The display screen has individual icons to select and perform the various motor and winding tests.



1. **Z/ψ** Icon performs the Impedance (Z), Phase Angle (ψ), Current/Frequency (I/F) and Phase Balance tests (*used to identify developing winding faults*).



2. **RES** Icon performs the phase-to-phase Resistance (R) tests. *(used to identify loose connections)*



3. **INS** Icon performs the Insulation to ground resistance test *(used to verify that the insulation to ground resistance is sufficient to prevent electrical shock).*



4. **PWR OFF** Icon turns the instrument off *(it will automatically shut-off after about 5 minutes).*



5. **Firmware Version** number can be displayed when the empty space to the right of **PWR OFF** icon is pressed – see the highlighted part below.

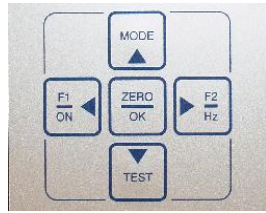


6. **Battery charge level** indicator. A fully charged battery will have 7 bars *(it is recommended to keep the AT31 on charge when not in use to ensure proper operation).*



Keypad Section

The keypad section provides keys to operate and control the functions of the instrument.



1. Up direction and MODE key *returns the display screen to the main menu.*



2. F1/ON and Left direction key *turns the instrument on and moves the cursor across the display screen toward the left.*



3. ZERO /OK (Selection) key *selects which test to perform and provides reference selection to calculate % difference of the measured impedance value.*



4. Down direction and TEST key *toggles between display screens and performs selected tests.*



5. Right direction and F2/Hz key *allows the operator to change the test frequency for the winding test and moves the cursor across the display screen to the right.*



Instrument Test Leads

The MOTOR GENIE™ uses a 15-pin DB connector for winding testing. The red test lead is the output and the black test lead, is the return. For insulation testing, the yellow test lead should be connected to ground.



IV. Testing a Three Phase Induction Squirrel Cage Motor

Testing can be performed remotely from the motor control center, the motor disconnect or at the motor itself. This instruction is provided to demonstrate all of the features of the MOTOR GENIE™, which can also be used to evaluate other types of electric machines.

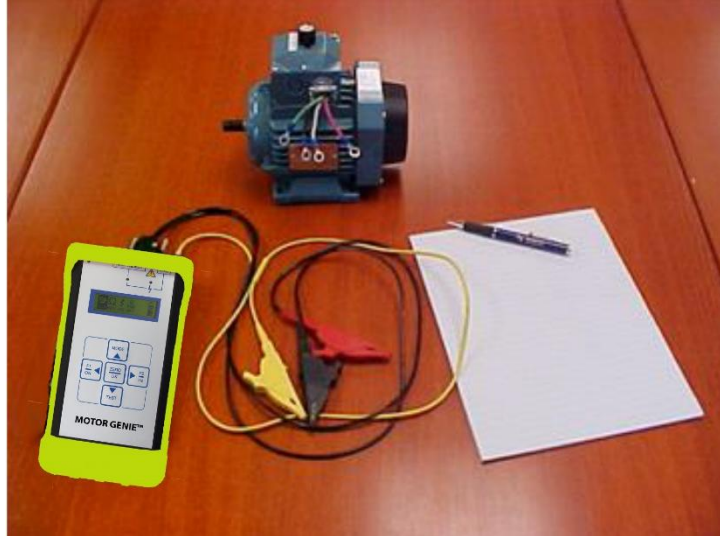


Figure 2: Equipment and Materials for Testing with the MOTOR GENIE™

To perform a motor test with the MOTOR GENIE™ requires:

- MOTOR GENIE™
- Test leads and lead clips
- A pen and paper (*or a copy of the Motor Test Form on page 38*).

Testing can be performed directly at the motor, at the nearest motor control center or disconnect. *For purposes of this manual, we will test at the motor using an M2002 training motor.*

Operating Procedure 3-Phase Motors

Winding Test

Measures and displays the winding impedance (Z), Phase Angle (ϕ), Current Frequency response (I/F), Resistance (R) and Impedance phase balance.

1. Label the three motor leads T1, T2, T3.

Note: It is very important to take the data in the same order for long term trending.

2. Connect the Test leads to the Motor leads T1 & T2.

Note: For quick trouble shooting the order of the readings is not important. However, for long term trending of the data, testing should be performed in the same order each time.



Optional: Connect the Yellow lead to ground, this is only required for measuring insulation to ground.

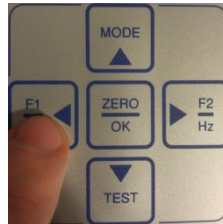
Turn the Instrument On

Press and hold the F1/ON key for 1 to 3 seconds. This will bring up the main display screen.

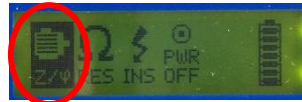


Z/φ Test

- Using the ◀ F1 and ▶ F2, keys highlight the Z/φ test icon



- Press the ZERO/OK Key to select the Winding Test icon (Z/φ) from the main menu.



Observe/Record the Test Data

- The default value is **200 Hz**, as displayed in the bottom right corner of the display screen.
 - The value of the impedance should be between 1 and 999 Ω. If the Z is less than 1 or greater than 999 Ω change the test frequency of the winding test (see Changing the Motor Test Frequency on page 22).
 - The current frequency response value (I/F) must be between -15 and -50, if it is not change the frequency of the winding test.
 - If the phase angle (Fi) is less than 15°, change the winding test frequency.

Note: If any of the measurements fall outside the above ranges, the test is not valid.

- Display screen 2 displays the results of the current frequency test. To view display screen 2 Press the TEST key.



Display screen 1: Displays the measured impedance in ohms 107, phase angle in degrees 66°, and the frequency of the winding test, 200 Hz. The screen number (1) is displayed in the upper left hand corner.



Display Screen 1

Display Screen 2: Displays the results of the Current Frequency (I/F) response test (-45), (*the current at 400 Hz is 45% lower than the current at 200 Hz*). The doubled test frequency is displayed in the lower right hand corner; screen number (2) is displayed in the upper left hand corner. Note: The 16% shown in upper right corner is the change in phase angle when the test frequency is doubled. Not used for analysis purposes.



Display Screen 2

To return to the Display Screen 1 Press the TEST key again, this displays the impedance and phase angle measurement.



3. Record the measured values on the Motor Test Form.

MOTOR GENIE™ Motor Test Form				
Motor ID:				
Location:				
Test Date:				
Test Frequency				
	Phase 1-2	Phase 1-3	Phase 2-3	
Impedance (Ω)	107			
Phase Angle (°)	66			
Z-Test or I/F	-45			
Resistance (Ω)				



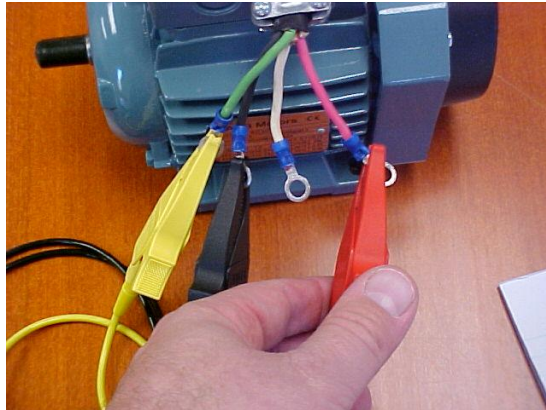
Error Codes

If the impedance readings are out of range an error code will be displayed on the measurement screen.

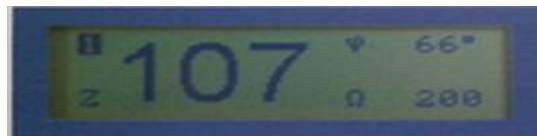
- E1 error code means the impedance value is out of range, i.e. greater than 999 ohms but less than 60,000 Ω.
- --- means either the impedance or resistance value is over 60,000 Ω, or the test is invalid.

Continue with Other Phases

1. **Move** the test leads to **T1 & T3** to make the measurements on the next phase.



2. Read the Impedance (Z) and Phase Angle (ψ) values from display screen 1 for winding. *Do not fill in the phase balance until all three phases have been measured.*



3. Depress the TEST key to display the Current Frequency Response (I/F).



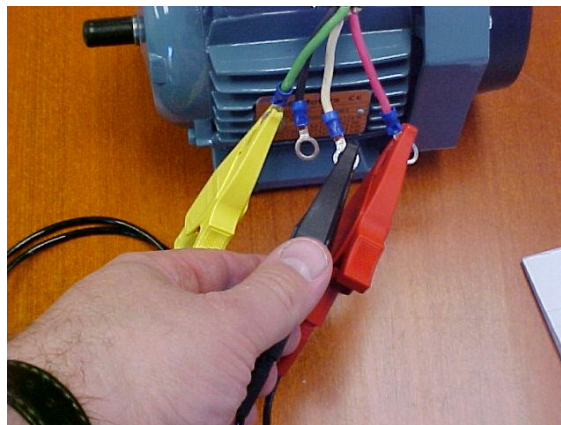
**Winding 2 Current
Frequency Response**

4. Record these test results on the Motor Test Form.

MOTOR GENIE™ Motor Test Form				
Motor ID:				
Location:				
Test Date:				
Test Frequency				
	Phase 1-2	Phase 1-3	Phase 2-3	
Impedance (Z)	107	107		
Phase Angle (°)	66	66		
Z-Test or I/F	-45	-45		
Resistance (Ω)				
Phase balance (opt)				
Ins Resistance (M Ω)		Test Voltage		
Comments:				
©2016 ALL-TEST Pro, LLC				

Continue with Last Phase

1. Move the Test Leads to T2 & T3



2. Read the Impedance (Z) and Phase Angle (ψ) values from display screen 1 for winding. *Do not fill in the phase balance until all three phases have been measured.*



3. Press the TEST key to display the Current Frequency Response (I/F).



Winding 3 Current Frequency

4. Record these test results on the Motor Test Form.

MOTOR GENIE™ Motor Test Form				
Motor ID: Test Motor				
Location: Warehouse				
Test Date: 8/8/16				
Test Frequency 200 Hz				
	Phase 1-2	Phase 1-3	Phase 2-3	
Impedance (Z)	107	107	109	
Phase Angle (°)	66	66	66	
Z-Test or I/F	-45	-45	-45	
Resistance (Ω)				
Phase balance (opt)				
Ins Resistance (M Ω)		Test Voltage		
Comments:				
©2016 ALL-TEST Pro, LLC				

Resistance Test

1. Using the ◀ F1 and ▶ F2, keys to highlight the **RES** test icon



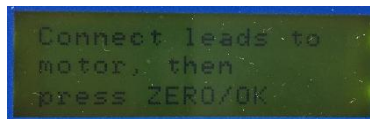
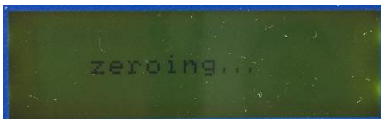
2. Press the ZERO/OK Key to select the resistance test icon (**RES**) from the main menu



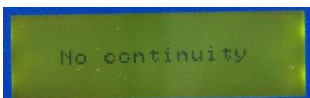
3. The screen instruction reminds users to short the two test leads. Then press ZERO/OK Key.



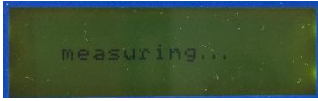
4. Wait until “zeroing ...” disappears and the right screen below shows up.



Note: for poor connection or no connection, the following screen will show up for a couple of seconds and resume to the right screen above. In such case, please check the connections and press ZERO/OK key again. No continuity means the circuit is open.



5. Connect the two test leads to the motor terminals T1 & T2, press ZERO/OK Key, the measuring screen shows up as the left screen below, then the resistance result will be displayed. An example is shown below.



Note: the following error codes may show up in certain situations. Please refer to the Section “Error Codes” below – “E 1” means resistance is over 999 Ω but below approximately 60,000 Ω. “- - -” means either the resistance is over 60,000 Ω or the test is invalid. The valid resistance measurement range is 100 mΩ ~ 250 Ω (0.1 to 250 Ω). Any measurement below 0.1 Ω should be verified using a low resistance ohmmeter.



6. Connect the two test leads to the motor terminals T1&T3 and perform another resistance test by pressing ZERO/OK Key. In the same way, test the resistance on the other two terminals T2 & T3. Record all test results on the Motor Test Form.

MOTOR GENIE™ Motor Test Form				
Motor ID: Test Motor				
Location: Warehouse				
Test Date: 8/8/06				
Test Frequency 200 Hz				
	Phase 1-2	Phase 1-3	Phase 2-3	
Impedance (Z)	107	107	109	
Phase Angle (°)	66	66	66	
Z-Test or I/F	-45	-45	-45	
Resistance (Ω)	17.3	17.6	17.1	
Phase balance (opt)				
Ins Resistance (M Ω)		Test Voltage		
Comments:				
©2016 ALL-TEST Pro, LLC				

7. To exit to the main menu, press the MODE key.



Note: To make resistance measurement again, repeat Steps 1 ~ 7 above.

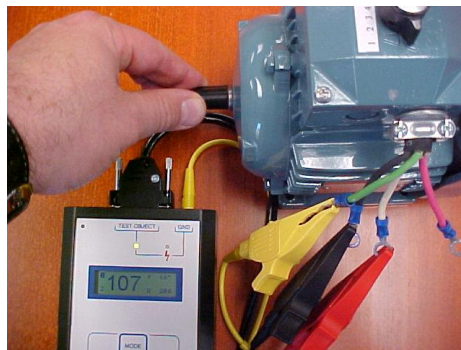
Phase Balance Test

This calculates the impedance unbalance between phases. This value can be used to relate energy, reliability and production-cost avoidance potential to electric motor systems impedance unbalance. The Impedance Unbalance Calculator (IUC) is available from ALL-TEST Pro. The concept of the IUC comes from *Keeping the Spark in Your Electrical System: An Industrial Electrical Distribution Maintenance Guidebook* published by the US Department of Energy, Bonneville Power Administration, Pacific Gas & Electric, PacifiCorp and Tacoma Public Utilities. As impedance varies with each phase, the current in each leg of the motor varies. This generates increased losses in the form of heat. Heat reduces both insulation life and the life of the lubricant.


(The Impedance Unbalance Calculator is available from **ALL-TEST Pro, LLC**).

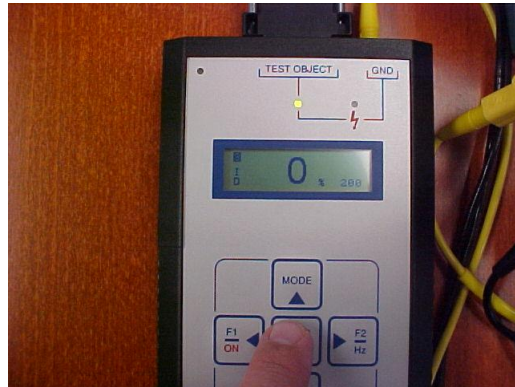
Impedance Unbalance Calculator		Company	ALL-TEST PRO
		Page No.	1
		Date	May 5, 2008
		Surveyor	Howard
General Information			
Motor Identification	a	Pump 1	
Location	b	Test Area	
Max impedance unbalance	a	5.0%	
Operating hours / year	b	4 000.00	
Lost Production Costs			
Plant downtime cost (\$/hr)	c	\$300 000.00	
% of plant affected	d	3%	
Time Estimated for			
Repair (hrs)	e	4.0	
Production startup (hrs)	f	2.0	
Lost Production Cost			
Base (\$/yr) - See Graphs	g	\$750.00	
Estimate (\$/yr)	h	\$9 248.50	
Power Consumption Costs			
Utility energy charge (\$/kWh)	i	\$0.00	
Actual motor size (hp)	j	175.0	
Motor Load (%)	k	100.00%	
Closest Graph Motor Size (hp)	l	200.0	
Power Consumption Cost			
Base (\$/yr) - See Graphs	m	\$2 100.00	
Estimate (\$/yr)	n	\$3 107.50	
Reduced Motor Life Costs			
Base (\$/yr) - See Graphs	o	\$660.00	
Estimate (\$/yr)	p	\$219.75	
Utility demand charge (\$/kW)	q	\$14.00	
Power Demand Cost			
Base (\$/yr) - See Graphs	r	\$50.00	
Estimate (\$/yr)	s	\$178.00	
Total Annual Costs	t	\$12 951.97	

1. Turn the instrument on, and place the test leads on any 2 motor leads, for discussion purposes use T2 & T3.
2. Select the Z/ϕ option and rotate the motor shaft until the maximum impedance value is reached. Record the value.



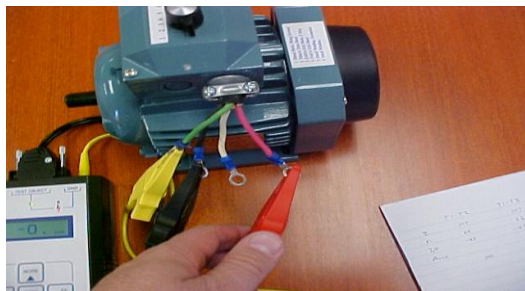
3. Perform the same Z/ϕ test on the other two phases.
4. Select the phase with the highest maximum impedances (for discussion purpose, assuming it is Phase T2-T3). Rotate the shaft to find the rotor position where the maximum impedance occurs.

5. Then press the ZERO  key to set the reference phase (T2-T3) to zero. Enter a zero for phase (T2-T3) on the Motor Test Data form.



6. Move the Test leads to T1 & T3. Turn the motor shaft slowly until the minimum % difference is obtained. Record this number on the Motor Test Data form.

Note: *The percentage should be less than 3% of phase unbalance. A percentage > 5% indicates a fault in the winding and should be investigated further*



MOTOR GENIE™ User Manual

7. Again move the Test leads to T1 & T2. Turn the motor shaft slowly until the minimum % difference is obtained. Record this number on the Motor Test Data form.

MOTOR GENIE™ Motor Test Form				
Motor ID: Test Motor				
Location: Warehouse				
Test Date: 8/8/16				
Test Frequency 200 Hz				
	Phase 1-2	Phase 1-3	Phase 2-3	
Impedance (Z)	107	107	109	
Phase Angle (°)	66	66	66	
Z-Test or I/F	-45	-45	-45	
Resistance (Ω)	17.3	17.6	17.1	
Phase balance (opt)	2	0	0	
Ins Resistance (M Ω)		Test Voltage		
Comments: ©2016 ALL-TEST Pro, LLC				

Insulation Resistance Testing

To prevent electrical shocks and to assure safety of personnel the MOTOR GENIE™ provides an insulation to ground test. The insulation resistance test provides either 500 or 1,000 V_{DC}, to measure the insulation resistance up to 500 Meg-Ohm.

NOTE: Guidelines for test voltages are presented in the Table below. Readings of insulation resistance are taken after the test voltage has been applied for 1 min. If these values differ from your equipment manufacturers, follow their guidelines.

Motor Voltage Rating	Insulation Test Voltage
< 1000 Volts AC	500 V

Insulation Resistance Test Voltage

Insulation Resistance Values (IEEE 43-2013)

Application	Pass/Fail Value
Insulation systems prior to 1970	> 1 Meg-Ohm + 1 Meg-Ohm per kV rating of motor
Random Wound motors less than 600 V	> 5 Meg-Ohms

- Using the ON key or the MODE key from the keypad section to navigate to the display screen (*This is the main menu*).



- Use the ◀▶ to highlight the INS icon from the display screen. *This sets the instrument up to measure insulation resistance to ground.*



- Connect **both** the Red lead & the Yellow lead to ground.

- Press the ZERO/OK key to select the Insulation Resistance Test. *This displays screen 8, the insulation resistance test screen.*



- View the insulation test voltage selected (*upper right hand corner of the insulation resistance display screen*). Refer to the insulation resistance test voltage table above for the correct voltage.

6. Press the F2 key to toggle between 500 & 1000V.



7. Press the TEST key and hold until the display shows '0' MΩ. This is to verify the test leads are connected to a good ground.



8. Move the “Red” test lead to any motor lead. *Standard Insulation Resistance measurements instruments require testing all 3 leads. This is not necessary with the instrument if impedance readings were successfully made on all three phases.*
9. Depress the TEST key and hold until 500 MΩ is displayed. If the instrument does not display 500 MΩ after one minute of testing, stop and record the value and test voltage on the Motor Test Form.



10. Depress the MODE key to return to the Main Display Screen.



MOTOR GENIE™ Motor Test Form				
Motor ID: Test Motor				
Location: Warehouse				
Test Date: 8/8/16				
Test Frequency 200 Hz				
	Phase 1-2	Phase 1-3	Phase 2-3	
Impedance (Z)	107	107	109	
Phase Angle (°)	66	66	66	
Z-Test or I/F	-45	-45	-45	
Resistance (Ω)	17.3	17.6	17.1	
Phase balance (opt)	2	0	0	
Ins Resistance (M Ω)	>500	Test Voltage	500	
Comments:				
Comments:				
©2016 ALL-TEST Pro, LLC				

Changing the Motor Test Frequency

The default testing frequency for the MOTOR GENIE™ is set at 200 Hz. This test frequency should be good for the majority of winding tests. However, there are some instances where a different frequency may be required. The instrument allows the user to select a test frequency of (25, 30, 50, 60, 100, 200, 400, or 800 Hz). The test frequency selected is not dependent on the frequency of the applied voltage to the winding. It is more dependent on the instrument making a valid measurement.

Note: Increasing the test frequency will increase the impedance measurement
 Reducing the test frequency will decrease the impedance measurement.
 Changing the test frequency will not impact the resistance measurement.

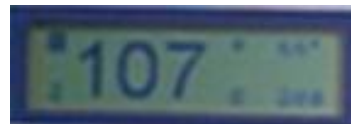
- Test frequencies must be changed if
 - 1) The impedance values are less than 1 Ω or greater than 999 Ω – see the Error Code section.
 - 2) The Fi and/or I/F values are outside of the recommended tolerances (See the Data Interpretation Section of this manual)

Select the Motor Test

Using the ◀ F1 or ▶ F2, key highlight the Winding Test (Z/ψ) icon



1. Press the ZERO/OK key to select the Winding test (Z/ψ) from the main menu. This will display screen 1.



2. While display screen 1 is displayed press the F2 key. The instrument will emit an audible “beep”

and the ‘1’ displayed in the upper left corner of the display screen will change to ◀▶



Also the value of the frequency in the lower right hand part of the display screen 1 will change. In this case it is 200 Hz.

3. Press the ▲▼ buttons:
 - a. The applied frequency will immediately change to the new value.



- b. The new impedance and phase angle (Fi) values will be displayed.
 - c. The display screen number returns to **1**.
4. The instrument frequency change is one-step at a time. To change to another frequency the steps 2 & 3 must be repeated for each frequency. (**Note:** *The test frequency can only be changed from display screen 1.*)
- Changing the test frequency will also change the I/F value.**

V. Additional Functions and Features

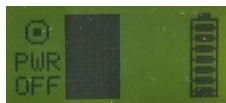
Resetting the Unit

On occasion, the MOTOR GENIE™ may fail to respond to keyboard, or lock up due to excessive EMI present or other reasons. Sometimes the unit may lock up during normal operation. To reset the unit if it locks up, simply PRESS the reset button (highlighted below in yellow) using a paper clip, pen tip or some other small device. Or simply press the push button on RESET switch if available.

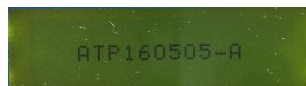


Firmware Version

Move the cursor to the empty space to the right of **PWR OFF** icon. See the image below.



Press OK button, the firmware version number will be displayed.



VI. Charging the MOTOR GENIE™

CAUTION: The supplied charger is an integral part of the charging circuit. **Using any other charger will destroy** your MOTOR GENIE™ and will **VOID** any warranty. If the supplied charger becomes lost or defective contact ALL-TEST Pro sales support for a replacement.

The installed batteries are not subject to retain memory. To ensure the MOTOR GENIE™ being fully charged, **leave it plugged into the charging unit when not in use**. A fully charged battery should last about 8 hours. A fully charged battery should display about 8V on the display screen with the battery charger connected to the instrument. The operational time can vary depending on the number of insulation to ground tests performed on a single battery charge. The more Insulation resistance tests the shorter the operational time. **NOTE:** *If the instrument is not continuously left on trickle charge it should be charged at least once a month.*

To charge the instrument:

1. Plug the battery charger into the battery charging port on the top of the instrument.



2. Plug the other end of the battery charger unit into the wall receptacle. The supplied charger is universal and can be used for 120/240 V & 50/60 Hz. Simply attach the required adapter for the countries wall receptacle.
3. When charging the charging indicating light will be illuminated red.



4. The display screen will provide the instruments condition during the charge. The data on the screen will identify information on the battery charge including length of time on charge, battery voltage level and battery temperature.
5. The battery charge indicating light will turn green when fully charged. If the unit is not being used, it is recommended that the unit be left on a trickle charge. The battery charge indicator light is more accurate regarding the state of charge in the battery compared to the battery indicator level shown on the LCD display.

VII. Data Interpretation Three Phase Motors

The basic analysis rules for the MOTOR GENIE™ are listed below.

Data Interpretation Tables

During testing with the MOTOR GENIE™ if a fault is detected using the interpretation tables, review all of the additional data interpretation consideration before issuing a pass/fail on the winding tested. When making repair/replace decisions it is also important to evaluate the specifics of the application, such as: Is the motor in a critical application, what are the operating conditions, environment, etc.?

Table 1: Three Phase Motor Test Results

Test	Limits	Description
Resistance (R)	< 5%	Likely loose or faulty connections
Impedance (Z)	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	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). This value should be greater than 15 degrees and less than 90 degrees.
Current/Frequency (I/F)	+/- 2 points	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). These readings should be between -15 and -50.
Phase Balance	< 5%	Read manual for test procedure and guidelines.
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
< 1000 Volts AC	500 V

Table 3: Insulation Resistance Values (IEEE 43-2013)

Application	Pass/Fail Value
Insulation systems prior to 1974	> 1 Meg-Ohm + 1 Meg-Ohm per kV rating of motor
Random Wound motors less than 600 V	> 5 MegOhms

Additional Data Interpretation Considerations Three Phase Motors

There are additional considerations when using an MOTOR GENIE™ :

- Test location
- Confirming winding faults

Test Location

If a fault is detected when testing from the motor control center, motor disconnect, or from any distance away from the motor through cabling, it is important that a confirmation test be performed at the motor connection box prior to condemning a winding. *Note: ALL-TEST PRO MCA™ instruments will detect cable faults.*

- If the readings are good at the motor during the confirmation test, then the fault may be 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.
- If the reading shows similar results at the motor, then the fault exists in the motor.

Confirming Suspected Winding Shorts

Experience has shown that for most three phases, AC, squirrel cage, inductions motors, 200 Hz is the best frequency at which to test the condition of the windings. However, in some cases, due to the permeability of the rotor or stator core, the rotor design, air gap, winding configuration or rotor position, the default frequency may provide a false negative at 200 Hz. However, we have found that if the winding appears good at any frequency it is generally a good winding.

Note: These guidelines are generic and hold true for identifying developing winding shorts for most applications. However, it may be necessary to compare reading to like motors.

If the winding test indicated a developing winding short, based upon an unbalance in phase angle (Fi) and/or Current Frequency Response (I/F) and:

1. Impedance is balanced (<3% from average) then a variable frequency test should be performed. (See variable frequency test below)
2. Impedance is unbalanced (>3% from average) then a rotor compensated test should be performed. (See rotor compensation test below)

The test results, such as those found in Table 4, indicate a potential winding fault as Fi is out by more than 1 from average:

Table 4: Sample Test Results

	T1-T2	T1-T3	T2-T3
Fi	66	67	69
I/F	-44	-44	-45

Method 1: Rotor Compensation

One of the reasons for the result shown in Table 4 may be a rotor position or a rotor anomaly, such as severe casting voids, rotor eccentricity, etc. To separate a rotor fault from a winding fault it is necessary to perform a rotor compensated winding test. Use the procedure listed below to perform the rotor compensation test:

1. With the Instrument test leads connected to T1 & T2. From display screen 1, turn shaft until the maximum impedance value is obtained.
2. Read and record the impedance and phase angle reading from display screen 1.

3. Depress the TEST key to read and record the I/F value.
4. Move the Test leads to T1 & T3, turn the shaft until the maximum impedance value is obtained on this phase.
5. Read and record the impedance and phase angle reading from display screen 1.
6. Depress the TEST key to read and record the I/F value.
7. Move the Test leads to T2 & T3, turn the shaft until the maximum impedance value is obtained on this phase.
8. Read and record the impedance and phase angle reading from display screen 1.
9. Depress the TEST key to read and record the I/F value.

The results should be +/- 1 digit from the average, and the I/F values should be within +/- 2 units from average.

Method 2: Variable Frequency Test

The variable frequency test is used to confirm winding faults if the impedance readings are balanced. It is recommended to test the winding at 400 Hz, 100Hz, and 50 Hz. If it tests “good” at any of these frequencies then it is generally a good winding (follow the procedure for changing the test frequency).

Example 1. If the test results remain similar, meaning that the actual readings may change by a few digits, but the difference between the readings remains the same, then the winding is considered good; In Table 4 the test spread of the Fi is 3 units, 66 to 69, after changing. At the test frequency, the results in Table 5 show the Fi values changed from 70 to 73. The spread is still 3 units. This is generally a “good” winding.

Table 4: Sample Test Results

	T1-T2	T1-T3	T2-T3
Fi	66	67	69
I/F	-44	-44	-45

Table 5: Adjusted Frequency Sample, Good

	T1-T2	T1-T3	T2-T3
Fi	70	71	73
I/F	-44	-44	-45

Example 2. If the unbalances of Fi and/or I/F at the other test frequency increase then the winding is most likely in poor condition. In table 4, the spread of Fi is 3 units, 66 to 69, after changing. At the test frequency, see Table 6, the Fi values changed from 70 to 75. Then the spread has increased to 5 units. This winding should be considered to be in poor condition.

Table 6: Adjusted Frequency Sample, Bad

	T1-T2	T1-T3	T2-T3
Fi	70	71	75
I/F	-45	-45	-47

MOTOR GENIE™ User Manual

VIII. Tech Support and Information

Technical support can be obtained by emailing or faxing your questions to **ALL-TEST Pro, LLC** at:

Email: support@alltestpro.com

Fax: 860-399-3180

Please put “MOTOR GENIE Tech Support” in your subject line.

IV. Available Accessories for the MOTOR GENIE™

- 40070** Training Motor
Software (*To be available soon*)

ALL-TEST Pro, LLC
PO Box 1139
Old Saybrook, CT 06475

Phone: 860-399-4222
Toll Free Phone: 800-952-8776
Fax: 860-399-3180
Email: support@alltestpro.com
Web: www.alltestpro.com



X. Motor Test Form

MOTOR GENIE™ Motor Test Form				
Motor ID:				
Location:				
Test Date:				
Test Frequency				
	Phase 1-2	Phase 1-3	Phase 2-3	
Impedance (Z)				
Phase Angle (°)				
Z-Test or I/F				
Resistance (Ω)				
Phase balance (opt)				
Ins Resistance (M Ω)		Test Voltage		
Comments:				
©2016 ALL-TEST Pro, LLC				

MOTOR GENIE™ Motor Test Form				
Motor ID:				
Location:				
Test Date:				
Test Frequency				
	Phase A-B	Phase A-C	Phase B-C	
Impedance (Z)				
Phase Angle (°)				
Z-Test or I/F				
Resistance (Ω)				
Phase balance (opt)				
Ins Resistance (M Ω)		Test Voltage		
Comments:				
©2016 ALL-TEST Pro, LLC				

XI. Disclaimer, Copyright & Trademarks

Notice of Service/Trademark Rights

The trademarks, service marks and logos (collectively, the "Marks") set forth below are registered and unregistered trademarks and/or service marks owned by ALL-TEST Pro, LLC in the United States and certain other countries throughout the world. Nothing contained in this manual should be construed as granting, by implication, estoppels or otherwise, any license or right to use any of the Marks without the written permission of ALL-TEST Pro, LLC. Any misuse of the Marks or any Content, except as provided in this Statement, is strictly prohibited and may violate trademark laws.

Other brands or product names used in this manual are trademarks and/or service marks of their respective owners, should be treated as such, and may be registered in various jurisdictions.

ALL-TEST PRO® is a Registered Trademark of ALL-TEST Pro, LLC
MOTOR GENIE™ is Trademark of ALL-TEST Pro, LLC.

Disclaimer:

Documents published by ALL-TEST Pro, LLC are provided "as is" without warranty of any kind, either expressed, implied or statutory, including, but not limited to any warranties of merchantability, fitness for a particular purpose, or non-infringement.

ALL-TEST Pro, LLC shall not under any circumstances be liable to any person for any special, incidental, indirect or consequential damages, including, without limitation damages resulting from use of or reliance on the information presented, loss of profits or revenues or costs of replacement goods, even if informed in advance of the possibility of such damages.

Reasonable efforts have been made to ensure the accuracy of the information presented. However, ALL-TEST Pro, LLC assumes no responsibility for the accuracy of the information. Product information is subject to change without notice. ALL-TEST Pro, LLC may make improvements and/or changes in the products and/or the programs described in these publications at any time without notice.

Information in this document is: © 2015, ALL-TEST Pro, LLC All Rights Reserved

You may cite or refer to information published in this manual, except as provided below, but you may not reproduce or distribute such information in whole or in part without the prior written permission of ALL-TEST Pro, LLC. You may not reproduce or distribute any image from the Manual, without securing advance written consent from ALL-TEST Pro, LLC. To request such permission, send email to info@alltestpro.com, including your name, address and a description of the purpose of your intended distribution and the information you would like to distribute.

You may print, reproduce and use the information in, and retrieve files containing software or images from ALL-TEST Pro, LLC for non-commercial, personal, or educational purposes only, provided that you (i) do not modify such information, and (ii) include any copyright originally included with such information and this notice in all such copies.

Nothing contained herein shall be construed as conferring by implication or otherwise any license or right under any patent or trademark of ALL-TEST Pro, LLC or any third party. No other rights under any copyrights of ALL-TEST Pro, LLC or any other party are granted herein, except as expressly stated above.

[BACK TO TOP](#)