

# CHAPTER 1: INTRODUCTION

## DESCRIPTION OF PRODUCT

MCEMAX powered by MCEGold® integrates testing, diagnostics, inventory control, scheduling, and cost containment for your company's motors/assets.

## MOTOR TESTING PHILOSOPHY

Throughout the manual the term MCE refers to deenergized motor testing capability. EMAX refers to energized motor testing capability. MCEMAX refers to both deenergized and energized motor testing capabilities in one tester.

### MCE

With electrical faults responsible for nearly 50% of all motor failures, taking a proactive approach to these problems becomes a necessity. Motor Circuit Evaluation (MCE) is a predictive maintenance technology that provides comprehensive, portable, motor testing. MCE allows you to test deenergized electric motors, large or small, AC or DC, and determine the condition of the motor and its associated power circuit in a short period of time. The data is immediately stored for trending, comparison, and report generating. The MCE tester, also known as MCE (motor circuit evaluator), allows you to perform condition-based maintenance rather than time-based maintenance. This prevents costly motor failures and unnecessary maintenance.

MCE testing can be performed for quality assurance, trending, and diagnostic troubleshooting.

- Quality Assurance (QA) testing of motors, when they are new or refurbished, ensures that only the highest quality motors are placed in service.
- Trending motor health over time allows for repair or replacement of motors, prior to failure. This can prevent unexpected down time and minimize costs associated with unexpected shut downs.
- Diagnostic troubleshooting is accomplished by using the MCE to troubleshoot the suspect circuit and narrow the problem down to a specific component or section of the motor circuit.

MCE testing is non-destructive and measures inherent characteristics of a deenergized motor circuit. The Standard Test takes approximately 1 1/2 (DC motor) to 3 1/2 (AC motor) minutes and measures these characteristics for AC and DC motors:

- Resistance-to-ground (RTG)  
Temperature corrected RTG tests the ground wall insulation of the motor and circuit cables, indicating the condition of the insulation.
- Capacitance-to-ground (CTG)  
CTG is an additional indicator of the insulation condition, identifying contamination buildup on the insulation.

- **Phase-to-phase Resistance**  
Phase-to-phase resistance tests the circuit and the stator coils for resistance, calculates resistive imbalance, and indicates when these imbalances are unsatisfactory. Resistive imbalances can be used to identify hot spots, high resistance connections, or coil shorting in the stator.
- **Phase-to-phase Inductance**  
Phase-to-phase inductance tests the circuit, stator coil, iron, and rotor components for inductive imbalances and indicates when these imbalances are unsatisfactory. Inductive imbalances can be used to identify winding faults and rotor defects.
- **Step Voltage**  
The Step Voltage test records the peak in-rush and decay of current as each increase (step) in DC voltage is applied across the circuit's ground wall insulation. The test allows the user to observe how the insulation system responds to over-voltage stress. Insulation condition can be identified by evaluating the resultant graph of leakage current.
- **Polarization Index (PI)**  
A ten minute insulation test is performed. The Dielectric Absorption (DA) ratio is calculated and a profile of RTG vs. time is plotted. The profile developed can be used to identify the condition of the motor's insulation system.

Additionally, MCE performs a Rotor Influence Check (RIC) on AC motors, Step Voltage and Polarization Index (PI) insulation tests on AC and DC motors, and a commutator bar-to-bar test on DC motors.

- **Rotor Influence Check (RIC)**  
The RIC is performed to isolate motor problems to either the rotor or stator. As the rotor is turned by hand, a plot of its influence on the stator coils is developed using inductance measurements. If the influence on the stator coils is uniform, then an anomaly is isolated to the rotor. If the influence on the stator coils is non-uniform, then an anomaly is isolated to the stator.
- **Commutator bar-to-bar**  
Commutator bar-to-bar testing is performed on the Armature section of DC motors. This aids in troubleshooting a faulty commutator or armature winding.

## EMAX

Often times it is not possible to shut down a motor to perform MCE testing. EMAX allows testing of AC and DC motors while they are operating (online). Energized motor testing allows you to determine when the motor needs to be shut down for further testing and/or maintenance. The types of energized motor testing possible with EMAX are Current Analysis, Power Analysis, and In-Rush/Start-Up. Also, for the Armature section of a DC motor is Drive Input testing. Like MCE, EMAX testing is non-destructive.

The AC motor tests are Rotor Evaluation (formerly known as Low/High Resolution), Eccentricity, In-Rush/Start-Up, Power, and Demod testing.

The DC motor Armature section tests are DC Power, DC Current Analysis, DC In-Rush/Start-Up, and Drive Input.

The DC motor Field section tests are DC Power and DC In-Rush/Start-Up.

The Current Analysis portion of EMAX takes current measurements of the three phases of an AC motor circuit. It performs the following tests on AC motors operating at a *recommended* steady state load of greater than 70% of full load.

- Rotor Evaluation  
Rotor Evaluation testing is performed to identify damage to rotor bars before causing secondary damage to the stator coils or bearings.
- Eccentricity  
Eccentricity testing is performed to determine motor eccentricity before damage to rotor, stator, and motor bearings occurs.
- In-Rush/Start-Up  
In-Rush/Start-Up testing is performed to monitor in-rush current and startup signatures, providing early signs of motor degradation and process analysis.

The Power Analysis portion of EMAX takes voltage and current measurements of the three phases of an AC motor circuit and provides the following information:

- Voltage, current, and power signals, with respect to time, are used to indicate the relationship between voltage and current to verify proper phase sequence and determine incoming power quality
- Voltage, current, and power FFT graphs are used to detect abnormal amplitudes of various known fault-frequencies
- Voltage, current, and power harmonics are used to determine power quality of the incoming signal
- A results page, with a variety of parameters, is used to document and trend the readings taken during each test.

The Demod test for AC motors filters out the 60 Hz carrier frequency and reveals the hidden signals, representing load variations. These load variations can then be analyzed.

The Drive Input test for the Armature section of DC motors is a test performed on the input of the drive to analyze the health of both the drive and the motor.

## ELECTRICAL SAFETY PRECAUTIONS

### Warning






USE CAUTION: WHEN WORKING WITH VOLTAGE LEVELS ABOVE 25V AC OR 60V DC. FAILURE TO FOLLOW SAFETY PRECAUTIONS CAN CAUSE SEVERE OR FATAL PERSONAL INJURY AND/OR DESTROY THIS UNIT.

- Avoid working alone
- Wear safety equipment
- Inspect the unit and test probes for damaged insulation
- DO NOT use damaged equipment.



*To prevent personal injury or equipment damage, follow all of your facility's applicable electrical safety precautions at all times.*

Table 1-1 International Electrical Symbols

Symbol	Publication	Description
	IEC 417, No. 5031	Direct current
	IEC 417, No. 5032	Alternating current
	IEC 417, No. 5172	Equipment protected throughout by double insulation or reinforced insulation (equivalent to Class II of IEC 536)
	ISO 3864, No. B.3.6	Caution, risk of electrical shock
	ISO 3864, No. B.3.1	Caution (refer to notation accompanying the symbol)

## MCE

MCE testing is performed on deenergized motors. However, it is often done *in the vicinity of* energized equipment. **Follow all electrical safety precautions and procedures required by your facility for working near energized equipment.**

The tester can be sensitive to electrostatic discharge. Exposure to electrostatic discharge during an ongoing test may cause the software to be momentarily interrupted.



Line voltage applied to the MCE tester may cause personal injury and **will** destroy the tester. This could come directly from power being applied to the circuit under test or be induced from a nearby source of power. Prior to connecting the MCE, deenergize, then verify that all sources of power to the circuit are deenergized. Use your facility's procedure for deenergizing and tagging out equipment.

Deenergized equipment means all of the following:



- Disconnected from all possible energy sources
- All stored energy in the circuit is released
- Program implemented to ensure all possible energy sources remain disconnected, such as the Danger Tag shown in Figure 1-1.
- Open and tag the circuit breaker supplying power to the starter cabinet. Voltage could still be present on the contactor if separate control power is available for remote starting. If equipment can be controlled remotely, ensure all local and remote control switches are tagged off using a tag, such as the Danger Tag shown in Figure 1-1.



**Figure 1-1**

To avoid personal injury, protect the MCE tester, and ensure accurate data collection use a multimeter prior to connecting the MCE to verify that the circuit is deenergized. Depending on the circuit voltage, using a hot stick may be required before using a multimeter. Perform the following steps to verify the circuit is deenergized:

1. Read the operating instructions and safety precautions accompanying your multimeter.
2. Verify proper operation of the multimeter (before use) by testing it on a known voltage source.
3. Verify induced phase-to-ground voltage is  $\leq 15$  VAC.
4. Verify induced phase-to-phase voltage is  $\leq 0.5$  VAC.
5. Verify low level stored voltage phase-to-ground is  $\leq 15$  VDC.
6. Verify proper operation of the multimeter (after use) by testing it again on a known voltage source.

After verifying the circuit is deenergized, test the circuitry with an ohmmeter to verify that the motor is connected and is not rotating by placing the multimeter on the resistance scale and measuring the resistance phase-to-phase. If the multimeter locks on to a resistance value and does not fluctuate, then the motor is not rotating.

## EMAX



Current and power testing is performed on energized motor circuits. ***Follow all electrical safety precautions and procedures your facility has for working on energized equipment.***

- Always connect the ground lead first.
- Ensure that the motor being tested is less than 600 volts prior to connecting test leads. Machines or equipment rated at greater than 600 volts should be tested on the secondary side of CTs (current transformers) and PTs (potential transformers).

When using EMAX, for online testing (Power and/or Current Analysis), high intensity RF fields may affect the performance of the unit.

The tester can be sensitive to electrostatic discharge. Exposure to electrostatic discharge during an ongoing test may cause the software to momentarily interrupted.

## TECHNICAL SUPPORT

Technical Support is available by phone Monday through Friday, 8 A.M. to 5 P.M., E.S.T. To facilitate customer support, please do the following prior to calling PdMA.

Have your company name and the tester serial number available.

Depending on what problem you are having, have your laptop attached to the tester with MCEGold running or have MCEGold running on your desktop PC. Tell the Technical Support Representative if you installed other software on the laptop or PC after MCEGold was installed.

*For assistance in analyzing data*, send the data as an email attachment, highlight the motor, select Export File on the tool bar, and follow the on screen directions. This will create a .pdp file. E-mail the .pdp file as an attachment to techsupport@pdma.com.

For MCE data, include:

- Nameplate data for motor
- RIC graph (AC motor)
- Standard Test (AC or DC motor)
- Polarization Index graph (AC or DC motor)

For EMAX data, include:

- Nameplate data for motor
- Results page (Power Analysis)
- Spectrum graph (Current Analysis)

You may contact PdMA Technical Support by any of the following methods.

- Telephone: (813) 621-6463 ext. 251
- Fax: (813) 620-0206
- E-mail: techsupport@pdma.com
- Web site: www.pdma.com

## RETURNING THE TESTER TO PdMA

You will need to return the tester to PdMA for annual calibration, upgrades, warranty work, or repair. When returning the tester to PdMA, return **all components** with the tester (laptop computer, batteries, test leads, etc.). Ship all components in the shipping case.

*Your warranty could be voided if you ship the tester improperly. To prevent damage to the tester follow the procedure below.*

To return your tester to PdMA, perform the following steps:

1. Call PdMA Technical Support at (813) 621-6463 ext. 251 for instructions and to obtain a WO (RMA) before returning the tester to PdMA.

2. Back up your data before returning the tester. PdMA is not responsible for missing or loss of your database. Refer to the section on copying and backing up the database in Chapter Three.

3. Park the shuttle.

To park the shuttle, when exiting MCEGold answer **Yes** to the Exit message asking if you want to park the shuttle. This starts the internal procedure to switch the shuttle to the MCE position (parking the shuttle). When the process is complete, the Shuttle Parked window opens. Go to step 4.

4. Remove the tester battery from its slot and click **OK**. MCEGold will shut down. DO NOT ship the tester with the camcorder battery in the battery slot. Damage to the battery monitor board could result.

5. Return the tester and all its components in the **Lexan shipping case**. Include the following:

- Completed Tester Report Sheet
- Laptop computer with the tester, include both in the ABS plastic case
- Test leads
- Computer support equipment including power adaptor, batteries, disk drive, etc.
- Camcorder batteries and battery charger

6. Tester must be properly packaged to prevent damage while in transit to PdMA's facility. Damage during shipment is the responsibility of the customer.

7. Ship the tester prepaid to PdMA at:

PdMA Corporation  
Attn: Technical Support  
5907-A Hampton Oaks Parkway  
Tampa, FL 33610

Testers found not to be defective may be assessed a service charge.

If the tester is in need of repair and is either out of warranty or the repair is not covered by the warranty, you will be notified of the estimated cost prior to repair. A purchase order or credit card is required prior to repair.

Normal repair is performed within seven to ten working days after receipt of the tester. Rush charges are considered on an individual basis. Customer authorization for cost of rush repair must be received in advance.

## WARRANTY

Warranties are not transferable. The warranty claim will only be honored when it is submitted by the original corporation taking title to the tester. Terms and conditions are subject to change without notice.

**Hardware.** PdMA Corporation warrants that its equipment shall be substantially free from defects in material, workmanship, and fabrication under normal use. This warranty shall be for a period of one (1) year after the date of delivery of the hardware to the customer. PdMA's entire liability and customer's exclusive remedy under this warranty

will be (at PdMA's option) to attempt to correct or help the customer solve problems encountered in using the hardware as intended or help the customer to work around errors. PdMA will apply efforts which it feels are suitable to the problem(s) being encountered, including (but not limited to) replacement of the hardware with functionally equivalent hardware. PdMA does not warrant that the operation of the hardware (or any revisions, upgrades, or special changes PdMA chooses to make to support customer use) will be uninterrupted or error free. Battery life will be prorated.

**Software.** PdMA warrants that, for a period of one (1) year from the date of delivery of the software to the customer that the software will, under normal use, perform without significant errors that make it unusable. PdMA's entire liability and the customer's exclusive remedy under this warranty will be (at PdMA's option) to attempt to correct or help customer solve problems encountered in using the software as intended or help customer work around errors. PdMA will apply efforts which it feels are suitable to the problem(s) being encountered, including (but not limited to) replacement of the software with functionally equivalent software. PdMA does not warranty that the operation of the software (or any revisions, upgrades, or special changes PdMA chooses to make to support customer use) will be uninterrupted or error free.

**Computer.** The laptop computer is registered with the computer manufacturer. Computer warranties vary between manufacturers. If you have problems with the laptop computer, you may contact PdMA Technical Support for guidance. If the problem is with the computer itself, or if you have continued problems, contact the computer manufacturer directly.

Dell: (800) 388-1290

**Replacement Parts.** Any replacement parts are warranted for the remainder of the original warranty or ninety days (90), whichever is longer.

**Data Analysis.** There is no intended or implied warranty or guarantee. Data Analysis is an interpretive recommendation based upon information and experience that should be corroborated with other technologies and further testing.

**Extended Warranty.** Extended warranties must be purchased within the original warranty period. Coverage is the same as the original warranty with the exception of the following items which are not covered: current probes, notebook computer, computer upgrades, computer accessories, batteries, AIS, AIS accessories, and any optional equipment.

**Maintenance Contracts.** Maintenance contracts, with varying levels of coverage, can be purchased for warranty coverage after the original or extended warranty has expired. The following items are not covered: current probes, notebook computer, computer upgrades, computer accessories, batteries, AIS, AIS accessories, and any optional equipment.