

CHAPTER 2: HARDWARE

A tester has three major hardware components: Shipping Case, Tester, and Accessory Bag.

Tables at the end of this chapter list specifications for the shipping case, tester case, and MCE and EMAX version of the tester.

SHIPPING CASE

The shipping case shown in Figure 2-1, designed for storage and shipping of the tester and accessory bag, is made of Lexan and has aluminum runners. It has steel feet, handles, and latches. The hinged cover has two latches to ensure positive closure. One of the latches has a hasp to allow locking the case.

There are two side handles on the shipping case for ease of carrying. The shipping case is approximately 22.5" long by 18.5" wide by 18" high. It weighs approximately 35 pounds empty and 75 pounds with the tester and all accessories enclosed.

The interior of the shipping case has two compartments carved out of closed cell foam; one for the tester and one for the accessory bag.

When returning the tester to PdMA for upgrades, annual calibration, or repair, it is imperative that you ship the tester in the shipping case. Severe damage to the tester may occur during shipping if it is not protected in the shipping case. Prior to sending the tester to PdMA, follow the instructions at the end of Chapter One, in the section titled "Returning the Tester to PdMA."

Specifications for the shipping case are found in Table 2-3, on page 2-16.



Figure 2-1: Shipping Case

TESTER

Case

The tester is enclosed in a waterproof, injection molded, black ABS plastic case. See Figure 2-2. The plastic hinge and stainless steel latch pins will not dent or corrode. The large ergonomically designed handle is cushioned. The case can withstand temperatures from -15° to 149° F (-25° to 65° C).

For security purposes, the case is lockable, by placing a lock (not provided) in the area provided beside the latch.

The case is 18.5x14.5x6 inches (46.99x36.83x15.24 cm). It weighs approximately 19 pounds (8.62 kg) empty and 26 pounds (11.79 kg) with the laptop computer installed. Specifications for the tester case are found in Table 2-4, on page 2-17.



Figure 2-2: Tester Case

The top cover of the case does not remove. Inside the top cover are two clips designed to hold the USB cable. To avoid damage to the cable, it must be removed from the laptop computer and placed in the clips provided before removing the laptop computer.

The laptop computer rests on the tester deck as shown in Figure 2-3. The deck contains a battery compartment, battery indicator, laptop computer hold down and connections for the computer, current probe cable, voltage probe, and MCE.



Figure 2-3: Tester Case with Laptop Computer

Figures 2-4 and 2-5, show an MCEMAX™ tester. The various tester components are numbered and described following the figures. MCE Specifications are found on page 2-14 and MCE Electrical Specifications are found in Table 2-1 on page 2-15. EMAX Specifications are found on page 2-15 and EMAX Electrical Specifications are found in Table 2-2 on page 2-16.



Figure 2-4: Tester Case Components

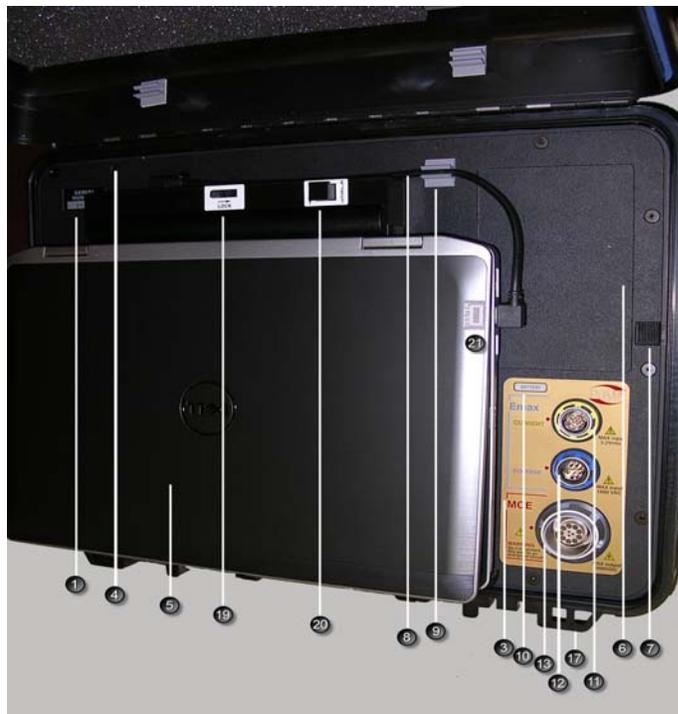


Figure 2-5: Tester Case Components

Components

1. Serial Number Tag – A Serial Number Tag is assigned to every unit. PdMA Corporation uses this number to identify the unit for repairs, updates, etc.
2. Identification Label – This label provides information such as model number, equipment-input rating, warning/safety advice, and PdMA's contact information.
3. Connection Identification Label – This label identifies the location of each test lead connection used with the system and includes the Battery Level Indicator.
4. Liner/deck – The liner/deck covers the printed circuit boards in the lower portion of the case and provides a platform for the connections, labels, switches, and clamp used to securely affix the laptop in the tester.
5. Computer – A laptop computer is used to run the software interface and communicates via a USB cable with the printed circuit boards located inside the unit.
6. Battery Compartment – The battery compartment is the designated location for the battery that supplies DC power to the unit.
7. Battery Compartment Latch - Use the latch to open the battery compartment by sliding the latch until the battery compartment lid pops up, then manually lift the lid to eject the battery.
8. USB Cable - The USB cable enables communication between the laptop computer software and the internal printed circuit boards of the system located below the liner. The cable connects to the laptop and plugs in to the top of the liner to the left of the Lock (# 19) and behind the laptop (unseen in picture). It must be disconnected and attached to the holding clips in the lid prior to the removal of the laptop computer.
9. Holding Clip - The holding clip holds the USB cable flat against the liner in the correct position to avoid damage.
10. Battery Level Indicator – This indicates the remaining life of the battery. How quickly the battery life is used depends on the beginning charge level and the type and number of tests being performed. During start-up the battery level is checked and the appropriate lights are lit. The battery life is indicated by two green, two yellow, two red, and two flashing red lights. When fully charged the two lights will be green, as the battery discharges the lights turn to: Green-yellow, yellow-yellow, yellow-red, red-red, and then blinking red. It is recommended that when the indicator reaches the red area, finalize any on-going test, close the software, turn off the tester, and recharge or replace the battery with a fully charged battery.
11. Current Probe Cable Connector – This connector is used for capturing AC or DC current signals during an online test. The area at the base of the connector displays dim yellow light. During the time current readings are being collected the light is bright. It returns to dim when the readings are finished.

Note: When the tester is turned on for EMAX testing the MCE logo along with associated warning triangles, connector rings, and dots are turned off and the EMAX logo along with the associated warning triangles, and the voltage and current dots are lit.

12. Voltage Probe Connector – This connector is used for capturing AC or DC voltage signals during an online test. The area at the base of the connector displays a dim blue light. During the time voltage readings are being collected the light is bright. It returns to dim when the readings are finished.

Note: When the tester is turned on for EMAX testing the MCE logo along with associated warning triangles, connector rings and dots are turned off and the EMAX logo along with the associated warning triangles, and the voltage and current dots are lit.

13. MCE Test Lead Connector – This connector is used for offline motor circuit analysis. The area at the base of the connector displays orange and red light rings in various configurations during operation indicating what is happening with the tester. During standard testing the orange light is steady and bright. During PI, Step Voltage, and RTG the red ring light comes on dim and brightens and flashes while the high voltage supply is on. During discharge the orange ring is dim and the red ring flashes.

Note: When the tester is turned on for MCE testing the MCE logo is lit along with associated warning triangles, connector rings and dots. The EMAX logo along with the associated warning triangles, and the voltage and current dots are turned off.



NOTE: *DO NOT input AC or DC voltage through the MCE connector. Follow the correct procedure to ensure that there is no voltage present in the circuit to be analyzed.*

14. Case – The case is made of a high impact grade ABS plastic, designed to protect against jarring, vibration, and crushing.
15. Silicone Seal – A silicone O-ring is installed on the lid and seals out water, salt air, and some gases, when the unit is closed.
16. Closing Latch – There are two latches which are used to hold the lid in a closed position when carrying or storing the unit.
17. Locking Port – For security purposes, a lock (not provided) can be placed through the hole in the locking port during travel or storage of the unit.
18. Handle – The tester case carrying handle.
19. Hold Down Lock – The Hold Down Lock is used to secure the clamp holding the laptop once the laptop is in place.
20. Eject Switch – The Eject Switch is used to release the laptop from the laptop computer hold down.

Tester Battery

The supplied battery pack is an Inspired Energy Rechargeable Smart Lithium Ion Battery, 14.4 Volt, 6.6 Amp-Hour. Do not use the battery below -4° F (-20° C) or above 140° F (60° C). A thermal protective safety device in the battery protects it from over temperature if the internal battery temperature reaches 199.4° F (93° C).

The battery is shipped in a partially charged state that will provide a minimum of six months of shelf life when stored at 77° F (25°C). If the storage temperature exceeds 77° F (25°C) over the 6-month period then the shelf life will be reduced and provisions should be made to recharge the battery periodically. Battery life will be reduced by repeated operation or storage at extreme temperatures.

The battery must be fully charged before use. Refer to the instruction manual that came with the supplied charger for charging instructions.

When charging the battery for the first time or after a prolonged storage time, it is normal for the charger to indicate that charging has been completed after 10 to 15 minutes. Remove the battery from the charger and repeat the charging procedure. It is not necessary to fully discharge the battery between charges, nor is it necessary to periodically precondition the battery. The battery charge may be topped off at anytime without adverse affects to the battery.

A fully charged battery lasts approximately four hours under constant testing. Batteries may last a full eight hours or longer, depending on the types of tests performed. The amount of time remaining on the battery depends on the status of the charge at the beginning of testing, the type of testing that is being performed, and the age and condition of the battery.

The battery charge level is indicated by an LED display, located on the Connection Identification Label below the battery compartment. As the battery discharges, the LED indication changes from green (fully charged) to red (fully discharged).

PdMA recommends that you shut down the tester before the battery is completely discharged, recharge the battery, and resume testing. Alternatively you may shut down the tester before the battery is completely discharged, replace it with a spare, fully charged battery and resume testing.



When the battery needs to be charged, remove it from the tester and place it in the supplied charging unit. **DO NOT REMOVE THE BATTERY FROM THE TESTER WHILE A TEST IS IN PROGRESS.** A green flashing light on the charger indicates the battery is charging and a red solid light indicates there is an error. The battery is fully charged when the green solid light on the charger displays.

If the battery is not significantly discharged and you will not be using it for the next two to three days, it is recommended that you store the battery as is and recharge it before use. If you will be storing it for longer than two weeks, it is recommended the battery be fully charged before storage and after that every six months while it is in storage. Do not store the battery in the tester battery compartment or the charger.

Install/Remove

To install the battery open the Battery Compartment by sliding the Battery Compartment Latch sidewise to the right until the Battery Compartment lid pops up. Lift the lid up using your hand until there is room to insert the battery.

To remove the battery, open the Battery Compartment by sliding the Battery Compartment Latch sidewise to the right until the Battery Compartment lid pops up. Lift the lid up using your hand, the battery will partially eject, grasp the battery with your hand and remove it.

Laptop Computer



WARNING: This laptop computer has been specially configured to operate your new MCEGold tester. Any changes made to the laptop settings including BIOS, config.sys, Autoexec.bat, Power Management, etc., may render the tester inoperable.

Installing software which uses the USB port could also adversely affect the operation of the tester.

Please contact our Technical Support at (813)621-6463 ext. 251 or techsupport@pdma.com if you have any questions.

General

The exact model of laptop computer your tester has depends on when your tester was built. Refer to the computer manufacturer's literature, supplied with the tester, for specific information on operation and maintenance of the laptop computer, installation of software, charging and maintenance of the battery, etc.

The MCEGold software is pre-installed on the laptop and a backup software disc is supplied.

To install and operate/run MCEGold, you must have the following minimum requirements (subject to change):

Computer	Dell Latitude E6430 Laptop*
Processor	2+ GHz Intel i5 or equivalent
Resolution	1600 x 900
Operating System	Microsoft Windows 7 SP1 32 or 64 bit**
Memory	2.0+ G RAM
Ports/Drive	M Series tester (1) USB Port
Drives	24x CD-RW + DVD Drive
Hard Disk	20G Available

* Using any other computer manufacturer in conjunction with the PdMA software may result in erratic computer behavior; including but not limited to:

- Power Management Issues
- Lock-up
- Communication Port Malfunction
- Drive Incompatibility
- Display Errors
- SQL Database Incompatibility
- Network Synchronization Issues

**For International Customers: Windows 7 Ultimate 32 or 64 bit

Laptop Battery

The primary computer battery is a six cell for higher amp/hour capacity. Supplied laptop batteries may change after this Product Support Manual is written, therefore you should check the manufacturer's literature for battery information and how to change the battery.

The battery automatically charges when the computer is plugged into an AC power source. DO NOT change batteries while the computer is on. To preserve battery life, when not using the tester for an extended period of time, exit MCEGold and shutdown the computer using the Windows shutdown feature.

Computer Ports

The USB port on the back of the laptop is used to connect the laptop to a printer or a desktop PC.

The USB port on the side of the laptop computer is used to connect the computer to the tester. When the laptop lid is closed there is a label indicating the USB port. See page 2-4, Figure 2-5, number 21 for the location.

Tester Care and Handling

Refer to the computer manufacturer's literature, supplied with the tester, for specific information on operation, specifications, and maintenance of the laptop computer.

Tester Batteries – charge immediately after use only if you will be using the tester in the next two to three days; do not completely discharge; do not drop; do not incinerate; do not short positive and negative terminals together; do not use in any other equipment; store out of direct sunlight and away from extreme heat. See page 2-6 for more information.

Tester Battery Charger – handle with care; follow instructions in the manual that came with the charger.

Case – Preventive maintenance consists of cleaning the unit with a mild detergent and water, and visual inspection of the unit, test leads, and attachments.

When cleaning the unit and/or deck, avoid spraying or pouring detergent or water directly on the unit and/or test leads. It is recommended that you spray a reasonable amount of mild detergent on a soft cloth and wipe the unit with the cloth. Then remove any detergent residue with a clean soft damp cloth.

There are no user serviceable parts inside the unit. However, when inspecting the unit, test leads, or attachments, search for broken parts, cracked wire insulation, and/or exposed wires. DO NOT use damaged equipment. If defects are found, contact PdMA immediately to arrange for repairs or replacement of the defective part. See Chapter One, Returning the Tester to PdMA, for information regarding contacting PdMA.

Tester Environmental Conditions

- Designed for indoor use
- Operating temperatures: 32° F to 95° F (0° C to 35° C)
- Storage temperatures: -40° F to 149° F (-40° C to 65° C)
- Operating humidity: 10% - 90% non-condensing
- Storage humidity: 5% - 95% non-condensing

Storage

- Store the laptop computer in the ABS plastic case
- Store the tester in the shipping case

Shipping

When returning the tester to PdMA for annual calibration, upgrades, or repair, follow the procedure at the end of Chapter One, Returning the Tester to PdMA.

Accessory Bag

Accessories

The tester accessory bag, shown in Figure 2-6, is designed to carry the supporting accessories needed for motor testing that is not part of the tester itself. The gray nylon bag has black trim and handles with a detachable shoulder strap.

On the outside of the bag are pockets for paperwork storage. On the front there is one large pocket with a flap secured with Velcro. The flap is embossed with the PdMA Corporation logo. On the front of the pocket is a clear plastic pouch which can be used for identification. The back has a pocket without the flap.

The interior of the bag is divided into two sections secured with zippers. The front section contains two large pockets with Velcro flaps, one on the front and the other against the dividing wall between the front and back sections. The back section contains four pockets, of equal size, with Velcro flaps. Two of the pockets are against the dividing wall and two pockets are against the back side.



Figure 2-6: Accessory Bag

The exact accessories you have depends on your tester model. This is determined by when your tester is built and which options you purchased. A newer, fully loaded tester includes the following accessories. Your tester may not have all of these accessories.

- MCE test leads
- DC commutator bar-to-bar test leads
- EMAX test leads
- Laptop computer AC to DC converter and power cord
- One tester battery and battery charger
- Spare laptop battery

MCE Test Leads

The MCE test lead cable connects to the MCE connector on the right side of the tester deck. The cable has four leads, which connect to the three phases of an AC motor (black, blue, red) and circuit ground (green). When testing DC motors, only the black, blue, and green leads are used. MCE test leads are shown in Figure 2-7.



Figure 2-7: MCE Test Leads

DC Commutator Bar-to-Bar Test Leads

The DC commutator bar-to-bar test lead cables connect to the MCE connector on the right side of the tester deck. Bar-to-bar test leads are available in either pistol grip or pencil probe styles. Either style provides for resistance measurement in a 4-wire configuration to allow for maximum accuracy.

DC bar-to-bar pistol grip test leads are shown on the right and pencil probe test leads are shown on the left in Figure 2-8.



Figure 2-8: Bar-to-Bar Test Leads

EMAX Test Leads

EMAX Voltage test leads contain fuses and are color coded black (phase 1), blue (phase 2), red (phase 3), and green (common). They connect to the Voltage connector on the right side of the tester deck. Figure 2-9 shows an EMAX Voltage test lead.



Figure 2-9: EMAX Voltage Test Leads

EMAX Current test leads consist of three individual current probes and are connected through a 3 BNC to a Fischer adaptor cable. The BNC side of the adaptor is color coded black for Phase 1, blue for Phase 2, and red for Phase 3. The Fischer side of the adaptor cable connects in the space provided on the right side of the tester deck.

When connecting the three clamp-on current probes to each phase of the three phase motor, ensure that the arrows on the current probes point in the direction of the motor or generator being tested.

NOTE: Current probes are sensitive to current flow direction. Follow the arrow prompt located on the probe.

Figure 2-10 shows EMAX Current probes.



Figure 2-10: EMAX Current Test Leads

Specifications

MCE

MCE performs tests in accordance with the following specifications:

Ground Resistance Test Voltages:

250-5000 V in 50 V steps

250-1000 V in 50 V steps

Range (Accuracy):

20 K Ω to 100 M Ω @250-500v ($\pm 2\%$)

100 M Ω to 1 G Ω @250-5000v ($\pm 2.5\%$)

1 G Ω to 220 G Ω @250-5000v ($\pm 5\%$)

220 G Ω to 1000 G Ω @1kV-5kV ($\pm 5\%$)

1 T Ω to 3 T Ω @1kV-5kV ($\pm 20\%$)

Short circuit current: 2 mA

Charge current: 1 mA

Capacitance Measurement:

Range (Accuracy):

1000 to 220,000 pF @ 1200 Hz ($\pm 5\%$)

220,000 to 1,000,000 pF @ 300 Hz ($\pm 5\%$)

Resolution:

250 pF

Inductance Measurement:

Range (Accuracy @ 1200 Hz):

.05mH to 250mH ($\pm 1\%$)

Range (Resolution):

.05mH to <50mH (.01mH)

50mH to <100mH (.05mH)

100mH to 250mH (.1mH)

Range (Accuracy @ 300 HZ):

220mH to <700mH ($\pm 1\%$)

700mH to 2000mH ($\pm 2\%$)

>2000mH to 5000mH ($\pm 5\%$)

Resolution:

.1mH to 25mH

Resistance Measurement:

Range (Accuracy):

100 $\mu \Omega$ to 2000 Ω ($\pm 1\%$)

Range/Resolution:

.00010 Ω .02000 Ω (.00001 Ω)

.0200 Ω to 2.000 Ω (.0001 Ω)

2.00 Ω to 50.0 Ω (.001 Ω)

50.00 Ω to 1000.00 Ω (.01 Ω)

1000.0 Ω to 2000.0 Ω (.1 Ω)

Test Lead Set:

10 ft. (3.05 m.)

Table 2-1: MCE Electrical Specifications

Item	Description
Battery Rating	14.4 VDC 6.6 Amp-Hour
Battery Type	Li-ion
MCE Connector Max Outputs	Polarization Index 5000 VDC @ ≤ 2 mA
	Resistance-to-Ground 5000 VDC @ ≤ 1 mA
	Resistance Phase-to-Phase ≤ 6 VDC @ 1A
	Inductance/Capacitance 10 VAC @ 300Hz or 1200Hz

EMAX**Voltage Measurement:**

AC Voltage 0-1000 VAC

Direct line $\pm 1\%$ (10 to 100% of range)Secondary line $\pm 1\%$ + PT error (10 to 100% of range)MTAP Leads 0-35 VAC $\pm 1\%$ +PT error (10 to 100% of range)DC Voltage 0-1000 V_{peak} (Qualitative only)**Current Measurement AC/DC:** $\pm 0.5\%$ of input (\pm accuracy of the probes)**Standard Current Probe Set:**

PdMA 2128.14

 $\pm 1\%$ (of reading) ± 0.1 mV from 1 to 12A @ 100mV/A $\pm 1\%$ (of reading) ± 2 mV from 10 to 80A @ 10mV/A $\pm 2.5\%$ (of reading) ± 2 mV from 100 to 150A @ 10mV/A**Power Measurement:**

THD/HVF/ Spectrum – 50th harmonic

Current Spectrum Analysis:

8,000 lines resolution

In-Rush/Start-Up Test:

Sampling rate 3,600/second

Test duration 1 minute

Rotor Evaluation Test:

Sampling rate 960/second

Fmax 0-480 Hz

Resolution 8,000 lines

Eccentricity and Power Test:

Sampling rate 12,288/second
 Fmax 0-6,000 Hz
 Resolution 8,000 lines

Test Lead Set:

10 ft. (3.05 m.) fused voltage leads for 3 phases and ground.
 10 ft. (3.05 m) current probe cable connects 3 probes via BNC connector
 Voltage probe accessory kit
 Three 6 ft. (1.83 m.) current probes for three phases

Table 2-2: EMAX Electrical Specifications

Item	Description
Battery Rating	14.4 VDC 6.6 Amp-Hour
Battery Type	Li-Ion
Current Connector Max Input	3V RMS
Voltage Connector Max	1000 VAC
Voltage Probe Fuse Type	F/0.5A/1000V/6x44mm
Current Probe	Refer to the probe manufacturers documentation included with the EMAX unit.

Hardware**Shipping Case****Table 2-3: Shipping Case Specifications**

Item	Description
Color	Gray
Material	Lexan and Aluminum
Outside Dimension (LxWxD)	22.5x18.5x18 inches 57.15x46.99x45.72 centimeters
Inside Dimension (LxWxD)	18.5x5.5x12.5/19x8.75x12.5 inches
Inside Front pocket	46.99x13.97x31.75/ centimeters
Inside Back pocket	48.26x22.225x31.75 centimeters
Weight - empty/full	35/75 pounds 15.826/34.02 kilogram

Tester Case**Table 2-4: Tester Case Specifications**

Item	Description
Color	Black
Material	ABS Resin
Outside Dimension (LxWxD)	18.5x14.5x6 inches 46.99x36.83x15.24 centimeters
Inside Dimension (LxWxD)	18x13x5 inches 45.72x33.02x12.7 centimeters
Computer Area Dimension (LxWxD)	11x14x2 inches 27.94x35.56x5.08 centimeters
Weight, without computer	19 pounds 8.62 kilograms
Weight, with computer	26 pounds 11.79 kilograms