Pay special attention to the warnings and safety instructions that accompany the above symbol wherever it is found within this manual!

All rights reserved by Manta Test Systems Inc. No part of this publication may be reproduced or distributed in any form or by any means without the permission of Manta Test Systems Inc.

The information and specifications contained within from Manta Test Systems are believed to be accurate and reliable at the time of printing. However, because of the nature of this product, specifications and features shown in this manual are subject to change without notice.

The features and capabilities described herein reflect those available in MTS-2000 firmware release 1.00.

March 2010
Document ID# CUR 001 01B
# MTS-2000 User’s Manual

## Table of Contents

1. **PRODUCT OVERVIEW** ................................................. 4  
2. **TECHNICAL SUPPORT** ............................................. 5  
   SAFETY CONSIDERATIONS ........................................... 5  
   LIMITED PRODUCT WARRANTIES .................................. 6  
   4.1 Hardware .......................................................... 6  
   4.2 Software & Firmware .......................................... 6  
   4.3 Separate Extended Warranty for Hardware Products .... 6  
   4.4 Exclusion of other Warranties ................................. 6  
   4.5 Limitation of Liability and Remedies ...................... 7  
   4.6 Limitation of Warranty Regarding Software ............ 7  
   4.7 Extension of Warranty .................. .......................... 7  
3. **PRIMARY MODULES** ............................................. 8  
   5.1 Front Panel ...................................................... 8  
   5.2 Display ........................................................... 8  
   5.3 RS-232 Communications ........................................ 8  
   5.4 DC Current Loop Output ....................................... 8  
   5.5 DC Current Loop Input ........................................ 8  
   5.6 Channels .......................................................... 8  
   5.7 Power supply ..................................................... 8  
4. **SPECIFICATIONS** .................................................. 9  
   6.1 Inputs ............................................................. 9  
   6.2 Outputs ........................................................... 9  
   6.2 Outputs (Cont’d) ................................................. 10  
   6.3 Data Interfaces .................................................. 11  
   6.4 Accessories ........................................................ 11  
   6.5 Physical Characteristics ....................................... 11  
5. **USER INTERFACE CHARACTERISTICS** .................. 12  
6. **OPERATING MODES** .............................................. 14  
   8.1 Manual Test Mode .............................................. 14  
   8.2 Meter Test Mode ............................................... 14  
   8.3 Setup Mode ....................................................... 15  
7. **EXAMPLE CONNECTION DIAGRAMS** .................... 16  
   9.1 Testing an Ammeter .............................................. 16  
   9.2 Testing a Voltmeter with Channel 1 ......................... 16  
   9.3 Testing a Voltmeter with Channel 2 ......................... 17  
   9.4 Testing a Wattmeter ............................................. 17  
   9.5 Testing a Current Transducer ................................. 18  
   9.6 Testing a Voltage Transducer with Channel 1 ........... 18  
   9.7 Testing a Voltage Transducer with Channel 2 ........... 19  
   9.8 Testing a Watt Transducer .................................... 19  
   9.9 Testing a Voltage Device (0 – 300V) ....................... 20  
   9.10 Outputting Transducer Current (0-20mA) ................. 20  
   9.11 Outputting DC Current (0 – 2500 mA DC) ................. 20
1. **PRODUCT OVERVIEW**

The MTS-2000 is a meter test system designed to test panel meters, transducers and similar metering hardware.

All applicable quantities (voltage, current, power, frequency, phase, etc) are displayed as required.

The MTS-2000 is designed to be easily operated from the controls on the front panel. The system displays output values, operating modes, etc. The user interface makes use of a “bank machine” type menu system that can be navigated with soft-keys on the instrument. All current and voltage inputs and outputs use standard banana jacks. The MTS-2000 can also be operated by remote control from an external computer.

**FEATURES:**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>4x20 Character Display</td>
</tr>
<tr>
<td>2.</td>
<td>Front Panel Membrane with Bank Machine Style Soft-key Interface</td>
</tr>
<tr>
<td>3.</td>
<td>Keypad for Data Entry</td>
</tr>
<tr>
<td>4.</td>
<td>0-150V AC/DC Voltage Output Channel</td>
</tr>
<tr>
<td>5.</td>
<td>Convertible Voltage (0-150V AC or DC) or Current (0-5Aac, 0-2.5Adc) Output Channel</td>
</tr>
<tr>
<td>6.</td>
<td>Front Panel On/Off Switch and 120Vac Input</td>
</tr>
<tr>
<td>7.</td>
<td>One RS-232 Port</td>
</tr>
<tr>
<td>8.</td>
<td>Cable Storage in Lid</td>
</tr>
<tr>
<td>9.</td>
<td>0-20mA Analog Input</td>
</tr>
<tr>
<td>10.</td>
<td>0-20mA Analog Output</td>
</tr>
</tbody>
</table>

Boot Time < 5 Seconds

---

![Diagram of MTS-2000 meter test system]
2. TECHNICAL SUPPORT

Our technical support team is committed to working with you, our customers, to ensure that you have the products which best serve your specific needs. The design of this instrument reflects decades of experience in the electric power industry. Manta Test Systems recognizes, however, that there will be testing situations encountered which were not considered during product design.

Manta Test Systems encourages any user questions, problems or suggestions to be forwarded to us, via the representative through whom the product was purchased, or directly to us via the fax numbers provided on the front cover or in the customer support area of our website.

3. SAFETY CONSIDERATIONS

This instrument can generate high levels of current and voltage. Incorrect usage may cause personal injury or damage to the instrument.

The user must be qualified to work safely in the intended application environment of this instrument. Non-adherence to the following minimum requirements constitutes misuse of the MTS-2000, and the manufacturer accepts no liability for damages arising from such misuse:

1) The instrument case must always be effectively grounded. The integrity of the power supply cord ground should always be verified before use.

2) All leads and connectors should be in good condition and rated for the appropriate voltage and current carrying requirements.

3) The outputs must not be connected to live outputs or live equipment.

4) All outputs must be turned off before making changes in connections.

5) Note: the black (return) terminals of Channel 1 and 2 are internally connected.
4. **LIMITED PRODUCT WARRANTIES**

4.1 **Hardware**

Manta Test Systems warrants that its hardware products, and the hardware components of its products, shall be free from defects in materials and workmanship under normal use and service for a period of one year from the date such products are shipped from Manta Test Systems.

Provided that Manta Test Systems receives notice of any defects in materials or workmanship of its hardware products, or hardware components of its products, within a one-year period, Manta shall, at its option, either repair or replace the defective hardware product or hardware component, if proven to be defective.

4.2 **Software & Firmware**

Manta Test Systems warrants that its software products, and the software and firmware components of its products, shall not fail to execute their programming instructions under normal use and service, due to defects in materials and workmanship, if properly installed on intended hardware, for a period of one year from the date such products are shipped from Manta Test Systems.

Provided Manta Test Systems receives notice of such defects within the warranty period, it shall, at its option, either repair or replace the software or firmware media, if proven to be defective.

4.3 **Separate Extended Warranty for Hardware Products**

Aside from the standard warranty set forth above, Manta Test Systems offers a separate extended warranty plan for all hardware products (excluding cables, batteries and accessories) which may be purchased, and extends the standard warranty by one additional year.

The extended warranty is issued under the same terms, conditions and exclusions as the standard warranty set forth herein. Pricing is based upon the cost of the product, and the average cost of servicing and calibration. Refer to the Manta Test Systems price list available from your local representative, or Manta Test Systems, for extended warranty pricing for specific products. The extended warranty must be purchased and paid for within three months from the date the product is shipped from Manta Test Systems.

4.4 **Exclusion of other Warranties**

THE FOREGOING WARRANTIES ARE EXCLUSIVE, AND ARE IN LIEU OF ANY AND ALL OTHER WARRANTIES (WHETHER WRITTEN, ORAL OR IMPLIED) INCLUDING, BUT NOT LIMITED TO, WARRANTY OF MERCHANTABILITY IN OTHER RESPECTS THAN AS SET FORTH ABOVE, AND WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE.
4.5 Limitation of Liability and Remedies

IT IS UNDERSTOOD AND AGREED THAT MANTA TEST SYSTEMS’ LIABILITY AND PURCHASER’S SOLE REMEDY, WHETHER IN CONTRACT, UNDER ANY WARRANTY, IN TORT (INCLUDING NEGLIGENCE), STRICT LIABILITY OR OTHERWISE, SHALL NOT EXCEED THE COST OF REPAIR OR REPLACEMENT OF MANTA TEST SYSTEMS’ PRODUCTS, AS SET FORTH ABOVE, AND, UNDER NO CIRCUMSTANCES, SHALL MANTA TEST SYSTEMS BE LIABLE FOR ANY SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, INCLUDING, BUT NOT LIMITED TO, PERSONAL INJURY, PROPERTY DAMAGE, DAMAGE TO OR LOSS OF EQUIPMENT, LOST PROFITS OR REVENUE, COSTS OF RENTING REPLACEMENTS, AND OTHER ADDITIONAL EXPENSES.

FURTHERMORE, IT IS UNDERSTOOD AND AGREED THAT MANTA TEST SYSTEMS SHALL NOT BE LIABLE FOR ANY DAMAGES, LOSSES OR EXPENSES AS A RESULT OF THE PURCHASER’S OR ANYONE ELSE’S:

I. NEGLIGENCE (WHETHER DEEMED ACTIVE OR PASSIVE),
II. MISUSE, ABUSE, OR MODIFICATION OF MANTA TEST SYSTEMS PRODUCTS,
III. USE OR OPERATION OF PRODUCTS NOT IN CONFORMITY WITH THE SPECIFICATIONS AND INSTRUCTIONS FURNISHED BY MANTA TEST SYSTEMS FOR ITS PRODUCTS,
IV. REPAIR OR MAINTENANCE OF MANTA TEST SYSTEMS’ PRODUCTS BY PERSONS OR ENTITIES NOT AUTHORIZED BY MANTA TEST SYSTEMS, OR
V. DAMAGE TO, OR DESTRUCTION OF, PRODUCTS, DURING DELIVERY TO MANTA TEST SYSTEMS FOR ANY REASON.

4.6 Limitation of Warranty Regarding Software

Manta Test Systems does not warrant that the operation of the software, firmware or hardware shall be uninterrupted or error free.

4.7 Extension of Warranty

At the discretion of Manta Test Systems, the warranty may be extended for a product which has been returned for service shortly after its warranty period has expired.
5. PRIMARY MODULES

5.1 Front Panel
The “bank machine” style user interface makes use of soft-keys that are selected by pressing the button adjacent to the description. A keypad is used for direct entry of numeric values.

5.2 Display
The system uses a 4x20 character vacuum florescent display device to display output values, operating modes, etc.

5.3 RS-232 Communications
An RS-232 port is provided to allow control of the instrument using a PC and to facilitate software upgrades.

5.4 DC Current Loop Output
A 0mA to 20mA output is provided for testing current loops normally driven by a transducer.

5.5 DC Current Loop Input
A –20mA to +20mA input is provided to measure a transducer’s output.

5.6 Channels
The system houses two independent power output channels. One channel operates in voltage mode only, and can generate up to 150V (AC or DC). The other channel can generate voltage or current. In voltage mode it generates up to 150V (AC or DC). In current mode it generates up to 5Aac or up to ±2.5Adc.

5.7 Power supply
The mains input is auto-ranging, power factor corrected and can operate from either 105-130 or 208-250Vac (50-60Hz).
6. SPECIFICATIONS

NOTE: Due to technical progress, specifications are subject to change without notice. All AC quantities are RMS values, except as otherwise noted. Power outputs are specified for nominal 120VAC/60Hz or 240VAC/50Hz power input, and 25°C ambient operating temperature. Derating applies for lower input power voltages and higher ambient temperatures.

For all current outputs, maximum obtainable current will vary inversely with load impedance. For extended operation at high power output levels, ensure adequate cooling (i.e. verify air intakes and exhaust ports are unrestricted).

6.1 Inputs

Mains Supply
Single phase 105-130VAC (or 208-250VAC) @400VA max, 47-63 Hz, auto-ranging

Transducer Input
Measures low level output from AC transducers
Maximum input level: ±20mA DC
Measurement accuracy: 0.04% reading + 0.01% range (25±5°C) after 10min warmup
(for waveforms under 2% THD )
Connector: 4mm Banana

6.2 Outputs

Transducer Output
Generates low level output for AC transducer inputs
Maximum output level: 0 - 20mA DC
Setting accuracy: 0.04% setting + 0.01% range (25±5°C) after 10min warmup
Compliance: >=10Vdc, (>=11Vdc typical )
Max Load: 10kΩ (to 1mA), 2kΩ (to 4mA), 1kΩ (to 10mA), 500Ω (to 20mA
Connector: 4mm Banana

Voltage
2 AC or DC voltage channels
0-150V (AC or DC) per channel in independent mode
0-300V (AC or DC) when channels are connected in series
Setting resolution: 0.01Vrms, 0.1Vdc
Accuracy greater of: 0.25% of setting or 0.03 Vrms (10Hz-400Hz, DC)
1.0% of setting (400Hz-800Hz), greater than 1% of range
Power AC: 30VA max per channel, 60VA min with 2 channels in series,60Hz.
Power DC: 15W dc max per channel, 30W dc with 2 channels in series
Noise & distortion at maximum power: <1%
Bandwidth: 3kHz (-3dB)
Protection: Overload, short circuit, over-temperature, transient overvoltage, clip indication
Surge Current (DC mode): 1A maximum (limited)
Connector: 4mm Banana
6.2 Outputs (Cont’d)

Current
1 AC or DC current channel
- 0-5Arms, or 0-2.5Adc, direct coupled
- Setting resolution: 0.001Arms
- Accuracy greater of: 0.25% of setting or 0.01 Arms (10Hz-400Hz, DC)
  1% (400Hz-1000Hz)
- Power: 50 VA maximum, 30W dc
- Noise & distortion at maximum power: <1%
- Bandwidth: 3kHz (-3dB)
  - Protection: Overload, short circuit, over-temperature, transient overvoltage, clip indication
  - Connector: 4mm Banana
- Compliance & Loading: (60Hz)

AC Outputs Frequency/Phase Angle
- Frequency range: DC, 10-1000 Hz
- Frequency resolution: 0.001Hz
- Frequency accuracy: 50ppm
- Capable of generating 2 simultaneous frequencies
- Phase angle range: 0-359.9°, resolution 0.1°
- Phase accuracy: 0.1° (43-65Hz), 0.5° (10-43Hz and 65-120Hz), 1.0° (120Hz-1000Hz)
6.3 Data Interfaces

All interfaces are fully isolated from AC/DC inputs and outputs. Ground, where present, is connected to frame ground.

RS-232 Serial Port

- Standard 9 pin male DB-9 wired as DTE (Data Terminal Equipment)
- 9600 to 115,200 baud

6.4 Accessories

- User’s manual
- AC power cord
- Test lead kit and detachable storage pouch
- RS-232 null modem cable – optional

6.5 Physical Characteristics

- 14.9”W x 6.9”H x 12.1”D (37.9cm W x 17.5cm H x 30.8cm D)
- Weight: 15 lbs (6.8 kg)
- Display: 20 character by 4 line VFD
- Operating temperature: 32° to 122°F (0° to 50°C)
- Storage temperature: -13° to 158°F (-25° to 70°C)
7. USER INTERFACE CHARACTERISTICS

Hardware related to the front-panel user interface includes:

A  4 line, 20 character-per-line display
B  8 function keys, positioned to the left and right of each line on the display device
C  MENU key
D  ENTER key
E  CE (clear entry) key
F  0-9 digit keys
G  decimal point key
H  +/- key

I  OUTPUTS ON key
J  OUTPUTS OFF key
K  OUTPUTS ENABLED
L  VOLTAGE MODE (2nd Channel)
When the device is powered on, the manual test mode screen described later in this document is shown. To change modes or exit menus, press MENU:

Pressing the function key adjacent to a label (“Manual Test”, etc.) causes the screen described by that key’s label to appear.

Pressing the MENU key at any time will always return you to the previous place in the menu tree.

Many screens contain editable values. For example, the following screen contains four editable values: 1.000, 1.000, 5.000, 5.000

Pressing the function key next to an editable value selects that value, highlighting it in inverse text on the display. If you type a numeric key, an editing screen appears similar to this one:

The editing display shows the name of the setting being edited and its allowable range. As you type in the digits, you can change the sign or enter a decimal point. Changes are reflected between the square brackets. When finished entering a number, you may press ENTER to store it or CE to abort entry.

The OUTPUTS ON and OUTPUTS OFF keys turn the two channels on or off. Whenever the amplifier outputs are on, the ENABLED LED is on.

Some tests configure channel 2 to output current, others configure it to output voltage. The VOLTAGE MODE LED is on when the convertible amplifier is configured to output voltage.
8. OPERATING MODES

The MTS-2000 offers various operating modes that are designed to provide an easy to use interface for the particular category of testing to be performed.

The basic modes are:
1. Manual test
2. Meter test
3. Transducer test
4. Setup

8.1 Manual Test Mode

The manual test mode is used for basic meter and transducer testing. It consists of a single screen, allowing you to set voltage, current, frequency and phase angle, and displays the current loop input current. The amplifiers are configured so that channel 1 generates voltage and channel 2 generates current. The voltage and current values entered by the user are generated as displayed, with no conversion or scaling.

When the device is powered on, the manual test mode screen is shown. From the main menu, the “Manual Test” function key returns to the manual test screen, shown below.

In this mode, you may adjust the voltage, current, frequency and phase angle, and use the OUTPUTS ON and OUTPUTS OFF keys to turn the channels ON or OFF. The 0-20mA current input is shown so the user can test transducers with current outputs.

8.2 Meter Test Mode

The “Test a Meter” function key in the main menu presents the user with a menu listing of available meter-specific test screens:
Each selection presents a series of screens to configure the test, including:
- Minimum and full-scale limits (V, A, W, etc.)
- CT and PT ratios
- “Connections” screen describes the channel wiring required for the specific mode, and the test screen allows the user to adjust the output levels and see the expected value on the meter.

For example, when the “Volts” function key is pressed, the following screens appear in sequence:

1. Full Scale=300.0V
   Min. Scale=0.0V
   NEXT »

2. 1.000 PT Ratio 1.000
   5.000 CT Ratio 5.000
   NEXT »

3. CONNECTIONS
   Use hot terminals of channel 1 + 2
   NEXT »

4. 120.00V  60.00Hz
   «CONFIG Quick Set »

Pressing the CONFIG function key returns to the full scale / min scale screen.

The meter-specific test modes include a “QUICK SET” function key. Pressing it repeatedly causes the appropriate values to be generated so that the meter will read 0%, 25%, 50%, 75% and 100% of full scale.

### 8.3 Setup Mode

The “Setup” selection in the main menu allows the user to configure the device, including:

* Calibrate the amplifiers
* Calibrate the current loop input and output
9. EXAMPLE CONNECTION DIAGRAMS

9.1 Testing an Ammeter

9.2 Testing a Voltmeter with Channel 1
9.3 Testing a Voltmeter with Channel 2

9.4 Testing a Wattmeter
9.5  Testing a Current Transducer

9.6  Testing a Voltage Transducer with Channel 1
9.7 Testing a Voltage Transducer with Channel 2

![Diagram of voltage transducer testing with Channel 2](image)

9.8 Testing a Watt Transducer

![Diagram of watt transducer testing](image)
9.9 Testing a Voltage Device (0 – 300V)

9.10 Outputting Transducer Current (0-20mA)

9.11 Outputting DC Current (0 – 2500 mA DC)

(note: Channel 2 must be set to DC)