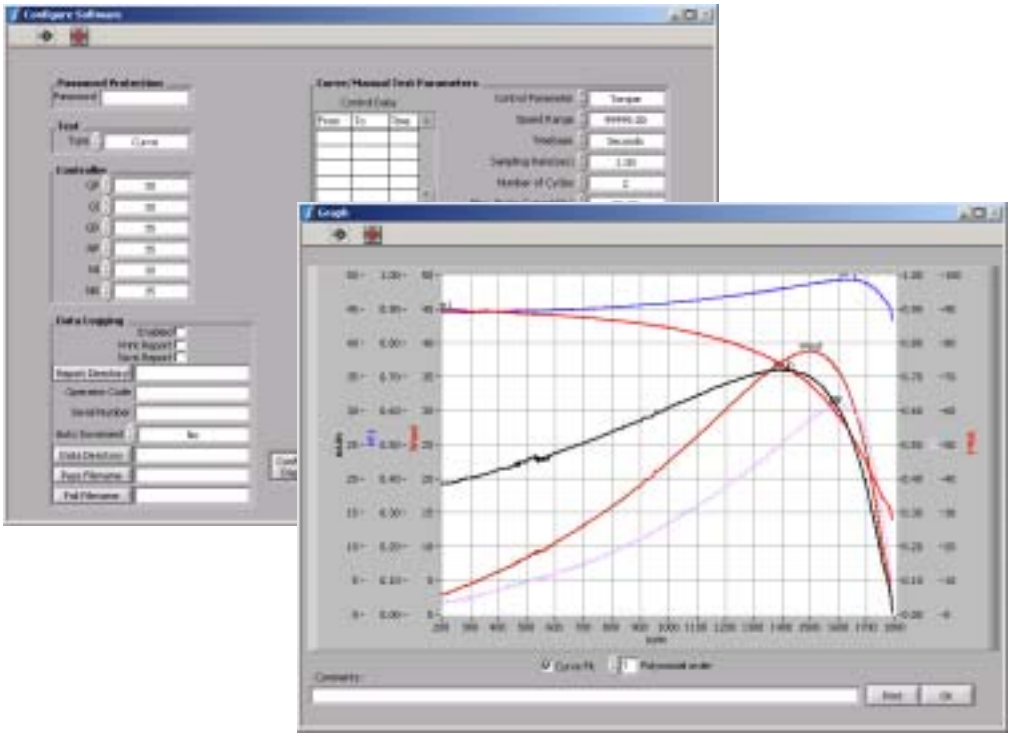
MAGTROL

M-TEST 4.0

Motor Testing Software



User's Manual

While every precaution has been exercised in the compilation of this document to ensure the accuracy of its contents, Magtrol, Inc. assumes no responsibility for errors or omissions. Additionally, no liability is assumed for any damages that may result from the use of the information contained within this publication.

TRADEMARKS

LabVIEW™ is a trademark of National Instruments Corporation.
Microsoft® is a registered trademark of Microsoft Corporation.
National Instruments™ is a trademark of National Instruments Corporation.
NI-DAQ™ is a trademark of National Instruments Corporation.
NI-488.2™ Software for Windows® is a trademark of National Instruments Corporation.
Pentium® is a registered trademark of Intel Corporation.
Windows® is a registered trademark of Microsoft Corporation.

2nd Edition, rev. A – July 2003

MAGTROL

Safety Precautions

1. Make sure that all Magtrol dynamometers and electronic products are earth-grounded, to ensure personal safety and proper operation.
2. Check line voltage before operating electronic equipment.
3. Make sure that dynamometers and motors under test are equipped with appropriate safety guards.

Revisions To This Manual

The contents of this manual are subject to change without prior notice. Should revisions be necessary, updates to all Magtrol User's Manuals can be found at Magtrol's web site at www.magtrol.com/support/manuals.htm.

Please compare the date of this manual with the revision date on the web site, then refer to the manual's Table of Revisions for any changes/updates that have been made since this edition.

REVISION DATE

Second Edition, revision A – July 2003 • corresponds to Release 2.6 and later versions of M-TEST 4.0

TABLE OF REVISIONS

Date	Edition	Change	Section(s)
07/30/03	Second Edition, revision A	Lambda Genesys power supply added to Device list	4.1.2
07/14/03	Second Edition	M-TEST Windows/Screens have slightly different appearance	throughout entire manual
07/14/03	Second Edition	Software now supports Tandem Dynamometers	1.3, 1.4
07/14/03	Second Edition	Manual scaling available in graphs	1.3, 1.4. 8.2
07/14/03	Second Edition	GPIB Interface Card ISA (part number 73-M014) no longer available	1.4
07/14/03	Second Edition	"Power Source" control renamed to "Device"	4.1.2
07/14/03	Second Edition	3 Hz cutoff frequency added to Torque Filter options/values	4.2.1
07/14/03	Second Edition	Clutch and DDL controls removed from channel configuration	4.2.1
07/14/03	Second Edition	Speed Range control added to Curve/Manual Test Parameters	6.5
07/14/03	Second Edition	DDL control removed from Adjust Dynamometer Controller parameters	6.10, A.4
07/14/03	Second Edition	Added Software Revision History to Appendix	Appendix C
03/18/03	First Edition, revision C	Additional power supply/measurement options	4.1.2, 4.1.3
03/18/03	First Edition, revision C	"Report Path" changed to "Report Directory"	6.4
03/18/03	First Edition, revision C	Added button to access file dialog box from Report Directory, Data Directory, Pass FIlename and Fail Filename	6.4
03/18/03	First Edition, revision C	Further described Pass/Fail FIlename functions	6.4
03/18/03	First Edition, revision C	Import parameter added	6.5, 6.6, 6.7
03/18/03	First Edition, revision C	Stop button is now Stop/Quit	6.10
03/18/03	First Edition, revision C	Both raw data plot and curve fit are displayed at the same time	8.2
03/18/03	First Edition, revision C	Comments added from screen plot now saved to data file	8.2
10/17/02	First Edition, revision B	WT1600 power measurement option added	4.1.3
10/17/02	First Edition, revision B	TC Offset added to temperature measurement configuration	4.1.5
10/17/02	First Edition, revision B	TC Gain function changed	4.1.5
10/17/02	First Edition, revision B	Function & options for ramp test Special Data Points parameters	6.6
10/17/02	First Edition, revision B	Speed & Torque Data Point table completely revised	6.6.1
07/25/02	First Edition, revision A	National Instruments FieldPoint now allows a maximum of 32 thermocouples to be read (8 thermocouples per module, up to 4 modules available)	1.4, 2.4.2.2, 2.4.2.4, 4.1.5
02/15/02	First Edition	Manual rewritten to include new pass/fail testing feature which was added with rev 1.9 of the software program	All
08/07/01	Preliminary Manual - rev. A	Added index to end of manual	Index
08/07/01	Preliminary Manual - rev. A	Added link to web page for downloading M-TEST Defaults file	4.2.4.1

Table of Contents

TABLE OF FIGURES

Preface

PURPOSE OF THIS MANUAL

This manual contains information required for installation and general use of Magtrol's M-TEST 4.0 Motor Testing Software. To achieve maximum capability and ensure proper use, please read this manual in its entirety before operating. Keep the manual in a safe place for quick reference whenever a question should arise.

WHO SHOULD USE THIS MANUAL

This manual is intended for those operators in need of a software program to complement their Magtrol test equipment setup. The setup may include any of the following Magtrol products:

- Hysteresis, Eddy-Current or Powder Brake Dynamometer
- In-Line Torque Transducer
- Power Analyzer (Model 5100, 5300, 6510, 6510*e*, 6530 or 6550)
- Dynamometer Controller (Model DSP6000, DSP6001, 5240 or 4629B)

Optional auxiliary instrumentation can also be utilized. If using a DC power supply, it may be used in place of a power analyzer to read back amps and volts but is not recommended because the readings are less accurate and the data transfer rates are substantially slower.

MANUAL ORGANIZATION

This section gives an overview of the structure of the manual and the information contained within it. Some information has been deliberately repeated in different sections of the document to minimize cross-referencing and to facilitate understanding through reiteration.

The structure of the manual is as follows:

Chapter 1: INTRODUCTION – Contains the technical data sheet for M-TEST 4.0 and highlights the new features of the software.

Chapter 2: INSTALLATION – Provides general installation instructions for M-TEST 4.0 product software, GPIB/RS-232 interface, and temperature measurement driver software and hardware.

Chapter 3: M-TEST 4.0 INTERFACE – Provides instruction for M-TEST 4.0 startup and navigation and includes a brief overview of the software capabilities.

Chapter 4: HARDWARE CONFIGURATION – Contains the information needed to program M-TEST 4.0 software with details pertaining to the hardware being utilized in the test setup.

Chapter 5: SELECTING A TEST – Describes the different testing options M-TEST 4.0 has available for easier test selection.

Chapter 6: SOFTWARE CONFIGURATION – Provides information required to configure M-TEST 4.0 for the type of test to be performed.

Chapter 7: RUNNING A TEST – Step-by-step instructions for setting up and running a basic curve, ramp, manual and pass/fail test from beginning to end.

Chapter 8: DATA OUTPUT – Describes the data output options available to the user along with providing instruction for use.

Chapter 9: TROUBLESHOOTING – Solutions to common problems encountered during setup and testing.

Appendix A: PID/SCALING – Describes the Proportional Integral Derivative (PID) Loop and Scaling and provides information on theory.

Appendix B: M-TEST 4.0 FLOW CHART – Representation of how M-TEST 4.0 is organized showing at a quick glance where all the main features are located.

Appendix C: SOFTWARE REVISION HISTORY – Provides a detailed description of all changes that have been made to Magtrol's M-TEST 4.0 Motor Testing Software since its initial release.

CONVENTIONS USED IN THIS MANUAL

The following symbols and type styles may be used in this manual to highlight certain parts of the text:

Note: This is intended to draw the operator's attention to complementary information or advice relating to the subject being treated. It introduces information enabling the correct and optimal functioning of the product to be obtained.

CAUTION: THIS IS USED TO DRAW THE OPERATOR'S ATTENTION TO INFORMATION, DIRECTIVES, PROCEDURES, ETC. WHICH, IF IGNORED, MAY RESULT IN DAMAGE BEING CAUSED TO THE MATERIAL BEING USED. THE ASSOCIATED TEXT DESCRIBES THE NECESSARY PRECAUTIONS TO TAKE AND THE CONSEQUENCES THAT MAY ARISE IF THE PRECAUTIONS ARE IGNORED.

WARNING! THIS INTRODUCES DIRECTIVES, PROCEDURES, PRECAUTIONARY MEASURES, ETC. WHICH MUST BE EXECUTED OR FOLLOWED WITH THE UTMOST CARE AND ATTENTION, OTHERWISE THE PERSONAL SAFETY OF THE OPERATOR OR THIRD PARTY MAY BE PUT AT RISK. THE READER MUST ABSOLUTELY TAKE NOTE OF THE ACCOMPANYING TEXT, AND ACT UPON IT, BEFORE PROCEEDING FURTHER.

1. Introduction

1.1 ABOUT M-TEST 4.0

Magtrol's M-TEST 4.0 Software is a state-of-the-art motor testing program for Windows®-based data acquisition. Used in conjunction with Magtrol's Motor Testing Equipment, M-TEST 4.0 provides testing and data options to help determine the performance and characteristics of a motor under test. The data generated by the program can then be stored, displayed and printed in tabular or graphic formats, and easily imported into a spreadsheet. M-TEST 4.0 is ideal for tasks such as simulating loads, cycling the unit under test and motor ramping.

M-TEST 4.0 is equipped to work in conjunction with any of the following Magtrol motor testing instruments:

- Dynamometer Controller (Model DSP6001, DSP6000, 5240 or 4629B)
- Hysteresis, Eddy-Current or Powder Brake Dynamometer
- In-Line Torque Transducer
- Power Analyzer (Model 5100, 5300, 6510, 6510*e*, 6530 or 6550)

Note: If using a DC power supply, it may be used in place of a power analyzer to read back amps and volts but is not recommended because the readings are less accurate and the data transfer rates are substantially slower.

Written in LabVIEW™, M-TEST 4.0 has the flexibility to test a majority of motor types in a variety of ways. Because of LabVIEW's versatility, obtaining data from other sources (e.g. thermocouples), controlling motor power and providing audio/visual indicators is relatively easy. These inputs usually require the addition of a National Instruments™ data acquisition board to your computer.

If you have a specialized test that you wish to perform, contact Magtrol Technical Assistance at 716-668-5555.

1.2 SYSTEM REQUIREMENTS

- Personal computer with Pentium® processor or equivalent
- Microsoft® Windows® 9x/Me/NT/2000/XP
- 32 MB of RAM
- 100 MB of available hard drive space
- VGA color monitor with screen resolution set at 800 × 600
- Parallel port laser or color ink jet printer
- National Instruments™ PCI-GPIB card and NI-488.2™ Software for Windows® is recommended for interfacing between computer and peripherals
- RS-232 serial interface can be used, instead of the PCI-GPIB card, for interfacing with Magtrol DSP6000 or DSP6001 controllers
- National Instruments™ DAQ Board and NI-DAQ™ for Windows® or National Instruments™ FieldPoint hardware and software, required only with MT-TEST 4.0 Software

1.3 NEW FEATURES OF M-TEST 4.0

Magtrol's M-TEST 4.0 Software is a new and improved motor testing program that replaces M-TEST 3.1. The software is comprised of many new features that make it unique.

- **Increased Product Support Capabilities:** Equipped to handle a wider range of Magtrol products including Dynamometer Controllers (DSP6001, 6000, 5240 and 4629B); Hysteresis, Eddy-Current and Powder Brake Dynamometers (including Tandem Dynamometers); Power Analyzers (Model 5100, 5300, 6510, 6510*e*, 6530 and 6550) and In-Line Torque Transducers.
- **Automatic Load Defaults Option:** When configuring the hardware settings, there is an optional load default feature that will automatically download the parameters of the Dynamometer being used based on the model number.
- **Multiple Testing Options:** 4 standard test options include:
  (1) Ramp – Ramp down with inertia correction factor or average ramp down/ramp up. The ramp test also allows extrapolation of free-run and locked rotor data, plus interpolation of specific speed or torque data points.
  (2) Curve – Parameters include speed, torque, amps, watts input, watts output and open loop. Capable of adjusting sampling rate and using step or ramp from one load point to the next.
  (3) Manual – Test is conducted through the front panel of the Dynamometer Controller while the computer is used solely for the purpose of data acquisition. The manual test allows adjustment of the sampling rate.
  (4) Pass/Fail – Checks amps, input watts (with optional Power Analyzer), speed, torque and output watts against user defined values.
- **Dynamic PID Scaling:** Produces consistent control loop results throughout motor speed range while running a ramp test, making for a better overall system response (for DSP6001 only).
- **PID Adjustment Routines:** Helps adjust the system properly for ramp and step functions.
- **Motor Shaft Direction Indicator:** Indicates if the motor is turning clockwise or counterclockwise.
- **Graphing Capabilities:** Tested parameters are displayed as a single graph with multiple curves that are easy-to-read with the use of colored and labeled plots. Screen plot axes can be manually scaled.
- **Save/Load Setup Function:** Test procedure configurations may be stored and recalled using standard Windows® file structure.
- **Three-Phase Power Analyzer Data Acquisition:** Can obtain data on each individual phase and/or the sum used in the chosen parameters (amps, volts, input watts and power factor).

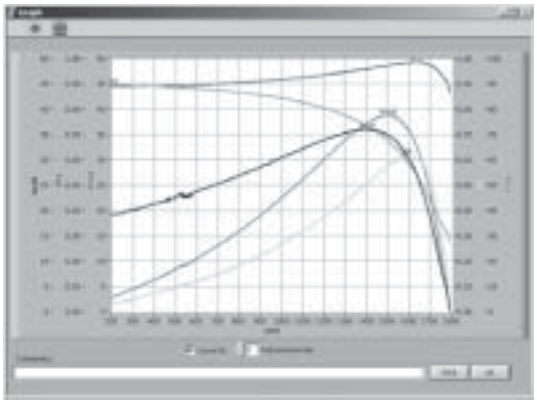
1.4 DATA SHEET

M-TEST 4.0
Motor Testing Software

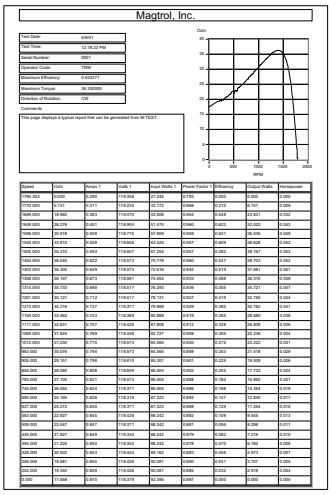
FEATURES

- **Automatic Load Defaults Option**: Downloads testing instrument parameters based on model number.
- **Multiple Testing Options:**
  - Ramp: Average ramp down/ramp up or ramp down with inertia correction factor. Also allows extrapolation of free-run and locked rotor data, plus interpolation of specific speed or torque data points.
  - Curve: Speed, torque, amps, watts input, watts output and open loop parameters. Capable of adjusting sampling rate and using step or ramp from one load point to the next.
  - Manual: Runs test from front panel of the Dynamometer Controller while computer acquires data. Allows adjustment of sampling rate.
  - Pass/Fail: Checks amps, input watts (with optional Power Analyzer), speed, torque and output watts against user defined values.
- **Dynamic PID Scaling:** Provides consistent control loop results throughout motor speed range during ramp test (for DSP6001 only).
- **PID Adjustment Routines:** Helps adjust the system for ramp and step functions.
- **Motor Shaft Direction Indicator:** Indicates if the motor is turning clockwise or counterclockwise.
- **Graphing Capabilities**: Single graph with multiple curves; Easy-to-read colored and labeled plots; Manual scaling.
- **Save/Load Setup Function:** Test procedure configurations may be stored and recalled using standard Windows® file structure.
- **Three Phase Power Analyzer Data Acquisition:** Obtain data on each individual phase and/or the sum used in the chosen parameters (amps, volts, input watts and power factor).
- **IEEE-488 and RS-232 Interface:** Computer interface with National Instruments™ PCI GPIB. RS-232 available with DSP6001 and DSP6000 only.
- **Displays 11 Tested and Calculated Parameters:** Torque, speed and auxiliary input are displayed from the DSP6001, DSP6000, 5240 or 4629B Controller; amps, volts and watts from the Power Analyzer (optional). Calculated values including horsepower, efficiency, power factor, output watts and time can also be displayed.
- **Customized Reports:** Allows user to produce a one-page motor test summary which can include the motor's serial number; maximum torque, speed, power and current values; operator name; time and date of test; motor direction; 32 data points and an X-Y plot.
- **Curve Fitting:** A curve fitting routine can be applied to most motor test curves.

M-TEST 4.0 Software Configuration



M-TEST 4.0 Graphical Data Output



M-TEST 4.0 Customized Report

Specifications

M-TEST 4.0

DESCRIPTION

Used with a Magtrol DSP6000/6001, 5240 or 4629B Dynamometer Controller, Magtrol M-TEST 4.0 Software provides the control of any Magtrol Dynamometer and runs test sequences in a manner best suited to the overall accuracy and efficiency of the Magtrol Motor Test System. M-TEST 4.0 is equipped to handle a wider range of Magtrol products including Dynamometer Controllers (DSP6001, DSP6000, 5240 and 4629B); Hysteresis, Eddy-Current, Powder Brake and Tandem Dynamometers; Power Analyzers (Model 5100, 5300, 6510, 6510*e*, 6530 and 6550) and In-Line Torque Transducers. The data that is generated by Magtrol's Motor Testing Software can be stored, displayed and printed in tabular or graphic formats, and can be easily imported into a spreadsheet.

Written in LabVIEW™, M-TEST 4.0 has the flexibility to test a majority of motor types in a variety of ways. Because of LabVIEW's versatility, obtaining data from other sources (e.g. thermocouples), controlling motor power and providing audio/visual indicators is relatively easy.

SYSTEM REQUIREMENTS

- Personal computer with Pentium® processor or equivalent
- Microsoft® Windows® 9x/Me/NT/2000/XP
- 32 MB of RAM
- 100 MB of available hard drive space
- VGA color monitor with screen resolution set at 800 × 600
- Parallel port laser or color ink jet printer
- National Instruments™ PCI-GPIB card (available from Magtrol) and NI-488.2™ Software for Windows® is recommended for interfacing between computer and peripherals
- RS-232 serial interface can be used, instead of the PCI-GPIB card, for interfacing with Magtrol DSP6000 or DSP6001 controllers
- National Instruments™ FieldPoint hardware (preferred) or National Instruments™ DAQ Board, required only with MT-TEST 4.0 Software

APPLICATIONS

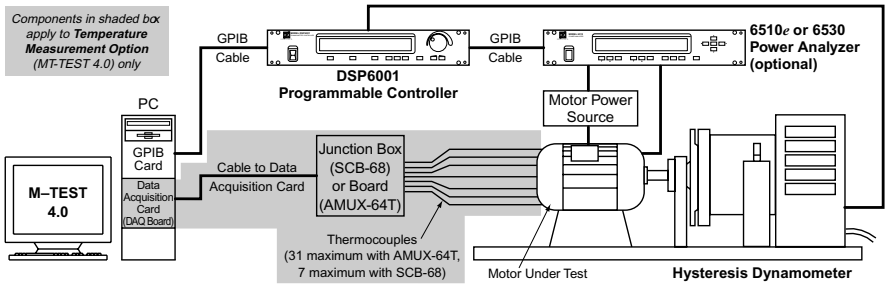
Magtrol's M-TEST 4.0 Software is ideal for simulating loads, cycling the unit under test and motor ramping. Because it is easy to gather data and duplicate tests, the software is ideal for use in engineering labs. Tests can be programmed to run on their own and saved for future use allowing for valuable time savings in production testing and incoming/outgoing inspection.

TEMPERATURE MEASUREMENT

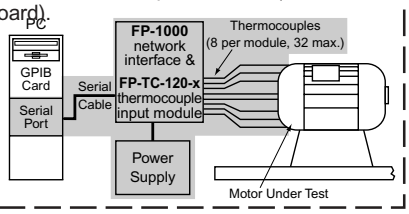
MT-TEST 4.0 (sold separately) is a version of M-TEST 4.0 that allows the user to perform temperature measurement testing. The software provides complete dynamometer control, allowing for temperature measurement while performing load simulation for duty cycle and life testing. Temperature measurement is ideal for performing heat rise curves on different areas of a motor such as the bearings, windings and housing. All other features of MT-TEST 4.0 are the same as M-TEST 4.0.

SYSTEM CONFIGURATION

A Magtrol Dynamometer provides motor loading with a Magtrol Programmable Dynamometer Controller acting as the interface between the personal computer running M-TEST 4.0 and the Dynamometer. If motor electrical parameters are to be measured or used to determine load points, a Magtrol Power Analyzer is also required. Interfacing between the computer and electronic instrumentation is by the National Instruments™ PCI-GPIB card or serial interface when using a DSP6000 or DSP6001.



Preferred MT-Test Option: Utilizing the FieldPoint thermocouple input module(s) (up to 4) and network interface card connected to the serial port, in place of the junction box/ board and data acquisition card (DAQ board).



Ordering Information M-TEST 4.0

CUSTOM SOFTWARE

Magtrol can make custom modifications to meet your specific requirements. If you wish to modify M-TEST 4.0 yourself, you will need to purchase the source code (available from Magtrol) and National Instruments™ LabVIEW™ software (available from National Instruments).

MODEL NUMBERS

MODEL NUMBER	SOFTWARE DESCRIPTION
SW-M-TEST-WE4.0	Standard M-TEST 4.0 Motor Testing Software
SW-M-TEST-WS4.0	Standard M-TEST 4.0 Motor Testing Software–includes source codes
SW-MT-TEST-FP-WE4.0	MT-TEST 4.0 Motor Testing Software with Temperature Testing option for FieldPoint
SW-MT-TEST-FP-WS4.0	MT-TEST 4.0 Motor Testing Software with Temperature Testing option for FieldPoint – includes source codes
SW-MT-TEST-DAQ-WE4.0	MT-TEST 4.0 Motor Testing Software with Temperature Testing option for DAQ Board
SW-MT-TEST-DAQ-WS4.0	MT-TEST 4.0 Motor Testing Software with Temperature Testing option for DAQ Board– includes source codes

For information on the most current software release available, refer to Magtrol's Web site at www.magtrol.com/motortesting/software.htm

SYSTEM OPTIONS AND ACCESSORIES

	DESCRIPTION	MODEL / PART #
TEMPERATURE TESTING HARDWARE	FieldPoint Interface and 8-Channel Isolated Input Module (120 V) *	HW-TTEST-FP
	FieldPoint Interface and 8-Channel Isolated Input Module (240 V) *	HW-TTEST-FP-A
	Additional FieldPoint 8-Channel Thermocouple Module (includes mounting base)	004968
	DAQ Board with ISA bus and SCB-68 8-Channel Junction Box **	HW-TTEST-ISA
	DAQ Board with PCI bus and SCB-68 8-Channel Junction Box **	HW-TTEST-PCI
	DAQ Board with SA bus and AMUX-64T 32-Channel Junction Board **	HW-TTEST-EXT-ISA
	DAQ Board with PCI bus and AMUX-64T 32-Channel Junction Board **	HW-TTEST-EXT-PCI
	Programmable Dynamometer Controller	DSP6001
TESTING INSTRUMENTS	Hysteresis Dynamometers	HD series ***
	Eddy-Current Dynamometers	WB series ***
	Powder Brake Dynamometers	PB series ***
	In-Line Torque Transducers	TM/TMHS/TMB series***
POWER ANALYZERS	Single-Phase Power Analyzer	6510*e*
	Three-Phase Power Analyzer	6530
	Enhanced Three-Phase Power Analyzer	6550
POWER SUPPLIES	Power Supply for WB & PB Dynamometers series 2.7 and 43	DES 310
	Power Supply for WB & PB Dynamometer series 65, 115 and 15	DES 311
	Power Supply for HD-825 Dynamometer	5241
MISC	Torque/Speed Conditioner	TSC 401
CARDS	GPIB Interface Card (PCI)	73-M023
CABLES	GPIB Cable, 1 meter	88M047
	GPIB Cable, 2 meters	88M048
	Torque Transducer Connector Cable	EB 113/01

* *Power supply and serial cable are included*
** *A one meter data acquisition cable is included.*

****Contact Magtrol Customer Service or refer to our web site at www.magtrol.com for a complete list of models.*

Due to the continual development of our products, we reserve the right to modify specifications without forewarning.

MTESTDS-US www 07/03

2. Installation

2.1 INSTALLATION PROCEDURE

The general installation order is as follows.

1. Install M-TEST 4.0 product software.
2. Install GPIB driver software and interface board. If only using a controller in the test setup, the RS-232 serial interface may be used.
3. Install NI-DAQ™ driver software and board if using MT-TEST 4.0.

The remainder of this chapter will provide specific installation instructions for each component of the system.

2.2 INSTALLING M-TEST 4.0 PRODUCT SOFTWARE

1. Exit all other programs before installing M-TEST 4.0.
2. Insert the M-TEST 4.0 CD in your CD-ROM drive. The installation process will begin automatically and the M-TEST 4.0 Installation window will appear.

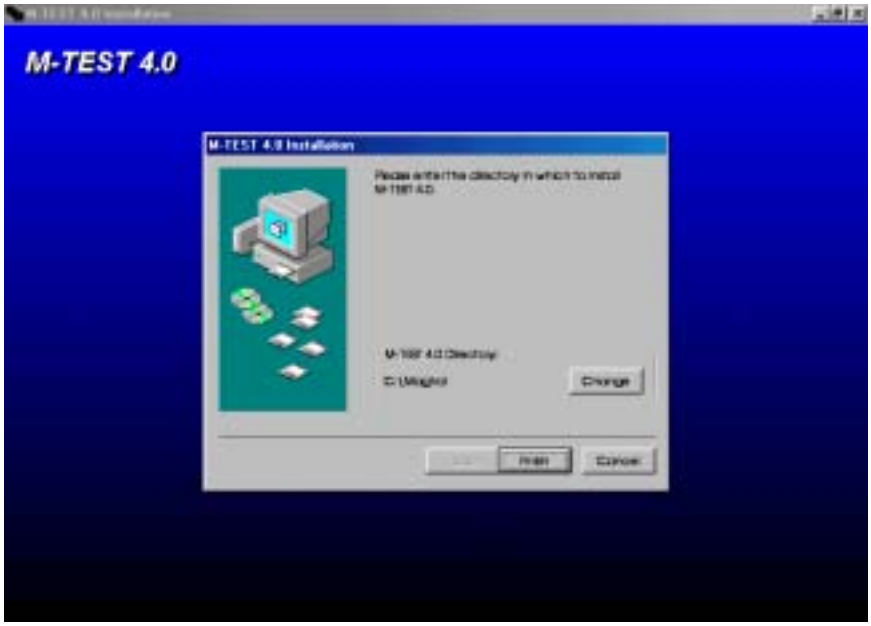


Figure 2–1 M-TEST 4.0 Installation

3. The default installation directory is C:\Magtrol. To keep the default location, click **Finish**. Although not recommended, this location can be changed. Click **Change** and type the new directory, then click **Finish**.
4. The software installation will continue and a message will appear indicating that the installation was successful and the computer must be rebooted before running the program. Click **OK**.
5. An M-TEST 4.0 window will appear displaying the drive:\path where the software program has been saved. Close this window by clicking the "X" in the upper-right corner and the installation process will be complete.

Note: To run M-TEST 4.0 at this time, you must restart you computer

2.2.1 CREATING A SHORTCUT

For easy access to the M-TEST 4.0 program, a shortcut can be placed on your computer desktop.

1. Start Windows Explorer and locate the directory where the M-TEST 4.0 Software was installed.
2. Click the **M-TEST.exe** file and drag it to your desktop.
3. To access the program, double-click the shortcut and the program will automatically start.

2.3 GPIB/RS-232 SERIAL INTERFACE CONNECTIONS

The GPIB driver software (NI-488.2™ For Windows® 9x/Me/NT/2000) and interface board (National Instruments™ PCI-GPIB), purchased through Magtrol or directly from National Instruments, must be installed at this time.

Note: If only using a controller in the test setup, the RS-232 serial interface may be used.

2.3.1 INSTALLING GPIB DRIVER SOFTWARE

1. Insert the NI-488.2 Software for Windows CD in your CD-ROM drive. The installation process will begin automatically and the GPIB Driver Software Main Menu window will appear.

Figure 2–2 GPIB Driver Software Main Menu

2. Click **Install NI-488.2 Software for Windows**.
3. Click **Next**.
4. Click **Yes** to accept the National Instruments License Agreement.
5. Click **Next** to bypass the online registration.

6. Select destination directory and click **Next**. To use default just click **Next**.
7. Select installation type. The default is recommended.
8. The software is now ready to install. Click **Next** to begin.
9. NI-VISA dialog box will appear. Click **Next**.
10. Installation is now complete. Click **Finish**.
11. Click **Exit** to quit the GPIB Driver Software installation program.

2.3.2 INSTALLING THE GPIB BOARD

1. Shut down your computer.
2. Install the PCI-GPIB controller board in an available expansion slot according to the hardware manufacturer's user documentation.
3. Turn on your computer. The new hardware will automatically be installed and the Getting Started Wizard will begin.
4. Click **verify your hardware and software installation**. The Troubleshooting Wizard dialog box will appear.

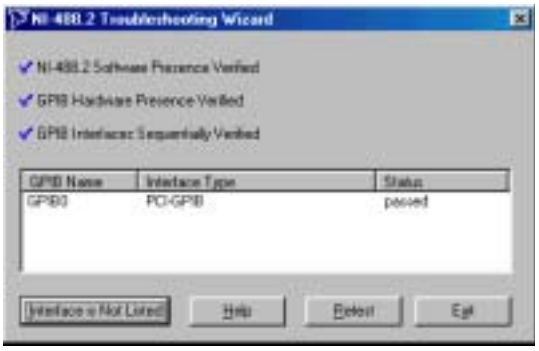


Figure 2–3 NI-488.2 Troubleshooting Wizard

5. When the software, hardware and interfaces have been verified, as shown in Figure 2–3 NI-488.2 Troubleshooting Wizard, click **Exit**.
6. Select the **Do not show at Windows startup** check box.
7. Close the dialog box by clicking the "X" in the upper-right corner.

2.3.3 CONFIGURING GPIB DEVICES

1. From the Windows taskbar, click **Start,** then point to **Settings** and click **Control Panel**.
2. Double-click **System**. This will bring up the System Properties dialog box.

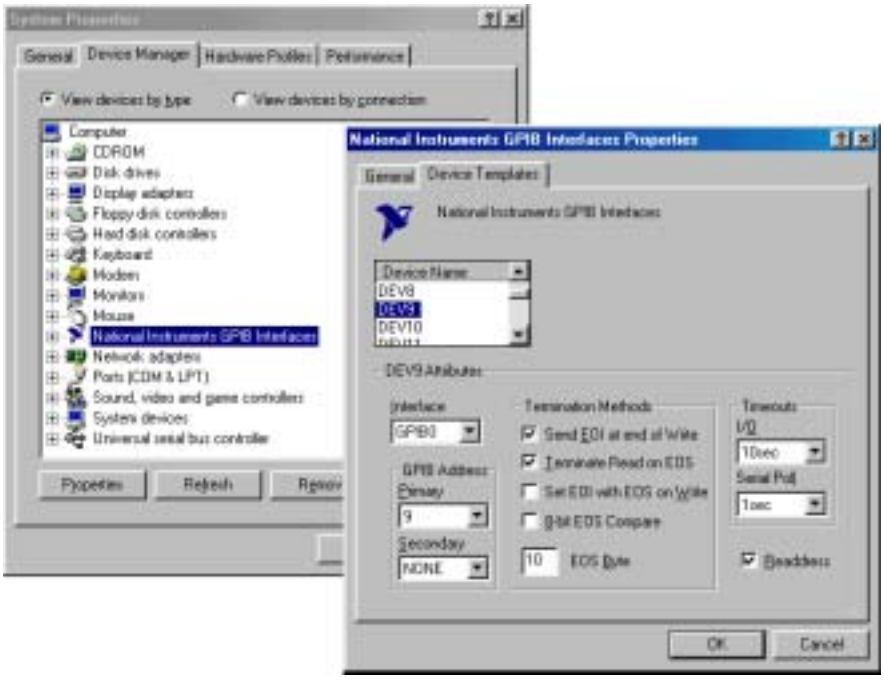


Figure 2–4 System Properties & GPIB Interfaces Properties

3. Click the **Device Manager** tab.
4. Using the right mouse button, click (right-click) **National Instruments GPIB Interfaces**.
5. Click **Properties**.
6. Click the **Device Templates** tab. *See Figure 2–4 System Properties & GPIB Interfaces Properties.*
7. Scroll down **Device Name** list until **DEV9** is reached.
8. Click **DEV9**.
9. Set DEV attributes to the following:
   a. Under Termination Methods, select the **Terminate Read on EOS** check box.
   b. Change EOS Byte to "**10**".
   c. Select the **Readdress** check box.

Note: The only DEV attributes that need to be changed are those that are outlined in item 9. All other settings should remain in their original format.

10. Scroll down **Device Name** list until **DEV12** is reached.
11. Click **DEV12**.
12. Set **DEV12** attributes by repeating steps 9a–c.
13. Scroll down **Device Name** list until **DEV14** is reached.

14. Click **DEV14**.
15. Set **DEV14** attributes by repeating steps 9a–c.
16. After all attributes have been set, click **OK** on the National Instruments GPIB Interfaces Properties dialog box.
17. Click **OK** on the System Properties diaolog box.
18. Close the Control Panel window.
19. The GPIB device configuration is complete.

2.3.4 RS-232 SERIAL INTERFACE

M-TEST 4.0 will communicate with the DSP6000/6001 Dynamometer Controller using an RS-232 Serial Interface. Connection diagrams and instructions can be found in the following User's Manuals:

- *DSP6000 – Section 5.7–Select the Baud Rate for the RS-232 Interface*
- *DSP6001 – Section 8.2–About the RS-232 Interface*

2.4 TEMPERATURE MEASUREMENT OPTION

MT-TEST 4.0 (sold separately) is a version of M-TEST 4.0 that allows the user to perform temperature measurement testing. The feature provides complete dynamometer control, allowing for temperature measurement while performing load simulation for duty cycle and life testing. All other features of MT-TEST 4.0 are identical to those in M-TEST 4.0. If using MT-TEST 4.0, additional hardware and software must be installed. The options, which may be purchased from either Magtrol or National Instruments include:

- National Instruments™ DAQ Board and NI-DAQ™ for Windows® or
- National Instruments™ FieldPoint

2.4.1 NATIONAL INSTRUMENTS DAQ BOARD AND NI-DAQ FOR WINDOWS

Features:

- 7 thermocouple inputs with SCB-68, 31 thermocouple inputs with AMUX-64T
- Non-isolated
- Non-filtered

2.4.1.1 Installing Driver Software

1. Insert the National Instruments NI-DAQ for Windows 2000/NT/9x/XP and Mac OS Data Acquisition Software CD in your CD-ROM drive. The installation process will automatically begin.
2. When the introductory window appears, click **Install**.
3. Read the Welcome Page and click **Next**.
4. Read the notes and click **Next**.
5. Read the License Agreement and click **Yes**.
6. To use defaults, click **Next**.
7. The Selection Confirmation dialog box will appear. Click **Next**.
8. The software installation will continue and the **Installation Status** dialog box will appear when finished. Click **Restart Later**. (You will shut down your computer prior to installing the Temperature Board).

2.4.1.2 Installing Board

1. Shut down your computer.
2. Install the National Instruments PCI-6024E Multifunction I/O board in an available expansion slot according to the hardware manufacturer's user documentation.
3. Turn on your computer. The new hardware will automatically be installed and the NI-DAQ Documentation Setup program will start.
4. Select the **If you do not want to install documents now, check this box** check box.
5. Click **Next**.
6. Select the **Configure Measurement & Automation System is selected** check box.
7. Click **Finish**.
8. Under User Preferences, click **OK**.
9. In MAX (Measurement & Automation Explorer) window, double-click **Devices and Interfaces**.
10. Right-click **PCI-6024E**.
11. Click **Properties**.
12. Click the **Accessory** tab.
13. Click inside the Accessory box and drag down to the desired selection. Options include:
    - **SCB-68** for hardware that allows up to 7 thermocouples. (HW-TTEST)
    - **AMUX-64T(1)** for hardware that allows up to 31 thermocouples. (HW-TTEST-EXT)
14. Select the **CJC Jumper Set** check box.
15. Click **Apply**.
16. Click **OK**.
17. Close MAX window.

2.4.1.3 Thermocouple Connections

Following are basic instructions for installing thermocouple connections. For more detailed information, refer to the instruction materials enclosed with the hardware.

2.4.1.3.1 SCB-68

1. Open the SCB-68 Connector Box to expose the terminal blocks.
2. The pair of terminals associated with Channel 0 are being used by the cold junction compensation sensor. Install thermocouples beginning at Channel 1.
3. When all are attached, route the wires out through the opening in the front panel and secure them with the hold down bar.
4. Close the cover.
5. Connect the 68-pin shielded cable assembly between the connector box and the data acquisition board.

   Following is a list of channels with the corresponding terminals.

Channels	Terminals
1	33, 66
2	65, 31
3	30, 63
4	28, 61
5	60, 26
6	25, 58
7	57, 23

2.4.1.3.2 AMUX-64T

1. The pair of terminals associated with Channel 0 are being used by the cold junction compensation sensor. Install thermocouples beginning at Channel 1.
2. Connect the 68-pin shielded cable assembly between the AMUX-64T board and the data acquisition board.

2.4.2 NATIONAL INSTRUMENTS FIELDPOINT

Features:

- 8 thermocouple inputs per module x 4 modules = 32 thermocouples maximum
- Built-in voltage isolation on all channels
- Filtering reduces electrical noise associated with putting thermocouples on motors
- Connects to computer through RS-232 serial port

2.4.2.1 Installing Driver Software

1. Insert the National Instruments FieldPoint Software CD in your CD-ROM drive. The FieldPoint Setup process will automatically begin.
2. When the introductory window appears, click **Install**.
3. Read the Software License Agreement and click **Yes**.
4. To use the default Destination Location, click **Next**. If you prefer to change your Destination Location, click **Browse**, choose a new folder, click **OK**, then click **Next**.
5. Select desired Setup Type, then click **Next**.
6. FieldPoint Setup will automatically add program icons to the Program Folder. You may type a new folder name or select one from the existing Folders list. Click **Next** to continue.
7. At this time FieldPoint Setup has enough information to start copying the program files. To review or change any setting, click **Back**. If you are satisfied with the settings, click **Next** to begin copying files.
8. FieldPoint Setup has finished copying files to your computer. Click **No, I will restart my computer later**, (you will shut down your computer prior to installing the hardware) remove any disks from their drives, then click **Finish** to complete setup.

2.4.2.2 Installing Hardware

1. Shut down your computer.
2. Connect the FP-1000 RS-232/RS-485 network interface to the FP-TC-120 8-channel thermocouple input module(s).
3. Connect a power supply to the network interface with the positive lead to the V terminal and the negative lead to the C terminal.
4. Connect the serial cable from the network interface to COM1 serial port on the computer.

2.4.2.3 Thermocouple Connections

1. Install thermocouples beginning at Channel 0.

   Following is a list of channels with the corresponding terminals.

Channels	IN+ (postive terminal)	IN- (negative terminal)
0	1	2
1	3	4
2	5	6
3	7	8
4	9	10
5	11	12
6	13	14
7	15	16

2.4.2.4 Thermocouple Type and Temperature Unit Changes

1. From the taskbar, click Start, point to Programs >> National Instruments FieldPoint, then click **FieldPoint Explorer**.
2. Click + sign located to the left of "IA Server with OPC".
3. Click **FieldPoint**.
4. Click **Add** button (+) on tool bar.
5. Select the COM port that the FieldPoint interface was connected to in hardware setup. See *Section 2.4.2.2–Installing Hardware*.
6. Click **Find Devices** button.
7. Click + sign located to the left of "FP Res".
8. Right click **FP-TC-120@1**.
9. Select **Edit this device**.
10. Click **Channel Configuration** button.
11. Select check box for the channel you wish to configure.
12. Select temperature range in either °F or °C.
13. Under Channel Attributes, select thermocouple type in the Value box.
14. Repeat steps 11-13 for each channel.

Note: If all channels use the same thermocouple type, click the check box next to **One channel at a time** so that it is disabled and click the **All** button. This will allow changes to be made to all the channels at once.

15. Click **OK**.
16. Click **OK**.

Note: If additional TC modules are installed, steps 8 through 16 will need to be repeated for modules FP-TC-120@2, FP-TC-120@3 and FP-TP-120@4 (where applicable).

17. Close FieldPoint Explorer. The program will prompt you to save changes to untitled.
18. Select **Yes**.
19. Locate the directory where M-TEST 4.0 has been installed.
20. Double click FieldPoint file.
21. Click **Yes** to replace file.

3. M-TEST 4.0 Interface

3.1 STARTING M-TEST 4.0

From the taskbar, click **Start,** point to **Programs** >> **M-TEST 4.0**, then click **M-Test.** If you created a shortcut on your desktop (*see Section 2.1.1–Creating A Shortcut*), double-click the desktop file and the program will automatically start.

3.2 MAIN WINDOW

When the program is open, the Main window will appear.

Figure 3–1 Main Window

The Main window contains buttons that lead to 7 different areas of the M-TEST 4.0 program. Following is a brief description of the functions of each area.

3.2.1 CONFIGURE HARDWARE

- Configures the system for the hardware being used including information pertaining to the power supply, controller, power measurement and temperature measurement.
- Includes a link to the Advanced Configuration window for setting the type of testing instrument(s) being used along with corresponding specifications.

3.2.2 CONFIGURE SOFTWARE

- Configures the system for the type of test to be performed.
- Sets up the corresponding test parameters.
- Includes links to configure the display and report, and adjust the controller.

3.2.3 RUN TEST

- Executes the test after the hardware and software configuration is complete or after retrieving a previous setup.

3.2.4 SAVE SETUP

- After a test procedure has been configured, it may be saved to any chosen file for future use.
- All hardware and software settings will be stored and may be password protected if desired.

3.2.5 LOAD SETUP

- Recalls previously stored configurations.
- If a password was part of the setup, it must be entered before any editing can be done to either the hardware or software configurations.

3.2.6 LOAD FILE

- Recalls previously stored test data.

3.2.7 EXIT

- Quits the M-TEST 4.0 program.

3.2.8 CONTROL BUTTONS

Located in the upper left corner of the Main window are two control buttons.

(1) Run 

(2) Stop 

3.2.8.1 Run

 indicates the program is running. If the program has been stopped, a variation of the run button will appear in its place. To start the program again, click  .

Note: The Run function can only be performed from the Main window.

3.2.8.2 Stop

Click  if you wish to stop the program. To quit the program, click "X" in the upper right corner of all open windows. To resume program, see *Section 3.2.8.1–Run*.

3.3 NAVIGATING M-TEST 4.0

The following details will assist in navigating through M-TEST 4.0.

- A mouse must be used to maneuver through the program.
- For an immediate description of any item, right-click the button or control. A drop-down menu will appear. Click **Description** and a message box will appear with a description of the item in question.
- Navigate from window to window using the programmed buttons.

  For example, when finishing a setup click **OK**. The window will automatically close and the program will return to the Main window.

3.3.1 SETTING CONTROLS

Controls will be available as needed. If there is no selection needed for a specific item, the control will be dimmed and no access may be gained to that control.

For example, when "None" is selected as the Power Source in the Power Supply section of the Configure Hardware window, there is no further input needed. Therefore, the remainder of the controls in that section are inaccessible to the user. *See Figure 3-2 Inaccessible Controls Example.*

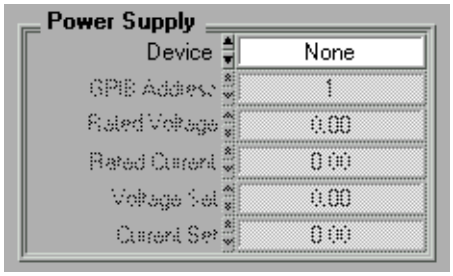


Figure 3–2 Inaccessible Controls Example

- For text controls, there are two ways to make a selection:
  (1) Click inside the box and drag down to the item of choice OR
  (2) Click the up and down arrows to the left of the box until the desired option is reached.
- For numeric controls, click the up and down arrows to the left of the box (pressing the SHIFT key will simultaneously speed up the rate of increments) or double-click inside the box and type the desired value. If a value is already entered and you wish to change it, drag the pointer to select what you would like changed then type the new value.

Note: When using the up and down arrows, the program will not allow the numbers to leave the specified range. If typing a value, any number can be used but those out of range will be ignored.

4. Hardware Configuration

Once the M-TEST 4.0 product software and GPIB components have been installed, the software is ready for configuration. The software needs to be programmed with information pertaining to the hardware being utilized in the test setup.

Note: The hardware and software must be configured before a test may be run.

4.1 STANDARD HARDWARE CONFIGURATION

Beginning from the Main window, click **Configure Hardware** to configure the system for the hardware being used. The Configure Hardware window will appear.

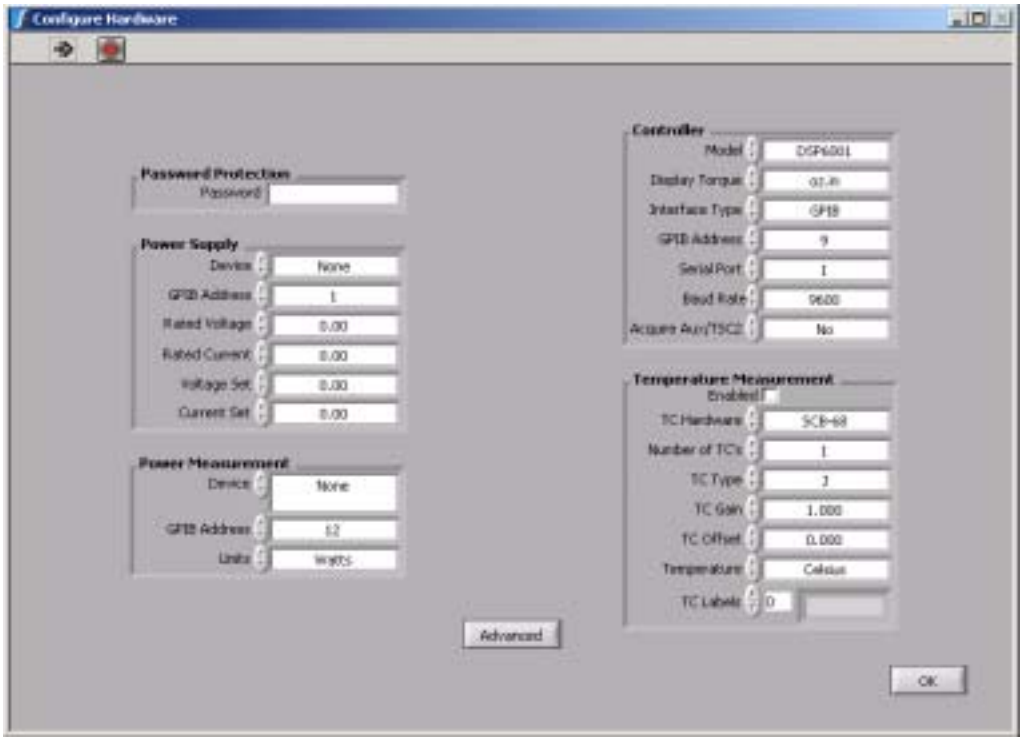


Figure 4–1 Configure Hardware Window

The Configure Hardware window is where power supply, power measurement and controller data is entered. There are also optional password and temperature measurement features available. For specific instructions on how to set controls, see *Section 3.3.1–Setting Controls*.

4.1.1 PASSWORD PROTECTION

Optional to the user is the Password Protection feature. This feature is used to secure the configuration from any unauthorized tampering. To enable, click inside the **Password** box and type the desired password.

Note: The Password Protection feature will only protect a specific configuration that has been saved. It will not prevent starting M-TEST 4.0 to set up a new program.

4.1.2 POWER SUPPLY

Tells the system which DC power source is being used and sets the corresponding attributes.

Note: "None" is defined as any AC or DC external power source not controlled by the system. DC is a DC power source that is controlled by the system.

CONTROL	FUNCTION	OPTIONS/VALUES
Device	Selects the type of power source being used. NOTE: If running from AC lines, select "None" as your power source. If using one of the mentioned DC power supplies, be sure that its GPIB address corresponds to what you have set in the GPIB Address control.	None, EMI, HP603xA, HP66xxA, Lambda Genesys, Power Ten and Sorensen DHP
GPIB Address	Sets the GPIB address for the DC power supply.	1 to 32
Rated Voltage	Sets the rated voltage that may be needed in order for GPIB programming to function properly with a DC power supply.	Any
Rated Current	Sets the rated current that may be needed in order for GPIB programming to function properly with a DC power supply.	Any
Voltage Set	Sets desired DC voltage.	Any
Current Set	Sets to the maximum current that the DC power supply needs to deliver.	Any

4.1.3 POWER MEASUREMENT

To read amps, volts, watts, power factor and system efficiency data, a separate device is needed.

CONTROL	FUNCTION	OPTIONS/VALUES
Device	Selects the device used to read the data. NOTE: The DC power supply may be used to read back amps and volts if absolutely necessary, however it typically has low accuracy and very slow data transfer rates which affect the number of data points acquired.	• None • EMI • HP603xA • HP66xxA • Power Ten • Sorensen DHP • 5100 • 5300 (1 and 3 phase) • 6510 • 6510*e* • 6530 (1 ph. 2 w., 1 ph. 3 w., 3 ph. 3 w., 3 ph. 4 w. and 3 ph. 3V3A) • 6550 (1 ph. 2 w., 1 ph. 3 w., 3 ph. 3 w., 3 ph. 4 w. and 3 ph. 3V3A) • LMG310 (1 ph. 2w., 3 (2) ph. 3w. 2m., 3 ph. 3w. 3m. star, 3 ph. 3w. 3m. delta and 3 ph. 4w.) • WT1600 (1 ph. 2w., 1 ph. 3w., 3 ph. 3w., 3 ph. 4w. and 3 ph. 3V3A)
GPIB Address	Selects the corresponding GPIB address for the power measurement device.	1 to 32
Units	Sets the power units that the 5100 is displaying. NOTE: This control is only needed when using a 5100 power analyzer with an external shunt because some current ranges cause the device to read power consumed in kilowatts. M-TEST 4.0 records and displays power in watts. If the 5100 is displaying power in kW, this control must be set to kW.	watts and kW

4.1.4 CONTROLLER

Used with a Magtrol DSP6000/6001, 5240 or 4629B Programmable Dynamometer Controller, M-TEST 4.0 provides the control of any Magtrol Dynamometer and runs test sequences in a manner best suited to the overall accuracy and efficiency of the Magtrol Motor Test System.

CONTROL	FUNCTION	OPTIONS/VALUES
Model	Selects the controller model being used.	5240/4629B, DSP6000 and DSP6001 NOTE: The DSP6000, 5240 and 4629B are only compatible with Magtrol Hysteresis Dynamometers. The DSP6001 is compatible with Magtrol Hysteresis, Eddy-Current, and Powder Brake Dynamometers, Magtrol In-Line Torque Transducers and auxiliary instrumentation.
Display Torque	Selects the torque units. NOTE: This may be the same as the dynamometer units, or converted to other units.	oz.in, oz.ft, lb.in, lb.ft, g.cm, kg.cm, mN.m, cN.m and N.m
Interface Type	Selects the method of interfacing between the controller and the computer.	GPIB and Serial
GPIB Address	Sets the GPIB address for the controller. NOTE: It must match the address that has been set up through the front panel COM SETUP menu on the controller.	1 to 32
Serial Port	Selects the computer port number when using serial communication.	1 to 4
Baud Rate	Sets the baud rate for serial communications. NOTE: This value must match the baud rate set up through the front panel COM SETUP menu on the controller.	300, 600, 1200, 2400, 4800, 9600 and 19,200
Acquire Aux/TSC2	If using the auxiliary input on the DSP6000/6001 to read an additional parameter, set this control to "Yes" if you desire to have the data displayed and stored with other acquired data. NOTE: Proper scaling must be set up from the front panel AUX SETUP menu on the controller.	Yes and No

4.1.5 TEMPERATURE MEASUREMENT

MT-TEST 4.0 (sold separately) is a version of M-TEST 4.0 software that allows the user to perform temperature measurement testing. The software provides complete dynamometer control, allowing for temperature measurement while performing load simulation for duty cycle and life testing. The feature also allows thermocouple temperatures to be recorded along with motor data. All other features of MT-TEST 4.0 are the same as M-TEST 4.0.

CONTROL	FUNCTION	OPTIONS/VALUES
Enabled	Allows acquisition of data from temperature measurement hardware.	Enabled (select check box) and Disabled (clear check box)
TC Hardware	Selects the thermocouple junction box being used with the system.	SCB-68, AMUX-64, FP-TC-120-1, FP-TC-120-2 , FP-TC-120-3 and FP-TC-120-4 NOTE: The SCB-68 allows 7 thermocouples, the AMUX-64T allows 31 and the FP-TC-120 allows 8 per module, 32 maximum.
Number of TCs	Selects the number of thermocouples being used. NOTE: Always install thermocouples so that the lowest numbered channels are used first. Leaving a channel open between two used channels will cause an overscale reading on that channel and may affect the adjacent channels.	1 to 31
TC Type	Selects the thermocouple type being used. NOTE: All standard types are available for use.	B, E, J, K, R, S, T and N
TC Gain	Adjusts any error that may occur between M-TEST and the reference temperature. NOTE: This control may also be used to compensate for filter loss if you have installed low pass filters at all of the thermocouple inputs.	Any
TC Offset	Adjusts any offset that may occur between M-TEST and the reference temperature.	Any
Temperature	Select the units of temperature measurement.	Celsius and Fahrenheit
TC Labels	Affixes a label to each thermocouple being used.	Select thermocouple number in box to the left then type desired label, up to 6 characters, in box to the right. (e.g. thermocouple 1 = a, 2 = b, etc.)

4.2 ADVANCED HARDWARE CONFIGURATION

The next step in the setup is the advanced hardware configuration. Beginning from the Configure Hardware window, click **Advanced**. The Advanced Configuration window will appear.

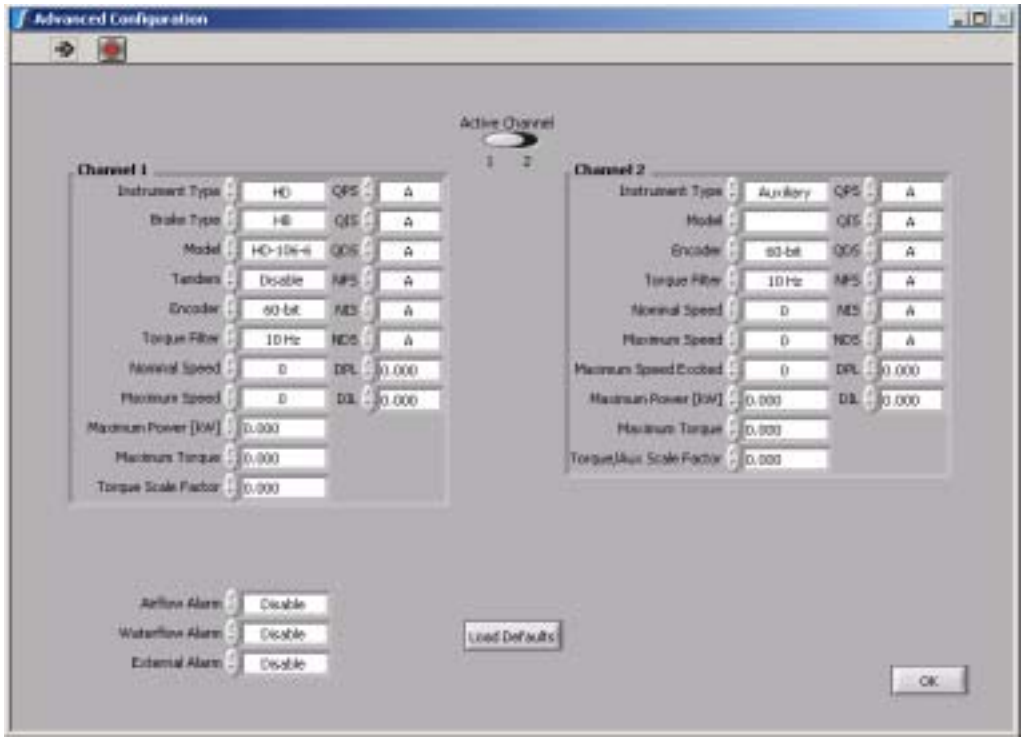


Figure 4–2 Advanced Configuration Window

The Advanced Configuration window is where the testing instrument specifications are set up for each channel. Alarms are also enabled or disabled at this time. For specific instructions on how to set controls, see *Section 3.3.1–Setting Controls*.

4.2.1 CHANNELS

M-TEST 4.0 channels are used for multiple testing instrument connections. If using a DSP6001 Dynamometer Controller, there can be up to 2 testing instrument connections. Any Magtrol dynamometer or brake can be connected to Channel 1 (TSC1). Channel 2 (TSC2) can only support a Magtrol Eddy-Current (WB) or Powder Brake (PB) Dynamometer, Magtrol In-Line Torque Transducer or auxiliary instrumentation. If using a 5240, 4629B or DSP6000 Dynamometer Controller, the default is set to Channel 1 (TSC1) and only a Hysteresis (HD) Dynamometer may be used.

CONTROL	FUNCTION	OPTIONS/VALUES
Instrument Type	Selects the type of loading device or dynamometer connected to the channel(s) (TSC1 and TSC2) of the controller.	For Channel 1 (TSC1): Hysteresis Dynamometer (HD) Eddy-Current Dynamometer (WB) Powder Brake Dynamometer (PB) Brake For Channel 2 (TSC2): Auxiliary Eddy-Current Dynamometer (WB) Powder Brake Dynamometer (PB) In-Line Torque Transducer (TM)
Brake Type	If using a brake and Magtrol In-Line Torque Transducer in a cross loop function, this control selects the type of brake connected to the Brake Output or Supply 1 of the controller. Applies to TSC1 only.	HB hysteresis brake WB eddy-current brake PB powder brake
Model	Selects the specific model number of the testing instrument. NOTE: Once the model is selected, click **Load Defaults** at the bottom of the window to update the parameters for that model. This step must be performed for the testing instrument torque units to be programmed properly in the controller. If it is necessary, once the defaults are set, they can be adjusted.	The available model numbers for the Instrument Type selected will be listed in this control.
Tandem	If a tandem dynamometer is being used, enable this function.	Enable and Disable
Encoder	This control sets the encoder type being used. Some models may have dual encoders for normal and low speed operation. Select the encoder currently in use.	20, 30, 60, 600 and 6000-bit
Torque Filter	This control is used to apply digital filtering to the torque signal input.	3, 10, 25, and 50 Hz cutoff frequencies Select **Off** to disable the filtering.

CONTROL	FUNCTION	OPTIONS/VALUES
Nominal Speed	For WB and PB dynamometers, this is the maximum speed at rated torque. Exceeding this will cause the dissipated power to be greater than the dynamometer's rating.	0 to 99,999
Maximum Speed	Maximum no-load speed at which the dynamometer can be run without physical damage.	0 to 99,999
Maximum Speed Excited	Maximum speed that may be used under any load condition.	0 to 10,000
Maximum Power	Maximum rated power (in kilowatts) that the dynamometer can dissipate without causing physical damage.	0 to 99,999
Maximum Torque	Maximum torque rating of the dynamometer.	0 to 10,000
Torque/Aux Scale Factor	This is the torque value at 5 volts output for dynamometers and TM transducers, and the scale factor for the auxiliary input.	0 to 99,999
QPS	Sets the torque proportional gain scaling.	A, B, C, D, E, F, G, H and I
QIS	Sets the torque integral scaling.	A, B, C, D, E, F, G, H and I
QDS	Sets the torque derivative scaling.	A, B, C, D, E, F, G, H and I
NPS	Sets the speed proportional gain scaling.	A, B, C, D, E, F, G, H and I
NIS	Sets the speed integral scaling.	A, B, C, D, E, F, G, H and I
NDS	Sets the speed derivative scaling.	A, B, C, D, E, F, G, H and I
DPL	When using dynamic scaling, this is multiplied by the P term to give the end P value.	0 to 99,999
DIL	When using dynamic scaling, this is multiplied by the I term to give the end I value.	0 to 99,999

4.2.2 ALARMS

Only for use with the DSP6001 Dynamometer Controller.

CONTROL	FUNCTION	OPTIONS/VALUES
Airflow	Enables the airflow alarm function for hysteresis dynamometers, indicating a lack of air flow.	Enable and Disable
Waterflow	Enables the waterflow alarm function for eddy-current and powder brake dynamometers, indicating a lack of water flow.	Enable and Disable
External	Enables the external alarm function for any dynamometer, indicating a problem based on additional user input.	Enable and Disable

Note: For more information on Alarms, see *Chapter 6 – Alarm System* in the *DSP6001 Dynamometer Controller User's Manual*.

4.2.3 ACTIVE CHANNEL

- Selects the channel on which the control loop is closed when using a DSP6001.
- Click inside the **Active Channel** box to select the channel.

Note: Certain load device/dynamometer combinations will not permit changing channels. See *Section 4.2.1–Channels.*

4.2.4 LOAD DEFAULTS

- Loads default values for all parameters from the M-TEST Defaults.txt file after a model has been selected.
- Click **Load Defaults** and the values will automatically update.

Note: This step must be completed for the testing instrument torque units to be programmed properly into the controller. If necessary, once the defaults are set, they can be adjusted.

4.2.4.1 Updated M-TEST Defaults File

The M-TEST Defaults file is subject to change as ratings on Magtrol's Motor Test Equipment change. If you have purchased any Magtrol Dynamometers or In-Line Torque Transducers since initially installing M-TEST 4.0, visit www.magtrol.com/support/downloads.htm#mtestdefaults on Magtrol's web site to ensure that you have the most recent M-TEST Defaults.txt file available. Simply click the link to connect you directly or type the web address into your browser. Please feel free to contact our sales department at 1-716-668-5555, if you should have any questions or concerns.

5. Selecting a Test

Before any further setup is completed, a test type must be chosen. M-TEST 4.0 offers 4 methods of testing: ramp, curve, manual and pass/fail. This chapter will provide all the information needed to make a test selection.

5.1 RAMP TESTING

5.1.1 OLD MEASURING METHODS

Years ago, motor performance was determined by loading a motor to a specific speed and recording the torque data. This was repeated at a number of points until sufficient data was acquired to construct a curve. While the method produced accurate data at each point, the time to accomplish this was excessive and the motors tended to heat up severely, causing a shift in the data.

5.1.2 NEW MEASURING METHODS

Methods were developed to quickly ramp a motor from free run to locked rotor, negating the heating effects. However, along with the ramping came inertial effects on the data.

When a motor is accelerating or decelerating:

Measured Torque = True Motor Torque ± Inertial Torque (stored energy)

Unless inertial torque is excluded, motor performance data will be in error since the measured torque will vary in proportion to the rate of acceleration or deceleration. This type of error can produce startling results. For example, during rapid deceleration, system inertia can produce apparent efficiency greater than 1. This may occur as output power is divided by input power without extracting the stored energy of the system. M-TEST 4.0 provides two methods of measuring inertially compensated data, Average-D/U (Down/Up) and Dynamic-CF.

5.1.2.1 Average-D/U (Down/Up)

When a motor is placed under controlled deceleration, the torque produced at any given point will be greater due to stored energy. When the motor is then accelerated, the torque produced will be less at any given point. If the deceleration and acceleration rates are equal, the corrected data is simply an average of the two curves. M-TEST 4.0 accomplishes this by ramping the motor down to a user-defined minimum speed. Because of system limitations, any speed less than 150 rpm (with the standard 60-bit encoder) will cause the motor to ramp down to 150 rpm and then begin accelerating. The motor will continue the controlled ramp until it has reached free run or until it no longer exhibits acceleration.

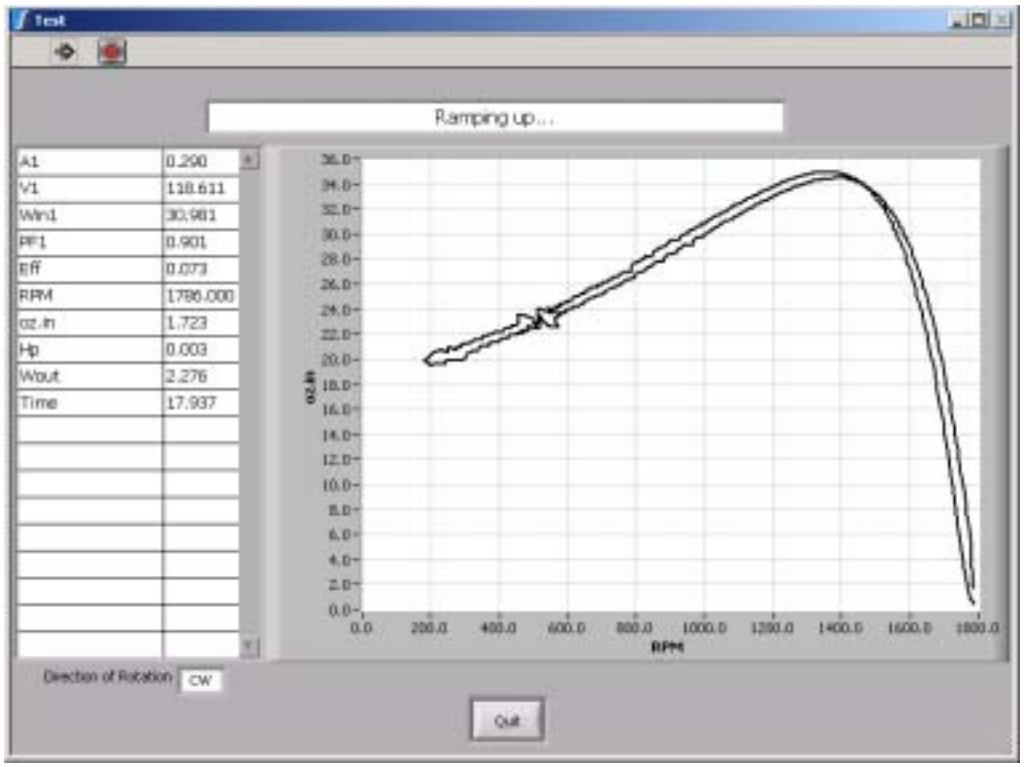


Figure 5–1 Average-D/U Motor Curve Before Inertial Cancellation

If locked rotor is specified as a minimum speed, the controller will run a separate procedure immediately after the acceleration ramp that will quickly take the motor to stall and record the data. The amount of time to wait at stall before taking data is defined by the Locked Rotor Dwell control, found under Ramp Test Parameters in the Configure Software window. See S*ection 6.6–Ramp Test Parameters*. Several seconds at locked rotor may be necessary for the system to stabilize (with stored energy and the load cell acting as a spring, there may be some bounce). After acquiring the locked rotor data the motor will accelerate to its free run speed.

The inertially corrected curve is produced by matching a speed from the deceleration curve with the same speed from the acceleration curve and averaging the associated torque data. This continues for every point on the curve. If no exact matching speed is found on the acceleration curve, the data will be interpolated to create a match. If requested, the locked rotor point will be added to the end of the data array to construct the complete curve.

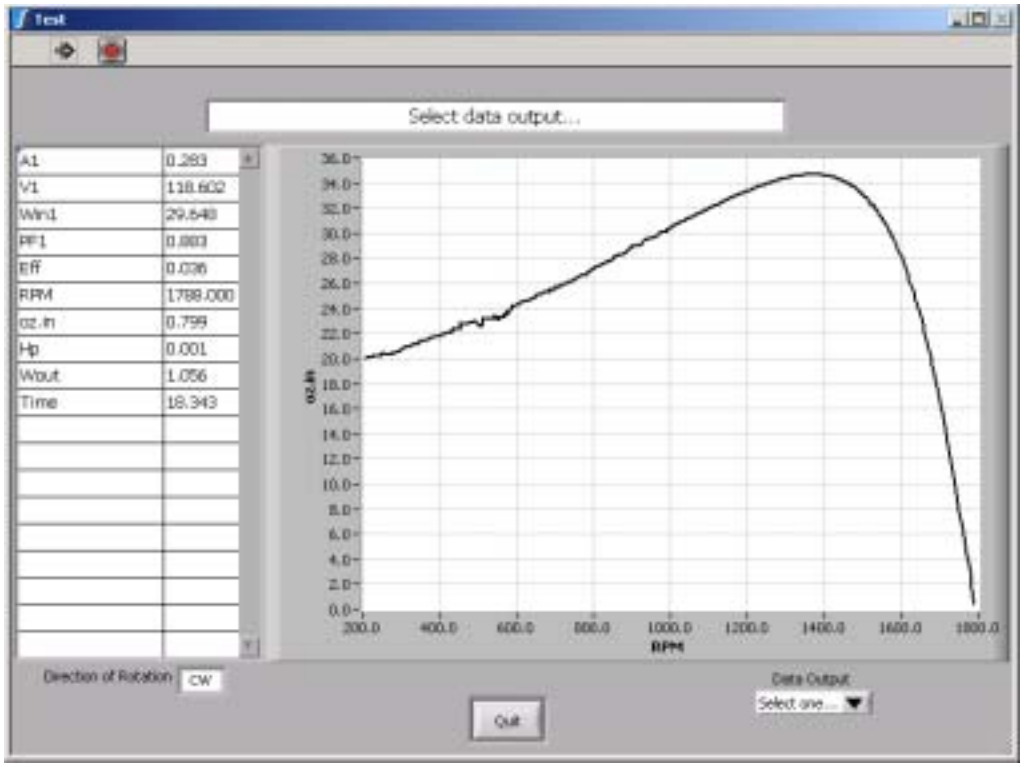


Figure 5–2 Average-D/U Motor Curve

5.1.2.2 Dynamic-CF

Since "inertial effect" is only a factor as speed is changing, and inertial torque is proportional to the rate of change, inertial value may be expressed as a unit of torque per change in rpm *in a given period of time*. The DSP6000 and 6001 accumulate data at intervals of approximately 10 milliseconds. With data rates this fast, the amount of speed change from reading to reading is too small to be used accurately in the correction. Therefore, M-TEST 4.0 inserts a wait state of 100 ms between each reading in order to allow a reasonable speed change.

In order to create a torque correction factor (CF), a torque value equal to the inertial torque and the difference in rpm (per 100 ms) that created that value is needed. In the following example, we have decelerated the motor from free run (FR) to some minimum speed value. A speed equal to approximately 75% of FR is selected from the curve. One speed point either side of that point is used to obtain an average speed change that produces that torque. That value is now programmed as a static speed point. We now have data from the deceleration curve at 75% of FR and data from a static point at 75% of FR. The difference in torque divided by the change in speed produces the torque correction factor.

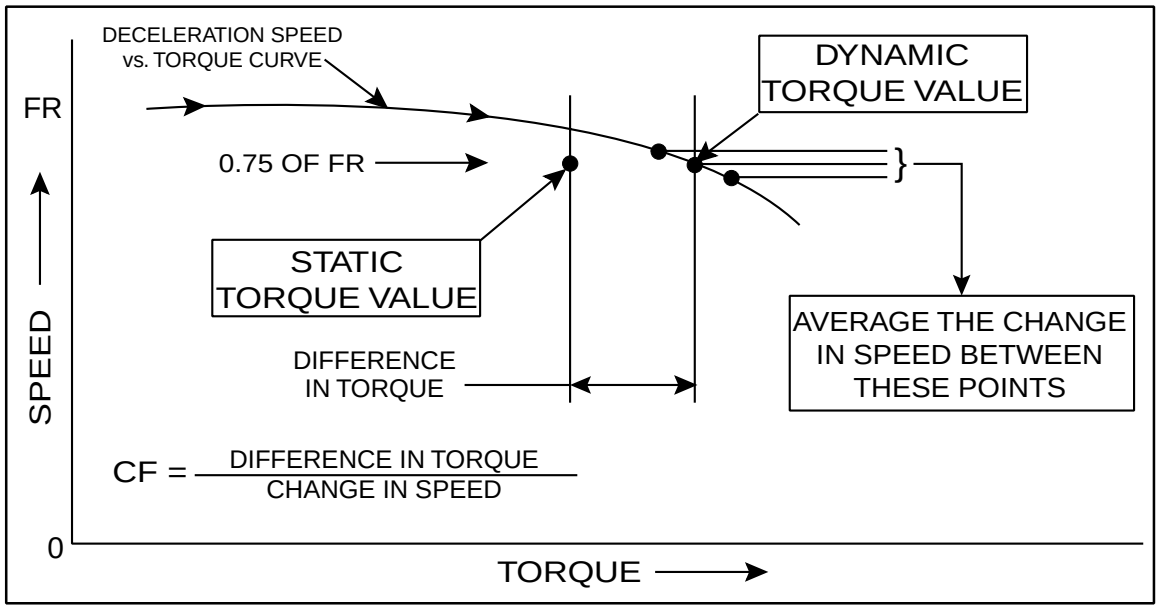


Figure 5–3 Correction Factor Calculation

The test sequence is to ramp a motor down from its free-run speed to a user-specified minimum speed or maximum torque. The ramp is then terminated and the motor is allowed to accelerate. When the motor nears free-run speed, it is loaded to a static speed (approximately 75% of free run). When ten readings are acquired within ± 0.3% of the target speed, loading is removed and the motor may be turned off. The correction factor is then calculated.

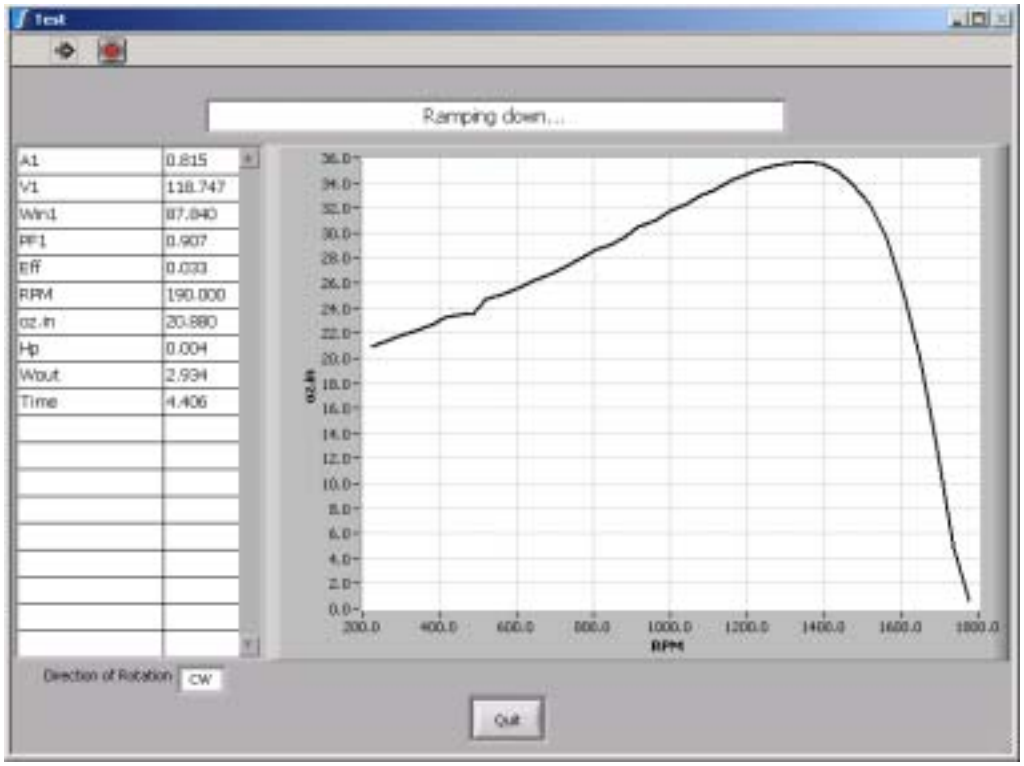


Figure 5–4 Dynamic-CF Test Before Inertial Cancellation

The correction can now be applied to the entire deceleration curve. For any point on the curve, the corrected torque is the measured torque minus the CF value times the speed difference between this point and the previous point. Because there is no deceleration at free run and locked rotor, torque correction is not applied to these points.

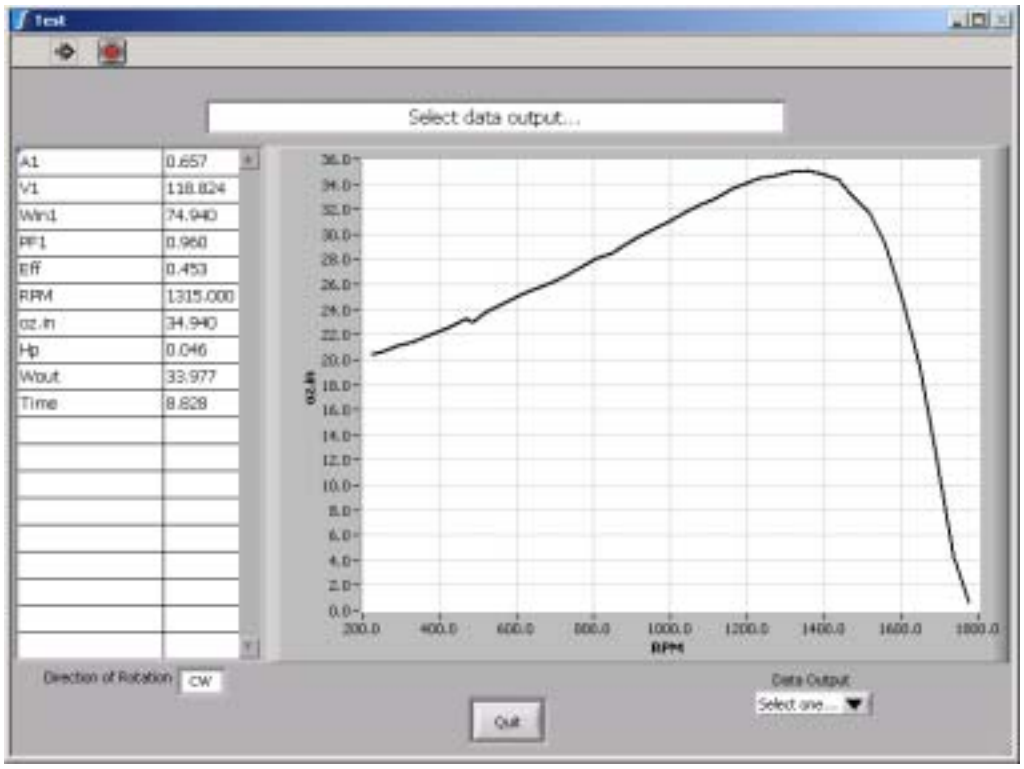


Figure 5–5 Dynamic-CF Test

5.2 CURVE TESTING

M-TEST 4.0 can be used in a way that simulates complex load profiles. This may be for heat run or endurance testing, simulating a real life usage, or just for checking a few specific data points. Loading may be accomplished by closing a control loop on Speed, Torque, or Output Watts, plus Amps or Input Watts if a power analyzer is incorporated into the system. Because closed loop speed and torque are internal functions of the dynamometer controller, the control loops are very fast and highly controllable. The remaining functions use a routine in M-TEST 4.0 to close the loop and provide control. These will not provide the tight control as the internal functions but are quite satisfactory for most applications.

Loading can be accomplished by either stepping or ramping to the desired point. If you wish to step to a load point, enter a time of “0” (zero) for that point. If you wish to ramp to a load point, enter the number of seconds (or minutes, depending on the timebase setting) for the controller to ramp from the starting point to the ending point. To remain at a fixed load for a period of time, use the same value for "From" and "To". To obtain free-run or locked rotor data use the following values:

Parameter	Free Run	Locked Rotor
Amps	0	99999
Input Watts	0	99999
Speed	99999	0
Torque	0	99999
Output Watts	0	99999

In the example below we will perform a Torque Curve test that will:

1. Ramp the torque from zero to 10 in 5 seconds
2. Dwell at 10 for 5 seconds
3. Step to 20 in zero seconds
4. Dwell at 20 for 5 seconds
5. Ramp to zero in 3 seconds
6. Dwell at zero for 5 seconds
7. Repeat the cycle a second time.

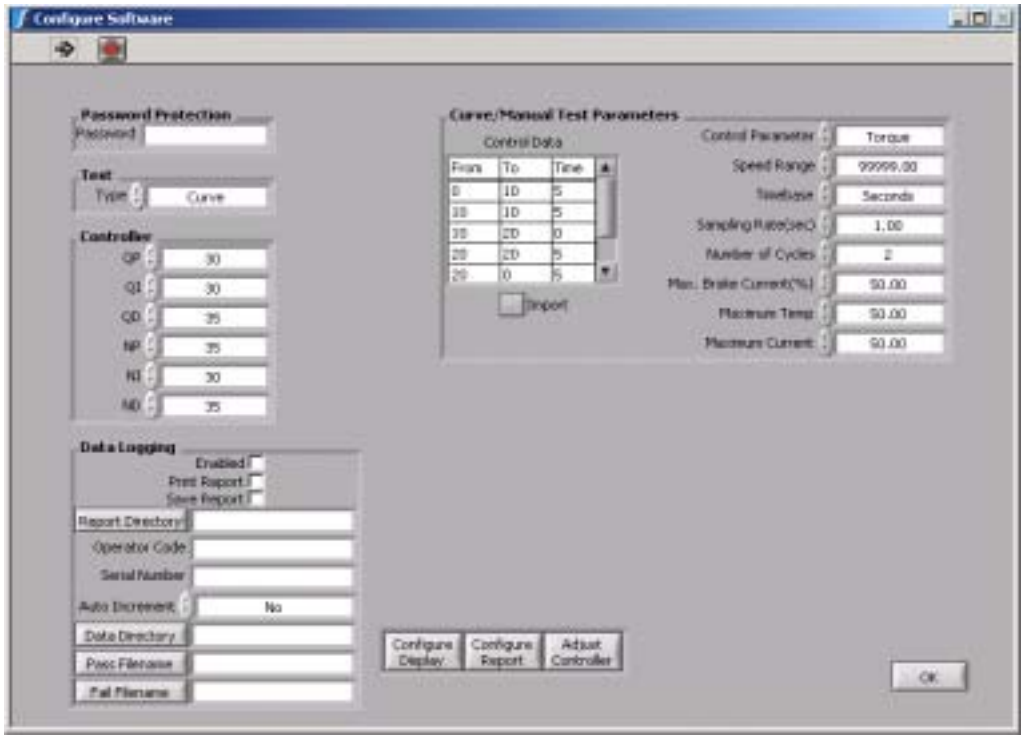


Figure 5–6 Torque Curve Setup Example

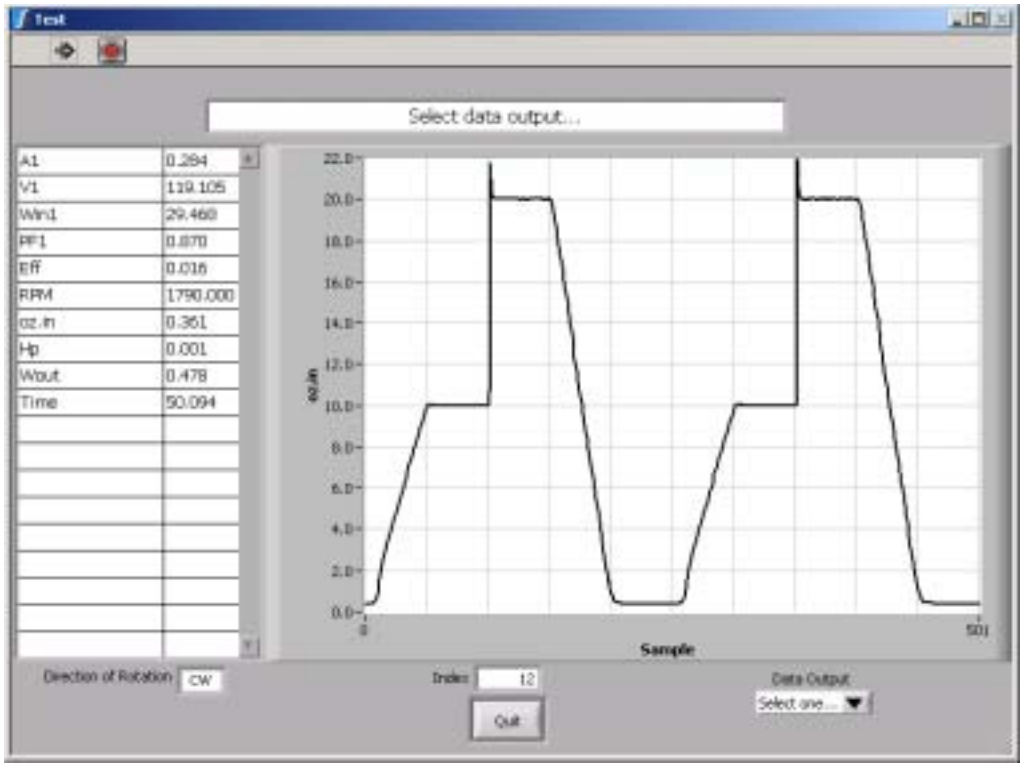


Figure 5–7 Torque Curve Test Example

5.3 MANUAL TESTING

In this mode of operation, the computer is being used only as a data acquisition device. No control is performed by M-TEST 4.0.

5.4 PASS/FAIL TESTING

Pass/Fail motor testing provides production line testing of motors at specified load points, test specification comparisons and a quick pass or fail indication to the operator. Up to five parameters can be tested simultaneously and checked against values entered by the user. Testing at free run and locked rotor can also be performed. The user determines the length of time to hold at each particular load point. Test runs and their associated data may be stored in any user defined directory (passed motor data in one, failed motor data in a separate directory) for future reference. This data can easily be exported to a Microsoft® Excel spreadsheet.

Loading can be accomplished by either stepping or ramping to the desired point. If you wish to step to a load point, enter a time of "0" (zero) for that point. If you wish to ramp to a load point, enter the number of seconds (or minutes, depending on the timebase setting) for the controller to ramp from the starting point to the ending point. To remain at a fixed load for a period of time, use the same value for "From" and "To". To obtain free-run or locked rotor data use the following values:

Parameter	Free Run	Locked Rotor
Amps	0	99999
Input Watts	0	99999
Speed	99999	0
Torque	0	99999
Output Watts	0	99999

In the example below we will perform a Pass/Fail test that will:

1. Dwell at 0 torque for 2 seconds.
2. Step to 5 oz·in and dwell for 2 seconds.
3. Step to 10 oz·in and dwell for 2 seconds.
4. Step to 15 oz·in and dwell for 2 seconds.
5. Step to 20 oz·in and dwell for 2 seconds. (not shown in example)

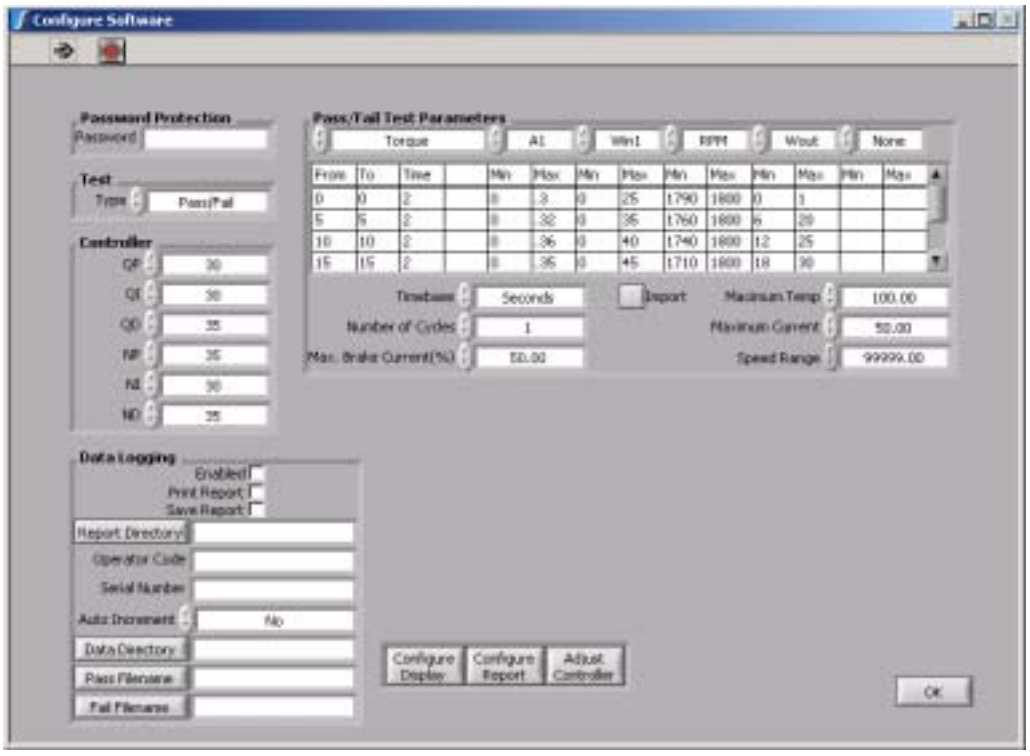


Figure 5–8 Pass/Fail Test Example

This example demonstrates a motor test that collects data from 5 different torque points—a typical test that might be run during incoming inspection or at the end of a production line. At each of the load points, information on amps, input watts, speed and output watts is gathered. A minimum and maximum value is given for each load point. A data directory (C:\test data) has been created containing two files where the data will be sent, depending on whether the motor passes (pass.xls) or fails (fail.xls). A serial number is also assigned to each motor with an automatic increment, which makes the information easy to track.

When the test is running, the data will appear as follows.

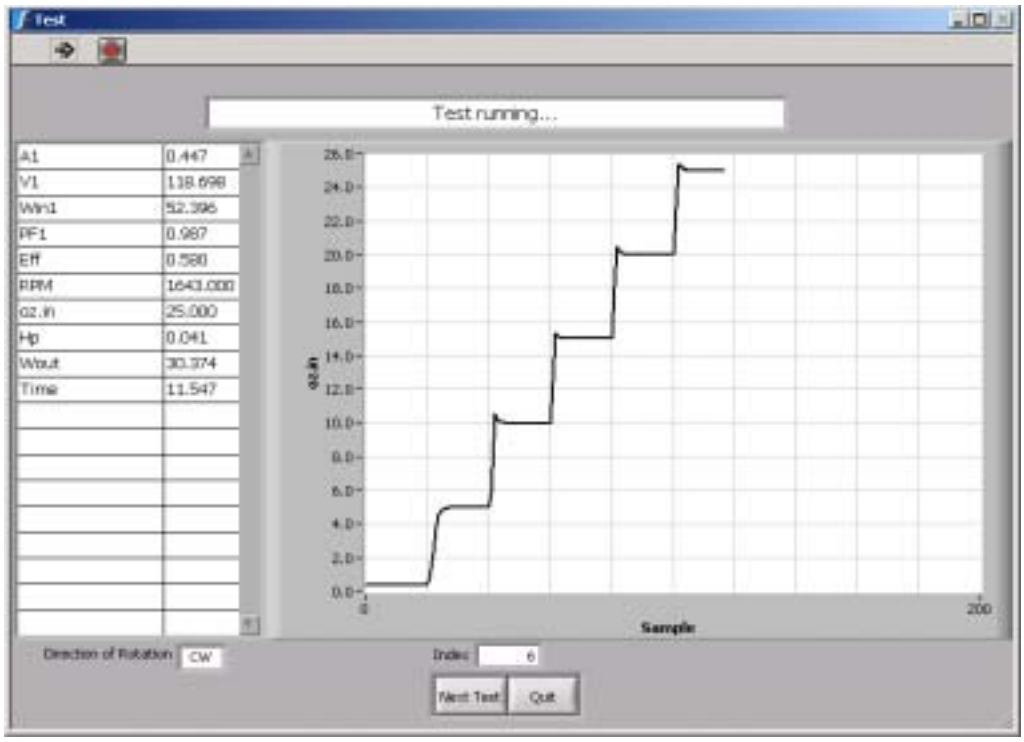


Figure 5–9 Pass/Fail Test Run Window

Once the test is completed, a window will appear that indicates the results of the test.

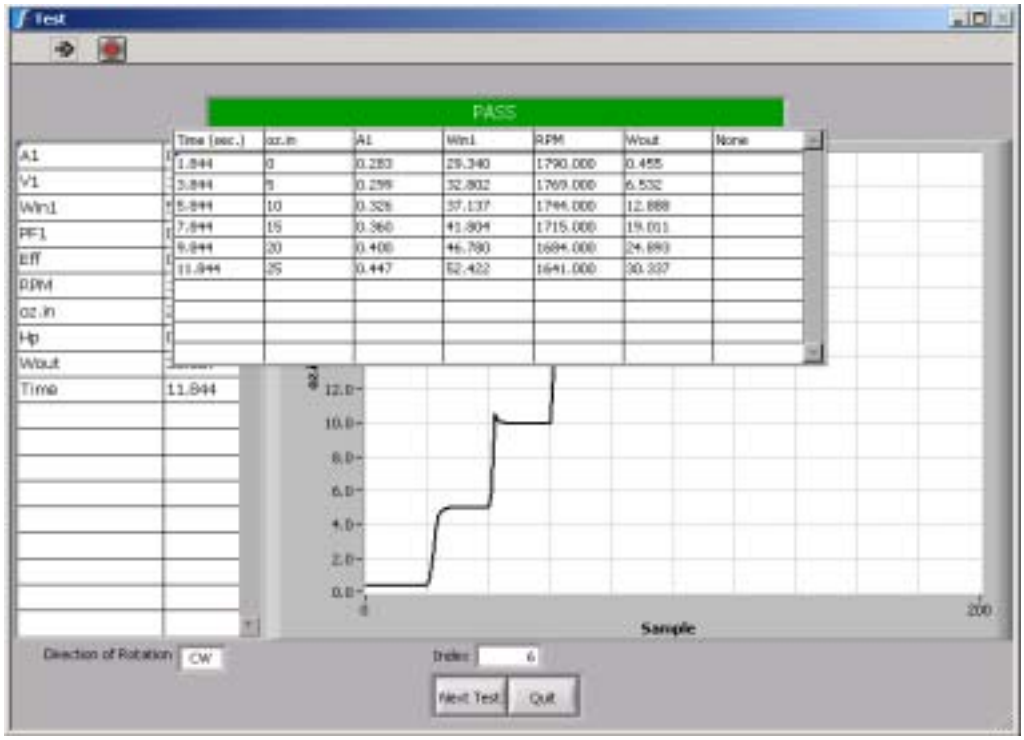


Figure 5–10 Pass/Fail Test Results Window

In this example all parameters passed the test as indicated by the green PASS bar in the upper portion of the window. In the event that at least one parameter fails, a red FAIL bar will appear in the window and the parameter that fails will be indicated with an asterisk (*) on either side of the value as demonstrated in the following example.

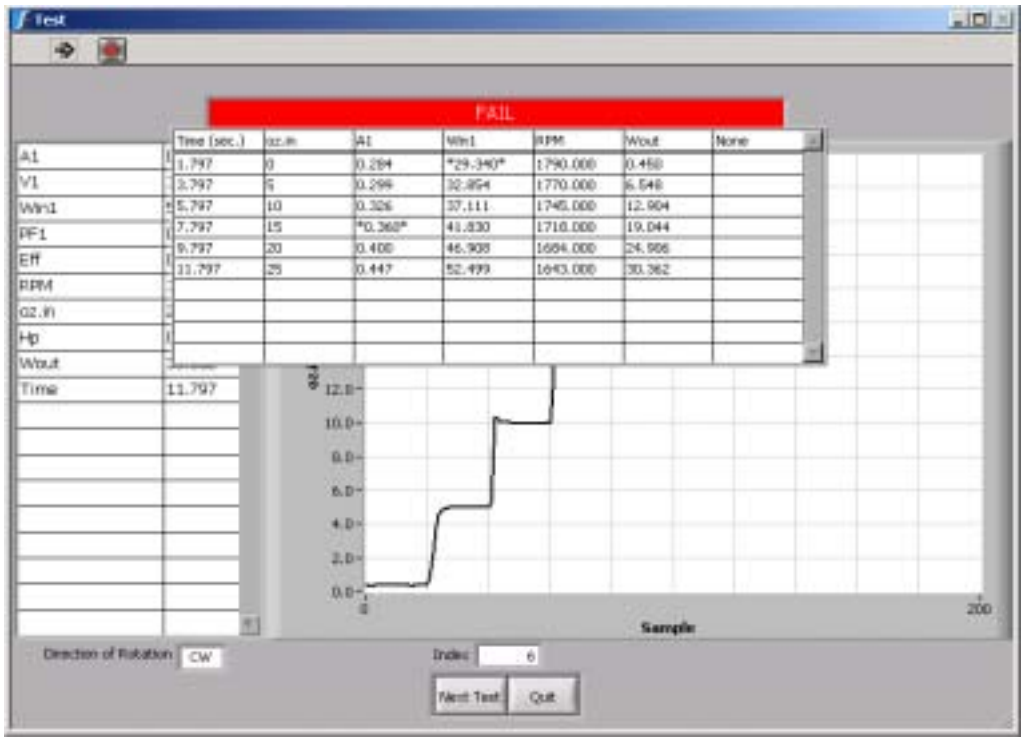
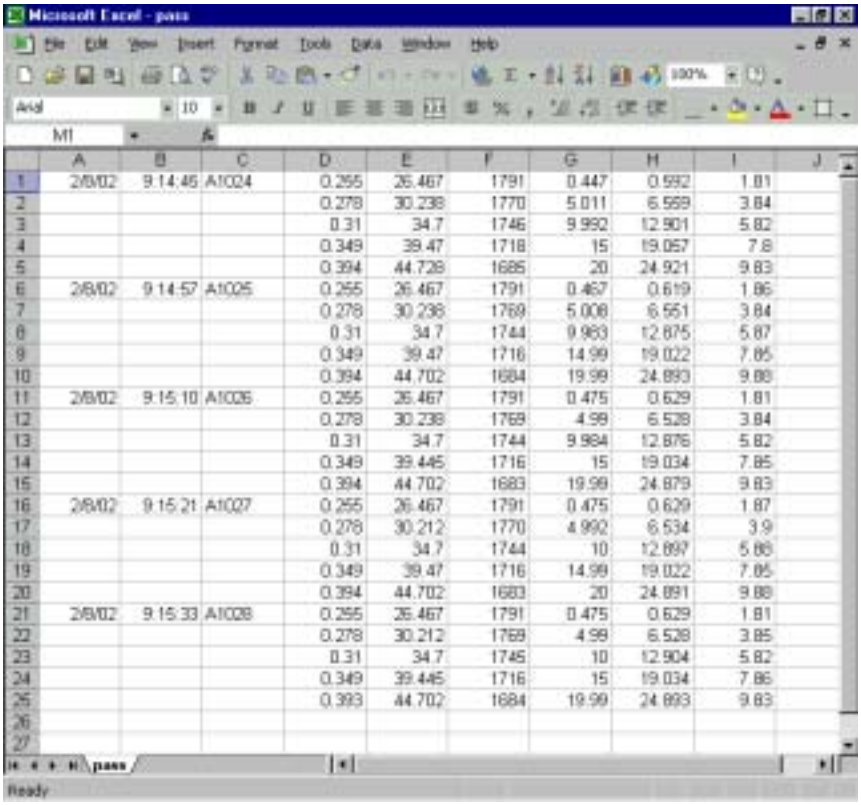


Figure 5–11 Failed Test Example

The data from the passed test will be sent to the pass.xls file that was set up at the beginning of the test.



	A	B	C	D	E	F	G	H	I	J
1	2/8/02	9:14:46	A1024	0.255	26.467	1791	0.447	0.592	1.81	
2				0.278	30.238	1770	5.011	6.559	3.84	
3				0.31	34.7	1746	9.992	12.901	5.82	
4				0.349	39.47	1718	15	19.057	7.8	
5				0.394	44.728	1685	20	24.921	9.83	
6	2/8/02	9:14:57	A1025	0.255	26.467	1791	0.467	0.619	1.86	
7				0.278	30.236	1769	5.008	6.551	3.84	
8				0.31	34.7	1744	9.983	12.875	5.87	
9				0.349	39.47	1716	14.99	19.022	7.85	
10				0.394	44.702	1684	19.99	24.893	9.88	
11	2/8/02	9:15:10	A1026	0.255	26.467	1791	0.475	0.629	1.81	
12				0.278	30.238	1769	4.99	6.528	3.84	
13				0.31	34.7	1744	9.984	12.876	5.82	
14				0.349	39.445	1716	15	19.034	7.85	
15				0.394	44.702	1683	19.99	24.879	9.83	
16	2/8/02	9:15:21	A1027	0.255	26.467	1791	0.475	0.629	1.87	
17				0.278	30.212	1770	4.992	6.534	3.9	
18				0.31	34.7	1744	10	12.897	5.86	
19				0.349	39.47	1716	14.99	19.022	7.85	
20				0.394	44.702	1683	20	24.891	9.88	
21	2/8/02	9:15:33	A1028	0.255	26.467	1791	0.475	0.629	1.81	
22				0.278	30.212	1769	4.99	6.528	3.85	
23				0.31	34.7	1745	10	12.904	5.82	
24				0.349	39.445	1716	15	19.034	7.86	
25				0.393	44.702	1684	19.99	24.893	9.83	
26										
27										

Figure 5–12 Microsoft Excel Data File

The data file contains the date and time of the test run, the serial number of the motor and the data that was collected during the test. The order in which the data is displayed from left to right is determined by the order of parameter selection in the Configure Display window during initial setup. See S*ection 6.7–Configure Display*.

6. Software Configuration

Once the hardware configuration is complete and the testing options have been reviewed, the software must be configured. Beginning from the Main window, click **Configure Software**. The Configure Software window will appear.

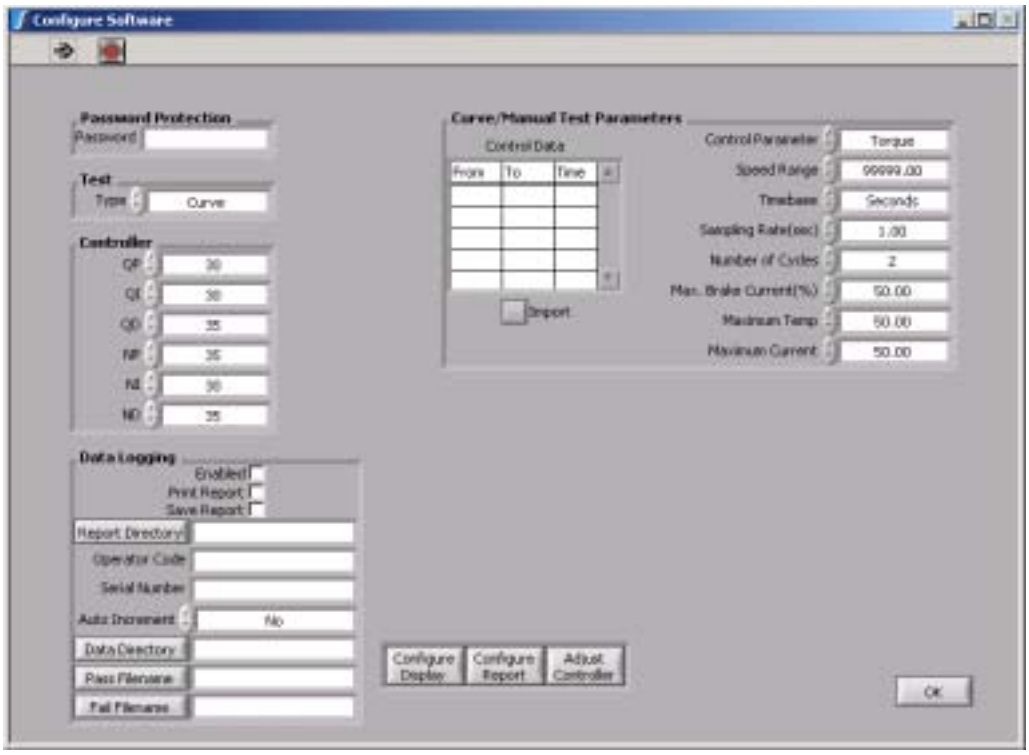


Figure 6–1 Configure Software Window

The Configure Software window is where the software is programmed for the type of test to be performed. For specific instructions on how to set controls, see *Section 3.3.1–Setting Controls*.

6.1 PASSWORD PROTECTION

Optional to the user is the Password Protection feature. This feature is used to secure the configuration from any unauthorized tampering. To enable, click inside the **Password** box and type the desired password.

Note:	The Password Protection feature will only protect a specific configuration that has been saved. It will not prevent starting M-TEST 4.0 to set up a new program.

6.2 TEST

- Selects the type of test you wish to perform.
- Options include Ramp, Curve, Manual and Pass/Fail tests.

As different tests are selected, the required controls for that test will become active.

Note: For detailed information on Ramp, Curve and Manual testing, see *Chapter 5 – Selecting a Test*.

6.3 CONTROLLER

CONTROL	FUNCTION	OPTIONS/VALUES
QP	Sets the torque proportional gain setting to be sent to the controller.	0 to 99
QI	Sets the torque integral setting to be sent to the controller.	0 to 99
QD	Sets the torque derivative setting to be sent to the controller.	0 to 99
NP	Sets the speed proportional gain setting to be sent to the controller.	0 to 99
NI	Sets the speed integral setting to be sent to the controller.	0 to 99
ND	Sets the speed derivative setting to be sent to the controller.	0 to 99

6.4 DATA LOGGING

Data Logging allows M-TEST 4.0 to automatically store acquired data at the end of each test. A file name will be created under the path that you have entered using the serial number with a Microsoft Excel (.xls) extension.

CONTROL	FUNCTION	OPTIONS/VALUES
Enabled	Enables data logging function.	Enabled (select check box) and Disabled (clear check box)
Print Report	Generates a custom printed report after each test. NOTE: The report must be configured first. Click the **Configure Report** button at the bottom of Configure Software window.	Enabled (select check box) and Disabled (clear check box)
Save Report	Saves a custom report after each test.	Enabled (select check box) and Disabled (clear check box) NOTE: The report must be configured first using the button at the bottom of the screen. The report will be saved in the path/filename entered in the Report Directory field, and can be recalled, viewed and printed at a later time. Reports are automatically saved with a .rpt extension. This is necessary to differentiate a report from test data when recalling into the program.
Report Directory	Accesses the file dialog box for selecting a drive and directory for report storage.	Any
Operator Code	Enter the operator's name or initials here for printing out on the report form.	Any
Serial Number	Enter a serial number for the motor being tested. This will be used for printing on the report and file name generation if data logging is enabled.	Any
Auto Increment	Enabling this feature will increment the serial number by one at the end of each test. If the serial number is in the form of an alphanumeric string, the program looks for the last alpha character in the string. If a number follows it, that number will be incremented by one at the end of the test. If no number follows the last alpha character, a number will be added and incremented after each test.	Yes and No

CONTROL	FUNCTION	OPTIONS/VALUES
Data Directory	Specifies the drive and directory for data logging. For curve, ramp or manual tests, the file name is automatically generated from the serial number. NOTE: To access the file dialog box for selecting a drive and directory for data storage, click the Data Directory button.	N/A
Pass Filename	Specifies the drive, directory and file name for Pass data logging. This is used only during Pass/Fail motor testing. The generated file will consist of the date, time and serial number in the first row, and the data in the following row(s). Each Pass/Fail checkpoint will have a row of data, which is the actual data recorded at that point. The data in the file will be the parameters that were selected in the "Configure Display" routine. The order in which they appear will be in the same sequence as they appear in the selection box. Additional tests using the same file name will have their data appended to the file. NOTE: To access the file dialog box for selecting a drive, directory and file name for Pass data logging, click the Pass Filename button.	Any
Fail Filename	Specifies the drive, directory and file name for Fail data logging. This is used only during Pass/Fail motor testing. The generated file will consist of the date, time and serial number in the first row, and the data in the following row(s). Each Pass/Fail checkpoint will have a row of data, which is the actual data recorded at that point. The data in the file will be the parameters that were selected in the "Configure Display" routine. The order in which they appear will be in the same sequence as they appear in the selection box. Additional tests using the same file name will have their data appended to the file. NOTE: To access the file dialog box for selecting a drive, directory and file name for Fail data logging, click the Fail Filename button.	Any

6.5 CURVE/MANUAL TEST PARAMETERS

When a Curve Test has been selected as the Test Type, the window will appear as follows.

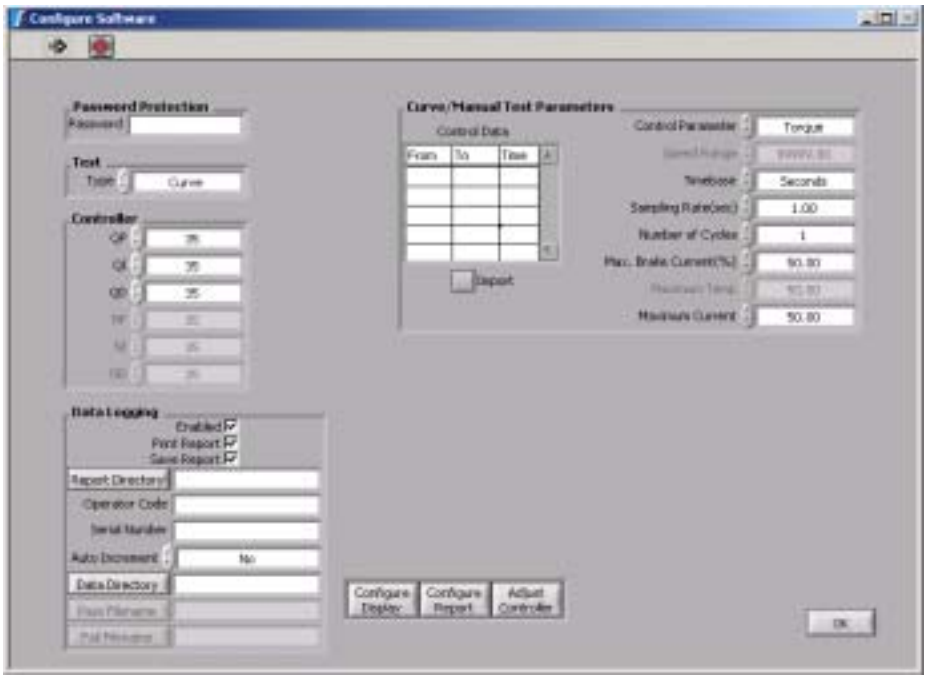


Figure 6–2 Curve Test Setup Window

When a Manual Test has been selected as the Test Type, the window will appear as follows.

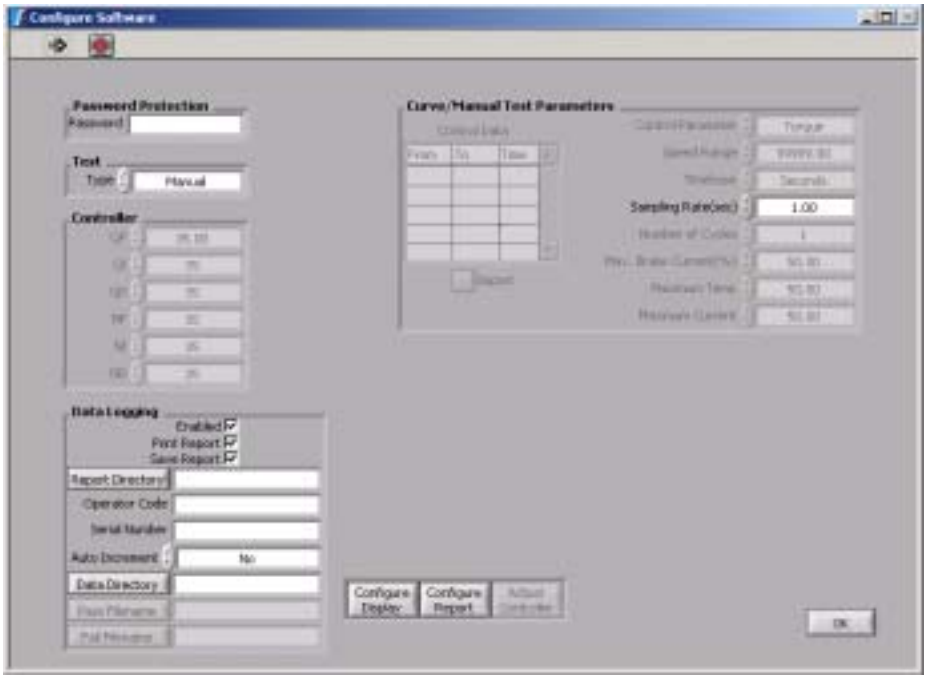


Figure 6–3 Manual Test Setup Window

The following parameters may be used when running a Curve or Manual Test.

CONTROL	FUNCTION	OPTIONS/VALUES
Import	Imports data for curve/manual table from an external tab-delimited text file. NOTE: To access the file dialog box and choose the appropriate file, click the Import button.	N/A
Control Parameter	Selects the desired parameter to be used as the control. NOTE: When controlling by Speed or Torque, the controller uses its internal circuitry to close the loop on the desired set point. The PID controls are fully active for system response tuning. However, when using Amps, Input Watts, or Output Watts control, the controller operates in an open loop mode and the loop is closed through the M-TEST 4.0 program. This means that the control loop will probably not be as tight as the Speed or Torque modes. The only system tuning control available is proportional gain.	Amps 1, Amps 2, Amps 3, Amps Sum, Input Watts 1, Input Watts 2, Input Watts 3, Input Watts Sum, Speed, Torque, Output Watts and Open Loop. NOTE: Torque will be in the units previously selected in the Display Torque control under "Controller" in the Configure Hardware window. For Amps and Input Watts control, the number refers to the phase of a three-phase system. If using a single-phase source, select an option with a "1".
Speed Range	Sets the speed range for the dynamometer controller. NOTE: The value entered should be slightly greater than the free run speed of the motor. Adjusting the Speed Range properly will give the best dynamic range for the PID settings. This parameter is only used with a tandem dynamometer setup.	0 to 99,999
Timebase	Sets the timebase for all the time values in the control table.	Seconds and Minutes
Sampling Rate (sec)	Sets the time interval at which a data point will be sampled and stored. NOTE: When using the Manual Test and timed storage, the data will be stored automatically at the rate selected here. The fastest rate is 100 samples per second (0.01 s).	Any NOTE: The fastest rate allowed in a Curve Test is 10 samples per second (0.10 s). This rate is necessary in order to maintain accurate timing for the ramp and dwell parameters. If you wish to acquire data only at the end of each dwell period, type "99999".
Number of Cycles	Selects the number of times to repeat the load cycle.	1 to 32767
Max. Brake Current	Different size dynamometers require different amounts of DC current to produce full torque, or enough torque to lock the rotor of a motor being tested. The hysteresis dynamometer's rotor will become magnetized if current is applied while the shaft is not turning. This produces residual magnetism, also known as a bump. If too much current is applied, the bump may be sufficiently large as to not allow the motor to begin rotating again. This control should be used to set the minimum amount of current necessary that will still lock the rotor if desired during the test sequence. NOTE: If locked rotor is not desired, this control is irrelevant.	0 to 99.99%

CONTROL	FUNCTION	OPTIONS/VALUES
Maximum Temp	Allows a maximum value to be set for temperature when using temperature acquisition hardware. NOTE: If any thermocouple exceeds the Maximum Temperature value, the test in progress will abort.	Any NOTE: Temperature units are the same as what was selected under Temperature Measurement in the Configure Hardware window.
Maximum Current	Allows a maximum value to be set for current. NOTE: If the measured current exceeds the value set up by this control, the test in progress will abort.	Any

6.5.1 CONTROL DATA

- Used for entering a load profile for curve tests.
- Table includes the following items:

  From: The starting load value.

  To: The ending load value.

  Time: The number of seconds or minutes to achieve the series.

  Volts: Sets the voltage for each step when using a DC power supply. The power supply will be programmed to the voltage desired at the beginning of each step.

Note: Volts are only applicable when using a DC Power Supply and will not be visible to the user during AC operation.

- To set, type values in the table and use the TAB key or mouse to move from cell to cell. The time units are set by the Timebase control to the right and are applied to all time values in the table. Any values entered in the "From" and "To" columns will be in the units specified by the control parameter. To clear the table, right-click inside of it and select **Empty Table**.

Note: If a certain profile is repetitive, enter the basic sequence in the table once and use the **Number of Cycles** control on the right to repeat that sequence any number of times.

The following is an example of using the Control Data while running a torque curve with an AC Power Supply.

Sequence	From	To	Time	Description
1	0	0	2	This will load the motor with zero torque for 2 seconds.
2	0	10	10	This will ramp the load from 0 to 10 torque units in 10 seconds.
3	10	10	5	This will dwell at 10 torque units for 5 seconds.
4	10	0	0	This will finish by stepping from 10 to 0 in 0 seconds.

Note: When loading by Amps, Input Watts, Torque, or Output Watts, a value of 0 (zero) will obtain free-run data. A value of 99999 will obtain locked rotor data.

Note: When loading by Speed, a value of 99999 will obtain free-run data. A value of 0 (zero) will obtain locked rotor data.

6.6 RAMP TEST PARAMETERS

When a Ramp Test has been selected as the Test Type, the window will appear as follows.

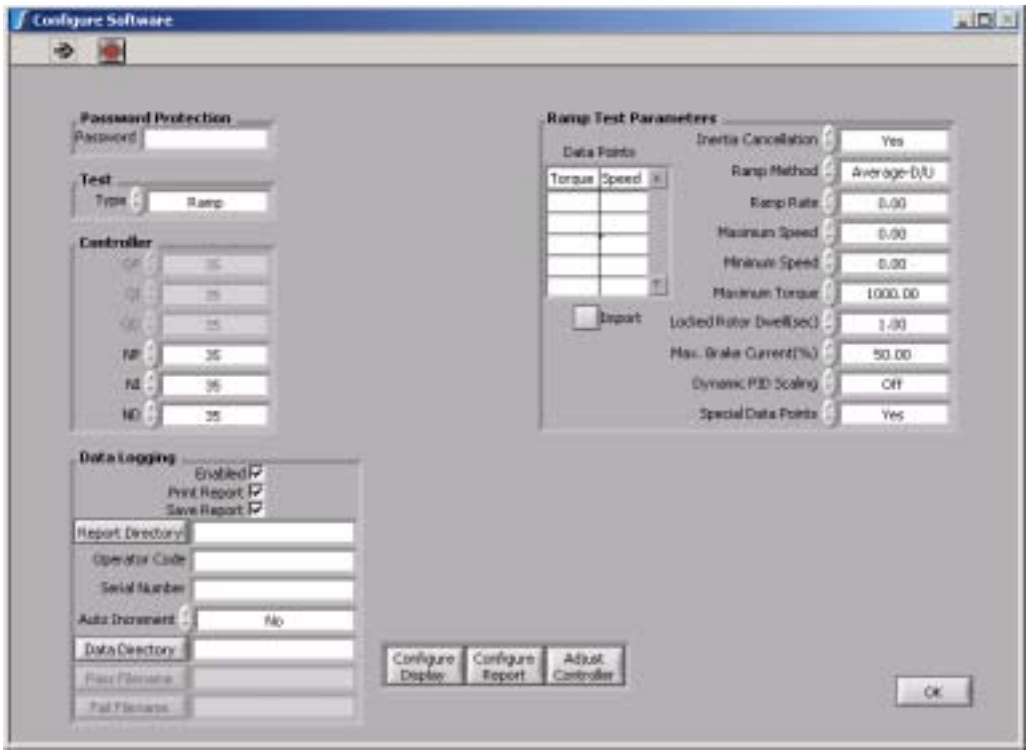


Figure 6–4 Ramp Test Setup Window

The following parameters may be used when running a Ramp Test.

CONTROL	FUNCTION	OPTIONS/VALUES
Inertia Cancellation	Provides accurate torque and power data during a ramp test. The stored energy of the rotating mass in the system tends to make the motor look stronger than it actually is during a deceleration ramp. Inertia cancellation removes the inertial component and gives data as if a number of discrete stabilized points were taken. NOTE: Under most circumstances, it is a good idea to use inertia cancellation. Once a Dynamic-CF test has been run with inertia cancellation, subsequent tests on the same motor, or same type of motor may be run using the coefficients obtained from the first run. Select **Previous Value** to use those coefficients without actually performing the inertia cancellation routine. The Average-D/U routine inherently has inertia cancellation every time it is run. For more information, refer to *Section 5.1 –Ramp Testing*.	Yes, No and Previous Value
Ramp Method	Selects the ramp method used to test the motor.	**Average-D/U**: An average of the deceleration and acceleration curves. Typically produces the most accurate results and is somewhat dependent on the controller ramp tuning. Inertia cancellation is automatic. **Dynamic-CF**: Determines correction factor based on deceleration curve and stabilized point. The correction factor is then applied to the entire data set. In order for this to work properly, the system tuning is highly critical.
Ramp Rate	Sets the deceleration rate of the ramp in rpm per second.	Any
Maximum Speed	Sets the upper limit or start of the ramp NOTE: This may be helpful in cases where the motor spins at a very high speed, possibly faster than the dynamometer is rated for. A speed stabilized command is sent to the controller to hold the motor at this value before the ramp begins. In order to function properly, the PID's must be set to a reasonable value or no loading will occur.	0 to 100,000

CONTROL	FUNCTION	OPTIONS/VALUES
Minimum Speed	Sets the lower limit of the ramp.	Any NOTE: Zero (0) can be specified to run to locked rotor, or any speed above that. The system response is such that accurately controlled operation in the range of 1–100 rpm is not possible without the use of an optional speed encoder. For that reason, Magtrol does not recommend trying to obtain data at those speeds.
Maximum Torque	Stops the ramp when a specific torque limit has been reached.	Any NOTE: Torque will be in the units previously selected in the Display Torque control under Controller in the Configure Hardware window.
Locked Rotor Dwell (sec)	When running the Average-D/U ramp test, a Minimum Speed setting of zero (locked rotor) will cause the motor to be loaded to stall at a rate ten times greater than what was specified for the test. This may cause a bounce in the torque reading that must be removed by waiting a short period of time. Adjust this control to set the settling time before taking a reading.	Any
Max. Brake Current	Different size dynamometers require different amounts of DC current to produce full torque, or enough torque to lock the rotor of a motor being tested. The hysteresis dynamometer's rotor will become magnetized if current is applied while the shaft is not turning. This produces residual magnetism, also known as a bump. If too much current is applied, the bump may be sufficiently large as to not allow the motor to begin rotating again. This control should be used to set the minimum amount of current necessary that will still lock the rotor if desired during the test sequence NOTE: If locked rotor is not desired, this control is irrelevant.	0 to 99.99%
Dynamic PID Scaling	Allows scaling of the PID values from full value at the start of the ramp to a percentage at the end of the ramp.	Off and On
Import	Imports data for ramp test table from an external tab-delimited text file. NOTE: To access the file dialog box and choose the appropriate file, click the Import button.	N/A
Special Data Points	Selects specific data points throughout the performance curve of the motor. NOTE: All display, graphing and file saving selections will be based on these points only. The graphing routine may be corrupted because of the unnatural order of special points.	No and Yes

6.6.1 DATA POINTS

- Speed and Torque Special Data Points are entered here.
- To set, type values in the table and use the TAB key to move from cell to cell.

Note: Data needs to be entered in decreasing order for Speed, and increasing order for Torque. If a matching value is not found within the measured data set, the program will interpolate the value from data obtained one point above and one point below. The process applies to all measured parameters.

- Extrapolation of true free-run and locked rotor values.

If a motor is coupled to a dynamometer there will be some amount of drag produced by bearing friction and windage. This can cause some motors to reduce their uncoupled free run speed by hundreds or even thousands of rpm. If desired, the program will calculate the true free-run parameters based on the slope of the curve over the first 25 data points taken.

To obtain locked rotor data without actually stalling the motor, run the motor to the lowest speed possible. The program calculates the locked rotor parameters based on the slope of the curve over the last 25 data points taken.

The following table provides information needed to create a specific data set based on desired data points.

Data to Obtain	Speed Data Points	Torque Data Points
free-run data	99999	0
locked rotor data	0	99999
full data set	88888	88888
free-run and locked rotor with full data set in between	99999, 88888 and 0	0, 88888 and 99999
extrapolated values with special points in between	99999… special points… 0	0… special points… 99999

Note: When specifying speed or torque points, other than free run and locked rotor, place them first in the table. The command for the full data set should be the last item.

6.7 PASS/FAIL TEST PARAMETERS

When a Pass/Fail Test has been selected as the Test Type, the window will appear as follows.

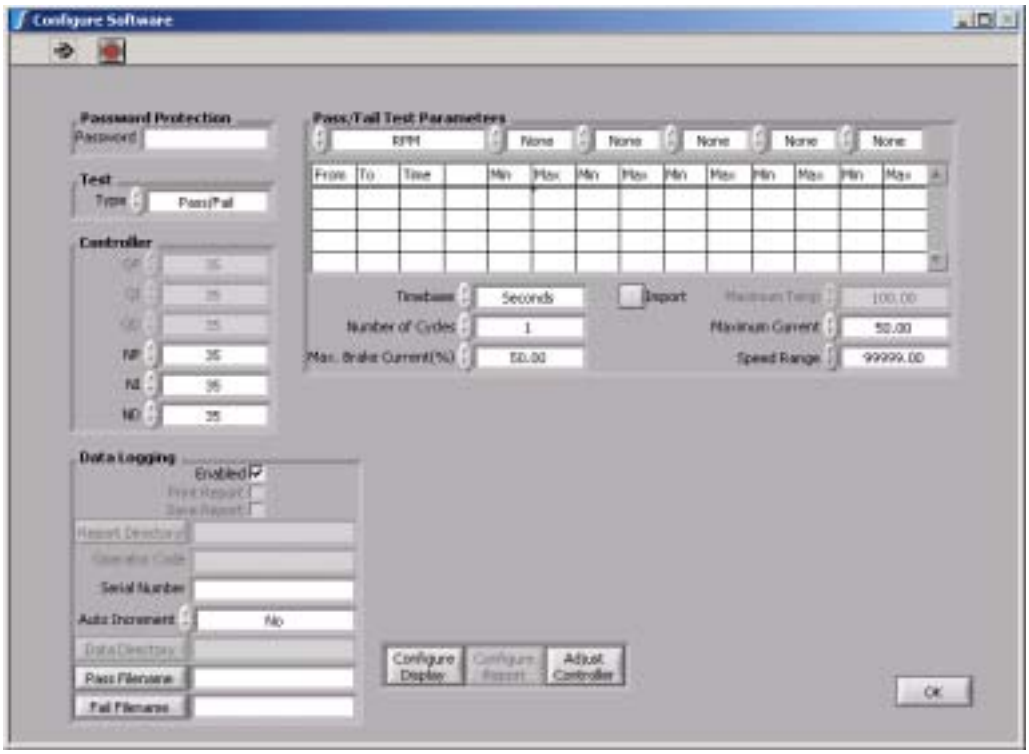


Figure 6–5 Pass/Fail Test Setup Window

The following parameters may be used when running a Pass/Fail Test.

CONTROL	FUNCTION	OPTIONS/VALUES
Pass/Fail Test Parameters	Selects the parameter that will be used for pass/fail checking.	Amps, Input Watts, Speed, Torque, Output Watts or the auxiliary input.
Timebase	Sets the timebase for all the Time values in the control table.	Seconds and Minutes
Number of Cycles	Selects the number of times to repeat the cycling of a load profile.	1 to 32,767
Max. Brake Current	Different size dynamometers require different amounts of DC current to produce full torque, or enough torque to lock the rotor of a motor being tested. The hysteresis dynamometer's rotor will become magnetized if current is applied while the shaft is not turning. This produces residual magnetism, also known as a bump. If too much current is applied, the bump may be sufficiently large as to not allow the motor to begin rotating again. This control should be used to set the minimum amount of current necessary that will still lock the rotor if desired during the test sequence. Note: If locked rotor is not desired, this control is irrelevant.	0 to 99.99
Maximum Temp	Sets the desired maximum temperature NOTE: Only required when using temperature acquisition hardware.	Any NOTE: The units of temperature are the same as what was selected in the hardware setup. If any thermocouple exceeds the value of this control, the test in progress will abort.
Maximum Current	Sets the desired maximum current.	Any NOTE: If the measured current exceeds the value set up by this control, the test in progress will abort.
Import	Imports desired load points, dwell times and limits from an external tab-delimited text file. NOTE: To access the file dialog box and choose the appropriate file, click the Import button.	N/A

6.8 CONFIGURE DISPLAY

From the Configure Software window, click **Configure Display**. The Configure Display window will appear.

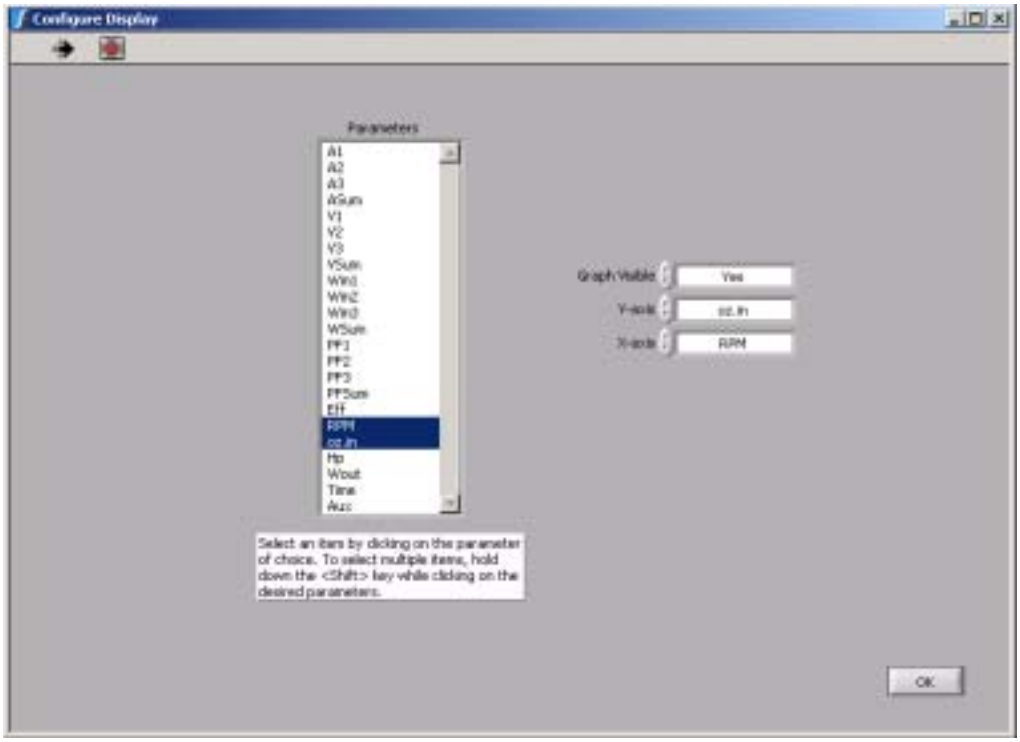


Figure 6–6 Configure Display Window

The Configure Display window is where desired parameters to be displayed during the test and shown on the graph are set up. For specific instructions on how to set controls, see *Section 3.3.1– Setting Controls*.

CONTROL	FUNCTION	OPTIONS/VALUES
Parameters	Selects the parameters that will be measured and displayed in the table during a test run. NOTE: Select an item by clicking on the parameter of choice. To select multiple items, hold down the SHIFT key while clicking on the desired parameters.	Amps 1, Amps 2, Amps 3, Amps Sum, Volts 1, Volts 2, Volts 3, Volts Sum, Input Watts 1, Input Watts 2, Input Watts 3, Input Watts Sum, Power Factor 1, Power Factor 2, Power Factor 3, Power Factor Sum, Efficiency, Speed, Torque Units (e.g. oz.in), Horsepower, Output Watts, Time and Auxiliary Input NOTE: The numbers refer to the phase of a three-phase system. If using a single-phase source, select an option with a "1".
Graph Visible	The test display screen may be set up to show a real-time graph during the test. Use this control to turn the graph function on or off.	Yes and No
Y-axis	Selects the parameter to graph on the Y-axis during the test.	Any of the Parameters that have been selected from the list to the left
X-axis	Selects the parameter to graph on the X-axis during the test. NOTE: If a curve test is being performed, the X-axis will default to the samples acquired and therefore will be disabled.	Any of the Parameters that have been selected from the list to the left

6.9 CONFIGURE REPORT

From the Configure Software window, click **Configure Report**. The Configure Report window will appear.

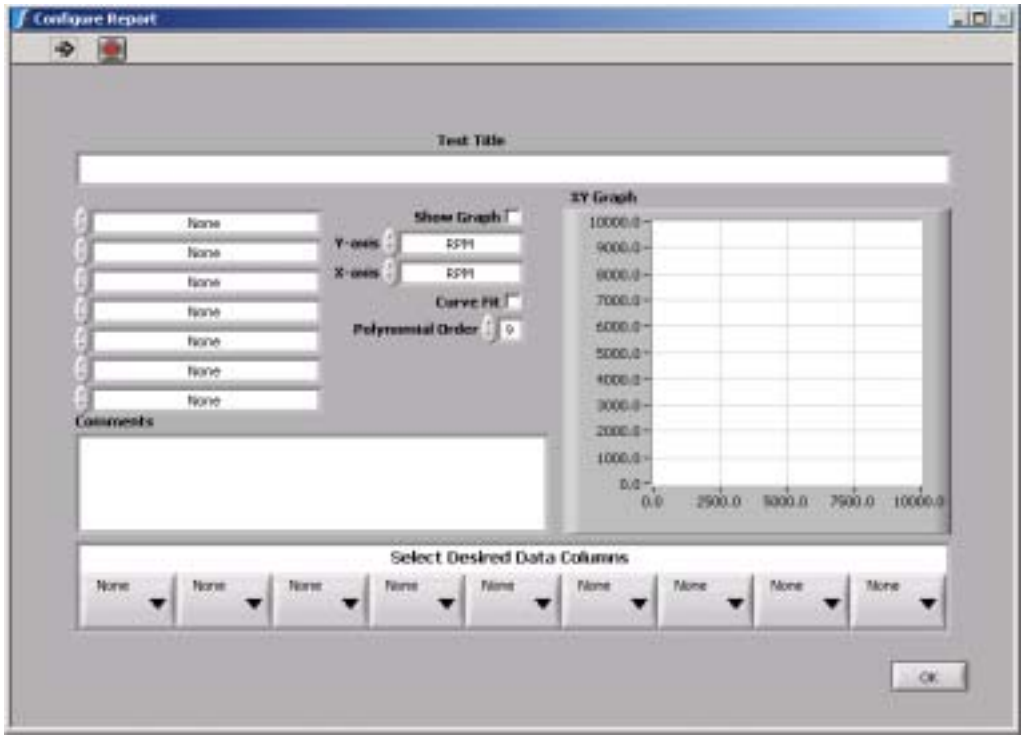


Figure 6–7 Configure Report Window

The Configure Report window is where the desired parameters and overall layout of the custom printed report is selected. For specific instructions on how to set controls, see *Section 3.3.1–Setting Controls*.

The following parameters may be used when configuring a report.

CONTROL	FUNCTION	OPTIONS/VALUES
Test Title	Displays the title to be placed at the top of the report.	Type desired title.
Functions	Selects special functions to be printed on report. Up to 7 different functions can be selected.	None, Test Date, Test Time, Serial Number, Operator Code, Maximum Current, Maximum Efficiency, Maximum Horsepower, Maximum Input Watts, Maximum Output Watts, Maximum Torque, Maximum Speed and Direction of Rotation
Comments	Displays the comments to be included in the report.	Type desired comments.
Show Graph	Shows graph on the report.	Select the check box to show the graph, clear check box to omit from report.
Y-axis	Selects the parameter to graph on the Y-axis.	Any of the Parameters previously selected in the Configure Display window
X-axis	Selects the parameter to graph on the X-axis.	Any of the Parameters previously selected in the Configure Display window
Curve Fit	If the resulting plot has a mathematical function, its shape may be smoothed by enabling curve fitting. The program will apply a general polynomial curve fit routine to the data set and re-plot the data. NOTE: The curve fit applies to the graph only and not the tabular data.	Enabled (select check box) and Disabled (clear check box)
Polynomial Order	Sets the order of polynomials in the curve fitting routine.	0 to 100 NOTE: The default of "2" should be sufficient for most curves, but may be increased to achieve a truer representation. It is recommended that you experiment with the Screen Plot routine to find the best fit and then use the same value for the report.
XY Graph	Displays a single plot using the parameters selected for the x and y-axis. The axes are auto scaled for best resolution.	Any of the Parameters previously selected in the Configure Display window
Select Desired Data Columns	Selects parameters to print in the data columns of the report. Up to 9 different parameters can be selected.	Any of the Parameters previously selected in the Configure Display window

6.9.1 SAMPLE REPORT

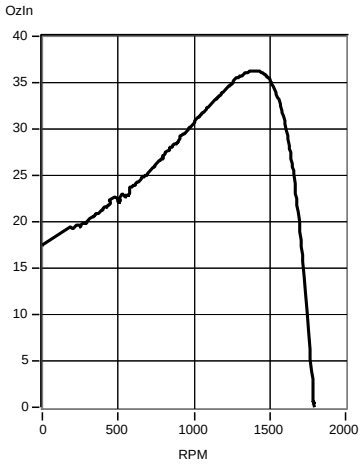
Following is an example of a customized report generated by M-TEST 4.0

Magtrol, Inc.

Test Date:	5/8/01
Test Time:	12:18:22 PM
Serial Number:	0001
Operator Code:	TRW
Maximum Efficiency:	0.633271
Maximum Torque:	36.330000
Direction of Rotation:	CW

Comments

This page displays a typical report that can be generated from M-TEST.



Speed	OzIn	Amps 1	Volts 1	Input Watts 1	Power Factor 1	Efficiency	Output Watts	Horsepower
1795.304	0.000	0.290	119.358	27.245	0.793	0.000	0.000	0.000
1770.000	5.151	0.311	119.235	32.172	0.868	0.210	6.741	0.009
1699.000	18.960	0.383	119.070	43.508	0.954	0.548	23.821	0.032
1648.000	26.276	0.451	118.904	51.474	0.960	0.622	32.022	0.043
1598.000	30.918	0.509	118.775	57.909	0.959	0.631	36.536	0.049
1545.000	33.810	0.558	118.658	63.425	0.957	0.609	38.628	0.052
1500.000	35.310	0.593	118.607	67.254	0.957	0.582	39.167	0.053
1452.000	36.045	0.622	118.573	70.778	0.960	0.547	38.703	0.052
1403.000	36.300	0.649	118.573	72.616	0.944	0.519	37.661	0.051
1358.000	36.157	0.673	118.591	74.454	0.933	0.488	36.310	0.049
1314.000	35.733	0.688	118.517	76.293	0.936	0.455	34.721	0.047
1261.000	35.121	0.712	118.517	78.131	0.927	0.419	32.750	0.044
1213.000	34.316	0.727	118.371	79.969	0.929	0.385	30.782	0.041
1159.000	33.462	0.743	118.389	80.889	0.919	0.355	28.680	0.038
1111.000	32.631	0.757	118.426	81.808	0.912	0.328	26.809	0.036
1069.000	31.924	0.769	118.446	82.727	0.908	0.305	25.236	0.034
1012.000	31.030	0.775	118.573	84.565	0.920	0.275	23.222	0.031
963.000	30.076	0.794	118.573	84.565	0.898	0.253	21.418	0.029
905.000	29.151	0.798	118.610	85.301	0.901	0.229	19.509	0.026
854.000	28.080	0.808	118.609	86.404	0.902	0.205	17.733	0.024
793.000	27.100	0.821	118.573	86.404	0.888	0.184	15.892	0.021
745.000	26.055	0.824	118.371	86.404	0.886	0.166	14.354	0.019
690.000	25.165	0.826	118.316	87.323	0.894	0.147	12.840	0.017
627.000	24.272	0.830	118.371	87.323	0.888	0.129	11.254	0.015
563.000	22.927	0.845	118.426	88.242	0.882	0.108	9.545	0.013
509.000	22.047	0.847	118.371	88.242	0.881	0.094	8.298	0.011
445.000	21.927	0.849	118.334	88.242	0.879	0.082	7.216	0.010
394.000	21.225	0.850	118.352	88.242	0.878	0.070	6.184	0.008
328.000	20.502	0.853	118.444	89.162	0.883	0.056	4.973	0.007
256.000	19.581	0.855	118.426	90.081	0.890	0.041	3.707	0.005
204.000	19.340	0.859	118.426	90.081	0.885	0.032	2.918	0.004
0.000	17.558	0.870	118.379	92.395	0.897	0.000	0.000	0.000

Figure 6–8 Sample Motor Test Report

6.10 ADJUST CONTROLLER

From the Configure Software window, click **Adjust Controller**. The Adjust Dynamometer Controller window will appear.

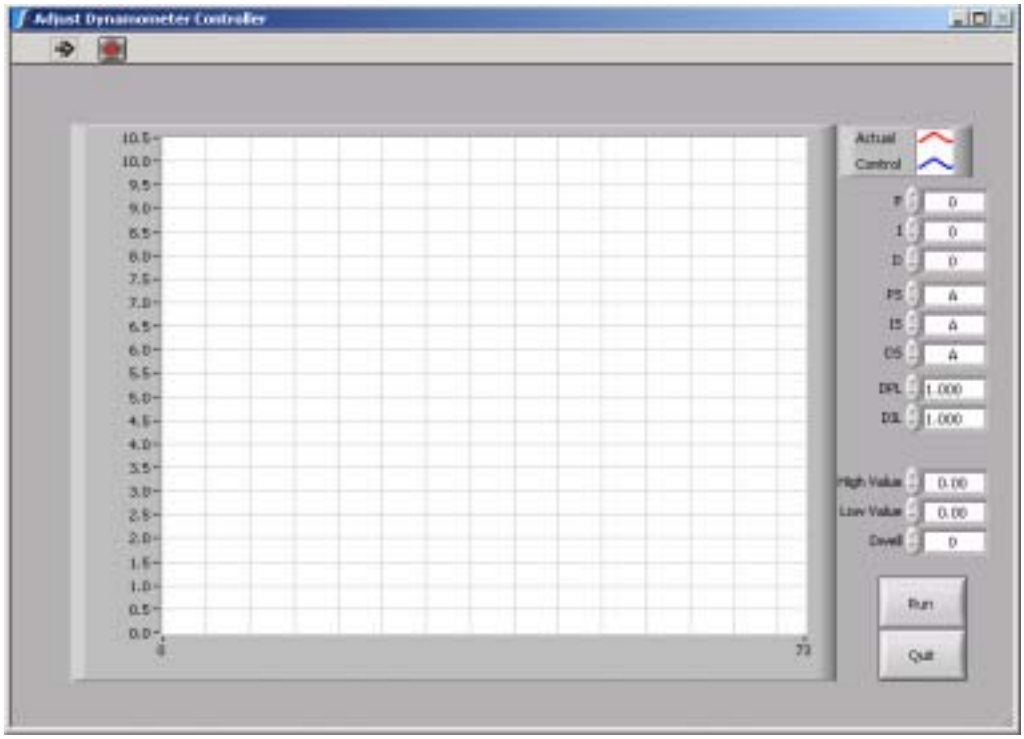


Figure 6–9 Adjust Dynamometer Controller Window

The Adjust Dynamometer Controller window is where PID setup routines are provided. For specific instructions on how to set controls, see *Section 3.3.1–Setting Controls*.

In order to assist the operator in adjusting the PID values, there are two setup routines:

(1) **Ramp Test Setup Routine:** The deceleration curve is shown against an ideal curve and PID's are adjusted until the curves align with each other.

(2) **Curve Test Setup Routine:** A step function is sent to the controller and the system response is plotted against it. Adjust PID values on the fly until desired response is obtained.

Adjustments made to the PID values during a Ramp and Curve Test Setup Routine are automatically transferred to the Configure Software and Advanced Configuration windows.

Note: When a manual test is being performed, the Adjust Dynamometer Controller window is disabled.

Note: For more detailed information, see *Appendix A – PID/Scaling* and *Section 7.3–Adjusting the Controller*.

TEST SETUP

The following parameters may be used when adjusting the controller.

CONTROL	FUNCTION	OPTIONS/VALUES
Actual	Indicates the plot in the graph that displays the actual system response to a test run.	N/A
Ideal	Indicates the plot in the graph that displays the optimum result of a test run. NOTE: This plot is only displayed during a Ramp Test.	N/A
Control	Indicates the plot in the graph that displays the value and dwell settings. NOTE: This plot is only displayed during a Curve Test.	N/A
P (Proportional Gain)	Adjusts the proportional gain setting on the DSP6000/6001.	0 to 99
I (Integral)	Adjusts the integral setting on the DSP6000/6001.	0 to 99
D (Derivative)	Adjusts the derivative setting on the DSP6000/6001.	0 to 99
PS (Proportional Gain Scaling)	Adjusts the proportional gain scaling on the DSP6001.	A, B, C, D, E, F, G, H and I
IS (Integral Scaling)	Adjusts the integral scaling on the DSP6001.	A, B, C, D, E, F, G, H and I
DS (Derivative Scaling)	Adjusts the derivative scaling on the DSP6001.	A, B, C, D, E, F, G, H and I
DPL (Dynamic Proportional Gain Scaling)	Adjusts the dynamic proportional gain scaling on the DSP6001. NOTE: Only applicable during a ramp test when Dynamic PID Scaling is turned "On" under Ramp Test Parameters in the Configure Software window.	Any
DIL (Dynamic Integral Scaling)	Adjusts the dynamic integral scaling on the DSP6001. NOTE: Only applicable during a ramp test when Dynamic PID Scaling is turned "On" under Ramp Test Parameters in the Configure Software window.	Any

CONTROL	FUNCTION	OPTIONS/VALUES
High Value	Sets the maximum value for the desired system repsonse adjustment. The program will cycle between the low value and this value.	Any
Low Value	Sets the minimum value for the desired system repsonse adjustment. The program will cycle between this value and the high value.	Any
Dwell	When using curve tests, this control sets the dwell time at no-load and at load for the adjustment procedure. The time is in seconds.	0 to 32,767
Run	When the controls are configured, click **Run** to begin the adjustment procedure. NOTE: Curve tests allow adjusment of the PID values on the fly. The ramp test will run once, and then the settings may be changed and the test run again.	N/A
Stop/Quit	Click the Stop button to stop the adjustment routine. The Stop button becomes Quit. Click the Quit button to exit the adjustment routine. The PID values will be transferred to the software setup screen.	N/A

7. Running A Test

Following are step-by-step instructions for setting up and running a basic curve, ramp and manual test from beginning to end.

7.1 HARDWARE TEST CONFIGURATION

The following hardware configuration is common for each test. For detailed descriptions of each control and option, see *Chapter 4 – Hardware Configuration*.

1. From the Main window, click **Configure Hardware**.
2. Select your Power Source and corresponding parameters.
3. Select your Power Measurement Device and corresponding parameters.
4. Select your Controller and corresponding parameters.
5. Click **Advanced**.
6. Select Instrument Type and Model for Channel 1 (TSC1).
7. If using, select Instrument Type and Model for Channel 2 (TSC2).
8. Click **Load Defaults**.
9. Make any necessary changes to settings, if needed.
10. Select Active Channel (channel that the test will be running on).
11. Click **OK** to return to Configure Hardware window.
12. Wait for M-TEST 4.0 to send setup information to the controller.
13. Click **OK** to return to the Main window.

7.2 SOFTWARE TEST CONFIGURATION

The software configuration for each test varies. Following are step-by-step instructions for setting up and running a curve, ramp and manual test. For detailed descriptions of each control and option, see *Chapter 6 – Software Configuration*.

7.2.1 CURVE TEST

Curve testing is best used for heat run or endurance testing simulating a real life usage or just for checking a few specific data points.

1. From the Main window, click **Configure Software**.
2. Under Test, select **Curve** for the Type.
3. Under Curve/Manual Test Parameters, select Control Parameter.
4. Enter values in Control Data table.
5. Click **Configure Display**.
6. Select parameters to record and/or display during test.
7. Select Y-axis parameter.
8. Click **OK** to return to Configure Software window.
9. Click **OK** to return to Main window.
10. Click **Run Test**. The Test window will appear based on the Configure Display setup.

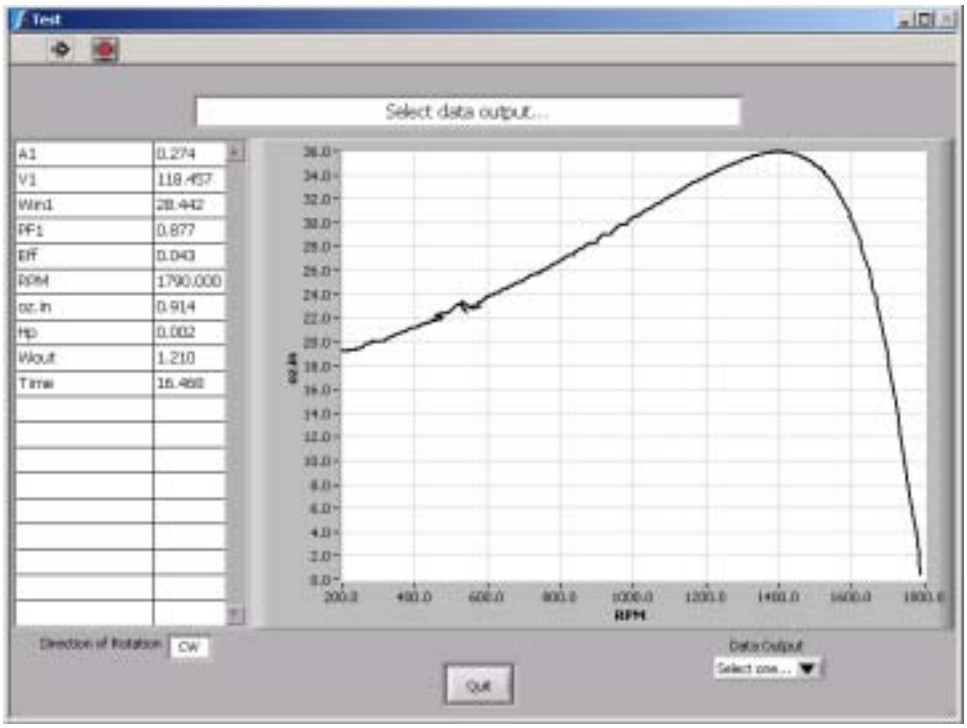


Figure 7–1 Test Window Example

11. When the test run is complete, select desired Data Output option. (For a detailed description, see *Chapter 8 – Data Output*.)

Note: If results are undesirable, see *Section 7.3.1–Adjusting the Controller for a Curve Test*.

7.2.2 RAMP TEST

Ramp testing is best used for obtaining a full performance curve in a short period of time.

1. From the Main window, click **Configure Software**.
2. Under Test, select **Ramp** for the Type.
3. Under Ramp Test Parameters, select Ramp Method.
4. Set Ramp Rate to approximately 1/10th of free-run speed of motor.
5. Set Minimum Speed.

Note: For initial test, achieving locked rotor is generally not desirable.

6. Click **Configure Display**.
7. Select parameters to record and/or display during test.
8. Select Y-axis parameter.
9. Select X-axis parameter.
10. Click **OK** to return to Configure Software window.

11. Click **OK** to return to Main window.
12. Click **Run Test**. The Test window will appear based on the Configure Display setup. See *Figure 7–1 Test Window Example*.
13. When the test run is complete, select desired Data Output option. (For a detailed description, see *Chapter 8 – Data Output*.)

Note: If results are undesirable, see *Section 7.3.2–Adjusting the Controller for a Ramp Test.*

7.2.3 MANUAL TEST

Manual testing is best used for a quick check of a parameter.

1. From the Main window, click **Configure Software**.
2. Under Test, select **Manual** for the Type.
3. Under Curve/Manual Test Parameters, set Sampling Rate.
4. Click **Configure Display**.
5. Select parameters to record and/or display during test.
6. Select Y-axis parameter.
7. Select X-axis parameter.
8. Click **OK** to return to Configure Software window.
9. Click **OK** to return to Main window.
10. Click **Run Test**.
11. Select Data Output option. (For a detailed description, see *Chapter 8 – Data Output*.)

7.2.4 PASS/FAIL TEST

Pass/Fail testing is best used for checking a few data points at the end of a production line or incoming inspection.

1. From the Main window, click **Configure Software**.
2. Under Test, select **Pass/Fail** for the Type.
3. Under Pass/Fail Test Parameters, select **Control Parameter**.
4. Enter values in data table.
5. Select Pass/Fail Parameters (up to 5) and enter minimum and maximum values for each of the load points.
6. Click **Configure Display**.
7. Select parameters to record and/or display during test.
8. Select Y-axis parameter.
9. Click **OK** to return to Configure Software window.
10. Click **OK** to return to Main window.
11. Click **Run Test**. The Test window will appear based on the Configure Display setup. Once the test has completed its sequence, the test results will appear indicating whether the motor was PASS or FAIL. The failing data points will be indicated with an asterisk (*).
12. Test saves automatically to pre-selected filename.
13. Select **Next Test** to run the same test for a new motor.

14. Once all of the motors have been tested, click **Quit** to return to the Main window.

7.3 ADJUSTING THE CONTROLLER

If results of a test are undesirable, the PID values will need to be adjusted. For more information on PID, see *Appendix A – PID/Scaling*.

1. From the Main window, click **Configure Software**.
2. Click **Adjust Controller**.

7.3.1 ADJUSTING THE CONTROLLER FOR A CURVE TEST

1. Set P to **35**.
2. Set I and D to **0**.
3. Set PS, IS and DS to **A**.
4. Set High Value to the highest load used on the motor during testing.
5. Set Low Value to the lowest load used on the motor during testing.
6. Set Dwell to **2** or **3** seconds.
7. Click **Run**. The result will appear similar to the following example.

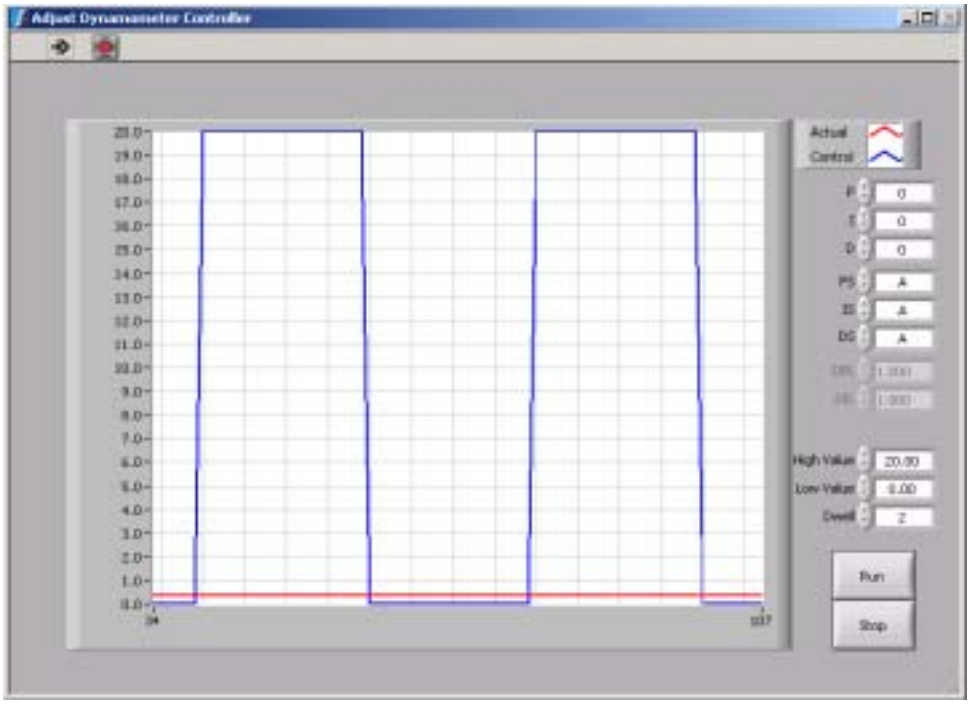


Figure 7–2 Curve (no I or D)

8. Increase PS until actual value is approximately ¼ of ideal value. If one PS value is too low and the other is too high, use the lower setting and increase the P value until optimal setting is reached. When optimal setting is reached, the result will appear similar to the following example.

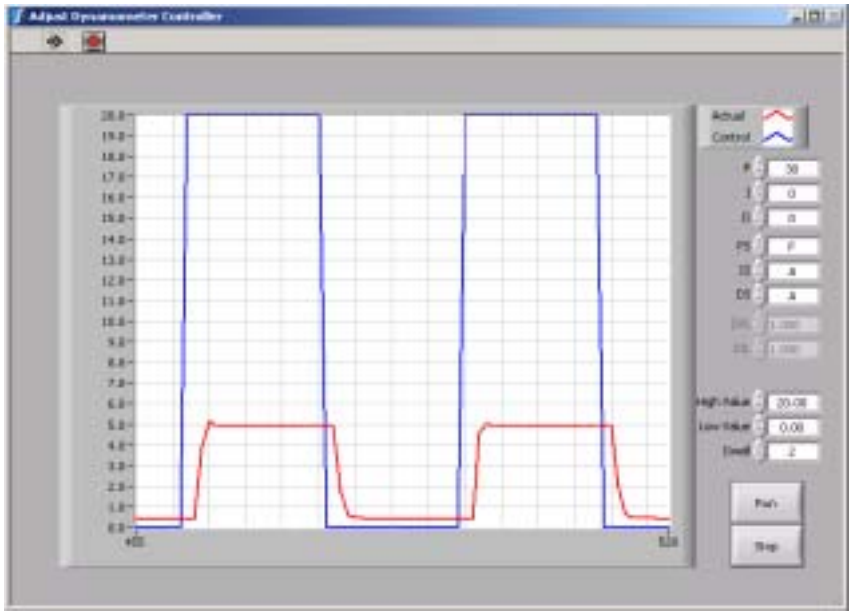


Figure 7–3 Curve (P at ¼)

9. Set I to **35**.
10. Start increasing IS until actual value reaches ideal value. If one IS value is too low and the other is too high, use the lower setting and increase the I value until optimal setting is reached. When optimal setting is reached, the result will appear similar to the following example.

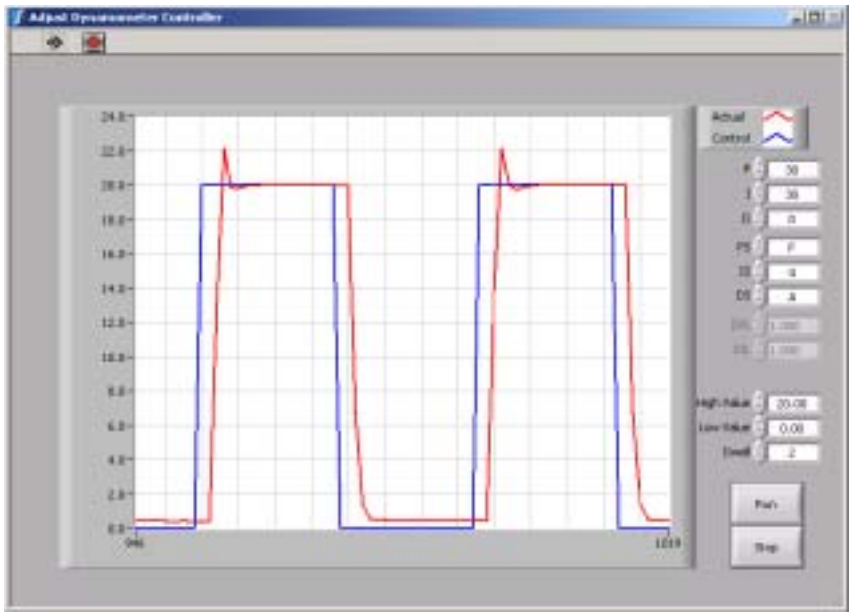


Figure 7–4 Curve (with P and I)

11. Set D value to **35**.
12. Start increasing DS until the actual curve matches or is as close to the ideal curve as possible. The final result will appear similar to the following example.

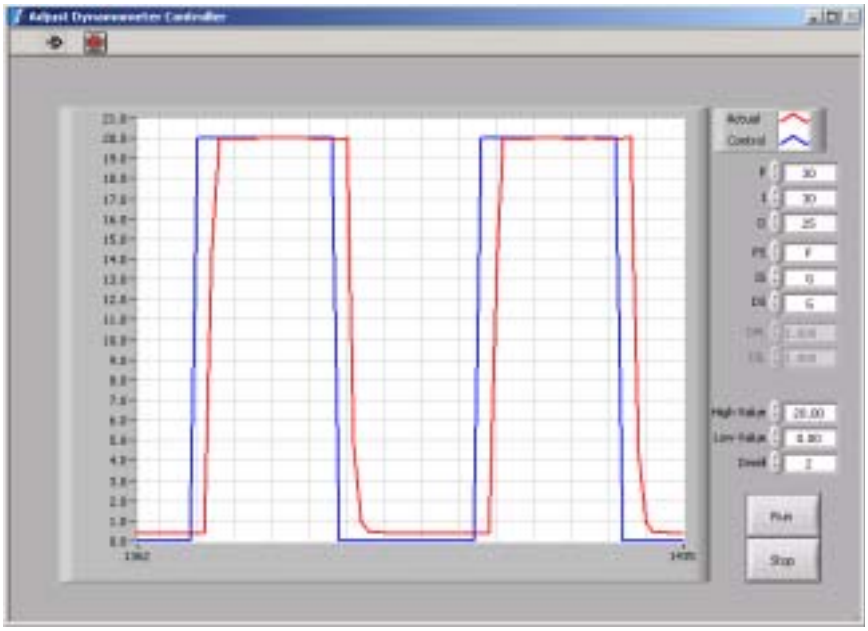


Figure 7–5 Matched Curve

13. If satisfied with response, click **Quit**.

Note: When the Adjust Dynamometer Controller window is closed, the new PID values will automatically update in the Configure Software and Advanced Configuration windows.

7.3.2 ADJUSTING THE CONTROLLER FOR A RAMP TEST

1. In the Configure Software window under Ramp Test Parameters, turn Dynamic PID Scaling **On**.
2. Click **Adjust Controller**.
3. Set P to **35**.
4. Set I and P to **0**.
5. Set PS, IS and DS to **A**.
6. Set DPL, DIL and DDL to **1**.
7. Click **Run**. The result will appear similar to the following example.

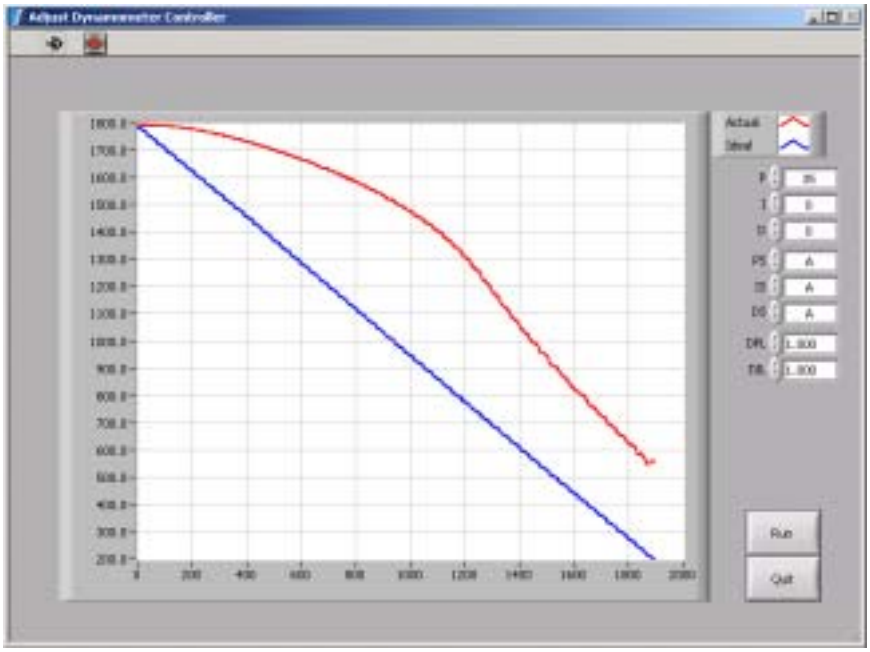


Figure 7–6 Ramp (with bump and offset)

8. If the actual response is not consistent with the ideal response and there is a bump as seen in Figure 7–5, set I to **35**. For more information on ideal and actual response, see *Section 6.9– Adjust Controller*.
9. Click **Run**. The result will appear similar to the following example.

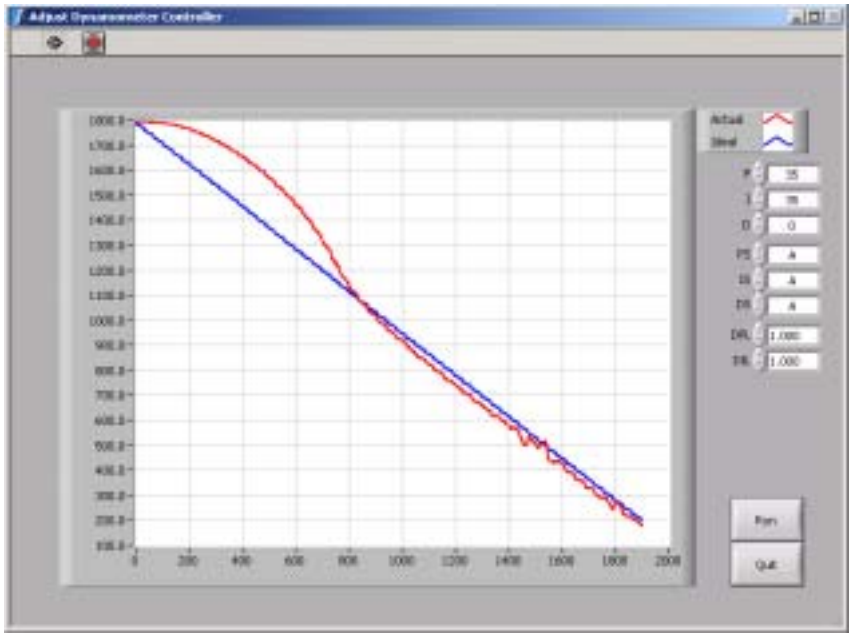


Figure 7–7 Ramp (with bump)

10. Increase IS value until bump diminishes. While adjusting, click **Run** between each adjustment to see results. When optimal setting is reached, the result will appear similar to the following example.

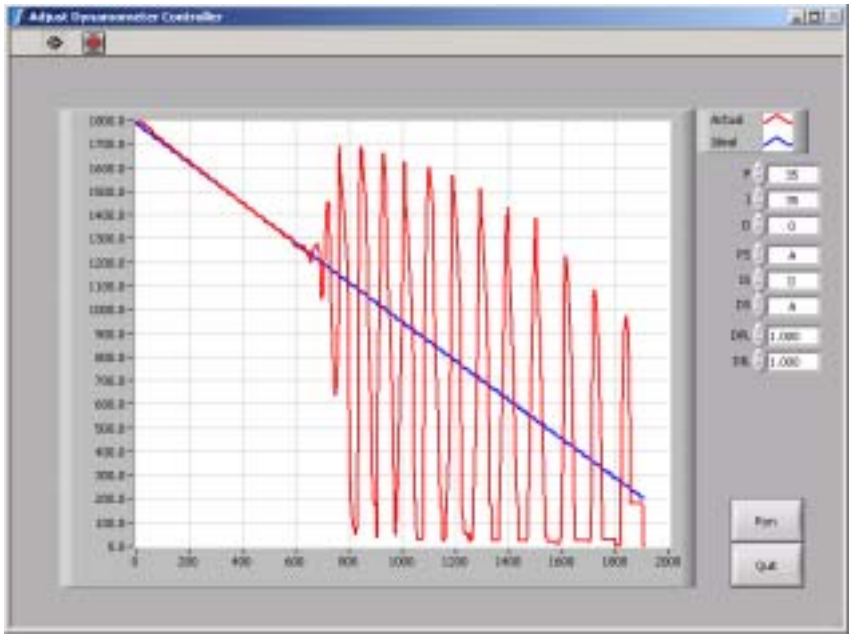


Figure 7–8 Ramp (no bump but unstable)

11. Set D to **35**.
12. Increase DS until major instability diminishes. While adjusting, click **Run** between each adjustment to see results. When optimal setting is reached, the result will appear similar to the following example.

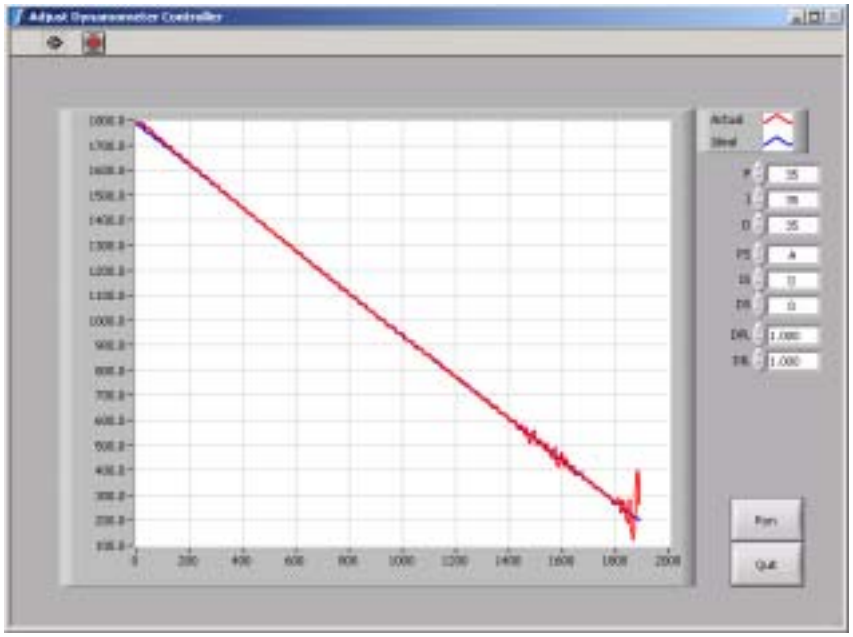


Figure 7–9 Ramp (no bump and stable)

13. Decrease DIL until minor instability diminishes. While adjusting, click **Run** between each adjustment to see results. When optimal setting is reached, the result will appear similar to the following example.

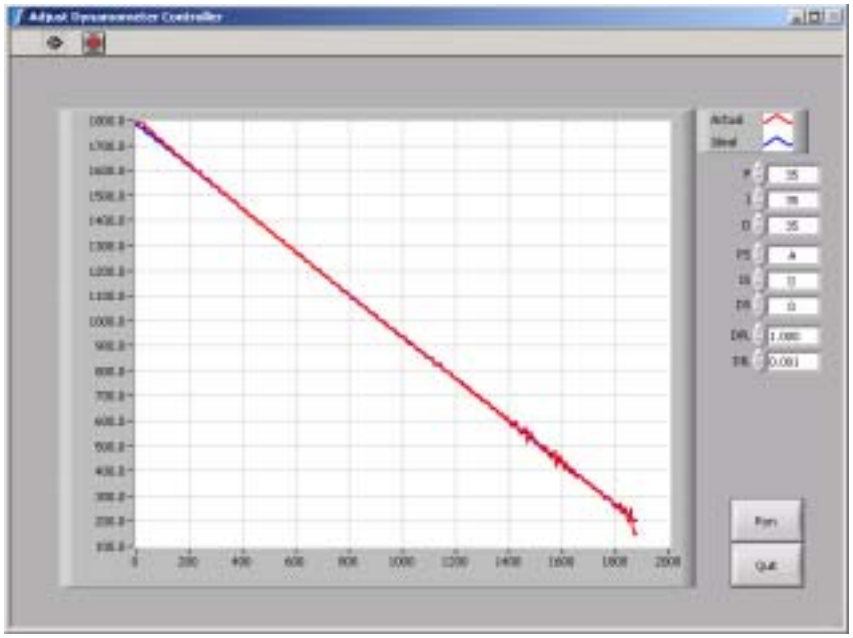


Figure 7–10 Final Ramp

8. Data Output

After the test has been completed, the Data Output options will appear in the Test window.

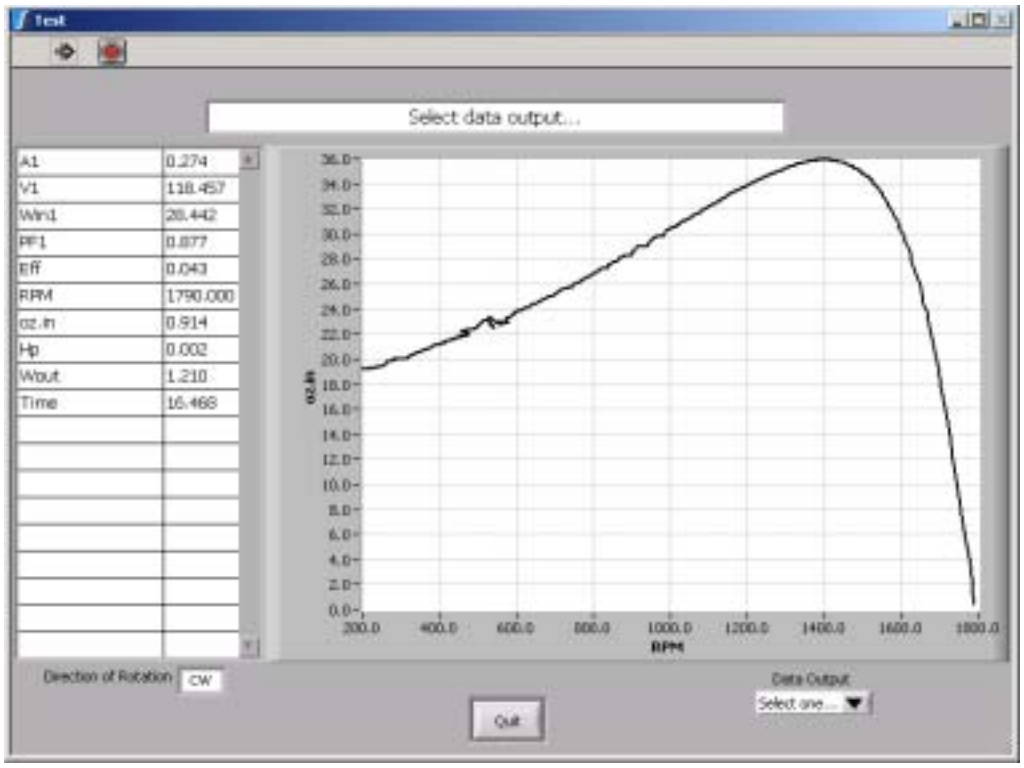


Figure 8–1 Test Window with Data Output Options

In the lower right corner is a list of data output options, which include Display, Screen Plot, File Save and Return. To select, click arrow and drag to the selection. A description of each option follows.

8.1 DISPLAY

Displays the acquired test data in a tabular format.

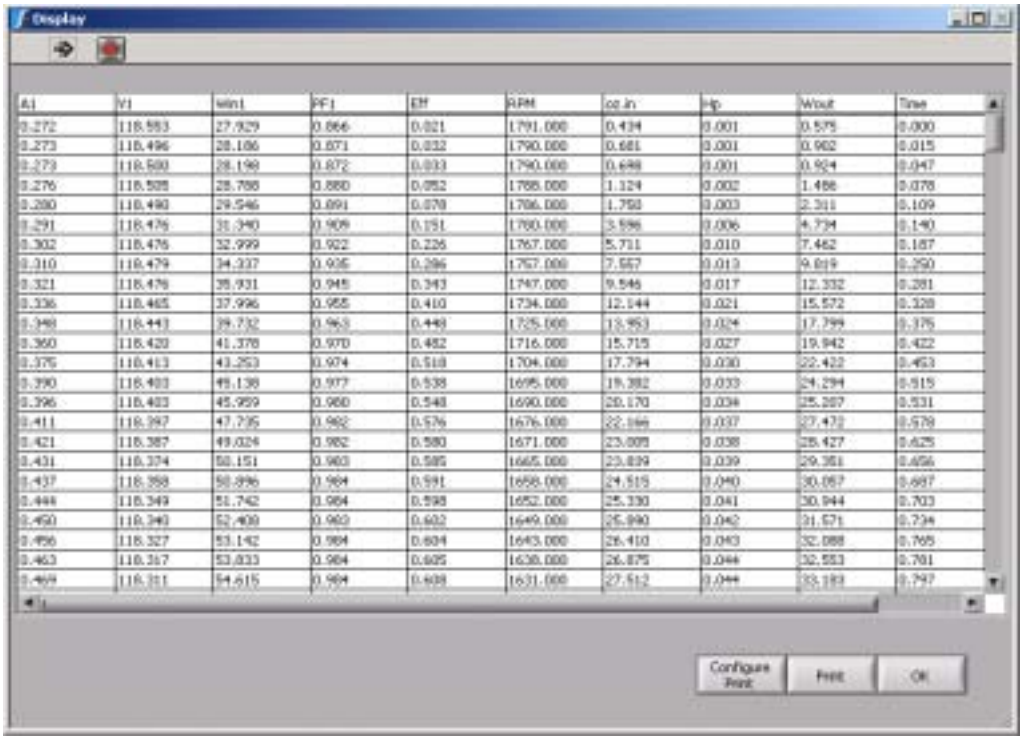


Figure 8–2 Display Window

The data can be reviewed by using the scroll bars to the right and at the bottom of the data table.

To customize the data, click **Configure Print** and the following window will appear.

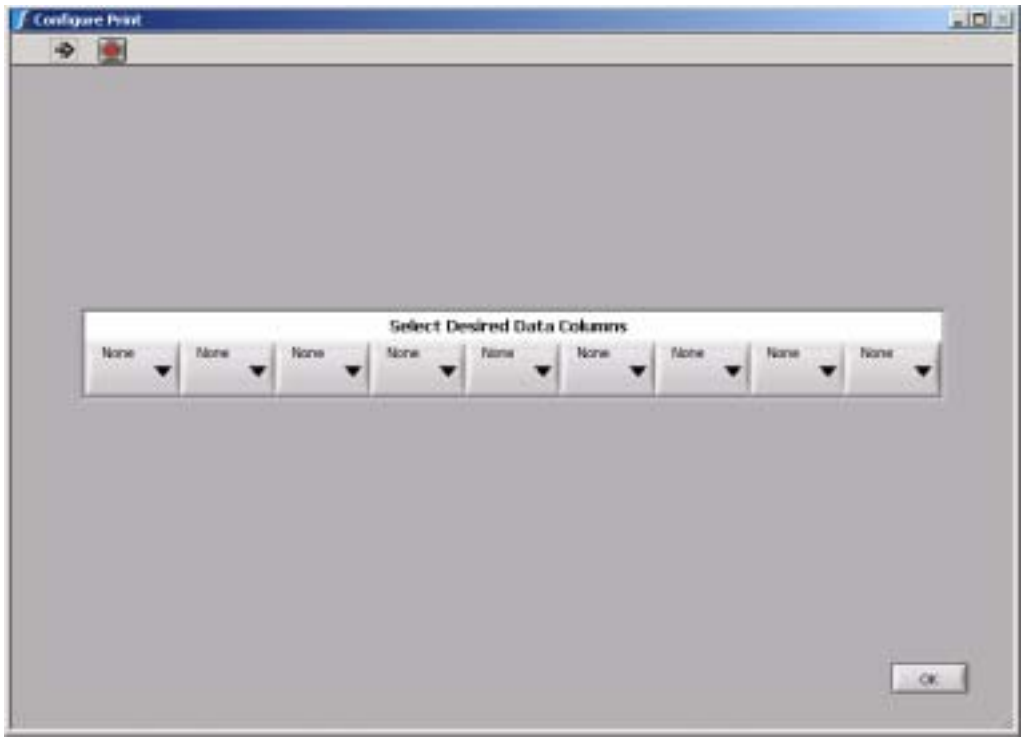


Figure 8–3 Configure Print Window

Select your Desired Data Columns and click **OK** to automatically return to the Display Window.

Click **Print** and the customized data that was selected in the Configure Print Window will be sent to your local printer.

Note: M-TEST 4.0 only has the capability to print 9 columns at a time. If printing more than 9 columns, it is suggested that the file be saved and then printed from another program. The file is formatted as a tab delimited text file that can be easily opened in any spreadsheet program. For instructions on how to save a file, see *Section 7.3–File Save*.

To return to the Test window, click **OK**.

8.2 SCREEN PLOT

Allows one parameter to be set for the X-axis and up to 5 parameters to be set for the Y-axes, which will then be displayed in a colored and labeled graph.

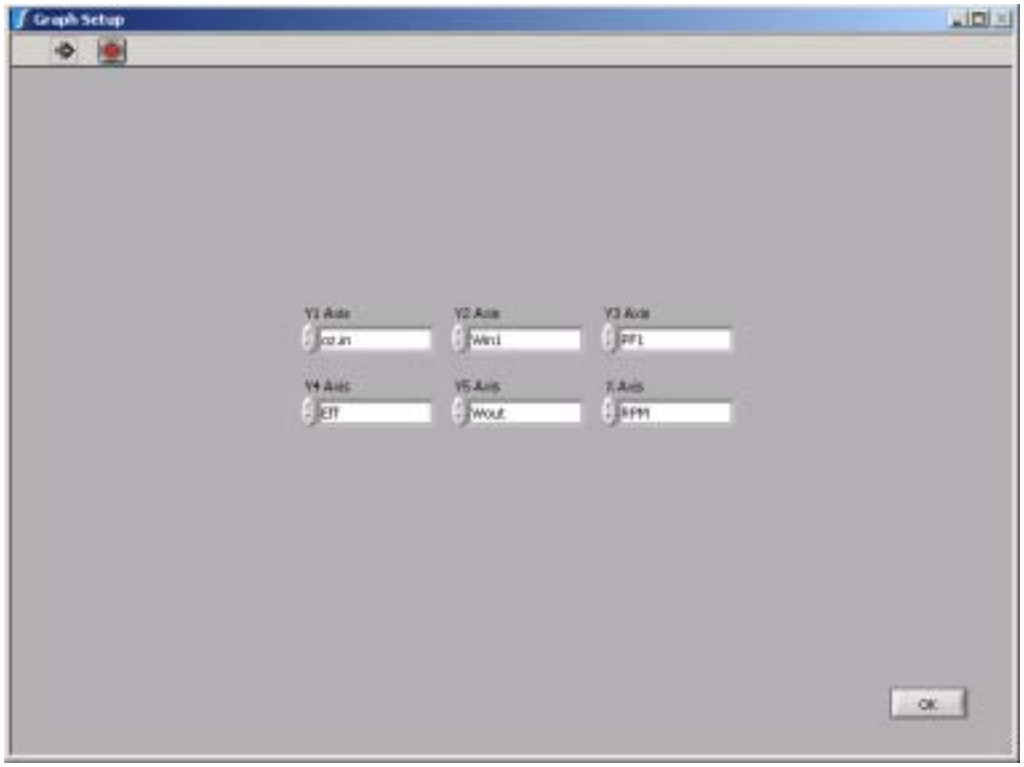


Figure 8–4 Graph Setup Window

To set up the graph, click inside the box and drag to the selection or use the up and down buttons to the left of the control until desired selection is reached. At least one parameter must be selected for both the X and Y1-axis. If no additional parameters are needed for the Y-axis, select **None**.

Note: The possible plotted parameters will only include those items that were originally set up in the Configure Software and Configure Display windows. See *Section 6.7–Configure Display*.

Click **OK** once setup is complete and the Graph window will appear.

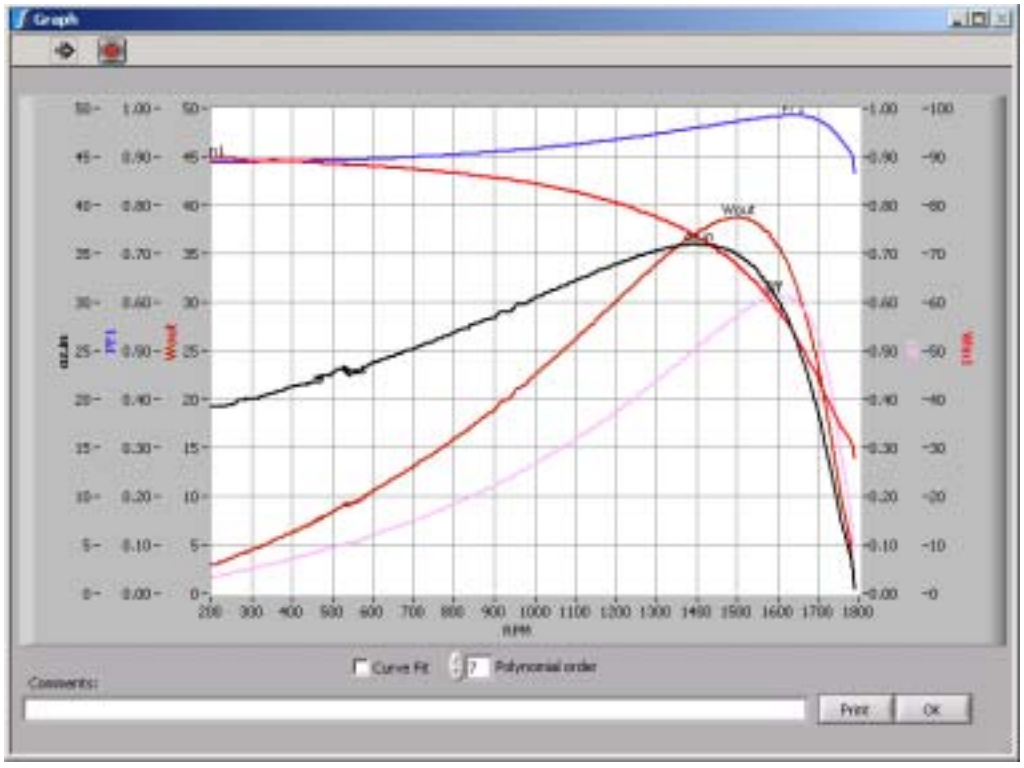


Figure 8–5 Graph Without Curve Fit

Each axis may be manually scaled by double clicking on the minimum or maximum value for that scale and entering a new value. The plotted data will follow the new scaling for that parameter. If a hard copy print is selected, the new scaling will be applied to it.

If a smoother curve is preferred, select the **Curve Fit** check box and adjust the Polynomial order by typing the value or clicking the up and down arrows to the left of the box. The Polynomial order is adjusted based on appearance and how well the curve approximates the actual data. When the curve reaches desired appearance, the Graph window will appear as follows.

Note: When enabled, the fitted data will be shown with narrow, dashed lines and the raw data will be shown with wide, solid lines.

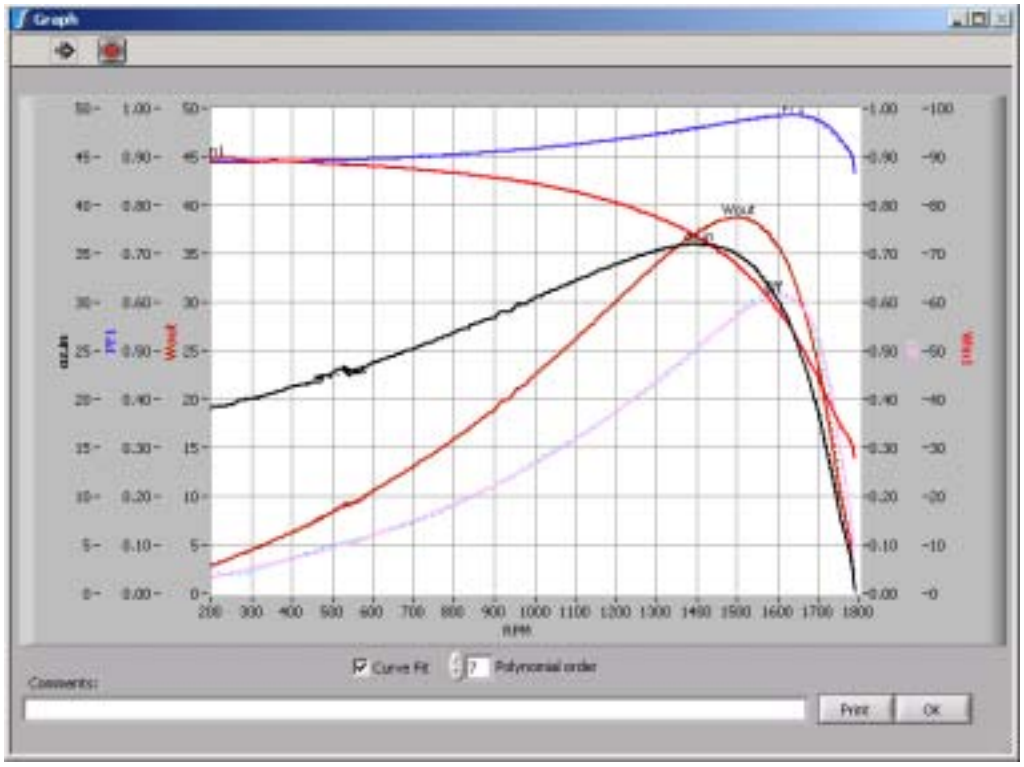


Figure 8–6 Graph With Curve Fit

Type desired notes into the Comments box and they will appear on the printed document and saved in the data file.

Click **Print** to send information to printer. If curve fitting is enabled, only the fitted data will be printed.

To return to the Test window, click **OK**.

8.3 FILE SAVE

When the File Save option is selected, the Save As dialog box will appear.

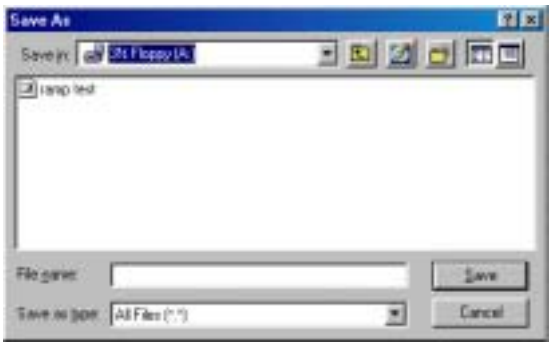


Figure 8–7 Save As Dialog Box

Select the location where the file should be saved and type the desired File name. Any files saved will be able to be retrieved at a later date and used for further testing.

8.4 RETURN

Selecting Return will end the Data Output options and return the program to the Main window.

Note: All data from the test will be lost unless the File Save option was chosen or the Data Logging feature was enabled in the Software Configuration setup. See *Section 6.4–Data Logging*.

8.5 LOAD FILE

Click **Load File** from the Main window to retrieve previously stored test data. Open the desired file and the Main window will appear with the Data Output option list.

Figure 8–8 Load File Data Output

The Data Output options include Display, Screen Plot and Return. They all function the same as described in Sections 8.1, 8.2 and 8.4. The only Data Output option that is not offered is the File Save option. The file is already saved, so it is not necessary.

9. Troubleshooting

PROBLEM	REASON	SOLUTION
Click **Run Test** and there is no response.	M-TEST 4.0 has not been properly configured.	The hardware and software must be configured before a test may be run.
The testing instrument model was changed in the Advanced Configuration window and the values did not update.	Did not load defaults.	Must click **Load Defaults** button to automatically update all values and program the torque units into the controller. NOTE: If necessary, once the defaults are set, they can be adjusted.
When starting M-TEST 4.0, the following message appears: "Error 7 occurred at Open File+.vi:Open File".	The M-Test Defaults.txt file is not found in the working directory.	Click **Stop**. Close M-TEST 4.0 by clicking "X" in the upper right corner of the window. Find the M-Test Defaults.txt file and save to the directory where M-TEST 4.0 is located.
No serial communication with controller.	Setup error and/or hardware fault.	Check cabling, Baud Rate and COM port of controller.
3-phase power analyzer (6550, 6530 or 5300) will not acquire data in single-phase mode.	The power analyzer has not been properly connected.	When using a 3-phase power analyzer to acquire data in single-phase mode, the circuitry that is being tested must be connected to phase 1 on the rear panel of the power analyzer.
The current revision of M-TEST 4.0 is not properly loading setups from older revisions of M-TEST 4.0.	The current revision of M-TEST 4.0 may have different setup parameters than what was used in older revisions.	New test setups will need to be created for the current revision of M-TEST 4.0. Because data might be distorted when downloading old test setups in the current revision, open the test in the old revision first to record any important parameters (e.g. PID, Scaling, Load Values, Dwell Times, etc.). Now a test can be easily re-created in the current revision of M-TEST 4.0.
Screen plot does not look exactly as it did during the curve test.	During the test, data is acquired and plotted at the maximum system sample rate but data is stored at the user-defined rate.	Increasing the sample rate will store more data points and the plot will look more like the original.
The Desired Data Columns in the Configure Report window only show Torque and Speed.	The software needs to be configured according to the data to be acquired and displayed.	From the Configure Software window, click Configure Display button. Hold down the Shift key and click the desired parameters. Click OK.
While running a curve test, the dwell period that was set caused the program to lock up when the test was started.	The software uses a timing function to determine how long data can be acquired. If a large number is entered (e.g. 99,999 minutes), the program is unable to read it and will crash.	To run a test for a long period of time, use a reasonable time scale. For example, 6 hours = 360 min.

If you require additional assistance, please contact Magtrol Customer Service at +1 716-668-5555 in the United States or +41 26 407 30 35 in Switzerland.

Appendix A: PID/Scaling

A.1 ABOUT THE PID LOOP

The DSP6001 has PID adjustment capability for both the speed and torque modes to provide the best system response. The PID Loop comprises the following three variables:

P = proportional gain
I = integral
D = derivative

Other important variables include:

- Set point - desired load or speed
- Error - difference between the set point and the actual measurement

A.1.1 P (PROPORTIONAL GAIN)

With proportional gain, the controller output is proportional to the error or to a change in measurement. Deviation from the set point is usually present. Increasing the proportional gain will make the PID loop unstable. Increasing the integral value will eliminate this instability. For best loop control, set the proportional gain as high as possible without causing the loop to become unstable.

A.1.2 I (INTEGRAL)

With integral, the controller output is proportional to the amount of time the error is present. Increasing the integral value eliminates the offset from the set point. If the response becomes oscillatory increase the derivative value.

A.1.3 D (DERIVATIVE)

With derivative, the controller output is proportional to the rate of change of measurement or error. Derivative can compensate for a changing measurement. Derivative takes action to inhibit more rapid changes of the measurement than proportional gain.

A.2 HOW THE PID LOOP WORKS

The following diagram demonstrates the correlation between the variables in the PID Loop.

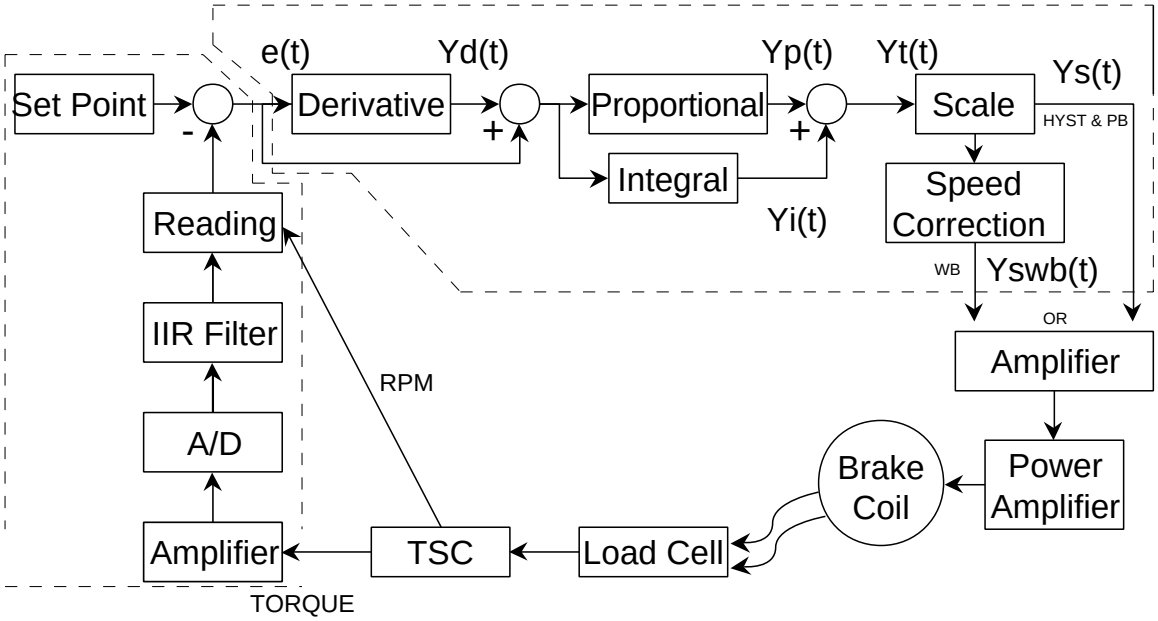


Figure A–1 System Block Diagram

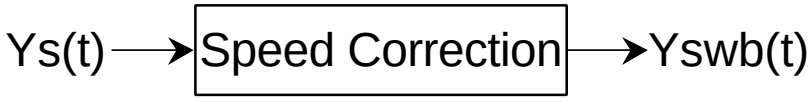
A.2.1 PID SCALING FOR HYSTERESIS, EDDY-CURRENT AND POWDER BRAKE DYNAMOMETERS

TORQUE: TSC1 $Ys(t) = Yt(t) / 1.725 * 2$

TSC2 $Ys(t) = Yt(t) / 1.725 * 2 * 1.6623$

SPEED: TSC1 & TSC2 $Ys(t) = Yt(t) * 5319.93 / MAX\ SPEED$

A.2.2 SPEED CORRECTION FOR WB (EDDY-CURRENT BRAKE) DYNAMOMETERS



The WB Dynamometer follows the same scaling as the HYST and PB with the addition of one calculation for both torque and speed. This calculation is due to the fact that for a given current the torque changes with speed. This is referred to as speed correction.

$Yswb(t) = (Ys(t) + Ys(t)\ /\ speed\ correction\ factor)\ /\ 2$

The speed correction factor is calculated on each entry into the PID loop equations.

Speed Correction Factor = - .0001 x 2 + .0203 x + .005 limited to .051 to 1

where x = RPM / NOMINAL SPEED * 100

NOMINAL SPEED is set by the user and obtained from the data sheets for the dynamometer or brake.

APPENDIX

A.2.3 EQUATIONS

Where Skp, Ski and Skd are system coefficients…

$Yd(t) = (e(t) - e(t-3) + 3 * (e(t-1) - e(t-2))) * (10/Skd) * D\%$

$Yp(t) = (e(t) + Yd(t)) * (10/Skp) * P\%$

$Yi(t) = Yi(t-1) + (e(t) + Yd(t)) * (10/Ski) * I\%$

$Yt(t) = Yp(t) + Yi(t)$

$Ys(t) = Scale * Yt(t)$

A.3 PID SCALING

PID Scaling is a multiplier of the P, I or D term. Due to the fact there are so many different dynamometer types and motor combinations, this multiplier is needed to extend the range of the PID. The letters represent the following:

A	=	0.001	F	=	0.5
B	=	0.005	G	=	1
C	=	0.01	H	=	5
D	=	0.05	I	=	10
E	=	0.1			

In using the multiplier, the user can input PID numbers from .001 (.001 x 1%) to 990 (10.0 x 99%) with good resolution.

A.4 DYNAMIC PI SCALING

In some cases, PI values that have been fine-tuned for best system response at higher speeds will not be suitable at lower speeds. The DSP6001 allows the use of dynamically changed PI values to correct this. When the DPL or DIL controls are set at 1.000, the PI coefficients remain constant between the free run speed and minimum speed. Changing any control to a value less than 1.000 dynamically changes the P or I from 1.000 at free run to the control value times the starting value, at minimum speed.

For example, a DIL of 0.010 produces an I term of 1/100th the starting value at the end of the ramp.

Note: This feature is available only during a Ramp Test.

A.4.1 SETTING THE PID FOR RAMP DOWN

It is nearly impossible to select a PID value that optimizes the control loop over a wide range of speed. With Magtrol's experience in motor testing, our engineers have developed a dynamic PID algorithm. The PID values change with the Speed Set Point. In most cases, the PI values are high when the motor is lightly loaded and tend to decrease at higher loads.

M-TEST 4.0 provides a setup PI function in the setup for the ramp test. In the program, the dynamic scaling can be enabled or disabled and the span of the scaling can also be selected. See *Section 6.6–Ramp Test Parameters*.

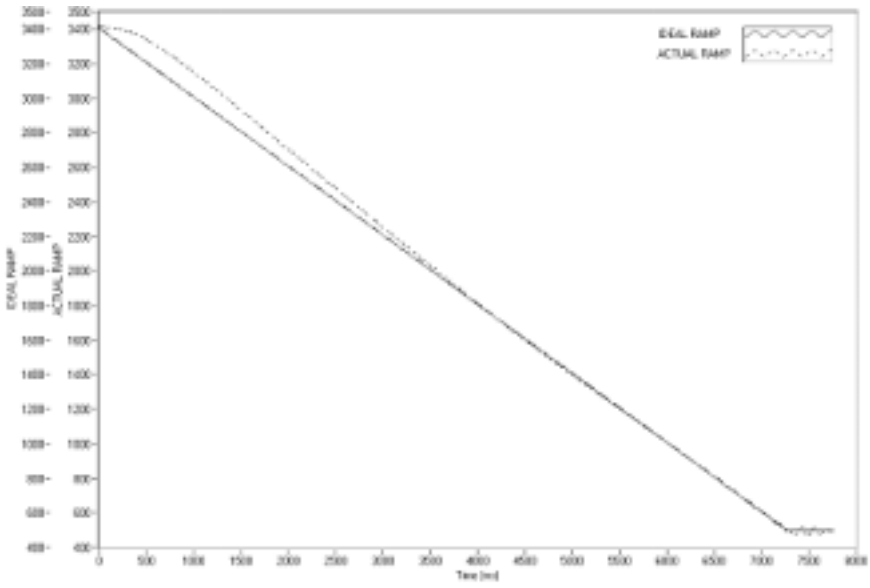


Figure A–2 Ramp Down Low I

Ramp shows low value for I term. Note “bump” at beginning of ramp and good results toward end of ramp.

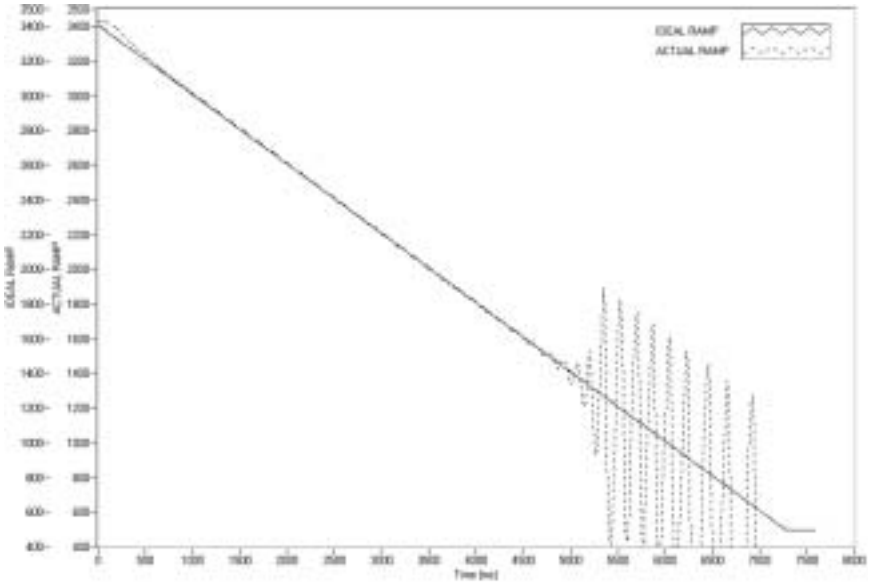


Figure A–3 Ramp Down High I

Ramp shows higher value for I term. Note “bump” at beginning of ramp has been reduced but there are poor results toward end of ramp.

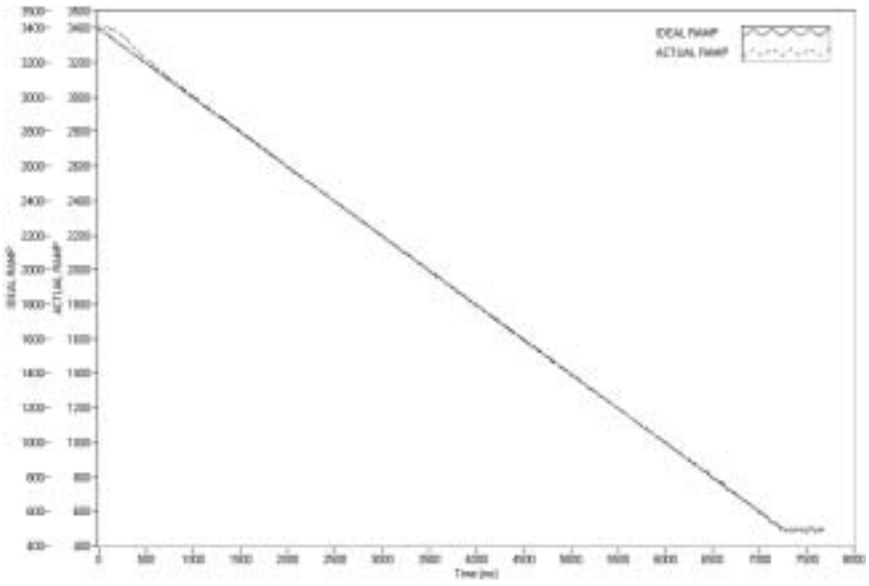
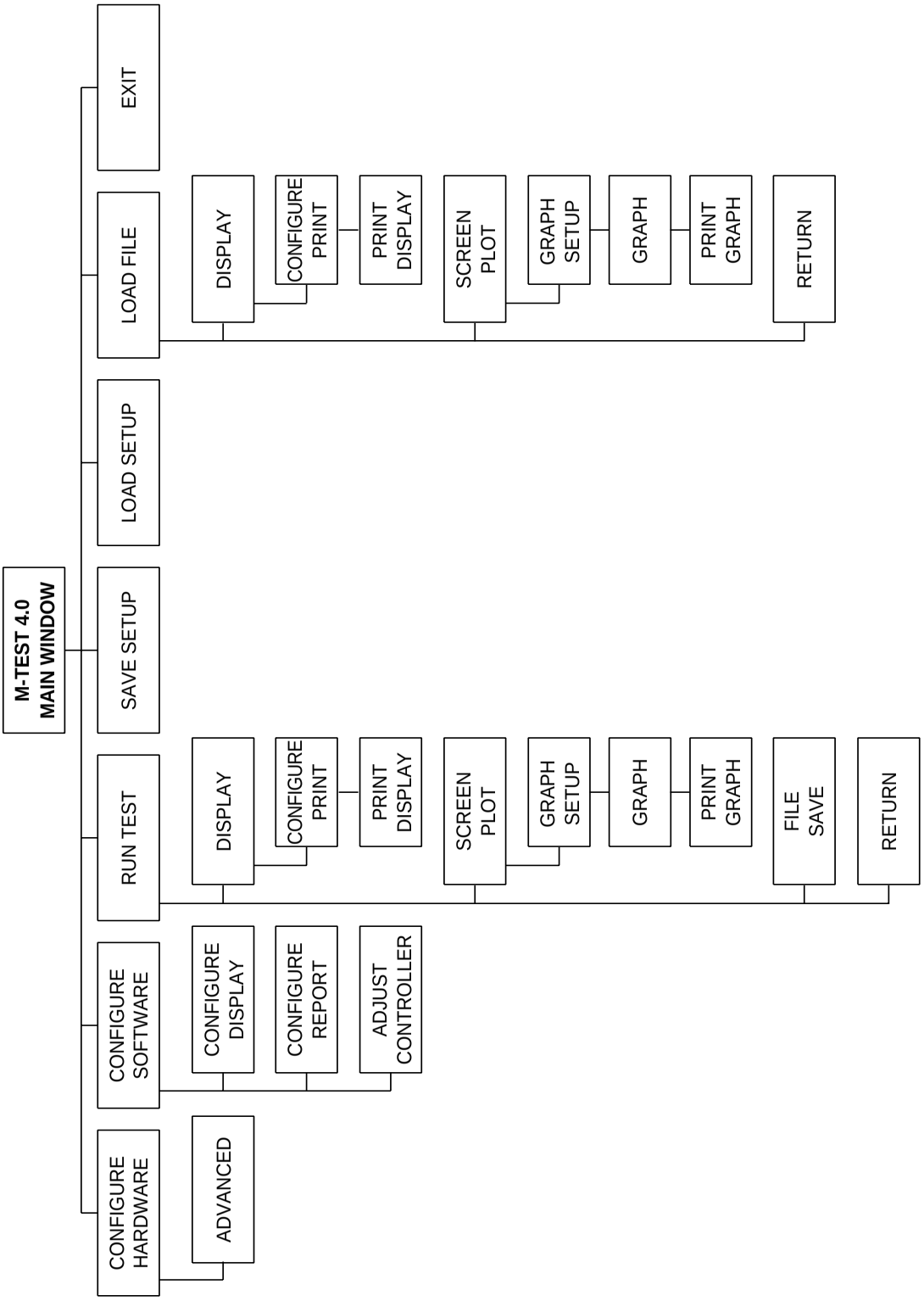


Figure A–4 Ramp Down Dynamic I

Ramp shows Dynamic Scale effect. Note “bump” at beginning of ramp has been reduced and there are good results toward end of ramp. DIL was set to 0.01. At the end of the ramp, the I term is 1/100th of the starting value.

Appendix B: M-TEST 4.0 Flow Chart

The following flow chart is a representation of how M-TEST 4.0 is organized and shows, at a quick glance, where all the main features are located within the program.



Appendix C: Software Revision History

Release	Date	Revisions
1.0	04/27/2001	Initial release.
1.1	05/02/2001	Disable Max. Temp if no TC HW. Disable Max. Current if no PA. Disable LR Dwell if Dyn-CF. Set Dyn-CF if IC = Prev. Val or No. Disable unused PID controls if not Torque or Speed Curve. Increased range of Max. Temp and Max. Current controls. Coordinated graying out of PID controls to test type. Fixed range of some controls mysteriously reset to 100 max. Added DC power supply control in Adjust Dyno Controller. Changed timer from counting seconds to horizontal slide bar. Changed background color of Adjust Dyno Controller curve graph. Fixed efficiency and time showing >0 at free run. Config Report wasn't recalled.
1.2	05/14/2001	Added Recalculate Data.vi so PF, Eff, Wo and Hp are shown properly. Added 6530 programming and calculations. Grayed PS, IS, DS in Adjust Dyno when using Amps or Watts Curve. Fixed Max. Current control not showing in Config. SW. Reset Load with 'R' for Amps or Watts curves. Coerced I to 0 if calculated to be >99.99.
1.3	05/17/2001	Fixed report sometimes showing extra blank line. Changed to Waveform Graph if Manual Test selected with X-axis = Time; This fixed graph buffer being overloaded and slowing down screen response. Added 'Test Running' message to Manual Test.
1.4	05/30/2001	Fixed File Open inserting extra blank data column. Edited descriptions of Avg-D/U and Dyn-CF ramp tests. Added Serial Port Init to Advanced Initialization. Fixed baud rate settings. Made serial port reads more robust.
1.5	06/04/2001	Advanced Config would not show last HD dyno model.
1.6	06/14/2001	Fixed serial port control not allowing COM1. Added absolute value to Eff, Wout, and Hp. Removed -1 function for serial port in Output Raw Ramp Data.vi. Copied serial port read routine to Aux. input.
1.7	06/27/2001	Changed waveform chart to scope update mode. If curve test is N or Q stabilized, send command only on change of value. Added 500mS GPIB timeouts to Send Command and Read Instruments. Use I99.99 to lock rotor after fast ramp down in Avg D/U test. Fixed column headers not coming back correctly from file.
1.8	09/25/2001	Added Max Brake Current control to Avg D/U ramp test. If maximum torque limit is reached in Avg D/U ramp, cancel locked rotor test. On report printout, limited special fields to 3 digits of precision. Added ramp start speed to ramp up in Avg D/U. Removed line feed from serial commands for DSP6000.

		Fixed File Save adding extra tab, and File Open deleting last column. Now, file may be edited in Excel, saved as tab delimited text, and recalled OK. Added Zimmer LMG310 to power analyzer menu. Fixed TC labels not showing up properly on graph. Added curve fit option for graph on generated report. Set power analyzer to local after adjust dyno routine. Added ability to select column parameters for printout. Fixed curve test where requesting a torque going from some value to zero stayed at that value.
1.9	02/20/2002	Added Pass/Fail testing. Fixed Graph Visible control. Added Fieldpoint hardware selection for temperature measurement. Fixed Manual Test - Quit - Cancel function not canceling. Made thermocouple label name show up on test-graph axis instead of just “Thermocouple”. Made graph update on screen after Ramp, Dynamic-CF, Previous Value test. Fixed quit from adjust dyno controller dropping motor to stall temporarily. Added Maximum Speed for Ramp test. This keeps motors from running away at free run. PID’s must be set to reasonable value first since this is a speed stabilized function. Removed unused columns from printout of data if there are less than nine. In Configure Display, made the torque selection show the units selected. Generated, one page report can now be saved and recalled for viewing and printing. Added 6510e. Made sampling rate entry of 0.01 seconds in manual test default to fastest possible acquisition. Added 5240/4629B controllers. Added Open Loop Curve test. Changed defaults on Config SW to Torque Curve. Added description of scaling letters for QPS-QDS and NPS-NDS. Added second control in Adjust Dyno Controller so that you can step between two load points instead of just no-load and some load. Changed Pre-Test Init. so that Max Speed Excited values are recalled when using PB’s. Added 3 Hz filter selection. Fixed curve test so that if you are in a torque or speed dwell period, the command is sent just once. Changed format of saved data in Pass/Fail test so it is easier to work with in Excel. Changed torque units for SI to mN.m, cN.m and N.m. Fixed Curve and Pass/Fail tests where not ending with a zero load value caused no loading the next time the test was run. Shift register was not being re-initialized.
2.0	03/15/2002	Added absolute value to Graph and Print Graph so negative values can be plotted. Otherwise, they disappear from the plot. Fixed Channel 2 Torque/Aux Scale Factor not being pulled from defaults file. Added capability of up to 4 FP modules (32 thermocouples). Re-wrote Average Down/Up Array with better programming, and to eliminate any data below minimum speed. Fixed a minor problem with report graph not showing data properly unless the selection was first changed to something else.
2.1	07/24/2002	Re-sized Curve Test graph so Y-axis values greater than 9999.9 don’t have the MSD cut off. Programs re-compiled in LabVIEW 6.0.2. Fixed logic error when entering special speed or torque points in Ramp Test. LV 6 conversion problems: Spreadsheet String to Array functions differently. LV 6 conversion problems: Pass/Fail table didn’t scroll.
2.2	08/02/2002	After many problems surfaced with LV6, went back to LV5. Need to make it work with FP3.0.1

2.3	10/01/2002	Re-compiled with FP 3.0.1 and NI-DAQ 6.9.1 drivers. Re-wrote File Open.vi with better programming. Added Yokogawa WT1600 power analyzer. Stopped Manual Test from sending any hidden PID values to controller. Saves graph axis settings. Added offset control for DAQ temperature measurement. Added ability to select special torque and speed points during ramp test at the same time.
2.4	03/06/2003	Updated Sorensen DCS to DHP. Changed quit from ramp so locked rotor is not performed. Fixed bug in wiring mode for LMG310 in 3ph. 3w. 3m. star and 3(2)ph. 3w. 2m. Added any comments from screen plot to the saved file. Show both raw data plot and curve fit at the same time on display only, not on print. Changed report path to report directory and used serial number + .rpt for filename. Access file dialog with a button next to field. Added button next to data directory to access file dialog. This now becomes active when data logging is enabled but not in Pass/Fail test. Added buttons next to pass filename and fail filename to access file dialog. This now becomes the drive/path/filename for Pass/Fail data storage. Added button for file dialog to import data from tab-delimited text file in the following tests:Curve -control data, Ramp - special speed and torque points, Pass/Fail - control data and limits. Enlarged white fields in data logging and control data. Improved quit function from adjust controller routine. One press stops routine, another press quits. Modified code so correct maximum power and maximum torque get sent to DSP6001 when using tandem dyno. Added Volts column to Pass/Fail table for controlling power supply at different levels (just like the curve test). Added delay after turn on of DC power supply before software checks for shaft rotation. Fixed “Ramp Test Parameters” label to 13 point application font. Caused small text on Win2k OS. When waiting for motor to reach freerun, you can use the Quit button to stop the procedure. Made screen plot Y1 and X axis selectors default to “None” to correct LabVIEW quirk. Fix special torque and speed points routine so program doesn’t lock up if value is outside data set. Fixed File Open from pulling in last data point as a comment if file didn’t contain one. Made 6510, 6510e, 6530 and 6550 power analyzers auto-range on Volts. Added HP66xx series power supplies. Fixed appearance of some text and buttons when using Win 2000. Changed to short data labels for column headers. Changed report path to accept multiple points (.) in name, not just the file extension.
2.5	06/23/2003	Rewrote M-TEST using LabVIEW 6.1 Changed 6510 so volts does not autorange during test. This is because it can't do this! Changed graphing routine so that you may rescale any axis to your liking. The rescaled axes will be plotted as such, if selected. Fixed freerun data not being included in complete data set. Removed the CJC reading from the data display when using multiple FieldPoint modules. Added Tandem code. Changed Adjust Dynamometer routine so that you can pre-set controls before starting motor.
2.6	07/21/2003	Added command to turn power supply back on after Next Test is selected in Pass/Fail mode. Added check for RPM if using a tandem dynamometer and changing the advanced configuration. Added Lambda Genesys power supply. Added tip strips to all front panel controls.

2.7	02/03/2004	Fixed last line of data not being recalled if no comment was added to data file. Added color to printed plots. Fixed Gain and Offset being reversed in Read Instruments DAQ vi. Configuration Save and Load using keys. Allows existing configurations (starting in Rev. 2.7) to be used in future program revisions. Added programmable external shunt support for 6510e and 6530. Added gear box ratio. Fixed PF calculation for 6530 and 6550 when in 3ph. 3w. and 3ph. 3V 3A modes. Pass/Fail window now shows actual measured load point value, not the requested value. Pass/Fail failure is now flagged by a white on red highlighted cell instead of asterisks. Removed "Recalculate Data.vi". Not needed after PF was fixed. Caused bad Eff. calculation.
2.8	5/13/2004	Changed "Please Start the Motor…" routine to wait until a speed signal is generated and the button is pressed. Added Pass/Fail checking for direction of rotation. Added Sorensen DCS to power supply list. Removed tip strips (more annoying than helpful). Fixed Y-axis label not indicating thermocouple name on test graph. Added dynamometer pre-load function for DSP6001. Open loop value stays active at all times. Fixed a bug in the configuration save/load where tables that contain more than nine columns were not being recalled properly.
2.81	5/19/2004	Allows 5300 to be used as three single phase analyzers. Efficiency is calculated from Watts on phase 1 only.
2.9	8/12/2004	Fixed 4629B/5240 torque conversion on writes during Curve and Pass/Fail tests. Added Output kW to displayed and control parameters. Changed mechanical action on Config HW and Config SW buttons so they don't latch down with fast computers.
3.0	11/03/2004	Changed order of N and F commands in ramp test and adjust dyno controller routine to solve problem with maximum speed being limited incorrectly on the DSP6001. Fixed quit during ramp down from resetting the maximum speed command. Another bug fixed in 4629B/5240 torque conversion on writes. Added Staco control as standard feature.
3.1	11/24/2004	Corrected efficiency calculation for 6530 and 6550 1-phase 2-wire. Added two button dialog for "Please start the motor…". Allows you to cancel out of the loop. No longer resets the High Value, Low Value and Dwell upon entry into Adjust Dyno Controller.

Index

Magtrol Limited Warranty

Magtrol, Inc. warrants its products to be free from defects in material and workmanship under normal use and service for a period of one (1) year from the date of shipment. Software is warranted to operate in accordance with its programmed instructions on appropriate Magtrol instruments. This warranty extends only to the original purchaser and shall not apply to fuses, computer media, or any other product which, in Magtrol's sole opinion, has been subject to misuse, alteration, abuse or abnormal conditions of operation or shipping.

Magtrol's obligation under this warranty is limited to repair or replacement of a product which is returned to the factory within the warranty period and is determined, upon examination by Magtrol, to be defective. If Magtrol determines that the defect or malfunction has been caused by misuse, alteration, abuse or abnormal conditions of operation or shipping, Magtrol will repair the product and bill the purchaser for the reasonable cost of repair. If the product is not covered by this warranty, Magtrol will, if requested by purchaser, submit an estimate of the repair costs before work is started.

To obtain repair service under this warranty, purchaser must forward the product (transportation prepaid) and a description of the malfunction to the factory. The instrument shall be repaired at the factory and returned to purchaser, transportation prepaid. **MAGTROL ASSUMES NO RISK FOR IN-TRANSIT DAMAGE.**

THE FOREGOING WARRANTY IS PURCHASER'S SOLE AND EXCLUSIVE REMEDY AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTY OF MERCHANTABILITY, OR FITNESS FOR ANY PARTICULAR PURPOSE OR USE. MAGTROL SHALL NOT BE LIABLE FOR ANY SPECIAL, INDIRECT, INCIDENTAL, OR CONSEQUENTIAL DAMAGES OR LOSS WHETHER IN CONTRACT, TORT, OR OTHERWISE.

CLAIMS

Immediately upon arrival, purchaser shall check the packing container against the enclosed packing list and shall, within thirty (30) days of arrival, give Magtrol notice of shortages or any nonconformity with the terms of the order. If purchaser fails to give notice, the delivery shall be deemed to conform with the terms of the order.

The purchaser assumes all risk of loss or damage to products upon delivery by Magtrol to the carrier. If a product is damaged in transit, PURCHASER MUST FILE ALL CLAIMS FOR DAMAGE WITH THE CARRIER to obtain compensation. Upon request by purchaser, Magtrol will submit an estimate of the cost to repair shipment damage.

Testing, Measurement and Control of Torque-Speed-Power • Load-Force-Weight • Tension • Displacement

www.magtrol.com

MAGTROL INC
70 Gardenville Parkway
Buffalo, New York 14224 USA
Phone: +1 716 668 5555
Fax: +1 716 668 8705
E-mail: magtrol@magtrol.com

MAGTROL SA
Route de Moncor 4B
1701 Fribourg, Switzerland
Phone: +41 (0)26 407 3000
Fax: +41 (0)26 407 3001
E-mail: magtrol@magtrol.ch

Subsidiaries in:
- Germany
- France
- Great Britain

Worldwide Network of Sales Agents

Magtrol SA ISO 9001:2000 certified

ISO 9001 SCES 003