MAGTROL

Model 3411

Torque Display

User's Manual

Purchase Record

Please record all model numbers and serial numbers of your Magtrol equipment, along with the general purchase information. The model number and serial number can be found on either a silver identification plate or white label affixed to each unit. Refer to these numbers whenever you communicate with a Magtrol representative about this equipment.

Model Number: _____

Serial Number: _____

Purchase Date: _____

Purchased From: _____

First Edition rev C – September 2014

MAGTROL

Safety Precautions

1. Make sure that all Magtrol Torque Transducers and electronic products are earth-grounded, to ensure personal safety and proper operation.
2. Make sure that torque transducers 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

First Edition rev C – September 2014

TABLE OF REVISIONS

Date	Edition	Change	Section(s)
09/12/14	1st. Edition - rev C	LAN Setup Commands updated.	5.3.3
07/28/14	1st. Edition - rev B	Chapter 7 - Theory added to manual.	Chapter 7
03/10/14	1st. Edition - rev A	3411 Block Diagram updated.	A.1

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7. THEORY

Preface

PURPOSE OF THIS MANUAL

This manual contains all the information required for the installation and general use of the Model 3411 Torque Display. To achieve maximum capability and ensure proper use of the instrument, 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 bench test operators who are going to use the 3411 Torque Display in conjunction with any Magtrol TM In-Line Torque Transducer and TF Torque Flange Sesnor.

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 the 3411 Torque Transducer Display, which describes the unit and provides its mechanical and electrical characteristics.

Chapter 2: CONTROLS - Description of the elements located on the front and rear panels of the unit.

Chapter 3: INSTALLATION/CONFIGURATION - Provides information needed for setup of the 3411.

Chapter 4: MANUALLY CONTROLLED OPERATION - How to run a test when the 3411 is used as a stand-alone unit.

Chapter 5: COMPUTER CONTROLLED OPERATION - How to run a test when the 3411 is used with a personal computer. Includes information on the USB and Ethernet interfaces and command set.

Chapter 6: CALIBRATION - Provides recommended calibration schedules along with step-by-step instructions for the calibration procedure.

Chapter 7: THEORY

Chapter 8: TROUBLESHOOTING - Solutions to common problems encountered during setup and testing.

Appendix A: SCHEMATICS - For the 3411 Display.

Appendix B: MENU SELECTION - Menu selection diagram.

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.

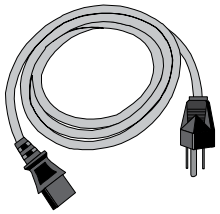
1. Introduction

1.1 UNPACKING YOUR 3411 TORQUE DISPLAY

Your 3411 Torque Display was packaged in reusable, shock resistant packing material that will protect the instrument during normal handling.

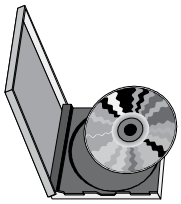
1. Make sure the carton contains the following:

3411 Torque Display

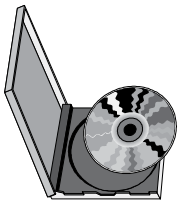


Line cord

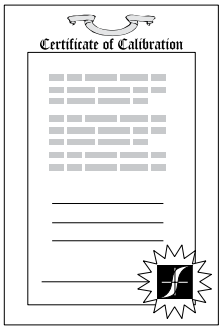
USB Cable



Magtrol
User Manual
CD-Rom



Torque 7 Data
Acquisition
Software



Calibration Certificate

2. Inspect the contents for any evidence of damage in shipping. In the event of shipping damage, immediately notify the carrier and Magtrol's Customer Service Department.

☞	Note:	Save all shipping cartons and packaging material for reuse when returning the instrument for calibration or servicing.

1.2 FEATURES OF THE 3411 TORQUE DISPLAY

Designed specifically for use with Magtrol's TM In-Line Torque Transducers and TF Torque Flange Sensors, the Model 3411 Torque Display powers the transducer and utilizes high-speed digital signal processing to display torque, speed and mechanical power. Its features include:

- High Quality, Easy-to-Read Display: Vacuum fluorescent readout.
- Addition of high resolution quadrature encoder enable slow RPM applications or position measurements
- Selectable English, Metric and SI Torque Units
- Isolated USB Interface
- Ethernet connectivity

- Torque: Analog, raw sensor output
- Speed output; analog or digital, user selectable
- BITE: Built-In Test Equipment
- Overload Indication
- Tare Function
- High Speed Data Acquisition: Up to 500 torque and speed points per second with time stamp
- Rack mount or handle versions available

1.3 DATA SHEET

MAGTROL

3411
Data Sheet

Model 3411
Torque Display

FEATURES

- For use with all Magtrol TM / TMHS / TMB In-Line Torque Transducers and TF Torque Flange Sensors
- High Quality, Easy-to-Read Vacuum Fluorescent Readout: Displays torque, speed and power
- Addition of high resolution quadrature encoder enables low RPM applications or position measurements
- Selectable English, Metric and SI Torque Units
- Isolated USB Interface
- Ethernet connectivity
- Torque: Analog, raw sensor output
- Speed output; analog or digital, user selectable
- BITE: Built-In Test Equipment
- Overload Indication
- Tare Function
- Includes Magtrol Torque 7 Software
- High Speed Data Acquisition: Up to 500 torque and speed points per second with time stamp
- Rack mount or handle versions available

DESCRIPTION

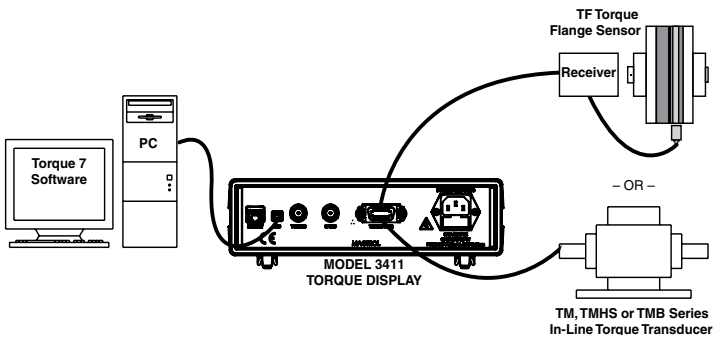
Magtrol's Model 3411 Torque Display is designed for use with all Magtrol TM, TMHS, TMB and TF Torque Transducers. This easy-to-use device powers the transducer and utilizes high speed processing to display torque, speed and mechanical power. It includes a tare function to help offset any slight residuals caused by couplings or suspended loads. The 3411 may also be used with any torque sensors requiring 24 V DC power (500 mA max.) with ± 5 V DC torque output (± 10 V DC max.) and open collector, TTL or CMOS output for the speed signal.

TORQUE 7 SOFTWARE

Magtrol's Torque 7 Software is a user-friendly LabView® executable program, used to automatically collect torque, speed and mechanical power data. The data can be printed, displayed graphically or quickly saved as a Microsoft® Excel spreadsheet. Standard features of Torque 7 include:

- Measured Parameter vs. Time
- Adjustable Sampling Rates
- Polynomial Curve Fitting
- Peak Torque Capture
- Direction of Rotation
- Multi-Axes Graphing
- Optional USB Interface: for reading up to 4 thermocouples

SYSTEM CONFIGURATION



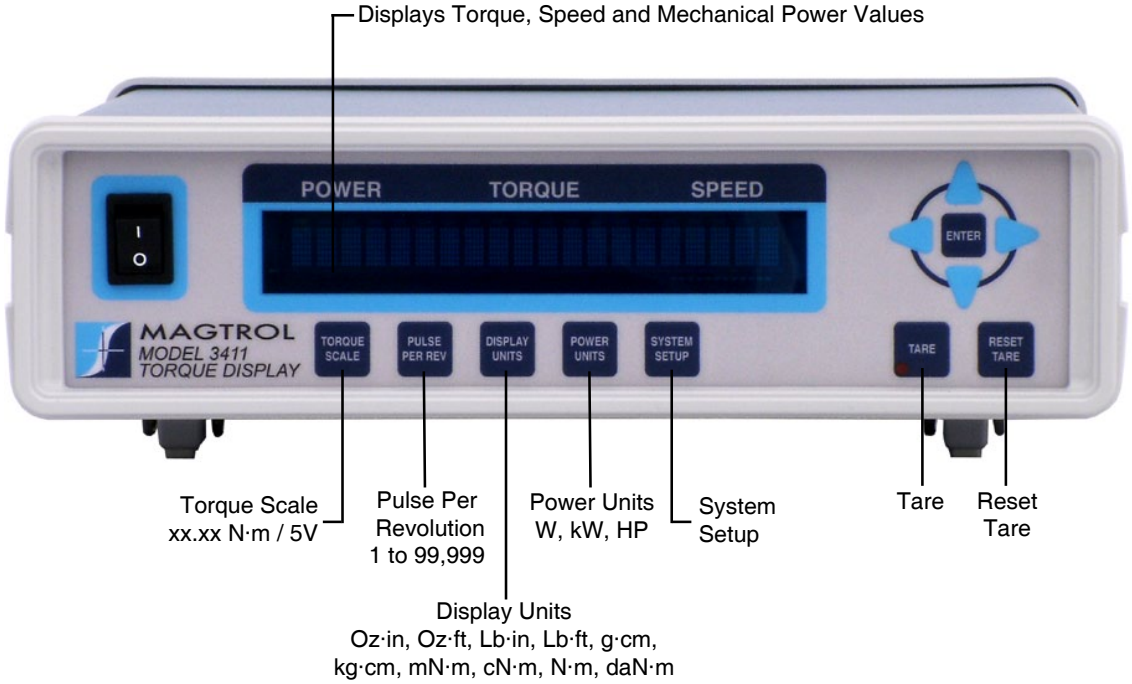
Specifications 3411

MEASUREMENT CHARACTERISTICS	
Maximum Speed / Input Frequency	199,999 rpm / 199,999 Hz
Accuracy	Speed: 0.01% of reading from 5 rpm to 199,999 rpm Torque: 0.02% of range (± 10 V)
ELECTRICAL CHARACTERISTICS	
Fuses (5 × 20 mm)	IEC 500 mA 250 V T
Power Requirements	36 VA
Voltage Requirements	120/240 V 60/50 Hz
INPUTS AND OUTPUTS	
Transducer Inputs	Speed/Angle: Open Collector, 5 V HC, TTL, CMOS Torque: ± 10 V DC max
Torque Output BNC	±10 V DC (direct from transducer)
Speed Output BNC	5 V HC pulse (buffered from transducer) or +/- 10 VDC analog

** Sensor power available at 14 pin connector:*
5 VDC 200 ma, fused internally at 500 ma
24 VDC 500 ma, short circuit protected

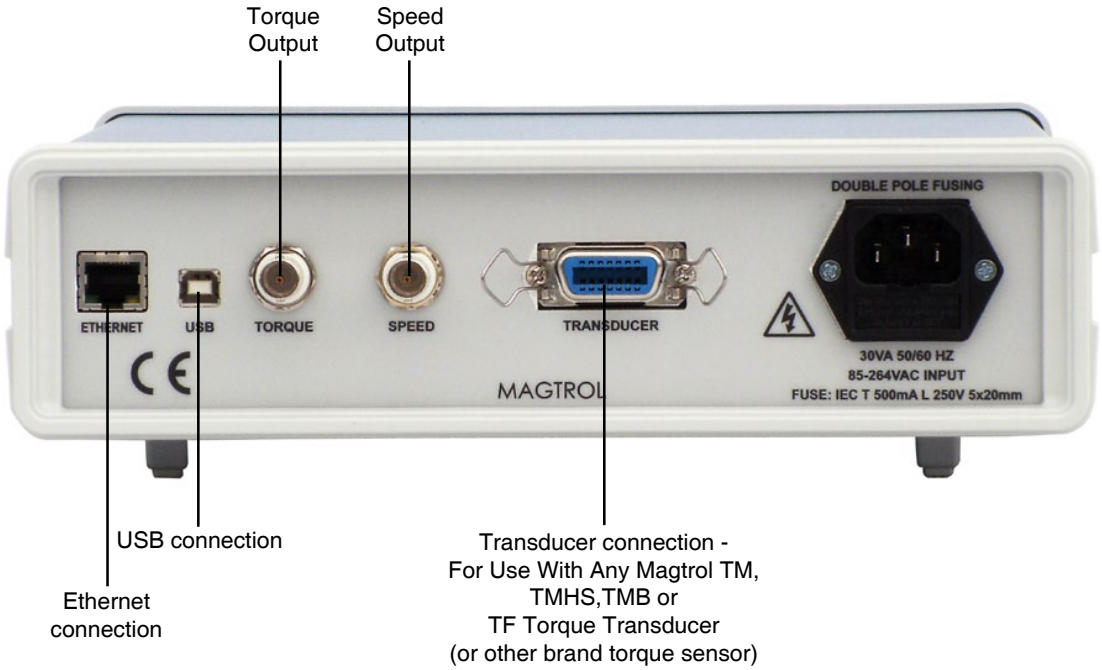
ENVIRONMENT		
Operating Temperature	5 ºC to 50 ºC	
Relative Humidity	< 80%	
Temperature Coefficient	0.001% (5 ºC to 50 ºC) of FS/ºC	
DIMENSIONS		
Width	10.14 in	257.5 mm
Height	4.05 in	103 mm
Depth	10.80 in	274.3 mm
Weight	5.11 lb	2.32 kg

FRONT PANEL



Ordering Information 3411

REAR PANEL



ACCESSORIES

Description	Model #
TM / TMHS / TMB In-Line Torque Transducer Connector Cable, 5 m	ER 113/01
TM / TMHS / TMB In-Line Torque Transducer Connector Cable, 10 m	ER 113/02
TM / TMHS / TMB In-Line Torque Transducer Connector Cable, 20m	ER 113/03
TF Flange Torque Transducer Connector Cable, 5 m	ER 116/01
TF Flange Torque Transducer Connector Cable, 10 m	ER 116/02
TF Flange Torque Transducer Connector Cable, 20m	ER 116/03
SBB-14 for optional high resolution encoder attachment	SBB-14

ORDERING INFORMATION

Description	Model/Part #	Stock Code
Torque Display	3411	006862
Torque Display with Handle	3411-HDL	007017
Torque Display with Rack Mount	3411-RMK	007015

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

2. Controls

2.1 FRONT PANEL

The front panel contains a Vacuum Fluorescent Display (VFD) that provides information about the control functions and torque transduce.

Figure 2–1 Front Panel

The buttons from left to right, top to bottom are:

- POWER SWITCH
- UP
- DOWN
- LEFT
- RIGHT
- ENTER
- TORQUE SCALE
- PULSE PER REV
- DISPLAY UNITS
- POWER UNITS
- SYSTEM SETUP
- TARE
- RESET TARE

The following table provides a quick reference on how to use each button. For more detailed information refer to *Chapter 4 – Manually Controlled Operation.*

Button	To Use	Function
POWER SWITCH	Press I to turn power ON. Press O to turn power OFF.	Turns power ON or OFF.
UP	Press.	The UP button will scroll up through the possible selections. The UP button will increase the number under the cursor.
DOWN	Press.	The DOWN button will scroll down through the possible selections. The DOWN button will decrease the number under the cursor.
LEFT	Press.	Moves the cursor left.

Button	To Use	Function
RIGHT	Press.	Moves the cursor right.
ENTER	Press.	Accepts current selection.
TORQUE SCALE	Press.	xx.xx N·m/5 V Use TORQUE SCALE to enter the rated torque of the attached transducer.
PULSE PER REV	Press.	Encoder pulse per revolution input to 99,999.
DISPLAY UNITS	Press.	Press and then use the UP/DOWN buttons to scroll through the possible selections. Press ENTER to select the desired display unit. • oz·in • oz·ft • lb·in • lb·ft • g·cm • kg·cm • mN·m • cN·m • N·m • daN·m
POWER UNITS	Press.	Press and then use the UP/DOWN buttons to scroll through the possible selections. Press ENTER to select the desired power unit. • hp • W • kW
SYSTEM SETUP	Press.	Press and then use the UP/DOWN buttons to scroll through the possible selections. Press ENTER to select the desired system setup. • BITE • USER SETUP • STATIC IP SET • DHCP ADDRESS VIEW • FILTER SETUP • CONTRAST • SPEED BNC OUTPUT • TM INVERT • RETURN
TARE	Press.	Sets the current A/D reading as the offset value during calculations of torque.
RESET TARE	Press.	Resets the TARE to the calibrated offset A/D reading value for calculations of torque.

2.2 REAR PANEL

The rear panel provides connectors and receptacles for connecting to appropriate equipment.

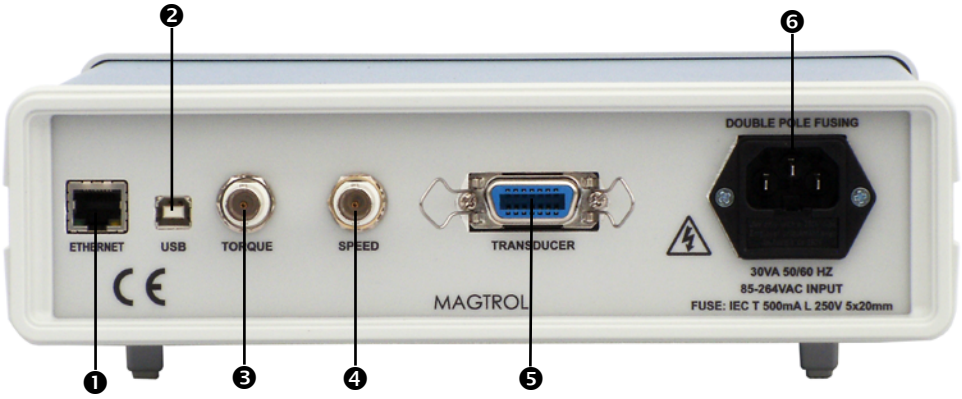


Figure 2–2 Rear Panel

2.2.1 REAR PANEL INPUTS AND OUTPUTS

❶ ETHERNET — Attach Ethernet cable here.

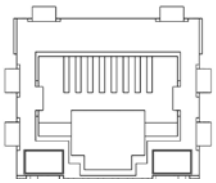


Figure 2–3 Ethernet Connector

❷ USB — Isolated USB Connector

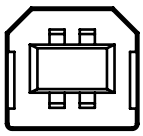
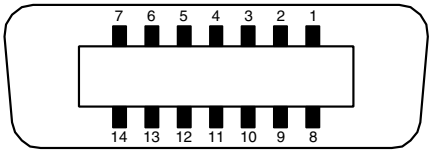


Figure 2–4 USB Connector

❸ Torque Output — Attach Torque Output cable here

❹ Speed Output — Attach Speed Output cable here

❺ TRANSDUCER Connect transducer signal cable here.



1. N/C	8. 5 V COM
2. TACH B	9. N/C
3. +24 VDC	10. TACH A
4. +24 VDC COM	11. N/C
5. +24 VDC COM	12. BITE
6. N/C	13. TORQUE COMMON
7. 5 V OUT	14. TORQUE SIGNAL

Figure 2–5 Transducer Connector

❻ POWER Attach IEC approved power cord here.

3. Installation/Configuration

Note: Before installing the 3411, you should become familiar with the front and rear panels, as outlined in *Chapter 2–Controls*.

3.1 POWERING UP THE 3411

Note: To reduce the risk of electric shock, the case of the 3411 is earth grounded.

3.1.1 LINE VOLTAGE

The 3411 will operate with either of the following power sources without any modifications:

- 120 V 50/60 Hz
- 230 V 50/60 Hz

3.1.2 SELF-TEST

Note: To make sure that the 3411 is operational, a Magtrol torque sensor must be installed and connected to the 3411.

1. Connect the 3411 to the torque transducer using a 14-pin to 6-pin signal cable.

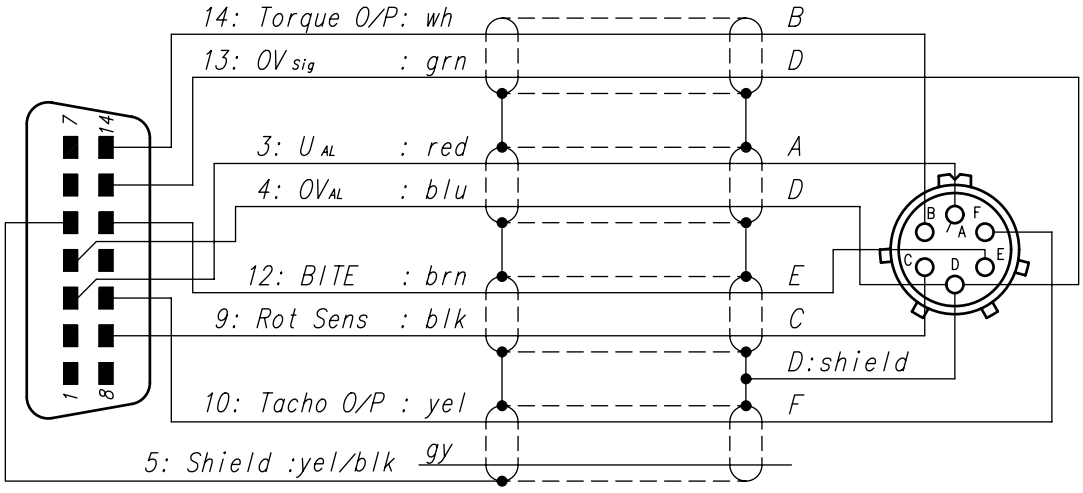


Figure 3–1 Cable and Connection Diagrams

2. Turn on the power to the 3411. The Title Displays will appear.

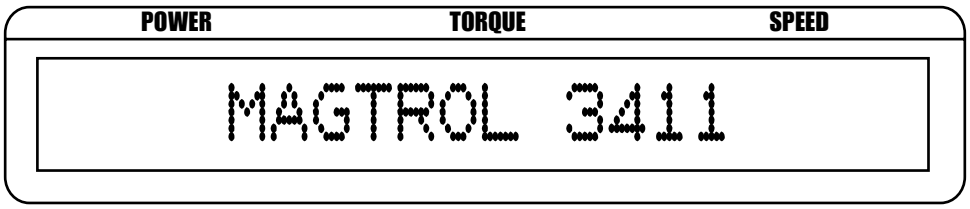


Figure 3–2 Title Display 1 (up to 1 minute)

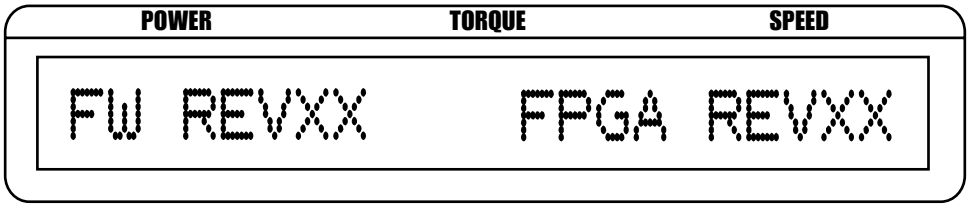


Figure 3–3 Title Display 2 (5 seconds)

3.1.3 Main Menu

When the 3411 is completely powered up and ready for use, the Main Menu will appear on the dispay.

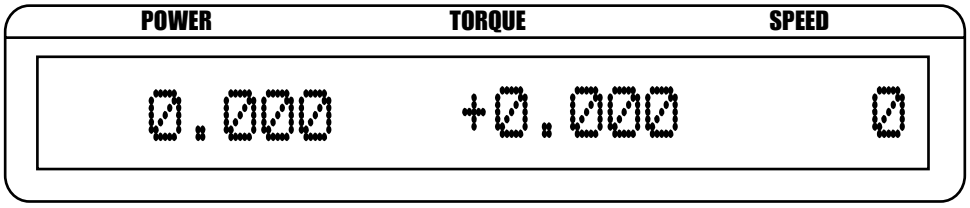


Figure 3–4 Main Menu

4. Manually Controlled Operation

4.1 SETTING DESIRED OPERATING PARAMETERS

4.1.1 Torque Scale Setup

Selects the Torque Scale for the 3411 Display.

1. Press and release TORQUE SCALE button. The display will appear as follows:

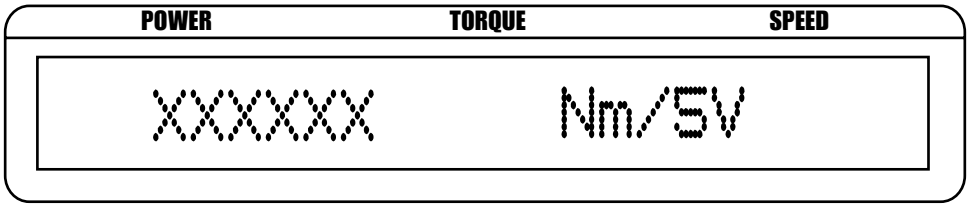


Figure 4–1 Torque Scale Setup

2. Press and release the arrow buttons until desired torque scale appears in display.
3. Press and release ENTER button to save and return to the Main Menu.

4.1.2 Pulse Per Rev Setup

Selects the Pulse per Rev for the 3411 Display.

1. Press and release PULSE PER REV button. The display will appear as follows:

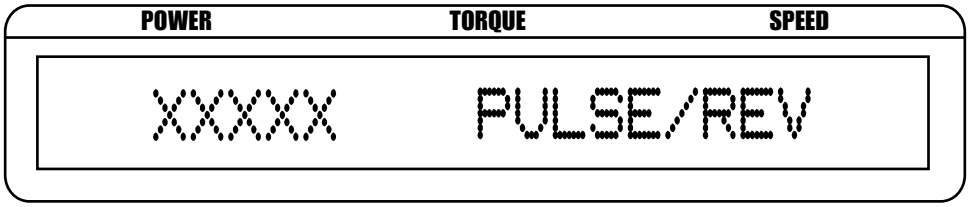


Figure 4–2 Pulse per Rev. Setup

2. Press and release the arrow buttons until desired pulse per rev appears in display.
3. Press and release ENTER button to save and return to the Main Menu.

4.1.3 Display Units Setup

Selects the desired unit of measure that corresponds with the values displayed. Options include:

- oz·in
- oz·ft
- lb·in
- lb·ft
- g·cm
- kg·cm
- mN·m
- cN·m
- N·m
- kN·m
- daN·m

OPERATION

1. Press and release DISPLAY UNITS button. The display will appear as follows:

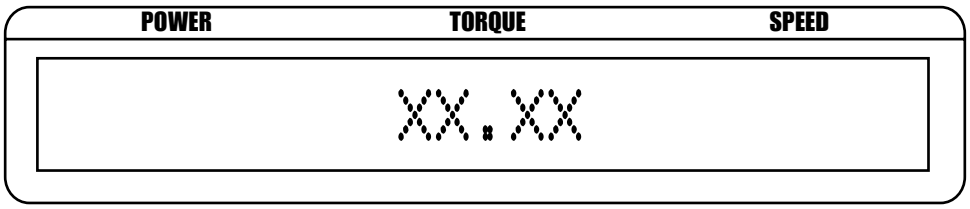


Figure 4–3 Display Units Setup

2. Press and release the UP/DOWN arrow buttons until desired display unit appears in display.
3. Press and release ENTER button to save and return to the Main Menu.

4.1.4 Power Units Setup

Selects the desired unit of power that corresponds with the values displayed. Options include:

- Watts
- kW
- hp

1. Press and release POWER UNITS button. The display will appear as follows:

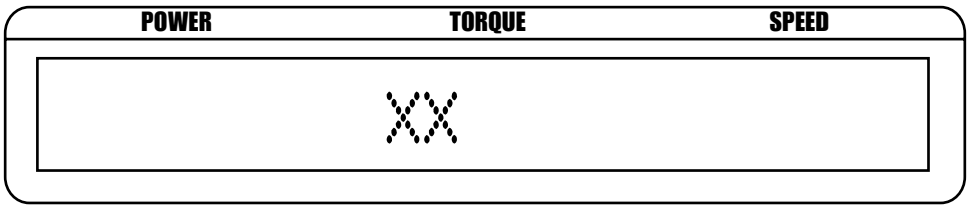


Figure 4–4 Power Units Setup

2. Press and release the UP/DOWN arrow buttons until desired power unit appears in display.
3. Press and release ENTER button to save and return to the Main Menu.

4.1.5 System Setup

Selects the display options for the 3411 Display. Options include:

- BITE
- USER SETUP
- IP ADDRESS VIEW
- FILTER SELECTION
- CONTRAST
- SPEED BNC OUTPUT
- TM INVERT
- RETURN

1. Press and release SYSTEM SETUP button.
2. Press and release the UP/DOWN arrow buttons until desired setup option appears in display.
3. Press and release ENTER to go to the setup menu for that option.

4.1.5.1 BITE

Built-In Test Equipment (BITE) has been programmed into the 3411 in order to test the system and make sure all devices are connected and running properly. When the BITE function is activated the software will turn on an NPN transistor internal to the 3411 that is in an open collector configuration. This output, or collector, is found on pin 12 of the 14-pin connector on the back of the unit. This signal is routed to the transducer and will activate internal circuitry to output a test signal. In the case of a TM series transducer, the output will be 5 volts (full scale) in addition to any offset value. As for the TF series, the output will be about 4 volts (about 80% of full scale) in addition to any offset value.

1. Press and release SYSTEM SETUP button.
2. Press and release UP/DOWN arrow buttons until BITE shows in the display.
3. Press and release ENTER. The BITE function will acitvate for 5 seconds and then reutrn to the Main Menu. The display will appear as follows while the BITE function is activated:

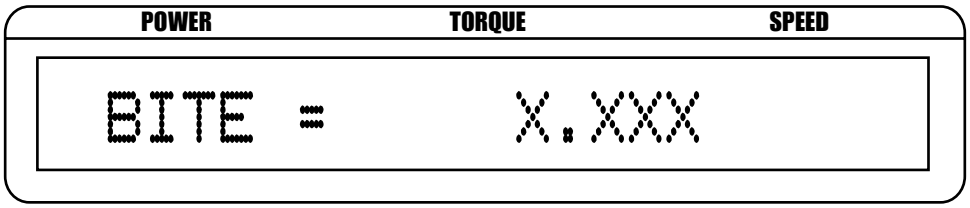


Figure 4–5 BITE Setup

4.1.5.2 User Setup

The 3411 Display allows 4 user setup configurations to be saved on the device.

1. Press and release SYSTEM SETUP button.
2. Press and release UP/DOWN arrow buttons until USER SETUP shows in the display.
3. Press and release ENTER to go to the user setup menu.
4. Press and release UP/DOWN arrow buttons until the desired user setup number appears in the display. The display will appear as follows:

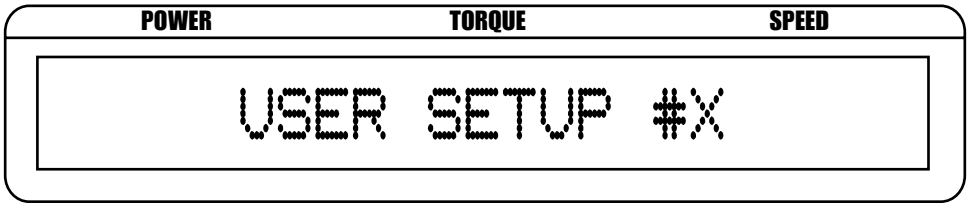


Figure 4–6 User Setup

5. Press and release ENTER to select the user setup and return to the Main Menu.

4.1.5.3 IP Address View

1. Press and release SYSTEM SETUP button.
2. Press and release UP/DOWN arrow buttons until IP ADDRESS VIEW shows in the display.
3. Press and release ENTER to view the 3411 Display's IP Address. The display will appear as follows:

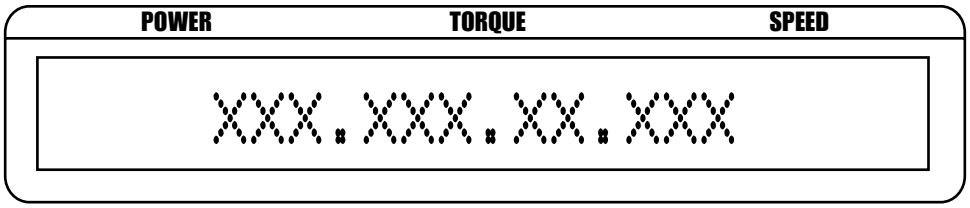


Figure 4–7 IP Address View

4.1.5.4 Filter Selection Setup

Sets the desired Filter Selection for the 3411 Display. The options include:

- None
- 2 Hz
- 5 Hz
- 10 Hz
- 20 Hz
- 50 Hz
- 100 Hz

1. Press and release SYSTEM SETUP button.
2. Press and release UP/DOWN arrow buttons until FILTER SELECTION shows in the display.
3. Press and release ENTER to go to the filter selection setup menu. The display will appear as follows:

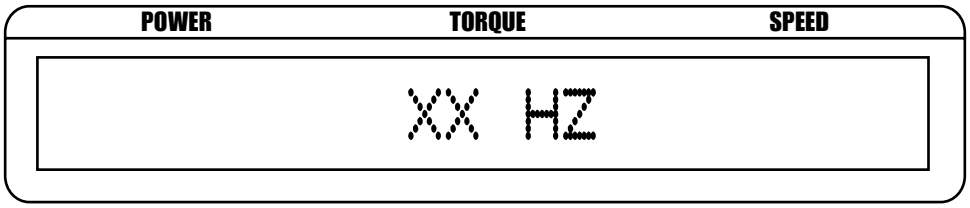


Figure 4–8 Filter Selection Setup

4. Press and release the UP/DOWN arrow buttons until the desired filter selection appears in the display.
5. Press and release ENTER to save and return to the Main Menu.

4.1.5.5 Contrast

The 3411 is shipped with the Contrast programmed to the lowest setting in order to prolong display life. If it is necessary to increase the Contrast for improved readability, execute the following steps:

1. Press and release SYSTEM SETUP button.
2. Press and release UP/DOWN arrow buttons until CONTRAST shows in the display.
3. Press and release ENTER to go to the contrast setup menu. Display will appear as follows:

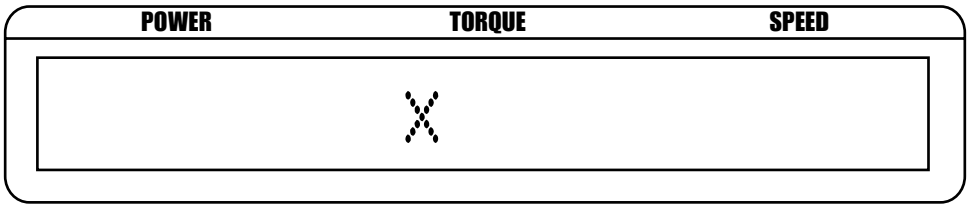


Figure 4–9 Contrast Setup

4. Press and release UP/DOWN arrow buttons until the desired contrast setting shows in the display.
5. Press and release ENTER to save and return to the Main Menu.

4.1.5.6 Speed BNC Output Setup

1. Press and release SYSTEM SETUP button.
2. Press and release UP/DOWN arrow buttons until SPEED BNC OUTPUT shows in the display.
3. Press and release ENTER to go to the speed BNC output setup menu.
4. Press and release UP/DOWN arrow buttons until desired speed BNC output is shown in the display.
5. Press and release ENTER to select. If you selected Digital the setup is complete and the display will return to the Main Menu. If you selected analog the display will appear as follows:

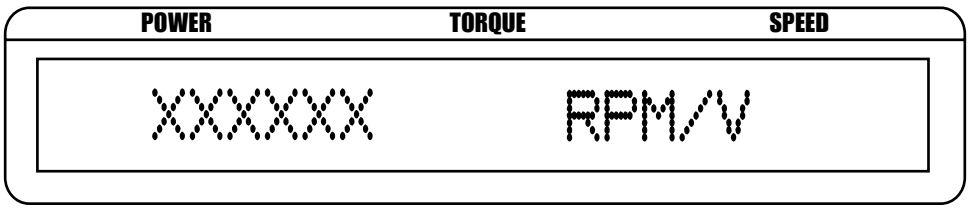


Figure 4–10 Analog Speed BNC Output Setup

6. Press and release the arrow buttons until the desired speed BNC output appears in the display.
7. Press and release ENTER to save and return to the Main Menu.

4.1.5.7 TM Invert Setup

1. Press and release SYSTEM SETUP button.
2. Press and release UP/DOWN arrow buttons until TM INVERT shows in the display.
3. Press and release ENTER to go to the TM invert setup menu. The display will appear as follows:

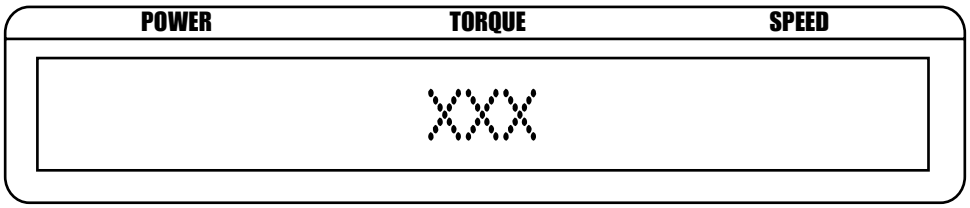


Figure 4–11 TM Invert Setup

4. Press and release the UP/DOWN arrow buttons until the desired TM invert selection appears in the display.
5. Press and release ENTER to save and return to the Main Menu.

4.1.6 TARE FUNCTION

The calibrated offset of the 3411 may be changed using the tare function. To set:

1. Press TARE button.
2. The red LED light will turn on and the unit will take the current value of the torque input and make it the new zero.

Note: In order to reset the tare value, press and release RESET TARE button.

5. Computer Controlled Operation

The 3411 Torque Display can be used with a personal computer for standard or custom torque and encoder setups. Using the 3411 with a computer enables the unit to perform at its full capacity.

5.1 ABOUT THE ETHERNET INTERFACE

Connect one Ethernet cable terminal to 3411 RJ45 interface, and another terminal to Ethernet RJ45 on wall outlet or Ethernet switch. Reference 4.1.5.4, dynamic IP address will show, for example, 192.168,14,88. Launch windows internet explorer, type http://192.168.14.88. The following authentication page will pop up. The default Authentication Username is “admin”. There is no Authentication Password.

Figure 5–1 Authentification Window

After the user name “admin” is entered, press “OK” button, the 3411 home web page will display.

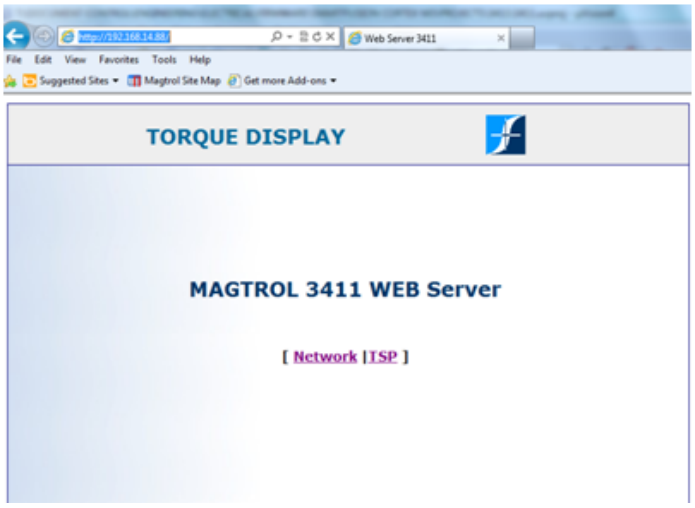


Figure 5–2 Magtrol 3411 home web page

Press “Network”to display the LAN settings.

Press  key, to return to the home web page.

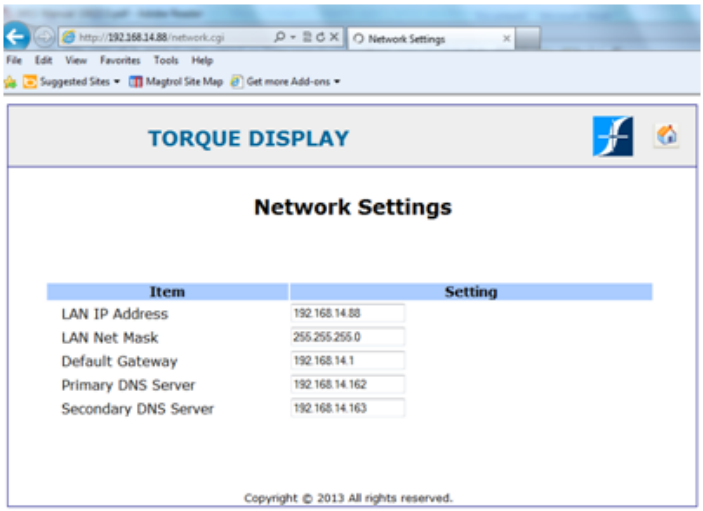


Figure 5–3 Network Settings web page

In the home web page, press "TSP" to display the torque, speed and power web page. Select the "Periodic" check box so that Power, torque, and speed values will refresh at 0.5S intervals.

Press  key, it will return home web page.

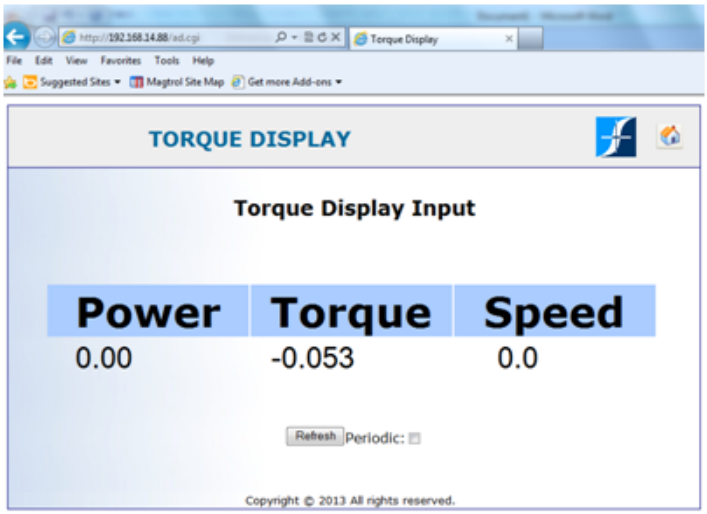


Figure 5–4 Torque Display Input web page

NOTE: Background checking for Ethernet connection could last up to 1 minute after power on to obtain a DHCP IP address.

OPERATION

NOTE: Ethernet communication will be lost during key entry into front panel menus after 2 minutes.

5.2 ABOUT THE USB INTERFACE

The USB interface is standard on the 3411 Torque Display. There is a need to set this up. The USB interface will be converted to a serial port in the PC. The USB driver must be installed in order for the 3411 to communicate with the PC.

5.2.1 USB DRIVER SETUP FOR WINDOWSXP/WINDOWS7 32BIT

Copy the 3411 USB driver files from the Magtrol Manual CD at programs\3411USB Driver\ directory into local drive of your PC.

1. Run CP210xVCPInstaller_x86.exe.
2. Power on the 3411. The Found New Hardware Wizard window will pop up as shown below. On the Driver Installation window choose “Install from a list or specific location (Advanced)” option as shown in figure 5–1 Driver Installation window.

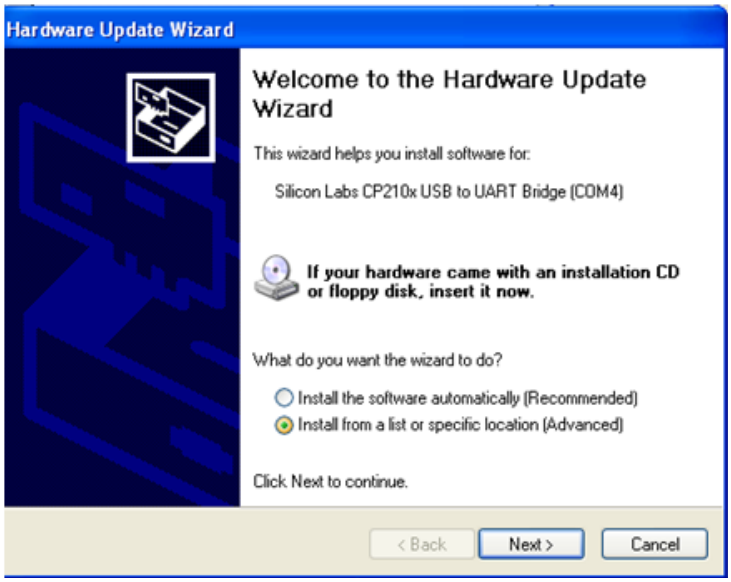


Figure 5–2 Driver Installation Window

3. Click the Next button. The following screen will display. Browse for the location “C:\ 3411 USB Driver\”.

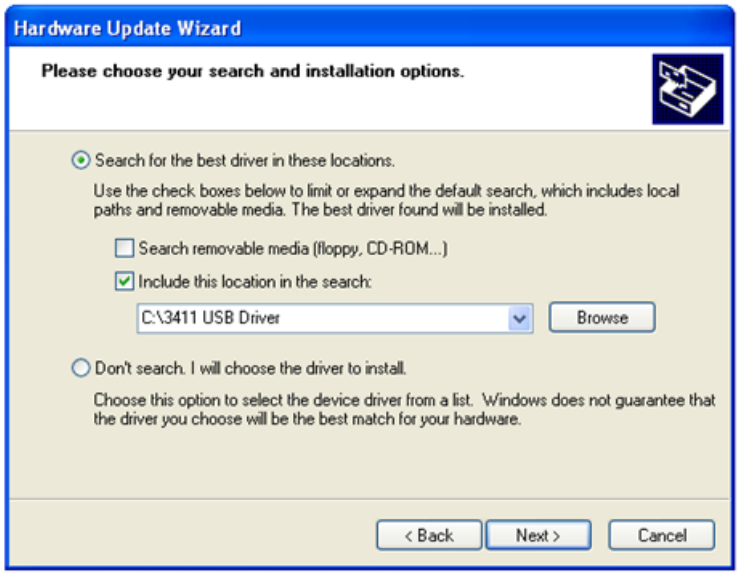


Figure 5–3 Installation Options Window

4. Click the Next button. The following screen will display. The driver will be installed.

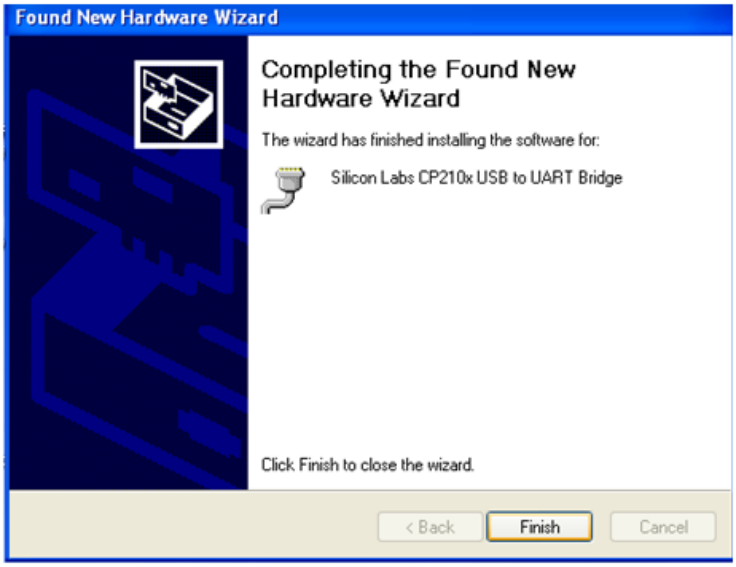


Figure 5–4 Installation Finish Window

5. Click Finish button, “Found new hardware” will show in right corner. Then USB driver has been installed correctly.

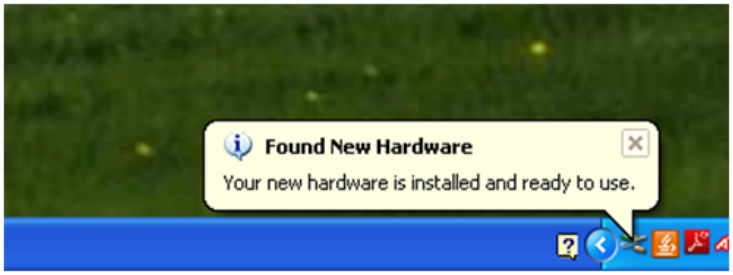


Figure 5–5 Installation Complete Window

5.2.2 USB DRIVER SETUP FOR WINDOWS7/8 64BIT

Copy the 3411 USB driver files from the Magtrol Manual CD at programs\3411USB Driver\ directory into local drive of your PC.

1. Run CP210xVCPInstaller_x64.exe.
2. Power on the 3411. A window in the right corner will show "Installing device driver software" and then show "Magtrol 3411 CP210x USB to UART Bridge(COM#)".

5.2.3 SET UP USB COMMUNICATION

5.2.3.1 Communication Parameters

- No parity
- 8 data bits
- 1 stop bit
- No protocol

5.2.3.2 Baud Rate

The application in PC should set up baud rate 921600 in order to communicate with PC via USB.

5.3 3411 COMMAND SET

When entering a command code:

1. Type all characters in uppercase ASCII format.
2. End all commands with a CR-LF (hex 0D-0A).
3. Do not string multiple commands together in one line.

The character # represents a floating-point numerical value following the command. Leading zeroes are not required.

Note: If a command is not recognized, a COMMAND ERROR CR-LF string return will occur.

OPERATION

5.3.1 COMMUNICATION COMMANDS

Command Code	Function	Explanation
*IDN?	Returns Magtrol identification and software revision.	Example: 3411 A0 B0
OD	Prompts to return speed-torque-direction data string.	Output Data prompt to return data string with this format: SxxxxxxTxxxxxRcrlf or SxxxxxxTxxxxxLcrlf R or L are used to indicate the polarity of the torque and may be used as a shaft direction indicator where: 1. With TM INVERT off: R will indicate positive L will indicate negative The speed will equal the displayed value and the torque will be in the same units as displayed on the front panel.
OP	Reads quadrature position	Quadrature position counter returns data string with 8 digit hex number.
OS	Reads speed	Read speed with four decimal digits.
OV	Reads voltage	Reads voltage applied to Torque input mV. Output sign follows the TM INVERT setting.
QR	Reset position counter	Resets the position counter to zero at current position. Quadrature Timer is not reset
OB	Output Binary Data	User can read up to 8 words data at a rate of 500 times per second . Please refer Output Binary table.
BITE	Activates BITE for 5 seconds	Built In Test Equipment command.

5.3.2 SETUP COMMANDS

Command Code	Function	Explanation

AF#	Sets filter	Values for # are:
		0 = None 4 = 20 Hz
		1 = 2 Hz 5 = 50 Hz
		2 = 5 Hz 6 = 100 Hz
		3 = 10 Hz

M0	Front panel lockout	Front panel lockout, keys will not function.
M1	Front Panel enable	Front Panel enable, keys will function.

SPS#	Speed selection	Values for # are:
		0 = Digital TachA output on pack panel BNC
		1 = Analog speed output on pack panel BNC

SPSFxx.xx	Analog speed scale factor	Values for xx.xx range from 1 to 999,999.
TR	Resets Tare	Resets tare to calibrated 0 (zero).
TS	Sets Tare.	Reads current torque and uses as tare value.
UE#	Sets encoder units to #	Values for # range from 1 to 99999

UP#	Sets the Power Units.	Values for # are:
		0 = hp
		1 = W
		2 = kW

UR#	Sets display torque units to #.	Values for # are:
		0 = oz•in 6 = mN•m
		1 = oz•ft 7 = cN•m
		2 = lb•in 8 = N•m
		3 = lb•ft 9 = kN•m
		4 = g•cm 10 = daN•m
		5 = kg•cm
		Torque unit conversion defaults to Nm if out of range.

UT#	Sets torque scale to #	Values for # range from 0.01 to 999999
INVERT#	Negates the incoming Voltage (Torque signal)	Values for # 0 Non Inverted (default value) 1 Inverted
USER#	Selects configuration number	Values for # 1,2,3,4 **NOTE:** If a USER SETUP is changed via the USB or Ethernet it is volatile until SAVE command is sent.
SAVE	Save set up	Save set up to current user configuration

5.3.3 LAN SETUP COMMANDS

Command Code	Function	Explanation

DHCP#	Enables/Disables DHCP use. You must send the "UPD" command after sending DHCP# for the change to take place. When disabling DHCP, you must also set a static ip, a gateway and a subnet netmask prior to sending the "UPD" command. Contact your network administrator for the appropriate network settings.	Values for # are:
		1 = Enable
		0 = Disable

DHCP?	Read current DHCP state	Return #: 1 = Enable 0 = Disable
IPAD, XXX.XXX.XXX	Sets the static ip address. You must send the "UPD" command after "IPAD,xxx.xxx.xxx.xxx" for the new setting to take effect.	If DHCP is enabled, setting the static ip address has no effect. Contact your network administrator for details.
IPAD?	Read current IP address	Typical Return: 192.168. 14. 35
GATEWAY, XXX.XXX.XXX.XXX	Sets the gateway address used. You must send the "UPD" command after "GATEWAY,xxx.xxx.xxx.xxx" for the new setting to take effect.	If DHCP is enabled, setting the gateway address has no effect. Contact your network administrator for details.
GATEWAY?	Read current default gateway address	Typical Return: 192.168. 14. 1
HOST?	Read current local host name	Typical return: M34110001
MAC?	Read MAC address	Typical return: 02AA00000002
SMAS, XXX.XXX.XXX.XXX	Sets the subnet netmask. You must send the "UPD" command after "SMAS,xxx.xxx.xxx.xxx" for the new setting to take effect.	If DHCP is enabled, setting the netmask has no effect. Contact your network administrator for details.
SMAS?	Read current subnet mask	Typical return: 255.255.255.0
UPD	Saves all LAN settings to non-volatile memory and activates them.	To disable DHCP, the static ip, gateway, and netmask commands must have been given prior to sending "UPD". If DHCP is already disabled, "UPD" may be used to change a single static network setting, i.e. only the netmask, or only the gateway. Contact your network administrator for details.

Command Code	Function	Explanation
WHOST, XXXXXXXXXXXXXX	Save new local host name to non-volatile memory and activate new host name	xxxxxxxxxxxxxx: String of up to 15 characters. Must start with letter (A-Z) May contain letters, numbers (0-9), or dashes (“-”)

5.4 CALIBRATION AND MISCELLANEOUS COMMANDS

Command Code	Function	Explanation
MODE#	User/Calibration mode	Values for # 0 User 1 Calibration/engineering
MODE 1 COMMANDS		
INIT	Reset to factory defaults	Caution calibration will be lost. *POWER cycle required after the command.
IOAOX.XXX	Write the value to DAC	Write the value to the Speed DAC. Volts are assumed. X.XXX floating point voltage value 3 decimal places +10.000 to -10.000
CAL	Command to start A/D Calibration	Response is ZERO
ZERO	Command to accept applied zero	Response is FS=X.XXX prompting the user to apply Full Scale
FS=X.XXX	Command to set the Positive Full Scale (gain)	User enters X.XXX (meter reading) Response is FN=-X.XXX
FN=X.XXX	Command to set the Negative Full Scale (gain)	User enters X.XXX (meter reading) Response is CAL COMPLETE
CALS	Command to start frequency Calibration	Response is FREQ=XXXXX.XX prompting the user to apply frequency
FREQ= X.XXX	Command to set the frequency correction	User enters X.XXX (meter reading) in Hz Response is CAL COMPLETE
CALDAC	Command to start DAC Calibration	Response is READ ZERO
ZDAC=X.XXX	Command to set applied zero	User enters X.XXX (meter reading) Response is ZERO OK?
ZERO OK	Command to accept DAC zero	Response is FSDAC=X.XXX
FSDAC= X.XXX	Command to set the Positive Full Scale (gain)	User enters X.XXX (meter reading) Response is FS OK?
FS OK	Command to accept DAC gain	Response is CAL COMPDAC
OV	Reads Voltage	Reads voltage applied to Torque input mV. Output sign follows the TM INVERT setting.

SPS#	Speed selection	Values for # are:
		0 = Digital TachA output on pack panel BNC
		1 = Analog speed output on pack panel BNC

5.5 OUTPUT BINARY TABLE

Number	Data	Description	Data Type
0	TimeH	Time stamp: the first 32 bit value	Integer
1	TimeL	Time stamp: the last 32 bit value	Integer
2	Display speed	Speed derived by using a 0.2 second gate (slow) Display value	Float
3	Torque display	Torque derived by using a heavily average (slow) Display value	Float
4	Quadrature counter	Quadrature Position counter	Integer
5.	Quadrature time	Quadrature Position Time	Integer
6	Speed	Speed derived by using an averaged time between edges. (fast)	Float
7	Torque	Torque value “2 ms” value	Float

6. Calibration

6.1 CLOSED-BOX CALIBRATION

The 3411 features closed-box calibration. The advantage of closed-box calibration is that the user does not have to disassemble the case or make mechanical adjustments.

The torque readout can be calibrated using external reference sources. Correction factors for offset and gain are stored in nonvolatile memory. They remain in effect until the user or the calibration house updates them.

6.2 CALIBRATION SCHEDULE

Calibrate the 3411:

- After any repairs are performed.
- At least once a year; more frequently to ensure required accuracy.

6.3 BASIC CALIBRATION PROCESS

The basic calibration process consists of two procedures which must be performed in the following order:

1. Initial Procedure
2. Torque Offset and Gain
3. Frequency Gain

Items needed for calibrating the 3411:

- External voltage reference of 0 to 10 volts DC
- Digital multimeter (DMM)
- Frequency generator capable of generating a square wave 0V to 5V
- Frequency meter capable of a measuring square wave 0V to 5V

Both measuring instruments should have a accuracy of 0.005% or better.

6.3.1 Initial Calibration Procedure

1. Allow the 3411 to stabilize in an environment with:
   - An ambient temperature of 18°C to 25°C.
   - Relative humidity less than 80%.
2. Turn on the 3411.
3. Allow the 3411 to warm up for at least 30 minutes.

6.3.2 Torque Offset and Gain

Connect the external voltage reference common to the input connector.

- Pin 13 of the transducer connector

Connect the external voltage reference high to the input connector.

- Pin 14 of the transducer connector

NOTE: Turn off filters before begining the calibration process.

1. Send the command MODE1 to the unit via USB.
2. Send the command CAL to the unit via the USB.
3. The response will be ZERO VOLTS.
4. Apply 0.0000 volts to the input.
5. Send the command ZERO.
6. The response will be FS=X.XXXX
7. Apply approximately 10,0000 VDC to the input (this can vary a few mV but must be measured accurately).
8. Send the command FS=X.XXXX (where X.XXXX is your meter reading).
9. The response will be FN=-X.XXX.
10. Apply approximately -10.000 VDC. This can vary a few mV.
11. Send the FN=-XX.XXX command where -XX.XXX represents the voltage applied.
12. The unit will respond CAL COMPLETE.
13. Send the command MODE0 to the unit via USB.

6.3.3 Speed DAC Calibration

1. Send the command MODE1 to the unit via USB.
2. Connect a voltmeter to the Speed BNC Output.
3. Send the CALDAC command.
4. The response will be READ ZERO.
5. User will read the meter and send the ZDAC=XX.XXX command where XX.XXX represents the voltage read. This offset is immediately applied.
6. The hardware will respond “ZERO OK?”
7. If the meter reading is not zero the user must return to step 3.
8. If the meter reading is within 3 mv of 0 the user responds “ZERO OK.”
9. The unit will respond “READ FS.”
10. User will read the meter and send the FSDAC=XX.XXX command where XX.XXX represents the voltage read. This gain is immediately applied.
11. The hardware will respond “FS OK?”
12. If the meter reading is not 9 volts ± 3 mv the user must return to step 8.
13. If the meter reading is 9 volts ± 3 mv the user responds “FS OK.” the unit will respond CAL COMP DAC.
14. Send the command MODE0 to the unit via USB.

6.3.4 Frequency Gain

1. Send the command MODE1 to the unit via USB.
2. Send the command CALS to the unit via the USB.
3. The response will be FREQ=XXXXXX.XX.
4. Apply a square wave of 50 kHz to 99 kHz volts to the input. (This can vary from 50 kHz to 99 kHz but must be measured accurately).
5. Send the command FREQ=XXXXXX.XX (where X.XXXX is your meter readingin Hz).

6. The response will be CAL COMPLETE.
7. Send the command MODE0 to the unit via USB.

7. Theory

7.1 FILTER PARAMETERS

The Digital Filters of the 3411 are used to remove undesired noise from the TSC inputs. This noise could be conducted from an undesired measured signal such as mechanical vibration or other electrical sources.

The input to the A/D converter internal to the 3411 has a traditional analog filter that is comprised of the following characteristics:

- -3db Point: 3.8 KHz
- A/D Sample Rate: 7812.5 Hz
- 16 Acquired and Averaged Samples: Average applied to filter at a rate of 488.28125 Hz
- Filter Cutoff Frequencies: 3 Hz, 10 Hz, 25 Hz, 50 Hz, 100 Hz
- Filter Output: Equivalent to second order Butterworth analog filter
- Transposed Direct Form II Architecture: The diagram below shows this architecture.

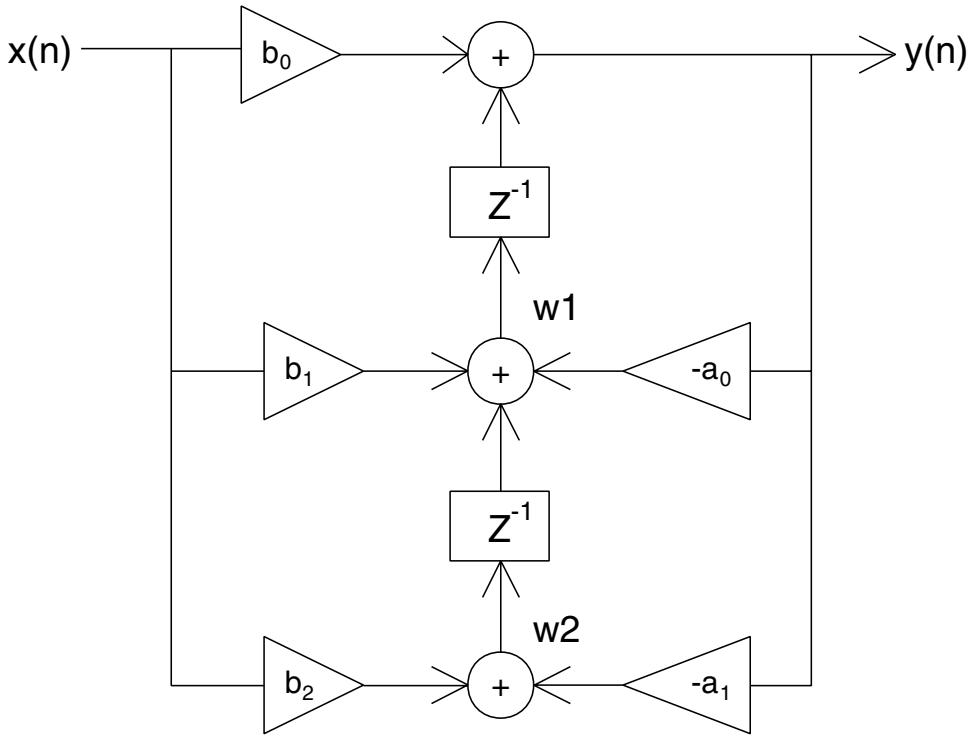


Figure 7–1 Transposed Direct Form II Architecture

With a Digital Filter, the 3411 is able to solve the following equations:

y(n) = b0 * x(n) + w1

w1 = b1 * x(n) + a1 * y(n) + w2

w1 = b2 * x(n) + a2 * y(n)

The equations are applicable to each channel, occurring every 2.48 milliseconds.

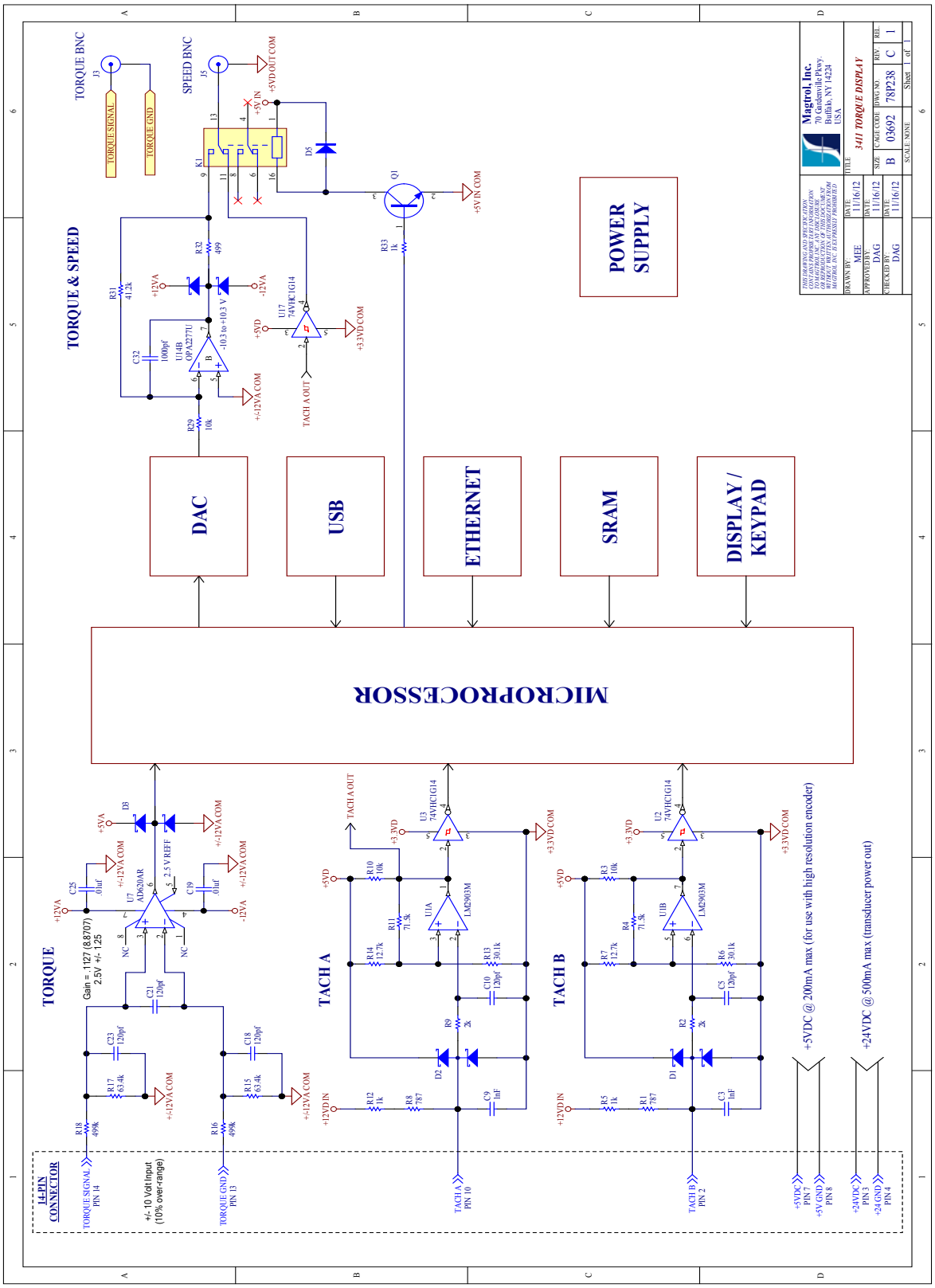
8. Troubleshooting

Problem	Reason	Solution
Returned data indicates COMMAND ERROR.	Command does not match the unit's programmed set of instructions.	Use correct command and format.
Mechanical power reads much higher or lower than expected.	Torque units or scale factor is incorrect.	Set torque input units and scale factor to match the specifications of torque transducer.
No USB communication.	Setup error and/or hardware fault.	Check: • Baud rate • Cable attachment from Torque Display to USB interface port of computer

If you require additional assistance, please contact Magtrol Customer Service at 1-716-668-5555.

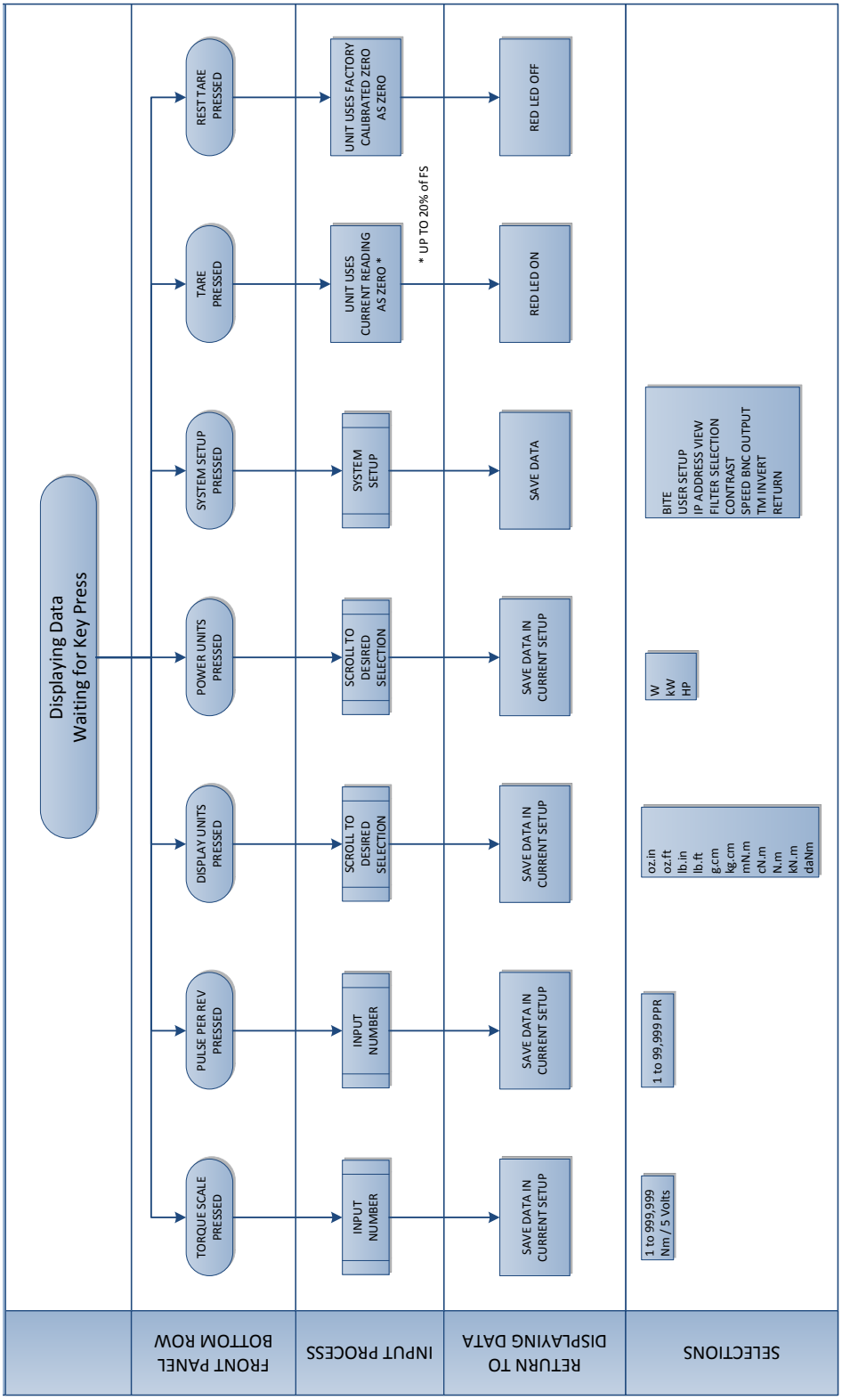
Appendix A: Schematics

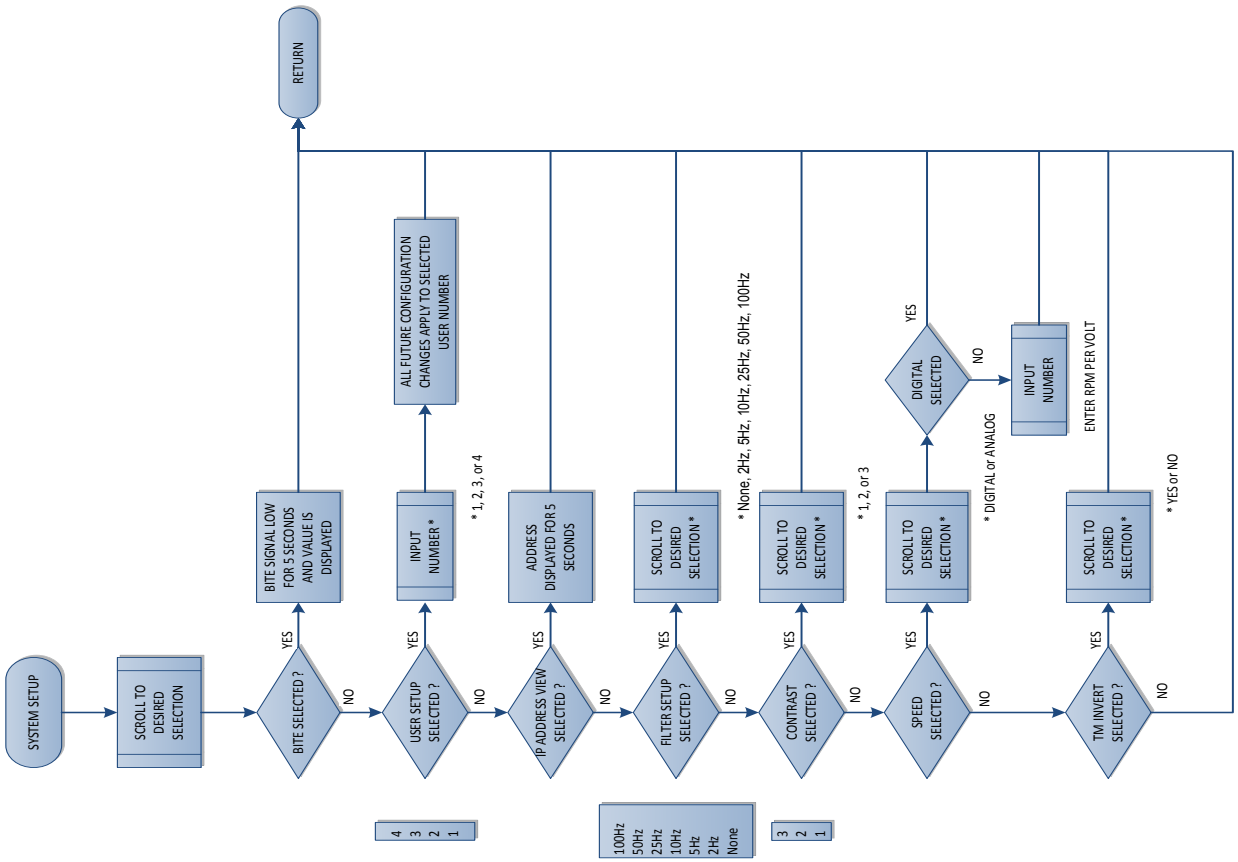
A.1 3411 SCHEMATIC

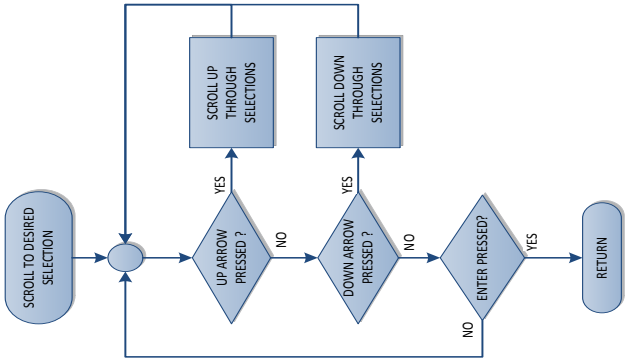


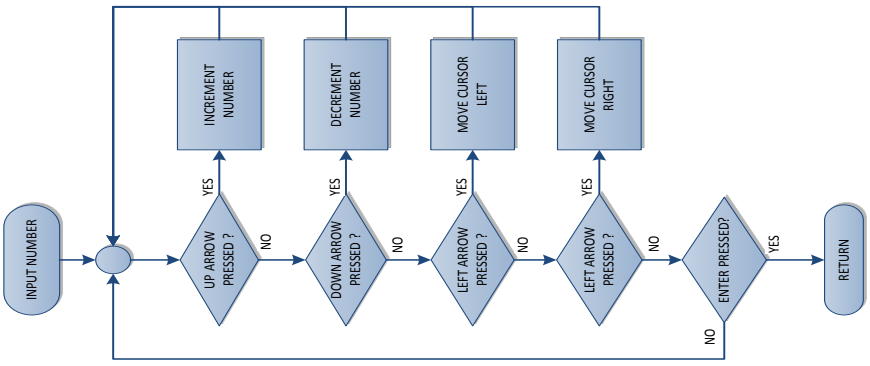
Appendix B: Menu Structure

B.1 3411 MENU STRUCTURE




SYSTEM SETUP
SCROLL TO DESIRED SELECTION
BITE SELECTED ?
BITE SIGNAL LOW FOR 5 SECONDS AND VALUE IS DISPLAYED
USER SETUP SELECTED ?
INPUT NUMBER *
* 1, 2, 3, or 4
ALL FUTURE CONFIGURATION CHANGES APPLY TO SELECTED USER NUMBER
IP ADDRESS VIEW SELECTED ?
ADDRESS DISPLAYED FOR 5 SECONDS
FILTER SETUP SELECTED ?
SCROLL TO DESIRED SELECTION *
* None, 2Hz, 5Hz, 10Hz, 25Hz, 50Hz, 100Hz
CONTRAST SELECTED ?
* 1, 2, or 3
SPEED SELECTED ?
DIGITAL SELECTED
* DIGITAL or ANALOG
INPUT NUMBER
TM INVERT SELECTED ?
ENTER RPM PER VOLT
* YES or NO
RETURN
YES
NO
4 3 2 1
100Hz 50Hz 25Hz 10Hz 5Hz 2Hz None
3 2 1


SCROLL TO DESIRED SELECTION
UP ARROW PRESSED ?
SCROLL UP THROUGH SELECTIONS
DOWN ARROW PRESSED ?
SCROLL DOWN THROUGH SELECTIONS
ENTER PRESSED?
RETURN
YES
NO


INPUT NUMBER
UP ARROW PRESSED ?
INCREMENT NUMBER
DOWN ARROW PRESSED ?
DECREMENT NUMBER
LEFT ARROW PRESSED ?
MOVE CURSOR LEFT
LEFT ARROW PRESSED ?
MOVE CURSOR RIGHT
ENTER PRESSED?
RETURN
YES
NO

Service Information

RETURNING MAGTROL EQUIPMENT FOR REPAIR AND/OR CALIBRATION

Before returning equipment to Magtrol for repair and/or calibration, please visit Magtrol's Web site at http://www.magtrol.com/support/rma.htm to begin the Return Material Authorization (RMA) process. Depending on where the equipment is located and which unit(s) will be returned, you will be directed to either ship your equipment back to Magtrol, Inc. in the United States or Magtrol SA in Switzerland.

Returning Equipment to Magtrol, Inc. (United States)

When returning equipment to Magtrol, Inc.'s factory in the United States for repair and/or calibration, a completed Return Material Authorization (RMA) form is required.

1. Visit Magtrol's Web site at http://www.magtrol.com/support/rma.htm to begin the RMA process.
2. Complete the RMA form online and submit.
3. An RMA number will be issued to you via e-mail. Include this number on all return documentation.
4. Ship your equipment to:
   MAGTROL, INC.
   70 Gardenville Parkway
   Buffalo, NY 14224
   Attn: Repair Department
5. After Magtrol's Repair Department receives and analyzes your equipment, a quotation listing all the necessary parts and labor costs, if any, will be faxed or e-mailed to you.
6. After receiving your repair estimate, provide Magtrol with a P.O. number as soon as possible. A purchase order confirming the cost quoted is required before your equipment can be returned.

Returning Equipment to Magtrol SA (Switzerland)

If you are directed to ship your equipment to Switzerland, no RMA form/number is required. Just send your equipment directly to Magtrol SA in Switzerland and follow these shipment instructions:

1. Ship your equipment to:
   MAGTROL SA
   After Sales Service
   Route de Montena 77
   1728 Rossens / Fribourg
   Switzerland
   VAT No: 485 572
2. Please use our forwarder : TNT • 1-800-558-5555 • Account No 154033
   Only ship ECONOMIC way (3 days max. within Europe)
3. Include the following documents with your equipment:
   - Delivery note with Magtrol SA's address (as listed above)
   - Three pro forma invoices with:
     - Your VAT number
     - Description of returned goods
     - Noticed failures
     - Value - for customs purposes only
     - Origin of the goods (in general, Switzerland)
4. A cost estimate for repair will be sent to you as soon as the goods have been analyzed. If the repair charges do not exceed 25% the price of a new unit, the repair or calibration will be completed without requiring prior customer authorization.

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