



**Commercial Products**

**Automated Control  
Electronics (ACE™)  
System Operation,  
Diagnostics, and Programming**

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# Introduction

ACE™ is an acronym for Automated Control Electronics. The “ACE System” is a machine control system which is currently used on the Groundsmaster® 580-D, Reelmaster® 5000/6000 series fairway mowers and Greensmaster® 3200 (gasoline only). All of these machines operate under the same concepts and utilize common diagnostic procedures. The ACE System is also used to control the TurfDefender™ hydraulic leak detection system and Sonic Boom™ accessory for spray systems.

The ACE System was developed for several reasons:

- Ease of operation and safety.
- Reduces mechanical linkage requirements (and adjustments).
- Reduces electrical wiring and components.
- Reliability.
- Allows ClipAce™ function on some fairway mowers (matches reel speed to traction speed).
- Common manufacturing and servicing capabilities.

The heart of the ACE system is an electronic control unit (ECU). This provides us with several advantages:

- Simplified diagnostic procedures.
- Software upgrades.
- Operational characteristics can be customized easily.
- Expandable system.

The “ACE System” includes two sub-systems:

- Electrical system.
- Hydraulic system.

The simplest explanation of the ACE system is that it utilizes an electrical system to control and activate the hydraulic system of a machine. This is extremely important to understand the interaction of these two systems because an ELECTRICAL PROBLEM CAN CAUSE A HYDRAULIC CONTROL VALVE TO MALFUNCTION, but a HYDRAULIC PROBLEM CAN NOT CAUSE AN ELECTRICAL MALFUNCTION.

If something goes wrong on the machine, the first step in diagnosis is to determine if the problem is electrical or hydraulic. Because the controller provides us with enhanced diagnostic capabilities, electrical system tests can be performed easily and quickly.

**Note:** If a machine equipped with ACE malfunctions, always check the electrical system first, before looking for possible hydraulic problems.

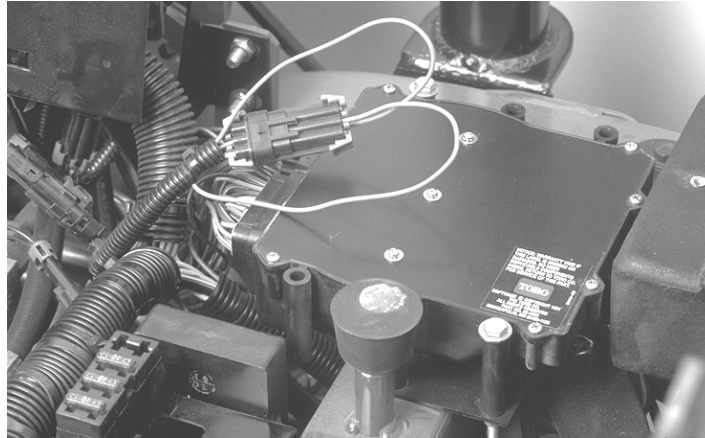
Follow proper troubleshooting procedures. Talk to the operator. By asking the correct questions, the operator may actually tell you what is wrong. It could be as simple as not understanding how the system operates (example: Reel Control lamp illuminates while mowing). Some questions to ask the operator:

- Exactly what is happening?
- Was (or is) the Diagnostic Lamp flashing?  
NO = First use the Diagnostic ACE Display tool to check INPUTS, then perform hydraulic tests.  
YES = Use Diagnostic ACE Display tool to check OUTPUTS.
- Is the problem repeatable? or is it intermittent?

**Note:** The controller can store output fault information which can be retrieved with the Diagnostic ACE Display tool or with TOROPC software and a personal computer. This can be very helpful when diagnosing intermittent problems. This feature requires a controller software upgrade on machines built prior to the 1997 model year (S/N before 70001).

# Controller Operation

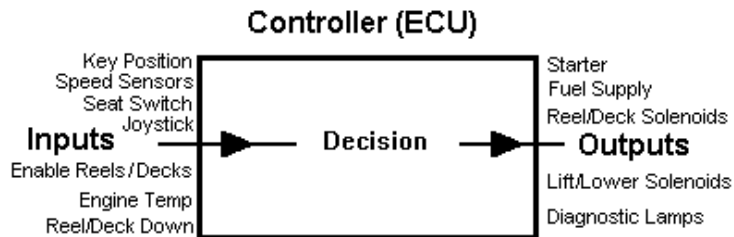
The controller (ECU) is the heart of the ACE system. The controller is the “brains” of the system and contains the programming (or instructions) needed to properly operate the machine it is installed in. All controllers currently in use are the same. What makes the controller a Groundsmaster 580-D or a Reelmaster 5300-D is the software that is programmed into the controller. Initial machine programming is performed at the factory when the controller is installed into a machine, but can also be performed by an authorized Toro Distributor if necessary.



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## Inputs and Outputs

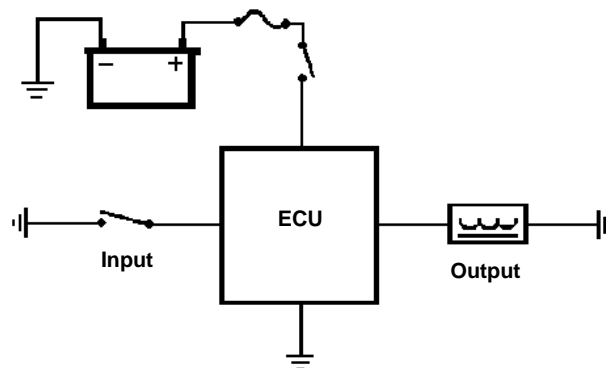
Connected to the controller are a series of INPUT switches. These on/off switch devices send electrical signals to the controller when an operator has made a request. The controller will then process the input information, decide what to do, and turn on the correct OUTPUT device to meet the operator's requests.



### Important information to remember:

- Inputs are usually switches (on/off devices).
- Outputs are usually solenoids (load devices).

**Note:** Not all outputs are solenoids. Diagnostic Lamps are also outputs.



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## Controller Protection

An **output solenoid**, which is activated by the controller, can have a large current draw if it fails in a “shorted” condition. If it fails “open”, it will not draw any current. These two conditions are known as faults. If either one of these faults occur, the controller will automatically shut off that output to prevent damage. The fault will register as a flashing Diagnostic Lamp and will be saved in the controller memory.

**Note:** The controller memory cannot tell you what kind of fault occurred (short or open circuit), but it will tell you what output solenoid (or related wiring) has failed.

The **input switches** only send on/off signals (switch state change) to the controller. A faulty input will not be saved in the controller memory.

### **Important information to remember:**

- A defective input switch or wiring will NOT register as a fault in the controller.
- The controller will only inform the operator of output faults.
- An output fault can be retrieved from controller.

# ClipAce Function (Reelmaster 5100/5300/6500/6700)

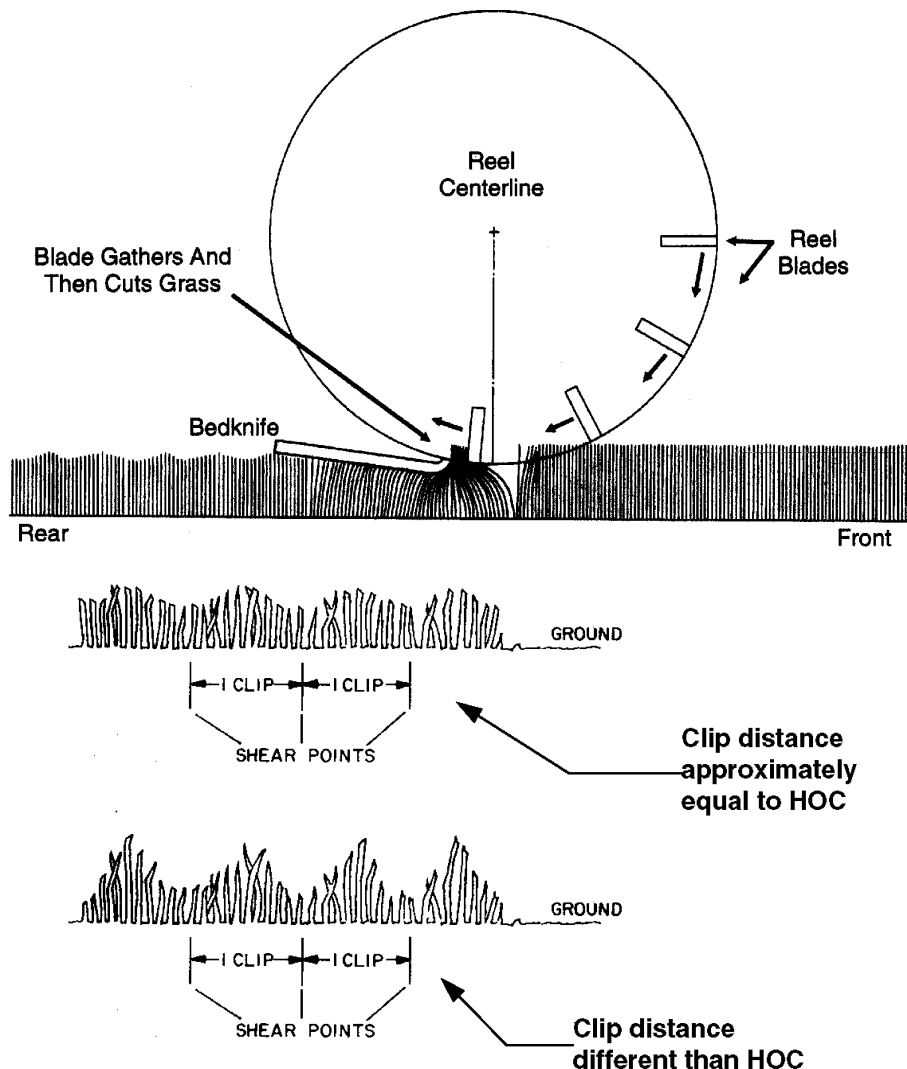
## Clip Rate

Clip rate is the numerical distance the traction unit travels between reel blade/bedknife contacts. The actual mathematical formula is:

$$\frac{\text{Ground Speed (in/min)} \times \text{MPH}}{\text{No. of Reel Blade} \times \text{Reel RPM}}$$

Research has shown that the desired clip rate is equal to the Height-of Cut (H.O.C.) setting of the cutting unit. If the cutting unit is set at 1/2 inch (13 mm) H.O.C., then for best results, every 1/2 inch (13 mm) of forward movement a reel blade should cut grass. This produces the best after-cut appearance.

On a machine with a manually set reel speed this would mean that there is a limited variance of traction speed in which the desired clip rate is actually achieved. If traction speed is too fast, a “choppy” after-cut appearance may be visible. If traction speed is too slow, the reels may fan the grass away, which may result in a “fuzzy” after-cut appearance.



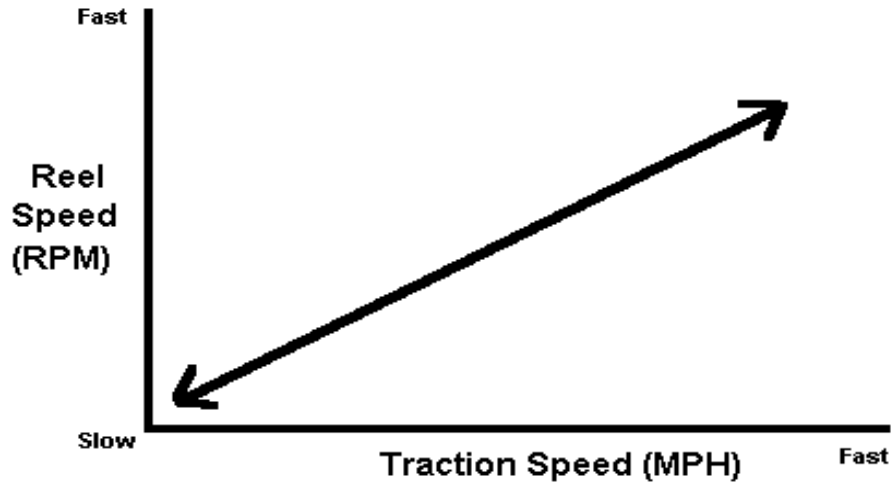


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## ClipAce Operation

ClipAce is the function of matching the reel speed (RPM) to the traction forward speed (MPH). This will obtain the best possible clip rate for satisfactory after-cut appearance.

The controller measures traction unit forward speed through a speed sensor. The controller then calculates what the proper reel RPM should be. The controller then electrically adjusts the amount of hydraulic oil flowing to the reel circuits to speed up or slow down the reels to match the desired clip rate of the reels. The controller also senses the actual reel speed to ensure that proper reel circuit RPM is maintained for the given traction unit speed. **As traction speed increases, so should reel speed. As traction speed decreases, so should reel speed.**



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## Controller (ECU) Information for ClipAce Operation

There are several cutting unit blade configurations available for the Reelmaster 5000/6000 series mowers, depending on the customers desired H.O.C. range. In order for ClipAce control to function properly, the controller (ECU) needs two important pieces of information:

**Number of blades on the installed cutting units.** The number of blades is critical information needed to determine the desired reel RPM vs. MPH to match clip rate. This information is programmed into the controller during set-up of the machine at the Distributor.

**What the Height of Cut (H.O.C.) setting is of the installed cutting units.** This information is critical for the controller to be able to match the clip rate (reel RPM) to the traction forward speed. This information is provided to the controller electrically by rotating the **H.O.C. Selection Knob** (located inside the operators control console) to the desired setting. Each machine is equipped with a H.O.C. selection chart located under the Seat platform.

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## Reel Control Lamp Operation (ClipAce Function)

The red **Reel Control Lamp** (on the steering tower or operator's console) serves as a visual aid to tell the operator if the unit is operating within the control of the ClipAce function. The Lamp will be illuminated if traction speed is too slow or too fast to allow the desired clip. For example, if the traction speed is zero, the reels will still run at the minimum speed of approximately 500 RPM, which will result in a clip smaller than desired and cause the Reel Control Lamp to illuminate. The speeds at which the Lamp turns on and off are determined by the cutting unit blade configuration, selected H.O.C knob position, and model of traction unit.

If the Reel Control Lamp illuminates:

1. The machine is being operated at a traction speed too slow to allow the desired clip. Increase traction speed until the lamp turns off.
2. The machine is being operated at a traction speed too fast to allow the desired clip. Reduce traction speed until the lamp turns off.
3. A foreign object, is restricting reel rotation.

If changing traction speed or removing the foreign object does not cause the lamp to go off, and the Reel Control Lamp remains illuminated regardless of traction speed, then the machine may have a malfunction (see *Diagnostic Lamps* for more information).

**Note:** See the Operator's Manual for information about a specific Toro model. Review *the Reel Speed Charts* in this manual to get a better understanding of when the Reel Control Lamp will be on or off.



# New Machine Set-up

All machines are pre-programmed at the factory. Complete controller (ECU) reprogramming prior to delivery should not be necessary.

**Greensmaster 3200 (gas), Groundsmaster 580 and Reelmaster 5200/5400** do not require any additional controller configuration prior to delivery.

**Reelmaster 5100/5300/6500/6700** have options for cutting unit configurations (5 blade, 7 or 8 blade, and 11 blade). This information must be programmed into the machine controller to ensure proper ClipAce operation.

**Note:** Blade configuration (or cutting unit selection) can be performed without a personal computer or other tools. Follow the procedures for Cutting Unit Selection in the *Quick Reference Guide* section of this manual.

LIMITMPH (speed limit option) in RMCONFIG does not need to be programmed during set-up unless the customer requests that this feature be set and activated.

## Diagnostics Tools

The two most important diagnostic tools are the machine Diagnostic Lamps (red Reel Control Lamp on steering tower and/or green Controller Diagnostic Lamp under the console) and a good understanding of system operation.

**Diagnostic Lamps** (on machine): Use to monitor ClipACE operation and assist with diagnostics. The lamp will flash on/off when the controller has sensed an output fault. (see *Diagnostic Lamps* for more information).

**Note:** See the Operator's Manual for information about a specific Toro model.



**Diagnostic ACE Display Tool (85-4750):** This tool can be used on any ACE equipped machine. Overlay Decals are used to identify specific inputs and outputs for each model.

**Note:** See the Operator's Manual or Service Manual for information about using the Diagnostic ACE Display tool on a specific Toro model.



**TOROPC and RMCONFIG software and a personal computer:** For use by an Authorized Toro Distributor to perform advanced diagnostics, set programming options or install upgraded software. (See *General Info/Admin Service Bulletin # 30* for the latest software part numbers.)



**Serial Interface Cable (85-4540):** Use to connect personal computer to Loop-back connector(s).

**Note:** If using a desktop computer instead of a portable computer, you may need to lengthen the serial interface cable. Cut and splice the cable with similar gauge wire or take the cable to a computer store and have them make an extension cable. The extension cable will go from the computer serial port (normally a DB9 or DB25 connector) to the DB9 connector on the Toro cable. It is only necessary to connect pins 2, 3 and 5. Be sure to check and see if your computer's serial connector is male or female. For reliable communication, cable length should be kept as short as possible. Do not exceed 18 feet (5.5 m) cable length. If you have communication problems, try making the cable shorter.



**Remote Programming Harness (85-4560):** Required to program controller when controller is removed from the machine.

**Battery (55-7520):** 12V power source for remote programming of controller.

**Battery Charger (92-1743):** Battery charger (110V) for above battery

**Battery Charger (22-4710):** Battery charger (220V) for above battery.

**DataLog System Diagnostic Recorder (85-4700):** For use by an Authorized Toro Distributor to find intermittent problems. The DataLog tool can record controller events for playback at a later time.



High impedance **Digital Multi-meter:** Used to measure voltage, amperage and resistance of electrical wiring and devices.



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## Fault Memory and Retrieval

All 1997 (S/N 70001) and newer machine controllers (except TurfDefender) have been enhanced with Fault Memory. If the controller senses a **fault** at one of the **output** circuits, the machine Diagnostic Lamp will flash and store the fault in controller memory. The fault can then be retrieved and viewed with the Diagnostic ACE display tool or a personal computer. The controller will store one (1) fault at a time and will not store another different fault until the first fault is cleared (see Fault Memory Retrieval in the *Quick Reference Guide* section).

**Note:** This feature is requires a controller software upgrade on machines built prior to the 1997 model year (S/N before 70001).

# Controllers and Functions

## Main Controller - All Machines

### Functions:

- Manages all functions of machine safety, sequencing of cutting units and ClipAce (Reelmasters).
- "Supervisor" for the RM 6700-D secondary controller (#2) and TurfDefender.
- Connected to other controller(s) by the CAN Bus (see CAN Information in *PC Capture* section).

### Fault Identification/Operator Warning:

- Flashing red Reel Control Lamp (steering tower) or green Diagnostic Lamp (console).

### Diagnostics: (through loop-back connector)

- Diagnostic ACE Display tool (with correct overlay for machine)
- TOROPC & personal computer
- DataLog

## Controller #2 (Secondary) Reelmaster 6700 Only

### Functions:

- Manages functions of #6 & 7 cutting units ONLY!
- Needs approval from controller #1 before executing an operator request.
- Same part # as main controller (#1), but requires different software.
- Connected to other controller(s) by the CAN Bus (see *CAN Information*)

### Fault Identification/Operator Warning:

- Flashing red Reel Control Lamp on steering tower **and** green Diagnostic Lamp under Console.

### Diagnostics: (through loop-back connector)

- Diagnostic ACE Display tool (with correct overlay for RM 6700 secondary controller).
- TOROPC & personal computer.
- DataLog.

## TurfDefender Leak Detector

### Function:

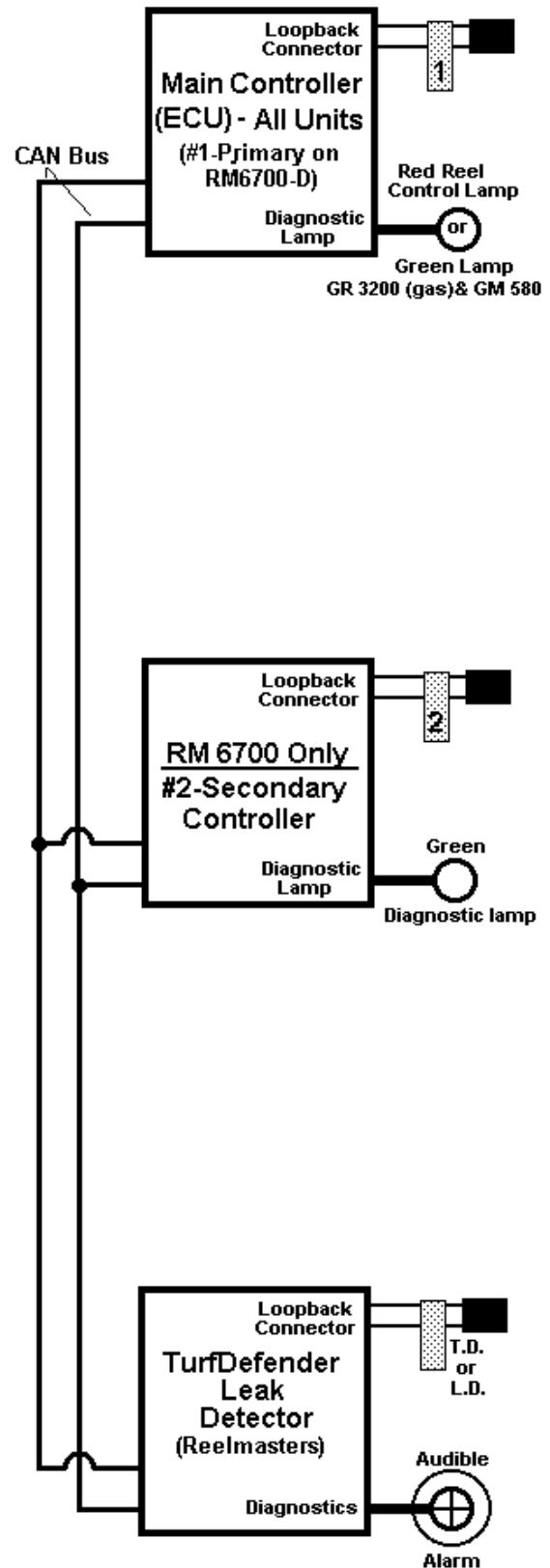
- Warns operator of a hydraulic leak and/or over-temp conditions by an audible alarm.
- Connected to other controller(s) by the CAN Bus (see *CAN Information*).

### Fault Identification/Operator Warning:

- Audible alarm and cutting unit shutdown.

### Diagnostics: (through Loop-back Connector)

- Diagnostic ACE Display tool (with correct overlay for TurfDefender).
- TOROPC & personal computer.



# Diagnostic Lamps

## Reel Control Lamp - Red (RM 5000/6000 series)

Lamp will be **on** when:

- Glow Plugs activated (Reelmaster 6000's only).
- Mowing too slow or too fast for proper ClipAce control.
- Defective Reel Speed Sensor (reels engaged).
- Defective Traction Speed Sensor (no ground speed).
- Jammed cutting unit reel.
- Bad reel motor (reel turns too slow or not at all).

Lamp will **flash on/off** when:

- Controller has sensed an Output Fault (primary only on RM6700 - also see #2 Secondary Controller below).
- Reel blade configuration not set (no reel engagement)
- Controller shut down reels during backlap (Controller sensed a reel speed of less than 50 RPM).
- Operator has exceeded optional programmed speed limit (see *New Machine Set-up*).
- TurfDefender has detected a leak.

No lamp illumination:

- Loop-back connector not connected.
- No power to controller.
- Lamp bulb burnt out.
- No software installed or Controller problem.

## Diagnostic Lamp - Green (Groundsmaster 580, Greensmaster 3200 gas, Reelmaster 223/5100/5300)

Lamp will be **on** when:

- Controller is successfully loaded and ready to operate (everything O.K.).

Lamp will **flash on/off** when:

- Output fault has been sensed.

No lamp illumination:

- Loop-back connector not connected.
- No power to controller.
- Lamp bulb burnt out.
- No Software Installed or Controller problem.

## #2 Secondary Controller (Reelmaster 6700 only)

Green Lamp (under console) will be on when:

- Controller #2 is successfully loaded and ready to operate (everything O.K.).

Green Lamp and Red Lamp (steering tower) will flash when:

- Controller #2 senses an OUTPUT fault.

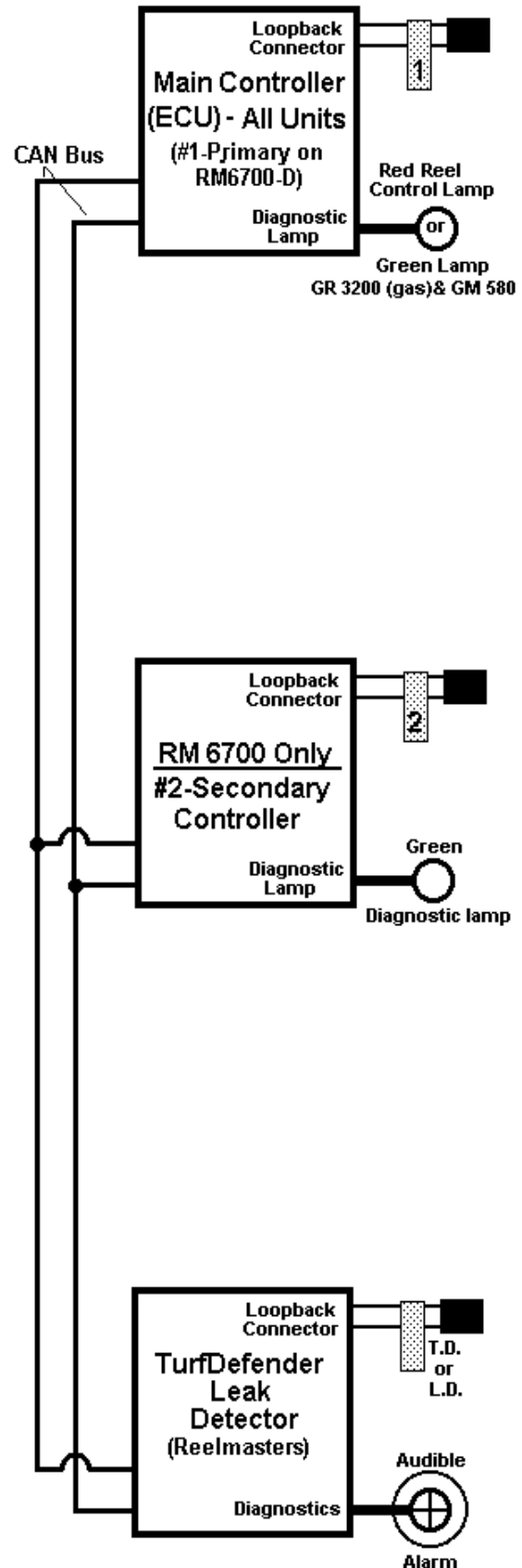
Green Lamp flashes and NO Red Lamp (steering tower) indicates:

- Program fault w/ controller #1 (Primary)
- Controller #1 not running.
- Possible CAN (Controller Area Network) fault.

## TurfDefender Leak Detector

Audible Alarm indicates:

- One (1) short beep at start-up. Detector is operating properly.
- Four (4) short beeps. Detector is indicating a problem.
- Long beeps (and reels shut off). Detector has sensed a leak.



## Quick Reference Guide

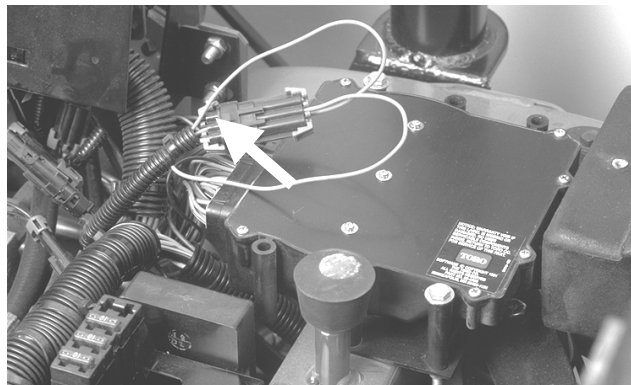
# Using the Diagnostic ACE Display tool

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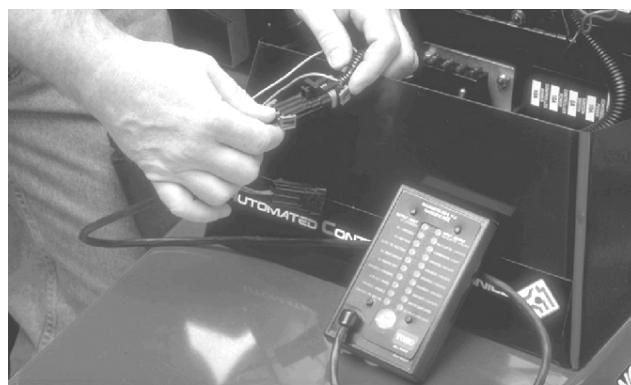
### Connecting the Diagnostic ACE tool

1. Park machine on a level surface, engage parking brake, lower cutting units, and turn ignition key switch OFF.
2. Carefully disconnect loop-back connector from wire harness.
3. Connect Diagnostic ACE Display tool to connector on wiring harness (where loop-back connector was removed).

**Note:** See the Operator's Manual for information about a specific model.



Controller and loop-back connector on a Greensmaster 3200



Connecting Diagnostic ACE Display tool to loop-back connector on a Reelmaster 5100-D



## Quick Reference Guide

# Using the Diagnostic ACE Display tool

## Checking INPUTS

**Note:** See the Operator's Manual for information about a specific model.

1. After connecting Diagnostic ACE Display tool and turning key switch ON, move any input switch, such as the seat switch or traction neutral switch, to get the Diagnostic ACE Display to function. **DO NOT** start the engine.



**CAUTION:** To prevent possible personal injury, lower cutting units before working on machine. If ignition key switch is on, cutting units may lower when joystick is moved to Lower/ mow position.

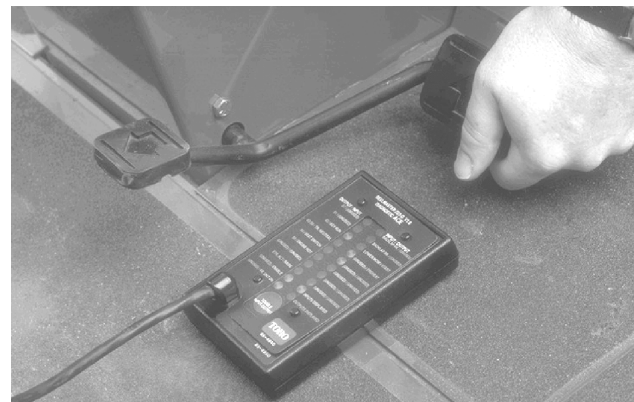
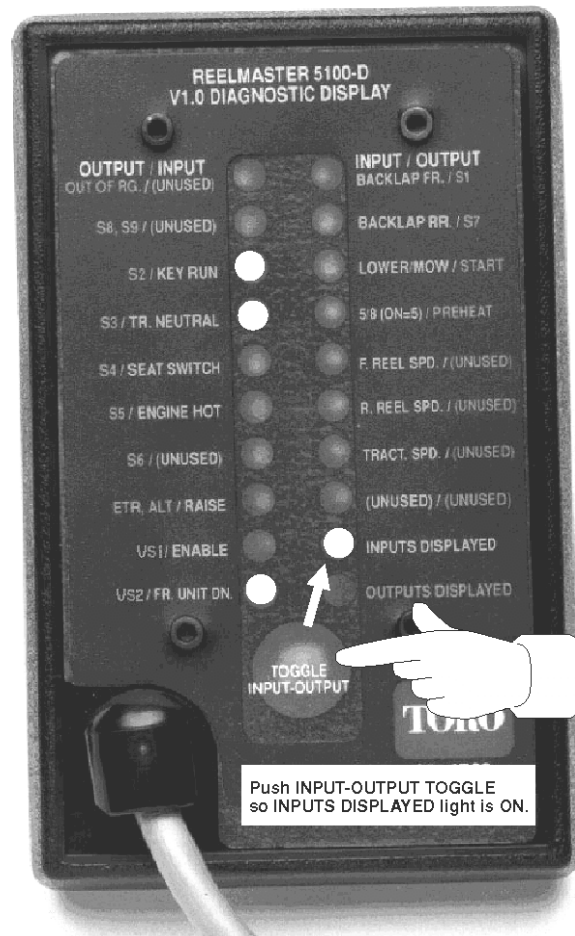
**Note:** After doing step 1, the INPUTS DISPLAYED lamp will be on. This indicates that the Controller and Diagnostic ACE Display tool are operating properly. If the Diagnostic Lamp on the machine comes on, but the INPUTS DISPLAYED lamp does not come on, there is a problem with the Diagnostic ACE Display tool.

2. If necessary, push toggle input-output button so INPUTS DISPLAYED lamp is on. Do not hold the button down.

**Note:** Red text on overlay decal refers to input switches and green text to outputs.

3. The Diagnostic ACE Display tool will illuminate the lamp associated with each input when that input switch is closed. Check each switch (input) by opening and closing the switch, then verifying that the corresponding lamp goes on and off as the switch position is changed. For example, with traction pedal in neutral, TR. NEUTRAL lamp should be on, then go off, when traction pedal is moved out of neutral. Check function for each input switch.

4. If a switch is closed and corresponding lamp does not go on, check all wiring and connections to switch and/or test switch and wiring with a digital multi-meter. Replace any faulty switches and repair or replace any faulty wiring or connectors.



Checking Reelmaster 5100-D  
Traction Neutral Switch

## Quick Reference Guide

# Using the Diagnostic ACE Display tool

## Checking OUTPUTS

**Note:** See the Operator's Manual for information about a specific model.

1. After installing the Diagnostic ACE Display tool, turn ignition key switch ON, but DO NOT start the engine.

**Note:** After installing Diagnostic ACE Display tool and turning ignition key switch ON, the INPUTS DISPLAYED lamp will be on. This indicates that the Controller and Diagnostic ACE Display tool are operating properly. If the Controller Diagnostic Lamp on the machine comes on, but the INPUTS DISPLAYED lamp does not come on, there is a problem with the Diagnostic ACE Display tool.

2. Push toggle input-output button so OUTPUTS DISPLAYED lamp is on.

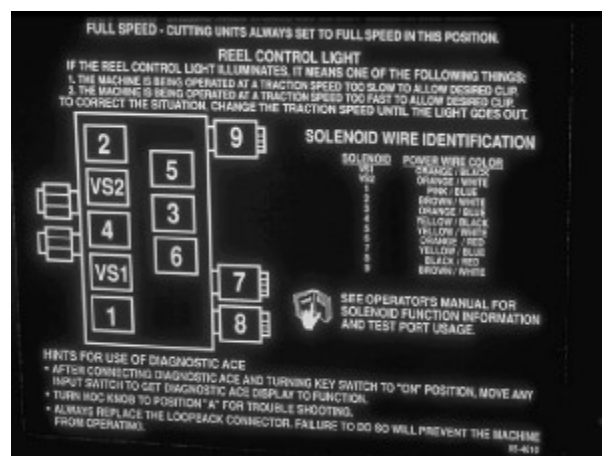
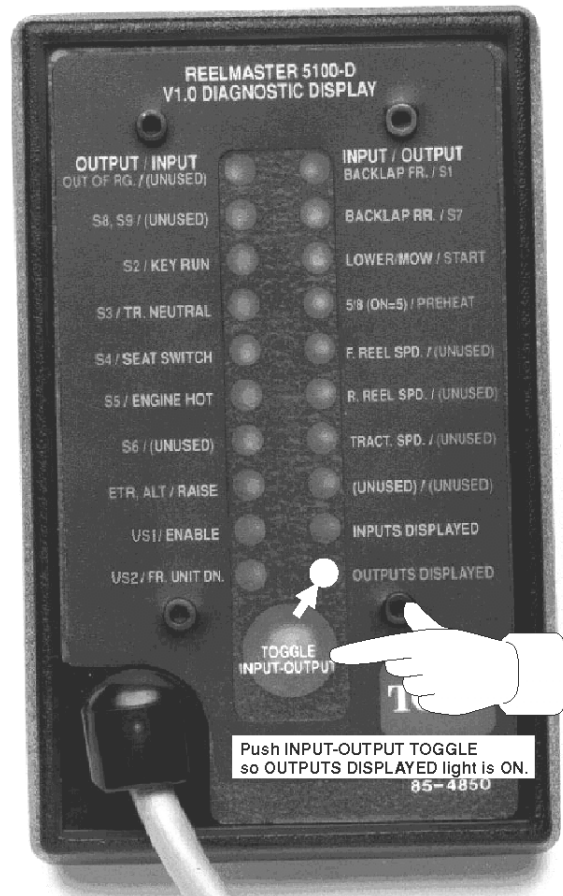
**Note:** It may be necessary to toggle between INPUTS DISPLAYED and OUTPUTS DISPLAYED several times to do this procedure. To toggle back and forth, press toggle button once. This may be done as often as necessary. DO NOT hold button.

**Note:** Red text on overlay decal refers to input switches and green text to outputs.

3. Sit on the seat and attempt to operate desired function of machine – do not start the engine. The appropriate output lamps should illuminate to indicate that the Controller is turning on that function. If any output lamp is flashing on and off, this indicates an electrical problem with that OUTPUT. To reset a flashing LED, turn the key switch OFF, then back ON. If no output lamps are flashing on and off, but the correct output lamps do not illuminate, verify that the required input switches are in the necessary positions to allow that function to occur.

If input switches are correct, but output lamps are not correct, this may indicate a controller malfunction. If output lamps are correct, but machine does not function properly, this may indicate a hydraulic problem.

**Note:** Due to electrical system constraints, the output lamps for START, PREHEAT and ETR/ALT may not flash on and off, even though an electrical problem may exist for one of those functions.



Decal under seat on Reelmaster 5100-D identifying output solenoids.

## Quick Reference Guide

# Reelmaster<sup>®</sup> 5100/5300/6500/6700

**Note:** Machines built before 1997 model year (S/N before 70001) must have updated software installed.

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### Cutting Unit Selection

The Reelmaster 5000 and 6000 series Controllers must be programmed with the Blade configuration (number of Blades) on the installed cutting units in order for the ClipAce<sup>™</sup> feature to operate properly. If the Blade configuration is not set, the cutting units will not operate in the mow position.

**Do not sit in the seat; A closed Seat Switch will void this procedure!**

1. Key switch in OFF position.
2. Connect the Diagnostic ACE Display tool to the Controller (Primary on RM 6700-D) Loop-back Connector. Remove the overlay from the tool.
3. Move Enable / Disable Switch to ENABLE position (Master on RM 6700-D).
4. Move Lower / Mow - Raise Lever to LOWER position and hold.
5. Turn Key switch ON, and continue to hold Lower / Mow - Raise Lever in LOWER position until Reel Control Lamp starts to flash (2 seconds).
6. Release the Lower / Mow - Raise Lever to center position. Reel Control Lamp will now be on steady.
7. Select Outputs Displayed on Diagnostic ACE Display tool.
8. Move Lower / Mow - Raise Lever to the Lower position once for each blade on the installed Cutting Units (*e.g. 5 times for 5 blades, 8 times for 8 blades, etc.*). **Wait for Reel Control Lamp to come back on before each Lower / Mow - Raise Lever movement.** Diagnostic ACE Display tool will display number of times Lower / Mow - Raise Lever has been moved.
9. Move Enable / Disable Switch to DISABLE position (Master on RM 6700-D). Reel Control Lamp will now flash the number of blades Controller has been programmed for, then turn off. The Diagnostic ACE Display tool will also display the Blade configuration programmed.
10. Turn Key switch OFF and disconnect Diagnostic ACE Display tool. Connect Loop-back Connector. The blade configuration now set.

**Note:** Do not do step 8 when verifying Blade configuration in the field.

## Quick Reference Guide

# Reelmaster<sup>®</sup> 5000 & 6000 Series

**Note:** Machines built before 1997 model year (S/N below 70001) must have updated software installed.

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## Retrieving Fault Information

### Retrieving Stored Faults

1. Key switch in OFF position.
2. Connect Diagnostic ACE Display tool to desired Controller Loop-back Connector (*use the proper overlay*).
3. Move Lower / Mow - Raise Lever to the RAISE position and hold.
4. Turn Key switch ON, and continue to hold Lower / Mow - Raise Lever in RAISE position until top left Diagnostic ACE Display lamp comes on (approx. 2 seconds).
5. Release Lower / Mow - Raise Lever to center position.
6. Diagnostic ACE Display tool will now playback the fault retained in Controller memory.

**Note:** The display will show eight (8) individual records, with the fault displayed on record 8. Each record will be displayed for 10 seconds. Make sure to select OUTPUTS DISPLAYED on Diagnostic ACE Display tool to view fault information. The fault circuit will be flashing. Records will repeat until key switch is turned off. The machine will not start in this mode.

### Clearing the Fault Memory (Diagnostic ACE Display tool not required)

1. Key switch in OFF position.
2. Move Backlap Switch to FRONT or REAR Backlap position.
3. Move Enable / Disable Switch to ENABLE (Master on RM 6700-D).
4. Move Lower / Mow - Raise Lever to the RAISE position and hold.
5. Turn Key switch ON, and continue to hold the Lower / Mow - Raise Lever in the RAISE position until Reel Control Lamp starts to flash (approx. 2 seconds).
6. Release Lower / Mow - Raise Lever and turn Key switch OFF. Memory is now cleared.
7. Move Backlap Switch to OFF and Enable / Disable switch to DISABLE.

## Quick Reference Guide

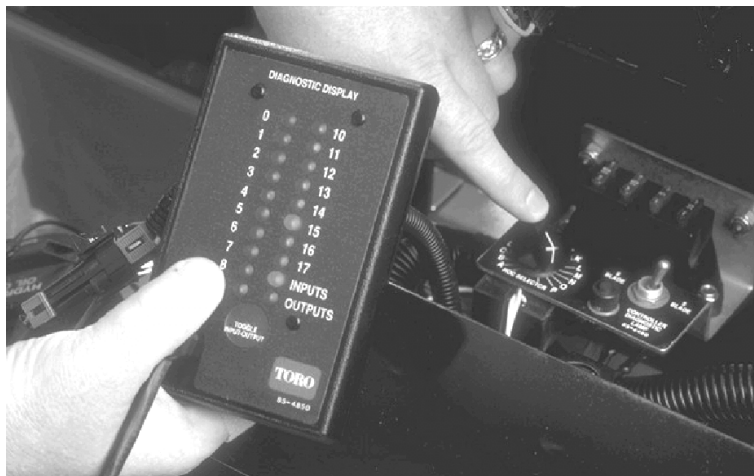
# Reelmaster<sup>®</sup> 5100/5300/6500/6700

### Checking H.O.C Selector (Potentiometer)

The Reelmaster 5000 and 6000 series H.O.C. Selector must be calibrated and operating properly for the ClipAce™ feature to operate properly.

1. Key switch in OFF position.
2. Connect the Diagnostic ACE Display tool to the Controller (Primary on RM 6700-D) Loop-back Connector.
3. Remove overlay decal from Diagnostic ACE Display tool so numbers "0" to "17" next to lamps are visible.
4. Turn ignition key switch OFF .
5. Raise seat and set Backlap switch to FRONT backlap position.
6. Set Enable / Disable switch to DISABLE position.
7. Hold Lower / Mow- Raise lever in RAISE position and turn ignition key switch to ON position. Release Lower / Mow - Raise lever.
8. Slowly turn HOC Selector. LED's on Diagnostic ACE Display tool will show how ECU is interpreting HOC Selector. LED labeled "0" should be illuminated when knob is pointed to "A", and LED labeled "15" should be illuminated when knob is pointed to "P".
9. Turn Key switch OFF and disconnect Diagnostic Ace Display tool. Connect Loop-back Connector.

Diagnostic ACE Display LED	HOC Selector Position
0	A
1	B
2	C
3	D
4	E
5	F
6	G
7	H
8	I
9	J
10	K
11	L
12	M
13	N
14	O
15	P



Refer to the Operator's Manual or decal under the seat plate for the HOC Selector Position and it's corresponding Height of Cut setting.

## Quick Reference Guide

# Greensmaster<sup>®</sup> 3200

**Note:** Machines built before 1997 model year (S/N below 70001) must have updated software installed.

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## Retrieving Fault Information

### Retrieving Stored Faults

1. Key switch in OFF position.
2. Connect Diagnostic ACE Display tool to Controller Loop-back Connector (*use the proper overlay*).
3. Move Lower / Mow - Raise Lever to the RAISE position and hold.
4. Turn Key switch ON, and continue to hold Lower / Mow - Raise Lever in RAISE position until top left Diagnostic Display lamp comes on (approx. 2 seconds).
5. Release Lower / Mow - Raise Lever to center position.
6. Diagnostic ACE Display tool will now playback the fault retained in Controller memory.

**Note:** The display will show eight (8) individual records, with the fault displayed on record 8. Each record will be displayed for 10 seconds. Make sure to select OUTPUTS DISPLAYED on Diagnostic ACE Display tool to view fault information. The fault circuit will be flashing. Records will repeat until key switch is turned off. The machine will not start in this mode.

### Clearing the Fault Memory (Diagnostic ACE Display tool not required)

1. Key switch in OFF position.
2. Move Lower / Mow - Raise Lever to RAISE position and hold.
3. Depress TEMP OVERRIDE button and hold.
4. Turn Key switch ON, and continue to hold the Lower / Mow - Raise Lever in the RAISE position and TEMP OVERRIDE button depressed until Green Controller Lamp starts to flash (approx. 2 seconds).
5. Release Lower / Mow - Raise Lever and button. Turn Key switch OFF. Memory is now cleared.

## Quick Reference Guide

# Groundsmaster<sup>®</sup> 580-D

**Note:** Machines built before 1997 model year (S/N below 70001) must have updated software installed.

---

## Retrieving Fault Information

### Retrieving Stored Faults

1. Key switch in OFF position.
2. Connect Diagnostic ACE Display tool to Controller Loop-back Connector (*use the proper overlay*).
3. Move PTO switch to ENGAGED position and hold.
4. Turn Key switch ON, and continue to hold PTO switch in ENGAGED position until top left Diagnostic Ace Display lamp comes on (approx. 2 seconds).
5. Release PTO switch.
6. Diagnostic ACE Display tool will now playback the fault retained in Controller memory.

**Note:** The display will show eight (8) individual records, with the fault displayed on record 8. Each record will be displayed for 10 seconds. Make sure to select OUTPUTS DISPLAYED on Diagnostic ACE Display tool to view fault information. The fault circuit will be flashing. Records will repeat until key switch is turned off. The machine will not start in this mode.

### Clearing the Fault Memory (Diagnostic ACE Display tool not required)

1. Key switch in OFF position.
2. Move PTO switch to ENGAGED position and hold.
3. Depress TEMP OVERRIDE button or CRUISE SET button and hold.
4. Turn Key switch ON, and continue to hold the PTO switch in ENGAGED position and TEMP OVERRIDE or CRUISE SET button depressed until Green Controller Lamp starts to flash (approx. 2 seconds).
5. Release PTO switch and button. Turn Key switch OFF. Memory is now cleared.

# TOROPC and RMCONFIG Software

There are two (2) software disks available for the ACE System - **TOROPC** and **RMCONFIG**. Each disk contains different programs and options depending on what you are trying to accomplish.

**Note:** Each disk contains a **readme** file what can be opened with Microsoft Windows Notepad or any DOS text editor. This file contains instructions, copyright information and revision tracking information.

Choose the correct disk depending on what it is you are trying to accomplish. Always use the latest version of each disk (*see General Info/Admin Service Bulletin # 30 for the latest part numbers*).

Authorized Toro Distributors can also download the latest TOROPC and RMCONFIG program files, and instructions from the Toro Distributor Extranet. Point your Internet Web Browser to **extranet.toro.com** After logging in to the Toro Distributor Extranet with your User Name and Password:

1. Select a Market View.
2. Select Link to Global Product Information.
3. Select Commercial Equipment Material.
4. Select ACE Software Download Page.

---

## TOROPC

This disk contains all the software for **programming** and **diagnostics** of the ACE Controllers.

**Note:** The TOROPC disk (P/N 100-5000 or newer) contains both the TOROPC and RMCONFIG programs.

---

## RMCONFIG

This disk contains all the software required to **configure** (customize) the Reelmaster 5000/6000 series for the customer. Examples are:

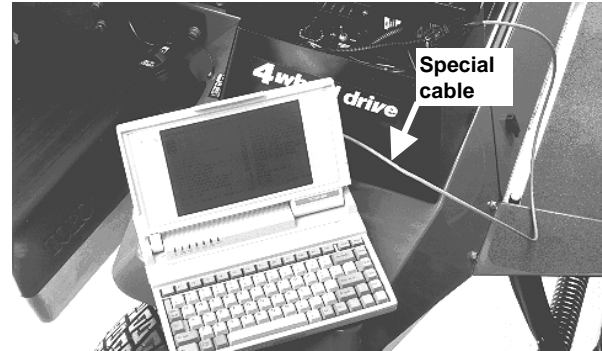
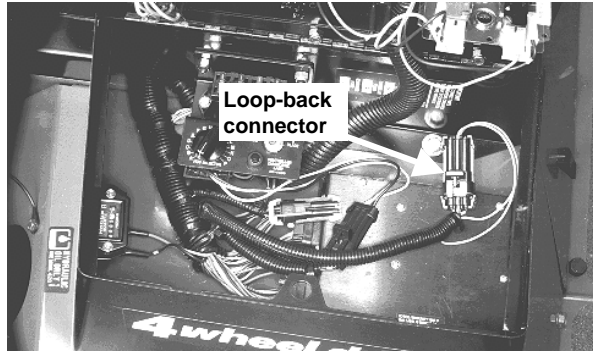
- Set the reel blade configuration
- Set the mowing speed limit.
- Adjust the lift height (of outboard cutting units) during turn-around.



---

## Using a Personal Computer

Connect the personal computer to the machine Controller. Connect the 9-pin end of Interface Cable (85-4540) to the COM1 port of the personal computer. Connect the black plastic Connector of the Interface Cable (6 pins) to the machine Controller Loop-back Connector. Turn on the personal computer, then turn the machine key switch to the ON position (do not start engine).



### To start a program from DOS:

1. Insert the correct 3.5 inch disk in the disk drive (TOROPC or RMCONFIG).
2. Type **a:** after the screen prompt and press the ↵ **Enter** key.
3. Type the program name after the screen prompt and press the ↵ **Enter** key.  
Example: A:\>**toropc** ↵ **Enter** (shown below), or A:\>**rmconfig** ↵ **Enter**

```
C:\>a:  
A:\>toropc
```

**Note:** You may also run a program from the internal hard disk on your computer. It is recommended that you create a directory named "toropc" (example: C:\>**md \toropc** ↵ **Enter**). Copy all of the files from the disk to the C:\toropc> directory you created (example: C:\>**copy a:.\* c:\toropc** ↵ **Enter**). To run the program, go to the directory where the program is installed (example: C:\>**cd \toropc** ↵ **Enter**). Start the program (example: C:\toropc>**toropc** ↵ **Enter**, or C:\toropc>**rmconfig** ↵ **Enter**). See *Making a Backup Copy of the Program Disk* for more information.

**IMPORTANT:** Make sure you delete all files from any previous version of TOROPC or RMCONFIG that is on your internal hard disk before copying the new files.

---

## Windows 3.1 or Windows 95/98 Environment

**IMPORTANT:** If you are using Windows 3.1, exit Windows and begin from MS-DOS. The TOROPC and RMCONFIG programs will not reliably operate from the Windows 3.1 operating system.

If you are using the Windows 95/98 operating system, you can reliably enter the TOROPC or RMCONFIG programs from the MS-DOS prompt without exiting Windows.

---

## Using Serial Ports other than COM1:

The TOROPC or RMCONFIG program allows the use of either serial port COM1: or COM2:. The program defaults to COM1 if you don't take any action. To select COM2:, enter the following command:  
C:\>**set toroport=com2** ↵ **Enter**. Do this before starting the TOROPC or RMCONFIG program.

# Using the TOROPC Program

Once into the TOROPC program, the first screen will ask you to enter the model and serial number of the machine you are working on. By entering the model and serial number, the program will automatically select the proper software options for the machine (this is the preferred method).

```
Enter the model number of machine: 03800
Enter the serial number: 70001_

ESC key will provide complete list of controller (ECU) software choices
```

By pressing the **Esc** key, you can bypass the need to enter the model and serial number. The screen will then display all the software (machine) options available for you to choose from:

**Note:** A sample screen is shown below - program files are subject to change with revisions to this program. Select an option (1 through 13) and press the **Enter** key.

```
Program files to choose from:
1: 854630 Reelmaster 223D Hybrid Rev G
2: 854710 DataLog Controller Revision E
3: 854770 Reelmaster 223D Upgrade Kit Revision J
4: 921749 Groundsmaster 580-D Upgrade Kit (1992 & prior) Rev C
5: 922365 Groundsmaster 580-D ACE Produced (1993 & later) Rev B
6: 946409 TurfDefender Rev E
7: 950657 SONIC BOOM - Automatic Boom Control Rev. A
8: 950686 RM51/5300D Light Fairway w/Turf Defender Rev. F
9: 952920 GR3200G Greensmower Machine & Engine Control Rev B
10: 984570 RM52/5400 Light Weight Fairway Mower Rev B
11: 987319 Groundsmaster 580-D Rev. B
12: 989973 RM6500/6700 ECU #1 (Primary) Rev B
13: 989974 RM6700 ECU #2 (Secondary)

Enter number of your choice and ENTER:
```

**IMPORTANT:** It is recommended that you select software by the "Enter model and serial number" method. Selecting Software by the Esc key method (not entering model and serial number) will result in a "Software upgrade suggested" message even if the most current software is installed (see message information).

---

## Main Menu and Messages

```
Toro ECU Control Program Version 2.0A 08/04/98 File: 989973

Machine: RM6500/6700 ECU #1 (Primary) Rev B
Toro Controller Status: Machine at current software revision

Main Menu:

A -> Programming Options for Controller (ECU)
B -> Memory Options for Controller (ECU)
C -> Diagnostic Options and Tools
D -- Verify communication with Controller (ECU)
Q -- Quit the program

Enter your choice:
```

Once the machine software has been selected, the Main Menu screen will appear: Just after **Toro Controller Status**, a status message will be shown. The message will be one of the following:

**Machine at current software revision.** This means that the Controller has responded and is at the latest revision of software. It is O.K. to proceed.

**Software Upgrade Suggested.** This means that the software contained on the TOROPC disk is newer than what is installed on the machine. The new software can be installed using Main Menu option **A**.

**Model and Serial number do not match. Check before reprogramming!** Verify your entry (model and serial number) by selecting option **A** or **B** and choosing the **Display Current Software revision** option. This will inform you of what the unit is programmed as.

**Controller (ECU) already has newer revision! Software upgrade not recommended!** This indicates that the TOROPC disk that you are using may not be current or a newer version was installed at the factory (see *General Info/Adm Service Bulletin # 30* for the latest part numbers).

**Controller (ECU) did not respond.** This indicates that the ignition Key switch is not "ON". This can also indicate a possible problem with the Interface cable, machine battery or controller.

There are two types of choices on the menus. One type is indicated by two dashes following the menu choice (**D - -**). This indicates that choosing this option will cause the requested action to occur. The second type is indicated by an arrow following the menu choice (**A - >**). This indicates that a sub-menu of choices will be displayed when this option is selected).

---

## Moving Around in the Program

Move around in the program by entering the letter or number of the option desired. In most cases, it is not necessary to press the ↵ Enter key. Follow the instructions at the bottom of each screen.

To move back a menu, or if a wrong choice is entered, press the **Esc** key. The **Esc** key will back up one level. You may return to the main menu by pressing **Esc** one or more times.

## A -> Programming Options for Controller (ECU)

```
Controller (ECU) Programming Options:

1 -- Display current software revision
2 -- Program controller (ECU) with new software
3 -- Calibrate inputs
4 -- Program DataLog w/new software

Press ESC to return to menu

Enter your choice:
```

### 1 - - Display current software revision

```
ECU Programming status:

Product Name      :RM65000
Model Number     :03800
Serial Number    :70001
Software Revision :B
Date Programmed  :062498
Comment         :989973B
Number of Cycles :8

Current monitor revision level: D

Controller Serial No: TA000236

ECU Processor Chip Type - KB

Press any key to continue
```

### 2 - - Program controller (ECU) with new software

Selecting option 2 will start the process of programming new software into the ECU. Follow the on-screen prompts. A status screen will appear showing progress and verification.

```
Programming new ECU program...
Loading into PC memory ...

program verified - 62%
```

When programming and verification is complete, a programming status screen will appear . Enter the **model number** and **serial number** of the machine to complete the programming. Press the **Enter** key after entering each item.

```
ECU Programming status:
Product Name      :RM65000
Model Number     :
Serial Number    :
Software Revision :B
Date Programmed  :080498
Comment          :989973B
Number of Cycles :8

          Press ESC to return to menu
```

### 3 - - Calibrate inputs (H.O.C. Selector)

Some inputs to the ECU, such as the H.O.C. Selector, read voltage supplied through a variable resistor (potentiometer). In order for the ECU to interpret (scale) the voltage reading it receives, it must know the minimum and maximum readings of the potentiometer. This selection allows the user to "train" the ECU so it knows what these values are.

**IMPORTANT:** For proper ClipAce operation, the potentiometer (H.O.C. selector) must be calibrated if it is replaced.

To calibrate inputs:

Press the **C** key to begin the calibration process.

```

Analog Channel                                High    Low
-----
1: HOC Selection Control

C=Calibrate Channel, E)xit and Save, ESC to return to menu
```

Press the **1** key to select the channel number.

**Note:** The Analog Channel(s) listed depends on the specific machine software that is chosen when starting TOROPC. This example is from the Reelmaster 6500.

<b>Analog Channel</b>	<b>High</b>	<b>Low</b>
<b>1: HOC Selection Control</b>		
Enter the channel number: _		
<b>C=Calibrate Channel, E)xit and Save, ESC to return to menu</b>		

After pressing **1** the prompt will be:

**Turn knob to maximum position in the clockwise direction  
and press any key**

Turn the knob clockwise to the maximum position (as far as it will go), then press any key. The new prompt will be:

**Turn knob to minimum setting in the counter clockwise direction  
and press any key**

Turn the knob counterclockwise to the minimum setting (A position) on the decal (not as far as it will go), then press any key. At this point, you are showing the ECU what the minimum setting is, not how far it will turn. The new prompt will be:

**Turn knob to maximum position in the clockwise direction  
and press any key**

Following the prompt, turn the knob clockwise to the maximum setting (P position) on the decal (not as far as it will go – this will not be as far as in the first step) and then press any key. At this point, you are telling the ECU what the maximum setting is, not how far it will turn.

After completing the calibration the "Analog Channel" screen will be displayed showing the High and Low settings for the channel (HOC Selection Control).

Press the **E** key to Exit and Save the calibration.

#### 4 - Program DataLog w/new software

This selection is similar to option 2 - - *Program controller (ECU) with new software*. This selection is used to program new software into a DataLog controller.

When the ECU Programming status screen appears after programming a DataLog, **enter the software part number (854710) for the Model Number**. Enter any serial number you wish. The software part number is shown on the *Program files to choose from*: screen (see Page 22 for an example).

---

### B - > Memory Options for Controller (ECU)

```
Controller (ECU) memory options:

1 -- Playback fault information from machine controller (ECU)
2 -- Erase/clear fault information from memory
3 -- Playback recorded data from PC or Disk
4 -- Playback recorded data from Datalog
5 -- Display current software revision

Press ESC to return to menu

Enter your choice:_
```

#### 1 - - Playback fault information from machine controller

This option is the same as Main Menu option C - > *Diagnostic Options and Tools*, option 4 - - *Playback fault information from machine controller*. See that section of this book for detailed information.

#### 2 - - Erase/clear fault information from memory

Press the **2** key to erase fault information from the controller memory. After the fault memory is erased the message "Program Download Successful" will appear, followed by "Fault Memory Cleared". Press any key to return to the menu.

#### 3 - - Playback recorded data from PC or Disk

This option is the same as Main Menu option C - > *Diagnostic Options and Tools*, option 5 - - *Playback recorded data from PC or Disk*. See that section of this book for detailed information.

#### 4 - - Playback recorded data from DataLog

This option is the same as Main Menu option C - > *Diagnostic Options and Tools*, option 6 - - *Playback recorded data from DataLog*. See that section of this book for detailed information.

#### 5 - - Display current software revision

Press the **5** key to display ECU Programming Status, Software Revision Level, Controller Serial Number and ECU Processor Chip Type. Press any key to return to the menu.

## C -> Diagnostic Options and Tools

```
Diagnostic options and tools:

1 -- Watch input switches (machine will not start)
2 -- Watch input switches and outputs (machine can start & run)
3 -> Record data with PC while machine runs
4 -- Playback fault information from machine controller (ECU)
5 -> Playback recorded data from PC or Disk
6 -> Playback recorded data from Datalog
7 -> Turn on output solenoids for testing (machine will not start)
8 -- PC Capture

Press ESC to return to menu

Enter your choice: _
```

### 1 - - Watch input switches (machine will not start)

This appearance of this screen depends upon which machine option is selected at program startup, this example is for a RM6500/6700. The text will be different for different machines, but the format is the same.

```
Toro Controller Status: RM6500/6700 ECU #1 (Primary) Rev B
  Inputs                               Outputs
Open Not Used                          Off Solenoid S2A
Open Not Used                          Off Solenoid S1A
Open Not Used                          Off Solenoid S5A
Open Traction Neutral                  Off Solenoid S4A
Open Seat Switch                      Off Solenoid S6A
Open High Engine Temperature          Off Solenoid S7A
Open Not Used                          Off Solenoid S1B
Open Raise Reels                      Off ETR Hold, ALT/Run
Open Enable Reels                     Off Solenoid US1A (Front Speed Cont
Open Front Reels Down Switch          Off Solenoid S2B
Open Front Backlapping                Off Solenoid S4B
Open Rear Backlapping                 Off Solenoid US1B
Open Lower/Mow Reels                  Off Start
Open Not Used                          Off Solenoid S3A/S3B
Open Front Reels Speed Switch          2 Start
Open Rear Reels Speed Switch           2 HOC Selection Control
Open Transmission Speed Sensor         3 Preheat
Open Not Used                          2 Not Used
                                         3 Not Used

0 of 0.) Time prior to last data ca 0.71 seconds Battery: 12.4U

Press ESC to return to menu
```

This screen is used to check the performance of each input switch. For example, changing the Enable/Disable switch from **disable** to **enable** should result in the *Enable reels* changing from *Open* to *Closed*.

When this option is selected, the machine will not run, and all of the outputs will always be listed as *Off*.

This option can be used to verify the correct performance of the analog inputs to the ECU (*Start* and *HOC selection control*). For example, the *Start* input is shown as 2 in this display above. When the key is in the run position, this number must be low. However, when the key is turned to the start position, this number must become larger. Or, for the example above, turning the HOC selector while watching this screen should result in the number in front of *HOC selection control* changing.



## 2 - - Watch input switches and outputs (machine can start & run)



**CAUTION:** When this menu selection is made, the machine will function normally. For example, you can start the engine, operate cutting units, etc. To avoid personal injury, sit on the seat (at operator's station), warn personnel to stay clear of machine, lower implement(s) to ground and lock the parking brakes before starting the program.

This display is different depending upon which machine option is selected at program startup, this example is RM6500/6700.

**Note:** After selecting this option, if no data appears on the screen, simply move any input switch (example: move enable/disable switch from enable to disable) to get the data to appear.

```
Toro Controller Status: RM6500/6700 ECU #1 (Primary) Rev B
  Inputs
Open Not Used
Open Not Used
Open Not Used
Open Traction Neutral
Open Seat Switch
Open High Engine Temperature
Open Not Used
Open Raise Reels
Open Enable Reels
Open Front Reels Down Switch
Open Front Backlapping
Open Rear Backlapping
Open Lower/Mow Reels
Open Not Used
Open Front Reels Speed Switch
Open Rear Reels Speed Switch
Open Transmission Speed Sensor
Open Not Used

  Outputs
Off Solenoid S2A
Off Solenoid S1A
Off Solenoid S5A
Off Solenoid S4A
Off Solenoid S6A
Off Solenoid S7A
Off Solenoid S1B
Off F ETR Hold, ALT/Run
Off Solenoid US1A (Front Speed Cont
Off Solenoid S2B
Off Solenoid S4B
Off Solenoid US1B
Off Start
Off Solenoid S3A/S3B

2 of 2.) Time prior to last data ca 2.53_ seconds
Press ESC to return to menu
```

This screen is used for two functions; the first is to check the performance of each input switch. For example, changing the enable/disable switch from **disable** to **enable** should result in the *Enable reels* changing from *Open* to *Closed*.

This screen also allows the user to check the output state of each solenoid. While in this display, the machine will actually run if desired.

**Important Diagnostic Note:** A more useful way to use this option is usually with the key switch ON but the machine NOT RUNNING. This way, the outputs will be turned on and off as if the machine were running, but the machine will not move. Then as the inputs are changed, the outputs will be turned on as required, and their operation can be verified.

### Faults

This screen will also display output faults if they occur:

In the example shown above, the ECU has detected a fault (F) on the output for *ETR Hold, ALT/Run*. This means that the output is either short-circuited or has an open-circuit.

As long as the fault has been detected and not reset, the ECU will not turn that output on again. To reset the fault, ECU power must be turned off by turning the key switch to the off position. After the key switch is turned off and back on, press ESC to back up the program and then reselect option 2 - - *Watch input switches and outputs* to restart the ECU.

**Important Diagnostic Note:** When the Traction Neutral Switch is open (not in neutral), Speed Sensor information (reel r.p.m. and traction speed) is blocked from option 2 - - *Watch input switches and outputs* and 3 - > *Record data with PC while machine runs* in C - > *Diagnostic Options and Tools*. This prevents the Speed Sensor change of state (on/off) from creating an excessive number of records when recording information with option 3 - > *Record data with PC while machine runs* or the DataLog. To accurately view Speed Sensor information, use option 8 - - *PC Capture* in C - > *Diagnostic Options and Tools*. See the *PC Capture* section of this manual for more information.

### 3 - > Record data with PC while machine runs

Use this option to save information on a disk for viewing later. This is different from using the DataLog or PC Capture and the resulting files should not be confused with the DataLog or PC Capture files.

Choosing this option will result in the following prompt:

```
Place disk in the disk drive where data is or will be stored.  
Enter the file name:
```

Enter the file name for information that is to be saved and press the **Enter** key. The program will automatically add the extension .MDD to the end of the file name. This allows files generated with this option to be identified. The file will be saved in the same location (disk or directory) where TOROPC was started from.

If the file already exists, the message and prompt will be:

```
File exists!!:acetest.MDD  
(O)verwrite, (R)ead, (A)dd to, or (Q)uit:_
```

Press **(O)** to overwrite the existing file and begin recording. Press **(A)** to add to the end of the existing file and begin recording, or **(Q)** to quit and cancel the attempt to open a file for recording.

Stop recording by pressing the **Esc** key. The file which has been created is automatically saved under the file name that was specified at the beginning.

#### 4 - - Playback fault information from machine controller (ECU)

If the ECU senses a fault at one of the output circuits, the machine Diagnostic Lamp will flash and store the fault in Controller memory. The fault can then be retrieved and viewed with the Diagnostic ACE display tool or by using the TOROPC program as shown here. The ECU will store one (1) fault at a time and will not store another different fault until the first fault is cleared. The ECU stores the last eight (8) events up to the occurrence of the fault. An event is any time an input or output changes state.

**Note:** This option is the same as 1 - - Playback fault information from machine controller in Main Menu option B -> Controller (ECU) memory options.

The screen below shows the output fault that occurred (ETR Hold, ALT/Run). **The fault is always shown in record 8.** Press the **f** key until you reach record 8. Press the **b** key to page backward if necessary.

**Note:** The record number (8 of 8) is shown in the lower left corner of the screen.

Press the **Esc** key to return the menu, when you are finished viewing records.

```
Toro Controller Status: RM6500/6700 ECU #1 (Primary) Rev B
  Inputs
Open Not Used
Open Not Used
Open Not Used
Open Traction Neutral
Open Seat Switch
Open High Engine Temperature
Open Not Used
Open Raise Reels
Open Enable Reels
Open Front Reels Down Switch
Open Front Backlapping
Open Rear Backlapping
Open Lower/Mow Reels
Open Not Used
Open Front Reels Speed Switch
Open Rear Reels Speed Switch
Open Transmission Speed Sensor
Open Not Used

  Outputs
Off Solenoid S2A
Off Solenoid S1A
Off Solenoid S5A
Off Solenoid S4A
Off Solenoid S6A
Off Solenoid S7A
Off Solenoid S1B
Off F ETR Hold, ALT/Run
Off Solenoid US1A (Front Speed Cont
Off Solenoid S2B
Off Solenoid S4B
Off Solenoid US1B
Off Start
Off Solenoid S3A/S3B

8 of 8.) Time prior to last data ca -49573261.04 seconds
'f' to scroll forward, 'b' scroll backwards, ESC to return to menu_
```

## 5 - > Playback recorded data from PC or Disk

Use this selection to retrieve data that was recorded previously and saved to a computer disk.

**Note:** This option is the same as 3 - - *Playback recorded data from PC or Disk* in Main Menu option B - > *Controller (ECU) memory options*.

Choosing this option will result in the following prompt:

```
Place disk in the disk drive where data is or will be stored.  
Enter the file name:
```

Enter the file name for the information to be retrieved and press the ↵ **Enter** key. If the file exists, the message and prompt will be:

```
File exists!!!acetest.MDD  
(O)verwrite, (R)ead, (A)dd to, or (Q)uit: _
```

Press the **(R)** key to read the file.

```
File contains:2 records.  
Which record would you like to begin at?
```

The file will likely contain many individual records or events. A record is made any time an input (excluding speed sensors) or output changes states (example: an input changes from open to closed). Enter the record number you would like to begin at and press the ↵ **Enter** key. The record(s) showing a malfunction would likely be toward the end of the records if you pressed the Esc key to stop recording when the malfunction occurred.

Shown below is an example of a record. Press the **f** key to go to the next record. Press the **b** key to go to the previous record.

**Note:** The record number is shown in the lower left corner of the screen.

Press the **Esc** key to return the menu, when you are finished viewing records.

```
Toro Controller Status: RM6500/6700 ECU #1 (Primary) Rev B
  Inputs
Open Not Used
Open Not Used
Open Not Used
Open Traction Neutral
Open Seat Switch
Open High Engine Temperature
Open Not Used
Open Raise Reels
Open Enable Reels
Open Front Reels Down Switch
Open Front Backlapping
Open Rear Backlapping
Open Lower/Mow Reels
Open Not Used
Open Front Reels Speed Switch
Open Rear Reels Speed Switch
Open Transmission Speed Sensor
Open Not Used

  Outputs
Off Solenoid S2A
Off Solenoid S1A
Off Solenoid S5A
Off Solenoid S4A
Off Solenoid S6A
Off Solenoid S7A
Off Solenoid S1B
On ETR Hold, ALT/Run
Off Solenoid US1A (Front Speed Co
Off Solenoid S2B
Off Solenoid S4B
Off Solenoid US1B
Off Start
Off Solenoid S3A/S3B

1 of 2.) Time prior to last data ca 0.00 seconds
'f' to scroll forward, 'b' scroll backwards, ESC to return to menu
```

**Important Diagnostic Note:** When the Traction Neutral Switch is open (not in neutral), Speed Sensor information (reel r.p.m. and traction speed) is not recorded. This prevents the Speed Sensor change of state (on/off) from creating an excessive number of records when recording information. See the *PC Capture* section of this manual for information on recording and playback of speed sensor information such as reel r.p.m. or traction speed.

## 6 - > Playback recorded data from DataLog

Use this selection to playback data that was recorded to the DataLog controller. The DataLog controller may be accessed in two ways: either while still connected to the machine, or after it has been disconnected from the machine.

The DataLog controller is used to capture what happens on a machine in the field, and is usually used to diagnose a machine which is experiencing intermittent failures or problems which are difficult to find using fault memory retrieval (example: intermittent input switch failure). See *Using the DataLog to Find Intermittent Problems* for more information.

**Note:** This option is the same as in 4 - - *Playback recorded data from DataLog* in Main Menu option B - > *Controller (ECU) memory options*.

Choosing this option will result in the following prompt:

```
Toro Data Log Controller Analysis
1.) Analyze a previously saved file
2.) Read data from the Data Log Controller
Enter your choice:_
```

Pressing option 2 will read data from the DataLog. The resulting display is shown below.

```
Reading the Data Log information!
pages programmed      - 87
```

After the data is read from the DataLog the following prompt will appear:

```
Options:
1.) Watch the machine as it ran
2.) Save file for analysis later
Enter your choice:
```

Choose option 1 to watch the machine as is ran (as recorded by the DataLog controller). This option will show data screens similar to the ones in option 5 - - *Playback recorded data from PC or disk* in main menu option C - > *Diagnostic Options and Tools*. The data screen will show the state of each of the inputs and outputs at the point in time that the red button was pushed (the latest record in time). Press the **b** (back) key to step backward in time through the data. The DataLog can save up to 746 records. A record is made any time an input (excluding speed sensors) or output changes states (example: an input changes from open to closed). Since the operator would have pressed the red button on the DataLog at the time of a malfunction, the record(s) showing this malfunction would likely be toward the end of the records. Press the **f** (forward) and **b** (back) keys to page through the data records. Press the **Esc** key to return the menu, when you are finished viewing records.

Choose option 2 to save the file from the DataLog controller to a computer disk. Follow the on-screen prompts.

## 7 -> Turn on output solenoids for testing (machine will not start)

This option electrically activates an entire group of hydraulic valve solenoids at once (the machine will not start).

When you make a selection from the *Choices:* prompt shown below, the OUTPUT solenoid circuits are activated continuously. This allows you to:

- Check an entire group of output solenoids at once without having to activate any input switches.
- Locate electrical problems throughout the wiring harness. You can "wiggle" wires to check for faulty connectors or damaged wires.
- Disconnect wiring connectors to perform voltage measurements.



**CAUTION:** Lower cutting units or other implements to the ground before using this option to prevent injury from unexpected lowering of a cutting unit or implement.

```
Choices:
1.) Valve Bank A Solenoids On
2.) Valve Bank B Solenoids On

Enter number of your choice and ENTER: (1 to 2):
```

After selecting choice 1 on the screen above all of the solenoids for Valve Bank A are activated. The example below shows that an output fault has been detected at Solenoid S2A.

**Important Diagnostic Note:** When a fault is detected an audible alarm will sound on the computer that is running the TOROPC program. The alarm will turn off if the circuit returns to normal operation. This allows you to examine wiring and perform voltage measurements without having to watch the computer screen.

```
Valve Bank A Solenoids On
Toro Controller Status: RM6500/6700 ECU #1 (Primary) Rev B

  Inputs                               Outputs
Open Not Used                          On Solenoid S2A
Open Not Used                          On Solenoid S1A
Open Not Used                          On Solenoid S5A
Open Traction Neutral                  On Solenoid S4A
Open Seat Switch                      On Solenoid S6A
Open High Engine Temperature          On Solenoid S7A
Open Not Used                          Off Solenoid S1B
Open Raise Reels                      Off ETR Hold, ALT/Run
Open Enable Reels                     On Solenoid US1A (Front Speed Cont
Open Front Reels Down Switch          Off Solenoid S2B
Open Front Backlapping                Off Solenoid S4B
Open Rear Backlapping                 Off Solenoid US1B
Open Lower/Mow Reels                  Off Start
Open Not Used                         On F Solenoid S3A/S3B
Open Front Reels Speed Switch         2 Start
Open Rear Reels Speed Switch         2 HOC Selection Control
Open Transmission Speed Sensor        3 Preheat
Open Not Used                         3 Not Used
                                       3 Not Used

0 of 0.) Time prior to last data ca 0.16 seconds

Press ESC to return to menu
```

**Important Diagnostic Note:** On Reelmaster machines the solenoid(s) controlling the backlap function will show a fault at the start of this test (S3A/S3B on Reelmaster 6000's). Move the Backlap switch to front or rear backlap to activate the solenoid, and shut off the fault and alarm.

## 8 - - PC Capture

See *PC Capture* section in this book for more information.

The machine key switch should be OFF before selecting this option.

Choosing this option will result in the following prompt:

```
Welcome to The Toro Company - CAPTURE
Copyright 1995 - All Rights Reserved
Turn on key of machine to begin CAPTURE
```

As soon as the machine is started, data will appear in the screen as shown below. Use the function keys on the computer to perform the desired function (example: press the **F5** key to begin recording to disk):

Quit Program <b>Esc</b>	Screen Help <b>F1</b>	Freeze Display <b>F2</b>	Unfreeze Display <b>F3</b>	Clear Display <b>F4</b>	Record to Disk <b>F5</b>	Stop Record to Disk <b>F6</b>
-------------------------------	-----------------------------	--------------------------------	----------------------------------	-------------------------------	--------------------------------	-------------------------------------

```
The Toro Company - ECU Serial CAPTURE Press "ESC" key to quit PC CAPTURE
Can: 0x00
19, 0, 0, 0, 0, 0, 0, 0
23, 0, 0, 0, 0, 0, 0, 0
27, 0, 0, 0, 0, 0, 0, 0
31, 0, 0, 0, 0, 0, 0, 0
35, 0, 0, 0, 0, 0, 0, 0
39, 0, 0, 0, 0, 0, 0, 0
42, 0, 0, 0, 0, 0, 0, 0
```

Press the **F6** key to stop recording to disk. The following prompt will appear:

```
The Toro Company - ECU Serial CAPTURE Press "ESC" key to quit PC CAPTURE

Please put a disk in the disk drive.
Enter the file name:
```

Enter a file name and press the **Enter** key to save the file. Use a text editor such as Windows Notepad or the DOS program Edit to view the file. The files created with PC CAPTURE are different from the .MDD data files recorded from the machine controller or DataLog controller. It is recommended that you save PC CAPTURE files with the extension .TXT for easier identification (example: test01.txt).

Press the **Esc** key at any time to exit PC CAPTURE.

---

## D - - Verify communication with Controller (ECU)

Select this option to verify if the TOROPC program is communicating with the machine controller.

---

## Q - - Quit the program

Select this option to quit the program and exit to the DOS prompt.



# Using the RMCONFIG Program

**Note:** The RMCONFIG program allows the use of either English or Metric units of measurement. The program uses English units as the default. In order to start the program using metric units:

```
A:\>set torounit=kph ↵ Enter
A:\>rmconfig ↵ Enter
```

After starting the RMCONFIG program you will see the opening screen as shown below. Follow the instructions on the screen.

```

Welcome to the Reelmaster Configuration Program

Revision 3.0
(c) Copyright 1998 - The Toro Company

Please turn the ignition key to the OFF position
connect serial cable to Machine Serial Port
then turn the ignition key to the ON position.

You have selected units: English

Press any key to continue_
```

---

## Moving Around the Program

Move around in the program by entering the number of the program option desired. It is not necessary to press the ↵ Enter key when selecting a program option. Follow the instructions on each screen.

To move back a menu, or if a wrong choice is entered, simply press the **Esc** key. The **Esc** key will back up one level.

---

## Program Options

```

Reelmaster Configuration Control Program

Program Options:
1 - Change the Mowing Speed Limit
2 - Change the number of blades
3 - Change the machine type
4 - Change the cutting unit 4 & 5 delay
5 - Erase the Mowing Speed Limit
6 - Exit and Save Current Configuration
7 - Quit and do not change Reelmaster
8 - Display Reelmaster Settings
9 - Change TurfDefender False Detect Inhibit (FDI) calibration

Enter your choice:
```

---

## 1 - Change the Mowing Speed Limit

Enter the desired mowing speed limit, then press the ↵ Enter key.

**Note:** Setting the Mowing Speed Limit is not required during machine set-up. Set the Mowing Speed Limit ONLY IF THE CUSTOMER REQUESTS IT.

```
Please enter the desired speed limit:  
Previously Programmed Speed: 0.00 MPH  
Enter new maximum speed (MPH): _
```

---

## 2 - Change the number of blades

Enter the number of cutting blades on the installed cutting units, then press the ↵ Enter key.

**Note:** Changing the number of blades (cutting unit selection) can also be performed without the use of a computer and RMCONFIG software. See the *Quick Reference Guide* on Cutting Unit Selection in this book for more information.

```
You must enter either 5 or 7,11  
Reelmaster has reels installed with 11  
Please enter the number of blades:_
```

---

## 3 - Change the machine type

The machine type is set automatically according to what machine program is selected when programming the controller. Do not change this setting.

```
Machine Type:          RM6500  
Please enter the machine type:  
Enter the machine type (RM5100, RM5300, RM6500, RM6700):_
```

---

## 4 - Change the cutting unit 4 & 5 delay

This option applies to the Reelmaster 5000 and 6000 series machines. The lifted height of the outer front cutting units (No. 4 and 5) in the turnaround "Enable" condition, can be customized to the mowing conditions or operator's preference. The lift height is adjusted by changing the delay time. This will allow the outer front cutting units to be raised to a higher position in the turnaround "Enable" condition if desired.

To adjust the lifted height of the two rear (No. 6 and 7) cutting units on the Reelmaster 6700-D, use RMCONFIG while connected to **Controller No. 2 (secondary)** loopback connector.

Enter the desired cutting unit 4 & 5 cylinder delay, then press the ↵ Enter key.

```
Enter the cutting unit 4 & 5 cylinder delay. Please enter a number
from 0 to 5. Each number is approximately .13 secs. A larger number
will cause the cutting units to lift higher in turnaround position.

Current delay set to: 0 ( 0.00 sec)

Please enter the cutting unit 4 & 5 cylinder delay: _
```

---

## 5 - Erase the Mowing Speed Limit

Select option 5 to erase the mowing speed limit. There will now be no mowing speed limit. The operator can mow at the machine's maximum forward speed.

---

## 6 - Exit and Save Current Configuration

Select option 5 to save the current configuration and exit the program. Use this option after making all the desired changes.

---

## 7 - Quit and do not change Reelmaster

Select option 5 to quit the program without saving any configuration changes from this session.

---

## 8 - Display Reelmaster Settings

This option is useful for reviewing the configuration before saving the current configuration and exiting the program (option 6).

```
Reelmaster Configuration Control Program

Current Reelmaster Settings:
Maximum Speed Allowed: 5.00 MPH
Number of blades on reels: 11

Height of Cut Selector: A
Nominal Height of Cut: 0.00 IN
Minimum CLIP ACE Speed: Full Speed
Maximum CLIP ACE Speed: Full Speed

Machine Type: RM6500

Cutting Units 4 & 5 Delay: 0.39 seconds

The TurfDefender False Detect Inhibit (FDI) is set to: 0

Press any key to continue_
```

---

## 9 - Change TurfDefender False Detect Inhibit (FDI) calibration

**IMPORTANT:** The computer cable must be connected to the loopback connector for the main tractor controller, NOT the TurfDefender controller.

**Note:** A traction unit main controller software upgrade may be required to adjust the TurfDefender False Detect Inhibit (FDI) option. If a machine exhibits symptoms of false detects as explained, upgrade the main traction unit controller software using the latest TOROPC program and test again for symptoms prior to any adjustment of FDI.

Sometimes a “false detect” can occur when the TurfDefender erroneously concludes that a hydraulic leak has occurred. This will sound the alarm and shut down the cutting units. Upon inspection, no leak is evident.

The Turf-Defender continually monitors several independent functions to determine if an oil leak is occurring. These functions are influenced by various external factors such as ambient temperature, variations between machines, and different machine mowing and transport practices. Machine operation in cool ambient temperatures (below 50° F) and/or short pass cross-cutting practices may trigger potential false alarms.

If false detects are suspected, adjusting the False Detect Inhibit (FDI) can alter the calibration between the TurfDefender and main tractor controller. Because of significant differences in the hydraulic systems of the Reelmaster 5000 and 6000 series tractors, the Turf Defender receives its leak target parameters from the tractor main controller it is installed in. Therefore, **the computer cable should be connected to the loopback connector for the main tractor controller, not the TurfDefender controller.**

If false detects seem to be occurring too frequently, enter a higher False Detect Inhibit (FDI) number. If false detects are not prevalent, you may wish to try a smaller FDI number. The factory FDI setting of 0 should be appropriate for most conditions.

<u>-2</u>	<u>-1</u>	<u>0</u>	<u>+1</u>	<u>+2</u>
More reactive		Standard		Less reactive

Follow the instructions shown on the screen below. Enter the desired FDI number, then press the **↵** **Enter** key.

```
Adjusting the False Detect Inhibit (FDI) can alter the calibration
between the Turfdefender and tractor Controller (ECU). This calibration
of the TurfDefender's is determined by the main Controller(ECU) in the
tractor.

The FDI adjustment scale goes from -2 to +2 (-2, -1, 0 +1, +2) with 0 being
the standard setting. Negative numbers decrease the Inhibit (more reactive
to minor variables) and positive numbers increase the Inhibit (less
reactive to minor variables). If false detects seem to be occurring too
frequently, input a higher "FDI" number (i.e +1 or +2). If false detects
are not prevalent, you may wish to try a smaller FDI number (i.e. -1 or -2).
The factory FDI setting of 0 should be appropriate for most conditions.

The TurfDefender False Detect Inhibit (FDI) is set to: 0

Please enter the TurfDefender FDI calibration setting (-2 to +2):
```

# PC Capture (Reel speed verification)

## Reelmaster 5100/5300/6500/6700

---

### What is PC Capture?

The PC Capture Test (under main menu option **C** - > *TOROPC Diagnostic Tools and Options*) is designed to let you see data provided by the controller, such as reel speed on the Reelmaster 5000 & 6000 series, without the use of a strobe tachometer. When in this test mode, actual reel speed verses target reel speed can be viewed to confirm proper ClipAce operation and hydraulic circuit efficiency.

PC Capture Test can be used to:

- Confirm Reel Speed Sensor(s) proper operation.
- Confirm Traction Speed Sensor proper operation.
- Check/confirm ClipAce operation.
- Check/confirm reel backlapping speeds.
- Help in diagnosing hydraulic circuit efficiency problems.

---

### Getting to the PC Capture Test

PC Capture available is in the TOROPC Program from option **C**: - > *Diagnostic tools and options*.

1. Connect the personal computer to the Controller Loop-back connector (Primary on RM6700-D) and leave the key switch OFF.
2. Turn on the computer. Once ready, screen will display C:>.
3. Install the TOROPC disk in the computer disk drive. Type **a:** and press ↵ **Enter**.
4. At the A:> prompt, type **toropc** and press ↵ **Enter**.
5. Enter the model and serial number of the machine when prompted to access the correct program.
6. At the Main Menu screen, select option **C** - > *Diagnostic Tools and Options*.
7. Select option **8** - - *PC Capture*.
8. Turn key switch ON. The PC Capture program will now start to run.

To get out of the PC Capture program at any time, press the **Esc** key.

---

### Screen Controls (F Keys) for PC Capture

The PC Capture program uses the “F” (Function) Keys for screen controls. The following is a list of the keys:

- F1** - Help Key (displays the screen control keys)
- F2** - Freeze Display
- F3** - Unfreeze Display
- F4** - Clear Display
- F5** - Record data to Disk
- F6** - Stop recording to Disk
- Esc** - Quit PC Capture and return to TOROPC (Escape Key)

---

## Understanding the PC Capture Data

Once into the PC Capture program, there will be 8 vertical columns of data that will continue to scroll down the page.

Sample of Screen Data at start-up of PC Capture (unit not running):

Column :	1	2	3	4	5	6	7	8
	(CAN Message) _Can: 0x01							
	12,	0,	0,	0,	0,	0,	0,	0
	15,	0,	0,	0,	0,	0,	0,	0
	19,	0,	0,	0,	0,	0,	0,	0
	23,	0,	0,	0,	0,	0,	0,	0
	27,	0,	0,	0,	0,	0,	0,	0

Column 1 - Controller data time reference number.

Column 2 - Traction unit ground speed. Divide value by 10 to get actual speed (example: 30 = 3 mph).

Column 3 - Front reel circuit target RPM. This value is dependent on 1) H.O.C. selector position, 2) number of reel blades, and 3) traction unit ground speed.

Column 4 - Front reel circuit actual RPM (from front Reel Speed Sensor).

Column 5 - Duty cycle of the front reel circuit Variable Speed Control Valve (VS Cartridge). Refer to Duty Cycle section for more information.

Column 6 - Rear reel circuit target RPM. This value is dependent on the same inputs as the front reel circuit

Column 7 - Rear reel circuit actual RPM (from rear Reel Speed Sensor).

Column 8 - Duty cycle of the rear reel circuit Variable Speed Control Valve (VS Cartridge). Refer to Duty Cycle section for more information.

**Note:** The first line of information is referred to as the CAN Message. Refer to the CAN Information section below.

---

## CAN Information

The acronym CAN stands for Controller Area Network. The CAN is a pair of wires that connect all the individual machine controllers (ECU's) to one another so they can communicate electronically between themselves.

For example, the Reelmaster 6700-D has up to 3 individual controllers: 1) primary controller, 2) secondary controller, and 3) TurfDefender electronic Leak Detector. All of these individual controllers communicate with each other through the CAN lines to provide machine operation and safety functions.

### The CAN Message

When the key switch is first turned on, the controller sends an electronic "message" out the CAN line. If there is another controller (or a TurfDefender) installed on the CAN, it will respond and send a message back to the main controller. This is how the main controller knows what is installed on each individual machine. If nothing responds back, then the controller assumes that there are no other controllers installed.

The CAN message that appears while in the PC Capture program will tell you if communications have been established with any other controllers installed on the machine being tested.

**Messages:**

- Can: 0x00 = no other controllers or devices responded.
- Can: 0x01 = Secondary Controller responded (RM 6700 only).
- Can: 0x02 = TurfDefender Leak Detector responded.
- Can: 0x03 = Secondary Controller and TurfDefender responded (RM 6700 only).

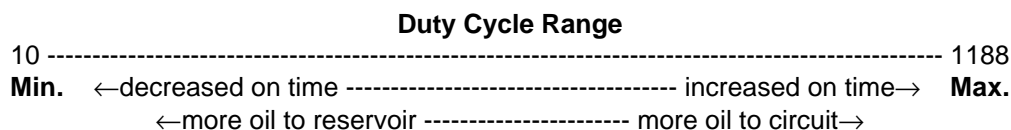
**Important Diagnostic Note:** The CAN message should only appear on the first screen during start-up. If it re-appears several times during testing, there is a problem with the communication lines or another controller's response.

---

### Duty Cycle of Variable Speed Control Valves (Column 5 and 8)

The controller will always try to match the "actual" reel speed with the target. In order to do this, it will vary each individual VS cartridges' duty cycle (on time vs. off time) to control the hydraulic oil flow to the reel circuit. If the actual reel speed is faster than the target, the controller will decrease the duty cycle to slow it down (diverts oil to the reservoir). If speed is slower than target, it will increase the duty cycle to speed it up (diverts oil to the circuit).

The assigned duty cycle range (numbers) seen in columns 5 and 8 should be between 10 and 1188 when ClipAce is functioning.



Because of system differences (RM 5000 or 6000 series, front or back reel circuits, system oil volumes, reel motor and valve efficiencies, etc.), the exact duty cycle number is not important. As long as the Duty Cycle is between 10 and 1188, the system is under ClipAce control and functioning properly.

---

### The "A" Position on the Height of Cut (H.O.C.) Selector

Turning the H.O.C. selector to the "A" position tells the controller to disable the ClipAce feature and run the reels at full speed. In this position, the controller will disregard any of the speed inputs and will not try to match reel speed with traction speed.

**Note:** This position will also disable the Reel Control Lamp as it relates to the ClipAce feature.

Sample of Screen Data (RM 6000 series shown):

Column :	1	2	3	4	5	6	7	8
	1106,	0,	0,	1388,	0,	0,	1394,	0
	1111,	0,	0,	1401,	0,	0,	1438,	0
	1115,	0,	0,	1383,	0,	0,	1438,	0
	1120,	0,	0,	1390,	0,	0,	1416,	0
	1124,	0,	0,	1404,	0,	0,	1399,	0
	1129,	0,	0,	1385,	0,	0,	1466,	0

Actual reel speed for the front and rear circuits is still displayed (columns 4 and 7), but the targets and VS Valve duty cycles revert to "0". Once the unit is moving, traction speed will register, but have no effect on reel speed.

---

## Diagnosing Reel Speed Sensors

A defective reel speed sensor will typically cause data to display as shown below (Reelmaster 6000 series shown):

Column:	1	2	3	4	5	6	7	8
	1879,	0,	500,	496,	575,	500,	503,	496
	1883,	0,	500,	495,	581,	500,	488,	484
	1887,	0,	500,	0,	637,	500,	481,	481
	1891,	0,	500,	0,	789,	500,	491,	495
	1895,	0,	500,	0,	939,	500,	497,	528
	1899,	0,	500,	0,	1089,	500,	506,	510
	1903,	0,	500,	0,	1188,	500,	506,	503
	1907,	0,	500,	893,	1150,	500,	514,	500

Note that when the reel speed sensor data drops to "0", the controller responds and tries to speed the circuit up by increasing the duty cycle to full on (column 5 - 1188). It does this because the Controller sees the reel speed as being too slow.

**Important Diagnostic Note - When in Mow or Backlap:** If the controller applies full duty cycle (1188) or minimum duty cycle (10) and cannot match the actual reel RPM (column 4) with the target RPM (column 3), it will turn the Reel Control Lamp on steady to indicate a problem.

---

## Backlapping

The controller knows when the backlap mode is requested by sensing a switch change at the Front/Rear Backlap Switch. It will then turn on the required solenoid cartridges to activate either the front or rear reels in the backlap direction.

### Backlap reel speed is determined by the following:

1. Engine running at minimum throttle (idling).
2. Target speed set by the H.O.C. Selector.
3. Light reel to bedknife contact.
4. Amount (and grit size) of backlap compound.

The following example of PC Capture is what typical data would look like when backlapping the front reels. The rear reel target speed is also displayed (column 6), but the rear circuit is shut off (columns 7 and 8 show "0"s - you can only backlap the front or rear cutting units, not both at the same time). Data for rear backlap will look similar with columns 4 and 5 reading "0"s.

Sample of Backlap Screen Data (Reelmaster 6000 series shown):

Column:	1	2	3	4	5	6	7	8
	3702,	0,	250,	244,	30,	250,	0,	0
	3706,	0,	250,	244,	38,	250,	0,	0
	3710,	0,	250,	243,	48,	250,	0,	0
	3714,	0,	250,	241,	59,	250,	0,	0
	3718,	0,	250,	241,	69,	250,	0,	0
	3721,	0,	250,	240,	78,	250,	0,	0

### Important Diagnostic Note - When in Backlap Mode:

If the controller senses that the actual reel speed (column 4 or 7) has dropped to 50 RPM or less for 2 to 3 consecutive time reference numbers (column 1), the controller will shut off the circuit and flash the Reel Control Lamp. This is how the backlap safety function operates.



# PC Capture (Engine Governor System)

## Greensmaster<sup>®</sup> 3200 (Gasoline Model Only)

---

### What is PC Capture?

The PC Capture Test (under main menu option *C* - > *TOROPC Diagnostic Tools and Options*) is designed to let you see data provided by the controller such as engine governor operation on the Greensmaster<sup>®</sup> 3200 which uses an electronic governor to control engine speed. When in this test mode, actual engine speed verses target engine speed can be viewed to confirm proper governor operation and assist in carburetor and fuel system troubleshooting.

PC Capture can be used to:

- Confirm Engine Speed Sensor proper operation.
- Confirm Engine Speed.
- Check/confirm Governor operation.
- Check/confirm Engine Governor Responsiveness.
- Confirm Water Temperature Sensor operation.
- Confirm Engine Anti-Oscillation Protection operation.
- Help in diagnosing Carburetor and Fuel System problems.

---

### Getting to the PC Capture Test

PC Capture available is in the TOROPC Program under main menu option *C* - > *Diagnostic tools and options*.

1. Connect the personal computer to the Controller Loop-back connector and leave the key switch OFF.
2. Turn on the computer. Once ready, screen will display C:>.
3. Install the TOROPC disk in the computer disk drive. Type **a:** and press ↵ **Enter**.
4. At the A:> prompt, type **toropc** and press ↵ **Enter**.
5. Enter the model and serial number of the machine when prompted to access the correct program.
6. At the Main Menu screen, select option **C** - > *Diagnostic Tools and Options*.
7. Select option **8** - - *PC Capture*.
8. Turn key switch ON. The PC Capture program will now start to run.

To get out of the PC Capture program at any time, press the **Esc** key.

---

### Screen Controls (F Keys) for PC Capture

The PC Capture program uses the "F" (Function) Keys for screen controls. The following is a list of the keys:

- F1** - Help Key (displays the screen control keys)
- F2** - Freeze Display
- F3** - Unfreeze Display
- F4** - Clear Display
- F5** - Record data to Disk
- F6** - Stop recording to Disk
- Esc** - Quit PC Capture and return to TOROPC (Escape Key)

---

## Understanding the PC Capture Data

Once into the PC Capture program, there will be 8 vertical columns of data that will continue to scroll down the page.

Sample of Screen Data at start-up of PC Capture (unit not running):

Column :	1	2	3	4	5	6	7	8
	12,	0,	0,	0,	0,	0,	0,	0
	15,	0,	0,	0,	0,	0,	0,	0
	19,	0,	0,	0,	0,	0,	0,	0
	23,	0,	0,	0,	0,	0,	0,	0
	27,	0,	0,	0,	0,	0,	0,	0

Column 1 - Controller data time reference number.

Column 2 - Target Engine Speed (Revolutions Per Minute).

This value is dependent on: 1)Position of the Function Control Lever, 2)Position of the High/Low Transport speed switch.

Column 3 - Actual Engine Speed (measured from the ignition trigger ring).

Column 4 - Duty Cycle: Square Wave Voltage Value Applied to the Governor (L.A.T.) Motor. Attempting to Match the Actual Engine Speed to the Desired Target Speed.

Column 5 - Analog to Digital Converter Number from Water Temperature Sender. Used to Adjust Governor Sensitivity During Cold Engine Operation.

Column 6 - Functional Control Lever Position Number.

Column 7 - Engine Anti-Oscillation (Hunting Protection) Identification Number. Used to Identify a Engine Hunting Condition.

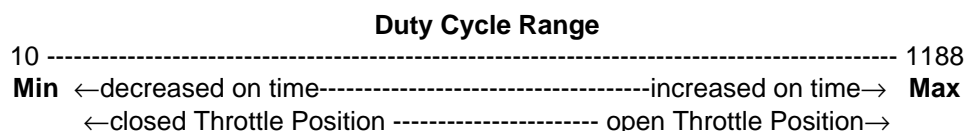
Column 8 - Engine Anti-Oscillation (Hunting Protection) Sensitivity Number. Used to Reduce Engine Governor Sensitivity when a Hunting Condition is Detected.

---

## Duty Cycle of the Governor Control Motor (L.A.T. Motor)

The controller will always try to match the “actual” engine speed with the “target” engine speed. In order to do this, it will vary the amount of time voltage applied to the Governor motor. The amount of time the voltage is applied vs. the amount of time voltage is not applied is known as the Duty Cycle. The number that is in column 4 represents the amount of voltage applied to the governor motor and is not an actual voltage value. The higher the number value, the further the carburetor throttle valve is open.

The assigned duty cycle range (numbers) seen in columns 4 should be between 400 to 600 when the unit is running under normal mowing conditions.



---

## PC Capture QuikRef Guide

Cut or copy the guide below and attach to your laptop as a "F Key" reference for PC Capture screen controls.

### PC Capture QuikRef Guide

Quit Program <b>Esc</b>	Screen Help <b>F1</b>	Freeze Display <b>F2</b>	Unfreeze Display <b>F3</b>	Clear Display <b>F4</b>	Record to Disk <b>F5</b>	Stop Record to Disk <b>F6</b>
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# Using the DataLog to Find an Intermittent Problem

**Important Diagnostic Note:** Most intermittent **OUTPUT** problems can be found by retrieving fault memory information with the ACE Diagnostic Display tool or TOROPC software. To retrieve fault information with the Diagnostic ACE Display tool see Retrieving Fault Information in *the Quick Reference Guide* section of this book. To retrieve fault information using a computer and the TOROPC program, select option **C** - > *Diagnostic Options and Tools*, then option **4** - - *Playback fault information from controller*.

1. Turn the key switch OFF. Find the 6 pin communication connector near the controller on the machine wiring harness and carefully remove the loop-back connector. Connect the 6 pin connector on the Data Log to the 6 pin connector on the machine wiring harness.
2. Put the DataLog in a secure location on the machine, such as in the toolbox, on the platform, etc. and fasten in place securely to prevent damage from the DataLog falling off the machine.
3. Turn the key switch to RUN position. The green light on the DataLog will illuminate to indicate that the Data Log is connected and operating.
4. Instruct the operator to run the machine normally until a intermittent problem occurs. Once the problem occurs, press the large red button on the DataLog. **DO NOT** turn off key switch after problem has occurred ! After pressing the red button, the red light on the Data Log will illuminate to indicate that the Data Log has stored the information. The switch **MUST** be pressed before the key switch is turned off or the information is lost. If the information is inadvertently lost, simply operate the machine until the problem occurs again, then save the information by pressing the switch.
5. Turn the key switch off and remove the DataLog. Re-connect the loop-back connector on the machine wiring harness.
6. Connect the Data Log controller to the computer. In the TOROPC program, select Main Menu option **C** - > *Diagnostic Options and Tools*, then option **7** - > *Playback Recorded Data from DataLog* to read the information on the personal computer. Analyze the data to determine the problem.

**Note:** An alternate power source is required for the Data Log when it is connected to the computer. Battery (55-7520), and 120V Charger (92-1743). A 220V Charger (22-4710) is also available.



# Making a Backup Copy of the Program Disk

It is recommended that you make a copy of the program disk to avoid the risk of being without the program if the disk should be damaged in some way.

**Note:** There are two (2) software disks available for the ACE System - TOROPC and RMCONFIG. Each disk contains different programs and options depending on what you are trying to accomplish. **The TOROPC disk (P/N 99-4400 and newer) contains both the TOROPC and RMCONFIG programs.** Refer to *General Info/Admin Service Bulletin #30* for the latest information.

Authorized Toro Distributors can also download the latest TOROPC and RMCONFIG program files, and instructions from the Toro Distributor Extranet. Point your Internet Web Browser to **extranet.toro.com** After logging in to the Toro Distributor Extranet with your User Name and Password:

5. Select a market view.
6. Select Link to Global [Product Information](#).
7. Select [Commercial Equipment Material](#).
8. Select [ACE Software Download Page](#).

The instructions below apply to the TOROPC disk. The same instructions would apply for making a backup copy of the RMCONFIG disk.

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## If Your Computer Has an Internal Hard Disk

If you have a PC with a hard disk drive, create a directory for the TOROPC and RMCONFIG program files. Then copy the program disk onto the hard disk to the directory you created.

**IMPORTANT: If a previous version of TOROPC or RMCONFIG already exists on your internal hard disk, erase all files in the c:\toropc directory before copying the new files.**

Insert the TOROPC disk in drive A:

```
C:\>md toropc  ↵ Enter (to create a directory named toropc)
```

```
C:>copy a:\*.* c:\toropc\*.*  ↵ Enter (to copy on the files from the Toro program disk)
```

Then, to use TOROPC from the hard drive, you would do these commands:

```
C:\>cd toropc  ↵ Enter
```

```
C:\TOROPC\>toropc  ↵ Enter
```

---

## If Your Computer Does Not Have an Internal Hard Disk

**Note:** If you have a Toshiba T1000E or other portable computer without a hard disk see *General Info/Admin Service Bulletin #21* for more information about making backup copies of program diskettes.

Insert a blank diskette in drive A:

```
C:\>format a:  ↵ Enter (follow instructions for formatting)
```

Insert the Toro program disk in the disk drive.

```
C:>\diskcopy a: a:  ↵ Enter if the computer has one disk drive, or C:>\diskcopy a: b:  ↵ Enter if the computer has two disk drives. This will copy all of the program disk to the new disk.
```

If you make a plain copy, you must turn on the PC and then insert the program disk and type **a: ↵ Enter** then **toropc ↵ Enter** to start the program.

# Reelmaster® 5000 Series Reel Speed Charts

## 5 Blade Reel

HOC Knob Position		MPH									
		1	2	3	4	5	6	7	8	9	10
<b>A</b>	<b>ClipAce Override</b>	<b>Full Reel Speed (1800 RPM)</b>									
<b>B</b>	<b>.50" 12.7mm</b>		850	1270	1780						
<b>C</b>	<b>.55" 14.0mm</b>		770	1150	1630						
<b>D</b>	<b>.60" 15.2mm</b>		700	1050	1480						
<b>E</b>	<b>.65" 16.5mm</b>		650	980	1380	1730					
<b>F</b>	<b>.70" 17.8mm</b>		600	890	1260	1580					
<b>G</b>	<b>.75" 19.0mm</b>			830	1180	1480	1770				
<b>H</b>	<b>.80" 20.3mm</b>			780	1110	1390	1660	1760			
<b>I</b>	<b>.85" 21.6mm</b>			750	1060	1320	1580	1670			
<b>J</b>	<b>.90" 22.9mm</b>			680	970	1210	1450	1530	1650		
<b>K</b>	<b>.95" 24.1mm</b>			650	920	1150	1370	1450	1570	1760	
<b>L</b>	<b>1.0" 25.4mm</b>			610	870	1080	1300	1370	1480	1670	
<b>M</b>	<b>1.1" 27.0mm</b>				820	1030	1240	1300	1400	1590	1760
<b>N</b>	<b>1.2" 30.0mm</b>				790	980	1180	1250	1350	1520	1680
<b>O</b>	<b>1.3" 33.0mm</b>				760	950	1140	1210	1300	1460	1630
<b>P</b>	<b>1.4" 36.0mm</b>				720	900	1090	1150	1240	1400	1550

Reel RPM

Reel Control Lamp will be "ON" in the dark shaded areas

## 8 Blade Reel

HOC Knob Position		MPH									
		1	2	3	4	5	6	7	8	9	10
<b>A</b>	<b>ClipAce Override</b>	<b>Full Reel Speed (1800 RPM)</b>									
<b>B</b>	<b>.25" 6.4mm</b>		920	1380							
<b>C</b>	<b>.30" 7.6mm</b>		770	1150	1530						
<b>D</b>	<b>.35" 8.9mm</b>		650	980	1310	1560	1790				
<b>E</b>	<b>.40" 10.2mm</b>			860	1150	1370	1570				
<b>F</b>	<b>.45" 11.4mm</b>			760	1020	1210	1390	1620			
<b>G</b>	<b>.50" 12.7mm</b>			690	920	1090	1250	1460	1670		
<b>H</b>	<b>.55" 14.0mm</b>			630	830	990	1140	1330	1520	1710	
<b>I</b>	<b>.60" 15.2mm</b>			600	800	960	1090	1280	1460	1640	
<b>J</b>	<b>.65" 16.5mm</b>				780	920	1060	1240	1410	1590	1770
<b>K</b>	<b>.70" 17.8mm</b>				740	890	1010	1180	1350	1520	1690
<b>L</b>	<b>.75" 19.0mm</b>				710	850	970	1140	1300	1460	1620
<b>M</b>	<b>.80" 20.3mm</b>				690	820	940	1090	1250	1400	1560
<b>N</b>	<b>.85" 21.6mm</b>				660	790	910	1060	1210	1360	1510
<b>O</b>	<b>.90" 22.9mm</b>				640	770	880	1020	1170	1310	1460
<b>P</b>	<b>.95" 24.1mm</b>				620	740	850	990	1130	1270	1410

Reel RPM

Reel Control Lamp will be "ON" in the dark shaded areas

# Reelmaster® 6000 Series

## Reel Speed Charts

### 5 Blade Reel

HOC Knob Position		MPH									
		1	2	3	4	5	6	7	8	9	10
<b>A</b>	<b>ClipAce Override</b>	<b>Full Reel Speed (1400 RPM)</b>									
<b>B</b>	<b>.63" 16.0mm</b>		550	830	1100	1380					
<b>C</b>	<b>.68" 17.3mm</b>		530	790	1050	1310					
<b>D</b>	<b>.73" 18.5mm</b>		500	750	1000	1250					
<b>E</b>	<b>.77" 19.6mm</b>			720	960	1200					
<b>F</b>	<b>.82" 20.8mm</b>			690	920	1150	1380				
<b>G</b>	<b>.86" 21.8mm</b>			660	880	1100	1320				
<b>H</b>	<b>.90" 22.9mm</b>			640	850	1060	1270				
<b>I</b>	<b>.94" 23.9mm</b>			610	820	1020	1230				
<b>J</b>	<b>.98" 24.9mm</b>			590	790	990	1180	1380			
<b>K</b>	<b>1.02" 25.9mm</b>			570	760	950	1140	1330			
<b>L</b>	<b>1.06" 26.9mm</b>			550	740	920	1100	1290			
<b>M</b>	<b>1.10" 27.9mm</b>			530	710	890	1070	1250			
<b>N</b>	<b>1.14" 29.0mm</b>			520	690	860	1030	1200	1380		
<b>O</b>	<b>1.18" 30.0mm</b>			500	670	840	1000	1170	1340		
<b>P</b>	<b>1.22" 31.0mm</b>				650	810	970	1140	1300		
<b>Reel RPM</b>											

Reel Control Lamp will be "ON" in the dark shaded areas

### 7 Blade Reel

HOC Knob Position		MPH									
		1	2	3	4	5	6	7	8	9	10
<b>A</b>	<b>ClipAce Override</b>	<b>Full Reel Speed (1400 RPM)</b>									
<b>B</b>	<b>.55" 14.0mm</b>		525	790	1050	1310					
<b>C</b>	<b>.59" 15.0mm</b>			740	980	1230					
<b>D</b>	<b>.64" 16.2mm</b>			695	930	1160	1391				
<b>E</b>	<b>.68" 17.3mm</b>			660	880	1090	1310				
<b>F</b>	<b>.73" 18.5mm</b>			620	830	1040	1240				
<b>G</b>	<b>.77" 19.5mm</b>			590	790	990	1190	1380			
<b>H</b>	<b>.81" 20.6mm</b>			560	750	940	1130	1310			
<b>I</b>	<b>.85" 21.6mm</b>			540	720	900	1080	1250			
<b>J</b>	<b>.89" 22.6mm</b>			510	690	860	1030	1200	1370		
<b>K</b>	<b>.93" 23.6mm</b>				660	820	990	1150	1310		
<b>L</b>	<b>.97" 24.6mm</b>				630	790	950	1100	1260		
<b>M</b>	<b>1.01" 25.6mm</b>				600	760	900	1060	1210	1360	
<b>N</b>	<b>1.05" 26.7mm</b>				580	730	880	1020	1170	1310	
<b>O</b>	<b>1.09" 27.7mm</b>				560	700	840	990	1130	1270	
<b>P</b>	<b>1.13" 28.7mm</b>				540	680	810	950	1090	1220	1360
<b>Reel RPM</b>											

Reel Control Lamp will be "ON" in the dark shaded areas

# Reelmaster® 6000 Series Reel Speed Charts

## 11 Blade Reel

HOC Knob Position		MPH									
		1	2	3	4	5	6	7	8	9	10
<b>A</b>	<b>ClipAce Override</b>	<b>Full Reel Speed (1400 RPM)</b>									
<b>B</b>	<b>.38" 9.6mm</b>		500	750	1000	1250					
<b>C</b>	<b>.42" 10.7mm</b>			680	910	1140	1370				
<b>D</b>	<b>.46" 11.7mm</b>			630	840	1050	1250				
<b>E</b>	<b>.50" 12.7mm</b>			580	770	960	1160	1350			
<b>F</b>	<b>.54" 13.7mm</b>			540	720	900	1070	1250			
<b>G</b>	<b>.58" 14.7mm</b>			500	670	840	1000	1170	1340		
<b>H</b>	<b>.62" 15.7mm</b>				630	780	940	1100	1250		
<b>I</b>	<b>.66" 16.8mm</b>				590	740	890	1030	1180	1330	
<b>J</b>	<b>.70" 17.8mm</b>				560	700	840	980	1110	1250	1390
<b>K</b>	<b>.74" 18.8mm</b>				530	660	790	920	1060	1190	1320
<b>L</b>	<b>.78" 19.8mm</b>				500	630	750	880	1000	1130	1250
<b>M</b>	<b>.82" 20.8mm</b>					600	720	840	950	1070	1190
<b>N</b>	<b>.86" 21.8mm</b>					570	680	800	910	1030	1140
<b>O</b>	<b>.90" 22.9mm</b>					540	650	760	870	980	1090
<b>P</b>	<b>.94" 23.9mm</b>					520	630	730	840	940	1050
		<b>Reel RPM</b>									

Reel Control Lamp will be "ON" in the dark shaded areas

# Reelmaster® 5000 & 6000 Series Backlap Speed Chart

(RPM listed is at engine idle RPM)

### Backlap

HOC Knob Position	
<b>A</b>	<b>Full Speed</b>
<b>B</b>	<b>850</b>
<b>C</b>	<b>800</b>
<b>D</b>	<b>750</b>
<b>E</b>	<b>700</b>
<b>F</b>	<b>650</b>
<b>G</b>	<b>600</b>
<b>H</b>	<b>550</b>
<b>I</b>	<b>500</b>
<b>J</b>	<b>450</b>
<b>K</b>	<b>400</b>
<b>L</b>	<b>350</b>
<b>M</b>	<b>300</b>
<b>N</b>	<b>250</b>
<b>O</b>	<b>200</b>
<b>P</b>	<b>150</b>
	<b>Reel RPM</b>



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