Operational Reference

T350 Scrubber

Controls Group

Revision Number A

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REVISION HISTORY

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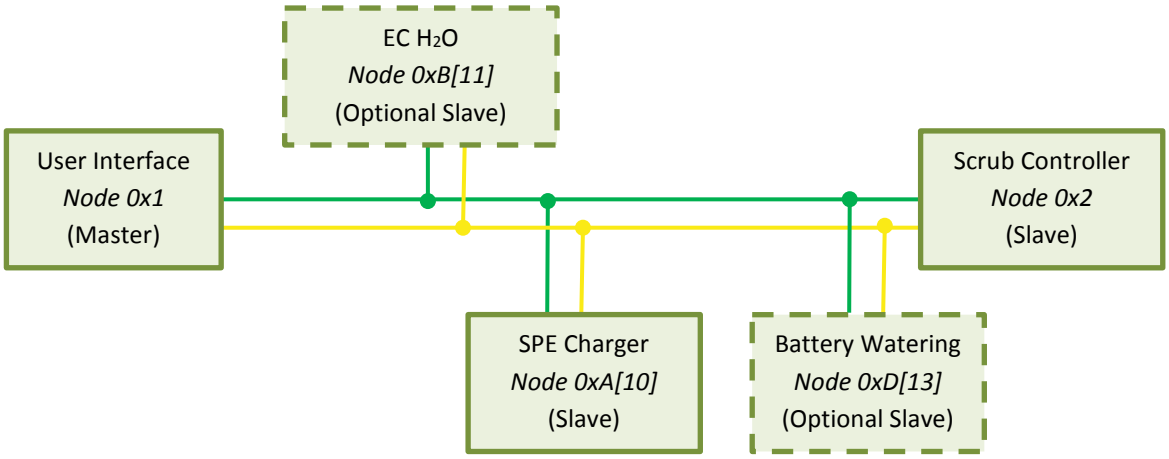
GENERAL INFORMATION

This document serves as a reference for general module operation and is for internal use only. The terminology in this document may not represent customer terminology.

CANOPEN NETWORK

The T350 family of machines utilizes a CANopen network to send data about the machine status in order to function. The following sections provide the machine specific implementation and wiring in general terms. For additional descriptions on CANopen network and design, see the Tennant CANopen Guide.

The following diagram shows the modules located on the CANopen bus for a T350. On the T350, the user interface, scrub controller, and On-board SPE charger nodes are always present and therefore contain the terminating network resistors. The EC H_2O and battery watering module are customer-configured options and therefore may not always be present on the machine.

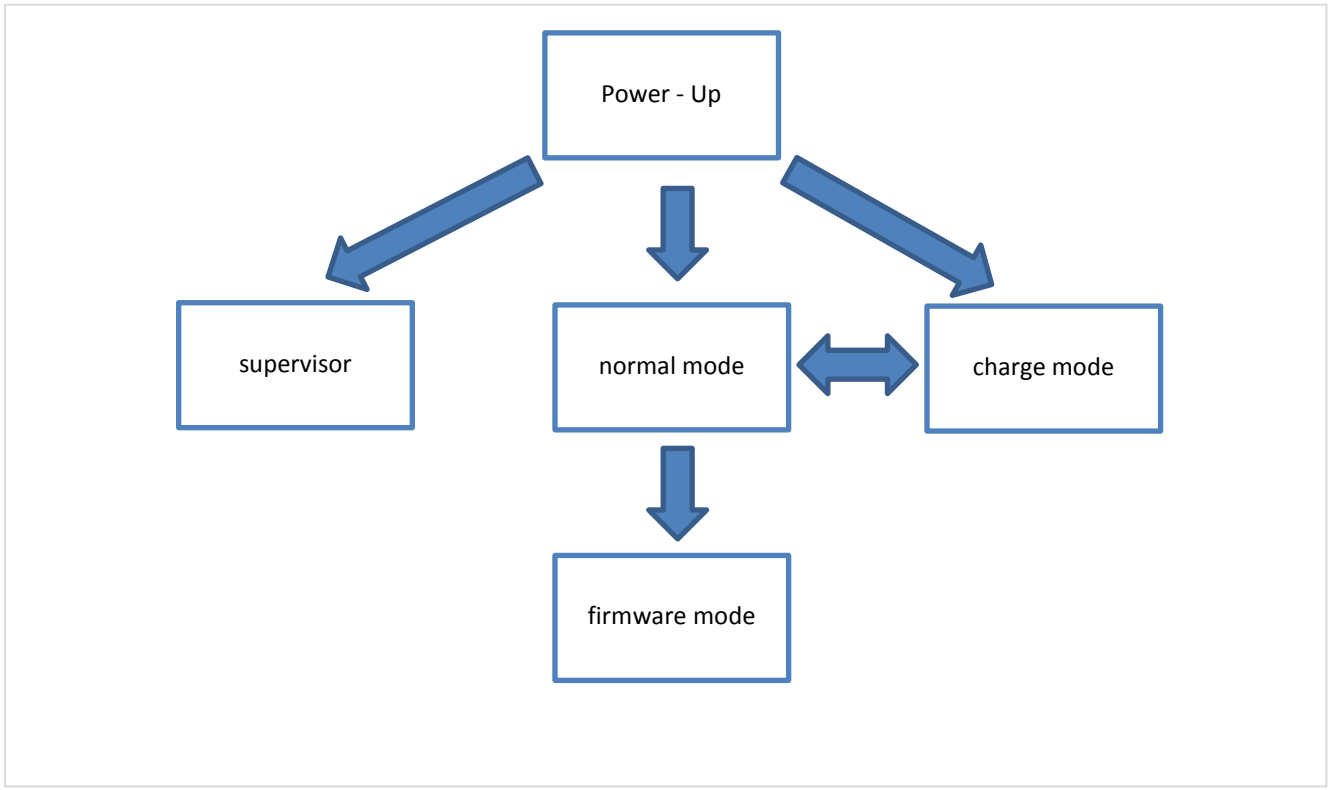


MACHINE OPERATING MODES

There are four modes of operation for the T350 Scrubber: Normal mode, Charge Mode, Supervisor Mode, and Firmware Mode. Only one mode can be active at a time. The conditions required for entering each of these modes are summarized in the table below.

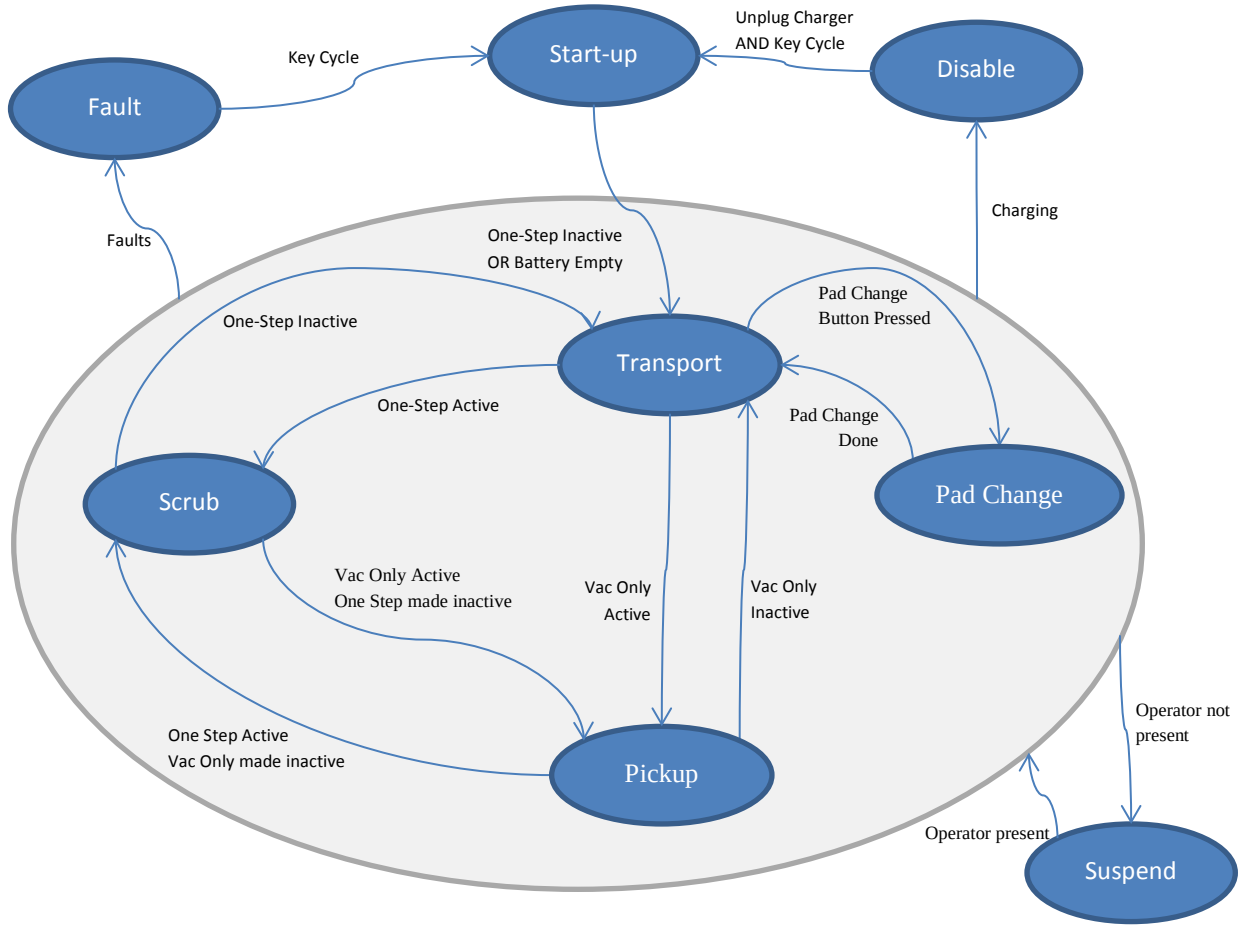
Table 1 Conditions for Entering Machine Modes

Mode	Reason
Normal	Machine Powered Up
Charge	Charger Plugged In
Supervisor	Machine Powered Up while Holding Down Pressure Adjust Button
Firmware	Firmware Downloaded via USB to the machine when machine is powered on.



NORMAL MODE

At a high level, the normal mode contains several operational states that control the running operation of the scrubber. This mode reads the machine health and inputs to determine how the machine should be behaving. The diagram below depicts the states and basic functions that causes state changes.



The following table summarizes the conditions for normal mode states:

Scrub Head	Vac Only	One Step	Operator Presence	Fault / Condition	State
Down	Inactive	Active	Present	None	Scrub
Up	Inactive	Inactive	Present	None	Transport
Down	Inactive	Inactive	Present	Low Battery	Transport
X	X	X	Not Present	Operator not Present	Suspend
X	X	X	X	Charging	Disable
X	X	X	X	Fault	Fault

CHARGE MODE

Charge mode is only available for on-board chargers. The charge mode handles the monitoring of the charge progress, monitors the fault codes, programs the charger profile (dependent on battery type), and controls the display information. This mode treats the charger as a pass through module such that charger status reports on the machine display. Plug the charger in to enter charge mode. CAN communication to the charger cannot happen in normal mode.

SUPERVISOR MODE

The supervisor mode allows a supervisor to configure the machines presets and lockout level. When this mode is active, the inputs (membrane buttons) and display (membrane LEDS) are controlled by this mode. The T500 Membrane Guide or T500 LCD Guide describes how to use Supervisor mode and navigation.

FIRMWARE MODE

The firmware mode allows a user to update the firmware on the machine through USB. The machine enters firmware mode when normal mode is active. When a user starts downloading firmware to the machine, it will enter firmware mode. After the firmware update is complete, the user must cycle the power on a machine with a membrane display. If the machine has an LCD display, the machine will power cycle itself after the firmware update is complete.

CHARGE/DISCHARGE OPERATION

BATTERY TYPES

The machine requires configuration for the type of batteries installed in the machine. This sets the charge and discharge behavior for best machine performance. The charger contains a mechanical rotary switch or dial that can be used in certain situations described below for configuration as well as a software option.

BATTERY PACK SETTING

On the assembly line, all chargers arrive from the vendor with the mechanical dial on setting 0. This allows the Tennant machine to set the correct battery type. This profile number is responsible for both the charge profile in the charger and the discharge profile in the machine. If the dial is changed from 0 to any other value, the machine switches to the new charger commanded setting for corresponding adjustments to the discharge curve.

If the charger dial remains on 0, the **machine** is in control of the battery type parameter for both charge and discharge profiles. The machine setting can be changed with the software application and/or though the touchscreen menu settings if equipped with a ProPanel.

If the dial is changed from 0, the **charger** is in control of the battery type parameter for both the charge and discharge profiles. The software will report the setting and may look to change it but the charger will override the value next time the charger is plugged in.

CAN communication is active in either approach. It is through the CAN communication that the machine knows who the “owner” of the setting is. Charge status and faults are fully functional either way.

There is no difference between using the charger dial or the software to set the battery type. They are both setting the same value in the machine and charger for proper operation. Therefore, there are no advantages except the software provides the easiest and quickest interface to changing the profile. This is especially useful for manufacturing lines to program to the customer order automatically (except for TNV site). It was recognized that the end operator may not have the software tool available and therefore the dial on the charger provides an alternate way to set this.

PRODUCTION CONFIGURATION

Tennant Capture programs the machine to the battery type set by the customer order. This means the battery defined on the production order is programmed automatically into the machine. Now, we had some issues with this due to the process in Uden differs from the other manufacturing sites. Uden builds machines with production orders set to the "Without" battery option. This means Tennant Capture programs all machines with this option to a default battery type (which is explained below).

Machines in Uden then go to a warehouse where they wait for a customer order to come in. When the order arrives at the warehouse, someone installs the batteries the customer ordered and then uses the Service app to set the correct battery profile value from the default.

The T350 machines setting for "Without" battery *used* to default to the flooded profile at product launch. There were concerns in TNV that if the step was missed to configure the correct battery or the customer order did not include batteries that the flooded profile would damage a non-flooded battery pack by over-charging. It was safer to undercharge flooded batteries. The decision was made to default the "Without" setting to the AGM profile (30 or equivalent to dial 3) which provided the highest battery discharge cutoff protecting the customer investment. It was deemed acceptable to have lower run times than damage their new battery pack. The cutoff voltages for the battery types are listed in the Controls Specification document.

The differences between Tennant Capture and Service Diagnostics is limited as both software applications set the same profile parameter. Where the value of the parameter comes from is what is different between the two: Capture programs to the SAP work order and Service Diagnostics programs to the user* selected value. (*User referring to the software user which can be warehouse employee, QC operator, service technician, distributor, etc.)

It is absolutely critical that if a machine ships out of Tennant without batteries, that the owner installing the battery pack configure the machine properly as outlined in the user manual to ensure best battery performance. They should never rely on the default setting of the machine since they did not order batteries from Tennant to ensure it is set correctly for them. The process outlined in the user manual is to change the dial on the charger or on the touchscreen with a ProPanel machine. For those tech-savvy service users, the Service Diagnostics application can be used for faster configuration than disassembling the machine.

PROPEL SYSTEM

The T350 propel system is dependent on many functions of the machine. The following section describes the decision process for the standard T350 machine.

T350 PROPEL DIAGRAM

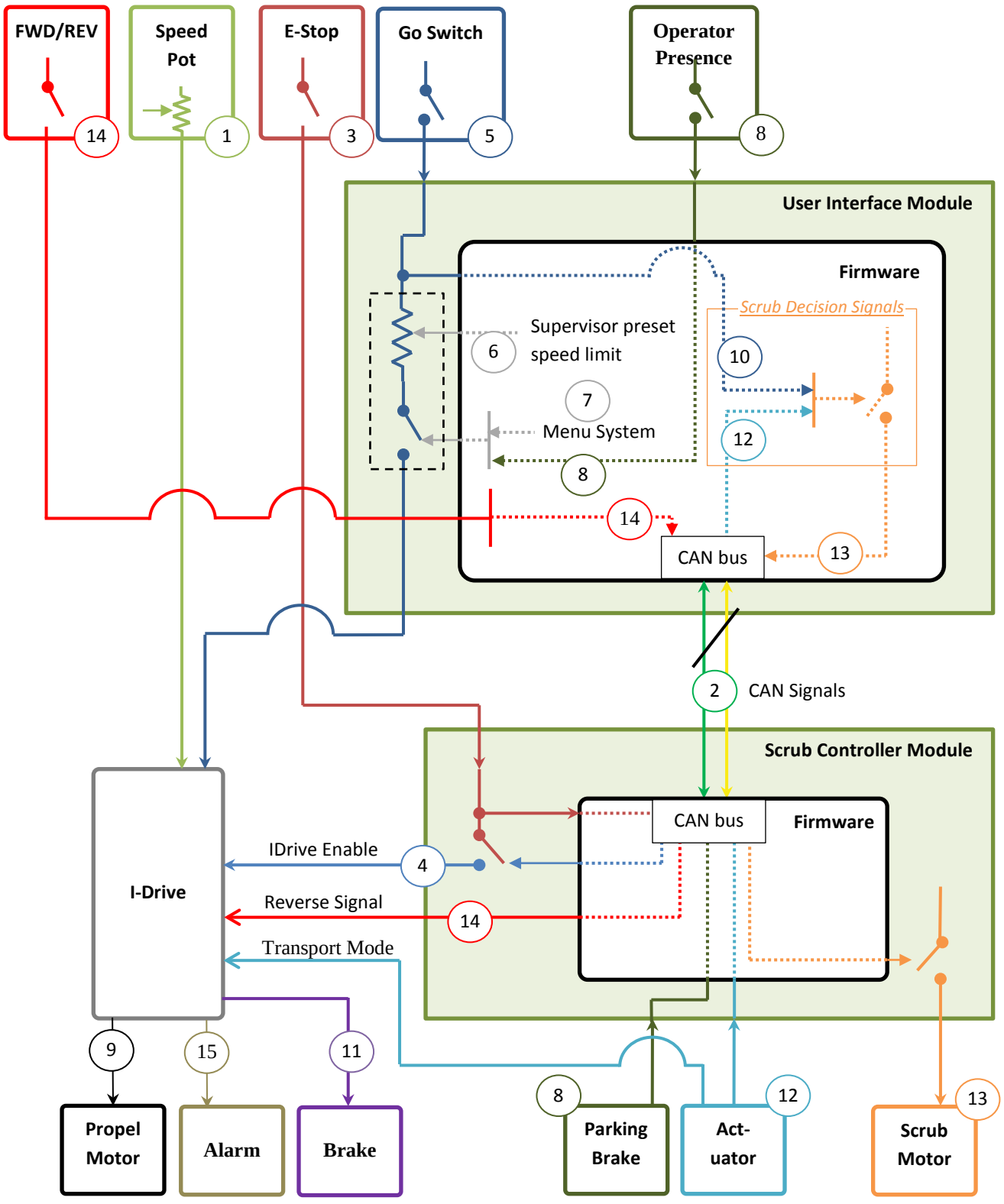


DIAGRAM DECISION PROCESS FOR SCRUBBING

Process Label Number	Identity	Description
1	Speed Pot	The speed potentiometer is directly wired to the iDrive via three wires. The speed is then controlled within the iDrive. Two speed ranges are available depending if the machine is in Transport or Scrub mode. For troubleshooting the propel system, adjust the speed pot fully down and then back up again. If there is a problem here, the machine should report a fault. Leave the knob at full speed to ensure the machine will propel as the lowest setting may in some situations, prevent the machine from moving.
2	CAN Bus	The CAN bus is the data communication line between modules or control boards on the machine. This network must be functioning properly as there are many propel signals that pass through the bus. If the machine is reporting a CAN related fault, investigate and fix the cause for propel to function.
3	E-Stop Switch	The propel machine contains a mechanical E-Stop switch. If this is engaged, the machine will report a fault and propel will be disabled in two ways: 1) the power is cut off from the iDrive and 2) the machine firmware opens a switch to ensure power remains cut off.
4	iDrive Enable (B+)	The iDrive Enable signal is controlled via firmware in the scrub controller module. Depending on whether the E-stop was pushed on the current key cycle or there was a high level propel fault the software will disable this connection.
5	Go Switch	The Go Switch is used to signal the machine whether or not to propel. When the Go Switch is activated, the User Interface board captures the signal.
6	Supervisor Speed Limit	The bail signal enters the User Interface module and the firmware applies a signal reduction if the supervisor has enabled the speed limit option within one or more presets. See the machine display guide for instructions on this. If there is no supervisor limit, the signal is passed through.
7	Menu System	The firmware only allows the full or supervisor signal to leave the UI board if the user is not in the menu system on a ProPanel machine. This prevents the propel system from functioning until returning to the normal home screen. See operator presence switch next for another restriction.
8	Operator Presence	The operator presence switch will need to detect an operator, otherwise the bail signal will be disabled. If an operator is detected, the operator will first have to select direction before the bail signal will be enabled.
9	Propel Motor	If there are no restrictions to the bail, the signal is an input into the iDrive module. The propel motor is powered from the iDrive and applies power to the machine transaxle to propel the machine. If the machine is propelling, then the system is functioning up to this point in the process.

Process Label Number	Identity	Description
10	Bail Active	The raw bail signal is used to enable scrub functions. The firmware reads the status of this signal to determine when the user has activated the machine.
11	Brake	If the machine is not actively propelling, the iDrive will engage the brake to prevent the machine from rolling on its own.
12	Actuator	The actuator switch status indicates whether or not the scrub head is lowered to the floor. The switch status is read by the Scrub Controller module, which passes that status to the User Interface module using the CAN bus data communication line. The User Interface module firmware combines the actuator switch signals and Bail active signals to turn on the scrub motor. The actuator switches also signal the iDrive whether to operator at scrub speed or transport speed.
13	Scrub Motor	The User Interface module sends the turn on command to over the CAN bus to the Scrub Controller. The Scrub Controller then enables the motor drive circuits.
14	Reverse Signal	The forward/reverse switch is a momentary switch that sends signals to the UI board to indicate the direction of machine travel. If the direction of travel changes, the UI board will send a command over the CAN bus to the Scrub Controller. The Scrub Controller will then change the state of the Reverse Signal line, which is connected to the iDrive.
15	Alarm	The alarm is powered from the iDrive and sounds when the machine is moving in reverse.

ACTUATOR CONTROL

Switches internal to the actuator are detected by the Scrub Controller board, which uses their states to determine the position the actuator is in. The Scrub Controller board controls the actuator to specific positions. Down force control is achieved by driving the actuator to a specific position.