ACU-RITE®

User's Manual

CSS I/O

English (en)
2/2010

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Operating Instructions

CSS I/O

General Information

Connecting the CSS I/O to X101 for executing switching functions (milling) or controlling the constant surface speed CSS (turning)

When the CSS I/O is connected to DRO's that support this feature, the functionality described above are available. Contact an authorized Acu-Rite product distributor for more information.

The DRO automatically recognizes when the CSS I/O is connected and displays the **CSS SETUP** option or the **SWITCHING OUTPUTS** option in the **INSTALLATION SETUP** menu. These options can be used to configure all functions of the switching unit.

I - 1 Execution of Switching Functions

If you want to use both the CSS I/O and the KT 130 edge finder at the same time, or if you want to transmit measured values via the external switching output, the distribution cable with ID 593761-01 is required.

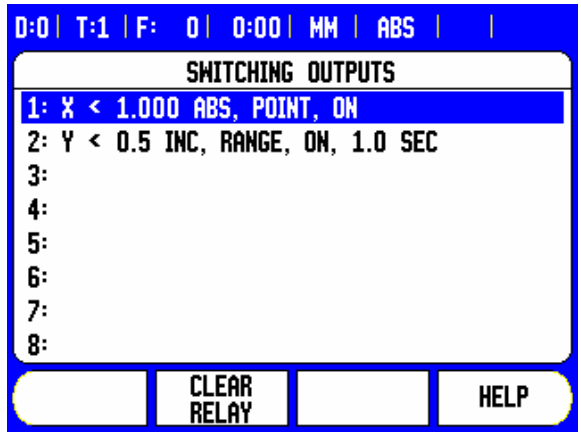
Switching inputs

The CSS I/O provides four inputs that are used to zero the actual value of the assigned axis. A low-to-high transition at the input causes the value for that axis to be set to zero.

Switching outputs

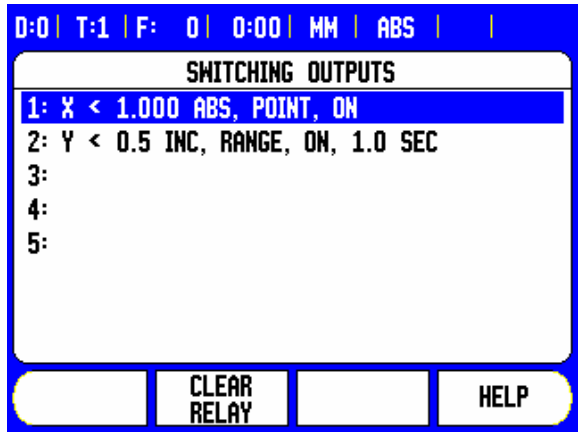
The switching outputs consist of integrated relays available for generic usage. The number of switching outputs available is dependent on the configuration options chosen. When the system is configured for a Mill, and the spindle speed control (RPM) is disabled, 8 switching outputs are available. If RPM is enabled, then only 5 switching outputs are available. See "Spindle Speed Control (RPM)" on page 8.

When the system is configured for a Lathe, and the constant surface speed (CSS) is disabled, 8 switching outputs are available. If CSS is enabled, then only 5 switching outputs are available. See "Controlling the Constant Surface Speed (CSS)" on page 14.



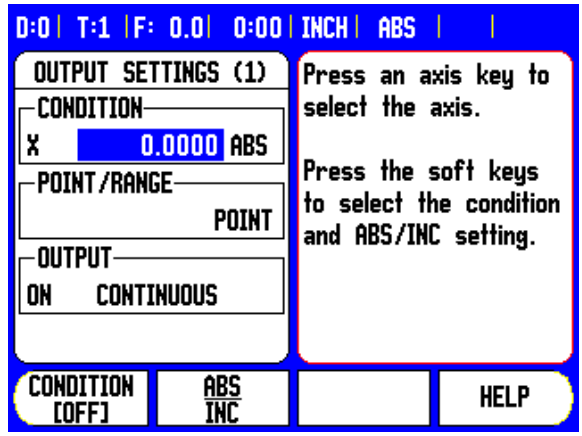
The switching outputs are activated depending on “position”. The relays can be configured to activate when a position display reaches a specific value, or within a specified range of zero. The ninth output relay indicates readiness.

Select SWITCHING OUTPUTS from the INSTALLATION SETUP menu to open the SWITCHING OUTPUTS table in which the configuration of the outputs are stored. If you want to change the configuration of an output, select it with the arrow keys, and press ENTER to confirm your selection. This opens the OUTPUT SETTINGS form in which you define the switching conditions. To reset a relay, select the relay in the table and press the CLEAR RELAY soft key, followed by the YES soft key for confirmation.

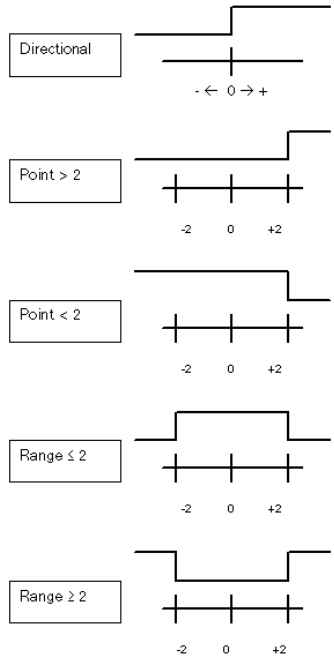


- The **CONDITION** field is used to assign an axis to the output and to specify whether the axis position is an actual-value or distance-to-go position. You also specify the position display value at which the relay is activated, and the required condition.
- The **POINT/RANGE** field is used to define whether the conditions refers to a point on the axis or refers to a range about zero.
- The **OUTPUT** field is used to specify the relay operation when the switching condition is met. When the condition is met, the relay is turned OFF or ON.

If the condition is set to equal, the relay will activate momentarily even if the switching point is crossed over too quickly for the value to appear.

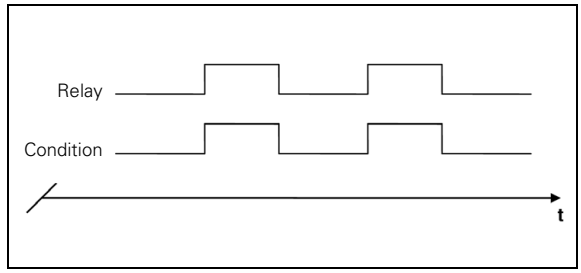


Possible switching states of the relays.



In PULSED mode, the relay is activated (ON or OFF) for a specific period of time. After the period has timed out, the relay is deactivated. The pulse time is 0.1 to 999 seconds.

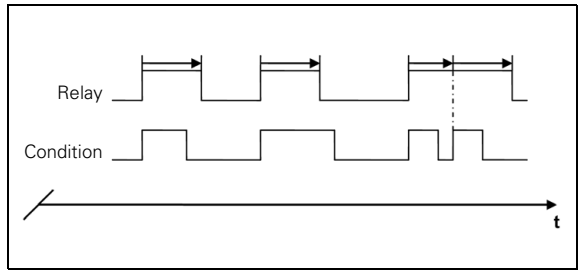
Continuous mode shown:



The time period begins whenever the switching condition transitions from FALSE to TRUE. If the switching conditions transitions to TRUE before the period has timed out, the timer will start over.

The switching functions cannot be used for coupled axes or for axes with backlash compensation.

Pulsed mode shown:



I - 2 Spindle Speed Control (RPM)

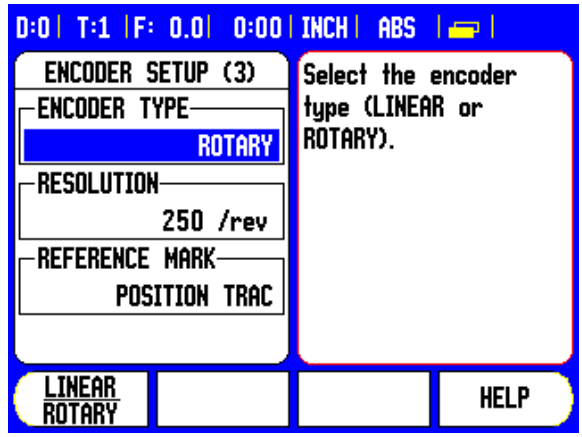
Milling Systems

The Mill Spindle Speed Control is for milling systems only, and provides an open loop spindle speed control.

- The spindle speed control requires the CSS I/O box.

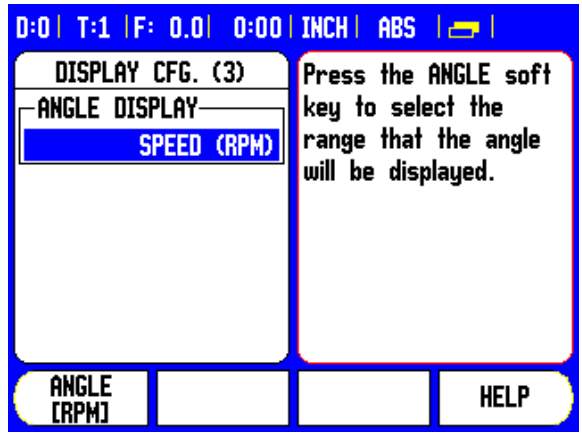
> The spindle speed control is only available for milling systems. If the DRO is configured for a turning system, then no Spindle Settings will be displayed.

▶ Define the last axis as a rotary encoder axis.



Display

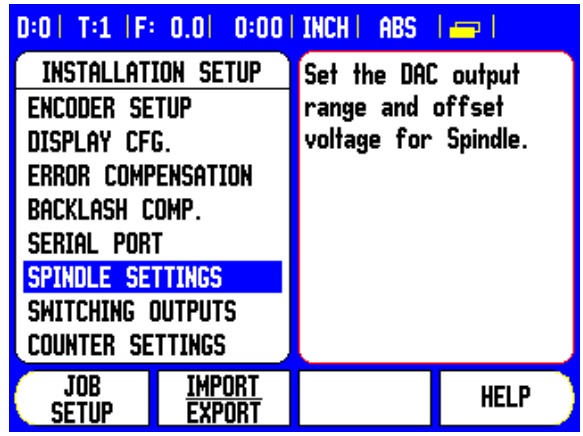
▶ Define the display as a speed display.



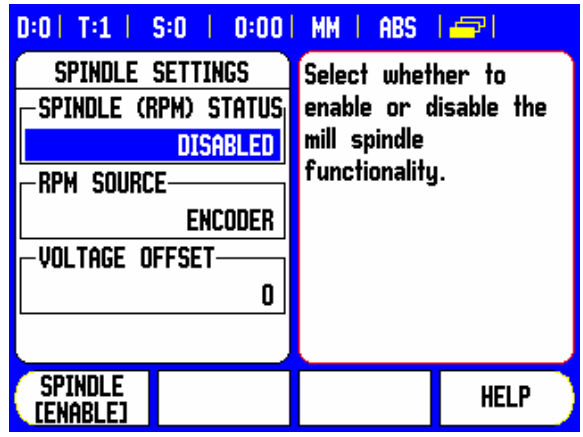
Mill Spindle Installation setup

The configuration parameters are found under Installation Setup. The Spindle Settings only appear in the list if the CSS I/O box is detected.

- Select Spindle Settings from the Installation Setup menu, and press the ENTER key.



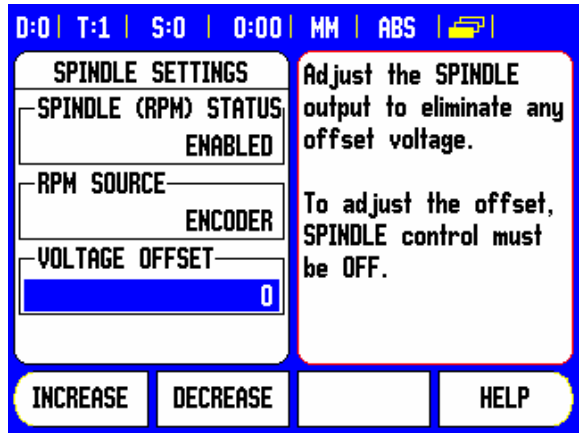
The spindle (RPM) status field allows the user to enable, or disable the spindle (RPM) fuctionality. If it is disabled, then no spindle (RPM) operations are available for usage. If the spindle (RPM) is enabled, then all of the following setup must be completed. Six (6) generic switching outputs will then be available.



Voltage Offset / RPM Source

The voltage offset field is used to adjust for any inherent offset in the DAC output. This value is added to the calculated DAC output. Use a voltmeter to measure the actual voltage at the DAC output. Press the INCREASE, or DECREASE soft key to adjust the offset until the output is 0 V. The offset range is limited to 0 - 50, (approximately 0 - 122 mV).

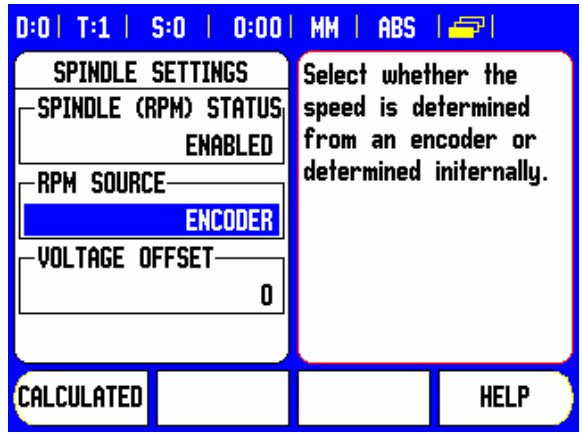
- Press ENTER to save the settings, and exit the form, or press the C key to exit without saving the changes.



The RPM source allows the user to define whether the RPM source is from an actual rotary encoder, or calculated by the software as a replacement for a rotary encoder.

User speed limits can be established to limit how fast, or slow the spindle may be run. These are run time limits, and must fit in within the actual hardware limits.

- Press ENTER to save the settings, and exit the form, or press the C key to exit without saving the changes.



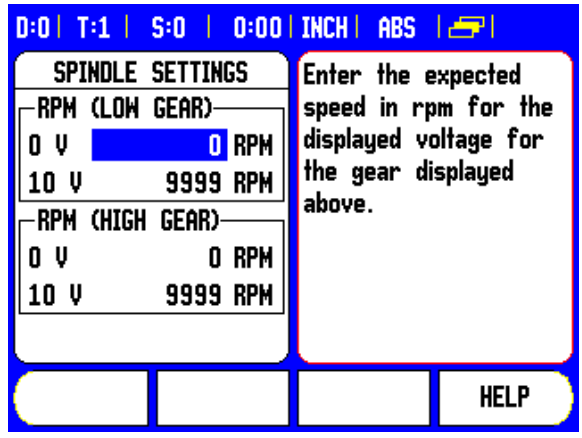
When in Setup mode, the status bar will display the current spindle speed in RPM's shown in the **S:** field on the status bar.

To set a specific spindle speed, the DAC output S_{Out} uses this linear relationship to determine the corresponding output voltage V_{Out}:

$V_{Out} = 10 \bullet (S_{Out} - S_0) / (S_{10} - S_0) + V_{Offset}$

Press ENTER to save the parameters and exit the input form. Press the C key to exit without saving the changes.

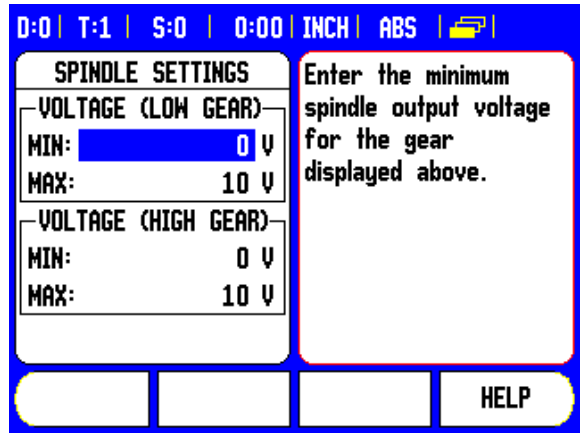
These are the physical limits of the machine.



Voltage / RPM Setup

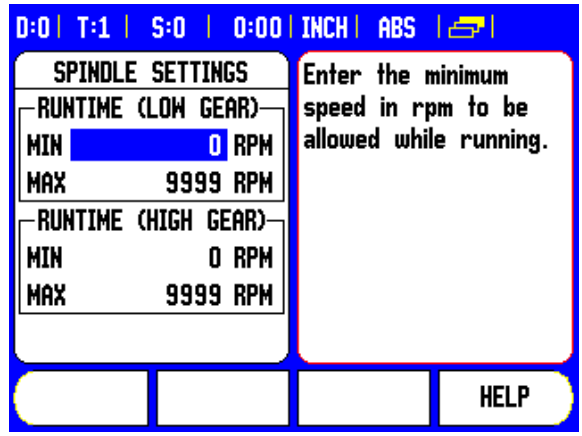
The voltage setup fields are used to establish the relationship between the DAC output signal (0 - 10 V), and the spindle speed for each gear.

- Enter min, and max voltage levels for each gear.
- Press ENTER to save the settings, and exit the form, or press the C key to exit without saving the changes.



This screen allows the spindle to have min, and max RPM settings defined. This limits the spindle not to exceed the limits set at start up. The spindle speed can then be manually increment above the "Run Time" limits.

- After selecting Spindle Settings from the Installation Setup menu, use the RIGHT or LEFT arrow hard keys to scroll to this menu.

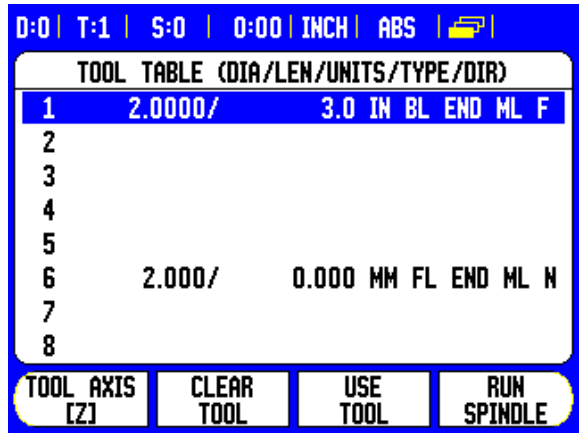


Operation / Job Execution

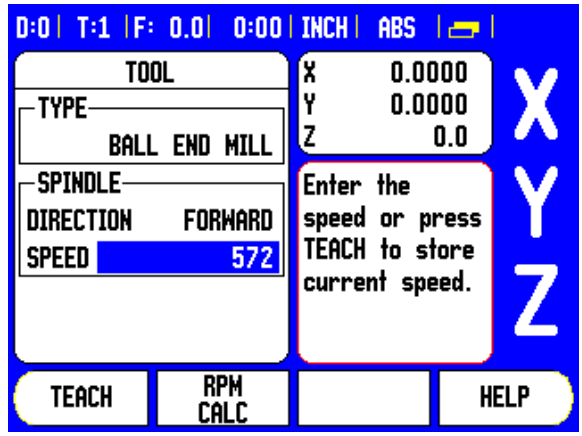
The operation of the Mill Spindle is associated with the use of the selected tool from the tool table, and the spindle parameters for running the tool.

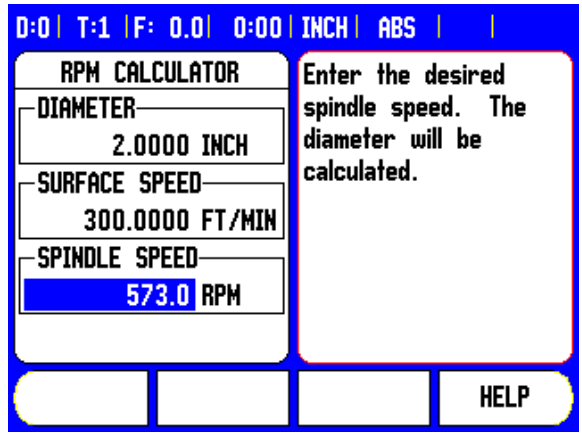
Refer to the DRO User's Manual for setting up, and using a tool from the tool table.

- Select the desired tool from the tool table.
- Press ENTER to open the tool setup form.



Press the RPM calc key to specify a surface speed, and get a resultant RPM spindle speed that is automatically loaded into the tool table when exiting the RPM calc.

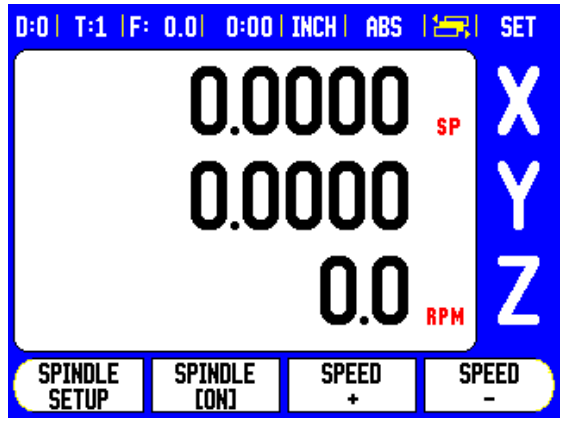




A tool can be run from the tool table, or by pressing enter after defining the spindle parameters for a tool.

Mill Spindle Feature Run

- With all tool, job, and installation setups entered, the Mill Spindle job can be run by toggling the Spindle ON/OFF soft key.
- Select the tool to be used, and the required gear.
- The spindle speed can be adjusted using the SPEED **+/-** soft keys.



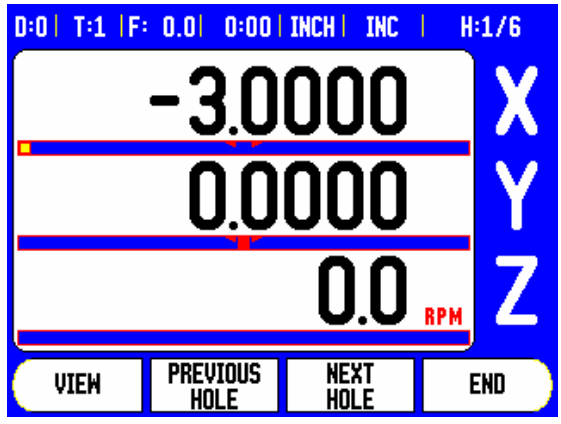
Mill Spindle Program Run

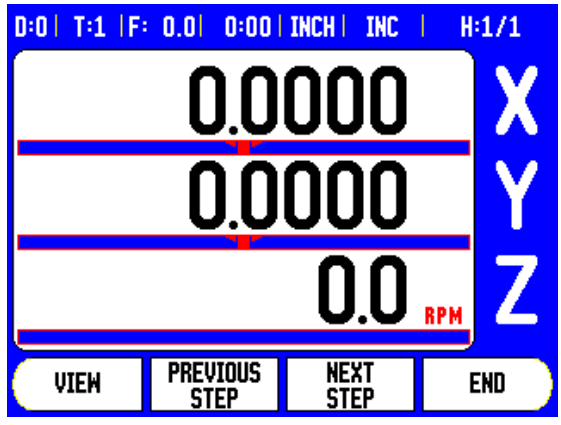
Mill Spindle can be used within a program for any program step that has a mill spindle tool defined for that step.

When in program run, if the SPINDLE: Direction, and Speed fields are defined for the tool, the operator can use the LEFT, or RIGHT ARROW keys to display the Spindle control soft keys. When these fields have not been defined, the Spindle control soft keys are not available.

To go back to the program control screen from the mill spindle control, press the LEFT, or RIGHT ARROW keys.

The speed of the mill spindle can also be adjusted while in the program control screen by pressing the SPEED **+/-** soft keys.





I - 3 Controlling the Constant Surface Speed (CSS)

In CSS mode, a constant surface cutting speed can be maintained on a lathe. The following functions are available:

- CSS mode: The DAC output signal provides constant surface speed by adjusting the spindle speed as the diameter (radius) of the workpiece changes.
- Direct entry of spindle speed: The DAC output signal sets the spindle speed based on the value entered via the numeric keypad.
- Speed limits: The user may set a safe operating range (minimum and maximum speeds) for spindle speed.
- Gear selection: Three different gears can be specified for varying the relation between the actual speed and the DAC output signal.
- The READY output (X103-12) is active when the readout has recognized the CSS I/O hardware, is monitoring the inputs, and is controlling the output relays. If the CSS I/O detects a communications error with the readout, the READY relay will be de-energized.

The CSS setting screen provides a choice between STANDARD, LIMITED or DISABLED mode. This setting should always be set to STANDARD mode.

When the CSS status field is set to disabled, then no CSS functionality is available. Eight (8) generic switching outputs are available for useage. When STANDARD, or LIMITED is selected, then the remaining setup options must be completed. Only 5 generic switching outputs will be available for usage.

Configuration of CSS

To use the CSS functionality, the last axis must be defined as a rotary axis. Define the display as a speed display, and configure them accordingly. The spindle control configuration parameters are set up in the INSTALLATION SETUP menu.

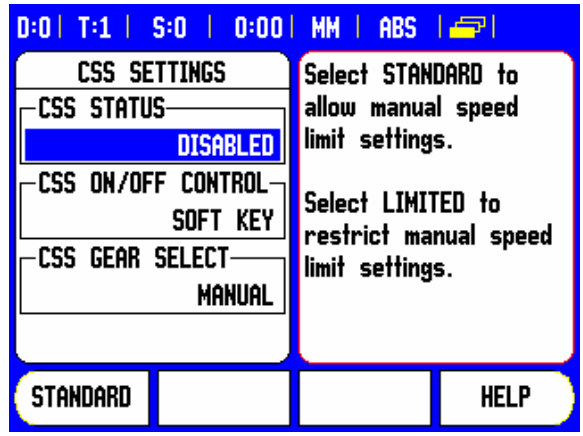
- Select the CSS SETTINGS parameter to open the associated input form
- The CSS ON/OFF CONTROL field is used to specify whether the CSS mode is operated by soft key or by an external hardware signal.
- The current gear may be selected by local control (MANUAL via CSS / DIRECT RPM in the JOB SETUP menu) or remote control (EXTERNAL; via switches in the machine gear). This is defined in the CSS GEAR SELECT field.
- The VOLTAGE OFFSET function is used to adjust for any inherent offset in the DAC signal. Using a voltmeter, measure the actual voltage at the DAC output. Press INCREASE or DECREASE to adjust the offset until the output is 0 V. The offset range is limited from 0 to 100 (approximately 0 to 244mV).
- The VOLTAGE / RPM fields are used to establish the relationship between the DAC output signal (0 to 10 V) and the spindle speed. The minimum and maximum limits for each gear are entered.

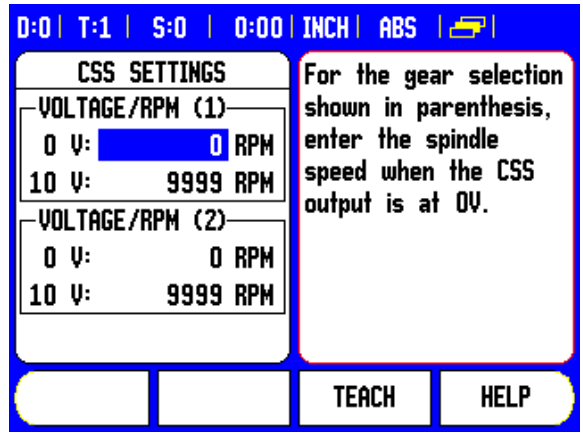
If the position display of the third axis is configured to be used for the spindle speed, the rpm in the SETTING field can be set to the current spindle speed by pressing the TEACH soft key.

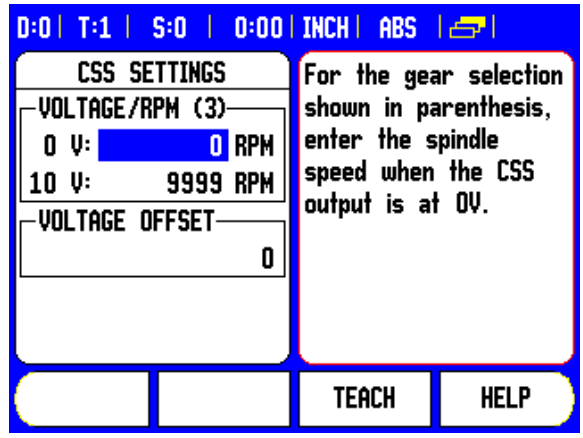
To set a specific spindle speed, the DAC output S_{Out} uses this linear relationship to determine the corresponding output voltage V_{Out}:

$V_{Out} = 10 \cdot (S_{Out} - S_0) / (S_{10} - S_0) + V_{Offset}$

Press ENTER to save the parameters and exit the input form. Press the C key to exit without saving the changes you made.







CSS operating mode

The operating parameters are set in the CSS / DIRECT RPM form.

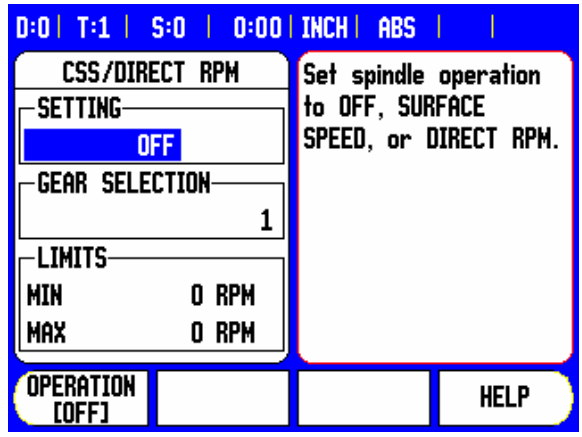
- Press the CSS SETUP soft key to open the form or select the parameter from the JOB SETUP menu.

The SETTINGS field is used to select the mode of operation and the control settings. The spindle is controlled by selecting CSS or by entering the spindle speed directly. The values to be entered depend on the selected option.

If CSS was selected to maintain a constant surface speed, the surface speed entered with the numeric keys is maintained. As the diameter of the part changes, the spindle speed will be adjusted.

- To set a specific spindle speed, select DIRECT / RPM and enter the value with the numeric keypad.
- If the position display of the third axis is configured to be used for the spindle speed, the rpm in the SETTING field can be set to the current spindle speed by pressing the TEACH soft key.
- Select OFF when spindle control is not needed.
- The GEAR SELECTION field is used to manually enter the operating gear with the numeric keypad.

If the gear control parameter in INSTALLATION SETUP is set to EXTERNAL, the field will show the current gear selection based on the external inputs. The field can then not be selected and is skipped.



- The LIMITS field is used to establish the minimum and maximum limits of the controlled spindle speed. When operating in the CSS or DIRECT RPM modes, the DAC output will not be set to a speed above or below these limits.
- Press ENTER to save the parameters and exit the input form. Press the C key to exit without saving the changes you made.

- The “Spindle Speed” will default to the OFF position when ever the Readout power is cycled, and the run mode must be reselected to use. No settings are lost when power is cycled. The Max RPM field is discarded between runs in Limited mode only, requiring to teach a new max RPM each time.

Activating the DAC output

After selecting the operating mode and entering its parameters, the DAC output must be enabled to begin controlling the spindle.

The output to the spindle inverter drive is an open loop signal. The system does not monitor the actual spindle speed. The output signal is based solely on the inverter's speed input versus the input voltage profile.

- Depending on the operating mode selected, the RPM or CSS soft key is displayed on the fourth page of the soft key menu. If the current state indicated on the soft key is ON, the DAC output is active. Press the soft key to OFF to disable the spindle control.

If CSS is active, the CSS icon appears next to the X-axis display. If the entered surface speed or rpm cannot be maintained because the speed is outside the range for the current gear or outside the limits from the CSS/RPM SETTINGS form, an arrow will appear after the CSS icon (CSS↑ or CSS↓). The direction of the arrow indicates whether the speed is at the upper or lower limit.

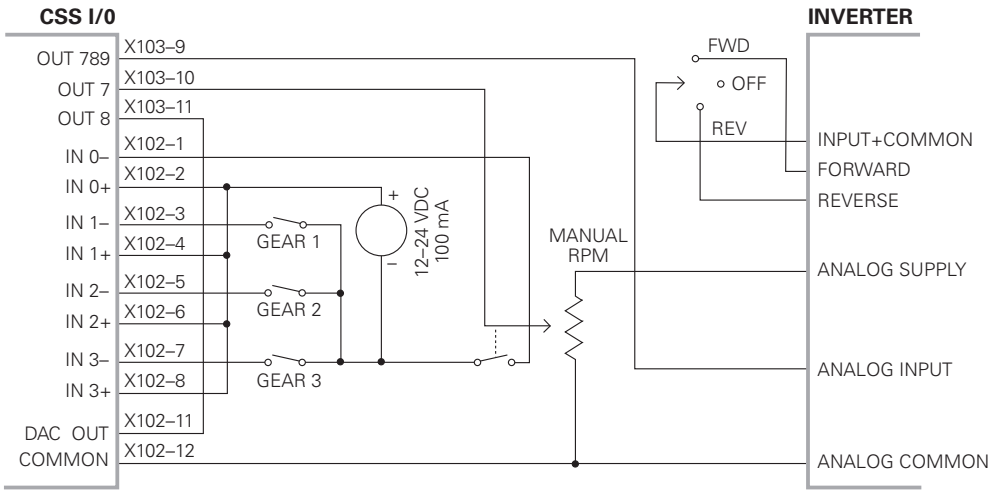
The soft key to enable CSS or RPM control will not appear if the operating mode is set to OFF.

If the CSS control parameter under INSTALLATION SETUP is set to EXTERNAL, the CSS or RPM operation cannot be controlled by soft key. The soft key will show the current state, but pressing it will have no effect.

The SPEED + and SPEED – soft keys are used to increase or decrease the current surface speed or spindle speed. The value is increased or decreased by 5% each time the soft key is pressed.

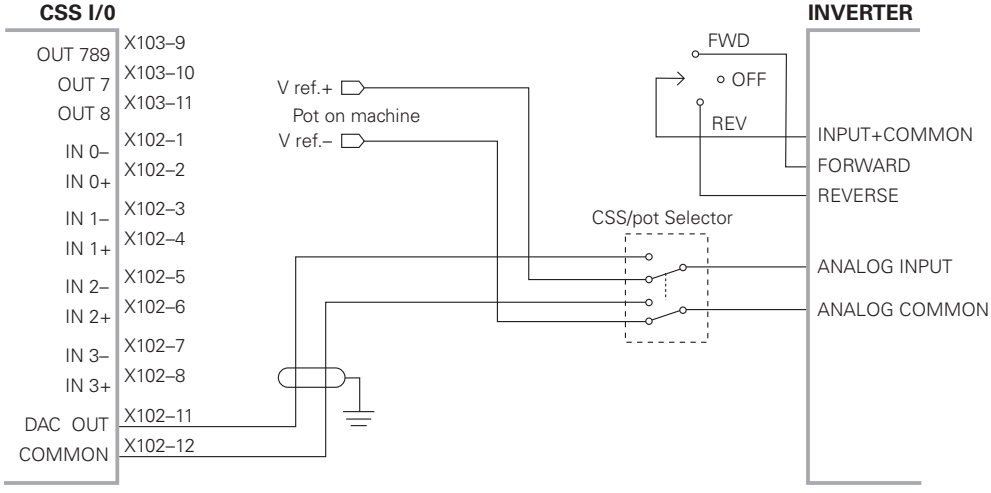
Connecting the CSS I/O to the inverter of the lathe

TURNING APPLICATION 1–Automatic CSS/Pot Control



Example of gear detection and switching to manual spindle speed control

TURNING APPLICATION 2–Manual CSS/Pot Control



Example of switching to manual spindle speed control

I - 4 Diagnostics

General Information

When the CSS I/O box is connected to the DRO, the DIAGNOSTICS menu under INSTALLATION SETUP provides further diagnostic possibilities. The information available varies depending on the configuration of the system, Switching I/O, CSS, or Mill Spindle functions.

Switching I/O functions

The SWITCHING I/O DIAGNOSTICS shows the status of the communication via the CAN bus and the state of the switching inputs and outputs to provide monitoring of the switching functions.

The CAN STATUS field shows the state of the bus communication between the DRO and the CSS I/O.

The status information has the following meaning:

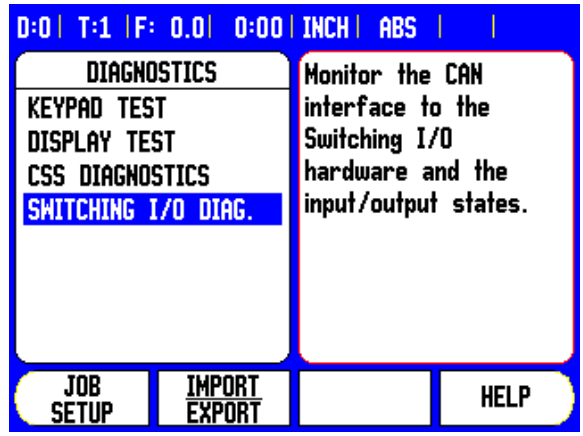
Information	Meaning
NOT PRESENT	No communication with hardware
NOR	Communication – normal operation
CAL	Communication – Hardware in calibration mode
Wen	Watchdog active
Wds	Watchdog inactive
Wto	Watchdog time-out
Tx	Data is transmitted to hardware
Rx	Data is received by hardware

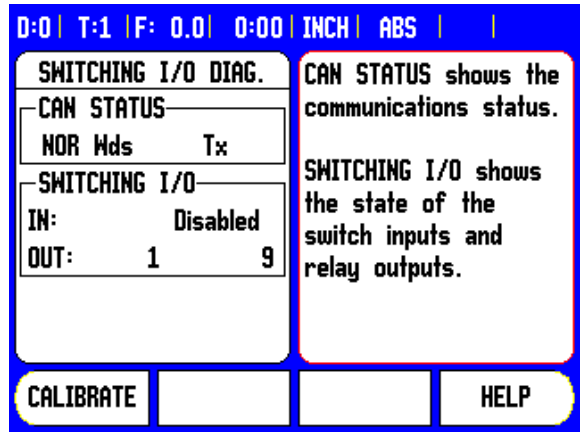
The SWITCHING I/O field shows the state of the inputs and the switch position of the relays.

All currently active inputs (1 to 3) are shown in the ON field.

All currently active relay outputs (1 to 9) are shown in the OFF field.

The CALIBRATE soft key is used to re-synchronize the communication with the CSS I/O. This, however, is only required if the module is not detected upon power on.





CSS, and Mill Spindle

CSS / MS DIAGNOSTICS shows the status of the communication via the CAN bus and the state of the DAC output to provide monitoring of the interfaces for operation with constant surface speed, (or Mill Spindle). The state of the switching inputs and outputs is also shown.

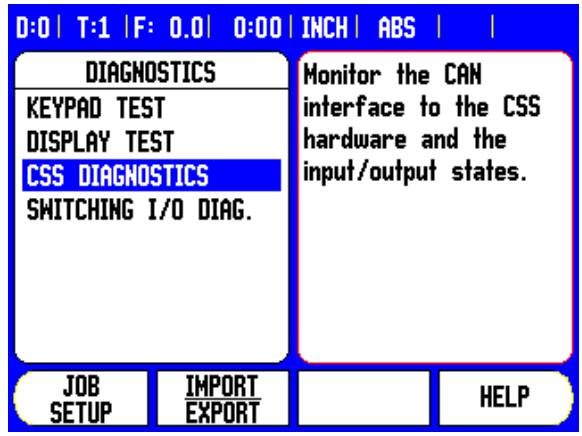
The CAN STATUS field shows the state of the bus communication between the DRO, and the CSS I/O, (or Mill Spindle and I/O).

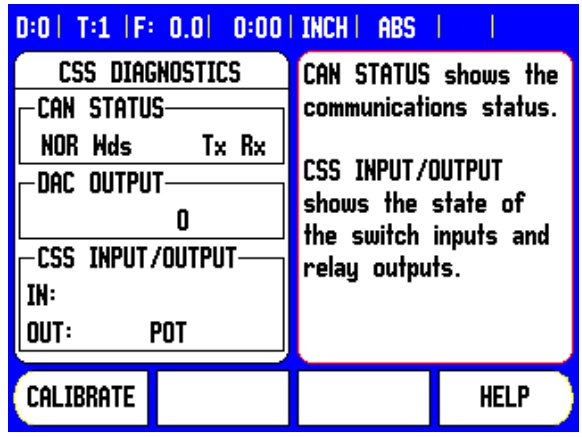
The status information has the following meaning:

Information	Meaning
NOT PRESENT	No communication with hardware
NOR	Communication – normal operation
CAL	Communication – Hardware in calibration mode
Wen	Watchdog active
Wds	Watchdog inactive
Wto	Watchdog time-out
Tx	Data is transmitted to hardware
Rx	Data is received by hardware

The DAC OUTPUT field shows the current value of the transmitted voltage. The value is between 0 and 4095, which corresponds to a voltage of 0 to 10 V at X102-11. The corresponding CSS icon will be displayed if the spindle speed is at the upper or lower limit (CSS↑ or CSS↓).

The CSS INPUT/OUTPUT field shows the state of the switching inputs, and relay outputs.





For CSS only, the MS INPUT/OUTPUT field shows the state relay outputs. The IN: field of the switching inputs is not used, and will be blank.

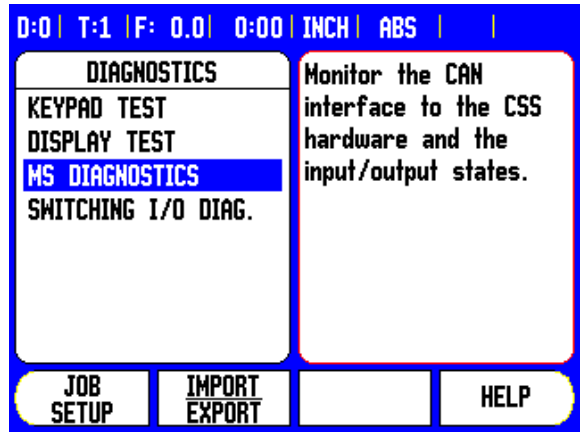
The status information has the following meaning:

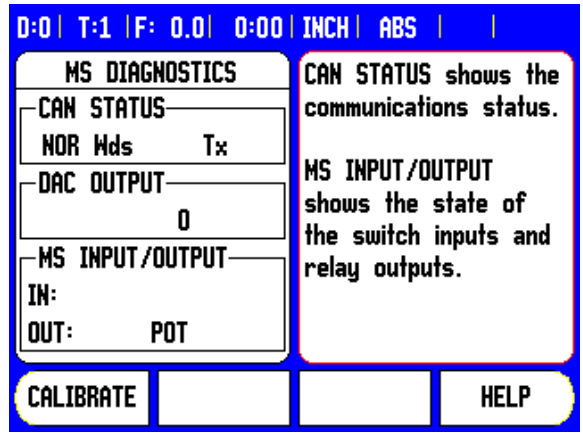
Information about the inputs	Meaning
EXT	External switch is active (X102-12)
G1	Switch for gear 1 is active (X102-3,4)
G2	Switch for gear 2 is active (X102-5,6)
G3	Switch for gear 3 is active (X102-7,8)

The following table applies to both CSS, and RPM.

Information about the outputs	Meaning
POT	Potentiometer relay is active (X102-10)
DAC	DAC output relay is active (X102-11)

The CALIBRATE soft key is used to re-synchronize the communication with the CSS I/O. This, however, is only required if the module was not detected at switch-on.





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