

Installation and Operational Manual

LevelMaster II-C

Blade control system for Grader and Dozer Applications





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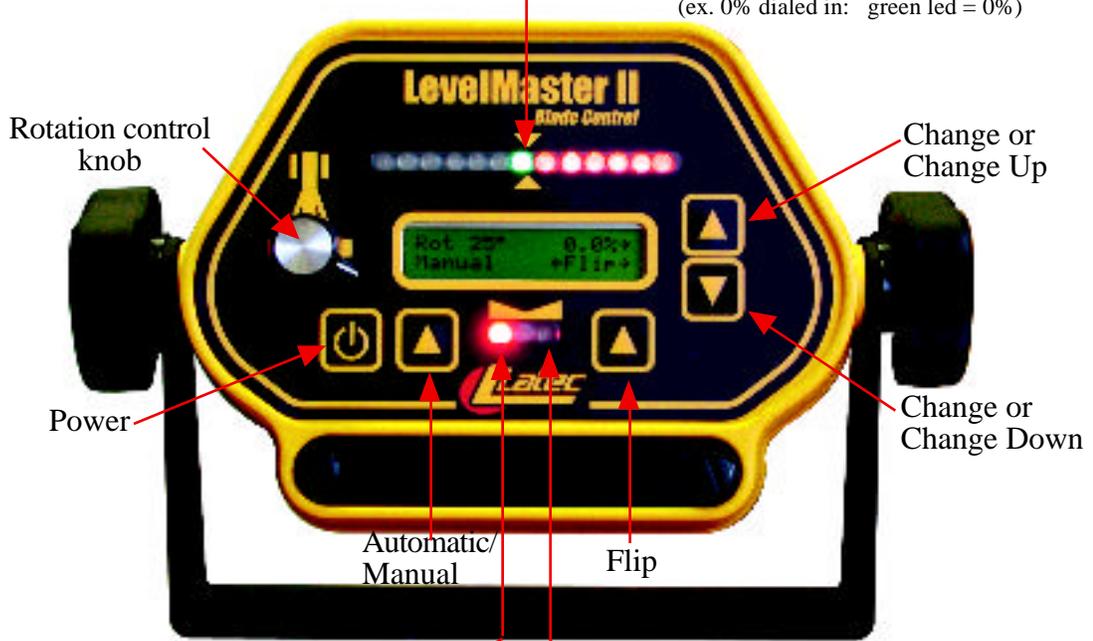
LevelMaster II-C Blade Control for dozer and grader applications

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LM2-C GENERAL IDENTIFICATION

Control Box Identification

Displays current position in relation to dialed in grade
(ex. 0% dialed in: green led = 0%)



This LED indicates valve will be driven up

This LED indicates valve will be driven down

Sensor Identification



LM2-C General Operation

The power button...

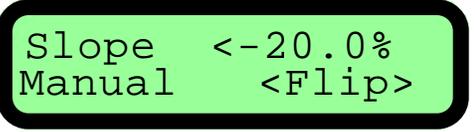
There are five buttons on the LevelMaster 2C. Press the power button briefly to turn it on, and the button must be pushed and held for about 2 seconds to turn the system off.



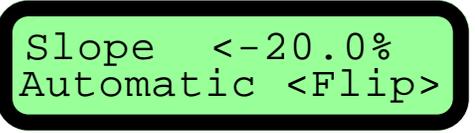
```
LevelMaster 2C  
v4.4 8 X 2003
```



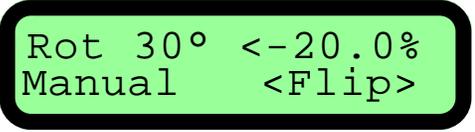
```
Slope Sensor ??  
Manual <Flip>
```



```
Slope <-20.0%  
Manual <Flip>
```



```
Slope <-20.0%  
Automatic <Flip>
```



```
Rot 30° <-20.0%  
Manual <Flip>
```

When the control box is turned on, its display will show the product name and the current software version. If a valid sensor is found on the data line, the LED display will give an indication of the sensor's tilt angle.

A sensor is valid only if you have "OK'd" its serial number elsewhere in the setup procedure. If no valid sensor is found, a distinctive rolling pattern is seen in the LED display.

After the software version has been displayed for about 5 seconds, the display will show the last-used slope if there is a valid sensor attached.

Normal operation is as simple as adjusting the slope with the up and down arrow buttons or the "Flip" button, and toggling between automatic (driven valves) and manual modes.

The rotation error compensator.

LevelMaster 2-C Blade control boxes have been equipped with the optional blade rotation emulator. This allows the operator to inform the control box about the angle between the blade and the direction in which the machine is moving. With this information the control box will calculate and display the proper angle in real time.

This is what the screen displays when this option is enabled and the parameters entered make sense. Otherwise, standard screen is displayed and the box assumes that the blade is perpendicular to the direction of the grader - this would correspond to a rotation of 0°.

The Up/Down buttons...

The two buttons on the right are used to change any parameter that appears in the display. In the normal operation mode, these two buttons will change the desired slope. The slope is limited to $\pm 25.0\%$.

The Flip button...

The slope can quickly be changed from right to left, or front to back, by pushing the "Flip" button. The numeric value of the slope does not change, but the direction does. If the display showed "<-20.0%", pushing the "Flip" button will change it to "20.0%->".

The Automatic/Manual button...

The button below the left-bottom of the display changes the LevelMaster 2C between automatic and manual mode when the slope display is showing. This button also gains special functions with respect to some of the display screens shown below.

The Menu System...

To enter the calibration and set up menu system, put the system in "Manual", and push both the "Manual" and "Flip" buttons at the same time. Subsequent menu items appear after pushing the "Next" button. If no button is pushed for about 20 seconds, the system will return to the "Slope" page.

SET-UP AND OPERATIONAL FUNCTIONS

The display contrast might need to be adjusted if your viewing angle changes. The Trumeter STN displays have a very wide viewing angle, and don't require frequent viewing angle adjustment.

Display Contrast
65% Next

Display Type
B Next

Rot. compens off
change Next

There is a chance that the display will show rolling clear bars through the displayed text. If this anomaly is seen, select the other display type (A or B) which will make a subtle change in the way the display is dealt with. There is a very good chance that the rolling bars will not be seen with either setting.

Rotation Compensation is an option which should be used if you are rotating your blade as well as changing grade. The rotational knob is to be manually adjusted to the same rotation as the blade. We recommend that you mark certain angles on the blade so accurate grade calculation may take place.

These following items can - and probably will - operate the hydraulic valve. Be careful with their use!

Minimum PW 120ms
Test Next

Down PW 120ms
Chg Dir Stop

If you're in Proportional time mode:

To ensure a consistent dead band (set below) and stability, the minimum pulse width sent to the valve for very small tilt errors must be set to the proper value. Various different directional valves have vastly different minimum pulse widths necessary to actually open them and deliver oil. This screen shows the minimum pulse width as it is currently set. Push the "Test" button to adjust the minimum pulse width.

If you select "Test", the down valve is pulsed twice per second; the initial pulse width is 10 ms. Use the up/down arrow keys to change the pulse width until the machine just begins to move. Remember that pulse width. Push the Chg Dir (Change Direction) button, and repeat the exercise until the machine just starts to move. Remember that pulse width. In either the Up PW or Down PW screen set the lower of the two numbers you just remembered in that window. Push "Stop" to save the number and turn the valve off.

Note that either the "Stop" button or the Power button will turn off the valve drive in a panic situation, and return you to the Minimum PW window. Also, the valve will shut off automatically after 20 seconds without any buttons being pushed.

Minimum DC 25%
Test Next

Down PlsDC 6%
Chg Dir Stop

Up PulseDC 19%
Chg Dir Stop

If you're in Proportional current mode:

Some variable volume valves have a minimum drive duty cycle (DC) below which their oil flow is zero. The LevelMaster 2C will, when oil flow is required, provide a minimum duty cycle as set in this mode.

If you select "Test", the down valve is energized with a 6% duty cycle signal. Use the Up/Down keys to adjust this duty cycle until the machine just begins to move. Push the "Chg Dir" button to verify your setting with the up valve energized. Push the "Stop" button to terminate the test and store the value just selected.

Note that either the "Stop" button or the Power button will turn off the valve drive in a panic situation, and return you to the Minimum PW window. Also, the valve will shut off automatically after 20 seconds without any buttons being pushed.

As a result of timing constraints in the valve driver hardware, the duty cycle (DC) moves in increments of about 6%.

If you're in Proportional time mode:

If the LevelMaster 2C has been set to the 'Proportional time' mode rather than 'Proportional current' (in a page below) the valve cycle time can be set between 100 ms (milliseconds) and 1000 ms (or 10 Hz to 1 Hz).

If the LevelMaster 2C has been set to the Proportional current mode, this screen is not shown.

Valve cycle time
250ms Next

Imagine that the sensor has been tilted to exactly the set slope; the valves will do nothing at that point because there is no slope error. There is a point on either side of that sensor position where the valves will be called into action to correct the slope error. Before that, there is a range of slope error that will not be corrected. The angular distance between the point at which valve 1 just stops working and the point at which valve 2 just starts working is the valve dead band, in percent slope.

Valve dead band
0.4% grade Next

Once a tilt error sufficient to overcome the valve dead band has been registered, one valve or the other will start to work. As the slope error increases, the valve drive increases - perhaps to the point where the valve is delivering maximum power. The span of slope error between the onset of valve operation and the point at which the valve is fully on is determined by the valve gain setting. In this case, the (percentage) units displayed are arbitrary, but higher numbers suggest more vigorous valve action. With the gain set to 100%, the slightest error will fully open the appropriate valve.

Valve gain
60% Next

To stabilize some machine control applications, it is necessary for the control box to know not only whether the machine is at the desired slope or not, but how fast the slope is changing and in what direction. This is known variously as velocity or derivative (dv/dt) feedback. The control box can vary the amount of velocity feedback added; choose among:

Derivative gain
Medium Next

High
Medium
Low
Off.

The LevelMaster 2C sensor was designed with a rather fast response time. As a result, when mounted on a vibrating machine, the sensor produces data which includes both tilt information and vibration information. This fast response also reflects machine acceleration. Either vibrations or accelerations can cause erratic grade control.

FAST ---|-- Slow
Filtering Next

To reduce these false signals, it will be necessary to 'slow down' the sensor to some degree. Select the fastest filtering level that produces stable machine control.

Hydraulic AI On
Change Next

When the plow strikes an unusually hard object the shoe is bounced in a variety of directions causing the valves to correct on an error. The LevelMaster has the intelligence to shut the valves off for a desired amount of time as well as selecting the amount of jump it will take to shut the valves off.

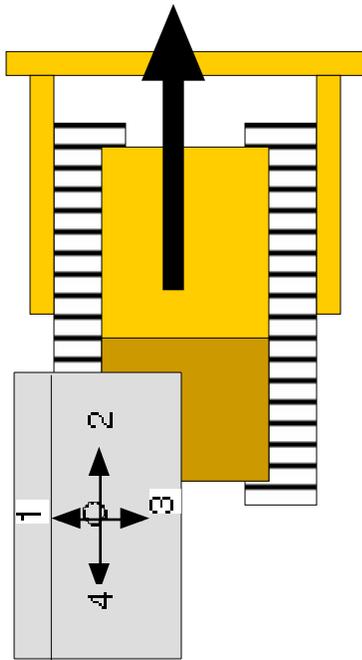
AI Sensitivity
5% Next

When the AI On is selected the next 2 screens will be sensitivity and time out. The sensitivity is what it says, with 5% being able to handle a large hit, to 95% which shut the valves off with a light

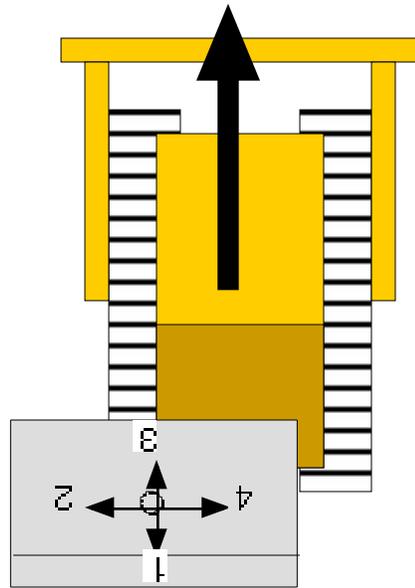
AI Time-out
1s Next

bump. (15% seems adequate for most functions). The AI time out is the amount of time the valves will be off(2 seconds is usually correct). When the valves are off due to the AI function all 3 bottom LED's will be on.

Possibilities for mounting the LevelMaster 2C Sensor..

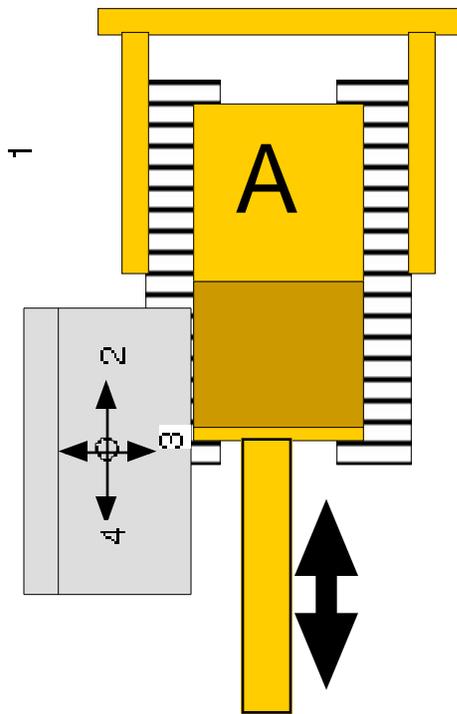


Sensor 2>Forward
Next



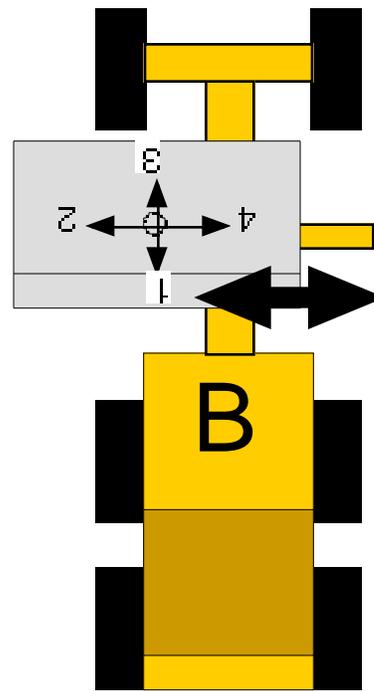
Sensor 3>Forward
Next

The LevelMaster 2C sensor can be mounted on the machine in any of four directions, but the control box needs to know how that sensor is mounted. There are four numbers printed on the top of the sensor box as shown in the pictures above: use the Up and Down keys to select the number pointing in the direction of normal machine travel.



Sensor 2 > Forward
Next

Control Axis
Fwd/Back Next



Sensor 3 > Forward
Next

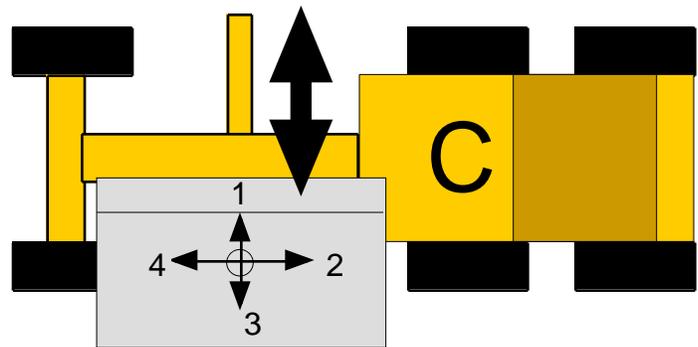
Control Axis
Cross Next

More possibilities for mounting the sensor...

The LevelMaster 2C can be used on machines where the controlled axis is the same as the direction of machine travel (“A”, above) or where the controlled axis is perpendicular to the direction of travel (“B”, above).

Indicate the axis to be controlled as shown. Machine “A” has the sensor mounted with its “2” indicator pointing forward, and controlling the “Forward/Back” axis. Machine “B” has the sensor mounted with its “3” indicator pointing forward, and controlling the “Cross” axis.

Note that the setup shown at “C” to the right will function exactly the same as the setup at “B” above it.



Sensor 4 > Forward
Next

Control Axis
Cross Next

Valve type
Prop time Next

Valve type 100Hz
Prop Curr Next

Valve type
Danfoss Next

LevelMaster 2C can control proportional time ('bang-bang') valves, proportional current (proportional flow) valves, and proportional flow valves with integrated electronics (Danfoss). If Proportional time mode is selected, the pulse frequency is changed under the "Valve Cycle Time" menu item, above. There are three Proportional current settings: 50 Hz., 100 Hz., and 200 Hz.; consult the valve manufacturer to find the proper frequency for your valve.

The Danfoss setting, as well as producing the low power analogue control signal for the valve, also drives both of the high current valve outputs. One of those high current outputs can supply power to the Danfoss valve, and the other can operate the hydraulic system loading valve as recommended by the manufacturer. Both of these high current outputs will be driven whenever the LevelMaster 2C is turned on and the Danfoss mode has been selected, and "Automatic" has been selected.

In any proportional current mode, the LevelMaster 2C valve output is a pulse-width-modulated, high current output; the output voltage will, during the valve on time, be equal to the DC input supply.

The options on this "valve type" screen cycle through the following five items:

- Proportional current 50 Hz
- Proportional current 100 Hz
- Proportional current 200 Hz
- Proportional time
- Danfoss.

Horn Off
OK Next

Horn Alert
OK Next

Horn Indicate
OK Next

LevelMaster 2 can provide an audio alert tone. The three options are:

- No tones.
- A tone when the grade error exceeds that error which would result in maximum power to the valve. The tone appears only in "Automatic".
- A varying tone pattern that indicates the direction of the grade error. The tone appears only in "Automatic".

Factory Settings

All of the LevelMaster variables can be restored to their default values with this window displayed. The defaults are restored by pushing the Auto/Manual button (right under 'Restore' on the screen). The values saved will be:

Factory settings
Restore Next

Slope	0.0%
Display contrast	63%
Display type	A
Rotation Comp.	Off
Minimum pulse width	80 ms (for proportional time)
Minimum Duty Cycle	25% (for proportional current)
Valve cycle time	250 ms
Valve dead band	0.5% grade
Valve gain	50%
Derivative gain	Low
Filtering	-- I --- (position 4)
Hydraulic AI	Off
AI Sensitivity	15%
AI Time-Out	2 seconds
Sensor axis	Fwd/Back
Sensor direction	1 -> Forward
Valve type	Proportional time
Horn	Off

Sensor #12345*
OK Next

Sensor #23456
OK Next

There may be several LM2-C sensors connected to the data bus. If so, it is necessary to select the sensor to use with this control box. The serial number printed on the sensor box is shown. If there is more than one sensor available, use the up and down arrow keys to display the serial numbers of the available sensors. Press "OK" to use the sensor currently displayed. If a sensor had been selected at some point in the past, its serial number will have a star beside it.

Francais
Changer Suite

English
Change Next

LATEC Instr. Inc
5192354585 Next

Pick your language...

The final screen in the menu displays the phone number. Outside of North America, dial +01.519.235.4585.

CABLE DIAGRAMS

Connections

All the connectors are marked on the back of the control box. Valve coil wiring depends on the type of hydraulics used and should be serviced by a qualified hydraulic technician. There are 3 sets of cables for each unit, if hydraulics are not being used the sensor cable should not be connected but stored in a safe and dry place until the time you decide that automatic use would be an asset.

Description(Connect to):	Conn. Pin #	Cable colour	Connector
+10 to +28 VDC	pin 1	red	power
system ground	pin 3	black	power
valve left (lower)	pin 3	blue	valve
valve left (raise)	pin 1	white	valve
valve right (lower)	pin 2	brown	valve
valve right(raise)	pin 4	red	valve
Danfoss (lower)	pin 5	orange	valve
Danfoss (raise)	pin 6	green	valve
Ground	pin 7	black	valve

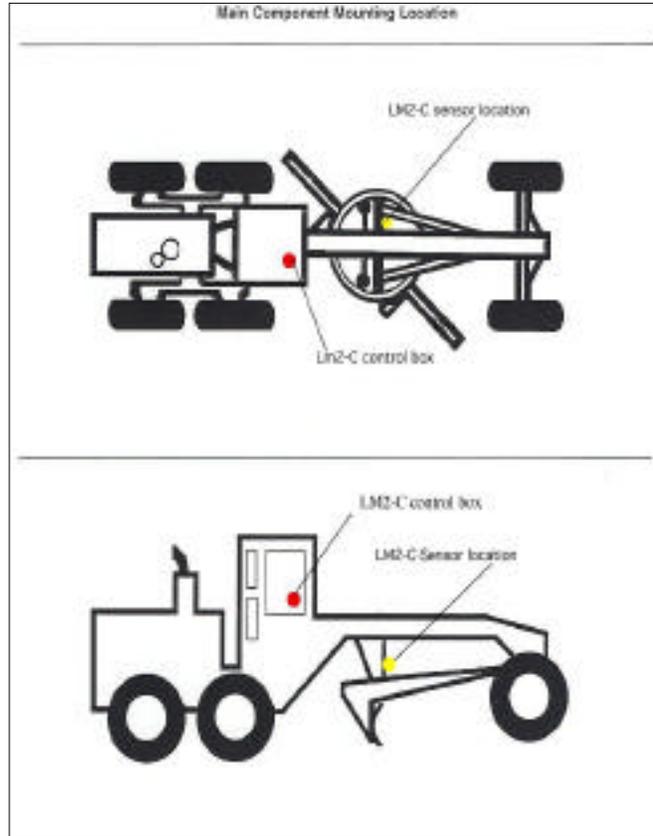
The sensor cable connections are:

Description	Control Box. Pin #	Sensor Box Pin #
+8 VDC	pin 1	pin 2
ground	pin 2	pin 4
CANH	pin 3	pin 6
CANL	pin 4	pin 8

The connections for the sensor cable should not be tampered with

INSTALLATION

Installation of the LevelMaster unit.



CONTROL BOX INSTALLATION

When installing the control box the Mounting bracket was made so the user can install the box to meet there machines needs. A couple of suggestions to keep in mind:

1. The cables need 3+” of clearance behind the control box.
2. Keep the mount below the control box (no top mounting)

The POWER cord is 15 ft. long and can be operated with any DC voltage from 12 to 30 Volts



possible mounting option

SENSOR INSTALLATION

1. Remove weldment bar from the Sensor Box using a 9/16" wrench
2. Clean off the surface of the A frame where the Weldment bar will be welded, ensure the plate where the bar will be welded is flat and free of bumps.
3. Weld the bar onto the unit so that both holes are vertical. (The straighter the bar is installed the better.)
4. Ensure the correct cable ends are at the control and sensor units. Carefully route the sensor cable so the blade can swivel without stretching the cable. Tie the cable with tie wraps(not included) so that the wire cannot be pinched.
5. Connect the sensor cable to the sensor box, and sensor installation is now complete.



Possible sensor mounting

UNIT CALIBRATION

1. With both cables routed the calibration of the machine can now begin. Using the supplied bolts attach the sensor to the weldment plate. Attach the cables to the boxes and power the unit up. Sliding the sensor box from side to side on the bar should scroll the lights from side to side.
2. The blade must be perfectly perpendicular(straight) to the machine. To do this string a tape measure from the left tip of the blade to a point at the front and perfectly centred on the machine, next take the same measurement from the right tip. Adjust the blade until both measurements are exactly the same.
3. Using a smart tool level or laser, level the blade of the machine. With the blade leveled the control box must have the dead band set to 0.1% and ensure the rotation of blade is either off or set to 0. Now adjust the sensor box to get the green LED's on both the top and bottom bank to be on with no other lights flashing.
4. Tighten the sensor box into place. Verify the blade is level and that both middle LED's are lit.

CALIBRATION IS NOW COMPLETE.



If you have any questions about operation or installation please give us a call.



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