

C4

LOAD WEIGHING DEVICE

VERSION 2.1

A nighttime photograph of a city skyline with numerous illuminated skyscrapers, including the CN Tower on the left. The image is in a dark blue color scheme.

 SMARTRISE

Document History

Date	Version	Summary of Changes
September 29,2021	2.1	Updated Start Timers menus Added Resetting Full Load and Overload Values section Changed the load added to the car for the full load and overload conditions to 15000 lbs or larger
June 21, 2021	2.0	Updated Adjustments Update Learning Load Values Replaced figures with new version LWD
July 1, 2020	1.3	Separated Calibration into various sections
April 29, 2020	1.2	Updated cover page and format Added Verification of Load Weigher and Monthly Calibration sections Added additional calibration steps
May 01, 2019	1.1	Initial Submittal

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Load Weigher

The load weighing device (LWD) monitors the weight of the car.

The LWD consists of two boards:

- Base board
- Extension board (top board) – The top board is not used in the C4 system



Figure 1: LWD

Base Board

The function of the Base board is as follows:

- The 24-bit A/D reads the loadcell
- Communicates with the C4 system

Sensors

The sensor performs the following:

- Crosshead Deflection – Load cells sense the load at the crosshead. This includes weight of the car, load inside the car, the traveling cable, and compensation cables.
- Rope Tension – Load cells sense the tension of the wire ropes.
- Load cell sensors are wired directly to the LWD.

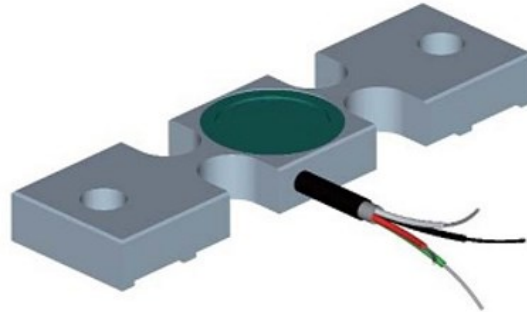


Figure 2: Sensor

Installation

Move the car to the lowest level prior to installing the load cells. After the car is at the lowest level, install the crosshead sensors according to manufacturer recommendations on top of the crosshead beam.

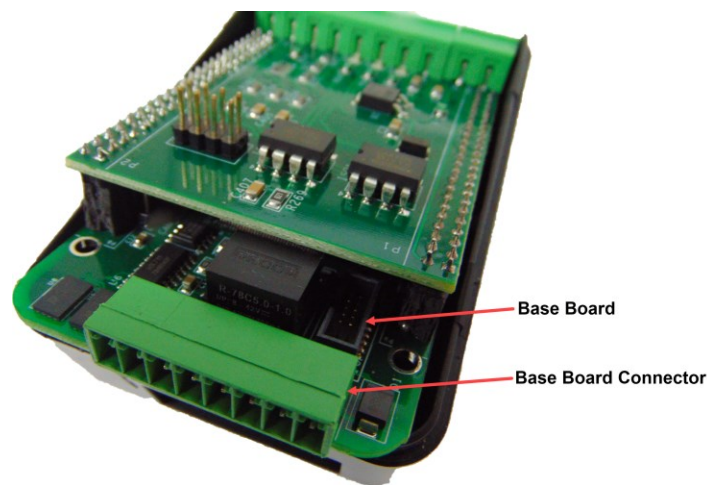


Figure 3: Base Board Connector

The table below lists the wiring configuration of the Sensor to the Base board of the LWD.

Table 1: Wiring Configuration of the Sensor to the Base Board of the LWD

Sensor	LWD Base Board Connector
Green	Pin 5
White	Pin 6
Black	Pin 7
Red	Pin 8

The table below lists wiring configuration of Power to the Base board of the LWD.

Table 2: Wiring Configuration of Power to the Base Board of the LWD

Power	LWD Base Board Connector
24V	Pin 1
REF	Pin 2

To connect the CAN network, connect the CANH and CANL as follows:

- If the LWD is in the machine room, connect the network to AN+ and AN-.
- If the LWD is located on the Cartop, connect the network to C3H and C3L.

Each sensor had to be tested individually to verify the sensors has been correctly installed. See Adjustments steps 1-12.

LEDs

The LEDs display the status of the LWD.



Figure 4: LED Location

The table below lists LED Indicators.

Table 3: LED Indicators

LED	Indicator	Normal Status
O1 (Green)	Power LED	On
O2 (Green)	Heartbeat	Blinks 1Hz
O3 (Red)	Fault	Off (On indicates a fault)
O4 (Orange)	N/A	Off
O5 (Green)	Serial Comm.	Blinks to reflect data traffic from the C4 controller

Calibration

The LWD must be calibrated after connecting the LWD and sensors.

LWD Communication

Depending on the location of the LWD, the device communicates to the controller serially to the MR board or CT board.

The following procedure describes how to set the Load Weighing Device communication.

1. Press the right button to access the Main Menu.
2. From the MAIN MENU, scroll and select Setup.



Figure 5: MAIN MENU – Setup

3. From the SETUP menu, scroll and select Load Weigher.



Figure 6: SETUP Menu – Load Weigher

4. From the LOAD WEIGHER SETUP menu, scroll and select Type Select.



Figure 7: LOAD WEIGHER SETUP Menu – Type Select

5. Is the LWD connected to the MR or CT board?

NOTE: Serial communication to the LWD will be disabled and system will look for discrete light/full/overload signals.



Figure 8: LOCATION SELECT Menu – DISCRETE

- a. If the LWD is connected to the MR board, go to step 6.
 - b. If the LWD is connected to the CT board, go to step 8.
6. From the LOCATION SELECT menu, scroll and select SERIAL MR.



Figure 9: LOCATION SELECT Menu – SERIAL MR

7. Scroll right and press Save. Process is complete.
8. From the LOCATION SELECT menu, scroll and select Serial CT.



Figure 10: LOCATION SELECT Menu – SERIAL CT

9. Scroll right and press Save.

Adjustments

The sensors must be verified for proper operation.

The following procedure describes how to verify sensor operation and adjust if needed.

NOTE: Weights must be available prior to performing calibration procedure.

1. Press the left button until the LOAD WEIGHER SETUP menu displays.

- From the LOAD WEIGHER SETUP menu, scroll and select Debug.



Figure 11: LOAD WEIGHER SETUP Menu – Debug

- From the DEBUG LWD menu, click the up button to select On.
NOTE: Verify this option is turned OFF when calibration is complete.



Figure 12: DEBUG LWD

- From the LOAD WEIGHER SETUP menu, scroll and select Enable WiFi.



Figure 13: LOAD WEIGHER SETUP Menu – Enable Wifi

- From the ENABLE WIFI menu, verify it is set to Off.



Figure 14: ENABLE WIFI Menu

- Connect just one of the crosshead sensors to the LWD.
- Press the left button until the LOAD WEIGHER SETUP menu displays.
- From the LOAD WEIGHING SETUP menu, scroll and select Enter Requests.

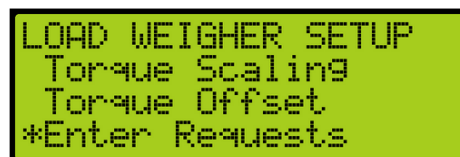


Figure 15: LOAD WEIGHER SETUP Menu – Enter Requests

9. From the Requests menu, scroll and select LOAD CELL. After a short delay, a large random value should appear on the screen. Record this value.

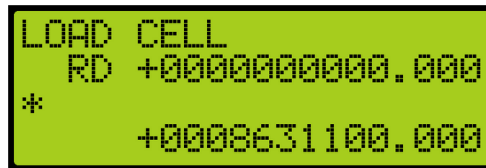


Figure 16: LOAD CELL Menu – Initial Value

10. Add weight to the car and record the new load cell value.

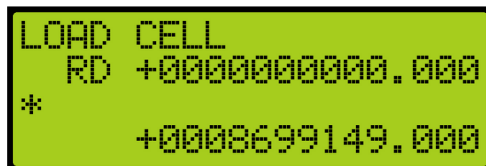


Figure 17: LOAD CELL Menu – With Weight Added

11. Have all sensors been tested?
 - a. If all sensors have been tested, go to step 13.
 - b. If all sensors have not been tested, go to step 12.
12. Verify both values do not read zero or 16,777,000, and the second number is greater than the first.
 - a. If both values do not read zero or 16,777,000, and the second number is greater than the first, remove the weight from the car and go to step 9 for the new sensors.
 - b. If both values read zero or 16,777,000, or the second number is not greater than the first, double check the sensor wiring.
 - If the value is unchanged this could indicate the crosshead beam is not level, or the sensor is over or under tightened. Go to step 9.
 - If the polarity of the signals is wrong, which can occur if the sensor is installed on the wrong side of the crosshead, the black and red wires of the sensor can be swapped at the LWD. Go to step 9.
13. After each sensor's installation has been verified, wire the sensors in parallel to the LWD. See Table 1.
14. Press the left button until LOAD WEIGHER SETUP menu displays.
15. From the LOAD WEIGHING SETUP menu, scroll and select Enter Requests. See Figure 15.

16. From the Requests menu, scroll and select MAX CAPACITY.

NOTE: Max Capacity is the weigh which should be loaded for the Load Learn operation. Set a well-known weight inside the car and adjust parameter with the weight added.

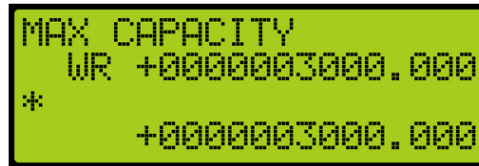


Figure 18: MAX CAPACITY Menu

From the Requests menu, the following can be adjusted:

- Pressing up and down with the cursor on the left most position changes which setting is selected.
 - NOTE:** The string on the first line will adjust accordingly.
- Press up and down with the cursor on the second position from the left to adjust the command:
 - RD = Read
 - WR = Write
 - GN = Generate
- Press up and down with the cursor on a position further to the right to adjust the value on the second line. This value is written to the LWD if the command is set to WR and the enter key is held.
- The value on the bottom line is the value read from the LWD.

17. Scroll right.

18. Scroll and select the WR command.

19. Scroll right.

20. Scroll and select the maximum capacity of the load.

21. Press Enter to write the information to the LWD.

22. Press the left button until the cursor is on the left most position.

23. Scroll and select CW PERCENT.



Figure 19: CW PERCENT Menu

24. Scroll right.

25. Scroll and select the WR command.

26. Scroll right.

27. Scroll and select the counterweight percentage of the maximum capacity of the load.

28. Press Enter to write the information to the LWD.

29. Press the left button until the cursor is on the left most position.
30. Scroll and select ROPE COUNT.

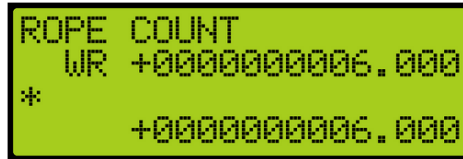


Figure 20: ROPE COUNT Menu

31. Scroll right.
32. Scroll and select the WR command.
33. Scroll right.
34. Scroll and select the rope count.
35. Press Enter to write the information to the LWD.
36. Press the left button until the cursor is on the left most position.
37. Scroll and select ROPE DIAMETER.



Figure 21: ROPE DIAMETER Menu

38. Scroll right.
39. Scroll and select the WR command.
40. Scroll right.
41. Scroll and select the diameter of the rope.
42. Press Enter to write the information to the LWD.
43. Press the left button until the cursor is on the left most position.
44. Scroll and select TORQUE OFFSET.



Figure 22: TORQUE OFFSET Menu

45. Scroll right.
46. Scroll and select the WR command.
47. Scroll right.
48. Scroll and set the torque value to zero.
49. Press Enter to write the information to the LWD.
50. Press the left button until the cursor is on the left most position.

51. Scroll and select FULL LOAD LB.

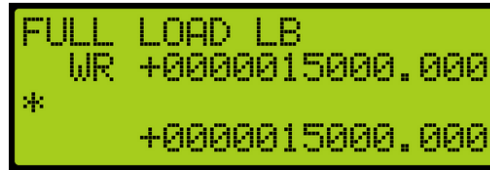


Figure 23: FULL LOAD LB Menu

52. Scroll right.

53. Scroll and select the WR command.

54. Scroll right.

55. Set the initial weight to 15000 pounds or larger. The correct settings for the full load value needs to be reset after calibration is complete. See Reset Full Load and Overload. Reset Full Load and Overload The Full Load flag is set when the weight reaches this level.

56. Press Enter to write the information to the LWD.

57. Press the left button until the cursor is on the left most position.

58. Scroll and select OVERLOAD LB.

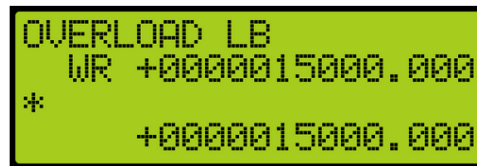


Figure 24: OVERLOAD LB Menu

59. Scroll right.

60. Scroll and select the WR command.

61. Scroll right.

62. Set the initial weight to 15000 pounds or larger. The correct settings for the overload value needs to be reset after calibration is complete. See Reset Full Load and Overload.

63. Press Enter to write the information to the LWD.

In certain instances, a light load may be required.

Perform the following to set the light load.

1. From the LOAD WEIGHING SETUP menu, scroll and select Enter Requests. See Figure 15.
2. From the Requests menu, scroll and select LIGHT LOAD LB. If the car weight is less than this value, the Light Load flag is set.



Figure 25: LIGHT LOAD LB Menu

Learning Load Values

The following procedure describes how to perform an empty car learn.

1. Press the left button until the LOAD WEIGHER SETUP menu displays.
2. From the LOAD WEIGHING SETUP menu, scroll and select Trigger Recalibrate.



Figure 26: LOAD WEIGHER SETUP Menu – Trigger Recalibrate

3. From the TRIGGER RECALIBRATE menu, scroll and select On.

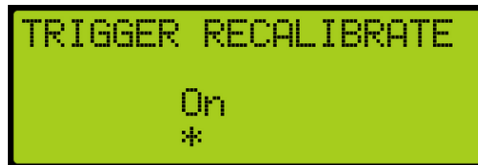


Figure 27: TRIGGER RECALIBRATE Menu – On

4. Scroll right and press Save.
5. The car is captured and moves from floor to floor to learn the empty load weight starting at the bottom floor. When the operation is complete, the On status will still be displayed but since the actual setting of this flag has changed back to Off, the Save notation will appear on the screen.



Figure 28: TRIGGER RECALIBRATE Menu – Learned

6. Scroll back and select Trigger Recalibrate. The TRIGGER RECALIBRATE status displays Off.

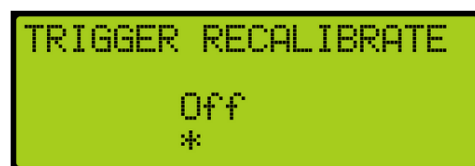


Figure 29: TRIGGER RECALIBRATE Menu – Off

The following procedure describes how to perform a full load learn.

1. Press the left button until the LOAD WEIGHER SETUP menu displays.

- From the LOAD WEIGHING SETUP menu, scroll and select Trigger Load Learn.



Figure 30: LOAD WEIGHER SETUP Menu – Trigger Load Learn

- From the TRIGGER LOAD LEARN menu, scroll and select On.



Figure 31: TRIGGER LOAD LEARN Menu – On

- Scroll right and press Save.
- The car is captured and moves from floor to floor to learn its full load weight starting at the bottom floor. When the operation is complete, the On status will still be displayed but since the actual setting of this flag has changed back to Off, the Save notation will appear on the screen.



Figure 32: TRIGGER RECALIBRATE Menu – Learned

- Scroll back and select Trigger Recalibrate. The TRIGGER LOAD LEARN status displays Off.



Figure 33: TRIGGER LOAD LEARN Menu – Off

Reset Full Load and Overload

The following procedure describes how to reset full load and overload back to the original values.

- Navigate to MAIN MENU | SETUP | LOAD WEIGHER SETUP | ENTER REQUESTS. See Figure 15.
- From the Requests menu, scroll and select FULL LOAD LB. See Figure 23.
- Scroll right.

4. Scroll and select the WR command.
5. Set full load back to the correct value.
6. Press Enter to write the information to the LWD.
7. Press the left button until the cursor is on the left most position.
8. Scroll and select OVERLOAD LB. See Figure 24.
9. Scroll right.
10. Scroll and select the WR command.
11. Set overload back to the correct value.
12. Press Enter to write the information to the LWD.

Status of the LWD

The following procedure describes how to verify the weight of the car after adjusting the sensors.

1. Press the right button to access the Main Menu.
2. From the MAIN MENU, scroll and select Status.



Figure 34: MAIN MENU – Status

3. From the STATUS menu, scroll and select Load Weigher Status.



Figure 35: STATUS Menu – Load Weigher Status

4. The accurate weight is shown on the LOAD WEIGHER menu.
NOTE: Scroll down to view all the LOAD WEIGHER menu lines.



Figure 36: LOAD WEIGHER Menu – 100% Part 1 of 2

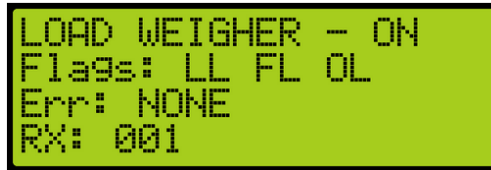


Figure 37: LOAD WEIGHER Menu Part 2 of 2

5. Remove load from the car and position it at the top landing.

Torque Scaling

Load information is used to provide pre-torquing of the motor to accommodate for load changes and prevent rollback.

The following procedure describe how to set torque scaling.

1. Press the left button until the Main Menu displays.
2. From the MAIN MENU, scroll and select Setup. See Figure 5.
3. From the SETUP menu, scroll and select Load Weigher. See Figure 6.
4. From the LOAD WEIGHER MENU SETUP menu, scroll and select Enter Requests. See Figure 15.
5. From the Request menu, scroll and select TORQUE SCALING.

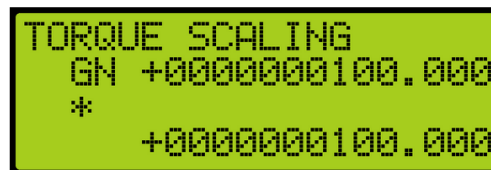


Figure 38: Request Menu – TORQUE SCALING

6. Scroll right.
7. Scroll and select command GN.
8. Press Enter to generate torque scaling.
9. Press the left button until Main Menu is displayed displays.
10. From the MAIN MENU, scroll and select Debug.



Figure 39: MAIN Menu – Debug

11. From the DEBUG menu, scroll and select Load Weigher. See Figure 35.
12. Verify the Torque is 100%. See Figure 36.
13. Position the car just below the top landing and enable torque.
14. Press the left button until the Main Menu displays.
15. From the MAIN MENU, scroll and select Setup. See Figure 5.

16. From the SETUP menu, scroll and select Load Weigher. See Figure 6.
17. From the LOAD WEIGHING SETUP menu, scroll and select Torque Scaling.



Figure 40: LOAD WEIGHER SETUP Menu – Torque Scaling

18. From the TORQUE SCALING menu, scroll and select the scale is set to 100%.
NOTE: If the torque is in the wrong direction, set this to negative value.



Figure 41: TORQUE SCALING Menu

19. Scroll right and press Save.
20. Turn on pretorque on the drive.
 - DSD – Function 114 Pre-Torque Enable to 1 (on)
 - KEB – Set LC01 control mode to Closed Loop Digital Pretorque(4)
 - M1000 – Set Trq Comp Cmd Src in the C1 menu to Serial HPV
 - Set one of the analog inputs to Torque Comp in C5 menu

Tuning

The start sequence must be adjusted to maximize reliance on pretorque and prevent the car from driving off the brake. This will be done by running the car on zero speed and adjusting for roll back.

The following procedure describes how to set the start sequence.

1. Set the C4 controller to Inspection operation by toggling the NORMAL/INSPECTION switch on the MR board to INPSECTION.
2. Press the left button until the SETUP menu displays, See Figure 3.
3. Set the inspection speed in the Speeds menu to 0 fpm. See the *C4 User Manual Inspection Run Options and Adjustments*.
4. From the SETUP menu, scroll and select Run Timers.



Figure 42: SETUP Menu – Run Timers

- From the TIMERS menu, scroll and select Start Timers.



Figure 43: TIMERS Menu – Start Timers

- From the START TIMERS menu, scroll and select Accel Delay (Auto).



Figure 44: START TIMERS Menu – Accel Delay (Auto)

- From the ACCEL DELAY (AUTO) menu, scroll and select the acceleration delay to 0.0 msec.



Figure 45: ACCEL DELAY (AUTO) Menu

- Scroll right and press Save.
- Press the left button until the START TIMERS menu displays.
- From the START TIMERS menu, scroll and select Accel Delay (Insp).



Figure 46: START TIMERS Menu – Accel Delay (Insp)

- From the ACCEL DELAY (INSP) menu, scroll and select the acceleration delay to 0.0 msec.



Figure 47: ACCEL DELAY (INSP) Menu

- Scroll right and press Save.
- Press the left button until the START TIMERS menu displays.

14. From the START TIMERS menu, scroll and select Brake Pick (Auto).



Figure 48: START TIMERS Menu – Brake Pick (Auto)

15. From the BRAKE PICK DELAY (AUTO) menu, scroll and select the brake pick speed to 0.0 msec.



Figure 49: BRAKE PICK DELAY (AUTO) Menu

16. Scroll right and press Save.

17. Press the left button until the START TIMERS menu displays.

18. From the START TIMERS menu, scroll and select Brake Pick (Insp).

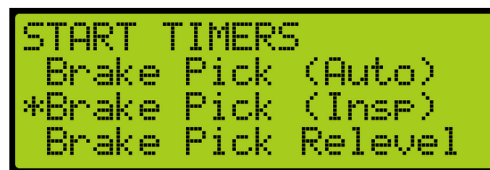


Figure 50: START TIMERS Menu – Brake Pick (Insp)

19. From the BRAKE PICK DELAY (INSP) menu, scroll and select the brake pick speed to 0.0 msec.



Figure 51: BRAKE PICK DELAY (INSP) Menu

20. Scroll right and press Save.

21. Press the left button until the SETUP menu displays.

22. From the SETUP menu, scroll and select Brake Setup.



Figure 52: SETUP Menu – Brake Setup

23. From the BRAKE SETUP menu, scroll and select Primary Setup.



Figure 53: BRAKE SETUP Menu – Primary Setup

24. From the BRAKE SETUP menu, select Ramp Time – Auto.



Figure 54: BRAKE SETUP Menu – Ramp Time – Auto

25. From the BRAKE RAMP TIME (AUTO) menu, set the ramp time speed to 100 msec.



Figure 55: BRAKE RAMP TIME (AUTO) Menu

26. Scroll right and press Save.

27. Press the left button until the BRAKE SETUP menu displays.

28. From the BRAKE SETUP menu, scroll and select Ramp Time – Insp.



Figure 56: BRAKE SETUP Menu – Ramp Time – Insp

29. From the BRAKE RAMP TIME (INSP) menu, set the ramp time speed to 100 msec.



Figure 57: BRAKE RAMP TIME (INSP) Menu

30. Scroll right and press Save.

31. Press the left button until the BRAKE SETUP menu displays.

32. From the BRAKE SETUP menu, scroll and select Secondary Setup.



Figure 58: BRAKE SETUP Menu – Secondary Setup

33. From the SECONDARY BRAKE SETUP menu, scroll and select Ramp Time.

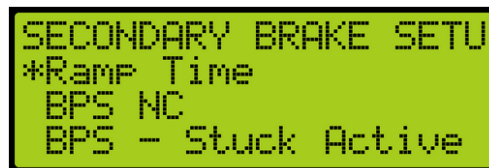


Figure 59: SECONDARY BRAKE SETUP Menu – Ramp Time

34. From the BRAKE RAMP TIME menu, set the ramp time speed to 100 msec.



Figure 60: BRAKE RAMP TIME Menu

35. Scroll right and press Save.

Verifying Calibration

The following procedure describes how to verify the LWD calibration.

1. Place the car at or near the top landing with empty load in the car.

2. Perform test inspection runs in the down direction at the top of the hoistway while adjusting the torque scaling value until the torque is just high enough to eliminate rollback.
NOTE: The pretorque scaling ranges from +127 to -128. See Torque Scaling.
If the user continues to increase the number past +127, the number goes to -128.
3. Place the car at the bottom landing with a full load in the car.
4. Perform zero speed and releveling test runs while adjusting the CW percent until the torque is just enough to prevent rollback. Decreasing the CW percent value will increase downward pretorque while increasing the CW percent value lowers the downward pretorque.
5. Perform the same zero speed and releveling test runs at various floors to verify ride quality.
6. Calibration is complete.

Turn Off Debug on LWD

The following procedure describes how to turn off Debug.

1. Press the right button to access the Main Menu.
2. From the MAIN MENU, scroll and select Setup. See Figure 5.
3. From the SETUP menu, scroll and select Load Weigher. See Figure 6.
4. From the LOAD WEIGHER SETUP menu, scroll and select Debug. See Figure 11.
5. From the DEBUG LWD menu, click the up button to select Off.



Figure 61: DEBUG LWD Menu - Off

6. Scroll right and press Save.

Status of Load Weigher

To verify the final calibration status, see Status of the LWD.

Each line of the LWD menu (see Figure 36 and Figure 37:) displays the current properties of the LWD.

The table below lists the Load Weigher menu definitions and solutions.

Table 4: Load Weigher Menu Definitions and Solutions

Line Number	Definition	Solution
1	Displays ON if the LWD is online. If not, then the display shows OFF.	If this line shows OFF, check the wiring of the LWD communication lines. Verify the location. See LWD Communication steps 5-8.
2	Displays the torque output of the LWD after applying the scaling and offset values settings. See Adjustments steps 43-46 and Torque Scaling steps 5-8. This is the value sent to the drive. The value seen is in parenthesis () is the raw unscaled torque value from the LWD.	Value is only visible if DEBUG LWD is set to ON.
3	Displays the current in car weight.	The car weight updates only when in DZ unless DEBUG is set to ON.
4	Displays the statuses from left to right: <ul style="list-style-type: none"> • LL – Light Load • FL – Full Load • OL – Overload 	N/A
5	Displays the error state of the load weigher.	<p>POR – The LWD has experienced loss of power.</p> <p>WDT – The LWD has experienced a stall which has triggered a board reset.</p> <p>BOR – The LWD has experienced a power dip which has triggered a board reset.</p> <p>COM SYS – The LWD has not seen communication from the C4 system. Check communication bus communication and termination.</p> <p>COM LOAD – The LWD internal communication is failing. Contact support.</p> <p>BUS RST – The LWD communication bus is experiencing errors and has reset. Check communication line wiring and terminations.</p> <p>WD DIS – The LWD watchdog jumper is missing. Restore the jumper and cycle power to the board.</p>
6	Displays a counter of the packets received from the LWD. This counter is only active when DEBUG is set to ON.	If this counter is still not incrementing, the communication line wiring and termination should be checked.

Monthly Recalibration

The C4 system can automatically be set for monthly calibration. This causes the empty load to automatically be relearned once a month on a specified day and time. The calibration is performed on the first occurrence of the configured day once a month.

The following procedure describes how to set automatic recalibration.

1. Press the right button to access the Main Menu.
2. From the MAIN MENU, scroll and select Setup. See Figure 5.
3. From the SETUP menu, scroll and select Load Weigher. See Figure 6.
4. From the LOAD WEIGHER SETUP menu, scroll and select Auto Recalibrate.

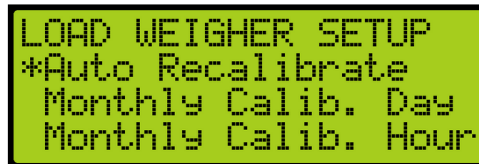


Figure 62: LOAD WEIGHER SETUP Menu – Auto Recalibrate

5. From the AUTO RECALIBRATE menu, press the up button and select On.



Figure 63: AUTO RECALIBRATE Menu – On

6. Scroll right and press Save.
7. Press the left button to display the LOAD WEIGHER SETUP menu.
8. From the LOAD WEIGHER SETUP menu, scroll and select Monthly Calibration Day.

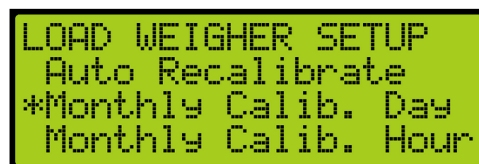


Figure 64: LOAD WEIGHER SETUP Menu – Monthly Calib. Day

9. From the MONTHLY CALIBRATION DAY menu, scroll and select the day of the week the calibration occurs.



Figure 65: MONTHLY CALIB. DAY Menu

10. Scroll right and press Save.
11. Press the left button to display the LOAD WEIGHER SETUP menu.
12. From the LOAD WEIGHER SETUP menu, scroll and select Monthly Calibration Hour.

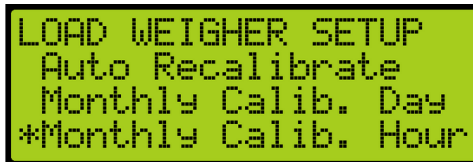


Figure 66: LOAD WEIGHER SETUP Menu – Monthly Calib. Hour

13. From the MONTHLY CALIB. HOUR menu, scroll and select the hour of the day the calibration occurs.



Figure 67: MONTHLY CALIB. HOUR Menu

14. Scroll right and press Save.

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