

SEELEVEL ACCESSTM

Data Portal & Remote Display with 4-20 mA Output and Serial Interface



MODEL T-DP0301-B RS-485 Version

IMPORTANT OPERATOR INFORMATION

DATE INSTALLED: _____

UNIT NUMBER: _____

COMPARTMENT: _____

DISPLAY CALIBRATION UNITS (e.g. inches, gallons): _____

MINIMUM TANK READOUT: _____

MAXIMUM TANK READOUT: _____

FULL SCALE ANALOG CALIBRATION VALUE: _____

SERIAL NUMBER : _____

NOTES: _____

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SEELVEL ACCESS™

Data Portal & Remote Display
with 4-20 mA Output and Serial Interface

MODEL T-DP0301-B
RS-485 Version

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T-DP0301-B_v5.0 - 13-Mar-2020

CHAPTER 1 - INTRODUCTION

Congratulations on purchasing the Garnet Instruments **SEELLEVEL Access™ Data Portal**. The **SEELLEVEL Access™** compliments the **SEELLEVEL ANNIHILATOR™** 806-B, 806-Bi, or **SEELLEVEL SPECIAL™** 808-P2 and **SEELLEVEL PROSERIES II** 810-PS2 gauges by providing an additional volume readout in the cab of your truck.

In addition to providing readout of the tank level, the **SEELLEVEL Access™** provides a 4-20 mA analog output proportional to the fluid volume displayed. This analog output can be used to communicate the tank level to other pieces of equipment such as fleet management systems or Electronic Logging Devices (ELD).

The full scale value of the analog output can be set using the buttons on the back of the display, no additional equipment is required for calibration.

The **SEELLEVEL Access™** also contains a serial RS-485 interface which allows fleet management or ELD systems to gather fluid volume data from the gauge. The interface is full duplex and contains security features to prevent unauthorized access.

The **SEELLEVEL Access™** display has been designed to withstand the vibration and shock encountered in mobile applications. While the 808-P2 and 810-PS2 operate on internal batteries, (12 volt truck power is used to operate the back light and external alarms), the **SEELLEVEL Access** display operates on 12V truck power.

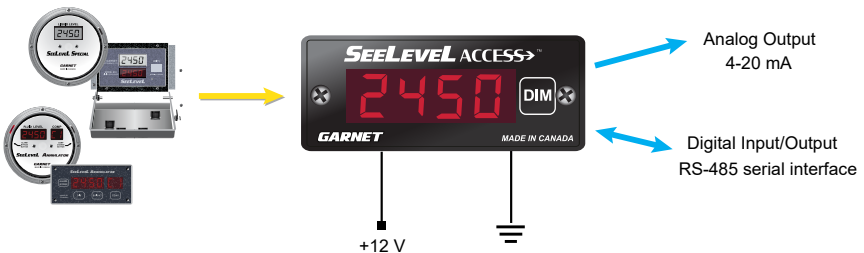
SEELLEVEL ACCESS™

Data Portal & Remote Display

with 4-20 mA Output and RS-485 Serial Interface

Signal from

806-B / 806-Bi / 808-P2 / 810-PS2



The SEELEVEL Access™ has been uniquely designed for specific applications and with specific features:

Standard SEELEVEL Access Features

1. The signal between the 806-B, 806-Bi, 808-P2 or 810-PS2 display and the SEELEVEL Access™ is digitally encoded so the signal line can be connected using a standard 7 pin trailer plug.
2. The display operates on 12 volt truck power, and draws less than 200 mA.
3. All-digital design eliminates reading drift or degradation, ensuring long term accuracy under all operating conditions.
4. Operation from -40 °C to +60 °C (-40 °F to +140 °F) ambient temperature.
5. Easy installation and servicing with a one year limited warranty.

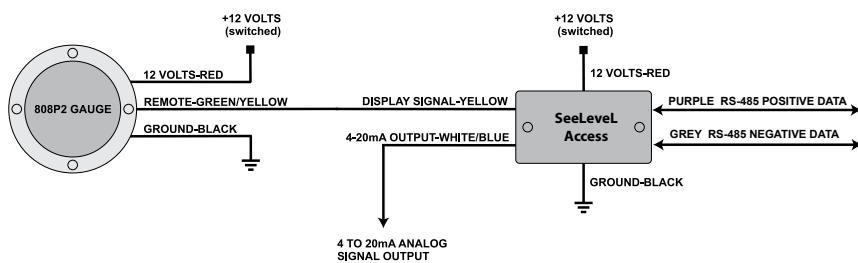
Additional SEELEVEL Access T-DP0301-B Features

6. An analog 4-20 mA output, with 4 mA corresponding to zero displayed volume, and 20 mA corresponding to the full scale displayed volume programmed into the remote display.
7. An RS-485 serial interface available to connect to a variety of ELD or fleet management systems.
8. The model SEELEVEL Access™ provides an easy-to-read LED display inside a compact, edge-view enclosure, optimized for top-of-dash or overhead console mounting. The display is housed in an aluminum enclosure 2.7" wide x 1.1" high x 3.4" deep (68 mm wide x 29 mm high x 87 mm. deep).
9. A dimmer button switch enables the operator to control brightness.
10. Simple 6 wire electrical installation - 12V power (red), ground (black), gauge signal (yellow), analog output (white/blue), RS-485 positive data (purple) and RS-485 negative data (grey).

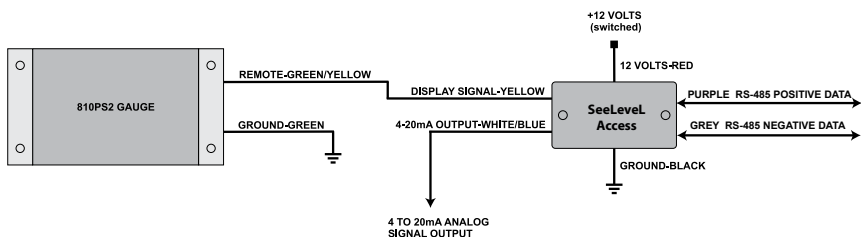
THE SEELEVEL Access™ has been designed for easy installation with your 806-B, 806-Bi, 808-P2 or 810-PS2 series SEELEVEL™ gauge. Installation instructions for the gauge were supplied with the equipment, and are available online at www.garnetinstruments.com.

The SEELEVEL Access™ Remote Display is easy to install:

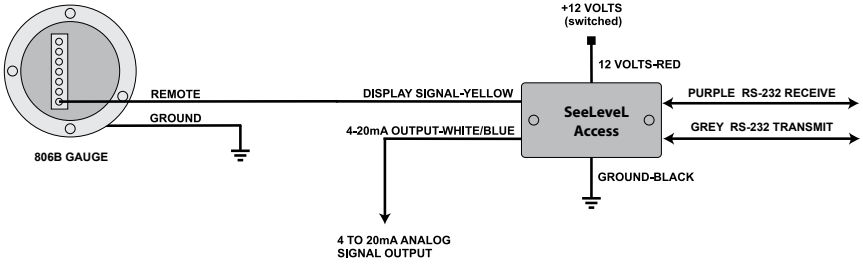
808-P2 Wiring Diagram



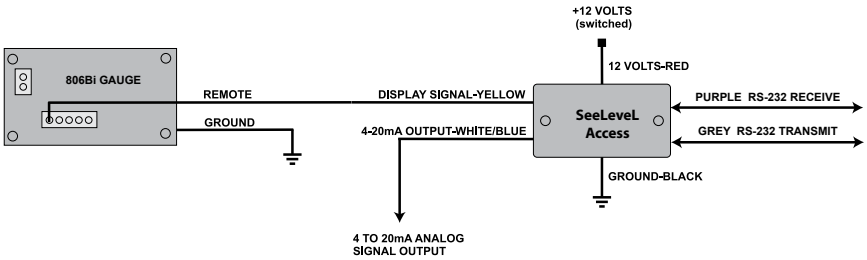
810-PS2 Wiring Diagram



806-B Wiring Diagram



806-Bi Wiring Diagram



The SEELEVEL Access™ display shows the tank level by repeating the information shown on the 806-B, 806-Bi, 808-P2 or 810-PS2 gauge. The 4-20 mA analog output is calculated from the display level with a 4 mA output corresponding to a display level of zero, and a 20 mA output corresponding to the full scale level programmed into the SEELEVEL Access™ display.

For example, if the full scale is programmed to be 500.0, then a display value of 400.0 will result in an analog output of 16.80 mA. The display will recognize the decimal location and adjust the output accordingly, so in this example a display value of 400 will also result in an analog output of 16.80 mA.

To set the full scale level:

1. Determine the maximum volume that can be displayed and pick a full scale amount that is equal to or greater than this volume.
2. Press both the **NEXT MENU** and **UP/ENTER** buttons on the back panel, the display will show $\overline{R} \overline{L} \overline{R} \overline{L}$. Release both buttons.
3. The display will show the existing calibration with the left digit bright. Press the **UP/ENTER** button to change the bright digit. Press the **NEXT MENU** button to go to the next digit.
4. Set all 4 digits, then press **NEXT MENU** again to set the decimal point, it will be bright to indicate that it is selected. Press the **UP/ENTER** button to select either x.xxx, xx.xx, xxx.x or no decimal. For best accuracy of the analog output, try to use all 4 digits such as 500.0 instead of just 500.
5. After the decimal as been set, press **NEXT MENU** again, the display will show $\overline{5} \overline{0} \overline{0} \overline{.}$. Press **UP/ENTER** to store the calibration and exit the setting menu. The display will continue to show $\overline{5} \overline{0} \overline{0} \overline{.}$ for a moment and then will show $\overline{d} \overline{0} \overline{0} \overline{.}$ for a second. Then normal operation resumes.
6. If you do not want to store the calibration, press **NEXT MENU** again and the display will show $\overline{R} \overline{b} \overline{r} \overline{t}$. Press **UP/ENTER** to abort which exits the calibration menu without saving.
7. If you press **NEXT MENU** again from the $\overline{R} \overline{b} \overline{r} \overline{t}$ display, the menu will return to the beginning with the left digit selected by being bright.

8. If the full scale calibration is below 103, the display will be unable to calculate a valid calibration, and will show **ERR** (calibration error) after a few seconds. The existing calibration will be retained, and the display will return to normal operation.

To view the existing calibration:

1. Press either the **NEXT MENU** or **UP/ENTER** button (but not both) on the back panel, the display will show the existing full scale analog calibration while the button is held down. Release the button to return to normal operation.

To test the analog output:

1. While either the **NEXT MENU** or **UP/ENTER** button on the back panel is pressed, the display will show the full scale calibration and the analog output will go to full scale (20 mA). This can be used to test or calibrate the equipment connected to the analog output.
2. While the display is in the calibration mode (entered by pressing both the **NEXT MENU** and **UP/ENTER** buttons) the analog output will be at 4mA.

SEELLEVEL ELD Link Format and Signal Format-RS-485

- This documents the supported data exchange format between the SEELLEVEL Access™ In Cab Display and a vehicle's ELD / Fleet Management unit.
- Version 1.2, January 3, 2019. Initial Release, plus two revision.
- The supported signal format is half duplex serial, RS485 voltage levels, 9600 baud, 8 bit, no parity, 1 stop bit.
- SEELLEVEL hardware will act as a slave with an address of 0x19.
- SEELLEVEL hardware will have a 120 ohm termination resistor installed but not bus bias resistors.
- All messages (ELD MASTER -> SEELLEVEL Slave) obey the following format: [Destination: SEELLEVEL address = 0x19] [Originator: Master address = 0x00] [total number of bytes in message] [message ID] [payload - optional depending on message] [Checksum (16 bit: 2 bytes)]
- All messages (SEELLEVEL Slave -> ELD MASTER) obey the following format: [Destination: Master address = 0x00] [Originator: Garnet address = 0x19] [total number of bytes in message] [message ID] [payload - optional depending on message] [Checksum (16 bit: 2 bytes)]
- All multi-byte parameters are transferred big-endian (MSB first)
- Total number of bytes in message (1 byte)
- Message ID (1 byte)
- Payload (optional depending on the message)
- Checksum (2 bytes) = direct sum of all preceding bytes, truncated to 2 bytes
- Allow for a 50ms timeout for replies (SEELLEVEL Slave -> ELD Master)
- The master must respond to handshake requests within 500ms.
- There must be a minimum of 5ms dead-band (bus inactivity) between messages on the bus. Any data between these dead-bands will be considered as one message and will be parsed as such.

SEELLEVEL Query Message (ELD Master-> SEELLEVEL Slave)

- Value: 0x00
- Allows the ELD to query the SEELLEVEL device
- [0x19][0x00][0x06][0x00][0x00][0x1F]

SEELLEVEL Query Response (SEELLEVEL Slave -> ELD Master)

- Value: 0x01
- SEELLEVEL responds with model ID (1 byte), H/W Rev (1 byte), S/W Rev (2 bytes), alarm capability (1 byte), and SN support (1 byte). If the SEELLEVEL device supports a unique serial number, it will follow (8 bytes in length).
- Example: SEELLEVEL model ID = 0x01, hardware rev = 'E' (0x45), software major rev = 0x05, minor rev = 0x14, no alarm capability = 0x00 (0x01 = alarm capable), serial number supported = 0x01 (serial number not supported = 0x00), and a serial number = 0x0102030405060708:
- [0x00][0x19][0x14][0x01][0x02][0x45][0x05][0x14][0x00][0x01][0x01][0x02][0x03][0x04][0x05][0x06][0x07][0x08][0x00][0xB3]

SEELLEVEL Handshake Demand Message (SEELLEVEL Slave -> ELD Master)

- Value: 0x02, 1 byte payload
- ELD must respond with the proper coded response in order to either begin or continue the transfer or broadcast of liquid levels from the SEELLEVEL device. Handshake demands will be broadcast at random times.
- Example:
- [0x00][0x19][0x07][0x02][0x3E][0x00][0x60]

ELD Handshake Response (ELD Master -> SEELLEVEL Slave)

- Value: 0x03, 1 byte payload
- To calculate the response, the payload from the SEELLEVEL Handshake Demand Message is used as an address/offset to fetch the contents of the lookup table.
- Response to example above:
- [0x19][0x00][0x07][0x03][0x85][0x00][0xA8]

Handshake Accepted Acknowledge Message (SEELLEVEL Slave -> ELD Master)

- Value: 0x04, no payload
- This message exists to preserve the Master/Slave communication arrangement.
- No response at all implies that the handshake was wrong.
- This is not used during the normal commands here, it is just in place for future applications.
- [0x00][0x19][0x06][0x04][0x00][0x23]

Send Liquid Level Message (ELD Master -> SEELLEVEL Slave)

- Value: 0x05, no payload
- SEELLEVEL responds with a single liquid level or a handshake demand message.
- [0x19][0x00][0x06][0x05][0x00][0x24]

SEELLEVEL Query Alarm Liquid Level Message (ELD Master -> SEELLEVEL Slave)

- Value: 0x07, no payload
- SEELLEVEL will either respond with a liquid alarm level response or an error response if the alarm function is not supported
- [0x19][0x00][0x06][0x07][0x00][0x26]

SEELLEVEL Liquid Alarm Level Response (SEELLEVEL Slave -> ELD Master)

- Value: 0x08, 7 byte payload
- SEELLEVEL responds with liquid alarm level (4 bytes = unsigned int32), number of digits to the right of the decimal (1 byte), alarm type (1 byte; high = 0x01, low = 0x00), and whether liquid level is currently in alarm (1 byte; alarm active = 0x01, no alarm = 0x00).
- Example: liquid alarm level = 347.56, alarm type = low level, alarm active:
- [0x00][0x19][0x0D][0x08][0x00][0x00][0x87][0xC4][0x02][0x00][0x01][0x01][0x7C]

SEELLEVEL Query Alarm Status Message (ELD Master -> SEELLEVEL Slave)

- Value: 0x09, no payload
- SEELLEVEL will either respond with current alarm status or an error response if the alarm function is not supported
- [0x19][0x00][0x06][0x09][0x00][0x28]

SEELLEVEL Query Alarm Status Response (SEELLEVEL Slave -> ELD Master)

- Value: 0x0A, 1 byte payload
- SEELLEVEL responds with current alarm status (1 byte; alarm active = 0x01, not active = 0x00)
- Example: alarm active:
- [0x00][0x19][0x07][0x0A][0x01][0x00][0x2B]

SEELLEVEL Error Response (SEELLEVEL Slave -> ELD Master)

- Value: 0x0F, 1 byte payload
- SEELLEVEL issues this response if a command/message is not supported. Payload = unsupported message code.
- Example: ELD has previously issued a SEELLEVEL Query Alarm Liquid Level Message (0x07) to a SEELLEVEL device which does not support alarms:
- [0x00][0x19][0x07][0x0F][0x07][0x00][0x36]

SEELLEVEL Liquid Level Report Message (SEELLEVEL Slave -> ELD Master)

- Value: 0x10, 6 or 7 byte payload, depending on whether alarms are supported
- SEELLEVEL Slave transmits liquid level (4 bytes = unsigned int32), number of digits to the right of the decimal (1 byte), optical error status (1 byte), and alarm status (currently active = 0x01, not in alarm state = 0x00). The alarm status field is optional and is not transmitted by a SEELLEVEL device which does not support alarms. Optical error status: no light = 0x00, low light level = 0x01, sunlight = 0x02, no error = 0x10. In the event that the optical error status is in an error condition, the liquid level and the number of digits to the right of the decimal is ignored.
- For the liquid level, the first 4 bytes of the payload represent the hex value of the level, not the BCD value.
- Example: liquid level = 1,083.1, no optical error, alarms not supported.
- [0x00][0x19][0x0C][0x10][0x00][0x00][0x2A][0x4F][0x01][0x10][0x00][0xBF]

NOTES

- ELD request needing handshake confirmation:
- Send liquid level.
- The handshake request is done every 25th time one of these requests is received. The handshake must be responded to within 500ms, or else the response is considered invalid. If no handshake is received, is late, or is incorrect, then no response is sent. This helps prevent "brute force" codebreaking attempts.

Handshake format:

- Request from ELD is received by SEELLEVEL
- SEELLEVEL responds with handshake request if more than 25 requests have occurred since the last handshake. Otherwise, SEELLEVEL sends reply to ELD request.

- ELD sends handshake response
- SEELEVEL sends reply to original ELD request if handshake response is correct and on time.
- The “handshake accepted acknowledge” message is not used here.
- Upon power-up of the display, the “20 requests” is reset so a handshake is needed for the first liquid level request.

The alarms are not currently supported. In the future, if they are:

- The content of Message \$08 is alarm set point, high or low level alarm, and current alarm status.
- The content of Message \$0A is just a short form of Message \$08, alarm status only.

The SEELEVEL will respond to source addresses of 0x00 (ELD) only.

The SEELEVEL will not respond at all to any message that has errors, has an invalid message, is not addressed to SEELEVEL, does not come from 0x00 (ELD), and does not follow the handshake protocol. This avoids unnecessary bus activity and possible contention, and makes it harder to break the code with repeated attempts using different values.

Query of Handshake Frequency (ELD Master-> SEELEVEL Slave)

- Value: 0x2D, no payload
- This asks for the handshake frequency, response is shown below.
- Message format:
- [0x19][0x00][0x06][0x2D][0x56][0x56]

Handshake Frequency Response (SEELEVEL Slave->ELD Master)

- Value: 0x2E, 1 byte payload
- The handshake frequency number occupies 1 byte in EEPROM in the SEELEVEL gauge. The frequency can range from 1 to 255 broadcasts per handshake request. The number is stored in hex from 0x01 to 0xFF.
- Message format, frequency is 25 (0x19):
- [0x00][0x19][0x07][0x2E][0x19][0x6C][0x56]

Error Code	Cause	Solution
no 5	The display is not receiving any signal from the 806-B, 806-Bi, 808-P2 or 810-PS2 gauge. The analog output will go to 0 mA. This differentiates the error condition from the zero display condition of 4 mA.	Check the wiring and grounding for errors or bad connections. Also ensure that the 806-B, 806-Bi, 808-P2 or the 810-PS2 is working properly.
Errr	The display is receiving corrupted data and the analog output will go to 0 mA.	
EErrr	The display cannot communicate with its own memory,	
SErrr	The display cannot communicate with its own digital to analog convertor.	The display will need to be serviced or replaced.

Accuracy:

The analog output has an accuracy of $\pm 0.25\%$ of the full scale value, so any output value should be within 0.05 mA of the “ideal” value. There are no user adjustments that can be made to alter the accuracy.

As with any digital system, there are round off and truncation errors inherent in the mathematical process. However, since the SEELEVEL Access™ utilizes a 10 bit digital to analog convertor, it has sufficient accuracy to allow the full resolution of the truck gauge to be realized. Note that the truck gauge sending the data has a resolution of only 8 bits ($1/3$ ” systems).

CHAPTER 7 - SPECIFICATIONS

Analog output accuracy:	"0.25% of full scale value ± 0.05 mA"
Minimum input supply voltage:	+10.0 V
Minimum difference between input supply voltage and voltage on analog 4-20 mA output:	4.0 V
Current drain:	200 mA or less
Temperature range:	-40°C to +60°C (-40°F to +140°F)
Enclosure:	<i>Material:</i> Aluminum <i>Size:</i> 68 mm wide x 29 mm high x 87 mm deep (2.7" wide x 1.1" high x 3.4" deep)
Display type:	LED 4-digit, 7 segment 10 mm (0.4") high digits
Display power:	Operates on 12 V truck power
Wiring:	6 wire electrical installation: 12 V power (red), ground (black), gauge signal (yellow), analog output (white/blue), RS-485 serial positive data (purple), and RS-485 negative data (grey)
RS-485 output voltage level:	+/- 2.0 V minimum
RS-485 serial format:	9600 baud Standard mark/space NRZ format Mode is 8 bits Non-inverted tx No parity No break character One start bit One stop bit

CHAPTER 8 - SERVICE & WARRANTY INFORMATION

The warranty will only apply if the warranty has been registered online from the Garnet Instruments registration web page.

Go online to seelevelsupport.com/ and select "Register Warranty".

DISCLAIMER OF WARRANTY ON HARDWARE

Garnet Instruments warrants equipment manufactured by Garnet to be free from defects in material and workmanship under normal use and service for a period of one year from the date of sale from Garnet or an Authorized Dealer. The warranty period will start from the date of purchase or installation as indicated on the warranty card. Under these warranties, Garnet shall be responsible only for actual loss or damage suffered and then only to the extent of Garnet's invoiced price of the product. Garnet shall not be liable in any case for labor charges for indirect, special, or consequential damages. Garnet shall not be liable in any case for the removal and/or reinstallation of defective Garnet equipment. These warranties shall not apply to any defects or other damages to any Garnet equipment that has been altered or tampered with by anyone other than Garnet factory representatives. In all cases, Garnet will warrant only Garnet products which are being used for applications acceptable to Garnet and within the technical specifications of the particular product. In addition, Garnet will warrant only those products which have been installed and maintained according to Garnet factory specifications.

LIMITATION ON WARRANTIES

These warranties are the only warranties, expressed or implied, upon which products are sold by Garnet and Garnet makes no warranty of merchantability or fitness for any particular purpose in respect to the products sold. Garnet products or parts thereof assumed to be defective by the purchaser within the stipulated warranty period should be returned to the seller, local distributor, or directly to Garnet for evaluation and service. Whenever direct factory evaluation, service or replacement is necessary, the customer must first, by either letter or phone, obtain a Returned Material Authorization (RMA) from Garnet Instruments directly. No material may be returned to Garnet without an RMA number assigned to it or without proper factory authorization. Any returns must be returned freight prepaid to: Garnet Instruments, 286 Kaska Road, Sherwood Park, Alberta, T8A 4G7. Returned warranted items will be repaired or replaced at the discretion of Garnet Instruments. Any Garnet items under the Garnet Warranty Policy that are deemed irreparable by Garnet Instruments will be replaced at no charge or a credit will be issued for that item subject to the customer's request.

If you do have a warranty claim or if the equipment needs to be serviced, contact the installation dealer. If you do need to contact Garnet, we can be reached as follows:

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