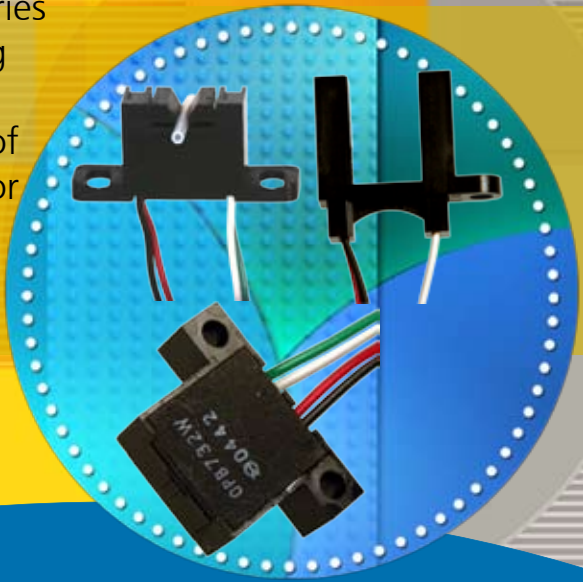
OCB100-KIT

The OCB100 Series Auto-Calibrating Boards take the guesswork out of tuning the sensor for your unique applications.



Auto-Calibration Design Kit

TT electronics
OPTEK Technology

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KIT DESCRIPTION

The OCB100-KIT design kit provides engineers an opportunity to become familiar with the capabilities of a variety of basic optoelectronic sensor types: transmissive, reflective, and fluid. The kit includes an automatic calibration circuit card that interfaces with each sensor to make evaluation of the sensor much easier. In addition, the calibration PCB can be interfaced to almost any optoelectronic sensor via the onboard Molex 70553-0038 four pin header. The circuit provides automatic calibration and therefore provides an easy way to utilize the full range of production devices that may be provided on any type of sensor. The circuit allows the engineer to compensate for manufacturing variations, temperature changes, and device aging present in optoelectronic systems.

INCLUDED IN YOUR OCB100-KIT DESIGN KIT

- OCB100CZ — PCBoard Calibration Circuit (includes OCB100 - MC24 mating cable)
- OPB350C125Z — Fluid Sensor for 0.125" [3.18mm] O.D. tubing
- OPB732CZ — Medium distance reflective object sensor.
- OPB885CZ — Slotted Switch 0.375" [9.53mm] slot width.
- Sample of 0.125" tubing
- Label / Liner sample



OCB100AZ



OCB100CZ



OPB732WZ *



OPB885Z *



OPB350W125Z *

* Denotes OPTEK part number of non-connectorized standard part

THEORY OF OPERATION OCB100

The OCB100 series is designed to minimize the change of optical devices due to manufacturing variance, temperature change, and device aging. This system can be used to calibrate either reflective or interruptive devices to provide a consistent output, thus eliminating the need to confirm either the LED drive resistance or the phototransistor load resistance. With the OCB100, the design engineer can reduce the sensor to sensor variation present in many systems. By providing a pre-calibrated sensor to the system design, the engineer can enhance the reliability and consistency. Degradation of the LED or phototransistor is compensated for each time the system is calibrated allowing the system to provide a known, consistent output level resulting in years of consistent quality. The OCB100 series is designed to maintain the calibrated setting even if power is lost, thus allowing faster startup without the need for calibration every time the device is initiated. The designer can initiate the calibration procedure at any time by momentarily grounding J1-Pin-4 (green wire). This allows the device to be remotely calibrated, and then mounted in the equipment.

The PCBoard has a set of shorting pins allowing the user to change the phototransistor load resistor. By arranging the shorting bar to the appropriate location (see table on pg. 9) you can change the load resistance from approximately 2.5K to 27K ohms. Increasing the load resistor increases the device sensitivity.

When the "Calibrate" pin (#4) is momentarily grounded, the system begins its calibration process and raises the current through the LED, from 0 mA to 14 mA, until the phototransistor reaches the preset calibration point. A green calibration light will blink 3 times when the

preset phototransistor output level is reached.

At this time, the LED drive current is locked and maintained until the calibration pin is grounded. If for some reason the LED drive current reaches the maximum allowable value, a RED warning light will turn on. During the calibration process, remote monitoring of J1-Pin 5 allows the designer to ensure the system is calibrated (this output should be at the preset calibrated output level of 1/2 Vcc when the calibration procedure is completed). Adjusting the phototransistor load resistor may allow the system to calibrate properly.

After the calibration process is complete, the device is ready for acknowledgement of a change in the signal. The design engineer can monitor either the Analog Output (J1-Pin 5) or Logical Output (J1-Pin 2 or J1-Pin 3).

Connection of the analog ouput to additional circuitry allows the design engineer to set any reference point to recognize an optical change for the device being monitored. The Analog Output can be used with reflective devices to monitor small changes in the distance from the device.

The Logical Output will change state once the preset optical light condition is reached. Logic Out A" (mating connector orange wire) switches when the optical output signal decreases below approximately 1/3 of Vcc while "Logic Out B" (mating connector blue wire) switches when the optical output signal increases above approximately 2/3 of Vcc.

As with all optical devices with logic outputs, the switching condition is consistent with the phototransistor receiving a preset light level.

This switching position and light level may vary dependent on several possible factors such as:

- Ambient light variation (reduced or eliminated with periodic recalibration)
- LED and phototransistor pair degradation (eliminated with periodic recalibration)
- Contamination in front of either the LED or phototransistor (reduced or eliminated with periodic cleaning)
- System power variation (reduced or eliminated with periodic recalibration)
- Temperature changes (reduced or eliminated with periodic recalibration)

The OCB100 PCBoard can be wired directly to any optical device with an LED and Phototransistor such as:

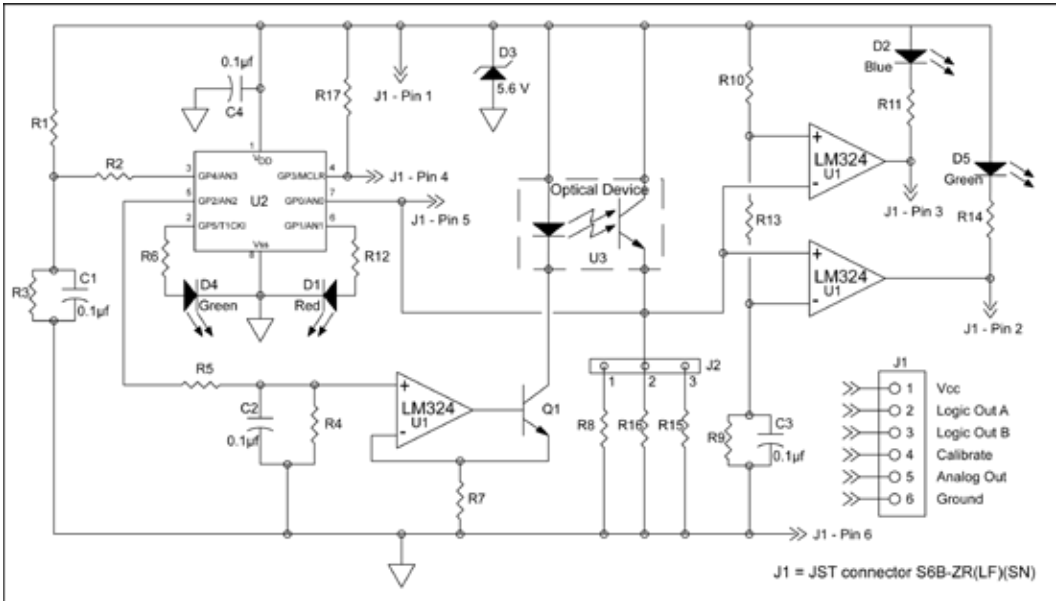
- Interruptive devices / slotted switches / interruptive encoders
- Reflective devices / reflective switches / reflective encoders
- Specialty devices / fluid sensors

POWERING UP THE OCB100CZ

The OCB100CZ should be powered by a 5.0V ± 0.5V, 50mA minimum regulated power supply.

You can also use three 1.5V AA batteries connected in series in a battery holder such as P/N SBH331AS available from batteryholders.com. Connect +5 volts to pin #1 of connector J1 (red wire of the supplied mating connector) and ground to pin #6 of J1 (black wire of the mating connector).

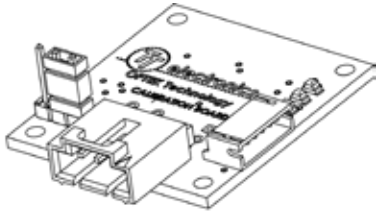
OCB100 Circuit Schematic

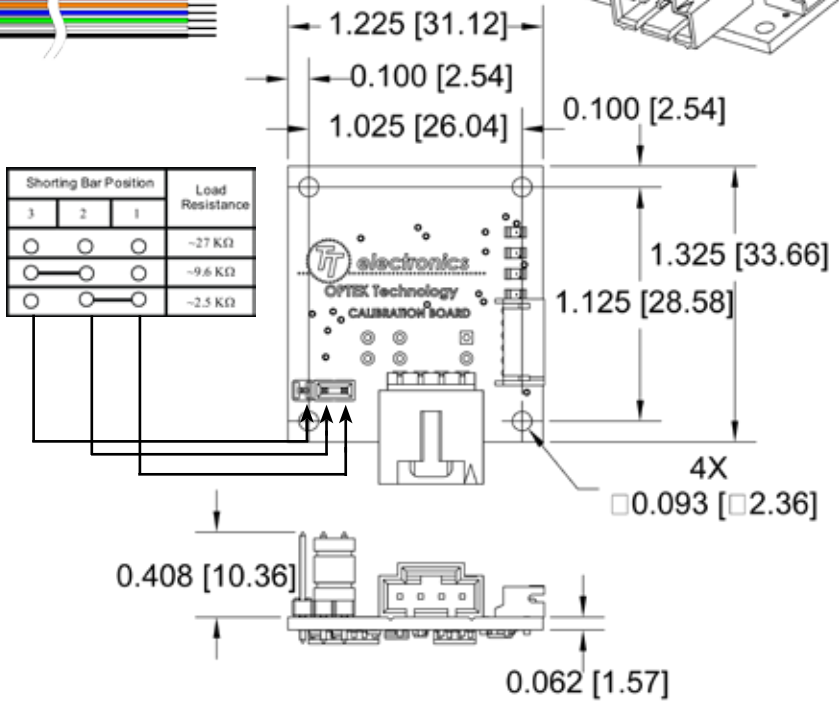


J-1					
Color - Pin #	**Function**	**Color - Pin #**	**Function**	**Color - Pin #**	**Function**
Red - 1	Vcc	Blue - 3	Logic Out B	White - 5	Analog Out
Orange - 2	Logic Out A	Green - 4	Calibrate	Black - 6	Ground

Calibration Circuit



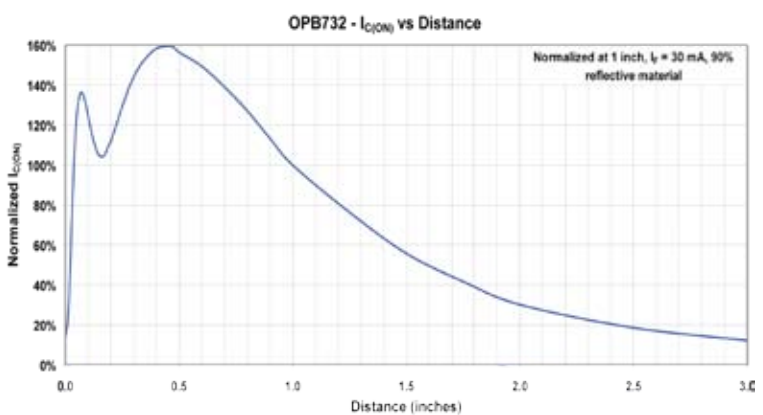




THEORY OF OPERATION OPB732 / OPB732WZ

The OPB732 (PCB mount, no mounting tabs) and OPB732WZ (mounting tabs and wires) are non-focused analog output reflective sensors designed to operate from .05" [1.27mm] to 2"[50.8mm] or greater with an output signal significantly above the typical background signal in a dark environment. These sensors are tested against a white 90% reflectance white card at a distance of 1.0" to guarantee a minimum $Ic_{(ON)}$ collector current of 0.25mA @ VCE = 0.4V and IF = 30mA. Other surfaces will give different signal levels.

Infrared light with a center wavelength of about 850nm is emitted from an LED with a total half power angle (ØHP, Beam Angle) around 18°. When the light strikes an object, it is reflected back toward the phototransistor. The amount of current $Ic_{(ON)}$ generated from the phototransistor is dependent upon the amount of light striking it. The following graph shows the effect of target distance on the output current of the OPB732.



USING THE OPB732CZ WITH THE OCB100CZ

Connect the OCB100CZ to a power source as described on page 7 "Powering up the OCB100CZ".

Plug the OPB732CZ connector into the 4 pin Molex mating connector on the OCB100CZ , and then apply power to the circuit. Adjust the phototransistor emitter load resistor to equal approximately 10Kohms (RL ≅10K) by placing the shorting bar on the board betweens pins 2 & 3 (see table on pg. 9) of the header. Point the OPB732CZ at a sheet of white paper and position its front surface about ½ " from the paper. While holding the sensor in this position, momentarily ground the pin 4 of connector J1 by touching the green wire of the mating connector to the black wire (ground) of the mating connector.

After approximately 2-3 seconds you should see an onboard green LED flash three times to indicate that the sensor has been calibrated at the distance it is held from the paper. If the unit calibrated correctly, and you have not allowed the sensor to move from the position it was calibrated at, there will be no LEDs lit on the calibration PCB. This means that the LED drive has ramped up to a current level sufficient to generate an output voltage level (V_{OUT}) ≅ to ½ Vcc.

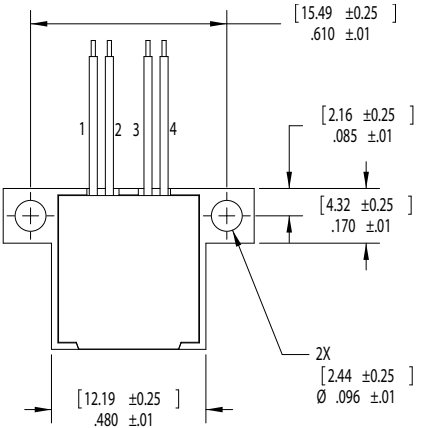
Now slowly move the sensor away from the sheet of paper until a green LED lights on the PCB. This light indicates that V_{OUT} has dropped to 1/3 Vcc or less. As you move the sensor closer to the paper, this green LED will go out and then come back on at a distance very close to the surface of the paper. At some distance between the two distances

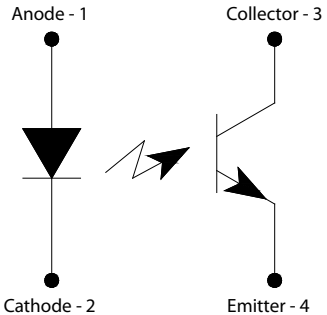
where the green light comes on, a blue LED may come on for some range of distance. The blue light indicates that V_{OUT} has risen to a level of 2/3 Vcc or greater. You can experiment with calibrating the sensor at various distances to see how this changes the distances at which the green and blue LEDs come on. Monitor the V_{OUT} voltage directly by connecting a volt meter or an oscilloscope between the white and black wires of the mating connector. If you move the sensor too far or too close to the paper, the circuit will be unable to calibrate because the V_{OUT} cannot reach ½ Vcc even when the LED has ramped to it's maximum value allowed by the calibration circuit (≅ 14mA). When this happens, a red LED indicator will flash multiple times and then remain lit to notify the user that the circuit could not calibrate. In practice, the OPB732 family LEDs can be driven at DC current levels up to 50mA (maximum rating at room temperature).

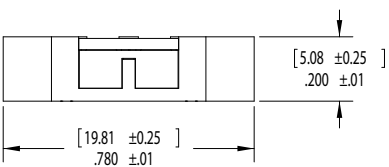
See the device data sheet at www.optekinc.com for more details.

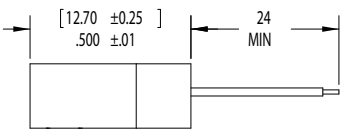
Applicable part numbers: OPB732, OPB732CZ, OPB732WZ

OPB732WZ package drawing









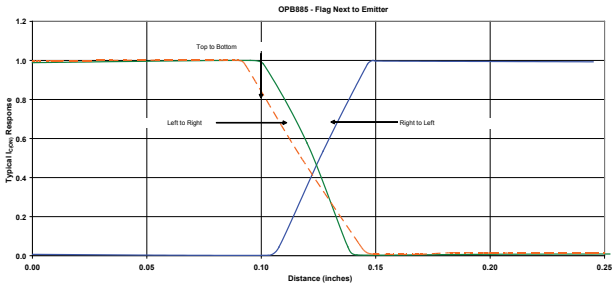
DIMENSIONS ARE IN INCHES AND [MILLIMETERS].

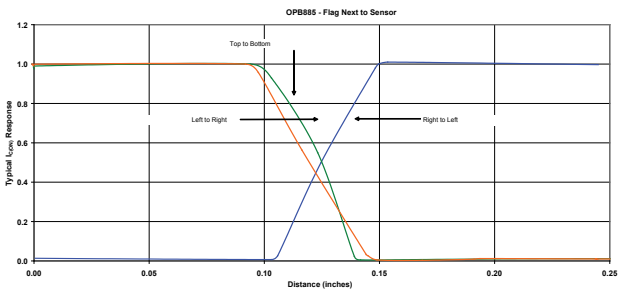
Color-Pin #	Function	Color-Pin #	Function
Red - 1	Anode	White - 3	Collector
Black - 2	Cathode	Green - 4	Emitter

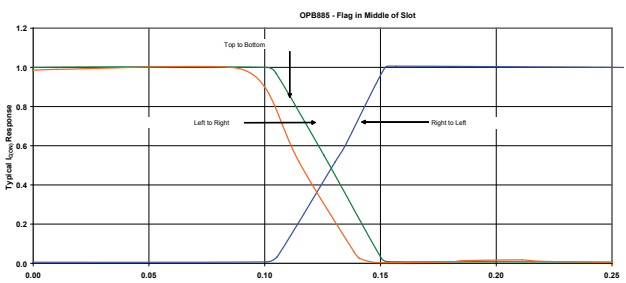
THEORY OF OPERATION OPB885Z / OPB885CZ

The OPB885Z is a wide gap slotted (transmissive) switch with a single mounting tab on the phototransistor side of the assembly. Current forced through the LED provides a light signal with a center wavelength of 890nm directed across the open gap of the switch toward the phototransistor sensor. The $Ic_{(ON)}$ collector current of the phototransistor is dependent on the amount of light striking it. When a non-transparent target passes through the gap, the amount of collector current is lowered significantly. The three graphs on the following page show the effect of an opaque target passing next to the LED tower, next to the phototransistor tower, and in the center of the slot. Analysis of these graphs shows a narrower signal area next to both towers. This effect is due to the beam angle and acceptance angle of the LED and phototransistor of about 40° and the presence of a .05”[1.27mm] wide aperture in front of each component.

OPB885 Switching Graphcs







USING THE OPB885CZ WITH THE OCB100CZ

Connect the OCB100CZ to a power source as described on page 7 "Powering up the OCB100CZ".

Plug the OPB885CZ connector into the 4 pin Molex mating connector on the OCB100CZ , and then apply power to the circuit. Adjust the phototransistor emitter load resistor to equal approximately 2.5Kohm (RL ≅ 2.5K) by placing the shorting bar on the board betweens pins 1 & 2 (see table on pg. 9) of the header. Insure that no object is blocking the gap of the OPB885CZ, and then calibrate the sensor momentarily grounding pin 4 of connector J1 by touching the green wire of the mating connector to the black wire (ground) of the mating connector.

After approximately 2-3 seconds you should see an onboard green LED flash three times to indicate that the sensor has been calibrated. There should now be no LEDs lit on the calibration PCB. If instead the red LED is lit on your calibration board, change the load resistor to a larger value and repeat the calibration process. If your board is calibrated, this indicates that the LED drive has ramped up to a current level sufficient to generate an output voltage level (V_{OUT}) ≅ to ½ Vcc. If Vcc = 5V and RL = 1K, then the sensor V_{OUT} will be approximately 2.5 volts. Therefore the present $Ic_{(ON)}$ current of the OPB885CZ is 2.5V / 1K = 2.5mA. The OPB885Z data sheet available at www.optekinc.com shows that the device has a specified minimum $Ic_{(ON)}$ guarantee of 1.3mA minimum @ IF=20mA, Vce = 5V. Since the calibration circuit is designed to ramp the LED drive up to a maximum of IF = 14mA, it may become apparent to you that this specification does not guarantee every OPB885CZ can reach an $Ic_{(ON)}$ of 1.0mA @ IF=14mA, and therefore it may be necessary to change

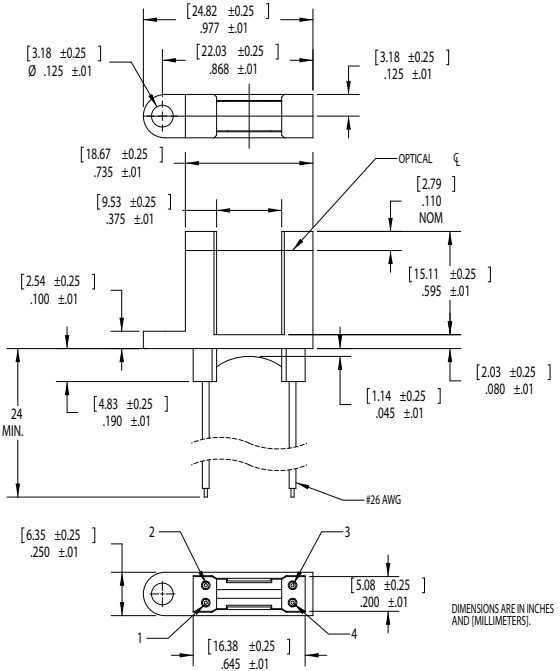
to a higher load resistor value in those cases. Place the shorting bar between pins 2 & 3 and try calibrating again. In this case the OP-B885CZ only needs to reach an $Ic_{(ON)}$ value of 2.5V / 10K = 0.25mA to calibrate. We could have suggested the 10K load resistor to begin with, but this exercise can show the importance of matching the phototransistor load resistance to data sheet specifications of the particular sensor being interfaced to the OCB100CZ.

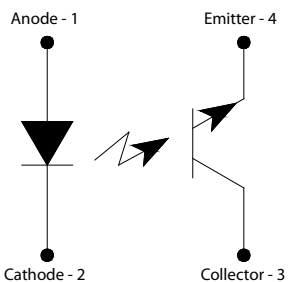
An example of an application where the OPB885Z could be used in combination with the OCB100CZ would be where a semi-opaque or semi-transmissive material needs to be sensed. Since the material does not block all of the light, the sensor might see through the material and not be able to detect its presence. The OCB100CZ solves this problem by calibrating the sensor output at a level slightly higher than the detection trip point. If the material to sense is 50% transmissive or less, it will be sensed.

Another example would be when the difference in two semi-transmissive materials needs to be detected, such as in a label printer where a sensor is required to see through the liner of a roll of labels, but detect the label. A sample label / liner is included in this OCB100-KIT. Try the following experiment:

Insure that the shorting bar is placed between pins 2 & 3 to set the load resistor at approximately 10K ohms. Place the gap between the two labels in the center of the optical path. Calibrate the sensor. Now move the labels back and forth in the gap to see that the green LED lights when the labels are present, but does not light when the label is present. Remove the label / liner from the gap completely. The blue light of the OCB100CZ should now be lit.

OPB885 Package Drawing





Color-Pin #	Function
Red - 1	Anode
Black - 2	Cathode
White - 3	Collector
Green - 4	Emitter

THEORY OF OPERATION OPB350 SERIES AND OCB350 SERIES

The OPB350 Liquid Sensor Series are designed to work with 1/16" [1.6mm], 1/8"[3.2mm], 3/16" [4.8mm], and 1/4" [6.3mm] outside diameter clear tubes. When custom output reference circuitry is added, multiple output states such as "fluid present", "no fluid present", and "no tube present " can be recognized.

Clear liquid present causes the phototransistor to sink the maximum current, while a dark liquid present causes it to sink the least current. As bubbles pass through the tube, the signal will vary between the "liquid present" and "no liquid" states. If no tube is present, the phototransistor sinks current between the dark fluid and clear fluid states. The designer must identify the typical current values for each situation and design the output reference circuitry to match.

The OPB350L Series have leads that are designed to mount directly to PCBs. The OPB350W Series with 26 AWG wires are remote mountable.

The OCB350 Series incorporate the OPB350L Series directly onto the OCB100AZ (ref page 2) calibration circuit board. This series is configured to minimize the design effort needed to use a fluid sensor by utilizing the onboard calibration circuitry. Four visible LED lights are provided on the board to indicate whether the sensor has been calibrated and what its output state is. The user will normally want to calibrate the sensor after placing empty tubing in the optical path. At the end of the calibration process, a green light will flash 3 times and then turn off to indicate that the sensor is properly calibrated. The OCB350 is now ready to be used to sense the presence of either a clear fluid (blue LED indicator), a dark fluid (green LED

indicator), or no fluid (no indicators will be lit). If the sensor is unable to calibrate, a red LED will flash multiple times and then remain lit. This is an indication that there is an insufficient infrared light reaching the phototransistor, such as when a dark object or dark fluid is in the optical path, or when the OCB100 circuit just needs higher gain.

The onboard jumper can be configured to set the gain at three different levels. See the OCB350 Series data sheet www.optekinc.com for more details.

COMPLETE PART NUMBERS OF OPB350 AND OPB350 SERIES	
OPB350	PCB mount for 1/8" tubing
OPB350L062	PCB mount for 1/16" tubing
OPB350W062Z	Wired assembly for 1/16" tubing, with mounting tabs
OPB350L125	PCB mount for 1/8" tubing
OPB350C125Z	Wired assembly for 1/8" tubing, mounting tabs & Molex connector 50-57-9404
OPB350W125Z	Wired assembly for 1/8" tubing, with mounting tabs
OPB350L187	PCB mount for 3/16" tubing
OPB350W187Z	Wired assembly for 3/16" tubing, with mounting tabs
OPB350L250	PCB mount for 1/4" tubing
OPB350W250Z	Wired assembly for 1/4" tubing, with mounting tabs
OCB350L062Z	OPB350L062Z mounted on OCB100AZ calibration circuit board
OCB350L125Z	OPB350L125Z mounted on OCB100AZ calibration circuit board
OCB350L187Z	OPB350L187Z mounted on OCB100AZ calibration circuit board
OCB350L250Z	OPB350L250Z mounted on OCB100AZ calibration circuit board

USING THE OPB350C125Z WITH THE OCB100CZ

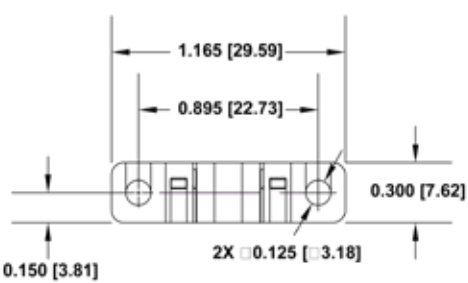
Note: The above discussion of the OCB350 series also applies to using the wired OPB350W series and the OPB350C125Z with the OCB100Z.

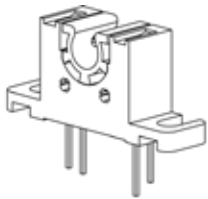
Connect the OCB100CZ to a power source as described on page 7 "Powering up the OCB100CZ".

Plug the OPB350C125Z connector into the 4 pin Molex mating connector on the OCB100CZ , and then apply power to the circuit. Adjust the phototransistor emitter load resistor to equal approximately 2.5Kohm (RL ≅ 2.5K) by placing the shorting bar on the board betweens pins 1 & 2 (see table on pg. 9) of the header. Calibrate the sensor by momentarily grounding pin 4 of connector J1 by touching the green wire of the mating connector to the black wire (ground) of the mating connector.

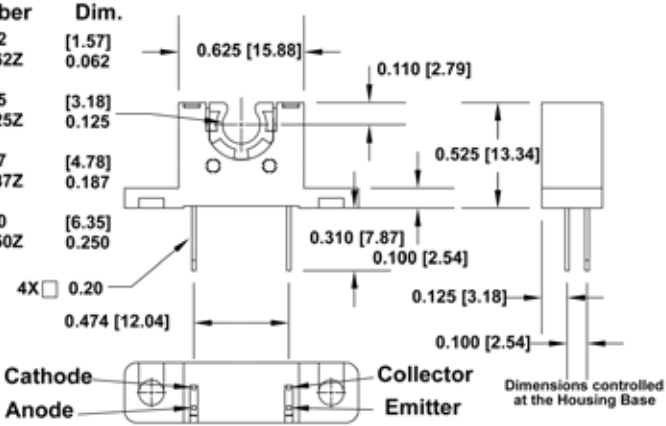
A short length of 1/8" clear tubing is included in the OCB100-KIT. Try the following experiment. Snap the tubing into place in the optical path of the OPB350C125Z. Calibrate the sensor. Insert water into the tubing sample. The blue light on the OCB100CZ should light when water is present in the optical path, and no LED should be lit when water is not present.

OPB350 Package Drawing





Part Number	Dim.
OCB350L062	[1.57]
OCB350W062Z	0.062
OCB350L125	[3.18]
OCB350W125Z	0.125
OCB350L187	[4.78]
OCB350W187Z	0.187
OCB350L250	[6.35]
OCB350W250Z	0.250



For wired versions:

Cathode = Black **Collector = White**
Anode = Red **Emitter = Green**

Dimensions are in Inches [mm]

For any additional information or questions please feel free to contact us via our applications hotline at 972.323.2488

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OCB100-KIT

OPTEK reserves the right to make changes at any time in order to improve design and to supply the best product possible.