CPL590 • CPL592 • EN591

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1   Approval and safety considerations

The EN591 is compliant with the following CE standards:

- Safety: IEC 61010-1:2010
- EMC: IEC 61326-1:2013, IEC 61326-2-3:2013, IEC 6100-3-2:2014, IEC 6100-3-3:2013 & EN 55011:2009 + A1:2010

To maintain compliance with these standards, the following operating conditions must be maintained:

- All I/O connecting cables must be shielded and less than three meters in length
- AC power cables must be rated at a minimum of 250 V and 5 A
- AC power must be connected to a grounded mains outlet rated less than 20A
- Use the included CE approved power supply with 1 slot enclosures. If an alternative power
- supply is used, it must have equivalent CE certification and provide safety isolation from the mains according to IEC 61010.
- Sensors must not be attached to parts operating at hazardous voltages in excess of 33VRMS or 70VDC

Use of the equipment in any other manner may impair its safety and EMI protections.

CAUTION: Probe Tip Contact Caution

The sensing tips of capacitive probes produce voltages as high as 70 Vrms. These are high frequency voltages with very low power so they pose no danger. Normally when the probe tip is touched, the probe stops functioning and voltage is reduced to near zero. But under certain circumstances, the voltage may cause a slight tingle or burning sensation, especially with the second generation probes used with the CPL490. For maximum performance probe tips should remain free of oils or other contaminants.

For these reasons, it is recommended the probe tips not be touched.

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2   Helpful Technical Support Documents Online

The IBS Precision Engineering's website has a large selection of technical documents (TechNotes and Application Notes) in the Technical Library. These documents provide detailed descriptions of the operation and use of the products of IBS Precision Engineering.

The Technical Library can be accessed at:

https://www.ibspe.com/expertise/technical-resources

Some of the titles include:

- Understanding Capacitive and Inductive Sensors
- Comparing Capacitive and Inductive Sensors
- Z-height Measurement with Non-contact Sensors
- Sensor Operation and Optimization
- Using Capacitive Sensors in Vacuum Applications
- Understanding Electrical Runout When Using an Eddy-Current Sensor for Roundness Measurements
- Inductive Probe Cabling Considerations

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3   EN591 - CPL591/592 Sub-Nanometer Capacitive Displacement Sensor

The CPL591/592 capacitive sensor is a precision, noncontact measurement device with digital features added. The output can be voltage or digital with changes in direct linear proportion to displacement between the probe and the target. The sensor is normally used to measure conductive targets, but it can also be used with nonconductive targets under the correct conditions.

4   Basic operation

The analog output voltage can be accessed from two locations. Single-ended output via the front panel BNC connector, or differential output via the rear panel DB9 connector. As the probe approaches the target, the output voltage will become more negative/smaller and the same applies to digital output.

The digital data is accessed via the USB, or through LVDS SPI via the display port. Digital data is presented by a 16-bit digital count from 0 to 65535 full scale where the calibrated range is from 3276 to 62259. Appendix A & Appendix B will provide more detailed information on the Demo Software and digital protocol command.

Note: "Near" and "Far" lights (red) indicate that the probe is out of its calibrated range and the output is not guaranteed to be accurate even though the voltage may be in range and continue to change.

Probes are calibrated to specific modules. Be sure the serial number on the probe matches the number on the calibration documents.

The CPL592 provides two calibration ranges for a single probe. Use the range button at the front panel or digital protocol to select the desired sensitivity. Calibration detail is provided on the calibration documents included.

Noncontact sensors normally measure changes from a reference position.
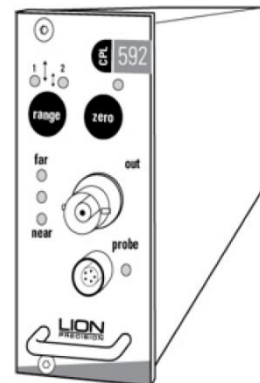
5   Interpreting the output

The amount of change of the output voltage or digital counts for a given change in the probe/ target gap is called Sensitivity. The sensitivity of the sensor is listed on the calibration documents.

Change in gap calculation in Voltage:

> **Gap Change = Voltage Change / Sensitivity**

For example: With a sensitivity of 1 V/2 µm and a voltage change of 3 V, the gap change would be 6 µm (3/0.5).

Change in gap calculation in Counts:

> **Gap Change = Count Change / Sensitivity**

For example: With a sensitivity of 236 Counts/µm and a count change of 1416, the gap change would be 6 µm (1416/236).

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6   Front panel controls, indicators and connectors

6.1   Zero Adjust

Adjusts the analog output voltage after the probe is initially positioned. Pushing the zero button while close to range center causes the analog output voltage at present position to adjust to zero volts. Pushing the zero button again will disable the zero adjustment.

6.2   Range Button (CPL592 Only)

The CPL592 provides two calibration ranges for a single probe. Refer to the calibration documents for specific calibration information. Pushing the range button will alternate between ranges.
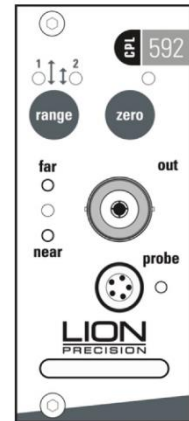
Note: Switching ranges will usually require repositioning the probe.

6.3   Calibrated Range Indicator

Green LEDs indicate that the probe is in its calibrated range and the output is an accurate representation of the target position. Red LEDs indicate that the probe is out of range and the output is not valid.

Analog Output - Single Ended

Provides connection to the analog output voltage, which is proportional to the distance between the probe and the surface of the material being measured. A typical output voltage range is ±10 VDC. The specific ranges are listed on the accompanying calibration documents.

6.4   Probe Connector

Connect the probe by aligning the red dots on the connectors and inserting the probe connector.

CAUTION: To disconnect the probe, pull on the knurled barrel of the probe connector to release it.
DO NOT PULL ON THE CABLE.

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7   Overview of rear panel controls and connectors

7.1   Remote Power Supply & Differential Output

The EN591 is powered by +15 VDC, -15 VDC & +5 VDC via DB9 connector. It also provides differential analog voltage output.

Table 1 DB9 Connector Pinout

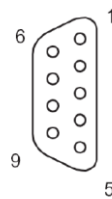| PINs	PINs Connection
1	Ground
2	NC
3	−15 VDC
4	+15 VDC
5	+5 VDC
6	Vo−
7	Vo+
8	Ground
9	Ground

Power Connector
Pin Numbers
On Rear Panel

Figure 1 DB9 Connector Pinout

7.2   Analog Output Differential

The non-inverted and inverted outputs are used together as a differential output. Differential output helps eliminate electrical noise induced into the connecting wires by noise source such as computers, power transformers, etc.

The non-inverted output voltage become more negative (relative to ground) as the probe nears the target. The inverted output voltage becomes more positive (relative to ground) as the probe nears the target. The non-inverted and inverted outputs are each ±5 VDC relative to ground; the differential output is therefore ±10 VDC.

The analog output connection pins are positioned to allow for twisted pair cable for maximum differential noise reduction.

CAUTION: DO NOT connect the outputs to ground or the unit will be damaged

7.3   USB

The EN591 provides a high/full speed USB 2.0 interface to gather digital data from the device to a PC. USB API documents, Demo Program, and examples can be downloaded from the product webpage. Appendix A provides a quick overview of the Quick Start Demo Program running on USB.

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7.4   LVDS SPI

LVDS SPI is accessible through the display port. For closed loop applications or other real time applications, this low-level communication protocol can be connected to a microcontroller,

microprocessor, FPGA, etc. It supports high speed sampling rate up to 10MHz (100 ns) and basic system controls such as sensitivity change, bandwidth change, and enable/disable excitation clock to the EN591. Appendix B provides electrical specifications, timing diagram, SPI commands, and a connection diagram for reference.

Note: Display port cables are not straight through.

7.5   Bandwidth Settings

The EN591 provides a four-position rotary switch for setting signal bandwidth. The following switch image and table below show the bandwidths available and their associated physical switch settings.

Table 2 Bandwidth Settings Table

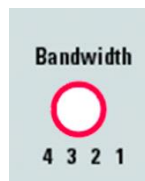| EN591	Position
15 kHz	4
10 kHz	3
1 kHz	2
100 Hz	1

Figure 2 Rotary Switch Artwork

7.6   Ground

There is a ground screw attached to the rear enclosure for grounding the target. In most cases, separate grounding of the target is not necessary. If the target is not grounded through another path, and the output exhibits excessive electrical noise, grounding the target may reduce the output noise. When low-noise operation is critical, separate grounding is recommended even if the target is well grounded through another path.

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8   EN591 – CPL591/592 Specifications [1]

Linearity Error	0.1% F. S
Error Band	0.2% F. S
Standard Bandwidth (-3 db)	Selectable: 100 Hz, 1 kHz, 10 kHz, 15 kHz Bandwidths are -10%+30%
Zero Adjustment Range	Within 50% of calibrated range
Meets ANSI/ASME B5.54 Standard	Yes
Probe Interchangeability	Typical sensitivity variation for same probe model: 10%
Operating Temperature	4 -50°C
Thermal Stability	0.04 % F.S. / °C
Typical Oscillator Frequency	Probe cable < 12 feet: 1 MHz Probe cable > 12 feet: 500 kHz
Output Impedance	0 Ω
Output Max Voltage	±11 VDC
Output Max Current	10 mA

[1] [1]These specifications are typical for standard components and calibrations. Customizations can affect performance. Check the calibration sheet shipped with the product for specific details on your system. In high EMI environments (10 V/m), output noise may rise to 0.2 VRMS (1% resolution) and DC output may shift.

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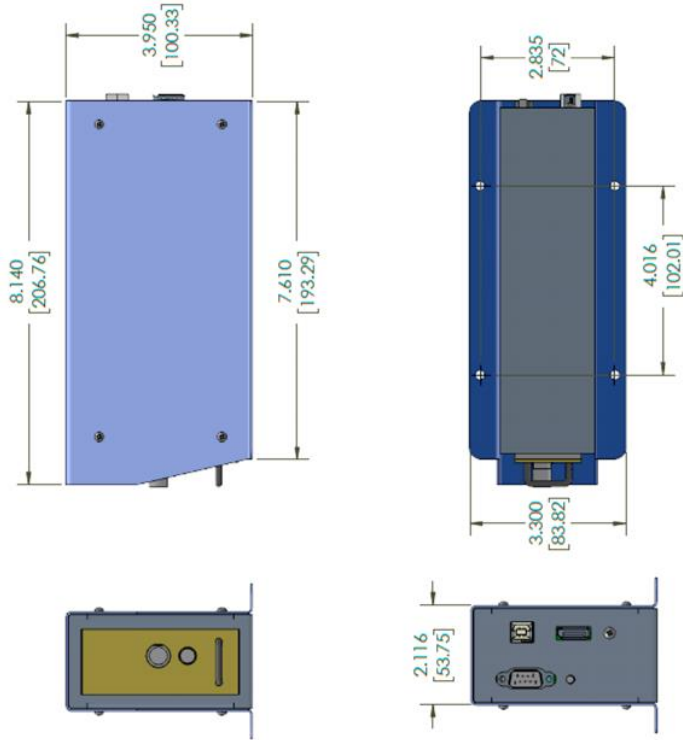
9   EN591 Enclosure Drawings

Figure 3 EN591 Dimensions

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10   Power specifications

Model	Power Input	Notes
EN591	±15 VDC ±1V, 400mA Maximum +5 VDC ±0.5V, 400mA Maximum	power supply or a power supply with switching frequency greater than 100 kHz such as Lion Precision Power Supply P017-9300. To maintain CE compliance, use the included power supply or equivalent CE compliant model.

11   External power supply

The EN591 systems include an external power supply. The supply has a connector which allows direct connection to the enclosure.

This supply features a high-frequency (100kHz) switching supply. The high switching frequency allows the sensing modules to operate at maximum resolution.

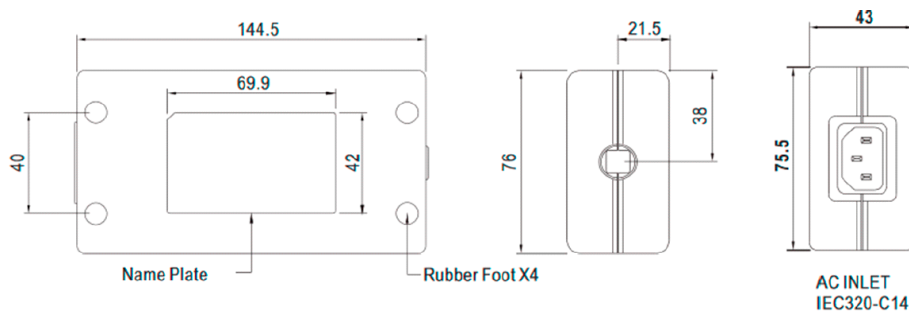| DC Output Voltage	+5V; 5A -15V; 0.8A +15V; 2A
AC Input Voltage	100-240 VAC, 50/60 Hz, 1.35A

Figure 4 External Power Supply Dimension

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Appendix A

A.1   Demo Software Installation

Minimum Requirements

- Window 7 & or higher (64 bit)
- 4 GB memory
- 2 GB free disk space
- USB port (2.0 or higher)

Installation Procedure

The software can be downloaded on the product webpage:

- https://cpl590viewer.blob.core.windows.net/cpl590demo/CPL590ViewerInstall.exe
- https://cpl590viewer.blob.core.windows.net/cpl590api/CPL590DLLInstall.exe
- https://cpl590viewer.blob.core.windows.net/cpl590api/Setup.exe

To use the CPL590 Demo Viewer:

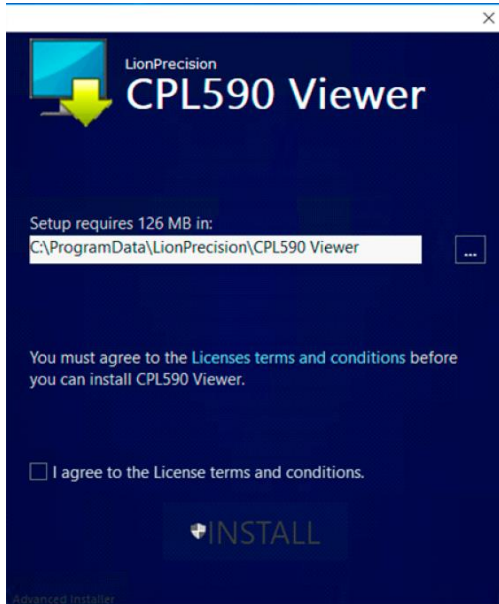1.   Download and run CPL590ViewerInstall.exe

Figure 5 CPL590 Viewer Installer Startup

2.   Read and agree to the T&C then click Install.
3.   Follow the directions of the installation programs.
4.   When the installation is complete, restart the computer.
5.   After restarting, run the program on the desktop or by selecting Start > All Programs > CPL590 Demo Viewer > CPL590 Demo Viewer.exe

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A.2   Demo Software Basic

Scan & Connect Device

When the CPL590 Demo Viewer is launched (Start > CPL590 Demo Viewer) it will display a Splash Screen and query the operator to begin to scan for EN591 devices on the USB Bus:

If the operator selects the 'Exit' button, the program will close.

If the operator selects the 'Scan' button, the program will find all EN591 devices on the USB bus and display the device (cabinet) assignment number, the name, and serial numbers of each device/driver found. If it does not find EN591 device, the operator will be given the option to 'Retry' the connection.

Run	CabinetNumber	Name	SerialNumber
☐	1	CPL592	19004874
☐	2	CPL592	19004873

Figure 6 Two EN591 Detected

If the Device/Driver is to be run, the operator must enable the 'Run' flag by checking the box:

Run	CabinetNumber	Name	SerialNumber
☑	1	CPL592	19004874
☑	2	CPL592	19004873

Figure 7 Select the EN591 to Run

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If the operator selects the 'OK' flag, the Home Screen will be displayed.

The program will automatically open a connection to the EN591 device after the Scan Dialog is closed.

The Home screen will show the Oscilloscope display and the Serial number(s) of the Device/Driver(s) that were enabled to be 'Run' in the Scan screen.

The top menu shows the possible commands (Start, Pause, Stop, Save File, About, Help).

The bottom toolbar indicates the state of communicating with the Devices (Not Connected, Connected, Data Running, Data Paused, Data Stopped). The bottom toolbar also shows the statistics (Min value, Max value, Peak-to-Peak value, and Average value) of the data buffer received from the first Device.

The **'Options', 'TEDs Data'**, and 'Zero/Gain Adjust' menu items, on the left toolbar, will be disabled until the Device(s) has been successfully connected.