PERKINELMER ELM

Citizen Science
Operating Procedure

Contents

PerkinElmer Elm

The PerkinElmer Elm (formerly the AirBase CanarIT) is a multi-sensor air quality monitoring device that measures particulate matter (PM), total volatile organic compounds (VOCs), nitrogen dioxide (NO_2), and several other atmospheric components. PM, VOCs, and NO_2 are among the pollutants identified by the U.S. Environmental Protection Agency as having harmful effects on both human health and the environment. The Elm takes continuous measurements that are transmitted to the PerkinElmer website for cloud-based storage and processing. This procedure will guide you through the steps needed to collect quality data using the Elm for your monitoring project.

Pollutants Measured and Their Sources

Particulate Matter (PM)

PM consists of particles of various sizes and is present in soot, smoke, dirt, and dust. These particles are often generated and released into the air from sources such as power plants, industrial processes, automobiles, and fires. PM can adversely affect breathing and contribute to respiratory and cardiovascular conditions. The smallest particles pose the greatest health risk. PM also contributes to atmospheric haze that reduces visibility.

Volatile Organic Compounds (VOCs)

VOCs are emitted as gases from many common household and office products including paints, varnishes, floor wax, cleaning supplies, cosmetics, degreasing agents, pesticides, building materials, home furnishings, copiers and printers, permanent markers, glues, and adhesives. Fuels are also made up of organic chemicals, emitted as gases when they burn. All of these products can release organic compounds during use and sometimes during storage. VOCs can have both short- and long-term adverse health effects.

Nitrogen Dioxide (NO_2)

NO_2 is a highly reactive gas that can irritate the lungs and cause bronchitis, pneumonia, and other respiratory problems. As NO_2 forms quickly from automobile emissions, significantly increased concentrations of NO_2 are often found near major roadways. Power plants and other industrial processes also emit NO_2.

For more information on these air pollutants, visit the U.S. Environmental Protection Agency's Web site at http://www.epa.gov/airquality/urbanair/.
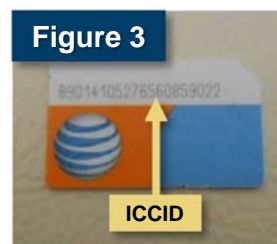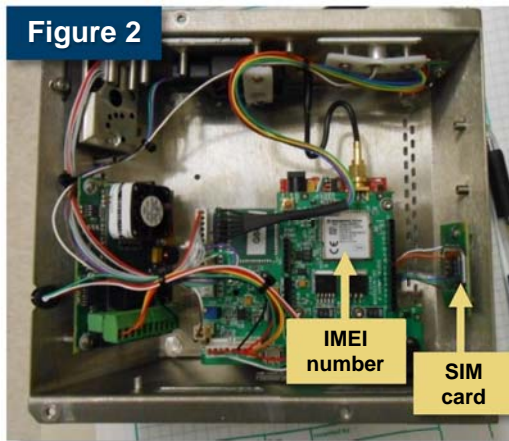
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Preparing the Device

You must configure your Elm prior to use, which first requires purchasing a data plan and acquiring a SIM card. You must also download the Elm software to a computer.
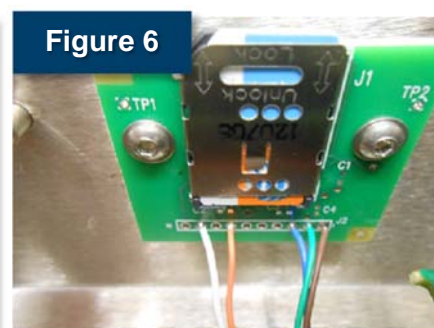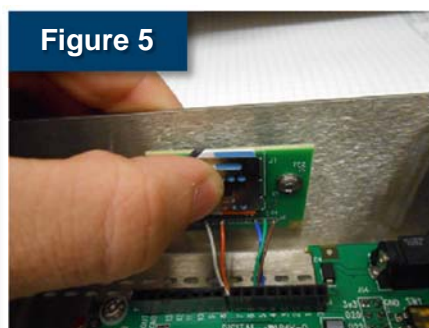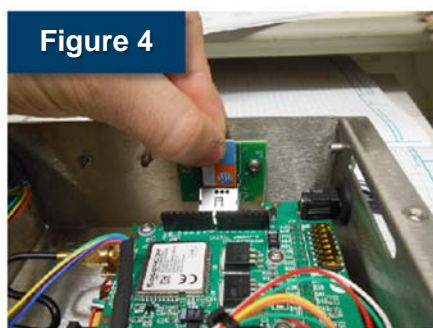

Figure 2

IMEI number

SIM card

Purchasing a Data Plan and Installing the SIM Card

Before collecting data with the Elm, you must first obtain a GSM SIM card and purchase a cellular phone data plan. To purchase the data plan, you will need to know the International Mobile Station Equipment Identity (IMEI) number for the unit. This number is printed on a chip inside the unit, as shown in Figure 2. You also need to know the Integrated Circuit Card Identifier (ICCID) number from the SIM card (Figure 3). After obtaining a SIM card and data plan, you will need to install the SIM card in the Elm.

Figure 3

ICCID

Procedure: Install SIM Card

1. Open the SIM card slot door.
2. Insert the SIM card into the slot (Figure 4).
3. Close the SIM card door (Figure 5).
4. Lock the SIM card door as indicated by the arrows on the slot door (Figure 6).

Figure 4

Figure 5

Figure 6

3

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3. Open the **AirBaseDriversInstallation.zip** file created during the download, and double click '**setup.exe**' to launch the installation wizard (Figure 9).

4. Click '**Next**' on the installation wizard welcome screen (Figure 10), click '**Install**' (Figure 11), and then click '**Finish**' (Figure 12) to complete installation.
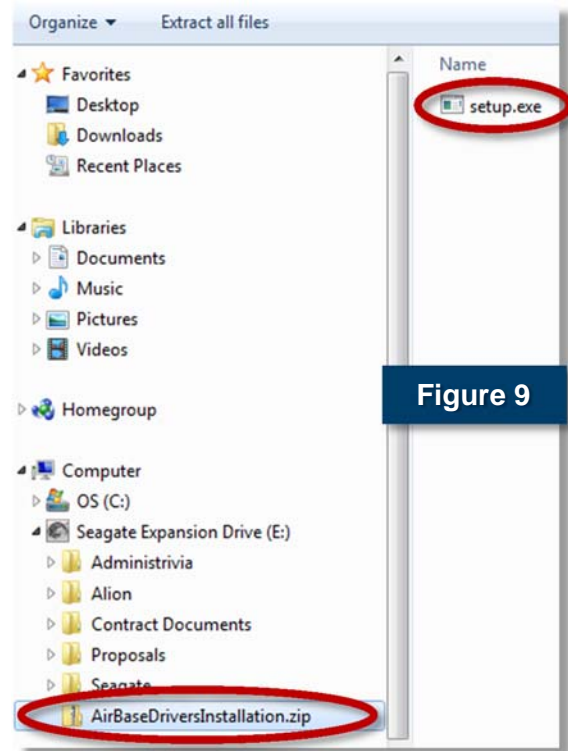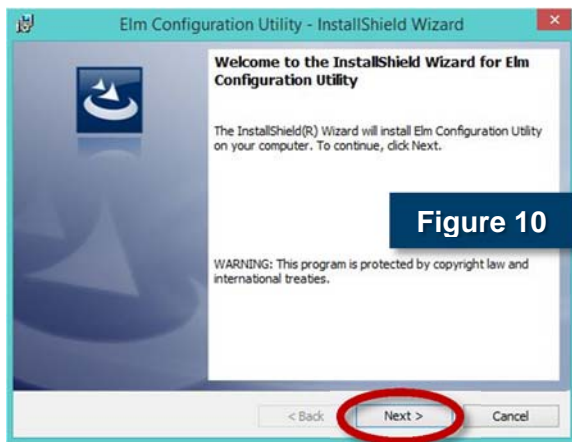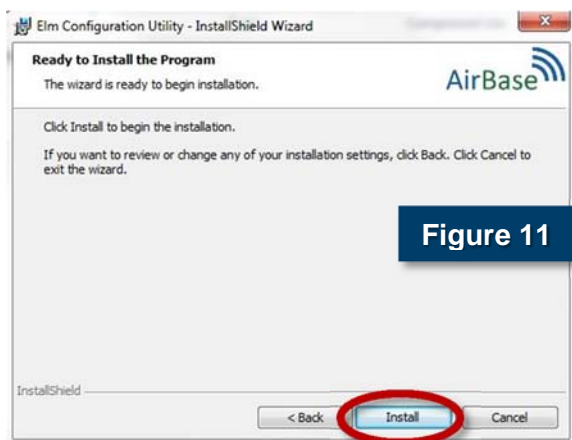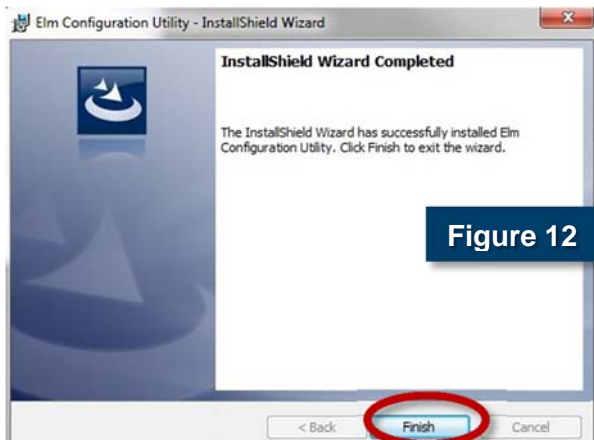

Figure 9

Figure 10

Figure 11

Figure 12

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3. Enter **"broadband"** (case-sensitive) into the **APN** field. You do not need to configure the Provider in the drop-down menu, and the User and Password fields should be left blank.

4. Click the **'Save'** button and wait for the message **"Saved to flash"**, and then click **'OK'** (Figure 15).

5. Click the **'Disconnect'** button to end the Elm software session.

6. Unplug the Elm from the power and the USB port.

Figure 15

Routine Data Collection

Collecting Data

Once configured and connected to the power supply, the Elm transmits data to the PerkinElmer website cloud database every 20 seconds. The sensor continues recording and saving data even if the wireless connection is lost. If the connection is lost, simply disconnect and reconnect the power supply. Any backlog of data is automatically transmitted to the cloud database when the connection is restored. Use the following procedure to begin collecting data.

Procedure: Initiate Data Collection

1. Use a cell phone to make sure the sampling site has service from the data plan provider (e.g., AT&T, Verizon) and to check the signal strength.

2. Plug the 12 V DC adapter included with the unit into the Elm and connect to 110 V AC power.

3. Make sure the indicator lights blink in the following pattern:

   Three lights—red, yellow, and green—on the left side of the unit (Figure 16) indicate whether the device is functioning properly. During normal operation, the green light blinks for approximately 15 seconds, with one blink followed by a pause (no blinks), and then the yellow and green lights

Figure 16

Indicator lights

Antenna

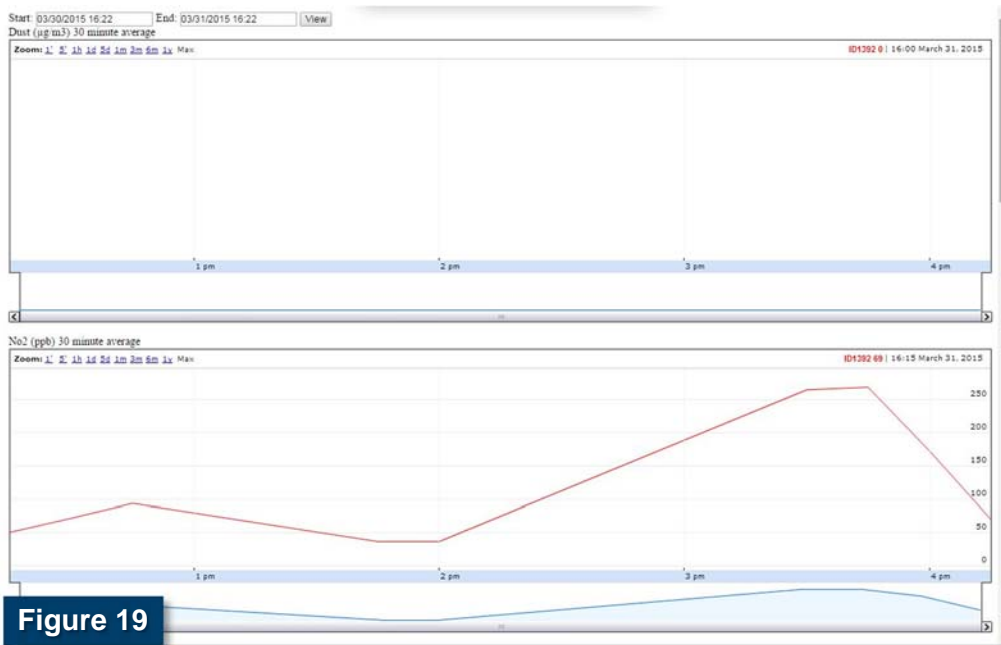Sampling port
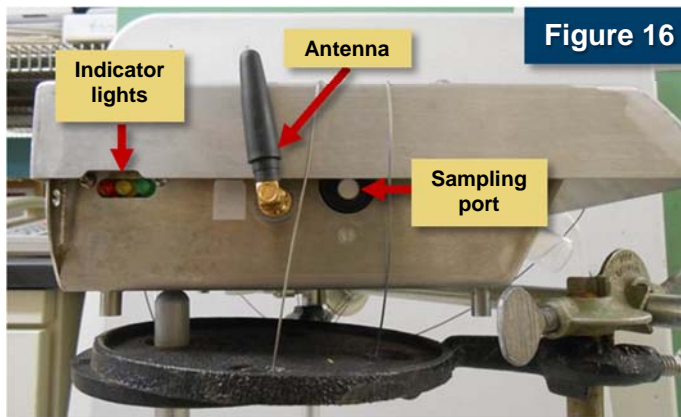
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Figure 19

Processing Data

To process your data, you will need to download it from the Elm Web site and then load it into spreadsheet software. Data are downloaded in comma-separated values (*.csv) format to a specified destination on your computer. The *.csv format is simply a text file that uses commas to separate each measured value or recorded information such as date, time, total VOCs, NO_2, and so on. Most spreadsheet software can easily read these text files. The following procedure will guide you through downloading and formatting your data for processing. Microsoft Excel 2013 is used to illustrate this procedure, but the process is similar in versions of Excel dating back to 2003.

Procedure: Process Data

1. Enter the Web site address http://elm.perkinelmer.com/myairbase/sensors/xls/xxxx in your Web browser, where "xxxx" is the unit number for your Elm (see Figure 17).
2. Enter the **Start** and **End** dates of the data you wish to download, as shown in Figure 20.
3. Leave the drop-down menu as **Row data**.
4. Press the **'Click here to Download'** button to begin the download process.

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All columns of data that might be generated by the Elm during data collection and displayed in the Excel file are listed below along with any applicable units of measure. Many of these data columns might not be pertinent for the purposes of your data collection. Other columns that appear in the file can be used by the manufacturer for advanced troubleshooting.

Time (local)	Noise (db)
Sensor ID	Unix Time (Greenwich Mean Time timestamp)
Ozone Sensor (ppb)	WSPD_mph (wind speed in miles per hour)
Carbon Monoxide Sensor (ppb)	WDIR_Deg (wind direction in degrees from north)
Total VOC Sensor (ppb)	PM2_5_micrg_m3 (a separate particulate sensor designed for $PM_{2.5}$ in $\mu g/m^3$)
Dust Sensor ($\mu g/m^3$)	NO_ppb (ppb)
NO_2 Sensor (ppb)	BP_HG (barometric pressure in millimeters of mercury)
Humidity (% RH)	Latitude (degrees)
Barometric Pressure	Longitude (degrees)
SO_2 Sensor (ppb)	Altitude (meters above sea level)
NucRad (not used)	AltitudeFromGround (meters above ground level)
CelRad (not used)	Odor (European odor units)
Temperature (ºC)	Ammonia (ppb)
Total VOC and CO_2 Sensor (ppb)	CO_2 (ppm)

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Environmental Protection
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Washington, DC 20460

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