



ESP Echo Particle Detector

Operating Manual

822-0001



Technology of the Future...Protection for today

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It is important that this entire manual be thoroughly the Echo Detector. Any deviation from this manual may impair system performance and compromise safety.

Date	Revision	Description	Approval/ECO
11/24/2017	A	Release to production	171124A

1.0 Introduction

1.1. Product Overview

Echo detector is a state-of the-art measuring device that uses the acoustic noise generated by particles of sand and condensed moisture to measure its amount in oil or gas production. Sand, when moving in a flow of oil or gas, acts on the walls of the pipe. Due to the inertia occurring in the bends of the pipes, noise is generated which is processed and identified by the Echo detector, after which the calculation is performed in real time. This technology is applicable in any substances, such as oil or gas, as well as in several flows simultaneously.

Key features

- Analysis of acoustic noise produced by sand and particles of condensed moisture on the pipe walls;
- Analog 4-20 w/HART, RS-485 Modbus RTU, and “dry contact” relays are standard data communication channels of the Echo Detector
- Event log is stored 90 days with a recording interval of 10 seconds
- Echo particle detector does not require any calibration or adjustment before use
- 316SS or aluminum construction, explosion-proof housing, Zone 1 and Zone 0
- Operating temperature -60°C to +85°C (-76°F to 185°F)
- Pipeline surface temperature -100°C to +290°C (-148°F to 554°F)

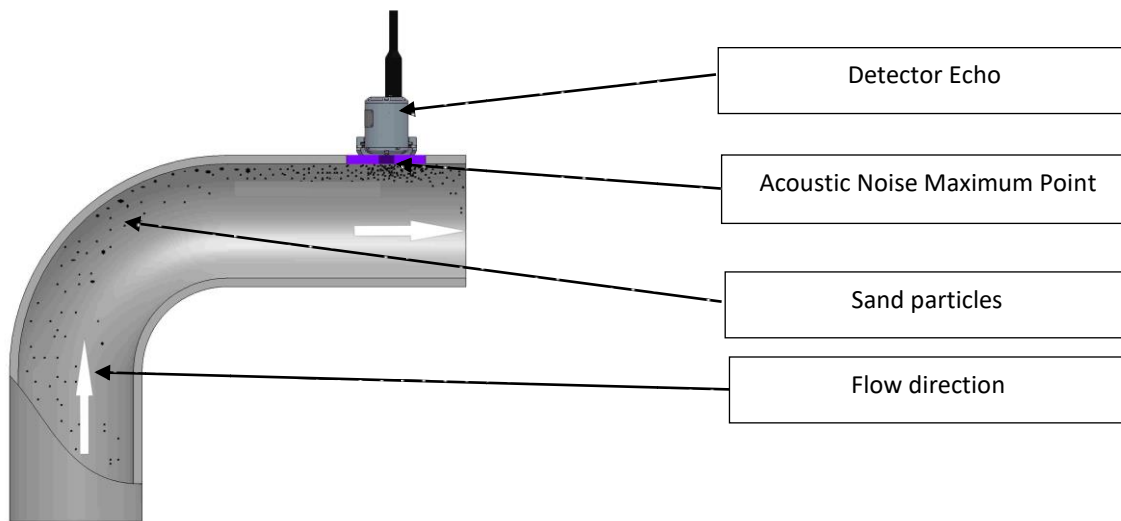
Field of Application

- oil, gas, chlororganic and gas condensate fields;
- gas pre-treatment and liquefaction plants;
- coastal technological complexes;
- gas distribution units (GDU) of underground natural gas storages in hazardous areas, where there is a risk of the formation of explosive mixtures;
- sand handling packages;
- rooms related to hazardous areas and outdoor installations according to explosion protection marking, IEC 60079-14-2011 (IEC 60079-14) and other regulatory documents governing the use of electrical equipment in hazardous areas.

Our Mission

ESP Safety, Inc.’s mission is to provide complete turn-key protection solutions beginning with the design stage, through system installation and commissioning, and on-going field service in hazardous environments. Our line of industry-leading products, services, and systems benefits society, saves lives, and preserves capital resources.

Figure 1-1: Echo installation



Principle of Operation

Echo is a contact device and is installed directly near the pipe elbow at a distance of at least 2 meters from the fountain fittings using the mounting base and the coupler clamp included in the delivery.

The maximum automation of the Echo detector allows it to display information on excess flow rates of sand and condensed moisture, as well as transmit it to the automatic process control system and the control center in real time, which implies high accuracy of recording the start of sand removal and timely notification.

Sand, when moving in a stream of oil or gas, acts on the walls of the pipe. The principle of operation of Echo is based on the detection of acoustic noise from droplet moisture or grains of sand by a piezoelectric sensor built into the detector. The signal from the sensor passes through a preliminary charge amplifier, a bandpass filter, and a terminal amplifier with digital gain control and passed to the microcontroller, which performs signal conversion with a sampling frequency of 1 MHz, which allows for spectral analysis.

The software evaluates by:

- 1) kinetic energy of impact of solid inclusions, particles of sand and water drops on the wall of the bend of the pipeline;
- 2) the ratio of peak energy to the width and frequency range of the signal;
- 3) the form and nature of the change in spectrum;
- 4) the duration of observation.

From the data collected by a special algorithm based on the methods of linear and nonlinear data filtering, statistical analysis and connectivity analysis, characteristic noise of sand and drip are distinguished.

The control of sand particles is 20 - 5000 mg/min and drop moisture 0.3 - 60 l / min, respectively, while the wall thickness of the pipe does not affect the sensitivity of the sensor.

Using the *Echo_configurator v.1.2*, you can set threshold levels for the amount of sand, as well as adjust the sensitivity and selectivity of the measuring system.

Echo Main Functions

- analysis of acoustic noise produced by sand and particles of condensed moisture on the pipe walls;
- control of excess flow rates of sand and condensed moisture;
- digital processing of the received signal;
- assessment of the amount of sand and condensed moisture according to predefined parameters;
- data transfer to the automatic process control system about exceeding preset levels

Echo Detector components

- A. Echo cover
- B. Explosion proof housing
- C. Coupler clamp
- D. Cable gland with heat shrink tubing
- E. Ground bolt
- F. LED indicator
- G. Mounting base

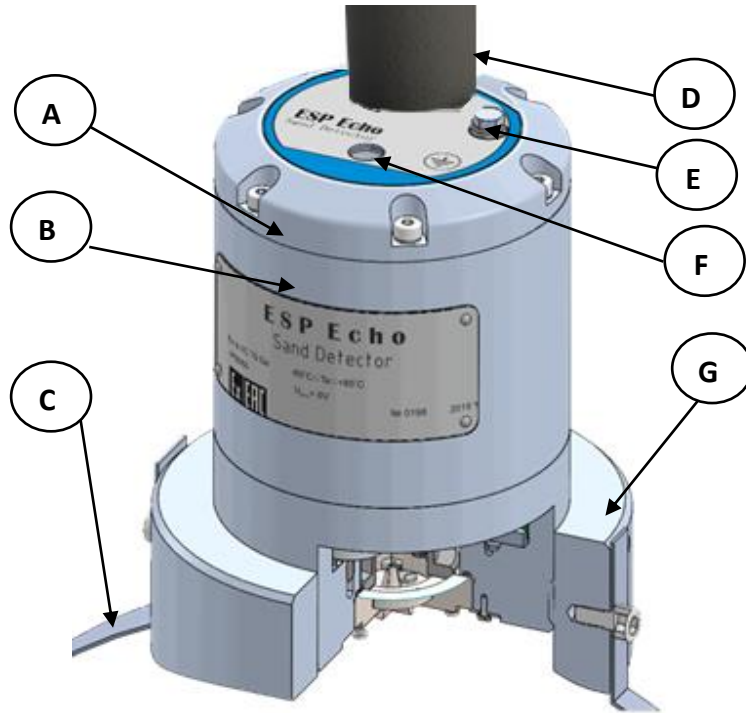


Figure 1-2: Echo components

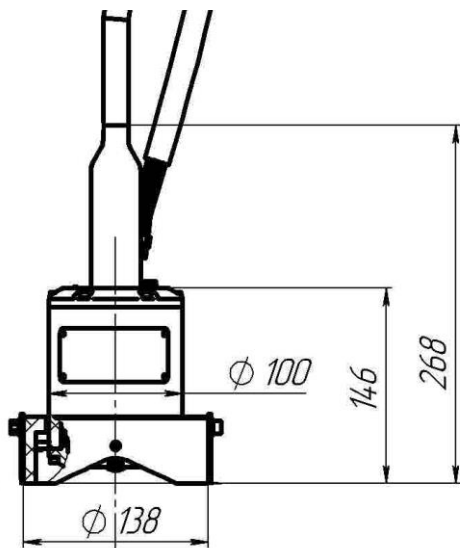


Figure 1-3: Echo Dimensions

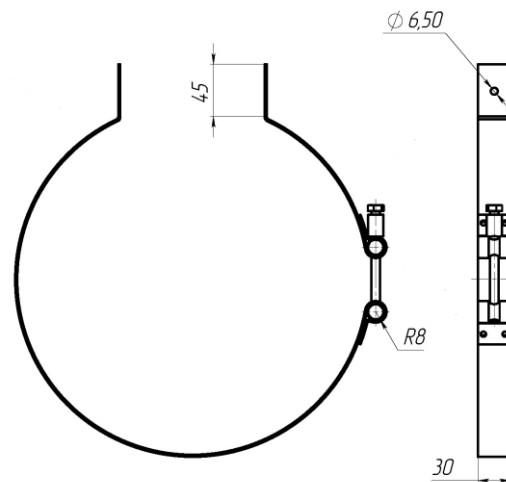


Figure 1-4: Coupler clamp dimensions

2.0 Specifications and Technical Data

Mechanical Characteristics	
Material	<i>Stainless Steel (Type 316)</i>
Conduit Connection	<i>¾ NPT</i>
Dimensions	<i>5.75" x Ø 3.94" (146 mm x Ø 100 mm)</i>
Mounting base size for pipes from 100 to 300 mm	<i>5.75" (138 mm)</i>
Weight (with mounting base)	<i>No more than 13.23lb (6 kg)</i>
Electrical Characteristics	
Input Voltage	<i>+24VDC Nominal (+18 to 32VDC)</i>
Power consumption	<i>≤ 2,4 W</i>
Output from Echo	<i>4-20mA industry standard analog output Digital RS-485 Modbus RTU¹⁾ "Dry contact relay"²⁾ HART³⁾</i>
Repeatability	<i>Detector has repeatability less than 1% The signal read by the sensor will have the same values, with a deviation of less than 1%, as the signal generated by a calibrated sound generator</i>
Warm up time	<i>30 seconds</i>
Operation Characteristics	
Method of operation	<i>Passive acoustic</i>
Uncertainty	<i>± 3 % (with sand injection calibration)</i>
Minimum flow velocity	<i>~ 1 m/s</i>
Minimum particle size	<i>≥ 10 µm - in gas ≥ 20 µm - in oil</i>
Data storage	<i>90 days with a recording interval of 10 seconds</i>
Operating Temperature	<i>-60 °C to +85 °C (-76 °F to 185 °F)</i>
Pipeline Surface Temperature	<i>-100 °C to +290 °C (-148 °F to 554 °F)</i>
Humidity Range	<i>Up to 100%, non-condensing (Withstands up to 100% RH for short periods)</i>
Storage/Transportation Temperature	<i>-50 °C to +50 °C (-58 °F to 122 °F)</i>
Ingress Protection	<i>IP66 / IP 68</i>
Life time	<i>10 years</i>
Detector Approvals	
Ex marking	<i>1Ex db IIC T4 Gb or 0Ex ia IIC T6 Ga</i>

¹⁾ The detector has a digital signal at the output for transmission through a standard RS-485 communication channel in the ModBus RTU protocol, via the USART communication channel (it is only a technological channel)

²⁾ For receiving the "dry contact" relay signals, the cable cores can be connected to the corresponding terminals 5, 6, 7 and 8 of the XT2 connector on the terminal board

³⁾ HART- optionally

3.0 Safety Considerations

Guidelines



Before installing and operating the Echo, be sure to read this entire manual. Failure to follow these guidelines could result in impaired product performance and safety hazards.

For maximum safety:

- Installation and operation of the Echo should be performed only by properly trained personnel who have thoroughly read and understand this manual.
- Echo wiring should comply with all governing electrical codes, standards and regulations.
- Never operate the Echo if the casing is damaged.
- Do not open the Echo case when the unit is energized.
- Perform regular testing and maintenance as outlined in the Maintenance section.
- Verify cable gland is sealed with heat shrink tubing of the Echo
- Also see the individual sections in this manual for relevant specific safety guidelines.

Explosion protection Means

The table below describes the Echo explosion protection design features.

Features	Protection Means
<i>Enclosure of Current Carrying Parts</i>	The casing includes threaded joints with controlled tolerances to meet explosion-proof requirements for installation in Zone 1, 2 for ATEX / IECEx /EAC Zone 1, 2 and Division 2 for UL US and Canada Zone 0, 1 for ATEX / IECEx /EAC Zone 0, 1 for Division 1 for US and Canada
<i>Case Mechanical Strength</i>	The high mechanical strength of the case is able to withstand high explosive pressures without rupture or failures of mechanical parts. The case design is in accordance with IEC 60079-0, and IEC 60079-1.
<i>Manufacturing Control Of Casing</i>	Important parameters include: <ul style="list-style-type: none"> • Maximum width and minimum length of threaded joints • Surface roughness of the joined parts • The number of complete intact threads at the conduit entry point
<i>Ignition Temperature</i>	The ignition temperature of the surrounding environment is limited by the outside surface temperature of the housing, which does not exceed 85°C
<i>Securing of Bolts, Joints and Grounding</i>	Spring washers, lock washers, and lock nuts maintain the integrity of the bolted connections by preventing loosening of the bolts.
<i>Joined Parts Protection</i>	Anti-seize lubricant is applied on the critical joints
<i>Casing Ingress Protection</i>	The design of the casing meets the requirements of class IP68 in accordance with IEC 60529-004.
<i>Sealing Cables at Conduit Entry</i>	Use approved hazardous location sealed conduit fittings

4.0 Installation

Component Parts and Delivery Set

The Echo component parts and delivery set consists of the following:

- One Echo Particle Detector
- One Echo Operating Manual
- Accessory Kit
 - a) Integrated cable of 3 m length
 - b) Mounting base
 - c) Perforated Coupler Clamp with Coupling bolt
 - d) Bolts for fasteners
 - DIN 931 bolt M8x100- A2 — 1 pcs
 - DIN 933 M6x12-A2 — 4 pcs

Compare the contents of the set to the packing list to be sure all items were received. If any items are missing, contact ESP Safety Inc.

Visual Examination

Before installing the Echo, examine the unit to ensure that:

- The nameplates and warning labels are in place.
- The external surfaces and joined surfaces of the Echo casing are free of dents or damage.
- Make sure all removable parts are joined to the casing as tightly as possible.
- The nut must not stick out at the input of the cable entry.
- The heat shrink tubing should fit snugly against the cable entry and nut.

4.1 Guidelines for locating the Echo on Pipelines

There are no standard rules for selection and placement of detector since the optimum detector choice location is unique for each application. Before installing the Echo and check the conditions at the installation site to make a placement determination.

The following guidelines can assist in determining the best possible placement of the Echo detectors:

- Detector Echo should be fixed at a distance of at least two diameters of the ECHO detector (maximum 700 mm) behind the pipe elbow in the direction of gas or oil flow
- Gate valves must be located no closer than 2 meters from the detector installation site.
- Thermal insulation/tar should be removed at the installation location of the clamp. Insulating material is removed completely from the entire pipe surface in a circle, the required width, to provide sufficient access to work with the sensor.

Preparing for installation

- Strip the place on the pipe measuring 10 x 10 cm to the metal on which the detector will be installed. For cleaning, you can use the abrasive material for metal surfaces. There should be no paint or other protective layer at the place of installation.
- Determine the required size of the coupler clamp and cut it in accordance with the diameter of the pipe. It is recommended to cut the tape so that one of them is shorter than the other and the turnbuckle is located on the side of the pipe with fasteners, which will facilitate access to it for rigid fixation.
- Fixed a clamp on one side of the mounting base with 2 bolts.
- Install on the pipe and fix the second clamp with 2 bolts.
- Tighten with a wrench of 12 the grub screw. The mounting base must not scroll or move. There should be no gaps at the junction of the mounting base to the pipe.

**Maintenance
Access**

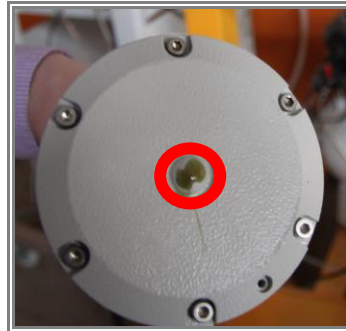
Consideration should be given to providing easy access for maintenance personnel. Detector location should also take into account the proximity to contaminants that may foul the detector prematurely.

**Tools
Required for
Mounting**

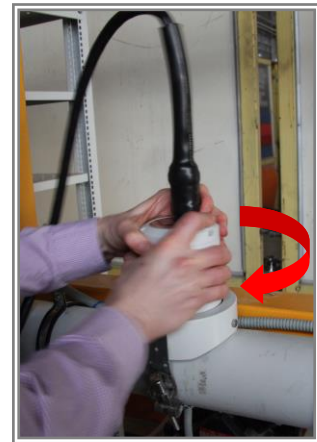
- Two (2) combination spanners, 10 mm and 12 mm
- Sandpaper for stripping
- Huskey HVS-100 Silicone Grease
- Metal scissors for trimming clamps
- Partially insulated screwdriver 2.5 mm

4.2 Mounting

- Apply Huskey HVS-100 Silicone Grease to the device concentrator; it should completely cover the cone of the receiver and reach the outer diameter of the concentrator. Huskey HVS-100 grease provides the best acoustic contact with the pipe and avoids the attenuation of ultrasonic waves during the metal-air-metal transition, and also preserves the contact point from oxidation and corrosion



- Insert the device into the slots of the mounting plate and turn it clockwise until it clicks.



Proof that the sensor cannot be pulled out vertically. Light springing of the detector is allowed.

4.3 Wiring Requirements



Caution: All cable/conduit entries must either be sealed within 18 inches with an appropriate and certified sealing plug and cable gland or directly connected to an explosionproof conduit system if installed in a hazardous area.

- If installing connection cables in an explosion proof conduit, do not use the same conduit to carry wiring for any other purpose or equipment.
- Cable requirements:
 - 1) Four single-wire round copper conductors with a nominal cross-section of 1.5 mm²
 - 2) PVC core insulation with a nominal thickness of 0.6 mm.
 - 3) Separation layer made of polyethylene or PVC compound 0.5 mm thick or in the form of tapes made of polyamide, polyethylene terephthalate film or crepe paper 0.5 mm thick.
 - 4) A protective cover. Lack of pillows. Armor from two steel galvanized tapes 0.3 mm thick. The outer cover is from a 1.8 mm thick pressed-out protective PVC hose.

Wiring connection marking

Since the Echo detector is supplied pre-assembled, the output cables are marked and correspond to the following marks:

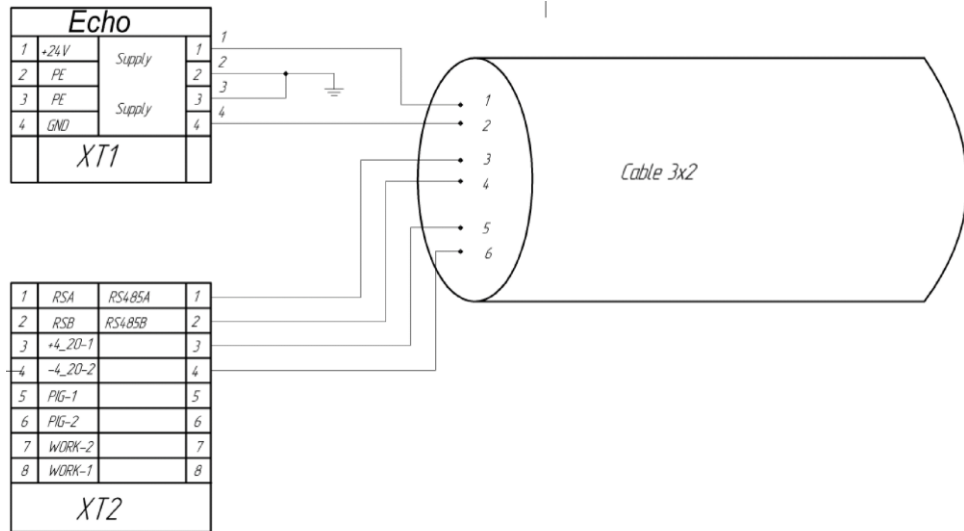
Core 1		Power «+»
Core 2		Power «-»
Core 3		RS- 485A
Core 4		RS-485B
Core 5		+ 4-20 mA
Core 6		- 4-20 mA
Ground core		



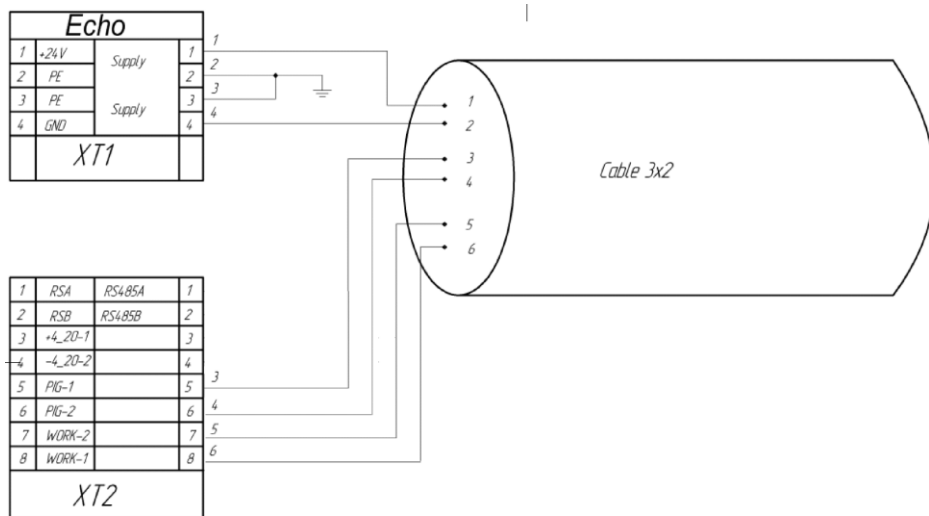
Attention! If it is necessary to remove signals from the relay outputs, the “dry contact” of the core can be reconnected to the corresponding terminals 5, 6, 7 and 8 of the XT2 connector on the terminal board.

Electrical Connection

Connection diagram of the Echo detector via 4-20 mA and RS-485 analog outputs. Factory Standard execution



Connection diagram of the Echo detector via a “dry contact” relay



5.0. Echo Detector Operation

The Echo detector has a self-diagnostic function and does not require periodic performance checks.

5.1. LED indicator operation modes:



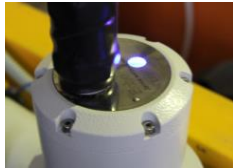
Detector has contacted.

After power-up, the LED indicator is recounted in different colors - red, green, blue, orange.



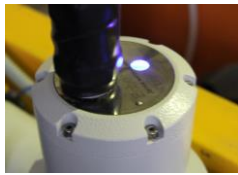
Self-diagnostic mode.

The green indicator lights up for 30-40 seconds. The self-diagnosis mode is carried out by the detector once an hour.



Operating mode.

The blue indicator is on - the self-diagnostic is completed - the device is in operating mode.



RS-485 software communication.

The blue indicator flashes.



Set level exceeded.

The red indicator is on.



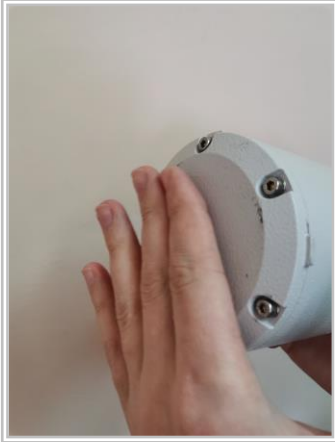
Malfunction.

The orange indicator is on. In case of malfunction of the measuring ultrasonic channel.

5.2. Echo Performance Checking

Check the response of the detector to acoustic noise in the absence of connection to a PC or laptop, in the field it is possible with a palm or finger. It is necessary to move along the protrusion of the sensitive element of the ultrasonic converter. If the set noise level is exceeded, the device will change the indicator light from blue to red.

Response time on this action will be around 5 to 10 seconds.



6.0 Software Echo Configurator v1.2.

6.1. To configure and visualize the operating parameters of the Echo Particle detector, the *Echo configurator v.1.2* software should be installed on the PC.

The program is intended for:

- viewing parameters and visualizing operating modes of the device in real time with the ability to save the measured parameters;
- changes in the communication parameters of the device connected via RS485;
- switching operating modes;
- functional checks.

The *Echo Configurator v.1.2* program is installed on the computer by copying or can work directly from a pen-drive.

6.2. The procedure for working with the program *Echo configurator v1.2*.

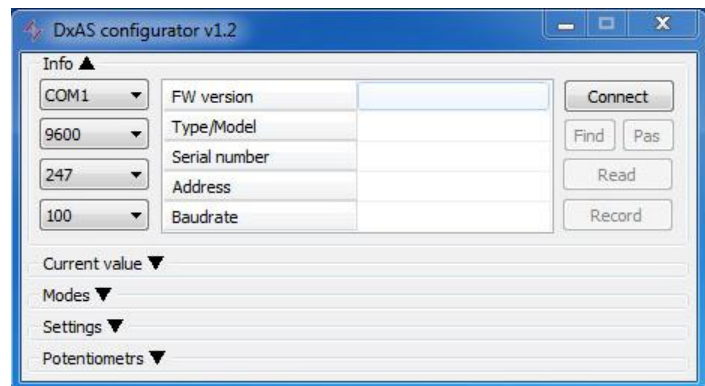
6.2.1. Open the ***DxAS Configurator v1.2*** program on the desktop by clicking on the program icon.



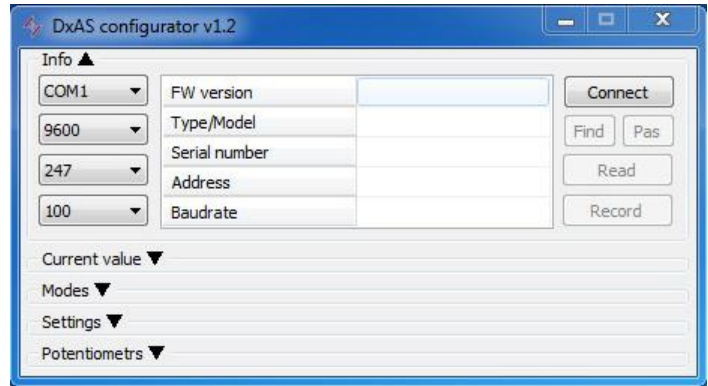
6.2.2. In the open program window, select COM port to connect the detector.

COM1

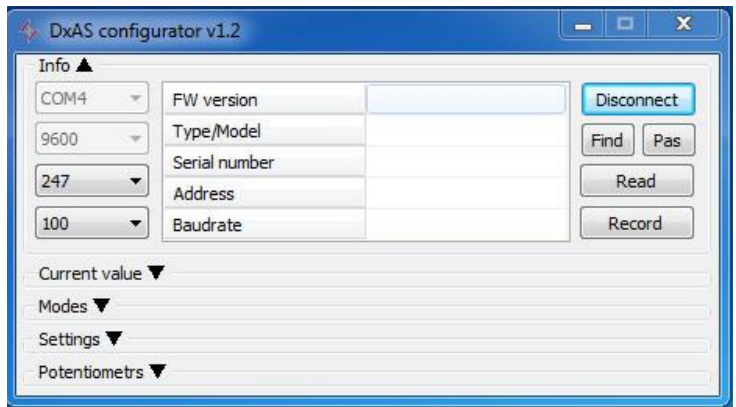
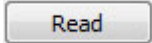
Before establishing communication with the device in the program, only the panel of connection parameters and information is available.



6.2.3. In the open program window, click on the "Connect" button

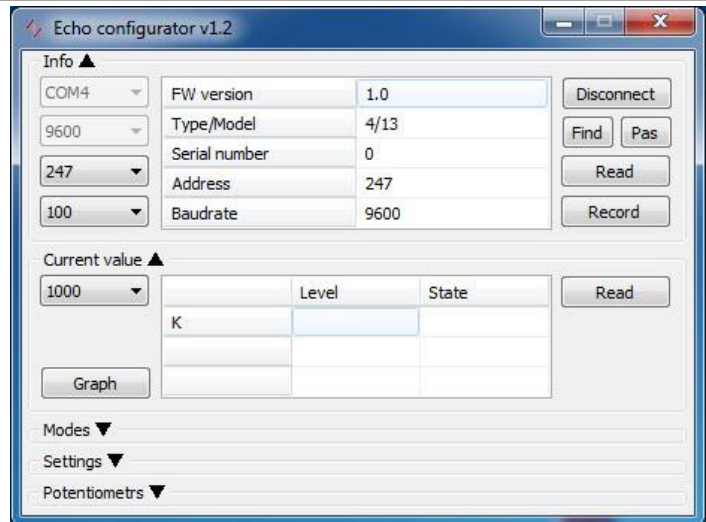


6.2.4. After connecting the detector, click the "Read" button.

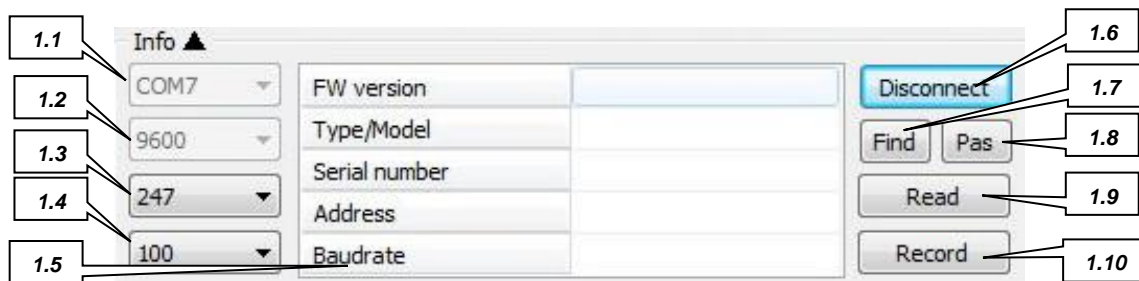


6.2.5. After establishing communication with the detector, the program interface will change to the *Echo configurator v1.2*.

Additional settings panels are available for adjustments.



6.2.6. Description of the program interface:



1.1 COM port number through which communication is carried out.

1.2 The exchange rate with the device.

1.3 MODBUS address of the device the program is accessing.

1.4 Response delay, in milliseconds.

1.5 Instrument Information I / O Table.

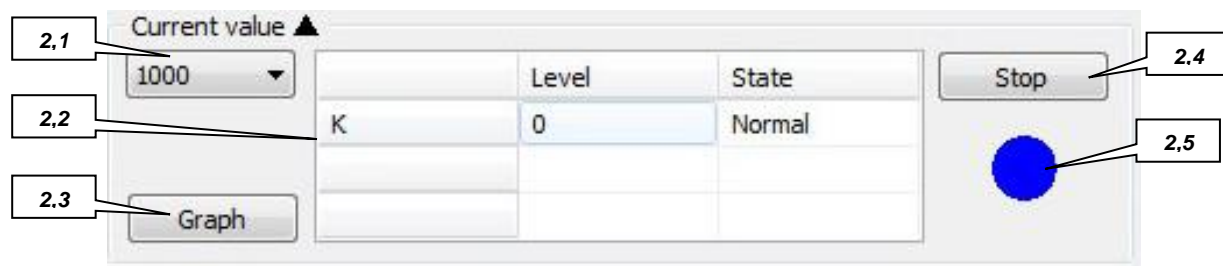
1.6 Button to enable or disable communication through the selected COM port.

1.7 Button to start the process of automatic device search for all (1-247) addresses. In case of a successful search, the address of the device found will remain in the corresponding field.

1.8 Button to enter the access key to additional device settings.

1.9 Instrument Read Button

1.10 Detector Information Record Button



2.1 Detector polling interval, set in milliseconds.

2.2 Output table for current detector parameters. Second column current level, third column state, depending on instrument settings.

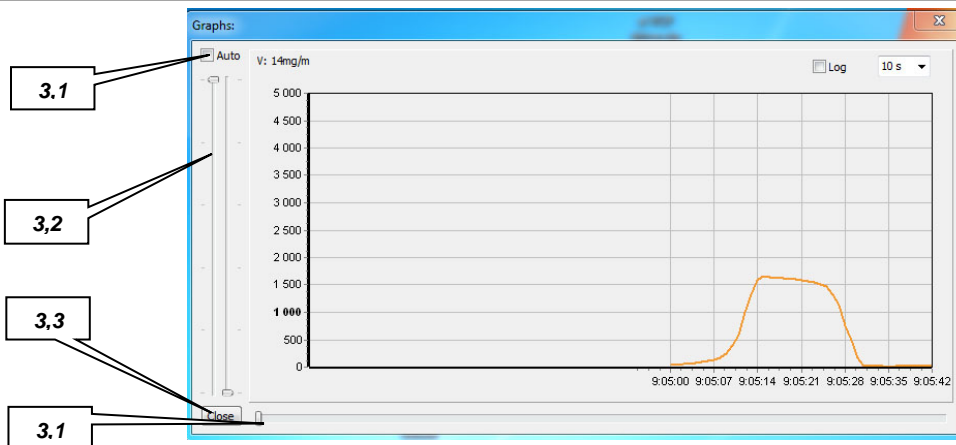
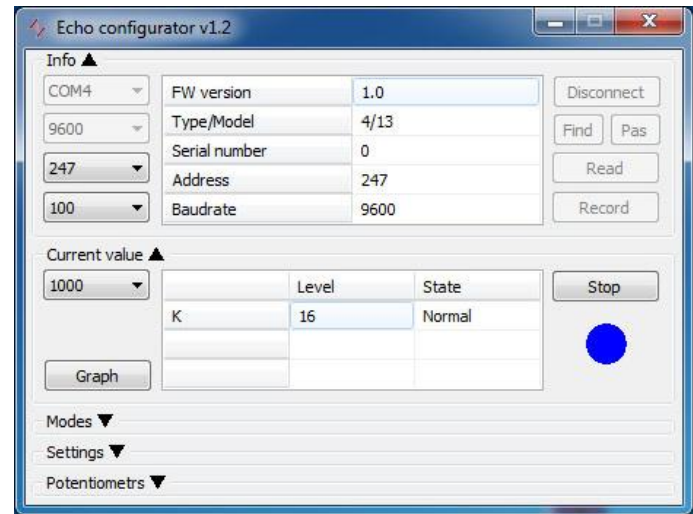
2.3 Button to display a window with graphs of current values.

2.4 Button to start / stop reading current levels and states from the detector.

2.5 Icon indicating the current status of the detector LED

6.2.7. When you click on the " Graph " button

it will be possible to track the operation of the detector in graphical mode. This will open the "Graph " window.



6.2.8. Graph Panel (Current Measured Values Panel)

3.1 Choice of automatic / manual scaling of charts.

3.2 In manual scaling mode - scale along the axis of values (Y).

3.3 "Graph" window close button.

3.4 In manual scaling mode - time axis scale (X).

Standard scaling with the mouse is also possible (selection of rectangular areas - from left to right to increase and vice versa to return to the original scale).

7.0 Troubleshooting

No	Malfunctions	Possible reason malfunctions	Remedy malfunctions
1	No signal LED	Lack of supply voltage	Disconnect the base with the cable entry from the housing and verify that 24 ± 6 V is present at the terminals.
2	Steady yellow LED	Detector malfunction	The device should be sent to the manufacturer for repair



The Echo does not contain any user-serviceable parts. Any repair of the Echo should be performed by ESP Safety personnel. Any attempt to repair or service the Echo by unauthorized personnel will void the product warranty.

8.0 Maintenance

The Echo Detector needs very little routine maintenance; but periodic can be advised is as follows:

- 8.1. **Conducting an external** inspection of the Echo detector for visible external damage.
- 8.2. **Checking the reliability of mounting the coupler clamp** on the pipe.
- 8.3. **Echo detector dust and dirt removal** - once every 2 years or as necessary, if there is visible dusting on the Echo surface. Cleaning is carried out by removing dust with a brush - wipe or slightly damp coarse calico from the body. In case of contamination of the case with oil products, cleaning is carried out with calico soaked in alcohol - rectified. After rubbing with alcohol, wipe the surface again with dry coarse calico to eliminate residual contaminants. The alcohol consumption rate for one service is 10g.
- 8.4. **If there is a bad contact between the detector and the pipe surface**, reapply Huskey HVS-100 Silicone grease to the device concentrator.
- 8.5. **The grounding** condition is checked by the tightness of the connection and the presence of grease on the contacts is concluded.
- 8.6. **Functional testing** is carried out at the installation site of the detectors and is carried out at least once every two years using a certified ultrasonic emitter. A certified autonomous ultrasonic emitter is installed in the immediate vicinity of the pipe from the Echo detector at a distance of 10 cm. The radiation level of the ultrasonic emitter in the pipe wall should ensure that the threshold of the monitored sensor is triggered at 0.3 g/min.

9.0 Warranties

ESP Safety, Inc. ("ESP") warrants the Echo Detector to be free from defects in material and workmanship under normal use and service for a period of ten (10) years, beginning on the date of shipment to the buyer. This warranty extends only to the sale of new and unused products to the original buyer. ESP's warranty obligation is limited, at ESP's option, to refund of the purchase price, repair, or replacement of a defective product or a component thereof, to the extent that the product is properly returned to ESP within the warranty period.

This warranty does not include:

- a) fuses, disposable batteries or the routine replacement of parts due to the normal wear and tear of the product arising from use;
- b) any product or component which in ESP's opinion, has been misused, altered, abused, tampered with, improperly maintained or used, neglected or otherwise damaged by accident or abnormal conditions of operation, handling or use, or to have deteriorated due to aging of any component made of rubber or any other elastomer; or
- c) any damage or defect attributable to repair of the product by any person other than an authorized dealer, or the installation of unapproved parts on the product.

The obligations set forth in this warranty are conditional on:

- a) proper storage, installation, calibration, use, maintenance and compliance with the product manual instructions and any other applicable recommendations of ESP;
- b) the buyer promptly notifying ESP of any defect and, if required, promptly making the product available for correction. No goods shall be returned to ESP until receipt by buyer of shipping instructions from ESP. A return authorization number must be obtained from ESP prior to shipment; and
- c) all warranty returns being shipped directly to ESP Safety, Inc.;
- d) the right of ESP to require that the buyer provide proof of purchase such as the original invoice, bill of sale or packing slip to establish that the product is within the warranty period.

THE BUYER AGREES THAT THIS WARRANTY IS THE BUYER'S SOLE AND EXCLUSIVE REMEDY AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. ESP SHALL NOT BE LIABLE FOR ANY SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES OR LOSSES. ESP WILL NOT BE LIABLE FOR LOSS OR DAMAGE OF ANY KIND CONNECTED TO THE USE OF ITS PRODUCTS OR FAILURE OF ITS PRODUCTS TO FUNCTION OR OPERATE PROPERLY. IN NO EVENT SHALL ESP'S LIABILITY HEREUNDER EXCEED THE PURCHASE PRICE ACTUALLY PAID BY THE BUYER FOR THE PRODUCT.

To the extent any provision of this warranty is held invalid or unenforceable by a court of competent jurisdiction, such holding will not affect the validity or enforceability of any other provision.

10.0 Repair and Return

Field Repair

The Echo is not intended to be repaired in the field. If a problem should develop, refer to the Troubleshooting section of this manual (Section 7.0). Please return the device to the factory for repair or replacement.

Return Material Authorization (RMA) Number

Contact ESP Safety Inc. at +1-408-886-9746 to obtain a Return Material Authorization (RMA) number. Please provide the following information during your call:

- Your Company Name
- Product Type
- Serial Number
- Date of Shipment
- Brief explanation of malfunction

Pack the unit properly to ensure that no shipping damage occurs and ship to:

ESP Safety, Inc.
555 North First Street
San Jose, CA 95112 USA

Write the RMA number on the front of the shipping carton.



ESP Safety, Inc. recommends that an inventory of spare detectors be kept on hand to enable rapid field replacement and minimize downtime.

11.0 Parts Ordering Information

The following items for the Echo may be ordered:

Echo Detector

ESP Echo Particle Detector	-	100-0030
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Accessories

Coupler Perforated Clamp	-	130-0001
Mounting Base	-	130-0002
Sandpaper	-	130-0003
Silicone Grease	-	130-0004
Metal scissors	-	130-0005
Bolts, DIN 931 bolt M8x100- A2	-	130-0006
Bolts, DIN 933 M6x12-A2	-	130-0007
Junction Box	-	130-0008

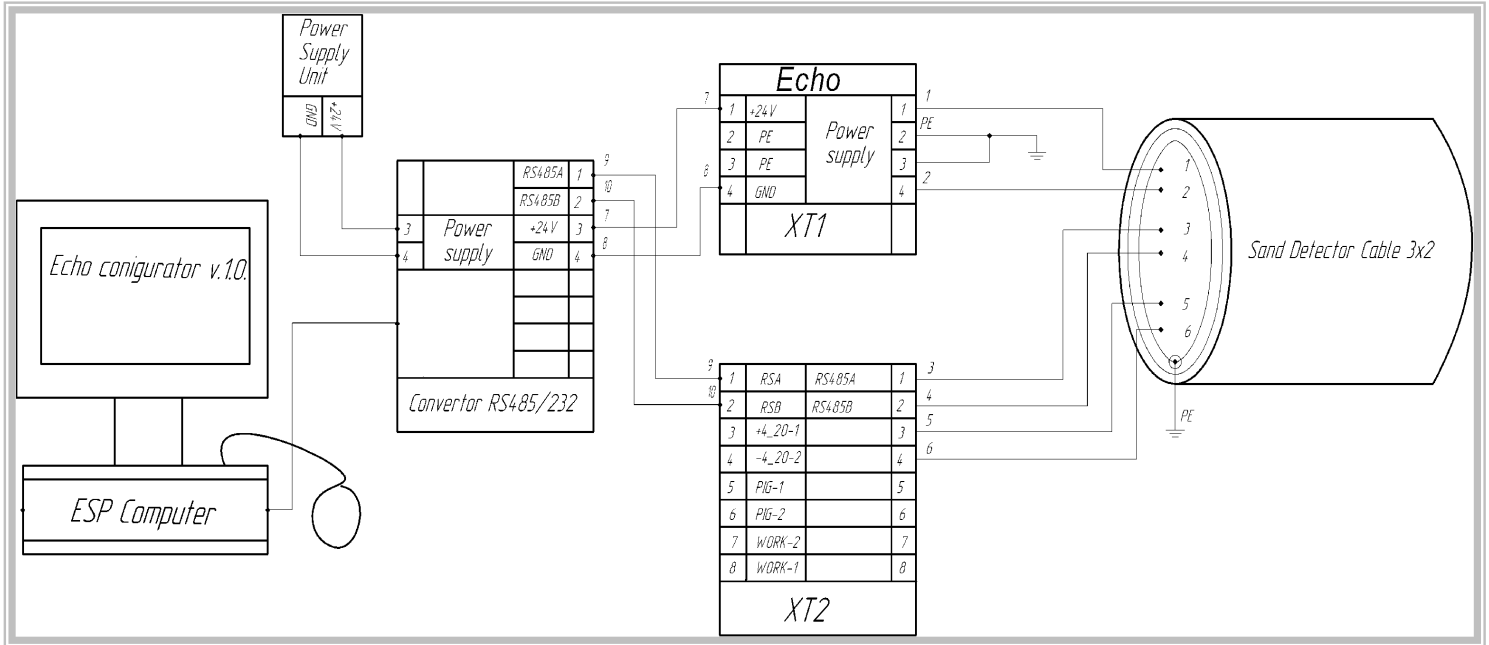
For applications not listed above, please contact ESP Safety.

Order from:

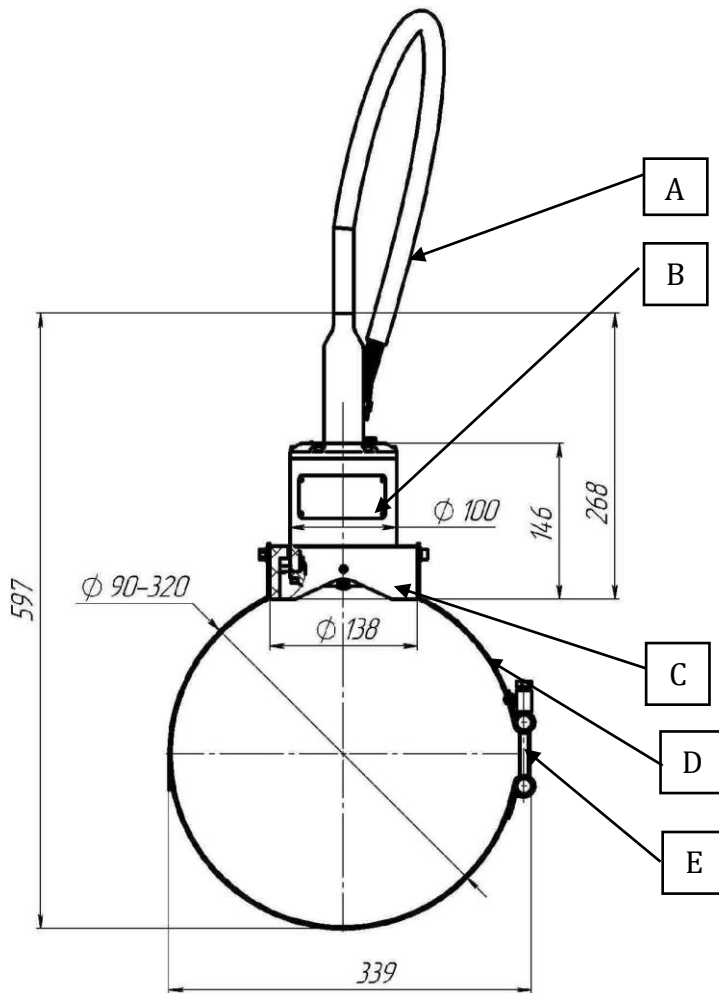
ESP Safety Inc.
555 North First Street
San Jose, CA 95112
USA
Ph: 408-886-9746
Fax: 408-886-9757
Website: www.espsafetyinc.com
Email: info@espsafetyinc.com

Please note that shipping charges will be added to your order.

Appendix 1 – Echo Detector Connecting Scheme



Appendix 2 – Echo Detector with Mounting Base dimensions



NOTES:

- A** Armored Cable with cable gland
- B** ESP Echo Particle Detector
- C** Mounting Base
- D** Coupler Clamp
- E** DIN 931 bolt M8x100- A2



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