



PIG Detector DSES

Operating Manual

825-0001



Technology of the Future...Protection for today

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

Date	Revision	Description	Approval/ECO
12/14/2017	A	Release to production	171214A

1.0 Introduction

1.1. Product Overview

PIG detector DSES (hereinafter – DSES) is a state-of the-art measuring device that is designed to detect and record the passing of PIG (hereinafter referred to as the DSES) of the DSES installation points on the pipe by processing signals from the registration channels and transmitting data to the automatic process control system about the passage of the PIG.

Key features

- low probability of false triggering of the detector and skipping the PIG;
- detection of the PIG moving through the pipeline in a wide speed range;
- Analog 4-20 w/HART, RS-485 Modbus RTU, and “dry contact” relays are standard data communication channels of the DSES Detector;
- DSES detector does not require any calibration or adjustment before use;
- 316SS or aluminum construction, explosion-proof housing, Zone 1;
- 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).

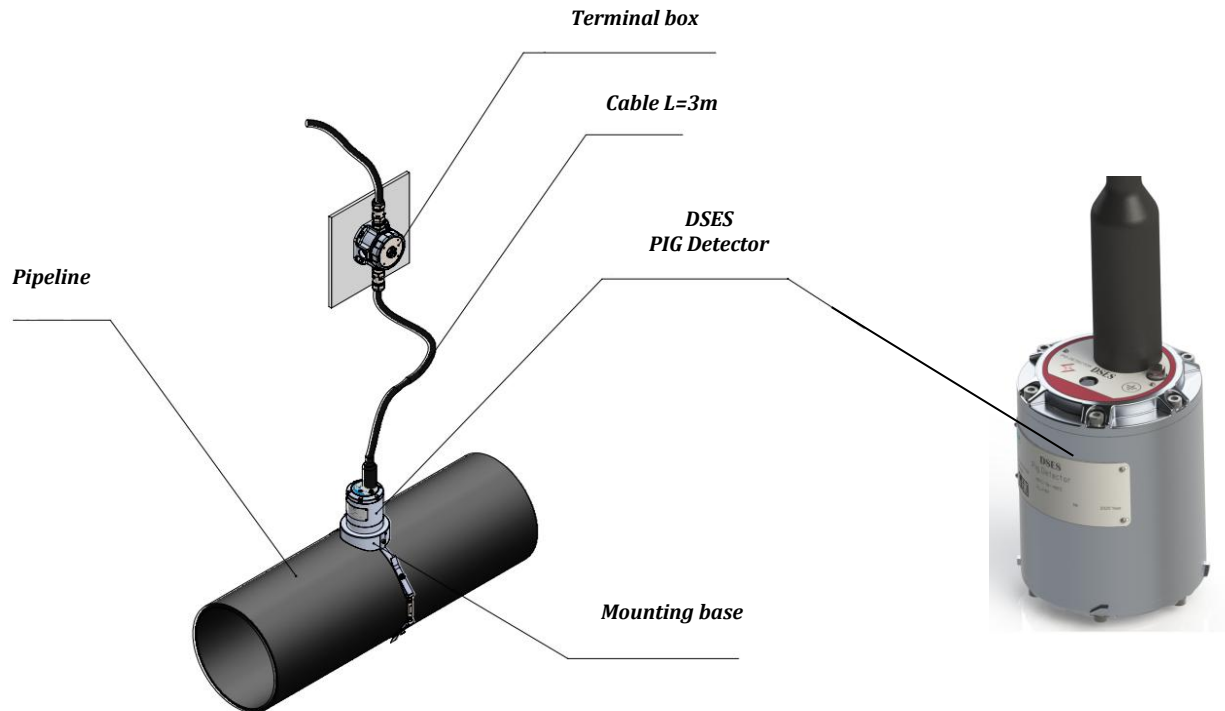
Field of Application

- 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: DSES installation



Principle of Operation

According to the principle of operation, DSES is contact device and is intended for installation directly on the body of the oil and gas pipeline on covers, in open sections of the pipeline and underground. The detector is mounted on the pipe body vertically with a magnetic clip or horizontally with a mounting clamp.

Acoustic noise in the ultrasonic range 100 ... 250 kHz created by a moving object is captured using a metal hub pressed against the surface of the pipe and a piezoelectric sensor rigidly mounted on the hub. The signal from the sensor passes through an amplifier with an adjustable gain, a high-pass filter, and enters the microcontroller. The microcontroller performs analog-to-digital signal conversion with a sampling frequency and Fourier transform, which allows for spectral analysis. The software estimates the frequency range of the signal, the shape and nature of the change in the spectrum, the duration of the observation, and concludes that the signal exceeds a generalized threshold value.

The conclusion about the passage of the PIG is made when thresholds are exceeded by at least two channels - acoustic (permanent) and electromagnetic or magnetic. The presence of one or another signal depends on the design of the object. The levels of generalized threshold values are set by setting a number of parameters for each channel separately using special software.

DSES Main Functions

- registration of the level of acoustic noise (acoustic channel);
- registration of an electromagnetic signal of a transponder;
- registration of fluctuations of a constant magnetic field (magnetic channel);
- processing signals from the registration channels and detecting the passage of a PIG based on the received data;
- digital processing of the received signal;
- data transfer to the automatic process control system about the passage of the PIG
- The detector has 3 measuring channels:
 - acoustical-mechanical based on a piezo sensor;
 - electromagnetic based on an oscillatory circuit;
 - magnetic channel based on a Hall sensor or inductor

PIG Detector DSES components

1. Cable gland
2. Ground bolt
3. LED indicator
4. DSES enclosure
5. Mounting base
6. Coupler clamp

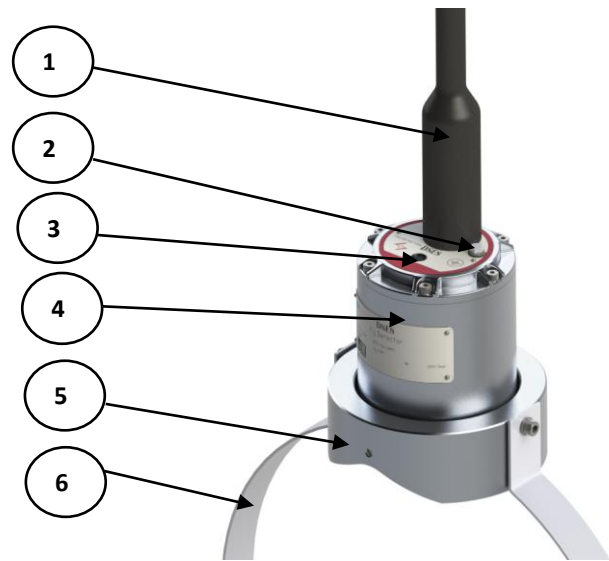


Figure 1-2: DSES components

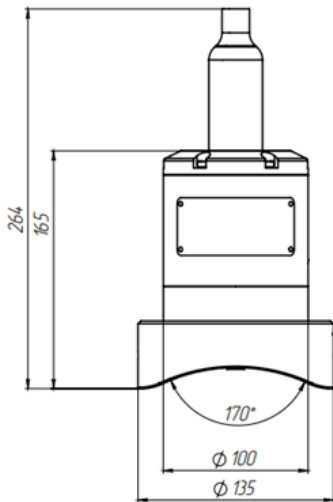


Figure 1-3: Echo Dimensions

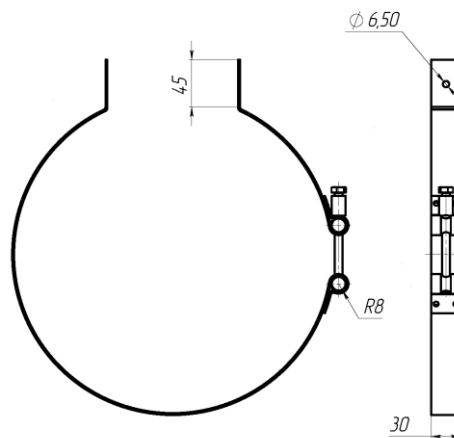


Figure 1-4: Coupler clamp dimensions

2.0 Specifications and Technical Data

Mechanical Characteristics	
Material	Stainless Steel (Type 316)
Conduit Connection	¾ NPT
Dimensions	5.75" x Ø 3.94" (146 mm x Ø 100 mm)
Mounting base size for pipes from 100 to 300 mm	5.75" (138 mm)
Weight (with mounting base)	No more then 13.23lb (6 kg)
Electrical Characteristics	
Input Voltage	+24VDC Nominal (+18 to 32VDC)
Power consumption	≤ 2,4 W
Output from Echo	4-20mA industry standard analog output Digital RS-485 Modbus RTU¹⁾ "Dry contact relay"²⁾ HART³⁾
Repeatability	Detector has repeatability less then 1%
Warm up time	30 seconds
Operation Characteristics	
Method of operation	Acoustic / electromagnetic / magnetic
Uncertainty	± 3 %
Transponder signal registration, frequency	22±1 Hz
Data storage	90 days with a recording interval of 10 seconds
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)
Humidity Range	Up to 100%, non-condensing (Withstands up to 100% RH for short periods)
Storage/Transportation Temperature	-50°C to +50°C (-58°F to 122°F)
Ingress Protection	IP66 / IP 68
Life time	10 years
Detector Approvals	
Ex marking	1Ex db IIC T4 Gb

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

Explosion protection Means

The table below describes the DSES 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 1Ex d IIB T4 Gb for ATEX / IECEx /EAC Zone 1, 2 and Division 2 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 DSES component parts and delivery set consists of the following:

- One PIG Detector DSES
- One PIG Detector DSES 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 DSES detector, examine the unit to ensure that:

- The nameplates and warning labels are in place.
- The external surfaces and joined surfaces of the DSES 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 DSES 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 DSES 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:

- DSES is installed on pipe with a mounting base and using bolts from the tool kit and accessories.
- 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**

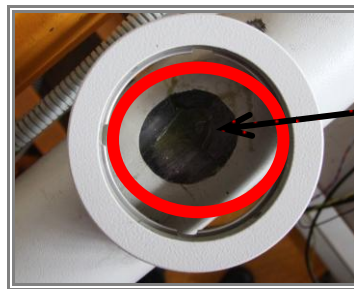
Consideration should be given to providing easy access for maintenance personnel. Detector location should also take into account the proximity to contaminants that may foul the detector prematurely.

**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

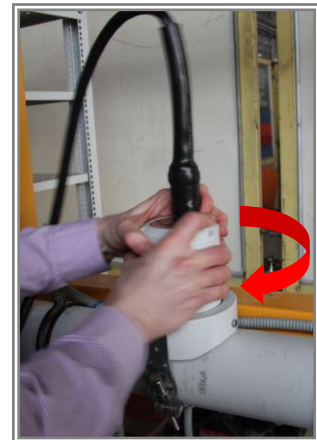
4.2 Mounting

- Apply Huskey HVS-100 Silicone Grease to the cleaned surface of pipe. 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



To clean a surface on a pipe to metal shine and apply grease

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



Proof that the detector 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 DSES detector is supplied pre-assembled, the output cables are marked and correspond to the following marks:

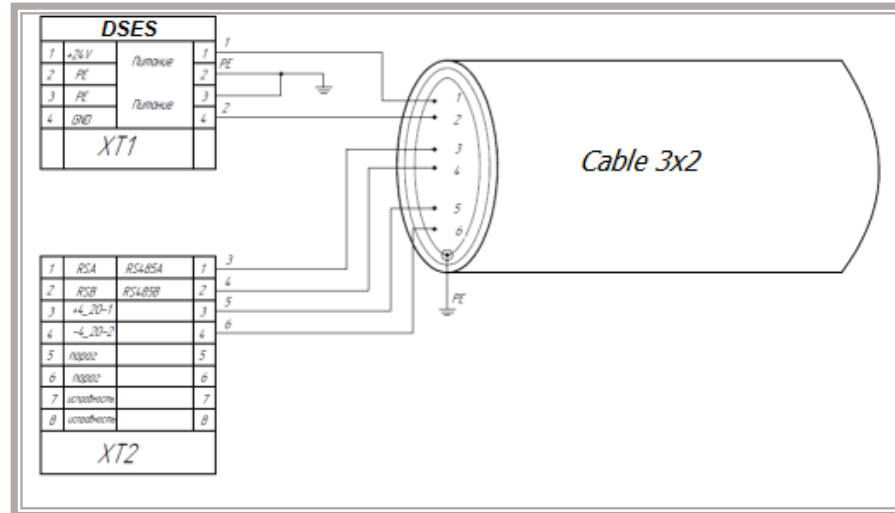
Core 1		Power «+»
Core 2		Power «-»
Core 3		RS- 485A
Core 4		RS-485B
Core 5		+ 4-20 mA
Core 6		- 4-20 mA
Ground core		



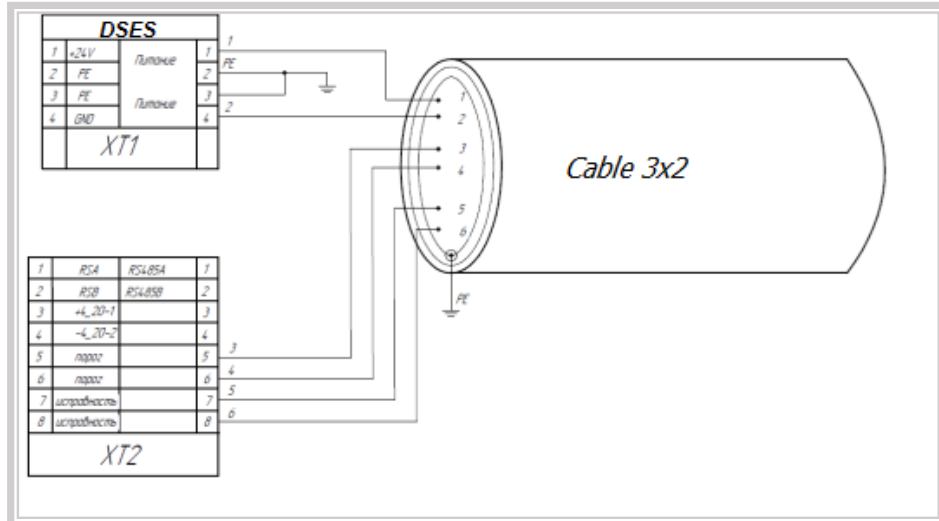
Attention! If it is necessary to remove signals from the relay outputs, the “dry contact” of the core can be reconnected to the corresponding terminals 5, 6, 7 and 8 of the XT2 connector on the terminal board.

Electrical Connection

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



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



5.0. PIG Detector DSES Operation

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

5.1. LED indicator operation modes:



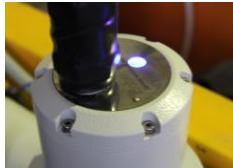
Detector has contacted.

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



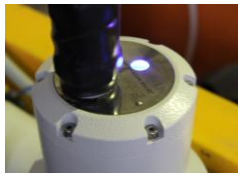
Self-diagnostic mode.

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.

6.0 Software DSES Configurator v1.0.


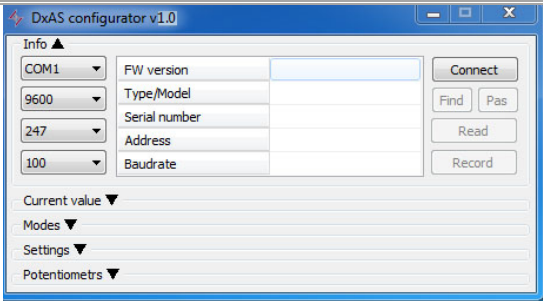
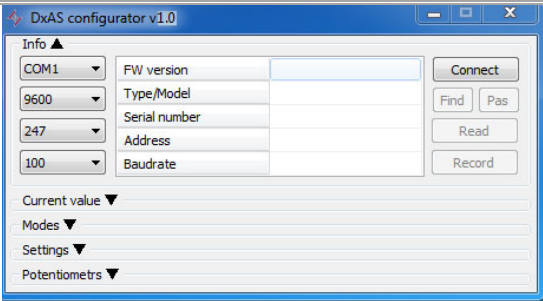
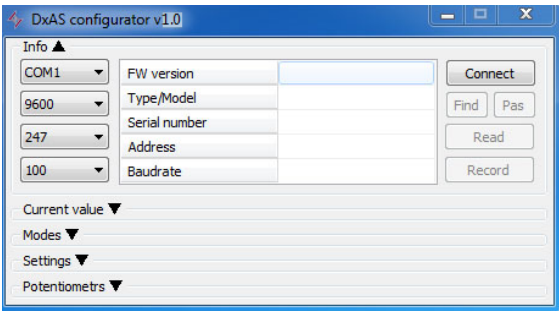
6.1. To configure and visualize the operating parameters of the PIG Detector DSES, the *DSES configurator v.1.0* software should be installed on the PC.

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 *DSES Configurator v.1.0* 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 *DSES configurator v1.0*.

<p>6.2.1. Open the DxAS Configurator v1.0 program on the desktop by clicking on the program icon.</p>	
<p>6.2.2. In the open program window, select COM port to connect the detector.</p> <p>COM1</p> <p>Before establishing communication with the device in the program, only the panel of connection parameters and information is available.</p>	
<p>6.2.3. In the open program window, click on the "Connect" button</p> <p>Connect</p>	
<p>6.2.4. After connecting the detector, click the "Read" button.</p> <p>Read</p>	

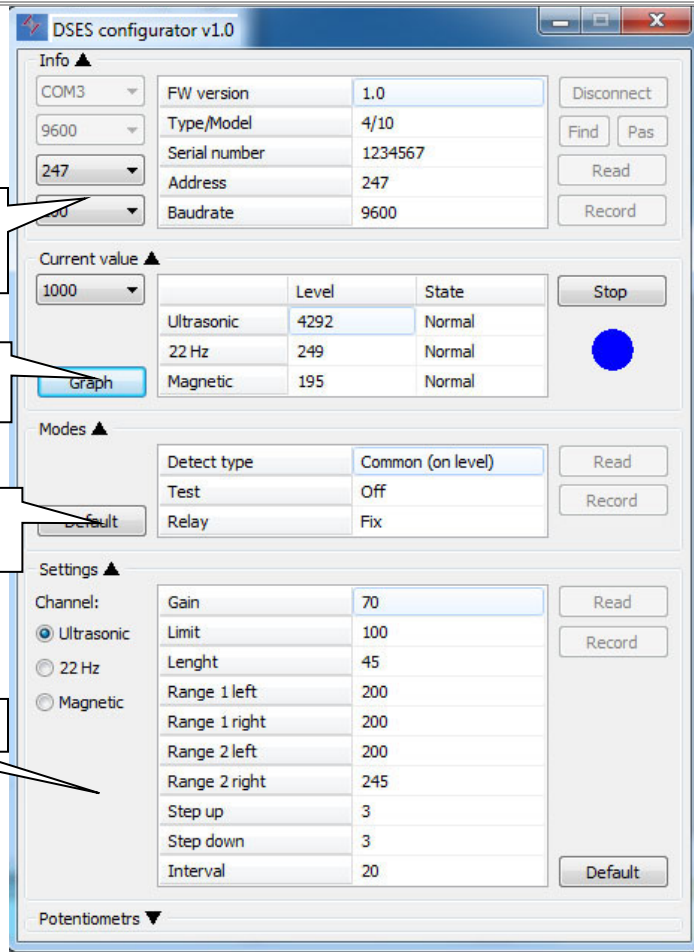
6.2.5. After establishing communication with the detector, the program interface will change to the *DSES configurator v1.0*. Additional settings panels are available for adjustments.

Panel of connection parameters and device information

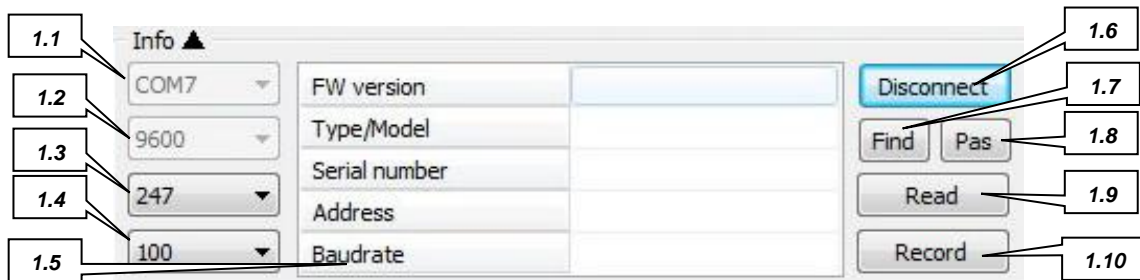
Settings panel

Panel of operating modes

Current Values Panel

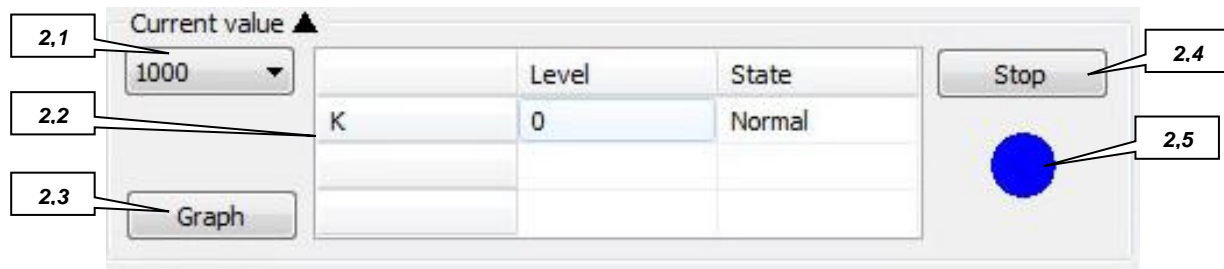


6.2.6. Description of the program interface:



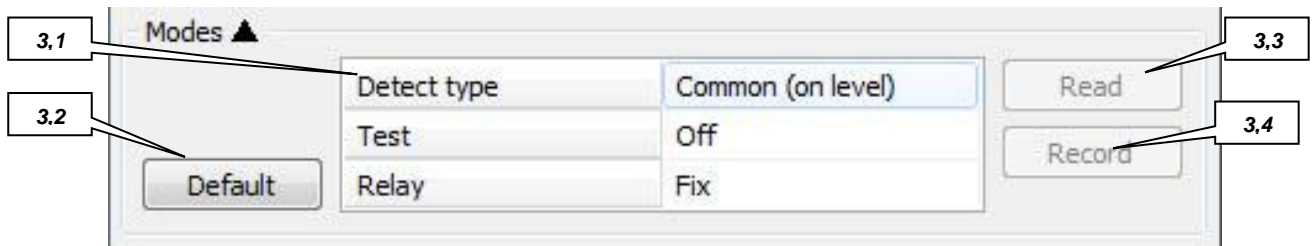
- 1.1 COM port number through which communication is carried out.
- 1.2 The exchange rate with the device.
- 1.3 MODBUS address of the device the program is accessing.
- 1.4 Response delay, in milliseconds.
- 1.5 Instrument Information I / O Table.
- 1.6 Button to enable or disable communication through 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

6.2.7. Description of the program interface:



- 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

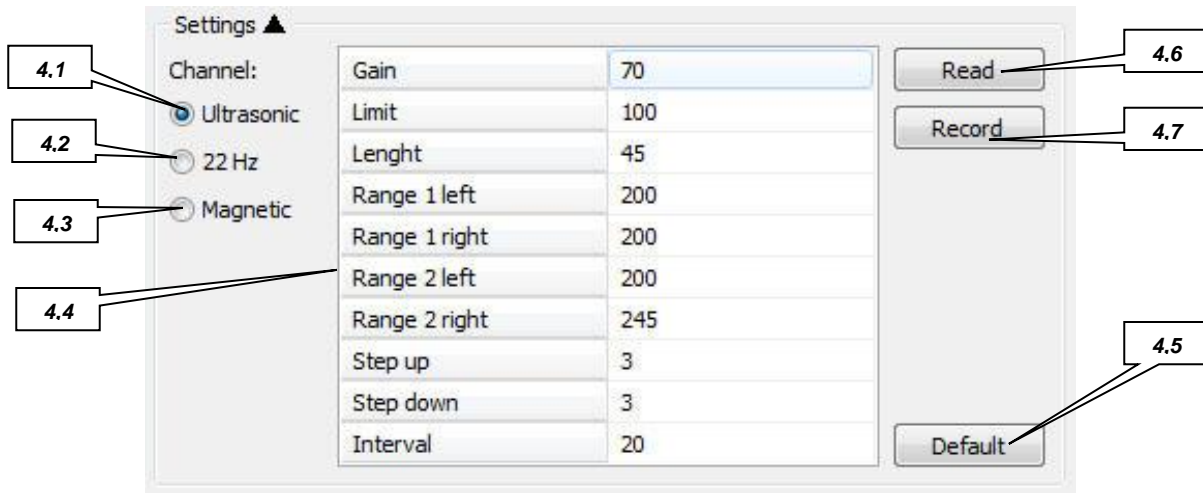
6.2.8. Description of the program interface:



- 3.1 Table of input / output information about the operating modes of the device.
- 3.2. Button for entering the default mode values (after entering, you must press the record button).
- 3.3 Button for reading operating modes.
- 3.4 Button for recording operating modes.

The panel of operating modes	
The panel of operating modes	
The panel of operating modes	

6.2.9. Description of the program interface:



4.1 The choice of the first channel is ultrasound.

4.2 The choice of the second channel - 22 Hz.

4.3 The choice of the third channel is magnetic.

4.4 Table of input / output settings.

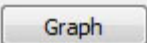
4.5. Button for entering the default settings (after entering, you must press the record button).

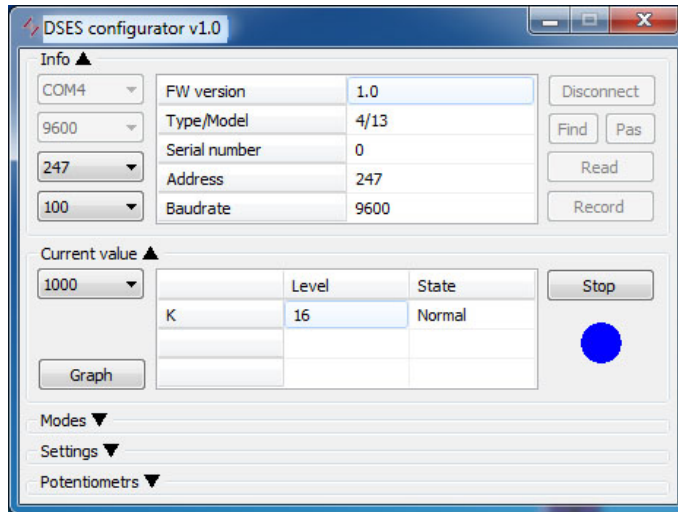
4.6 Button for reading device settings.

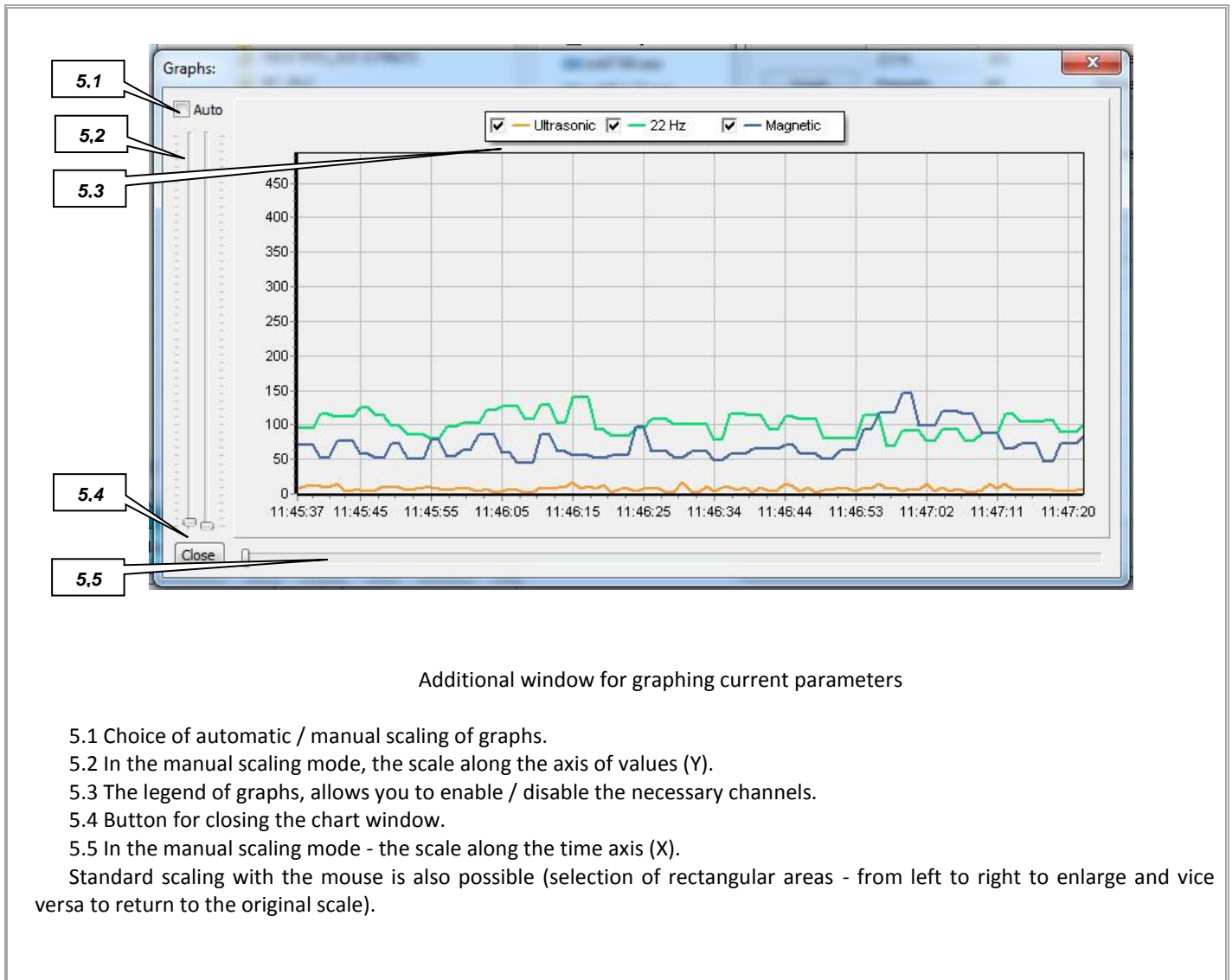
4.7 Button for recording instrument settings.

Input / output, reading / writing as well as entering the default settings is carried out ONLY for the selected channel (clauses 4.1 - 4.3).

6.2.10. 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.





Additional window for graphing current parameters

5.1 Choice of automatic / manual scaling of graphs.

5.2 In the manual scaling mode, the scale along the axis of values (Y).

5.3 The legend of graphs, allows you to enable / disable the necessary channels.

5.4 Button for closing the chart window.

5.5 In the manual scaling mode - the scale along the time axis (X).

Standard scaling with the mouse is also possible (selection of rectangular areas - from left to right to enlarge 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 DSES does not contain any user-serviceable parts. Any repair of the DSES should be performed by ESP Safety personnel. Any attempt to repair or service the DSES by unauthorized personnel will void the product warranty.

8.0 Maintenance

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

- 8.1. **Conducting an external** inspection of the DSES detector for visible external damage.
- 8.2. **Checking the reliability of mounting the coupler clamp** on the pipe.
- 8.3. **DSES 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.

9.0 Warranties

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 DSES 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:

DSES Detector

PIG Detector DSES	-	100-0034
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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

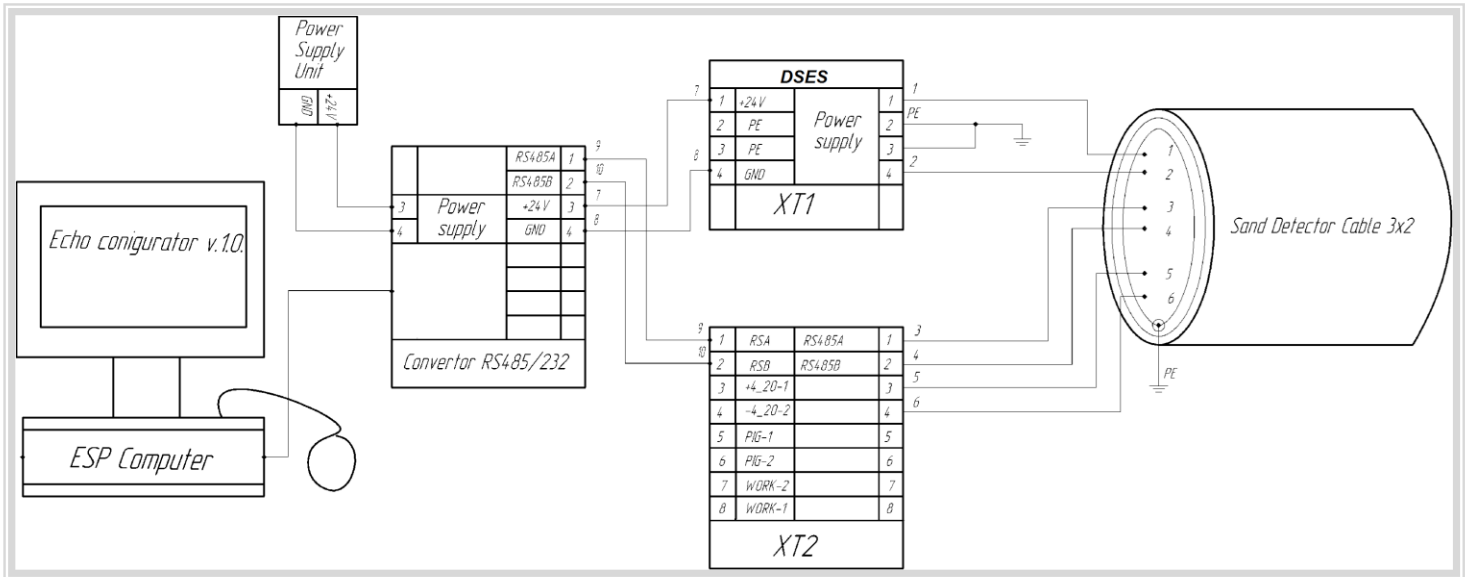
For applications not listed above, please contact ESP Safety.

Order from:

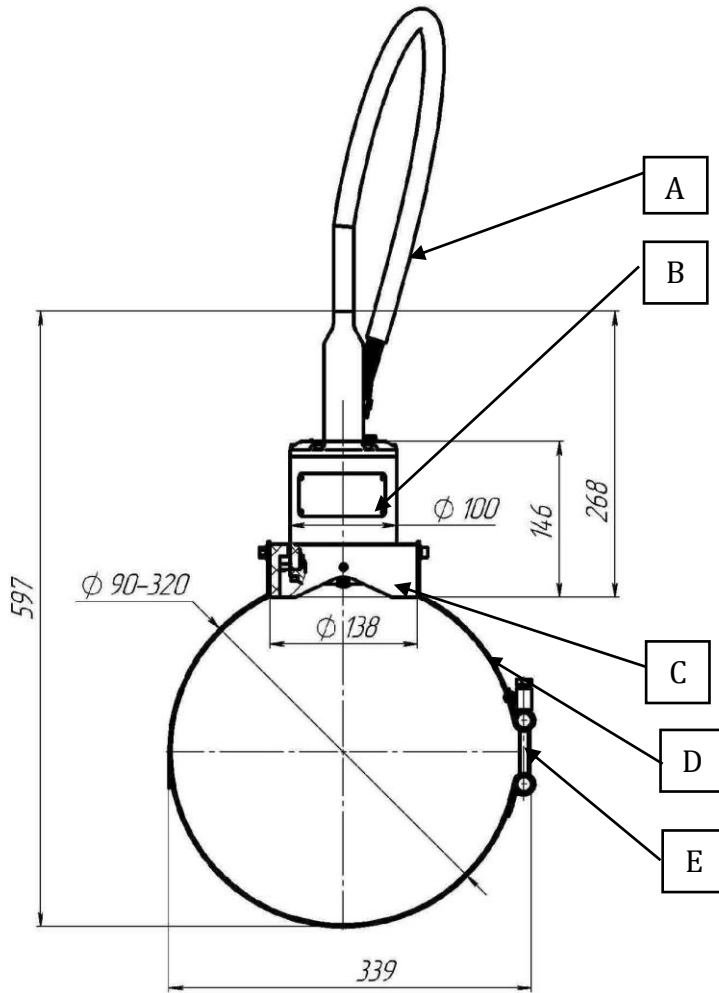
ESP Safety Inc.
 555 North First Street
 San Jose, CA 95112
 USA
 Ph: 408-886-9746
 Fax: 408-886-9757
 Website: www.espsafetyinc.com
 Email: info@espsafetyinc.com

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

Appendix 1 – DSES Detector Connecting Scheme



Appendix 2 – PIG Detector DSES with Mounting Base dimensions



NOTES:

- A** Armored Cable with cable gland
- B** PIG Detector DSES
- C** Mounting Base
- D** Coupler Clamp
- E** DIN 931 bolt M8x100- À2



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