

User Manual

Vesala SG33 X2.0 ENG

for Vesala Signal Generator SG33 version X2.0

IMPORTANT: Read carefully before use.

Keep for future reference.



English

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VESALA

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1 Safety notes

To avoid possible harm, read and follow these instructions.



DANGER: Risk of electric shock

When Signal Generator SG33 is connected to a hazardously live circuit, batteries will become hazardously live. Touching hazardously live batteries may result in an injury or death. Always disconnect both test leads before removing the battery cover. Do not operate the device without its battery cover. Inspect the battery cover seal every time the battery cover is opened. If necessary, clean the battery cover seal according to section 5.2: Cleaning and maintenance. Close battery cover carefully after every battery change.

 **DANGER:** Risk of electric shock, fire or property damage

Connecting to hazardously live circuits with inappropriate test leads or accessories may result in an injury, death, fire or property damage. Only use test leads with adequate rated voltage and measurement category. In wet conditions, only use test leads and accessories with adequate protection against ingress of water. Note that the supplied test leads and accessories have no protection against ingress of water.

 **CAUTION:** Documentation must be consulted, risk of electric shock

When Signal Generator SG33 is connected to a previously safe circuit, the circuit may become hazardously live. Touching live circuits may result in an injury. Do not touch connected circuits when wet. In wet conditions, use protection against electric shock when possible. Do not use boost mode in wet conditions if protection against electric shock cannot be used. Do not connect Signal Generator SG33 between a hazardously live circuit and a circuit that does not have protection against electric shock. For safe and proper connection consult section 4: Operating Signal Generator SG33.



CAUTION: Documentation must be consulted, risk of electric shock or fire
Damaged or modified device may behave in an unsafe way. Using a damaged or modified device may result in an injury or property damage. Do not try to open the enclosure. Do not attempt to modify the device or accessories in any way. Do not use an unspecified battery. Periodically inspect the device and accessories against any signs of damage due to aging, mishandling, fall, etc. Dispose of any damaged accessories appropriately. Replacements are available from the supplier. Immediately stop using a damaged device and remove batteries. Make sure that a damaged device is serviced or disposed of before next use. For replacement accessories consult sections 3.3: Package contents and section 6: Supplier contact information. For instructions for proper disposing of consult section 5.6: Disposal.



CAUTION: Documentation must be consulted, risk of electric shock or fire
Signal Generator SG33 has been specified to operate at altitudes up to 2000 m when connected to hazardous live circuits. Connecting the device to a hazardous live circuit at an altitude over 2000 m may result in an injury or property damage. Before connecting Signal Generator SG33 to a circuit at an altitude over 2000 m, make sure that the circuit is not hazardous live. For permitted ambient conditions consult section 3.2: Specifications.

In the event of electric shock

1. Quickly assess the situation.
2. Turn off the power if possible.
3. Disconnect the patient from the supply with an insulating object if necessary.
4. Assess the condition of the patient.
5. Alert emergency responders if necessary.
6. Give CPR if necessary.
7. Direct emergency responders to the patient.
8. Prevent further injuries by informing others about the accident.
9. Always seek medical attention.

In the event of fire

1. Quickly assess the situation.
2. Turn off the power if possible.
3. Alert others in danger.
4. Alert emergency responders if necessary.
5. Try to put out the fire if possible.
6. Contain the fire if possible.
7. Direct emergency responders to the location.

In the event of property damage

1. Quickly assess the situation.
2. Turn off the power if possible.
3. Prevent further damage by informing others about the accident.
4. Repair or replace damaged property.

2 Explanation of symbols placed on the product



DANGER: Possibility of electric shock.



CAUTION: Documentation must be consulted in all cases where this symbol is marked.

3 General description

3.1 Intended use

Signal Generator SG33 is a rugged 33 kHz cable locator signal generator which can be used indoors and outdoors to locate and identify cables, wires, pipes, ducts, circuit breakers, switches, fuses and cable faults. Signal Generator SG33 outputs a signal at 32768 Hz which is detected with a separate compatible cable locator. SG33 may be connected directly using test leads to a live or non-energized circuit or between a non-energized circuit and ground. Additionally, SG33 may be connected indirectly using a clamp-on transformer accessory or an inductive coupler accessory. SG33 is intended to be used by a skilled electrician.

3.2 Specifications

I/O ports	Two 4 mm safety sockets
Output signal	32768 Hz \pm 2 Hz sine wave, either continuous wave or 100% AM at 4 Hz or 8 Hz
Output level, normal mode	<16 V, <110 mA, <0.5 W
Output level, boost mode	<30 V, <220 mA, <1.7 W
Output impedance	180 Ω @ 33 kHz
Input impedance	23 k Ω @ 60 Hz, 450 V
Rated voltage and frequency	450 V, 0...60 Hz
Measurement categories	CAT III 300 V CAT II 450 V
Output fuse	400 mA, time-delay, 600 V
Ambient temperature, LR6 batteries, device in boost mode	+5°C...+40°C
Ambient temperature, LR6 batteries, device in normal mode	-10°C...+40°C

Ambient temperature, HR6 or FR6 batteries	-10°C...+40°C
Humidity	0...100 % RH
Atmospheric pressure and altitude	75...106 kPa, maximum altitude 2000 m
Storage conditions, batteries installed	+5°C...+30°C, 10...90 % RH non-condensing
Storage conditions, batteries removed	-20°C...+40°C, 10...90 % RH non-condensing
Indicators	6 LED bar for output current and battery voltage, power LED, boost LED, pulse LED
Batteries	6 pcs, 1.2...1.5V, IEC LR6 alkaline, HR6 NiMH or FR6 Li-FeS2
Nominal battery voltage	9 V
Operating voltage range	6.9...11 V
Current consumption	10...300 mA @ 9 V
Battery fuse	1.5 A, 8 V, resettable
Enclosure	ABS+PC, size 155 x 90 x 52 mm
Degree of protection	IEC 60529 IP67 (not operational)

Weight	438 g including LR6 batteries
International standards this product is in conformance with	EN 61326-1:2013 EN 61326-2-2:2013 EN 61010-1:2010/A1:2019/AC:2019-04 EN 61010-2-030:2010 EN IEC 63000:2018
Electromagnetic environment	EN 6326-1:2013 Industrial electromagnetic environment
Supported accessories	S3TB Test lead for connecting to low-voltage mains installation, CEE 7/7, 250 V PM50 Clamp-on transformer for cable diameter up to 50 mm PM100 Clamp-on transformer for cable diameter up to 100 mm SY33 Inductive coupler for buried cables, 33 kHz SPA10 Flexible antenna for locating ducts, length 10 m

3.3 Package contents

The following items are supplied in the package.

- Signal Generator SG33, version X2.0 (V11358)
Version number is indicated at the beginning of the serial number.
- 1.5 V alkaline battery LR6 (J01576), 6 pcs
- TB10p Safety test lead for direct connection,
4 mm 1 m CAT III 1000V red (V15925)
- XKKp Alligator clip for direct connection,
insulated 1000 V red (X25915)
- TB10m Safety test lead for direct connection,
4 mm 1 m CAT III 1000V black (V15926)
- XKKm Alligator clip for direct connection,
insulated 1000 V black (X25913)



One or more of the following optional accessories may be included in the kit.

- S3TB Test lead for connecting to low-voltage mains installation, CEE 7/7, 250 V (V15928)
- 10/TX-Earthstake grounding rod for earthing an output (Z32268)
- PM50 Clamp-on transformer for inductively coupling to small objects, diameter up to 50 mm (V14150)
- PM100 Clamp-on transformer for inductively coupling to objects, diameter up to 100 mm (V14158)
- SPA10 Pipe transmitter antenna for locating short, non-conductive ducts, length 10 m, flexible (V14160)
- SY33 Inductive coupler for indirectly connecting to buried cables, 33 kHz (V14120)



Accessories and spares may be purchased separately. Other devices may be sold together with Signal Generator SG33 or included in the kit. Refer to their corresponding information for use.

3.4 Selecting and changing batteries

Signal Generator SG33 can use three different types of batteries: IEC LR6 alkaline, HR6 NiMH or FR6 Li-FeS₂. Ambient temperature, boost mode usage, environment and economy should be considered when selecting batteries. Disposable FR6 Li-FeS₂ batteries give the best performance and longest battery life but are rather expensive. Rechargeable HR6 NiMH batteries are an all-round good choice at temperatures down to -10°C and especially when boost mode is used. Low cost LR6 alkaline batteries perform well in normal mode at ambient temperatures above +5°C. At lower temperatures boost mode cannot be used with LR6 batteries. However, LR6 batteries can be used in normal mode down to -10°C with slightly reduced battery life.



DANGER: Risk of electric shock

When Signal Generator SG33 is connected to a hazardously live circuit, batteries will become hazardously live. Touching hazardously live batteries may result in an injury or death. Always disconnect both test leads before removing the battery cover.

If the device is dirty or wet, clean and dry the outer surface of the device with a soft cloth before removing the battery cover. Open two PZ2 screws at the bottom of the device to remove the battery cover. Inspect the battery cover seal for dirt. If necessary, clean the battery cover seal according to section 5.2: Cleaning and maintenance. Remove old batteries. Insert six batteries of the same type. Observe battery polarity. Close battery cover carefully with hand tools and do not overtighten the screws. Do not operate the device without its battery cover in place.

3.5 Signal Generator SG33 parts and functions

Output connectors: Two 4 mm safety sockets

Strap

Secure to a solid object when working at heights

Output current indicator

Displays current between 0.3 mA and 100 mA

Power LED

LED blinks if batteries are weak

Power button

Long press: toggle power on or off

Short press and releasing after start-up:
display battery voltage

Extended start-up press: display firmware version

BOOST LED and button

Toggle boost mode which increases output voltage

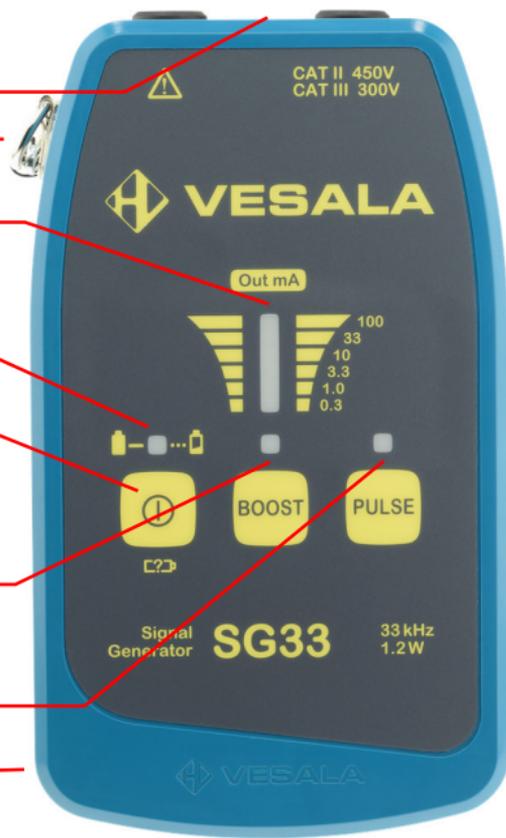
Long press is required to turn on boost mode

PULSE LED and button

Cycle pulsing modes: continuous, 4 Hz, 8 Hz

Batteries

Bottom side, under the battery cover: 6 x LR6, HR6 or FR6



4 Operating Signal Generator SG33

4.1 Introduction to locating

A cable locator detects the magnetic field or, in some cases, electric field, emitted by the located object. In most cases a signal generator is used to generate this signal. The output current indicator in Signal Generator SG33 displays how strong the signal is. The following chapters describe the most common cases when a signal generator is connected to a cable, wire, duct or pipe. The same principles can be applied to other similar cases. Technical support and training are available at your supplier. Majority of cable locating work should be done when located cables are either disconnected or voltage free and conditions are dry.

4.2 Precautions with hazardously live circuits and in wet conditions

Precautions shall be taken before connecting Signal Generator SG33 to a hazardously live circuit or when conditions are wet. When these instructions are followed, operation is safe with hazardously live circuits and in wet conditions.

 **DANGER:** Risk of electric shock, fire or property damage

Connecting to hazardously live circuits with inappropriate test leads or accessories may result in an injury, death, fire or property damage. Only use test leads with adequate rated voltage and measurement category. In wet conditions, only use test leads and accessories with adequate protection against ingress of water. Note that the supplied test leads and accessories have no protection against ingress of water.

 **CAUTION:** Risk of electric shock

When Signal Generator SG33 is connected to a previously safe circuit, the circuit may become hazardously live. Touching live circuits may result in an injury. Do not touch connected circuits when wet. In wet conditions, use protection against electric shock when possible. Do not use boost mode in wet conditions if protection against electric shock cannot be used. Do not connect Signal Generator SG33 between a hazardously live circuit and a circuit that does not have protection against electric shock.

When simultaneously all three conditions apply, the Signal generator SG33 output voltage alone may be considered hazardous:

- Conditions are wet.
- Boost mode is in use.
- Circuit connected between Signal Generator SG33 outputs has high impedance.



CAUTION: Conditions and impedance can vary unexpectedly and without warning. Conditions can be wet at other parts of circuits even when connection is made in dry conditions. Especially when locating faults, impedance of connected circuits can vary suddenly and unexpectedly.

When simultaneously all three conditions apply, current flowing through Signal Generator SG33 may cause a hazard:

- One output is connected to a hazardously live circuit.
- The other output is connected to a circuit that has no protection against electric shock.
- A transient phenomenon triggers an over voltage protection device inside Signal Generator SG33 shunting hazardous current to the unprotected circuit for a short time period.



CAUTION: Risk of electric shock or fire

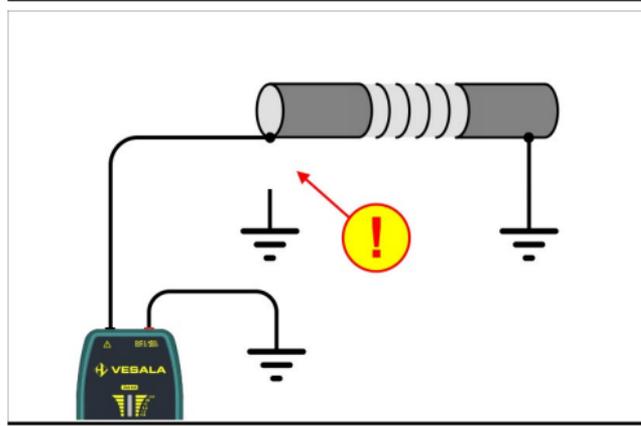
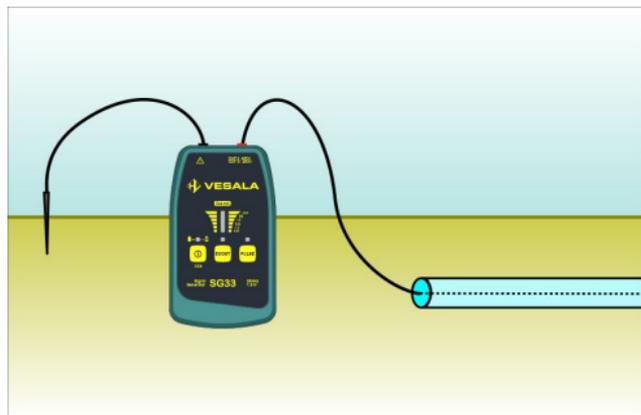
Signal Generator SG33 has been specified to operate at altitudes up to 2000 m when connected to hazardously live circuits. Connecting the device to a hazardously live circuit at an altitude over 2000 m may result in an injury or property damage. Before connecting Signal Generator SG33 to a circuit at an altitude over 2000 m, make sure that the circuit is not hazardously live.

4.3 Locating accessible buried cables

To locate a buried cable whose end is accessible, connect one SG33 output to the cable. If the cable has a grounded shield, disconnect the shield from the cable end SG33 is connected to and connect SG33 to the shield. Ground the second SG33 output in the opposite direction from the located cable with a grounding rod, or to a nearby grounded object.

Boost mode is recommended if the other end of the cable has poor or no connection to ground or the soil is dry. Buried cables whose other end has poor or no connection to ground have a section at the other end that cannot be located. The length of this section varies from a few meters to tens of meters.

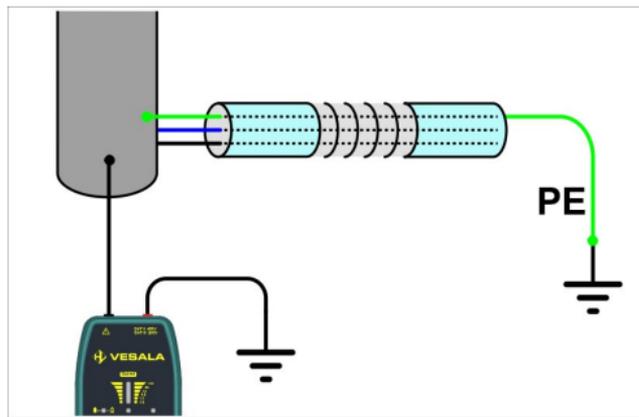
Conductive pipes and ducts can also be located using this method.



4.4 Locating cables connected to a grounded object

To locate a cable connected to a grounded object, connect one SG33 output to the object itself. Ground the second output in the opposite direction from the located cable with a grounding rod as far as possible. If soil is inaccessible, ground the second output to another nearby grounded object that is not connected to the located cable.

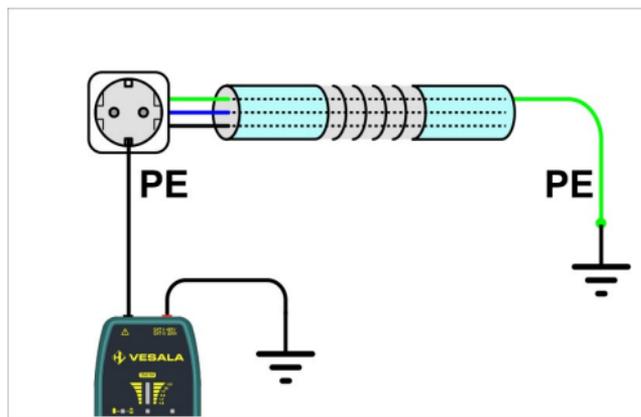
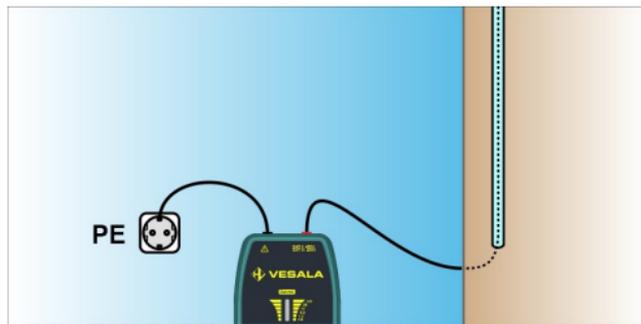
Boost mode is recommended if the other end of the cable has poor or no connection to ground or the soil is dry. It is possible to locate multiple cables connected to the same grounded object with this method.



4.5 Locating cables indoors

To locate a cable indoors, connect one SG33 output to the cable and the other output to a nearby grounded object, like a wall outlet PE connector. If the located cable and the cable feeding the grounded object share the same route, locating may be difficult. It is therefore advisable to connect to a grounded object far away from the located cable. Ideally, use an additional wire to connect to a grounding rod, placed outdoors.

It is possible to connect SG33 between two different conductors in the same cable but locating range will be reduced. Boost mode may be required if the other end is unconnected. To locate exposed wire ends, refer to section 4.9: Locating and identifying open ends of wires.

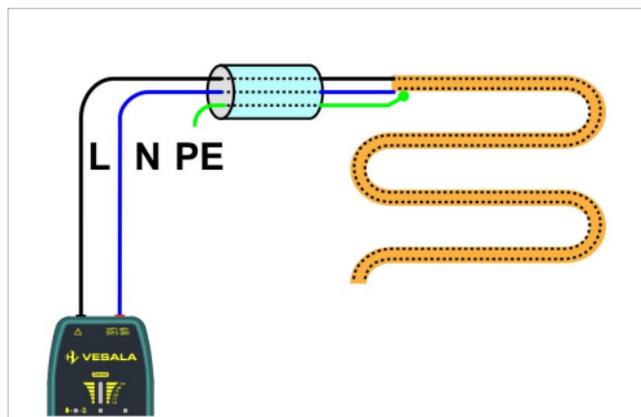
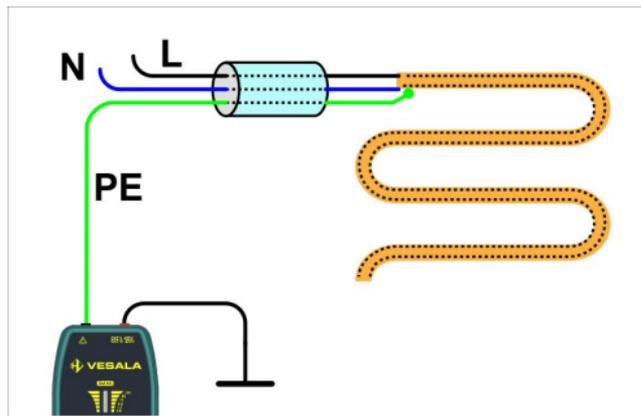


4.6 Locating heating cables

Disconnect all heating cable conductors before connecting SG33 to it.

Connect SG33 between heating cable's PE conductor and ground. Locating accuracy is good with this method, but a short section at the end of the heating cable cannot be located. Boost mode is recommended to minimize the length of this section.

If PE conductor or ground is inaccessible or the entire cable needs to be located, connect SG33 between heating cable's current carrying conductors, possibly marked live and neutral. Locating accuracy may be lower using this method, but the whole cable can be located if it is intact.



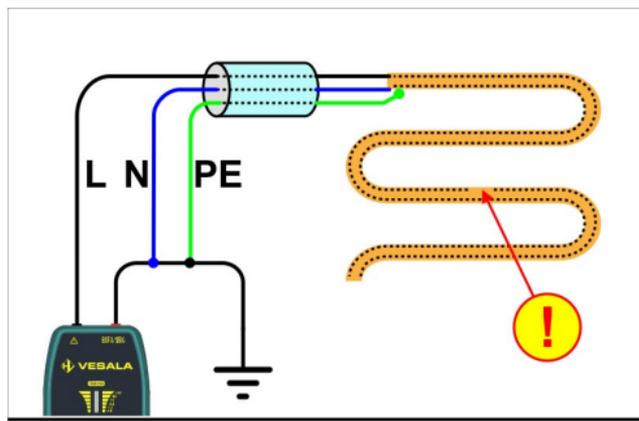
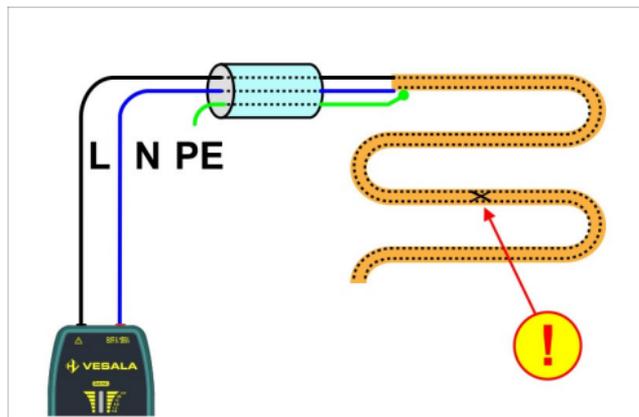
4.7 Locating cable faults

Cable faults are sometimes difficult to locate. It is possible that a failed cable has multiple faults which may or may not be of different types. Repairing some faults may be necessary before the rest can be found. Fault properties can change during locating making work even more difficult.

Disconnect all conductors and shielding at both ends of the faulty cable and use a multimeter to determine the type of the fault: short circuit, open circuit or a combination of faults. If necessary, refer to multimeter information for use.

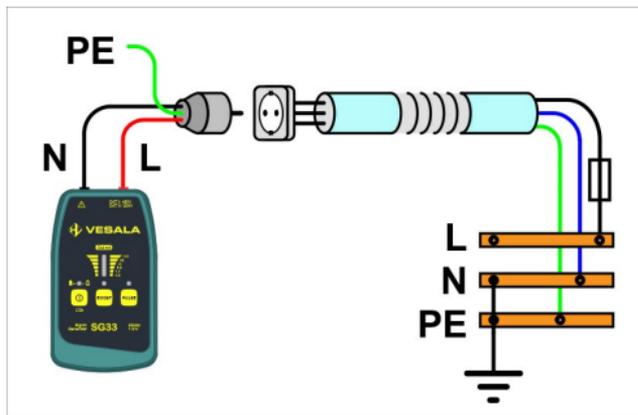
Short circuit: Connect SG33 between the shorted conductors and leave other conductors unconnected.

Open circuit: Connect SG33 between ground and the faulty conductor. Ground all the other conductors and cable shield. Boost mode is recommended.



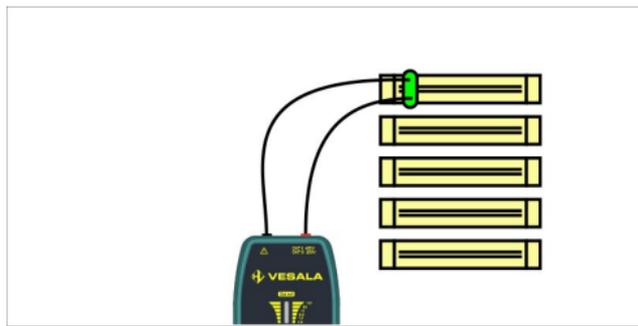
4.8 Identifying circuit breakers, switches and fuses in low voltage network

When there is a need to locate the circuit breaker, switch or fuse that feeds a cable, connect SG33 between the live and neutral conductors of the cable. If possible, use S3TB test lead to connect SG33 to an outlet already connected to the cable. Connect S3TB's red and black wires to SG33 and leave yellow-green PE wire unconnected.



4.9 Locating and identifying open ends of wires

Connect both SG33 outputs to a wire pair or between a single wire and ground. Wires should be located using cable locator's capacitive, or E-field, antenna.

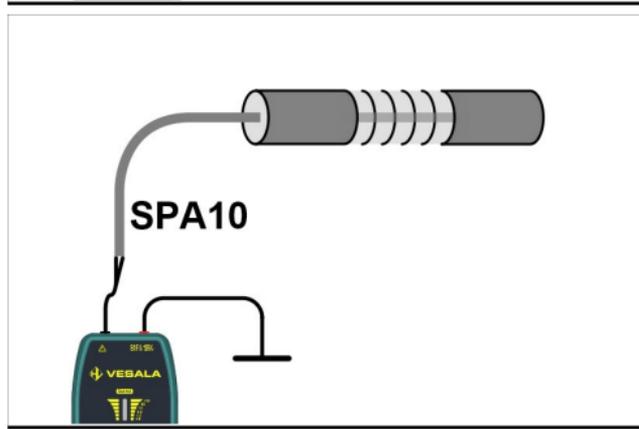
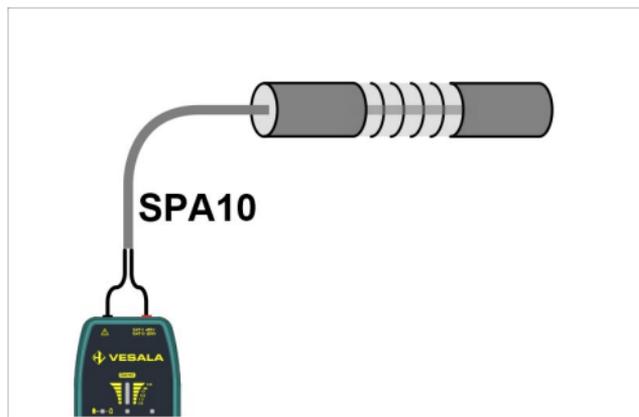


4.10 Locating short non-conductive pipes and ducts

SPA10 Pipe transmitter antenna accessory may be used to locate up to 10 m long non-conductive pipes or ducts and to pinpoint their blockages.

Blockage: Connect both SPA10 connectors to SG33. Push SPA10 into the pipe or duct until it stops at the blockage. Refer to your cable locator information for use for how to locate 33 kHz sondes.

Route: Connect both SPA10 connectors to one SG33 output. Ground the other SG33 output. Push SPA10 into the pipe or duct until it stops or its length runs out. Boost mode is recommended. Refer to your cable locator information for use for how to locate cables.

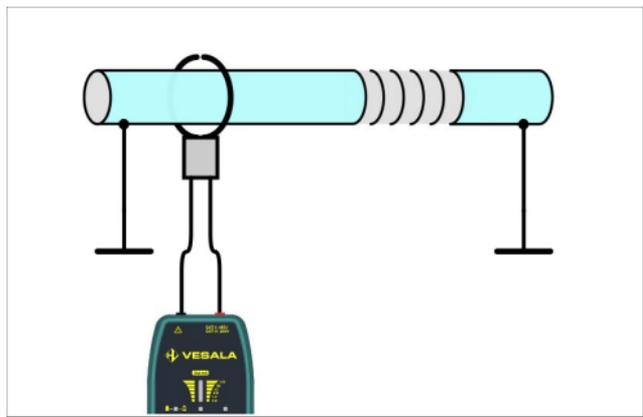


4.11 Using clamp-on transformers

Clamp-on transformer accessories may be used to locate cables, wires, conductive ducts or pipes whose both ends are inaccessible for direct connection. They may also be used to speed-up and simplify cable locating since connected cables do not have to be disconnected.

Select a clamp-on transformer that has a larger inner diameter than the located object. Connect both clamp-on transformer wires to SG33. Clamp the clamp-on transformer on the located object.

Locating is easiest when both ends are grounded or the object is looped. If one end is unconnected, position the clamp-on transformer near the connected end. A section at the end of the unconnected end cannot be located. If both ends are unconnected, position the clamp-on transformer near the midpoint. Neither end can then be located. Boost mode is recommended if one or both ends have poor or no connection to ground or when the located object is buried.



4.12 Using inductive couplers

Inductive coupler accessories may be used to locate buried cables, wires, conductive ducts or pipes that are inaccessible for both direct connection and for clamp-on transformers. Inductive couplers have limited range and a zone near the coupler where locating is impossible. Often locating has to be done in sections. Inductive couplers are ineffective on short objects and near end points.

Position the inductive coupler on the located object perpendicular (at a 90° angle) to the object. Connect both inductive coupler wires to SG33 and enable boost mode. Refer to your cable locator information for use for how to locate cables. Start locating outside the immediate proximity of the inductive coupler. Mark the path on the ground. When signal strength is too low, relocate the inductive coupler further on the path.

4.13 Using pulse function

Pulse function modulates SG33 output signal with 4 Hz or 8 Hz. Pulsing makes SG33 signal easier to distinguish among other 33 kHz signals and noise. Using pulse function lowers battery consumption and locating range.

If two SG33s are available when locating cable faults, connect one SG33 to each end of the cable and use a different pulse frequency in both of them. At the fault point both signals should have approximately the same strength.

5 Taking care of your equipment

5.1 Storing

Remove batteries before storing the device for an extended period of time or in extreme temperatures. Batteries left in the device may eventually leak and cause damage. Batteries may deteriorate at high temperatures and may not be ready for use after being stored at a low temperature. Store the device, batteries and accessories inside its original packaging in a dry, warm place.

5.2 Cleaning and maintenance

If the device is dirty or wet, clean and dry the outer surface of the device with a soft cloth. Avoid getting dirt or water inside the device. A small amount of isopropanol can be used to remove stains and disinfect the surface. When changing batteries check that the batteries have not leaked. Battery contacts and battery cover seal should only be cleaned with isopropanol and a soft, lint free cloth.

Periodically inspect that battery cover seal is in working condition. The battery cover can be sent to your supplier for seal replacement.

5.3 Troubleshooting

If case of trouble, follow the table below for possible remedy.

Problem	Possible explanations	Remedy
The device does not power up.	One or more battery is empty.	Replace all batteries.
	One or more battery is reversed.	Orient batteries according to markings.
Received signal strength is too high.	Boost mode is in use unnecessarily.	Use boost mode only when needed to conserve batteries and to avoid overdriving the locator.
Received signal is weak.	Boost mode is not in use when needed.	Use boost mode when located object is long, buried deep or failed open. Also use boost mode when using inductive couplers or clamp-on transformers.
	Connection to located circuit is wrong.	To learn how to properly connect SG33, see section 4: Operating Signal Generator SG33.

Problem	Possible explanations	Remedy
No received signal.	The located circuit has failed open or short.	See cable locator information for use to learn how to identify and locate cable faults.
	SG33 is unconnected or connection is wrong.	To learn how to properly connect SG33, see section 4: Operating Signal Generator SG33.
	SG33 has shut down.	Replace all batteries.
	Boost mode has been used with alkaline batteries in low temperatures. This may temporarily prevent operation for up to a minute while battery voltage recovers after boost mode is dropped because of low battery voltage.	Do not use boost mode when temperature is low and LR6 alkaline batteries are installed.
		Use HR6 NiMH or FR6 Li-FeS2 batteries when boost must be used in low temperatures.
SG33 output fuse has blown.	Service your SG33.	

Problem	Possible explanations	Remedy
Inductive coupler or clamp-on transformer does not work properly.	Inductive coupler or clamp-on transformer is positioned too close to an unconnected cable end.	Position inductive coupler or clamp-on transformer further from the cable end.
		Ground the unconnected cable end.
	Clamp-on transformer is not completely closed.	Use a larger size clamp-on transformer to allow it to close on a located cable.
	Inductive coupler is misaligned.	Align inductive coupler perpendicular (at a 90° angle) to the located cable.
	Distance between inductive coupler and located object is too high.	Inductive couplers have limited range. Locate inductive coupler closer to the located object.
	Inductive coupler or clamp-on transformer connected to SG33 has been damaged or failed.	Handle fragile inductive couplers and clamp-on transformers with care. Replace the damaged accessory.

5.4 Modifying, misuse and damaged equipment

Do not use accessories other than recommended by the supplier. Do not drop, throw or step on the device.



CAUTION: Risk of electric shock or fire

Damaged or modified device may behave in an unsafe way. Using a damaged or modified device may result in an injury or property damage. Do not try to open the enclosure. Do not attempt to modify the device or accessories in any way. Do not use an unspecified battery. Periodically inspect the device and accessories against any signs of damage due to aging, mishandling, fall, etc. Dispose of any damaged accessories appropriately. Replacements are available from the supplier. Immediately stop using a damaged device and remove batteries. Make sure that a damaged device is serviced or disposed of before next use.

5.5 Warranty

Signal Generator SG33 has one-year warranty against material or manufacturing defects from the date of purchase. The warranty shall not cover batteries, normal wear and tear, misuse or faults resulting from modifying the product.

5.6 Disposal

Do not discard this product with household or general waste after its end-of-life. Return it for recycling according to EU Waste Electrical and Electronic Equipment directive (WEEE). For more information contact your supplier or local agent.



6 Supplier contact information

Service, accessories, spare parts, replacement user manuals and technical support:

H. Vesala Oy

Peräsimentie 1, FI-03100 Nummela, Finland

Tel. +358 44 200 2005, info@vesala.fi, www.vesala.fi



7 Declaration on conformity

Hereby, H. Vesala Oy, declares that the measuring equipment type Signal Generator SG33 version X2.0 is in compliance with the essential requirements and other relevant provisions of directives 2011/65/EU, 2014/30/EU, 2014/35/EU and 2015/863/EU. The full text of the EU declaration of conformity is available at the following internet address: www.vesala.fi/sg33/doc



Hereby, H. Vesala Oy, declares that the measuring equipment type Signal Generator SG33 version X2.0 is in conformity with the relevant UK legislation: S.I. 2016/1091, S.I. 2016/1101 and S.I. 2012/3032. The full text of the UK declaration of conformity is available at the following internet address: www.vesala.fi/sg33/ukdoc

