PITE 3836 Ground-Fault Locator

User Manual

P-120419-V1.1

Catalog

▲Safety Information

For your protection, please read this safety information completely before operating the locator. Carefully observe all warnings, precautions and instructions.

WARNING: Servicing described in this manual is to be done only by qualified personnel. To avoid electrical shock or equipment damage, do not service the instrument unless you are qualified and with PITE's instruction.

⚠**DANGER**	Safety testing has been done on this instrument thoroughly before shipment. However, mishandling during use could result in injury or other bad consequences, as well as damage to the instrument. Make sure that you understand the instructions and precautions in the manual before use. We disclaim any responsibility for accidents or injuries not resulted directly from instrument defects.

Safety Symbols

Description of symbols used in this manual.

WARNING	Indicates correct operation to prevent a significant hazard that could result in serious injury or other bad consequences to users or instrument.
NOTE	Indicates advisory items related to performance or correct operation of the instrument.

▲Operating Precautions

To avoid electrical shock or fire, read these precautions first before using the locator:

- Except as explained in this manual, do not attempt to service this equipment yourself.
- Do not operate the locator around explosive gas or vapor.
- Use only PITE's testing leads and other accessories with the locator.
- Before use, inspect the locator, testing leads and other accessories for mechanical damage and replace when necessary. Pay special attention to the insulation surrounding the connectors.
- Remove all clamps, testing leads and accessories that are not in use.
- Do not apply the instrument in other purpose not described in this user manual
- Ensure the equipment is provided with adequate ventilation.
- Proper installation is essential to the correct functioning of your analyzing software CD. If you have any questions about installation, please contact your supplier for assistance.
- This manual describes the general installation and use of the testing system. If your system has features or accessories not addressed in this manual, please contact your supplier.

1. ABOUT PITE 3836

1.1 Why Need a Ground Fault Locator?

Before using PITE 3836 Ground Fault Locator, it is very necessary to know why a ground fault locator is so important.

From some very typical accidents in DC systems in different countries, we learn that cost can be tremendous upon bad insulation or grounding in the power system. It may even cause power break-off which is costly to repair. Fast localization and elimination of grounding faults will be significant for electricians and technicians. It is also required by DIN VDE 0100-410 (VDE 0100-410): 2007-06 chapter 411.6.3.1 and IEC 60364-4-41 chapter 413.1.5.4. PITE 3836 is developed to fast detect, track and locate virtual grounding faults on DC systems. This spares you from hours of unnecessary trouble-shooting and helps to increase the reliability of your electrical equipment. It is widely used in locomotive, telecom, power utilities, etc

1.2 What is PITE 3836?

PITE 3836 is PITE's revolutionary ground fault locator applying with advanced technique for earth fault detection. This patent-protected product is built based on years of field experience in different DC systems. It specially deals with current leakage in DC system of high resistance below 1MΩ. Without switching off the DC system, it pinpoints faulty grounding online where electrical lines have breakage and current lost to the ground. It gives excellent solutions for troubleshooting and preventative maintenance.

Compact and rugged design makes the PITE 3836 easy to use in small places and harsh environment. It is widely used in locomotive, telecom, power utilities, and so on.

1.3 PITE 3836 Main Functions

1.3.1 Ground Fault Location

With comprehensive ways including signal strength, phase angle and precise judgment for leakage current direction, it fast pinpoints ground fault.

It accurately measures grounding resistance and distributing capacitance. Based on different distributing capacitance, it selects the right output frequency for testing, which enables it to be widely used in different DC systems.

Output voltage of signal generator: 24V, 48V, 110V, 220V and 500V. This will meet requirement for various electric circuit of different voltage levels.

Output current of signal generator: 1mA, 2mA, 5mA and unlimited current. It is selected as per reality, preventing from incorrect operation of circuit relay.

Output frequency of signal generator: 0.5Hz, 1.0Hz, 2.5Hz, 5.0Hz, 10Hz, 20Hz, 50Hz, 100Hz, 200Hz and 325Hz. It is selectable based on different DC systems.

1.3.2 Frequency Spectrum Analysis

It effectively analyzes the working signal and surrounding interferences signals of DC system. This will help to select the right output frequency for ground fault location and avoid interference by the surrounding signal.

1.3.3 Oscilloscope

It checks waveform of target signal after band pass filter.

1.4 Features

- Patented technology, pinpoint current leakage fault with grounding resistance lower than 1MΩ
- Config with different sizes of current detector for different environments application
- Adjustable output frequency on signal receiver effectively avoids interference from DC system itself
- Signal receiver with adjustable sensitivity in different location of circuit help judge current leakage quickly
- Digital signal processing technology for detecting grounding resistance and distributing capacitance
- No disconnection of the electrical installation, ground fault location is carried out during operation
- Unique and precise indication for current direction (positive or reversed) help fast locate the faulty grounding
- Waveform analysis will analyze the interference signal in the circuit, greatly keep it away from interfered frequency
- Signal-generator with adjustable output voltage (24V, 48V, 110V and 220V) and output frequency (0.5～325Hz), suitable for different electronic equipments
- More signal receivers can work simultaneously to narrow down the searching scope and find out the fault quicker
- Reflects aging status of facilities for further reparation, and reduced maintenance and repair costs.

1.5 Typical Application

Railway: signal, communication and locomotive electronic equipments in railway
Communication: electronic equipments of different voltage range with faulty grounding
Power utility: DC system with faulty grounding, e.g. switchgear in substation
Others: DC system in aviation, metallurgy, auto works, household appliances and so on

1.6 Technical Specification

Ground fault location	Output voltage: 24V, 48V, 110V, 220V, 500V Output frequency: Selectable among 0.5Hz, 1.0Hz, 2.5Hz, 5.0Hz, 10Hz, 20Hz, 50Hz, 100Hz, 200Hz, 325Hz Output current limitation: 1mA, 2mA, 5mA & no limit Fault location sensitivity: ≤ 1.5 MΩ Current detect sensitivity of AC/DC circuit: ≥ 0.5mA Quick-search clamp: 55mm (diameter), 60mm (jaw opening) φ8 current detector:8mm(diameter), 20mm(jaw opening),20mm (width) φ20 current detector:20mm(diameter), 30mm(jaw opening),36mm (width)
Power supply	Signal generator: 4200mAh/16.8V rechargeable Li-ion battery Input: AC220V/110V, output: DC16.8V/2A, durable for long time working with adaptor Standard signal receiver: 2400mAh/8.4V rechargeable Li-ion battery Charger input AC220V/110V, output:DC8.4V300mA Quick signal receiver: 200mAh/ 8.4V Ni-MH rechargeable battery Charger input: AC220V/110V, output: DC9V/20mA

Power consumption	≥4 hours
Memory	128M
Display	Signal generator: 128×64bit LCD Signal receiver: 240×320 pixel 3.5″ TFT touch screen
Working temperature	-10℃～55 ℃
Dimension	L360*W260*H135mm
Weight	7.0 kg

1.7 Composition of PITE 3836

1.7.1 Packing List

Below is picture of PITE 3836 main package:

Fig. 1.7.1

Full packing list:

Item	Parts		No.	NOTE
1	Main body (in molding case)	Signal generator	1	
2		Power adaptor	1	Input: AC110V/220V Output:16.8VDC/2A
3		Signal testing lead	2	One red and one black 2.5m long each
4		Alligator clip	2	One red and one black
5		Punctuation clip	1	Red
6	Quick signal receiver (Optional)	Signal receiver	1	Defaulted as 10Hz
7		Earphone	1	Optional for high frequency
8		Battery charger	1	Input: 220VAC Output: DC9V/20mA×2
9		Backup battery	2	8.4V/200mAh Ni-MH rechargeable battery
10	Standard signal receiver	Signal receiver	1	
11		Φ8 current detector	1	With 400mm long lead

		φ20 current detector	1	With 400mm long lead
14		Battery charger	1	Input: AC110V/220V Output: 8.4VDC/300mA
15	User manual		1	This manual
16	USB drive		1	
17	DVD disk		1	For software and manual back
18	Qualification certificate		1	

1.7.2 PITE 3836 Main Body

Below is picture of PITE 3836 main body and functionality of each part.

Fig 1.7.2.1

After turning on the On/Off switch, press any key on the keypad to continue and you will see the main menu as below for each function and system setting. Use the arrow keys to highlight each and press **ENT** to confirm the selection or press **Esc** to go back. Main body function and setting will be introduced in details in this manual later.

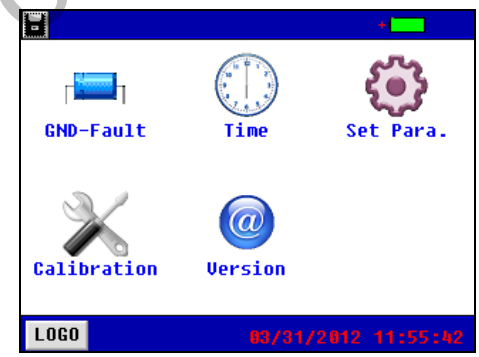

Fig 1.7.2.2

1.7.3 Signal Receiver

Currently we offer standard signal receiver and optional quick signal receiver. All standard units will come with standard signal receiver and two sizes of current detector. Unless introduced separately, otherwise

all “signal receiver” described in this user manual will mean the standard signal receiver.

Standard signal receiver

Based on different application area and sizes of conductors, standard signal receiver will be connected with 2 sizes of current detectors to carry out operations for ground fault detection, frequency spectrum analysis and oscilloscope analysis.

Main body of standard signal receiver:

Back

Side

Bottom

Top for current detector

Fig 1.7.3

Fig 1.7.3.1

Fig 1.7.3.2 current detectors

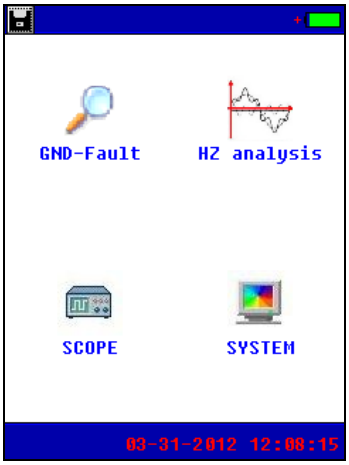

Fig 1.7.3.3

Standard signal receiver could be operated by touch screen, keypad or quick navigation keys at side. After switching on the unit, you will see the main functions including ground fault location, frequency spectrum analysis, oscilloscope and system setting as Fig 1.7.3.3. We will introduce these functions in details in the following context.

Optional signal receivers

10Hz signal receiver:

Fig 1.7.3.4

325Hz signal receiver:

Fig 1.7.3.5

Compared with standard signal receiver, optional quick signal receivers are only used for ground fault location (no frequency analyzing or scope function). It has bigger opening jaw which could be clamped on a batch of wires (like in substation) for overall signal searching. This will help narrow down the search scope of current signal.

In 325Hz signal receiver, selected Hz means only one frequency (325Hz) is used during ground fault location. Full Hz indicates that the signal receiver may use different frequencies available to pinpoint ground fault. In this case, signal will be comparatively stronger than that of selected Hz. However it (Full Hz) may be interfered by surrounding circumstances if there are other equipments running with different frequencies. In these complicated circumstances, Full Hz may not be as accurate as Selected Hz.

NOTE: For optional signal receiver, 325Hz has LED signal indicator and audio indicator. In low frequency signal receiver like 10Hz, signal is indicated in the way of flashing light.

Details about testing signal indicator

Fig 1.7.3.6 shows the meaning of signal indicator. This is one way to check the ground fault. We will introduce in 3.3 Ground-Fault Location in details.

As the signal receiver is switched on, the power indicator (in green, Fig 1.7.3.6) is on.

When battery is full charged, the second grid is dim. As the battery is low, the light will be on (in green). You are suggested to charge it timely to ensure its performance.

When signal is detected in the circuit, signal indicators will be on in the consequence of green, orange and red from the 3rd grid to the 7th. Signal light of the 4th grid is stronger than the 3rd, and so forth like Fig 1.7.3.7.

NOTE: Due to signal interference by ambient magnetic filed, the receiver may be in full signal right after switch-on. Therefore please hold it for about 3 seconds; it will be stabilized as normal signal.

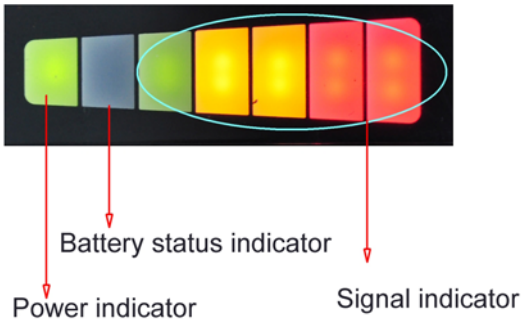

Fig 1.7.3.6

Fig 1.7.3.7

1.8 Basic Concepts

1.8.1 About Faulty Grounding

AC or DC power systems are generally insulated to the ground in railway electric works, power substation, telecom base station and the alike. There are also clear and strict rules for insulating resistance in different voltage levels of AC or DC power systems.

And it is generally considered as the phenomenon of faulty “Grounding” when resistance of one point (or multi-points) to ground becomes lower than tolerance value. Take following chart for example, Point A is the grounding point, R is the grounding resistance, C1 and C2 indicate distributed capacitances before and after the malfunction point.

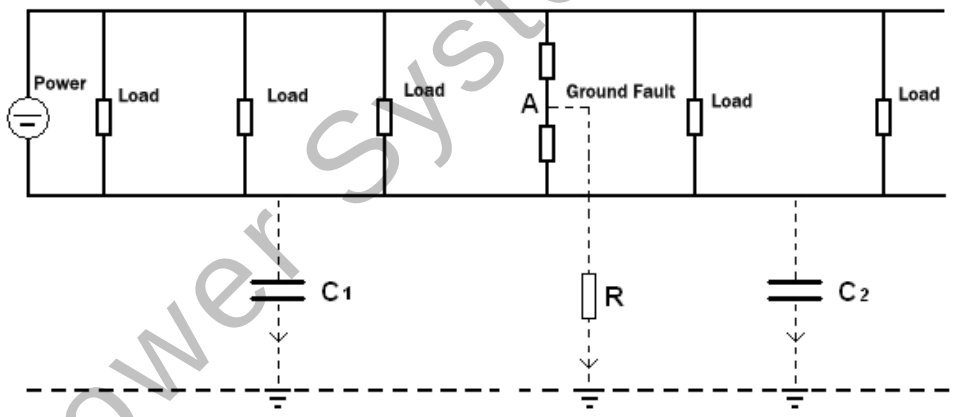

Fig 1.8.1

When one point of circuit has unwanted grounding like this, protection equipments, signaling equipments and automation equipments may have incorrect operation or may stop running, or fuse will burn and thus cut off power supply for protection equipments, automation equipments, controlling circuit and communication signaling system.

If one point problem is unsolved for long time until more points have the same problem, it may damage electronic circuit or equipments. Therefore, unwanted grounding of electronic circuit is very big hidden danger and thus a fast detection of ground fault will be very necessary before “small” problem becomes big accident.

1.8.2 Wire Mix-connection

Some times two or more groups of power systems are working simultaneously, and normally they are insulated from each other. When insulating resistance between these individual powers become lower

than required value in one point or more points, we call it as “wire mix-connection”. Below is one example. Point A and B are malfunction points. R indicates the mix-connection resistance. C1 and C2 indicate the distributed capacitances.

Wire mix-connection is common problem in signaling system in railway. It also has big hidden hazard like faulty grounding.

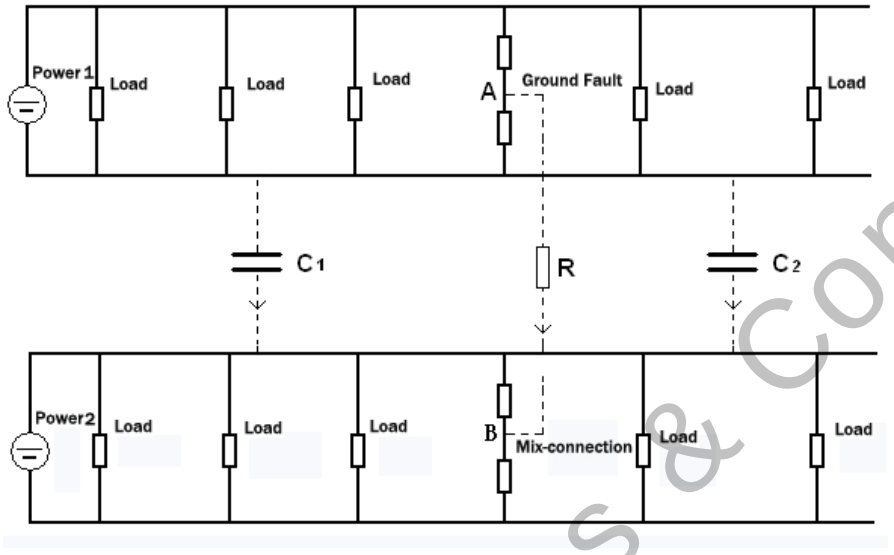

Fig 1.8.2

1.8.3 Short circuit

One power system generally comes with several loads working together at the same time. Normally when all loads are disconnected, power output current becomes O Amps. However, when insulating values of one point or more are lower than requirement but there is still current flow, we call it as “short circuit”. In this case, positive busbar is short-circuited to negative busbar.

Short circuit will increase power consumption and may even burn up power supply and cause other bad accidents like faulty grounding.

1.8.4 Current leakage

Circuits, which are normally insulated to the ground, have current flow to the ground due to bad insulation or circuit distributing capacitance.

1.8.5 Tracing of Current Signal

When we are using the PITE 3836 to locate the faulty grounding, signal generator (main unit) will send a “current signal” in certain frequency to the circuit. This current signal will flow in the circuit. With a signal receiver (connected with a current detector), we will trace the current signal in different points of the circuit. In comprehensive ways of signal judgment like current direction, signal strength and phase angle, we will fast locate the ground fault caused by different ways of grounding problems.

For detailed ways to pinpoint the faulty grounding, we will introduce in Chapter 2 below.

2. MAIN OPERATION OF PITE 3836

2.1 General Steps for Ground Fault Location

For ground fault location, we will generally follow steps as blow:

1) Measurement preparation
   Get familiar with wiring diagram of DC system and judge which line has faulty grounding.
2) Connect the signal generator well with DC system
3) Set output signal in signal generator and set signal mode as “Continue”.
   Signal generator will automatically test output voltage, current and grounding resistance.
4) Synchronize the output frequency of signal receiver and generator
5) Proceed with “Reference setting” in signal receiver
6) Follow the theory of ground fault location to pinpoint the faulty grounding one by one.
7) Solve the problem of faulty grounding as per requirement.

In the following context, we will describe in details on the operation of ground fault location.

2.2 Operation Preparation

Before the onsite testing to find faulty grounding, please prepare as below:

1) Make sure both PITE 3836 signal generator and receivers are fully powered. PITE 3836 main body can work with power adaptor connecting with AC power supply.
2) Get familiar with onsite wiring for target DC system. It will be very helpful to have the wiring instruction indicating how each equipment is connected in the whole DC system.
3) For security purpose, please wear helmet and insulation-protected gloves.
4) Judge which busbar has faulty grounding:
   A. DC circuit: use a multimeter, switch to DC voltage testing mode and respectively test the voltage between busbar and ground. Normally both absolute values should be equal (around half of nominal voltage). If one of the voltage values is lower, that busbar should have faulty grounding.
   B. AC circuit: Switch the multimeter to AC voltage testing mode and respectively test the voltage value between each power line (phase line and null line) and the ground. Normally both absolute values should be the same. If one of the voltage values is lower, that line has faulty grounding.
5) Connect testing leads with signal generator and current detectors with Standard signal receiver.

2.3 Wire connection

Fig 2.3.1

First connect the testing leads with PITE 3836 main body, red lead with red socket and black lead with black socket (Fig 2.3.1). Make sure that they are not mixed up. Then connect other ends of the leads with alligator clips. After correct judgment on which busbar has ground fault, connect red clip with that busbar and black clip with the ground like below:

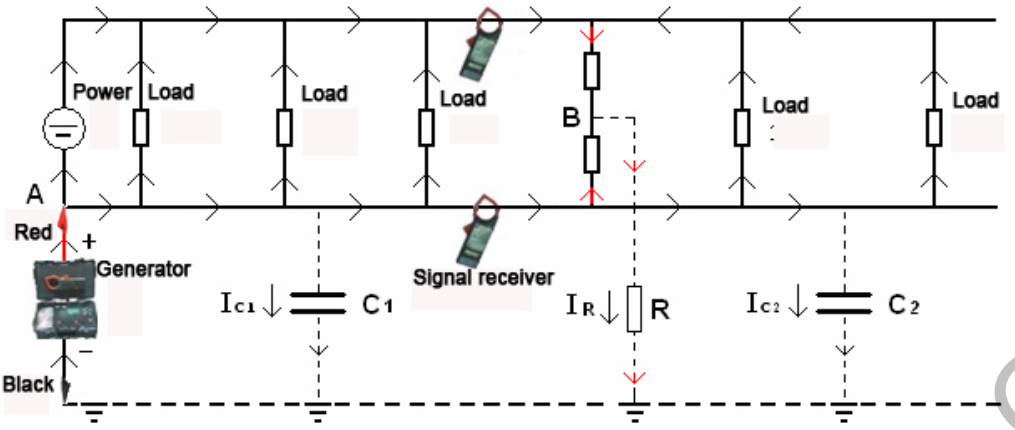

Fig 2.3.2

2.4 Set Generator Output Signal

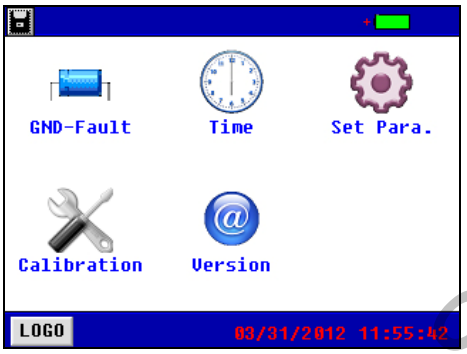

Fig 2.4.1

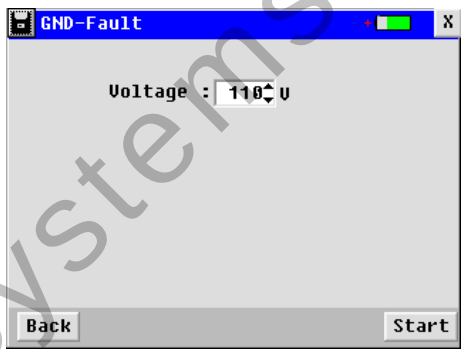

Fig 2.4.2

Measurement of Grounding resistance and Distributed Capacitance:

After the signal generator is well connected with the DC circuit, please turn on the unit, you will see the main screen as Fig 2.4.1. Use arrow key to highlight “GND-fault” and press **ENT** to select it. You will go to the next screen for voltage type selection. Please select the voltage type based your tested system. For example, if it is DC110V substation, then please select 110V. Voltage type here has options between 24V, 48V, 110V, 220V and 500V.

NOTE: Screen setting here is based on basic version of PITE 3836 which simplify the setting. And output frequency is 10Hz. Based on PITE’s years field testing, 10Hz output frequency will fit most DC systems.
For “Pro” version software setting, please refer to system setting section (**3.1.2 Parameter Setting**).

Click **Start** to continue, you see testing value for grounding resistance, distributed capacitance and output current and waveform of the circuit in Fig. 2.4.3. Display of waveform could be set as sine wave, square wave or triangular wave in system setting (**3.1.2 Parameter Setting**). The waveform indicates output voltage (blue) and current (red) of main body. Numbers (e.g. 509 363 93 in Fig 2.4.3) above the waveform indicate the maximal, average and minimal sampling value of voltage and current. Blue

numbers for voltage values and red for current.

NOTE: For definition and its relationship with resistance and frequency, please refer to **2.10.1 Distributed Capacitance**.

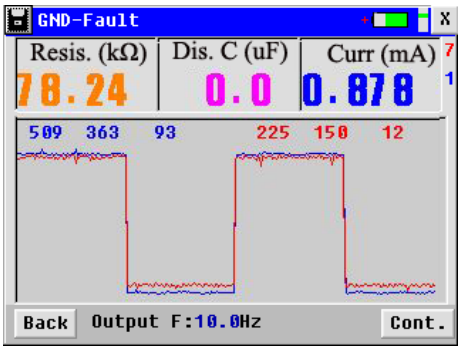

Fig 2.4.3

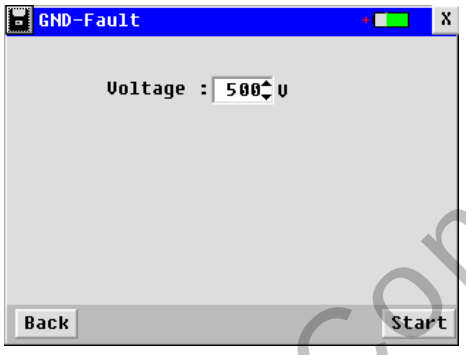

Fig 2.4.4

To ensure the testing result of location, better set the output current higher than 3mA. Current value 0.878mA in Fig 2.4.3 is comparatively low, please click **Continue** to voltage adjustment screen. Then you could set the output voltage higher than before. Example, previous setting is 110V, now you could set it as 500V. Thus output current will be 4.5 times of previous current (110V*4.5=495, near 500V). Output current become 0.878×4.5=3.951mA.

Output signal to DC circuit:

After above setting, click **Start** to output the signal to the DC circuit. You will see the screen like Fig 2.4.5 with output voltage, current, grounding resistance and waveform. Defaulted waveform is displayed as “Continued”, you could use arrow key to change it as “Discontinue” which will have 1 second interval. Different ways of display is illustrated as diagram in Fig 2.4.6 and Fig 2.4.7.

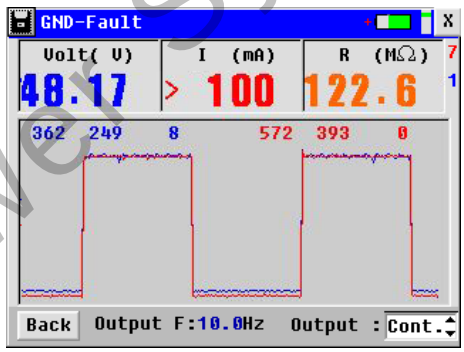

Fig 2.4.5

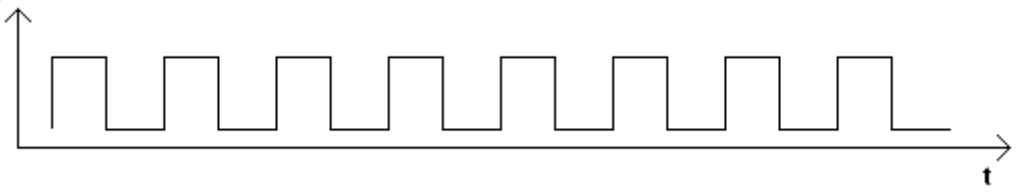

Fig 2.4.6 continued waveform

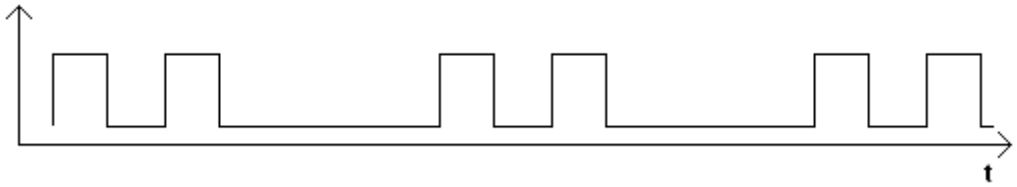

Fig 2.4.7 Discontinued waveform

2.5 Setting of Signal receiver

2.5.1 Frequency Synchronization

This is to set the frequencies of signal generator and receiver identical for precise location of fault. To help users simplify the operation in most DC systems, frequency of all standard PITE 3836 generator is set as 10Hz and signal receiver is synchronized well before shipment to PITE's customers.

If your unit is basic unit, please skip and go to 2.5.2 below.
If your signal generator is set as "Pro" unit in system setting and output frequency is not 10Hz, please refer to **3.2.3 System Setting-Frequency Synchronization** for synchronization instruction.

2.5.2 Setting of Signal Receiver

After signal receiver is connected well with current detector, turn on the unit and select "**GND-Locate**". You will see the screen for signal setting as below:

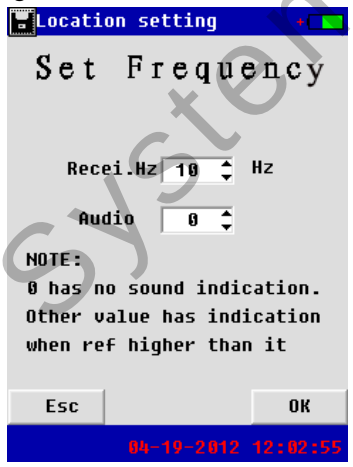

Fig 2.5.2.1

After frequency synchronization, receiving frequency is kept unchanged. Audio setting has option from 0 to 9. 0 means no audio indication during leakage signal searching. Other number means that when detected signal is higher than setting value, signal receiver will have audio indication in the way of BEEP. For example, if setting value is 5, when detected signal is higher than 50%, signal receiver will beep.

Reference setting

This is very important step for PITE 3836 during ground fault location.
After initial setting for receiving frequency and audio, click **OK** to proceed in the screen like Fig 2.5.2.2.

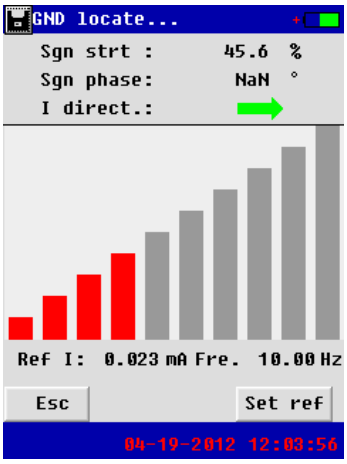

Fig 2.5.2.2

What is reference setting?

Clamp current detector of signal receiver in certain point the circuit (named “Reference point”), click Reference setting button **Set ref** to set this point as referenced point. So this point will have:

Signal strength: 100%

Phase angle: 0°

Signal direction: (positive direction)

After setting of reference point, move current detector of signal receiver in the circuit. In different point, there will be different indication for signal strength, phase angle and current direction. All this info will be compared with the Reference point to judgment signal difference.

Example:

Signal strength: 83%

Phase angle: -153°

Signal direction: （negative direction）

Above info means that signal strength of this point is 83% of reference point (17% weaker). Phase angle is 153° lag off and current direction is opposite.

NOTE:

During ground fault location, “reference point” could be set several times. Once you are sure that there is current flow in certain point, you could set it as “referenced point” and proceed in the circuit. Then compare the signal difference later with the latest referenced point.

Reference Point setting for the first time

After signal generator is connected with the leakage circuit, current signal will flow from the red testing lead to DC circuit and finally flow back to the black testing lead. This is a return circuit. Let us refer to the wire connection instruction again. No matter how complicated the DC system is, the equivalent model could be exemplified as below:

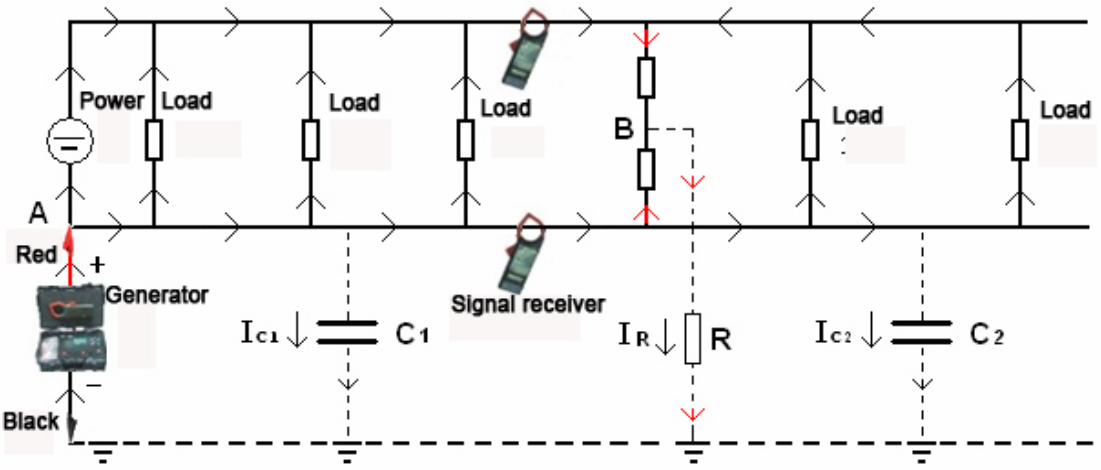

Fig 2.5.2.3

In above return circuit, the signal at the beginning (close to red socket on signal generator) of red testing lead is strongest.

For the first reference setting, please clamp the current detector around beginning of read testing lead with arrow (on the clamp) pointing to the direction of current flow as Fig 2.5.2.4. Keep the current detector stable and then click the button **Set ref** in the screen of signal receiver.

Fig 2.5.2.4 correct connection

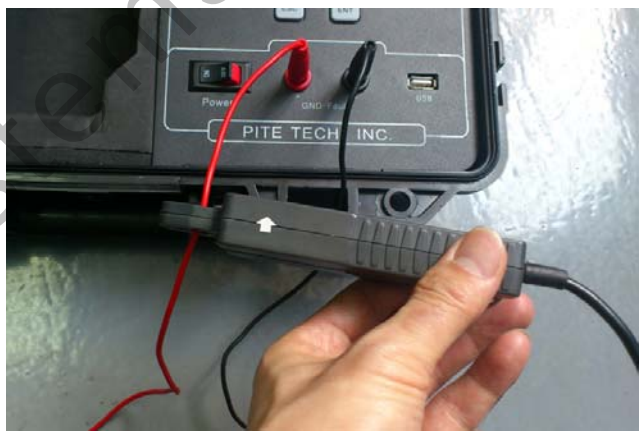

Fig 2.5.2.5 incorrect connection

Signal strength of reference will be 100%, phase angle is 0° and current direction will be positive ➡ .
Below are the examples before and after reference setting.

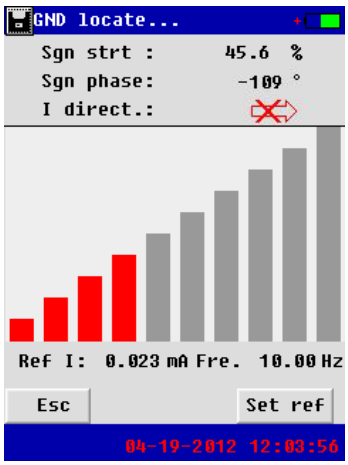

Fig 2.5.2.6 before

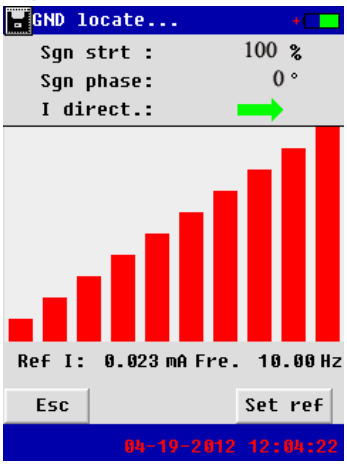

Fig 2.5.2.7 after

Red columns in between of the screen indicate strength of signal in percentage. It will increase one column when signal increases by 10%.

NOTE:
When using indicating function of current direction, please make sure to set signal as "**Continue**" in signal generator.

2.6 How to Locate Ground Fault?

After setting the reference point in the screen, connect current detector with the DC circuit beginning from the output of red testing lead on the signal generator, and search the signal in different points of the system. Following the direction indication in the signal receiver screen, you will fast locate the faulty grounding. Make sure to keep arrow marking (on the current detector) pointing to the same direction as "reference setting".

If receiver indicates  , then grounding current is in the same direction with arrow in current detector. If it indicates  , then they are in the opposite direction. You need to go back and keep searching the signal with the help of direction display.
Also, generally if there are big changes for signal strength and phase angle before and after certain point, we can judge that there is grounding current flow in this point or may be there it is grounding fault there.

For detailed illustration of ground fault location, please refer to below for the location theory and measurement tip.

2.7 Theories to Detect Faulty Grounding

Based on the characteristics of different DC ground fault, PITE 3836 uses comprehensive ways to pinpoint the faults with the following working rules:

1) Signal generator injects a low-frequency current signal with direction to the DC system. This signal will outflow from the faulty grounding point.
2) Signal receiver will trace this current signal with the help of direction judgment. Direction of current signal always goes to the faulty point
3) When there are circuit branches, you could continue searching along with the branch that has stronger signal.
4) Strength and phase angle of current signal will have big changes before and after the grounding fault.

Signal changes before and after ground fault:
Please see below for detailed illustration of this theory

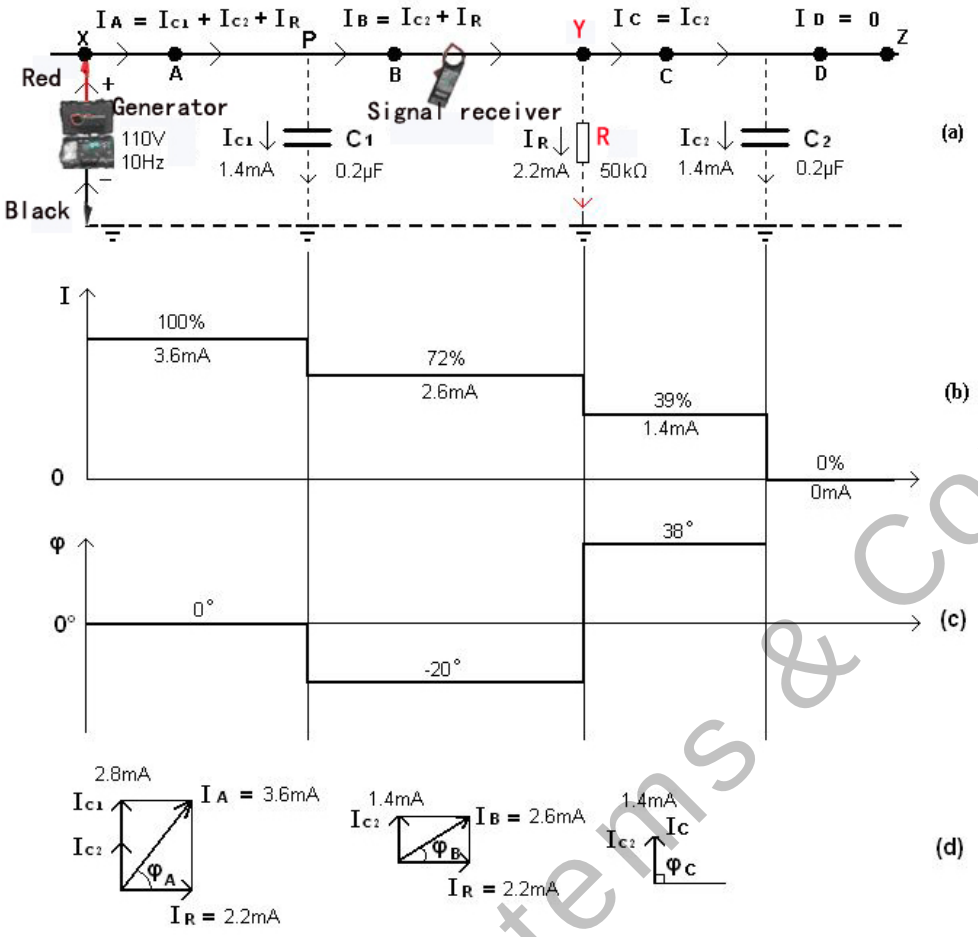

Fig 2.7.1

(a) In above illustration, supposed that point Y has ground fault (e.g. grounding resistance is 50kΩ), C1 and C2 indicate the distributed capacitance to the ground (assume that C1=C2=0.2μF). Red testing lead of signal generator is connected with busbar and black lead with ground. So there will be returned circuits between ground respectively with C1, R and C2. The current flow outputs from red testing lead and finally flows back to black testing lead.

(b) This diagram indicates the current signal changes (signal strength) along with the current flow from Point X to Z. Assumed that Point X is set as “Reference Point” with 100% signal strength. Other percentages (72%, 39% and 0%) indicate the relative signal differences compared to Point X. We can see that the current signal is getting weaker and weaker from X to Z.

(c) This indicates the phase angle changes from Point X to Z. Numbers (0°, -20° and 38°) indicate the phase angle differences compared to the Point X.

(d) This indicates the vectorgram of Point A, B and C. It clearly explains the relationship of Grounding resistance current and Distributed capacitance current.

NOTE: For definition of “Distributed capacitance” and its influences, please refer to **2.10.1 Distributed Capacitance.**

From above graphic instructions, we can see that current flows from Point X to P. Current strength gets weaker and phase angle get lower after Point P. Current strength gets weaker because distributed-capacitance current is getting less but grounding-resistance current is unchanged until Point Y. Therefore, Point P is not the faulty point.

Later, current flow from Point P to Point Y. Current strength gets lower but phase angle get bigger. Current strength gets weaker because grounding-resistance current get weaker but distributed-capacitance current is unchanged. Therefore, we could judge that Point Y has ground fault.

2.8 Some Tips for Ground Fault Location

1) **Gross searching**

Physically divide the DC system into several sections. For example, in power substation, there are different cases (chargers, switchgears, control panels and so on) in the same DC system. Wiring could be complicated and most of the time different wires are tied together. In this case, you don't need to check wire by wire, you could check the inlet (or outlet) terminal of each case to see the current strength, phase angle and direction.

Assume that Load 1, 2, 3 are Case 1, 2, 3 in substation (Fig 2.8.1). You will not need to check the busbar all the way inside Case 1, Case 2 and so forth.

This way of gross searching will be time saving and no need to take out all the wires that have been tied together inside the cases. But when using this way, make sure that are you are familiar with the wiring structure of the DC system.

This way of operation is also applicable to quick signal receiver.

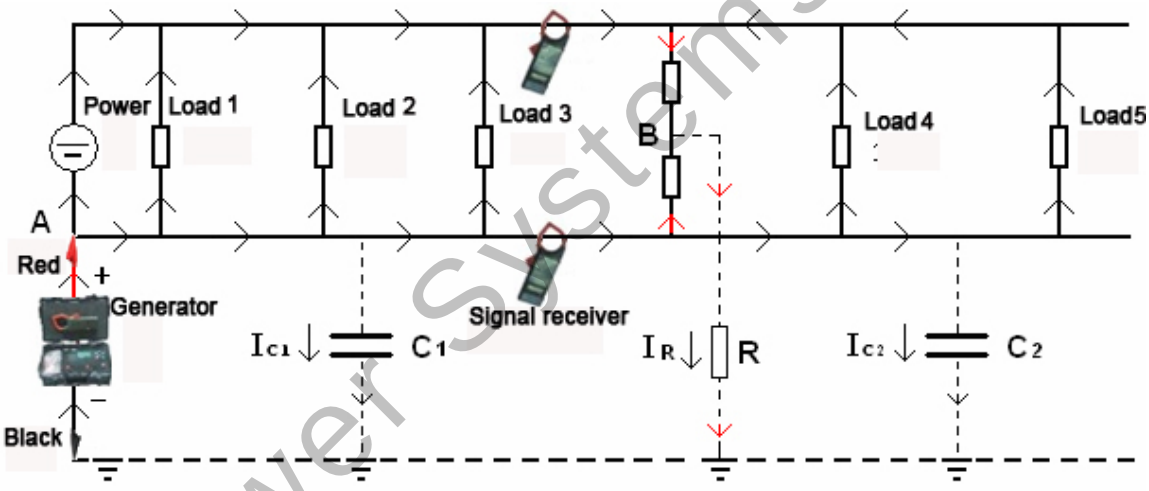

Fig 2.8.1

2) **Multi-time setting for Reference Point**

As described before, during ground fault location, "reference point" could be set several times. Once you are sure that there is current flow in certain point, you could set it as "referenced point" and proceed in the circuit. Then compare the signal difference later with the latest referenced point.

3) **Use more than one signal receiver**

To save time, you could have more personnel holding more signal receiver checking simultaneously to narrow down the scope of signal searching. All PITE 3836 signal receivers (of same frequency) could be used at the same time for ground fault location.

2.9 Location for Other Ways of Fault

2.9.1 Wire Mix-connection

Location of mix-connection fault is same like that of ground fault location. The difference is that signal generator injects the current signal in the two lines that are mix-connected (see Fig 2.9.1 for wiring instruction). Then trace the current signal with the signal receiver in the same rules like ground fault location as explained before.

If both of the two lines are accidentally grounded, they are mix-connected through the earth. Then please check the ground fault of each line as ground fault location described in **2.7 Location Theory for Faulty Grounding**.

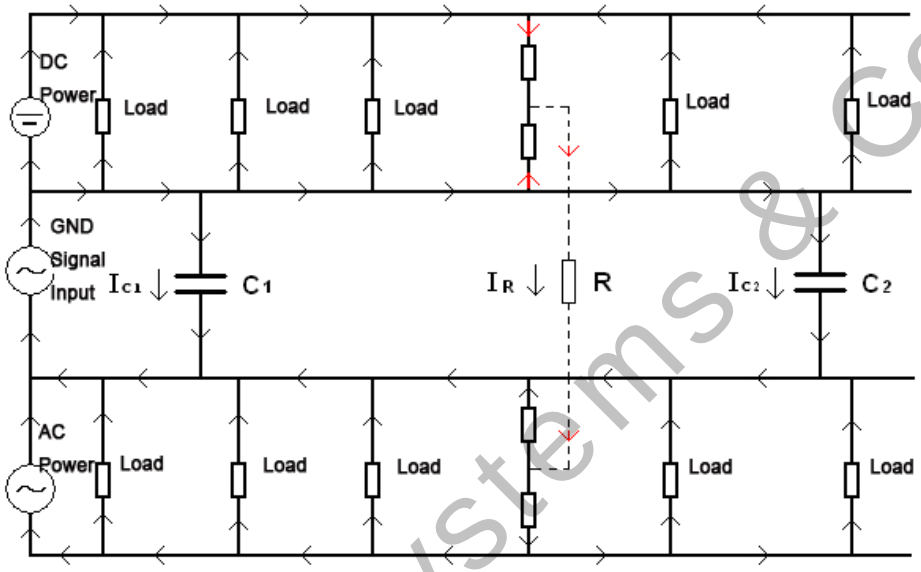

Fig 2.9.1.1

If there is mix wire connection between DC and AC (single phase), you could use 50Hz or 60Hz of AC signal to check the malfunction. No signal generator is needed. Use the signal receiver to go along with the current flow. When there are big differences of signal strength and phase angle before and after certain point, there is point for grounding malfunction. Graphic wiring is as below:

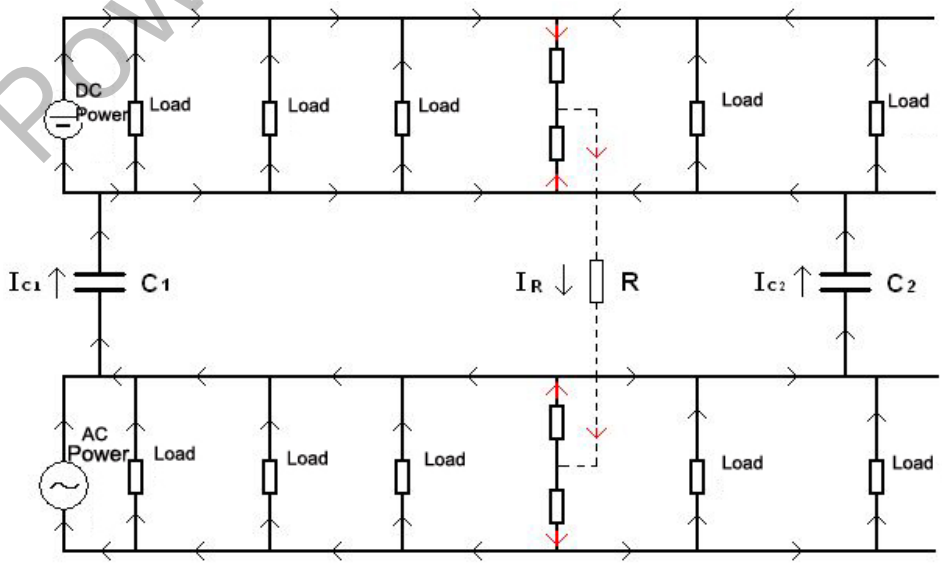

Fig 2.9.1.2

2.9.2 Short-circuit Fault Location

Short-circuit fault is similar to ground fault location. Signal generator will inject a signal to the circuit and use signal receiver to trace the current signal.

2.10 What Might Affect Ground-fault Location?

2.10.1 Distributed Capacitance

Distributed capacitance is very common phenomenon. Generally there is big distributed capacitance when circuit line is long and wiring structure is complicated in electric circuit. Even if circuit is insulated to the ground, there could be return circuit when signal generator injects current signal due to the existence of distributed capacitance. Fig 2.10.1.1 is one example. C1 and C2 are distributed capacitance before and after ground fault (R).

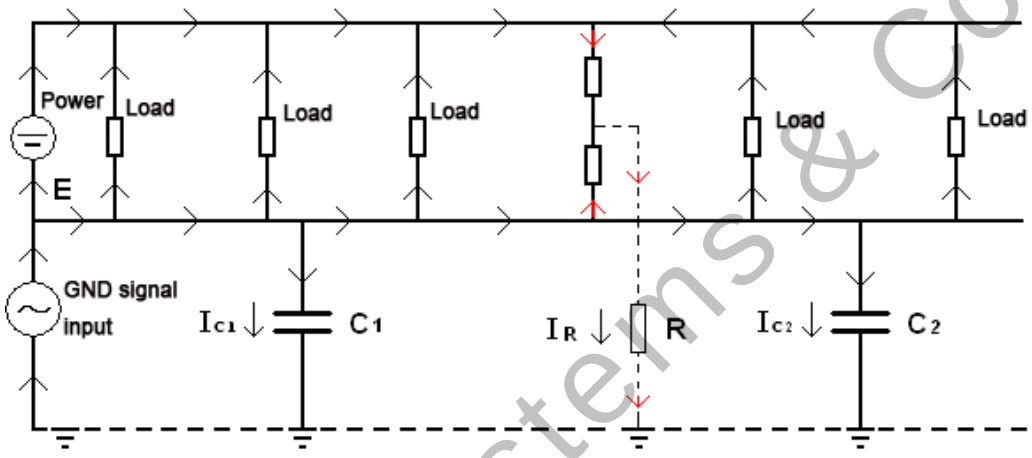

Fig 2.10.1.1

In ground fault location, grounding malfunction that we mention is for resistance grounding malfunction. Grounding caused by distributed capacitance is not what we concern. But we have to know its existence and affection.

Equivalent resistance of distributed capacitance is:

$$f = \frac{1}{2\pi RC}$$

f: recommended grounding location frequency (unit: Hz);

R：Grounding resistance (unit: Ω);

C：Distributed capacitance in the circuit (unit: F)

In actual detection of grounding malfunction, the circuit has grounding resistance and distributed capacitance. Distributed capacitance current and resistance current have 90°difference for phase angle. Current signal in the circuit is composed of distributed capacitance current and resistance current. Their directions are as below:

Resistance current: Flow from signal generator output terminal (red testing lead) to DC circuit and finally flow out from the grounding point.

Distributed capacitance current: Flow from signal generator output terminal (red testing lead) to DC circuit and finally flow out the earth from different points of circuit in the way of distributed capacitance current.

2.10.2 Interference Signal that Affects Measurement

Most of time ground fault location needs to be carried out when DC system is not shut down. Current signal of the DC circuit will affect the inspection of ground fault, especially when the frequency of working signal is close to output frequency of signal generator.

Solution by PITE 3836:

1) By software and hardware filtering, PITE 3836 will effectively get rid of the interference signal in the DC circuit.
2) Through frequency spectrum analysis, PITE 3836 will analyze the surrounding signals of different frequencies. This will help users get the most suitable output frequency for ground fault detection. For detailed introduction of analyzing function, please refer to **3.2.1 Frequency Spectrum Analysis.** Output frequency by generator is selected among 0.5Hz, 1.0Hz, 2.5Hz, 5.0Hz, 10Hz, 20Hz, 50Hz, 100Hz, 200Hz and 325Hz.

2.10.3 Selection Output Voltage for Location

For different electric circuits, output voltage of signal generator could be selected among 24V, 48V, 110V, 220V and 500V based on relevant nominal voltage of circuit. Generally you could select higher output voltage to amplify the grounding signal and make it easier for ground fault detection. But please make sure output voltage should not exceed the tolerance of the circuit, otherwise it may damage the electric circuit.

2.10.4 Selection of Output Current

If the circuit with ground fault also have relay, too high output current may cause maloperation or refuse-operation to relay. Therefore proper selection of output current is important to avoid maloperation and refuse operation of relay.

Based on requirement of different circuit, output current of signal generator has selection among 1mA, 2mA, 5mA and no limit.

In basic software version, the signal generator will select the most suitable one for ground fault location. It is no need to select output current.

3. OTHER SETTINGS OF GENERATOR AND RECEIVER

3.1 Signal Generator Setting

3.1.1 Set Date & Time

Select "**Time**" in main menu, you will see the pop up screen as below. Please use arrow keys to change date and clock. Then click **Set** to confirm the change.

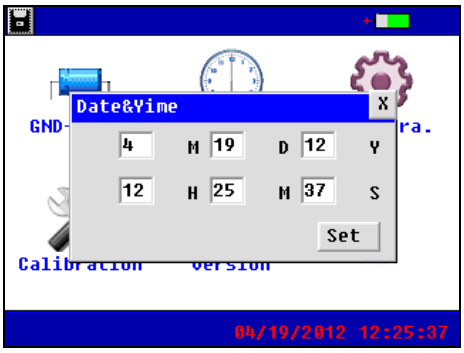

Fig 3.1.1

3.1.2 Parameter Setting

Go to "**Set Para**."in main menu and use arrow keys to input the password 88888888. Then you will see the screen as below.

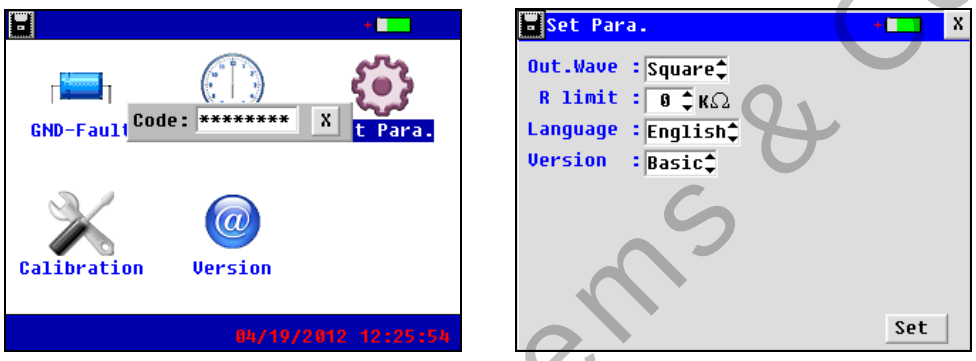

Fig 3.1.2

Out. Wave: Display of waveform could be set as sine wave, square wave or triangular wave.
Language: English or Chinese version setting
Version: Basic version and Pro version. Basic version use defaulted output frequency of 10Hz. Based PITE's field experience, this is applicable for most DC systems for ground fault location. Pro version allows users to set output frequency and current limit.

After the changes, please click Set to save the changes.

3.1.3 Signal Generator Calibration

All units are well calibrated in PITE's lab before they leave for our customers'. Generally it is no need to calibrate again. Upon big accuracy errors and calibration is needed. Please contact PITE to get separate calibration manual.

3.1.4 Firmware Version

Select "**Version**" in main menu, you will see version information of signal generator firmware like below. PITE continuously updates its software and firmware. To get the latest update, you could log in our website at http://www.pitetech.com/Downlist.htm

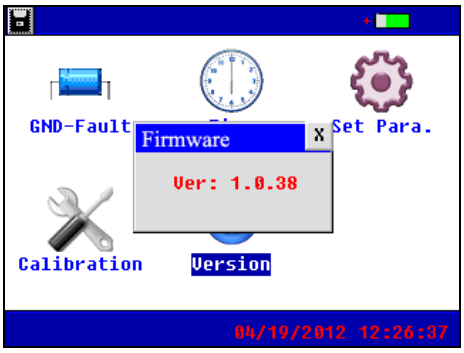

Fig 3.1.4

3.2 Signal Receiver Functions and Settings

3.2.1 Frequency Spectrum Analysis

Purpose: Analyzes surrounding signals and helps you get the right output frequency for ground fault detection.

Standard signal receiver of PITE 3836 has frequency spectrum analyzing function to test surrounding frequencies. By testing different frequencies and their strength in the surrounding environment, it will be very helpful for users to avoid interferences signal and select the right output frequency for ground fault location.

After the signal generator is connected with the DC system and it does not output any signal, please connect the current detector with standard signal receiver. Switch on the receiver and you will see the main screen as Fig 3.2.1.1. Select "**Freq. Spec.**" to go to the next screen for frequency spectrum analysis:

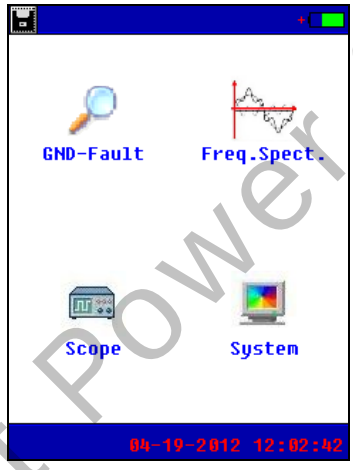

Fig 3.2.1.1

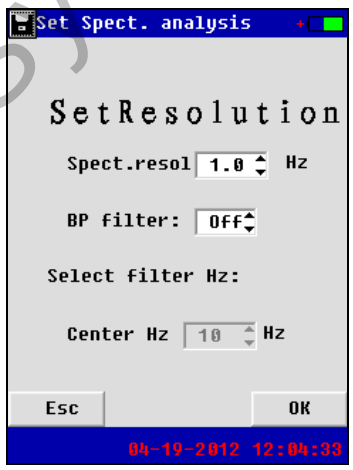

Fig 3.2.1.2

Frequency spectrum resolution is selected between 0.5 Hz, 1 Hz, 5 Hz, 10 Hz and 25 Hz. Different resolutions have different related fineness and maximal frequency. This will be reflected in the screen (Fig 3.2.1.3) when the current detector is close to the tested circuit for signal analysis (Fig 3.2.1.4).

Below is their relationship:

Frequency spectrum resolution(Hz)	Frequency spectrum fineness(Hz)	Frequency spectrum analyzing max frequency (Hz)
0.5	0.5	50
1	1	100

5	5	500
10	10	1000
25	25	2500

Programmable band pass filter is built in the signal receiver to enhance the capability of anti-interference. For frequency spectrum analysis, current detecting signal will not go through band pass filter. Therefore, for surrounding frequencies analysis, band pass filter should be shut off.

NOTE: When band pass filter is open, current detecting signal will go through band pass filter. In that case, center frequency could be selected among 0.5Hz, 1.0Hz, 2.5Hz, 5.0Hz, 10Hz, 20Hz, 50Hz, 100Hz, 200Hz and 325Hz. Generally center frequency of band pass filter is same as that of signal generator.

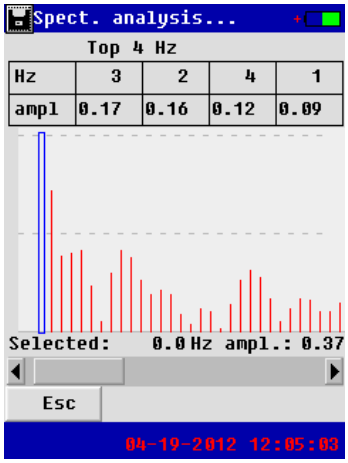

Fig 3.2.1.3

Fig 3.2.1.4

After setting of frequency spectrum resolution and band pass filter, click **OK** and you will see the top four frequencies with different signal strength in the ambient environment (Fig 3.2.1.3). The higher the signal strength, the higher interference it will be to ground fault location.

3.2.2 Oscilloscope

This is to measure the waveform of tested circuit.

Please click "**Scope**" in main menu, you will see the screen as below:

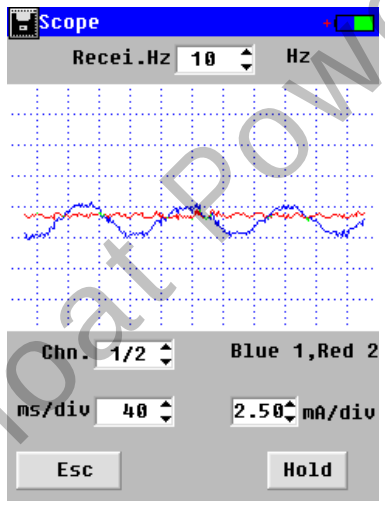

Fig 3.2.2

Screen introduction:

Frequency: means receiver frequency. It is defaulted as 10Hz.

CH: Channel selection. Channel 1 in blue indicates the waveform after using band pass filter. Channel 2

in red indicates the waveform not using band pass filter. Selection options: CH1, CH2 and CH1/2.

ms/div: Indicates the time (ms) of each grid in horizontal axle. It is selectable for different view.

mA/div: Indicates current value (mA) of each grid in vertical axle. It is also selectable.

3.2.3 System Setting

Click "**System**" in main menu, you will see the screen for system setting as below:

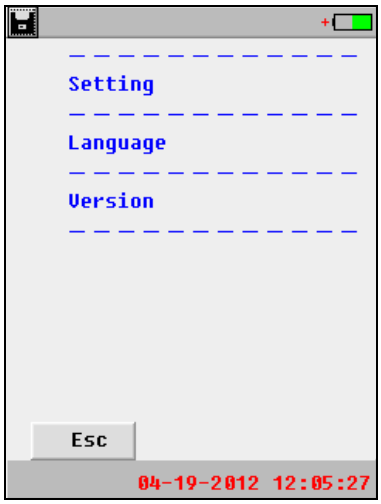

Fig 3.2.3

3.2.3.1 Frequency synchronization

This is to make receiving frequency of signal receiver identical with output frequency from signal generator. All PITE 3836 with software setting as "Basic" have been synchronized well before shipment to our customers. However, to ensure the accuracy, you could do this after using for some months.

For operation instruction, please follow the steps as below:

1) Preheat signal generator and signal receiver for at least 20 minutes.
2) Connect the two signal testing leads with signal generator and connect the other two ends of leads together.
3) Output voltage of signal generator is set as 48V. Do not set it too high.
4) Clamp current detector of signal receiver around output terminal (red testing lead like Fig 3.2.1.1) and keep it still.
5) Go to **System—Setting—Hz syn**. Confirm the output frequency and click the button **Hz syn.** in the screen below (Fig 3.2.1.2 and Fig 3.2.1.3). Frequency synchronization will be done and saved in seconds.

Fig 3.2.1.1

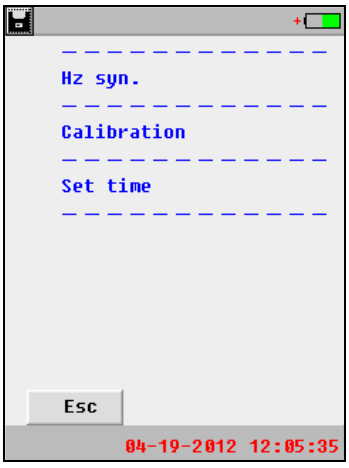

Fig 3.2.1.2

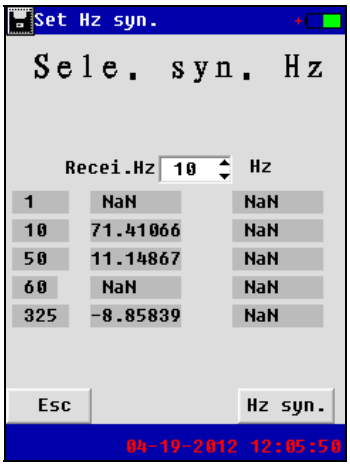

Fig 3.2.1.3

3.2.3.2 Signal Receiver Calibration

All units are well calibrated in PITE's lab before they leave for our customers'. Generally it is no need to calibrate again. Upon big accuracy errors and calibration is needed. Please contact PITE to get separate calibration manual.

3.2.3.3 Signal Receiver Time Setting

Go to **System—Setting—Set time** in the menu and set time with touch screen or keypad in the following screen and click **OK** to save the change.

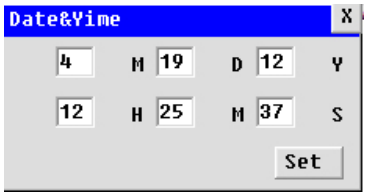

Fig 3.2.3.3

3.2.3.4 Language

English or Chinese version setting

3.2.3.5 Firmware version

Select "**Version**" in main menu, you will see version information of signal generator firmware like below. PITE continuously updates its software and firmware. To get the latest update, you could log in our website at http://www.pitetech.com/Downlist.htm.

Fig 3.2.3.5

4. SERVICE & MAINTENANCE

4.1 Self-Check

Before ground fault location with PITE 3836, please follow the steps below for self-check of the equipment:

1) To ensure the performance of signal generator and receiver in long time operation, please charge them timely when.
2) Check if signal generator is normal
   Connect the two signal testing leads with signal generator and connect the other two ends of leads together. Output voltage of signal generator is set as 48V, and current is set as "UL" (unlimited).
   As it is short circuited in this way of connection, normally voltage and resistance will become 0. And current is around 6.5mA. If output voltage is 24V and current unlimited, normally voltage and resistance become 0. Current value is around 2.7mA.
   For testing of voltage, resistance and current, please refer to **2.4 Set Generator Output Signal.**
   NOTE: To ensure the security of equipment, please do not output higher voltage for short-circuit.
3) Check if signal receiver is normal

When signal generator is short-circuited, set the same receiving frequency in receiver (10Hz), set frequency synchronization and set reference point.

Normally after frequency synchronization, phase angle and signal strength are pretty stable. After reference setting, signal strength becomes 100%, phase angle is around 0° and current direction will be . If current detector is clamp on the opposite direction, phase angle will become around 180° and direction will be reverse  .

4.2 FAQ

Item	Description	Causes	Solutions
1	Signal strength and phase angle in signal receiver sometimes is high sometimes low	1. Signal display of signal generator is set as “Discontinue” mode.	Change it to “Continue” mode.
		2. Signal is too weak	Increase the output voltage somehow
		3. There might be similar frequencies around that interferes the signal	Use frequency spectrum analyzing function of signal receiver to test surrounding signals and select the right output frequency.
		4. Opening jaw of current detector is closed or the jaw has dirt.	Close the jaw of current detector and clean the clamp jaw.
2	In the same point, signal receiver shows steady signal strength but phase angle is increased or decreased in certain rate.	1. Frequency synchronization is not done in the signal receiver. 2. Current detector is not kept stable during frequency synchronization.	Redo “Frequency synchronization” with current detector clamped on red testing lead.
3	Relay maloperation during ground fault location	Red test lead is incorrectly connected with busbar that has normal insulation.	Connect it in the right busbar
4	Equipment works for short time. Battery power off pretty soon.	Not fully powered before operation	1. Fully charge the signal generator and receiver before using. 2. For long time operation, please connect power adaptor with signal generator.
5	Not sure whether signal generator or receiver can work normally or not.		Please do as per **4.1 Self-Check.**
6	Screen has no display after power-on		Please check if input power lead is well connected or not.
7	Keypad invalid or has wrong operation		Please check if keypads are stuck in the panel or not. If so, make them pop up.

4.3 Cleaning & Storage

4.3.1 Cleaning

Clean PITE 3836 main unit and its accessories with soft damp cloth and a mild cleaner. Do not use abrasives, solvents, or alcohol, as they can deform or discolor the Locator and the accessories.

After cleaning voltage testing clip with software cloth, clean it again with water and wipe it. Do not damage the metal part of the clips to ensure its accurate performance during testing.

⚠**WARNING**: For your own safety, make sure that the main unit and accessories are not working and disconnected from the power supply before cleaning.

4.3.2 Storage

After using PITE 3836, put the main unit and all its accessories into the carrying case, store the case in ventilating place under proper temperature and humidity. Never expose the equipment and its accessories to water, high humidity, or dampness. If not used for some time, the Li-battery will discharge itself gradually. To keep its best performance, you are suggested to charge the battery periodically, like once a month.

5. CONTACT PITE

Please contact our Authorized Representative in India :

Float Power Systems & Controls
#127/11, Bull Temple Road, Kempegowda Nagar, Bangalore - 560 019, Karnataka.