Introduction to Cable Fault Location

Cable Fault diagnosis

HIGH VOLTAGE
VLF HIPOT INSTRUMENTS

Fault Notification
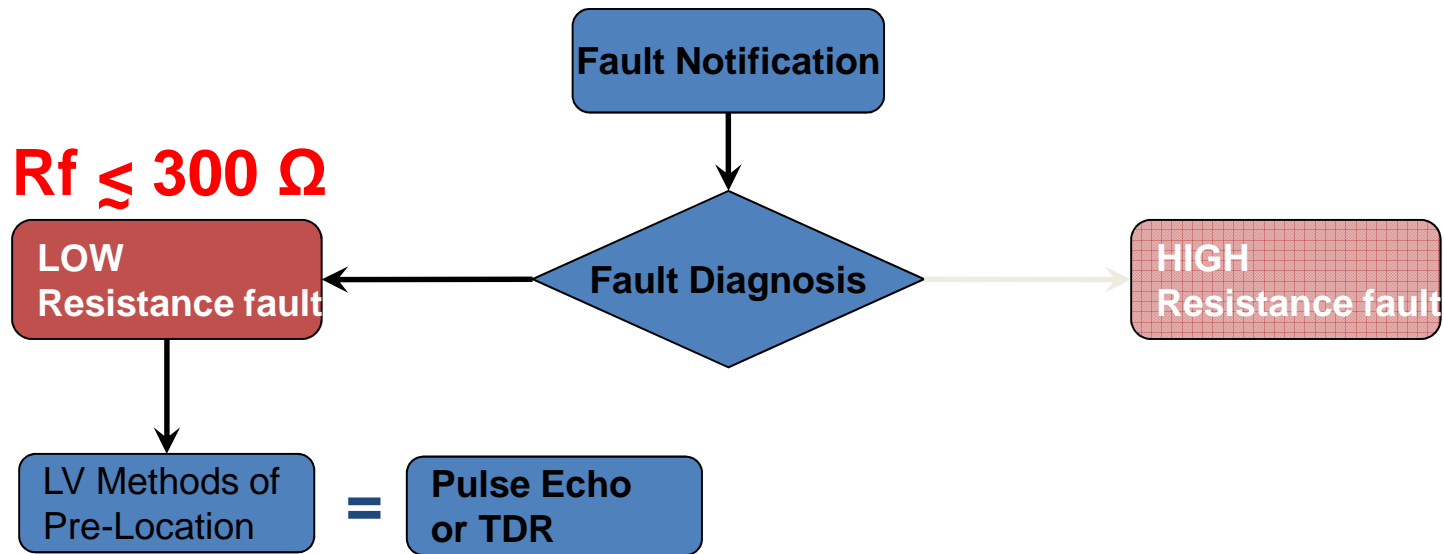
Rf $\leq$ 300 Ω

LOW Resistance fault

Fault Diagnosis

Rf $\geq$ 300 Ω

HIGH Resistance fault
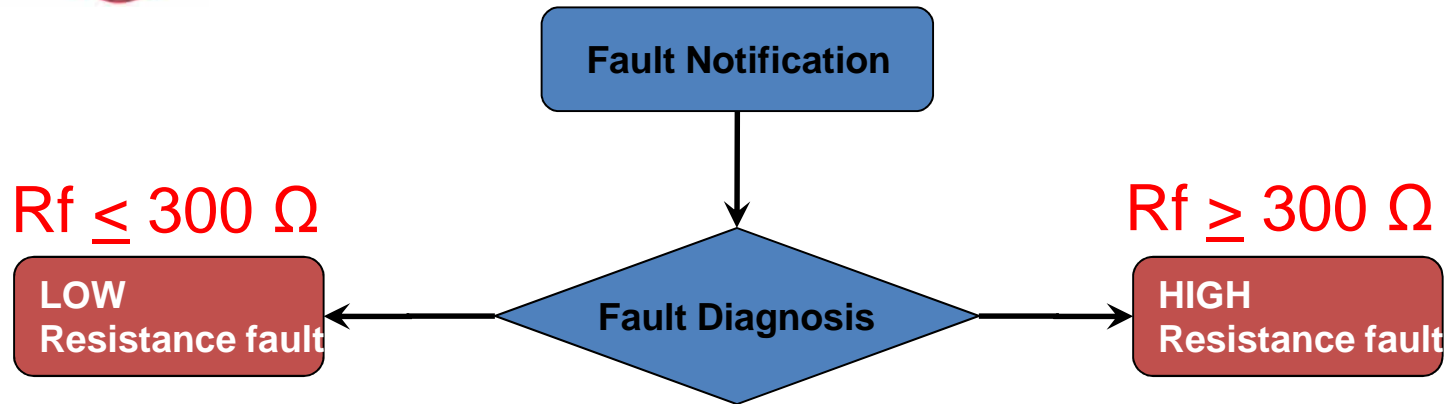
For cable fault location, we distinguish in:
- Parallel Faults:
  - Low resistance : $R_f \leq 300$ Ω
  - High resistance: $R_f \geq 300$ Ω
- Series Faults:
  - Low resistance : $R_f \leq 10$ Ω
  - High resistance: $R_f \geq 10$ Ω

Low resistance means: Standard pulse echo method should be possible
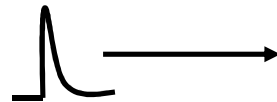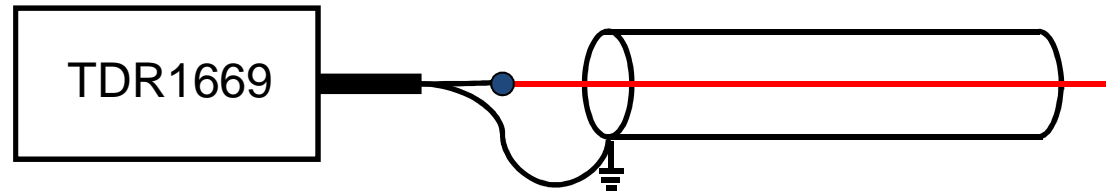High resistance means: High Voltage Methods should be applied

Decision – Low Resistance Fault? Yes, then TDR

Fault Notification

Rf $\lesssim$ 300 Ω

LOW Resistance fault ← **Fault Diagnosis** → **HIGH Resistance fault**

LV Methods of Pre-Location = **Pulse Echo or TDR**

Decision – Low Resistance Fault? Yes, then TDR

TDR1669

It is like radar:
A pulse is send into the cable

A change of cable impedance
will reflect this pulse.
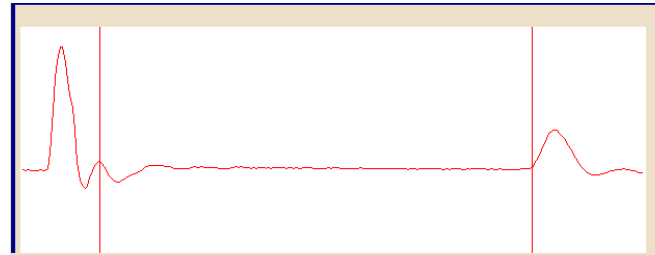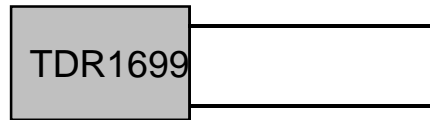In this case: The reflection is caused
by the end of the cable

Pulses visible on the screen of the TDR

➢ **PULSE ECHO:** **Low resistance Fault <300Ω**
  ➢ **TDR stands for T**ime **D**omain **R**eflection
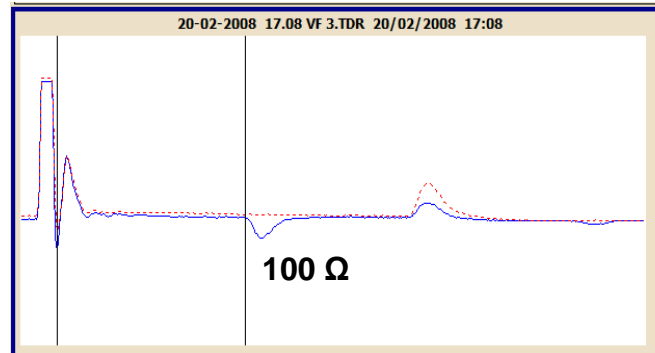 ➢ **model TDR1699: High Voltage Inc.**

Decision – Low Resistance Fault? Yes, then TDR

Typical traces

TDR1699

Cable without fault
(start / end of cable)

TDR1699

20-02-2008 17.08 VF 3.TDR 20/02/2008 17:08

100 Ω
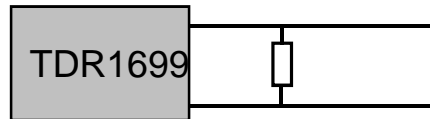
Parallel Resistance Fault
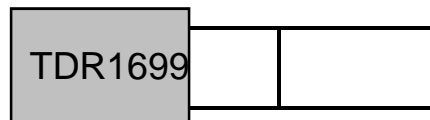
TDR1699

Short circuit Fault

0 Ω

Decision – High Resistance Fault? Yes, then HV Methods

Fault Notification

Rf $\geq$ 300 Ω

Fault Diagnosis

LOW Resistance fault

HIGH Resistance fault

LV Methods of Pre-Location

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Pulse Echo TDR

HV Methods of Pre-Location

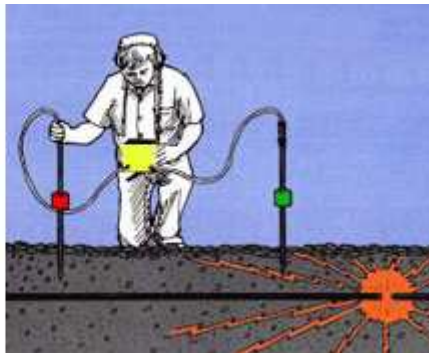=

Arc Reflection

=

Impulse Current
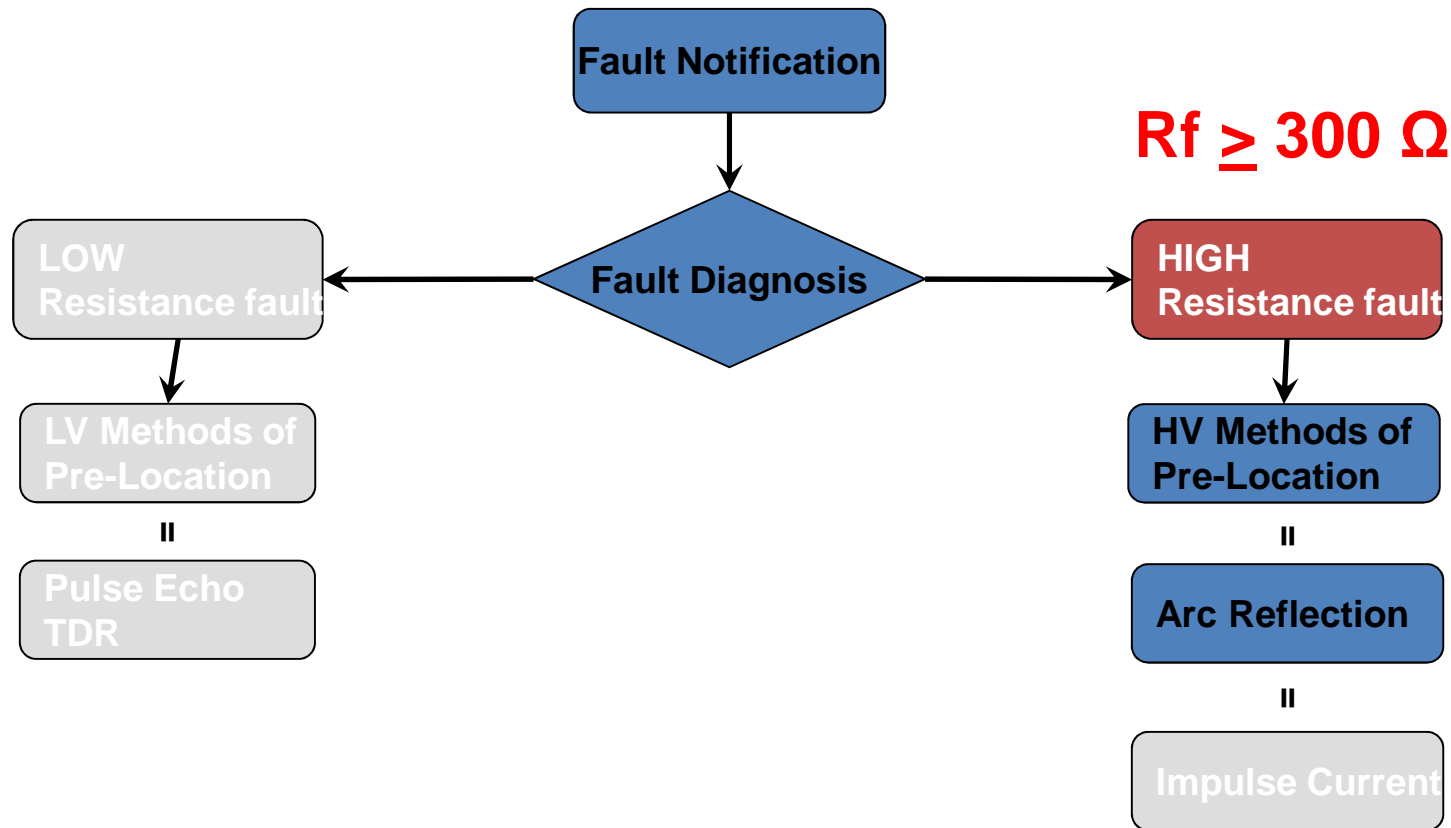
Decision – High Resistance Fault?
Yes, ARC REFLECTION

➢ **It is a combination between:**
   - **TDR**
   - **Surge generator**
   - **Arc stabilisation unit.**

➢ **This method allows to prelocate high resistance faults and flashing faults, using standard pulse echo techniques**

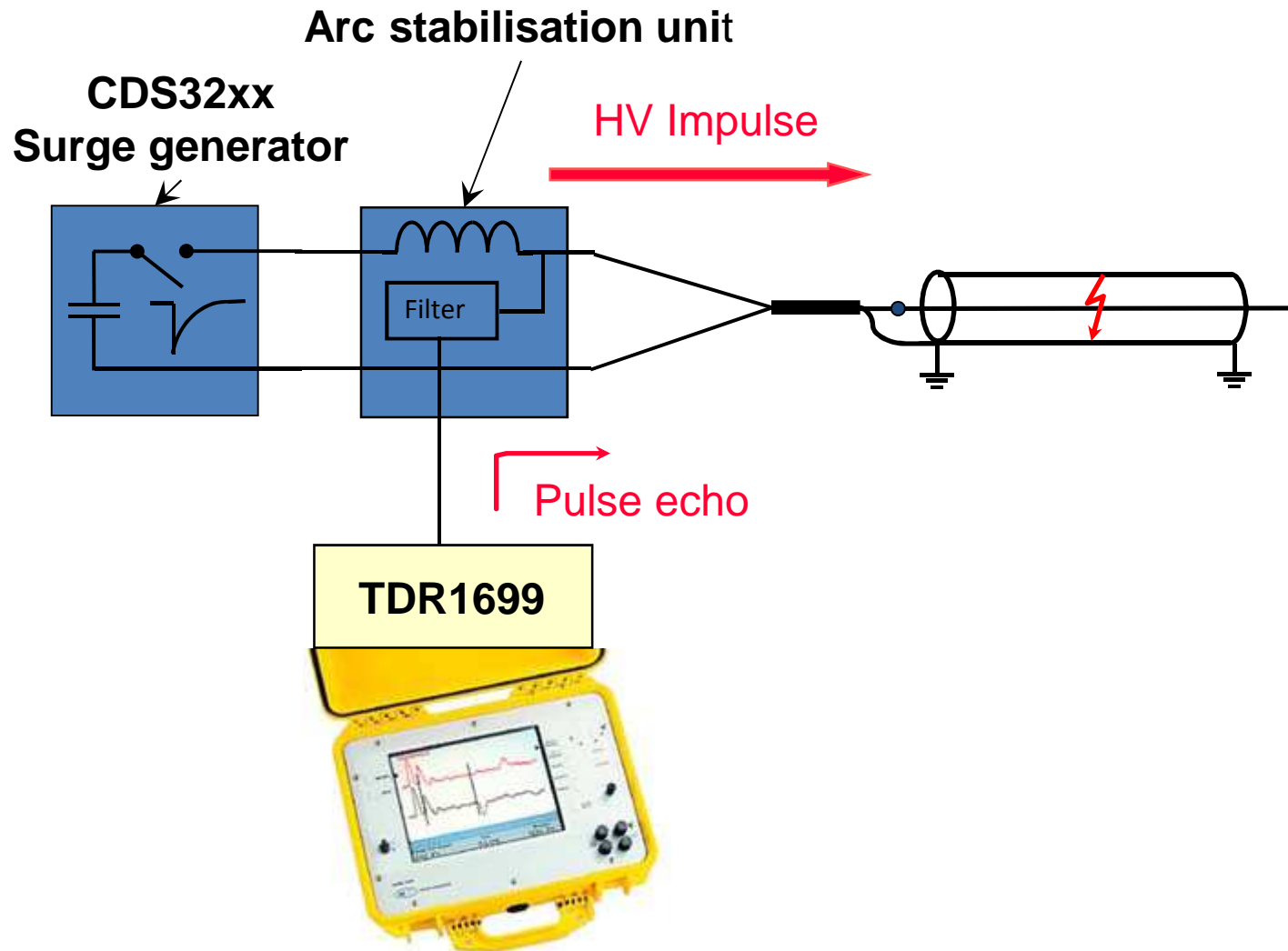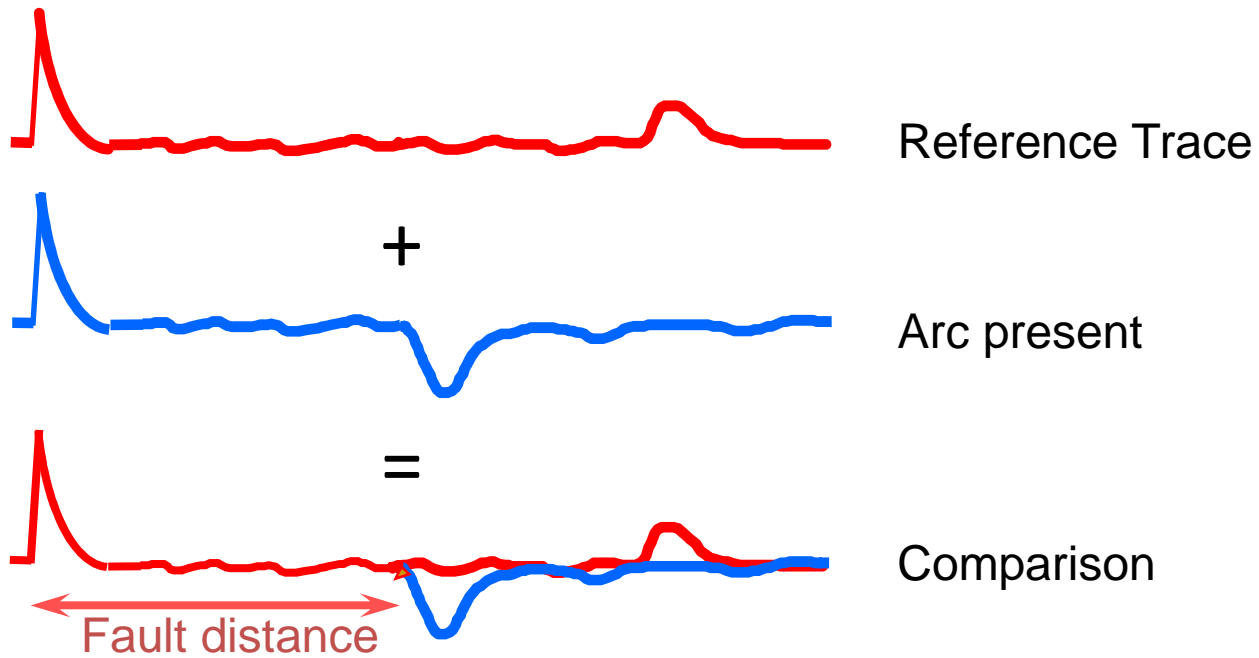➢ **This method can be used anywhere where a fault can be ignited.**

CDS3632U
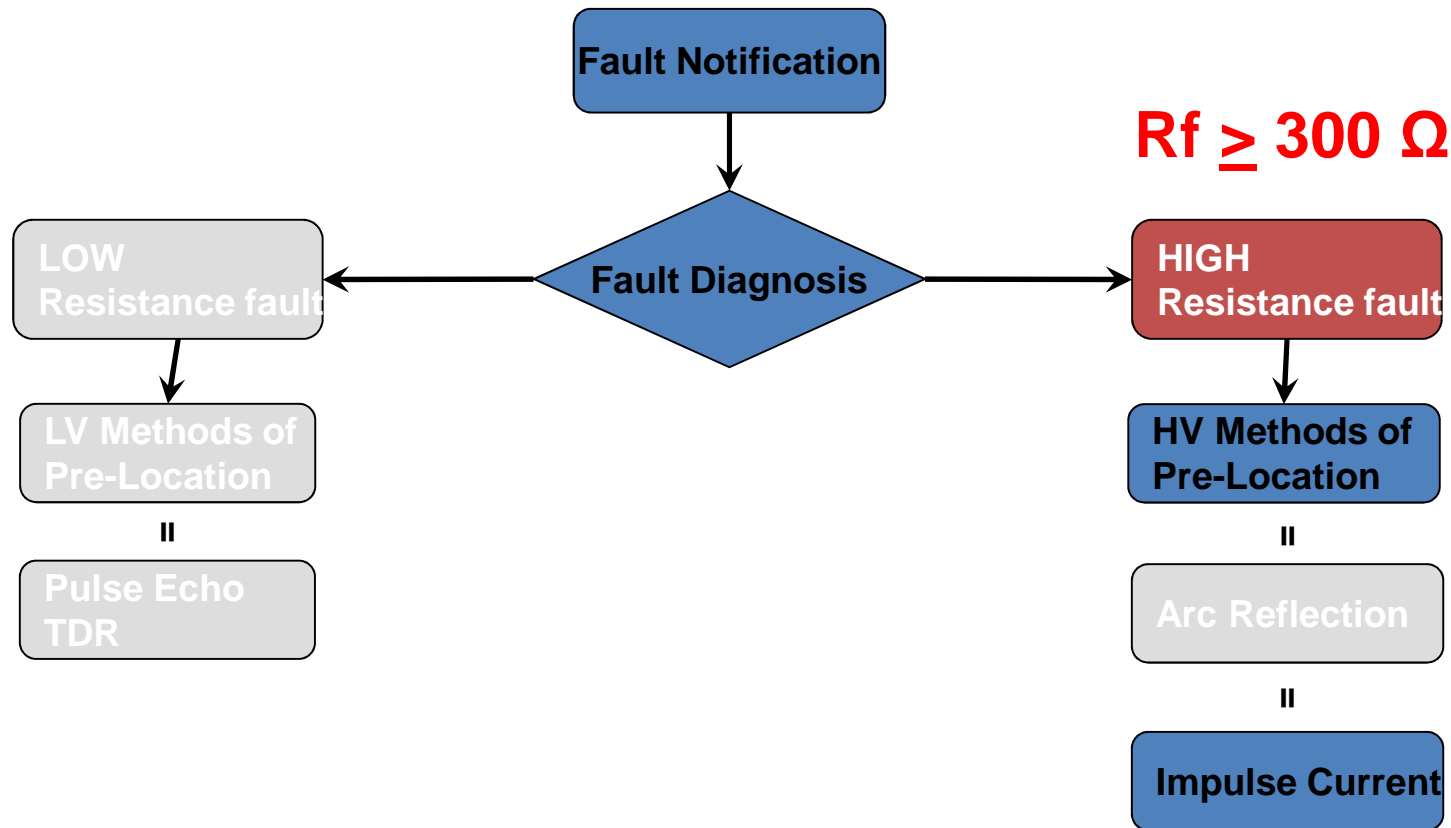
CDS2016U

CDS3632U Arc Reflection

CDS3632U Arc Reflection

Typical Traces

Reference Trace

\+

Arc present

=

Comparison

Fault distance

Decision – High Resistance Fault?
Yes, then HV Methods

Fault Notification

Rf $\geq$ 300 Ω

Fault Diagnosis

LOW Resistance fault

HIGH Resistance fault

LV Methods of Pre-Location

HV Methods of Pre-Location

=

=

Pulse Echo TDR

Arc Reflection

=

Impulse Current

Decision – High Resistance Fault?
Yes, IMPULSE CURRENT

➢ **It is a combination between:**
- **Surge generator**
- **TDR (Memory)**
- **Pulses are detected by an inductive coupler**
  (Current Transformer)

➢ **This method allows to prelocate <u>high resistance</u> faults and flashing faults.**

This concept has 2 methods:
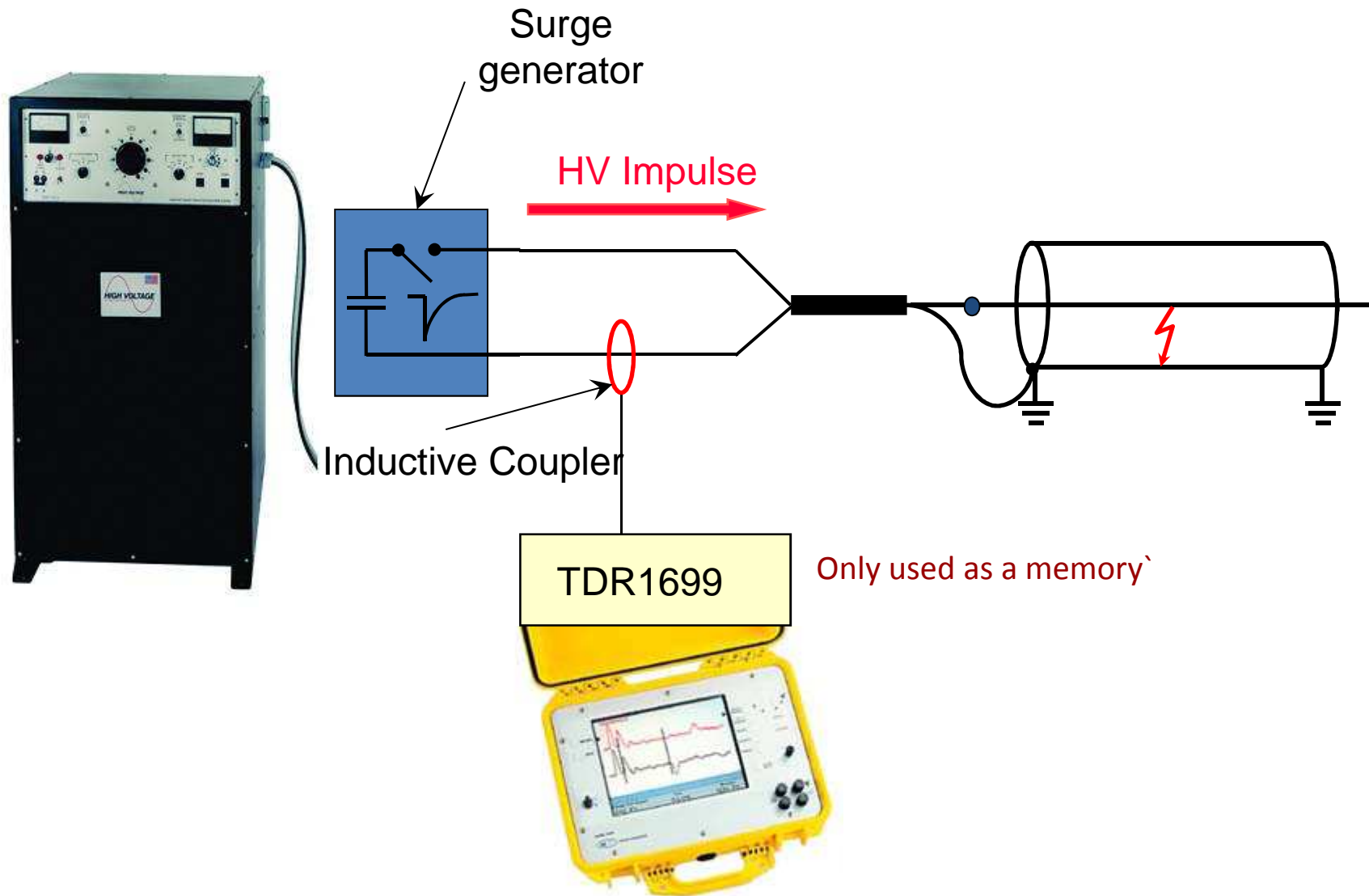➢ **Standard method**
➢**Loop on – Loop off method (Advanced)**

A B

$t_X + \Delta t$ t_X
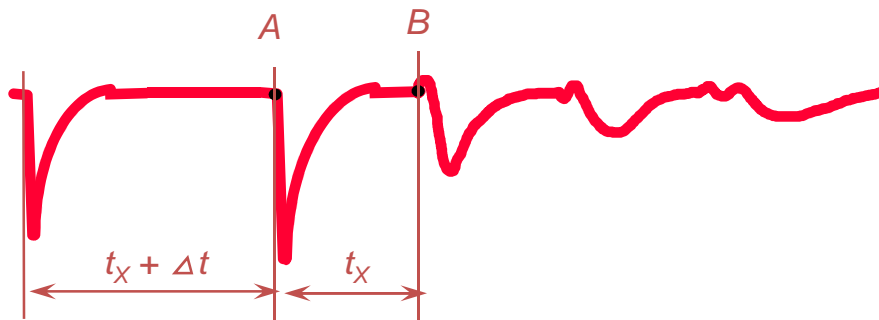
Typical
Trace

CDS3632U

CDS2016U

CDS3632U Impulse Current ICE

Surge generator

HV Impulse

Inductive Coupler

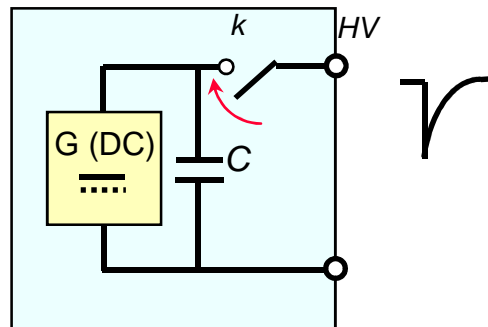TDR1699

Only used as a memory`
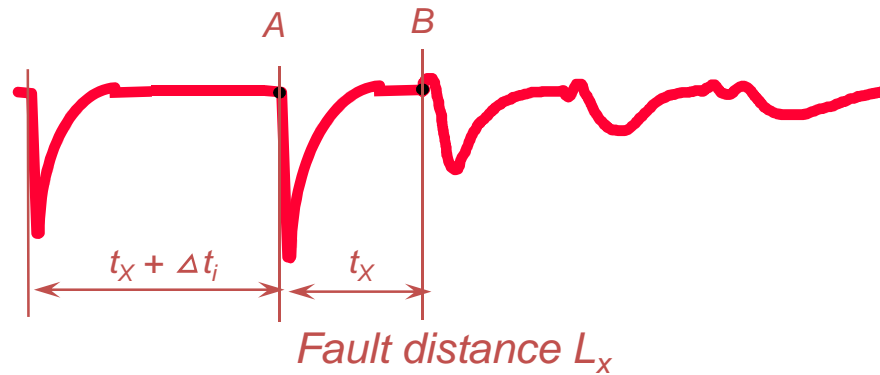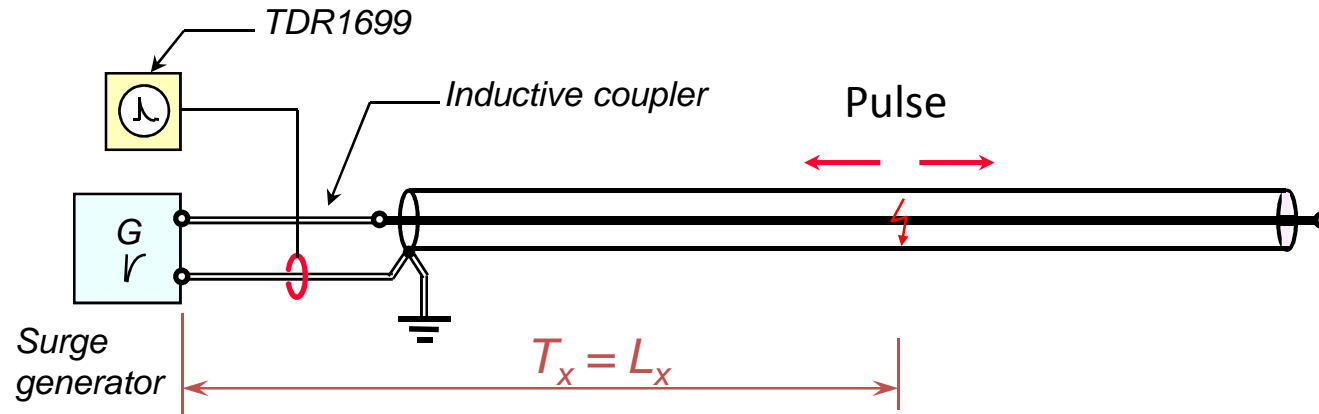
CDS3632U Impulse Current ICE

The surge generator sends a HV Impulse into the cable.
This creates a spark at the faulty spot.
This spark is a source for an impulse which is used to
measure the fault distance
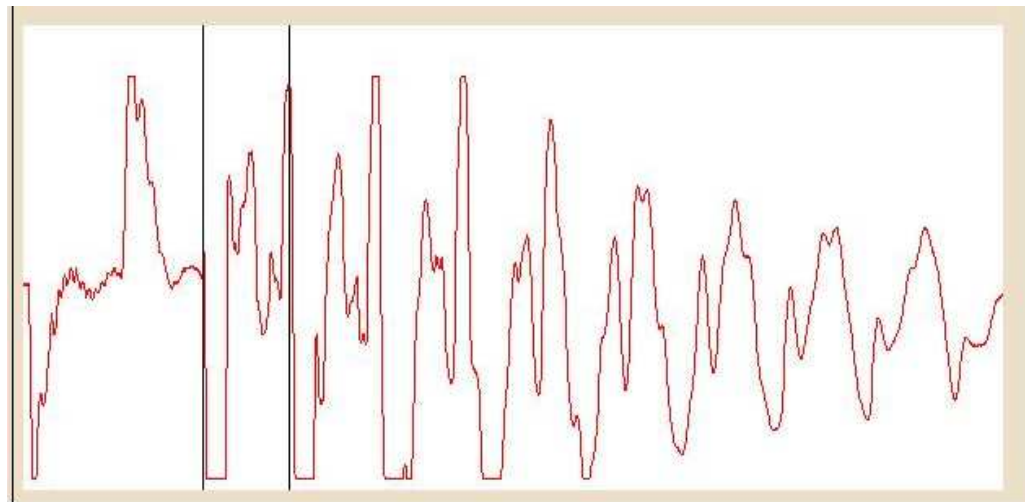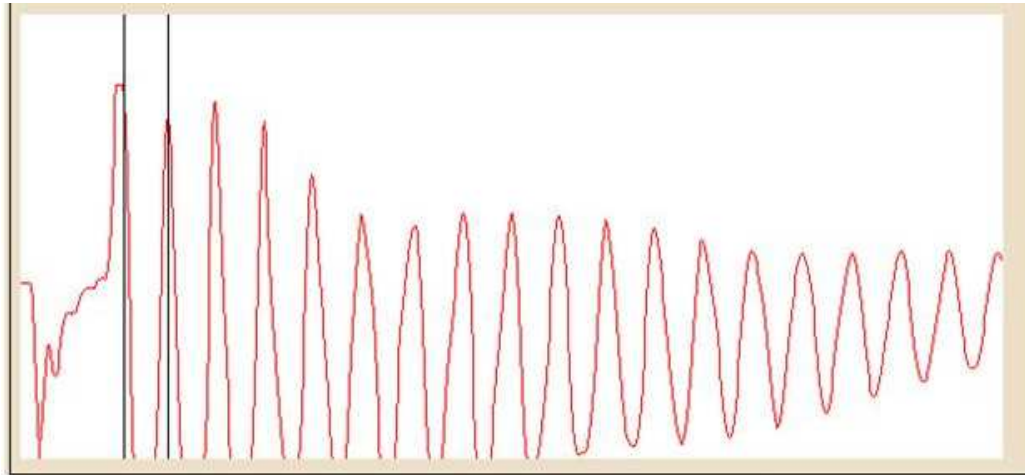
Shock Discharge Generator:

CDS3632U Impulse Current ICE

Typical Trace

Fault distance L_x

Impulse Current ICE
Standard method–Results 1 &2

Cable Fault Location

Rf ≥ 300 Ω

Fault Notification

Fault Diagnosis

LOW
Resistance fault

HIGH
Resistance fault

LV Methods of
Pre-Location

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Pulse Echo
TDR

HV Methods of
Pre-Location

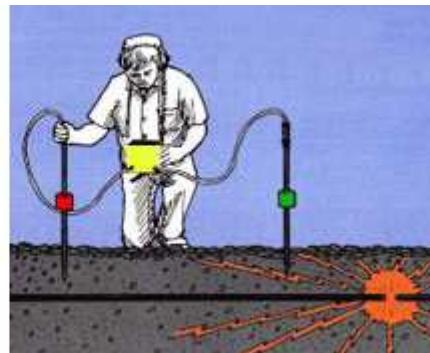Fault Located?

No

Fault
Conditioning
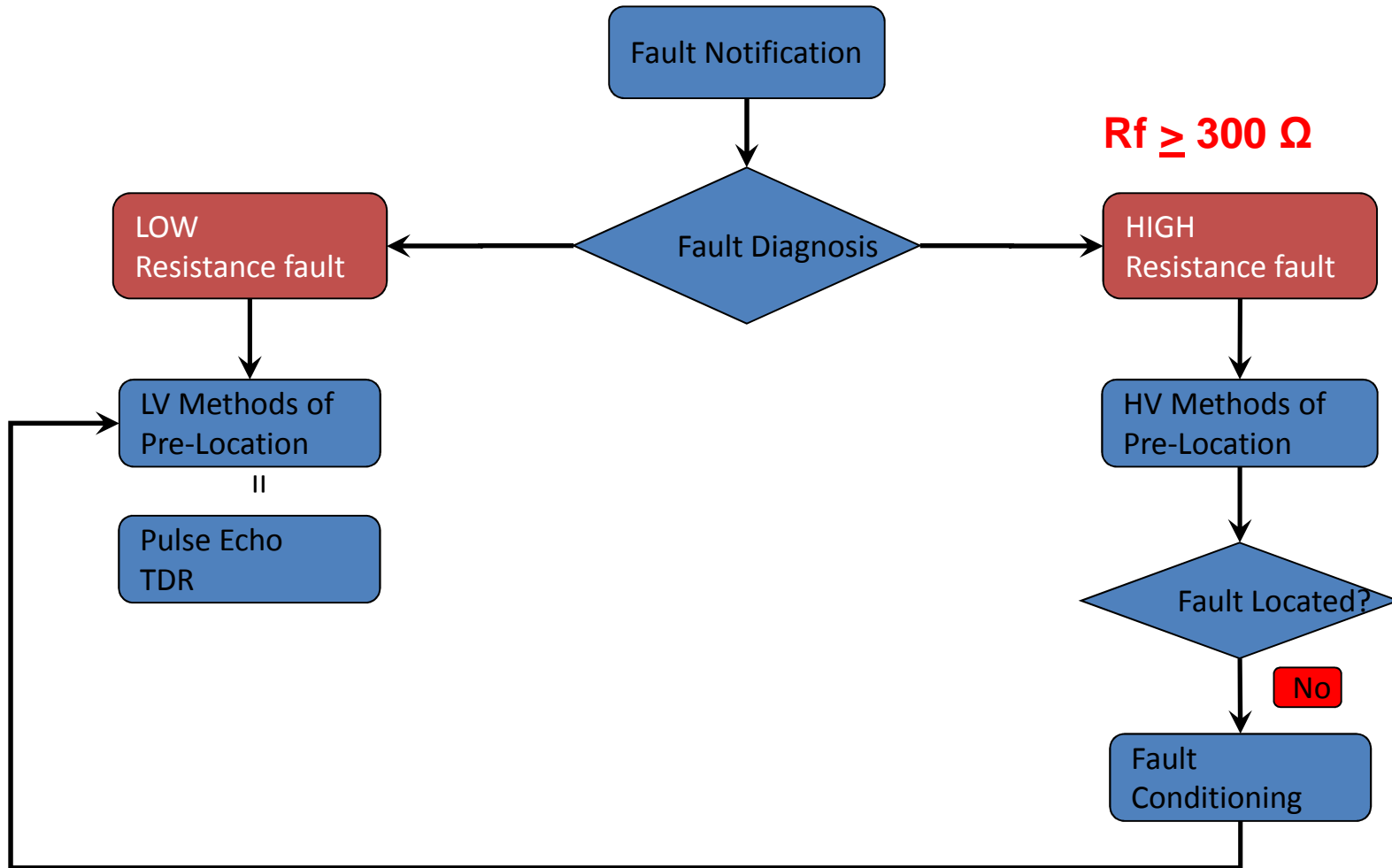
PIN POINT Fault Location

What is Pinpoint Fault Location ?

➢ **It is the technique used to accurately identifying the actual point of fault (all other techniques up to now have been _pre_location!)**

Basics:

➢ **A Surge generator is used to generate a "flashover" at the point of fault. The noise, created by this flashover, is then detected using a ground microphone + amplifier and headphone**

PIN POINT Fault Location

➢ **Using an Impulse / Surge generator in conjunction with acoustic and electromagnetic detection.**

➢ **Dominates fault pinpointing.**

➢ **It is the best, accurate way of pinpointing the fault position**

➢ **It has an almost perfect record of success in pinpointing faults**

➢ **A measure of your success is how many excavations there have been !**