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JURNAL INFOKUM, Volume 10, No.1, Desember 2021 **ISSN : 2302-9706**

Reliability System Detection Of 1 Phase Network Short Detection Disorders

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Abstract

Article Info
Received : 29 November 2021
Revised : 19 December 2021
Accepted : 28 December 2021

In this study describes a circuit to detect the location of a fault line short 1 phase network. The single power supply that emits a voltage of 12 V will be converted into 2 voltage sources, namely voltage (+) and voltage (-). This voltage is used to supply a parallel resistance circuit which functions to find the difference in voltage to be measured. The difference in voltage is sent to the op amp. The op amp used is IC TL084 CN which has 4 op amps and only 1 op amp is used. After outputting the voltage from the op amp, it is sent to the interface (ADC). The signal emitted by the op amp is still an analog signal. While we use a PC that can only receive digital signals. So we need a series of interfaces (ADC) so that the PC can receive signals from the circuit. The cable used to send the signal uses an RS 232 cable or a serial USB cable. After the PC receives the signal via a serial USB cable, the signal is processed in Visual Basic 6.0. Before testing the tool, calibration is carried out first so that the resulting data results are more accurate which will be displayed in Visual Basic 6.0

Keywords : Control System, Interface, Short Circuit Interference

1. Introduction

The protection system is an important component to maintain continuity and reliability of distribution electrical energy. The protection system serves to protect equipment from damage in the event of a disturbance and to localize the disturbance so that it does not spread. With a good protection system, unwanted losses can be avoided, especially on vital equipment such as electronic equipment in office buildings.

In electricity, it is inseparable from the use of cables as a means of connecting and distributing power from the center to consumers, namely households and installations which are generally planted on walls where the aim is security or to avoid things that endanger safety. But it is not uncommon to experience disturbances, such as the occurrence of short circuits between cables which result in disruption of the electrical system and this can endanger humans. So we need a tool that is efficient and can be used to determine the presence of short circuit disturbances as well as to determine the locationof the short circuit on the cable.

Insulating materials are divided into 3, namely: solid, liquid or gas. The insulation will result in an electric breakdown or a short circuit if the damage is caused internally or externally. Cable insulation is classified as solid insulation, solid insulation will cause damage due to basic, electromechanical, streamer, thermal, and erosion failures. If the electrical discharge occurs due to the penetration of solid material insulation, it is said to have occurred. Damage to solid insulation always leaves permanent damage marks. Such disturbances are also called permanent disturbances.
Based on the duration of the disturbance:

JURNAL INFOKUM, Volume 10, No.1, Desember 2021 ISSN : 2302-9706

a. Transient fault, is a disturbance that disappears by itself when the circuit breaker is open from the transmission line for a short time and after that it is reconnected.

The causes of temporary disturbances, for example:

1) Due to lightning and others.
2) Because of the birds, the leaves, the kite strings, etc.

b. Permanent fault, is a disturbance that does not go away or persists when the circuit breaker is open in the transmission line for a short time and after that it is reconnected.

The causes of permanent disturbance:

1) Due to the occurrence of overvoltage (by lightning, etc.) that exceeds the insulation strength.
2) Due to mechanical damage to the insulation.
3) Due to the process of deteriorating the insulation itself. For example due to humidityand heating.
4) Due to an operation error.

If based on the symmetry, the fault is divided into 2 parts:

a. asymmetrical fault, where the disturbance that causes the voltage and current flowing in each phase to become unbalanced, this disturbance consists of:
1) Single-phase short-circuit fault to ground
2) Two-phase
3) short-circuit fault phase to ground

b. Symmetrical fault, where the fault occurs in all phases so that the current and voltage of each phase remain balanced after the fault occurs. This fault consists of:
1) Three-phase
2) short-circuit fault Three-phase short-circuit fault to ground

$Ia1 = Ia2 = Ia0$ ....(2.1)

$Ia1 = \frac{Vf}{Z1+z2+zc} \frac{Vf}{Z1+z2+zc}$ .... (2.2)

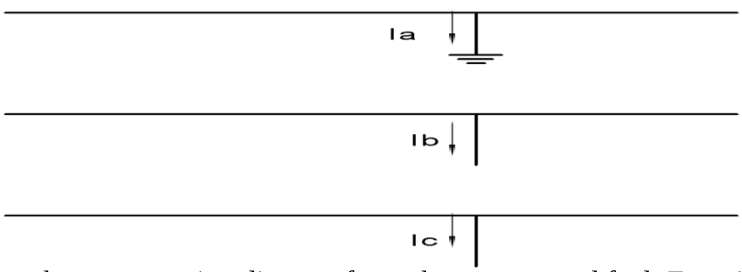

Figure 1. The phase-connection diagram for a phase-to-ground fault Equations 1 and 2 show that the three sequence lines must be connected in series through the fault point in order to simulate a single phase-to-ground fault.

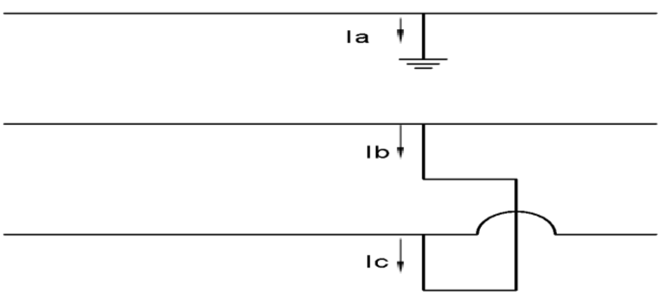

Figure 2. phase-to-phase connection diagram of an inter-phase

a. fault Inter-phase fault in a power system

For an inter-phase fault, each phase of the three lines of the fault is connected as shown in Figure 2.3. In this fault there are the following relationships

Vb = Vc Ia = 0 Ib = -Ic

The above equations are identical in form to the equations used for an interphase fault in an isolated generator.

Va1 = Va2 ....(2.3)

Ia1 = ... $\frac{Vf}{Z1+Z2}$ $\frac{Vf}{Z1+Z2}$ .... (2.4)

Equations (2.3) and (2.4) show that positive and negative-sequence networks must be connected in parallel at the fault point in order to simulate an inter-phase fault.

b. Dual phase to ground fault in a power system

For a dual phase to ground fault, the phases are connected as shown in figure 2.3.there are the following relationships in the disturbance:

Vb = Vc = 0Ia = 0

By comparing with the reduction made, we get

Va1 = Va2 = Va0..(2.4)

Ia1 = ... $\frac{Vf}{Z1+Z2Z0/(Z2+Z0)}$ $\frac{Vf}{Z1+Z2Z0/(Z2+Z0)}$ ....(2.5)

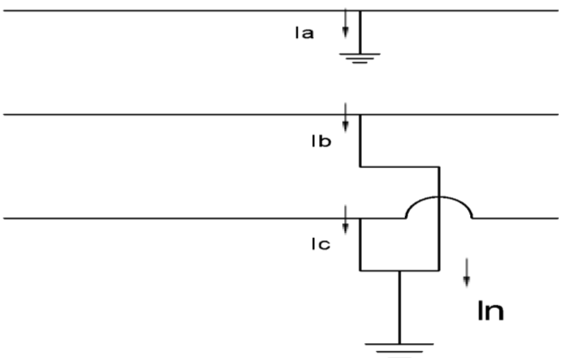

Figure 3 Phase-phase connection diagram for a double fault from phase to ground

2. Method

The method used in this research is to design a short circuit fault detection device. computer interface based phase. The computer is used as a unit to get a view of the location of the short circuit fault. The existing interface functions as an analog to digital signal converter so that the computer can read the signal from the device. The action of this resistor is as a voltage divider from both the resistance of the resistor and the resistance of the cable itself. And the OP AMP functions as a voltage amplifier.

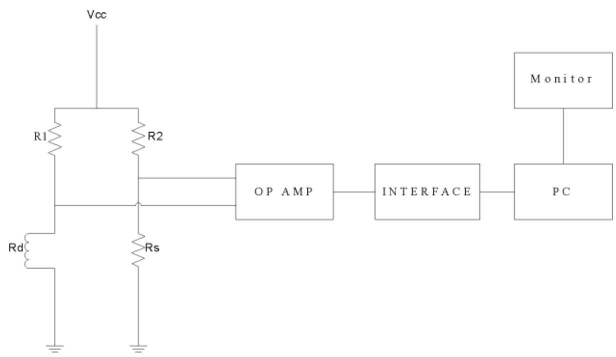

Figure 4. Block diagram of a short circuit detecting device.

3. Results And Discussion

At this time we discuss the design and manufacture of a short circuit fault detector. The design of this system includes hardware and software design. The hardware design includes the design of resistors, power supplies, amplifiers that function to amplify the voltage so that the ADC can be read, the third part is the ADC which functions to convertanalog data into digital data and PC. While the software includes the *Visual Basic 6.0*. Several other aspects that need to be explained in the discussion of this chapter are determining the specifications of the designed system, block diagrams and system working principles.

Hardware (*hardware*)

a) Power supply

circuit The power supply circuit used is useful for providing sufficient power so that the entire circuit can carry out its functions properly. The power supply circuit consists ofseveral parts, namely:

1) Voltage reducer The voltage

reducer used is a center tap (CT) type step down transformer. This transformer servesto reduce the AC voltage of 220 V to AC voltage of 12 V. where the amount of current that will be used to supply the circuit of the device. Then the output voltage is rectified bythe diode and stabilized to 12 V using a 12 V regulator IC (7812).

2) Voltage

Rectifier The rectifier used is a silicon diode as a full-wave rectifier which changes the AC waveform to DC with a frequency value of 2x50Hz, which is 100Hz. The diodes used are 2 diodes to rectify the positive wave and the ceter tap (CT) as a negative output with a diode current capacity of 1 A so that the diode does not work too hard. The output of this diode has become a unidirectional wave but the waveform is still in an impurestate or in other words there are still ripple waves.

Where is the peak voltage, namely: $V_{RMS} = 0{,}707 x V_P$

$$V_P = \frac{V_{RMS}}{0{,}707}$$

$$V_P = \frac{12v}{0{,}707}$$

$$V_P = 16{,}97 \text{ Volts}$$

So that the resulting DC voltage (still in the form of DC ripple voltage), namely:

$V_{DC} = 0{,}636 x V_P$

V DC= 0.636 x 16.97 VV$_{DC}$ = 10.79 Volt

3) Filter

The filter used is an electrolytic capacitor. This capacitor serves to filter (filter) or to equalize the output voltage of the diode so that the filter output produces a flat (pure) unidirectional waveform

$$V_{DC} = V_P - \frac{V_{ripple}}{2}$$

with an output voltage of 5 VDC. This capacitor is rated at 220µF/25V. after the capacitor is installed, the VDC is:

Where by setting the ripple voltage (V_{ripple}) at 10% of the V_P, we get:

$V_{ripple} = \frac{10}{100} x 16{,}97V$

= 1.697 Volts

So that the V_{DC} now becomes:

$$V_{DC} = 16{,}97 - \frac{1{,}697}{2}$$

VDC = 16.12 Volts

With the known ripple voltage and load current, where the load current is determinedbased on the maximum current used, which is 500 mA. So, the value of the capacitor can be determined, namely:

$$V_{ripple} = \frac{0{,}75 x I}{f.C}$$

where 0.75 is a constant value.

So from the above formula, we can calculate the value of the capacitor, namely:

$C = \frac{0{,}75 x I}{f.V_{ripple}}$

$= \frac{0{,}75 x 0{,}5}{100 x 1{,}697}$

= 0.0002209

= 220.9 F

with the reason that the capacitor is not on the market, then the value of the capacitor is selected as 220 F .

For the use of a regulator IC, at the output the capacitor value is added to be filtered again according to the value on the regulator IC data sheet to be used, in this case the IC used is 7812.

Single power supply

In this circuit, a power supply that emits a positive voltage is needed (+) and negative voltage (-). This voltage is used for the voltage source in the voltage divider circuit and the op amp. The op amp input consists of a positive (+) and negative (-) voltage.

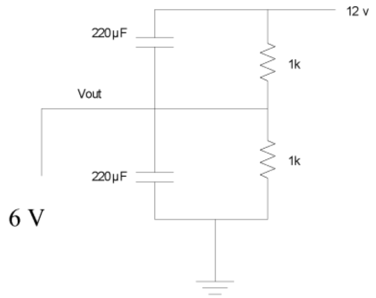

Figure 4. Single power supplyVcc

Where to find the input voltage is =Rt =

$$= \frac{R1 \times R2}{R1+R2} \frac{R1 \times R2}{R1+R2}$$

$$= \frac{5609\Omega x\ 5603{,}2\Omega}{5609\Omega+5603{,}2\Omega} \frac{5609\Omega x\ 5603{,}2\Omega}{5609\Omega+5603{,}2\Omega}$$

= 2803Ω
Vr = I x Rt
= 0.001 x 2803
= 2.803 V
So, Vin to supply the load is

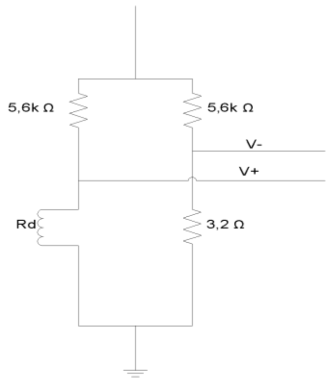

Figure 5. Voltage divider circuit

Vin = V – Vr
= 6v - 2.8v
= 3.2v
Where the voltage generated by each resistance is :

$$V- = \frac{R2}{R1 + R2} \text{Vin}$$

$$= \frac{3{,}2\Omega}{5600\Omega + 3{,}2\Omega} 3{,}2v$$

$= \frac{3,2\Omega}{5603,2\Omega} 3,2v$

= 0.00057 x 3.2

V(-)= 0.002 VV+ =

=3.2 v $\frac{R2}{R1+R2}$ Vin $\frac{R2}{R1+R2}$ Vin

= $\frac{9\,\Omega}{5600\Omega+9\Omega}$ $\frac{9\,\Omega}{5600\Omega+9\Omega}$

Circuit Op-Amp as a voltage

= $\frac{9\Omega}{5605\,\Omega}$ $\frac{9\Omega}{5605\,\Omega}$ 3.2 v

V(+)=0.0047

amplifier Operational amplifier (Op-Amp) is an analog electronic component thatfunctions as a multipurpose amplifier in the form of an IC and has the following symbol:

Operational amplifier (Op-Amp) has the following characteristics:

1) large Input Impedance (Zi) =Output
2) Impedance (Z0) = 0
3) Voltage Gain (Av) high =
4) *Band Width* wide frequency response =
5) V0 = 0 if V1 = V2 and does not depend on the magnitude of V1.
6) The operational characteristics of the amplifier (Op-Amp) are not temperaturedependent.

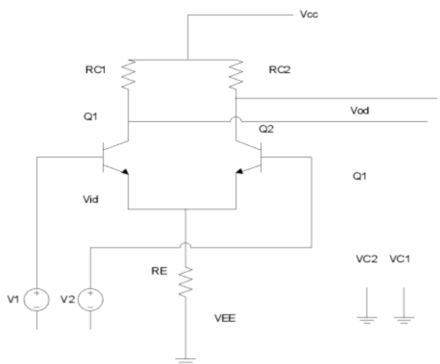

Figure 6. basic op-amp circuit

In the differential amplifier above, there are two input signals, namely V1 and V2. Under ideal conditions, if the two inputs are identical (Vid = 0), then the output Vod = 0. This is because IB1 = IB2 so IC1 = IC2 and IE1 = IE2. Therefore, the output voltages (VC1 and VC2) are the same, so Vod = 0. If there is a difference between the signals V1 and V2, then Vid = V1 – V2. This will cause a difference between IB1 and IB2 voltage in the circuit is:

Vout = A {Vin(+) – Vin(-)}

Where, A = $\frac{10.000\ -9}{9}$ $\frac{10.000\ -9}{9}$

= 1110 times

= 1110 (0.0047 – 0.002)

Vout =2,997 V

Software

General steps to create a program:

1) Place the required components in the form window using the tools in the *toolbox,* adjust the layout of the components.
2) Setting kompoonenn properties through the *properties*
3) Write program code in the code window, according to the event of an event that will be felt by the component. For example click and so on.

Designing the main form for the toolbar display:

1) Place *control command buttons* that function as buttons to view data.
2) Labels are used to write descriptions.
3) *Textbox* is used to write facility names or numbers.
4) MS Comm is used as computer communication with external devices that are connected to available applications.

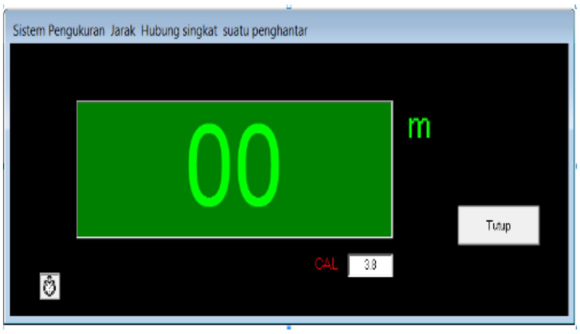

Figure 7. display of short circuit location measurement

Weakness

1. This design can only measure or detect the location of short circuit faults in one phase network line only.
2. If you want to measure using other types of cables and other diameters, then we must calibrate the tool and determine the resistance ratio.

This circuit is designed only to detect the location of a single phase network short circuit fault. In this design the required voltage is a positive (+) and negative (-) voltage.

The single power supply that emits the 12v voltage will be converted into 2 voltage sources, namely voltage (+) and voltage (-). This voltage is used to supply a parallel resistance circuit which functions to find the difference in voltage to be measured. The difference in voltage is sent to the op amp to be processed. The op amp used is the opamp on IC TL084 CN which has 4 op amps and only 1 op amp is used.

After outputting the voltage from the op amp, it is sent to the *interface* (ADC). The signal emitted by the op amp is still an analog signal. While we use a PC that can only receive digital signals. Therefore, an *interface* (ADC) is needed so that the PC can receive signals from the circuit. The cable used to send the signal is to use an RS 232 cable or a serial USB cable.

After the PC receives the signal via a serial USB cable, the signal is processed in Visual Basic 6.0. Before testing the tool, first calibrate it so that the resulting data corresponds to the actual distance in the measurement. Every cable that is used, whether fiber or single, small or large diameter, then we will calibrate so that the data produced is in accordance with reality. After calibrating visual basic, then we can measure how long the short circuit occurs and the data will be displayed in Visual Basic 6.0

4. Conclusion

From the results of the discussion and the workings of the circuit that has been designed, several conclusions can be drawn, including; From the design that has been made then it is known that the difference in the resulting voltage division or resistance can find out how many 1 phase short circuit faults are located with a Visual Basic display. In the interface design, the data that is sent analogously can be converted into digital so that it can be displayed on a PC. This design can measure the data accurately if the length of the cable you want to measure the location of the disturbance is above 20 M. The larger the diameter of a cable, the greater the resistance of the cable, therefore the cable used is of small diameter (fibers).

From the results of the discussion and how the tool works, the author can provide suggestions as follows; Because this tool is used portable only to detect the location of short circuit faults, so if this design wants to detect whether there is a short circuit and the location of short circuit faults (designed permanently at the source) then it can be replaced with a microcontroller with an LCD display.

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