



GROUNDING MEASUREMENTS IN RESIDENTIAL ELECTRICAL INSTALLATIONS IN KUPANG CITY

By

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Abstract

The grounding system is a crucial component of a residential electrical installation, providing protection against the dangers of electric shock and leakage currents. This study aims to determine the grounding resistance value in residential electrical installations and evaluate their compliance with applicable electrical safety standards. The method used in this study was direct measurement using an earth tester at several grounding points in the residential installation. The measurement data were then analyzed based on the General Requirements for Electrical Installations (PUIL) standards. The measurement results showed that the grounding resistance values obtained varied, with 78 points, with values ranging from 0 to 4 ohms below the standard. ≤ 5 ohms at 72 points and resistance values of 5 – 23.8 ohms above the standard at 6 points. influenced by soil conditions, electrode depth, and soil moisture content and The diameter of the installed conductor wire. Good grounding resistance values are obtained in moist soil conditions with standard electrode installation. Based on the analysis, most installations met safety standards, but there were some Points that still have resistance values above the recommended limits require periodic grounding system repairs. This is based on grounding system measurements and evaluations. This, it is hoped that the level of security of residential electrical installations can be increased and be able to Minimize the risk of disruption or accidents due to electrical current. Can be recommended the electricity company and its team of experts will check the grounding installation in residential homes periodically and it is mandatory to plant the ground in the ground uses rod rod (BC) with a diameter of 4 – 6 mm, so it is easier to conduct excess current to the ground if there is a short circuit that comes suddenly from a large power network.

Keywords: Grounding, Electrical Installation, Earth Tester, Grounding Resistance, Electrical Safety.

INTRODUCTION.

1. Background

Electrical installations in homes are essential for supporting daily activities. As the use of electrical equipment increases, the risk of electrical disturbances such as short circuits, current leaks, and overvoltages also increases. These conditions can endanger the safety of occupants and potentially damage electrical equipment. Therefore, an effective safety system is necessary, one of which is a grounding system.

The grounding system functions to channel fault current directly to the ground, thereby reducing the risk of electric shock and preventing equipment damage. Furthermore, this system plays a role in stabilizing voltage and protecting installations from the effects of lightning strikes. However, in practice, many residential electrical installations still lack a proper grounding system or even fail to meet established standards.

According to the General Requirements for Electrical Installations, grounding resistance must be below a certain limit

for the protection system to operate optimally. In reality, grounding resistance is significantly affected by soil conditions, such as soil type, humidity, and temperature. This means that not all installed grounding systems can immediately meet standards without further measurement and evaluation.

Lack of public understanding of the importance of grounding systems and minimal regular testing are key factors contributing to the poor quality of residential grounding systems. Therefore, measuring and analyzing grounding systems is necessary to determine their resistance and determine necessary repairs.

With this research or study on grounding systems, it is hoped that it can increase awareness of the importance of safe electrical installations, as well as provide technical recommendations in designing and maintaining grounding systems that comply with standards.

2. Land Value Standards

The standard grounding value in electrical installations is determined so that the protection system can work safely and effectively. In Indonesia, the main reference is the General Requirements for Electrical Installations. Where the grounding resistance value for residential installations is ≤ 5 ohms, sensitive electronic equipment installations (e.g. computers, servers): $\leq 1-2$ ohms, lightning rod installations ≤ 10 ohms (but smaller is recommended for optimal results) and in electrical substations / power systems: ≤ 1 ohm. In terms of the smaller the grounding resistance value, the better the system's ability to channel fault currents to the ground. The higher the grounding resistance value, the less good the system's ability to channel currents to the ground. This can cause interference with the protection (MCB / ELCB) to work less optimally so that the risk of electric shock will increase and cause damage to electronic equipment installed in the house. There are several factors that cause high or low grounding values, namely: Soil type (clay, sandy, rocky), Soil moisture, Depth and number of electrodes, Distance between electrodes.

3. Grounding Installation Techniques

Grounding installation techniques in residential homes are essential for every home. Grounding in a home is part of the overall protection of electrical installations and electronic equipment in the home against lightning strikes. One factor that causes home grounding protection to not work properly is because not all consumers understand the function of grounding. As a result, many electronic components installed in the home are damaged due to lightning strikes flowing through the wiring installation that produces high currents for a certain time. Therefore, electrical experts must implement grounding installation techniques following applicable standards, namely:

1. The grounding conductor uses a copper medium in the form of a 4mm diameter NYA cable. This cable serves as a conductor that is connected directly from the KWh meter equipment to the ground.
2. Round copper rod with a minimum diameter of 4-10 mm and a length of 50 cm. This rod will be buried 50 cm into the ground without protection. It functions as a conductor for excess current from lightning strikes and distributes it to the ground. This rod can be connected to the NYA cable coming from the kWh meter as a ground conductor.
3. A control tank is constructed above ground at the connection point between the cable coming from the KWh meter and the buried ground tip. The control tank can function as a monitoring site to control the grounding installation by conducting direct tests on the buried ground to obtain the resistance value of the ground conductor periodically.
4. When conducting tests on grounding installations, especially on buried ground, many cases of resistance values produced do not meet the standard, namely ≤ 5 ohms. It is necessary to review the area and soil humus, whether the soil is rocky, sandy, clay or swampy. The soil humus obtained can affect the resistance value of the conductor buried in the ground.

5. If the test results are higher than the specified standard, additional conductors must be buried in the ground and connected in series. This is a solution for achieving resistance values below the standard.

4. Grounding test

Testing is one of the requirements for grounding installations, where this test is carried out in two stages, namely: first, testing the grounding installation conductor connected from the KWh meter to the rod point. This test needs to be done to determine the resistance value of the conductor itself in ohms. The maximum value produced is 1000 ohms, the minimum is 100 ohms. If the test results do not reach the standard, repairs or replacement of the installed conductor with a larger diameter are necessary. Second, testing the conductor point or so-called rod that is planted in the ground, this is necessary to determine the resistance value produced by the conductor reaches the standard of ≤ 5 ohms or exceeds. The results of this grounding installation test are a basic attachment to the process for processing the Operational Eligibility Certificate (SLO) involved by the agency involved in the electricity sector.

5. Grounding test equipment

The tool for testing grounding installations is not the same as the tool for testing resistance on electrical installations in homes or grounding. The measuring tool used to measure resistance on grounding uses the Kyoritsu Digital Earth Tester, this tool has several features or symbols with very accurate specifications where the measurement range is from 0 - 20 ohms, 0 - 200 ohms and 0 - 2000 ohms, has a ground voltage of 0-200 volts AC. Then the level of accuracy with ground resistance is $\pm 2\%$ rdg ± 0.1 ohms range 20 ohms and $\pm 2\%$ rdg 3 ohms range 200 ohms. The level of protection is more against ground resistance of 280V AC for 10 seconds from terminals 2 and 3. This tool has three cable sources that are removed from the measuring tool where the green cable can be connected directly to the buried conductor point, the yellow cable is connected to the ground with a nail 15 cm deep and the red cable is also connected to the ground using an iron 15 cm deep. then the connection between the two yellow and red cables must be in opposite directions with a distance of 5 - 10 meters.



picture 1 Earth Tester Kyoritsu

source: <https://www.alibaba.com/pla/New-Original-KYORITSU-4105A-Digital>

6. RESEARCH METHODS

This research is a direct observation in the field, through checking the grounding and grounding installations installed in residential homes. The process of checking the grounding can determine the value of the resistance produced in each house and is adjusted to the applicable standards referring to PUIL, SPLN and SNI. The stages of this research begin with checking the type and brand of the grounding conductor wire (cable) and the rood (BC) buried in the ground and connecting the cable from the grounding installation to the rood (BC) in real time, in order to observe for more efficient and effective use and reduce the risk of accidents due to lightning strikes, short circuit currents. The stages carried out in this research are through the flow diagram below.

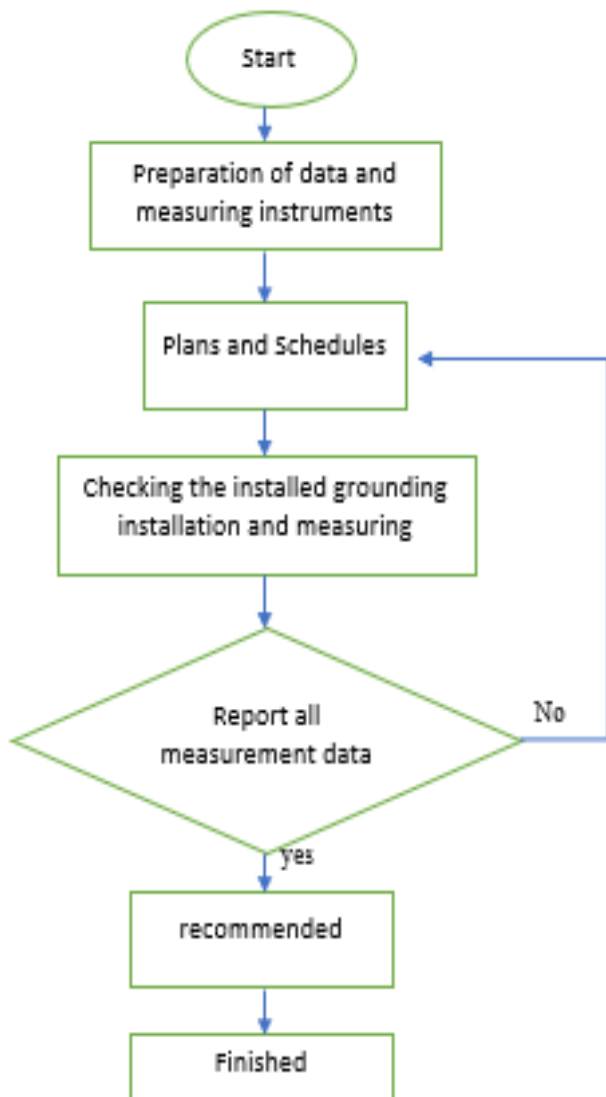


Figure 2 Process of checking grounding installations in a house

Source: Checking steps by researchers (2026)

This research is an instrumental study aimed at checking all grounding and grounding installations installed in 78 residential homes in Kupang City, East Nusa Tenggara. This study uses a quantitative approach using the instrument method for the electrical installation grounding system. Several important components that play a primary role in carrying out checks on grounding installations in residential homes are:

1. Scheduling and preparing documents and measuring equipment that can be transported to the site.
2. Checking the grounding installation in the residence.
3. Measuring the grounding resistance of the ground (BC) embedded in the ground.

7. DISCUSSION

A. Types of Grounding Conductors

Grounding is a grounding system that requires regular inspection of the grounding and ground wire installations installed in homes in Kupang City. During the inspection, There are several criteria, including: connected power, installed cable type, number of conductors, cable diameter, cable brand, and grounding resistance measurement. To better understand the electrical installation components connected to the ground in a home, see the table below:

No	City/Regency	Grounding		
		Wire Diameter Ø (mm)	Cable resistance R(Ω)	Grounding cable type
1	Kt. Kupang	4	4	NYA
2	Kt. Kupang	2	0,4	NYA
3	Kt. Kupang	2	32,8	NYA
4	Kt. Kupang	2	0,4	NYA
5	Kt. Kupang	4	0,4	NYA
5	Kt. Kupang	4	0,5	NYA
7	Kt. Kupang	4	23,8	NYA
8	Kupang	4	23,8	NYA
9	Kt. Kupang	4	4	NYA
10	Kupang	6	4	BC
11	Kupang	2	4	NYA
12	Kupang	2	4	NYA
13	Kupang	2,5	0,04	NYA
14	Kt. Kupang	2,5	0,04	NYA
15	Kupang	2,5	13,7	NYA
16	Kt. Kupang	2,5	2	BC
17	Kt. Kupang	2,5	0,4	NYA
18	Kt Kupang	4	0,68	NYA
19	Kupang	2,5	0,2	NYA
20	Kupang	2,5	0,2	NYA
21	Kupang	2,5	0,2	NYA
22	Kupang	2,5	0,2	NYA

23	Kupang	2,5	0,2	NYA
24	Kupang	2,5	0,2	NYA
25	Kupang	2,5	0,2	NYA
26	Kupang	2,5	0,2	NYA
27	Kupang	2,5	0,2	NYA
28	Kupang	2,5	0,2	NYA
29	Kupang	2,5	0,2	NYA
30	Kupang	2,5	0,2	NYA
31	Kupang	2,5	0,2	NYA
32	Kupang	2,5	0,2	NYA
33	Kupang	2,5	0,2	NYA
34	Kupang	2,5	0,2	NYA
35	Kupang	2,5	0,2	NYA
36	Kupang	2,5	0,2	NYA
37	Kupang	2,5	0,2	NYA
38	Kupang	2,5	0,2	NYA
39	Kupang	2,5	0,2	NYA
40	Kupang	2,5	0,2	NYA
41	Kupang	2,5	0,2	NYA
42	Kupang	2,5	0,2	NYA
43	Kt Kupang	2,5	23,8	NYA
44	Kupang	2	0,4	NYA
45	Kupang	2	0,4	NYA
46	Kt Kupang	2	4	BC
47	Kt Kupang	2	0,4	NYA
48	Kt Kupang	2	4	BC
49	Kt. Kupang	2,5	0,88	NYA
50	Kupang	2	0,14	NYA
51	Kupang	2	0,14	NYA
52	Kt. Kupang	2	0,14	NYA
53	Kt. Kupang	2,5	2,38	NYA
54	Kupang	2	2	NYA
55	Kupang	2,5	2,38	NYA
56	Kt. Kupang	2,5	0,4	NYA
57	Kt. Kupang	2,5	2,38	NYA
58	Kupang	4	0,5	NYA
59	Kupang	2,5	0,5	NYA
60	Kt. Kupang	2	0,5	NYA
61	Kt. Kupang	2	0,5	NYA
62	Kupang	2,5	0,5	NYA
63	Kt. Kupang	2,5	0,5	NYA

64	Kupang	10	0,5	NYA
65	Kupang	2,5	0,5	NYA
67	Kupang	4	0,5	NYA
68	Kupang	2,5	0,5	NYA
69	Kupang	2,5	0,5	NYA
70	Kt Kupang	2,5	0,5	NYA
71	kt. kupang	2,5	0,5	NYA
72	Kt. Kupang	2,5	0,4	NYA
73	Kt. Kupang	4	23,8	NYA
74	Kupang	4	0,88	NYA
75	Kt.	2,5	0,5	NYA
76	Kt. Kupang	2,5	2,62	NYA
77	Kupang	2	0,4	NYA
78	Kupang	2	0,4	NYA

Table 1 above explains the type of grounding conductor wire, diameter and resistance value obtained after measuring. Measurements were carried out at 78 grounding points at consumer homes, the highest conductor wire diameter was 10 mm and the lowest was 2 mm, the highest resistance value measurement results reached 843 Ω (Ohm) and the lowest was 2 Ω (Ohm) and the type of conductor wire on average used NYA and BC 4 mm cables. Consumers who use grounding installations with reference to SNI, PUIL and SPLN standards, namely 1 customer with a BC wire diameter of 10 mm, 1 customer with a BC wire diameter of 6 mm, 11 customers with a BC wire diameter of 4 mm, 46 customers with a NYA 2.5 mm cable and 18 customers with a 2 mm wire. In order for readers to better understand and comprehend the measurement values, it is necessary to group the measurement results that are below the standard, namely ≤ 1 ohm, ≤ 5 ohm and above the standard ≥ 5 ohm. You can see this in the graphic below.

8. GRAPHICS

The graph below shows how to make it easier to find out the amount of electrical power connected to the house. The data in this graph is from Table 1 above.

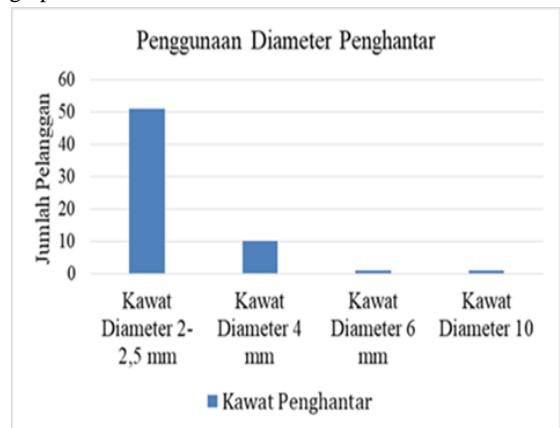


Figure 3 Graph of Use of Conductor Diameter
Source: Data Processing (2026)

Figure 3 Graph of the number of customers using grounding installations installed in their homes. The graph shows that 51 customers use 2-2.5 mm conductor wires, 11 customers use 4 mm wire diameters, 1 customer uses 6 mm wire diameters, and 1 customer uses 10 mm wire diameters. Based on the graph above, the use of grounding conductor wires in homes that meet standards is 13 customers and the use of conductor wires that do not meet standards is 51 customers. This data is the result of a random measurement of grounding installations on 78 customers in Kupang City.

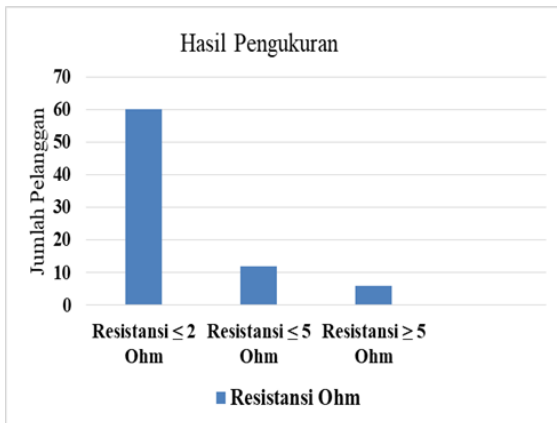


Figure 4 Resistance Measurement Graph (Ohm)

Source: Data Processing (2026)

Figure 4 above illustrates the results of resistance measurements on residential grounding installations. Measurements were conducted on 78 customers in Kupang City. Sixty customers found resistance values below 2 ohms, 12 customers found resistance values below 5 ohms, and six customers found resistance values above the standard limit (5 ohms or more). The results are the result of direct field testing.

CONCLUSION

Based on the theoretical basis and discussion regarding measuring resistance in grounding installations in customers' homes, the following conclusions are drawn:

1. The grounding wiring installed in the house, with the installation and connection of the grounding cable to the ground directly, does not meet standards, meaning there is no control box for continued maintenance during future maintenance.
2. The use of grounding cables for grounding, with the cable diameter used and the grounding not meeting standards, results in the failure of the short-circuit current dissipation process from the installation, which can easily and quickly damage electronic components in the house.
3. The results of grounding measurements for 78 customers, with resistance values obtained 0 – 4ohm below the standard ≤ 5 ohm for 72 customers and resistance values 5 – 23.8ohm above the standard for 6 customers. This needs to be noted to the relevant electricity company to carry out periodic checks on installations and grounding values that do not reach the standard can be repaired, before an accident occurs due to the electrical network installed in the customer's home.
4. As input, the electricity company can send a team of experts to check the grounding installations in residential homes periodically and recommend to all customers that it is mandatory to embed the grounding into the ground using a 4-6 mm diameter rod (BC), so that it is easier to conduct excess current to the ground if there is a short circuit that comes suddenly from a large electricity network.

BIBLIOGRAPHY

1. Badan Pusat Statistik; Profinsi Nusa Tenggara Timur (BPS), 2023 jumlah-pelanggan-listrik-kelompok-sosial.html; <https://ntt.bps.go.id/id/statistics-table/2/MTI3NSMy>.
2. Badan Standarisasi Nasional (BSN), Persyaratan Umum Instalasi Listrik Tahun 2011.
3. B.L. Tobing, Dasar Teknik Pengujian Tegangan Tinggi, Penerbit PT. Gramedia Pustaka Utama, Jakarta, 2003, p.68.
4. Haykal Silaban; Implementasi Instalasi Listrik Rumah Tangga Yang Sesuai Standar PUIL Untuk Meningkatkan Keselamatan Masyarakat; *jurnal Vol. 3 No.6(2025)*: <https://ejurnal.kampusakademik.my.id/index.php/jipm/issue/view/31>
5. Indra Z, dan Ikhsan Kamil; Analisis Sistem Instalasi Listrik Rumah Tinggal dan Gedung untuk
6. Mencegah Bahaya Kebakaran; *Jurnal Ilmiah Elite Elektro, VOL. 2, NO. 1, (2011)* Jurusan Teknik Elektro, Politeknik Negeri Jakarta.
7. IEC (*International Electrotechnical Commision*), <http://www.iec.ch/>, 2010.
8. Standar Nasional Indonesia, Persyaratan Umum Instalasi Listrik (PUIL) 2000, SNI 04-0225-2000, Jakarta, 2000.
9. Fransiskus.S,Yustinus.S.B.Ada,Rochani,Markus.D. Letik&Zilman.S.(2026). Penerapan Standar Instalasi Tenaga Listrik Satu Fasa Golongan Tarif R1 pada Rumah Tinggal di Kota Kupang Nusa Tenggara Timur. *Jurnal Impresi Indonesia (JII),5(4)*. Jurusan Teknik Elektro, Politeknik Negeri Kupang
10. Yustinus.S.B.Ada Maria.D.B, Sulaiman.A,Duma.P&Rochani.(2025).Engineering Study of Grounding Systems Through Experimental Methods on Down Rod Conductors. *American Journal of Economic and Management Business,4(10)*. Jurusan Teknik Elektro, Politeknik Negeri Kupang

11. Mulyadi, M., Muliadi, M., & Syukri, S. (2024). Analisa Kelayakan Instalasi Listrik Pada Rumah Tinggal: Studi Kasus Di Gampong Mesjid Tanjong Kecamatan Padang Tiji Kabupaten Pidie. *Aceh Journal of Electrical Engineering and Technology*, 4(2), 16–22. Universitas Iskandar Muda