

Current Transformers PA 123a and PA 145a

Installation and operation manual



Your safety first!

This is the reason why our manual begins with the following guidelines:

- Use the transformer for its intended purpose.
- Observe the technical data given in the rating plate and in the specification.
- To facilitate the installation and ensure high quality standards, the installation should be carried out by specially trained personnel or supervised by the service department of ABB.
- Operations have to be carried out by specially trained electricians who are familiar with the following instructions.
- It is recommended to observe the standards (DIN VDE/IEC) and local OHS regulations, as well as the requirements of the local electric authority.
- Transformer work should be changed over in accordance with the instructions in the manual.
- All documentation should be available to all persons involved in installation, maintenance and operation.
- Operating personnel shall bear all responsibility for all aspects related to the operational safety as stated in EN 50110 (VDE 0105) and national regulations.
- Observe the safety rules, which are compliant with EN 50110 (VDE 0105). This standard regards ensuring a no-voltage status at the site for works to be carried out on the transformer.

If you have any questions regarding the information contained in this manual, our organisation will provide the necessary information.

Important information

This manual is intended to explain the mode of operation and installation of the product.



NOTE:

All descriptions contained in this document are for general information only and do not make consideration for specific design requirements. Please refer to the exact design documentation while connecting the device.

Operating the device without first reading the manual may entail property damage, serious injury or death. The person responsible for the installation of the device should read the following instructions and follow the recommendations contained herein.

For your own safety:

- Make sure that all installation, service and maintenance works are carried out by professionals.

- Make sure that all applicable regulations will be preserved during all the work phases (installation, service, maintenance).
- Make sure that the guidelines contained in this manual are followed.

Basic guidelines for this manual

Read the relevant chapters of this manual to provide adequate work.

Chapters in this manual are marked according to their meaning.



For the purposes of this manual, failure to follow the instructions concerning the dangers could result in death, serious injury and damage of equipment.

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Current Transformers PA 123a and PA 145a

1. Introduction

The subject of this manual are type PA 123a and PA 145a overhead current transformers. These transformers are used for feeding measurement and protection systems in power networks with maximum system voltage of 123 kV and 145 kV or lower (the greatest effective value of phase-to-phase voltage) and 50 Hz frequency. They are designed for operation in power systems with earthed or insulated neutral points as well as in compensated networks.

2. Delivery of transformer

Typically, the transformers are delivered in bulk packaging (3 pcs) where they are stacked vertically. The packaging is in the form of a complete crate. The delivered transformers are fully assembled, tested and ready for direct use. Product test protocols are delivered together with the transformers.

Immediately after the delivery, check the transformer for any transport damage. Check the transport packaging. A damaged packaging may indicate a careless handling of the transformer. Then, check the transformer. Special attention should be paid to possible damage of sheds and binder at insulator flanges, the transformer tightness and the correct oil level indication in the device. One should ensure that technical parameters of the transformer given in the rating plate are in accordance with the parameters given when submitting the order and in accordance with the design documentation parameters.

Any damage or other defects should be immediately notified to the manufacturer and, if appropriate, the carrier. Photos will be helpful for any damage assessment.

3. Transportation, unpacking, lifting

Transformers should be transported in a vertical position. Transformers should be transported in accordance with transport manual No 2GKA612015.

Transformers should be transported in wooden complete crates, 3 pcs in each. Due to the high centre of gravity, transformers must be additionally protected with boards attached at the level of the head.

4. Storage

Transformers should be stored on a levelled and hardened surface, preferably in the original packaging. In the case of long-term storage, it is recommended to protect contact surfaces against corrosion.

Transformers can be stored in the open air for up to two years. If this period is exceeded, it is recommended to place transformers in a well-ventilated room or under a roof, and to insert silica gel or another moisture absorbent into terminal boxes.

5. Installation

The support structure should be flat and horizontal. The level correction can be carried out using shims placed between the transformer and the support structure. Provisions of the transport manual No 2GKA612015 should be followed while erecting/lifting the transformer. Use bolts of correct size for fastening the transformer to the support structure. The support structure and fastening elements are not included in the delivery. The transformer should be placed in the vertical position at least 24 h before energising.

5.1. Earthing terminals

Two earthing terminals are located diagonally in the bottom tank. Prior to connection, the contact surface of the terminals should be thoroughly cleaned from the oxide layer so it becomes uniform and smooth. Additionally, a thin layer of conducting grease can be applied in order to improve contact. The earthing should be connected using stainless bolts.

5.2. Primary terminals

Primary terminals of the transformer, marked as P1 and P2, are placed on the opposite sides of the head. The transformer can be switched on the primary side as well as on the secondary side. A metal jumper is used for current range switching on the primary side.

The primary winding should be switched to the required current range by locating a moving jumper, fastened with two M16 bolts, in the respective position.



Note:

Jumper tightening torque 90 Nm

Current range jumper positions are shown on the rating plate.

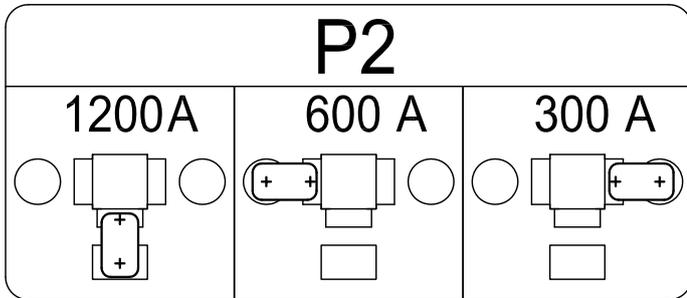


Fig. 1. Example: Rating plate with current range jumper positions.

All contact surfaces of the primary terminals should be even and cleaned from the oxide layer before connecting. In the case of copper terminals, use of extraction naphtha is usually sufficient. Conducting grease can be applied in order to improve contact. Use M10 bolts (stainless steel is recommended) to connect wire lugs with the terminals. Incorrect primary connection could induce the transformer to overheat, which can cause failures. Primary connections should be made in such a way so as to minimise mechanical static loads of the transformer terminals. The maximum allowable static load of each transformer terminal is equal

to 3,600 N in any direction. Only one terminal may be loaded with such force at a time.

5.3. Secondary terminals

Secondary windings are connected to terminal blocks in the terminal box on the bottom tank of the transformer. These are typically Phoenix Contact ST spring connectors with terminals adapted to connection of cables of cross-section up to 10 mm² or up to 6 mm². Each terminal is described in compliance with the winding markings given on the rating and schematic diagram plates.

Yellow-green terminals (with the earthing mark) are intended for earthing the secondary windings with the use of push-in crosswise bridges. The crosswise bridge can be removed with a screwdriver by inserting it in the slit and levering.

Optionally, the connectors to which metering windings are led, may be adapted for sealing with the use of a transparent cover. The current coil screen is led out with a pin through the resin bushing (tg δ terminal).

A rating plate is placed on the external side of the door, while the schematic diagram plate is placed inside. The plate with holes for the secondary circuit wire glands is located on the terminal box bottom wall. Typically, they are two M40 glands with the choking range of Φ 19–28 mm. An example of a terminal box for secondary windings of the transformer is shown in Figure 2.

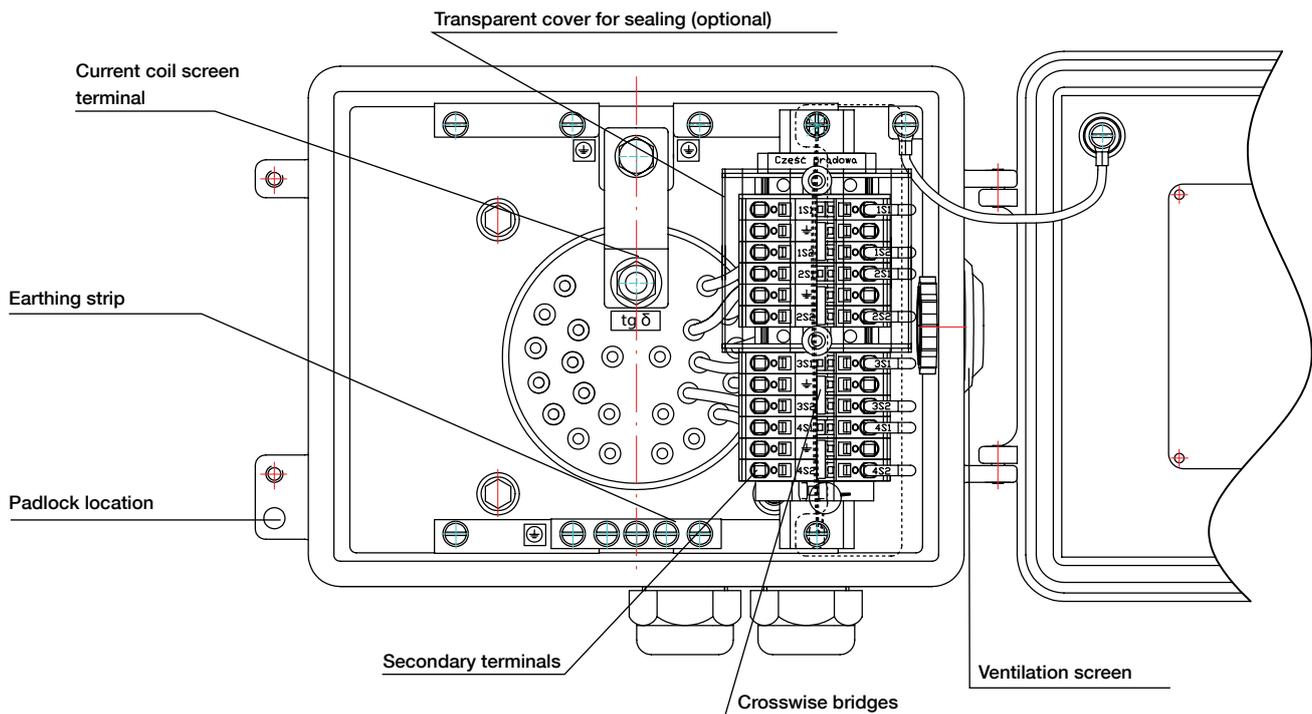


Fig. 2. Example of a terminal box

Connect external circuits to secondary terminals of the current module of the transformer pursuant to the wiring shown on the schematic diagram plate and in accordance with the design documentation.

The current coil screen terminal (tg δ) should be earthed with a jumper during normal transformer operation.

Connectors inside the terminal box are arranged so that, when using crosswise bridges, earthing is possible for any secondary terminal of a given winding.

Transformer with taps on the secondary side:

- In the case of a transformer with the secondary side switching option, the unused taps must remain unearthed. Only connect the earthing to one of the terminals, which are connected with the external circuit for the selected secondary winding.

Unused windings:

- The first and the last terminals (for the secondary side switching option: those terminals correspond to the highest transformer ratio) of the unused secondary winding should be connected with each other (minimum wire size: 6 mm²) and earthed with a crosswise bridge. Each unused winding should be earthed in one point only.



Note:

Opening the current module secondary circuit in the standard operation mode causes high voltage on terminals of this circuit. This is hazardous to the staff and may damage the transformer insulation.

6. Bolt tightening torques

Primary terminal bolts M10	40 Nm
M16 Bolts fastening the jumper	90 Nm
Bolts fastening the transformer to the support structure	280 Nm

7. Operation and maintenance



Note:

Combined transformers are HV devices, hence appropriate safety precautions shall be observed during their operation. The transformer measurement range is only guaranteed within the operating range determined based on the ratings in compliance with the respective standards. The standard number is shown on the transformer rating plate. The measurement range of the transformer is also shown in the product test protocol as delivered with the transformer. The measurement parameters are not guaranteed off that range.

7.1. Operation

The combined transformers do not require any special maintenance procedures. Visual inspection is usually sufficient. The checklist is included at the end of this manual.

Visual inspection

The visual inspection should include the checking of:

- position of the oil level indicator,
- tightness of the transformer,
- lack of mechanical damage,
- condition of the insulator and binder connecting the insulator with flanges.

From time to time, primary terminals torque should be checked.

The transformer tightness is of a particular importance as moisture could penetrate the device in the case of oil leaks.

Oil level indicator:

Changes of the oil level indicator position depend on oil temperature in the transformer. The indicator should remain within the green field range. Shifting of the indicator to the upper or bottom red field points out to an incorrect transformer operation. In such case, the transformer should be put out of service, and the manufacturer should be contacted.

On the lid covering the head stainless steel expansion bellows (1) are placed, used for compensation of oil volume thermal changes in the transformer. The oil level indicator (2) is placed on the upper surface of the bellows. The bellows is seated in a metal housing (3) equipped with a window (4). Cover removal does not result in unsealing of the transformer. The whole compensation system is shown in Figure 3.



Note:

Oil level indication for all three transformers installed on adjacent phases should be almost equal.

Measurement of the dielectric loss factor tg δ:

During measurement of the dielectric loss factor tg δ, the measuring bridge should be connected to the correct terminal marked with the tg δ symbol, after the previous removal of the earthing jumper from this terminal. Remember to earth the terminal again after the measurement. Typically, the test voltage should be 10 kV RMS and should be applied between the closed primary terminals and terminal tg δ.

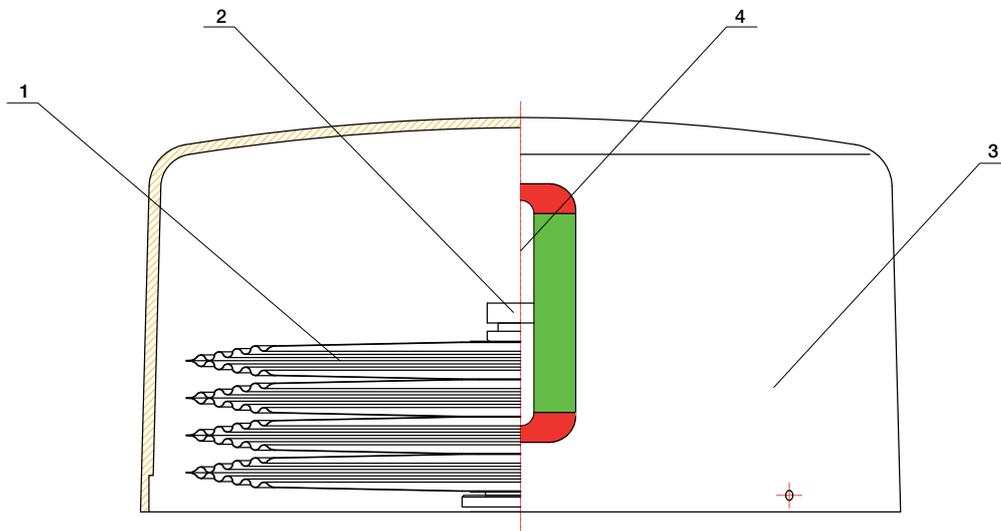


Fig. 3. Construction of the compensation system

Oil sampling:

Due to the fact that transformers are airtight, they do not require periodical oil checking. Oil used in the transformer meets the requirements of PN-EN 60296 (IEC 60296). Oil check is recommended after 15–20 years of operation or after a fault, if any suspicion as to the transformer efficiency exists.

Contact the manufacturer in order to obtain necessary instructions for the oil sampling procedure. Oil sampling without the manufacturer's permission during the guarantee period is the reason for the guarantee cancellation.

7.2. Corrosion protection

External components of the transformer casing are made of corrosion-proof cast aluminium alloy. Casts can be unpainted or painted. Standard colours for the paint coat: light-grey (RAL 7035), grey-green (RAL 7033). The remaining metal elements, such as bolts, are made of stainless steel.

Position of the oil level indicator	Interpretation
Indicator in the green area	Correct operation of the transformer
Indicator on the upper red field	Oil pressure too high Transformer overheating Oil gasification (insulation failure) Further inspection necessary
Indicator on the lower red field	Oil level too low Suspicion of oil leakage (moisture may penetrate inside) Further inspection necessary

8. Structure of the transformer

PA 123a and PA 145a type current transformers comprise the current coil in tight casing filled with transformer oil.

This is a "top core" type structure, where the magnetic toroidal cores are located in the transformer head. The cores with secondary windings are additionally encapsulated in a metal can connected via a tube to terminal box tg δ terminal. Both the metal can as well as the tube are insulated with oil impregnated electrical grade paper.

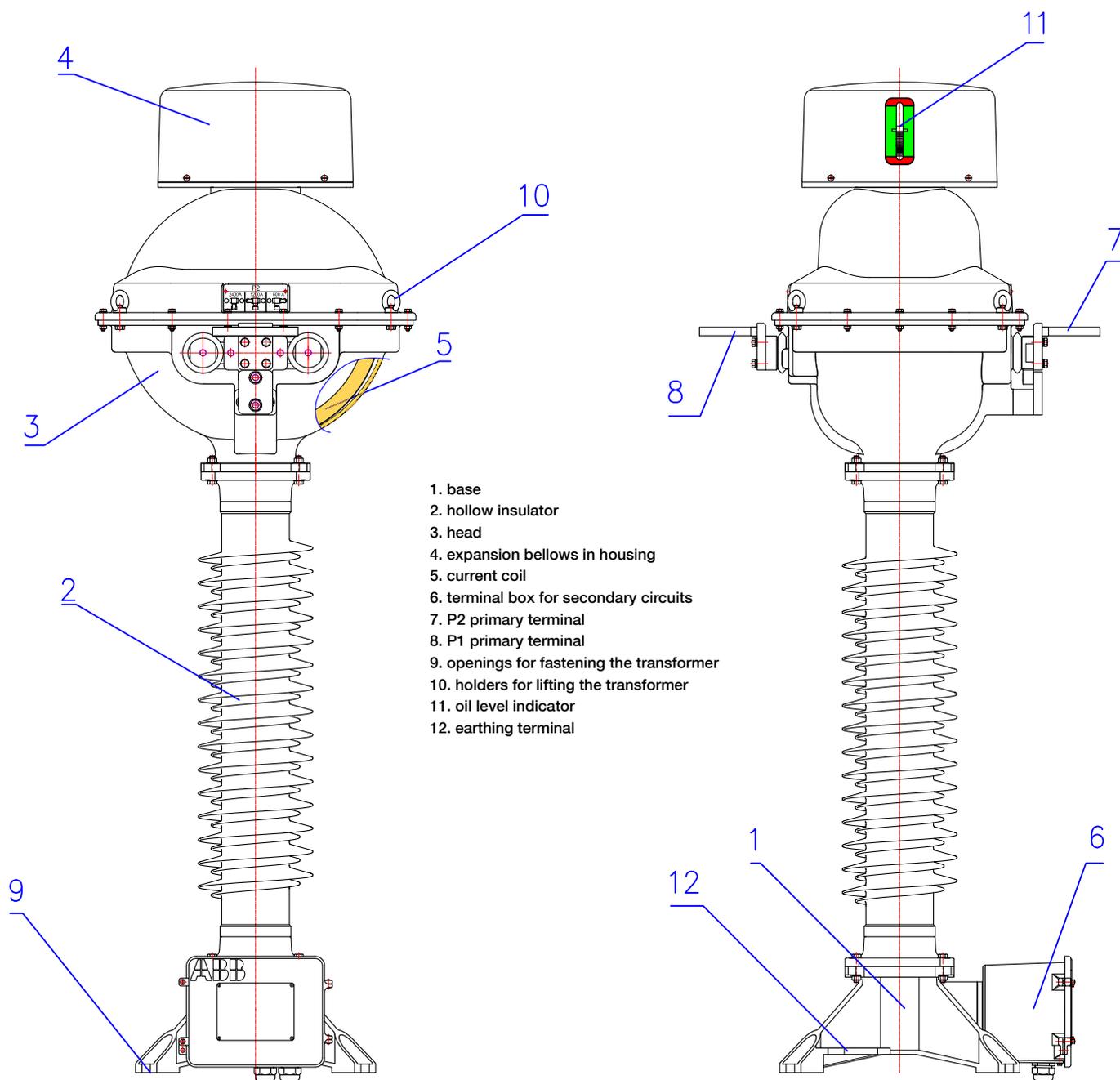


Fig. 4. Structure of PA 123a and PA 145a current transformers

The distribution of electric stresses in the paper insulation is capacitor controlled. An exterior screen is located external to the coil, connected to the primary terminal inside the head.

External insulation comprises a hollow insulator made out of electrical porcelain with brown enamel or a glass reinforced plastic (FRP) tube coated with grey silicon rubber. O-ring seals are made of NBR oil-resistant rubber.

If calibration of measuring windings has been performed, respective marking (designations) have been placed on the transformer and the rating plate (where required).

9. Recycling and disposal

During correct operation and if no mechanical damage occurs, the transformer should operate over 30 years. Once this period of time has expired or if the operation is no longer required, it is recommended to dispose of the transformer.

Primary materials used in the transformer:

No	Material	Quantity [kg]
1	Copper (Cu – ETP)	20
2	Aluminium alloy AC-Al Si10Mg (Cu)	80
3	Steel	20
4	Transformer sheet steel	to 150
5	Permalloy (iron-nickel alloy)	10
6	Mineral transformer oil	90
7	Electrical grade paper	25
8	Solid insulation materials (epoxy resin, bakelite paper)	10
9	Porcelain	80
10	Composite insulator	20

Items 9 and 10 alternatively.

The above values are approximate.

9.1. Recycling and disposal proceedings

Recycling and disposal should meet national (or local) regulations. On the territory of the Republic of Poland, the transformer disposal procedure is defined in “The Waste Act” (“Ustawa o odpadach”) of 14 December 2012, as published in Journal of Laws item 21/2013, as amended.

10. Checklist

10.1. Before the first energising

What to check:	When	Check:
1. External packing appearance	A	No signs of careless handling
2. Transformer tightness	A, B, C	No visible oil leaks or greasy stains (even if the packaging is intact)
3. Transformer casing	B, C	Insulator, terminals and transformer casing show no signs of mechanical damage.
4. Oil Level	B, C	Oil level indicator is in the proper position
5. Quality and correctness of connections	C	The connections are reliable and in accordance with the design

10.2. After the first energising

What to check:	When	Check:
6. Transformer tightness	D, E	No visible oil leaks or greasy stains
7. Transformer casing	D, E	Insulator, terminals and transformer casing show no signs of mechanical damage.
8. Oil Level	D, E	Oil level indicator is in the proper position
9. Secondary winding insulation test (measurement method depends on local practices)	E	Values dependent on age, voltage level, measurement method and temperature
10. Dielectric loss factor $\text{tg } \delta$ (measurement method depends on local practices)	E	Values dependent on age, voltage level, measurement method and temperature Respective terminals are marked: „tg δ ”
11. Oil sampling: gas analysis (DGA), $\text{tg } \delta$, water content	E	Measurements have not indicated exceeding of permissible limits

When

A	After arrival of the transformer to the site
B	After unpacking
C	Directly before applying voltage
D	During routine inspections in accordance with the schedule determined for the station
E	After 15–20 operation years, or an inspection of efficiency after a fault, if any suspicion as to the transformer efficiency exists

11. Conclusion

For additional information concerning the operation and maintenance of PA 123a and PA 145a transformers, please contact the transformers manufacturer.

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