HWDK
External Reactance-Type Vacuum On-Load Tap-Changer

Instruction Manual

HM 0.460.5801-01.06/2025

Caution:
For safe and proper use,
follow these instructions.
Retain for future reference.

Preamble

Thank you for choosing our product.

Please read this manual carefully before operation. Product specifications are subject to change without prior notice. Please refer to the quotation and order confirmation for binding information. Shanghai Huaming Power Equipment Co., Ltd. (hereinafter referred to as "Huaming") shall not be liable for any losses or damages caused by misinterpretation of this manual.

Keep this manual for future reference. If you have any questions, please contact Huaming.

The source language of the manual is Chinese.

TABLE OF CONTENTS

1. Reading Guide

This chapter provides an overview of the product and explains the information presented in this manual.

1.1 Document Overview

This technical document provides detailed information on product safety, installation procedures, connection processes, and commissioning methods. It also includes general information and safety precautions relevant to the product.

This manual is intended for qualified personnel with specialized training and authorization to work with electrical equipment.

1.1.1 Manufacturer

This product is manufactured by:
Shanghai Huaming Power Equipment Co., Ltd.
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For further information or a copy of this manual, please contact us using the information above.
The information in this document is based on the technical specifications at the time of printing. Product specifications are subject to change without notice as part of our continuous improvement efforts.

Significant revisions will be incorporated into new editions of this manual. Please refer to our website or contact us for the latest version.

1.1.2 Related Documents

This document is a general guide and should be used in conjunction with the following documents:
- Supplementary Documents
- Routine Test Report
- Wiring Diagram
- Order Confirmation

Reading this manual in isolation may not provide a complete understanding of the product.

1.1.3 Document Retention

Keep this manual and all related documents in a safe place for future reference.

1.2 Information Indicators

1.2.1 Safety Symbols and Signal Words

Safety information in this document follows the format below:

Signal Word:	
	**Warning Label! (Optional)** Hazard/Consequence. ✓ Precaution/Action.

Signal Word	Hazard Level	Potential Consequences
Danger	Imminent hazard	Death or serious injury
Warning	Potential hazard	Death or serious injury
Caution	Potential hazard	Minor or moderate injury
Notice	Important information (non-injury related)	Potential damage to equipment or property

Signal Word	Potential Consequences
	Danger: Indicates a hazard that will result in serious injury or death if not avoided.
	Warning: Indicates a hazard that could result in serious injury or death if not avoided.
	Overhead Load
	High Voltage
	Explosive Material
	Flammable Material

1.2.2 Important Notes

The following symbol is used to highlight important information:

Important Note!
This blue annotation symbol signifies critical information that requires attention.

1.2.3 Procedural Instructions

Procedural instructions are presented as single-step or multi-step operations.

1.2.3.1 Single-Step Operations

Objective:

✓ Pre-operation preparation (Optional)

Step:

- Specific instructions/Expected results (Optional)
- Outcome (Optional)

1.2.3.2 Multi-Step Operations

Objective:

✓ Pre-operation preparation (Optional)

1. Step 1
- Specific instructions/Expected results (Optional)

2. Step 2
- Specific instructions/Expected results (Optional)
- Outcome (Optional)

2. Pre-Operational Precautions

Carefully read this manual to familiarize yourself with the product.
This manual is an integral part of the product.
Read and follow all safety instructions provided in this chapter.
Pay close attention to all warning and cautionary information in this manual to prevent hazards.
This product is designed and manufactured using state-of-the-art technology. However, improper operation can result in injury to personnel, damage to the equipment, and/or property loss.

2.1 Basic Safety Precautions

2.1.1 Safety Measures

Table 2-1 Safety Measures

Precaution	Instructions
Electric Shock	Always de-energize the equipment and disconnect it from the power supply before performing any inspection or maintenance. Maintain a safe distance from high-voltage equipment and wear appropriate personal protective equipment (PPE).
Transformer Oil	Collect used transformer oil in designated containers and store them properly. Keep oil away from open flames, sparks, or any potential ignition sources. Avoid direct contact with transformer oil as it may be harmful to your health.
Fire	In case of fire, use a dry chemical, foam, or carbon dioxide fire extinguisher. Do not use water.
Waste Disposal	Dispose of waste materials in accordance with local regulations. Different waste categories require specific disposal methods. Improper waste disposal can harm the environment and human health.

2.2 Operator Responsibilities

2.2.1 Operator Qualifications

This product is designed for use in electrical power systems and installations and must be operated exclusively by qualified personnel. Qualified personnel are those who have received specific training and are familiar with the installation, assembly, commissioning, and operation of such equipment.

2.2.2 Operator Obligations

To prevent accidents, malfunctions, damage, and environmental impact, personnel responsible for the transportation, installation, operation, maintenance, and disposal of this product must ensure the following:

- Strictly adhere to all warnings and safety instructions.
- Personnel receive regular training on all relevant aspects of operational safety, including operating procedures and safety guidelines.
- Safety regulations, operating manuals, and emergency procedures are readily available and displayed in the workplace.

- The product is operated only when in good working condition. Regularly inspect safety devices to ensure reliable operation.
- Use only manufacturer-authorized replacement parts, lubricants, and auxiliary materials.
- Adhere to specified operating conditions and installation requirements.
- Provide all necessary tools and PPE for each task.
- Strictly follow prescribed maintenance intervals and procedures.
- Product installation, electrical connections, and commissioning must be performed by qualified and trained personnel according to this manual.
- Operators must ensure proper use of the product.

2.2.3 Personal Protective Equipment (PPE)

The following PPE must be worn during operation and maintenance to mitigate potential risks:

Table 2-2 Personal Protective Equipment

	Wear appropriate clothing to protect against workplace hazards.
	Wear safety shoes with puncture resistance and slip-resistant soles.
	Wear safety glasses to protect eyes and face from impact, dust, splashes, and heat.
	Wear a hard hat to protect the head from impact.
	Wear hearing protection in noisy environments to prevent hearing damage.
	Wear insulating gloves to protect hands from electrical hazards.

3. Intended Use

This product is an on-load tap-changer (OLTC) designed to regulate the transformer turns ratio under load. It is specifically engineered for electrical power systems and installations, and its application requires specialized knowledge and expertise.

When used according to its intended purpose, adhering to the conditions and warnings detailed in this manual, the product does not pose any risk to personnel, property, or the environment throughout its entire lifecycle, from delivery to disposal.

The following are considered intended uses:

- Equipment Compatibility
  This OLTC is designed for use with the specific transformer and MDU specified in the order documentation. If the OLTC and accessories are supplied as a set, ensure that the serial numbers of all components (including drive components) match.

- Product Identification
  The product nameplate contains information regarding applicable standards and the year of manufacture. This information helps identify the product's key specifications and manufacturing date.

- Operating Procedures
  Operate the OLTC strictly in accordance with the procedures and instructions outlined in this technical document, the agreed-upon delivery conditions, and the technical data sheet.

- Qualified Personnel
  All work on this product, including installation, commissioning, maintenance, and other operations, must be performed only by qualified personnel with the appropriate skills and training to minimize operational errors and safety risks.

- Proper Tool Use
  Use the provided tools and equipment solely for their intended purpose and in accordance with the instructions in this manual. Do not modify or misuse the tools.

- Auxiliary Equipment
  The use of an oil filtration unit with the OLTC is not mandatory. Users may decide whether or not to use an oil filtration unit based on their specific application and requirements.

Unintended Use:
Any use of this product outside the scope described above is considered unintended use.

Shanghai Huaming Power Equipment Co., Ltd. shall not be liable for any damage or losses resulting from unauthorized modifications or improper use. Unauthorized modifications without prior consent from Huaming may cause personal injury, equipment damage, and operational malfunctions.

4. Product Overview

The HWDK external reactance-type vacuum on-load tap-changer (hereinafter referred to as OLTC) is mounted on the transformer tank via a welded flange connection. It can be operated locally or remotely using a motor-drive unit (MDU).

This OLTC is designed for a maximum voltage of 69 kV and below. It is available in three maximum three-phase rated through-current ratings: 1500 A, 2000 A, and 2500 A. With a change-over selector, it can provide up to 33 operating positions. It is suitable for use with 50 Hz or 60 Hz three-phase Wye or Delta-connected power and industrial transformers.

4.1 Product Functions and Applications

4.1.1 Importance in Power Systems

- Maintaining Grid Voltage Stability
  The OLTC effectively compensates for voltage fluctuations in the transmission network, ensuring that the voltage at the user's end remains within acceptable limits. This improves power quality and maintains the safe and stable operation of the power system.

- Optimizing Power Resource Allocation
  By adjusting the transformer turns ratio, the OLTC enables optimal reactive power distribution within the power system, reducing transmission losses and increasing operational efficiency.

- Enhancing Power System Flexibility
  The OLTC allows for flexible voltage adjustments to accommodate varying load conditions and operational requirements. For example, it can boost voltage during peak loads and reduce voltage during low-load periods.
  4.1.2 Product Features and Advantages

- Structural Layout
  All components of the HWDK OLTC, including the tap selector, are housed in a separate oil tank that is completely isolated from the main transformer tank, with no oil or gas exchange between the two tanks. The OLTC oil tank is mounted on the side of the transformer tank, and the MDU is integrated into the OLTC oil tank assembly.
  The mechanical drive mechanism and the OLTC body are located in separate compartments, enhancing the dielectric strength of the transformer oil in the OLTC tank and ensuring the integrity of the insulation.

- Safety Features
  In addition to a traditional pressure relief device and a bursting disc, this product includes a control module that detects and locks out a failed vacuum interrupter.

- Arc Extinguishing and Contact Characteristics
  The use of a vacuum interrupter for load current switching eliminates oil carbonization issues, as the arc is extinguished within the vacuum tube. This eliminates the need for an on-line oil purification system and allows for maintenance-free operation.
  The dedicated mechanical main contacts carry the continuous transformer current, while the vacuum tube only handles current during switching, enhancing the OLTC's ability to withstand short-circuit currents.
  The tap selector's moving and stationary contacts use a multi-point contact design to ensure adequate current-carrying capacity. The compression springs for the moving contacts have been replaced with leaf spring assemblies, reducing the axial dimensions.

- Switching Synchronization
  The power input for the three-phase diverter switch is provided by a rapid-acting mechanism in the drive unit through a common drive shaft, which actuates the three-phase rocker arms. This design ensures switching synchronization within 3 ms for all three phases, with all vacuum interrupters securely fixed to maintain a consistent switching sequence.

- Ease of Maintenance
  Tap-changing operations take place within the OLTC's dedicated oil tank. Although minor mechanical wear may occur, this design eliminates potential contamination of the transformer winding insulation.
  During maintenance or troubleshooting, it is not necessary to drain the transformer oil. The spacious internal design allows for inspection and replacement of components without the need to lift out the core, reducing maintenance and repair costs.

4.2 Product Structure and Components

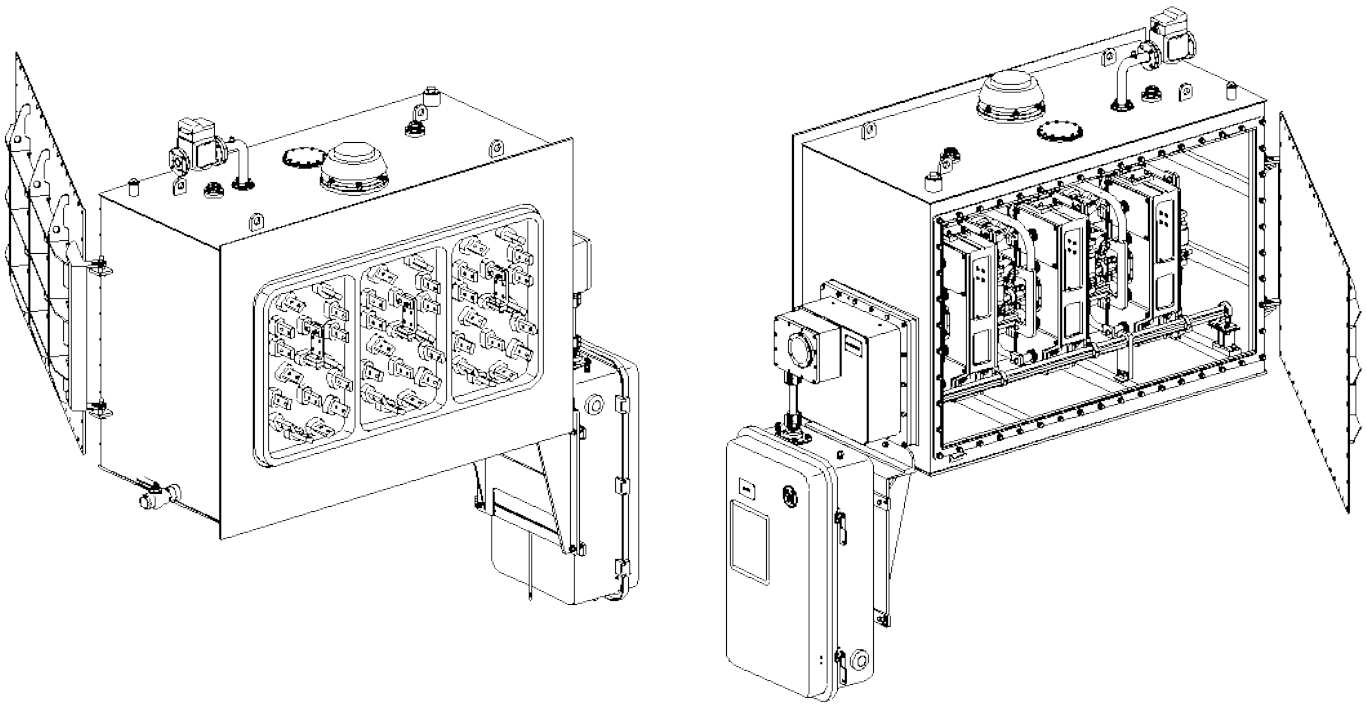


Figure 4-1 OLTC Structure Overview (Standard Version)

4.2.1 OLTC Body Structure

- OLTC Insert
  Consists of a polarity selector, a tap selector, a terminal board, and a diverter switch.
  The power input for the three-phase diverter switch is provided by a rapid-acting mechanism in the drive unit through a common drive shaft, which actuates the three-phase rocker arms to achieve switching synchronization within 3 ms.

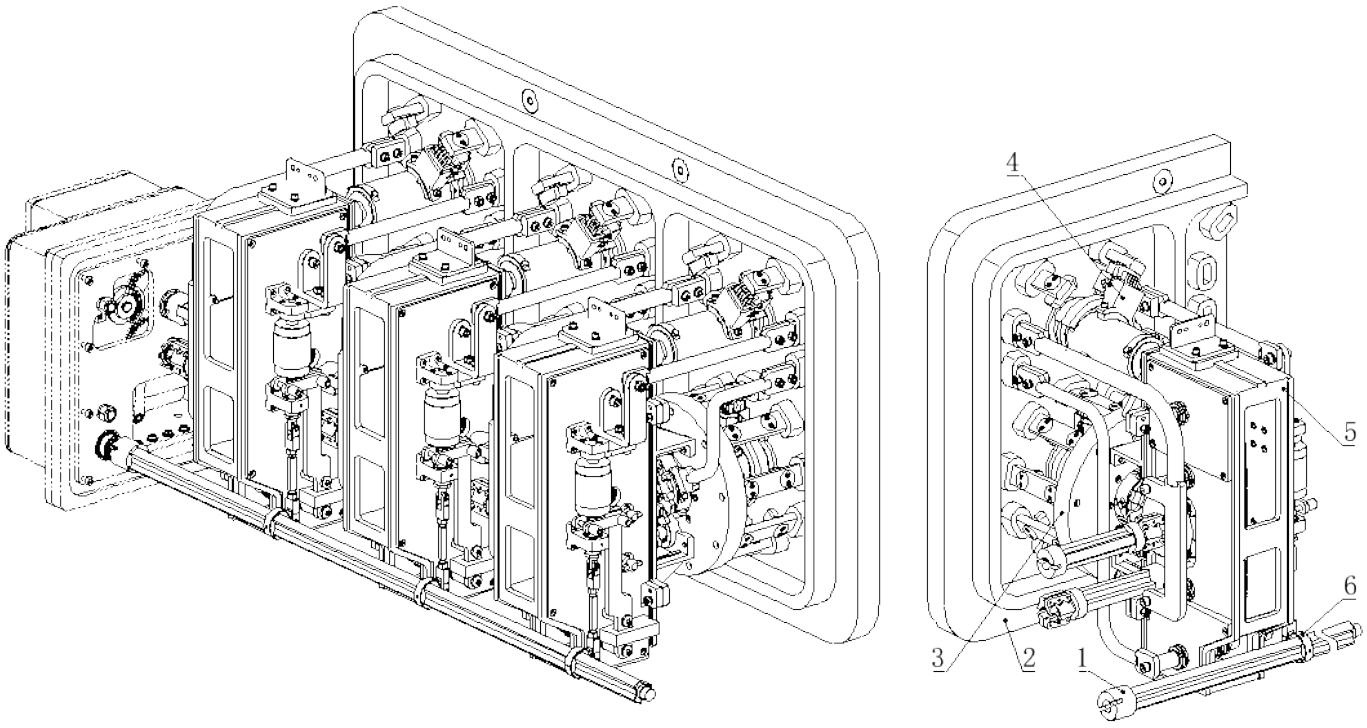
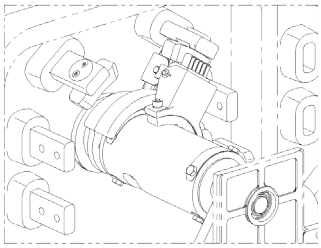
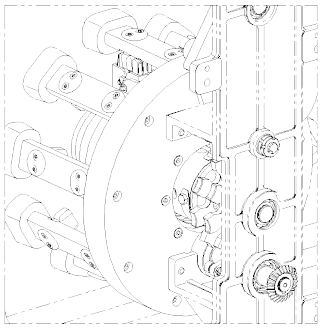


Figure 4-2 OLTC Insert Overview

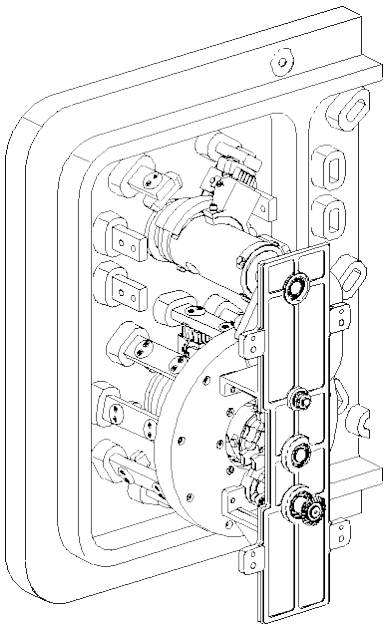
1.Drive Shaft	2.Terminal Board
3.Tap Selector	4.Polarity Selector
5.Diverter Switch	6.Rocker Arm



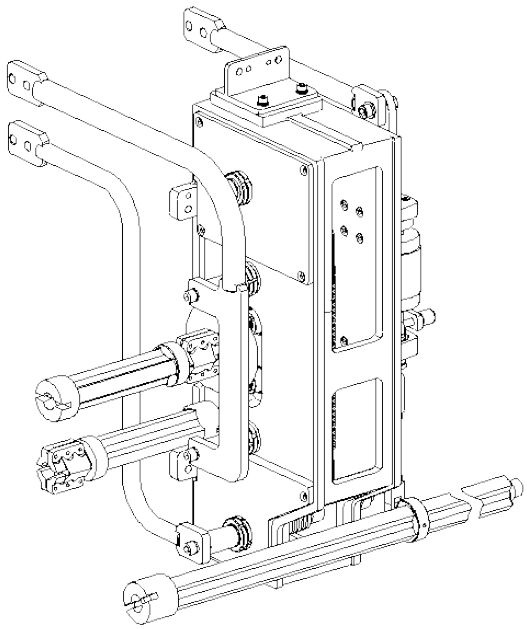
Polarity Selector



Tap Selector



Selector and Terminal Board



Diverter Switch

Figure 4-3 OLTC Insert Components

- Drive Unit

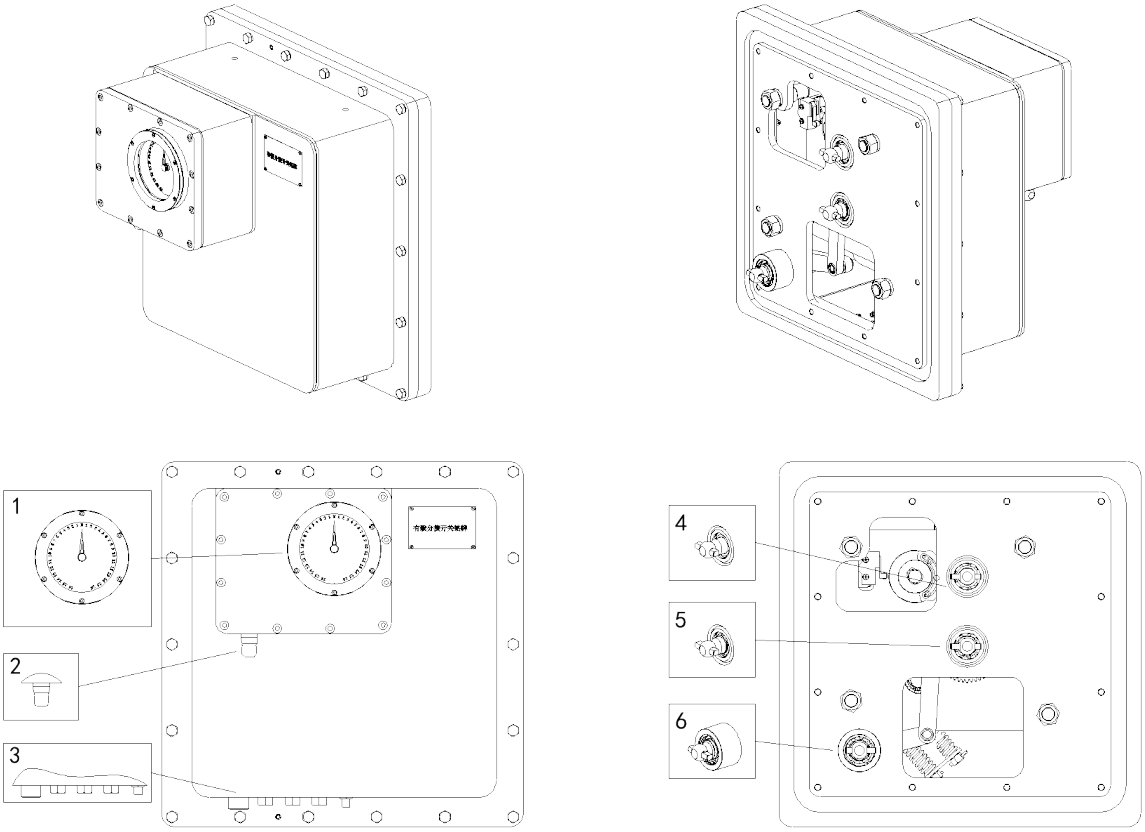


Figure 4-4 Drive Unit

1.Tap Position Indicator	2.Drive Unit Drive Shaft	3.Signal Interface
4.Diverter Switch Drive Shaft	5.Tap Selector Drive Shaft	6.Vacuum Interrupter Drive Shaft

- Oil Tank

  The oil tank is sealed and can withstand a pressure of 0.1 MPa for 24 hours without leakage. It can also withstand a full vacuum down to 133 Pa. The oil tank is completely isolated from the main transformer tank, with electrical connections made only through the terminal board. There is no oil or gas exchange between the two tanks

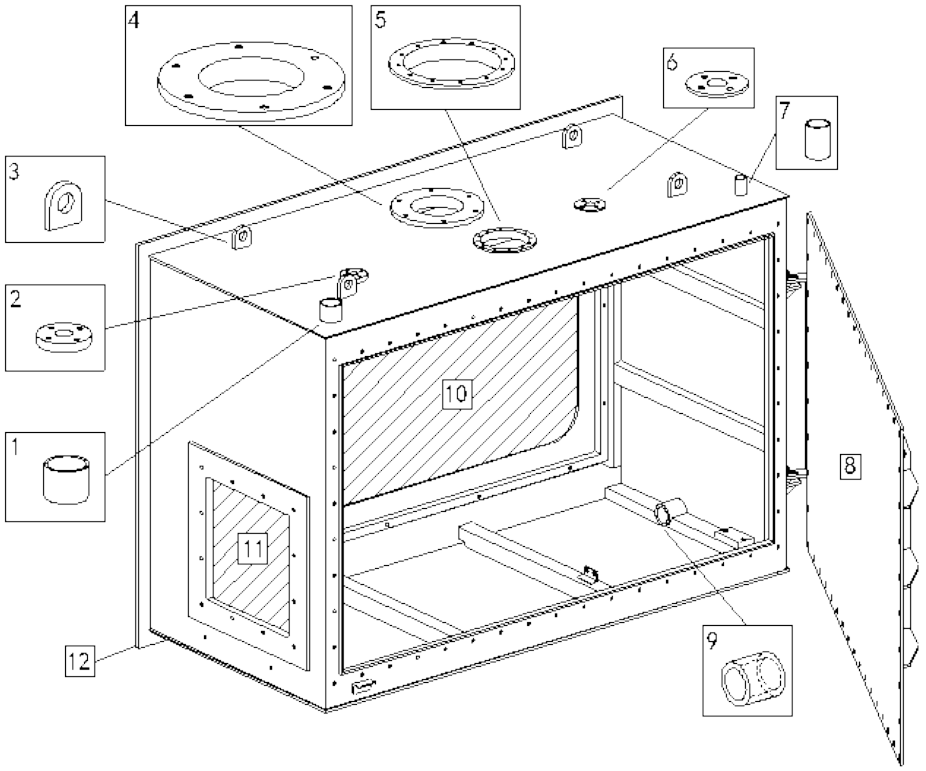
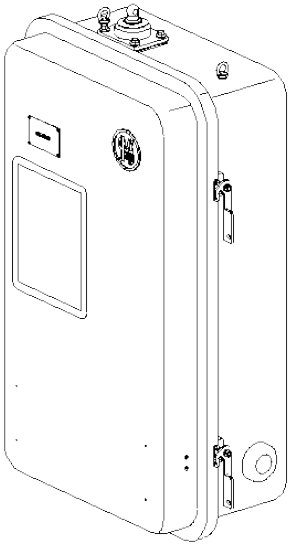


Figure 4-5 Oil Tank (Standard Version)

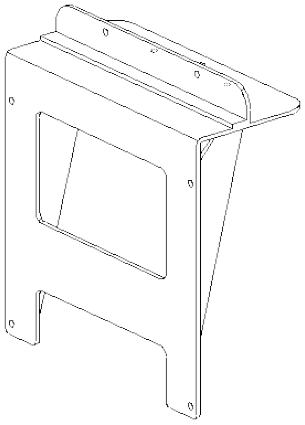
1. Oil Filler Port 2"	2. Bleeder Valve Flange Hole	3. Lifting Lug	4. Pressure Relief Device Flange Hole
5. Bursting Disc Flange Hole	6. Connecting Pipe Flange Hole	7. Oil Filler Port 1"	8. Sealing Plate
9. Oil Drain Valve Mounting Hole	10. Terminal Board Mounting Hole	11. Drive Unit Mounting Hole	12. OLTC Mounting Flange

4.2.2 Motor-Drive Unit (MDU)

- MDU Body
  Drives the OLTC.
- MDU Bracket
  Connects and secures the MDU to the OLTC.
- Drive Shaft
  Transmits power between the MDU and the OLTC.
- MDU Accessories
  Components that facilitate adjustment and support the proper operation of the MDU.



Motor-Drive Unit Body



Motor-Drive Unit Bracket

Figure 4-6 Motor-Drive Unit

4.2.3 Protective Devices

- Vacuum Interrupter Failure Detection and Lockout Control Module (Used with OLTC and MDU)
  During OLTC switching, this control module monitors the current through a current transformer (CT) after the vacuum interrupter has opened (microswitch closed). If the module detects a CT-induced current exceeding a preset value, it immediately issues a stop command to the MDU, halting the motor and returning it to its original position (before the tap selector operates). This protects the OLTC and prevents major incidents.

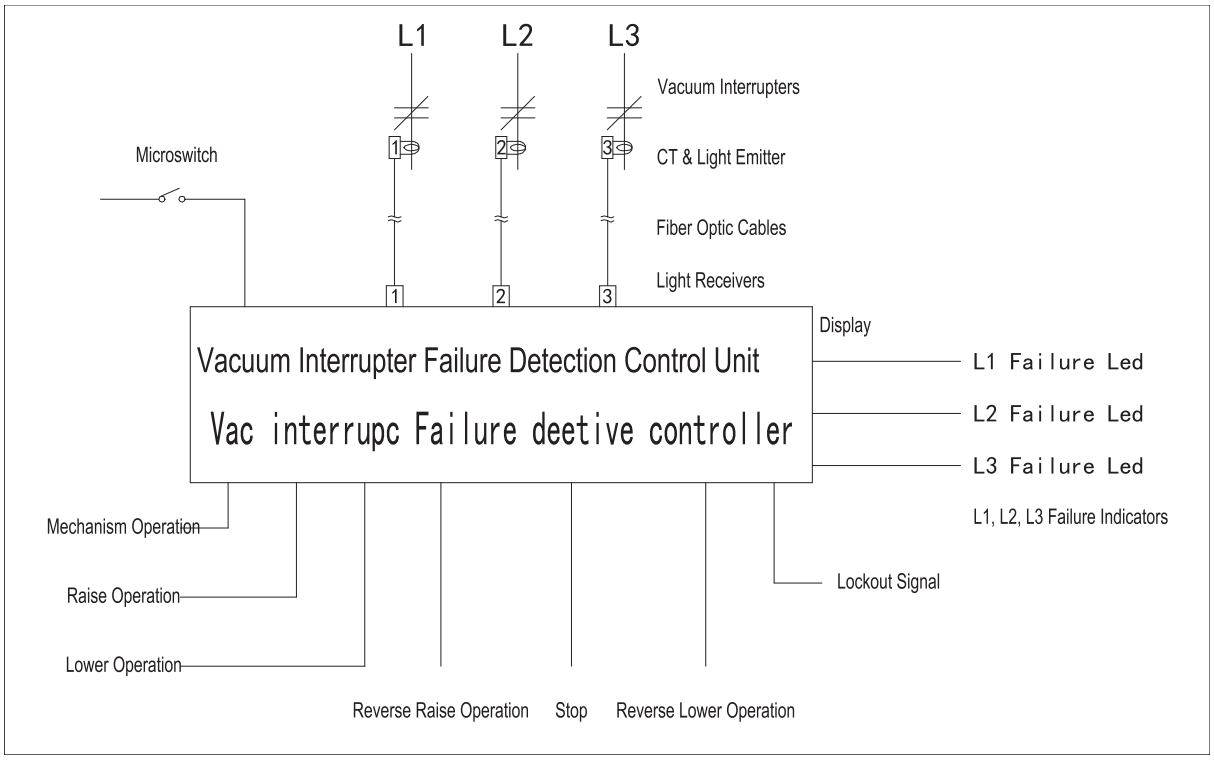


Figure 4-7 Vacuum Interrupter Failure Detection and Lockout Control Module

- Pressure Relief Device
  The pressure relief device has three main functions: (1) overpressure protection: it automatically opens when the internal pressure exceeds a preset value, releasing gas or liquid to prevent equipment damage; (2) maintaining a normal pressure environment within the equipment: this ensures the stable performance of the dielectric medium (e.g., insulating oil), preserving its insulating and heat dissipation capabilities; and (3) providing a fault warning signal: the device's activation indicates an abnormal pressure change within the equipment, prompting personnel to inspect and perform maintenance to prevent further failures.

- Protective Relay (with Gas Signal)
  This relay is installed on the connecting pipe between the transformer tank and the conservator, connecting to both via the pipe. Its electrical signal output is connected to the protection control circuit. A minor gas accumulation triggers an alarm signal, while a major gas accumulation trips the circuit breaker, disconnecting the transformer from the power grid.

- Sudden Pressure Relay
  The sudden pressure relay monitors pressure changes within the OLTC oil tank. When the internal pressure suddenly rises above the relay's setpoint, a pressure-sensitive element deforms, activating the relay.

- Bursting Disc
  Typically serving as the final safety barrier, the bursting disc activates when other pressure regulation devices fail. It provides a release path for high-pressure media, preventing equipment damage.

4.2.4 Accessories

- Bleeder Valve
  Primarily used to vent gases from the system.
- Connecting Pipe
  Connects the OLTC oil tank to other components (e.g., breather, protective relay).
- Oil Level Gauge
  Monitors the oil level within the tank.
- Breather
  Regulates gas exchange between the equipment's interior and the external environment.
- Oil Drain Valve
  Used to drain oil from the tank.

4.3 Operating Conditions

Important Note!
Customized designs are available for specific environmental conditions. Contact Huaming for further information.

- Ambient Operating Temperature
  -25°C to +45°C (consult the manufacturer for special ambient temperature requirements).
- Ambient Operating Humidity
  Relative humidity not exceeding 95% at 25°C.
- Installation Site: The installation site must be free of gases, vapors, chemical dust, and other explosive substances and gases that could significantly affect the OLTC's insulation.
- Vibration: The installation and operating site must be free of excessive vibration.

4.4 Model Designation

4.4.1 Model Number Structure

The OLTC model number indicates its specifications, including the number of phases, maximum rated through-current, maximum equipment voltage, tap selector insulation class, and connection type (see Figure 4-8).

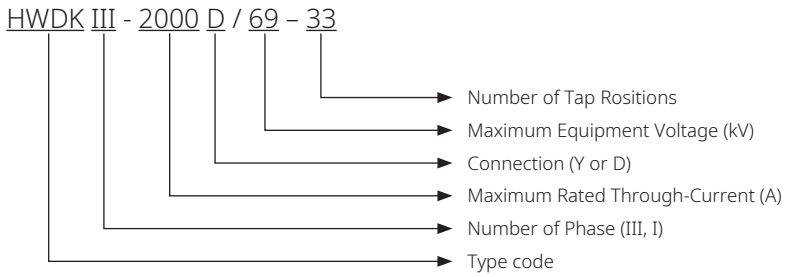


Figure 4-8 Product Model Number Structure

5. Technical Parameters

5.1 On-Load Tap-Changer

5.1.1 Mechanical and Electrical Data

Table 5-1 Mechanical and Electrical Data[1]

Item	Model		HWDK I	HWDK III
1	Maximum Rated Through-Current Ium (A)		1000/2000/2500	
2	Maximum Circulating Current of Current-Limiting Autotransformer (A)		700	
3	Rated Frequency (Hz)		50/60	
4	Maximum Step Voltage Uim (V)		2000	
5	Rated Step Capacity (kVA)		2500	
6	Standard Number of Operating Positions		33	
7	Regulating Winding Segments		9 (8 effective)	
8	OLTC-to-Ground and Phase-to-Phase Insulation Level (kV)	Maximum Continuous Operating Voltage Between Lines (IEC/IEEE) (kV)	69/35	
		Rated Power Frequency Withstand Voltage (50 Hz, 1 min)	140/95	
		Rated Lightning Impulse Withstand Voltage (1.2/50 μs)	400/250	
9	OLTC Maximum-Minimum Tap (Extreme Range) Insulation Level (kV)	Rated Power Frequency Withstand Voltage (50 Hz, 1 min)	70	
		Rated Lightning Impulse Withstand Voltage (1.2/50 μs)	250	
10	OLTC Step-to-Step Insulation Level (kV)	Rated Power Frequency Withstand Voltage (50 Hz, 1 min)	50	
		Rated Lightning Impulse Withstand Voltage (1.2/50 μs)	125	
11	Short-Circuit Withstand Capability (kA)	Thermal (3 s)	24	
		Dynamic (Peak)	60	
12	Mechanical Life (x 10,000 operations)		100	
13	Vacuum Interrupter Contact Life (x 10,000 operations)		60	

*OLTC execution standard:
IEC 60214-1 Tap-changers-Part 1:Performance requirements and test methods
IEEE Std C57.131™-2012:IEEE Standard Requirements for Tap Changers

Item	Model		HWDK I	HWDK III
14	OLTC Oil Tank	Sealing Performance	0.1 MPa, 24 h, no leakage	
		Withstand Full Vacuum (Pa)	133	
		External Dimensions (mm) L x W x H	780x838x1124	1720x820x1158
				1720x750x1108
				Below 35kV
15	OLTC Weight (kg)		830	1390/1310
16	OLTC Oil Capacity (L)		660	1505/1300

5.1.2 Insulation Tests

Item	Maximum Equipment Voltage (72.5 kV)		Power Frequency Voltage (50 Hz, 1 min)	Impulse Voltage (1.2/50 μs)
1	To Ground (kV)		140	400
2	Phase-to-Phase (kV)		140	400
3	Between Maximum and Minimum Taps (kV)		70	250
4	Step-to-Step (kV)	Diverter Switch	5	20
5		Tap Selector	50	125

5.2 Motor-Drive Unit

Table 5-3 Motor-Drive Unit Parameters

Item	Model		SHM-X
1	Power (kW)		0.75
2	Voltage (V)		AC380
3	Motor Speed (rpm)		1400
4	Operating Time per Step (s)		2.6-2.7
5	Vacuum Interrupter Failure Detection	Lockout Control Function	Yes
1		Anti-Slip Protection Time (s)	0.6

5.3 Oil Sample Data

Table 5-4 Oil Sample Limit Values

Parameter		Dielectric Strength	Water Content
Mineral Oil (IEC 60296)			
Initial Transformer Commissioning		> 60kV/2.5mm	< 15μL/L
During Operation	Class I OLTC	> 30kV/2.5mm	< 40μL/L
	Class II OLTC	> 40kV/2.5mm	< 30μL/L
After Maintenance		> 45kV/2.5mm	< 15μL/L
Natural Ester Oil (IEC 62770)			
Initial Transformer Commissioning		> 60kV/2.5mm	≤ 100μL/L
During Operation	Class I OLTC	> 30kV/2.5mm	≤ 200μL/L
	Class II OLTC	> 40kV/2.5mm	≤ 200μL/L
After Maintenance		> 45kV/2.5mm	≤ 100μL/L

6. Transportation, Acceptance, and Storage of the OLTC

6.1 OLTC Transportation

- The OLTC is shipped in packaging suitable for various modes of transportation.
- Boxes can be stacked appropriately during storage.
- The maximum permissible load on the top of the packaging is 500 kg/m².
- Position the OLTC for transport according to the marked center of gravity.
- Lift the OLTC according to the lifting markings on the packaging.
- The OLTC oil tank is filled with high-purity nitrogen for transportation (nitrogen purity ≥ 99.9%, dew point ≤ -40°C, pressure 0.05 ± 20% MPa).

6.1.1 Securing and Protective Measures

Warning	
	**Risk of Toppling!** Toppling or falling packages can cause serious injury to personnel and damage equipment. ✓ Sling selection and load securing must be performed by trained and authorized personnel. ✓ Do not stand under suspended loads. ✓ Use transport equipment and lifting devices with a load capacity greater than 3000 kg.
Caution	
	✓ Transportation and lifting of the packaged OLTC must be carried out by qualified personnel. ✓ Ensure that the transport vehicle and lifting equipment have a load capacity of at least 3000 kg. ✓ Securely fasten the packaging during transport and handling to prevent damage due to vibration, impact, dropping, tilting, collision, or swaying. ✓ If the package is dropped or subjected to a severe impact, inspect the OLTC for damage. Contact Huaming for inspection and/or repair by qualified personnel if necessary.

6.1.2 Transportation Markings

Figure 6-1 Outer Packaging Warning Markings

6.2 Unpacking and Acceptance

Upon delivery, immediately inspect the OLTC for moisture damage that may have occurred during transportation. Installation and commissioning can only proceed if the OLTC is confirmed to be free of moisture. If immediate installation is not possible, select a suitable storage method based on the actual conditions.

6.2.1 Unpacking and Verification

Each shipment must be inspected by the recipient against the packing list and Confirmation of Acceptance form. Verify the following:

- Quantity of received items against the shipping manifest.
- Product specifications against the order documentation.
- Packaging for any signs of damage.

6.2.2 Handling Damaged or Non-Conforming Goods

- Damaged Packaging
  If possible, photograph the damaged packaging and contents, then refuse delivery.
- Non-Conforming Goods
  If the goods do not match the shipping manifest, refuse delivery.
  In either of these cases, immediately contact the carrier. If the issue cannot be resolved with the carrier, contact Huaming's After-Sales Service department in writing (contact number: 800-820-8231).
  Follow these same procedures if corrosion is found due to moisture ingress (e.g., rain, snow, condensation).

6.3 Storage Conditions

Store components in a dry location before installation. Keep the OLTC in its sealed packaging until it is ready to be installed.

6.3.1 Storage Environment Requirements

- Ambient temperature at the storage location: -25°C to +40°C.
- Do not store in environments containing flammable, explosive, or corrosive gases.
- Protect stored equipment from moisture, dust, rodents, and insects.
- Regularly inspect stored equipment for abnormalities.

For extended storage, periodically replace the desiccant and ensure the packaging remains sealed.

6.3.2 Storage Methods

There are two primary storage methods: high-purity nitrogen-filled storage and oil-filled storage. If the OLTC is to be stored for more than two months, use the oil-filled storage method.

6.3.2.1 High-Purity Nitrogen-Filled Storage

Procedure:

1. Pre-Storage Inspection:
   - Nitrogen Pressure Verification: Check the internal nitrogen pressure (nitrogen purity ≥ 99.9%, dew point ≤ -40°C, pressure 0.05 ± 20% MPa).
   - Bottom Oil Sample Test: Take a sample of the residual oil at the bottom of the tank and test it. The dielectric strength must be ≥ 35 kV/2.5 mm, and the water content must not exceed 30 ppm.

2. Storage Procedures and Key Points (if the above requirements are met):
   - Storage Duration: If the inspection results meet the requirements, the OLTC can be stored with nitrogen for a maximum of two months. After two months, switch to oil-filled storage.
   - Daily Monitoring and Maintenance: During nitrogen storage, record the internal pressure and nitrogen condition daily. If a sharp pressure drop is detected, immediately inspect for leaks and perform repairs to prevent moisture ingress.
3. Actions if Requirements Are Not Met:
   - Leakage and Moisture Inspection: If the inspection results do not meet the requirements, thoroughly inspect the OLTC for leaks and moisture.
   - Corrective Actions:
   - If leaks or moisture are found, do not proceed with nitrogen storage. The OLTC cannot be installed or commissioned. Contact the manufacturer for reprocessing and recommissioning.
   - If no leaks are found, dry the OLTC according to the procedures in Section 8.4.1 to restore it to a condition suitable for storage or use.

6.3.2.2 Oil-Filled Storage

1. Oil Draining:
   - Drain Bottom Oil: Open the drain valve and completely drain the residual oil from the bottom of the tank.
2. Oil Filling:
   - Simultaneous Filling and Venting: Slowly open the bleeder valve on the top of the tank while filling with transformer oil (dielectric strength ≥ 45 kV/2.5 mm, water content ≤ 30 ppm) through the ball valve at the bottom of the tank. Ensure a smooth filling process and complete filling of the tank while venting internal air.
3. Oil Sample Testing and Follow-Up:
   - Oil Sample Collection and Analysis: After the OLTC is completely filled with oil, take an oil sample and test it. The oil must have a dielectric strength ≥ 35 kV/2.5 mm and a water content below 30 ppm.
   - Handling Non-Conforming Results:
   - If the test results do not meet the requirements, immediately inspect the OLTC for leaks and moisture.
   - If no leaks are found, dry the OLTC according to the procedures in Section 8.4.1 to ensure its quality and performance.

7. Supplied Components and Accessories

7.1 Supplied Components

Important Note!
The specific components included in the shipment are listed on the packing list.

7.1.1 Standard Configuration

The standard OLTC package includes:

- OLTC Body
- MDU, Controller, and Connecting Cables
- Pressure Relief Device (Standard)
- Gas Relay (Standard)
- Accessories for Special Customer Requirements (if applicable)

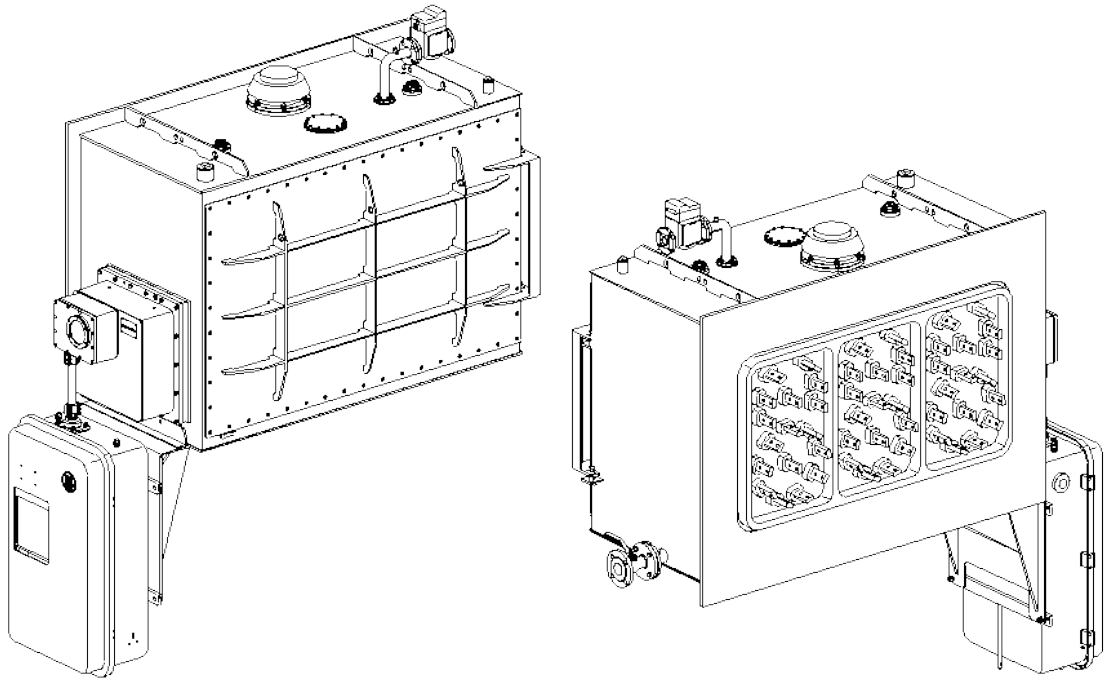


Figure 7-1 Standard Configuration (Customer Supplies Oil Conservator)

7.1.2 Non-Standard Configuration

The non-standard OLTC package includes:

- OLTC Body
- MDU, Controller, and Connecting Cables
- Sudden Pressure Relay (Non-Standard)
- Oil Level Gauge (Non-Standard)
- Breather (Non-Standard)
- Accessories for Special Customer Requirements (if applicable)

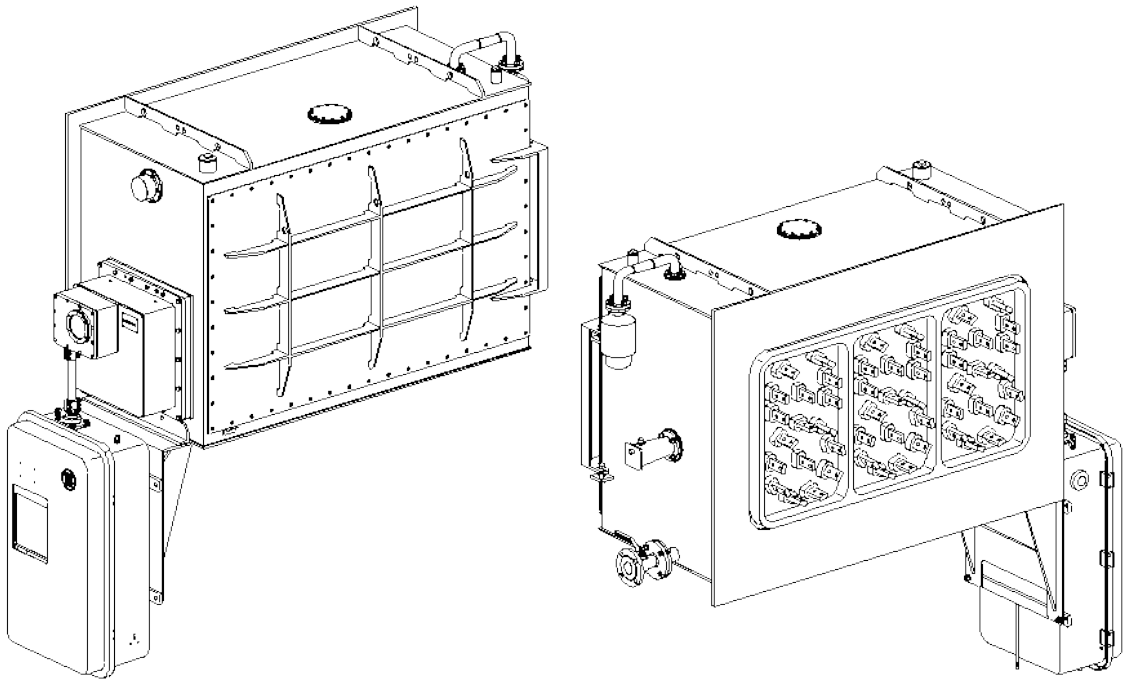


Figure 7-2 Non-Standard Configuration

8. Installation Guide

8.1 Pre-Installation Preparations

4.1.1 Importance in Power Systems

Equipment Inspection:

- **Visual Inspection:** Carefully inspect the equipment's exterior for damage, deformation, scratches, rust, or other defects. Check the condition of the paint and ensure the nameplate markings are clear and accurate. If any issues are found, contact the manufacturer for resolution.

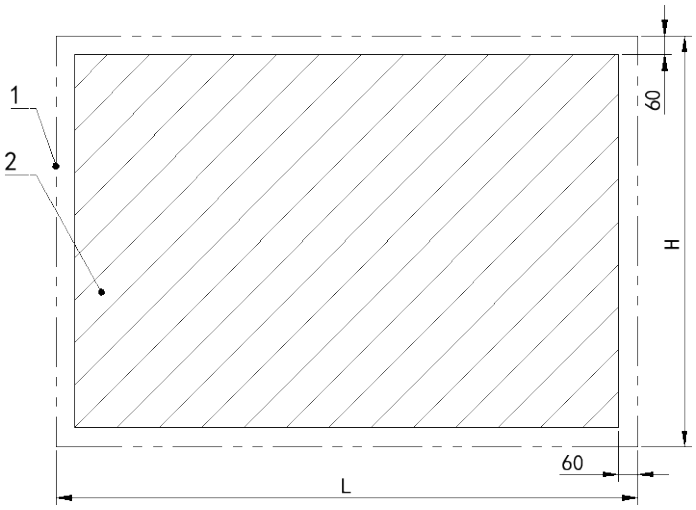
- **Component Inspection:** Inspect all components to ensure they are complete, undamaged, and undeformed. This includes the tap selector, change-over selector, MDU, drive shaft, and protective devices. Check critical components such as contacts, gears, and bearings for wear. Replace or repair any abnormal components.

- **Electrical Performance Check:** Use professional testing equipment to perform preliminary electrical checks, including insulation resistance measurement, winding DC resistance measurement, and electrical connection continuity checks. Ensure the electrical system is functioning properly, with no short circuits, open circuits, or insulation issues.

8.2 Mechanical Connection of the OLTC to the Transformer

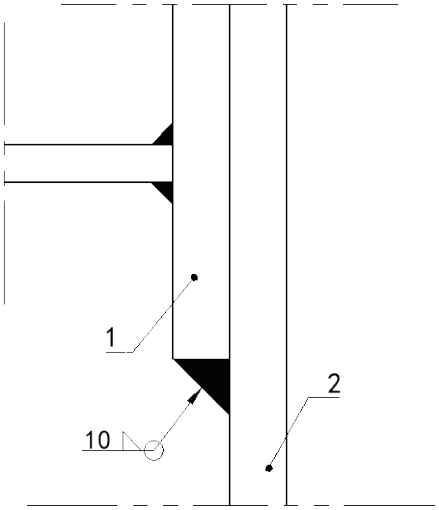
8.2.1 Connecting the OLTC to the Transformer

Caution	
	Radiated heat from welding may damage the terminal plate or its oil seal. ✓ Use protective devices such as heat shields or curtains as needed.
	Important Note! ✓ Mount the OLTC to a wall of the transformer tank specifically designed to withstand routine testing and operating pressures (at least 15 psi (1 bar)). ✓ Form a 0.25" oil-impermeable weld around the periphery of the OLTC mounting flange. ✓ Ensure that there are no welds on the transformer side of the OLTC mounting flange.



1. OLTC Mounting Flange 2. Transformer Opening Size

Figure 8-1 OLTC Positioning and Transformer Opening



1. OLTC Mounting Flange 2. Transformer Oil Tank

Figure 8-2 Welding Diagram

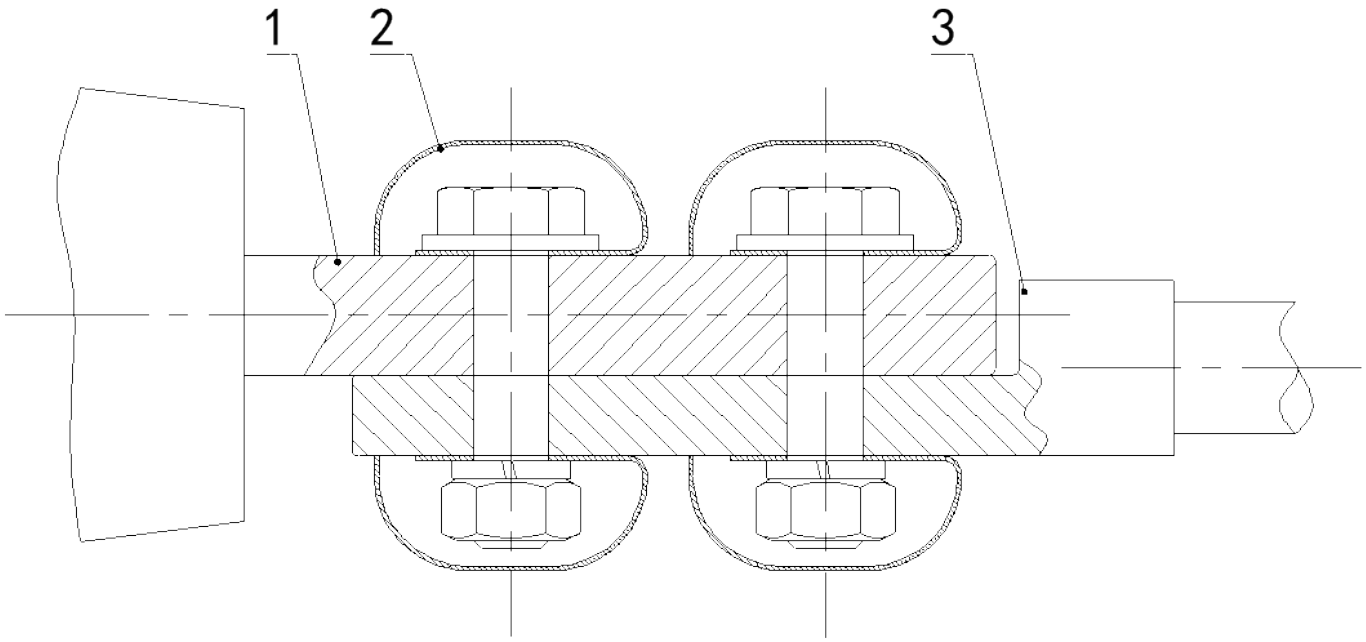
✓ Obtain order-specific outline dimension drawings to verify the transformer tank opening size.

1. Check the opening size in the transformer tank.
2. Weld the OLTC oil compartment to the transformer tank.
   - Use a lifting device to position the OLTC at the designated location on the transformer tank (Figure 8-1) and weld it in place (Figure 8-2).

8.3 Electrical System Connections

8.3.1 Securing the Regulating Winding Taps to the OLTC Terminals

Caution	
	Mechanical stress on the OLTC connecting leads can damage the OLTC. ✓ Connect the leads carefully. ✓ Avoid twisting the terminals. ✓ Do not bend or deform the connecting leads. ✓ Ensure there is sufficient slack in the connecting leads.
	**Important Note!** ✓ Install expansion loops in the connecting leads if there is a possibility of lead expansion or movement due to factors such as significant ambient temperature variations or vibration sources. ✓ The OLTC terminal board is labeled with contact position markings. Connect the regulating winding taps to the OLTC terminals according to the markings on the OLTC. ✓ Provide adequate slack in the connections between the OLTC terminals and the final clamping point of the transformer leads. These connections should be flexible and not too short.



1.OLTC Terminals	2.Shield Cap	3.Regulating Winding Tap

Figure 8-3 Cross-Sectional View of Regulating Winding Tap Connection to OLTC Terminal

✓ Obtain the wiring diagram to identify the wiring tasks.

1. Make preliminary connections as shown in Figure 8-3.
   - Install the shield cap, washer, bolt, and nut in sequence.
2. Tighten the M10 bolts.
   - Tightening torque: 30 ± 10% Nm.
3. Flip the shield cap over.

8.3.2 Electrical System Verification

Caution	
	Misalignment between the OLTC and the MDU can damage the OLTC. ✓ Before verification, ensure the tap position indicators on the OLTC and MDU are the same. ✓ During verification, observe the tap position indicators on the OLTC and MDU to avoid exceeding the OLTC's end positions. ✓ After verification, ensure the OLTC and MDU are returned to their designated operating positions.
Caution	
	Incomplete tap-changing operations can damage the OLTC. ✓ After completing a manual tap change, continue rotating the handle an additional two and a half turns.
	Important Note! ✓ If operating the OLTC without oil, do not exceed six tap-change operations.

8.3.2.1 Turns Ratio Test

- Verify the correct connection of the OLTC.
- Confirm the proper functioning of the OLTC.
- Monitor for any changes in OLTC performance.

8.3.2.2 DC Resistance Measurement

- Check the condition of the OLTC contacts.
- Identify any connection faults in the OLTC.
- Assess the operational status of the OLTC.

8.4 Oil System Installation

8.4.1 Drying Process

Normally, the OLTC does not require drying. If the packaging materials are wet, dry the OLTC before installing it on the transformer. Use either a normal temperature vacuum drying process or a heated vacuum drying process (temperature ≤ 110°C, vacuum ≤ 133 Pa), depending on the equipment condition and the degree of moisture exposure.

8.4.2 Installing the Connecting Pipes

The connecting pipe on top of the OLTC tank can be oriented in the desired direction by loosening the pipe's collar ring and rotating the pipe as needed.

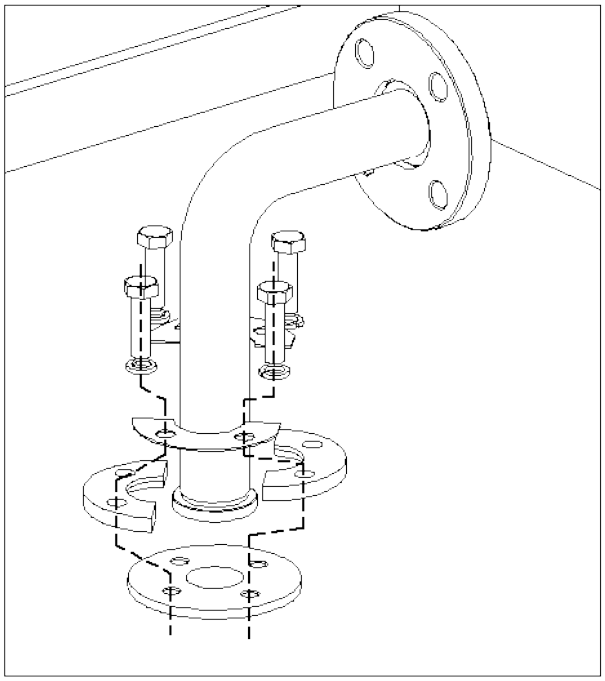


Figure 8-4 Connecting Pipe Installation Diagram

8.4.3 Initial Oil Filling

Caution	
	Incomplete degassing can significantly reduce the OLTC's insulation to ground. ✓ After filling with oil at atmospheric pressure, allow the OLTC to sit for at least five hours to eliminate air bubbles before energizing the transformer.

Generally, do not open the OLTC tank top cover or sealing plate. To minimize moisture ingress, refill the tank with oil as quickly as possible. Oil filling can be performed under normal atmospheric pressure or under vacuum.

8.4.3.1 Standard Tank Oil Filling

For transformers equipped with an oil conservator (customer-supplied), the conservator is connected to the protective relay with a conservator valve in between (see Figure 8-5).

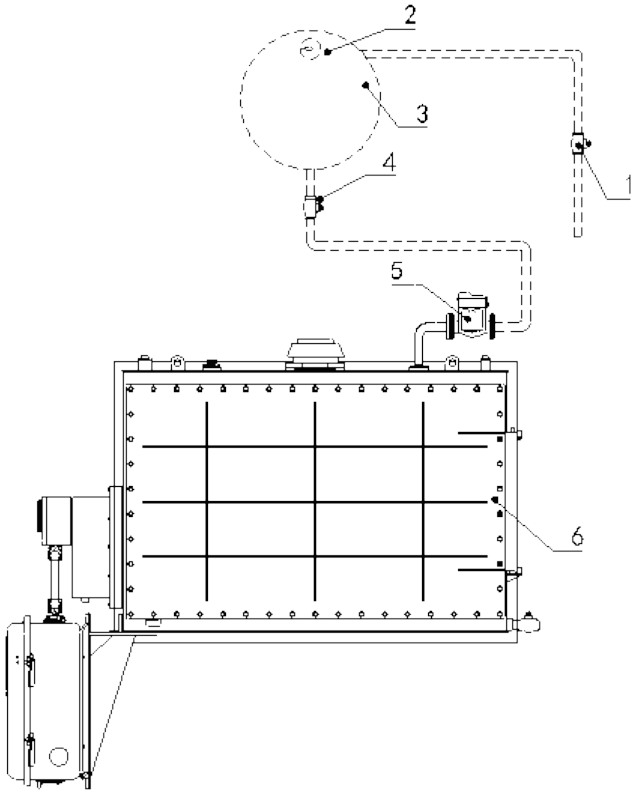


Figure 8-5 Standard OLTC Configuration

1.Conservator Valve	2.Conservator Oil Level Gauge	3.Oil Conservator
4.Oil Compartment Valve	5.Protective Relay	6.OLTC Oil Tank

8.4.3.1.1 Oil Filling at Atmospheric Pressure

Important Note!
Refer to the MDU instruction manual for more detailed installation instructions.

1. Open the conservator valve.
2. Disconnect the breather pipe (if applicable).
3. Connect the oil pump, open the oil compartment valve, and start the pump. Fill to the correct oil level as indicated on the oil level gauge.
4. Close the oil pump and conservator valve. Disconnect the oil pump.
5. Reconnect the breather pipe.

8.4.3.1.2 Vacuum Oil Filling

Vacuum oil filling is generally not required. If necessary, follow these steps:

1. Close the conservator valve and open the oil compartment valve.
2. Disconnect the breather pipe (if applicable).
3. Apply a vacuum to the OLTC oil tank (vacuum ≤ 133 Pa).
4. Connect the oil filling pipe to the conservator's oil inlet pipe.
5. Open the oil filling pipe valve and begin filling to the correct oil level as indicated on the oil level gauge.
6. Close the conservator valve.
7. Reconnect the breather pipe.

8.4.3.2 Non-Standard Tank Oil Filling

For oil filling at atmospheric pressure without an oil conservator, oil is injected directly through the OLTC oil filling pipe, with an oil filling valve in between (see Figure 8-6).

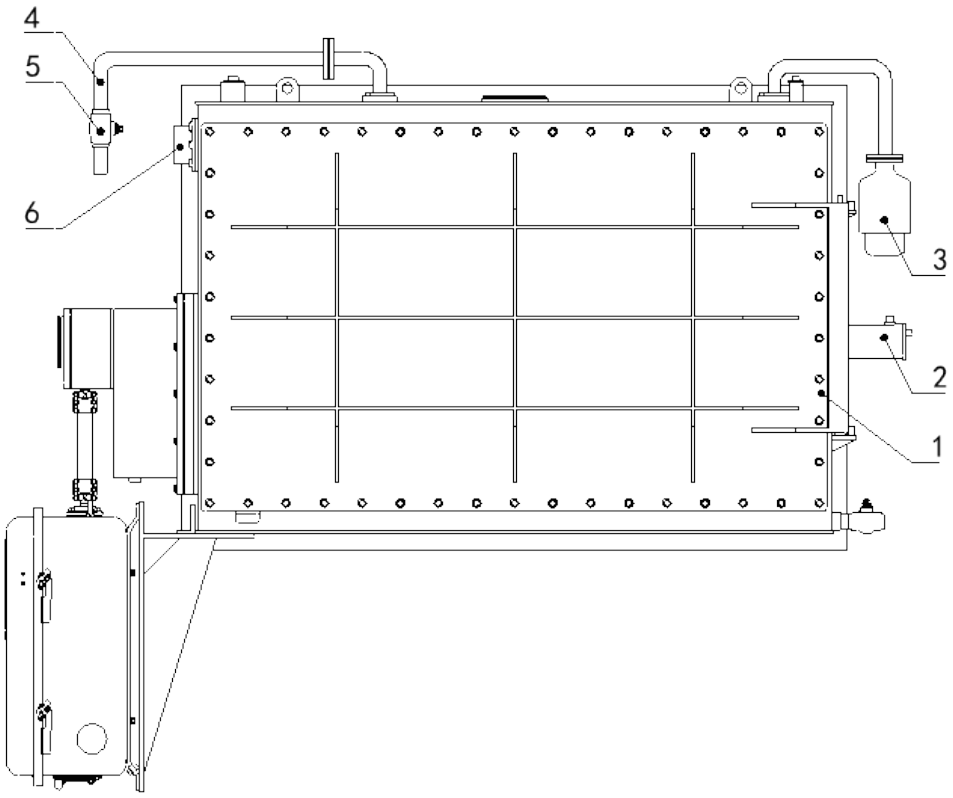


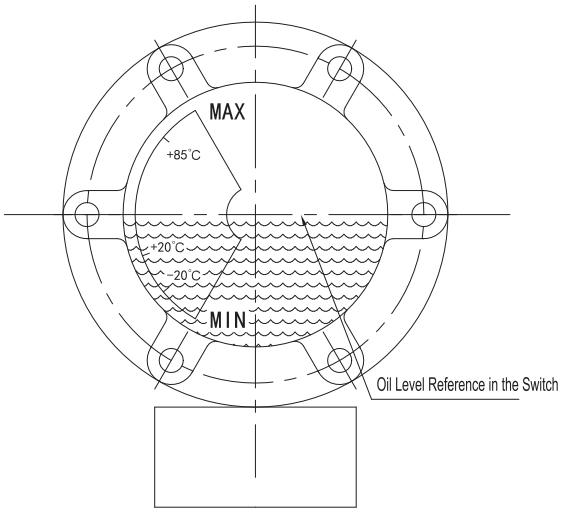
Figure 8-6 Non-Standard OLTC Configuration

1.OLTC Oil Tank	2.Sudden Pressure Relay	3.Breather
4.Oil Filling Pipe	5.Oil Filling Valve	6.Oil Level Gauge

8.4.3.2.1 Oil Filling at Atmospheric Pressure

1. Open the oil filling valve.
2. Remove the breather and pipe.
3. Connect the oil pump and start filling with oil to the correct level indicated on the oil level gauge.
4. Close the oil pump and oil filling valve. Disconnect the oil pump.
5. Reinstall the breather and pipe.
6. Correct oil level position. (See the image on the right)

Correct Oil Level: For non-standard tanks without an oil conservator, the oil level should be between the MIN and MAX marks at +20°C, leaving an air gap between the oil surface and the top cover.



8.4.3.2.2 Vacuum Oil Filling

Vacuum oil filling for non-standard tanks is similar to that for standard tanks. Refer to Section 8.4.3.1.2.

8.5 Mechanical Drive System Installation

8.5.1 Motor-Drive Unit (MDU) Installation

Important Note!
Refer to the relevant MDU operating instruction manual for more detailed installation procedures.

1. Install the connection bracket.

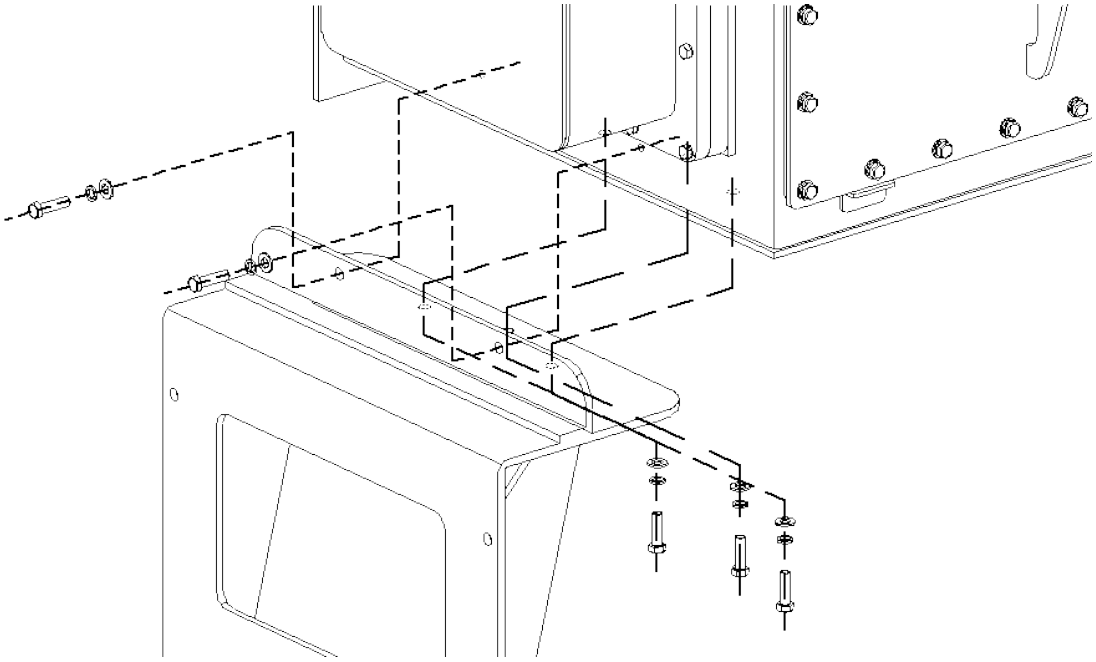
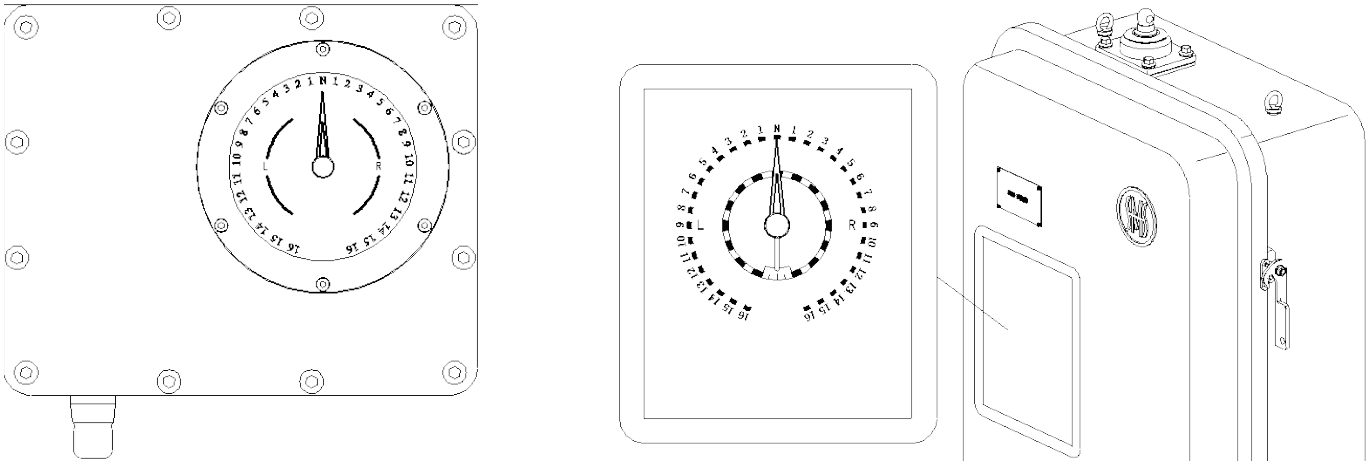


Figure 8-7 MDU Connection Bracket Installation

- Connect the bracket as shown in Figure 8-7.
- The OLTC oil compartment has five M12 connection bolt holes on the bottom and sides.

2. Install the MDU.
   - Refer to the corresponding Huaming MDU instruction manual for detailed installation and adjustment procedures.
3. Install the drive shaft.
   - Before installation, ensure that the tap position indicator on the drive unit and the MDU are aligned (see Figure 8-8).



Drive Unit Tap Position Indicator MDU Tap Position Indicator

Figure 8-8 Drive Unit and MDU Tap Position Indicators

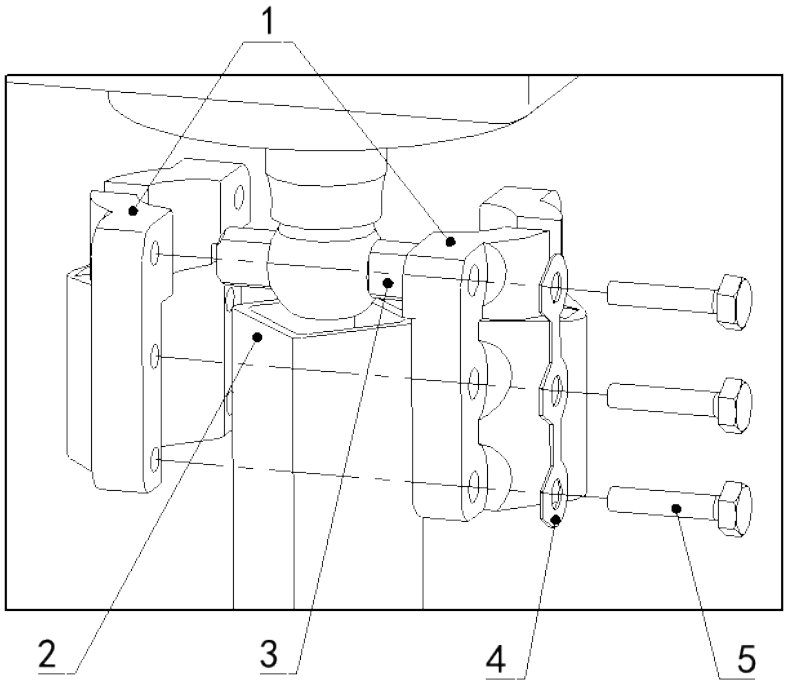


Figure 8-9 Coupling Installation Diagram

1.Coupling	2.Drive Shaft	3.Cylindrical Pin
4.Locking Tab	5.M6 Bolt	

4. Connect the fiber optic cable.
   - Connect as shown in Figure

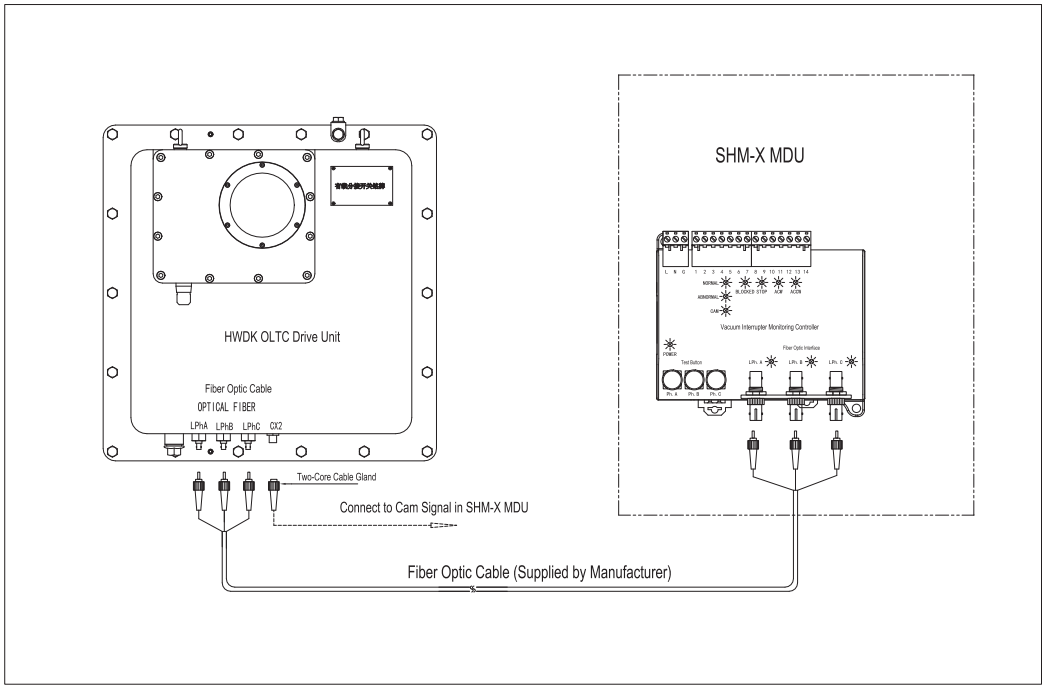


Figure 8-10 MDU and Drive Unit Signal Connection Diagram

8.5.2 Mechanical Drive System Verification

1. Preparation:
   - Obtain the hand crank and insert it securely into the hand crank hole on the MDU.
2. Clockwise Operation and Recording:
   - According to the operating sequence diagram, slowly rotate the MDU clockwise 33 turns. Note the number of turns when the diverter switch opens and closes (audible click).
3. Counterclockwise Operation and Recording:
   - After completing the clockwise operation, rotate the MDU counterclockwise 33 turns, again noting the number of turns when the diverter switch opens and closes.
4. Error Adjustment:
   - Compare the difference in the number of turns for clockwise and counterclockwise diverter switch operation. If the difference exceeds 1/4 turn, loosen the drive shaft and make fine adjustments in either direction until the difference is within 1/4 turn to ensure accurate operation.

8.6 Protective Device Installation

8.6.1 Gas Relay Installation

Install the gas relay according to the instructions provided in the gas relay's manual.

8.6.2 Pressure Relief Device Installation

The red crossbar on top of the pressure relief device must be removed before operating the OLTC.

9. Commissioning and Acceptance

9.1 Commissioning Inspection Items

- Installation Completeness Check
  Thoroughly inspect the entire installation, including mechanical, electrical, and oil systems, to ensure it is complete according to design and specifications, and that no issues are present.

- Protective Device Verification
  Check the installation location, wiring, and parameter settings of protective relays, pressure and temperature monitoring devices, etc. Perform simulation tests to verify their tripping, alarming, and other protective functions to ensure the equipment is promptly protected in case of abnormalities.

- Coupling Check
  Inspect the connection between the MDU and the OLTC. Manually operate the MDU to ensure it can smoothly drive the OLTC, confirming proper coupling and reliable power transmission.

- Oil Level Assurance
  Check the oil level gauges on the transformer tank and the OLTC oil compartment to ensure the oil level is correct and the oil quality meets the requirements. Replenish oil if necessary and check for and address any oil system leaks.

9.2 OLTC Commissioning at the Transformer Manufacturer's Facility

9.2.1 Functional Test

1. Pre-Test Preparation:
   - Ensure the transformer is de-energized, the OLTC and MDU are installed and adjusted, and the test equipment is functioning properly.

2. Test Procedure:
   - Start the MDU to drive the OLTC through mechanical operation and begin the cycle test.
   - After each completed cycle, the counter records the number of operations. Verify that the local position indicator on the MDU, the remote position indicator, and the OLTC position indicator all show the same position. Also, check that the mechanical and electrical limit protections are functioning correctly.

3. Test Completion Criteria:
   - Perform five cycles (or at least 200 operations). If the OLTC and MDU are undamaged, the position indicators are consistent, and the protection functions are reliable, the test is considered successful.
   - Document the test data and create a test report

9.2.2 Final Oil Filling

Caution	
	Incomplete degassing can significantly reduce the OLTC's insulation to ground. ✓ Completely degas the OLTC.

1. Preparation:
   - Oil Quality Check: Ensure the insulating oil meets the required quality standards.
   - Oil Filling Equipment Check: Inspect the oil filling pump and its accessories.
   - Transformer Inspection: Clean and inspect the inside of the transformer tank.

2. Oil Filling Procedure:
   - Refer to Section 8.4.3, "Initial Oil Filling," for detailed procedures.
   - Begin filling with oil.
   - Initially, maintain a moderate oil filling speed to avoid impacting internal transformer components.
   - Monitoring.
   - Perform a brief check for oil leaks.
   - Monitor the oil level gauge readings.
   - Approaching Rated Oil Level: When the oil level approaches the transformer's rated level, further reduce the filling speed to precisely control the oil level and prevent overfilling.

3. Post-Filling Procedures:
   - Degassing: After filling, some air bubbles may remain in the transformer.
   - Allow the transformer to sit undisturbed or use other methods to facilitate oil-gas separation.
   - OLTC Oil Compartment Degassing.
   - Remove the M30 bolt on bleeder valve E1 (use a 36 mm wrench).
   - Carefully pry open the valve stem using a screwdriver to bleed air from the OLTC oil compartment until oil flows out (see Figure 9-1).
   - Tighten the bolt cap on valve E1 (torque: 9-12 Nm).
   - Hot Oil Circulation (to be determined by the user):
   - Hot oil circulation further removes impurities and gases from the oil, improving its quality.
   - During hot oil circulation, use an oil filter to remove fine particulate matter.

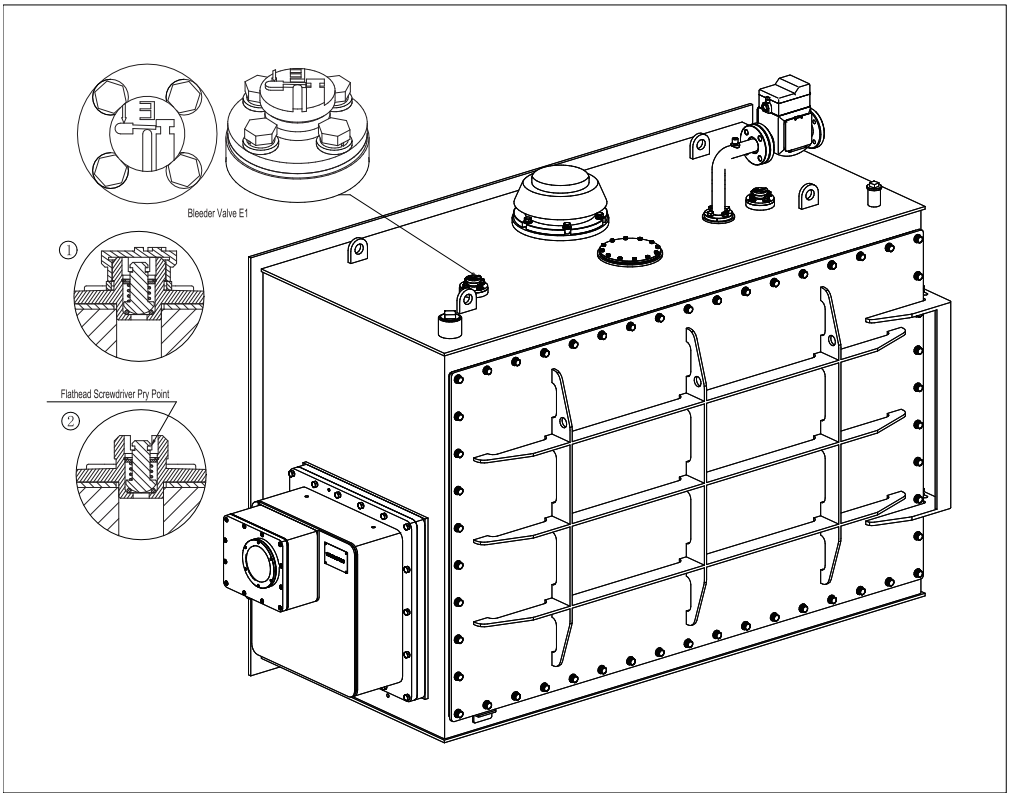


Figure 9-1 Bleeder Valve

4. Final Inspection:
   - Check the oil level.
   - Inspect the sealing areas for oil leaks.
   - Verify that oil temperature, oil quality, and other parameters meet the requirements.
   - Inspect the protective devices.

9.2.3 Grounding

The grounding points on the OLTC and MDU enclosure, marked with the grounding symbol, must be reliably grounded.

9.3 Electrical Tests for Transformer Acceptance

Important Note!
After testing, return the OLTC and MDU to their designated operating positions as specified in the delivery documentation.

After completing the above procedures, perform the electrical acceptance tests for the transformer.

10. Transformer Transportation to the Installation Site

10.1 Handling of Components During Transportation

- Overall Acceleration Requirements for Transportation
  When transporting the assembled OLTC and transformer, ensure that the acceleration and deceleration during transport do not exceed 4g to protect the product.

- OLTC Handling
  Generally, it is recommended to keep the OLTC in its installed state without disassembly. However, users should consider special circumstances, such as poor road conditions, specific transportation methods, or extreme environments, which may necessitate disassembling the OLTC or performing on-site installation to prevent damage.

- MDU Handling
  Generally, it is recommended to keep the MDU in its installed state without disassembly to ensure accuracy and reliability. However, if transportation is difficult, disassemble and reassemble the MDU at its designated operating position. Recalibration is required after reassembly.

10.2 Transformer Transportation Methods

10.2.1 Transporting Oil-Filled Transformers

- Transportation with Oil Conservator Installed
  The transformer and OLTC must be filled with oil and connected to the conservator.
- Transportation with Oil Conservator Removed
  Drain 20% of the oil from the OLTC oil tank. Seal the opening on the conservator with suitable packaging for transport.

10.2.2 Transporting Non-Oil-Filled Transformers

Completely drain the oil from the OLTC oil tank. Protect the interior of the oil compartment using the same methods as for the transformer, such as nitrogen blanketing.

10.3 Transformer Storage at the Installation Site

10.3.1 Transformer and OLTC

Refer to Section 6.3 for storage guidelines.

10.3.2 Motor-Drive Unit

For long-term storage, periodically energize the MDU heater to prevent moisture accumulation.

11. On-Site Inspection and Commissioning of the OLTC

- Installation Completeness Check
  Thoroughly inspect the entire installation, including mechanical, electrical, and oil systems, to ensure it is complete according to design and specifications, and that no issues are present.

- Protective Device Verification
  Check the installation location, wiring, and parameter settings of protective relays, pressure and temperature monitoring devices, etc. Perform simulation tests to verify their tripping, alarming, and other protective functions to ensure the equipment is promptly protected in case of abnormalities.

- Coupling Check
  Inspect the connection between the MDU and the OLTC. Manually operate the MDU to ensure it can smoothly drive the OLTC, confirming proper coupling and reliable power transmission.

- Oil Level Assurance
  Check the oil level gauges on the transformer tank and the OLTC oil compartment to ensure the oil level is correct and the oil quality meets the requirements. Replenish oil if necessary and check for and address any oil system leaks.

11.1 Oil Replenishment/Final Filling

Before commissioning the transformer, ensure that the OLTC oil tank is filled with oil (except for non-standard tanks).

Before initial operation of the transformer, ensure the oil has a dielectric strength (Ud) > 40 kV/2.5 mm (minimum) and a water content < 30 µL/L (maximum).

Refer to Section 9.2.2, "Final Oil Filling," for oil filling and degassing procedures.

Refer to Section 8.4.3, "Initial Oil Filling," for detailed oil filling steps.

11.2 Motor-Drive Unit

1. Perform a functional check according to the instructions in the relevant MDU operating manual.
2. Incorrect MDU coupling can damage the OLTC.
   Perform a test tap-change operation over the entire operating range. Ensure that the position indicators on the MDU and the OLTC (through the inspection window on the OLTC drive unit) match at each operating position.

11.3 Protective Devices

- OLTC Oil Level Signal Contact for Oil Conservator
  Ensure that the minimum oil level signal contact in the OLTC conservator is connected to the circuit breaker trip circuit. This allows the circuit breaker to trip when the oil level is too low, preventing equipment damage due to insufficient oil.

- Gas Relay Check
  Check the function of the gas relay according to the Huaming QJ-25 series gas relay instruction manual. The gas relay detects gas buildup inside the transformer. Gas generation due to a fault will trigger an alarm or trip the circuit breaker. Verifying its function before operation is crucial.

- Pressure Relief Device Operation
  Before commissioning the transformer, remove the red protective strip from the pressure relief device. The pressure relief device prevents excessive internal pressure in the transformer. Failure to remove the protective strip will prevent it from functioning properly, potentially damaging the transformer.

11.4 Conducting Handover Tests

Verify the quality of the transformer and OLTC installation.
Establish a baseline for comparison during long-term operation of the transformer and OLTC.

11.5 Commissioning

Caution	
	Inrush current during transformer startup can be several times the rated current, potentially causing abnormal current flow and overloading the OLTC during switching. ✓ Only perform tap-change operations after the inrush current has completely subsided.

- Ensure that the minimum oil level signal contact in the OLTC conservator is correctly connected to the circuit breaker's trip circuit. This allows the circuit breaker to trip when the oil level reaches the minimum warning level, protecting the equipment.
- Confirm that all protective devices are properly connected to the circuit breaker's trip circuit, enabling timely circuit interruption in case of abnormalities and preventing fault escalation.
- All protective devices should be in normal operating condition, ready to activate their protective functions, and currently operational to ensure safe equipment operation.
- The MDU must be functioning correctly, free from defects, and able to respond reliably to operating commands, performing all necessary actions, including tap changes.
- The OLTC oil compartment must be completely filled with dielectric fluid to ensure proper insulation, heat dissipation, and arc extinguishing, contributing to stable equipment operation.
- Open all shut-off valves between the OLTC and its conservator.

12. Monitoring the Operating Status of the OLTC

12.1 Monitoring Pressure Rise in the OLTC Oil Compartment

- The gas relay trip contact is set to operate at an oil flow rate of 1.0 m/s ± 10%.
  This contact should be connected to the tripping circuit of the transformer's circuit breaker. When a fault occurs inside the OLTC, a large amount of gas will be generated, increasing the oil flow rate. This will cause the relay's baffle to move, closing the trip contact, cutting off power to the transformer, and preventing further damage. Once the gas relay has tripped, do not manually close the external circuit breaker before inspecting the OLTC.

- The OLTC top cover has an overpressure protection bursting disc.
  This disc will not rupture during normal tap-changing operations. It will only rupture if a fault occurs inside the diverter switch, causing the oil compartment pressure to exceed 0.3 ± 20% MPa. This provides overpressure protection and prevents further damage. During OLTC installation and maintenance, be extremely careful not to step on or strike the bursting disc.

12.2 Monitoring OLTC Oil Quality

Voltage Regulation Method	Dielectric Strength	Water Content
Neutral Point Regulation	≥30kV/2.5mm	<40μL/L
Other than Neutral Point Regulation	≥40kV/2.5mm	<30μL/L

12.3 Monitoring the OLTC Operating Load

- Avoid frequent OLTC operation during transformer overload conditions.
  Install an "overcurrent lockout" to prevent OLTC switching when the load current exceeds twice the rated current (2 x In).

13. Periodic Maintenance and Repair of the OLTC

Danger	
	**Electric Shock Hazard!** Contact with energized equipment can cause death or serious injury. ✓ De-energize and disconnect the transformer's high-voltage and low-voltage terminals. ✓ Lock out the transformer to prevent accidental re-energization. ✓ Ensure that all components are de-energized. ✓ Ground all transformer terminals (including ground wires and grounding disconnect switches) and ensure they are short-circuited. ✓ Cover or isolate adjacent energized components.
Danger	
	**Electric Shock Hazard!** Working on an energized OLTC can be fatal. ✓ Do not operate or work on an energized OLTC. ✓ Disconnect all auxiliary circuits, including the tap-changer control, pressure relief valve, and pressure monitoring devices. ✓ Verify all components are de-energized.
Danger	
	**Explosion Hazard!** Explosive gases in the OLTC oil compartment, transformer, piping, conservator, and dehydrating breather outlet can ignite or explode, causing death or severe injury. ✓ Ensure the area around the transformer is free of open flames, hot surfaces, sparks (including static discharge), and any other potential ignition sources. ✓ Do not operate any electrical equipment that could generate sparks (e.g., impact wrenches). ✓ Use only electrically conductive and grounded hoses, tubing, and pumping equipment suitable for flammable liquids.
Caution	
	Condensation in the MDU can damage the MDU. ✓ Always maintain the MDU seal. ✓ If operation is interrupted for more than two weeks, connect and operate the anti-condensation heater in the MDU. If this is not possible, place a sufficient quantity of desiccant inside the MDU enclosure.

13.1 Periodic OLTC Maintenance

13.1.1 Periodic OLTC Maintenance Items

- Perform periodic OLTC maintenance concurrently with minor transformer maintenance.
- Perform periodic maintenance annually.

13.1.2 Periodic OLTC Maintenance Tasks

- Inspect and maintain the transmission gears.
- Check the condition of seals in all areas.
- Check the operational status of protective devices.
- Check the oil level, oil color, moisture absorber, and desiccant in the OLTC conservator to ensure they are in normal condition.
- Check the dielectric strength and water content of the oil sample in the OLTC oil compartment.
- Inspect and maintain the MDU.
- Inspect the core (optional).
- Inspect the drive shaft (after separating the MDU from the OLTC).
- Check the functional status of the automatic controller (if equipped).

13.2 Maintenance Intervals

Table 13-1 OLTC Maintenance

Interval	Task
300,000 operations (based on the MDU counter)	Inspect and maintain the OLTC. Contact Huaming's After-Sales Service department.
600,000 operations (based on the MDU counter)	Replace the diverter switch insert. Contact Huaming's After-Sales Service department.

14. Appendix

Figure 1: HWDK Three-Phase (Standard) External Reactance-Type Vacuum OLTC Dimensions

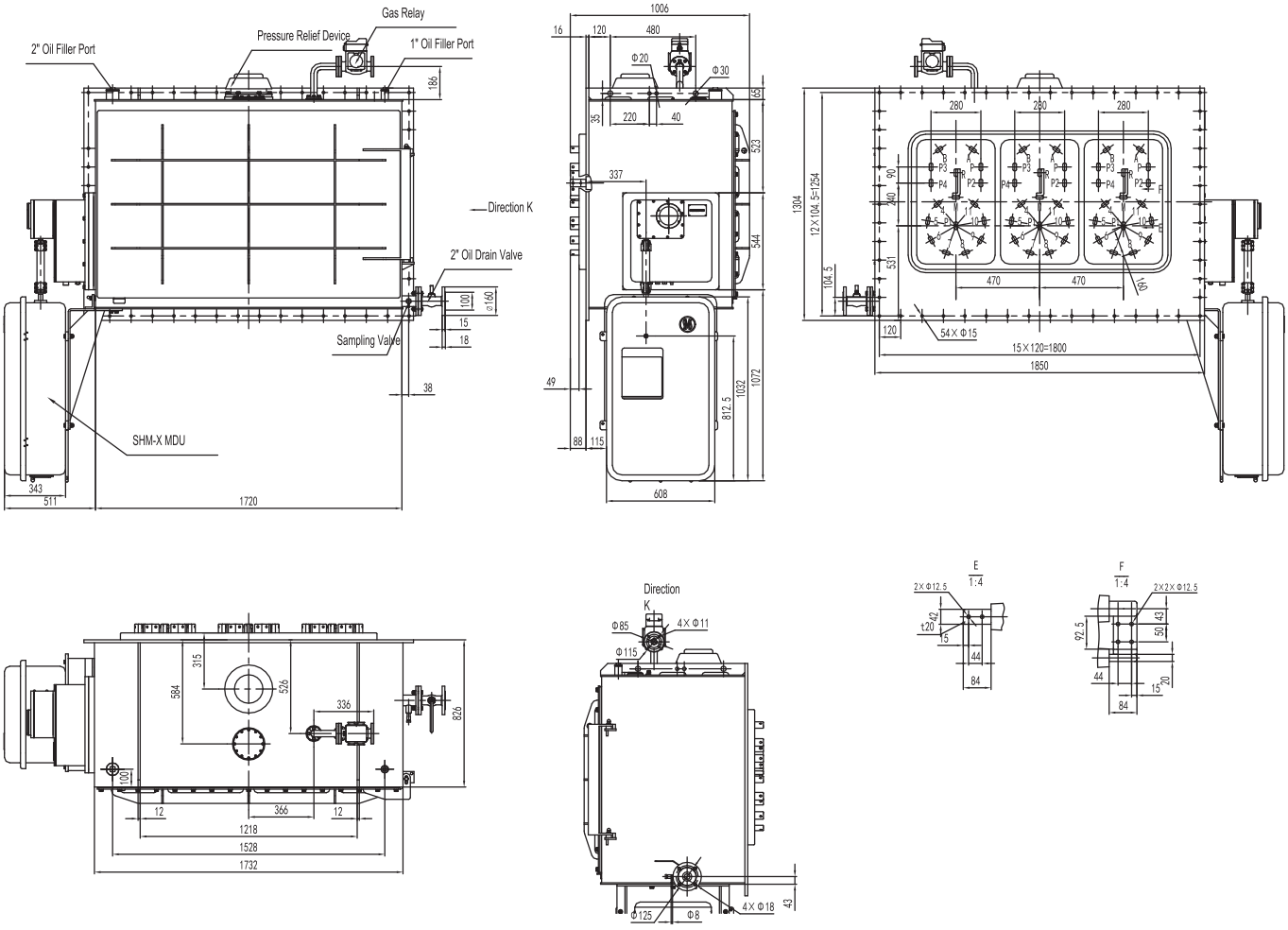


Figure 2: HWDK Three-Phase (Non-Standard) External Reactance-Type Vacuum OLTC Dimensions

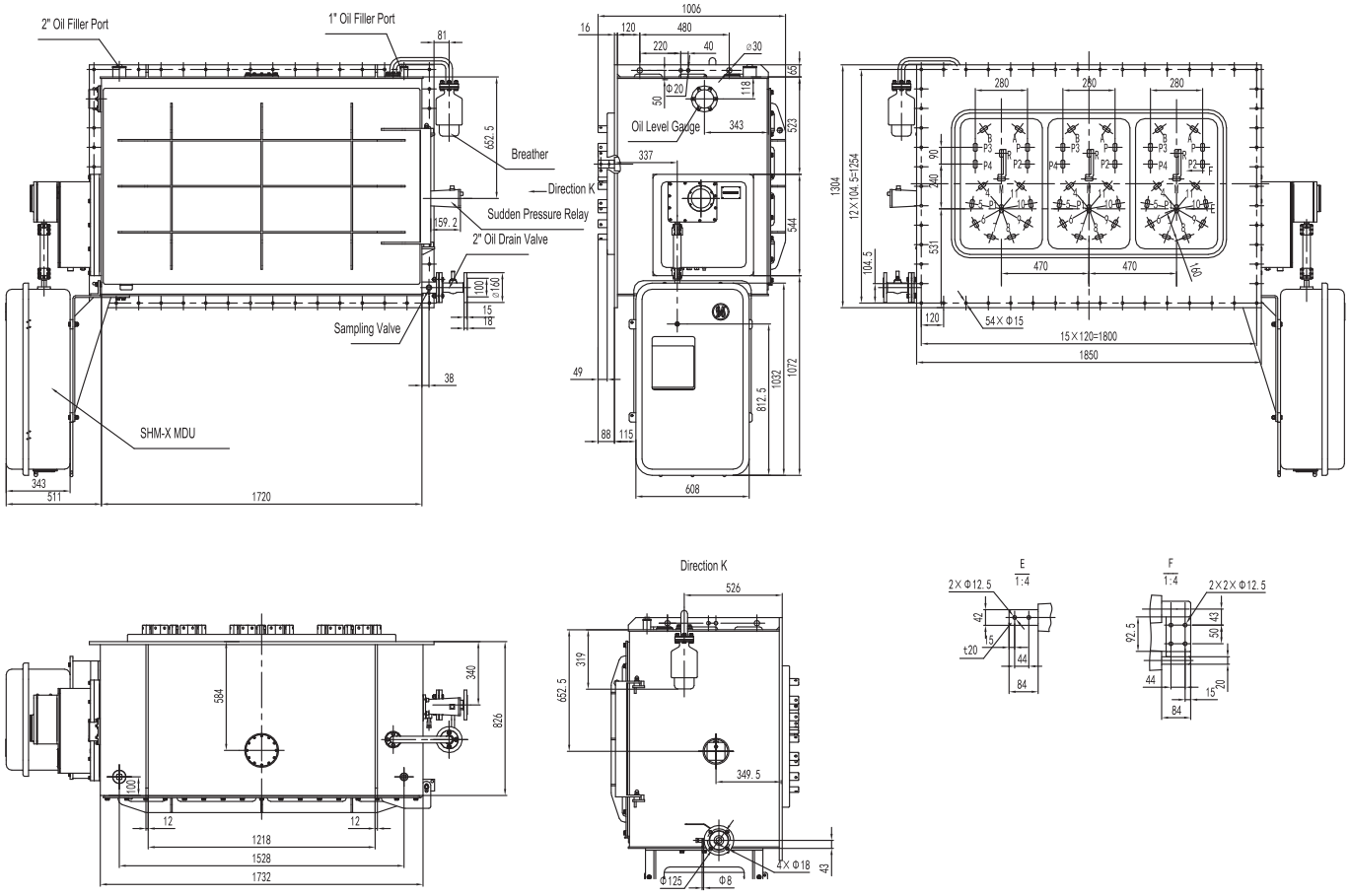


Figure 3: HWDK Single-Phase (Standard) External Reactance-Type Vacuum OLTC Dimensions

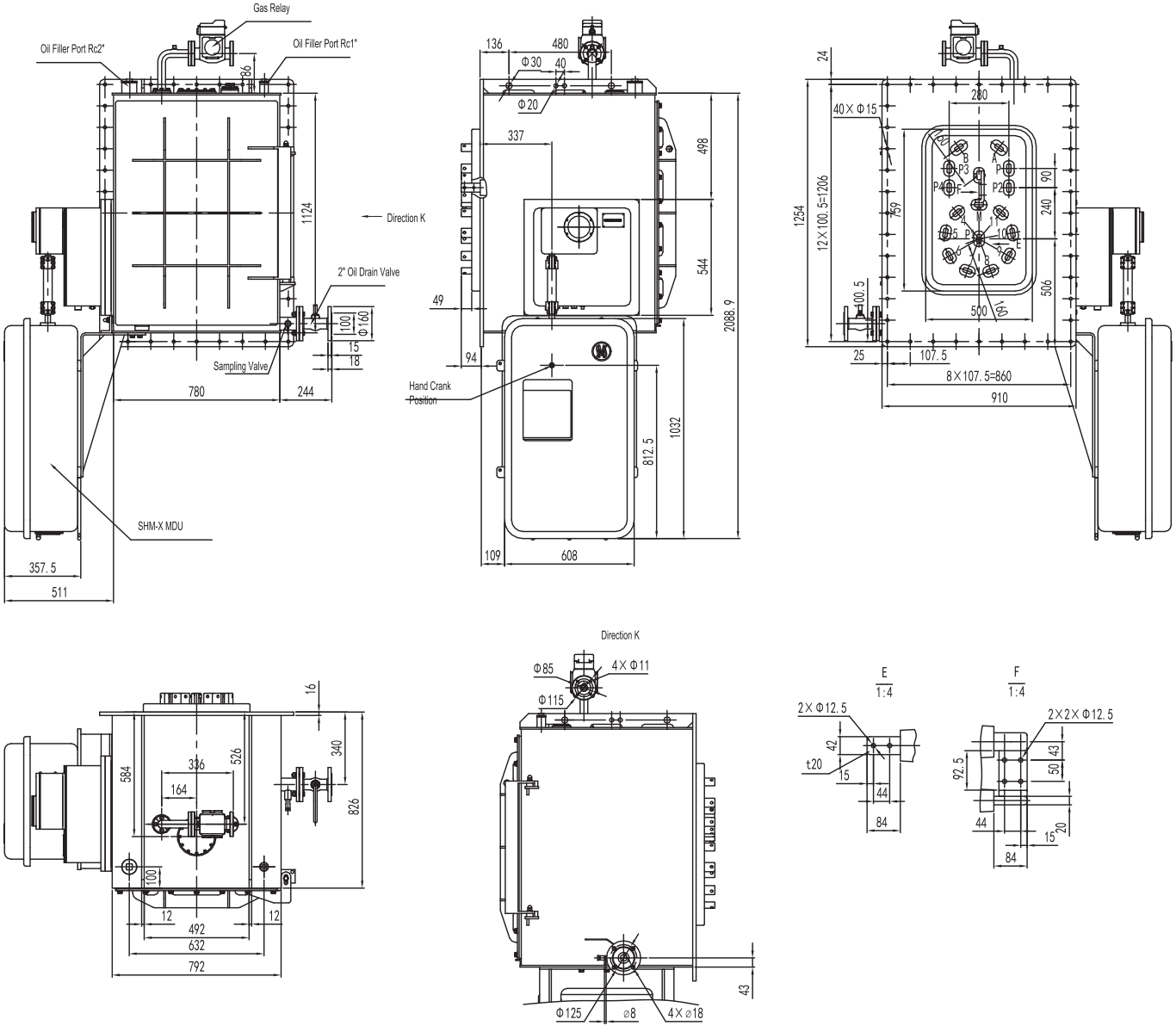


Figure 4: HWDK Single-Phase (Non-Standard) External Reactance-Type Vacuum OLTC Dimensions

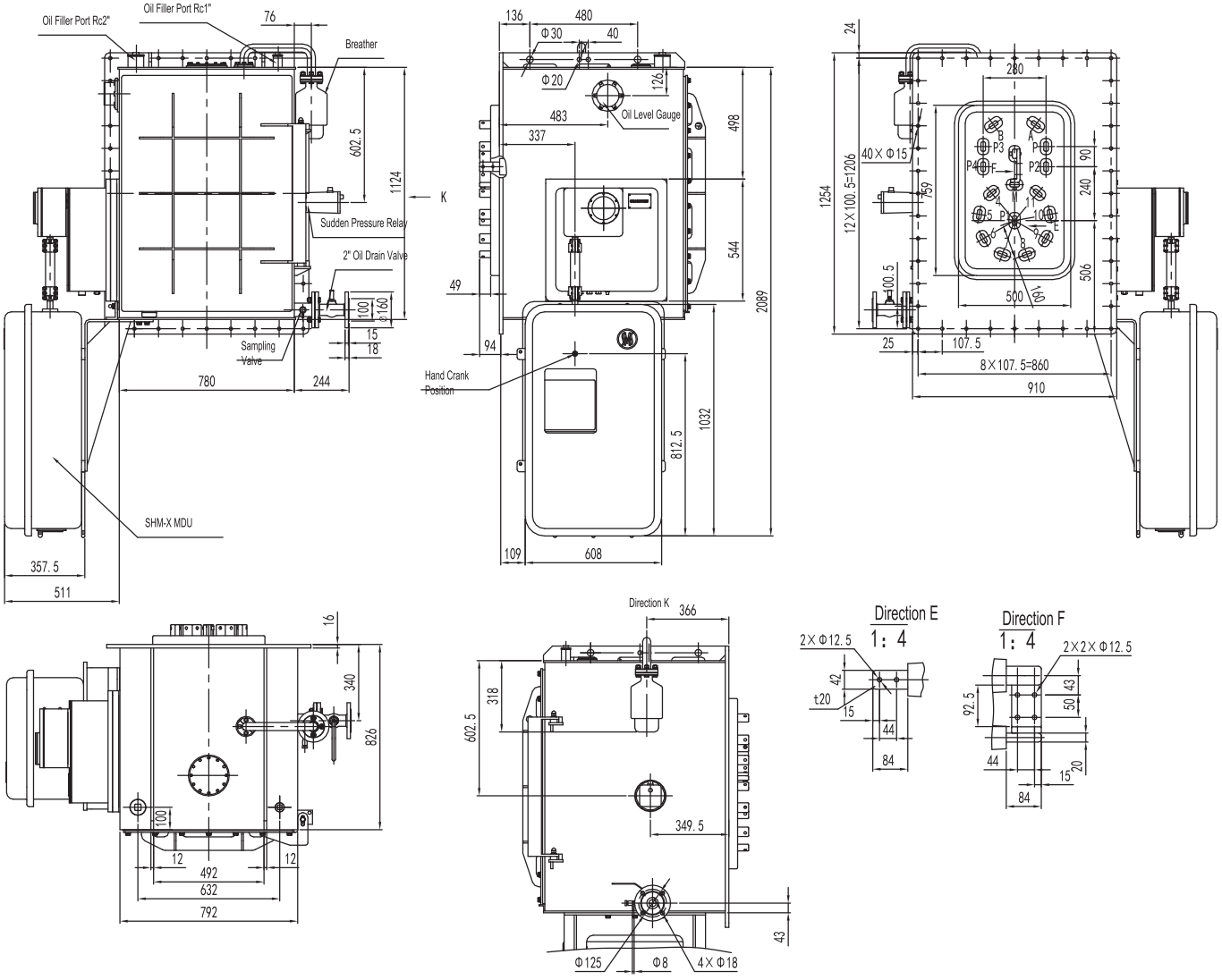
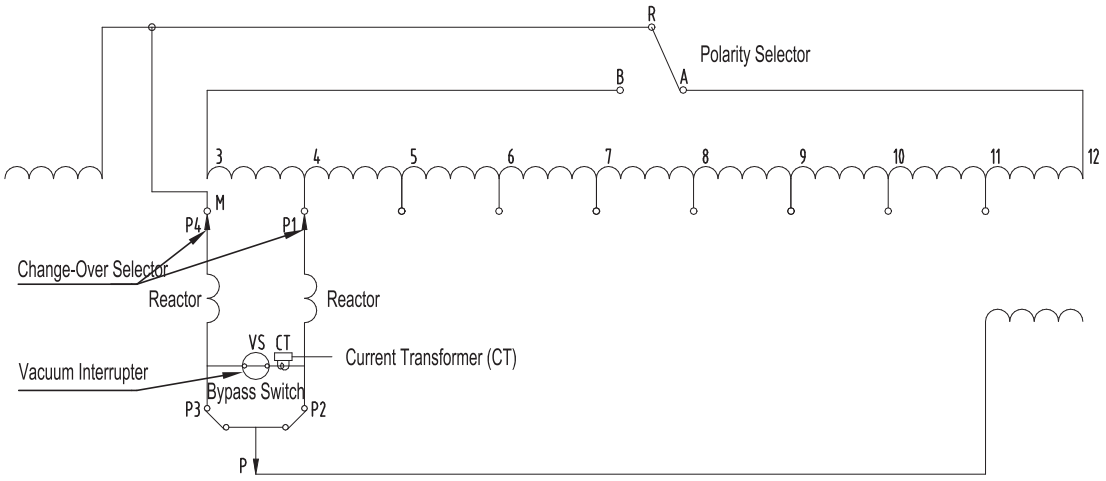
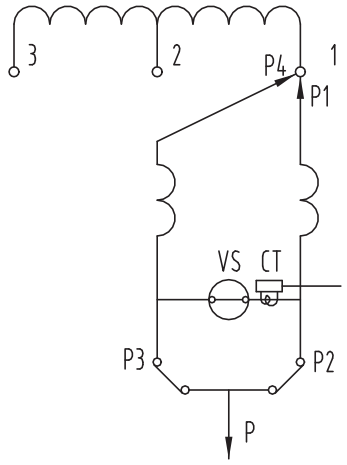
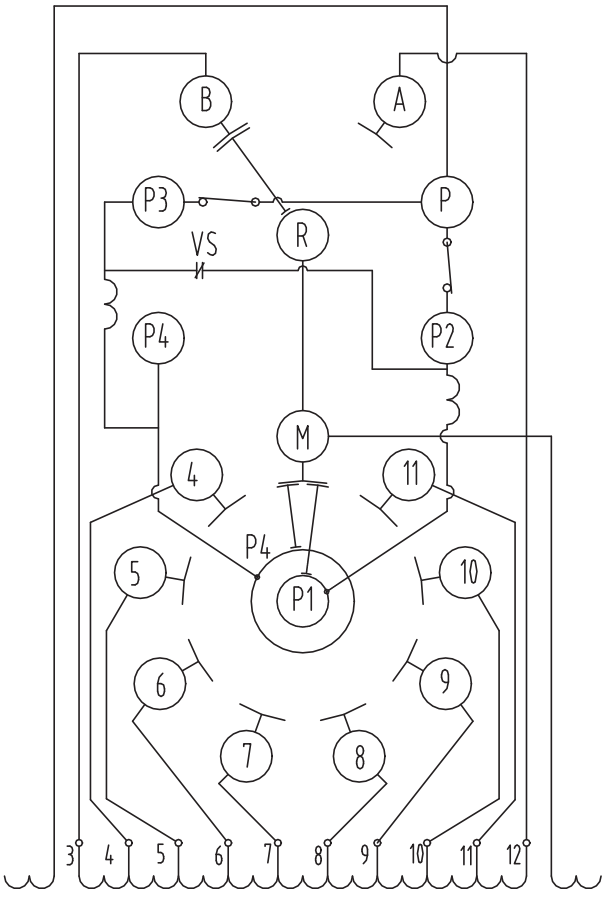


Figure 5: HWDK External Reactance-Type Vacuum OLTC Wiring Diagram







Position / Switch	L (Lower)																	R (Raise)														
	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	N	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
P4 Connect to	11	11	10	10	9	9	8	8	7	7	6	6	5	5	4	4	M	M	11	11	10	10	9	9	8	8	7	7	6	6	5	5	4
P1 Connect to	11	10	10	9	9	8	8	7	7	6	6	5	5	4	4	M	M	11	11	10	10	9	9	8	8	7	7	6	6	5	5	4	4
R Connect to	B																	A														

● ← Diagram Shows the Set Operating Position

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