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by prolec ge

Waukesha® UZDvac® Technical Manual

Vacuum On-Load Tap Changer

Power Transformers Division

prolec® | GE

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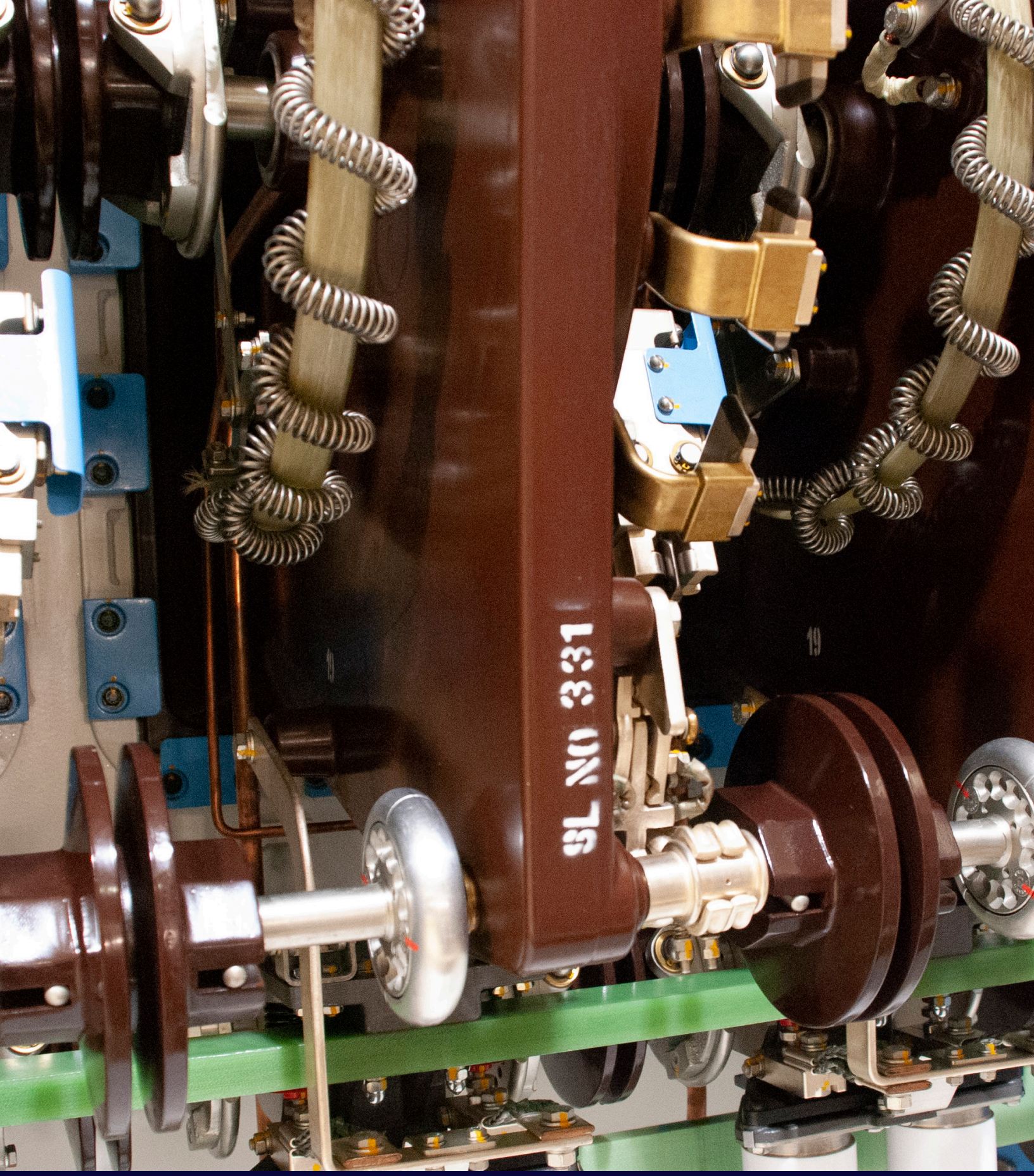
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General Description

UZDvac® on load tap changer (OLTC) is externally mounted (on-tank type) and intended for application in liquid-filled power transformers for varying the transformer turns ratio while energized and carrying load. UZDvac® OLTC is a high speed, resistance bridging (transition) tap changer, employing a resistor for the transition impedance. Transition impedance limits the circulating current in the "transitioning bridging position." The "bridging position" is the operating position of the tap changer when two adjacent taps are bridged temporarily during a tap change operation.

UZDvac® OLTC employs vacuum interrupters for current interruption, which eliminates arcing in oil on the mechanical contacts. All switching activities are designed to be confined to the interior of vacuum interrupters, eliminating contamination of liquid due to arcing. Refer to Table 1 for a summary of the UZDvac® OLTC ratings.

UZDvac® OLTC consists of three main components (Figure 1):

- Oil-filled power switch compartment, which houses phase moldings, tap selectors, reversing selector switches, vacuum interrupter line, and oil-side gearbox.
- Motor Drive Unit (MDU): Air-filled cabinet, which houses the drive motor, spring battery assembly, reversing arm geneva, gearing, and some electrical switches.
- Motor Control Unit (MCU): Air-filled cabinet, which houses most of the controls, manual operation drive, operations counter, and position indicator.

UZDvac® OLTC utilizes a spring-loaded drive mechanism to rotate the tap selector switch. The drive motor in the MDU compresses a spring battery assembly, which drives the tap change, not the motor. The design of the spring drive assembly minimizes arcing time. The switching time after discharge of the spring drive assembly is approximately 200 milliseconds. The spring drive assembly also helps ensure that if control power is lost or if the motor fails, the OLTC will not remain in an off-tap position.

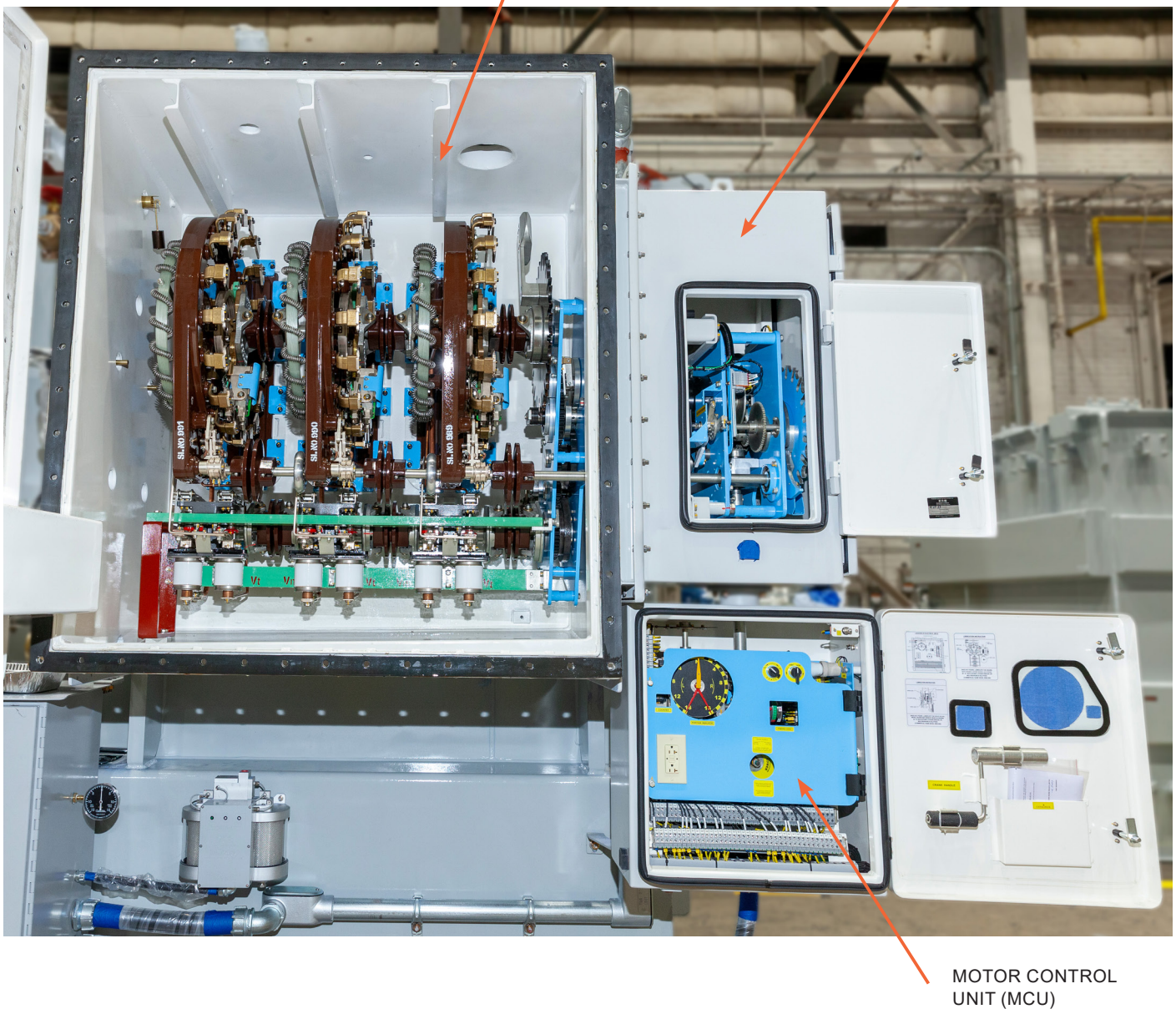
UZDvac® OLTC can be manually operated with a provided hand crank handle. Manual operation of the crank handle charges the spring drive assembly as defined in the previous paragraph. The speed at which the hand crank is manually turned has no bearing on the speed at which the tap selector switch contacts move, as this is determined by the energy stored in the spring battery assembly. The tap change will occur at normal speed regardless of hand crank speed.

TABLE 1: UZDvac® OLTC RATINGS

RATINGS & TECHNICAL DATA	
Maximum through-current	750A
Maximum operating voltage	34.5 kV
Maximum step voltage at rated through-current of 225A	1350V
Impulse withstand Voltage (BIL)	250 kV
Short circuit withstand capability (peak/rms) for 2 seconds	30 kA / 12 kA
Maximum service voltage across regulating windings	12 kV at 750 amps 21.5 kV at 225 amps
Maximum number of service tap positions	33 → 16R to N to 16L (16 + 1 + 16)
Dimensions	81.2” W x 37.2” D x 80.8” H
Weight *(including oil)*	6,758 lbs.
Oil fill capacity	340 gallons

Construction

FIGURE 1: MAIN ASSEMBLIES



OLTC TANK POWER SWITCH COMPARTMENT (LIQUID-FILLED)

Power switch parts and the motor drive unit are enclosed in an outdoor/grounded steel tank (Figure 2 below).

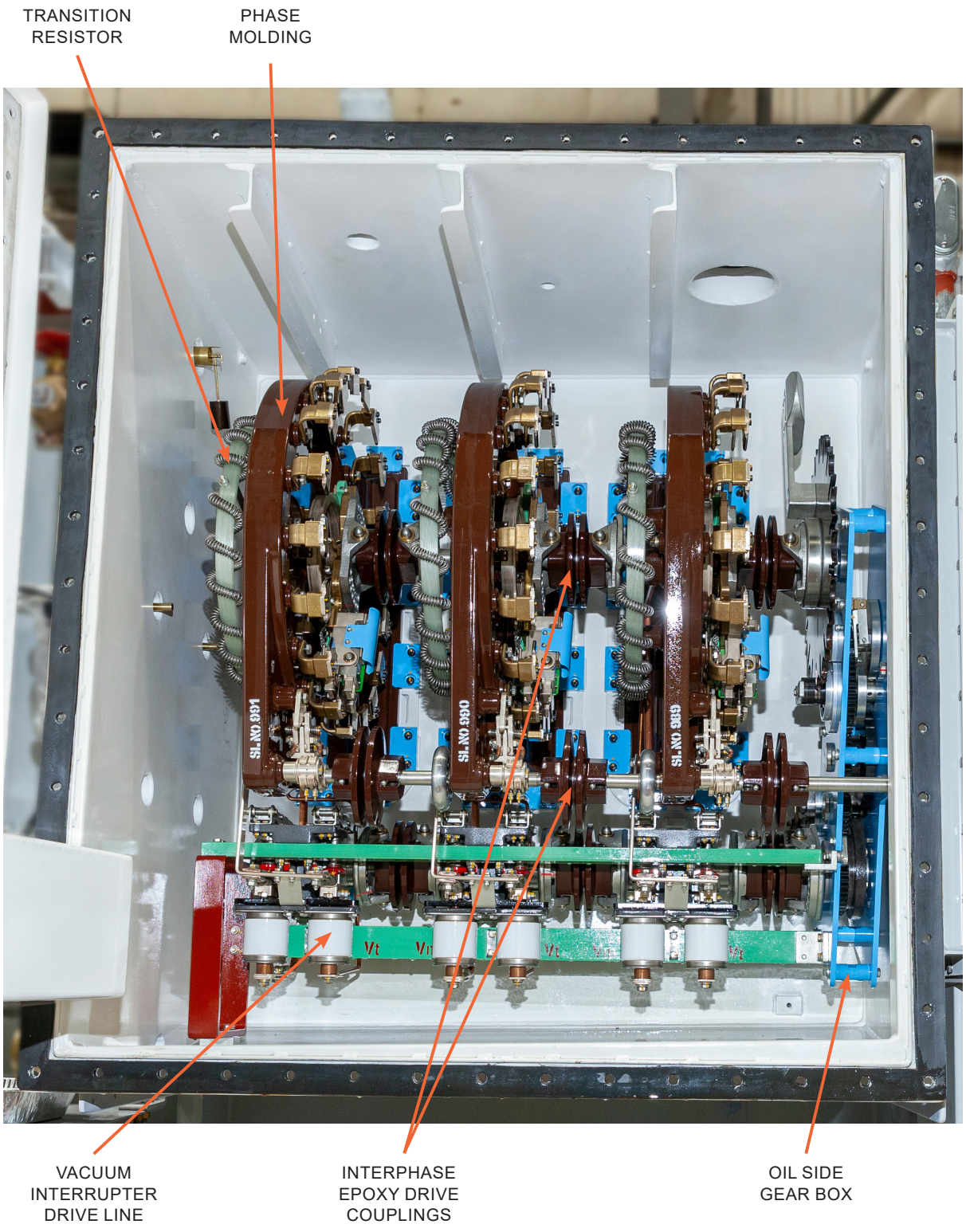


FIGURE 2:
MAJOR INTERNAL ASSEMBLIES

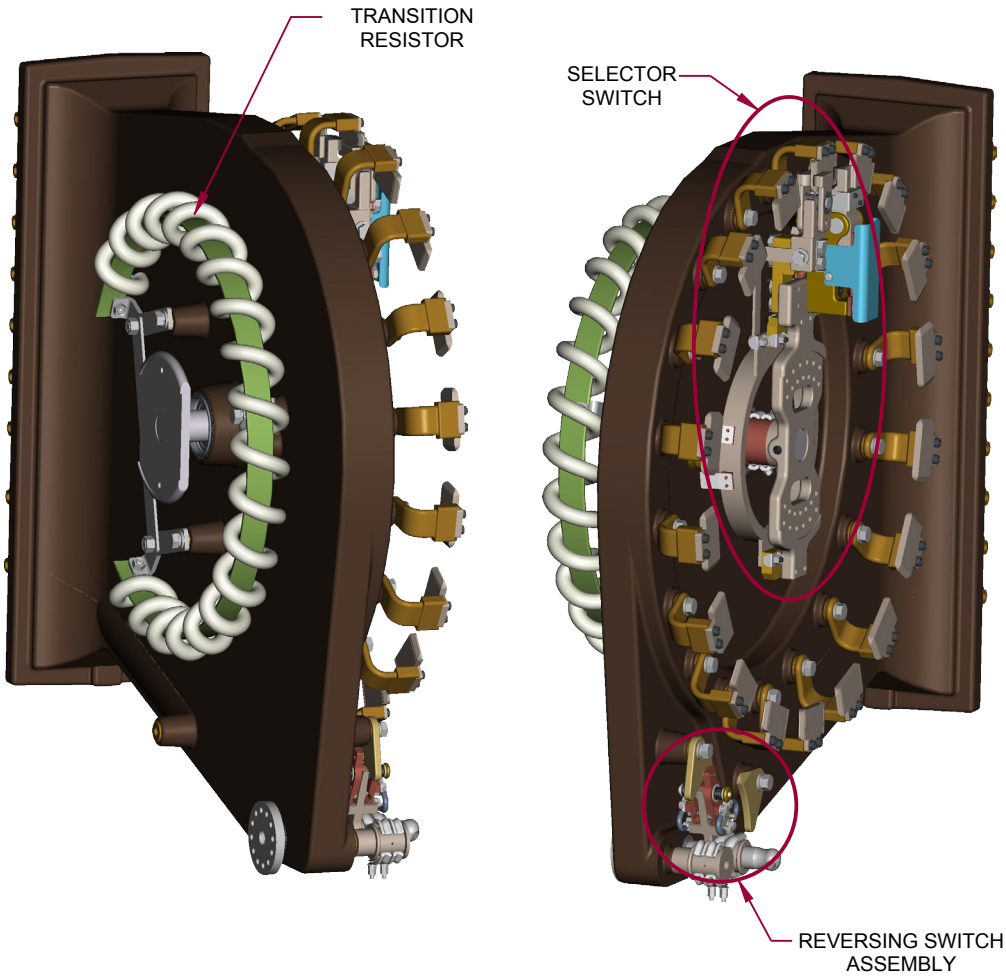


FIGURE 3:
PHASE MOLDING ASSEMBLIES

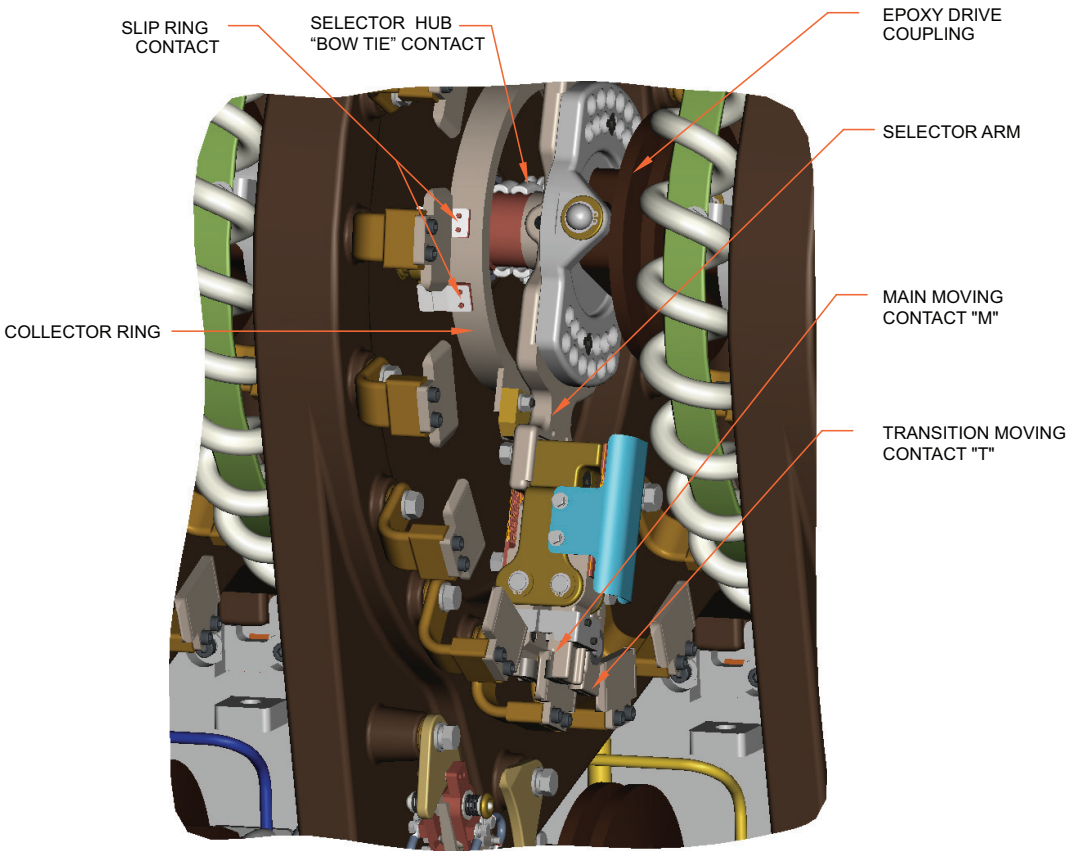
Epoxy Phase Molding

Referring to Figure 3 above, three (one per phase) cast epoxy insulated phase moldings are mounted in the liquid-filled compartment. A tap selector switch assembly, reversing change-over (reversing switch) assembly and transition resistor are mounted on each phase molding. The phase moldings are sealed to the back of the tap changer tank with a rectangular gasket in a recessed gasket groove molded into the epoxy. The molding is held in place with bolts and clamps. Copper rods are embedded in the epoxy moldings, connecting the fixed contacts in the switching compartment and output terminals in the transformer tank. Bearing housings for operating shafts of the moving tap selector switch and reversing change-over selector switch are also embedded in the phase moldings.

Winding leads are connected to the output terminals of the phase moldings without opening the switching compartment. Connections are made from inside the transformer tank after the core and coil assembly is installed. All terminals are numbered for proper identification. Connections are made via special crimp-on cable connectors.

Movement of the tap selector switch of all three phase moldings is driven in sync by the oil-side gearbox assembly via interphase epoxy drive couplings.

FIGURE 4:
TAP SELECTOR SWITCH



Tap Selector Switch

In each phase, 18 stationary selector switch contacts are mounted in a circle on a cast epoxy insulated phase molding (Figure 4 above). Two moving contacts per phase are located on the tap selector switch. The main selector moving contact is designated as “M”, and the transition moving contact is designated as “T”. These assemblies consist of two opposing contact fingers held onto the stationary contact by springs. “M” and “T” are isolated from each other and mounted on a selector arm, pinned to the central drive shaft. The three phase moldings are linked by epoxy drive couplings that provide insulation and flexibility in alignment between phases. At the right end, the drive is connected with an epoxy drive coupling to a Geneva gear in the oil filled compartment. The Geneva gear ensures correct indexing of the tap selector switch and locks the moving contacts in position at each tap.

The main selector moving contact M carries the tap changer current and is in series with vacuum interrupter V_m. The vacuum interrupter breaks the current before the main switching contact M breaks and closes after the main contact makes, so no arcing takes place on the main switching contact M. Current collected by the main switching contact M passes directly to a pair of “bowtie” contacts near the center of the phase molding and flows back to the transformer through copper rods embedded in the phase molding. The transition moving contact T is connected in series with the transition resistor and vacuum interrupter V_t through its own slip ring contacts to the collector ring mounted on the phase moldings. The vacuum interrupter breaks the current before the transition contact T breaks and closes after the transition contact makes, so no arcing takes place on the transition contact T.

The moving selector contacts “M” and “T” have arc-resistant material brazed to the copper contact body in the contact tip area. This allows the UZDvac® OLTC to continue to operate in the event a vacuum interrupter fails to open (up to 12,000 operations at 750 amps load).

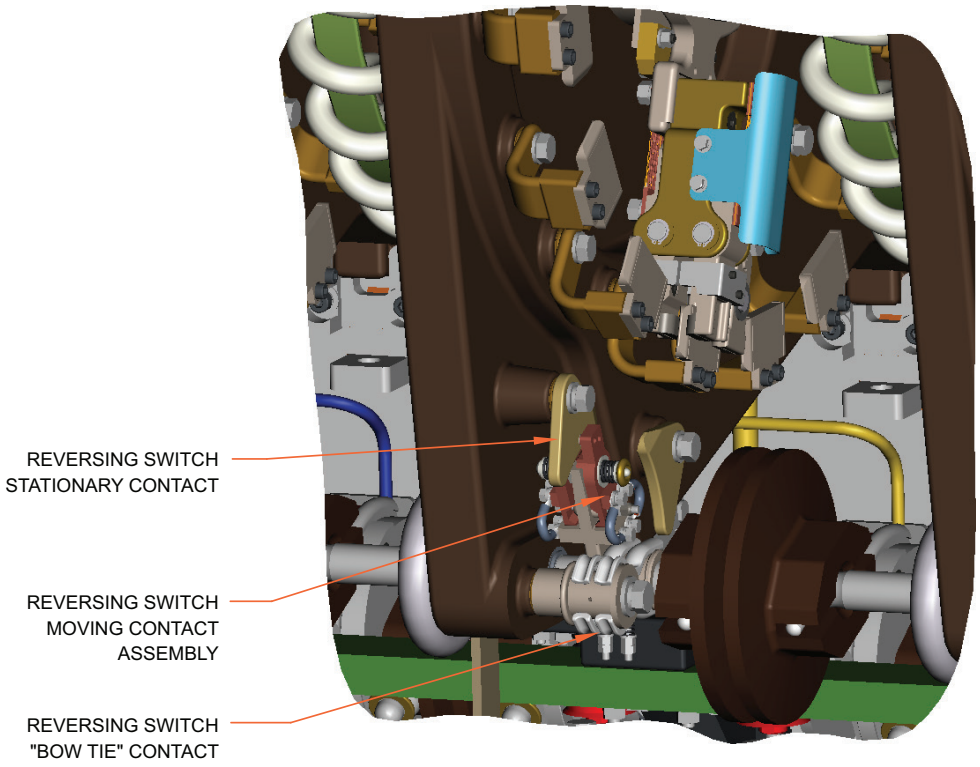


FIGURE 5:
REVERSING CHANGE
OVER SWITCH

Reversing Change-Over Switch (Reversing Switch)

Referring to Figure 5 above, each phase includes a single pole, double throw reversing change-over (reversing switch) near the bottom end of the epoxy phase molding. The moving reversing switch contact assembly consists of two contact fingers mounted to a moving arm with springs applying pressure to the contact fingers. Current is passed from the contact fingers through a pair of bowtie contacts riding on the reversing switch moving contact arm to a stationary copper post in the phase molding. This is a slow speed switch, arranged by internal drive gearing to change over at a circuit position where no current is being carried. The reversing switch moving contacts are driven by the motor drive mechanism through a Geneva gear located in the MDU compartment connected by a shaft which enters the liquid space from the MDU through a mechanical seal. The Geneva gear helps ensure correct indexing and locking of reversing switch contacts.

Movement of the reversing switch is arranged in three stages. In the first stage, the moving contacts wipe along the face of the stationary contact while staying mated to it. In the second stage, the moving contacts move from one stationary contact to the other. In the third stage, the moving contacts wipe the face of the other stationary contact to the final position. This wiping action is intended to keep these contacts clean of film buildup and prevent coking. The reversing switch does not carry current in any of these three stages.

The reversing switch changes the polarity of the regulating winding such that voltage generated in the regulating winding either adds to or subtracts from the voltage produced in the main winding. This doubles the duty of the turns in the regulating (tapping) winding so that 16 taps produce 32 different voltages.

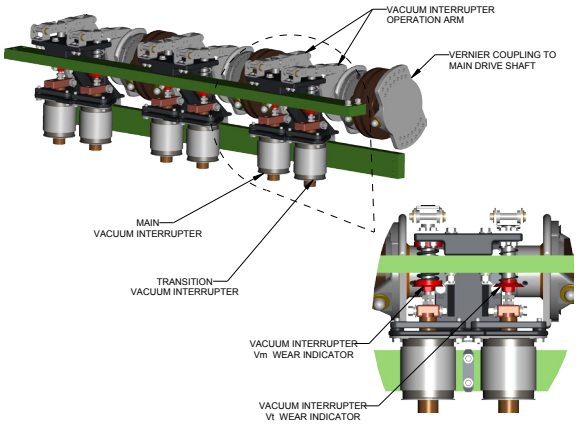
Transition Resistors

Transition resistors (see Figure 2 on page 6) are made from spirally-wound wire mounted on a fiberglass bobbin. Each phase includes one resistor, which is connected between moving mechanical contact T and vacuum interrupter V_t. These limit circulating current between M and T as the OLTC operates and is momentarily bridging two positions. Two resistors are connected in parallel, each rated at 2 ohms, for a net resistance of 1 ohm.

Vacuum Interrupter Drive Line

Vacuum interrupters have been specifically designed for the operating characteristics of this on-load tap changer. Vacuum interrupters are operated by cams and cam followers on a shaft geared from the tap selector switch drive shaft. Six vacuum interrupters are arranged linearly along a vacuum interrupter drive line (Figure 6). Each phase assembly has two vacuum interrupters, V_m and V_t, mounted on horizontal insulating support bars. The drive shaft is insulated between phases by cast epoxy drive couplings similar to the tap selector switch assembly. The design is such that the complete vacuum interrupter line can be removed from the tap changer for inspection or repair, if necessary.

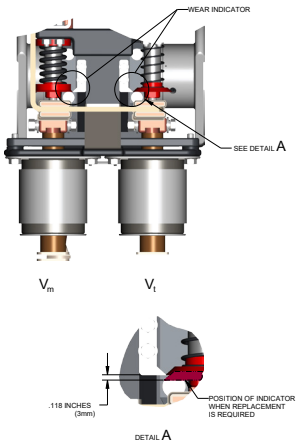
FIGURE 6:
VACUUM INTERRUPTER LINE



UZDvac® OLTC is designed such that, when at rest (not in process of a tap change), the vacuum interrupters are closed. V_m carries current at all times except during certain parts of a tap change operation. A smaller spring is used for the transition interrupter V_t, which only carries any significant current while V_m is transitioning from one stationary contact to the next during a tap operation.

The vacuum interrupters selected for use in the UZDvac® OLTC have been designed for a minimum of 1,000,000 operations at 750 amps. Over the life of the interrupter, the contacts inside will wear as a result of interrupting current during tap operations. Wear indicators, located at the top of each vacuum interrupter, are provided for a quick visual check of the interrupter wear while performing major maintenance inspections (Figure 7). These are set at the factory when the interrupters are new and are considered at the end of life when they have worn 3mm (0.118" as measured from the bottom of the moving red disc to the stationary red pointer on the wear indicator) and need to be replaced.

FIGURE 7:
VACUUM INTERRUPTER WEAR INDICATOR

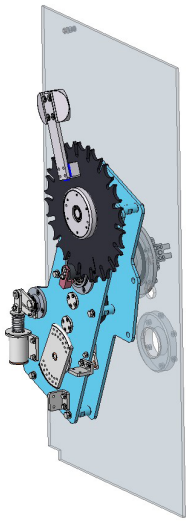


The Operating (Switching) Principle of the UZDvac® OLTC is explained in detail on page 20.

Oil Side Gearbox

The tap selector switch and vacuum interrupter line are driven by a gearbox mounted at the right hand side of the liquid-filled compartment (Figure 2 on page 6). Mounted on the oil side gearbox is a Geneva gear (Figure 8), which ensures correct indexing and locking of the tap selector switch contacts. The oil side gearbox also contains additional gearing to drive the synchronized vacuum interrupter line. Attached to this gearing is a cam that drives a dashpot device. The dashpot absorbs surplus kinetic energy at the end of the tap change operation.

FIGURE 8:
OIL SIDE GEARBOX



Cold Weather Provisions

Below -25°C oil temperature the operation of vacuum interrupters slow to a degree that the timing of tap changes is not predictable. The OLTC will complete a tap change but the sequence of opening and closing the interrupters may not coincide with the selector movement.

There are two methods to deal with cold weather (below -25°C oil temperature) concerns. One method is to disable OLTC operation when the oil temperature drops below -25°C. The OLTC will remain in its last tap position until the oil temperature rises. The other method is to activate optional heaters to keep the oil temperature above the -25°C set point. There would still be a -25°C operational block in case of heater failure.

Controls

A multiset point temperature probe would be installed on the tank wall. If the option was to block operation, a relay contact would open at -25°C to block power to the motor. If the option is to use heaters, the heaters would be turned on at a set point above -25°C. Again, there would still be a -25°C operational block in case of heater failure.

Heaters

The heaters will be in an air chamber built into the oil chamber door. All units have this provision, and heaters can be added later. The chamber is accessible from outside the tank.

Two sets of two heaters (redundancy) are used. One set of heaters is adequate to keep the oil warm. The heaters are only on when required. For example, heater set one turns on at -15°C, heater set two turns on at -20°C, and finally lockout at -25°C.

FIGURE 9:
MOTOR DRIVE UNIT SIDE VIEW

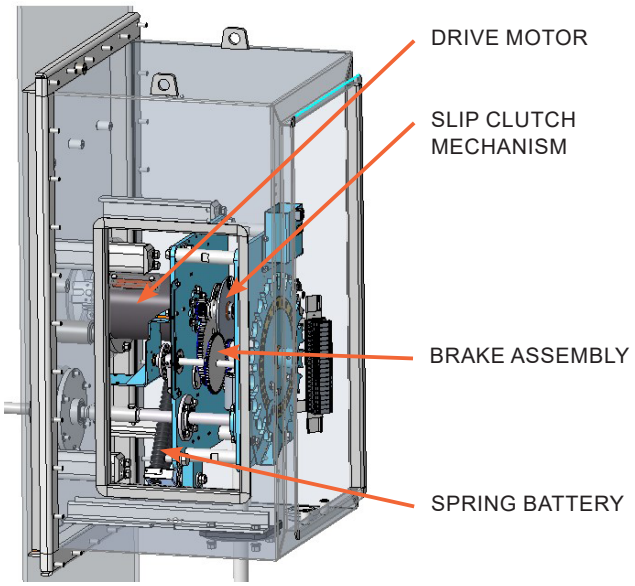
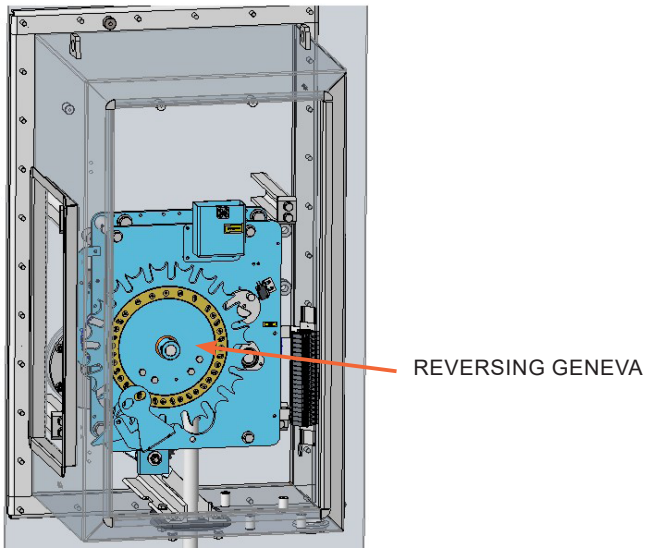


FIGURE 10:
MOTOR DRIVE UNIT FRONT VIEW



MOTOR DRIVE UNIT (MDU)

Cabinet
The motor drive unit is enclosed in its own outdoor, weatherproof, air-filled metal enclosure rated NEMA 4 per test/ IP 54 (to IEC 529). The cabinet is bolted to the side of the tap changer switch compartment. Two access doors are provided to accommodate entry into the cabinet. A 1.5" NPTF threaded phoenix flange provision is available for conduit access (Figures 9 & 10).

Motor
The standard motor supplied has the following ratings: single-phase, 120 volt, 60 Hz. The motor is designed for intermittent duty and is capable of making 150 starts per hour.

Slip Clutch
A spring-loaded, slip clutch is located between the motor and drive gear. This device operates to de-couple the motor safely from the rest of the tap changer drive whenever load exceeds a factory-preset value. The slip clutch will operate if the mechanical end stop is engaged or if some other malfunction causes the main drive shaft to bind. The motor will continue to run for 30 seconds, at which time the motor time delay relay will trip and the motor will stop.

Gear Assembly
The drive gear (driven by the motor through the slip clutch) provides rotation to the gear assembly that performs three functions. The gear assembly provides the proper torque to compress the springs in the spring battery assembly, it drives a second set of gears to directly operate the reversing arm assembly drive at the proper time (neutral) and rotates the electronic position monitor.

Spring Battery Assembly
The spring battery assembly consists of three compression springs. The springs provide energy to move the selector switch arm. The gear assembly applies compression to the spring assembly to store the energy necessary to make a tap change. At the end of spring assembly compression, the spring energy discharges quickly, independent of the motor and drive gears.

Reversing Switch Drive Assembly
A Geneva drive is on one end of the gear assembly. The Geneva drive indexes the reversing Geneva gear as the tap changer operates. A drive pin located on the back of the reversing Geneva gear engages and moves the reversing switch selector arm as the tap changer transitions through neutral.

Tap Position Transmitter
The transmitter is driven by the gear assembly and electrically connects to tap position receiver in the transformer control panel. The receiver displays tap position and can be used to monitor for off position or incomplete tap change, as well as provide a 4-20 MVA output for remote position indicate.

Brake
A brake with rubber brake pad is attached to stop the gear assembly in the correct position after a tap change occurs.

Mechanical End of Travel Stops
End stops on the back side of the Geneva gear to prevent operation beyond the 16 raise or lower position.

Heater Provisions
MDU has provision for either PTC or thermostat controlled strip heater.

OLTC TANK EXTERNALS

Tank and Accessories

UZDvac® OLTC provides a number of flanges for accessories. Flanges not used are provided with a blank cover. Flanges are typically raised with untapped holes for through bolts. Standard accessories include a pressure relief device, rapid pressure rise relay, drain valve with sampling port and a liquid level indicator with alarm contacts.

UZDvac® OLTC tank is a welded, carbon plate steel enclosure and is supplied with a flange to facilitate welding the UZDvac® OLTC to the transformer tank. The bottom of the oil-filled switching compartment is sloped toward the middle of the tank and also sloped toward the left side of the tank to allow oil to flow to the drain valve. The front door is hinged and easily removable.

Two access doors are provided to accommodate entry into the MDU compartment. For ambient temperatures below –25°C, an additional heater kit can be mounted in the spring drive compartment to prevent condensation.

The UZDvac® OLTC tank is designed to withstand a range of pressure from full vacuum to 15 psi positive pressure. Bypass piping with an isolation valve is provided by Prolec GE Waukesha between the transformer tank and the UZDvac® OLTC tank to equalize pressures when performing vacuum oil filling of the main transformer. For initial transformer installation, the bypass isolation valve needs to be open before pulling vacuum on the main tank such that the pressure drops at the same rate in both tanks. Additionally, when oil filling is complete, the main tank and OLTC tank should be allowed to increase pressure at the same rate until atmospheric pressure is reached. The isolation valve is then closed and the breather reconnected to the OLTC. The main tank can then continue to be pressurized to the correct pressure.

The UZDvac® OLTC tank is not completely filled with oil. The gas space above the oil serves as expansion space. The tap changer's tank is designed to be free breathing and comes equipped with an auto recharging dehydrating breather.

Standard tank features:

- Pressure relay with alarm contacts
- Liquid level gauge with alarm contacts
- Bottom drain valve with sampling port
- Access cover to tank heater compartment
- Provision for pressure vacuum bleeder
- Provision for mounting upper fill valve
- Provision for mounting pressure relief device
- Provision for mounting sudden pressure (rapid pressure rise) relay
- Provisions for mounting temperature probes
- Provisions for online gas monitor piping inputs/outputs
- Provision for mounting temperature switch to disable motor operation at low temperature

Pressure Relay

A pressure control relay is provided as standard and is designed to indicate excessive pressure in the tap changer switching compartment if a fault occurs. The relay then sends a signal to the transformer's protective equipment to disconnect the transformer from the system if an unusually high pressure exists inside the UZDvac® OLTC tank. Under normal operating conditions, the switch will operate in less than 5 ms. Contacts on this relay are factory set to close at 4.3 psi ±5%. In the event of an operation of this relay, an internal examination of the on-load tap changer should be made to determine its suitability for use before returning it to service.

Liquid Level Gauge

A magnetic liquid level gauge is mounted on the side of the tap changer tank. The maximum and minimum liquid levels corresponding to lowest and highest temperatures are marked on the dial. Filling level at 25°C ambient is also marked. The gauge has one electrical form C contact for low liquid level alarm.

Drain Valve

One inch drain valve with female NPT thread and 3/8 inch sampling outlet is provided at the bottom of the tank.

Upper Fill Connection

Two inch flanged opening fitted with a gasket and cover plate is located near the top of the liquid-filled compartment and is provided for liquid filling purposes.

Pressure Relief Device (PRD)

A flange and cover plate for mounting an optional diaphragm-type pressure relief device is provided. This flange has a 9.25 inch diameter bolt circle with six equally spaced holes. The gasket and gasket groove are on the pressure relief device.

Rapid Pressure Rise Relay (RPRR)

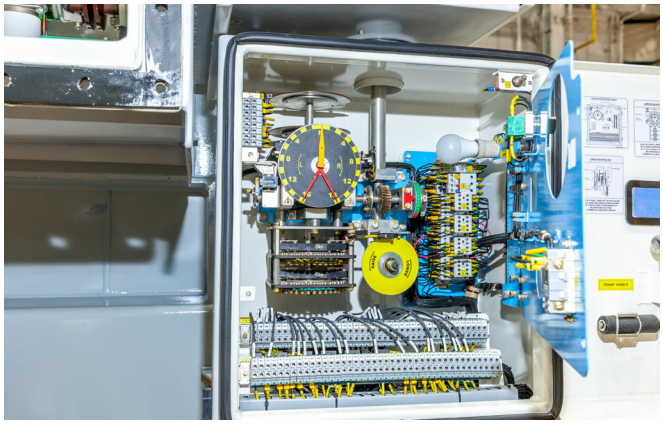
Each tap changer is equipped with a flange and cover plate for mounting an optional rapid pressure rise relay to operate in the gas space. This flange has a four inch diameter bolt circle with four equally spaced holes. The gasket and gasket groove are on the sudden pressure relay. If a relay is specified to operate in liquid rather than gas, it will be mounted in place of the standard pressure relay.

Temperature Switch

A 3/4 inch NPT female opening with pipe plug is located in the bottom of the spring drive compartment. This will accommodate an optional thermally-operated switch to block the tap changer motor from operating at temperatures below –25°C for mineral oil.

FIGURE 11:
MOTOR CONTROL UNIT

FIGURE 12:
MOTOR CONTROL UNIT WITH SWING PANEL OPEN



MOTOR CONTROL UNIT (MCU)

Cabinet

The motor control unit (MCU) is enclosed in its own outdoor, weatherproof, air-filled metal enclosure rated NEMA 3R per test/ IP 54 (to IEC 529). The enclosure has a lockable, hinged, steel door. A window is provided to enable observation of tap position indicator, maximum and minimum position indicator drag hands, progress wheel, direction flag and operations counter (Figures 11 & 12).

Electrical

The motor control unit works off 120V AC, 60Hz power. Line and neutral wiring is connected to TB1 terminal 501 & 502. For the cold weather option there is provision for strip heaters & thermostat in MCU, MDU and an oil temperature lockout for LTC door heaters. Only six cam switches are utilized for tap changer operation and signaling. Two contact decks are standard and there is an optional resistor position transmitter deck. There are two control switches on the swing panel, heater on/off and Raise/Lower. Cabinet light is activated by the door switch when its opened.

Convenience Outlet

A 15 amp, 120 volt, GFCI convenience outlet is also provided inside the enclosure, accessible from the front of the swing panel.

Heater

A switch is included to turn heater on or off. Unless specified otherwise, a 200/400 watt positive temperature coefficient anti-condensation heater is mounted in the enclosure. This heater is always "on" and varies heat output based on ambient temperature. Therefore, no thermostat is required. An optional strip heater with thermostat is available.

Relays

Motor Protection Relay (MPR)

This relay is intended to prevent the drive motor from overheating via thermal elements and is shipped from the factory on a setting of “6”.

Raise/Lower Control Switch (43T-1)

Operates the OLTC in the raise and lower direction.

Step-by-Step Provision

Step-by-step operation is an optional feature only used in the manual mode, UZDvac LTC will normally make tap change operations continuously if the raise or lower switch (43T-1) is held. In step-by-step operation, only one tap change will be made until the raise or lower switch has been released. When the raise or lower switch is operated again, one more tap change will occur.

Relay, 84S, is provided in the MCU control box to perform this function. Normal operation is continuous operation. Removing a jumper allows for step by step operation.

Time Delay Relay (TDR)

This relay protects motor from running continuously should there be any issues between the motor control unit shaft connecting to motor drive unit. When a Raise or Lower switch is activated the time delay relay is energized and will time out after 30 seconds and open the control circuit to de-energize the motor, if a tap change has not been completed. If this occurs, use the manual hand crank to make sure the progress wheel is near 0 degrees.

33A

Seal in relay for continuation of raise or lower operation.

Tap Position Switch

TPS 1

Tap position switch one, contains the following

- 84C contacts for continuation movement through neutral
- 33N to indicate neutral position
- LS1c to indicate 16 raise position
- LS2c to indicate 16 lower position

TPS2

Tap position switch two, which indicates

- Even position
- Odd position
- Neutral Position

TPS3 or 33RPT (Optional)

Tap position switch three, (or Resistance position transmitter) is an option, which indicates position for analog position sensing. The resistors are 40Ω, 3watt.

CONTACT TIMING AND CONTROLS

Multiple devices and switches are critical to proper motor drive operation. A table of key components discussed throughout the remainder of the manual are listed in Table 2 below.

TABLE 2: MOTOR CONTROL UNIT (MCU), MOTOR DRIVE UNIT (MDU) DEVICES AND SWITCHES

LABEL	DESCRIPTION	FUNCTION	LOCATION
33	Tap change progress	Tap change progress indication - position transmitter receiver	TCC*
33A	Contactor sealing	Seal-in contactor raise and lower	MCU
33N	Neutral	For neutral position indication	MCU
33RPT	Resistance position transmitter	Optional resistance position transmitter 40 ohm, 3 watt	MCU
33S	Sealing switch	Sealing switch	MCU
33SPT	Synchro position transmitter	Position transmitter	MDU
33X	Tap completion cam switch	Monitors Geneva gear drive	MDU
43T1	OLTC manual raise/lower switch	Three position switch (raise, off and lower) used to manually operate the OLTC	MCU
84C	Run through switch	Continuation contacts to operate OLTC through raise neutral or lower neutral positions to next position (TPS1 Board)	MCU
84H	Hand crank lockout switch	Prevents electrical operation when hand crank is engaged	MCU
84L	Lower motor contactor	Operates OLTC in lower direction	MCU
84M	Motor	1 phase, 120 volt drive motor	MDU
84R	Raise motor contactor	Operates OLTC in raise direction	MCU
84S	Step contactor	Operation mode (step by step or continuous)	MCU
C	Motor capacitor	AC capacitor (50MFD + 20MFD,440V)	MDU
CO2	Convenience outlet	120 Volt AC outlet	MCU
H1A	Heater	PTC heater	MCU
H1B	Strip heater	Strip heater 120V AC, 200W	MCU
H2A	PTC heater	PTC heater	MDU
H2B	Strip heater	Strip heater 120V AC, 200W	MDU
HS	Heater switch	Control switch for motor control and/or motor drive unit heater	MCU
LS1a	Raise end limit switch #1	End limit – opens after 16 raise, opens motor circuit	MCU
LS1b	Raise end limit switch #2	End limit – opens after 16 raise, opens raise contactor circuit	MCU
LS1c	Raise end TPS1 contact	Signal – at 16 raise (TPS1 board)	MCU
LS2a	Lower end limit switch #1	End limit – opens after 16 lower, opens motor circuit	MCU
LS2b	Lower end limit switch #2	End limit – opens after 16 lower, opens lower contactor circuit	MCU
LS2C	Lower end TPS1 contact	Signal – at 16 lower (TPS1 board)	MCU
LT3	Cabinet light	Light	MCU
LTS2	Door operated light switch	Door switch	MCU
MPR	Motor protective relay	Protects motor from overload – temperature protection	MCU
TDR	Time delay relay	Stops motor if clutch is engaged – factory set at 30 seconds	MCU
TS	Thermostat	Strip heater thermostat	MCU
TPS1	Tap position switch #1	Tap position signal – 84C, LS1c, LS2c and 33N	MCU
TPS2	Tap position switch #2	Tap position signal – Odd, Even and Neutral	MCU

** TCC - Transformer Control Cabinet*

FIGURE 13: CAM SWITCH DIAGRAMS

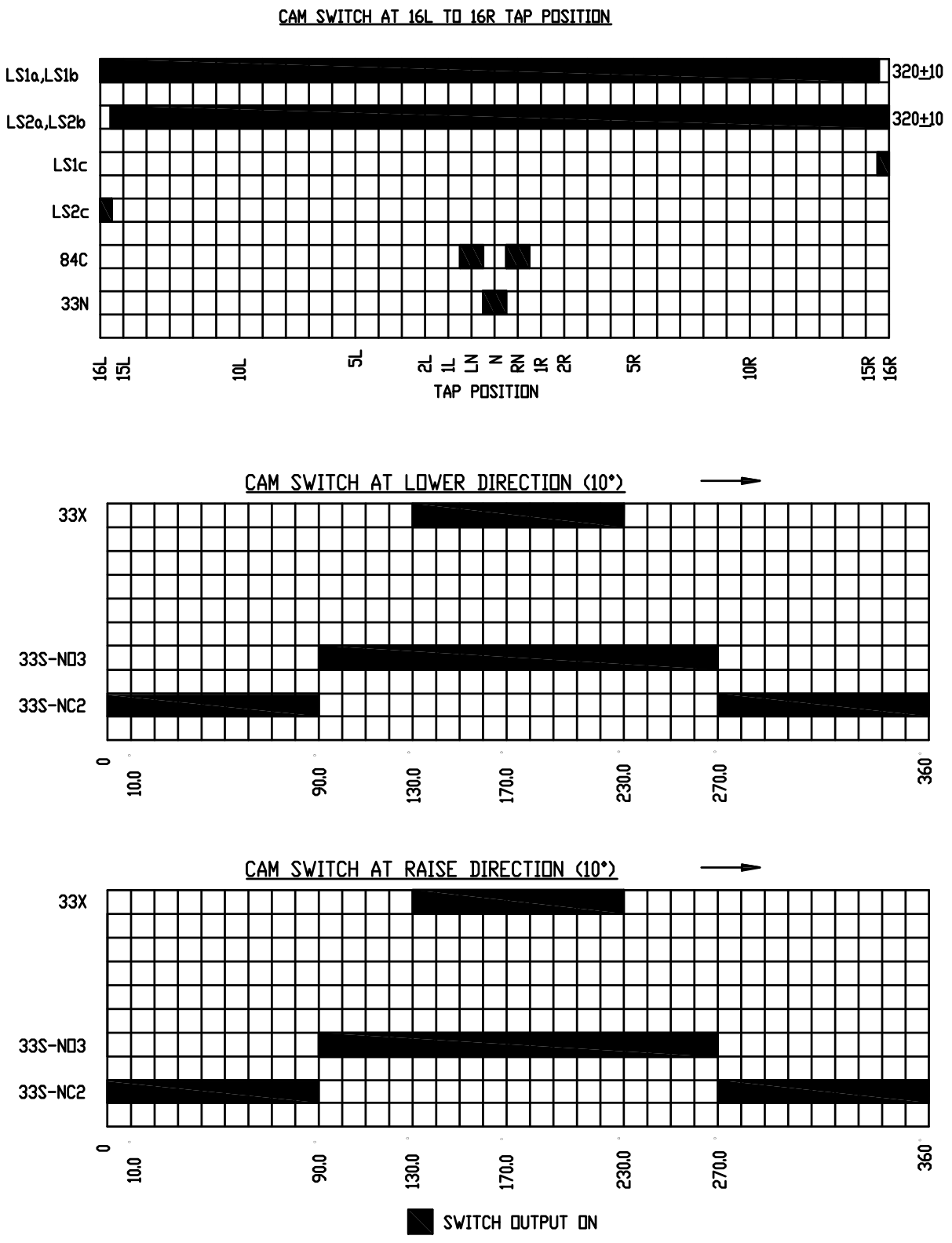


FIGURE 14: ELECTRICAL SCHEMATICS

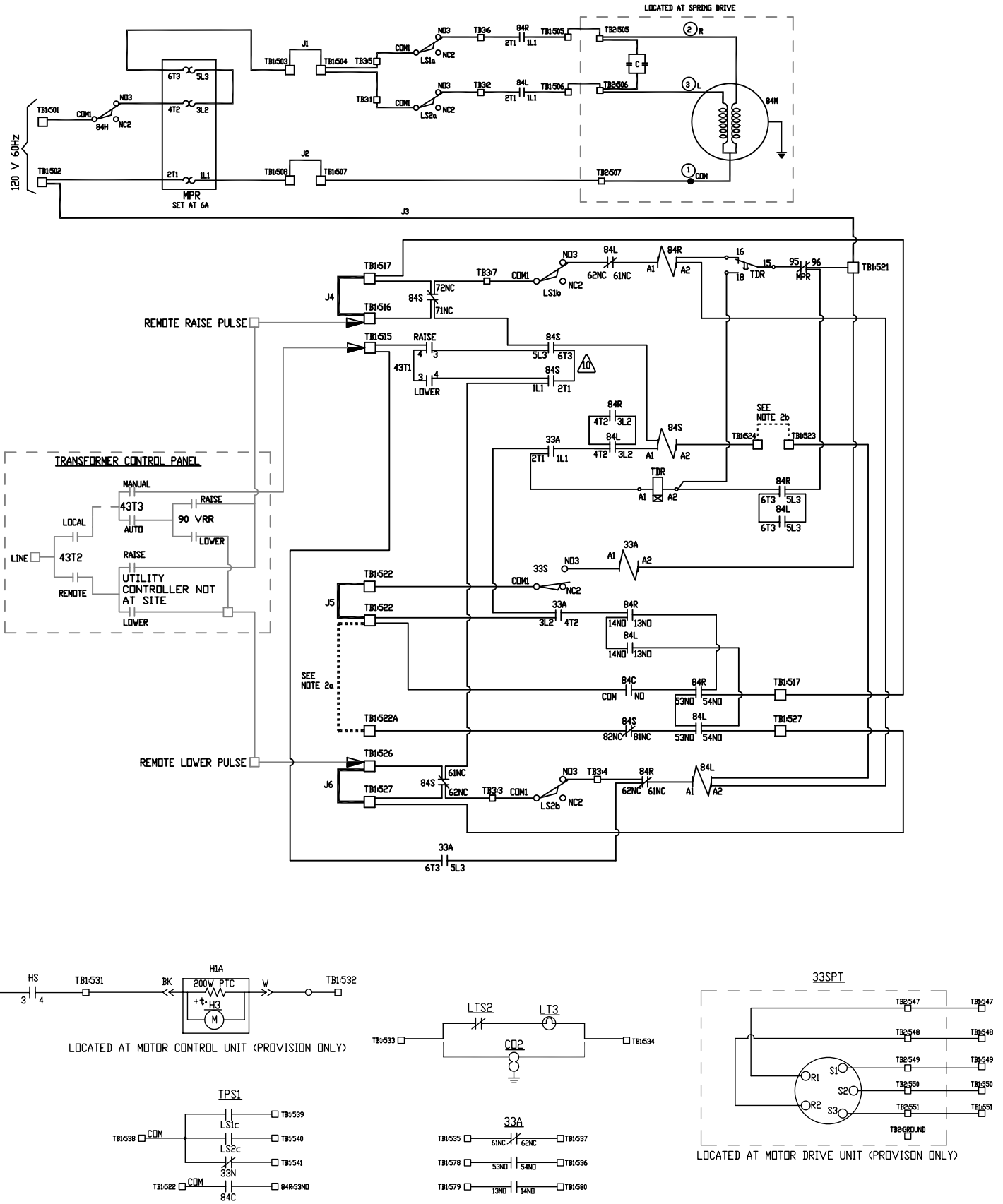
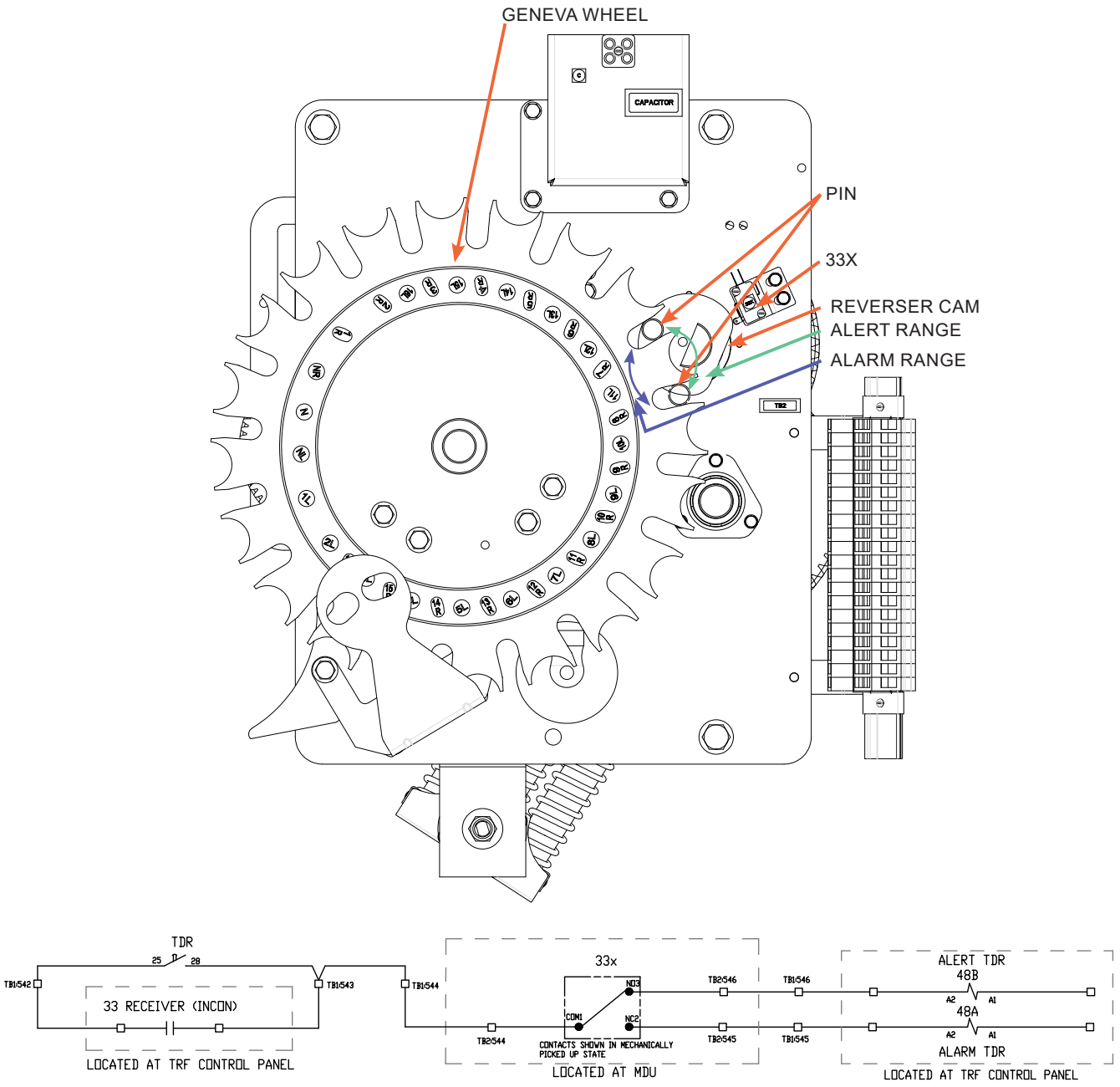


FIGURE 15: OFF POSITION SENSING COMPONENTS AND SCHEMATIC



UZDvac comes with incomplete tap position sensing to detect a mechanical break or misalignment of the drive shaft and gearing all the way to the motor in MDU. There are two scenarios for an Off-Position – when Incon or TDR indicate incomplete but 33X is complete it is Off-Position Alert. When Incon or TDR indicate incomplete and 33X is incomplete it is Off-Position Alarm.

Off-Position Alert

When the pin of the reverser cam is out of the Geneva wheel (33:COM & 33S:NO3 contact closed, see Figure 15, alert range) and any one or both below conditions are true:

1. TDR relay times out after 3 minutes
2. 33 receiver (Incon) N.O. contacts close when it detects tap range is outside of set threshold limit 9°(+/-3°).

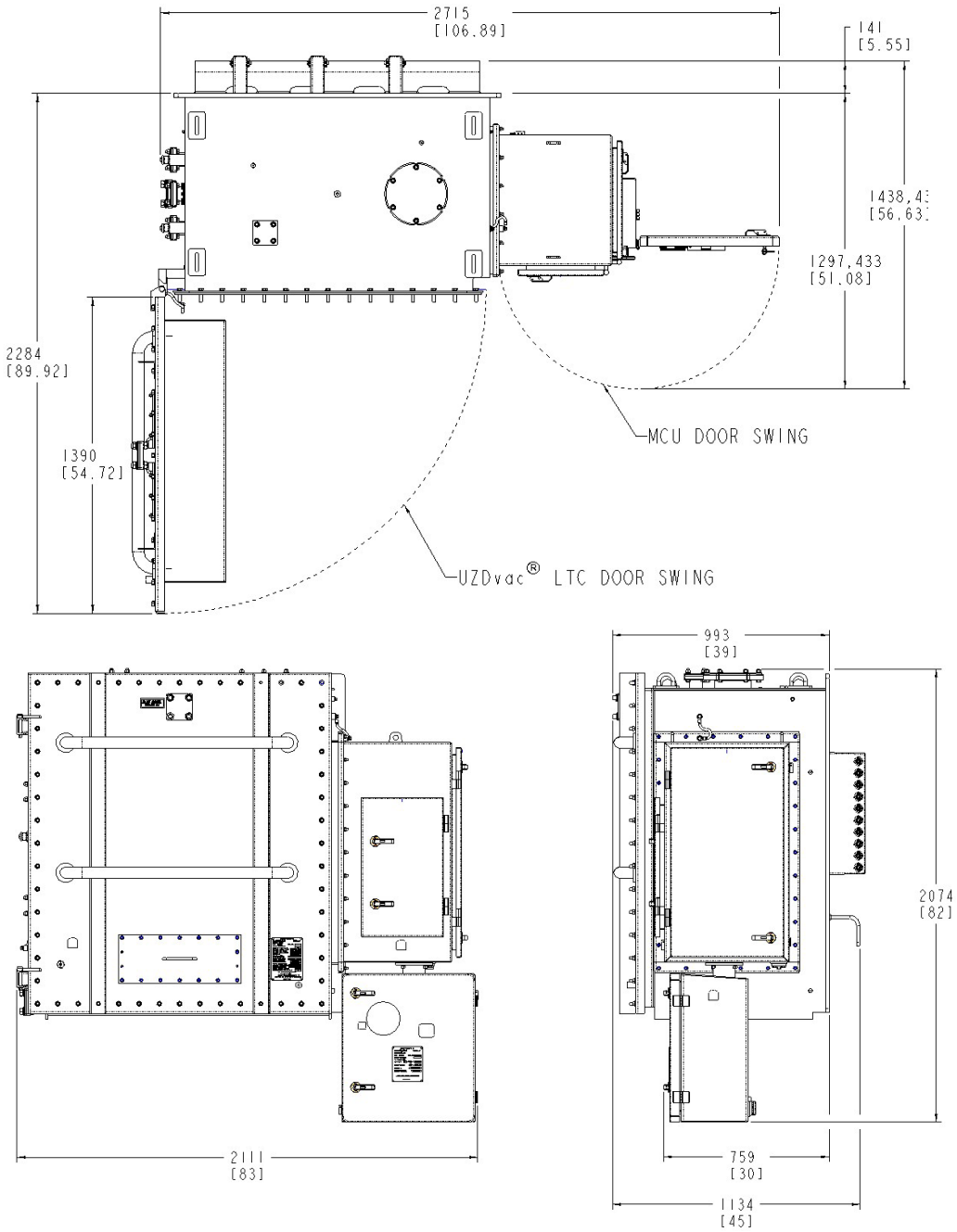
Off-Position Alarm

When the pin of the reverser cam is aligned with the Geneva gear (33X:COM & 33X:NC2 contact closed, see Figure 15, alarm range) and any one or both below conditions are true:

1. TDR relay times out after 3 minutes
2. 33 receiver (Incon) N.O. contacts close when it detects tap range is outside of set threshold limit 9°(+/-3°).

FIGURE 16: DIMENSIONS FOR EXTERNAL TANK

Technical Data & Characteristics



UZDvac® OLTC Tank External

Weights and Dimensions

Dimensions in Figure 16 above are shown as millimeters first with inches in parentheses. If only one number is shown, it is in millimeters.

UZDvac® LTC weight without oil = 4,114 lbs (1870 kgs)
MCU weight = 264 lbs (120 kgs)
UZDvac® LTC without oil + MCU weight total = 4,378 lbs (1,990 kgs)
UZDvac® LTC holds 340 US gallons of liquid; weight of 340 gal mineral oil = 2,380 lbs (1,082 kgs)
Total weight with mineral oil = 6,758 lbs (3,072 kgs)

Standards & Testing

Design tests were performed and passed to verify the UZDvac® LTC meets all specified requirements in IEEE C57.131-2012. Copies of design test reports are available upon request.

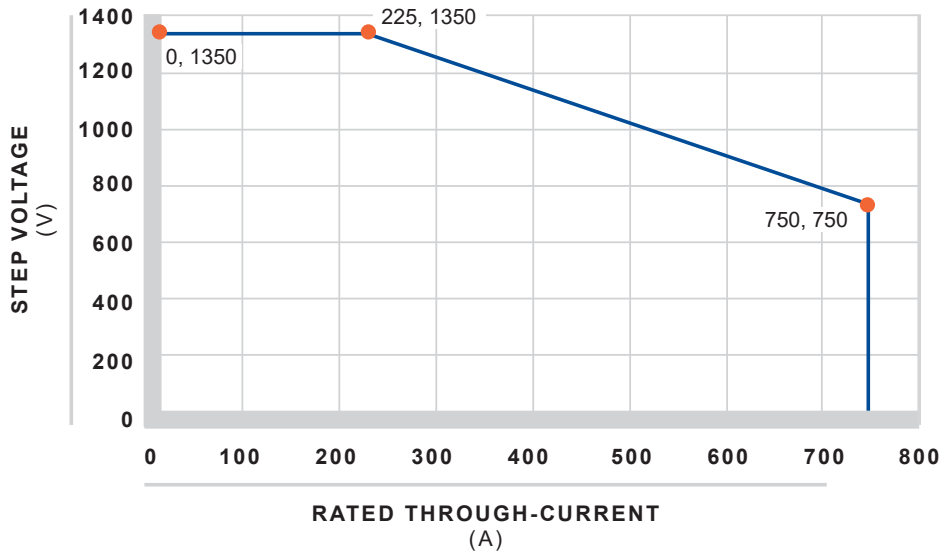
Design tests include:

- Temperature rise of contacts
- Switching tests
- Short-circuit current tests
- Mechanical life
- Cold temperature to - 25°C

Rated Step Voltage

Maximum allowable step voltage is limited by the electrical strength of the selector switch and the switching capacity of the vacuum interrupter. Therefore, this is a function of the rated through-current as shown in Table 3 below. For the UZDvac® OLTC, maximum rated step voltage is 1,350 volts with a relevant rated through-current of 225 amperes.

TABLE 3: STEP VOLTAGE VS. RATED THROUGH-CURRENT



Loading Beyond Nameplate

UZDvac® OLTC complies with IEEE C57.131-2012 section 5.2.1 "Temperature Rise of Contacts for OLTCs". When installed and properly applied in a transformer or regulating transformer, the OLTC can be thermally loaded in accordance with the applicable ANSI or IEEE loading guide.

Liquid Temperature

Temperature of the liquid in the LTC shall be between –25°C and +80°C for normal operation. Operation below –25°C has extended tap changing time and is not recommended. An optional thermal switch can be provided to either block operation of the motor or turn on oil heaters should fluid temperatures go below –25°C.

Motor Drive Mechanism Ambient Air Temperature

Normal operating range is —25°C to +50°C. For ambient air temperatures greater than +50°C, the motor drive mechanism should be shaded from direct sunlight. For ambient air temperatures below —25°C, additional heaters should be specified.

Operating Principle

ON-LOAD TAP CHANGER

Switching Sequence of Tap Selector and Vacuum Interrupters

UZDvac® is a high speed, resistance bridging on-load tap changer utilizing two vacuum interrupters per phase so all arcing takes place in the vacuum interrupters. The moving tap selector switch consists of one main contact (referred to as "M") and one transition resistor contact (referred to as "T") per phase. The M and T contacts are mounted on a common arm, isolated from each other, which rotates at the center of the epoxy phase molding as represented in Figure 17. The M and T contacts are each in series with vacuum interrupters designated V_m and V_t respectively. Transition resistor (impedance) R_t is in series with T and V_t.

In an at-rest position, both M and T are on the same stationary contact. Both V_m and V_t are closed. Through-current is flowing through both legs of this circuit (including R_t). However, since the resistance of M is in the range of microohms and R_t is typically one ohm, only microamps of current will be flowing in R_t on a continuous basis.

The sequence of events is different depending on the direction of travel of the rotating tap selector switch (raise or lower). When making a tap change operation in the lower direction, the tap selector switch will rotate clockwise when viewed from the contact side of the epoxy phase molding. In this case, M is the leading contact. All switching actions described below (Figure 17) happen after the spring battery stored energy is released. As the moving contacts start to rotate, V_m will open first. The through-current is now carried by T, R_t and V_t. After V_m opens, M will move to the next stationary contact. After sufficient time for contact settlement on M, V_m will close. M and V_m are once again carrying the through-current due to their much lower resistance relative to R_t. Since T is still on its original contact and V_t is closed, a circulating current will flow while the tap changer continues movement to the next tap position.

Next, V_t will open, interrupting the circulating current. M and V_m continue to carry the though-current. T moves to the same contact as M and then V_t closes. The switching operation is now complete. One tap change takes approximately 5 to 6 seconds with an actual switching time of approximately 200 ms. Figure 17 shows proper switching sequence of M, V_m, T, and V_t when traveling in either raise or lower directions.

For a tap change in the opposite (raise) direction as described above, the same sequence of events will occur, but T will be the leading contact.

FIGURE 17: SWITCHING SEQUENCE

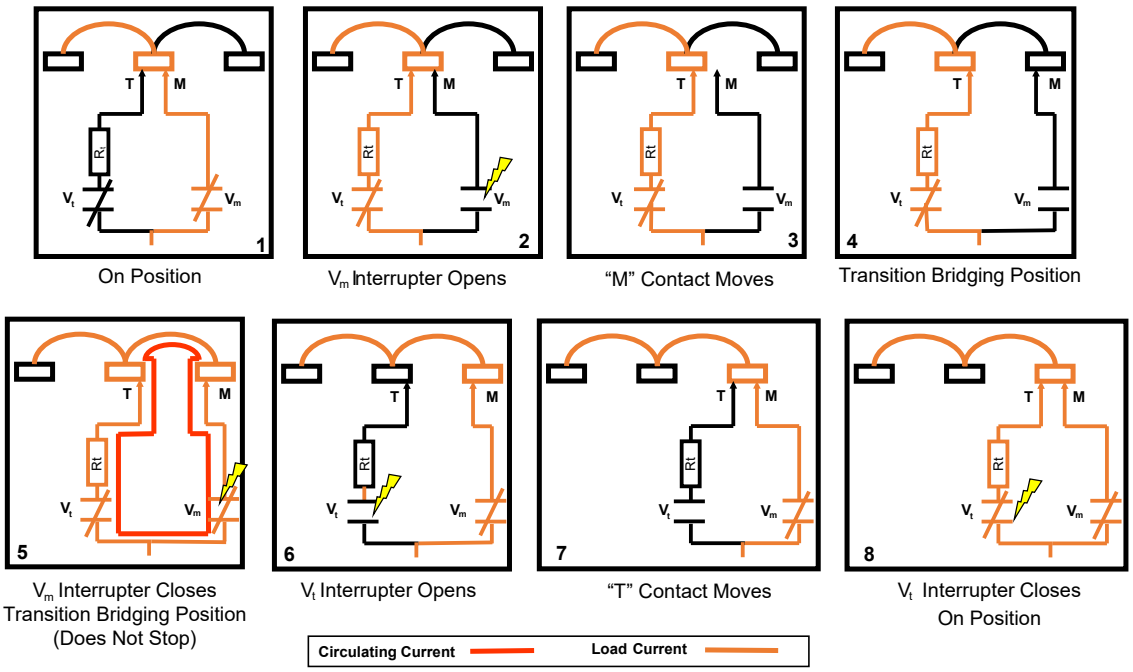


FIGURE 18: SWITCHING TIMING CHART

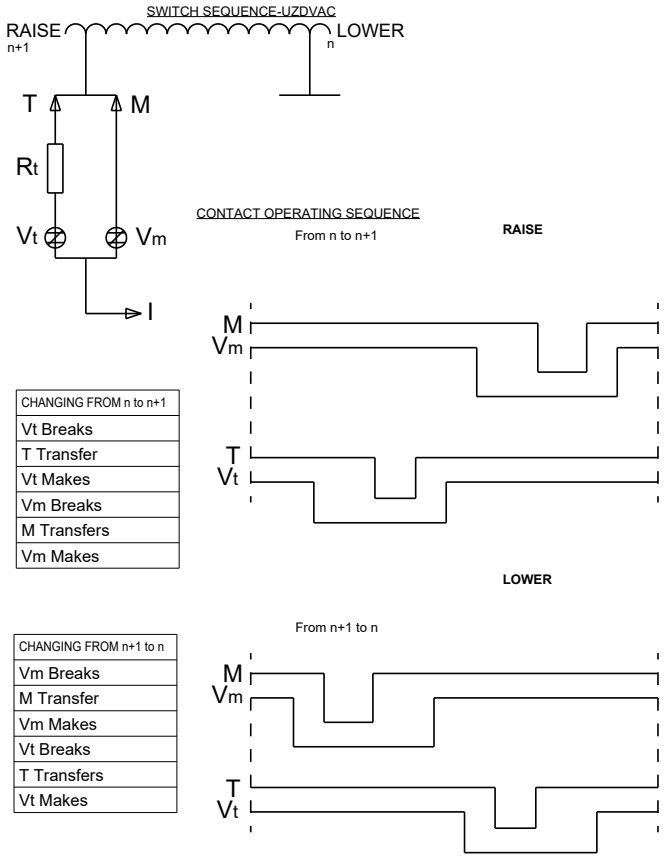
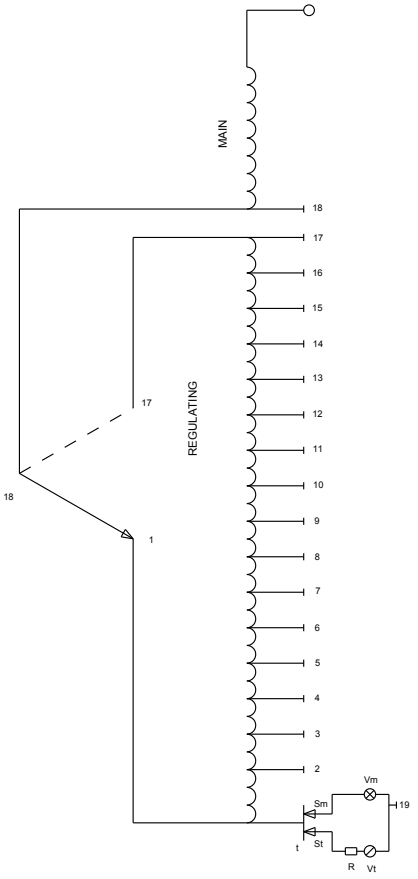


FIGURE 19: CONNECTION DIAGRAM

TAP POSITION	SELECTOR POSITION 19 TO	REVERSE SWITCH 18 TO	
16L	1	17	
15L	2	17	
14L	3	17	
13L	4	17	
12L	5	17	
11L	6	17	
10L	7	17	
09L	8	17	
08L	9	17	
07L	10	17	
06L	11	17	
05L	12	17	
04L	13	17	
03L	14	17	
02L	15	17	
01L	16	17	
LN	17	17	17
N	18	1	17
RN	1	1	1
01R	2	1	
02R	3	1	
03R	4	1	
04R	5	1	
05R	6	1	
06R	7	1	
07R	8	1	
08R	9	1	
09R	10	1	
10R	11	1	
11R	12	1	
12R	13	1	
13R	14	1	
14R	15	1	
15R	16	1	
16R	17	1	



Switching Sequence Reversing Change-Over Switch

This device, also called a reversing switch, is used to change the polarity of the regulating winding 180° with respect to the winding being regulated. This allows double duty of the contacts on the selector switch. Reversing switch pivots between contacts 1 and 17 (Figure 19), from contact 18. This occurs when the selector is on contact 18 while there is no current flowing through the reversing switch. Through-current travels from the main winding being regulated, through contact number 18 and out through the selector arm's center contact.

If a raise command is received, reversing change-over switch travels from contact 17 to contact 1 while the spring battery is being charged in preparation to move the tap selector switch from N (neutral—contact number 18 on epoxy phase molding) to RN (raise neutral—contact number 1 on epoxy phase molding). This changes the winding direction, or polarity, of the regulating winding 180° with respect to the main winding being regulated. This is a through-position and continuation contact 84C remains closed and initiates a second tap change operation which moves the tap selector switch from RN to 1R position.

Through-Positions

The UZDvac® on-load tap changer passes through two positions: one labeled raise neutral (RN) and the other labeled lower neutral (LN). Each of these through-positions is at the same voltage as neutral. Continuation contact 84C is closed when the tap changer is in one of these two positions. The closure of 84C causes the mechanism to make an additional tap change operation to prepare for the reversing change-over selector to operate without current flow.

If the motor power is interrupted while operating in a through-position, the motor will resume movement in the same direction once power is restored until it reaches the next position.

If the progress wheel is outside of the zero band and the mechanism is left between two positions or in a through-position, the mechanism starts immediately upon removal of the crank handle and resetting of the yellow headed button on the hand crank shaft.

Sequence of Events for a Raise Operation

(see Figure 14 on page 16)

When the 43T-1 Lower-Off-Raise switch is operated in the raise direction, raise relay 84R becomes energized. The contactor closes and is held by sealing switch 33S and sealing contact 33A:3L2,4T2. Raise relay 84R has two interlocks:

1) Normally closed contact of the lower contactor 84L to prevent both 84R and 84L from being energized at the same time, and
2) Limit switch LS-1b that opens at the maximum tap changer operating position 16R to prevent travel beyond the end of range

With the 84R contacts closed, the motor starts and drives the mechanism in the raise direction. Maintaining contact 33a closes and holds contactor 84R energized. Contact 33a is closed until just before the tap change is complete, then it opens (de-energizes) 84R which disconnects the motor.

Sequence of Events for a Lower Operation

A similar cycle of operation is obtained but in the lower direction. When control switch 43T-1 Lower-Off-Raise switch is operated in the lower direction, lower relay 84L becomes energized. The contactor closes and is held by sealing switch 33S and sealing contact 33A:3L2,4T2. The lower relay 84L has two interlocks:

1) Normally closed contact of the raise contactor 84R to prevent both 84R and 84L from being energized at the same time, and
2) Limit switch LS-2b that opens at the maximum tap changer operating position 16L to prevent travel beyond the end of range

With the 84L contacts closed, the motor starts and drives the mechanism in the lower direction. Maintaining contact 33a closes and holds contactor 84L. Contact 33a is closed until just before the tap change is complete, then opens (de-energizes) 84R which disconnects the motor.

NOTE: For details on cam and auxiliary control switches, see Table 2 on page 14, under "Contact Timing and Controls".

Local Control

The tap changer can be operated manually by control switch 43T-1 Lower-Off-Raise. To operate the tap changer manually, 43T-2 should be in the “Local” position, and 43T-3 should be in the “Manual” position. Switches 43T-2 and 43T-3 are mounted in the transformer control cabinet.

Remote Control

To operate the tap changer by remote control, optional control selector switch 43T-2 Local/Remote, mounted in the transformer control cabinet, must be in the “Remote” position.

A terminal in the motor drive cabinet supplies control voltage for the remote push button. Local operation is not possible when switch 43T-2 is in the “Remote” position, and remote operation is not possible when in the “Local” position.

Automatic Operation Local Mode (Optional)

To operate the tap changer automatically, 43T-2 must be in the “Local” position and 43T-3 in the “Automatic” position.

The tap changer can now be operated by the “90” voltage regulating relay.

Over Current Relay 50-1 (Optional)

A “50-1” over current relay can be provided in the transformer control cabinet to prevent the tap changer from operating when load current is excessive, such as during a short circuit. The 50-1 is adjustable from one to two times full load current.

Step-by Step Operation (Optional)

Step-by-step operation is an optional feature only used in the manual mode. UZDvac® OLTC will normally make tap change operations continuously if the raise or lower switch (43T-1) is held. In step-by-step operation, only one tap change will be made until the raise or lower switch has been released. When the raise or lower switch is operated again, one more tap change will occur. 84S relay is included in MCU. For step by step operation, relocate jumper 4 (J4) from 516-517 to 522-522A jumper 6 (J6) from 526-527 to 523-524.

Installation & Commissioning OLTC into Service

RECEIVING INSPECTION

Upon receipt of the transformer/OLTC, the OLTC must be thoroughly inspected to ensure no damage occurred in transit. The UZDvac® OLTC is shipped pre-wired as well as filled with clean, dry oil free-breathing through a dehydrating breather. A thorough visual inspection of the following items should be performed:

- Verify the correct oil level is present via the oil level gauge on the OLTC tank
- Inspect all OLTC tank accessories (i.e oil level gauge; pressure relief device, if equipped; dehydrating breather) and associated wiring/ conduit for signs of shipping damage
- Inspect the exterior of the OLTC tank for signs of shipping damage and/or oil leaks
- Inspect the outside of the MCU cabinet for signs of shipping damage; open MCU door and visually inspect components inside for any signs of shipping damage (i.e. broken or loose hardware, loose wires)
- Open MDU compartment doors and inspect for evidence of shipping damage (i.e. broken or loose hardware, oil leaking from shaft seals on OLTC tank wall)

In the event shipping damage is found, note all damage observed, contact Prolec GE Waukesha's warranty department at 800-835-2732 and file a claim with the freight carrier.

COMMISSIONING OLTC INTO SERVICE

Prior to placing the OLTC and motor drive in service, the following inspection and testing must be completed to ensure the unit is working correctly:

- Open motor drive compartment doors and visually inspect the spring drive mechanism for signs of shipping damage, i.e. oil leaks from shaft seals on OLTC tank, broken hardware, etc.
- Insert hand crank in the MCU. While hand cranking, operate the OLTC manually from neutral position 16 Raise and from 16 Raise back through neutral down to 16 Lower, and back to Neutral; while performing this operation, observe and verify the following:
  - Hand crank operation should be smooth and turn freely
  - OLTC position indicator changes tap position
  - Tap operation counter increases by one with each operation
  - Spring battery should charge and discharge
  - Tap operations are executed smoothly and without hesitation once the spring battery discharges
  - At 16 R and 16L, continuing to hand crank the OLTC engages the mechanical end of travel limit stop after the electrical limit switch has opened
  - After completing hand crank operations, ensure progress wheel indicates “0 degrees” +/– 20 degrees at the end of a tap operation
- Energize the MDU's power source and operate the OLTC electrically using control switches from Neutral to 16 Raise and down to 16L and repeat the inspection steps for hand cranking. While operating the OLTC electrically, verify the following:
  - Electrical end of travel limit switches at 16 Raise and
    16 Lower are working properly, preventing motor from operating past its limits
  - Motor will not run with hand crank engaged in motor drive
  - Motor drive convenience outlet and light are functioning properly
  - Verify the heater functions properly by turning on motor drive heater switch

    NOTE: OLTC drive motor is thermally protected by an MPR device. Extended operation of the OLTC drive motor electrically across consecutive taps may result in MPR operation damage to the motor. For testing purposes, maximum number of consecutive operations of the drive motor should be limited to 150, after which the motor should be allowed five minutes for cooling before operating again.
  - Energize the auto recharging dehydrating breather and verify the breather begins a drying cycle and heats up

The OLTC and motor drive are now ready for service once the transformer has been fully tested.

LONG-TERM STORAGE

UZDvac® OLTC is shipped filled with clean, dry oil and requires no additional oil processing for long-term storage. Ensure the breather air hose is connected to the OLTC tank and a source of power is connected to the breather and heater in the MCU cabinet while the OLTC/transformer are in storage.

OIL FILLING THE OLTC TANK

NOTE: The OLTC tank is rated for full vacuum. During vacuum processing/oil filling of the transformer tank and OLTC, the company recommends the OLTC and transformer tank be connected together via vent plugs and 3/8" copper tube with an isolation valve to equalize pressure differential and reduce stress across OLTC phase moldings. Prior to performing vacuum processing/ oil filling, the OLTC breather air hose should be disconnected and the tank port plugged. For initial transformer installation, the bypass isolation valve needs to be open before pulling vacuum on the main tank such that the pressure drops at the same rate in both tanks. The transformer main tank and OLTC should be oil-filled while both tanks are under vacuum. Additionally, when oil filling is complete, the main tank and OLTC tank should be allowed break vacuum (increase pressure) at the same rate until OLTC is at atmospheric pressure. The valve is then closed and the breather reconnected.

CAUTION

If performing maintenance on the OLTC and the main tank has been previously filled with oil, DO NOT open the bypass isolation valve and DO NOT pull vacuum on the main tank. In this case, pull vacuum on the OLTC only and then oil fill the OLTC under vacuum.

Check instructions for other tank accessories, such as liquid level gauge, pressure relief device, rapid pressure rise relay, etc. to determine if vacuum pressure can cause damage to them. If so, remove and isolate the device(s) prior to vacuum processing.

- After completion of internal receiving inspection or maintenance of the OLTC tank, the inspection door has been closed and the hardware securing the door has been evenly torqued to 35 ft-lbs, apply a minimum vacuum to the OLTC tank of 1 Torr and hold for 2 hours. This will flash off any surface moisture that may have accumulated in the tank while performing the internal receiving inspection.
- Fill the OLTC tank with oil to the correct level while maintaining vacuum.
- Once filled to the correct level, break the vacuum and reconnect the Auto Regenerating Dehydrating Breather air hose to the OLTC tank and obtain oil samples for benchmark oil quality and dissolved gas analysis.

Maintenance (Minor Annual & Major)

SAFETY NOTICES

- **To prevent injury due to unwanted operation and electrical shock, automatic operation should be locked out and power supply(s) to the UZDvac® OLTC locked out when cleaning, lubricating or making adjustments.**
- **Do not operate OLTC while under vacuum.**

GENERAL MAINTENANCE

The UZDvac® on-load tap changer has been designed for long, reliable operating life with minimal monitoring.

Inspection requirements can be categorized by:

- Annual routine inspections (at minimum) – see an example of the Annual Inspection Form on page 26.
- Major inspections – see an example of the Major Inspection Form on page 26.
  - 15 years / 500,000 operations, whichever occurs first
  - 10 year inspections after first inspection – years 25, 35, etc.
  - Follow instructions for oil filling OLTC tank as described on page 24.

Inspection forms can be downloaded by going to www.waukeshatransformers.com/resources/product manuals.

Beyond routine dissolved gas analysis and oil quality, Prolec GE Waukesha recommends lubricating all mechanical wear components in the spring drive every six years. For any maintenance or service questions or concerns, please contact a local Prolec GE Waukesha Service representative at 800-758-4384.

FORM 1: ANNUAL INSPECTION FORM

waukesha by prolec ge

Waukesha® UZDvac® OLTC Annual Inspection Form

EQUIPMENT DESCRIPTION	INFORMATION	NOTES/COMMENTS
OLTC serial number		
Motor drive or control unit serial number		
Year manufactured		
Transformer serial number		
High voltage		
Low voltage		
MVA		
Substation name		
Transformer designation		
Date of inspection		
Inspected by		
OIL SAMPLE	**INFORMATION**	**NOTES/COMMENTS**
Oil sample for test	☐ Completed Fluid Temperature _____	
Verify proper oil level	☐ Level Okay Fluid Added _____ gallons	
SWITCH COMPARTMENT	**INFORMATION**	**NOTES/COMMENTS**
Inspect all tank oil seals and seams for signs of leaks	☐ Completed	
Functional check of pressure control switch [4.3 psi + 0.5%]	☐ Completed and verified at _____ psi	
Verify that auto-recharging dehydrating breather is functioning properly	☐ Completed	
De-energize and energize breather to verify heating cycle	☐ Completed	
Verify water drains from bottom of breather	☐ Completed	
Verify the breather tube between the breather and the switch compartment is open and not plugged	☐ Completed	
Note rust / corrosion	☐ Completed	
MOTOR DRIVE UNIT [MDU]	**INFORMATION**	**NOTES/COMMENTS**
Drive position (from Geneva gear		
Any oil leaks from selector / reversing drive shafts	☐ Yes ☐ No	
Condition of door gaskets, any evidence of water in spring drive compartment	☐ Yes ☐ No	
Any unusual mechanical wear on exposed gears	☐ Yes ☐ No	
Springs in good condition, i.e., broken springs, debris in bottom of compartment	☐ Yes ☐ No	
Any notable mechanical concerns	☐ Completed	
Compartment heater functional if present	☐ Yes ☐ No	
Note rust / corrosion	☐ Completed	

continued on next page...

MOTOR CONTROL UNIT [MCU]	INFORMATION	NOTES/COMMENTS
Record counter operations	Start _____ Finish _____	
Record tap position		
Does tap position match MDU's position?	☐ Yes ☐ No	
Record tap range	_____ to _____	
Did unit pass through neutral since last inspection	☐ Yes ☐ No	
Condition of door gaskets, evidence of water in spring drive compartment	☐ Yes ☐ No	
Any unusual appearance of electrical components	☐ Yes ☐ No	
Any notable mechanical concerns	☐ Yes ☐ No	
Compartment heater functional	☐ Yes ☐ No	
Note rust / corrosion	☐ Completed	
Operate tap changer in both directions passing through neutral and return to tap position listed above	☐ Completed	
Counter working	☐ Yes ☐ No	
Unusual sounds	☐ Yes ☐ No	
Reset drag hands to current position [position listed above]	☐ Completed	

For assistance or more information, please contact our Waukesha® Components group at 800-338-5526.

FORM 2: MAJOR INSPECTION FORM

waukesha by prolec ge

Waukesha® UZDvac® OLTC Major Inspection Form

EQUIPMENT DESCRIPTION	INFORMATION	NOTES/COMMENTS
OLTC serial number		
Motor drive or control unit serial number		
Year manufactured		
Transformer serial number		
High voltage		
Low voltage		
MVA		
Substation name		
Transformer designation		
Date of inspection		
Inspected by		
Complete annual inspection	☐ Completed	
SAFE OPERATION		
De-energize Transformer	☐ Completed	
Complete and document owner's safety review	☐ Completed	
OIL SAMPLE (if not done during annual inspection)	**INFORMATION**	**NOTES/COMMENTS**
Oil sample for test	☐ Completed Fluid Temperature _____	
Verify proper oil level	☐ Level Okay Fluid Added _____ gallons	
MOTOR CONTROL UNIT (MCU)	**INFORMATION**	**NOTES/COMMENTS**
Record counter operations	Start _____ Finish _____	
Record tap position	☐ Completed	
Check gears for wear and lubrication; if needed use Exxon Beacon P-290	☐ Completed	
Verify manual safety interlock operates properly	☐ Completed	
Check limit switch operation	☐ Completed	
Check wiring and controls	☐ Completed	
Verify GFI outlet operates correctly	☐ Completed	
MOTOR DRIVE UNIT (MDU)	**INFORMATION**	**NOTES/COMMENTS**
Check gears for wear and lubrication; if needed use Exxon Beacon P-290	☐ Completed	
Inspect condition of drive pin and to OLTC tank for wear, lubricate if needed Exxon Beacon P-290	☐ Completed	
Check exposed Geneva gears and drives for wear and lubrication; if needed, use Exxon Beacon P-290 grease.	☐ Completed	
Verify end of travel limits operate properly	☐ Completed	

continued on next page...

SWITCH COMPARTMENT	INFORMATION	NOTES/COMMENTS
OLTC tank drained of fluid before opening	☐ Completed	
Debris on bottom of tank	☐ Yes ☐ No	
Any loose hardware	☐ Yes ☐ No	
Evidence of heating or arcing	☐ Yes ☐ No	
Verify operation of accessories and protective devices	☐ Completed	
Verify molded coupling alignment and engagement	☐ Completed	
Verify alignment of main and reversing contacts - Operate from 16R to 16L	☐ Completed	
Check main contact pressure	☐ Completed	
Check contact pressure on reversing switches	☐ Completed	
Check contact pressure on bow ties main and reversing	☐ Completed	
Inspect wear indicators on vacuum interrupters	☐ Completed _____ gap	
Check transition resistors – 1 Ω	☐ Yes ☐ No	
Contact resistance measurement – tap selector	A: _____ μΩ B: _____ μΩ C: _____ μΩ	
Contact resistance measurement – reversing switch	A: _____ μΩ B: _____ μΩ C: _____ μΩ	
Note rust / corrosion / leaks	☐ Completed	
GENERAL	**INFORMATION**	**NOTES/COMMENTS**
Describe any areas of concern	☐ Completed	
Oil compartment door gasket	☐ New ☐ Re-used	
Were any gaskets replaced list	☐ Yes ☐ No	
Were any contacts replaced list	☐ Yes ☐ No	
Any other parts replaced	☐ New ☐ Re-conditioned ☐ Old	
Fluid used	☐ Completed	
Vacuum filled	☐ Yes ☐ No	
Reset drag hands to current position [position listed above]	☐ Completed	

For assistance or more information, please contact our Waukesha® Components group at 800-338-5526.

Inspection forms can be downloaded by going to www.waukeshatransformers.com/resources/product manuals.

Figure, Table & Form Reference

FIGURES

TABLES

FORMS

Waukesha® UZDvac® Technical Manual

Vacuum On-Load Tap Changer

www.waukeshatransformers.com

United States locations

WAUKESHA PLANT
400 South Prairie Avenue
Waukesha, WI 53186
800 835 2732

GOLDSBORO PLANT
2701 US HWY 117 South
Goldsboro, NC 27530
800 758 4384

COMPONENTS
9011 Governors Row
Dallas, TX 75247
800 338 5526

SERVICE
Emergency Service Available
24/7/365: 888 365 24x7
800 758 4384

Prolec-GE Waukesha, Inc. (formerly SPX Transformer Solutions, Inc.) is one of the largest U.S. manufacturers of power transformers and a valued supplier of complete transformer service solutions, reverse-engineered components and replacement parts as well as a variety of substation-applicable training classes for all skill levels. Manufacturing locations include our headquarters in Waukesha, Wisconsin as well as satellite sites in Goldsboro, North Carolina and Dallas, Texas.

WAUKESHA® TRANSFORMERS

Our modern transformer manufacturing operations in Waukesha, Wisconsin and Goldsboro, North Carolina have amassed over 80 years of combined experience producing high quality power transformers that meet stringent customer demands. Utilizing sophisticated computer-controlled equipment and test systems, Waukesha also maintains one of the shortest production cycles in the industry, which allows the team to respond quickly to customer delivery and installation requirements.

WAUKESHA® SERVICE

Waukesha® Service can provide complete transformer service solutions for almost any manufacturer's units including installation, maintenance, relocation, testing and technical assessments; oil processing, dryouts and retrofills; corrective and preventative maintenance; on-load tap changer field retrofits and repairs. Along with a vast number of skilled personnel located strategically across the country, we manage one of the largest fleets of specialized transformer service equipment in the United States. This allows us flexibility, optimized installation hours and costs while helping us provide efficient, safe and high quality service to our customers.

WAUKESHA® COMPONENTS AND TRAINING

Waukesha® Components operates a manufacturing, testing and training facility in Dallas, Texas as a leading supplier of parts for most major current and obsolete on-load tap changer (OLTC) and oil circuit breaker brands as well as being the original manufacturer of a line of Transformer Health Products®. Additionally, we offer a variety of OLTC services, including maintenance training, failure analysis reporting and complete overhauls at this location while also continuing to build our reputation as an industry leader in reverse-engineering and design enhancement.

PROLEC GE

Prolec GE designs and provides solutions for the generation, transmission, and distribution of electrical energy. With more than 50 years' experience in the industry, Prolec GE is an important player in the Americas with business units in Mexico, the United States, and Brazil. It has an installed base in more than 35 countries and employs more than 8,000 people. www.prolec.energy/prolecge/

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