MOTOR DRIVE MA2
General & Operating Manual
MOTOR DRIVE UNIT MA 2

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CAUTION
Description and Technical Specifications given in this booklet are for general purpose guidance only. We reserve the option of changing any detail if found necessary.
1. GENERAL

The housing of the motor drive unit contains all mechanical and electrical parts necessary for operating the onload tap changer. The motor drive is controlled according to the step-by-step principle.

Overrunning the end positions is prevented by electrical and mechanical limits, provided that motor drive and onload tap changer are properly coupled. When the crank handle is fitted, a safety switch automatically operates and prevents energization during manual service.

The standard equipment comprises of a transmitter for remote position indication, a 6-figure counter, and a heater.

2. TECHNICAL DATA

(STANDARD VERSION)

Motor rating data:

- Power: 1 H.P.
- Voltage: 380/440, Three-phase
- Current: 1.8 Amps
- Frequency: 50 HZ
- Synchronous Speed: 1500 rpm
3. **DESIGN**

3.1 Refer our Standard General Arrangement & Dimensional Drawing 180 081 R2. (see Appendix).

The housing consists of two parts, the body and the cover. Both are manufactured from Mild Steel Sheet. This steel sheet cabinet gets a course of metal treatment, a prime coat and a finish coat of B.S. grey outside and furniture green inside (generally).

The cover can easily be removed by just lifting the door upwards. The joints between cover and the body are protected by a ledge and sealed by flat neoprene gasket.

The eyepiece for the position indicator and the counter is put between 2 gaskets and is held by an aluminum window frame fixed at the external side of the door. The apertures for the push buttons are sealed by gaskets. The vents are in the top and bottom of the body. The clamp for the hand crank is on the inner side of the door.

3.2 **Motor and Gearing (See Fig 3)**

Gearing and motor flanged to each other form a unit. The gear box is fitted by four screws in the upper part of the body. The gear box contains:

- The principal gear, consisting of the cogwheels 2, 3 and 5 and the interruption gear 6. The overall transmission ratio is 2:1.
The Additional gear for the hand crank, consisting of the bevel wheel 12 and the cogwheels 14 and 15. Cogwheels 15 gears with shaft 4 of the principal gear. The global transmission ratio between crank shaft 10 and driving shaft 7 is 1:2.

The control gear for the spring unit 111 and the pawl 121 in both end positions, consisting of worm 101, worm wheel 102, the cogwheels 104 and 105. The global transmission ratio between driving shaft 7 and spring unit shaft 106 is 264:1, i.e., the spring unit shaft performs 1/4 of a revolution per switching operation. The drive of the pawl is effected by the cogwheels 107 and 118.

Moreover the control gear comprises of unit fixed at the external side of the gear box and consisting of the spring unit 111, the cogwheels 112 and 115, and the position wheel 113 that also serves as technical position indicator. 112, 115 and 114 are put into operation by the spring unit 111. This unit comprises also the counter 110 (arranged mechanically before the spring unit), the change over switch 1161) for the step-by-step gear (effected by the cogwheel 115), the limit switch 1172) (put into operation by two limit stops 114 of the position wheel 113), and the remote control transmitter3 (contact range).

The limit switch 114 fixed at the right side of the gear box is operated by the hand crank via a shaft with lever.

Note: Standard Designation in the circuit diagram
1) b9  2) b6, b7  3) b8
4. CONTROL CIRCUIT

4.1 Wiring of Electrical circuit

In the wiring of all electrical circuits, (PVC black colour insulation) 600V grade copper wire with cross section of 2.5 sq. mm. is used.

For wiring the tap position control indication 18 SWG tinned wire 230V grade PVC yellow color insulation is used.

For wiring the additional dial switch 1.5 sq. mm. PVC black color conductor 600V grade is used.

4.2 Operation

Connect 415V 3 phase A.C 50Hz in RYB sequence to the motor circuit and 110V A.C single phase to the control circuit. The tap changing operation can be performed either by raise or lower push buttons provided on the right side of the housing.

4.3 Running through to an end position (position 1 or position n)

After position 1 has been reached, the corresponding limit switch opens so that energisation of the same operating coil is no longer possible. The motor drive can only be operated in the direction towards position “n” by energisation of the other operating contactor via push button. When position “n” is reached the other limit switch opens, the contactor can no longer be energized. Now the motor drive can only be controlled in direction towards position 1.

4.4 Manual Service

By fitting the hand crank, the crank handle interlock switch is energized and two phases of the motor circuit as well as the control circuit are cut off.

5. ASSEMBLY

For coupling of OLTC and Drive, Please refer Appendix.

5.1 Mounting the motor drive unit to the transformer tank

The Motor drive unit is fastened by four bolts to the transformer tank. The corresponding mounting holes are in the back side of the body. The position of these bolts should be adjusted to the axis of the hand crank of the shaft so that the correct measure “V” will be obtained. Take care that the motor drive unit is mounted vertically and that the driving shaft, is exactly in alignment with the shaft of the bevel gear. The motor drive unit should be fixed at the transformer tank rigidly, so that it does not move from its final position when it operates.

5.2 Mounting the driving shaft

5.2.1 General

The drive shaft is the mechanical connection between motor drive and tap changer head. The bevel gear unit connects the vertical and horizontal parts of the drive shaft. The vertical part has to be
mounted between motor drive unit and bevel gear, and the horizontal part between bevel gear and tap changer head. The drive shaft couplings are same for both the parts. Both ends of the square shaft are connected respectively to two coupling brackets and one coupling pin. Square shafts have to be trimmed to the required lengths when they are mounted on the transformer.

5.2.2 Coupling instructions

When mounting observe the following instructions:

1. Check the shaft length between the two shaft ends.
2. Attach the two coupling brackets to the shaft by “6” screws M6 (wrench size 10) add flat washer (M6). Slide the coupling brackets on the square shaft as far as possible, tighten the M6 nuts (maximum torque 9Nm).
3. Lubricate “O” ring and coupling pin.
4. Place the coupling pin into the trunnion and slide the square shaft together with the coupling.
5. Provide the opposite trunnion with coupling bracket and coupling pin. Fit in the square shaft. Place second coupling bracket and tighten the “6” bolts (M6) with flat washer, lock washer and (M6) nuts.
6. Make sure that there is an axial clearance of 2mm between coupling pin and coupling brackets.
7. Finally tighten the coupling brackets (max. torque 9Nm) placed on both side of the bevel gear and next to the tap changer head.

Note:
The screws of coupling brackets next to motor drive unit must be tightened and locked when the rotation lag of motor drive has been equalized.

5.3 Relational lag adjustment of the tapchanger and motor drive

For the following procedure the tapchanger and motor drive must be the same tap position. The motor drive has to be set to the same position as found in the tapchanger.

Motor drive and tapchanger can, however, finally be coupled only when the rotation lag (if there is any) has been balanced. For this purpose proceed as follows:

5.3.1 Turn the hand crank clockwise towards “Lower” until the energy accumulator of the tapchanger is released.
5.3.2 Continue cranking and count the revolutions necessary for releasing the spring unit of the motor drive, till a “click” which can be distinctly heard (about 3 to 5 revolutions).
5.3.3 Turn the hand crank counter clockwise towards “Raise” until the energy accumulator of the tapchanger is released.
5.3.4 Continue cranking and count the revolutions, as in 5.3.2.
5.3.5 Balancing the rotation lag is necessary if the number of clockwise revolutions does not equal that of the counter clockwise revolutions. In this case the vertical part of the driving shaft is uncoupled. The hand crank is then turned in the rotation sense which required more revolutions to be effected. The number of the balancing revolutions amounts to half the difference between the clockwise and counter clockwise revolutions.
Example: (see Fig. 5)

Turn the crank clockwise (e.g. from position 6 to 5) rotation lag determined: 3 revolutions ‘a’ (Fig.5). Turn the crank counter clockwise (e.g. from position 5 to 6) rotation lag determined: 5 revolutions ‘b’. Uncouple, ‘c’. Equalize by turning the crank for half the difference: \( \frac{1}{2} (5-3) = 1 \) revolution counter clockwise ‘d’. Recouple, ‘e’.

Checking the result:
Cranking clockwise (e.g. towards position 5) and then counter clockwise (e.g. towards position 6) results in both cases in the same number of revolutions constituting the rotation lag f and g (Ref. Fig.-5).

5.4 Preparing the electrical service

After finishing the adjustment the coupling brackets are locked by self-lock nut. Finally the motor drive is connected to the mains, the remote control panel and other equipment according to the circuit diagram assigned with the order. For re-setting the motor drive from manual service to motor service the crank handle has to be removed and the locking bolt (yellow marked) to be pushed back. This causes the crank shaft to be disengaged. At the same time the electrical motor blocking (safety switch) is suspended.

6. PUTTING INTO OPERATION

Before connecting the motor drive to the mains check whether voltage, current and power of the supply coincide with the required values- When checking the voltage for the motor circuit take care that the R-Y-B phase sequence is clockwise.

7. MAINTENANCE

As the gearing and the ball bearings of the driving motor are sufficiently supplied with grease, a regular maintenance is not necessary. We recommend, however, occasional inspections that should focus in

- The housing is still water-proof
- Proper functioning of the built-in electrical heater
- The appearance of the motor drive and the built-in equipment
- The proper functioning of the Snap Action Switch (Part 111). Refer Appendix for instructions to change the same.

8. SPECIAL DESIGNS

If the equipment described in section 2 is not sufficient for certain operating conditions, the motor drive unit MA2 may be supplied with the following additional equipment.

8.1 Other rated voltages and/or rated frequencies for motor circuit, control circuit, and auxiliary circuit.
8.2 D.C. Control circuit

8.3 Motor protective switch (built-in)

8.4 Device for automatically running through one or several operating positions.

**APPENDIX**

Schematic diagram (Standard) ........................................................................................................ 4 71526
General Arrangement of Driving Mechanism .............................................................................. 1 80 081 R4
Coupling of OLTC & Drive MA2 with Type ‘D’ Tapchanger .................................................... B 25 553
Coupling of OLTC & Drive MA2 with Type ‘M’ Tapchanger .................................................... B 25 557
Bevel Gear Dimensional Drawing .............................................................................................. D 14 014

**Instructions for changing the snap action switch (stored energy unit) in OLTC DM**

1. Remove the dial plate cover by undoing 4 M4 4mm x 10. Hex. Head screws.
2. Bring the Drive Mechanism to reference tap positions where the match mark punching can be found on the DM dial switch and the two pinions connecting the energy accumulator and b9 switch.
3. Unscrew 3 Nr, M8 nuts from the 3 studs holding the TPI Plate assembly.
4. If required, disconnect all the wiring connections from TPI plate to TB1 and TB2. Now remove the TPI plate assembly from the gearing unit.
5. The claw coupling between energy accumulator shaft and gear shaft will dislodge on removing the TPI plate. Ensure this is refitted before TPI reassembling.
6. Open the 2 M6 lock sheets and nuts. The energy accumulator can be removed now.
7. Before refixing the new unit, it should be taken care that the grub screw inclination of the snap action switch shaft and the drive shaft from the gear box are in line. Now it should also be ensured that the phosphor-bronze spring plate is pressed tight towards the spring gap. Now place the bottom plate of the snap action switch in the mounting plate with the stepped portion facing the switch.
8. Ensuring the match marks on the pinions are in the original reference positions, reassemble the snap action switch.
9. Fix the 2 M6 nuts and lock sheet and tighten it by hand feel. Now perform about 4 trial operations on both sides using the claw coupling with a small screw driver. Now tighten these M6 nuts firmly and fold the lock sheets.
10. Bring back the dial plate to the reference position and reassemble the TPI plate assembly onto the gearing unit taking care that the claw coupling is provided in between the snap action switch shaft and the drive shaft of the gearing unit.

Check electrical and manual operations of Tapchanger driving mechanism.