TYPE QS-GBN™
US PATENT NOS. : 9,196,438 B2
9,530,591 B2

INSTRUCTION MANUAL

NETWORK HIGH VOLTAGE PRIMARY DISCONNECT AND GROUNDING SWITCH

CAUTION: DE-ENERGIZE TRANSFORMER BEFORE PERFORMING ANY MAINTENANCE PROCEDURE OUTLINED IN THIS PUBLICATION
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INTRODUCTION

Quality Switch's liquid immersed network grounding switches are designed to meet IEEE/ANSI standard C57.12.40-2017. They are small compact units equipped with mechanical and electrical interlocks. All switches are suitable for transformer oil or other common dielectric fluids. The switch parts are mounted on steel rails, allowing a firm but free standing assembly.

There are two basic types of switches available: a 'dead-break' and a 'mag-break'. The 'dead-break' switch is equipped with a single solenoid interlock, energized from the transformer, which prevents movement of the switch from any position when the transformer is energized. The 'mag-break' version is equipped with double solenoid interlocks that allow the switch to move from 'CLOSED' to 'OPEN' (or 'OPEN' to 'CLOSED') only when the network protector is in the 'OPEN' position. The 'quick-break' mechanism (AKA Mag-I) furnished on 'mag-break' switches uses a spring loaded auxiliary contact arm which allows an extremely fast interruption of the transformer exciting current as the switch is moved from 'CLOSED' toward the 'OPEN' position. These operate with a snap action, regardless of the speed at which the operating handle is moved. Both versions can be equipped with sequence indication grounding.

The following is an instruction manual that will include information on shipping, inspection, handling, installation, storage, operation, and maintenance of these switches. Each specific switch will have its own specification and unique combination of construction features. These features will be detailed in the outline drawings for each type of switch. The outline drawings in conjunction with this manual will provide the information necessary for reliable installation and operation for any specific network grounding switch.

CAUTION: This manual is not intended as an application guide for network grounding switches nor is it a substitute for adequate training in safe working procedures for this and/or related high voltage equipment.

NOTE: If further information is desired or should particular problems arise which are not covered sufficiently by this manual, the matter should be referred to Quality Switch, Inc.
SHIPPING, INSPECTION, HANDLING, AND STORAGE

SHIPPING --- The primary network grounding switches are individually packed unless specified by the customer. Each unit is shipped completely ready for installation into a chamber. Several parts are packed in individual wrapping and are sent in the same box as the switch. These parts will be used either in the weld area or in the final assembly area when installing the switch. The parts shall be marked accordingly and the packing list will include a list of any parts shipped with the switch.

INSPECTION --- Make a visual inspection of the package of the network switch immediately upon receipt. This should be done prior to unloading. If damage or rough handling is evident, file a claim with the Transportation Company promptly and notify Quality Switch Inc. Please consult Quality Switch Inc. before rejecting any unit or performing any additional labor. A serial number is engraved on the middle phase of the switch contact deck board edge (please provide that for reference when contacting Quality Switch when possible).

External Inspection --- The following is a list of external switch features that should be checked prior to and during unpacking from the box:

1. Check for any obvious damage to packaging that may have occurred during shipment.
2. Check to make sure that no clips or blades are severely bent.
3. Check to make sure that no decks are cracked or chipped.
4. Check to make sure that all miscellaneous parts are accounted for.
HANDLING --- Each switch is shipped in individual boxes for ease of handling. Each box is provided with hand grips that allow it to be moved easily. If a pallet is provided for shipment, please take care in moving the pallet as damage can occur to the switches if severe force is applied to the side of any of the individual boxes. Also, if a pallet shipment is provided, please do not place any other objects on top of the pallet as damage can occur to the switches if excessive weight is placed on top. Care must be taken when unpacking the switch. Grab the switch under the front plate and the underside of the rear deck to lift it out of the box. **CAUTION:** Neither the switch's connection clips nor its moving connection blades can be used to lift the switch. Damage and misalignment of the switch can occur. Handling the switch by the insulating drive tube is not recommended because contamination can be transferred onto the surface.

STORAGE --- If the switch must be stored, care must be taken to prevent corrosion and damage from occurring. If possible, leave the switch in its packaged container. The switch’s original packing protects the switch in a plastic bag. This bag includes desiccant and a vapor corrosion inhibiting paper to help keep the switch dry and protect the contacts from excessive oxidation. The switch must be kept at room temperature and covered from outside exposure. A number of switches can be stacked on top of one another if left in their packaged container, but no more than 5 high. Please do not store any of the switches on concrete as concrete promotes moisture. A wooden or plastic pallet is preferred.
INSTALLATION

GENERAL --- A hole must be put into the chamber side to accommodate a 2.63" diameter stainless steel gland body for the installation of the switch into the transformer chamber (2.656" hole recommended). The vertical centerline of this hole shall be put at a distance to the inside of the chamber bottom that will accommodate the locations of the flex connectors shown on the outline drawing, but a minimum of 7.75". The depth location of this hole depends on electrical clearances to ground from the switch. See the outline drawing for overall dimensions of the switch and allow appropriate clearances from the chamber wall to the switch for the voltage class. The bushing locations and spacing should be discussed with Quality Switch when the drawing is reviewed. The following is a step by step procedure that will facilitate the installation of the switch.

STEP1: The stainless steel gland body is to be placed into the cutout in the chamber and tack welded with the key-way tab kept vertical (perpendicular to the chamber bottom). A torpedo level may be used to assist in keeping the tab vertical during this process. The locating jig mentioned in STEP 2 may also be attached to the gland using the three bolt holes. This locating jig may be used to assist in keeping the gland tab vertical during the tack welding process.

STEP2: A weld nut is supplied to be located inside the chamber that will be used along with steel threaded rod to support the rear of the switch. This weld nut will need to be located using the locating weld jig (p/n RD-125-400). This jig will mock mounting a switch into the chamber. If not already done, the jig will need to be bolted to the gland that is tacked into the chamber (3 PLCS, 5/16-18 bolts). The rear of the jig has a bolt to locate the weld nut. Use this bolt to secure the weld nut and adjust the bolt until the nut flange is on the bottom of the chamber. Tack the weld nut to the bottom of the chamber. After tacking is complete, the jig can be removed and the chamber is ready for the finish welding. The gland body needs to be a leak proof weld to the chamber.
STEP3: After the welding is finished, the chamber can be painted. A step must be taken to keep the face of the gland on the inside of the chamber from being painted, as that face is a key part of the ground path.

STEP4: After painting is complete, the switch body is ready to be installed into the chamber. The switch will need to be installed from the front of chamber with the switch body in the GROUND position. The switch must be in the ground position in order to access the three bolt holes that are used to secure the switch to the gland body (the switch is shipped from QS in the ground position with hardware supplied by QS). Tighten these three bolts down, but not completely. They should be tightened to be secure enough to hold the switch until the handle shaft is installed. Final tightening down to a minimum of 9ft-lbs of torque to ensure a snug fit will be done after fit and finish is verified and the handle shaft is coupled with switch shaft during STEP 5. The switch frame may need to be blocked or supported in the rear of the switch to assist with aligning the mounting plate for the installation of the three bolts. The plate will fit up over the keyway and mounting pin in the gland that is welded into the chamber.

SUPPORT OR BLOCKING IN THE REAR OF THE SWITCH UNDER THE MTG RAILS MAY AIDE IN INSTALLATION OF FRONT PLATE BOLTS.

INSTALL SWITCH THRU FRONT OF CHAMBER AND THEN MOVE FORWARD TO ALIGN PLATE

3 SOCKET HEAD CAP SCREWS & BELLVILLE WASHERS

7.75" MIN.
STEP5: With the switch partially fastened on the inside of the chamber, the exterior operating components can be fastened to the outside of the chamber. This will include the brass gland cover, which has three Viton O-rings installed on the inside and outside for a redundant seal once the chamber is filled with fluid. The brass gland cover has a three hole pattern that will align with the welded in gland. The index plate will then be fastened on top of brass gland cover thru the three hole bolt pattern using three flat head Allen screws. Before installing the screws, apply medium strength (blue) Loctite 242 or equivalent to each screw which shall prevent the screws from loosening due to vibration. After the bolts are secured, the handle and shaft assembly can be installed. Caution must be taken not to damage the O-rings when sliding the shaft through the gland. The drive shaft attached to the handle has an offset slot machined in it that will mate up with the switch. Ensure the shaft has not been damaged and has no burrs on the edges of the slot before inserting it to couple with the switch body. Once the handle is installed and coupled with the switch there should be approximately 3/32” gap between the handle and the index plate (position plate). Then proceed to ensure the handle/switch shafts are joined inside the chamber without a bind. Tighten the three bolts referred to in STEP 4 to 9 ft-lbs once overall fit is verified.
STEP5 (CONT): Once the handle is fully engaged, a dog point socket head screw and lock washer are to be installed thru a hole in the side of the brass gland cover. This dog point on the screw will prevent the shaft and handle assembly from coming out. Care must be taken when it is tightened down to ensure the point is in between a groove in the handle shaft and not dragging on the OD of the shaft (which may prevent the shaft from rotating). Once the handle is secured, the switch can be operated. To operate the handle pull the pull ring to free the plunger from the index plate and lift the lever up or down until the switch is in the desired position. The handle lever can be folded out of the way by pulling an L-pin that is tethered to the handle with a chain that is bolted to the underside of the handle. This pin must be re-inserted through a hole when the lever is put back in place for operation. This pin is not a drive pin, but it does prevent the handle lever extension from slipping off during operation.
STEP6: With the switch now secured to the gland in the front and the handle is installed with assurance the switch is not in a bind, install the rear mounting support to the hole in the steel rail closest to the back chamber wall. A 3/8”-16 steel threaded rod is supplied with two serrated flange nuts. While holding one of the serrated flange nuts under the steel switch rail thread the rod down into the weld nut. Then install the second serrated flange nut on the top of the mounting rail and tighten them to the mounting rail. Take care not to pull the switch rails down or force them up during this process as it may cause the switch to bind during operation. The threaded rod should not drag on the edges of the hole in the mounting rail. The hole is oversized to accommodate minor misalignment. The amount of threaded rod that sticks up past the nut on the top of the rail shall not exceed 11/16” max.
STEP7: The switch can now be connected to the bushings in the chamber. It is supplied with braided flex cable attached loosely to a copper connector clip that will connect directly to the threaded stud of the bushing. See the outline drawing for the locations of the connectors. Connect the contact clips to the bushings. This can be accomplished using a socket (15/16” socket for 5/8” hex nut) as shown in the picture. After the bushing connections are secured, the hardware on the stabilizer bar between the three phases can be secured. The connections from the transformer bushings (closed position) are to be cabled and bolted using the .531” diameter hole supplied in the stationary contact clip (this can be done before or after the braided flex is connected). Make sure all cable connections are properly tightened and ensure that there are no strains on the switch that could cause it to bind. Provide sufficiently flexible leads to avoid mechanical strains caused by thermal expansion and contraction. The schematic in Figure 7a is typically how the switch is wired in a network transformer. Figure 7b is the schematic that shows how both interlock coils are typically used in a mag-break application.
Figure 7a: Typical Network Schematic (Dead-Break)

WIRING SCHEMATIC FOR SINGLE SOLENOID
TYPICAL NETWORK TRANSFORMER SWITCH APPLICATION

Figure 7b: Typical Network Schematic (Mag-Break)

WIRING SCHEMATIC FOR DUAL SOLENOID
TYPICAL NETWORK TRANSFORMER SWITCH APPLICATION
OPERATION

GENERAL --- The three positions of the switch are 'OPEN', 'CLOSED', and 'GROUND'. In the 'OPEN' position, the high voltage cable terminals are disconnected from the transformer and from ground. In the 'CLOSED' position the high voltage cable terminals are connected to the transformer terminals. In the 'GROUND' position, the high voltage cables are short-circuited and solidly grounded to the switch chamber, but the transformer terminals are neither grounded nor short-circuited. CAUTION: As mentioned before, disconnecting switches must not be used to interrupt load current, and can be used to interrupt transformer exciting current only, when designed for that purpose (see 'mag-break' type switches).

OPERATION --- To operate a dead break switch, first make sure that the transformer is de-energized. The switch is normally equipped with an electric interlock that will prevent operation of the switch when the transformer is energized. To close the switch from the 'OPEN' position, pull the pull ring plunger on the operating handle and move the handle to the 'CLOSED' position. The handle will strike the brass toggle pin in the 'CLOSED' position and the spring-operated plunger will drop into the hole provided for it. In order to move in to the 'GROUND' position the operator must first release the brass toggle that restricts the handle from rotating any further. The purpose of this brass toggle pin is to ensure a pause before moving through the 'CLOSED' position to the 'GROUND' position or the 'OPEN' position if operating in the opposite direction. This pause allows time for the electrical interlock to engage if the transformer is energized. After the brass toggle pin has been released, the operator must pull the pull ring on the operating handle to release the spring operated plunger as before. The handle can then be moved to the 'GROUND' position and the spring-operated plunger will drop into the hole provided for it. If opposite direction is desired the switch will operate in the same manner.

NOTE: The handle can be locked in any permanent position by a padlock inserted into the hole provided for it in the latch and handle casting. The padlock will prevent the switch from being operated in any position as it restricts the ability to pull the spring operated plunger from the hole in the plate. Sequence grounding switches cannot be locked in sequence 1 or 2. These positions are not designed to withstand fault current or serve as a true ground of the incoming cables.
MAINTENANCE

GENERAL --- Little maintenance work will normally be required and the switch is designed to last the entire life of the transformer. However, it is necessary to follow the same maintenance instructions for the transformer. Quality of the fluid in the chamber is a major factor in the performance of the switch. If any seals on gages or valves are broken on the chamber and not re-sealed properly, moisture or other contamination in the fluid can cause catastrophic failure. Another factor often overlooked is fluid level in the switch chamber. Leaking seals or valves along with fluid sampling are common contributing factors to the level dropping below recommended levels. This also could lead to catastrophic failure.

GLAND SEALING --- The brass gland cover is supplied from the factory with a triple O-ring sealing system designed for redundancy. The O-rings are made of Viton® designed for uses at serviceable temperature ranges of -25°C minimum and 204°C maximum. There is no need for any adjustment to this sealing system after initial installation. If for any reason a leak is detected through the O-ring sealing system please contact Quality Switch, Inc. as soon as possible.

SOLENOID REPLACEMENT --- If the operation of any of the solenoids does not meet IEEE/ANSI standard C57.12.40-2017 section 6.2.6, then replacement is necessary.

TOP SOLENOID --- Use a 7/16 inch wrench to hold the nuts on the bottom of the mounting block while using a 3/8 inch drive ratchet and a 7/16 inch standard socket to loosen the two bolts on top of the mounting block 1-1/2 turns (they do not need completely removed). Once the bolts are loose and coil leads are disconnected, the coil can be removed by sliding the solenoid mounting plate away from the mounting block. Let the spring assembly and the solenoid T fall free and leave them attached to the arm. Insert the T into the solenoid and reinstall the solenoid in reverse order.

BOTTOM SOLENOID --- The bottom solenoid is replaced similar to the top solenoid except a 6 inch extension (3/8 in drive) will be needed and the top assembly arm will need to be removed. Using a 9/16 inch standard socket and a 3/8 inch drive ratchet remove the nut that secures the top assembly arm. Care must be taken when removing the arm. Gently remove the arm from the shoulder bolt. Do not remove any of the spring assembly from the arm. The bottom solenoid can now be removed in the same manner as the top solenoid. Reinstall the bottom solenoid and arm in reverse order.
SOLENOID ARM REPLACEMENT--- Using a 9/16 inch standard socket and a 3/8 inch drive ratchet the nut securing the assembly arm can be removed. Gently remove the assembly arm from the shoulder bolt. Remove the spring from the assembly arm. Be extremely careful not to lose the pin that is inserted into the spring. Replace the spring onto a new arm by looping one end of the spring around the groove on the stud. If the pin came loose from the spring then reinsert it now. Insert the T into the solenoid and gently replace the arm onto the shoulder bolt and retighten the nut.

HANDLE REPLACEMENT --- The entire handle and shaft assembly can be removed by removing the dog point screw from the side of the brass gland cover (see STEP 5). If this dog point screw is loosened such that the point in the screw is no longer engaged with the groove in the shaft, the handle and shaft assembly can be pulled out of the switch. This can only be done when the fluid has been removed from the chamber as once the shaft is removed; there is no longer a seal. The pin that secures the handle to the shaft is a 3/16” diameter grooved pin. This pin is designed to shear before any damage occurs to the drive system inside the chamber or tank. The intent is to protect the switch operator if they try to close in while the transformer is energized and the switch interlock is engaged.
HANDLE REPLACEMENT (CONT) ---
An arrow indicator is etched into the end of the switch shaft and will not move in conjunction with the handle if the pin is sheared (the pin can be replaced if sheared). In order to remove this groove pin from the handle it will require a drive punch and a hammer. Using a 5/32”punch and a hammer drive the 3/16” pin out of the handle. Take caution as the pin must be pounded out from the opposite side it was installed. The grooved/flared end of the pin will not go thru the hole. Be careful that excessive force is not used, as the shaft may get bent. Remove the handle from the shaft. Use a flat fine file to file any burrs that remain on the shaft after the pin is removed. Lubricate hole in handle with WD40 or equivalent and install the handle onto the shaft and re-pin it to the shaft using a new 3/16” grooved pin. If the pin is being replaced for any reason (including shearing), do not reuse the same pin.
HANDLE REPLACEMENT (CONT) ---

VIEW LOOKING ON TOP OF SHEAR PIN (FLARED END HAS GROOVES). MUST BE POUNDED OUT FROM UNDERSIDE OF SHEAR PIN BECAUSE GROOVES ARE TAPERED.

VIEW LOOKING ON BOTTOM OF SHEAR PIN (NO GROOVES VISIBLE ON THIS END). MUST BE POUNDED OUT FROM UNDERSIDE OF SHEAR PIN BECAUSE GROOVES ARE TAPERED.
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