

# GENERAL FEATURES

Since 1905, G&W has provided custom power solutions to utilities and electric power users around the world. G&W has a wide selection of reliable, quality switching and fault interrupting products to meet the most stringent customer requirements. Whether the application involves load switching, line sectionalizing, fault interruption or Smart Grid automation, G&W can provide a solution for distribution system switching and protection. When specifying switchgear, consider these features:

## MAXIMUM OPERATOR SAFETY

SF<sub>6</sub> gas is a nontoxic, nonflammable switching dielectric. Dead front switch construction eliminates any exposed live parts. Spring-assisted mechanisms assure quick-make, quick-break operation. Viewing windows permit visual verification of open or closed contacts. Tamper-resistant enclosures utilize pentahead bolts and padlocking provisions. Motor actuators are available permitting remote operation. The result is maximum operator safety.

## MINIMAL MAINTENANCE

G&W SF<sub>6</sub> switches are corrosion-resistant, totally sealed and factory filled. No more field adjustments of critical contact areas or concerns with environmental contamination or intrusions. A periodic check of the pressure gauge is all that is required.

## APPLICATION VERSATILITY

**Multi-way Configurations** — Switches are available for either two-position or three-position (incorporating an integral ground, tie or test position) switching. Single or multiple sources can feed multiple loads. Bus tie configurations are available permitting multiple sources to feed different loads within the same switch.

**Mounting Flexibility** — Horizontal and vertical configurations are available with operating apparatus accessible from the front, top or side compartments.

**Bushing Variety** — Many bushing styles are available including an exclusive disconnectable style permitting field changeout. Cable entry can be bottom, front, back or side. Transformer throat designs are available.

**Visible Break** — Load break switches can incorporate a visible break of all three phases.

**Overcurrent Protection** — Fusing or electronically controlled, resettable vacuum interrupters are available.

**Smart Grid / Lazer Solutions** — Complete SCADA distribution automation and Smart Grid solutions are available including automatic transfer. G&W's Lazer distribution automation systems provide pre-engineered, time-proven solutions for automatic power restoration.



# LOAD AND FAULT INTERRUPTING SWITCHES

## PUFFER VACUUM INTERRUPTERS

G&W load and fault interrupting combination switches combine the total cost and operating benefits of fuseless, electronically controlled, resettable overcurrent protection with the safety and maintenance benefits of a totally sealed, deadfront, SF<sub>6</sub> insulated device. The switches are designed for automatic single or three phase fault interruption with manual load break capabilities for systems through 35kV, 630A continuous. Ratings to 900A continuous are available on certain models. Single side access designs are available for confined space applications.

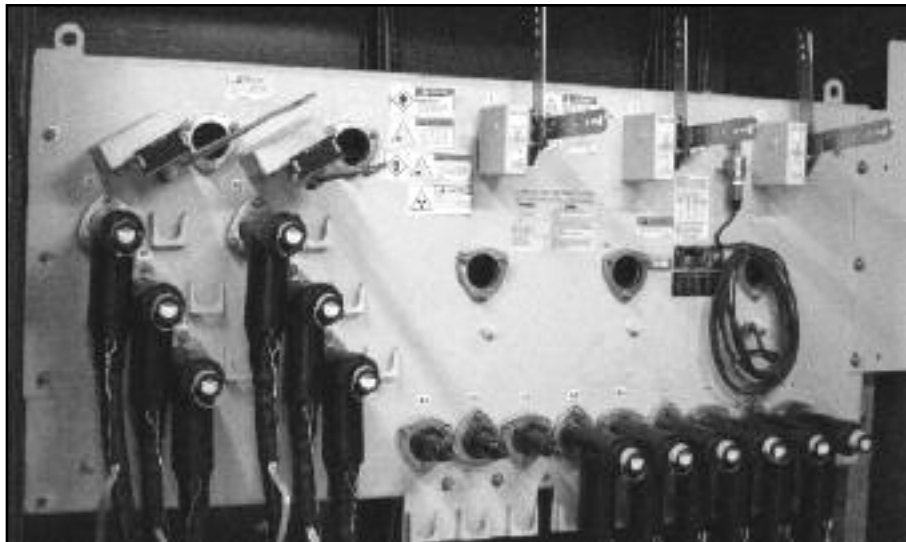
### FEATURES

**Operator Safety** — G&W combination switches are totally sealed, dead front and insulated with non-flammable, nontoxic SF<sub>6</sub> gas. Operators are spring assisted for positive quick-make, quick-break operation. A trip-free mechanism permits interruption independent of the operating handle if closing into a fault. Viewing windows permit visible indication of interrupter contact position.

**Minimal Maintenance** — No more routine inspections or dielectric testing as with oil gear. No more contact contamination, rodent problems or insulator maintenance as with air gear. A periodic check of the gas pressure gauge is all that is required.

**Three Phase Tripping** — No more single phasing problems. Simultaneous three phase tripping is available through the electronics and with three phase operating handles for manual operation and reset.

**Protection Curve Compatibility** — G&W solid state electronic controls permit extremely accurate, consistent protection curve characteristics compared to conventional fuses. The exclusive controls can emulate the



▲ VPNI single side access switch.

most common time current curves (TCC) for power fuses, relays and fuse links (oil fuse cutouts). Optional electronic packages can provide ground trip, inrush restraint and adjustable time delay capability.

**Fully Tested** — Switches are designed and tested per applicable sections of IEEE C37.71, C37.60, C37.74 and IEC 265 standards.

### APPLICATIONS

G&W combination switches provide a direct replacement for power fused air and vacuum-in-oil switchgear. Some ideal applications include:

**Transformer and Motor Protection** — The three phase trip feature and high continuous current capability make PVIs ideal for protecting three phase motors and transformers.

**Loop and Tap Switching** — Full 630A and optional 900A loop switching is accomplished using the latest puffer technology. Tap switching through 630A and up to 25kA symmetric fault protection is accomplished using resettable, electronically controlled vacuum interrupters. The vacuum interrupters also function as load break switches.

**Automatic Transfer** — For critical load applications, switches can be supplied with an automatic transfer control package to provide automatic transfer from one source to another to minimize downtime.

**Smart Grid / Lazer Solutions** — Switches can be supplied with motor actuators on both the line and load side providing remote control capability. Various control packages including portable controls are available.

For Smart Grid applications, G&W works with the top control manufacturers of the industry, including Schweitzer and GE, to match the right control for the job. For automatic power restoration, G&W's Lazer solution provides a pre-engineered, field proven system which can be preassembled and factory tested prior to shipment.

**Metalclad Switchgear Replacement** — Front access designs can provide up to a 900A rated main bus with up to six 25kA symmetric protected load ways for a compact, economical alternative to metalclad and metal enclosed lineups. All switches can be equipped with SEL relays, providing flexibility, as well as complete remote monitoring and control capabilities.

# THREE POSITION LOAD BREAK SWITCHES

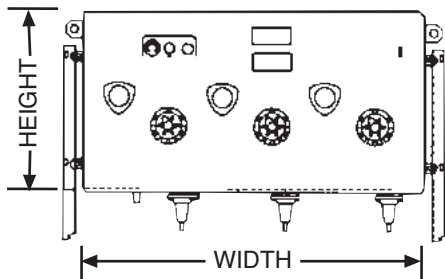
## THREE POSITION, GROUND SWITCHES - GRAM SERIES (Close-Open-Ground)

An integral ground position within the switch tank permits safe and easy grounding of the cable circuit without having to disconnect elbow or other cable entrance connections. Switching to ground is accomplished through the simple throw of the operating handle without having to de-energize other circuits through the switch. This feature is beneficial for applications using lead covered cables where cable movement needs to be minimized. Ground stops with padlocking provisions help assure proper operation in the desired position.

### Rotary Puffer (RP) Ratings

See contact principle page for Rotary Blade (SF) ratings.

|                                    |      |           |           |
|------------------------------------|------|-----------|-----------|
| Maximum design voltage,            |      |           |           |
| kV .....                           | 15.5 | .....27   | .....38   |
| Voltage class,                     |      |           |           |
| kV .....                           | 15   | .....25   | .....35   |
| Impulse level (BIL),               |      |           |           |
| kV .....                           | 110  | .....125  | .....150  |
| One minute withstand,              |      |           |           |
| AC kV .....                        | 35   | .....60   | .....70   |
| One minute withstand,              |      |           |           |
| Production test rating             |      |           |           |
| AC kV .....                        | 34   | .....40   | .....50   |
| 15 minute withstand,               |      |           |           |
| DC kV .....                        | 53   | .....78   | .....103  |
| Continuous and load break current, |      |           |           |
| Amps .....                         | 630  | .....630  | .....630  |
| Momentary current,                 |      |           |           |
| kA asym .....                      | 40   | .....40   | .....40   |
| Fault-close current, (3 times)     |      |           |           |
| kA asym .....                      | 32   | .....32   | .....32   |
| One second current                 |      |           |           |
| kA sym .....                       | 25   | .....25   | .....25   |
| Mechanical endurance,              |      |           |           |
| operations .....                   | 2000 | .....2000 | .....2000 |



| One-line Diagram (Horizontal) | Voltage Class (kV) | Mom (kA) asym. | Catalog Number* | Approximate      |                                 |
|-------------------------------|--------------------|----------------|-----------------|------------------|---------------------------------|
|                               |                    |                |                 | Width in. (mm)** | Wt. w/SF <sub>6</sub> lbs (kgs) |

## GRAM SERIES (GROUND SWITCHES)

|    |    |                  |                  |              |            |
|----|----|------------------|------------------|--------------|------------|
|    | 15 | 40               | GRAM21-376M-40RP | 29 (737)     | 700 (318)  |
|    |    | 40               | GRAM21-376M-40SF | 37.8 (960)   | 750 (341)  |
|    | 25 | 40               | GRAM21-386M-40RP | 29 (737)     | 700 (318)  |
|    |    | 40               | GRAM21-386M-40SF | 37.8 (960)   | 750 (341)  |
|    | 15 | 40               | GRAM33-376M-40RP | 40.5 (1029)  | 950 (431)  |
|    |    | 40               | GRAM33-376M-40SF | 54 (1372)    | 1444 (657) |
|    | 25 | 40               | GRAM33-386M-40RP | 40.5 (1029)  | 950 (431)  |
|    |    | 40               | GRAM33-386M-40SF | 54 (1372)    | 1444 (657) |
|    | 15 | 40               | GRAM44-376M-40RP | 52 (1321)    | 1200 (544) |
|    |    | 40               | GRAM44-376M-40SF | 70.3 (1786)  | 1500 (682) |
|    | 25 | 40               | GRAM44-386M-40RP | 52 (1321)    | 1060 (482) |
|    |    | 40               | GRAM44-386M-40SF | 70.3 (1786)  | 1500 (682) |
|    | 15 | 40               | GRAM55-376M-40RP | 63.5 (1613)  | 1500 (681) |
|    |    | 40               | GRAM55-376M-40SF | 86.5 (2197)  | 1713 (779) |
|    | 25 | 40               | GRAM55-386M-40RP | 63.5 (1613)  | 1500 (681) |
|    |    | 40               | GRAM55-386M-40SF | 86.5 (2197)  | 1713 (779) |
|    | 15 | 40               | GRAM66-376M-40RP | 75 (1905)    | 1500 (682) |
|    |    | 40               | GRAM66-376M-40SF | 102.8 (2610) | 2056 (935) |
|    | 25 | 40               | GRAM66-386M-40RP | 75 (1905)    | 1500 (682) |
|    |    | 40               | GRAM66-386M-40SF | 102.8 (2610) | 2010 (914) |
| 35 | 40 | GRAM66-396M-40RP | 75 (1905)        | 1500 (682)   |            |

\*Suffix RP = Rotary Puffer, SF = Rotary Blade. Inverted designs with top entry bushings are available.

\*\*For 40A rotary puffer style switches: tank depth = 25" (635mm), tank height = 27" (686mm). Dimensions are approximate and do not include entrances, gauges, frames or operators.

\*\*For 40kA rotary blade style switches: tank depth = 23" (584mm), tank height = 28" (711mm). Dimensions are approximate and do not include entrances, gauges, frames or operators.

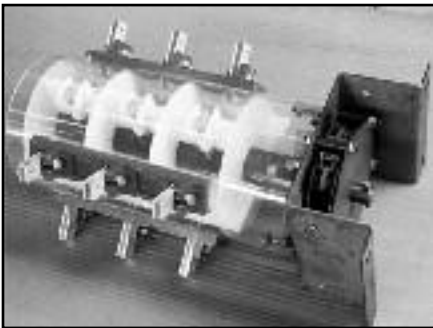
For typical specifications, go to [www.gwelec.com](http://www.gwelec.com).

For contact principle, see page 34 & 35.

# CONTACT PRINCIPLES

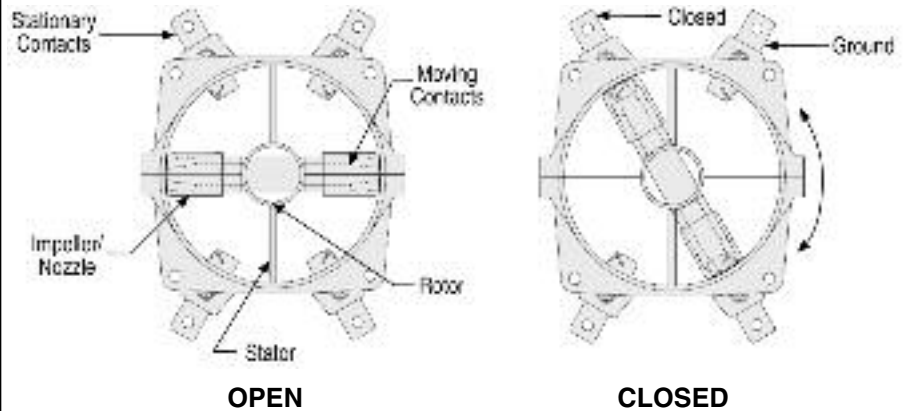
## THREE POSITION, ROTARY PUFFER STYLE

For systems through 38kV, 630A continuous current with 40kA asym. momentary, 32kA close into fault current and 25kA sym. one second rating; rotary puffer (RP) style switches are used. G&W's multi-position spring operator permits an integral third switching position to increase the application capability over conventional two position switches. Three position switches combine increased switching flexibility with compact construction.



▲ Three position rotary puffer mechanism.

## THREE POSITION, ROTARY PUFFER CONTACT PRINCIPLE



**A.** The stationary contacts and the multi-chamber rotor (an assembly of interlocking parts which form a rotational framework including moving contacts) are housed in a clear cylindrical shell. The stationary contacts are supported independent of the cable entrance bushings, eliminating possible misalignment resulting from tank deflections. Tank deflections are caused by normal tank pressure variance due to ambient temperature fluctuations. Each rotating contact simultaneously disengages from two stationary contacts, providing two break points per phase. This provides improved interrupting capability as compared to single break contact systems.

**B.** As the rotor tube assembly turns to disengage the moving contact from the stationary contacts, dielectric media ( $\text{SF}_6$  gas) is compressed between the impeller and stator. The shell, phase barrier and rotor tube also act to confine the gas for proper compression and flow. The compressed  $\text{SF}_6$  gas is directed through the nozzle into the arc zone. The  $\text{SF}_6$  flows (is puffed) across the contacts and around the arc established by the separating puffed contacts, cooling the arc over the length of the nozzle. The cooling action is increased by the higher pressure (due to compression) and the flow of gas which constantly provides a supply of cool  $\text{SF}_6$  into the arc zone.

**C.** At current zero, the temperature of the arc is reduced to the point of deionization. The  $\text{SF}_6$  gas rapidly recovers dielectric strength withstanding the system recovery voltage and preventing re-ignition of current across the contacts.

**D.** As the rotor tube assembly turns to engage the moving contact with the stationary contacts, the impeller induces a flow of  $\text{SF}_6$  gas between the contacts to minimize pre-strike.



# ACCESSORIES AND OPTIONS



## 3-1/C, 600A QUIK-CHANGE APPARATUS BUSHINGS

Cable entrance bushings can be damaged at any time due to improper handling, accidental shifting during shipment, elbow failure or even normal wear and tear. In the case of SF<sub>6</sub> gas insulated switches where the tank is totally welded, conventional bushing replacement means sending the switch back to the factory for repair. G&W's exclusive Quik-Change Disconnectable Bushing permits quick, easy field replacement without having to open the switch tank.

Bushings are designed to IEEE 386 standards with standard interface accepting conventional elbow style connectors and include an aluminum conductor with 5/8"-11 aluminum threaded stud and aluminum single hole pad (**elbows must be ordered separately**). Copper studs are available. For bottom entry switches, recommended switch frame height is 42" for all voltages.



## 3-1/C, 600A VOLTAGE SENSING BUSHINGS

G&W's Voltage Sensing Bushing (VSB) system is a temperature compensated, built-in, voltage measuring system that eliminates the need for PTs when three phase analog voltage monitoring is required. Compared to potential transformers, the VS bushing system offers these benefits:

- Significant cost savings
- Cleaner, less cumbersome installation
- Less space required
- Fewer add-on components which could potentially fail
- Installed and tested prior to shipment
- Can be field calibrated
- One digital output per way for threshold voltage detection



The VS bushing system utilizes a capacitively coupled screen which is embedded within the epoxy bushing. The low energy output of the screen is amplified by integral circuitry, resulting in a 0-120 VAC analog output suitable for direct connection to any relay, IED or RTU. The circuitry incorporates built-in calibration and temperature compensation which improve accuracy.

Bushings are designed to IEEE 386 standards with standard interface accepting conventional elbow style connectors and include an aluminum conductor with 5/8"-11 aluminum threaded stud and aluminum single hole pad (**elbows must be ordered separately**). Bushings are bolt-on style. Copper studs are available. For bottom entry switches, recommended switch frame height is 42" for all voltages.

| SPECIFICATIONS   |   |   |
|--|---|---|
| Operating temperature:<br>-40°C to +65°C               | Analog voltage outputs: 3 or 6                          | Maximum burden (per output): 0.06VA   |
| Input voltage range (phase-to-phase):<br>10.7kV - 38kV | Number of digital outputs: 1 or 2                       | Voltage accuracy:<br>+/- 2% from 0°C to 65°C and +/- 5%<br>from -40°C to 0°C. |
| Nominal output voltage: 120 VAC                        | Digital pick-up voltage:<br>90% of Vnom (on all phases) | Voltage signal delay: 1/2 cycle max   |
|  | Digital drop-off voltage:<br>75% of Vnom (on any phase) |   |



## 3-1/C, 600A / 900A APPARATUS BUSHINGS

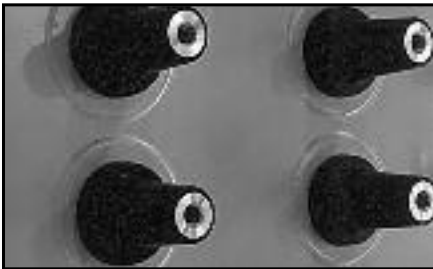
Bushings are designed to IEEE 386 standards with standard interface accepting conventional elbow style connectors and include an aluminum conductor with 5/8"-11 aluminum threaded stud and aluminum single hole pad for a 600A rating (**elbows must be ordered separately**). A copper conductor is available which extends the continuous current rating to 900A. For bottom entry switches, recommended switch frame height is 42" for all voltages. Welded flange bushings are available.

# ACCESSORIES AND OPTIONS



## 3-1/C, 200A DEEPWELL BUSHINGS

Bushings are designed to IEEE 386 standards with standard interface accepting deadbreak or loadbreak inserts and conventional elbow connectors (**inserts and elbows must be ordered separately**). A copper conductor is standard. For bottom entry switches, recommended switch frame height is 42" for all voltages. Welded flange bushings are available.



## 3-1/C, 600A APPARATUS BUSHINGS WELDED FLANGE STYLE

Bushings are designed to IEEE 386 standards with standard interface accepting conventional elbow style connectors. Bushings include a stainless steel flange and an aluminum conductor with 5/8"-11 aluminum threaded stud. (**Elbows must be ordered separately**). 200A deepwell welded flange bushings are also available.



## 3-1/C, 600A UNIVERSAL BUSHINGS

The combination Universal Cable End and Universal bushing provides an extremely versatile interface between cable and equipment for easy connecting, disconnecting, and isolating of distribution cable circuits. End caps for both bushing and splice module permit dead-ending of the cable and equipment for fast cable sectionalizing if required.

Universal bushings are designed to accept G&W universal bushing cable ends (**G&W Universal bushing cable ends must be ordered separately. See chart below**). An aluminum conductor and aluminum single hole pad is standard. For bottom entry switches, recommended switch frame height is 36" for all voltages. Hi-pot test kits are available.

**NOTE:** Universal bushings can accept up to two G&W Universal bushing cable ends per phase. For applications requiring this feature, consult factory.

## UNIVERSAL BUSHING CABLE ENDS (PER PHASE)

Complete cable data required before order can be processed.

| Configuration                                   | Catalog Number |         |
|---|----------------|---------|
|   | 15.5kV         | 27kV    |
| Terminate 1 cable per phase                     | 15CE           | 27CE    |
| Terminate 2 cables per phase                    | 15CE-CE        | 27CE-CE |
| Dead End Kit                                    | 15DCE          | 27DCE   |
| Change 1 cable per phase to 2 cables per phase* | 151V2          | 271V2   |

\* Kit includes second cable end (CE) and hardware necessary for connection.

# ACCESSORIES AND OPTIONS



## 3-1/C, 600A OPEN STUD BUSHINGS

Open stud bushings are furnished standard with 3/4"-16 threaded copper stud connectors and require G&W air termination kits (G&W air termination kits must be ordered separately. See below). For bottom entry switches, recommended switch frame height is 42" for all voltages where this bushing is used. If other than G&W termination kits are used, a NEMA 2-hole pad must be specified. See note below.

NOTE: 1. Bushings are also available with NEMA 2-hole pad. G&W air termination kits must be purchased separately. See below.

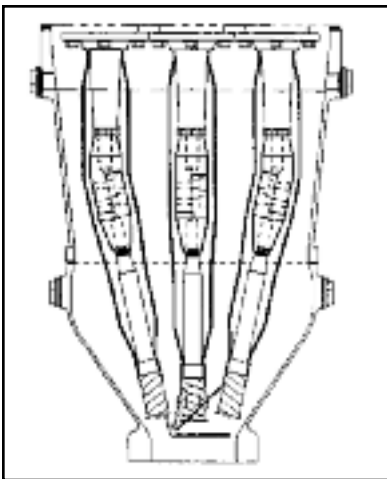
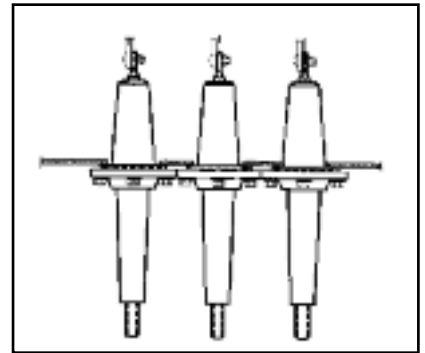
| kV | Amp | kV BIL | Wt./3Ø set lbs (kgs) |
|----|-----|--------|----------------------|
| 15 | 600 | 110    | 35 (16)              |

## AIR TAPE TERMINATION KITS

Tape termination kits include all material required for fully shielded air terminations. Specify by completing the catalog number below:

AT X X X X MR - Y Y - Z Z

XXXX = Conductor size, i.e. #4AWG (0004), 4/0 (04/0), 1000kcm (1000), etc.  
 YY = Conductor type, i.e. Stranded Compressed (SC), Compact Round (CR).  
 ZZ = Connector style, i.e. Aluminum Crimp (AC), Copper Solder (CS), Copper Crimp (CC).



## 3/C, 600A STUD BUSHING COMPARTMENT

Stud bushing compartments include stud bushings with copper conductor, cast iron or non-magnetic cast aluminum mounting plate, shape C body and compartment, solder connector for copper conductors (aluminum conductors require compression style connectors), and WS, RS or DP entrances. Entrance style is dependent upon cable construction. Specify complete cable data when ordering. Accessory entrance fittings may also be required. Stud bushing compartments are designed for a maximum conductor size of 750KCM aluminum or 1000KCM copper. For bottom entry switches, recommended switch frame height is 60" for all voltages. **Stress cone kits and compound are required. Consult factory for proper compound selection.**

| kV | Amp | Wt. lbs (kgs) | Comp'd Req'd gals (L) |
|----|-----|---------------|-----------------------|
| 15 | 600 | 140 (64)      | 5 (19)                |

## STRESS CONE KITS

| Conductor Size AWG/KCM (mm <sup>2</sup> ) | Catalog Number |
|---|----------------|
| 4-4/0 (21-107)                            | T1MR           |
| 250-500 (127-253)                         | T2MR           |
| 600-1000 (304-507)                        | T3MR           |

Stress cone kits include all material required for fully shielded air terminations. Specify solder (copper) or compression (copper or aluminum) connector and complete cable data. Kits may differ depending upon cable insulation type.

# ACCESSORIES AND OPTIONS

For standard components, refer to typical specifications at [www.gwelec.com](http://www.gwelec.com) under Support.

## Gas Pressure Gauge and Fill Valve (Standard)

The pressure gauge is a “GO-NO-GO” style which is color coded to simplify verification of proper operating conditions. A Schraeder type fill valve permits refilling in the field. The gauge and fill valve are made of brass for corrosion resistance. Both are protected by a steel guard.



▲ Pressure gauge and fill valve

## Temperature Compensated Gas Density Gauge (Optional)

measures internal tank gas density for maximum precision of switch operating conditions. The gauge is colored coded to simplify reading.



▲ Temperature compensated gauge

## Viewing Windows (Standard)

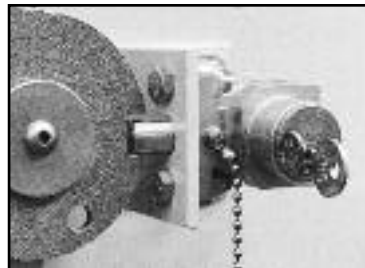
provide a means to visibly verify switch contact position. Single phase or three phase contact viewing is available.

## Frames (Optional)

are corrosion-resistant galvanized steel channels and supplied factory assembled to the switch. Open or panel style frames are available in various heights.



▲ Auxiliary switches



▲ Key interlocks



▲ Low pressure warning device

## Key Interlocks (Optional)

may be used as an added safety measure to prevent operation by unauthorized personnel or to assure safe coordination of energized equipment. Switches can be provided with provisions only (two maximum per operating mechanism) or with key interlocks factory installed. Specify locking scheme when ordering, i.e. lock in open, lock in closed or lock in both open and closed position. For key interlocks to be coordinated with other equipment, manufacturer's information must be provided.

## Ground Lugs (Optional)

are bronze, eyebolt style for 4/0 maximum conductor cable.

## Auxiliary Switches (Optional)

can be included to provide remote indication of contact position. One N.O. and one N.C. contact is supplied and can be wired by G&W or the customer. A maximum of two auxiliary switches can be installed per operating mechanism.

## Low SF<sub>6</sub> Remote Monitoring Devices:

**1) Low Pressure Warning Devices** are factory set at 5 psig and permit remote indication of internal tank pressure. It can also be used for low pressure control lockout. One Form C contact is provided for wiring by the customer.

**Recommended for installations where ambient temperature does not fall below 0°F (-15°C).**

## 2) SF<sub>6</sub> Density Switches

permit remote indication of internal tank gas density to assure proper pressure/temperature operating conditions. One Form C contact is provided for wiring by the customer.

**Recommended for installations where ambient temperatures fall below 0°F (-15°C).**



## Window Cover (Optional)

Available for Type 1, Type 2 or Type 3 interrupter controls.



▲ SF<sub>6</sub> density switch



# ACCERORIES AND OPTIONS

## OPTIONS

Select from the following options and add to the appropriate switch specification:

- Stainless steel tank, type 304
- Temperature compensating pressure gauge
- Low pressure warning device
- SF<sub>6</sub> density switch
- 4/0 brass ground lug
- Key interlock provisions
- Key interlocks to lock in open position
- Current transformers for load break ways
- Potential transformers for voltage monitoring and/or control power
- Automatic transfer control type ATC451-4
- Motor actuators for remote switch operation
- Auxiliary switches for remote switch position indication
- Stationary switch controls for remote switch operation and SCADA integration
- Portable switch controls for remote switch operation
- Remote terminal units and communication packages for SCADA integration
- Operation counters
- Voltage sensors with 120VAC output or a contact to indicate presence of voltage
- Voltage indication panels
- 200A deepwell bushings
- 600A apparatus bushings
- 600A voltage sensing bushings
- 600A Quik-Change apparatus bushings
- 600A Universal bushings (through 25kV)
- 600A Open stud bushings
- 600A 3/C Stud bushing compartment
- Type 2 vacuum interrupter control including ground fault trip and time delay selector switches (three phase only)
- Type 3 vacuum interrupter control including ground fault trip, inrush restraint, programmable vacuum fluorescent display (VFD) and RS232/485 port
- Type 4 vacuum interrupter control (same as Type 3 with laptop programming only)
- Clear window cover for Type 1, Type 2 or Type 3 interrupter controls
- Submersible NEMA 6P enclosure for vacuum interrupter control
- SEL relays including 751A, 501, 551 and others
- External power / trip for vacuum interrupter control
- Refill kit consisting of regulator, hose and SF<sub>6</sub> bottle