**GENERAL SWITCH INFORMATION**

**PHD Switches need a magnet or target to actuate.**
- Switch is stationary, magnet or target passes underneath
- 4 types of actuation devices
  - Reed Magnet Option M
  - Hall Magnet Option E
  - MR Magnet Option I
  - Target Kits

**Reed Magnets**
- Option M must be ordered
- Axial Polarity
- 50 Gauss minimum

**Hall Effect and MR Magnets**
- Option E Hall Effect
- Option I MR
- Radial Polarity
- 110 Gauss Minimum

**Mechanical Sensing Option M**
- Mechanical sensing is PHD’s Reed Switch
- Switches AC or DC
- Glass Encapsulated for a long life and protection
- Typical life...8 mil
- Low cost

**Solid State Sensing Option E & Option I**
- Solid State Sensing is PHD’s Hall Effect or Magneto Resistive Switch
- Switches DC only
- No moving parts
- Typical life...forever
- Higher cost
**GENERAL SWITCH INFORMATION**

**Compare PNP vs. NPN**

**PNP**
- Source (PNP)
  - PNP (Source) is what everyone is accustomed to.
  - Provides current to the load
  - Most common switch

**NPN**
- Sink (NPN)
  - NPN (Sink) is the opposite of PNP (Source).
  - Provides a path to negative
  - a.k.a. negative switching, true low

**Let's Put it Together (PNP)**

**Let's Put it Together (NPN)**
### SWITCH SELECTION GUIDE

The Switches are available on each product!

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<th>ROTARY ACTUATORS</th>
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<td>SERIES O</td>
<td>SERIES CRS &amp; CTS</td>
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<td>SERIES CV</td>
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Option code, kit, or specification must be specified on the unit ordering number when switches are to be used. For kit numbers or option callouts, see ordering data page in each specific product section. BLANK BOXES INDICATES NOT AVAILABLE OR NOT COMPATIBLE.
The Switches are available on each product!

**SWITCH SELECTION GUIDE**


### SWITCHES/SENSORS

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**ANGULAR GRIPPERS**

| SERIES 8400 | -5 | -3 |
| SERIES 190 | -5 | -4 |
| SERIES 8600 | (S) | -3 | -4 |
| SERIES 5300 | -7 | -3 | -4 |
| SERIES 7900 | -6 -5 | -2 -1 | -3 -4 |
| SERIES GRB (180°) | -2 | (S) | -5 |

**PARALLEL GRIPPERS**

| SERIES GRD | -2 -1 | -6 | -7 | -8 | SENSOR OPTION |
| SERIES 190 & 191 | (S) | -5 | (S) | (S) | (S) |
| SERIES 8600 | -3 | |
| SERIES 5300 | -7 | |
| SERIES 7900 | -6 -5 | -2 -1 |
| SERIES GRC | -2 | (S) | -5 | |

**NOTES:**

1) * GRIDx5x & GRIDx6x  ** GRIDx3x  ** GRIDx4x, 5x, 6x  ** GRIDx3x, 4x, 5x, 6x
2) Option code, kit, or specification must be specified on the unit ordering number when switches are to be used. For kit numbers or option callouts, see ordering data page in each specific product section. BLANK BOXES INDICATES NOT AVAILABLE OR NOT COMPATIBLE.
3) Escapement -2 option only on standard duty 1600x units.
4) -4 option is Hall sensor ready.
Q: What is the minimum Gauss reading of the different switches?
A: Hall Effect - 120 Gauss, Reed - 55 Gauss, Magnetoresistive -60 Gauss

Q: My AV cylinder with a option M has a “Deadspot.”
A: If the customer can turn the piston rod of his AV cylinder and find a “deadspot” when the switch should be activated, the reed magnet segments may have been assembled incorrectly.

Q: What is the working principle of a set point module?
A: It works under a progressive theory. As the gripper jaws close/rotary moves clockwise the voltage increases. This voltage is set with screws on the side of the set point module. Once the voltage is equal to or greater than the set voltage (set by you) the output goes high, then the next, and so on. Once the output goes high, it will remain high until the voltage drops below the set voltage. You have up to 4 settings per set point module.

Q: What is the difference between a Hall Effect switch and a Hall Effect sensor?
A: The sensor must be used with a set point module and a sensor cable. It is always on, it is not a binary device, it is an analog device. The switch is used with a target and does NOT need a set point module, it is either on or off.

Q: How do I know to order a sinking or sourcing switch?
A: This is based solely on the input of the PLC. Every PLC comes with a wiring diagram.

Q: What is the temperature limitations of the magnets in our units?
A: 180°F. This is based on the limitations of the switch.

Q: What is the temperature range of our switches?
A: As a rule 32 - 180°F (0 - 80°C)
   You will need to verify this in the switch section of the PHD main catalog.

Q: Is a magnetoresistive switch a Hall or a Reed Switch?
A: Magnetoresistive is a solid state switch, which makes it a type of Hall Switch.

Q: Can I power a Hall Effect switch with AC?
A: No, it is a solid state switch.
THE MAIN DIFFERENCES BETWEEN SERIES 1750 DESIGN 1 SWITCHES AND DESIGN 2 ARE:
(Design 2 and Design 3 for 175x9 family)

1) Cable jacket was gray PVC .133" dia. and is now black Polyurethane .177" dia.
   This gives us a more robust cable while still maintaining a high degree of flexibility. It also will be more resistant
to chemical or coolant attack.

2) The individual conductors within the cable have gone from 28 AWG to 24 AWG.
   The larger gauge wire in the new models is easier to work with at installation. (The smaller number means a
   larger wire.)

3) The color of the wires has changed from red, white, and black to brown, black, and blue.
   This will bring us in line with all three major conductor cable manufacturers and all other switch manufacturers.
   This really should not cause any major confusion in the field as almost all proximity switches use these colors.
   Labels on the switch and packers in the bag also denote color and function of all cables.

4) Better reverse polarity protection on power leads. Diode protection of reverse polarity on PNP output lead.
   Should result in fewer returns from “blown” switches.

5) True IP67 class environmental protection for Quick Connect models when used with the new 63549-xx threaded
cordsets.
   The new switches will continue to work with old cordsets as in the case of a replacement switch. New
   installations of the new switch should include the new cordset number. Old switches are not recommended for
   use with new cordsets. This is stated in the new four page brochure, SW05, and in Catalog 2K.

6) Old solid state switches were rated from 4.5 to 24 VDC and new solid state models rated from 10 to 30 VDC.
   While unable to cover the range of TTL logic (4.5 - 5 VDC) we felt that the inclusion of the upper range of 30
   volts was more important. Some less regulated systems have voltages that run a little higher than the optimum
   24 VDC and could previously damage our switches. Very few if any of our customers were actually operating at
   a 5 VDC level.
SWITCH APPLICATION TROUBLESHOOTING

REED SWITCHES:
15900, 15901, 17502, 17522-1, 17501, 17521-1, 17509-1-06, 17509-1

SYMPTOM: NO INDICATION OR NO OUTPUT TO PLC

CHECK THE WIRING
- Wires can loosen over time or be wired incorrectly.
- Wire ties may be too tight, causing wires to break.
- Check all connections from the power supply and to the load to verify proper connections.
- Remove power connections completely and reconnect.
- Contact PHD.

CHECK THE MAGNET
- Loosen the switch and bracket, and with the power connected, slide them along the cylinder barrel, checking to see if the LED lights up. Or, disassemble the unit and visually inspect for the presence of a magnet on the piston.
- If there is no magnet, obtain an RGA (Return Good Authorization) from PHD to send the unit back for modification.
- On some models the magnetic segments can be ordered separately.
- Order the correct piston and rod assembly with magnet.

CHECK THE POWER SUPPLY
- Always use a properly rated power supply, well-regulated against transient potential. Some problems can occur when insufficient current is supplied. Care must be taken when sizing the proper supply.
- Replace the power supply with proper current size and regulation.
- Contact PHD for further assistance.

CHECK TO SEE IF THE WRONG SWITCH IS WIRED IN SERIES
- Due to severe voltage drop, it is not advisable to wire Triac (15901-1) switches in series with one another.
- Wire to relay control system individually.
- Disconnect each switch and wire separately to the power supply and individually wire into the input card. Suggest writing an statement in the PLC program.

STROKE TOO SHORT
- Be aware that for the Reed Switch to operate properly there is a minimum stroke requirement. Check the PHD catalog for specific details for your application.
- Use a stop tube or bumper to lengthen the overall dimension, allowing more room for the on/off state.
- Use a commercially available external switch.
- Contact PHD.
SYMPTOM: NO INDICATION OR NO OUTPUT TO PLC

CHECK FOR PROPER MAGNET

• Using the incorrect magnet for the switch (-E for Reed Switch or -M for Hall Switch) will cause improper indication unless controlled. This is due to the way the magnetic field radiates from the magnet. Check the unit label for the proper magnet letter.
• Use the correct switch for the correct magnet.
• Order or send back to PHD (on some models) the piston and rod assembly for conversion.
• Order a new unit.

ENSURE PROPER SWITCH ORIENTATION

• The LED indicators on the switch must face inward (15900-1, 15901-1); the wire must come out towards the center of the tube (17502, 17509).
• Check and relocate the switch and bracket to the correct orientation if required.

LOOSE WIRING

• A supply or ground wire can loosen, causing erratic operation. Visually inspect all the wires.
• Reconnect the switch.
• Recheck all the other connections.
• Ground directly to the power supply.

TEMPERATURE EXCEEDING OPERATION LIMITS

• Check the ambient temperature in the area in which the switch is operating. It is recommended that the Reed Switch operate between -40° F to 170° F for the 15900-1, and 15901-1 models, and between 0° to 80° C for the 17502, 17501, and 17509 models.
• Change the ambient temperature to be within the proper range.
• Contact PHD.

STRAY MAGNETISM FROM OTHER SOURCES

• A magnetic field close to the switch (inductive welding, etc.) can cause the Reed to misfire.
• Isolate the switch from the magnetic field.

INCORRECT GROUND

• When using AC voltages, a machine ground should never be used (neutral only). This is a symptom of an improper ground: when the switch comes into contact with the magnet, a normal light indication occurs; however, when the magnet leaves the switch area instead of turning off, the light from the switch has a low glow causing erratic operation.
• Rewire to AC neutral.
• Call PHD.

VELOCITY TOO FAST FOR SWITCH TO OPERATE

• When the piston travels at a fast rate it is possible that the switch trips so quickly that the programmable controller does not receive the signal. This is generally due to the PLC scan time being too slow to scan the input and program.
• Slow down the cycle time.
• Change to a faster, newer programmable controller.
SWITCH APPLICATION TROUBLESHOOTING

REED SWITCHES:
15900, 15901, 17502, 17522-1, 17501, 17521-1, 17509-1-06, 17509-1

SYMPTOM: SWITCH FAILS AFTER OPERATING

CHECK WIRING
- Loose wiring from load or power supply can cause switch malfunction. Jarring of the wire or a twisting motion of the unit that the switch is connected to can cause the wire to loosen or brake over a period of time.
- Check the wire ties.
- Reconnect the switch to the load or power supply.
- If twisting motion is evident, replacement of the switch should be considered.

TRANSIENTS
- Voltage spikes occurring in the system are generally caused by an inductive load (valves, pilot light, etc.) or improperly regulated voltage supply.
- If a condition is present for possible voltage spikes, replace the switch (if damaged) and install a commercially available transient suppressor or clamping diode circuit.
- Check the power supply for proper regulation.
- Contact PHD.

SUDDEN SURGE CURRENT
- Current value exceeding the recommended rating is generally caused by inductive loads, but can also be caused by some types of input filtering on PLCs.
- Replace the switch with the proper size (current capability).
- Add surge protection (resistor or any commercially available device).
- Call PHD.

LOOSEN BRACKET
- A loose bracket can move from its desired position and cause misfire of the switch.
- Relocate the bracket and tighten it down.
- If the bracket still becomes loose, a drop of adhesive on the screws can sometimes correct the problem.

NORMAL WEAR
- Reed Switches can wear out their contacts after about seven million cycles under certain circumstances. (Dependent on current levels.)
- Replace the switch.
- Contact PHD for further assistance.
SWITCH APPLICATION TROUBLESHOOTING

HALL EFFECT SWITCHES:
15902, 17503, 17523-1, 17504, 17524-1

SYMPTOM: NO INDICATION OR NO OUTPUT TO PLC

CHECK WIRING
• Wires may be loose or wired incorrectly.
• Wire ties may be too tight, causing the wires to break.
• Check all connections from the power supply and to the load to verify proper connections.
• Remove completely and reconnect.

CHECK SWITCH OUTPUT TO LOAD
• Wiring the switch to sink when sourcing, or wiring the switch to source when sinking, is a potential problem often encountered.
  Loosen the wire to the input card of the PLC. Be careful. You should always check with the PLC manufacturer’s manual to verify whether your system has a sinking input or output.
• Replace the damaged switch and rewire correctly.
• Check all wiring to verify proper connection.

CHECK THE MAGNET
• Customers sometimes do not order the correct unit and occasionally order a unit with no magnet at all.
• Loosen the switch and bracket, and with the power connected, slide them along the cylinder barrel, checking to see if the LED lights up. Or, disassemble the unit and visually inspect for the presence of a magnet on the piston.
• Return the unit to PHD for modification.
• Order the piston and rod assembly with the correct magnet.

CHECK THE POWER SUPPLY
• Always use a properly rated power supply, well-regulated against transient potential. Some problems can occur when insufficient current is available. Care should be taken when sizing power supplies.
• Replace the power supply with proper current size and regulation.
• Contact PHD.

CHECK FOR CORRECT VOLTAGE
• Hall Effect Switches have a minimum “on” voltage of 10 VDC, and a maximum voltage of 30 VDC.
• Readjust the voltage levels to the proper rating.

STRAY MAGNETISM FROM OTHER SOURCES
• A magnetic field close to the switch (inductive welding, etc.) can cause the Reed to misfire.
• Isolate the switch from the magnetic field.
**HALL EFFECT SWITCHES:**
15902, 17503, 17523-1, 17504, 17524-1

**SYMPTOM: SWITCH OPERATES ERRATICALLY**

**CHECK FOR PROPER MAGNET**
- Using the incorrect magnet for the switch (-E for Reed Switch or -M for Hall Switch) will cause improper indication unless controlled. This is due to the way the magnetic field radiates out of the magnet. Always check the unit label for the proper magnet letter.
- Use the correct switch for the correct magnet.
- Order or send back to PHD (on some models) the piston and rod assembly for conversion.
- Order a new unit.

**CHECK FOR LOOSE SWITCH WIRING**
- A supply or ground wire can loosen and cause erratic operation. Visually inspect.
- Reconnect the switch.
- Recheck all other connections.
- Ground directly to power supply.

**TEMPERATURE EXCEEDING OPERATION LIMITS**
- The switch may be operating at too high of a temperature. It is recommended that the switch operate at a temperature no higher than 120°F.
- Change the external temperature so it does not exceed 120°F.

**VELOCITY TOO FAST FOR SWITCH TO OPERATE**
- When the piston travels at a fast rate it is possible that the switch trips so quickly that the programmable controller does not receive the signal. This is generally due to the PLC scan time being too slow to scan both the input and the program.
- Slow down the cycle time.
- Change to a faster, newer programmable controller.
SWITCH APPLICATION TROUBLESHOOTING

HALL EFFECT SWITCHES:
15902, 17503, 17523-1, 17504, 17524-1

SYMPTOM: SWITCH FAILS AFTER OPERATING

CHECK WIRING
• Loosen wiring from load or power supply can cause malfunction. Jarring of the switch wire or a twisting motion of the unit the switch is connected to can cause the switch wire to loosen or possibly break over a period of time.
• Visually inspect the connections and reconnect where applicable.
• Check where the twisting motion is evident and loosen and loop the switch wire.

TRANSIENT
• Voltage spike occurring in the system is generally caused by an inductive load (valves, pilot light, etc.) or improperly regulated voltage supply.
• If a condition is present for possible voltage spike, replace the switch (if damaged) and install a commercially available transient suppressor or clamping diode circuit.
• Check the power supply for proper regulation.
• Contact PHD.

SUDDEN SURGE CURRENT
• Current values going beyond the recommended rating is generally caused by inductive loads and can also be caused by some types of input filtering on the PLCs.
• Add surge protection (i.e., resistor, etc.).
• Call PHD.

LOOSEN BRACKET
• A loose bracket can move away from its desired position and cause a misfire of the switch.
• Relocate the bracket and tighten it down.
• If the bracket still becomes loose, a drop of adhesive on the screws can sometimes correct the problem.
SWITCH APPLICATION TROUBLESHOOTING

SET POINT MODULES:
9800-01-0100, 9800-01-0200, 9800-01-0300, 9800-01-0400

SYMPTOM: SET POINT MODULE FAILS TO OPERATE

CHECK THE WIRING TO THE SET POINT MODULE
- Voltage supply wires may be coming loose or the unit may be wired incorrectly.
- Check all connections from the power supply and to the load to verify proper connections (pin 1).
- Remove the power connections and reconnect.
- Call PHD.

CHECK WIRING AND VOLTAGE FEEDBACK FROM SENSOR
- Wires may be coming loose from the set point module or the supply/return signal may not be operating properly.
- Verify that the sensor wires are connected properly, then disconnect and reconnect.
- Check that the sensor is properly connected to the unit.

CHECK POWER SUPPLY
- Always use a properly rated power supply, well-regulated against transient potential. Some problems can occur when insufficient current is available (150 mA operating current per unit excluding supply at pin 10). Care should be taken when sizing the proper supply.
- Replace the power supply with the proper current size and regulation.
- Contact PHD.

SET POINTS NOT ADJUSTED CORRECTLY
- Applying power to the module and not seeing the LED turn on does not mean that the unit is not working. Adjust the potentiometer clockwise until the LED comes on.
- If the LED does not come on, verify voltage at pin 1 using a voltmeter.
- If there is voltage (18 to 24 volts) at pin 1, verify voltage at pin 5 (this verifies the feedback voltage from the sensor).
- Contact PHD.
SYMP T OM: SET POINT WORKS THEN FAILS

RECHECK ALL CONNECTIONS
- Wires not properly connected to the module will eventually loosen, causing the module to malfunction.
- Visually inspect all connections going to and coming from the set point module. Disconnect and reconnect.

TEMPERATURE OUT OF SET POINT RANGE
- The set point temperature range is recommended at the minimum 0°C [32°F] and a maximum 60°C [140°F]. Example: The set point is adjusted in the morning. The temperature in the building increases throughout the day, possibly exceeding 140°F, which could cause the set point to drift and give a false reading.
- Contact PHD.

VERIFY THAT SENSOR IS FUNCTIONING
- Malfunction can cause the set point to fail, resulting in no LED indication or the LED staying on continuously. Causes can be anything from fluid contamination to severe bending or sensor wire. To verify sensor operation, attach the positive lead of the voltmeter at pin 5, negative lead to ground. Observe the voltmeter while turning the shaft (rotary actuator) or moving the fingers (gripper) of the unit in test. If the sensor is bad, there will be no change in voltage.
- If fluid contamination is evident, contact PHD.
- If severe bending of the cable seems to be the cause of the malfunction, add more support where the cable comes out of the sensor plate.

INTERNAL MAGNET LOOSE OR BROKEN
- If the round magnet within the plastic housing becomes loose either by fluid contamination or by some other mean (severe vibration, trauma, etc.), this will cause failure due to non-consistency with the feedback signal from the sensor to the set point module.
- Remove the sensor and reattach the magnet using an alpha-cyanoacrylate type adhesive (Super Glue).
- If fluid contamination is evident, contact PHD.

TOOLING COMING LOOSE FROM UNIT
- The tooling connected to the shaft (rotary) or fingers (gripper) could come loose causing signal inconsistency from the sensor to the set point module.
- Tighten the tooling to unit in test and readjust the set points.

PART SLIPPING
- A common problem with grippers is part slipping. The gripper fingers may pick up a part in an incorrect orientation or the part may slip when being picked up.
- Check parts for proper orientation.
**DUAL SET POINTS SETUP AND ADJUSTMENT**

**SETUP**

1. Turn all four Trim Pots (Trimming Potentiometer) fully counterclockwise approximately 20-23 turns to turn off all set point module outputs. (20-turn Trim Pots will idle at ends of travel so damage will not occur.)
2. Rotate actuator shaft fully counterclockwise (facing end of shaft). For grippers, open the gripper jaw completely.

**ADJUSTMENT**

1. Rotate actuator shaft clockwise to desired position. For grippers, close around the desired part.
2. Turn any single Trim Pot clockwise until the corresponding LED indicator turns on.
3. Continue to repeat steps 1 and 2 until all desired set points are adjusted.

Notes: If using one rotary actuator or one gripper and all four LED indicators are required, connect a jumper wire from pin 4 to pin 5 (dual set point modules only). These illustrations are for example only. Set points are totally independent from one another and may be adjusted to turn on in any order.

The most commonly used logic example for a rotary actuator consists of no outputs at the extreme counterclockwise position of the actuator shaft, one output just slightly clockwise from there, and additional outputs at further positions of clockwise rotation of the actuator shaft. Once turned on, an output will remain on throughout the remainder of actuator clockwise rotation.

The most commonly used logic example for a gripper consists of no outputs for jaws fully open, one output for gripping a large diameter part and additional outputs for smaller diameter parts. Once turned on, an output will remain on throughout the remainder of the jaw travel.