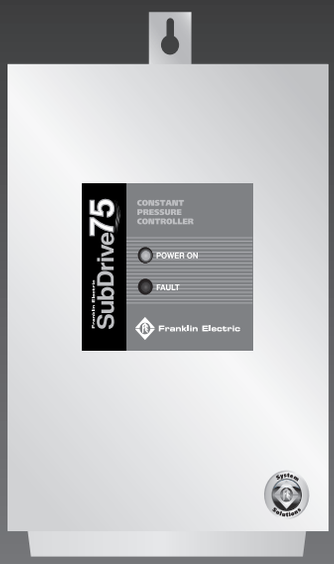
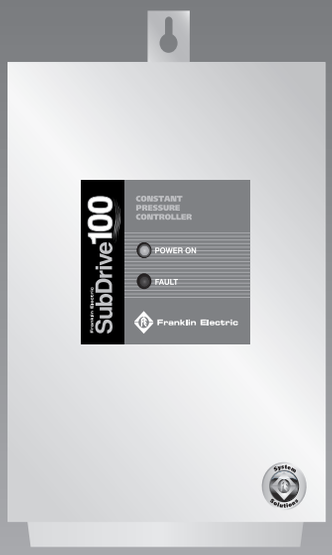




Franklin Electric

# SubDrive75/100/150

## Constant Pressure Controller Installation Manual

05.2010
Doc Nb.: 308 018 602; Rev.: 0

## Contents

# Declaration of Conformity

Franklin Electric declares under our sole responsibility, all SubDrive/MonoDrive series 587 020 3xx0 controllers are in conformity with the Council Directives on the approximation to the laws of the EEC member states relating to the following:

- Electromagnetic Compatibility 2004/108/EC: Adjustable Speed Electrical Power Drive Systems: Standard EN61800-3
- Low-Voltage Electrical Safety 2006/95/EC: Safety of Household and Similar Electrical Appliances: Standard EN60335-1

# About this document

- The instructions and information in this manual form an integral part of the equipment and describe its safe and intended use.
- Keep this manual in the immediate vicinity of the installation.
- Hand this manual to any subsequent owner or installer.
- The instructions and specifications only apply to the equipment described in this manual.
- Technical changes may be made without  notice in the interest of product development.

**Loss of guarantee and liability exclusion:**

Franklin Electric shall not be liable for the damage resulting from any non-intended use. The risk of such use rests solely with the user.

**Target group**

Any electrical system such as described in this manual must only be installed by professional staff (qualified electrical technician).
Per EN 61800-3, the equipment described in this manual is intended for restricted distribution, to be installed by a professional in the first enviroment (Domestic) as Classification C2 (Fixed Installation).

# Warnings notices and symbols

| Warning notices and symbols | Meaning |
|---|---|
|  Danger ! | Direct/Immediate danger to life and/or health |
|  Warning ! | Possible danger to life and/or health. |
|  Information | Important information. You should observe this information to ensure correct and safe operation. Possible danger of physical harm and/or material damage may otherwise result. |

# Safety

Observe the safety rules in this manual. Safety measures are listed in this section.

**Intended use**

- The equipment described in this manual is intended for use with a Franklin Electric submersible motor.
- A correctly sized pump must be fitted to the motor.
- The pump and motor must operate under water only.
- The pumping system must fulfill the applicable directives, regulations and statutory provisions.

**General safety instructions**

The following safety instructions must be observed prior to putting the control gear into use:

- Mount the control gear in an appropriate location, orientation and position.
- Do not modify the control gear or its electrical or mechanical connections.
- Do not remove any part or parts of the control gear.
- Never install any control gear with a known defective motor.
- Remove power before working on control gear. Switching off the power is not sufficient.
- Make sure that nobody can switch on the power unexpectedly while work is being carried out.
- Never work on electrical systems during a thunderstorm.
- Commissioning or testing can only be performed by qualified professional staff (qualified electrical technician).
- Replace all protection and safety devices after completing work.
- Ensure that all electrical connections and safety devices have been checked and that all fuses and safety devices have been set correctly before switching on.
- Make sure that no danger zones are accessible (e.g. electrical connections).
- Read the pump manufacturer‘s commissioning instructions before switching on any control gear.
- Repairs must only be carried out by authorized professional workshops. Use only original Franklin Electric spare parts.

**Storage, transport and disposal Storage**

- Do not remove the control gear from its original packaging until the time of installation.
- Keep this manual with the control gear for future use.
- Do not store in direct sunlight or close to any heat source.

**Transport**

Observe temperature and humidity specifications during periods of transport. (-25°C to +55°C without condensation).

**Unpacking**

After unpacking, check for physical damage that may impact on the safety of the control gear such as a damaged enclosure, dislodged cable glands etc. Observe the local regulations and dispose of any packaging material accordingly.

**Disposal**

Observe the local regulations and dispose of any control gear accordingly. This product contains electrical and electronic components and should be disposed of accordingly.

# Model parameters

**Table: 1**

| Model Name | Part Number | Use with Motor Series |
|---|---|---|
| SubDrive75 | 5870203380 | 234 714 xxxx (1.1 kW) |
| SubDrive100 | 5870204100 | 234 715 xxxx (1.5 kW) |
| SubDrive150 | 5870204150 | 234 716 xxxx (2.2 kW) |

# Description and Features


The Franklin Electric SubDrive is a dependable residential water system controller that uses advanced electronics to enhance the performance of standard submersible pumps. When used with the specified Franklin Electric motor (see Table 1, pg. 3), the SubDrive eliminates pressure cycling associated with conventional water well systems and owners of private water well systems can enjoy “city-like” water pressure. Pump speed and energy consumption automatically adjust to water demand.
In addition, the reduced tank size (see Table 4, pg. 14) allows installation in small spaces.

**SubDrive Key Features:**

- Constant water pressure with a wide range of settings 1.7-5.4 bar
- Smaller pressure tank can be used
- Fits the pump to the application – pump speed is controlled to provide the optimum performance without overloading the motor
- Flexibility – this unit can be used with standard off-the-shelf pumps
- No in-rush (power-on transient) current
- Low motor start-up current (soft-starting)
- Active Power Factor Correction minimizes input RMS current

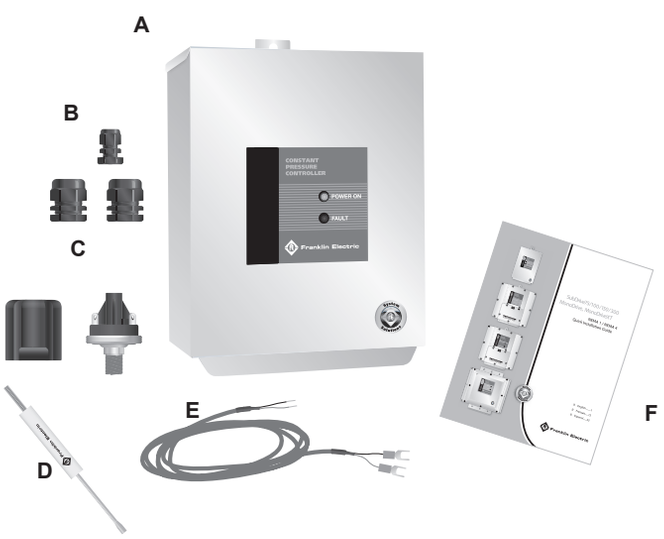
**Protection Features:**

- Dry well conditions – with smart pump monitoring (see Figure 1, pg. 10)
- Bound pump – with auto-reversing torque
- High voltage / lightning surge
- Low line voltage
- Open motor circuit
- Short circuit

# Included Items

## SubDrive75/100/150

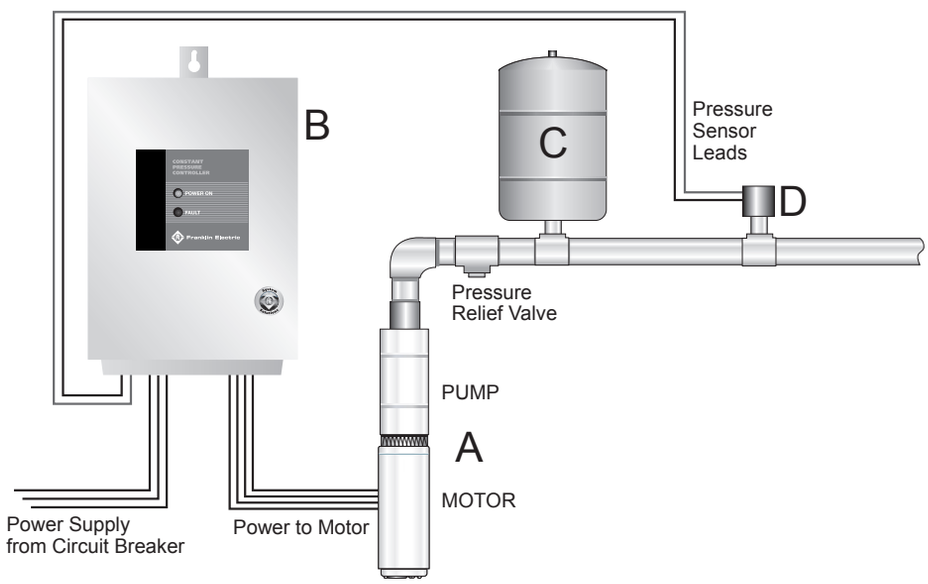
**A. Controller Unit**
**B. Strain Relief Fittings**
**C. Pressure Sensor and Boot**
**D. Sensor Adjustment Tool**
**E. Sensor Cable**
**F. Installation Manual**



# How it Works

The Franklin Electric SubDrive is designed to be part of a system that consists of only four components:

A. Standard Pump and Franklin Electric Motor
B. SubDrive Controller
C. Small Pressure Tank (see Table 4, pg. 14)
D. Franklin Electric Pressure Sensor (provided)




SubDrive controllers provide the ultimate in system performance, utilizing Franklin Electric's three-phase motor series for maximum starting torque, high efficiency and smooth operation. SubDrives convert residential single-phase 60 Hz power into the variable-frequency three-phase needed by the motor. In addition, SubDrives can spin a smaller pump slightly faster to boost output to roughly double its 60 Hz horsepower rating. This allows use of smaller pumps for less system cost. If a smaller pump of the desired flow rating is not available, the controller can be configured to use larger pumps up to the horsepower rating of the motor.

## Constant Pressure

The Franklin Electric SubDrive provides consistent pressure regulation using advanced electronics to drive a standard motor and pump according to the pressure demands indicated by a highly accurate, heavy-duty, long-life pressure sensor. By adjusting the motor/pump speed, the SubDrive can deliver constant pressure dependably, even as water demand changes. For example, a small demand on the system, such as a bathroom faucet, results in the motor/pump running at a relatively low speed. As greater demands are placed on the system, such as opening additional faucets or using appliances, the speed increases accordingly to maintain the desired system pressure.

## Motor Soft-Start

Normally, when there is a demand for water, the SubDrive/MonoDrive will be operating to accurately maintain system pressure. Whenever the SubDrive/MonoDrive detects that water is being used, the controller always "ramps up" the motor speed while gradually increasing voltage, resulting in a cooler motor and lower start-up current compared to conventional water systems. In those cases where the demand for water is small, the system may cycle on and off at low speed. Due to the controller's soft-start feature and sensor's robust design, this will not harm the motor or the pressure sensor.

## System Diagnostics

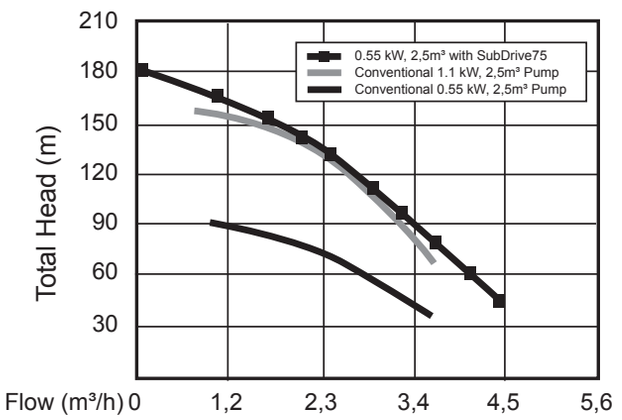
In addition to regulating pump pressure and accurately controlling motor operation, the SubDrive/MonoDrive continuously monitors system performance and can detect a variety of abnormal conditions. In many cases, the controller will compensate as needed to maintain continuous system operation. But if there is high risk of equipment damage, the controller will protect the system and display the fault condition. If possible, the controller will try to restart itself when the fault condition subsides.

# Pump Sizing – SubDrive75

The SubDrive75 is configured at the factory for use with 0.55 kW pumps that are mounted to 1.1 kW Franklin Electric three-phase motors. **In general, the SubDrive75 will enhance the performance of a 0.55 kw pump to a similar or better performance than a conventional 1.1 kW pump of the same flow rating (pump series).**

To select the proper 0.55 kW pump, first choose a 1.1 kW curve that meets the application's head and flow requirements. Use the 0.55 kW pump in the same pump series (flow rating). The SubDrive75 will adjust the speed of this pump to produce the performance of the 1.1 kW curve. An **EXAMPLE** of this is illustrated in the graph at right. Please consult the pump manufacturer's pump curve for your specific application.

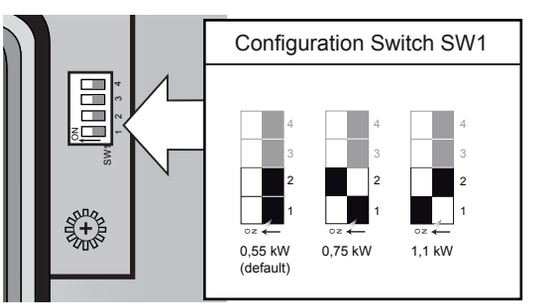
**EXAMPLE 1**
**Typical CP Water SubDrive 75 Performance**




## Drive Configuration

The SubDrive75 can also be set up to run a 0.75 kW or 1.1 kW pump if desired, but larger pumps will still produce to the 1.1 kW curve and may only be operated with a 1.1 kW motor. To operate a different pump size, a DIP switch must be positioned to select the correct pump rating. Otherwise, the SubDrive75 may trigger erroneous faults.

To configure the SubDrive75 for a 0.75 kW or 1.1 kW pump, locate the DIP switch marked "SW1". Use a small screwdriver (provided) to change the DIP switch setting according to the chart as shown.




**DANGER**

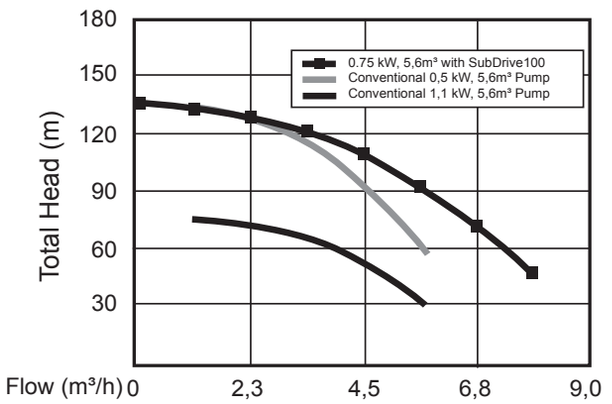
Serious or fatal electrical shock may result from contact with internal electrical components. DO NOT, under any circumstances, attempt to modify DIP switch settings until power has been removed and 5 minutes have passed for internal voltages to discharge! Power must be removed for DIP switch setting to take effect.

# Pump Sizing – SubDrive100

The SubDrive100 is configured at the factory for use with 0.75 kW pumps that are mounted to 1.5 kW Franklin Electric three-phase motors. **In general, the SubDrive100 will enhance the performance of a 0.75 kW pump to a similar or better performance than a conventional 1.5 kW pump of the same flow rating (pump series).**

To select the proper 0.75 kW pump, first choose a 1.5 kW curve that meets the application's head and flow requirements. Use the 0.75 kW pump in the same pump series (flow rating). The SubDrive100 will adjust the speed of this pump to produce the performance of the 1.5 kW curve.An **EXAMPLE** of this is illustrated in the graph at right. Please consult the pump manufacturer's pump curve for your specific application.

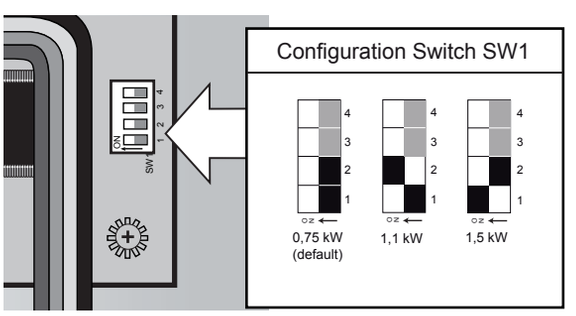
**EXAMPLE 2**
**Typical CP Water SubDrive100 Performance**




## Drive Configuration

The SubDrive100 can also be set up to run a 1.1 kW or 1.5 kW pump if desired, but larger pumps will still produce to the 1.5 kW curve and may only be operated with a 1.5 kW motor. To operate a different pump size, a DIP switch must be positioned to select the correct pump rating. Otherwise, the SubDrive100 may trigger erroneous faults.

To configure the SubDrive100 for a 1.1 kW or 1.5 kW pump, locate the DIP switch marked "SW1". Use a small screwdriver (provided) to change the DIP switch setting according to the chart as shown.




**⚠ DANGER**

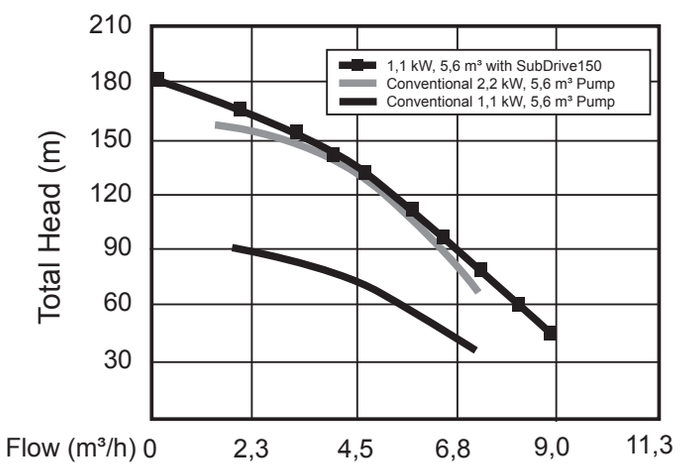
Serious or fatal electrical shock may result from contact with internal electrical components. DO NOT, under any circumstances, attempt to modify DIP switch settings until power has been removed and 5 minutes have passed for internal voltages to discharge! Power must be removed for DIP switch setting to take effect.

# Pump Sizing – SubDrive150

The SubDrive150 is configured at the factory for use with 1.1 kW pumps that are mounted to 2.2 kW Franklin Electric three-phase motors. **In general, the SubDrive150 will enhance the performance of a 1.1 kW pump to a similar or better performance than a conventional 2.2 kW pump of the same flow rating (pump series).**

To select the proper 1.1 kW pump, first choose a 2.2 kW curve that meets the application's head and flow requirements. Use the 1.1 kW pump in the same pump series (flow rating). The SubDrive150 will adjust the speed of this pump to produce the performance of the 2.2 kW curve. An **EXAMPLE** of this is illustrated in the graph at right. Please consult the pump manufacturer's pump curve for your specific application.

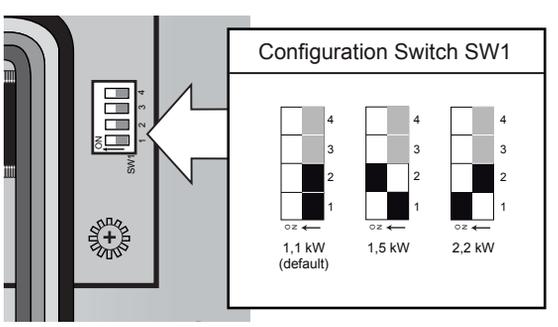
**EXAMPLE 3**
**Typical CP Water SubDrive150 Performance**




## Drive Configuration

The SubDrive150 can also be set up to run a 1.5 kW or 2.2 kW pump if desired, but larger pumps will still produce to the 2.2 kW curve and may only be operated with a 2.2 kW motor. To operate a different pump size, a DIP switch must be positioned to select the correct pump rating. Otherwise, the SubDrive150 may trigger erroneous faults.

To configure the SubDrive150 for a 1.5 kW or 2.2 kW pump, locate the DIP switch marked "SW1". Use a small screwdriver (provided) to change the DIP switch setting according to the chart as shown.



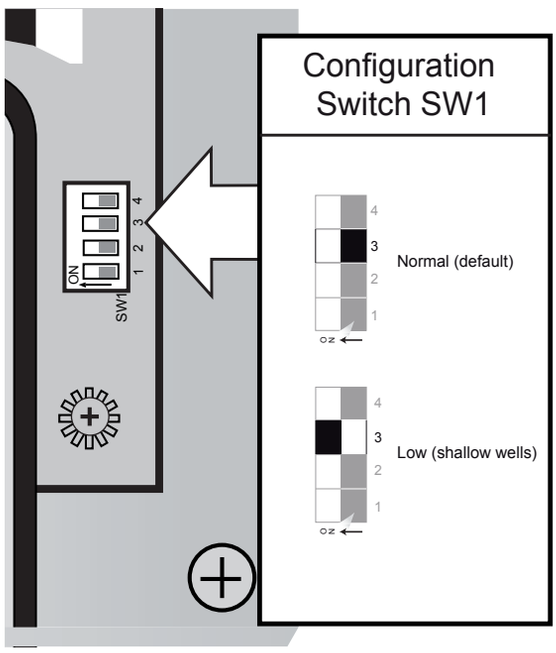

**⚠ DANGER**

Serious or fatal electrical shock may result from contact with internal electrical components. DO NOT, under any circumstances, attempt to modify DIP switch settings until power has been removed and 5 minutes have passed for internal voltages to discharge! Power must be removed for DIP switch setting to take effect.

# Underload Sensitivity Selection – SubDrive75/100/150

The SubDrive controller is configured at the factory to ensure detection of Underload faults in a wide variety of pumping applications. In rare cases (as with certain pumps in shallow wells) this trip level may result in nuisance faults. If the pump is installed in a shallow well, activate the controller and observe system behavior. Once the controller begins to regulate pressure, check operation at several flow rates to make sure the default sensitivity does not induce nuisance Underload trips.

If it becomes necessary to desensitize the Underload trip level, remove power and allow the controller to discharge. Once the internal voltages have dissipated, locate the DIP switch marked “SW1” at the lower right corner of the main circuit board. Use a small screwdriver (provided) to change Position 3 to the “ON” position to select the lower Underload sensitivity as shown in the chart below.

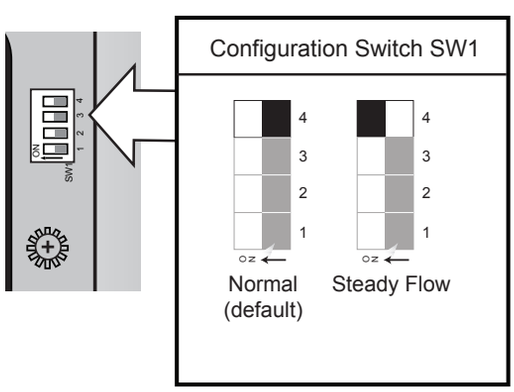



**⚠ DANGER**
Serious or fatal electrical shock may result from contact with internal electrical components. DO NOT, under any circumstances, attempt to modify DIP switch settings until power has been removed and 5 minutes have passed for internal voltages to discharge! Power must be removed for DIP switch setting to take effect.

# Steady Flow Selection SubDrive75/100/150

The SubDrive/MonoDrive controller is configured at the factory to ensure quick response to maintain constant pressure. In rare cases (as with a water line tap before the pressure tank), the controller may need to be adjusted to offer better control.

If the controller is used on a system that has a water line tapped before the pressure tank and close to the well head or where audible speed variations of the PMA can be heard through the pipes, adjusting the pressure control response time may be necessary. After enabling this feature, the installer should check flow changes for possible overshoot. A larger pressure tank and/ or wider margin between regulation and valve pressure may be required as the Steady Flow features reduce the controller’s reaction time to sudden changes in flow.




If it is necessary to adjust the pressure control, remove power and allow the controller to discharge. Wait 5 minutes to allow internal voltage to dissipate, locate the DIP switch marked “SW1”. Use a small screwdriver (provided) to move position 4 to “ON” as shown.

**⚠ DANGER**
Serious or fatal electrical shock may result from contact with internal electrical components. DO NOT, under any circumstances, attempt to modify DIP switch settings until power has been removed and 5 minutes have passed for internal voltages to discharge! Power must be removed for DIP switch setting to take effect.

## Underload Smart Reset

If a motor Underload fault condition occurs, the most likely cause is an overpumped or dry well. To allow the well to recover, the SubDrive controller will wait 30 seconds to 5 minutes, determined by duration of the previous run time, before restarting the motor. For example, the first time the fault occurs, the controller will wait 30 seconds before attempting to restart the pump. If the system would then run for 1 minute and an Underload fault recurs, the controller will wait 4 minutes before attempting to restart the pump. This schedule allows for the minimum off-time possible based on the recovery time of the well.


**Figure 1:** Smart Reset Well Recovery Time

## Over Temperature Foldback

The SubDrive controller is designed for full power operation in ambient temperatures up to 50 °C as long as the input voltage is kept at 230 VAC. Under extreme thermal conditions, the controller will reduce output power in an attempt to avoid shutdown. Full pump output is restored when the controller temperature cools to a safe level.

## Generator Sizing for SubDrive/MonoDrive

Basic generator sizing for the Franklin Electric SubDrive/MonoDrive system is 1.5 times maximum input Watts consumed by the drive, rounded up to the next normal sized generator.

Recommended minimum generator sizes:

**SubDrive75** = 3500 Watts (3.5 kW)
**SubDrive100** = 5700 Watts (6 kW)
**SubDrive150** = 7000 Watts (7 kW)

**NOTE:** Not to be used on GFIC circuit Externally regulated generators Verify voltage, hertz and idle speed are appropriate to supply drive.

## Before Getting Started

### DANGER

Serious or fatal electrical shock may result from failure to connect the ground terminal to the motor, SubDrive/MonoDrive controller, metal plumbing, or other metal near the motor or cable, using wire no smaller than motor cable wires. To minimize risk of electrical shock, disconnect power before working on or around the SubDrive/MonoDrive system. CAPACITORS INSIDE THE SUBDRIVE CONTROLLER CAN STILL HOLD LETHAL VOLTAGE EVEN AFTER POWER HAS BEEN DISCONNECTED.

ALLOW 5 MINUTES FOR DANGEROUS INTERNAL VOLTAGE TO DISCHARGE BEFORE REMOVING SUBDRIVE/MONODRIVE COVER.

Do not use motor in swimming areas.

### WARNING

This equipment should be installed by technically qualified personnel. Failure to install it in compliance with national and local electrical codes and within Franklin Electric recommendations may result in electrical shock or fire hazard, unsatisfactory performance, or equipment failure. Installation information is available through pump manufacturers and distributors, or directly from Franklin Electric at our toll-free number **1-800-348-2420**.

### INFO

Use SubDrive only with Franklin Electric 4-inch submersible motors as specified in this manual. Use of this unit with any other Franklin Electric motor or with motors from other manufacturers may result in damage to both motor and electronics.

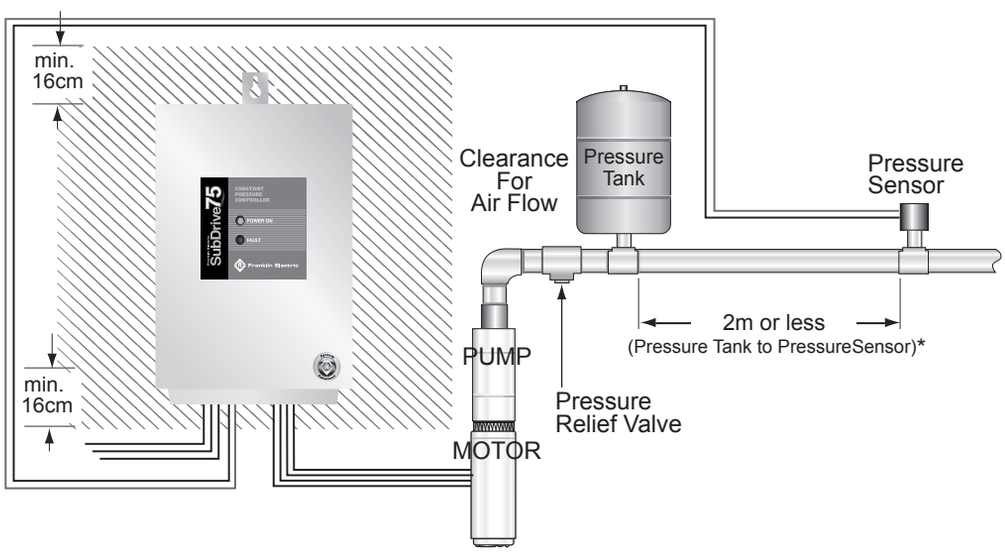
# Controller Location Selection

The SubDrive controller is intended for operation in ambient temperatures up to 50 °C at 230 VAC input. The following recommendations will help in selection of the proper location of the SubDrive unit:

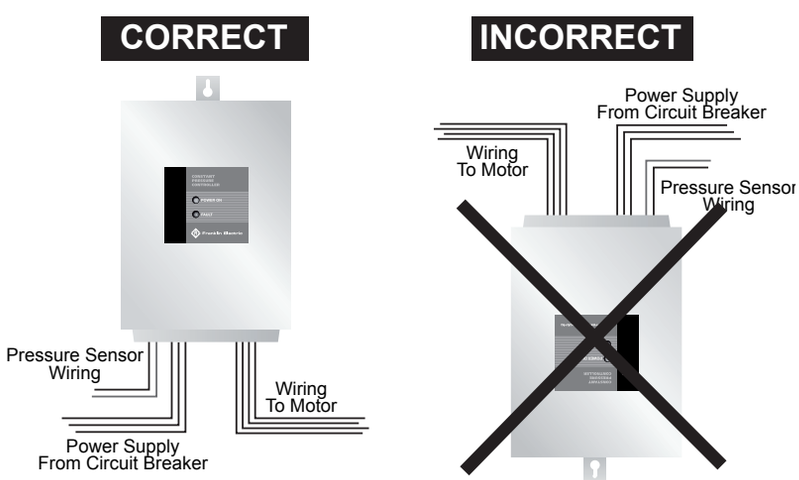
1. A tank tee is recommended for mounting the tank, pressure sensor, pressure gauge, and pressure relief valve at one junction. If a tank tee is not used, the pressure sensor should be located within 2 meters of the pressure tank to minimize pressure fluctuations. There should be no elbows between the tank and pressure sensor.
2. The unit should be mounted on a sturdy supporting structure such as a wall or supporting post. Please take into account the weight of the unit.
3. The electronics inside the SubDrive are air-cooled. As a result, there should be at least 16 cm of clearance on each side and below the unit to allow room for air flow.

**INFO**

There should be at least 16 cm of clearance on each side and below the unit to allow room for air flow.




*** NOTE:** There should be no elbows between the tank and pressure sensor.




4. Do not expose a SubDrive to rain or water spray.
5. The SubDrive should only be mounted with the wiring end oriented downward. The controller should not be placed in direct sunlight or other locations subject to extreme temperatures or humidity (mounting location should not be subjected to freezing conditions or condensation).

6. The mounting location should have access to 230VAC electrical supply and to the submersible motor wiring. If possible, use a dedicated circuit for the SubDrive. Specific installation precautions for variable frequency drives should be observed:
    - Standard ground fault protection relays (RCDs-Residual Current Devices) will not work with the Sub-Drive. If their presence is required, only B-type RCDs may be used. However, extensive EMC measures in the drive generate high frequency capacitive currents which may cause RCD nuisance tripping. Refer to IEC 61800-5-1 Annex E for further details on RCD selection.
    - Ensure good grounding of the drive. Effective overvoltage protection and EMC can only be obtained with low-impedance grounding. Do not create ground loops.
    - Keep adequate distance to other household wiring, especially low-voltage and telecom circuitry. When it cannot be avoided, cross such circuits at right angles and maximum possible distance to minimize interference.

**⚠ DANGER**
Standard RCD's used upstream of SubDrive may fail to offer protection because of the presence of smooth DC residual currents that can saturate their cores.

## Circuit Breaker and Wire Sizing

Please observe local (national) electrical codes to determine suitable wire sizing. Below examples are based on German Code and should only serve as recommendations:

**Table A: Circuit breaker sizing and maximum input cable length (from grid to SubDrive)**

| Controller Model | Breaker Amps | Nominal Input Voltage | Max. Amps. | Metric Cable Size, Square Millimeters, Copper Wire, 90°C Rated Insualtion | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | A | V | A | 1,5 | 2,5 | 4 | 6 | 10 | 16 |
| SubDrive 75 | 16 | 230 | 11 | 26 | 44 | 70 | 105 | 176 | 281 |
| SubDrive 100 | 25 | 230 | 19 | - | 25 | 41 | 61 | 102 | 163 |
| SubDrive 150 | 25 | 230 | 23 | - | 21 | 34 | 50 | 84 | 134 |

**NOTE:**
- Based on 3% voltage drop
- Solid copper wire cable, method of installation: fixed installation on surface / in walls acc. to VDE 100 part 430 / 09.91

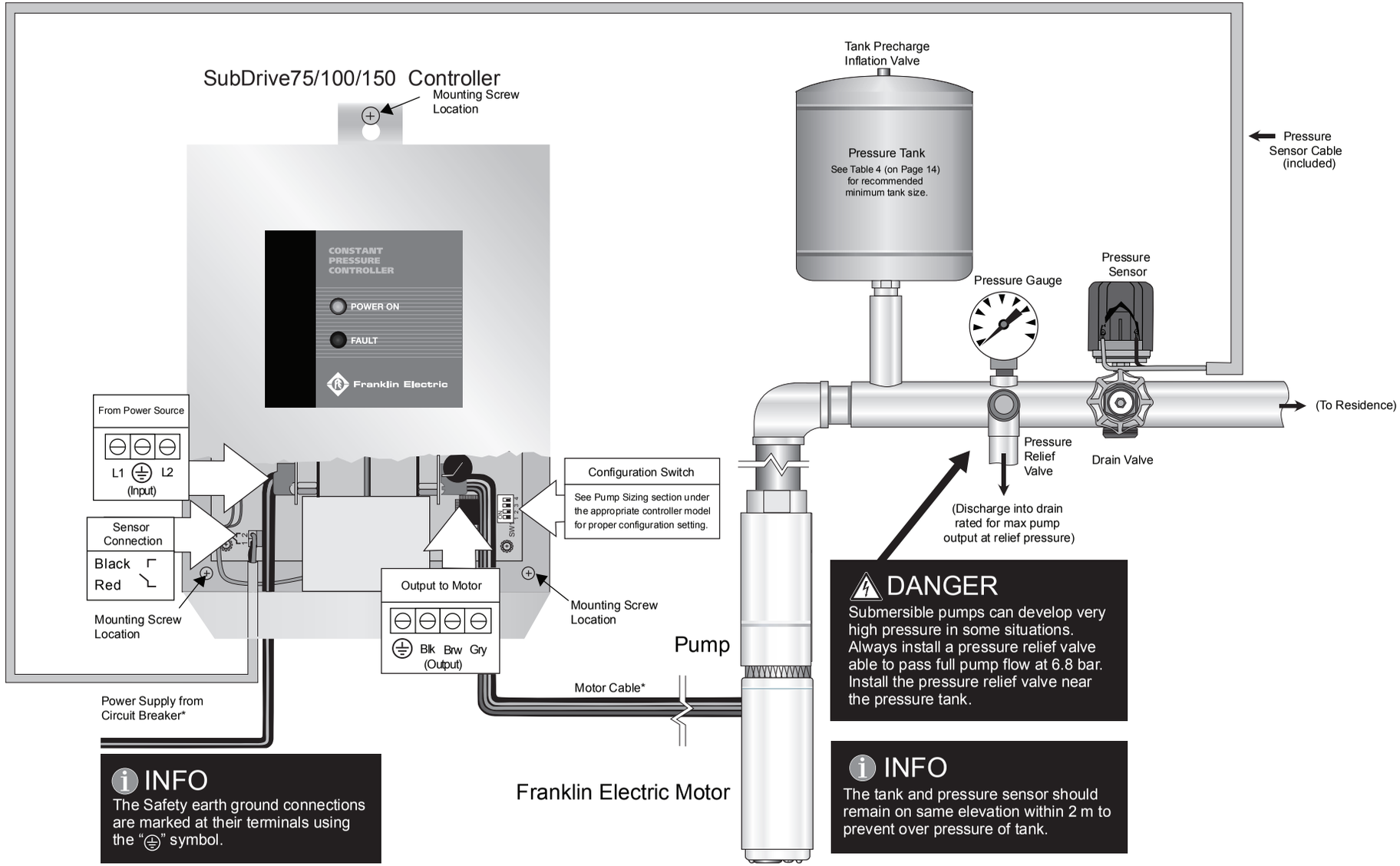
**Table B: Maximum motor cable length (from SubDrive to motor)**

Below recommendations are identical to ones found in motor literature for off the grid operation at 230V / 50Hz, cable length being limited to max. 330m.

| Controller Model | Franklin Electric Motor Model | Rated Power | | Metric Cable Size, Square Millimeters, Copper Wire, 70°C Rated Insulation | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | KW | HP | 1,5 | 2,5 | 4 | 6 | 10 | 16 |
| SubDrive 75 | 234 714 xxxx | 1,1 | 1 1/2 | 120 | 200 | 330 | 330 | 330 | 330 |
| SubDrive 100 | 234 715 xxxx | 1,5 | 2 | 90 | 150 | 250 | 330 | 330 | 330 |
| SubDrive 150 | 234 716 xxxx | 2,2 | 3 | 50 | 100 | 160 | 250 | 330 | 330 |

**NOTE:**
- Maximum lengths are measured between controller and motor
- Aluminum wires should not be used with SubDrive

# Quick Reference Guide to Controller Installation
# SubDrive75/100/150




* Note: To avoid possible interference with other appliances, please refer to the Installation Guide and observe all precautions regarding power cable routing.

## Pressure Tank

The SubDrive needs only a small pressure tank to maintain constant pressure. (See table below for recommended tank size.) For pumps rated 2,5 m³/h or more, a slightly larger tank is recommended for optimum pressure regulation. The SubDrive can also use an existing tank with a much larger capacity.

**Table 4: Minimum Pressure Tank Size (Total Capacity)**

| Pump Flow Rating | Controller Model | Minimum Tank Size |
|---|---|---|
| Less than 2,5 m³/h | SubDrive75 | 8 liters |
| | SubDrive100 | 18 liters |
| | SubDrive150 | 18 liters |
| | | |
| 2,5 m³/h and higher | SubDrive75 | 18 liters |
| | SubDrive100 | 30 liters |
| | SubDrive150 | 30 liters |

The minimum supply pipe diameter should be selected not to exceed a maximum velocity of 2,4 m/s (See Table 6 below for minimum pipe diameter). The pressure tank pre-charge setting should be 70% of the system pressure sensor setting as indicated in the following table.

**Table 5: Pressure Tank Pre-charge bar**

| System Pressure (bar) (at Pressure Sensor) | Pressure Tank Setting (bar) |
|---|---|
| 1,7 | 1,2 |
| 2 | 1,4 |
| 2,4 | 1,7 |
| 2,7 | 1,9 |
| 3 | 2,1 |
| **3,4 Factory Setting 2,3** | |
| 3,7 | 2,7 |
| 4 | 2,8 |
| 4,4 | 3 |
| 4,7 | 3,3 |
| 5 | 3,7 |

**Table 6: Minimum Pipe Diameter**

| Maximum Velocity 2.4 m/s | |
|---|---|
| min. Pipe Dia (inches) | max. m³/h |
| 1/2" | 1,2 |
| 3/4" | 2,4 |
| 1" | 4,5 |
| 1-1/4" | 6,8 |
| 1-1/2" | 10 |
| 2" | 17 |
| 2-1/2" | 40 |

## Installation Procedure

1. Disconnect electrical power at the main breaker.
2. Drain the system (if applicable).
3. Install the pressure sensor at the pressure tank tee downstream of the pressure tank. (The pressure tank should be between the pressure sensor and the pump.) The pressure sensor has a 1/4-18 National Pipe Thread (NPT) connection. The pressure sensor should not be installed in an inverted orientation (upside down). Make sure the pressure sensor and tank are not located more than 1m off the main piping.
4. Install the unit to the wall using adequate mounting screws (not included) as shown in Figure 2. The top mounting holes are slotted in order to hang the drive in place, while the bottom fasteners are inserted to secure the unit from ever sliding up.
5. Remove the SubDrive lid as shown in Figure 2.


**Figure 2: Shipping / Mounting / Lid Screws**

# Wiring Connections

## ⚠ DANGER

Serious or fatal electrical shock may result from failure to connect the motor, the SubDrive, metal plumbing and all other metal near the motor, or cable to the power supply ground terminal, using wire no smaller than motor cable wires. To reduce risk of electrical shock, disconnect power before working on or around the water system. **Do not use motor in swimming areas.**

1. Verify that the power has been shut off at the main breaker.
2. Verify that the dedicated branch circuit for the SubDrive is equipped with a properly-sized circuit breaker.
3. Use appropriate strain relief or conduit connectors.
4. Remove the SubDrive lid.
5. Feed the motor leads through the opening on the bottom right side of the unit and connect them to the terminal block positions marked GND (Green/Yellow Ground Wire), Black, Brown, Grey (Figure 3).

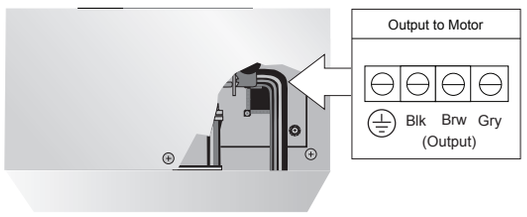



Figure 3: Motor Lead Connections

## ⚠ WARNING

For retrofit application , make sure to check integrity of power and motor leads.
This requires measuring the insulation resistance with the suitable megohmmeter.

6. Feed the 230 VAC power leads through the larger opening on the bottom left side of the SubDrive controller and connect them to the terminals marked L1, GND, and L2 (Figure 4).
7. Use the smaller opening on the bottom left side of the SubDrive unit and connect the red and black leads to the terminals marked “1” and “2” (interchangeable) with a small screwdriver (provided).
   **Note:** A 3 m section of pressure sensor cable is provided with the controller, but it is possible to use similar 0,33 mm² wire for distances up to 30 m from the pressure sensor. A 30 m section of pressure sensor cable is available from your local Franklin Electric distributor. (See Accessories)

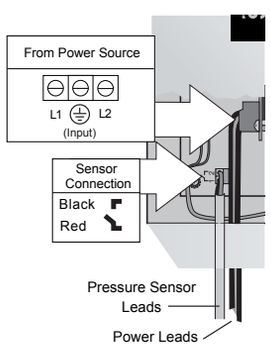



**Figure 4:**
**Power and Pressure Sensor Connections**

8. Verify that the SubDrive unit is properly configured for the horsepower rating of the motor and pump being used. (See the section on Pump Sizing for information on Drive Configuration pg. 6- 8.)
9. Replace the cover. Do not over-tighten the screw.

10. Connect the other end of the pressure sensor cable with the two spade terminals to the pressure sensor. The connections are interchangeable (Figure 5A).
11. Set the pressure tank pre-charge at 70% of the desired water pressure setting. To check the tank's pre-charge, de-pressurize the water system by opening a tap. Measure the tank pre-charge with a pressure gauge at its inflation valve and make the necessary adjustments.

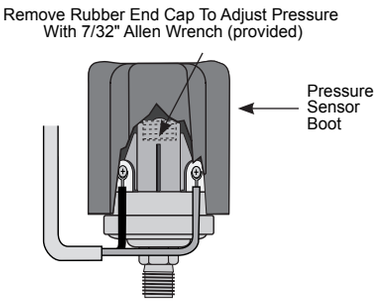



Figure 5A: Pressure Sensor

12. The pressure sensor communicates the system pressure to the SubDrive controller. The sensor is preset at the factory to 3.4 bar, but can be adjusted by the installer using the following procedure:
    a. Remove the rubber end-cap (Figure 5A).
    b. Using a 7/32" Allen-wrench (provided), turn the adjusting screw clockwise to increase pressure and counter-clockwise to decrease pressure. The adjustment range is between 1.7 and 5.5 bar (1/4 turn = approximately 0.2 bar)).
    c. Replace the rubber end cap.
    d. Cover the pressure sensor terminals with the rubber boot provided (Figure 5A).

**INFO**
When increasing the pressure, do not exceed the mechanical stop on the pressure sensor or 5.5 bar. The pressure sensor may be damaged.

**NOTE:** Ensure that the system is properly grounded all the way to the service entrance panel. Improper grounding may result in the loss of voltage surge protection and interference filtering.

## Start-Up and Operation

Apply power to the controller. A steady green light indicates that the SubDrive has power but the pump is not running. The green light will flash continuously when the pump is running.

**Leaky Systems**

Leaky water systems might keep the controller running due to the accurate pressure sensing capability of the pressure sensor. Continuous running or starts and stops do not hurt the controller, pump or motor. However, to reduce the on-time of the controller/pump/motor, a "Bump-Mode" procedure is installed. During low flow (or leaky) conditions, this feature periodically increases the system pressure slightly above the set point and shuts off the pump. This adds some time to bleed off before the system starts up again.

**NOTE:**
Conventional private water systems intermittently fill a pressure tank as commanded by a standard pressure switch 2 - 3.4 bar. The SubDrive maintains a constant pressure at the pressure sensor up to the maximum capability of the motor and pump.

Although the pressure is constant at the pressure sensor, pressure drops may be noticeable in other areas of the home when additional taps are opened. This is due to restrictions in the plumbing and will be more pronounced the farther the taps are from the pressure sensor. This would be true of any system, and if observed, should not be interpreted as a failure in the performance of the SubDrive.

## Specifications – SubDrive75

| | | | |
|---|---|---|---|
| **Input from Power Source (single-phase)** | Voltage | 190-260 VAC | |
| | Frequency | 60/50 Hz | |
| | Current (max) | 11 Amps (RMS) | |
| | Power Factor | 1.0 (constant) | |
| | Power (idle) | 35 Watts | |
| | Power (max) | 2400 Watts | |
| **Output to Motor (three-phase)** | Voltage | Adjusts with Frequency | |
| | Frequency Range | 0.55 kW pump | 30 - Hz |
| | | 0.75 kW pump | 30 - Hz |
| | | 1.1 kW pump | 30 - Hz |
| | Current (max) | 5.9 Amps (RMS, each phase) | |
| **Pressure Setting** | Factory Preset | 3.4 bar | |
| | Adjustment Range | 1.7 and 5.5 bar | |
| **Operating Conditions** (A) | Drive | IP10 | |
| | Pressure sensor | IP24 | |
| | Temperature (at 230 VAC input) | -25 to 50 °C | |
| | Relative Humidity | 10-95%, non-condensing | |
| **Controller Size** (B) **(approximate)** | indoor IP10 | 42 x 32 x 23 cm<br>6.80 kg | |
| **For Use With** (C) | Pump (50 Hz) | 0.55 kW (default)<br>0.75 kW<br>1.1 kW | |
| | Motor (three-phase) | 234514 - series 1.1 kW | |

## Specifications – SubDrive100

| | | | |
|---|---|---|---|
| **Input from Power Source (single-phase)** | Voltage | 190-260 VAC | |
| | Frequency | 60/50 Hz | |
| | Current (max) | 19 Amps (RMS) | |
| | Power Factor | 1.0 (constant) | |
| | Power (idle) | 65 Watts | |
| | Power (max) | 3800 Watts | |
| **Output to Motor (three-phase)** | Voltage | Adjusts with Frequency | |
| | Frequency Range | 0.75 kW pump | 30 - Hz |
| | | 1.1 kW pump | 30 - Hz |
| | | 1.5 kW pump | 30 - Hz |
| | Current (max) | 8.1 Amps (RMS, each phase) | |
| **Pressure Setting** | Factory Preset | 3.4 bar | |
| | Adjustment Range | 1.7 -5.5 bar | |
| **Operating Conditions** (A) | Drive | IP10 | |
| | Pressure sensor | IP24 | |
| | Temperature (at 230 VAC input) | -25 to 50 °C | |
| | Relative Humidity | 10-95%, non-condensing | |
| **Controller Size** (B) **(approximate)** | indoor IP10 | 42 x 32 x 23 cm<br>8 kg | |
| **For Use With** (C) | Pump (50 Hz) | 0.75 kW (default)<br>1.1 kW<br>1.5 kW | |
| | Motor (three-phase) | 234315 - series (1.5 kW) | |

Notes:
A. Operating temperature is specified at full output power when installed as described in Controller Location Selection on pg. 11.
B. Refer to pg. 18 for detailed Mounting Dimensions.
C. If a pump other than the default rating is used, refer to pg. 6/7 for Drive Configuration.

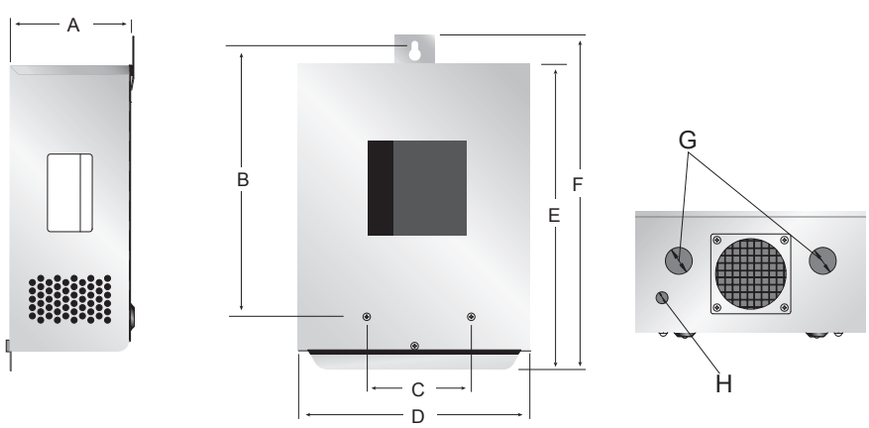
## Specifications – SubDrive150

| | | | |
|---|---|---|---|
| **Input from Power Source (single-phase)** | Voltage | 190-260 VAC | |
| | Frequency | 60/50 Hz | |
| | Current (max) | 23 Amps (RMS) | |
| | Power Factor | 1.0 (constant) | |
| | Power (idle) | 65 Watts | |
| | Power (max) | 4600 Watts | |
| **Output to Motor (three-phase)** | Voltage | Adjusts with Frequency | |
| | Frequency Range | 1.1 kW pump | 30 - Hz |
| | | 1.5 kW pump | 30 - Hz |
| | | 2.2 kW pump | 30 - Hz |
| | Current (max) | 10.9 Amps (RMS, each phase) | |
| **Pressure Setting** | Factory Preset | 3.4 bar | |
| | Adjustment Range | 1.7 -5.5 bar | |
| **Operating Conditions** (A) | Drive | IP10 | |
| | Pressure sensor | IP24 | |
| | Temperature (at 230 VAC input) | -25 to 50 °C | |
| | Relative Humidity | 10-95%, non-condensing | |
| **Controller Size** (B) **(approximate)** | indoor IP10 | 42 x 32 x 23 cm<br>7.94 kg | |
| **For Use With** (C) | Pump (50 Hz) | 1.1 kW (default)<br>1.5 kW<br>2.2 kW | |
| | Motor (three-phase) | 234316 - series (2.2 kW) | |

Notes:
A. Operating temperature is specified at full output power when installed as described in Controller Location Selection on pg. 11.
B. Refer to pg. 18 for detailed Mounting Dimensions.
C. If a pump other than the default rating is used, refer to pg. 8 for Drive Configuration.

## Mounting Dimensions

SubDrive75/100/150:




| | A | B | C | D | E | F | G | H |
|---|---|---|---|---|---|---|---|---|
| Dimension (cm) | 13.4 | 29.2 | 14 | 24.8 | 32.5 | 35.6 | 2.9 | 1.3 |
| Conduit Sizes | - | - | - | - | - | - | 1.9 | - |

* Use knock-outs as required.

# Accessories

**Pressure Sensor Kit** - replacement sensor with 10 ft of 22 AWG cable and sensor adjustment tool: **223 995 901** (SubDrive75/100/150)

**Sensor Cable Kit** - 100 feet of 22 AWG pressure sensor cable: **223 995 902** (SubDrive75/100/150,)

**Input Filter** – filter used on the input side of drive to help eliminate interference: **225 198 901** (SubDrive75/100/150)

**Output Filter** – filter used on the output side of the drive to help eliminate interference: **225 300 901** (SubDrive75/100/150,)

**Surge Capacitor** – capacitor used on the service panel to help eliminate power interference: **225 199 901** (SubDrive75/100/150)

**SubDrive75 N1 Fan Kit** – replacement fan for SubDrive75 with 80 mm (3.15 in) fan: **225 635 905**

**SubDrive75 N1 Fan Kit** – replacement fan for SubDrive75 with 92 mm (3.62 in) fan: **225 635 908**

**SubDrive100/150 N1 Fan Kit** – replacement fan for SubDrive100/150 with 80mm (3.15 in) fan: **225 635 907**

**SubDrive100/150 N1 Fan Kit** – replacement fan for SubDrive100/150 with 92 mm (3.62 in) fan: **225 635 909**

# Notes

# DIAGNOSTIC FAULT CODES

| NUMBER OF FLASHES | FAULT | POSSIBLE CAUSE | CORRECTIVE ACTION |
|---|---|---|---|
| **1** | MOTOR UNDERLOAD | - Overpumped well<br>- Broken shaft or coupling<br>- Blocked screen, worn pump<br>- Air/gas locked pump<br>- SubDrive not set properly for pump end | - Frequency near maximum with less than 65% of expected load, 42% if DIP #3 is “on”<br>- System is drawing down to pump inlet (out of water)<br>- High static, light loading pump - reset DIP switch #3 to “on” for less sensitivity if not out of water<br>- Check pump rotation reconnect if necessary for proper rotation<br>- Air/gas locked pump - if possible, set deeper in well to reduce<br>- Verify DIP switches are set properly |
| **2** | UNDERVOLTAGE | - Low line voltage<br>- Misconnected input leads | - Line voltage low, less than approximately 150 VAC (normal operating range = 190 to 260 VAC)<br>- Check incoming power connections and correct or tighten if necessary<br>- Correct incoming voltage - check circuit breaker or fuses, contact power company |
| **3** | LOCKED PUMP | - Motor and/or pump misalignment<br>- Dragging motor and/or pump<br>- Abrasives in pump | - Amperage above SFL at 10 Hz<br>- Remove and repair or replace as required |
| **5** | OPEN CIRCUIT | - Loose connection<br>- Defective motor or drop cable<br>- Wrong motor | - Open reading on DC test at start.<br>- Check drop cable and motor resistance, tighten output connections, repair or replace as necessary, use “dry” motor to check drive functions, if drive will not run and exhibits underload fault replace drive |
| **6** | SHORT CIRCUIT | - When fault is indicated immediately after power-up, short circuit due to loose connection, defective cable, splice or motor | - Amperage exceeded 50 amps on DC test at start or SF amps during running<br>- Incorrect output wiring, phase to phase short, phase to ground short in wiring or motor<br>- If fault is present after resetting and removing motor leads, replace drive |
| | OVER CURRENT | - When fault is indicated while motor is running, over current due to loose debris trapped in pump | - Check pump |
| **7** | OVERHEATED DRIVE | - High ambient temperature<br>- Direct sunlight<br>- Obstruction of airflow | - Drive heat sink has exceeded max rated temperature, needs to drop below 85 °C to restart<br>- Fan blocked or inoperable, ambient above 50 °C, direct sunlight, air flow blocked<br>- Replace fan or relocate drive as neccessary |
| **RAPID** | INTERNAL FAULT | - A fault was found internal to drive | - Contact your Franklin Electric Service Personnel<br>- Unit may require replacement. Contact your supplier. |

Power down, disconnect leads to the motor and power up the SubDrive:

- If the SubDrive does not give an “open phase” fault (5 flashes every 2 seconds), then there is a problem with the SubDrive.
- Connect the SubDrive to a dry motor. If the motor goes through DC test and gives “underload” fault (1 flash every 2 seconds), the SubDrive is working properly.

| CONDITION | INDICATOR LIGHTS | POSSIBLE CAUSE | CORRECTIVE ACTION |
|---|---|---|---|
| **NO WATER** | NONE | - No supply voltage present | - If correct voltage is present, replace drive |
| | SOLID GREEN | - Pressure sensor circuit | - Verify water pressure is below system set point<br>- Jumper wires together at pressure sensor, if pump starts, replace sensor<br>- If pump doesn't start, check sensor connection at printed circuit board (PCB), if loose, repair<br>- If pump doesn't start, jumper sensor connection at PCB, if pump starts, replace wire<br>- If pump doesn't start with sensor PCB connection jumpered, replace drive |
| | SOLID RED<br>OR<br>SOLID RED<br>AND GREEN | - Power surge, bad component | - Power system down to clear fault, verify voltage, if repetitive, replace drive |
| | FLASHING RED | - Fault detected | - Proceed to fault code description and remedy |
| | FLASHING GREEN | - Drive and motor are operating<br><br><br><br>- Loose switch or cable connection<br>- Gulping water at pump inlet | - Frequency max, amps low, check for closed valve, or stuck check valve<br>- Frequency max, amps high, check for hole in pipe<br>- Frequency max, amps erratic, check pump operation, dragging impellers<br>- This is not a drive problem<br>- Check all connections<br>- Disconnect power and allow well to recover for short time, then retry |
| **PRESSURE FLUCTUATIONS**<br>(POOR REGULATION) | FLASHING GREEN | - Pressure sensor placement and setting<br>- Pressure gauge placement<br>- Pressure tank size and pre-charge<br>- Leak in system<br>- Air entrainment into pump intake (lack of submergence) | - Correct pressure and placement as necessary<br>- Tank may be too small for system flow<br>- This is not a drive problem<br>- Disconnect power and check pressure gauge for pressure drop<br>- Set deeper in the well or tank; install a flow sleeve with airtight seal around drop pipe and cable<br>- If fluctuation is only on branches before sensor, flip DIP switch #4 to "on" (07C and newer) |
| **RUN ON WON'T SHUT DOWN** | FLASHING GREEN | - Pressure sensor placement and setting<br>- Tank pre-charge pressure<br>- Impeller damage<br>- Leaky system<br>- Sized improperly (pump can't build enough head) | - Check frequency at low flows, pressure setting may be too close to pump max head<br>- Verify precharge at 70% if tank size is larger than minimum, increase precharge (up to 85%)<br>- Verify that the system will build and hold pressure |
| **RUNS BUT TRIPS** | FLASHING RED | - Check fault code and see corrective action | - Proceed to fault code description and remedy on reverse side |
| **LOW PRESSURE** | FLASHING GREEN | - Pressure sensor setting, pump rotation, pump sizing | - Adjust pressure sensor, check pump rotation<br>- Check frequency at max flow, check max pressure |
| **HIGH PRESSURE** | FLASHING GREEN | - Pressure sensor setting<br>- Shorted sensor wire | - Adjust pressure sensor<br>- Remove sensor wire at PCB, if drive continues to run, replace drive<br>- Verify condition of sensor wire and repair or replace if necessary |
| **AUDIBLE NOISE** | FLASHING GREEN | - Fan, hydraulic, plumbing | - For excessive fan noise, replace fan<br>- If fan noise is normal, drive will need to be relocated to a more remote area<br>- If hydraulic, try raising or lowering depth of pump<br>- Pressure tank location should be at entrance of water line into house |
| **NO LIGHTS** | NONE | - Ribbon cable detached from LED printed circuit board | - Reattach cable - if cable is attached, replace drive |
| **RFI-EMI INTERFERENCE** | FLASHING GREEN | - See interference troubleshooting procedure | |