Constant Pressure Water System

SubDrive300

Installation Manual

Franklin Electric

Contents

Tables

Figures

Table 1: SubDrive Models

Model Name	Part Number	Use with Motor Series
SubDrive300	5870206300 (NEMA 4)	234 317 xxxx (5.0 Hp)

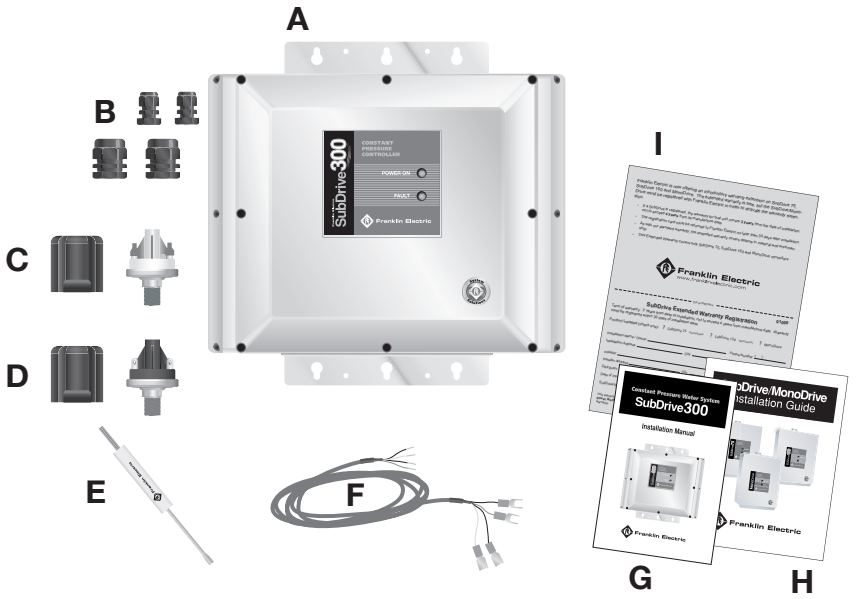
Description and Features

The Franklin Electric SubDrive300 is a dependable residential and light commercial 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), the SubDrive eliminates pressure cycling associated with conventional water well systems and owners of private water well systems can enjoy “city-like” water pressure.

In addition, the reduced tank size (see Table 3) allows installation in small spaces. Key features of the SubDrive include:

- Constant water pressure with a wide range of settings (25-80 psi)
- 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 – you can use this unit 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 – using smart pump monitoring (see Page 26)
  - Bound pump – with auto-reversing torque
  - High voltage / lightning surge
  - Low line voltage
  - Open motor circuit
  - Short circuit

Included Items

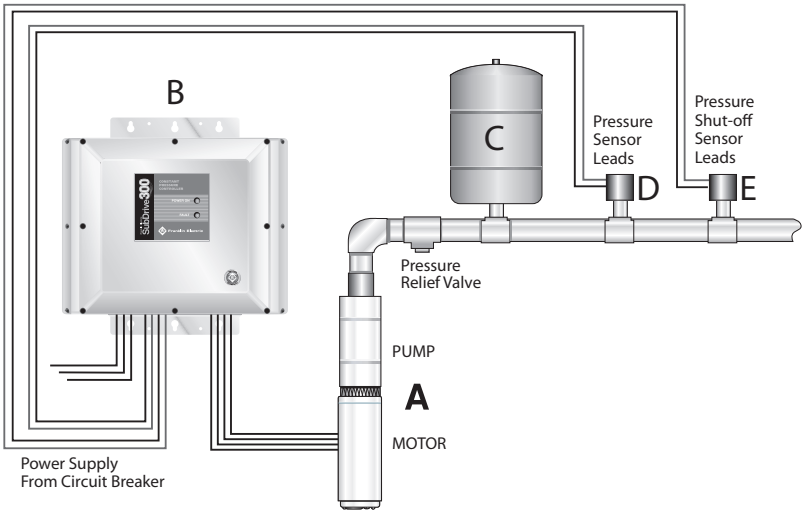


A. Controller Unit
B. Strain Relief Fittings
C. Pressure Shut-off Sensor and Boot
D. Pressure Sensor and Boot
E. Sensor Adjustment Tool
F. Sensor Cable
G. Installation Manual
H. Installation Guide
I. Warranty Card

How It Works

The Franklin Electric SubDrive300 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 (for tank size, see Table 3).
D. Franklin Electric Pressure Sensor (provided).
E. Franklin Electric Pressure Shut-Off Sensor (provided).



Constant Pressure

The Franklin Electric SubDrive300 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 SubDrive300 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 SubDrive300 will be operating to accurately maintain system pressure. Whenever the SubDrive300 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 SubDrive300 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.

Unique Features

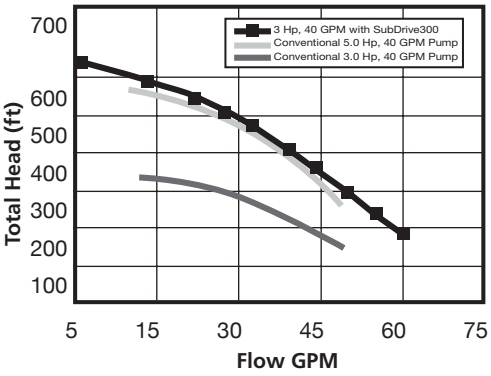
SubDrive controllers provide the ultimate in system performance, utilizing Franklin Electric’s three-phase motor series for maximum starting torque, high efficiency and smooth operation. SubDrives convert residential single-phase 60Hz power into the variable-frequency three-phase needed by the motor. In addition, SubDrives can spin a smaller pump slightly faster to boost output to roughly double its 60Hz 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.

Pump Sizing

The SubDrive300 is configured at the factory for use with 3 Hp pumps that are mounted to 5 Hp Franklin Electric three-phase motors. **In general, the SubDrive300 will enhance the performance of a 3 Hp pump to a similar or better performance than a conventional 5 Hp pump of the same flowrating (pump series).**

To select the proper 3 Hp pump, first choose a 5 Hp curve that meets the application's head and flow requirements. Use the 3 Hp pump in the same pump series (flow rating). The SubDrive300 will adjust the speed of this pump to produce the performance of the 5 Hp curve. An example of this is illustrated in the graph at right.

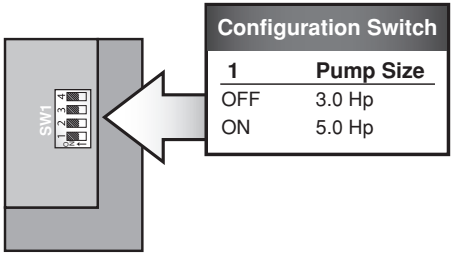
Typical SubDrive300 Performance



Drive Configuration

The SubDrive300 can also be set up to run a 5 Hp pump if desired, but the larger pump will still produce to the 5 Hp curve and may only be operated with a 5 Hp motor. To operate a different pump size, a DIP switch must be positioned to select the correct pump rating. Otherwise, the SubDrive300 may trigger erroneous faults.

To configure the SubDrive300 for a 5 Hp pump, locate the DIP switch marked "SW1" at the lower right corner of the main circuit board. Use a small screwdriver (provided) to change the DIP switch setting according to the chart as shown.



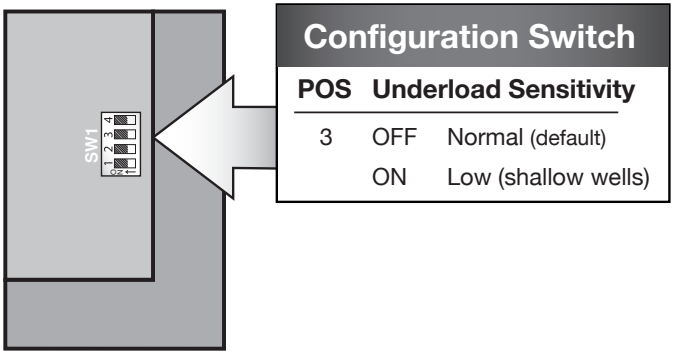
⚠ WARNING

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!

Underload Sensitivity for Shallow Wells

The SubDrive300 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.



Configuration Switch

POS	Underload Sensitivity	
3	OFF	Normal (default)
	ON	Low (shallow wells)

⚠ WARNING

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!

Before Getting Started

⚠ WARNING

Serious or fatal electrical shock may result from failure to connect the ground terminal to the motor, SubDrive 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 SubDrive300 system. CAPACITORS INSIDE THE SUBDRIVE300 CONTROLLER CAN STILL HOLD LETHAL VOLTAGE EVEN AFTER POWER HAS BEEN DISCONNECTED.

ALLOW 5 MINUTES FOR DANGEROUS INTERNAL VOLTAGE TO DISCHARGE BEFORE REMOVING SUBDRIVE300 COVER.

Do not use motor in swimming areas.

⚠ ATTENTION

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**.

⚠ CAUTION

Use SubDrive300 only with Franklin Electric 4-inch submersible motors as specified in this manual (see Table 1). 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.

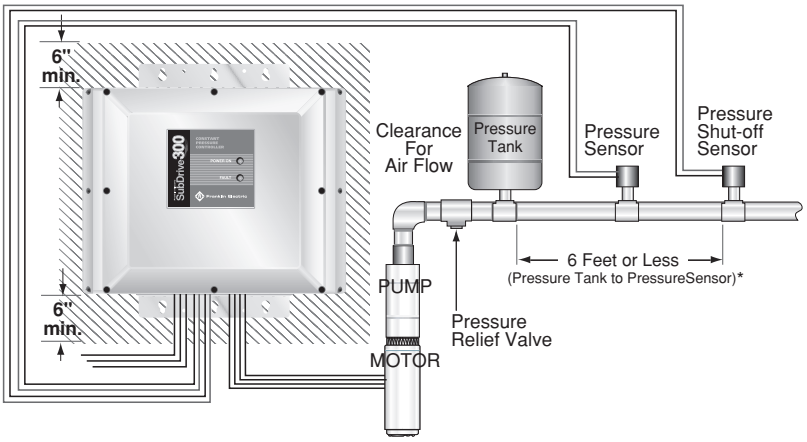
Controller Location Selection

The SubDrive controller is intended for operation in ambient temperatures up to 125°F (51°C) at 230 VAC input. The following recommendations will help in selection of the proper location of the SubDrive unit:

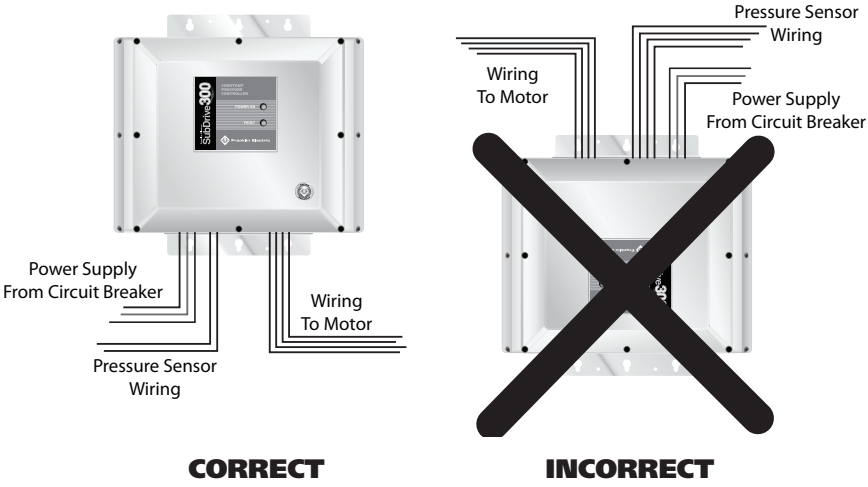
1. A tank tee is recommended for mounting the tank, pressure sensor, pressure gauge, and pressure relief valve at one junction. If a tank tee is not used, the pressure sensor should be located within 6 feet (1.8 meters) of the pressure tank to minimize pressure fluctuations. There should be no elbows 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, which weighs approximately 34 pounds (15.5 kg).
3. The electronics inside the SubDrive are air-cooled. As a result, there should be at least 6 inches of clearance above and below the unit to allow room for air flow.

⚠ CAUTION

There should be at least 6 inches of clearance above and below the unit to allow room for air flow.



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



4. For indoor or outdoor installations.
5. The SubDrive300 should only be mounted with the wiring end oriented downward. The controller should not be placed in direct sunlight or other locations subject to direct rain or snow.
6. The mounting location should have access to 230 VAC electrical supply and to the submersible motor wiring. To avoid possible interference with other appliances, please refer to the enclosed Installation Guide and observe all precautions regarding power cable routing.
7. To assure maximum weather protection, the unit must be mounted vertically with the cover properly aligned and secured with all eight lid screws.

Circuit Breaker and Wire Sizing

The minimum circuit breaker size and maximum allowable wire lengths for connection of motor to the SubDrive300 are given in the following table:

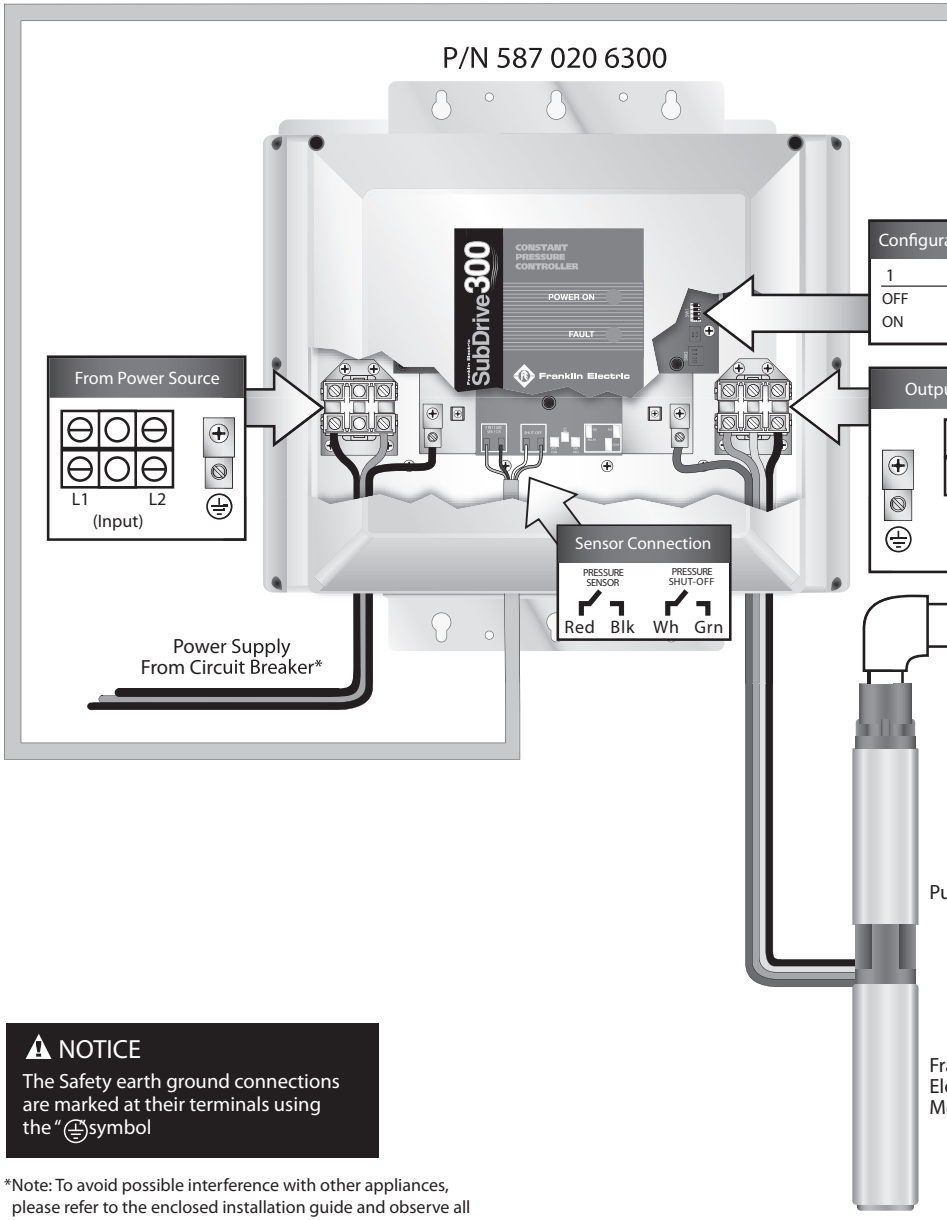
Table 2: Minimum Breaker Size and Maximum Cable Length (in Feet)

Controller Model	Franklin Electric Motor Model	HP	Breaker Amps	AWG Copper Wire Size					
				14	12	10	8	6	4
SubDrive300	234 317 xxxx	5	40	140	230	370	590	920	1430

A 10-foot section of cable is provided with the SubDrive300 to connect the pressure sensors.

NOTE:

- Maximum allowable wire lengths are measured between the controller and motor.
- Aluminum wires should not be used with the SubDrive300.
- Wire sizing between the service entrance and the controller must be sufficient to provide the required maximum input amps to the controller while conforming to local standards and codes.
- SubDrive300 minimum breaker amps may be lower than AIM Manual specifications for the motors listed due to the soft-starting characteristic of the SubDrive300 controller.

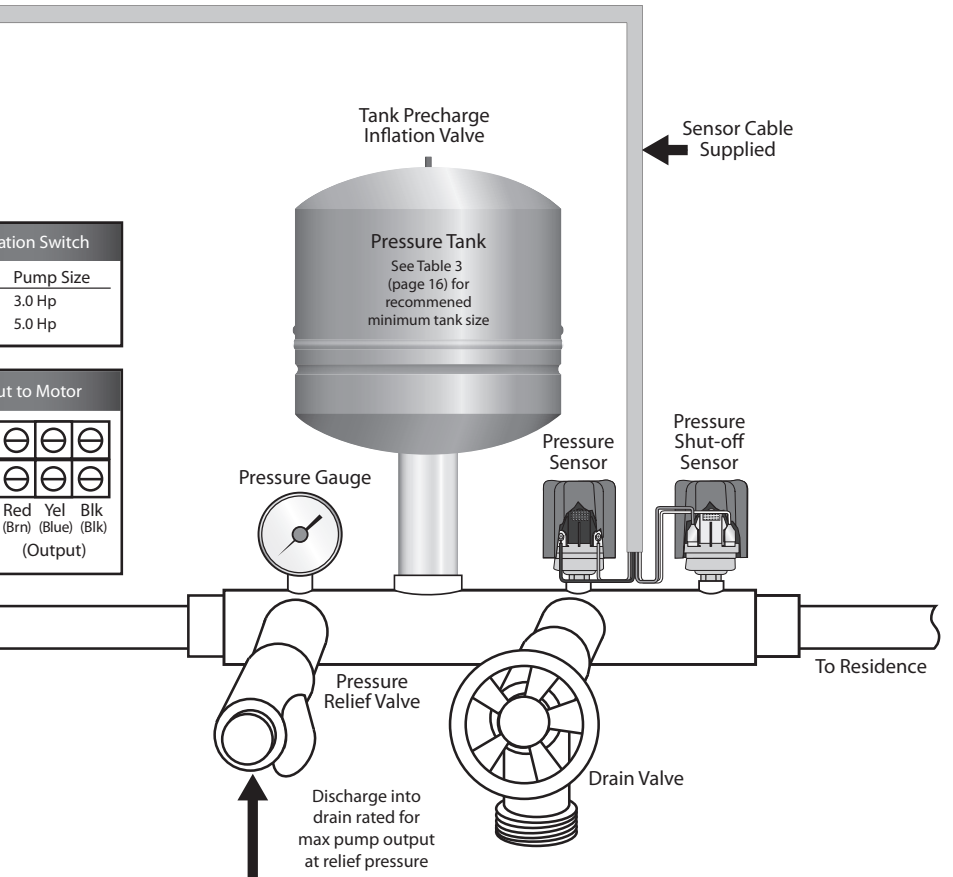


⚠ NOTICE

The Safety earth ground connections are marked at their terminals using the "⏚ symbol

*Note: To avoid possible interference with other appliances, please refer to the enclosed installation guide and observe all precautions regarding power cable routing

e SubDrive300 (not to scale)



ation Switch

Pump Size
3.0 Hp
5.0 Hp

ut to Motor

Red (Brn) Yel (Blue) Blk (Blk)
(Output)

ump

anklin
ectric
otor

⚠ WARNING

Submersible pumps can develop very high pressure in some situations. Always install a pressure relief valve able to pass full pump flow at 100 PSI. Install the pressure relief valve between the pump and pressure tank.

Pressure Setting Guide	
Pressure Switch Set Point (PSI)	Pressure Tank Pre-Charge (PSI)
25	18
30	21
35	25
40	28
45	32
50 (Factory set)	35
55	39
60	42
65	46
70	49
75	53
80	56

Pressure Tank

The SubDrive needs only a small pressure tank to maintain constant pressure (see table below for recommended tank size). For pumps rated 12 gpm 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 3: Minimum Pressure Tank Size (Total Capacity)

Pump Flow Rating	Controller Model	Minimum Tank Size
Less than 12 gpm	SubDrive300	8 gallon
12 gpm and higher	SubDrive300	20 gallon

The pressure tank pre-charge setting should be 70% of the system pressure sensor setting as indicated in the following table.

Table 4: Pressure Tank Precharge (PSI)

System Pressure (at Pressure Sensor)	Pressure Tank Setting (±2 psi)	
25	18	
30	21	
35	25	
40	28	
45	32	
50	**35**	**Factory Setting**
55	39	
60	42	
65	46	
70	49	
75	53	
80	56	

NOTE: Check tank precharge regularly to maintain optimum pressure regulation.

Installation Procedure

1. Disconnect electrical power at the main breaker.
2. Drain the system (if applicable).
3. Install the pressure sensor and pressure shut-off sensor at the pressure tank tee downstream of the pressure tank (the pressure tank should be between the pressure sensor and the pump). The sensors have a ¼-18 National Pipe Thread (NPT) connection.

   The pressure sensors should not be installed in an inverted orientation (up-side down). Make sure the pressure sensor and tank are not located more than 3 feet off the main piping.
4. Install the unit to the wall using four mounting screws (not included) as shown in Figure 1 below. Remove the SubDrive lid by removing the eight lid screws.

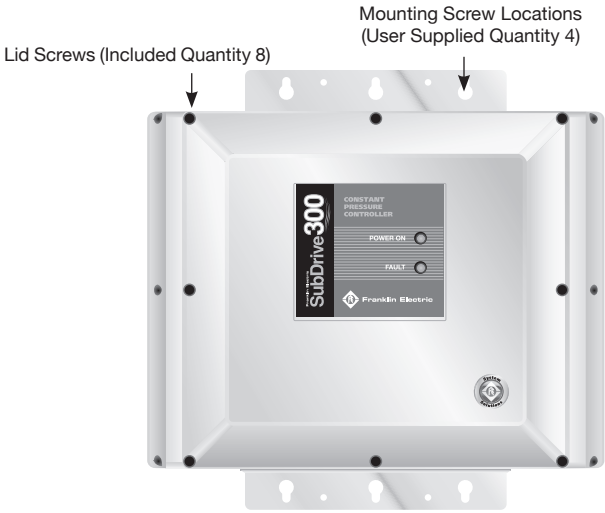


Figure 1: Mounting Screws

Wiring Connections

⚠ WARNING

Serious or fatal electrical shock may result from failure to connect the motor, the SubDrive300, 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 SubDrive300 is equipped with a properly-sized circuit breaker. Refer to Table 2 (Page 13) for minimum breaker size.
3. Use the appropriate strain relief or conduit connectors. Type B liquid tight fittings are recommended for maximum weather protection.
4. Remove the SubDrive300 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 ground wire), Red, Yellow and Black (Figure 2).

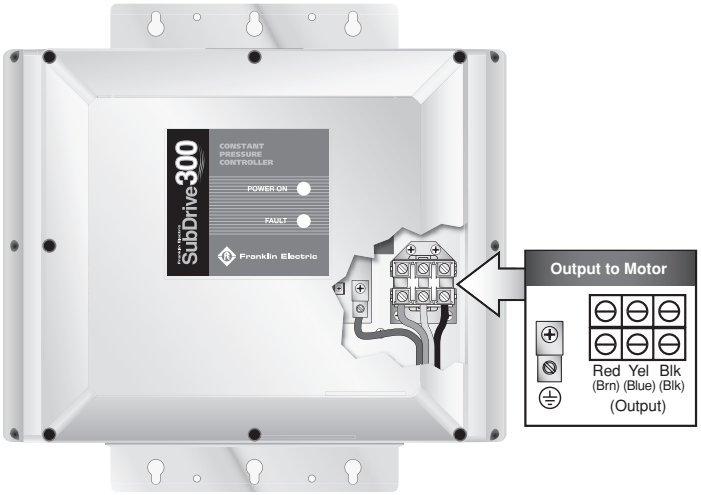


Figure 2: Motor Lead Connections

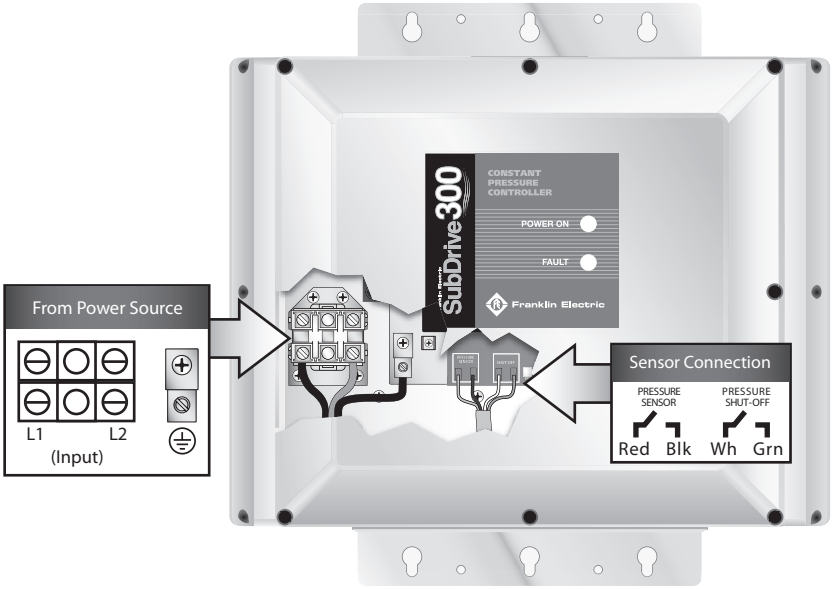


Figure 3: Power and Pressure Sensor Connections

6. Feed the 230 VAC power leads through the bottom left side of the SubDrive300 controller and connect them to the terminals marked L1, L2, and GND (Figure 3).

   A 10-foot section of pressure sensor cable is provided with the controller, but it is possible to use similar 22 AWG wire for distances up to 100 feet from the pressure sensor. A 100-foot section of pressure sensor cable is available as an accessory.

7. Feed the pressure sensor leads through the smaller opening located in the bottom middle of the SubDrive300 unit and press on the quick connect terminals.

8. Verify that the SubDrive300 unit is properly configured for the horsepower rating of the motor and pump being used. Please refer to the section on Pump Sizing for information on drive configuration.

9. Replace the lid. Do not over-tighten the screws.

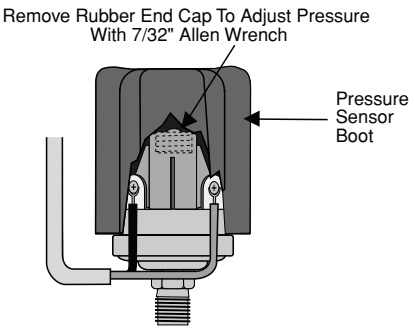


Figure 4A:
Pressure Sensor

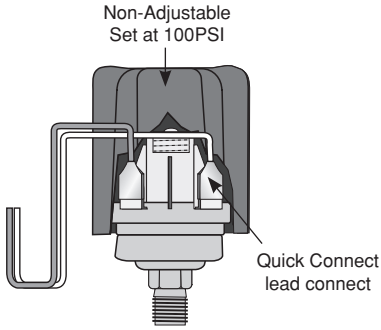


Figure 4B:
Pressure Shut-off Sensor

10A. Connect the other end of the pressure sensor cable with the two spade terminals to the pressure sensor. The connections are interchangeable (Figure 4A).

10B. Connect the other end of the pressure sensor cable with the two ¼" quick connect terminals to the pressure shut-off sensor. The connections are interchangeable (Figure 4B).

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.

12. The pressure sensor communicates the system pressure to the SubDrive300 controller. The sensor is preset at the factory to 50 psi, but can be adjusted by the installer using the following procedure:

    a. Remove the rubber end-cap (Figure 4A).

    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 25 and 80 psi (¼ turn = approximately 3 psi).

    c. Replace the rubber end cap.

    d. Reset the pressure tank pre-charge to the appropriate pressure.

    e. Cover the pressure sensor terminals with the rubber boot provided (Figure 4A).

⚠ CAUTION

When increasing the pressure, do not exceed the mechanical stop on the pressure sensor or 80 psi. 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 SubDrive300 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 speed of the pump several PSI 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 (e.g. 30 - 50 psi). The SubDrive300 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 SubDrive300.

Specifications

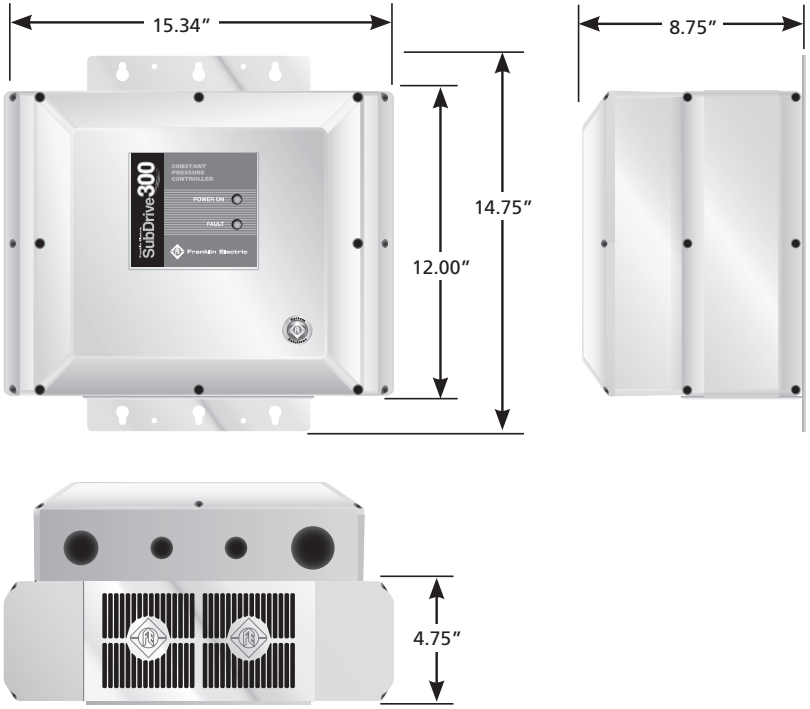
Input from Power Source (single-phase)	Voltage	190-260 VAC
	Frequency	50/60 Hz
	Current (max)	36 Amps (RMS)
	Power Factor	1.0 (constant)
	Power (idle)	65 Watts
	Power (max)	7200 Watts
Output to Motor (three-phase)	Voltage	Adjusts with Frequency
	Frequency Range	30-80 Hz (3 Hp pump) 30-60 Hz (5 Hp pump)
	Current (max)	17.8 Amps (RMS, each phase)
Pressure Setting	Factory preset	50 psi
	Adjustment range	25-80 psi
Operating (A) Conditions	NEMA 4 (indoor/outdoor)	Model 5870206300
	Temperature (at 230 VAC input)	-13 to 125°F (-25 to 51°C)
	Relative Humidity	0-100%, non-condensing or condensing
Controller Size (B) (approximate)	Outer dimensions	14¾" H × 15¾" W × 8¾" D
	Weight	34 lbs (15.5kg)
For Use With (C)	Pump (60Hz)	3.0 Hp (default) 5.0 Hp
	Motor (3-phase)	234317- series (5.0 Hp)

NOTES: (A) Operating temperature is specified at full output power when installed as described in Controller Location Selection on Page 11.

(B) Refer to Page 23 for detailed mounting dimensions.

(C) If a pump other than the default rating is used, refer to Page 8 for drive configuration.

Mounting Dimensions



Diagnostic Fault Codes

Should an application or system problem occur, built-in diagnostics will protect the system. The red “FAULT” light on the front of the SubDrive300 controller will flash a given number of times to indicate the nature of the fault. In some cases, the system will shut itself off until corrective action has been taken. Fault codes and the recommended corrective action for each are listed in the following chart.

# of Flashes	Fault	Possible Cause	Corrective Action
1	Motor Underload	Air-locked pump. Overpumped or dry well. Worn pump. Damaged shaft or coupling. Blocked pump or screen.	Wait for well to recover and automatic restart timer to time out. If the problem does not correct, check motor and pump. See description of “Smart Reset” on Page 26.
2	Undervoltage	Low line voltage. Misconnected input leads.	Check for loose connections. Check line voltage. Report low voltage to the power company. Unit will start automatically when the proper power is supplied.
3	Locked Pump	Motor/pump misaligned. Abrasive/Sand-bound pump. Dragging pump or motor.	Unit will attempt to free a locked pump. If unsuccessful, check the motor and pump.
4	Reserved for factory use		
5	Open Circuit	Loose connection. Defective motor or cable.	Check motor wiring. Make certain all connections are tight. Make certain proper motor is installed. Cycle input power** to reset.
6	Short Circuit	When fault is indicated immediately after power-up, short circuit due to loose connection, defective cable, splice or motor.	Check motor wiring. Cycle input power** to reset.
	Over Current	When fault is indicated while motor is running, over current due to loose debris trapped in pump.	Check pump.
7	Overheated Controller	High ambient temperature. Direct sunlight. Obstruction of air-flow.	This fault automaticallyresets when the temperature returns to a safe level.

** “Cycle input power” refers to turning the power off until both lights fade off, then applying power again.

System Troubleshooting Guide

Symptom	Possible Cause	Corrective Action
Water flow rate is not as high as expected.	Motor is running backwards.	Verify motor connections. See Figure 2 in the "Wiring Connections" section.
	Temperature in the controller is too high. If the controller's heat exchanger becomes too hot, the controller will reduce the speed of the pump to lower the power consumption.	Make sure there is at least 6" of room around the controller for movement of air. Avoid direct sunlight. Reduce ambient temperature below 125°F (51°C). Increase input voltage if below 230 VAC.
	Pump capacity cannot supply the demand.	Use pump with higher flow rating (if head requirement is still satisfied).
Excessive pressure fluctuations.	Waterlogged tank.	Check tank for bladder damage. Replace if necessary.
		Reset the tank pre-charge pressure (should be 70% of pressure sensor setting).
	Pressure tank is too small for flow rating of the pump.	Use larger tank (refer to Table 3 on Page 16 for minimum Pressure Tank size).
Motor runs continuously with no flow demand.	Leak in the pitless adapter.	Re-seat the pitless adapter. Replace seal as needed.
	Leak in the household or outdoor plumbing	Check for leaky faucets, valves and/or pipe fittings and repair.

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 SubDrive300 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 5: "Smart Reset" Well Recovery Time

Over-Temperature Foldback

The SubDrive300 controller is designed for full power operation in ambient temperatures up to 125°F (51°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.

TOLL-FREE HELP FROM A FRIEND
Franklin Electric
Submersible Service Hotline
800-348-2420

Franklin Electric

400 E. Spring Street
Bluffton, IN 46714
Tel: 260-824-2900
Fax: 260-824-2909
www.franklin-electric.com

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