Constant Pressure Controller

for Submersible Well Pumps

User Manual

SubCon™ 1.5

SubCon™ 3.0

c UL us LISTED

SJE-Rhombus®

www.sjerhombus.com

⚠ WARNINGS

Failure to read and understand the information provided in this manual may result in personal injury or death, damage to the product or product failure. Please read each section in its entirety and be sure you understand the information provided in the section and related sections before attempting any of the procedures or operations given.

Failure to follow these precautions could result in serious injury or death. Keep these instructions after installation. This product must be installed in accordance with National Electrical Code, ANSI/NFPA 70 so as to prevent moisture from entering or accumulating within the controller housing.
See additional specifications on page 9 of this manual.

⚠WARNING **ELECTRICAL SHOCK HAZARD**

Disconnect power to the SubCon™ Drive and wait 10 minutes before removing the terminal cover. A qualified service person must install and service this product according to applicable codes and electrical schematics.

- Lethal voltages are still present inside the SubCon™ VFD after power is disconnected. Wait 10 minutes to allow internal capacitors to fully discharge before attempting to connect or disconnect wires or to service this equipment.
- Do not connect incoming power to motor terminals U/T1, V/T2, W/T3. Doing so will result in irreversible damage to the Drive.
- Do not connect power to this equipment if it's been damaged or has any missing parts.
- Do not apply power to the SubCon™ VFD with the terminal cover removed.
- Verify that the incoming voltage supply is 230 VAC before applying power to the unit.
- The SubCon™ VFD contains no serviceable parts, do not attempt to repair this equipment.
- The SubCon™ VFD must be grounded at the grounding terminal ⏚ according to N.E.C. Refer to the electrical connection on page 6.
- The SubCon™ VFD has been designed for indoor mounting only.
- Do not install in areas with: excessive or conductive dust, corrosive or flammable gas, moisture or rain, excessive heat, regular impact shocks or excessive vibration.

⚠WARNING **EXPLOSION OR FIRE HAZARD**

Do not install this product in hazardous locations as defined by National Electrical Code, ANSI/NFPA 70.

This device complies with Part 15 of the FCC Rules.
Operation is subject to the following two conditions: **(1)** this device may not cause harmful interference, and **(2)** this device must accept any interference received, including interference that may cause undesired operation.

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Detroit Lakes, MN 56502 USA
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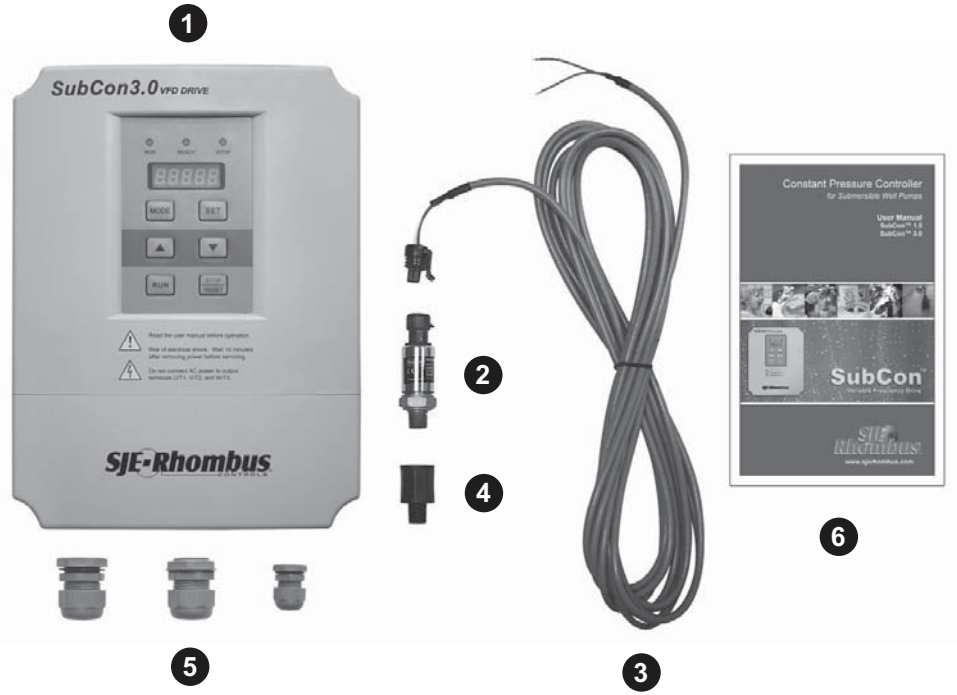
Thank you for purchasing the SubCon™ Variable Frequency Drive controller. The SubCon™ VFD provides a state-of-the-art solution for water well pumping control applications. The controller will monitor the water pressure continuously and automatically adjust the pump speed to maintain a constant pressure discharge.



Included in the box:

1. SubCon™ VFD controller (SubCon™ 1.5 or SubCon™ 3.0)

2. Pressure transducer (0-145 PSI range) with 20 ft. of cable

3. Transducer cable

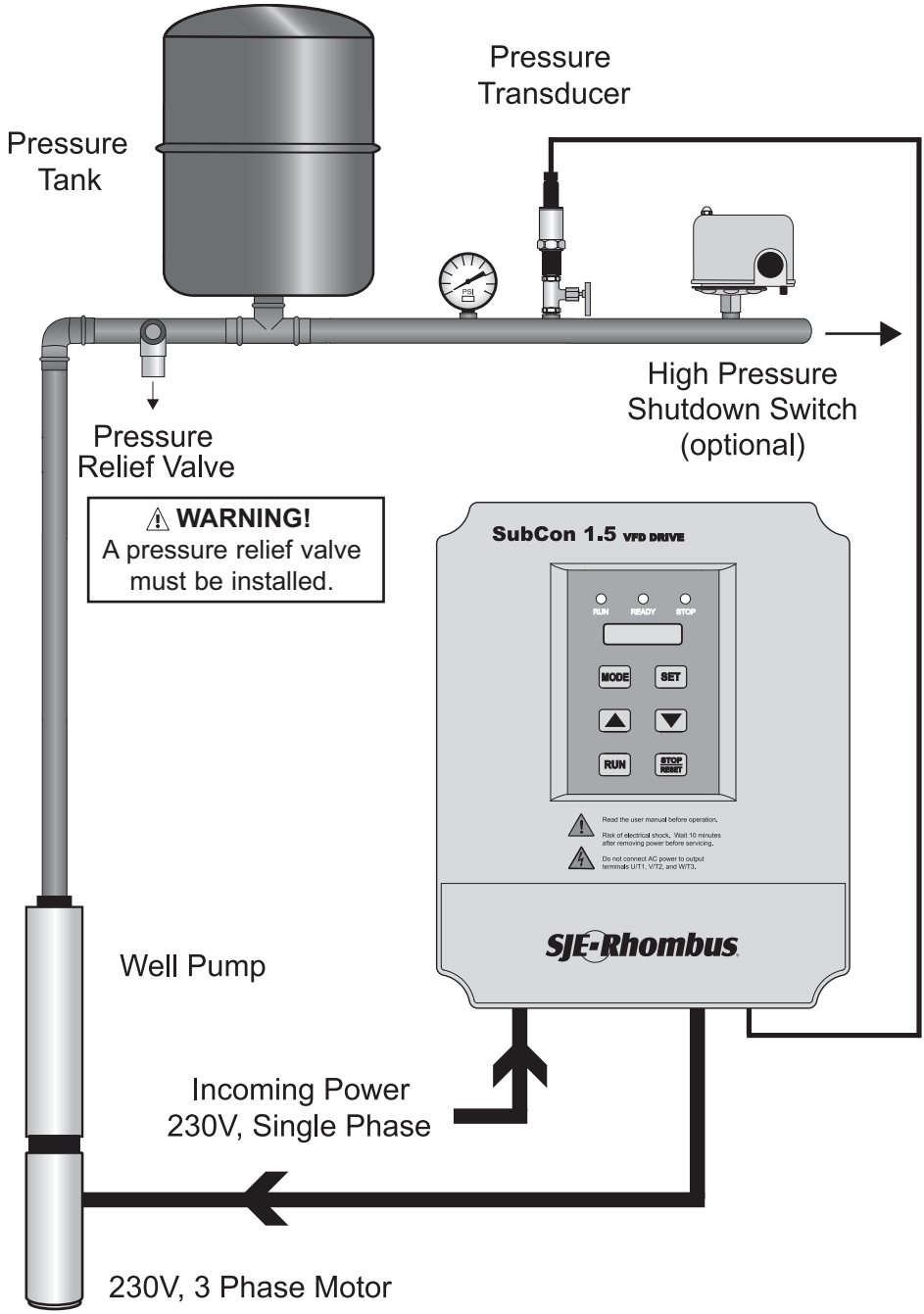
4. Transducer isolator

5. Strain reliefs (1 x 0.5”, 2 x 0.75”)

6. User manual

Verify that all components are included and the SubCon™ model number is correct.

Simplex Operation Diagram for SubCon™ 1.5 and SubCon™ 3.0



Pressure Tank
To maintain constant pressure and prevent frequent startup, a small-capacity pressure tank is needed in the system (refer to the minimum capacity of pressure tank table below). The SubCon™ VFD may use the pressure tank of a larger capacity than listed on the table.

Minimum Capacity of Pressure Tank

Flow Rate	Inverter Model	Motor Capacity	Minimum Pressure Tank Total Capacity
12.0 GPM or less	SubCon™ 1.5	1.5 HP	2 gallon
	SubCon™ 3.0	3.0 HP	4 gallon
12.0 GPM or more	SubCon™ 1.5	1.5 HP	4 gallon
	SubCon™ 3.0	3.0 HP	8 gallon

Initial Pressure Tank Charge Pressure

1. Initial charge pressure should be at least 70% of the system pressure.
2. To maintain the optimum pressure level, check the air pressure in the tank regularly.

Set Pressure (PSI)	Initial Charging Pressure (PSI)
50 (default)	35
55	39
60	42
65	46

A Pressure Relief Valve Must be Installed.
A pressure relief valve **MUST** be installed as close to the incoming source as possible and plumbed to a drain able to pass the pumps full flow in the event of a malfunction.

⚠ **WARNING**
Failure to use a pressure relief value could result in burst pipes and flooding if a system failure should occur.

High Pressure Shutdown Switch (optional)
A pressure switch may be used to shut down the pump on high pressure, in the event of a pressure transducer malfunction. A reverse action pressure switch is required (open on pressure drop). The switch must be set to close before the pressure rises and reaches the piping system pressure rating. See **page 6** for electrical connections.

Product Nameplate and Mounting

Information on Nameplate

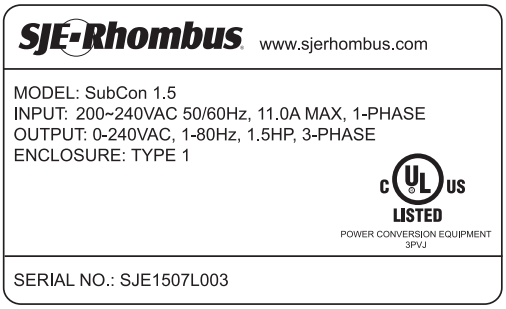
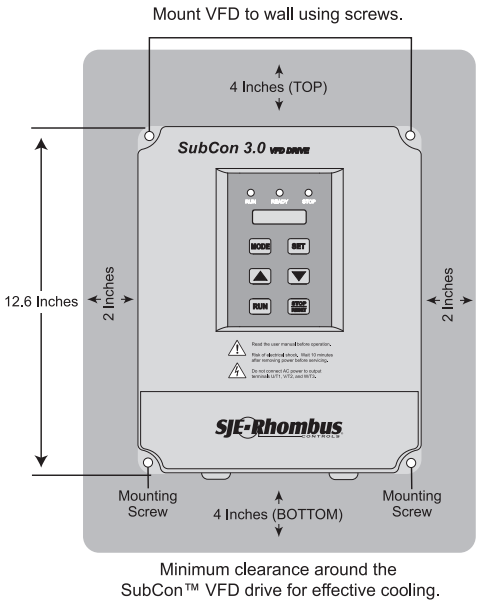


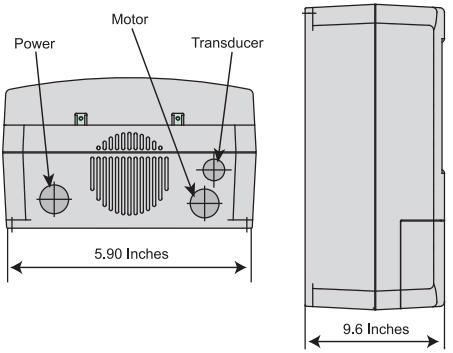
Figure 1 VFD Nameplate

*Description of VFD Model

SubCon™ 1.5 - VFD Model 1.5 or 3.0

Outline and conduit size for SubCon™ 1.5 and SubCon™ 3.0





Hole Size	Conduit Size
0.82 in (21 mm)	1/2 in
1.10 in (28 mm)	3/4 in

Figure 2 Installation Location

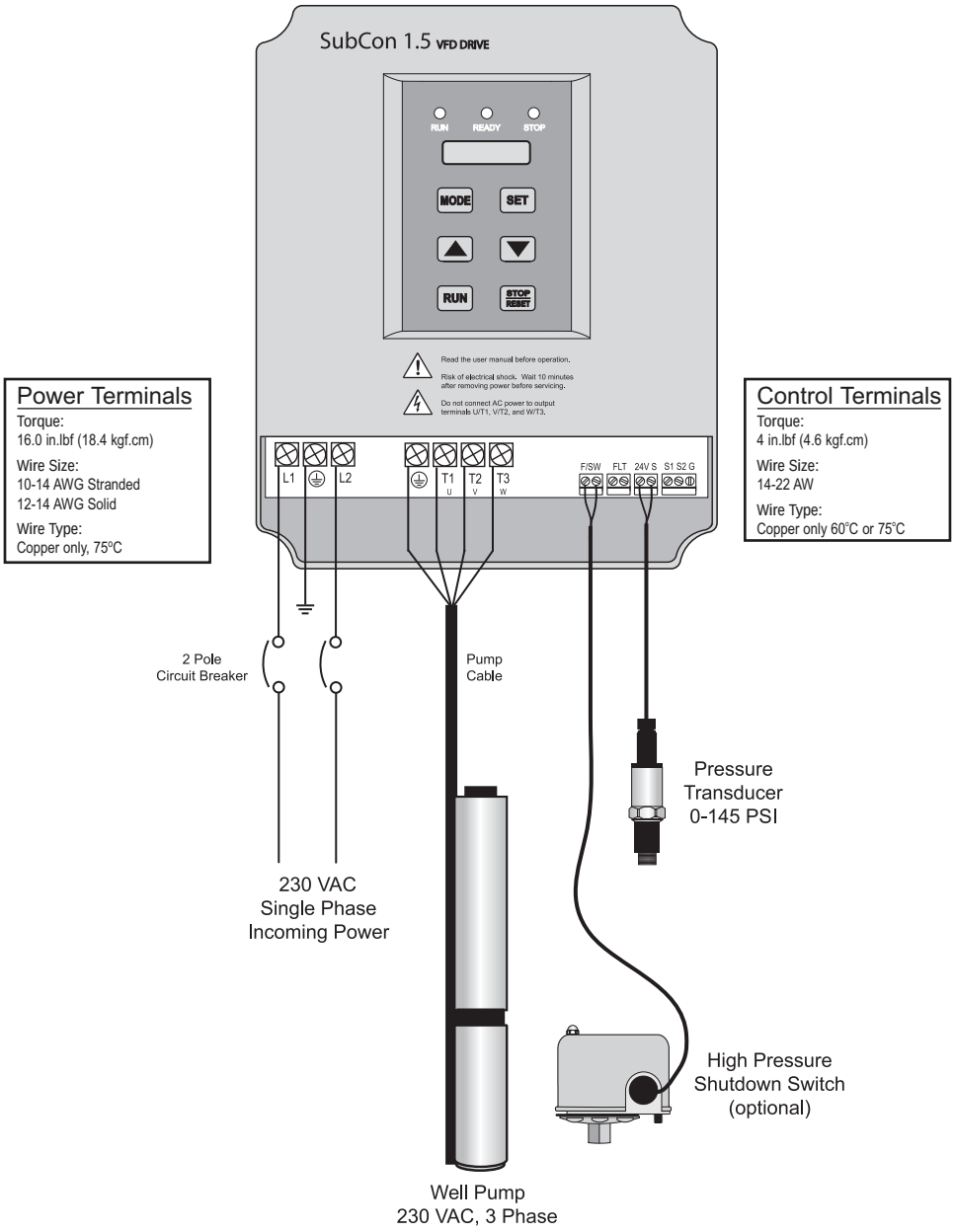
VFD Mounting

1) The SubCon™ VFD is designed to be wall mounted vertically using four (4) screws as shown in **Figure 2**.

2) The SubCon™ VFD requires a minimum clearance on all sides for adequate ventilation as shown in **Figure 2**.

3) Only install the SubCon™ Drive indoor in a clean and dry environment. See specifications on **page 9** of this manual.

Electrical Connections Diagram for SubCon™ 1.5 and SubCon™ 3.0



Model	Max Voltage	Circuit Breaker	Min Cable Size
SubCon™ 1.5	240 V	20A	12 AWG
SubCon™ 3.0	240V	30A	10 AWG

Power Terminal Connections

Symbol	Function
L1, ⏚, L2	Incoming power terminal block
U/T1, V/T2, W/T3, ⏚	Output power terminal block for the pump motor connections

Control Terminal Connections

Symbol	Function
24V, S	Pressure transducer connection 24V = 24 VDC transducer power S = 4-20mA signal from transducer
S1, S2, G	Communication (for duplex operation)
F/SW	Remote stop switch input: use with an optional high pressure shut down switch or high level septic tank switch. Only use a potential free contact (dry contact). There is a 30 second delay after contact closure for the pump to shut down.
FLT	Relay output

Motor Cable Size (AWG) and Length (Feet)

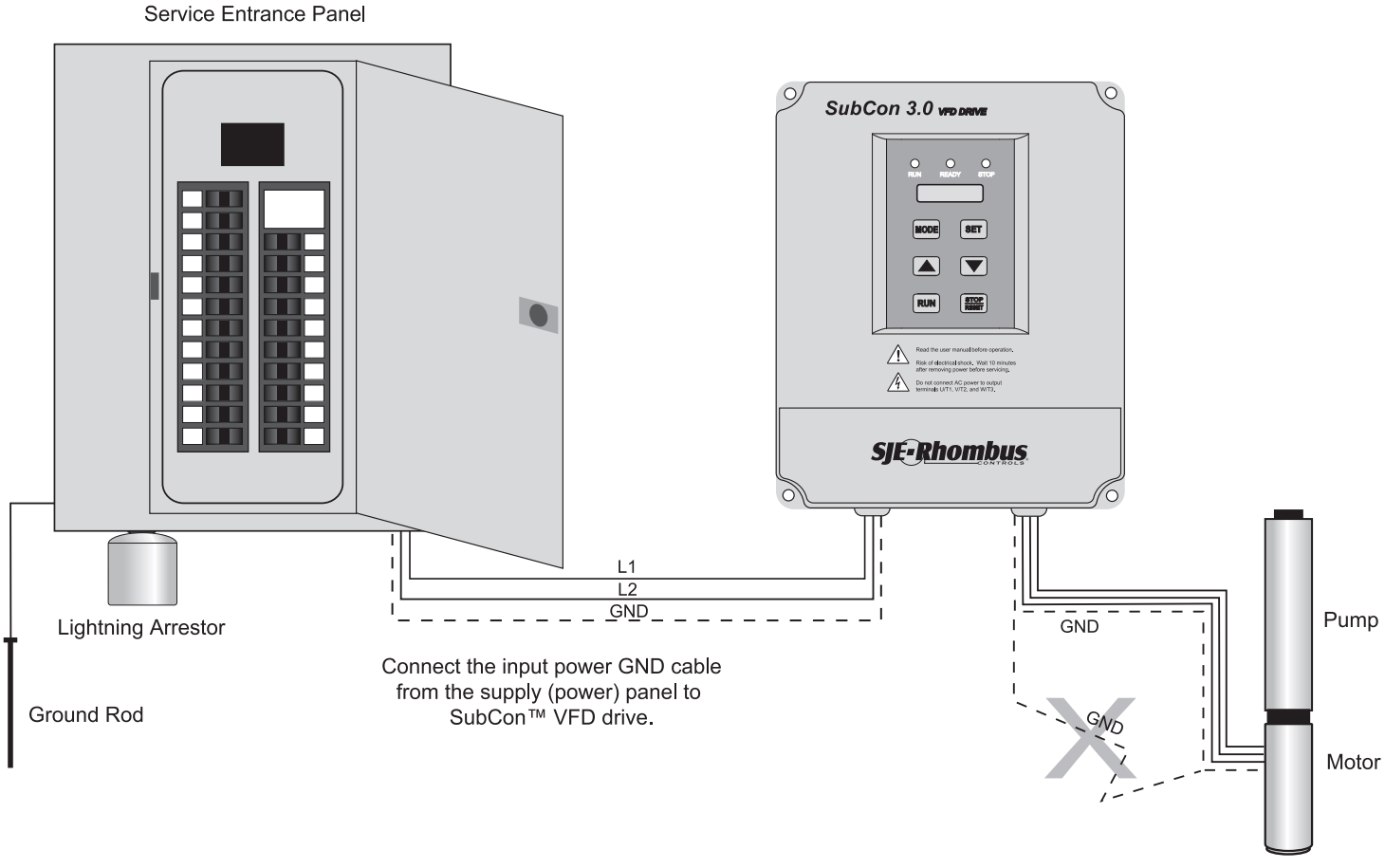
Controller Model #	14 AWG	12 AWG	10 AWG
SubCon™ VFD 1.5	410 ft.	656 ft.	--
SubCon™ VFD 3.0	240 ft.	394 ft.	656 ft.

1. Cable length is measured from SubCon™ to the motor.
2. Do not use flat cable. Use round cable with twisted conductors (3 wire + ground).
3. Do not use aluminum conductors.
4. For cable lengths greater than specified, please contact factory.

Lightning Arrestor

The use of a lightning arrestor will reduce problems resulting from power surges and lightning, however 100% protection is not achievable. The lightning arrestor must be installed in the service entrance panel. Do not connect lightning arrestors to the SubCon™ output or motor.

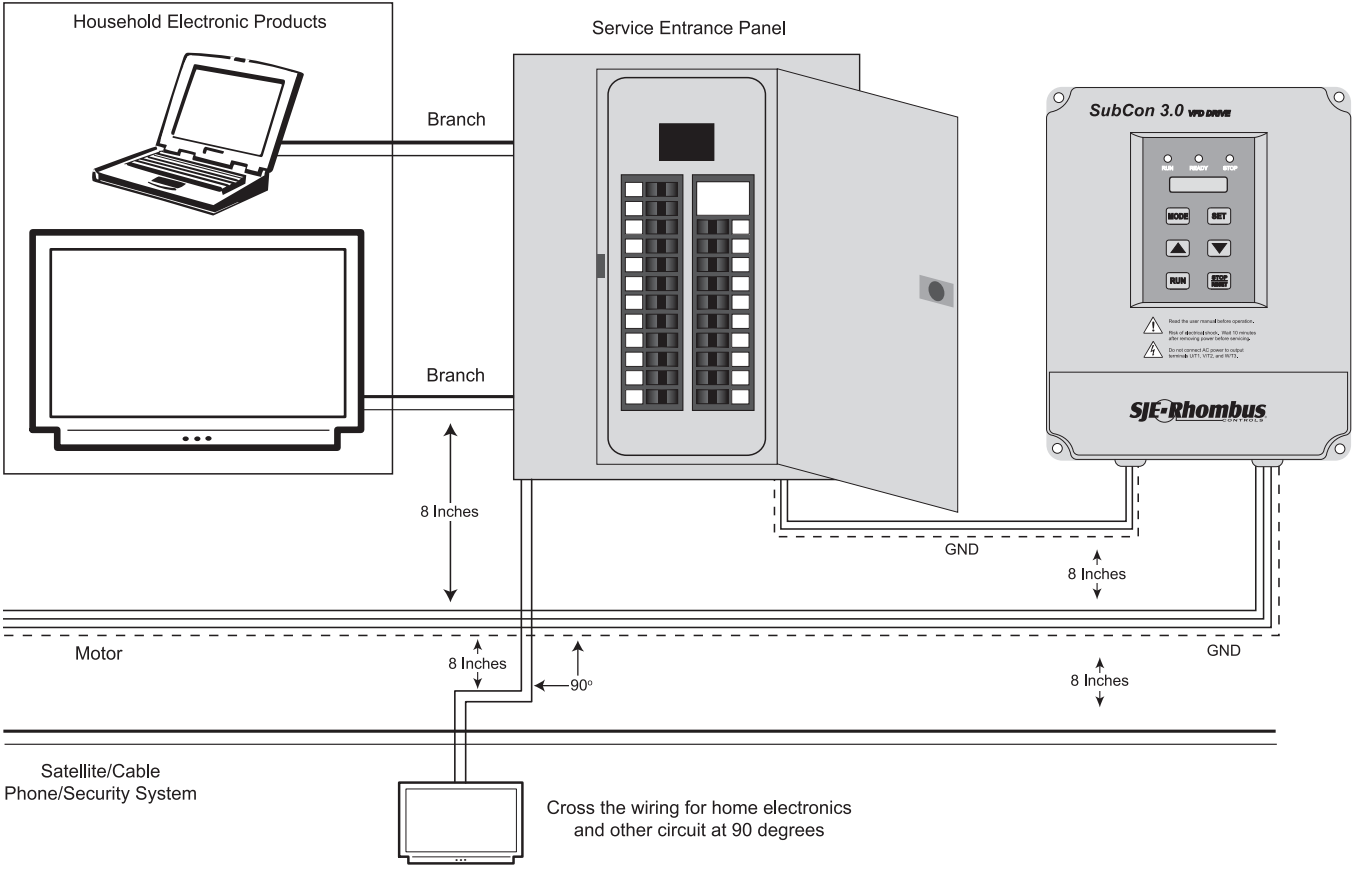
Grounding Method



SubCon™ Specifications	SUBCON™ 1.5	SUBCON™ 3.0
Output Rating		
Maximum Applicable Motor Output (HP)	1.5 HP	3 HP
Rated Output Current (A)	5.9 A	11.0 A
Output voltage	0 - 240 VAC three phase	
Output Frequency (Hz)	30 - 60 Hz (default) - adjustable	
Carrier Frequency (kHz)	2.5 - 8 kHz	
Input Rating		
Rated Input Current (A)	11 A	23 A
Rated Input Voltage (V)	200 - 240 VAC Single Phase	
Rated Input Power (kW)	2.4 kW	4.6 kW
Frequency tolerance (Hz)	50/60 Hz	
Control Characteristics		
Control	Pulse Width Modulation (PWM) V/F control	
Overload capacity (%)	115% of rated output current for 10 seconds	
Over Current Capacity (%)	150% of rated output current	
Acceleration / Deceleration time (s)	2 - 60 Seconds	
V/F Pattern	Adjustable V/F pattern	
Operating Characteristics		
Pressure setting	50 PSI (default) - adjustable	
Pump speed	30 - 60 Hz (default) - adjustable	
Control method	Proportional+Integral+Derivative (PID)	
Start method	Auto-start on pressure drop below setpoint + differential	
Stop method	Auto-stop on motor min. speed + timer	
Pressure signal	0 - 145 PSI transducer, 4-20 mA signal	
Digital input	Dry contact closure for remote stop drive	
Digital output	Relay output 2A, 250V (Run/Alarm)	
Environment		
NEMA enclosure rating	Type 1 (indoor)	
Installation location	Altitude less than 9,842 feet (3,000 m)	
Pollution Degree	2	
Corrosion	Keep away from corrosive gases, liquids, dust	
Explosion	Not suitable for installation in hazardous locations	
Operating temperature	14°F to 104°F (-10°C to 40°C)	
Storage Temperature	4°F to 122°F (-20°C to 50°C)	
Ambient Humidity	Less than 95% Non Condensing	
Cooling Method	Forced Fan-cooled	
Approvals	UL/cUL Listed (USA and Canada)	

Cable Routing Guidelines - Distance Between Power Cables

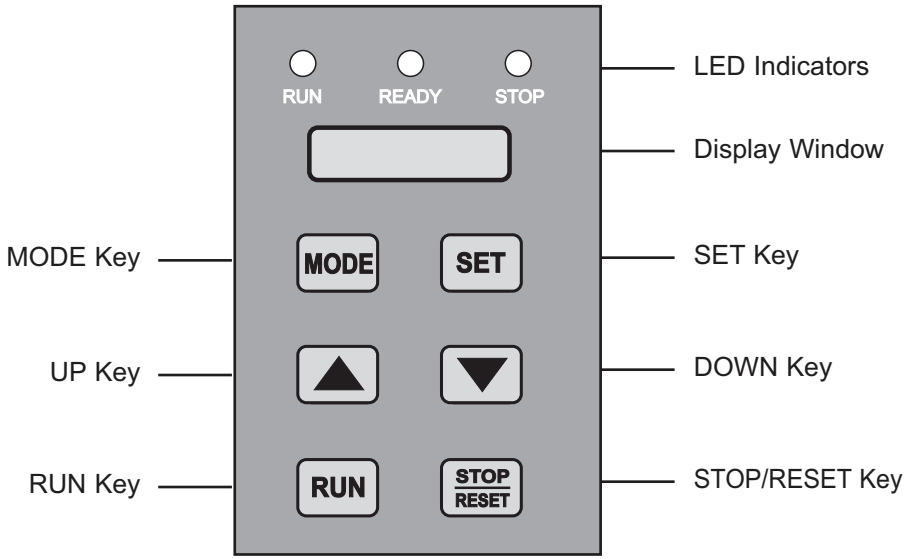
As shown below, separate the input power cable and the motor wiring by 8 inches or more.



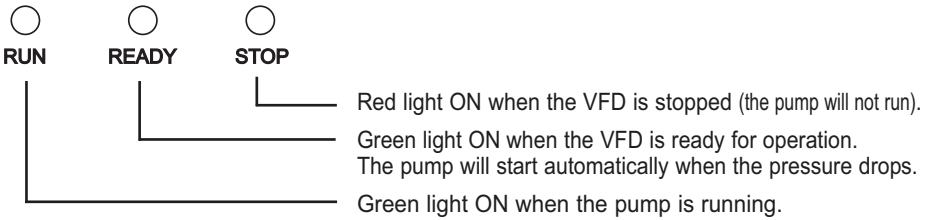
Digital Control Buttons

This section describes the display unit and LED indicators shown below. It also describes the keypad operation.

Display



Description of LED Indicator



Description of Display Buttons

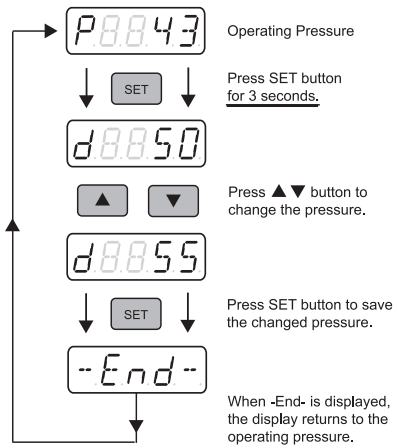
Buttons	Description
MODE	Used to enter and escape the BR mode.
SET	Used to save edited parameter values.
UP/DOWN	Used to edit parameter values.
RUN KEY	Used to run the VFD in Automatic mode.
STOP/RESET	Used to stop or reset the VFD.

How to use the Keypad

Viewing Operational Information Using ▲ and ▼ Buttons

Display	Description
	Displays the operating pressure in **PSI** *(verify that it is equal to the reading on the pressure gage)*.
	Displays the set pressure in **PSI** (default is **50 PSI**).
	Displays the frequency (motor speed in **Hz**).
	Displays the motor current in **Amps**.
	Displays the total **hours** of operation of the pump (0 - 24h).
	Total number of **days** of operation of the pump (0 - 9999).
	VFD **communication** is set as MASTER (only used in duplex operation).

Setting the Pressure



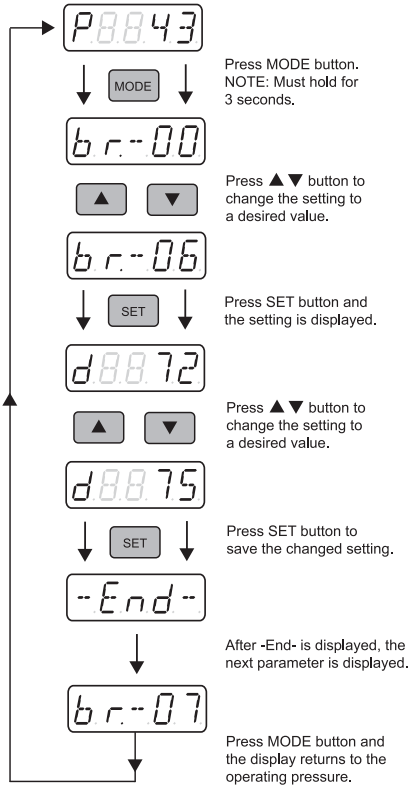
⚠ WARNING!

Setting the pressure higher than the piping system rating will result in burst pipes and flooding.

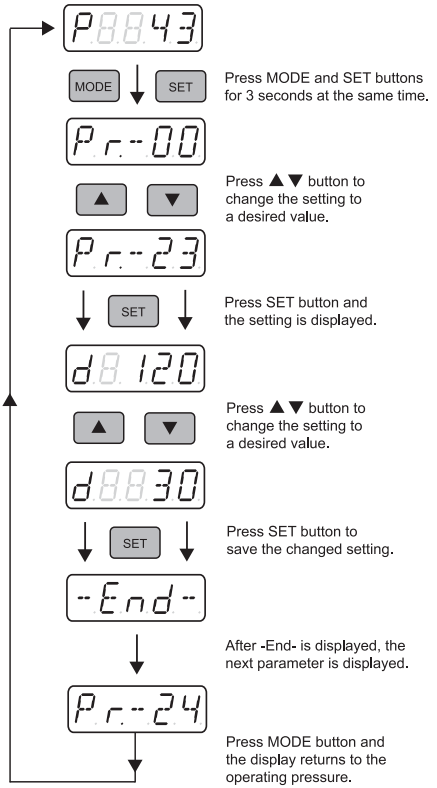
NOTE: If any buttons are **not** pressed for two minutes, the display will return to the operating pressure automatically.

Changing BR and PR parameters

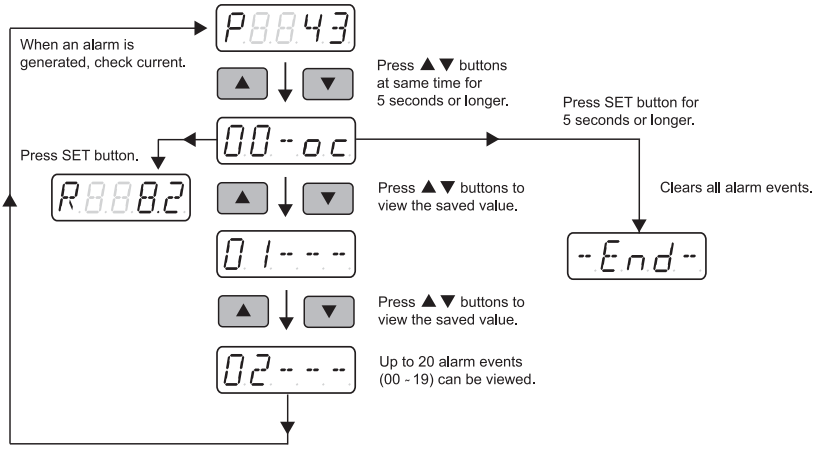
How to Change BR Mode Parameters



How to Change PR Mode Parameters



Viewing the Alarm Log



BR Parameters Table

NO	Parameter Name		Parameter Value Min.	Max.	Preset	Unit	Function Description
BR-00*	Horse Power (SubCon™ 1.5) Horse Power (SubCon™ 3.0)		0.5 0.5	3.0 3.0	1.5 3.0	HP HP	0.5HP, 0.75HP, 1HP, 1.5HP, 2HP, 3HP
BR-01*	Motor Rated Current	1.5HP	0.0	20.0	5.9	A	Set to the motor rated current
		3.0HP	0.0	20.0	10.9	A	Set to the motor rated current
BR-02*	Maximum Frequency		40	80	60	Hz	Maximum frequency
BR-03*	Direction of Rotation		0	1	1	Hz	0: Forward / 1: Reverse
BR-04	Minimum Frequency		30	90	50	%	Minimum frequency (50% = 30)
BR-05	Sensor Value		0 (0.0)	290 (20.0)	145 (10.0)	PSI (bar)	Set the pressure transducer sensing range (span)
BR-06	High Pressure Alarm		0 (0.0)	363 (25.0)	72 (4.9)	PSI (bar)	High discharge pressure alarm setting
BR-07	Low Pressure Alarm		0 (0.0)	290 (20.0)	10 (0.6)	PSI (bar)	Low discharge pressure alarm setting
BR-08	Start Pressure Differential		0 (0.0)	28 (2.0)	4 (0.3)	PSI (bar)	Pressure drop below the setpoint before starting the pump
BR-09	Do Not Use		--	--	--	--	--

*These parameters can only be edited when the SubCon™ is in the “STOP” mode.

BR Parameters Description

BR-00 BR-01 Horse Power, Motor Rated Current

These parameters are used to set the VFD to match the motor Horse Power (HP) and rated current (A).

[BR-00] Motor Capacity (HP) 0.5, 0.75, 1.0, 1.5, 2.0, 3.0

SubCon™ 1.5 (1.5HP): 1.5HP
SubCon™ 3.0 (3.0HP): 3.0HP

Set the HP in BR-00 to match the motor HP.

[BR-01] This is the motor nameplate rated current information. This data is used to protect the motor and VFD in the event of overload conditions.

Motor rated current (typical, check your motor nameplate and adjust accordingly)

Motor Capacity (HP)	0.5	0.75	1.0	1.5	2.0	3.0
Rated Current (A)	2.9	3.8	4.7	5.9	8.1	10.9

The VFD will trip on a motor overload fault (ER-oL) when the motor current exceeds the value in BR-01 by 15% for more than 10 seconds.

BR-02 Maximum Frequency

[BR-02] This parameter is used to set the VFD maximum output frequency delivered to the motor. 60Hz is the default value.

⚠ **Warning!** Extreme precautions must be taken in order to operate the pump at frequencies over 60Hz:

- The motor must be over-sized to handle the extra mechanical load.
- The pump and motor must be rated for operation over 60Hz.
- The pump and motor selection and sizing must be approved by the pump and motor manufacturers.

Failure to do so may result in motor overloading and possible pump and/or motor damage.

BR-03 Direction of Rotation

This parameter allows the user to change the rotation of the motor without the need to change the motor wiring.

0: Clockwise Rotation
1: Counterclockwise Rotation

BR-04 Minimum Motor Frequency %

This parameter is used to set the VFD minimum output frequency delivered to the motor. This value is in percentage of the maximum value. If BR-02 is 60Hz and BR-04 is 50%, the minimum frequency will be 30Hz. You must consult the motor and pump manufacturer if you wish to operate less than 30Hz. Increase this value if the pump runs continuously (even at no flow conditions).

BR-05 Sensor Value

Enter the pressure transducer sensing range (Span). The default value is 145 PSI which corresponds to the supplied 0-145PSI range pressure transducer.

Note: You must verify that the pressure reading on the SubCon™ display matches the reading on the pressure gage. A deviation of more than +/- 5 PSI would indicate a defective transducer or defective pressure gage, or BR-05 is set incorrectly. It is recommended that these two displays be compared on a monthly basis.

⚠ **Warning!** Setting an incorrect value for BR-05 will result in inaccurate pressure readings and may result in unpredictable operation and possible equipment/property damage from over-pressure.

BR-06 BR-07 High Pressure Alarm, Low Pressure Alarm

When the discharge pressure rises above the high pressure alarm [BR-06], the SubCon VFD will stop the pump immediately and will display the fault code "Er-HP"
When the discharge pressure drops below the low pressure alarm [BR-07], the SubCon VFD will stop the pump after a time delay and will display the fault code "Er-LP".
The low pressure alarm is used to detect **broken pipe** or **dry run** conditions (see PR-20 & PR-21).

BR-08 Start Pressure Differential

This value determines the pressure drop below the set pressure before the VFD starts the pump.
Example: If the set pressure is 50 PSI and [BR-08] is 5 PSI, then the pump will start when the pressure drops below 45 PSI.

BR-09 Do Not Use

PR Parameters Table *(factory-trained technicians only)*

NO	Parameter Name	Parameter Value				Function Description
		Min.	Max.	Default	Unit	
PR-00*	PFC Circuit	0	1	1		0: Not Used, 1: Used
PR-01*	Operation Mode	0	1	1		0:Basic VFD Control, 1:Pressure Control
PR-02*	PWM Frequency	2	6	2	kHz	2: 3.2kHz, 3: 4.0kHz, 4: 5.0kHz 5: 6.4kHz, 6: 8.0kHz
PR-03	Acceleration Time	2	60	2	Sec	Time during which the motor operates up to the maximum frequency
PR-04	Deceleration Time	2	60	2	Sec	Time during which the motor stops operating until the minimum frequency is reached
PR-05*	Minimum Frequency	0	20	2	Hz	Minimum frequency set in V/F curve
PR-06*	Minimum Voltage	2	50	10	VAC	Minimum voltage set in V/F curve
PR-07*	Medium Frequency	0	80	5	Hz	Medium frequency set in V/F curve
PR-08*	Medium Voltage	2	230	30	VAC	Medium voltage set in V/F curve
PR-09*	Base Frequency	60	60	60	Hz	Maximum voltage/frequency
PR-10*	Stop Method	0	1	0		0: Stop by Decel mode 1: Stop by Free Run mode
PR-11*	Pressure Unit	0	1	1		0: BAR, 1: PSI
PR-12	Sensor Calibration	-.14 (-1.0)	14 (1.0)	0 (0.0)	PSI (BAR)	Set offset for pressure transducer error
PR-13	Proportional Control (P)	0	100	50	%	Proportional Gain
PR-14	Integral Control (I)	0	100	70	%	Integral Gain
PR-15	Differential Control (D)	0	100	0	%	Differential Gain
PR-16	Control Cycle	1	30	1	10mSec	Set P.I.D. control cycle
PR-17	Alternation Mode	0	1	1		0: No Alternation 1: Alternation
PR-18	Alternation Time for Duplex Operation	0	99	0	Hour	Hours of pump run time before alternation. If time is set to zero, the alternation will be cycle rather than accumulated time based
PR-19*	Slave Address	0	1	0		0: Master, 1: Slave
PR-20	Low Level Alarm Reset Counter (Er-Ln)	0	100	3	Times	0-99: Reset Attempts, 100: Continuous
PR-21	Low Level Alarm Reset Delay Timer (Er-Ln)	0	999	1	Min	Delay time before alarm reset and auto-start (in minutes)
PR-22	Level Switch - Digital Input	0	1	0		0: Normally open, 1: Normally closed
PR-23	Back to Main Screen Timer	60	200	120	Sec	Time delay before returning to main display
PR-24	Stall Prevention	0	1	0		0: Stall prevention OFF 1: Stall prevention ON
PR-25*	Prevention of Over-current Stall during Acceleration	50	200	150	%	
PR-26*	Prevention of Over-current Stall during Operation	50	200	150	%	
PR-27	Relay Output Operation	0	1	0		0: FAULT, 1: RUN, *Relay Open Normal
PR-28*	Parameter Reset	0	1	0		0: Do Not Reset, 1: Reset
PR-29	Version			1.08		

* These parameters can only be edited when the SubCon™ is in the “STOP” mode.

PR Parameters Description

PR-00 Power Factor Correction (PFC)

This is used for long motor cable length (from the VFD to the motor). PFC compensates for voltage drop and is able to deliver full power to the motor.

0: PFC Circuit Not Used
1: PFC Circuit Used

PR-01 Operation Mode

This parameter is used for setting the motor operation mode. There are two types of operation mode. One is pressure control operation mode to control the output frequency automatically according to the pressure setting and the other is normal VFD operation mode to control frequency manually.

0: VFD operation - Sets the desired frequency and operates the motor manually.
1: Pressure control operation - Motor operates automatically according to set pressure.

PR-02 PWM Frequency (Carrier Frequency)

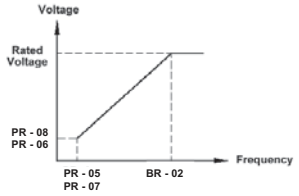
PWM frequency affects the electromagnetic noise level to the motor, heat dissipation and environmental interference of the VFD. When the carrier frequency is high, the electromagnetic noise is less while the heat dissipation in the VFD increases.

PR-03 PR-04 Acceleration Time, Deceleration Time

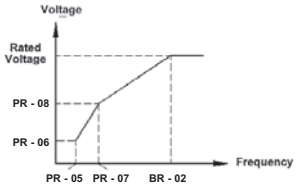
These are used for reducing startup load and ensuring smooth startup and stop of motor operation. [PR03] ACCEL TIME refers to the time required for reaching maximum frequency set to [BR-03]. [PR-04] DECEL TIME refers to the time required for stopping at maximum frequency during the VFD operation in [BR-00] operation mode.

PR-05 PR-06 PR-07 PR-08 Min. Freq., Min. Voltage, Med. Freq., Med. Voltage

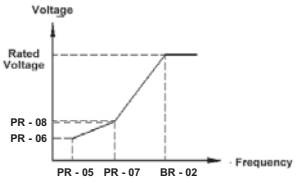
These are used for setting voltage/frequency (V/F) pattern, one of the startup characteristics of the motor. [PR-05] and [PR-06] are used for setting median frequency and voltage for startup. [PR-07] and [PR-08] are used for setting minimum frequency and voltage. At the time of delivery from the factory, these parameters are set according to the standard V/F curve. If the motor is operated at an excessive startup torque, it may result in damage to the motor.



[Standard V/F Curve]



[When the startup torque is raised]



[When the startup torque is lowered]

PR-09 Base Frequency

Refers to the frequency at which the VFD outputs the motor rated voltage.

PR-10 Stop Method

This parameter is used for setting stop mode of the motor.

0: DECEL TO STOP - This mode is used when the VFD is stopped, the motor will decelerate according to the [PR-04] parameter.

1: COAST TO STOP - Upon a “STOP” command, the VFD output voltage is shut off and the motor coasts to a stop.

PR-11 Pressure Unit

This parameter is used for setting the pressure unit of measurement.

0: bar

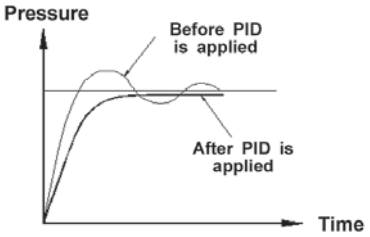
1: psi

PR-12 Sensor Calibration Value

The pressure reading can be offset to match a pressure gage reading.

PR-13 PR-14 PR-15 PR-16 PID Control Setting and Control Cycle

The inverter receives feedback of pressure from the pressure transmitter and calculates proportional control (P), integral control (I), and control (D), to control its output frequency. At this time, the control cycle refers to the cycle for repeating PID control.



PR-17 PR-18 PR-19 Alt. Mode, Alt. Time for Duplex Operation, Slave Address

These parameters are used to set alternation in duplex pump operation.

[PR-17] Alternation Mode is used for the alternation method.

0: No Alternation - Only designated pump operates but no alternation is made among pumps.

1: Alternation

[PR-18] Alternation will occur after one pump has accumulated more hours than set in this parameter.

[PR-19] is used for setting master pump and slave pump.

0: Master Pump

1: Slave Pump

PR-20 PR-21 Low Pressure Alarm Auto Reset Counter, Auto Reset Timer

[PR-20] is used for automatically resetting Low Pressure Alarms (Er-LP). It can be used for low producing well applications.

[PR-20] = 0 (no reset)

[PR-20] = 100 (continuous reset)

[PR-21] Delay before auto reset (well re-charge time) in minutes.

PR-22 Level Switch Contact Point

One of the methods to detect low water level using an external device (level switch, etc.). When low water level is detected by the level switch, the VFD will stop. When this low level alarm is cleared, the VFD resumes its normal operation. The VFD should be set according to the external device contact point setting.

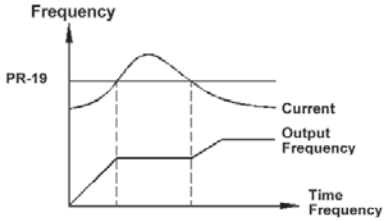
0: Level switch of the contact point “normally open”
1: Level switch of the contact point “normally closed”

PR-23 Display Timer (Return to Main Screen)

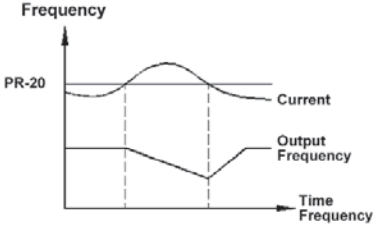
This parameter is used for viewing the operation data or for setting the time to return to the initial display according to the time set in BR or PR mode.

PR-24 PR-25 PR-26 Over-current Stall Prevention, Prevention of Over-current Stall during Acceleration, Prevention of Over-current Stall During Operation

[PR-24] Over-current Stall Prevention
0: Stall Prevention OFF
1: Stall Prevention ON
[PR-25] Prevention of Over-current Stall during Acceleration sets the limit to current that may be generated over the rated current while the VFD is accelerating or because the VFD acceleration time is too short.
[PR-26] Prevention of Over-current Stall during Operation.



[Prevention of Over-current Stall during Acceleration]



[Prevention of Over-current Stall during Operation]

PR-27 Relay Output Operation

This parameter determines the operation of the output relay. This relay can be used for remote alarming or to signal another device that the pump is running.

When [PR-27] = 0 the relay will close when the VFD has faulted
When [PR-27] = 1 The relay will close when the VFD is running the pump.

Both relays are normally open.

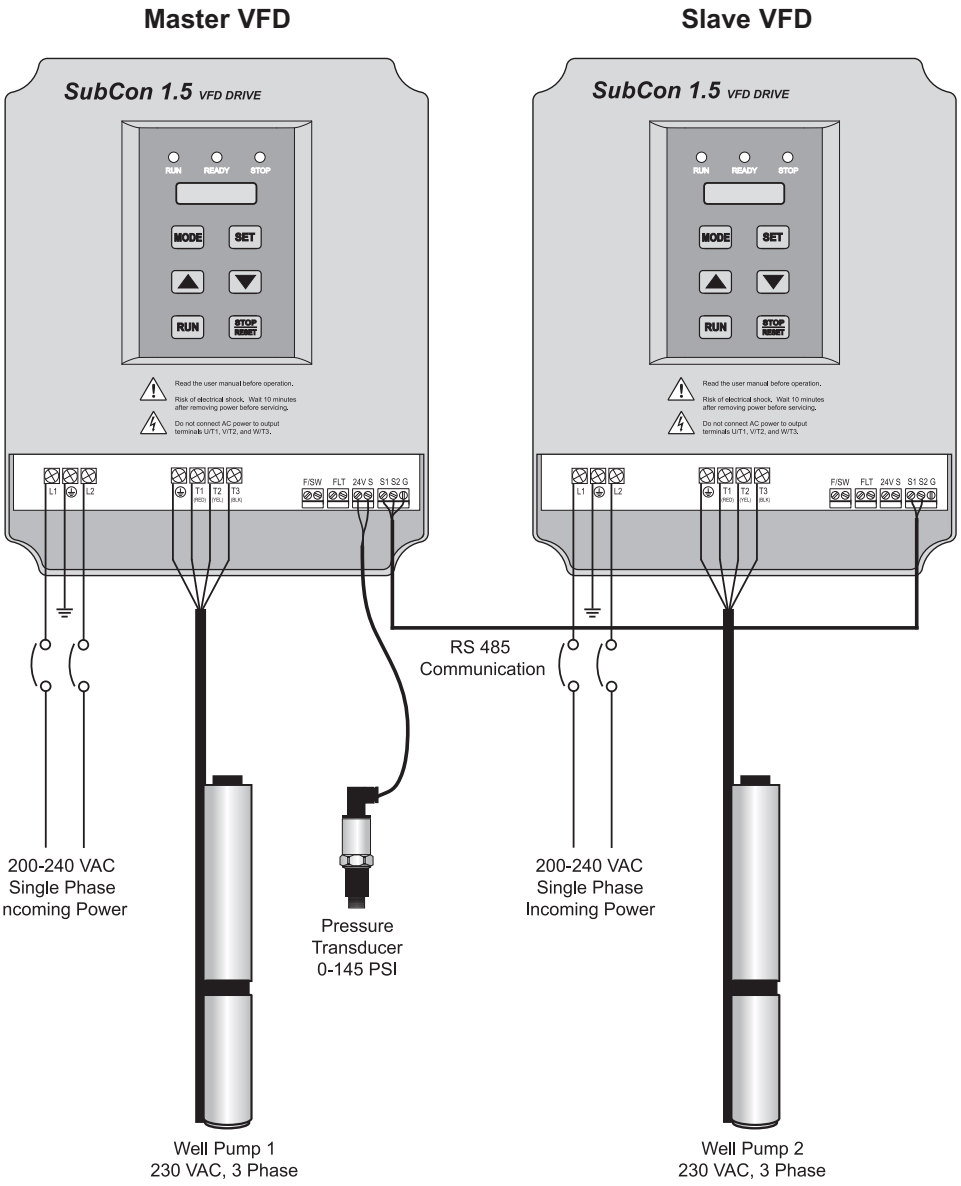
PR-28 Parameter Reset

This parameter is used for resetting all PR mode parameters to the default settings.

PR-29 Viewing Program Version

This parameter is used for viewing the firmware version.

Duplex VFD Operation Electrical Connections



Two Subcon™ VFDs may be used to provide constant pressure to a system. In this mode, the pumps will automatically alternate and both pumps will run if one pump is not able to meet the set pressure.

Duplex Communication Parameters Setup

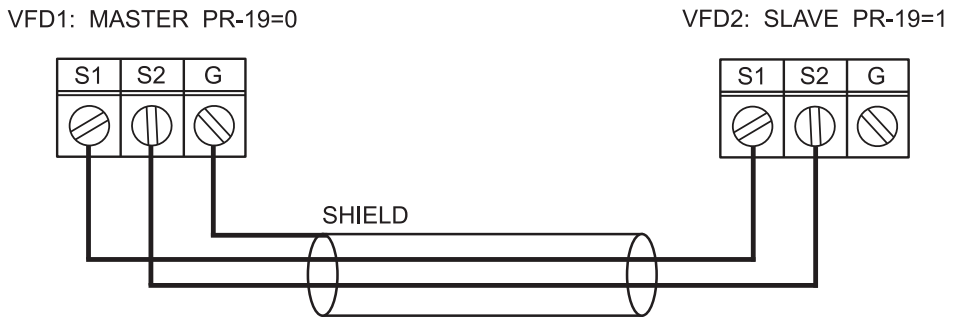
1) Set master VFD PR-19 parameter to 0.

2) Set slave VFD PR-19 parameter to address 1.

3) You will be able to set the pressure on any controller when the communication between the two VFDs operates correctly. The set pressure for both VFDs will be the same. (Refer to the booster mode pressure set method)

4) Press the Run buttons of each of the VFDs to start the operation.

*High Pressure Warning, Low Pressure Warning, Set Pressure and Alternation Time are shared parameters by both VFDs when using the communication link.



NOTE: In duplex mode, it is not possible to detect a broken pipe or dry run condition using “Low Pressure Alarm”.

Troubleshooting

This VFD has a built-in diagnosis system that detects faults in the system and displays the corresponding fault messages. When a fault is detected, the corresponding protective function is activated to stop the VFD and ensure that it will restart when the fault is cleared. The “STOP” LED is ON on the LED display unit on the front of SubCon™ VFD and the fault code is blinking on the VFD display window. Possible causes and actions for various fault diagnosis codes are listed in the table below. A qualified service person must perform any electrical or mechanical troubleshooting and repair of the system.

Possible Causes for Fault Messages and Actions

Fault Code	Fault Description	Possible Causes	Actions
Er-HoC	Hardware Over Current	The VFD fault was detected.	Disconnect power to the VFD, and notify SJE-Rhombus.
Er-oC	Over Current	Over-current trip circuit detected abnormal current increase.	Check whether the motor output matches the VFD output. Check if there is a short between the VFD and the motor. Increase the acceleration time. Check whether the motor is overloaded.
Er-oH	Over Heat	The temperature sensor of the VFD detected overheat inside the VFD.	Check whether the room temperature is within the prescribed temperature range, and check the VFD installation location. Check if the vent is blocked and if the fan is in working condition.
Er-oL	Overload	The VFD detected excessive output current. It can last for 10 seconds at 115% of the motor rated current.	Check if the motor is overloaded. If not, adjust BR-01 to match the motor data. Will auto reset 5 times.
Er-cE	Communication Error	There is a problem in the communication cable.	Check the communication cable connection duplex operation.
Er-So	Sensor Open	The transducer is not connected.	Check the transducer connection and cable.
Er-SS	Sensor Short	The transducer is short-circuited.	Transducer has failed. Replace the transducer.
Er-HP	High Pressure	High pressure alarm detected.	Check the high pressure setting [BR-06]. Check the system.
Er-LP	Low Pressure	Low pressure alarm detected.	Check the low pressure setting [BR-07]. Check the system for the low water level, broken pipe or leakage.
Er-Ln	Low Level (Level Switch)	Low water level detected by the external level switch or by optional high pressure shutdown switch.	Check the water supply. Verify that your pressure display matches your pressure gage reading.

Error Symptoms and Actions

Error Symptoms	Major Causes	Actions
Operation pressure does not rise after the pump starts up.	Check valve installed backward flow or damaged.	Repair or replace the check valve.
	A smaller capacity pump was selected.	Replace the pump with one of proper capacity.
	Foreign substances got into the pump.	Clean the pump and the piping.
	Broken shaft.	Check the pump; replace it if necessary.
	The pump rotates counterclockwise.	Check direction of rotation; correct if necessary [BR-03].
	The discharge valve is shut.	Open the discharge valve.
	Pump or piping is air locked.	Purge the air from the discharge piping, and correct the bent piping.
	The discharge piping is broken.	Repair the discharge piping.
	The pump rotor is damaged.	Repair or replace the pump.
The pump does not stop but keeps running.	Set pressure is too high.	Reduce the set pressure.
	Minimum frequency too low.	Increase BR-04 by 5%.
	The pump rotor is damaged.	Repair or replace the pump.
The pump is cycling too frequently.	Check valve failure.	Repair or replace the check valve.
	Tank air pressure failure in the tank, or damage.	Adjust air pressure or replace pressure tank (see page 4).
	Insufficient flow.	Replace filter, if in use.
	Insufficient pressure.	Increase the set pressure by 3 PSI, if it can be done safely.
The pump does not start up even when power is applied.	The circuit breaker is OFF.	Turn on the circuit breaker.
	The pump is locked.	Repair or replace the pump.
	No water supply for the pump.	Run the pump again after water is available.
	Motor failure.	Repair or replace the motor.
	Abnormal voltage is applied.	Check the incoming voltage.
	Pressure transmitter failure.	Replace the pressure transmitter.
	Motor wiring error.	Check the motor wiring, and correct if necessary.

*For other errors not specified above, please contact the factory or your local distributor.

INFORMATION TO THE USER

This equipment has been tested and found to comply with the limits for Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer for help.

WARNING!

Any changes to or modifications not expressly approved by SJE-Rhombus could void the user's authority to operate the equipment.

THREE-YEAR LIMITED WARRANTY

SJE-RHOMBUS® warrants to the original consumer that this product shall be free of manufacturing defects for three years after the date of manufacture. During that time period and subject to the conditions set forth below, SJE-RHOMBUS will repair or replace, for the original consumer, any component which proves to be defective due to defective materials or workmanship of SJE-RHOMBUS.

ELECTRICAL WIRING AND SERVICING OF THIS PRODUCT MUST BE PERFORMED BY A LICENSED ELECTRICIAN.

THIS WARRANTY DOES NOT APPLY: (A) to damage due to lightning or conditions beyond the control of SJE-RHOMBUS; (B) to defects or malfunctions resulting from failure to properly install, operate or maintain the unit; (C) to failures resulting from abuse, misuse, accident, or negligence; (D) to units which are not installed in accordance with applicable local codes, ordinances, or accepted trade practices, and (E) to units repaired and/or modified without prior authorization from SJE-RHOMBUS.

Some states do not allow limitations on how long an implied warranty lasts, so the above limitation may not apply to you. Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

TO OBTAIN WARRANTY SERVICE: The consumer shall assume all responsibility and expense for removal, reinstallation and freight of controller deemed defective. Any controller to be repaired or replaced under this warranty must be returned to SJE-RHOMBUS, or such place as designated by SJE-RHOMBUS.

ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS ARE LIMITED TO THE DURATION OF THIS WRITTEN WARRANTY. SJE-RHOMBUS SHALL NOT, IN ANY MANNER, BE LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES AS A RESULT OF A BREACH OF THIS WRITTEN WARRANTY OR ANY IMPLIED WARRANTY.

Warranty void if SubCon™ VFD is modified. Call factory with servicing questions: 1-800-RHOMBUS (1-800-746-6287).

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