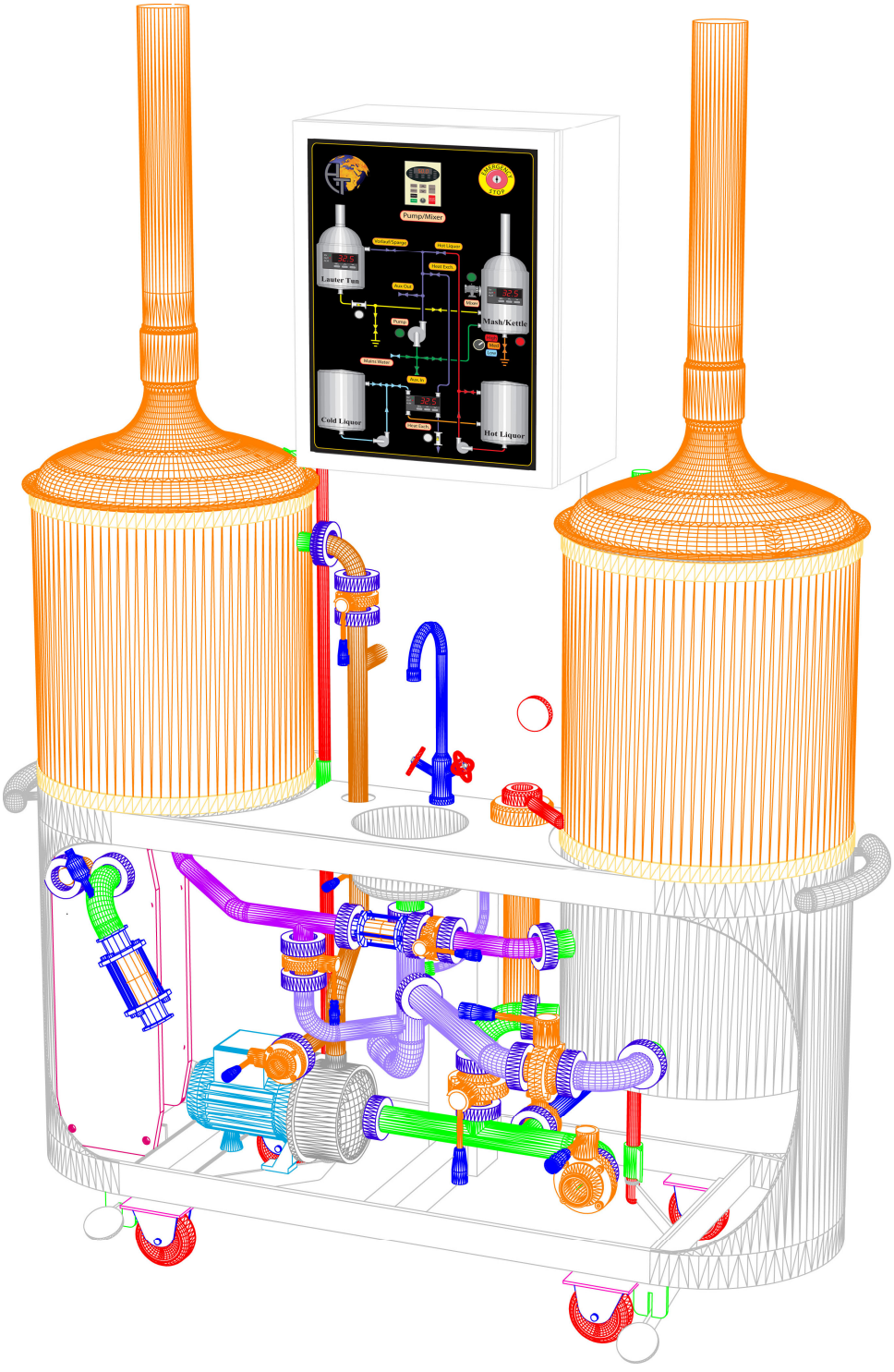
Instruction Manual
NanoTech Brewery System



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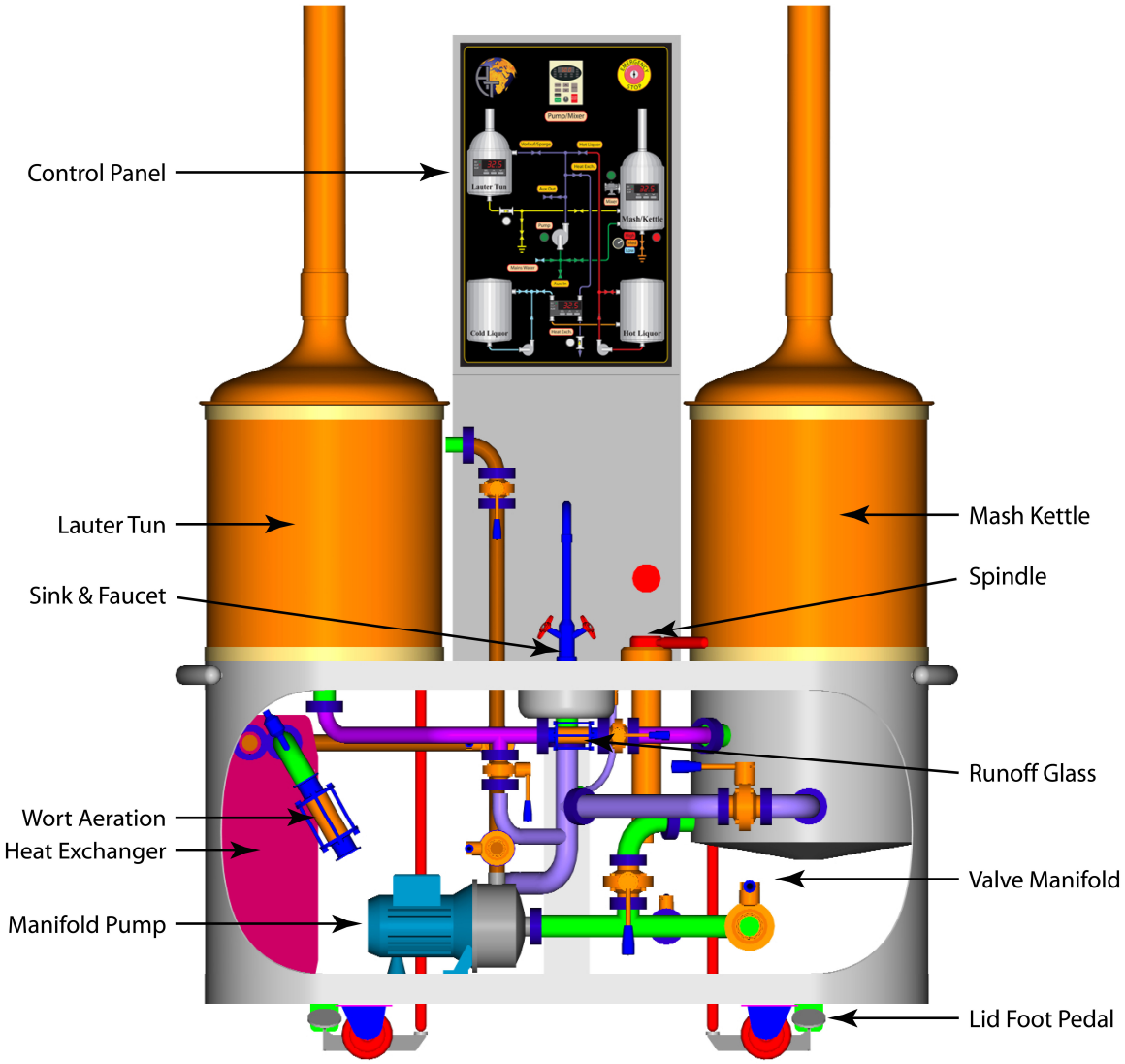
1.0 Overview of complete system

The NanoTech brewery system consists of three modular units; the brewhouse block, hot & cold liquor block and fermenter block. All three units are on wheels, so installation and operation is very flexible. Each unit has its own dedicated electrical control panel, and are completely pre-wired at the factory, so all that is required in the field is to plug them into the proper electrical supply. Unless otherwise specified, all three blocks are supplied with a 3 meter electrical cable and corresponding male plug. The units are connected together by the supplied hoses.

1.1 Brewhouse Description

The NanoTech brewhouse block is comprised of a mash kettle, lauter vessel, central pump, all stainless plate heat exchanger, electrical control panel, hard-piped stainless valve manifold; all mounted to a modular, mobile stainless frame. The components of the brewhouse are illustrated below:



1.11 Lauter Tun

The lauter tun is a stainless steel vessel insulated with PU foam and clad with copper-colored stainless steel. The copper onion dome is non-insulated and acts as a vessel access door. By lid is raised by stepping on the foot pedal, and can then be rotated by hand to gain access to the vessel interior. By rotating the lid back to the front position, the lid can be lowered and sealed.

The milled lauter plate is removable and has an open area of 16%. The slits are arranged in parralell rows of 50 mm long x 0.65 mm wide. A central handle is installed for ease of removal. The tank bottom is conical for full drainage. Vessel temperature is displayed on control panel.

Fittings include:

- 1 x DN25 Bottom outlet (under-screen for runoff).
- 1 x DN25 Side inlet (for filling tank, vorlauf, sparge).
- 1 x ½“ Thermowell.

1.12 Mash Kettle

The mash kettle also has a stainless steel interior with PU foam and clad with copper-colored stainless steel. The lid operates in the same fashion as the lauter tun. Heating of the vessel is accomplished by electrical heating elements directly attached to the tank floor. The tank floor slopes 5% to the front of the vessel for full drainage. Temperature is controlled digital temperature controller on control panel.

A side-mounted variable speed mixer located at the rear of the vessel is controlled by a digital keypad on the control panel.

Fittings include:

- 1 x DN40 Bottom outlet (front of vessel, tied to central drain).
- 1 x DN40 Side outlet (racking port to inlet manifold).
- 1 x DN25 Side inlet (runoff from lauter).
- 1 x ½“ Thermowell.

1.13 Heat Exchanger

The Heat exchanger is made completely of stainless steel and is dis-mountable and can be disassempled for cleaning and maintenance. It is a multi-pass design grouiped into 3 sections of 9 plates. Cold liquor from the cold liquor tank is pumped through the heat exchanger in one dirction and hot wort is pumped in the other and sent to fermenter via hose connection.

The heat exchange design parameters are as follows:

	Inlet	Outlet
Wort (50 L/30 min).....	94ºC	8ºC
Cold Liquor (70 L/ 30 min).....	5º	80ºC

A back-lit wort aeation device in attached to the outlet to saturate the cool wort with Oxygen or compressed air. The sintered stainless filter tube can be removed and cleaned. A check valve is included to prevent back-flow of wort into air line.

1.14 Pump and Manifold

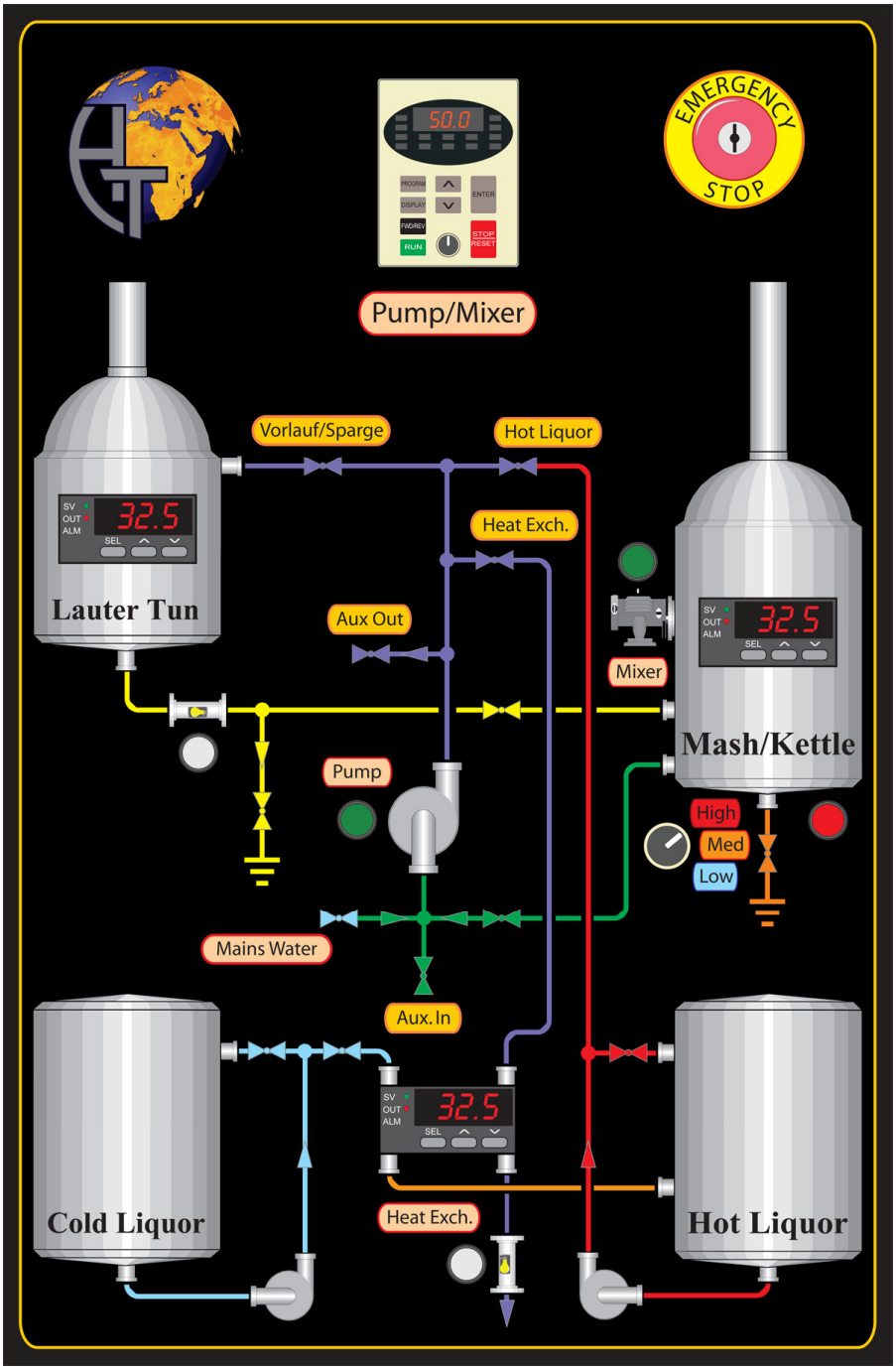
The brewhouse is completely hard-piped in stainless steel, allowing all brewing operations to be completed without the use of detachable hoses (with the exception of wort transfer to fermenter). All valves are sanitary stainless butterfly valves, and all piping is sanitary purge-welded. The pump is stainless steel and has varable speed control from the keypad on the control panel. Hot liquor is supplid to the manifold from the hot liquor tank, using its own varable speed pump. This provides a high degree of control over flow rate, while freeing the manifold pump to perform simultanious duties. All drain points in the system are hard-piped to a single drain connection (DN40 to be connected to a hose) at the rear of the brewhouse. An auxilliary manifold inlet (DN40) and outlet (DN50) are provided for auxiliary pumping functions such as transfer, filtering or CIP. A single water connection supplies water to the inlet manifold, spindle and sink. An optional hot water connection supplies hot water to the sink faucet.

Control points of the manifold are as follows:

- Water inlet (from mains)
- Inlet from kettle racking port
- Hot liquor inlet (to outlet manifold)
- Cold liquor to heat exchanger
- Auxilliary inlet
- Runoff to kettle
- Runoff to drain
- Mash kettle drain
- Sink drain
- Spindle drain
- Outlet to lauter tun (for fill, sparge, vorlauf)
- Outlet to heat exchanger
- Auxilliary outlet
- Hot liquor return from heat exchanger

1.15 Control System

The control panel is made completely of stainless steel with a color digital control interface. It contains a single varable speed drive for control and protection over both the manifold pump and mash mixer. Controls and enunciation for runoff and heat exchange lights, mixer, pump, and heating, as well as a piping schematic of the manifold provides an intuitive interface for operation of the system. It is suppoted by a stainless steel post which also acts as the cable duct providing a clean wiring installation. Safety features include an Emergeny stop located on the front of the interface panel as well as a disconnect switch and thermal protection for all motors and branch circuits.

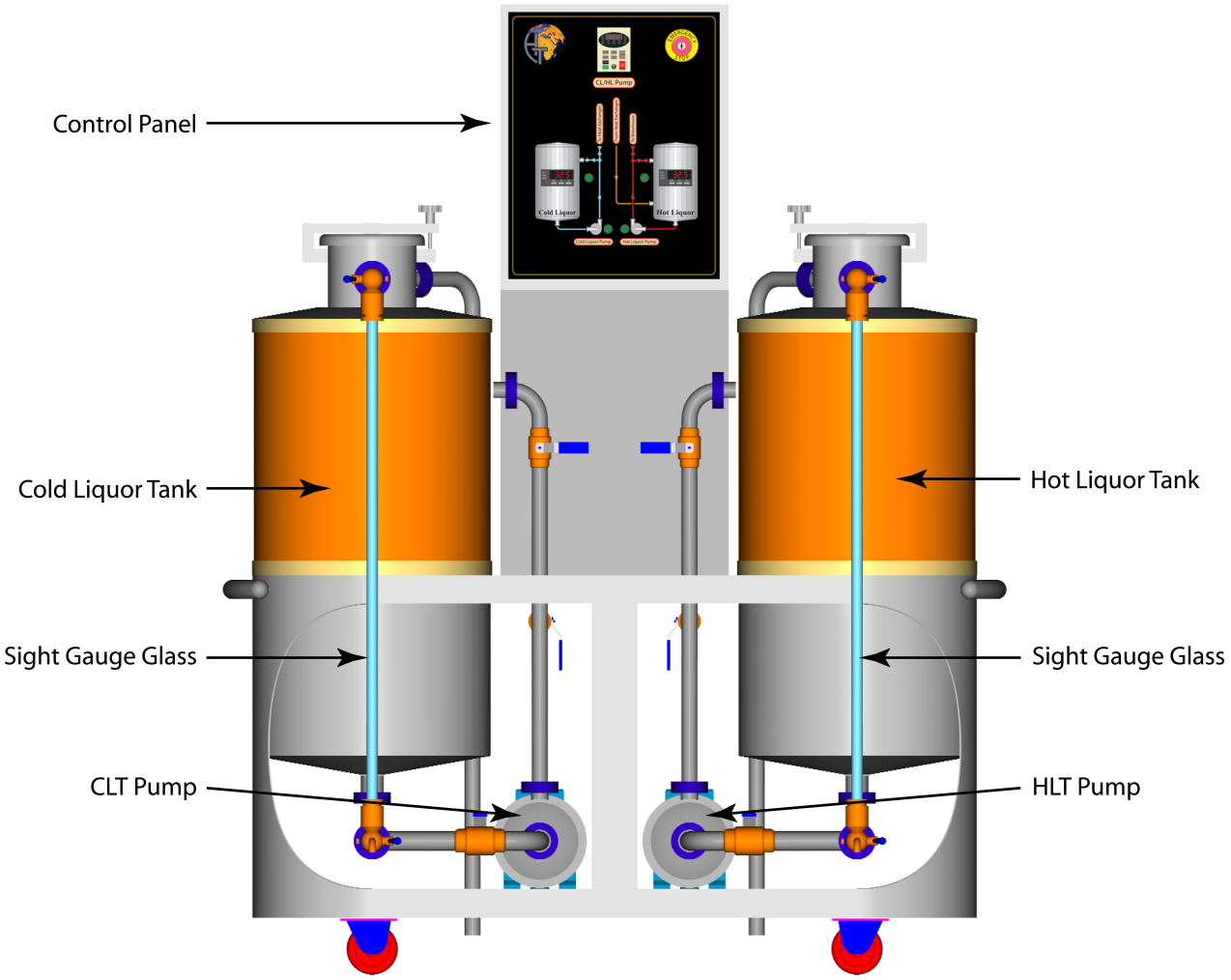


1.16 Other Brewhouse Features

All components mentioned above are mounted to a fully welded stainless frame with castors for ease of mobility. Castors can be locked for stable operation. Integrated into the frame is a sink with faucet, a spindle station, a small work table surface, and a handle at each end for control of mobility. The syetm is literally “Plug and Play“ with only requirements for mains water, single electrical connection, drain for 40 mm hose, and hot water for sink faucet (optional) is all that is required. The three hoses and clamps for connecting the CLT+HLT block are included with tri-clamp connectors installed. Two lengths of brewers hose (2 M. and 4 M.) are included for wort transfer, auxilliary pumpimg, etc.

1.2 Cold Liquor Tank + Hot Liquor Tank (CLT + HLT) Description

The NanoTech CLT + HLT block is comprised of a Cold Liquor Tank, Hot Liquor Tank, 2 centrifugal pumps, electrical control panel, hard-piped stainless valve manifold; all mounted to a modular, mobile stainless frame. The components of the CLT + HLT block are illustrated below:



1.21 Cold Liquor Tank (CLT)

The Cold Liquor Tank (CLT) is a stainless steel vessel insulated with PU foam and clad with copper-colored stainless steel used to store chill water for heat exchange. Can also be used as a treatment tank. The top manway door acts as the tank head as well as an access hatch. The tank is fitted with a sight gauge glass and overflow/vent pipe. The bottom of the gauge glass assembly has a sample cock that can be used as a tank drain as well. Cooling jackets on the tank cylinder are controlled by the digital temperature controller on the control panel.

Fittings include:

- 1 x DN40 Bottom outlet.
- 1 x DN25 Side inlet (for recirculation).
- 1 x DN25 Side inlet (sight gauge, on door collar).
- 1 x DN40 Side vent (on door collar).
- 4 x ½“ BSP (female) for cooling jackets (inlet & outlet).
- 1 x ½“ Thermowell.

1.22 Hot Liquor Tank (HLT)

The Hot Liquor Tank (HLT) is a stainless steel vessel insulated with PU foam and clad with copper-colored stainless steel used to store, heat and recover water from heat exchange. This vessel supplies hot water to the brewhouse manifold for mashing in, sparging, rinsing, etc. The top manway door acts as the tank head as well as an access hatch. The tank is fitted with a sight gauge glass and overflow/vent pipe. The bottom of the gauge glass assembly has a sample cock that can be used as a tank drain as well. The tank is outfitted with an immersion heater, which is controlled by the digital temperature controller on the control panel.

Fittings include:

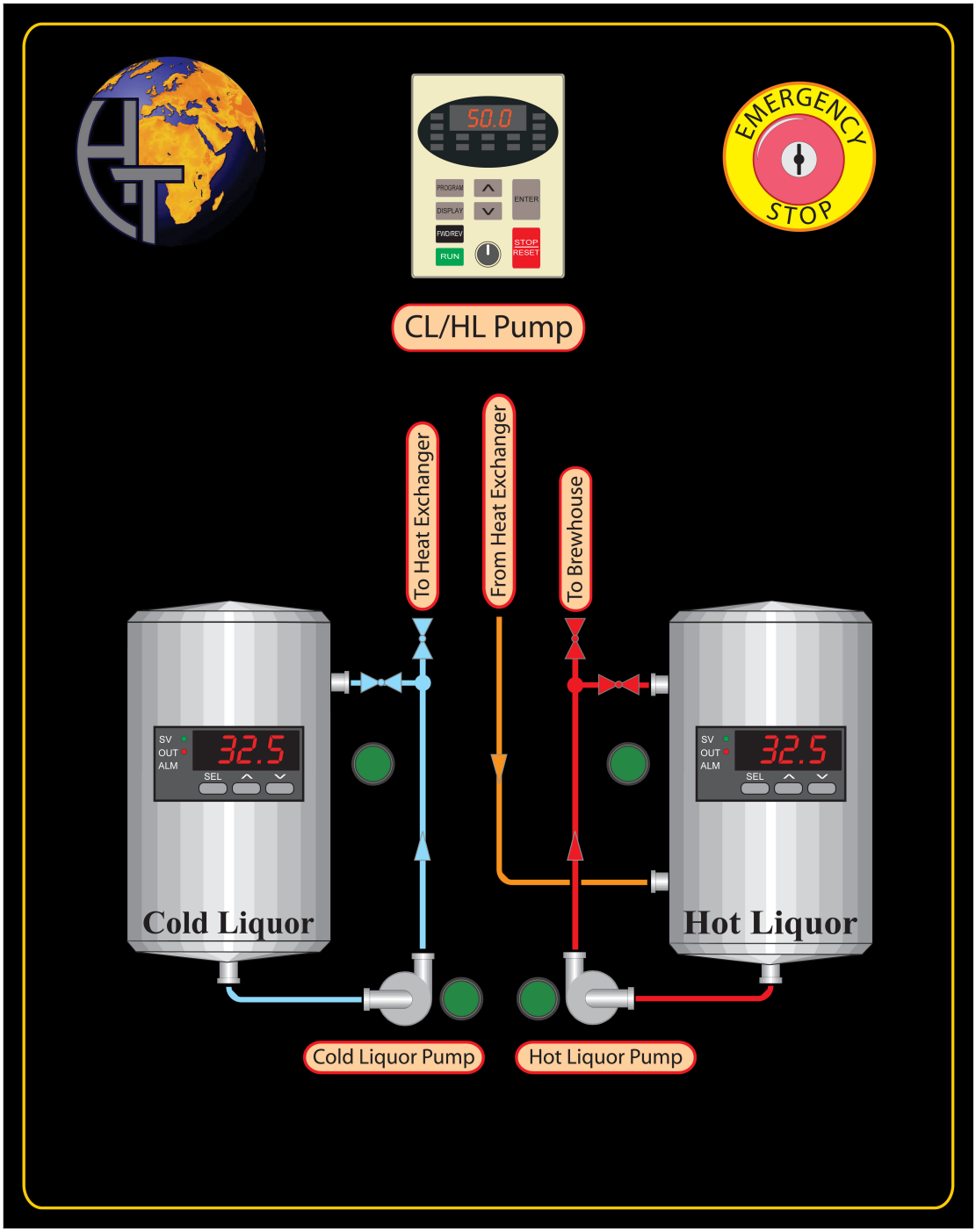
- 1 x DN40 Bottom outlet.
- 1 x DN25 Side inlet (for recirculation).
- 1 x DN25 Side inlet (sight gauge, on door collar).
- 1 x DN40 Side vent (on door collar).
- 1 x 2“ BSP for Immersion heater.
- 1 x ½“ Thermowell.

1.23 Pumps and Manifold

The CLT+HLT block is completely hard-piped in stainless steel, allowing all operations to be completed without the need to remove and replace detachable hoses. Each tank has its own dedicated pump, but both pumps share a common variable speed drive for accurate flow control. Valves can be changes for re-circulation, allowing for better mixing and heating/cooling efficiency. All components listed above are mounted to a common modular, mobile frame with handles at each end for better mobile control. Castors can be locked for stable operation. The syetm is literally “Plug and Play“ with only requirements for mains water, glycol supply and return and a single electrical connection is all that is required. The three hoses and clamps for connecting the CLT+HLT block are included with tri-clamp connectors installed.

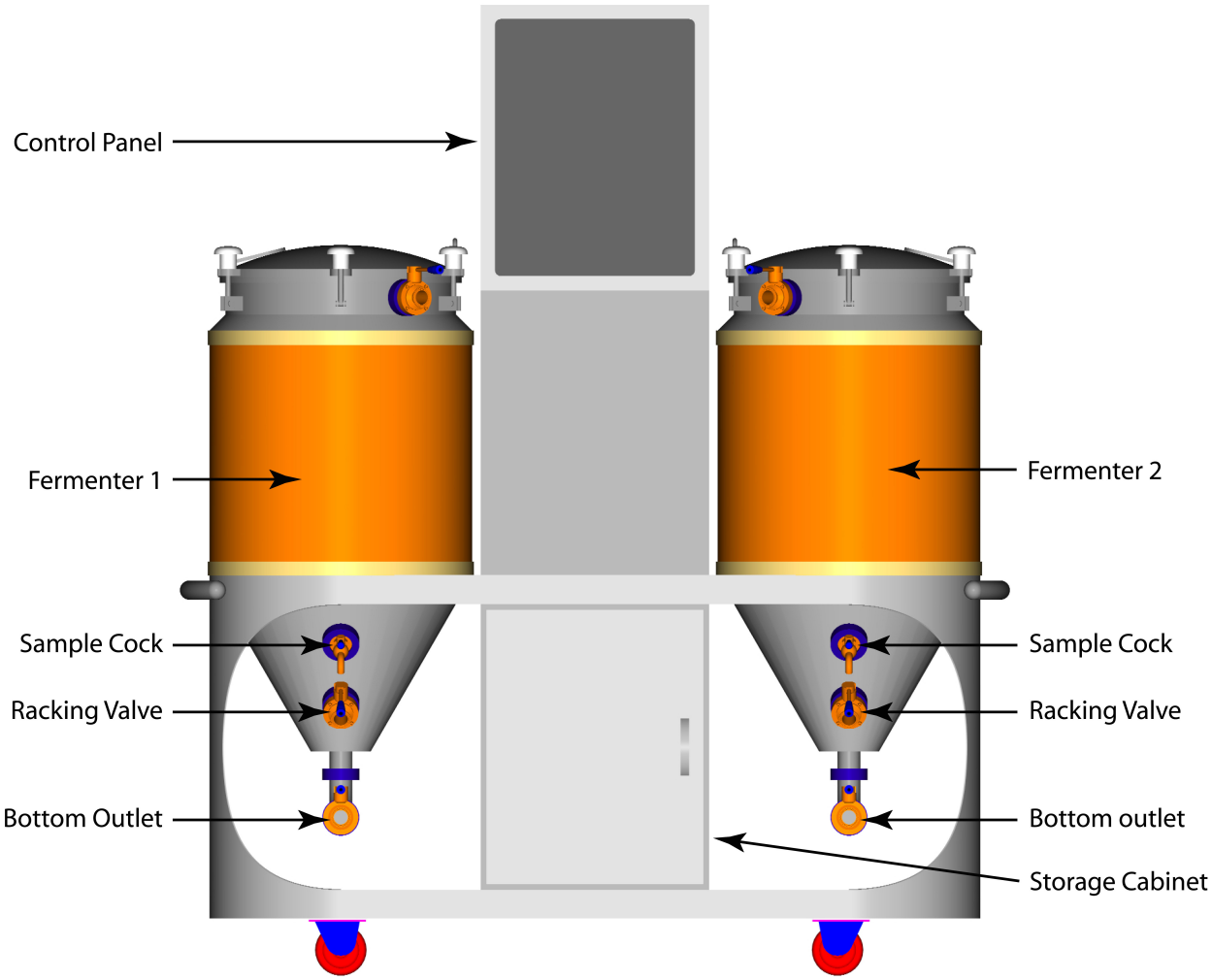
1.24 Control System

The control panel is made completely of stainless steel with a color digital control interface. It contains a single varable speed drive for control and protection over both the Cold Liquor and Hot Liquor pumps. Controls and enunciation for pump start/stop, as well as heating and cooling. It is suppoted by a stainless steel post which also acts as the cable duct providing a clean wiring installation. Safety features include an Emergeny stop located on the front of the interface panel as well as a disconnect switch and thermal protection for all motors and branch circuits.



1.3 Fermenter Block Description

The NanoTech Fermenter block is comprised of two fermentation vessels (4 possible) and electrical control panel, mounted to a modular, mobile stainless frame. The components of the fermenter block are illustrated below:



1.31 Fermentation Vessel

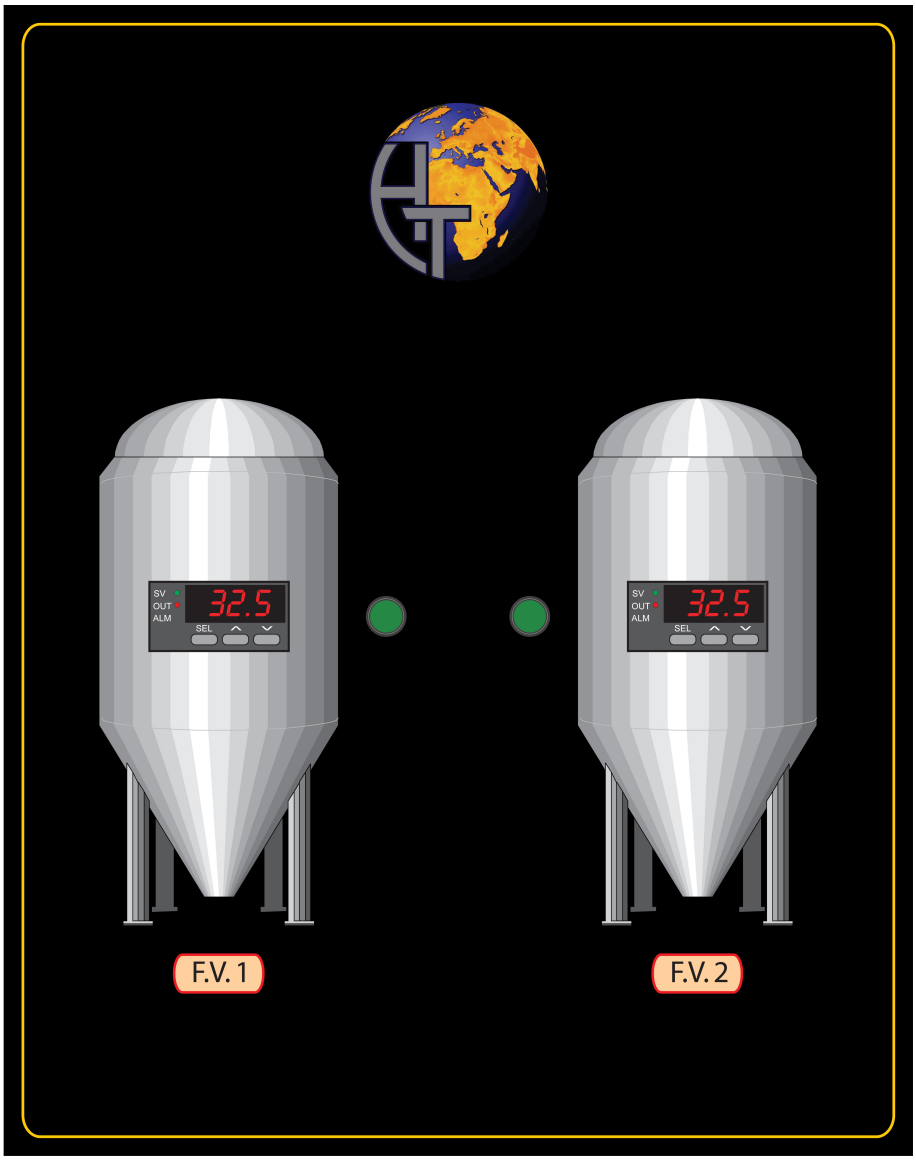
The fermentation vessel is a stainless steel cylindro-conical vessel insulated with PU foam and clad with copper-colored stainless steel. The vessel is used to ferment wort and chill rough beer for conditioning. The top manway door acts as the tank head as well as an access hatch. The tank is fitted with a valve for CIP. The racking port enables the removal of finished beer from above the yeast cone. Cooling jackets on the tank cylinder and cone are controlled by the digital temperature controller on the control panel.

Fittings include:

- 1 x DN40 Bottom outlet.
- 1 x DN25 Racking Port (on cone).
- 1 x DN25 Sample Port (on cone).
- 1 x DN25 Side CIP (on door collar).
- 4 x ½“ BSP (female) for cooling jackets (inlet & outlet).
- 1 x ½“ Thermowell.

1.32 Control System

The control panel is made completely of stainless steel with a color digital control interface. Digital Temperature controllers for control of glycol solenoid valves. It is suppoted by a stainless steel post which also acts as the cable duct providing a clean wiring installation. Includes thermal protection for control voltage and branch circuits.



2.0 System Installation

As described above, all of the NanoTech brewery blocks are virtually “Plug and Play“. Specifications and utility requirements are outlines at the end of this section, although custom configurations may cause electrical requirements to differ. Please check the electrical nameplates located on the side of the control panels fo exact electrical requirements. Other utilities should be the same as listed in the specification sheet.

2.1 Brewhouse Installation

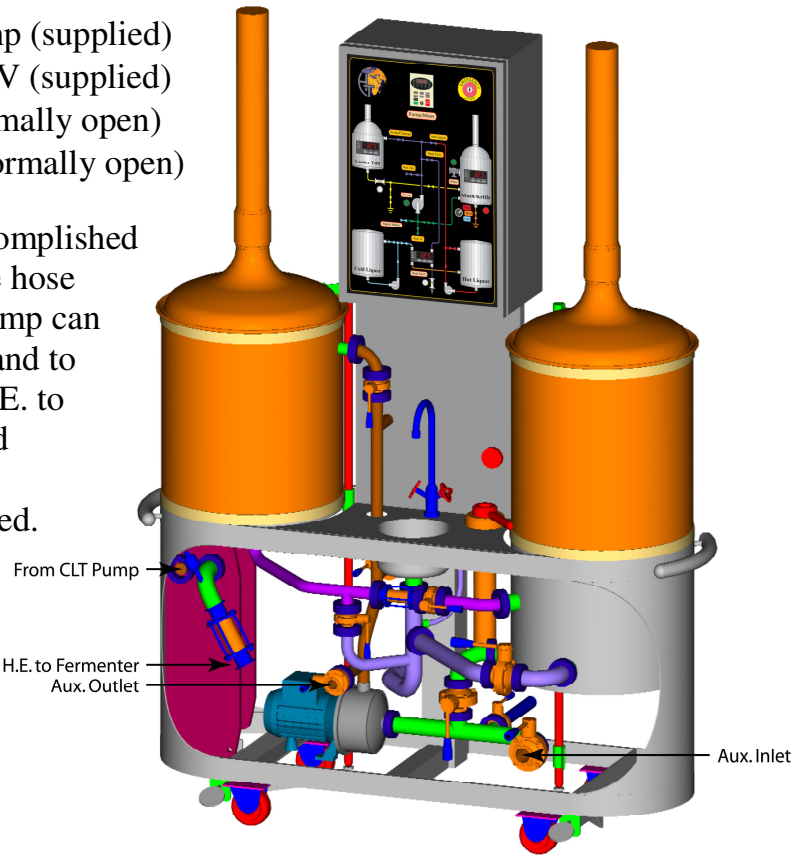
The NanoTech brewhouse has several utility connection on both front and rear of the block. Please refer to the diagrams below to show the locations for such connections.

Front connections include:

- Hose from CLT pump (supplied)
- Hose from H.E. to FV (supplied)
- Auxilliary Inlet (normally open)
- Auxilliary Outlet (normally open)

Connection of hoses is accomplished by means of tri-clamp style hose clamp. Hose from CLT pump can be routed around the H.E. and to the rear. The hose from H.E. to fermenter is only connected during wort transfer, and normally left as disconnected.

Auxilliary inlet and outlet Are normally only con- Nected during tranfer, filtration, or CIP functions.



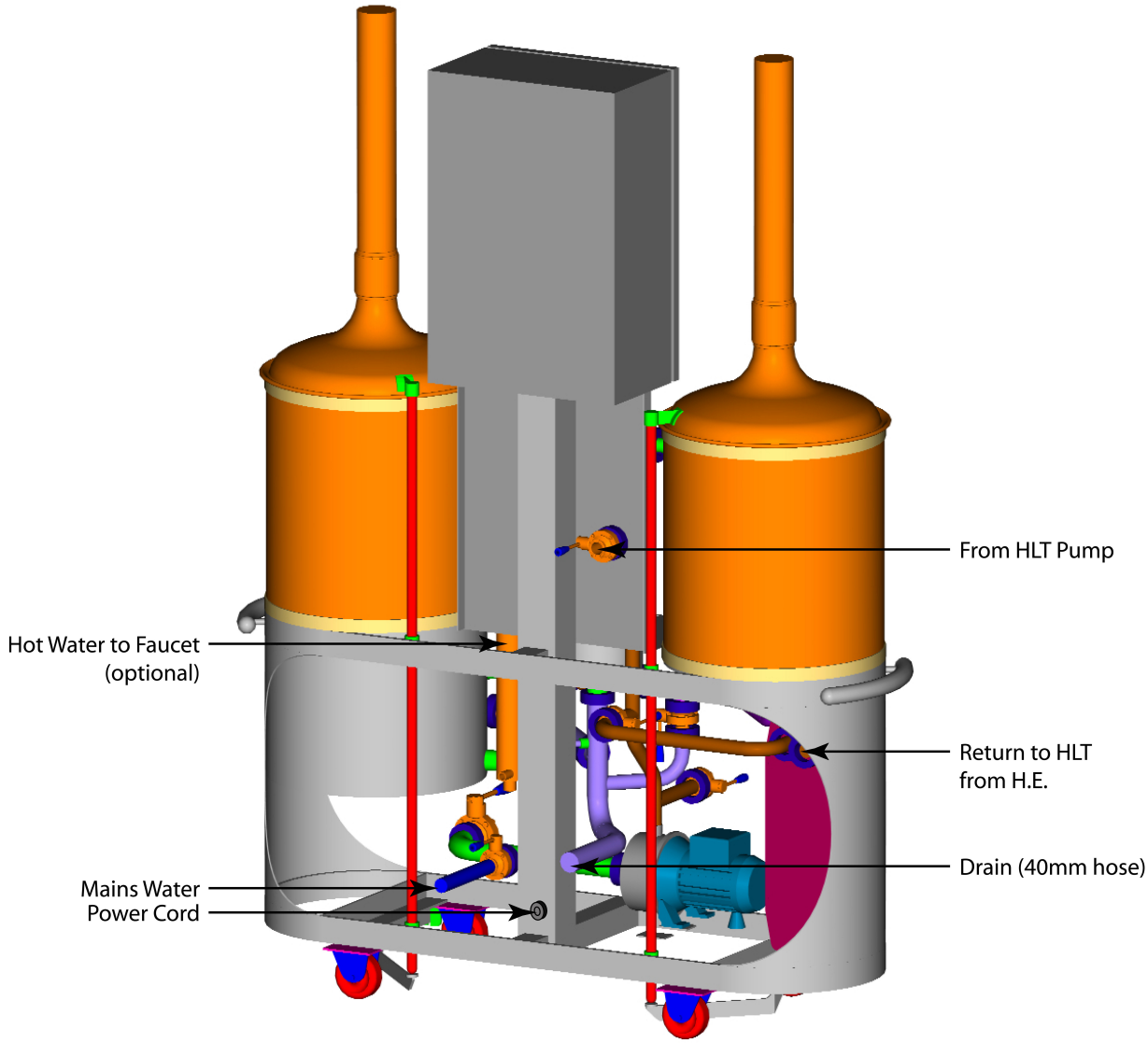
Front Utility Connections

Connections to the rear of the brewhouse block are illustrated below:

Rear connections include:

- Hose from HLT pump to outlet manifold (supplied)
- Hose from H.E. to HLT (supplied)
- Mains Water In, 3/4“ BSP (female)
- Hot water supply for faucet (3/8“ BSP, optional)
- Drain, 40 mm (DN40 x 40 mm hose barb included)
- Electrical Mains (according to nameplate data, cord and plug included)

Connection of hoses is accomplished by means of tri-clamp style hose clamp. The mains water, hot water for sink and drain hose should be connected by a certified plumber with knowledge of local codes and standards. The electrical mains should be connected by a certified electrician with knowledge of local codes and standards as well.

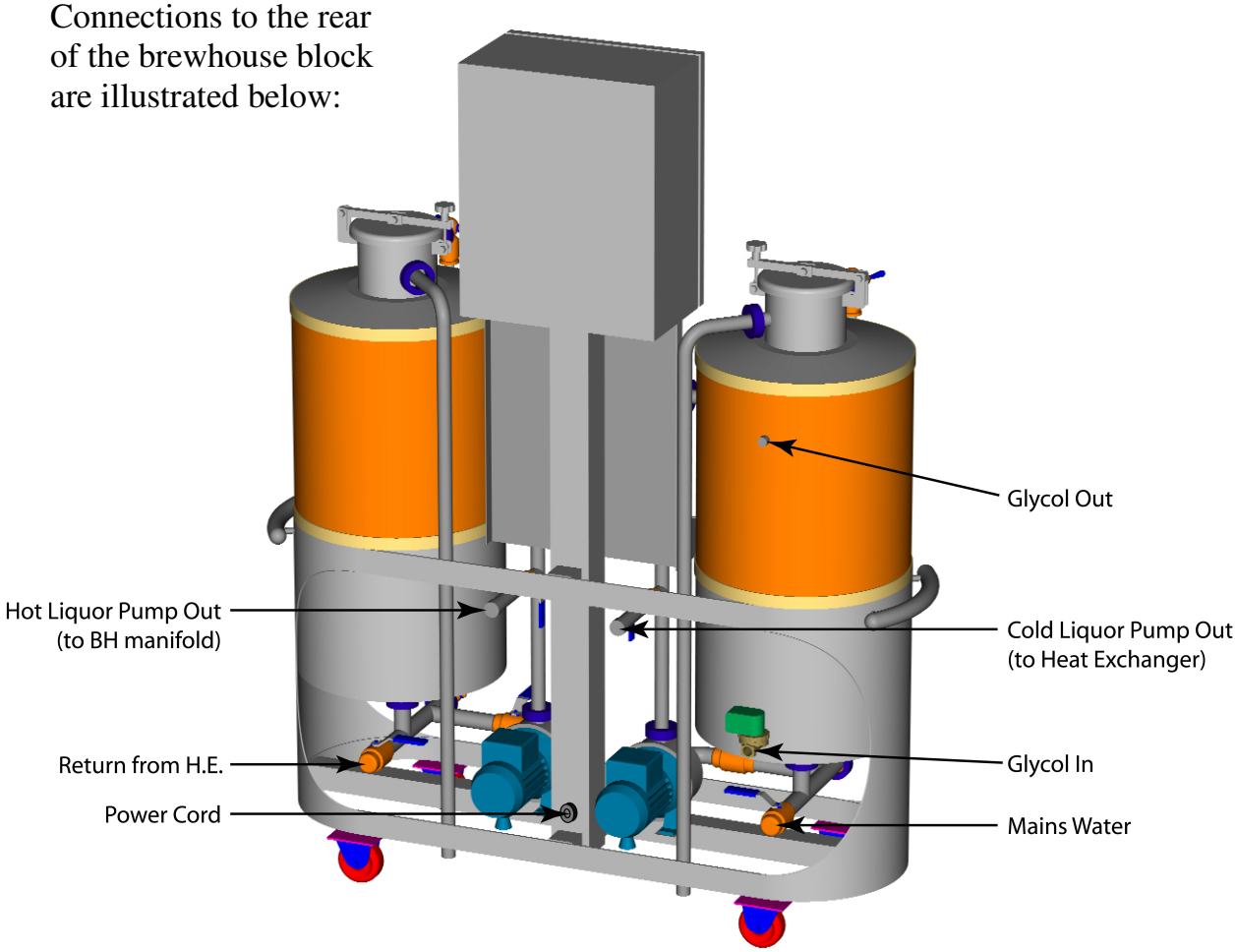


Rear Utility Connections

2.2 CLT + HLT Installation

The NanoTech Cold Liquor/Hot Liquor block is installed much in the same way as the brewhouse, ecept that all utility connections are located on the rear of the unit. A connection to the glycol supply and return manifolds is also required, but valves and controls are factory preassembled.

Connections to the rear of the brewhouse block are illustrated below:



Rear Utility Connections

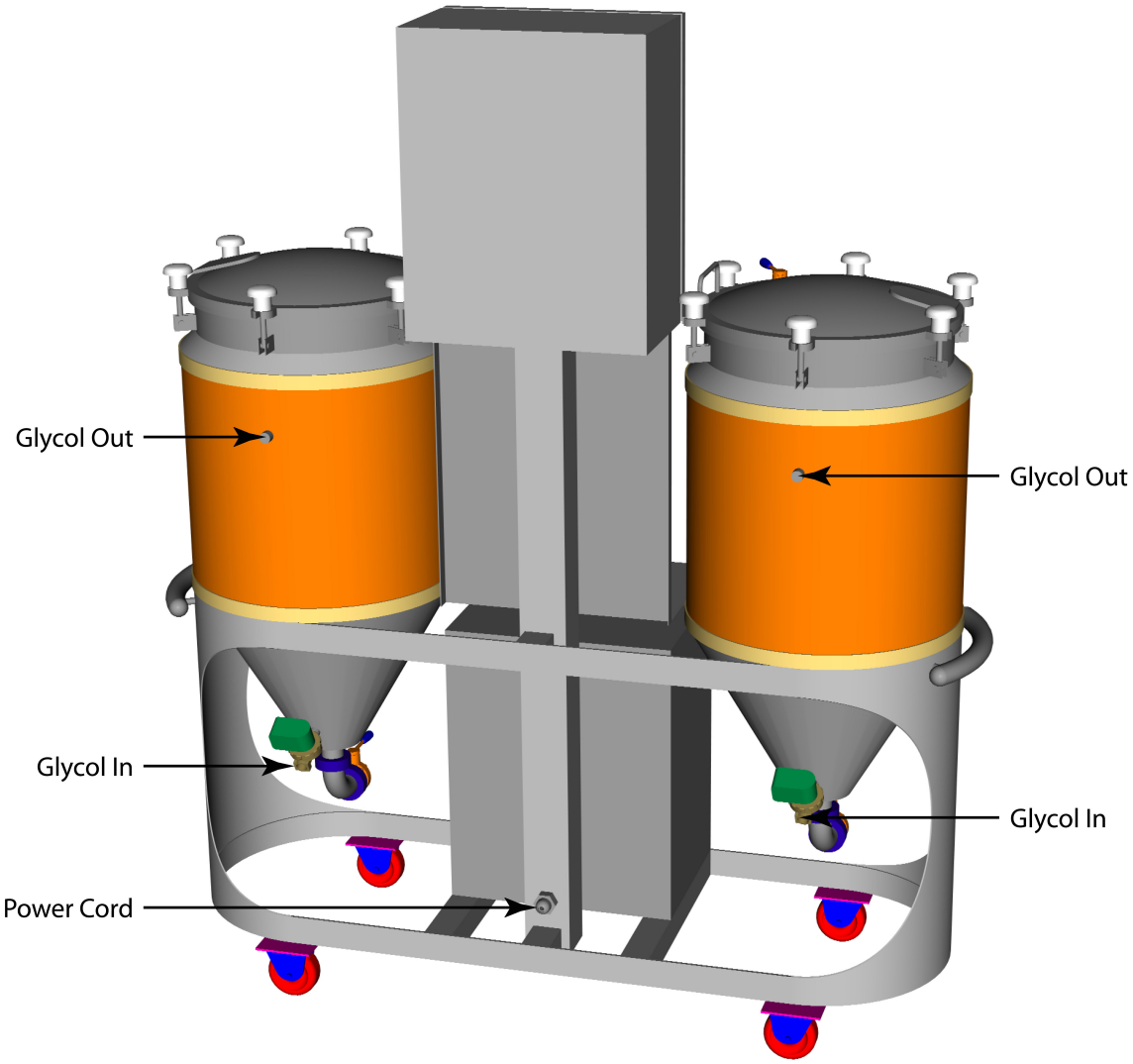
Rear connections include:

- Hose from HLT pump to outlet manifold (supplied)
- Hose from H.E. to HLT (supplied)
- Mains Water In, 3/4“ BSP (female)
- Hose from CLT pump to H.E. (supplied)
- Glycol supply, ½“ BSP (branch from glycol supply manifold)
- Glycol Return, ½“ BSP (branch from glycol return manifold)
- Electrical Mains (according to nameplate data, cord and plug included)

Connection of hoses is accomplished by means of tri-clamp style hose clamp. The mains water as well as glycol supply/return should be connected by a certified plumber with knowledge of local codes and standards. The electrical mains should be connected by a certified electrician with knowledge of local codes and standards as well.

2.3 Fermenter Block Installation

The NanoTech fermenter block is the easiest of the three units to install. It requires only a single electrical connection to mains via plug, and a set of connections to the glycol supply and return manifolds. All glycol valves and controls are preassembled the the factory. All connections are located on the rear of the unit, with the exception of the transfer hose from the brewhouse heat exchanger and CIP operations (temporary connections), which take place at the front of the unit.



Rear Utility Connections

Rear connections include:

- Glycol supply for each FV, ½“ BSP (branch from glycol supply manifold)
- Glycol Return for each FV, ½“ BSP (branch from glycol return manifold)
- Electrical Mains (according to nameplate data, cord and plug included)

2.4 Post-Installation Test and Start-Up Proceedures

Upon completion of utility hook-ups and interconnection of blocks via supplied hoses, the system should be tested to ensure that all components work properly. By following these testing and start-up proceedure, the operator can be assured that the system is fully functional, cleaned and ready for operation.

2.41 Brewhouse Power-Up

Before applying power to the brewhouse control panel, ensure that the voltage listed on the nameplate matches the mains voltage you intend to connect to. Once this is confirmed, depress the emergengy stop button on the control panel faceplate and turn the main disconnect to the OFF position (as shipped). Also ensure that all pushbuttons are disengaged (not depressed). Plug the power cord into the mains socket, then turn the disconnect to the ON position. After a second or two, the digial displays on the Variable Frequency Drive keypad and temperature controllers should iluminate. If not, open the control panel and ensure that all the branch circuit protection breakers are in the ON or START postition. With the emergency stop switch engaged, none of the pumps, motors or heating elements will function. Disengage the emergency stop by turning the key in the counter-clockwise direction.

Add enough water to cover the mixer impeller in the kettle by opening the mains water inlet and kettle racking valves. *Liquid should always be present in order to prevent damage to pump and mixer seals.* When enough water has been added, close the mains water inlet valve. Depress the mixer switch on the contol panel, ensure that the speed potentiometer on the VFD keypad is in the minimum position and press the green „Start“ button. Now slowly turn the speed control on the VFD keypad in the clockwise direction. The mixer motor should engage and begin rotating the mixer blade. A very low setting (< 10 Hz) should be sufficient to begin this action. When proper mixer operation is confirmed, press the red „Stop/Reset“ button on the VFD keypad and return the speed control to minimum. The mixer button can now be disengaged.

Leaving the kettle racking port open, open the lauter vorlauf/sparge valve. Depress the pump switch on the control panel, ensure that the speed potentiometer on the VFD keypad is in the minimum position and press the green „Start“ button. Now slowly turn the speed control on the VFD keypad in

the clockwise direction. The pump should engage and begin pumping water to the luter tun. A very low setting (< 10 Hz) should be sufficient to start moving water. If the pump is running but water is not flowing (and the valves are properly opened), the phase on the mains power may have to be changed (for 3-phase mains only). This can be accomplished by switching two of the hot legs on the mains power input (at the disconnect switch). *Before doing so, ensure that the plug is completely removed from the mains socket.* When proper pump operation is confirmed, press the red „Stop/Reset“ button on the VFD keypad and return the speed control to minimum.

Note: The control panel utilizes a single Variable Frequency Drive for both the pump and mixer, meaning that either the pump OR the mixer can operate at a time (not simultaniously). The pump has priority, so if the pump and mixer swithes are both depressed, only the pump will operate.

Return water to the kettle by opening the lauter runoff valve. To test the heating elements on the kettle, adjust the temperature setpoint of the kettle to a temperature higher than that of the process value (a setpoint of 50º C should be sufficient). The control panel is outfitted with a combination „manual override/indicator“ illuminated switch for heating operations. The heating elements will only operate if this switch is depressed AND the setpoint is higher than the process value. The same is true for the indicator lamp, which is only illuminted when the heating elements are active. For example, if the button is depressed, but the setpoint is lower than the process value, the indicator lamp will not be illuminated, and the heating elements will not be active. A rise in temperature should begin within a few minutes of activating the heating elements.

The final two items to test are the sight glass lamps on the runoff and heat exchanger outlet. These are operated by simply depressing the appropriate pushbuttons on the control panel faceplate.

2.42 CLT + HLT Block Power-Up

Before applying power to the CLT+HLT control panel, ensure that the voltage listed on the nameplate matches the mains voltage you intend to connect to. Once this is confirmed, depress the emergengy stop button on the control panel faceplate and turn the main disconnect to the OFF position (as shipped). Also ensure that all pushbuttons are disengaged (not depressed). Plug the power cord into the mains socket, then turn the disconnect to the ON position. After a second or two, the digial displays on the Variable Frequency Drive keypad and temperature controllers should iluminate. If not, open the control panel and ensure that all the branch circuit protection breakers are in the ON or START postition. With the emergency stop switch engaged, niether of the pumps will

function. Disengage the emergency stop by turning the key in the counter-clockwise direction.

Fill the CLT with water (100 mm from the top). Open the pump inlet valve and the re-circulation valve on the CLT. Depress the CLT pump switch on the control panel, ensure that the speed potentiometer on the VFD keypad is in the minimum position and press the green „Start“ button. Now slowly turn the speed control on the VFD keypad in the clockwise direction. The pump should engage and begin pumping water to the luter tun. A very low setting (< 10 Hz) should be sufficient to start moving water. If the pump is running but water is not flowing (and the valves are properly opened), the phase on the mains power may have to be changed (for 3-phase mains only). This can be accomplished by switching two of the hot legs on the mains power input (at the disconnect switch). *Before doing so, ensure that the plug is completely removed from the mains socket.* When proper pump operation is confirmed, open the „CL to Heat Exchanger“ valve on the rear of the CLT and close the re-circulation valve, allowing cold liquor to flow through the brewhouse heat exchanger (returning to the HLT). When approximately half of the water has been transferred to the HLT, press the red „Stop/Reset“ button on the VFD keypad and return the speed control to minimum.

Open the pump inlet valve and the re-circulation valve on the HLT. Follow the same test proceedures for the HLT pump, and when proper operation is confirmed, press the red „Stop/Reset“ button on the VFD keypad and return the speed control to minimum.

Note: The control panel utilizes a single Variable Frequency Drive for both the CLT pump and HLT pump, meaning that either the CLT OR HLT pump can operate at a time (not simultaniously). The HLT pump has priority, so if the CLT pump and HLT pump swithes are both depressed, only the HLT pump will operate.

To test the heating element in the HLT, adjust the temperature setpoint to a temperature higher than that of the process value (as in the kettle test proceedure). The control panel is outfitted with a combination „manual override/indicator“ illuminated switch for heating operations. The heating element will only operate if this switch is depressed AND the setpoint is higher than the process value. The same is true for the indicator lamp, which is only illuminted when the heating element is active. A rise in temperature will occur much slower than that of the kettle, so allow at least 15 minutes before determining proper function.

Similarly, the cooling can be tested on the CLT, but the setpoint must be set lower than the process value. The CLT cooling control is outfitted with an

indicator lamp only, and no manual override switch is provided. Please allow as much as 30 minutes to determine proper cooling function.

2.43 Fermenter Block Power-Up

Before applying power to the Fermenter control panel, ensure that the voltage listed on the nameplate matches the mains voltage you intend to connect to. The Fermenter block is not outfitted with an emergengy stop button, because no motors, pumps or heating elements are being controlled. Because of this, the Fermenter control panel operates on single-phase only.

The cooling controls for the fermenters operate in the same fashion as the CLT, and therefore the cooling test proceedures are the same. The temperature change in the fermenters will be slightly faster than that of the CLT.

2.44 System Cleaning & Passivation

Before brewing the first batch of beer, the entire system should be cleaned thoroughly. It is recommended to use a caustic cleaning solution (such as sodium hydroxide or similar) followed by an acid rinse (such as phosphoric acid), and finally passivated with a nitric acid based solution.

Each of the above proceedures should begin in the CLT where the chemical solutions are prepared, and pumped through the entire system ending in the fermentation vessels. A complete hot water rinse should be performed between each of the chemical proceedures listed above. Each operator may have thier own preferred cleaning regiments, but the following should act as a good starting guide:

1. Prepare 50 liters of cleaning solution according to chemical manufacturers recommendation in CLT.
2. Recirculate solution in CLT (through spray ball) for minimum 20 minutes.
3. Close recirculation valve, open rear outlet valve and pump solution through heat exchanger (and return to HLT).
4. Open HLT recirculation valve and recirculate solution in HLT (through spray ball) for minimum 20 minutes.
5. Close recirculation valve, open rear outlet valve, open Kettle racking valve and pump solution at medium speed to „from HLT pump“ connection on brewhouse outlet manifold, allowing to fill Kettle through racking port.
6. Following the procedure as outlined in section 2.41, pump the cleaning solution to the Lauter Tun through the vorlauf/sparge apparatus and allow to fow back to the Kettle through the runoff piping. Continue this operation for 15-20 minutes at low to medium speed. Adjust setpoint of kettle to maintain appropriate cleaning tempeature (according to chemical manufacturers specifications; usually around 50º C).
7. Stop pump and allow entire cleaning solution to flow back to Kettle.

8. Connect a flexible brewer's hose (supplied) from the Heat Exchanger outlet to the Kettle bottom outlet, close Laute Tun vorlauf/sparge valve, and open Kettle bottom outlet valve.
9. Start the pump and allow to run for 20 minutes at medium to high speed.
10. Stop pump, **turn off heating control for the Kettle**, and close all valves. Disconnect hose from Kettle bottom outlet following safety procedures as outlined in section 4.3, and connect to Fermenter bottom outlet. Pump entire contents of cleaning solution from Kettle to Fermenter (with Fermenter door open). Slow speed of pump as the contents of the kettle nears the bottom outlet fitting ensuring that the pump does not suck air (avoiding de-priming).
11. If a portable pump is utilized for Fermenter CIP, then disconnect hose form Heat Exchanger outlet and connect to Pump inlet. If the brewhouse pump is to be utilized for Fermenter CIP, then connect hose to auxilliary Pump inlet. Connect a second hose from the portable pump outlet (or auxilliary pump outlet on brewhouse) to the Fermenter CIP fitting (located on the manway door collar).
12. Ensure that cooling of the fementer is disabled (set to maximum setpoint temperature), and allow fermenter temperature to stabilize for 20 minutes. Ensure that manway door on Fermenter is tightly closed.
13. Start pump and run at medium speed (if speed control is available) for 20 minutes. Stop pump and wait 1 or 2 minutes for solution levels in hoses to stabilize.
14. Close both valves on Fermenter, disconnect hose from CIP fitting and connect to second Fermenter bottom outlet. Pump entire contents of cleaning solution from Fermenter 1 to Fermenter 2 (with Fermenter door open). Slow speed of pump as the cleaning solution nears the bottom outlet fitting ensuring that the pump does not suck air (avoiding de-priming). Close Fermenter 2 bottom outlet valve.
15. Remove hose from bottom outlet of Fermenter 2 and re-connect to Fermenter 2 CIP fitting. Remove hose from Fermenter 1 bottom outlet and re-connect to Fermenter 2 bottom outlet. Open both valves on Fermenter 2 and follow steps 12 – 13.
16. Pump cleaning solution to a recovery vessel (if avaiable), otherwise dispose of appropriately.
17. At this point the system has been completly cleaned, and is ready for rinsing. The rinsing procedure should follow the same basic sequence of the cleaning regiment, starting with the CLT, althoug most of the rinsing will be accomplished trhough the means of manual rinsing with a hose and spray gun.
18. Open CLT bottom outlet and rinse thoroughly and allow rinse water to drain. Remove sprayball assembly and rinse re-circulation tube to pump for 30 seconds.
19. Fill CLT with 50 liters of clean rinse water and follow procedure in step 3.
20. Open HLT bottom outlet valve and allow to drain completely. Remove sprayball assembly and rinse re-circulation tube to pump for 30 seconds.
21. Fill HLT with 50 liters of clean rinse water and open Heat exchanger inlet valve. Attach hoses (optional; otherwise allow to drain to floor) to Heat Exchanger outlet, Lauter Tun drain and Kettle bottom outlet. Open the drain valves mentioned above, and begin pumping rinse water at medium to high speed allowing rinse water to flow through the heat exchanegr to drain. Avoid de-priming pump as mentioned earlier.
22. Stop pump when HLT is emptied, and shut HLT to brewhouse manifold valve. Open HLT bottom valve to allow to drain completely.
23. Remove the vorlauf/sparge apparatus from the Lauter Tun, open all valves on brewhouse manifold except for the HLT inlet valve, auxilliary inlet and auxilliary outlet valves and allow mains water to start flowing through the pipes. After 10 seconds shut the Kettle racking valve. Wait 10 more seconds and shut the Heat Exchanger inlet valve, and after 20 seconds shut the mains water inlet valve.

24. Open the auxilliary inlet and outlet valves as well as the Kettle racking valve and rinse the Kettle and Lauter Tun thoroughly. At this point all drain valves should be open and the entire brewhouse will be rinsed and drained.
25. Remove fermenter sample valves and rinse as in step 18.
26. Prepare 50 liters of acid solution according to chemical manufacturers recommendation in CLT.
27. Follow steps 2-16, but times can be cut in half, and acid rinse solution normally does not require heating. Allow all tanks and piping to drain thoroughly.
28. The passivation process is the same as the cleaning process (speps 2-16), followed by a thorough rinsing as in steps 17-25.

3.0 Operating Instructions

The NanoTech brewing system is intended for the production of rough beer, which can then be transfered to kegs for conditioning or filtered for bright beer. Any other usage of the equipment is not supported by the manufacturer and could be dangerous. *The manufactuer cannot be held responsible for damage caused by improper use of the machinery.*

3.1 Brewhouse Operations

The NanoTech brewhouse is designed to produce aerated hopped wort. It is assumed that the operator has a reasonable understanding of the brewing process, and this section will act as a guide to illustrate the means of achieving the different operations of the brewing process.

The control panel offers several points of enunciation as well as control. In addition the graphical faceplate displays a complete process piping diagram for easy navigation and control. Temperature for the kettle can be set on the temperature controller by pressing the SET key. Temperature is displayed for the Lauter tun and Heat Exchanger output as well, but cannot be controlled. The kettle heating control also has an „operating“ enunciator light combined with “manual override“ control. Motor controls for pump and mixer are also included.

The pump has priority, so if both the pump switch and the mixer switch are engaged simultaneously, the pump would operate and the mixer would not. Otherwise the pump or mixer can be chosen normally, and the START, STOP and Speed are controlled by the digital keypad at the top center of the control panel.

Emergency stop, when depressed will disable all motors, heating and lights. Temperature controllers and VFD will remain powered up, but motors will not engage. To reset the emergency stop, turn counter-clockwise and allow spring to return switch to normal position.

As stated earlier, the control panel faceplate has a graphical display of the process piping, so following a piping route is like following a subway map. Always open valves completely and use the VFD to control flow. Never restrict the inlet of the pump as the pump will cavitate.

3.2 CLT + HLT Block Operations

The NanoTech CLT + HLT block is designed to perform the following tasks:

- Store and chill cold water (Cold Liquor).
- Supply cold liquor (via pump) to plate heat exchanger on Brewhouse.
- Store and heat hot water (Hot Liquor).
- Supply hot liquor (via pump) to brewhouse manifold.
- Recover hot water from heat exchange.

The CLT+HLT block is equipped with a variable frequency drive for the CLT and HLT pumps, which is operated via the keypad display on the control panel (just as on the brewhouse). Temperature for both vessels is controlled by the digital temperature controllers on the control panel (same as brewhouse). The block is also equipped with valves and piping which allow the contents of each vessel to be recirculated for more accurate temperature indication.

3.3 Fermenter Block Operations

The NanoTech fermenter block is designed to perform fermentation of wort and precipitation (flocculation) of yeast. Each vessel has temperature control and provisions for CIP. A threaded port on the tank door allows for pressure relief/indication.

4.0 Cleaning & Sanitation

Proper cleaning and sanitizing is one of the most important precautions which will lead to successful operation of the NanoTech system. It cannot be overstated the importance of both cleaning and sanitation.....

4.1 Cleaning and CIP

The brewhouse and fermenter blocks should be cleaned with a caustic solution following the proceedures outlined in section 2.44 „System Cleaning & Passivation“ after each use. The CLT + HLT block should be cleaned before the first use, and the once per month or so, depending on water quality. The Fermenters should be sanitized before each use, afetr being cleaned with caustic solution.

4.2 Safety Precautions

Cleaning and sanitizing can be hazardous if proper safety precautions are not adhered to. Always be sure to wear safety clothing, gloves and eye protection whenever working with cleaning & sanitizing chemicals. Proper temperatures for these chemicals should always be followed according to manufacturer’s specifications.

5.0 Care & Maintenance

Proper maintanence will ensure a long service life and prevent any „down time“. Under normal working conditions, the NanoTech brewery system will provide many years of reliable operation. Periodic visual inspection of all „wearable“ parts, such as seals and gaskets, as well as lubrication of the onion dome lifting system should be carried out.

5.1 Gasket & Seal Replacement

All three blocks use sanitary butterfly valves with tri-clamp style connections. This style of connection utilizes a gasket which must be seated correctly in order to ensure a water-tight seal. Improper seating of the gasket will lead to pre-mature failure. With proper use tri-clamp gaskets will last for 2-3 years.

The butterfly valves have internal silicon seals that require replacing, which is accomplished by disassembling the valve body (after removing the handle assembly). Under normal use, butterfly valve seals have a useful life of 5-8 years.

5.2 Hose Maintenance

The utility hoses supplied with the complete NanoTech system should be cleaned after every use, and preferable should be stored in a weak sanitizing solution. Visual inspection of hoses will indicate how frequently the hoses need to be changed, but generally they will last 2-3 years with proper care.

5.3 Maintenance Chart

Inset here.....

6.0 Appendices

6.1 Contact Information

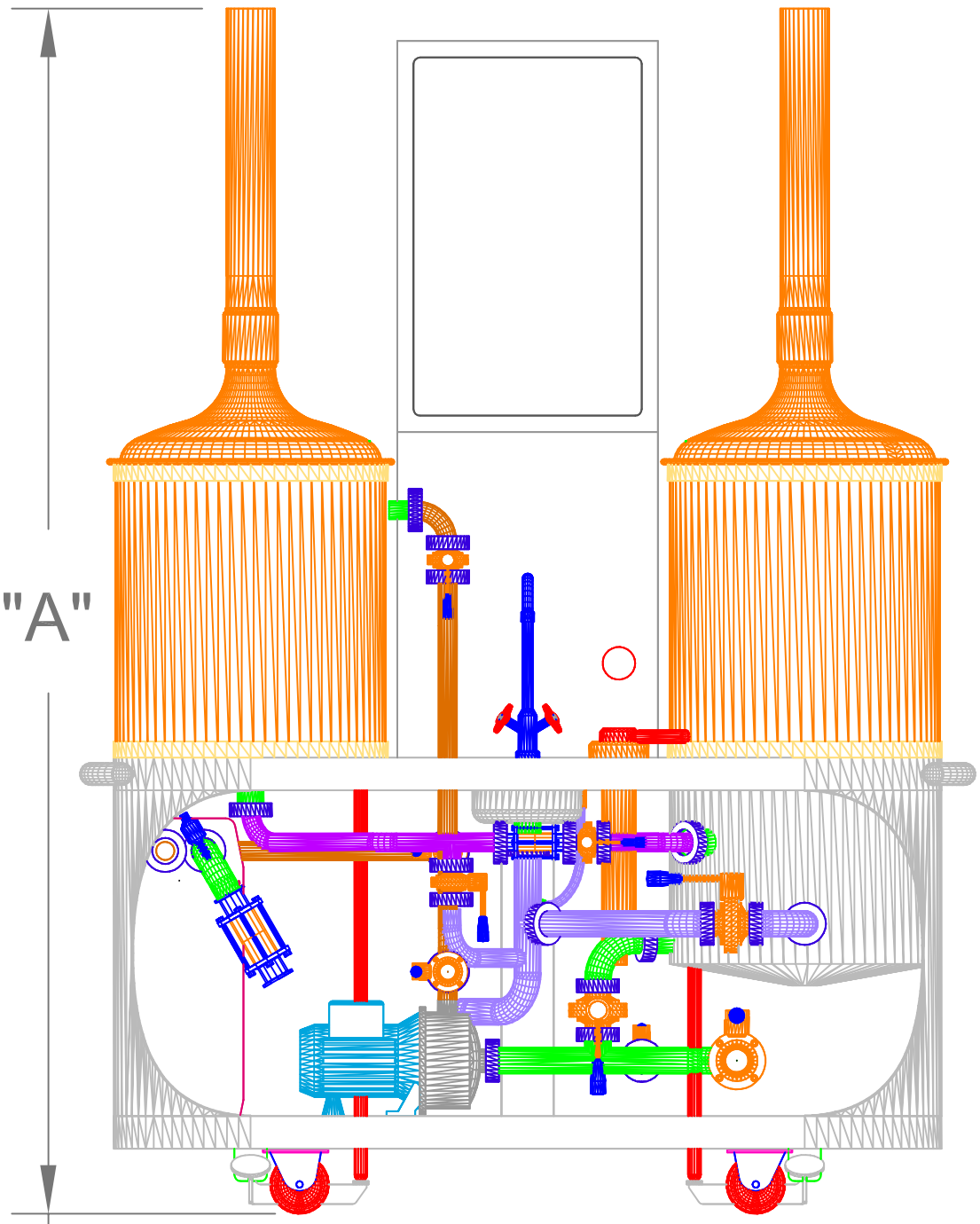
In the event that an item on one of the blocks malfunctions or needs replacing, please contact Paul Holborn using the following information:

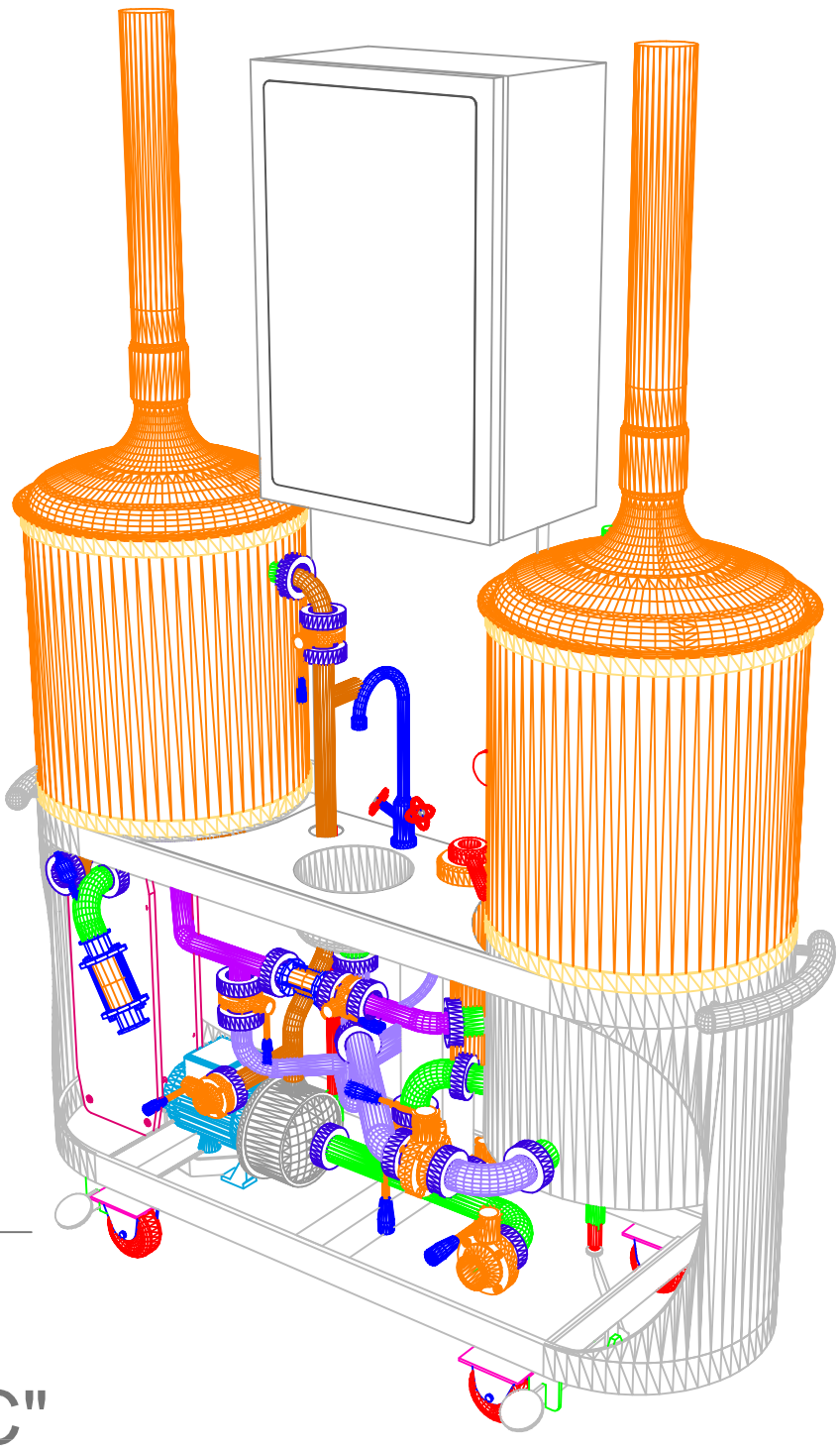
Paul Holborn (Director)
Holborn Technologies s.r.o.
Libkova Voda 85
394 62 okr. Pelhrimov
Czech Republic
paul@holborntechnologies.cz
T: +420/565/327 071
F: +420/565/327 072
M: +420/607/525 069

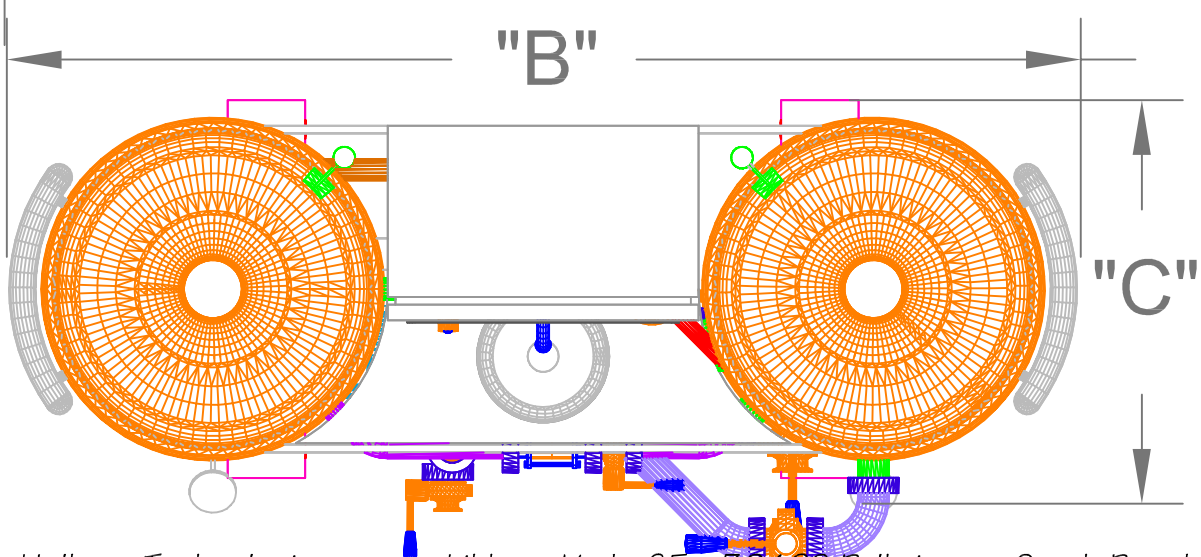
50-100-250 L
NANOTECH BREWHOUSE

	50 L	100 L
DIMENSION A	1850 mm (73")	1850 mm (73")
DIMENSION B	1375 mm (54")	1375 mm (54")
DIMENSION C	525 mm (20.75")	525 mm (20.75")
STEAM VENT	104 mm (4") Diameter	104 mm (4") Diameter
EMPTY WEIGHT (approx.)	150 kg (330 lbs)	170 kg (375 lbs)
FULL WEIGHT (approx.)	280 kg (617 lbs)	440 kg (970 lbs)
LAUTER TUN CAP.	50 L (13.25 gal.)	100 L (13.25 gal.)
MASH/KETTLE CAP.	85 L (22.5 gal.)	170 L (22.5 gal.)

NOTES: Required clearance behind brewhouse is 300mm (12") minimum, 450mm (18") recommended.







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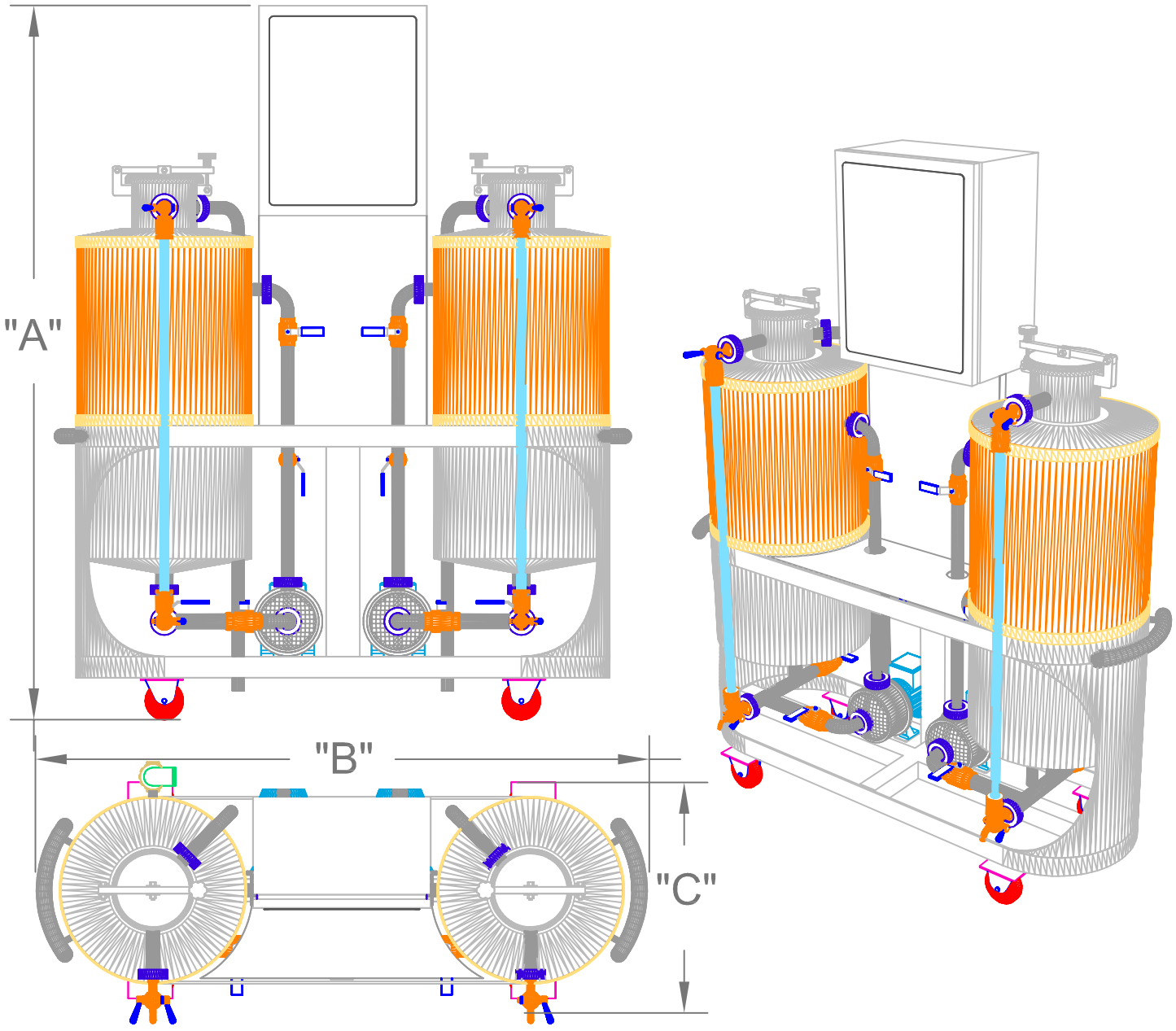
50-100 HL
NANOTECH HLT + CLT

	50 L	100 L
DIMENSION A	1700 mm (67")	1850 mm (73")
DIMENSION B	1375 mm (54")	1375 mm (54")
DIMENSION C	525 mm (20.75")	525 mm (20.75")
STEAM VENT	104 mm (4") Diameter	104 mm (4") Diameter
EMPTY WEIGHT (approx.)	150 kg (330 lbs)	170 kg (375 lbs)
FULL WEIGHT (approx.)	280 kg (617 lbs)	440 kg (970 lbs)
Hot Liquor Tank Capacity	90 L (23.75 gal.)	180 L (47.5 gal.)
Cold Liquor Tank Capacity	90 L (23.75 gal.)	180 L (47.5 gal.)
Operating Voltage	230 VAC / 1 Ph / 50/60 Hz / 12 A.	230 VAC / 1 Ph / 50/60 Hz / 20 A.

NOTES: Required clearance behind brewhouse is 300mm (12") minimum, 450mm (18") recommended.



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50-100 HL
NANOTECH FERMENTERS

	50 L	100 L
DIMENSION A	1700 mm (67")	1850 mm (73")
DIMENSION B	1375 mm (54")	1375 mm (54")
DIMENSION C	525 mm (20.75")	525 mm (20.75")
STEAM VENT	104 mm (4") Diameter	104 mm (4") Diameter
EMPTY WEIGHT (approx.)	150 kg (330 lbs)	170 kg (375 lbs)
FULL WEIGHT (approx.)	280 kg (617 lbs)	440 kg (970 lbs)
Hot Liquor Tank Capacity	90 L (23.75 gal.)	180 L (47.5 gal.)
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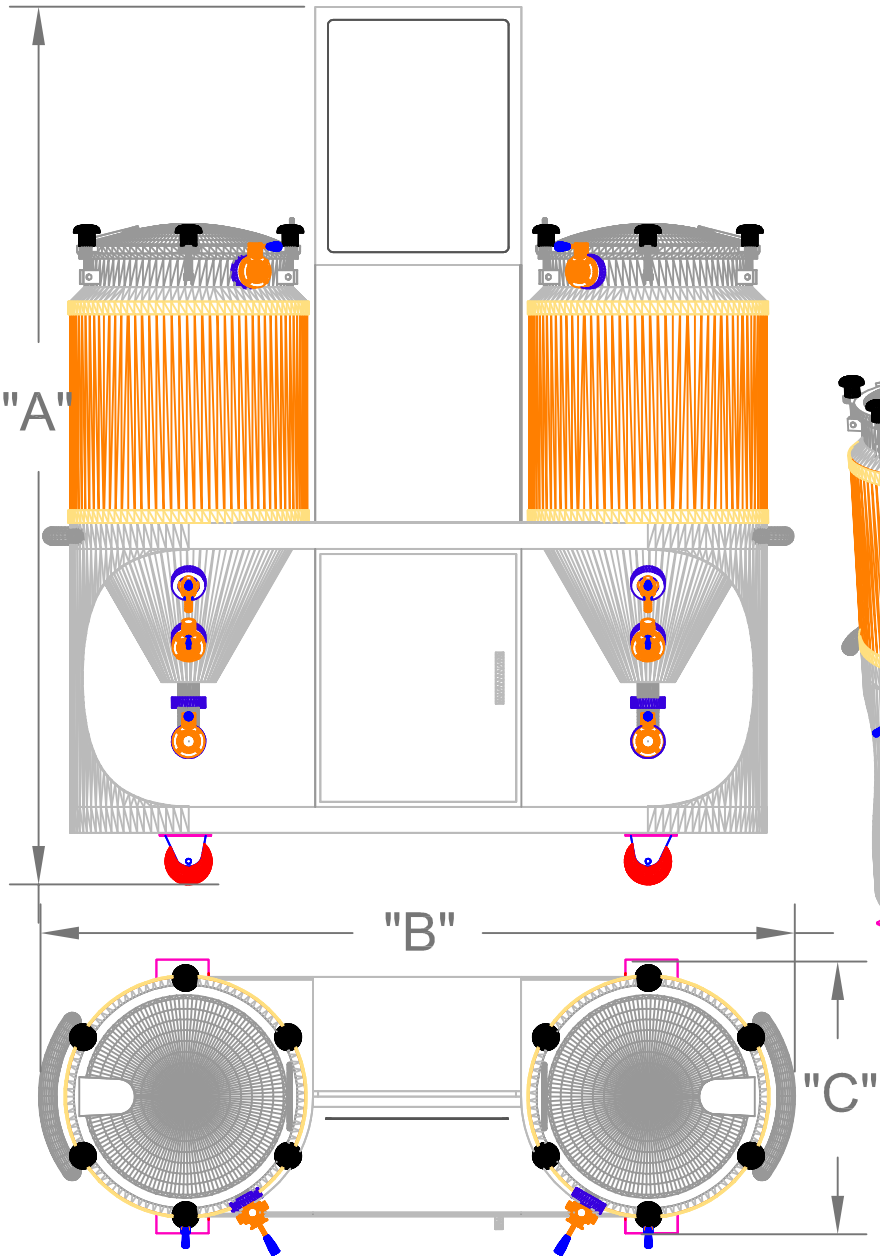
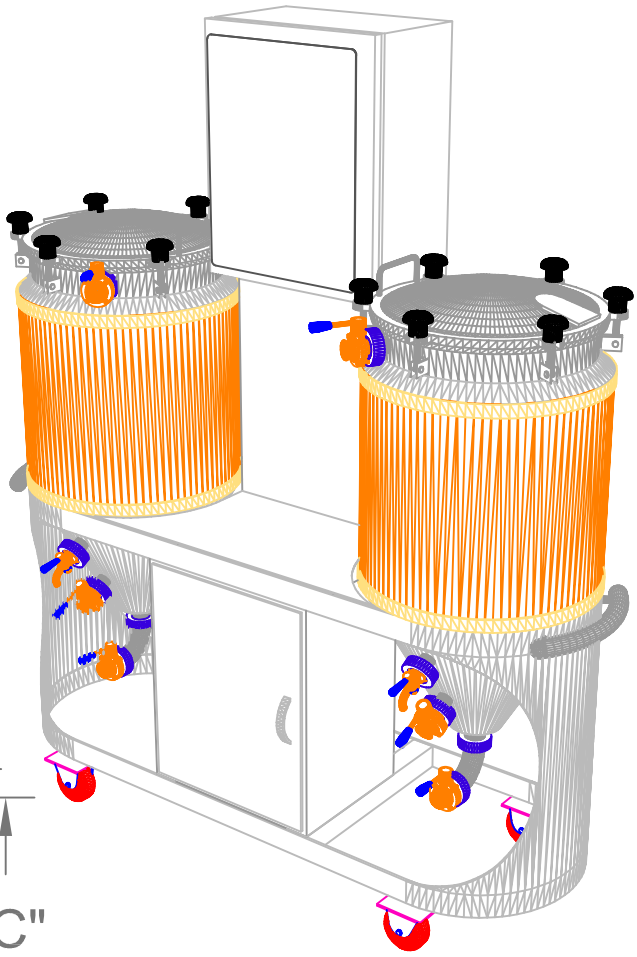
NOTES: Required clearance behind brewhouse is 300mm (12") minimum, 450mm (18") recommended.





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GS2 Series Drives

User Manual

GS2

AC DRIVE

230V Input: 0.5 - 7.5 Hp

460V Input: 1.0 - 10 Hp

WARNING

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To minimize the risk of potential safety problems, you should follow all applicable local and national codes that regulate the installation and operation of your equipment. These codes vary from area to area and usually change with time. It is your responsibility to determine which codes should be followed, and to verify that the equipment, installation, and operation is in compliance with the latest revision of these codes.

At a minimum, you should follow all applicable sections of the National Fire Code, National Electrical Code, and the codes of the National Electrical Manufacturer's Association (NEMA). There may be local regulatory or government offices that can also help determine which codes and standards are necessary for safe installation and operation.

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WARNING

WARNING: Always read this manual thoroughly before using GS2 Series AC Motor Drives.

WARNING: AC input power must be disconnected before performing any maintenance. Do not connect or disconnect wires or connectors while power is applied to the circuit. Maintenance must only be performed by a qualified technician.

WARNING: There are highly sensitive MOS components on the printed circuit boards. These components are especially sensitive to static electricity. To avoid damage to these components, do not touch these components or the circuit boards with metal objects or your bare hands.

WARNING: A charge may still remain in the DC-link capacitor with hazardous voltages even if the power has been turned off. To avoid personal injury, do not remove the cover of the AC drive until all "DISPLAY LED" lights on the digital keypad are off. Please note that there are live components exposed within the AC drive. Do not touch these live parts.

WARNING: Ground the GS2 AC Drive using the ground terminal. The grounding method must comply with the laws of the country where the AC drive is to be installed. Refer to "Basic Wiring Diagram" in CHAPTER 2.

WARNING: The mounting enclosure of the AC drive must comply with EN50178. Live parts shall be arranged in enclosures or located behind barriers that meet at least the requirements of the Protective Type IP20. The top surface of the enclosures or barrier that is easily accessible shall meet at least the requirements of the Protective Type IP40. Users must provide this environment for GS2 Series AC Drive.

WARNING: The AC drive may be destroyed beyond repair if incorrect cables are connected to the input/output terminals. Never connect the AC drive output terminals T1, T2, and T3 directly to the AC main circuit power supply.

GS2 SERIES AC DRIVE
USER MANUAL

Please include the Manual Number and the Manual Issue, both shown below, when communicating with us regarding this publication.

Manual Number: **GS2-M**

Issue: **First Edition**

Issue Date: **3/19/02**

Publication History		
Issue	**Date**	**Description of Changes**
First Edition	3/19/02	Original

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CHAPTER 1

GETTING STARTED

In This Manual...

Manual Overview 1–2
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Manual Overview

Overview of this Publication

The GS2 AC Drive User Manual describes the installation, configuration, and methods of operation of the GS2 Series AC Drive.

Who Should Read This Manual

This manual contains important information for those who will install, maintain, and/or operate any of the GS2 Series AC Drives.

Supplemental Publications

The National Electrical Manufacturers Association (NEMA) publishes many different documents that discuss standards for industrial control equipment. Global Engineering Documents handles the sale of NEMA documents. For more information, you can contact Global Engineering Documents at:

15 Inverness Way East
Englewood, CO 80112-5776
1-800-854-7179 (within the U.S.)
303-397-7956 (international)
www.global.ihs.com

NEMA documents that might assist with your AC drive systems are:

- **Application Guide for AC Adjustable Speed Drive Systems**
- **Safety Standards for Construction and Guide for Selection, Installation, and Operation of Adjustable Speed Drive Systems.**

Technical Support

By Telephone: 770-844-4200
(Mon.-Fri., 9:00 a.m.-6:00 p.m. E.T.)
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Special Symbols

When you see the "notepad" icon in the left-hand margin, the paragraph to its immediate right will be a special note.

When you see the "exclamation mark" icon in the left-hand margin, the paragraph to its immediate right will be a WARNING. This information could prevent injury, loss of property, or even death (in extreme cases).

GS2 AC Drive Introduction

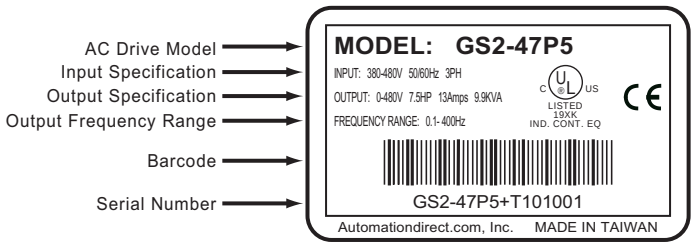
Unpacking

After receiving the AC motor drive, please check for the following:

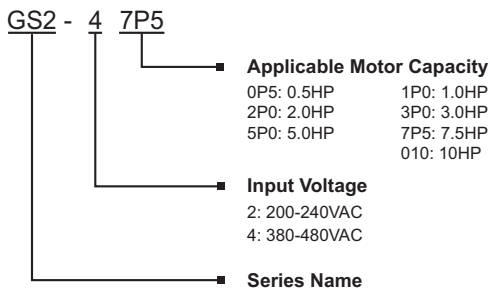
- Make sure that the package includes an AC drive, the GS2 Series AC Drive User Manual, and the GS2 Series AC Drive Quick Reference.
- Inspect the unit to insure it was not damaged during shipment.
- Make sure that the part number indicated on the nameplate corresponds with the part number of your order.

Nameplate Information:

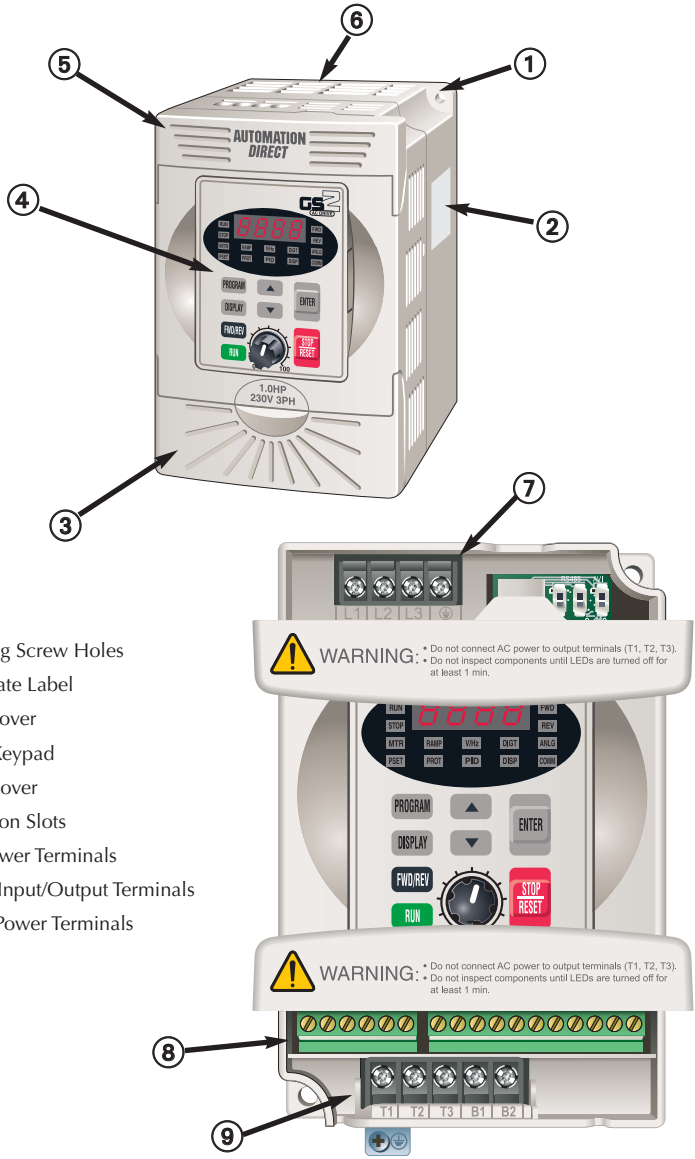
Example of 7.5HP 460V AC drive



Model Explanation:



External Parts and Labels:



① Mounting Screw Holes
② Nameplate Label
③ Lower Cover
④ Digital Keypad
⑤ Upper Cover
⑥ Ventilation Slots
⑦ Input Power Terminals
⑧ Control Input/Output Terminals
⑨ Output Power Terminals

GS2 AC Drive Specifications

200V Class							
Model Name: GS2-xxxx		20P5	21P0	22P0	23P0	25P0	27P5
Output Rating	Maximum Motor Output (Hp)	0.5	1.0	2.0	3.0	5.0	7.5
	Maximum Motor Output (kW)	0.4	0.75	1.5	2.2	3.7	5.5
	Rated Output Current (Amps)	2.5	5.0	7.0	10.0	17.0	25
	Maximum Output Voltage (V)	Three-phase 200 to 240V (proportional to input voltage)					
	Rated frequency (Hz)	0.1 to 400 Hz					
Input Rating	Rated Voltage / Frequency	Single/Three-phase, 200/208/220/230/240 VAC, 50/60Hz				Three-phase, 200/208/220/230/240 VAC, 50/60Hz	
	Voltage/Frequency Tolerance	Voltage: +/- 10%, Frequency: +/- 5%					

400V Class							
Model Name: GS2-xxxx		41P0	42P0	43P0	45P0	47P5	4010
Output Rating	Maximum Motor Output (Hp)	1.0	2.0	3.0	5.0	7.5	10
	Maximum Motor Output (kW)	0.8	1.5	2.2	4.0	5.5	7.5
	Rated Output Current (Amps)	3.0	4.0	5.0	8.2	13	18
	Maximum Output Voltage (V)	Three-phase 380 to 480V (proportional to input voltage)					
	Rated frequency (Hz)	0.1 to 400 Hz					
Input Rating	Rated Voltage / Frequency	Three-phase 380/400/415/440/460/480 VAC 50/60Hz					
	Voltage/Frequency Tolerance	Voltage: +/- 10%, Frequency: +/- 5%					

General Specifications			
Control Characteristics			
Control System			Pulse Width Modulation, Carrier frequency 1k - 12kHz
Output Frequency Resolution			0.1 Hz
Overload Capacity			150% of rated current for 1 minute
Torque Characteristics			Includes auto-torque boost, auto-slip compensation, starting torque 125% @ 0.5Hz / 150% @ 5.0Hz
Braking Torque			20% without dynamic braking, 125% with optional braking resistor - braking transistor built-in
DC Braking			Operation frequency 60-0Hz, 0 - 100% rated current, Start time 0.0 - 5.0 seconds, Stop time 0.0 - 25.0 seconds
Acceleration/Deceleration Time			0.1 to 600 seconds (linear or non-linear acceleration/ deceleration), second acceleration/deceleration available
Voltage/Frequency Pattern			Settings available for Constant Torque - low & high starting torque, Variable Torque - low & high starting torque, and user configured
Stall Prevention Level			20 to 200% or rated current
Operation Specification			
Inputs	**Frequency Setting**	**Keypad**	Setting by <UP> or <DOWN> buttons or potentiometer
		External Signal	Potentiometer - 2kohm/2W, 0 to 10Vdc (input impedance 10kohm), 4 to 20 mA (input impedance 250ohm), Multi-Speed Inputs 1 to 3, RS232 interface
	Operation Setting	**Keypad**	Setting by <RUN> , <STOP> buttons
		External Signal	Forward/Stop, Reverse/Stop (run/stop, fwd/rev), 3-wire control, Serial Communication RS232 & RS485 (Modbus RTU)
	Input Terminals	**Digital**	6 user-programmable: FWD/STOP, REV/STOP, RUN/STOP, REV/FWD, RUN momentary (N.O.), STOP momentary (N.C.), External Fault (N.O./N.C.), External Reset, Multi-Speed Bit (1-3), Jog, External Base Block (N.O./N.C.), Second Accel/Decel Time, Speed Hold, Increase Speed, Decrease Speed, Reset Speed to Zero, PID Disable (N.O.), PID Disable (N.C.), Input Disable
		Analog	1 user-configurable, 0 to 10Vdc (input impedance 10kohm) or 4 to 20mA (input impedance 250ohm), 10 bit resolution Frequency setpoint or PID process variable PV
Outputs	**Output Terminals**	**Digital**	2 user-programmable: Inverter Running, Inverter Fault, At Speed, Zero Speed, Above Desired Frequency, Below Desired Frequency, At Maximum Speed, Over Torque Detected, Above Desired Current, Below Desired Current, PID Deviation Alarm
		Analog	1 user-programmable, 0 to 10Vdc, 8 bit resolution frequency, current, process variable PV
	Operating Functions		Automatic voltage regulation, voltage/frequency characteristics selection, non-linear acceleration/deceleration, upper and lower frequency limiters, 7-stage speed operation, adjustable carrier frequency (1 to 12 kHz), PID control, skip frequencies, analog gain & bias adjustment, jog, electronic thermal relay, automatic torque boost, trip history, software protection

General Specifications (cont.)		
Protective Functions		Electronic Thermal, Overload Relay, Auto Restart after Fault, Momentary Power Loss, Reverse Operation Inhibit, Auto Voltage Regulation, Over-Voltage Trip Prevention, Auto Adjustable Accel/Decel, Over-Torque Detection Mode, Over-Torque Detection Level, Over-Torque Detection Time, Over-Current Stall Prevention during Acceleration, Over-Current Stall Prevention during Operation
Operator Interface	**Operator Devices**	8-key, 4-digit, 7-segment LED, 14 status LEDs, potentiometer
	Programming	Parameter values for setup and review, fault codes
	Status Display	Actual Operating Frequency, RPM, Scaled Frequency, Amps, % Load, Output Voltage, DC Bus Voltage, Process Variable, Set-point Frequency
	Key Functions	RUN, STOP/RESET, FWD/REV, PROGRAM, DISPLAY, <UP>, <DOWN>, ENTER
Environment	**Enclosure Rating**	Protected Chassis, IP20
	Ambient temperature	-10°C to 50°C (14°F to 122°F) -10°C to 40°C (14°F to 104°F) for models 7.5Hp (5.5kW) and higher
	Storage temperature	-20°C to 60°C (-4°F to 140°F) – during short term transportation period
	Ambient humidity	20 to 90% RH (non-condensing)
	Vibration	9.8 m/s^2 (1G) less than 10Hz, 5.9 m/s^2 (0.6G) 10 to 60Hz
	Installation Location	Altitude 1000m or lower above sea level, keep from corrosive gas, liquid and dust
Options		Noise filter, input AC reactor, output AC reactor, cable for remote operator, programming software, Dynamic braking resistor, input fuses

Installation and Wiring

In This Chapter...

Ambient Conditions 2–2
Installation 2–3
Dimensions 2–4
GS2 Circuit Connections 2–6

Ambient Conditions

The AC drive should be kept in the shipping carton before installation. In order to retain the warranty coverage, the AC drive should be stored properly when it is not to be used for an extended period of time. Some storage suggestions are:

- Store in a clean and dry location free from direct sunlight or corrosive fumes.
- Store within an ambient temperature range of -20°C to +60°C.
- Store within a relative humidity range of 0% to 95% and non-condensing environment.
- Store within an air pressure range of 86 kPA to 106kPA.

Ambient Conditions	
Air Temperature	-10°C to 50°C (14°F to 122°F) , -10°C to 40°C (14°F to 104°F) for models 7.5Hp (5.5kW) and higher
Storage/Transportation Temperature	-20°C to 60°C (-4°F to 140°F)
Relative Humidity	0% to 90%, no condensation allowed
Atmosphere pressure	86 to 106 kPa
Installation Site Altitude	Altitude 1000m or lower above sea level, keep from corrosive gas, liquid and dust
Vibration	9.8 m/s^2 (1G) less than 10Hz, 5.9 m/s^2 (0.6G) 10 to 60Hz
Protection Degree	IP20: Protection against contact by fingers. Protection against medium-size foreign objects

Installation

Improper installation of the AC drive will greatly reduce its life. Be sure to observe the following precautions when selecting a mounting location.

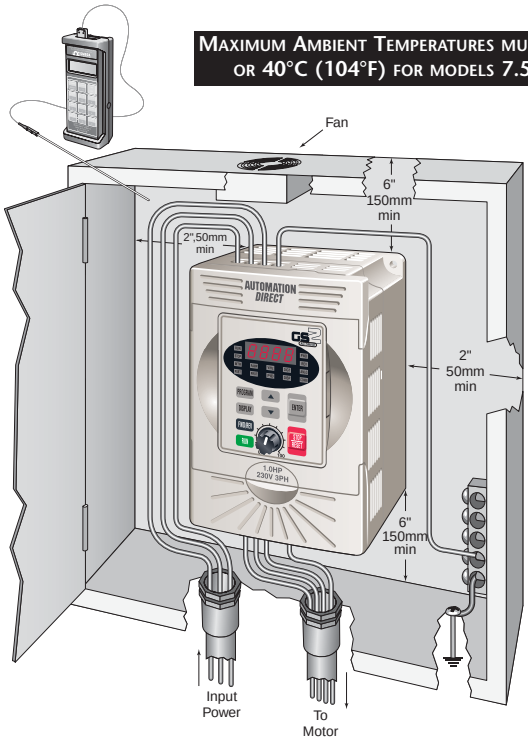
Warning: Failure to observe these precautions may damage the drive and void the warranty!

- Do not mount the AC drive near heat-radiating elements or in direct sunlight.
- Do not install the AC drive in a place subjected to high temperature, high humidity, excessive vibration, corrosive gases or liquids, or airborne dust or metallic particles.
- Mount the AC drive vertically and do not restrict the air flow to the heat sink fins.

WARNING: AC drives generate a large amount of heat which may damage the AC drive. Auxiliary cooling methods are typically required in order not to exceed maximum ambient temperatures.

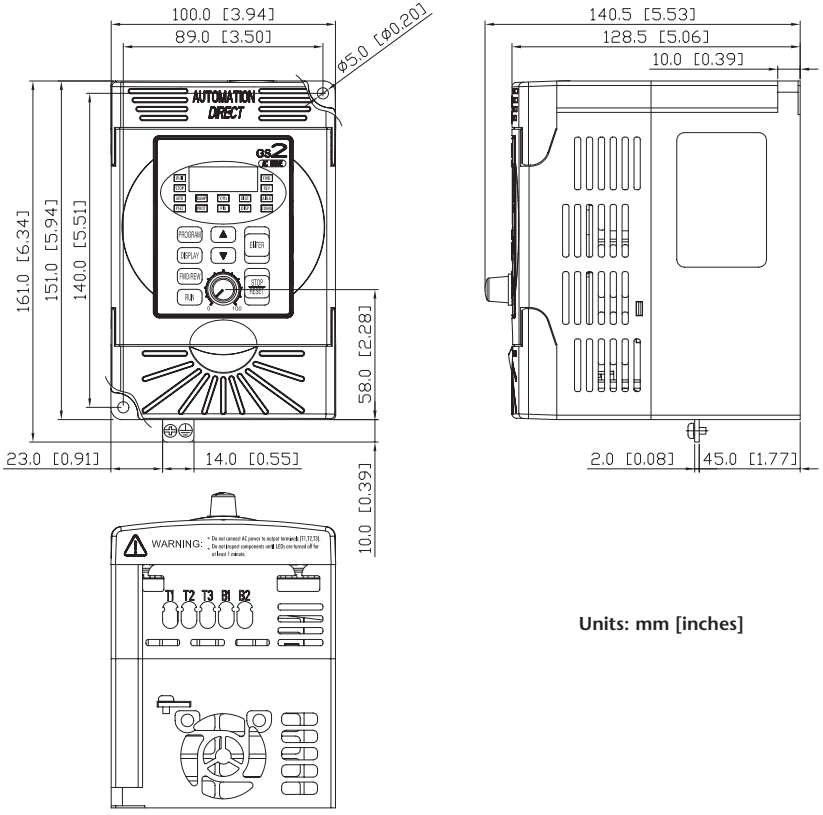
Minimum Clearances and AirFlow

MAXIMUM AMBIENT TEMPERATURES MUST NOT EXCEED 50°C (122°F), OR 40°C (104°F) FOR MODELS 7.5HP (5.5KW) AND HIGHER!



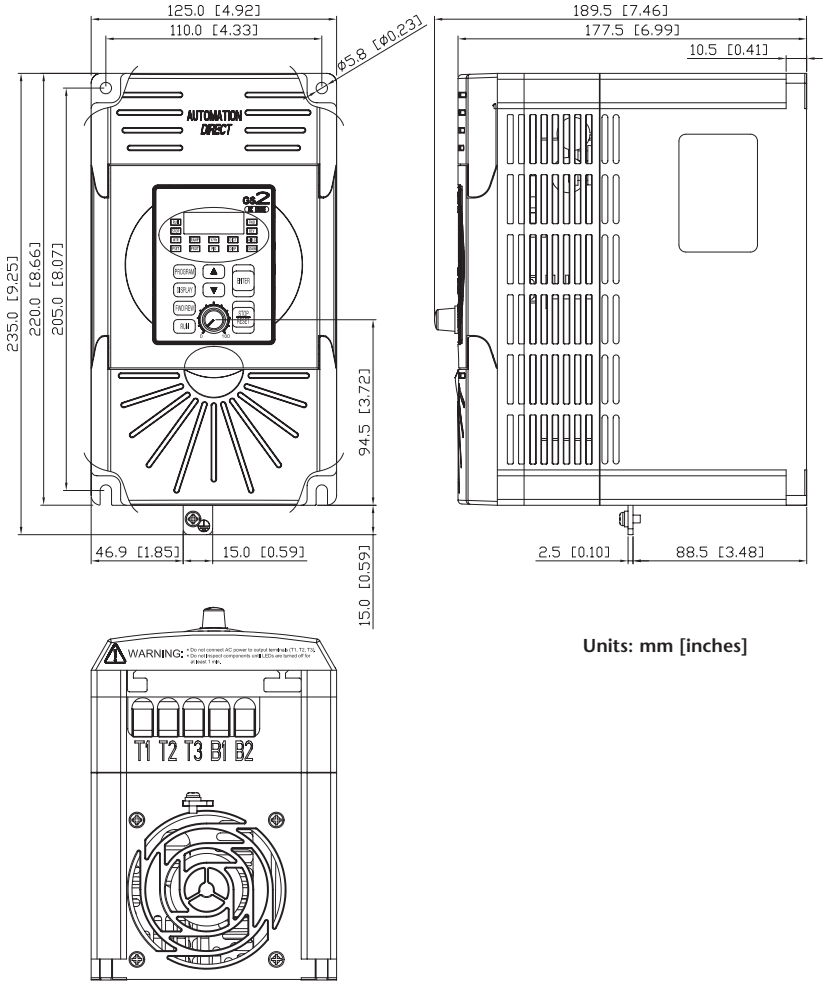
Dimensions

GS2-20P5, GS2-21P0, GS2-22P0, GS2-41P0, GS2-42P0, GS2-43P0



Units: mm [inches]

GS2-23P0, GS2-25P0, GS2-27P5, GS2-45P0, GS2-47P5, GS2-4010



Units: mm [inches]

GS2 Circuit Connections

DANGER!

HAZARDOUS VOLTAGE! Before making any connection to the AC drive, disconnect all power to the AC drive, and wait five minutes for DC bus capacitors to discharge.

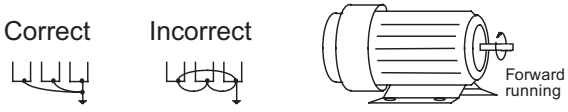
WARNING: Any electrical or mechanical modification to this equipment without prior written consent of AutomationDirect.com, Inc. will void all warranties, may result in a safety hazard, and may void the UL listing.

Wiring Notes: PLEASE READ PRIOR TO INSTALLATION.

WARNING: Do not connect the AC input power to the T1, T2, T3 output terminals. This will damage the AC drive.

WARNING: Tighten all screws to the proper torque rating. See "Main Circuit Wiring" later in this chapter.

1. During installation, follow all local electrical, construction, and safety codes for the country the AC drive is to be installed in.
2. Make sure the appropriate protective devices (circuit breaker or fuses) are connected between the power supply and AC drive.
3. Make sure that the leads are connected correctly and the AC drive is properly grounded. (Ground resistance should not exceed 0.1Ω.)
4. Use ground leads that comply with AWG/MCM standards and keep them as short as possible.
5. Multiple GS2 units can be installed in one location. All the units should be grounded directly to a common ground terminal. The GS2 ground terminals may also be connected in parallel, as shown in the figure below. **Make sure there are no ground loops.**



6. When the AC drive output terminals T1, T2, and T3 are connected to the motor terminals T1, T2, and T3, respectively, the motor will rotate counterclockwise (as viewed from the shaft end of the motor) when a forward operation command is received. To reverse the direction of motor rotation, switch the connections of any of the two motor leads.
7. Make sure that the power source is capable of supplying the correct voltage and required current to the AC drive.

8. Do not attach or remove wiring when power is applied to the AC drive.
9. Do not inspect components unless inside "POWER" lamp is turned off.
10. Do not monitor the signals on the circuit board while the AC drive is in operation.
11. For the single-phase rated AC drives, the AC power can be connected to any two of the three input terminals L1, L2, and L3. Note: This AC drive is not intended for use with single-phase motors.
12. Route the power and control wires separately, or at 90 degree angle to each other.
13. If a filter is required for reducing EMI (Electro Magnetic Interference), install it as close as possible to AC drive. EMI can also be reduced by lowering the Carrier Frequency.
14. If the AC drive is installed in a place where a load reactor is needed, install the filter close to the T1, T2, and T3 side of AC drive. Do not use a Capacitor, L-C Filter (Inductance-Capacitance), or R-C Filter (Resistance-Capacitance), unless approved by AutomationDirect.
15. When using a GFCI (Ground Fault Circuit Interrupt), select current sensor with sensitivity of 200mA, and not less than 0.1-second detection to avoid nuisance tripping.

Motor Operation Precautions

1. When using the AC drive to operate a standard 3-phase induction motor, notice that the energy loss is greater than for an inverter duty motor.
2. Avoid running a standard induction motor at low speed, which may cause the motor temperature to exceed the motor rating due to limited airflow produced by the motor's fan.
3. When the standard motor operates at low speed, the output load must be decreased.
4. If 100% output torque is desired at low speed, it may be necessary to use a special "inverter-duty" rated motor.

Short Circuit Withstand:

Suitable for use on a circuit capable of delivering not more than 5,000 rms symmetrical amperes. For all 460V models, the maximum is 480 volts. For all 230V Models, the maximum is 240 volts.

Applicable Codes

All GS2 Series AC drives are Underwriters Laboratories, Inc. (UL) and Canadian Underwriters Laboratories (cUL) listed, and therefore comply with the requirements of the National Electrical Code (NEC) and the Canadian Electrical Code (CEC).

Installation intended to meet the UL and cUL requirements must follow the instructions provided in "Wiring Notes" as a minimum standard. Follow all local codes that exceed UL and cUL requirements. Refer to the technical data label affixed to the AC drive and the motor nameplate for electrical data.

The "Circuit Protection Devices" in APPENDIX A, lists the recommended fuse part number for each GS2 Series part number. These fuses (or equivalent) must be used on all installations where compliance with U.L. standards is required.

Main Circuit Wiring

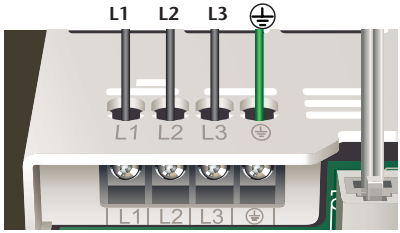
Main Circuit Wiring	
Terminal	**Description**
L1, L2, L3	Input Power
T1, T2, T3	AC Drive Output
B1, B2	DB Resistor Connection
⏚	Ground

Main Circuit Terminal Specifications			
AC Drive Model	**Max. Current (Input/Output)**	**Wire Gauge**	**Torque**
GS2-20P5 (1-phase)	6.3A	12-14 AWG	14kgf-cm
GS2-20P5 (3-phase)	3.2A	12-14 AWG	
GS2-21P0 (1-phase)	11.5A	12-14 AWG	
GS2-21P0 (3-phase)	6.3A	12-14 AWG	
GS2-22P0 (1-phase)	15.7A	12 AWG	
GS2-22P0 (3-phase)	9A	12-14 AWG	
GS2-23P0 (1-phase)	27A	8 AWG	15kgf-cm
GS2-23P0 (3-phase)	15A	8-12 AWG	
GS2-25P0	19.6A	8-10 AWG	
GS2-27P5	32A	8 AWG	
GS2-41P0	4.2A	12-14 AWG	14kgf-cm
GS2-42P0	5.7A	12-14 AWG	
GS2-43P0	7A	12-14 AWG	
GS2-45P0	8.5A	8-14 AWG	15kgf-cm
GS2-47P5	14A	8-12 AWG	
GS2-4010	19A	8-10 AWG	

*WIre type: 75° Copper only

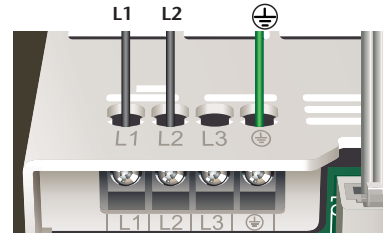
Main Circuit Wiring (cont.)

3-phase Input Power Connections



3-phase Input Power	
200V Class	200-240V ± 10%; 50, 60Hz ± 5%
400V Class	380-480V ± 10%; 50, 60Hz ± 5%

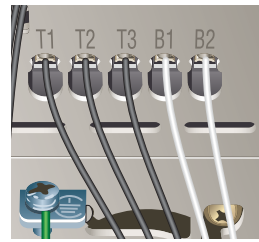
1-phase Input Power Connections*



1-phase Input Power	
200V Class	200-240V ± 10%; 50, 60Hz ± 5%

* Only models GS2-20P5, GS2-21P0, GS2-22P0, and GS2-23P0 are rated for 1-phase input power

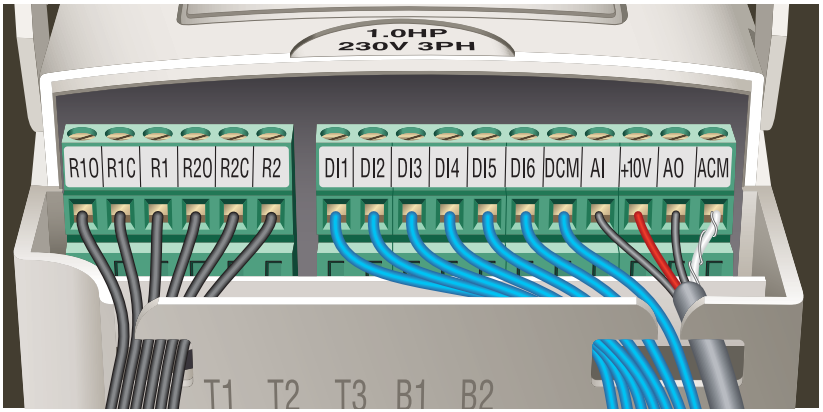
Output Power Connections



200V Class Output Power						
Model: GS2-xxxx	**20P5**	**21P0**	**22P0**	**23P0**	**25P0**	**27P5**
Maximum Motor Output (Hp)	0.5	1.0	2.0	3.0	5.0	7.5
Maximum Motor Output (kW)	0.4	0.75	1.5	2.2	3.7	5.5
Rated Output Current (A)	2.5	5.0	7.0	10.0	17.0	25
Maximum Output Voltage (V)	Three-phase 200 to 240V (proportional to input voltage)					
Rated frequency (Hz)	0.1 to 400 Hz					

400V Class Output Power						
Model Name: GS2-xxxx	**41P0**	**42P0**	**43P0**	**45P0**	**47P5**	**4010**
Maximum Motor Output (Hp)	1.0	2.0	3.0	5.0	7.5	10
Maximum Motor Output (kW)	0.8	1.5	2.2	4.0	5.5	7.5
Rated Output Current (A)	3.0	4.0	5.0	8.2	13	18
Maximum Output Voltage (V)	Three-phase 380 to 480V (proportional to input voltage)					
Rated frequency (Hz)	0.1 to 400 Hz					

Control Terminal Wiring (Factory Settings)

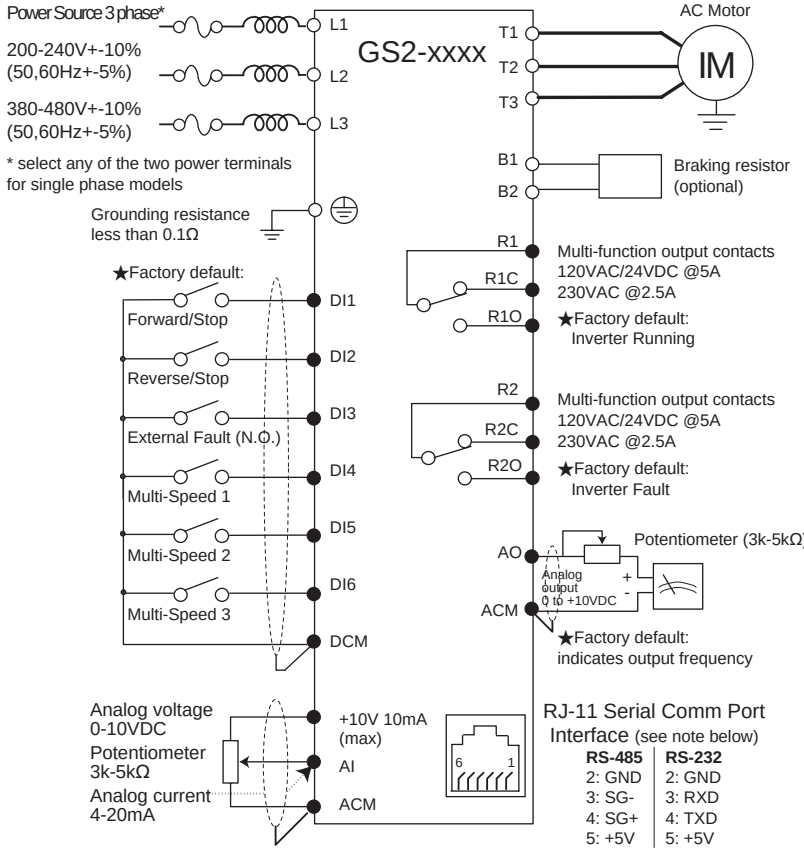


Control Circuit Terminals		
Terminal Symbol	**Description**	**Remarks**
R1O	Relay Output 1 Normally Open	120VAC/24VDC @5A 230VAC @2.5A
R1C	Relay Output 1 Normally Closed	
R1	Relay Output 1 Common	
R2O	Relay Output 2 Normally Open	
R2C	Relay Output 2 Normally Closed	
R2	Relay Output 2 Common	
DI1	Digital Input 1	See “Basic Wiring Diagram” on next page.
DI2	Digital Input 2	
DI3	Digital Input 3	
DI4	Digital Input 4	
DI5	Digital Input 5	
DI6	Digital Input 6	
DCM	Digital Common	
AI	Analog Input	0 to +10 V (Max. Output Frequency) Input or 4 to 20mA (Max. Output Frequency) Input
+10V	Internal Power Supply	+10VDC
AO	Analog Output	0 to +10 V (Max. output Frequency) Output
ACM	Analog Common	

Note: Use twisted-shielded, twisted-pair or shielded-lead wires for the control signal wiring. It is recommended to run all signal wiring in a separate steel conduit. The shield wire should only be connected at the AC drive. Do not connect shield wire on both ends.

Basic Wiring Diagram

Note: Users must connect wiring according to the circuit diagram shown below.

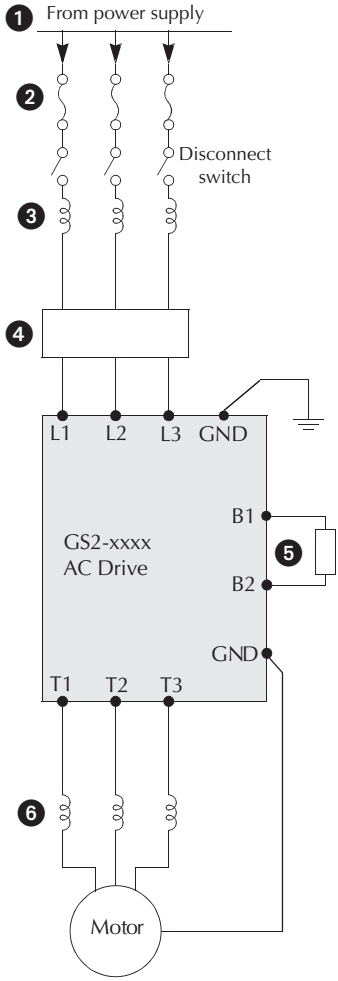


★Factory default: output frequency determined by the potentiometer on the keypad.

○ Main circuit (power) terminals ● Control circuit terminal ⫩ Shielded leads

WARNING: Do not plug a modem or telephone into the GS2 RJ-11 Serial Comm Port, or permanent damage may result. Terminals 2 and 5 should not be used as a power source for your communication connection.

External Wiring



1 Power Supply
Please follow the specific power supply requirements shown in CHAPTER 1.

2 Fuse
Input fuses protect the AC drive from excessive input current due to line surges, short circuits, and ground faults. They are recommended for all installations and may be required for UL-listed installations.

3 AC Line Reactor (Optional)
Input line reactors protect the AC drive from transient overvoltage conditions, typically caused by utility capacitor switching. The input line reactor also reduces the harmonics associated with AC drives. Input line reactors are recommended for all installations.

4 EMI filter (Optional)
Input EMI filters reduce electromagnetic interference or noise on the input side of the AC drive. They are required for CE compliance and recommended for installations prone to or sensitive to electromagnetic interference.

5 Braking Resistor (Optional)
Dynamic braking allows the AC drive to produce additional braking (stopping) torque. AC drives can typically produce between 15% & 20% braking torque without the addition of any external components. The addition of optional braking may be required for applications that require rapid deceleration or high enertia loads.

6 AC Line Reactor (Optional)
Output line reactors protect the motor insulation against AC drive short circuits and IGBT reflective wave damage. Output line reactors also "smooth" the motor current waveform, allowing the motor to run cooler. AC line reactors can be used for both input and output protection. Output line reactors are recommended for operating "non-inverter=duty" motors and when the length of wiring between the AC drive and motor exceeds 75 feet.

Note: Please refer to APPENDIX A for specifications on GS2 AC Drive Accessories.

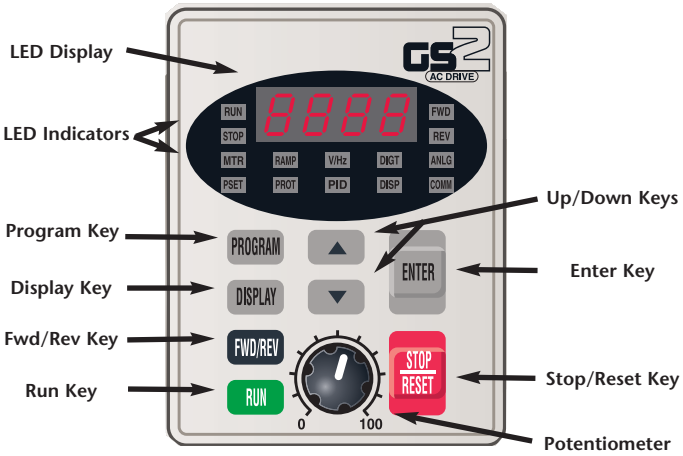
Keypad Operation and Quickstart

In This Chapter...

The GS2 Digital Keypad 3–2
GS2 Quickstart 3–6

The GS2 Digital Keypad

The digital keypad includes a 4-digit LED display, 14 LED Indicators, 8 function keys, and a potentiometer. The diagram below shows all of the features of the digital keypad and an overview of their functions.



LED Display

The LED Display shows the operation values and parameter settings of the AC drive.

LED Indicators

RUN The RUN LED indicates the AC drive is in Run Mode.

STOP The STOP LED indicates the AC drive is not in Run Mode.

FWD The FWD LED indicates the AC drive is running the motor in the forward direction.

REV The REV LED indicates the AC drive is running the motor in the reverse direction.

MTR The MTR LED indicates the AC drive is in Program Mode and is displaying the Motor Parameters group (P 0.xx).

RAMP The RAMP LED indicates the AC drive is in Program Mode and is displaying the Ramp Parameters group (P 1.xx).

V/Hz The V/Hz LED indicates the AC drive is in Program Mode and displayes the Volts/Hertz Parameters group (P 2.xx).

DIGT The DIGT LED indicates the AC drive is in Program Mode and displayes the Digital Parameters group (P 3.xx).

ANLG The ANLG LED indicates the AC drive is in Program Mode and displayes the Analog Parameters group (P 4.xx).

PSET The PSET LED indicates the AC drive is in Program Mode and displayes the Preset Parameters group (P 5.xx).

PROT The PROT LED indicates the AC drive is in Program Mode and displayes the Protection Parameters group (P 6.xx).

PID The PID LED indicates the AC drive is in Program Mode and displayes the PID Parameters group (P 7.xx).

DISP The DISP LED indicates the AC drive is in Program Mode and displayes the Display Parameters group (P 8.xx).

COMM The COMM LED indicates the AC drive is in Program Mode and displayes the Communication Parameters group (P 9.xx).

Function Keys

Program Key

Pressing the "Program" key repetitively cycles through the parameter groups. As you cycle through the parameter groups, an LED indicator lights to show you which parameter group is selected.

Display Key

Pressing the Display key will cycle through the operational values of the AC drive when the AC drive is not in Program Mode. When in Program Mode, the Display key will display the value of the selected parameter.

Fwd/Rev Key

Pressing the FWD/REV key changes the direction in which the motor operates.

Run

Pressing the Run key starts the AC drive operation. This key has no function if the AC drive is controlled by the external control terminals.

Up / Down Keys

Press the "Up" or "Down" keys momentarily to change parameter settings. These keys may also be used to scroll through different operating values or parameters. Pressing the "Up" or "Down" key momentarily, changes the parameter settings in single-unit increments. To quickly run through the range of settings, press and hold the “Up” or "Down" key.

Enter Key

Press the "ENTER" key to view parameters and store parameter settings.

Stop/Reset Key

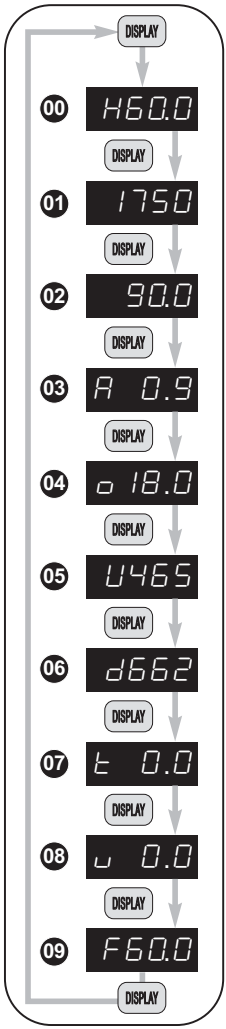
Used to stop AC drive operation. If the AC drive has stopped due to a fault, clear the fault first, then press this key to reset the AC drive.

Potentiometer

The potentiometer is for setting operation frequency.

Displaying the Status of the GS2 AC Drive

Press the display button on the keypad repeatedly to cycle through the status messages on the AC drive. The diagram below shows the order of the status messages as you cycle through them and shows the definition of the status messages. The status of the AC drive can be shown in RUN or STOP mode.



00 Actual Operating Frequency

Displays the actual operating frequency present at the T1, T2, and T3 terminals. *Example: 60.0Hz*

01 RPM

Displays the present *estimated* speed of the motor. *Example: 1750 RPM*

02 Scaled Frequency

Displays the result of output frequency x P 8.01. *Example: 60Hz x 1.5 = 90.0*

03 Amps

Displays the output current present at the T1, T2, and T3 terminals. *Example: 0.9A*

04 % Load

Displays the amount of load on the AC drive. *Example: (Output Current ÷ Drive Rated Current) x 100*

05 Output Voltage

Displays the output voltage present at the T1, T2, and T3 terminals. *Example: 465V*

06 DC Bus Voltage

Displays the DC Bus Voltage. *Example: 662 VDC*

07 PID Setpoint

Displays the PID setpoint. *Note: It is possible to change the PID setpoint with the ▲ and ▼ keys when the PID setpoint value is displayed on the keypad. The PID function (P 7.00) must be enabled, and the PID Setpoint source (P 7.02) must be set to keypad (00).*

08 PID Feedback Signal (PV)

Displays the PID feed-back signal.

*NOTE: The PID LED will flash when the **PID Setpoint** or **Process Variable** is displayed.*

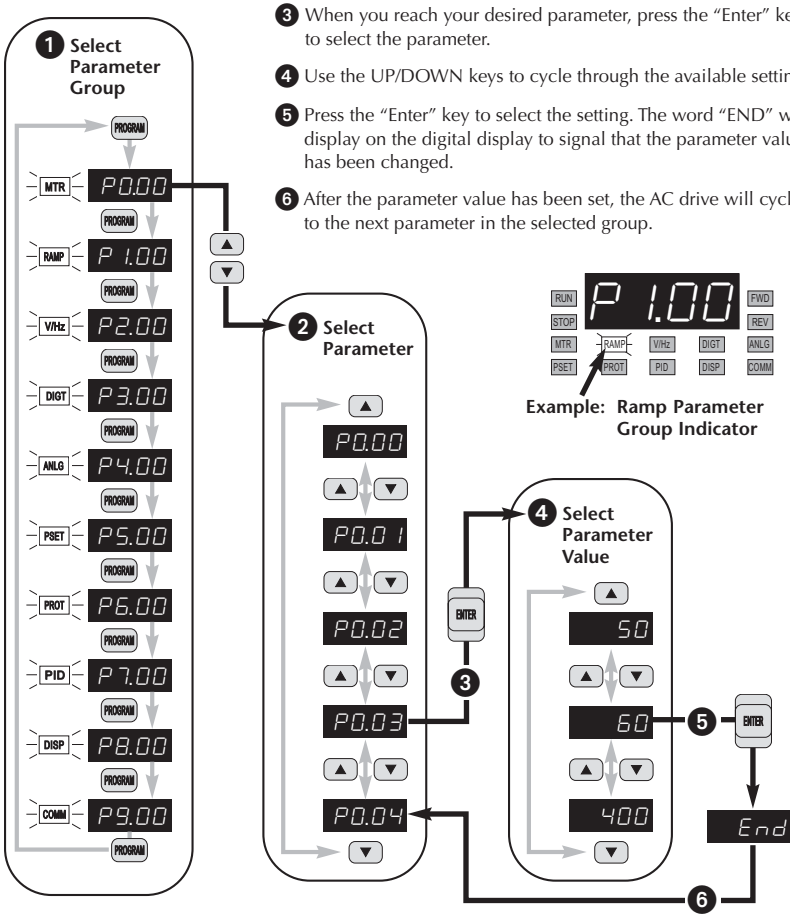
09 Setpoint Frequency

Displays the frequency setting of the AC drive. *Example: 60.0Hz*

Programming the GS2 AC Drive

The GS2 AC Drive parameters are organized into 10 different groups according to their functions. The illustration below shows you how to navigate through the parameter groups and parameter settings. For a complete list of parameters, see CHAPTER 4.

1. Press the "Program" key repetitively to cycle through the parameter groups. As you cycle through the parameter groups, an LED indicator will light to show you which parameter group is selected.
2. Once you reach the desired parameter group, use the UP/DOWN keys to cycle through the available parameters in that group.
3. When you reach your desired parameter, press the "Enter" key to select the parameter.
4. Use the UP/DOWN keys to cycle through the available settings.
5. Press the "Enter" key to select the setting. The word "END" will display on the digital display to signal that the parameter value has been changed.
6. After the parameter value has been set, the AC drive will cycle to the next parameter in the selected group.



GS2 Quickstart

The following examples will help you quickly setup your GS2 AC Drive for two common applications.The first example applies to an application that requires constant torque, and the second example requires variable torque in its application.

Note: For a complete list and description of the parameters for the GS2 Series AC drives, see CHAPTER 4.

Example 1: Constant torque (e.g. conveyors, compressors, etc.)

In this example, the AC drive needs to operate a motor that is connected to a conveyor. In order to decide which parameters need modifications, we will make a list of the needs for the application.

Application Needs

- The AC drive must control a 460V, 1HP motor. The AC drive model we will be using for this application is a GS2-41P0. An example of the motor nameplate

INVERTER DUTY MOTOR							
HP	1	Volts	460	PHASE	3	TYPE	P
RPM	1725	AMPS	2.6	HZ	60	SF	1.15
DESIGN	B	AMB	40°C			INSUL CLASS	F
DUTY	CONT	ENCL	TEFC			CODE	K

  is shown below.
- The maximum speed for the motor is 2000 RPM.
- The motor should accelerate to maximum speed in 5 seconds.
- The motor should decelerate from maximum speed in 5 seconds.
- The motor will require a high torque when starting.
- The operation of the motor (start, stop, etc.) will be controlled by remote control terminals. All keys on the GS2 keypad should be disabled.
- The frequency of the AC drive will be determined by remote potentiometer that has a 0 to +10V signal.
- The display of the AC drive should default to the motor speed (RPM) when running.

Parameter Setup

In order to meet the needs of this application, the parameters should be set as follows:

P 0.00 **Motor Nameplate Voltage** **Setting: 460**

Range: 200V series: 200/208/220/230/240 Default Setting: 240
460V series: 380/400/415/440/460/480 Default Setting: 480

This parameter setting is determined by the motor nameplate.

P 0.01 **Motor Nameplate Amps** **Setting: 2.6**

Range: Drive Rated Amps x .3 to Drive Rated Amps x 1.0 Default Setting: Drive Rating (A)

This parameter setting is determined by the motor nameplate..

P 0.02 **Motor Base Frequency** **Setting: 60**

Range: 50/60/400 Default Setting 60

This parameter setting is determined by the motor nameplate.

P 0.03 **Motor Base RPM** **Setting: 1725**

Range: 375 to 9999 RPM Default Setting: 1750

This parameter setting is determined by the motor nameplate.

P 0.04 **Motor Maximum RPM** **Setting: 2000**

Range: P 0.03 to 9999 RPM Default Setting: P 0.03

This parameter setting is determined by the needs of the application.

WARNING: The Motor Maximum RPM parameter (P 0.04) should never exceed the maximum RPM rating for the motor you are using. If this information is not readily available, consult your motor manufacturer.

P 1.00 **Stop Methods** **Setting: 00**

Range: 00 Ramp to Stop Default Setting: 00
01 Coast to stop

The application requires that this parameter be set to Ramp to Stop because the motor needs to stop under power. If the AC drive was set for Coast to Stop, the AC drive would ignore the Deceleration Time setting.

WARNING: If the Stop Method for the GS2 AC drive is set for Coast to Stop, the AC drive will ignore any setting you have for Deceleration Time (P 1.02).

P 1.01 **Acceleration Time** **Setting: 5.0**

Range: 0.1 to 600 sec Default Setting: 10 sec

The motor should accelerate from 0 RPM to Base RPM (P 0.03) in 5 seconds.

P 1.02 **Deceleration Time** **Setting: 5.0**

Range: 0.1 to 600 sec Default Setting: 30 sec

The motor should decelerate from 2000 RPM (maximum speed) to 0 RPM in 5 seconds.

P 2.00 **Volts/Hertz Settings** **Setting: 01**

Range: 00 - General Purpose Default Setting: 0.0
01 - High Starting Torque
02 - Fans and Pumps
03 - Custom

The GS2 Series AC drive has some predefined torque settings that meet the needs of most applications. A custom setting is available if needed. In this example, the application requires a high starting torque.

P 3.00 **Source of Operation Command** **Setting: 02**

Default Setting: 00

Settings	00	Operation Determined by Digital Keypad
	01	Operation determined by external control terminals. Keypad STOP is enabled.
	02	Operation determined by external control terminals. Keypad STOP is disabled.
	03	Operation determined by RS232/RS485 interface. Keypad STOP is enabled.
	04	Operation determined by RS232/RS485 interface. Keypad STOP is disabled.

The AC drive operation will be determined by external control terminals and the keypad stop will be disabled.

P 4.00 Source of Frequency Command Setting: 02

Default: 00

Settings:
- 00 Frequency determined by keypad potentiometer
- 01 Frequency determined by digital keypad up/down
- 02 Frequency determined by 0 to +10V input on AI terminal. Switch, SW1 must be set to AVI.

Switch SW1 must be set to AVI in order to use a 0 to +10V input

- 03 Frequency determined by 4 to 20mA input on AI terminal. Switch SW1 must be set to ACI.

Switch SW1 must be set to ACI in order to use a 4 to 20mA input

- 04 Frequency determined by 0 to 20mA input on AI terminal. Switch SW1 must be set to ACI.

Switch SW1 must be set to ACI in order to use a 0 to 20mA input

- 05 Frequency determined by RS232/RS485 communication interface

The frequency of the AC drive will be determined by an external potentiometer with a 0 to +10V signal.

P 8.00 User Defined Display Function Setting: 01

Default Setting: 00

Settings:
- 00 Output Frequency (Hz)
- 01 Motor Speed (RPM)
- 02 Output Frequency x P 8.01
- 03 Output Current (A)
- 04 Motor Output Current (%)
- 05 Output Voltage(V)
- 06 DC Bus Voltage (V)
- 07 PID Setpoint
- 08 PID Feedback (PV)
- 09 Frequency Setpoint

The AC drive display will default to motor speed (RPM) when running.

Example 2: Variable torque (e.g. fans, pumps, etc.)

In this example, the AC drive needs to operate a motor that is connected to a pump. As in Example 1, we will make a list of the needs for the application in order to decide which parameters need modifications.

Application Needs

- The AC drive must control a 208V, 3HP motor. The AC drive model we will be using for this application is a GS2-23P0. An example of the motor nameplate is shown below.

INVERTER GRADE MOTOR							
HP	3	Volts	208	PHASE	3	TYPE	P
RPM	3525	AMPS	9.2	HZ	60	SF	1.15
DESIGN	B			AMB	40°C	INSUL CLASS	F
DUTY	CONT			ENCL	TEFC	CODE	K

- The maximum speed for the motor is 3600 RPM.
- The motor should accelerate to maximum speed in 20 seconds.
- The motor should coast to stop when operation is terminated.
- The motor will be turning a pump.
- The operation of the motor (start, stop, etc.) will be controlled by the GS2 digital keypad.
- The frequency of the AC drive will be determined by the GS2 keypad potentiometer.
- The display of the AC drive should default to output current (A) when running.

Parameter Setup

In order to meet the needs of this application, the parameters should be set as follows:

P 0.00 **Motor Nameplate Voltage** **Setting: 208**

Range: 200V series: 200/208/220/230/240 Default Setting: 240
460V series: 380/400/415/440/460/480 Default Setting: 480

This parameter setting is determined by the motor nameplate.

P 0.01 **Motor Nameplate Amps** **Setting: 9.2**

Range: Drive Rated Amps x .3 to Drive Rated Amps x 1.0 Default Setting: Drive Rating (A)

This parameter setting is determined by the motor nameplate.

P 0.02 **Motor Base Frequency** **Setting: 60**

Range: 50/60/400 Default Setting 60

This parameter setting is determined by the motor nameplate.

P 0.03 **Motor Base RPM** **Setting: 3525**

Range: 375 to 9999 RPM Default Setting: 1750

This parameter setting is determined by the motor nameplate.

P 0.04 **Motor Maximum RPM** **Setting: 3600**

Range: P 0.03 to 9999 RPM Default Setting: P 0.03

This parameter setting is determined by the needs of the application.

WARNING: The Motor Maximum RPM parameter (P 0.04) should never exceed the maximum RPM rating for the motor you are using. If this information is not readily available, consult your motor manufacturer.

P 1.00 **Stop Methods** **Setting: 01**

Range: 00 Ramp to Stop Default Setting: 00
01 Coast to stop

The application requires that this parameter be set to Coast to Stop.

WARNING: If the Stop Method for the GS2 AC drive is set for Coast to Stop, the AC drive will ignore any setting you have for Deceleration Time (P 1.02).

P 1.01 **Acceleration Time** **Setting: 20.0**

Range: 0.1 to 600 sec Default Setting: 10 sec

The motor should accelerate from 0 RPM to Base RPM (P 0.03) in 20 seconds.

P 2.00 **Volts/Hertz Settings** **Setting: 02**

Range: 00 - General Purpose Default Setting: 0.0
01 - High Starting Torque
02 - Fans and Pumps
03 - Custom

The GS2 Series AC drive has some predefined torque settings that meet the needs of most applications. A custom setting is available if needed. In this example, the motor will be running a pump.

P 3.00 Source of Operation Command Setting: 01

Default Setting: 00

Settings
- 00 Operation Determined by Digital Keypad
- 01 Operation determined by external control terminals. Keypad STOP is enabled.
- 02 Operation determined by external control terminals. Keypad STOP is disabled.
- 03 Operation determined by RS232/RS485 interface. Keypad STOP is enabled.
- 04 Operation determined by RS232/RS485 interface. Keypad STOP is disabled.

The AC drive operation will be determined by external control terminals and the keypad stop is enabled.

P 4.00 Source of Frequency Command Setting: 00

Default: 00

Settings:
- 00 Frequency determined by keypad potentiometer
- 01 Frequency determined by digital keypad up/down
- 02 Frequency determined by 0 to +10V input on AI terminal. Switch, SW1 must be set to AVI.

Switch SW1 must be set to AVI in order to use a 0 to +10V input

- 03 Frequency determined by 4 to 20mA input on AI terminal. Switch SW1 must be set to ACI.

Switch SW1 must be set to ACI in order to use a 4 to 20mA input

- 04 Frequency determined by 0 to 20mA input on AI terminal. Switch SW1 must be set to ACI.

Switch SW1 must be set to ACI in order to use a 0 to 20mA input

- 05 Frequency determined by RS232/RS485 communication interface

The frequency of the AC drive will be determined by keypad potentiometer.

P 8.00 **User Defined Display Function** **Setting: 03**

Default Setting: 00

Settings:

00	Output Frequency (Hz)
01	Motor Speed (RPM)
02	Output Frequency x P 8.01
03	Output Current (A)
04	Motor Output Current (%)
05	Output Voltage(V)
06	DC Bus Voltage (V)
07	PID Setpoint
08	PID Feedback (PV)
09	Frequency Setpoint

The AC drive display will default to motor speed (RPM) when running.

Note: For a complete list and description of the parameters for the GS2 Series AC drives, see CHAPTER 4.

AC Drive Parameters

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GS2 Parameter Summary

Motor Parameters			
GS2 Parameter	**Description**	**Range**	**Default**
P 0.00	Motor Nameplate Voltage	200/208/220/230/240 380/400/415/440/460/480	240 480
P 0.01	Motor Nameplate Amps	Drive Rated Amps X .3 to 1.0	Drive Rated Amps X 1.0
P 0.02	Motor Base Frequency	50/60/400	60
P 0.03	Motor Base RPM	375 to 9999 RPM	1750
P 0.04	Motor Maximum RPM	P 0.03 to 9999 RPM	P 0.03
Ramps			
P 1.00	Stop Methods	00: Ramp to Stop 01: Coast to Stop	00
◆ **P 1.01**	Acceleration Time 1	0.1 to 600 sec	10.0
◆ **P 1.02**	Deceleration Time 1	0.1 to 600 sec	30.0
P 1.03	Accel S-curve	00 to 07	00
P 1.04	Decel S-curve	00 to 07	00
◆ **P 1.05**	Acceleration Time 2	0.1 to 600 sec	10.0
◆ **P 1.06**	Deceleration Time 2	0.1 to 600 sec	30.0
P 1.07	Select method to use 2nd Accel/Decel	00: RMP2 from terminal 01: Transition Frequencies P1.08 & P1.09	00
P 1.08	Accel 1 to Accel 2 frequency transition	0.0 to 400.0 Hz	0.0
P 1.09	Decel 1 to Decel 2 frequency transition	0.0 to 400.0 Hz	0.0
P 1.10	Skip Frequency 1	0.0 to 400.0 Hz	0.0
P 1.11	Skip Frequency 2	0.0 to 400.0 Hz	0.0
P 1.12	Skip Frequency 3	0.0 to 400.0 Hz	0.0
P 1.13	Reserved	N/A	N/A
P 1.14	Reserved	N/A	N/A
P 1.15	Reserved	N/A	N/A
P 1.16	Reserved	N/A	N/A
P 1.17	Skip Frequency Band	0.0 to 20.0 Hz	0.0
P 1.18	DC Injection Current Level	00 to 100 %	00
P 1.19	Reserved	N/A	N/A
P 1.20	DC Injection during Start-up	0.0 to 5.0 sec	0.0
P 1.21	DC Injection during Stopping	0.0 to 25.0 sec	0.0
P 1.22	Start-point for DC Injection	0.0 to 60.0 Hz	0.0

◆ Parameter can be set during RUN Mode.

Volts/Hertz (cont.)			
GS2 Parameter	**Description**	**Range**	**Default**
P 2.00	Volts/Hertz Settings	00: General Purpose 01: High Starting Torque 02: Fans and Pumps 03: Custom	00
◆ **P 2.01**	Slip Compensation	0.0 to 10.0	0.0
◆ **P 2.02**	Auto-torque Boost	00 to 10	00
P 2.03	Reserved	N/A	N/A
P 2.04	Mid-point Frequency	0.1 to 400 Hz	1.5
P 2.05	Mid-point Voltage	240V 2.0 to 240V	10.0
		480V 2.0 to 480V	20.0
P 2.06	Min. Output Frequency	0.1 to 20.0 Hz	1.50
P 2.07	Min. Output Voltage	240V 2.0 to 50V	10.0
		480V 2.0 to 100V	20.0
P 2.08	PWM Carrier Frequency	01 to 12 KHz	12
Digital			
P 3.00	Source of Operation Command	00: Operation determined by digital keypad 01: Operation determined by external control terminals, keypad STOP is enabled 02: Operation determined by external control terminals, keypad STOP is disabled 03: Operation determined by RS-485 interface, keypad STOP is enabled 04: Operation determined by RS-485 interface, keypad STOP is disabled	00
P 3.01	Multi-function Input Terminals (DI1 - DI2)	00: DI1 - FWD / STOP, DI2 - REV / STOP 01: DI1 - RUN / STOP, DI2- REV / FWD 02: DI1 - RUN momentary (N.O.) DI2 - REV / FWD DI3 - STOP momentary (N.C.)	00

◆ Parameter can be set during RUN Mode.

DIGITAL (cont.)			
GS2 Parameter	**Description**	**Range**	**Default**
P 3.02	Multi-function Input (DI3)	00: External Fault (N.O.) 01: External Fault (N.C.) 02: External Reset 03: Multi-Speed Bit 1 04: Multi-Speed Bit 2 05: Multi-Speed Bit 3 06: Reserved 07: Reserved 08: Reserved 09: Jog 10: External Base Block (N.O.) 11: External Base Block (N.C.) 12: Second Accel/Decel Time 13: Speed Hold 14: Increase Speed 15: Decrease Speed 16: Reset Speed to Zero 17: PID Disable (N.O.) 18: PID Disable (N.C.) 99: Input Disable	00
P 3.03	Multi-function Input (DI4)		03
P 3.04	Multi-function Input (DI5)		04
P 3.05	Multi-function Input (DI6)		05
P 3.06	Reserved	N/A	N/A
P 3.07	Reserved	N/A	N/A
P 3.08	Reserved	N/A	N/A
P 3.09	Reserved	N/A	N/A
P 3.10	Reserved	N/A	N/A
P 3.11	Multi-Function Output Terminal 1	00: AC Drive Running 01: AC Drive Fault 02: At Speed 03: Zero Speed 04: Above Desired Frequency 05: Below Desired Frequency 06: At Maximum Speed 07: Over torque detected 08: Above Desired Current 09: Below Desired Current 10: PID Deviation Alarm	00
P 3.12	Multi-Function Output Terminal 2		01
P 3.13	Reserved	N/A	N/A
P 3.14	Reserved	N/A	N/A
P 3.15	Reserved	N/A	N/A
◆ **P 3.16**	Desired Frequency	0.0 to 400.0 Hz	0.0
◆ **P 3.17**	Desired Current	0.0 to <Drive Rated Amps>	0.0
◆ **P 3.18**	PID Deviation Level	1.0 to 50.0 %	10.0
◆ **P 3.19**	PID Deviation Time	0.1 to 300.0 sec	5.0

◆ Parameter can be set during RUN Mode.

ANALOG			
GS2 Parameter	**Description**	**Range**	**Default**
P 4.00	Source of Frequency Command	00: Frequency determined by keypad potentiometer 01: Frequency determined by digital keypad up/down 02: Frequency determined by 0 to +10V input on AI terminal with jumpers 03: Frequency determined by 4 to 20mA input on AI terminal with jumpers 04: Frequency determined by 0 to 20mA input on AI terminal with jumpers 05: Frequency determined by RS-485 communication interface	00
P 4.01	Analog Input Offset Polarity	00: No Offset 01: Positive Offset 02: Negative Offset	00
◆ **P 4.02**	Analog Input Offset	0.0 to 100.0%	0.0
◆ **P 4.03**	Analog Input Gain	0.0 to 300.0%	100.0
P 4.04	Analog Input Reverse Motion Enable	00: Forward Motion Only 01: Reverse Motion Enable	00
P 4.05	Loss of ACI Signal (4-20mA)	00: Decelerate to 0Hz 01: Stop immediately and display error code "EF" 02: Continue operation by the last frequency command	00
P 4.06	Reserved	N/A	N/A
P 4.07	Reserved	N/A	N/A
P 4.08	Reserved	N/A	N/A
P 4.09	Reserved	N/A	N/A
P 4.10	Reserved	N/A	N/A
◆ **P 4.11**	Analog Output Signal	00: frequency Hz 01: Current A 02: PV	00
◆ **P 4.12**	Analog Output Gain	00 to 200%	100

◆ Parameter can be set during RUN Mode.

PRESETS			
GS2 Parameter	Description	Range	Default
◆ P 5.00	Jog	0.0 to 400.0 Hz	6.0
◆ P 5.01	Multi-Speed 1	0.0 to 400.0 Hz	0.0
◆ P 5.02	Multi-Speed 2	0.0 to 400.0 Hz	0.0
◆ P 5.03	Multi-Speed 3	0.0 to 400.0 Hz	0.0
◆ P 5.04	Multi-Speed 4	0.0 to 400.0 Hz	0.0
◆ P 5.05	Multi-Speed 5	0.0 to 400.0 Hz	0.0
◆ P 5.06	Multi-Speed 6	0.0 to 400.0 Hz	0.0
◆ P 5.07	Multi-Speed 7	0.0 to 400.0 Hz	0.0

PROTECTION			
P 6.00	Electronic Thermal Overload Relay	00: Constant Torque 01: Variable Torque 02: Inactive	00
P 6.01	Auto Restart after Fault	00 to 10	00
P 6.02	Momentary Power Loss	00: Stop operation after momentary power loss 01: Continue operation after momentary power loss, speed search from Speed Reference 02: Continue operation after momentary power loss, speed search from Minimum Speed	00
P 6.03	Reverse Operation Inhibit	00: Enable Reverse Operation 01: Disable Reverse Operation	00
P 6.04	Auto Voltage Regulation	00: AVR enabled 01: AVR disabled 02: AVR disabled during decel 03: AVR disabled during stop	00
P 6.05	Over-Voltage Trip Prevention	00: Enable Over-voltage Trip Prevention 01: Disable Over-voltage Trip Prevention	00
P 6.06	Auto Adjustable Accel/Decel	00: Linear Accel/Decel 01: Auto Accel, Linear Decel 02: Linear Accel, Auto Decel 03: Auto Accel/Decel 04: Auto Accel/Decel Stall Prevention (limited by P 1.01, P 1.02, P 1.05 and P 1.06)	00
P 6.07	Over-Torque Detection Mode	00: Disabled 01: Enabled during constant speed operation 02: Enabled during acceleration	00
P 6.08	Over-Torque Detection Level	30 to 200%	150
P 6.09	Over-Torque Detection Time	0.1 to 10.0	0.1
P 6.10	Over-Current Stall Prevention during Acceleration	20 to 200%	150

◆ Parameter can be set during RUN Mode.

PROTECTION (cont.)			
GS2 Parameter	**Description**	**Range**	**Default**
P 6.11	Over-Current Stall Prevention during Operation	20 to 200%	150
P 6.12	Maximum Allowable Power Loss Time	0.3 to 5.0 sec	2.0
P 6.13	Base-Block Time for Speed Search	0.3 to 5.0 sec	0.5
P 6.14	Maximum Speed Search Current Level	30 to 200%	150
P 6.15	Upper Bound of Output Frequency	0.1 to 400Hz	400
P 6.16	Lower Bound of Output Frequency	0.0 to 400Hz	0.0
P 6.17	Reserved	N/A	N/A
P 6.18	Reserved	N/A	N/A
P 6.19	Reserved	N/A	N/A
P 6.20	Reserved	N/A	N/A
P 6.21	Reserved	N/A	N/A
P 6.22	Reserved	N/A	N/A
P 6.23	Reserved	N/A	N/A
P 6.24	Reserved	N/A	N/A
P 6.25	Reserved	N/A	N/A
P 6.26	Reserved	N/A	N/A
P 6.27	Reserved	N/A	N/A
P 6.28	Reserved	N/A	N/A
P 6.29	Reserved	N/A	N/A
P 6.30	Reserved	N/A	N/A
P 6.31	Present Fault Record	00: No Fault occurred 01: Over-current (oc) 02: Over-voltage (ov) 03: Overheat (oH) 04: Overload (oL) 05: Overload 1 (oL1) 06: Overload 2 (oL2) 07: External Fault (EF) 08: CPU failure 1 (CF1) 09: CPU failure 2 (CF2) 10: CPU failure 3 (CF3) 11: Hardware Protection Failure (HPF) 12: Over-current during accel (OCA) 13: Over-current during decel (OCd) 14: Over-current during steady state (OCn) 15:Ground fault or fuse failure (GFF) 16: Reserved 17: Input power 3-phase loss 18: External Base-Block (bb) 19: Auto Adjust accel/decel failure (cFA) 20: Software protection code (codE)	00
P 6.32	Second Most Recent Fault Record		00
P 6.33	Third Most Recent Fault Record		00
P 6.34	Fourth Most Recent Fault Record		00
P 6.35	Fifth Most Recent Fault Record		00
P 6.36	Sixth Most Recent Fault Record		00

◆ Parameter can be set during RUN Mode.

PID			
GS2 Parameter	**Description**	**Range**	**Default**
P 7.00	Input Terminal for PID Feedback	00: Inhibit PID operation 01: Input negative PID feedback, PV from AVI (0 to + 10V) 02: Input negative PID feedback, PV from ACI (4 to 20mA)	00
P 7.01	PV 100% Value	0.0 to 999	100.0
P 7.02	PID Setpoint Source	00: Keypad 01: Serial Communications	00
◆ **P 7.10**	Keypad PID Setpoint	0.0 to 999	0.0
◆ **P 7.11**	PID Multi-setpoint 1	0.0 to 999	0.0
◆ **P 7.12**	PID Multi-setpoint 2	0.0 to 999	0.0
◆ **P 7.13**	PID Multi-setpoint 3	0.0 to 999	0.0
◆ **P 7.14**	PID Multi-setpoint 4	0.0 to 999	0.0
◆ **P 7.15**	PID Multi-setpoint 5	0.0 to 999	0.0
◆ **P 7.16**	PID Multi-setpoint 6	0.0 to 999	0.0
◆ **P 7.17**	PID Multi-setpoint 7	0.0 to 999	0.0
◆ **P 7.20**	Proportional Control	0.0 to 10.0	1.0
◆ **P 7.21**	Integral Control	0.00 to 100.0 sec	1.00
◆ **P 7.22**	Derivative Control	0.00 to 1.00 sec	0.00
P 7.23	Upper Bound for Integral Control	00 to 100%	100
P 7.24	Derivative Filter Time Constant	0.0 to 2.5 sec	0.0
P 7.25	PID Output Frequency Limit	00 to 110%	100
P 7.26	Feedback Signal Detection Time	0.0 to 3600 sec.	60
P 7.27	PID Feedback Loss	00: Warn and AC Drive Stop 01: Warn and Continue Operation	d00
DISPLAY			
◆ **P 8.00**	User Defined Display Function	00: Output Frequency (Hz) 01: Motor Speed (RPM) 02: Output Freq. X P 8.01 03: Output Current (A) 04: Motor Output Current (%) 05: Output Voltage (V) 06: DC Bus Voltage (V) 07: PID Setpoint 08: PID Feedback Signal (PV) 09: Frequency Setpoint	00
◆ **P 8.01**	Frequency Scale Factor	0.01 to 160.0	1.0

◆ Parameter can be set during RUN Mode.

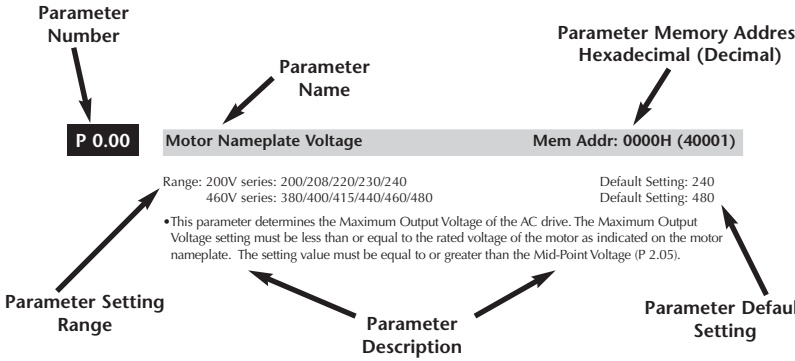
Communications			
GS2 Parameter	**Description**	**Range**	**Default**
P 9.00	Communication Address	01 to 254	01
P 9.01	Transmission Speed	00: 4800 baud 01: 9600 baud 02: 19200 baud 03: 38400 baud	01
P 9.02	Communication Protocol	00: MODBUS ASCII mode 7 data bits,no parity,2 stop bits 01: MODBUS ASCII mode 7 data bits,even parity,1 stop bit 02: MODBUS ASCII mode 7 data bits,odd parity,1 stop bit 03: MODBUS RTU mode 8 data bits,no parity,2 stop bits 04: MODBUS RTU mode 8 data bits,even parity,1 stop bit 05: MODBUS RTU mode 8 data bits,odd parity,1 stop bit	00
P 9.03	Transmission Fault Treatment	00: Display fault and continue operating 01: Display fault and RAMP to stop 02: Display fault and COAST to stop 03: No fault displayed and continue operating	00
P 9.04	Time Out Detection	00: Disable 01: Enable	00
P 9.05	Time Out Duration	0.1 to 60.0 seconds	0.5
◆ **P 9.07**	Parameter Lock	00: All parameters can be set and read 01: All parameters are read-only	00
P 9.08	Restore to Default	99: Restores all parameters to factory defaults	00
◆ **P 9.11**	Block Transfer Parameter 1	P 0.00 to P 8.01	P 9.99
◆ **P 9.12**	Block Transfer Parameter 2	P 0.00 to P 8.01	P 9.99
◆ **P 9.13**	Block Transfer Parameter 3	P 0.00 to P 8.01	P 9.99
◆ **P 9.14**	Block Transfer Parameter 4	P 0.00 to P 8.01	P 9.99
◆ **P 9.15**	Block Transfer Parameter 5	P 0.00 to P 8.01	P 9.99
◆ **P 9.16**	Block Transfer Parameter 6	P 0.00 to P 8.01	P 9.99
◆ **P 9.17**	Block Transfer Parameter 7	P 0.00 to P 8.01	P 9.99
◆ **P 9.18**	Block Transfer Parameter 8	P 0.00 to P 8.01	P 9.99
◆ **P 9.19**	Block Transfer Parameter 9	P 0.00 to P 8.01	P 9.99
◆ **P 9.20**	Block Transfer Parameter 10	P 0.00 to P 8.01	P 9.99
◆ **P 9.21**	Block Transfer Parameter 11	P 0.00 to P 8.01	P 9.99
◆ **P 9.22**	Block Transfer Parameter 12	P 0.00 to P 8.01	P 9.99

◆ Parameter can be set during RUN Mode.

Communications			
GS2 Parameter	**Description**	**Range**	**Default**
◆ **P 9.23**	Block Transfer Parameter 13	P 0.00 to P 8.01	P 9.99
◆ **P 9.24**	Block Transfer Parameter 14	P 0.00 to P 8.01	P 9.99
◆ **P 9.25**	Block Transfer Parameter 15	P 0.00 to P 8.01	P 9.99
◆ **P 9.26**	RS485 Speed Reference	0.0 to 400.0 Hz	60.0
◆ **P 9.27**	RUN Command	00: Stop 01:Run	00
◆ **P 9.28**	Direction Command	00: Forward 01:Reverse	00
◆ **P 9.29**	External Fault	00: No fault 01:External fault	00
◆ **P 9.30**	Fault Reset	00: No action 01:Fault Reset	00
◆ **P 9.31**	JOG Command	00: Stop 01:Jog	00
P 9.41	GS Series Number	01: GS1 02: GS2 03: GS3 04: GS4	##
P 9.42	Manufacturer Model Information	00: GS2-20P5 (230V 1ph/3ph 0.5HP) 01: GS2-21P0 (230V 1ph/3ph 1.0HP) 02: GS2-22P0 (230V 1ph/3ph 2.0HP) 03: GS2-23P0 (230V 1ph/3ph 3.0HP) 04: GS2-25P0 (230V 3ph 5.0HP) 05: GS2-27P5 (230V 3ph 7.5HP) 06: Reserved 07: GS2-41P0 (460V 3ph 1.0HP) 08: GS2-42P0 (460V 3ph 2.0HP) 09: GS2-43P0 (460V 3ph 3.0HP) 10: GS2-45P0 (460V 3ph 5.0HP) 11: GS2-47P5 (460V 3ph 7.5HP) 12: GS2-4010 (460V 3ph 10HP)	##

◆ Parameter can be set during RUN Mode.

Detailed Parameter Listings



Note: If the ◆ symbol is found next to the parameter name, the parameter can be edited when the AC drive is in RUN Mode.

Motor Parameters

P 0.00 **Motor Nameplate Voltage** **Mem Addr: 0000H(40001)**

Range: 200V series: 200/208/220/230/240 Default Setting: 240
460V series: 380/400/415/440/460/480 Default Setting: 480

•This parameter determines the Maximum Output Voltage of the AC drive. The Maximum Output Voltage setting must be less than or equal to the rated voltage of the motor as indicated on the motor nameplate. The setting value must be equal to or greater than the Mid-Point Voltage (P 2.05).

P 0.01 **Motor Nameplate Amps** **Mem Addr: 0001H(40002)**

Range: Drive Rated Amps x 0.3 to Drive Rated Amps x 1.0 Default Setting: Drive Rating (A)

•This parameter sets the output current to the motor. The value is determined by the value found on the motor nameplate.

P 0.02 **Motor Base Frequency** **Mem Addr: 0002H(40003)**

Range: 50/60/400 Default Setting 60

- This value should be set according to rated frequency of the motor as indicated on the motor nameplate. Maximum Voltage Frequency determines the volts per hertz ratio.

P 0.03 **Motor Base RPM** **Mem Addr: 0003H(40004)**

Range: 375 to 9999 RPM Default Setting: 1750

- This value should be set according to rated Base RPM of the motor as indicated on the motor nameplate.

P 0.04 **Motor Maximum RPM** **Mem Addr: 0004H(40005)**

Range: P 0.03 to 9999 RPM Default Setting: P 0.03

- This value should be set according to the desired maximum speed of the motor. This value should not exceed the motor's maximum rated speed.

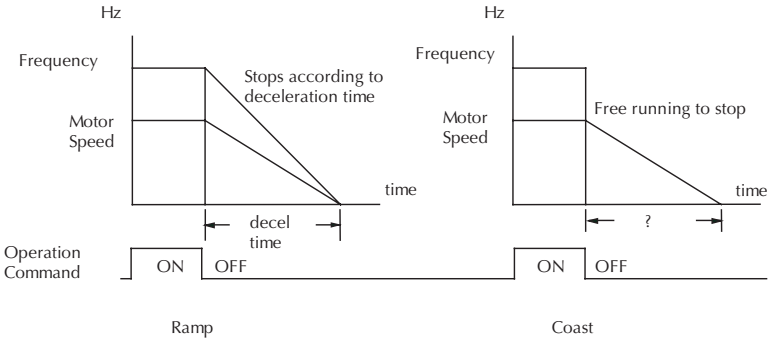
Ramp Parameters

P 1.00 **Stop Methods** **Mem Addr: 0100H(40257)**

Range: 00 Ramp to Stop
01 Coast to stop
Default Setting: 00

- This parameter determines how the motor is stopped when the AC drive receives a valid stop command.
- Ramp: The AC drive decelerates the motor to Minimum Output Frequency (P 2.06) and then stops according to the deceleration time set in P 1.02 or P 1.06.
- Coast:The AC drive stops output instantly upon command, and the motor free runs until it comes to a complete stop.

Note:The drive application or system requirements will determine which stop method is needed.



P 1.01 **◆ Acceleration Time 1** **Mem Addr:0101H(40258)**

Range: 0.1 to 600 sec
Default Setting: 10 sec

- This parameter is used to determine the time required for the AC drive to ramp from 0 to its Maximum Motor RPM (P 0.04). The rate is linear unless S-Curve is "Enabled."

P 1.02 ◆ Deceleration Time 1 Mem Addr: 0102H(40259)

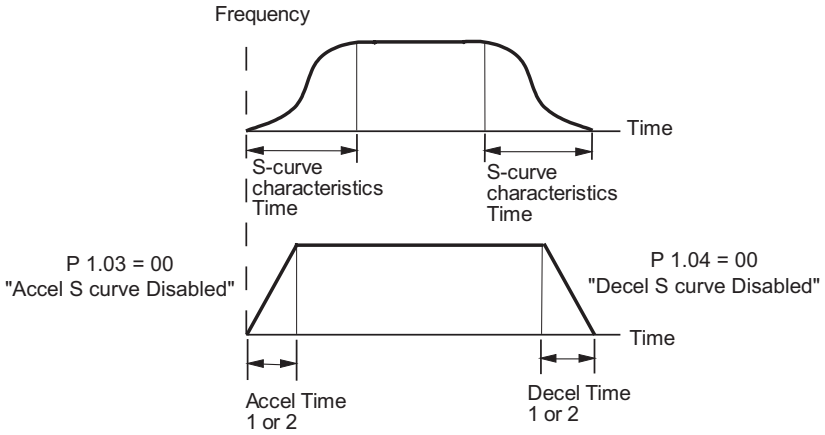
Range: 0.1 to 600 sec Default Setting: 30 sec

•This parameter is used to determine the time required for the AC drive to decelerate from the Maximum Motor RPM (P 0.04) down to 0Hz. The rate is linear unless S-Curve is "Enabled."

P 1.03 Accel S-Curve Mem Addr: 0103H(40260)

Range: 00 to 07 Default Setting: 00

•This parameter is used whenever the motor and load need to be accelerated more smoothly. The Accel S-Curve may be set from 0 to 7 to select the desired acceleration S Curve.

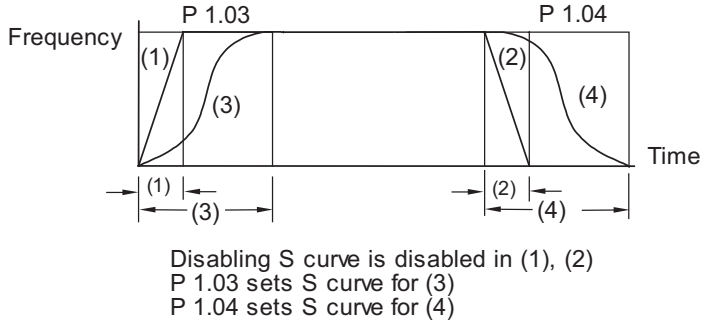


P 1.04 **Decel S-Curve** **Mem Addr 0104H(40261)**

Range: 00 to 07 Default Setting: 00

This parameter is used whenever the motor and load need to be decelerated more smoothly. The Decel S-Curve may be set from 00 to 07 to select the desired deceleration S-Curve.

Note: From the diagram shown below, the original setting accel/decel time will be for reference when the function of the S-curve is enabled. The actual accel/decel time will be determined based on the S-curve selected (1 to 7).



Disabling S curve is disabled in (1), (2)
P 1.03 sets S curve for (3)
P 1.04 sets S curve for (4)

P 1.05 **◆ Acceleration Time 2** **Mem Addr 0105H(40262)**

Range: 0.1 to 600 sec Default Setting: 10.0

- The Second Acceleration Time determines the time for the AC drive to accelerate from 0 RPM to Maximum Motor RPM (P 0.04). A Multi-Function input terminal must be programmed to select Second Accel/Decel Time, and the same terminal must be closed. See P 3.02 to P 3.05.

P 1.06 **◆ Deceleration Time 2** **Mem Addr 0106H(40263)**

Range: 0.1 to 600 sec Default Setting: 30 sec

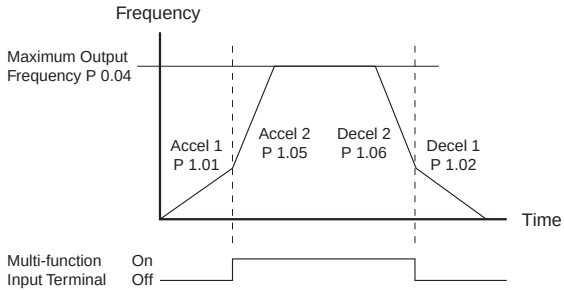
- The Second Deceleration Time determines the time for the AC drive to decelerate from Maximum Motor RPM (P 0.04) to 0 RPM. A Multi-Function input terminal must be programmed to select Second Accel/Decel Time, and the same terminal must be closed. See P 3.02 to P 3.05.

P 1.07 Select method for 2nd Accel/Decel Mem Addr 0107H(40264)

Range: 00: Second Accel/Decel from terminal Default Setting: 00
01: Frequency Transition
P 1.08 & P 1.09

- The second set of acceleration and deceleration times P 1.05 and P 1.06 can be selected either with a multi-function input terminal programmed to Second Accel/Decel or by the values of the transition frequencies P 1.08 and P 1.09

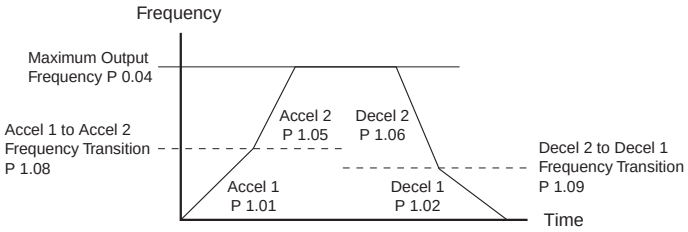
Second Accel/Decel Times selected with Multi-Function Input Terminal



P 1.08 Accel 1 to Accel 2 Frequency Transition Mem Addr 0108H(40265)

Range: 0.0 to 400.0 Hz Default Setting: 0.0

Second Accel/Decel Times selected with Frequency Transition



P 1.09 Decel 1 to Decel 2 Frequency Transition Mem Addr 0109H(40266)

Range: 0.0 to 400.0 Hz Default Setting: 0.0

P 1.10 **Skip Frequency 1** **Mem Addr 010AH(40267)**

Range: 0.0 to 400.0Hz Default Setting: 0.0

P 1.11 **Skip Frequency 2** **Mem Addr 010BH(40268)**

Range: 0.0 to 400.0Hz Default Setting: 0.0

P 1.12 **Skip Frequency 3** **Mem Addr 010CH(40269)**

Range: 0.0 to 400.0 Hz Default Setting: 0.0

- P 1.10, P 1.11, and P 1.12 determine the location of the frequency bands that will be skipped during AC drive operation.

P 1.13 **Reserved**

P 1.14 **Reserved**

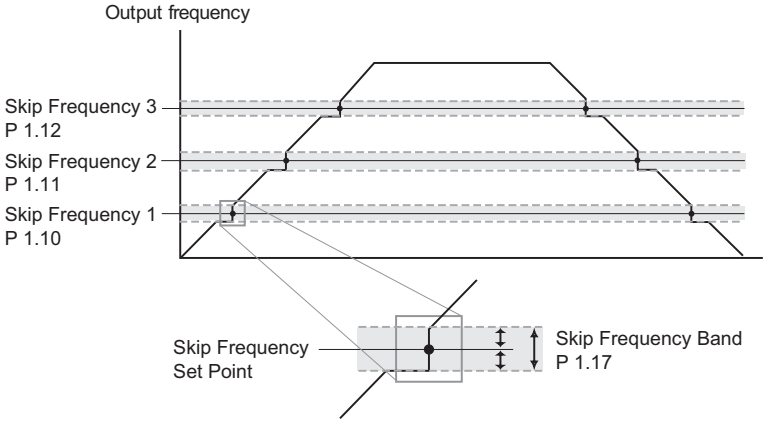
P 1.15 **Reserved**

P 1.16 **Reserved**

P 1.17 Skip Frequency Band — Mem Addr 0111H(40274)

Range: 0.0 to 20.0 Hz — Default Setting: 0.0

- This parameter determines the frequency band for a given Skip Frequency (P 1.10, P 1.11, or P 1.12). Half of the Skip Frequency Band is above the Skip Frequency and the other half is below. Programming this parameter to 0.0 disables all skip frequencies.



P 1.18 DC Injection Current Level — Mem Addr 0112H(40275)

Range: 00 to 100% — Default Setting: 00

- This parameter determines the amount of DC Braking Current applied to the motor during start-up and stopping. When setting DC Braking Current, please note that 100% is equal to the rated current of the drive. It is recommended to start with a low DC Braking Current Level and then increase until proper holding torque has been attained.

P 1.19 Reserved

P 1.20 DC Injection during Start-up — Mem Addr 0114H(40277)

Range: 0.0 to 5.0 sec — Default Setting: 0.0

- This parameter determines the duration of time that the DC Braking Current will be applied to the motor during the AC drive start-up. DC Braking will be applied for the time set in this parameter until the Minimum Frequency is reached during acceleration.

P 1.21 DC Injection during Stopping Mem Addr 0115H(40278)

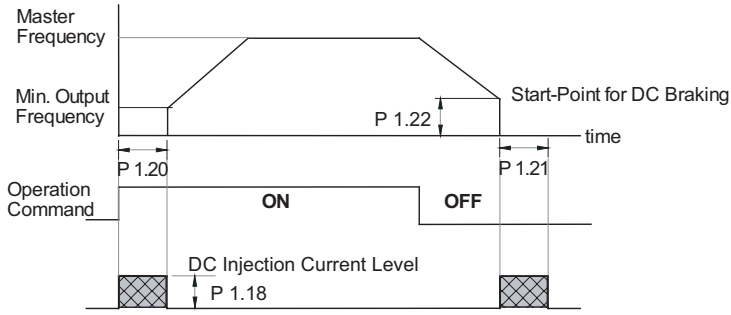
Range: 0.0 to 25.0 sec Default Setting: 0.0

- This parameter determines the duration of time that the DC braking voltage will be applied to the motor during stopping. If stopping with DC Braking is desired, then P 1.00 must be set to Ramp to Stop (00).

P 1.22 Start-point for DC Injection Mem Addr 0116H(40279)

Range: 0.0 to 60.0 Hz Default Setting: 0.0

- This parameter determines the frequency when DC Braking will begin during deceleration.



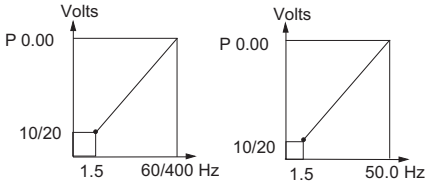
Volts/Hertz Parameters

P 2.00 **Volts/Hertz Settings** **Mem Addr 0200H(40513)**

Range: 00 - General Purpose
01 - High Starting Torque
02 - Fans and Pumps
03 - Custom

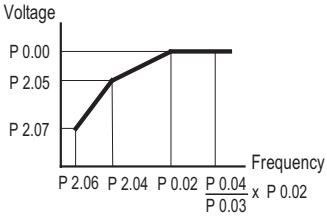
Default Setting: 0.0

00: General Purpose

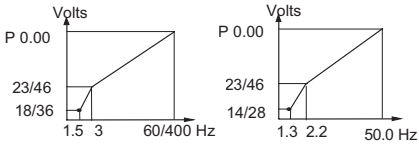


60/400Hz Base Frequency 50Hz Base Frequency

03: Custom

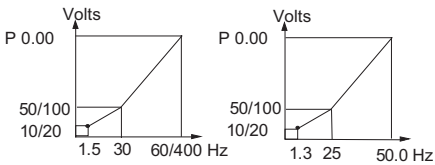


01: High Starting Torque



60/400Hz Base Frequency 50Hz Base Frequency

02: Fans and Pumps



60/400Hz Base Frequency 50Hz Base Frequency

P 2.01 ◆ **Slip Compensation** **Mem Addr 0201H(40514)**

Range: 0.0 to 10.0 Default Setting: 0.0

- When controlling an asynchronous induction motor, load on the AC drive will increase causing an increase in slip. This parameter may be used to compensate the nominal slip within a range of 0 to 10. When the output current of the AC drive is greater than the motor no-load current (P 0.01), the AC drive will adjust its output frequency according to this parameter.

P 2.02 ◆ **Auto-torque Boost** **Mem Addr 0202H(40515)**

Range: 00 to 10 Default Setting: 00

Note: P 2.04 through P 2.07 are only used when the Voltz/Hertz parameter (P 2.00) is set to 03.

P 2.04 **Mid-point Frequency** **Mem Addr 0204H(40517)**

Range: 0.1 to 400 Hz Default Setting: 1.5

- This parameter sets the Mid-Point Frequency of V/F curve. With this setting, the V/F ratio between Minimum Frequency and Mid-Point frequency can be determined. **This parameter must be greater than or equal to the Minimum Output Frequency (P 2.06) and less than or equal to the Maximum Voltage Frequency (P 0.02).**

P 2.05 **Mid-point Voltage** **Mem Addr 0205H(40518)**

Range: 240V - 2.0 to 240V Default Setting: 10.0
480V - 2.0 to 480V 20.0

- This parameter sets the Mid-Point Voltage of any V/F curve. With this setting, the V/F ratio between Minimum Frequency and Mid-Point Frequency can be determined. **This parameter must be greater than or equal the Minimum Output Voltage (P 2.07) and less than or equal to the Maximum Output Voltage (P 0.00).**

P 2.06 **Minimum Output Frequency** **Mem Addr 0206H(40519)**

Range: 0.1 to 20.0 Hz Default Setting: 1.5

- This parameter sets the Minimum Output Frequency of the AC drive. **This parameter must be less than or equal to the Mid-Point Frequency (P 2.04).**

P 2.07 **Minimum Output Voltage** **Mem Addr 0207H(40520)**

Range: 240V - 2.0 to 50V Default Setting: 10.0
480V - 2.0 to 100V 20.0

- This parameter sets the Minimum Output Voltage of the AC drive. **This parameter must be equal to or less than Mid-Point Voltage (P 2.05**).

P 2.08 PWM Carrier Frequency Mem Addr 0208H(40521)

Range: 01 to 12 KHz Default Setting: 12

- This parameter sets the carrier frequency of PWM (Pulse-Width Modulated) output.
- In the table below, we see that the carrier frequency of PWM output has a significant influence on the electromagnetic noise, leakage current, heat dissipation of the AC drive and the acoustic noise to the motor

Carrier Frequency	Acoustic Noise	Electromagnetic Noise, Leakage Current	Heat Dissipation
1kHz	significant	minimal	minimal
12kHz	minimal	moderate	moderate

Digital Parameters

P 3.00 Source of Operation Command Mem Addr 0300H(40769)

Default Setting: 00

Settings		
	00	Operation Determined by Digital Keypad
	01	Operation determined by external control terminals. Keypad STOP is enabled.
	02	Operation determined by external control terminals. Keypad STOP is disabled.
	03	Operation determined by RS232/RS485 interface. Keypad STOP is enabled.
	04	Operation determined by RS232/RS485 interface. Keypad STOP is disabled.

- This parameter sets the input source for the AC drive operation commands.
- Refer to P 3.01 to P 3.05 for more details.

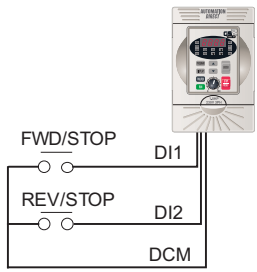
P 3.01 Multi-function Input Terminals (DI1-DI2)Mem Addr 0301H(40770)

Default Setting: 00

Settings		
	00	DI1 - FWD/STOP DI2 - REV/STOP
	01	DI1 - RUN/STOP DI2 - REV/FWD
	02	DI1 - RUN (N.O. latching input) DI2 - REV/FWD DI3 - STOP (N.C. latching input)

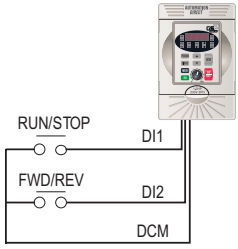
Note: Multi-function Input Terminals DI1 and DI2 do not have separate parameter designations. DI1 and DI2 must be used in conjunction with one another to operate two and three wire control.

P 3.01: Setting 00



DI1	DI2	Result
OFF	OFF	STOP
ON	OFF	FWD
OFF	ON	REV
ON	ON	STOP

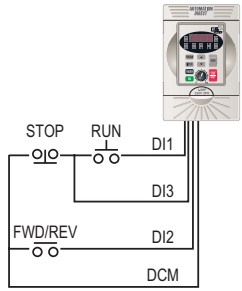
P 3.01: Setting 01



DI1- RUN/STOP select
"Open" : Stop
"Close" : Run

DI2- FWD/REV select
"Open" : FWD
"Close" : REV

P 3.01: Setting 02



DI1- RUN command
Latching input (N.O.)
Runs when closed

DI2- FWD/REV select
"Open" : FWD
"Close" : REV

DI3- STOP command
Latching input (N.C.)
Stops when open

P 3.02 Multi-Function Input (DI3) Mem Addr 0302H(40771)

P3.03 Multi-Function Input (DI4) Mem Addr 0303H(40772)

P 3.04 Multi-function Input (DI5) Mem Addr 0304H(40773)

P 3.05 Multi-function Input (DI6) Mem Addr 0305H(40774)

Settings for P3.02 to P 3.05 Default Setting: 00

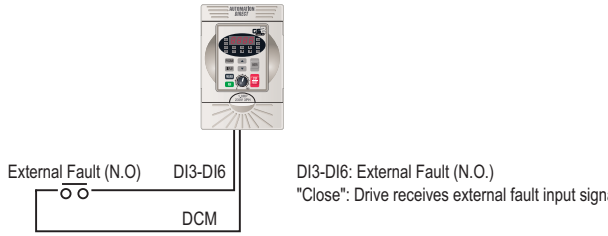
Settings		
	00	External Fault (N.O.)
	01	External Fault (N.C.)
	02	External Reset
	03	Multi-Speed Bit 1
	04	Multi-Speed Bit 2
	05	Multi-Speed Bit 3
	06:	Reserved
	07	Reserved
	08	Reserved
	09	Jog
	10	External Base Block (N.O.)
	11	External Base Block (N.C.)
	12	Second Accel/Decel Time
	13	Speed Hold
	14	Increase Speed
	15	Decrease Speed
	16	Reset Speed to Zero
	17	PID Disable (N.O.)
	18	PID Disable (N.C.)
	99	Input Disable

} P 4.00 must be set to 01.

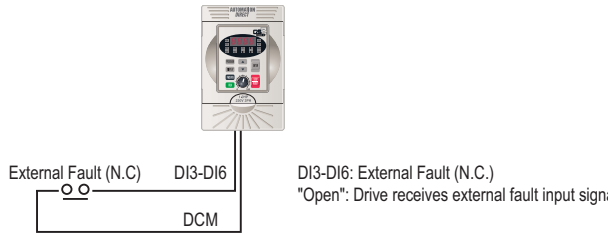
Setting Explanations for parameters P 3.02-P 3.05

Setting 00: External Fault (N.O.)

When an External Fault input signal is received, the AC drive output will turn off, the drive will display "EF" on the LED Display, and the motor will Coast to Stop.To resume normal operation, the external fault must be cleared, and the drive must be reset.

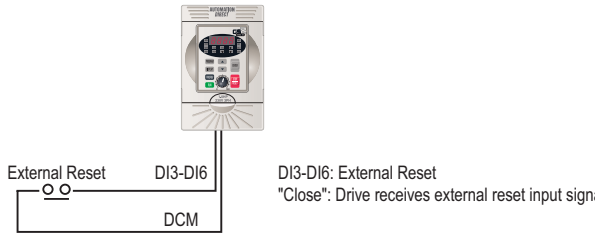


Setting 01: External Fault (N.C.)



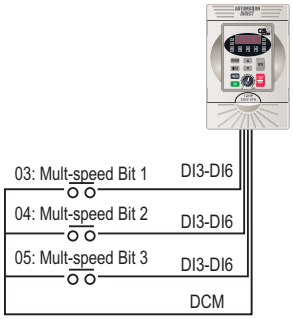
Setting 02: External Reset

An External Reset has the same function as the Reset key on the digital keypad. Use an External Reset to reset the drive after a fault.



Settings 03, 04, and 05: Multi-Speed Bits 1, 2, and 3

The three Multi-Speed Bits are used to select the multi-speed settings defined by parameters P 5.01 to P 5.07.



Multi-Speed Bits			Speed Selection
Bit 3	Bit 2	Bit 1	
OFF	OFF	OFF	P 4.00: Source of Frequency
OFF	OFF	**ON**	P 5.01: Multi-Speed 1
OFF	**ON**	OFF	P 5.02: Multi-Speed 2
OFF	**ON**	**ON**	P 5.03: Multi-Speed 3
ON	OFF	OFF	P 5.04: Multi-Speed 4
ON	OFF	**ON**	P 5.05: Multi-Speed 5
ON	**ON**	OFF	P 5.06: Multi-Speed 6
ON	**ON**	**ON**	P 5.07: Multi-Speed 7

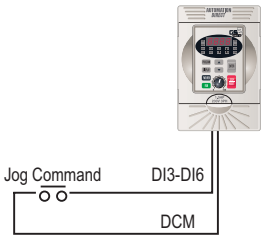
Note: In order to use the Multi-Speed settings, parameters P 5.01-P 5.07 must be set.

Note: When all multi-speed inputs are off, the AC drive reverts back to the Command Frequency (P 4.00).

Setting 09: Jog Command

This setting configures a Multi-function Input Terminal to give the Jog Command when activated. P 5.00 sets the Jog Speed.

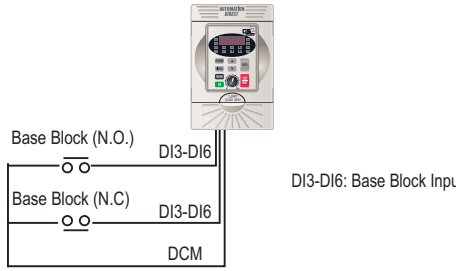
Note: The Jog Command cannot be used when the motor is running. The motor must be stopped to initiate this command.



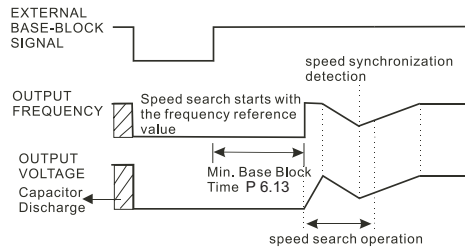
DI3-DI6: Jog Command
"Close": Drive receives Jog Command signal

Setting 10 and 11: External Base Block (N.O.) and External Base Block (N.C.)

Value 10 is for a normally open (N.O) input and value 11 is for a normally closed (N.C.) input.

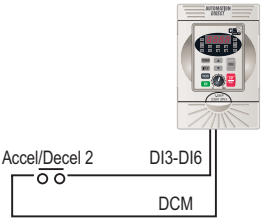


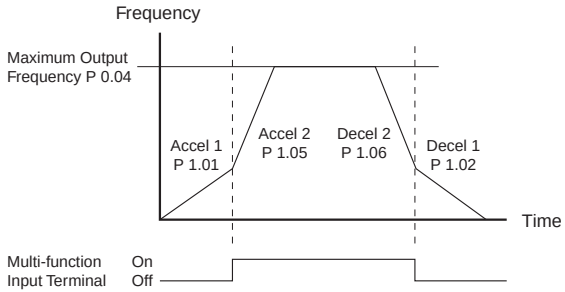
When an External Base Block is activated, the LED display shows bb, the AC drive stops all output, and the motor will free run. When the External Base Block is deactivated, the AC drive will start the speed search function and synchronize with the motor speed. The AC drive will then accelerate to the Master Frequency.



Setting 12: Second Accel/Decel Time

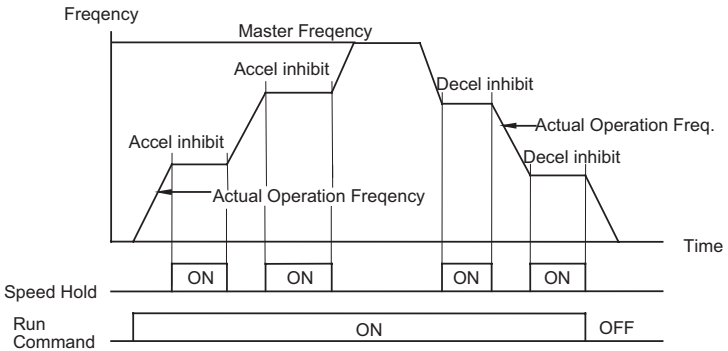
Multi-function Input Terminals DI3-DI6 can be set to select between Accel/Decel times 1 and 2. Parameters P 1.01 and P1.02 set Accel 1 and Decel 1 times. Parameters P 1.05 and P 1.06 set Accel 2 and Decel 2 times.





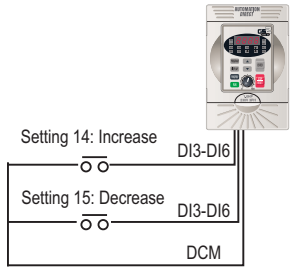
Setting 13: Speed Hold

When the Speed Hold command is received, the drive acceleration or deceleration is stopped and the drive maintains a constant speed.



Settings 14 and 15: Increase and Decrease Speed
(Electronic Motor Operated Potentiometer)

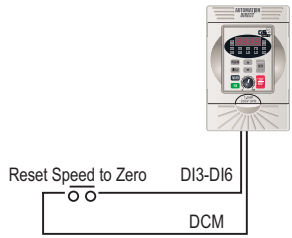
Settings 14 and 15 allow the Multi-function terminals to be used to increase or decrease speed incrementally. Each time an increase/decrease speed input is received the Master Frequency will increase/decrease by one unit.



DI3-DI6: Increase or Decrease Frequency
"Close": Drive receives Increase or Decrease Frequency Input

Note: In order to use these settings, P 4.00 must be set to 01.

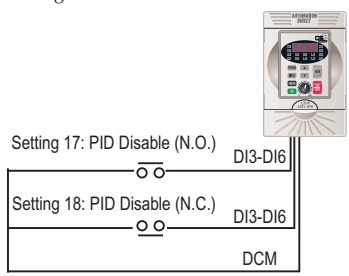
Setting 16: Reset Speed to Zero



DI3-DI6: Reset Speed to Zero
"Close": Drive receives Reset Speed to Zero signal

Settings 17 and 18: PID Disable (N.O) and (N.C.)

Settings 17 and 18 set the Multi-function terminals to disable PID operation.



DI3-DI6: PID Disable (N.O.) or (N.C.)

Setting 99: Multi-Function Input Disable

Setting a Multi-Function Input to 99 will disable that input. The purpose of this function is to provide isolation for unused Multi-Function Input Terminals. Any unused terminals should be programmed to 99 to make sure they have no effect on drive operation.

Note: Any unused terminals should be programmed to 99 to make sure they have no effect on drive operation.

P 3.06 **Reserved**

P 3.07 **Reserved**

P 3.08 **Reserved**

P 3.09 **Reserved**

P 3.10 **Reserved**

P 3.11 Multi-function Output Terminal 1 Mem Addr 030BH(40780)

Default Setting: 00

P 3.12 Multi-function Output Terminal 2 Mem Addr 030CH(40781)

Default Setting: 01

Settings:	00	AC Drive Running
	01	AC Drive Fault
	02	At Speed
	03	Zero Speed
	04	Above Desired Frequency (P 3.16)
	05	Below Desired Frequency (P 3.16)
	06	At Maximum Speed (P 0.02)
	07	Over Torque Detected
	08	Above Desired Current (P 3.17)
	09	Below Desired Current (P 3.17)
	10	PID Deviation Alarm (P 3.18 and P 3.19)

Function Explanations:

Setting 00: AC Drive Running—The terminal will be activated when there is an output from the drive.

Setting 01: AC Drive Fault—The terminal will be activated when a fault occurs.

Setting 02: At Speed—The terminal will be activated when the AC drive attains the Command Frequency (P 4.00).

Setting 03: Zero Speed—The output will be activated when Command Frequency (P 4.00) is lower than the Minimum Output Frequency (P 2.06).

Setting 04: Above Desired Frequency—The output will be activated when the AC drive is above the Desired Frequency (P 3.16).

Setting 05: Below Desired Frequency—The output will be activated when the AC drive is below the Desired Frequency (P 3.16).

Setting 06: At Maximum Speed—The output will be activated when the AC drive reaches Motor Maximum RPM (P 0.04).

Setting 07: Over Torque Detected—The output will be activated when the AC drive reaches the Over-torque Detection Level (P 6.08) and exceeds this level for a time greater than the Over-torque Detection Time (P 6.09).

Setting 08: Above Desired Current—The output will be activated when the AC drive is above the Desired Current (P 3.17).

Setting 09: Below Desired Current—The output will be activated when the AC drive is below the Desired Current (P 3.17).

Setting 10: PID Deviation Alarm—The output will be activated when the AC drive exceeds the PID Deviation Level (P 3.18) for longer than the PID Deviation Time (P 3.19).

P 3.13 **Reserved**

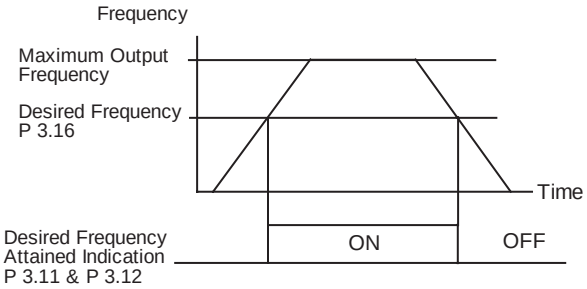
P 3.14 **Reserved**

P 3.15 **Reserved**

P 3.16 **◆ Desired Frequency** **Mem Addr 0310H(40785)**

Range: 0.0 to 400.0 Hz Default Setting: 0.0

- If a Multi-function output terminal is set to function as Desired Frequency Attained (P 3.11 or P 3.12=04 or 05), then the output will be activated when the programmed frequency is attained.



P 3.17 **◆ Desired Current** **Mem Addr 0311H(40786)**

Range: 0.0 to <Drive Rated Amps> Default Setting: 0.0

P 3.18 **◆ PID Deviation Level** **Mem Addr 0312H(40787)**

Range: 1.0 to 50.0% Default Setting: 10.0

P 3.19 **◆ PID Deviation Time** **Mem Addr 0313H(40788)**

Range: 0.1 to 300.0 sec Default Setting: 5.0

Analog Parameters

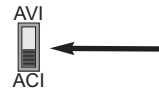
P4.00 Source of Frequency Command Mem Addr 0400H(41025)

Default: 00

Settings:
- 00 Frequency determined by keypad potentiometer
- 01 Frequency determined by digital keypad up/down
- 02 Frequency determined by 0 to +10V input on AI terminal. Switch, SW1 must be set to AVI.

Switch SW1 must be set to AVI in order to use a 0 to +10V input

- 03 Frequency determined by 4 to 20mA input on AI terminal. Switch SW1 must be set to ACI.



Switch SW1 must be set to ACI in order to use a 4 to 20mA input

- 04 Frequency determined by 0 to 20mA input on AI terminal. Switch SW1 must be set to ACI.

Switch SW1 must be set to ACI in order to use a 0 to 20mA input

- 05 Frequency determined by RS232/RS485 communication interface

P 4.01 Analog Input Offset Polarity Mem Addr 0401H(41026)

Range: 00 Offset disabled
01 Positive Offset
02 Negative Offset

Default Setting: 00

- This parameter sets the potentiometer Bias Frequency to be positive or negative.
- The Analog Input Offset calculation will also define the Offset Polarity. See the note after P 4.02.

P4.02 ◆ Analog Input Offset — Mem Addr 0402H(41027)

Range:0.0 to 100% Default Setting: 0.0

This parameter can be set during the operation

- This parameter provides a frequency offset for an analog input.
- Use the equation below to determine the Analog Input Offset. For this equation, you will need to know the necessary Minimum and Maximum Frequency References needed for your application.

$$\text{Analog Offset \%} = \left(\frac{\text{Min. Frequency Reference}}{\text{Max. Frequency Reference}} \right) \times 100$$

Note: The result of the Analog Input Offset calculation will also define the Analog Input Offset Polarity (P 4.01). A positive answer means you should have a positive offset. A negative answer means you should have a negative offset.

P 4.03 ◆ Analog Input Gain — Mem Addr 0403H(41028)

Range: 0.0 to 300.0% Default Setting: 100.0

This parameter can be set during the operation

- This parameter sets the ratio of analog input vs frequency output.
- Use the equation below to calculate the Analog Input Gain. For this equation, you will need to know the minimum and maximum set-point frequencies needed for your application.

$$\text{Analog Gain \%} = \left(\frac{\text{Max. Frequency Reference} - \text{Min. Frequency Reference}}{\text{Maximum Output Frequency}} \right) \times 100$$

P 4.04 Analog Input Reverse Motion Enable — Mem Addr 0404H(41029)

Range: 00 Forward Motion Only Default Setting: 00
01 Reverse Motion Enable

- P 4.01 to P 4.04 are used when the source of frequency command is the analog signal (0 to +10V DC or 4 to 20mA DC). Refer to the following examples:

Analog Input Examples

Use the equations below when calculating the values for the Maximum Output Frequency, Analog Input Offset, Analog Input Gain, and the Mid-point Frequency.

A) **Max. Output Frequency =** $\left(\frac{\text{Maximum Speed (P 0.04)}}{\text{Base Speed (P 0.03)}}\right)$ x Base Frequency (P 0.02)

Note: The Maximum Output Frequency is not a parameter setting but is needed in order to calculate the Analog Gain. The default Maximum Output Frequency for the GS2 drive is 60Hz. If parameters P 0.02, P 0.03, or P 0.04 are changed, then the Maximum Output Frequency will change.

B) **Analog Offset % =** $\left(\frac{\text{Min. Frequency Reference}}{\text{Max. Frequency Reference}}\right)$ x 100

C) **Analog Gain % =** $\left(\frac{\text{Max. Frequency Reference} - \text{Min. Frequency Reference}}{\text{Maximum Output Frequency}}\right)$ x 100

D) **Mid-point Freq. =** $\left(\frac{\text{Max. Freq. Reference} - \text{Min. Freq. Reference}}{2}\right)$ + Min. Freq. Reference

Note: The Mid-point Frequency calculation shows the frequency reference of the drive when the potentiometer or other analog device is at its mid-point.

Example 1: Standard Operation

This example illustrates the default operation of the drive. The example is given to further illustrate the use of the analog calculations. The full range of the analog input signal corresponds to the full forward frequency range of the AC drive.

- Minimum Frequency Reference = 0Hz
- Maximum Frequency Reference = 60Hz

Calculations

A) **Max. Output Frequency =** $\left(\frac{1750\ \text{RPM}}{1750\ \text{RPM}}\right)$ x 60Hz = (60Hz)

B) **Analog Offset % =** $\left(\frac{0\text{Hz}}{60\text{Hz}}\right)$ x 100 = (0%)

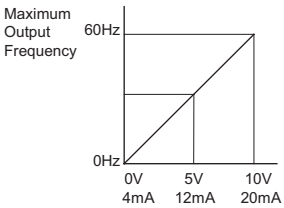
C) **Analog Gain % =** $\left(\frac{60\text{Hz} - 0\text{Hz}}{60\text{Hz}}\right)$ x 100 = (100%)

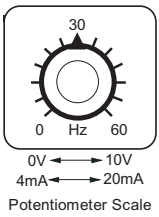
D) **Mid-point Frequency =** $\left(\frac{60\text{Hz} - 0\text{Hz}}{2}\right)$ + 0Hz = (30Hz)

Parameter Settings

P 4.01: 01 – Positive Input Offset Polarity
P 4.02: 00 – 0% Analog Input Offset
P 4.03: 100 – 100% Analog Input Gain
P 4.04: 00 – Forward Motion Only

Results





Potentiometer Scale

Example 2: Positive Offset

In this example, the Analog Input will have a positive offset while still using the full scale of the potentiometer. When the potentiometer is at its lowest value (0V, 0mA, or 4mA), the set-point frequency will be at 10Hz. When the potentiometer is at its maximum value (10V or 20mA), the set-point frequency will be at 60Hz.

- Minimum Frequency Reference = 10Hz
- Maximum Frequency Reference = 60Hz

Calculations

A) **Max. Output Frequency =** $\left(\frac{1750\ \text{RPM}}{1750\ \text{RPM}}\right)$ x 60Hz = (60Hz)

B) **Analog Offset % =** $\left(\frac{10\text{Hz}}{60\text{Hz}}\right)$ x 100 = (16.7%)

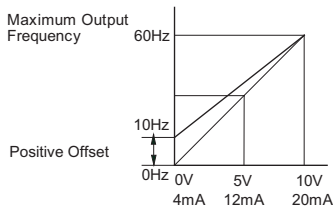
C) **Analog Gain % =** $\left(\frac{60\text{Hz} - 10\text{Hz}}{60\text{Hz}}\right)$ x 100 = (83.3%)

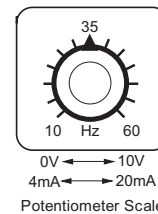
D) **Mid-point Frequency =** $\left(\frac{60\text{Hz} - 10\text{Hz}}{2}\right)$ + 10Hz = (35Hz)

Parameter Settings

P 4.01: 01 – Positive Input Offset Polarity
P 4.02: 16.7 – 16.7% Analog Input Offset
P 4.03: 83.3 – 83.3% Analog Input Gain
P 4.04: 00 – Forward Motion Only

Results





Example 3: Forward and Reverse Operation

In this example, the potentiometer is programmed to run a motor full-speed in both forward and reverse direction. The frequency reference will be 0Hz when the potentiometer is positioned at mid-point of its scale. Parameter P 4.04 must be set to enable reverse motion.

Note: When calculating the values for the Analog Input using reverse motion, the reverse frequency reference should be shown using a negative (-) number. Pay special attention to signs (+/-) for values representing reverse motion.

- Minimum Frequency Reference = -60Hz (reverse)
- Maximum Frequency Reference = 60Hz

Calculations

A) **Max. Output Frequency =** $\left(\frac{1750\ \text{RPM}}{1750\ \text{RPM}}\right) \times 60\text{Hz} = 60\text{Hz}$

B) **Analog Offset % =** $\left(\frac{-60\text{Hz}}{60\text{Hz}}\right) \times 100 = -100\%$

Note: The negative (-) value for the Analog Offset % shows that a negative offset is needed for P 4.01.

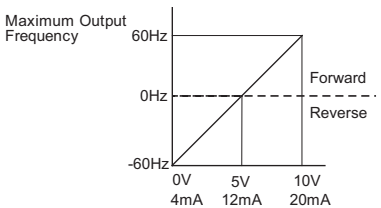
C) **Analog Gain % =** $\left(\frac{60\text{Hz} - (-60\text{Hz})}{60\text{Hz}}\right) \times 100 = 200\%$

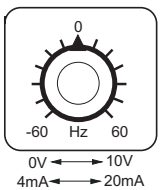
D) **Mid-point Frequency =** $\left(\frac{60\text{Hz} - (-60\text{Hz})}{2}\right) + (-60\text{Hz}) = 0\text{Hz}$

Parameter Settings

P 4.01: 02 – Negative Input Offset Polarity
P 4.02: 100 – 100% Analog Input Offset
P 4.03: 200 – 200% Analog Input Gain
P 4.04: 01 – Reverse Motion Enable

Results





Potentiometer Scale

Example 4: Forward Run/Reverse Jog

This example shows an application in which the drive runs full-speed forward and jogs in reverse. The full scale of the potentiometer will be used.

Note: When calculating the values for the Analog Input using reverse motion, the reverse frequency reference should be shown using a negative (-) number. Pay special attention to signs (+/-) for values representing reverse motion.

- Minimum Frequency Reference = -15Hz (reverse)
- Maximum Frequency Reference = 60Hz

Calculations

A) **Max. Output Frequency =** $\left(\frac{1750\ \text{RPM}}{1750\ \text{RPM}}\right)$ x 60Hz = 60Hz

B) **Analog Offset % =** $\left(\frac{-15\text{Hz}}{60\text{Hz}}\right)$ x 100 = -25%

Note: The negative (-) value for the Analog Offset % shows that a negative offset is needed for P 4.01.

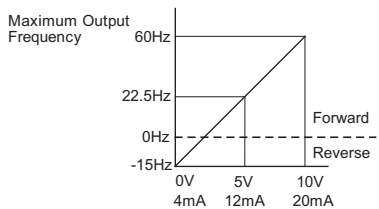
C) **Analog Gain % =** $\left(\frac{60\text{Hz} - (-15\text{Hz})}{60\text{Hz}}\right)$ x 100 = 125%

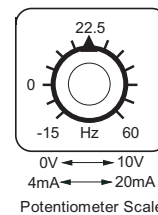
D) **Mid-point Frequency =** $\left(\frac{60\text{Hz} - (-15\text{Hz})}{2}\right)$ + (-15Hz) = 22.5Hz

Parameter Settings

P 4.01: 02 – Negative Input Offset Polarity
P 4.02: 25 – 25% Analog Input Offset
P 4.03: 125 – 125% Analog Input Gain
P 4.04: 01 – Reverse Motion Enable

Results





P 4.05 **Loss of ACI Signal (4-20mA)** **Mem Addr 0405H(41030)**

Range: 00 - Decelerate to 0Hz Default Setting: 00
01 - Stop immediately and display "EF".
02 - Continue operation by the last frequency command

- This parameter determines the operation of the drive when the ACI frequency command is lost.

P 4.06 **Reserved**

P 4.07 **Reserved**

P 4.08 **Reserved**

P 4.09 **Reserved**

P 4.10 **Reserved**

P 4.11 **◆ Analog Output Signal** **Mem Addr 040BH(41036)**

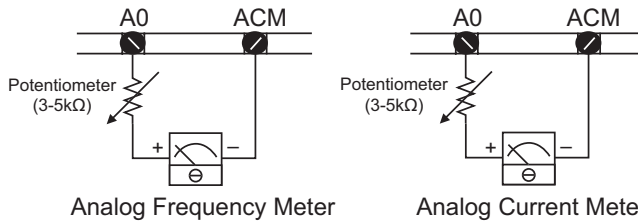
Range: 00 - Frequency Hz Default Setting: 00
01 - Current A
02 - PV

- This parameter selects either Output Frequency or current to be displayed using the 0 to10V A0 output.

P 4.12 ◆ **Analog Output Gain** **Mem Addr 040CH(41037)**

Range: 00 to 200% Default Setting: 100

•This parameter sets the voltage range of the analog output signal, on output terminal A0.



Analog Frequency Meter Analog Current Meter

- The analog output voltage is directly proportional to the output frequency of the AC drive. With the factory setting of 100%, the Maximum Output Frequency of the AC drive corresponds to +10VDC analog voltage output. (The actual voltage is about +10VDC, and can be adjusted by P 4.12)
- The analog output voltage is directly proportional to the output current of the AC drive. With the factory setting of 100%, the 2.5 times rated current of the AC drive corresponds to +10 VDC analog voltage output. (The actual voltage is about +10 VDC, and can be adjusted by P 4.12).

Note: Any type of voltmeter can be used. If the meter reads full scale at a voltage less than 10 volts, then P 4.12 should be set by the following formula:

P 4.12 = (meter full scale voltage ÷ 10)×100%

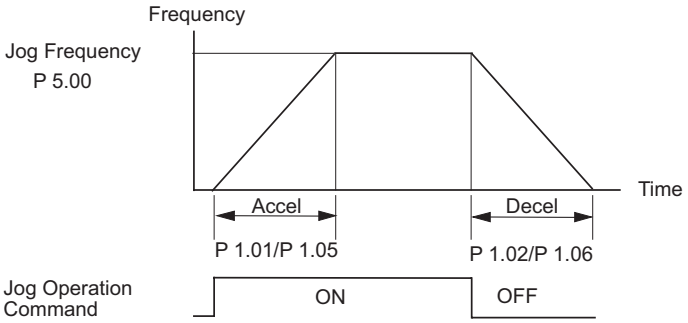
For Example: When using the meter with full scale of 5 volts, adjust P 4.12 to 50%.

Preset Parameters

P5.00 ◆ **Jog** **Mem Addr 0500H(41281)**

Range: 0.0 to 400.0 Hz Default Setting: 6.0

- The Jog Command is selected by a Multi-Function Input Terminal (P 3.02 to P 3.05) set to the Jog Function (09).



P 5.01 ◆ **Multi-Speed 1** **Mem Addr 0501H(41282)**

P 5.02 ◆ **Multi-Speed 2** **Mem Addr 0502H(41283)**

P 5.03 ◆ **Multi-Speed 3** **Mem Addr 0503H(41284)**

P 5.04 ◆ **Multi-Speed 4** **Mem Addr 0504H(41285)**

P 5.05 ◆ **Multi-Speed 5** **Mem Addr 0505H(41286)**

P 5.06 ◆ **Multi-Speed 6** **Mem Addr 0506H(41287)**

P 5.07 ◆ **Multi-Speed 7** **Mem Addr 0507H(41288)**

Range for P 5.01-P 5.07: 0.0 to 400.0 Hz Default Setting: 0.0

- The Multi-Function Input Terminals (refer to P 3.01 to P 3.05) are used to select one of the AC drive Multi-Step speeds. The speeds (frequencies) are determined by P 5.01 to P 5.07 shown above.

Multi-Speed Bits			Speed Selection
Bit 3	Bit 2	Bit 1	
OFF	OFF	OFF	P 4.00: Source of Frequency
OFF	OFF	**ON**	P 5.01: Multi-Speed 1
OFF	**ON**	OFF	P 5.02: Multi-Speed 2
OFF	**ON**	**ON**	P 5.03: Multi-Speed 3
ON	OFF	OFF	P 5.04: Multi-Speed 4
ON	OFF	**ON**	P 5.05: Multi-Speed 5
ON	**ON**	OFF	P 5.06: Multi-Speed 6
ON	**ON**	**ON**	P 5.07: Multi-Speed 7

Note: When all multi-speed inputs are off, the AC drive reverts back to the Command Frequency (P 4.00).

Protection Parameters

P 6.00 Electronic Thermal Overload Relay — Mem Addr 0600H(41537)

Range: 00 - Constant Torque
01 - Variable Torque
02 - Inactive

Default Setting: 00

- This function is used to limit the output power of the AC drive when powering a "self-cooled" motor at low speed.

P 6.01 Auto Restart after Fault — Mem Addr 0601H(41538)

Range: 00 to 10

Default Setting: 00

- After fault occurs (allowable faults: over-current OC, over-voltage OV), the AC drive can be reset/restarted automatically up to 10 times. Setting this parameter to 0 will disable the reset/restart operation after any fault has occurred. When enabled, the AC drive will restart with speed search, which starts at the Master Frequency. To set the fault recovery time after a fault, please see (P 6.13) base-block time for speed search.

P 6.02 Momentary Power Loss — Mem Addr 0602H(41539)

Default Setting: 00

Settings:		
	00	Stop operation after momentary power loss.
	01	Continue operation after momentary power loss, speed search from Speed Reference.
	02	Continue operation after momentary power loss, speed search from Minimum Speed.

Note: This parameter will only work if the Source of Operation (P 3.00) is set to something other than 00 (Operation determined by digital keypad).

P 6.03 Reverse Operation Inhibit — Mem Addr 0603H(41540)

Default Setting: 00

Settings:		
	00	Enable Reverse Operation
	01	Disable Reverse Operation

This parameter determines whether the AC Motor Drive can operate in the reverse direction.

P 6.04 Auto Voltage Regulation Mem Addr 0604H(41541)

Default Setting: 00

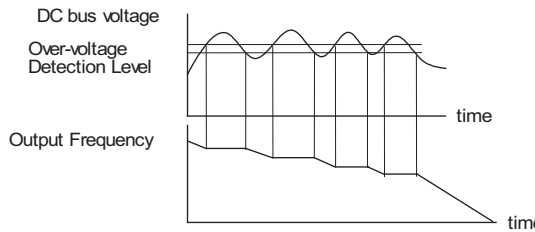
Settings:
- 00 AVR enabled
- 01 AVR disabled
- 02 AVR disabled during decel
- 03 AVR disabled during Stop

- AVR function automatically regulates the AC drive output voltage to the Maximum Output Voltage (P 0.00). For instance, if P 0.00 is set at 200 VAC and the input voltage is at 200V to 264VAC, then the Maximum Output Voltage will automatically be regulated to 200 VAC.
- Without AVR function, the Maximum Output Voltage may vary between 180V to 264VAC, due to the input voltage varying between 180V to 264 VAC.
- Selecting program value 2 enables the AVR function and also disables the AVR function during deceleration. This offers a quicker deceleration.

P 6.05 Over-Voltage Trip Prevention Mem Addr 0605H(41542)

Range: 00 Enable Over-voltage Trip Prevention
01 Disable Over-voltage Trip Prevention
Default Setting: 00

- During deceleration, the AC drive DC bus voltage may exceed its Maximum Allowable Value due to motor regeneration. When this function is enabled, the AC drive will stop decelerating, and maintain a constant output frequency. The drive will resume deceleration when the voltage drops below the factory-preset value.



Note: With moderate inertial loads, over-voltage during deceleration will not occur. For applications with high inertia loads, the AC drive will automatically extend the deceleration time. If deceleration time is critical for the application, a dynamic braking resistor should be used.

P 6.06 Auto Adjustable Accel/Decel Mem Addr 0606H(41543)

Default Setting: 00

Settings:		
	00	Linear Accel/Decel
	01	Auto Accel, Linear Decel
	02	Linear Accel, Auto Decel
	03	Auto Accel/Decel
	04	Auto Accel/Decel Stall Prevention

If the auto accel/decel is selected, the AC drive will accel/decel in the fastest and smoothest means possible by automatically adjusting the time of accel/decel.

This parameter provides five modes to choose:

- 00 Linear Acceleration and deceleration (operation by P 1.01, P 1.02 or P 1.05, P 1.06 acceleration/deceleration time).
- 01 Automatic acceleration, linear deceleration (Operation by automatic acceleration time, P 1.02or P 1.06 deceleration time).
- 02 Linear acceleration and automatic deceleration (Operation by automatic acceleration time, P 1.01 or P 1.05 acceleration time).
- 03 Automatic acceleration, deceleration (Operation by AC drive auto adjustable control).
- 04 Auto acceleration, deceleration. The auto accel/decel will not be quicker than the settings for acceleration (P 1.01 or P 1.05) or deceleration (P 1.02 or P 1.06). The operation is specific to preventing a stall.

P6.07 Over-Torque Detection Mode Mem Addr 0607H(41544)

Default Setting: 00

Settings:		
	00	Disabled
	01	Enabled during constant speed operation
	02	Enabled during acceleration

P 6.08 Over-Torque Detection Level Mem Addr 0608H(41545)

Range: 30 to 200% Default Setting: 150

- A setting of 100% is proportional to the Rated Output Current of the drive.
- This parameter sets the Over-Torque Detection level in 1% increments. (The AC drive rated current is equal to 100%.)

P 6.09 Over-Torque Detection Time Mem Addr 0609H(41546)

Range: 0.1 to 10.0 Default Setting: 0.1

This parameter sets the Over-Torque Detection Time in units of 0.1 seconds.

P 6.10 **Over-current Stall Prevention during Acceleration** **Mem Addr 060AH(41547)**

Range: 20 to 200% Default setting: 150

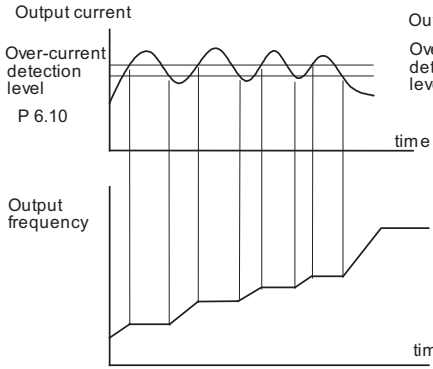
A setting of 100% is equal to the Rated Output Current of the drive.

- Under certain conditions, the AC drive output current may increase abruptly, and exceed the value specified by P 6.10 This is commonly caused by rapid acceleration or excessive load on the motor. When this function is enabled, the AC drive will stop accelerating and maintain a constant output frequency. The AC drive will only resume acceleration when the current drops below the maximum value.

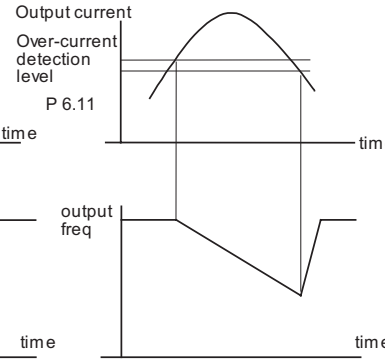
P 6.11 **Over-current Stall Prevention during Operation** **Mem Addr: 060BH(41548)**

Range: 20 to 200% Default Setting: 150

- During steady-state operation with motor load rapidly increasing, the AC drive output current may exceed the limit specified in P 6.11. When this occurs, the output frequency will decrease to maintain a constant motor speed. The drive will accelerate to the steady-state output frequency only when the output current drops below the level specified by P 6.11.



Over-current Stall Prevention during Acceleration



Over-current Stall Prevention during Operation

P 6.12 Maximum Allowable Power Loss Time Mem Addr: 060CH(41549)

Range: 0.3 to 5.0 sec Default Setting: 2.0

- During a power loss, if the power loss time is less than the time defined by this parameter, the AC drive will resume operation. If the Maximum Allowable Power Loss Time is exceeded, the AC drive output is turned off.

P 6.13 Base-Block Time for Speed Search Mem Addr 060DH(41550)

Range: 0.3 to 5.0 sec Default Setting: 0.5

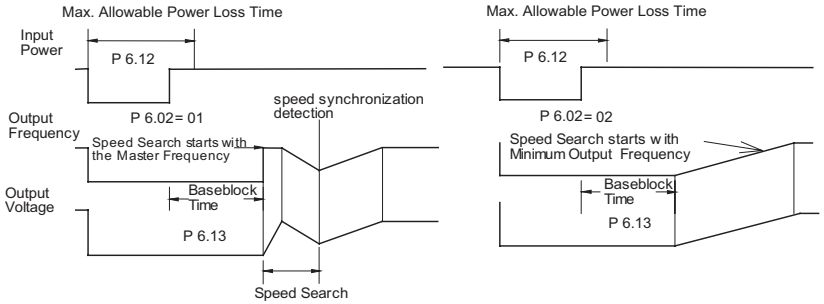
- When a momentary power loss is detected, the AC drive turns off for a specified time interval determined by P 6.13 before resuming operation. This time interval is called Base-Block. This parameter should be set to a value where the residual output voltage due to regeneration is nearly zero, before the drive resumes operation.

- This parameter also determines the searching time when performing external Base-Block and Fault Reset (P 6.01)

P 6.14 Maximum Speed Search Current Level Mem Addr 060EH(41551)

Range: 30 to 200% Default Setting: 150

- Following a power failure, the AC drive will start its speed search operation only if the output current is greater than the value determined by P 6.14. When the output current is less than that of P 6.14, the AC drive output frequency is at a "speed synchronization point". The drive will start to accelerate or decelerate back to the operating frequency at which it was running prior to the power failure.



P 6.15 **Upper Bound of Output Frequency** **Mem Addr 060FH(41552)**

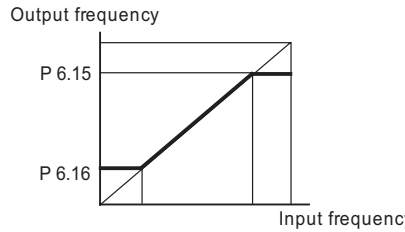
Range: 0.1 to 400 Hz Default Setting: 400

This parameter must be equal to or greater than the Lower Bound of Output Frequency (P 6.16).

P 6.16 **Lower Bound of Output Frequency** **Mem Addr 0610H(41553)**

Range: 0.0 to 400 Hz Default Setting: 0.0

- The Upper/Lower Bound is to prevent operation error and machine damage.
- If the Upper Bound of Output Frequency is 50 Hz and the Maximum Output Frequency is 60 Hz, the Maximum Output Frequency will be limited to 50 Hz.
- If the Lower Bound of Output Frequency is 10 Hz, and the Minimum Output Frequency (P 2.06) is set at 1.0 Hz, then any Command Frequency between 1-10 Hz will generate a 10 Hz output from the drive.
- This parameter must be less than or equal to the Upper Bound of Output Frequency.



P 6.17 **Reserved**

P 6.18 **Reserved**

P 6.19 **Reserved**

P 6.20 **Reserved**

P 6.21 **Reserved**

P 6.22 **Reserved**

P 6.23	Reserved
P 6.24	Reserved
P 6.25	Reserved
P 6.26	Reserved
P 6.27	Reserved
P 6.28	Reserved
P 6.29	Reserved
P 6.30	Reserved

P 6.31	**Present Fault Record**	**Mem Addr 061FH(41568)**
P 6.32	**Second Most Recent Fault Record**	**Mem Addr 0620H(41569)**
P 6.33	**Third Most Recent Fault Record**	**Mem Addr 0621H(41570)**
P 6.34	**Fourth Most Recent Fault Record**	**Mem Addr 0622H(41571)**
P 6.35	**Fifth Most Recent Fault Record**	**Mem Addr 0623H(41572)**
P 6.36	**Sixth Most Recent Fault Record**	**Mem Addr 0624H(41573)**

Default Setting: 00

Settings for P 6.31 - P 6.36:

00	No Fault occurred
01	Over-current (oc)
02	Over-voltage (ov)
03	Overheat (oH)
04	Overload (oL)
05	Overload 1 (oL1)
06	Overload 2 (oL2)
07	External Fault (EF)
08	CPU failure 1 (CF1)
09	CPU failure 2 (CF2)
10	CPU failure 3 (CF3)
11	Hardware Protection Failure (HPF)
12	Over-current during accel (OCA)
13	Over-current during decel (OCd)
14	Over-current during steady state (OCn)
15	Ground fault or fuse failure (GFF)
16	Reserved
17	Input Power 3 phase loss
18	External Base Block (bb)
19	Auto Adjust Accel/decel failure (cFA)
20	Software protection code (co)

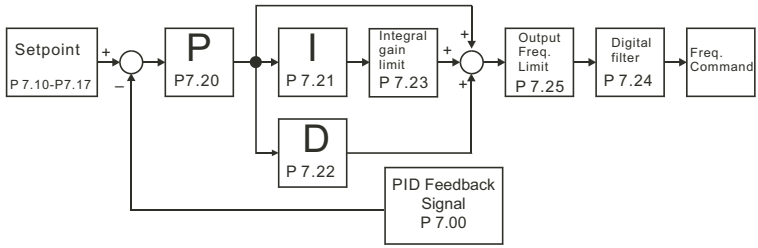
PID Parameters

P 7.00 **Input Terminal for PID Feedback** **Mem Addr 0700H(41793)**

Default Setting: 00

Settings:
- 00 Inhibit PID operation.
- 01 Input negative PID feedback,PV from AVI (0 to +10V)
- 02 Input negative PID feedback, PV from ACI (4 to 20mA)

Note: When using PID operation, the Source of Frequency parameter (P 4.00) must be set to 00 or 01. If PID operation is disabled, the AC drive will operate using the Source of Frequency specified by P 4.00.



P 7.01 **PV 100% Value** **Mem Addr 0701H(41794)**

Range: 0.0 to 999 Default Setting: 100.0

This parameter should be set to the value corresponding to the 100% value of the process variable (PV). The setting for P 7.01 cannot be less than any setting for P 7.10 to P 7.17.

Note: The setting for PV 100% value (P 7.01) cannot be set less than any value set for P 7.10 to P 7.17. If you are unable to reduce P 7.01 to the desired value, check parameters P 7.10 to P 7.17 and reduce these values accordingly.

P 7.02 **PID Setpoint Source** **Mem Addr 0702H(41795)**

Range: 00 - Keypad Default Setting: 00
01 - Serial Communications

P 7.10 **◆ Keypad PID Setpoint** **Mem Addr 070AH(41803)**

Range: 0.0 to 999 Default Setting: 0.0

• Setting cannot be greater than setting for P 7.01.

P 7.11 ◆ **PID Multi-setpoint 1** **Mem Addr 070BH(41804)**

Range: 0.0 to 999 Default Setting: 0.0

P 7.12 ◆ **PID Multi-setpoint 2** **Mem Addr 070CH(41805)**

Range: 0.0 to 999 Default Setting: 0.0

P 7.13 ◆ **PID Multi-setpoint 3** **Mem Addr 070DH(41806)**

Range: 0.0 to 999 Default Setting: 0.0

P 7.14 ◆ **PID Multi-setpoint 4** **Mem Addr 070EH(41807)**

Range: 0.0 to 999 Default Setting: 0.0

P 7.15 ◆ **PID Multi-setpoint 5** **Mem Addr 070FH(41808)**

Range: 0.0 to 999 Default Setting: 0.0

P 7.16 ◆ **PID Multi-setpoint 6** **Mem Addr 0710H(41809)**

Range: 0.0 to 999 Default Setting: 0.0

P 7.17 ◆ **PID Multi-setpoint 7** **Mem Addr 0711H(41810)**

Range: 0.0 to 999 Default Setting: 0.0

Note: The settings for P 7.10 to P7.17 cannot exceed the setting for P 7.01.

P 7.20 ◆ **Proportional Control (P)** **Mem Addr 0714H(41813)**

Range: 0.0 to 10.0 Default Setting: 1.0

The first parameter of PID control is Proportional Control (P). For a given process, if the Proportional Value is set too low, the control action will be too sluggish. If the Proportional value is set too high, the control action will be unstable (erratic).

Set the Integral Control (I) and Derivative Control (D) to zero (0). Begin tuning the process with a low Proportional Value, and increase the Proportional value until the system goes unstable (erratic). When instability is reached, reduce the Proportional Value slightly until the system becomes stable (smaller values reduce system Gain). Stability can be tested by moving between two wide-spread setpoint values.

With 10% deviation and P=1, then P X 10% = Control Output. For example, if the speed of a motor is dragged down 10% due to a load increase, a corrective speed signal increase of 10% is generated. In a perfect world, this increase in speed command should bring the motor speed back to normal.

P 7.21 ◆ **Integral Control (I)** **Mem Addr 0715H(41814)**

Range: 0.00 to 100.0 sec Default Setting: 1.00

Using only the Proportional Control, the corrective action may not increase fast enough or the setpoint may never be reached because of system losses. The Integral Control is used to generate addtional corrective action.

When tuning, begin with a large Integral value and reduce the value until the system goes unstable (erratic). When instability is reached, increase the Integral value slightly until the system becomes stable and the desired setpoint value is reached.

P 7.22 ◆ **Derivative Control (D)** **Mem Addr 0716H(41815)**

Range: 0.00 to 1.00 sec Default Setting: 0.00

If the control output is too sluggish after the Proportional Control (P) and Integral Control (I) values are set, Derivative Control (D) may be required. Begin with a high Derivative value and reduce the value to the point of system instability. Then increase the Derivative value until the control output regains stability.Stability can be tested by moving between two wide-spread setpoint values.

P 7.23 **Upper Bound for Integral Control** **Mem Addr 0717H(41816)**

Range: 00 to 100% Default Setting: 100

- This parameter defines an upper boundary or limit for the integral gain (I) and therefore limits the Master Frequency. Use the formula below to calculate the Integral upper limit.

$$\textbf{Max. Output Frequency} = \left(\frac{\text{Maximum Speed (P 0.04)}}{\text{Base Speed (P 0.03)}}\right) \text{x Base Frequency (P 0.02)}$$

- The formula is: Integral upper limit = (Maximum Output Frequency) X P 7.23. This parameter can limit the Maximum Output Frequency

P 7.24 **Derivative Filter Time Constant** **Mem Addr 0718H(41817)**

Range: 0.0 to 2.5 sec Default Setting: 0.0

- To avoid amplification of measured noise in the controller output, a derivative digital filter is inserted. This filter helps smooth oscillations. Larger values for P 7.24 provide more smoothing.

P 7.25 PID Output Frequency Limit Mem Addr 0719H(41818)

Range: 00 to 110% Default Setting: 100

- This parameter defines the percentage of output frequency limit during the PID control. The formula is Output Frequency Limit = (Maximum Output Frequency) X P 7.25. This parameter will limit the Maximum Output Frequency

$$\text{Max. Output Frequency} = \left(\frac{\text{Maximum Speed (P 0.04)}}{\text{Base Speed (P 0.03)}}\right) \times \text{Base Frequency (P 0.02)}$$

P 7.26 Feedback Signal Loss Detection Time Mem Addr 071AH(41819)

Range: 0.0 to 3600 sec Default Setting: 60

- This parameter defines how long the PID Feedback signal is lost before an error is generated. Setting this parameter to 0.0 disables the PID Feedback loss timer. When the feedback signal is lost, PID Feedback loss timer starts timing. When the timer value is greater than the setting value of P. 7.26, the PID Feeback Loss parameter (P 7.27) is activated. Furthermore, the Keypad will display "FbE" means the feedback abnormality detected. When the signal is corrected, the warning message "FbE" will automatically be cleared.

P 7.27 PID Feedback Loss Operation Mem Addr 071BH(41820)

Range: 00 - Warn and AC Drive Stop Default Setting: 00
01 - Warn and Continue Operation

- This parameter sets the operation of the drive when there is a loss of the PID feedback signal.

Display Parameters

P 8.00 ◆ User Defined Display Function Mem Addr 0800H(42049)

Default Setting: 00

Settings:		
	00	Output Frequency (Hz)
	01	Motor Speed (RPM)
	02	Output Frequency x P 8.01
	03	Output Current (A)
	04	Motor Output Current (%)
	05	Output Voltage(V)
	06	DC Bus Voltage (V)
	07	PID Setpoint
	08	PID Feedback (PV)
	09	Frequency Setpoint

P 8.01 ◆ Frequency Scale Factor Mem Addr 0801H(42050)

Range: 0.01 to 160.0 Default Setting: 1.0

- The coefficient K determines the multiplying factor for the user-defined unit.
  - The display value is calculated as follows:

Display value = output frequency x K

  - The display window is only capable of showing four digits, but P 8.01 can be used to create larger numbers. The display window uses decimal points to signify numbers up to three digits as explained below:

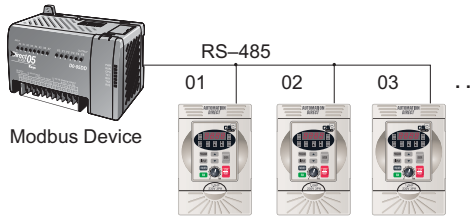
DISPLAY	*NUMBER REPRESENTED*
9999	The absence of a decimal point indicates a three digit integer.
999.9	A single decimal point between the middle and the right-most numbers is a true decimal point; it separates ones and tenths as in "30.5 (thirty and one-half).
9999.	A single decimal point after the right-most number is not a true decimal point; instead it indicates that a zero follows the right-most numbers. For example, the number 1230 would be displayed as "123."

Communication Parameters

P 9.00 Communication Address Mem Addr 0900H(42305)

Range: 01 to 254 Default Setting: 01

- If the AC drive is controlled by RS-485 serial communication, the communication address must be set via this parameter.



P 9.01 Transmission Speed Mem Addr 0901H(42306)

Range: 00 to 03 Default Setting: 01

Setting
00: 4800 baud data transmission speed
01: 9600 baud data transmission speed
02: 19200 baud data transmission speed
03: 38400 baud data transmission speed

- Users can set parameters and control the operation of the AC drive via the RS-485 serial interface of a personal computer. This parameter is used to set the transmission speed between the computer and AC drive.

P 9.02 Communication Protocol Mem Addr 0902H(42307)

Default Setting: 00

Settings:

00	MODBUS ASCII mode. <7 data bits, no parity, 2 stop bits>
01	MODBUS ASCII mode <7 data bits, even parity, 1 stop bit>
02	MODBUS ASCII mode <7 data bits, odd parity, 1 stop bit>
03	MODBUS RTU mode <8 data bits, no parity, 2 stop bits>
04	MODBUS RTU mode <8 data bits, even parity, 1 stop bit>
05	MODBUS RTU mode <8 data bits, odd parity, 1 stop bit>

P 9.03 **Transmission Fault Treatment** **Mem Addr 0903H(42308)**

Default Setting: 00

Setting: 00 - Display fault and continue operating
01 - Display fault and RAMP to stop
02 - Display fault and COAST to stop
03 - No fault displayed and continue operating

P 9.04 **Time Out Detection** **Mem Addr 0904H(42309)**

Range: 00 - Disable
01 - Enable
Default Setting: 00

•This parameter is used for ASCII mode. When this parameter is set to 01, it indicates that the over-time detection is enabled and the time slot between each character cannot exceed 500 ms.

P 9.05 **Time Out Duration** **Mem Addr 0905H(42310)**

Range: 0.1 to 60.0 seconds
Default Setting: 0.5

P 9.07 **◆ Parameter Lock** **Mem Addr 0907H(42312)**

Range: 00 - All parameters can be set and read
01 - All parameters are read-only
Default setting: 00

P 9.08 **Restore to Default** **Mem Addr 0908H(42313)**

Range: 0 to 99
Default Setting: 00

• Setting 99 restores all parameters to factory defaults.

P 9.11 **◆ Block Transfer Parameter 1** **Mem Addr 090BH(42316)**

Range: P 0.00 to P 8.01
Default Setting: P 9.99

P 9.12 **◆ Block Transfer Parameter 2** **Mem Addr 090CH(42317)**

Range: P 0.00 to P 8.01
Default Setting: P 9.99

P 9.13 **◆ Block Transfer Parameter 3** **Mem Addr 090DH(42318)**

Range: P 0.00 to P 8.01
Default Setting: P 9.99

P 9.14 ◆ **Block Transfer Parameter 4** **Mem Addr 090EH(42319)**

Range: P 0.00 to P 8.01 Default Setting: P 9.99

P 9.15 ◆ **Block Transfer Parameter 5** **Mem Addr 090FH(42320)**

Range: P 0.00 to P 8.01 Default Setting: P 9.99

P 9.16 ◆ **Block Transfer Parameter 6** **Mem Addr 0910H(42321)**

Range: P 0.00 to P 8.01 Default Setting: P 9.99

P 9.17 ◆ **Block Transfer Parameter 7** **Mem Addr 0911H(42322)**

Range: P 0.00 to P 8.01 Default Setting: P 9.99

P 9.18 ◆ **Block Transfer Parameter 8** **Mem Addr 0912H(42323)**

Range: P 0.00 to P 8.01 Default Setting: P 9.99

P 9.19 ◆ **Block Transfer Parameter 9** **Mem Addr 0913H(42324)**

Range: P 0.00 to P 8.01 Default Setting: P 9.99

P 9.20 ◆ **Block Transfer Parameter 10** **Mem Addr 0914H(42325)**

Range: P 0.00 to P 8.01 Default Setting: P 9.99

P 9.21 ◆ **Block Transfer Parameter 11** **Mem Addr 0915H(42326)**

Range: P 0.00 to P 8.01 Default Setting: P 9.99

P 9.22 ◆ **Block Transfer Parameter 12** **Mem Addr 0916H(42327)**

Range: P 0.00 to P 8.01 Default Setting: P 9.99

P 9.23 ◆ **Block Transfer Parameter 13** **Mem Addr 0917H(42328)**

Range: P 0.00 to P 8.01 Default Setting: P 9.99

P 9.24 ◆ **Block Transfer Parameter 14** **Mem Addr 0918H(42329)**

Range: P 0.00 to P 8.01 Default Setting: P 9.99

P 9.25 ◆ **Block Transfer Parameter 15** **Mem Addr 0919H(42330)**

Range: P 0.00 to P 8.01 Default Setting: P 9.99

P 9.26 ◆ **RS485 Speed Reference** **Mem Addr 091AH(42331)**

Range: 0.0 to 400.0 Hz Default Setting: 60.0

- This parameter is used to set the Master Frequency when the AC drive is controlled by communication interface.

P 9.27 ◆ **RUN Command** **Mem Addr 091BH(42332)**

Range: 00 - Stop Default Setting: 00
01 - Run

P 9.28 ◆ **Direction Command** **Mem Addr 091CH(42333)**

Range: 00 - Forward Default Setting: 00
01 - Reverse

P 9.29 ◆ **External Fault** **Mem Addr 091DH(42334)**

Range: 00 - No action Default Setting: 00
01 - External fault

P 9.30 ◆ **Fault Reset** **Mem Addr 091EH(42335)**

Range: 00 - No action Default Setting: 00
01 - Fault Reset

P 9.31 ◆ **JOG Command** **Mem Addr 091FH(42336)**

Range: 00 - Stop Default Setting: 00
01 - Jog

P 9.41 GS Series Number Mem Addr: 0929H(42346)

Default Setting: ##

Settings:		
	01	GS1
	02	GS2
	03	GS3
	04	GS4

P 9.42 Manufacturer Model Information Mem Addr 092AH(42347)

Default Setting: ##

Settings:		
	00	GS2-20P5 (230V 1 ph/3ph 0.5 HP)
	01	GS2-21P0 (230V 1 ph/3ph 1.0 HP)
	02	GS2-22P0 (230V 1ph/3ph 2.0 HP)
	03	GS2-23P0 (230V 1ph/3ph 3.0 HP)
	04	GS2-25P0 (230V 3ph 5.0 HP)
	05	GS2-27P5 (230V 3ph 7.5 HP)
	06	Reserved
	07	GS2-41P0 (460V 3ph 1.0 HP)
	08	GS2-42P0 (460V 3ph 2.0 HP)
	09	GS2-43P0 (460V 3ph 3.0 HP)
	10	GS2-45P0 (460V 3ph 5.0 HP)
	11	GS2-47P0 (460V 3ph 7.5 HP)
	12	GS2-4010 (460V 3ph 10 HP)

GS2 MODBUS COMMUNICATIONS

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GS2 Status Addresses 5–4
Communicating with DirectLogic PLCs 5–5
Communicating with Third-party Devices 5–16

Communication Parameters Summary

A summary of the GS2 Communications Parameters is listed below. For a complete listing of the GS2 Parameter, refer to CHAPTER 4.

Communications			
GS2 Parameter	**Description**	**Range**	**Default**
P 9.00	Communication Address	01 to 254	01
P 9.01	Transmission Speed	00: 4800 baud 01: 9600 baud 02: 19200 baud 03: 38400 baud	01
P 9.02	Communication Protocol	00: MODBUS ASCII mode 7 data bits,no parity,2 stop bits 01: MODBUS ASCII mode 7 data bits,even parity,1 stop bit 02: MODBUS ASCII mode 7 data bits,odd parity,1 stop bit 03: MODBUS RTU mode 8 data bits,no parity,2 stop bits 04: MODBUS RTU mode 8 data bits,even parity,1 stop bit 05: MODBUS RTU mode 8 data bits,odd parity,1 stop bit	00
P 9.03	Transmission Fault Treatment	00: Display fault and continue operating 01: Display fault and RAMP to stop 02: Display fault and COAST to stop 03: No fault displayed and continue operating	00
P 9.04	Time Out Detection	00: Disable 01: Enable	00
P 9.05	Time Out Duration	0.1 to 60.0 seconds	0.5
◆ **P 9.07**	Parameter Lock	00: All parameters can be set and read 01: All parameters are read-only	00
P 9.08	Restore to Default	99: Restores all parameters to factory defaults	00
◆ **P 9.11**	Block Transfer Parameter 1	P 0.00 to P 8.01	P 9.99
◆ **P 9.12**	Block Transfer Parameter 2	P 0.00 to P 8.01	P 9.99
◆ **P 9.13**	Block Transfer Parameter 3	P 0.00 to P 8.01	P 9.99
◆ **P 9.14**	Block Transfer Parameter 4	P 0.00 to P 8.01	P 9.99
◆ **P 9.15**	Block Transfer Parameter 5	P 0.00 to P 8.01	P 9.99
◆ **P 9.16**	Block Transfer Parameter 6	P 0.00 to P 8.01	P 9.99
◆ **P 9.17**	Block Transfer Parameter 7	P 0.00 to P 8.01	P 9.99
◆ **P 9.18**	Block Transfer Parameter 8	P 0.00 to P 8.01	P 9.99

Communication Parameters Summary (cont.)

Communications				
GS2 Parameter	**Description**	**Range**		**Default**
◆ **P 9.19**	Block Transfer Parameter 9	P 0.00 to P 8.01		P 9.99
◆ **P 9.20**	Block Transfer Parameter 10	P 0.00 to P 8.01		P 9.99
◆ **P 9.21**	Block Transfer Parameter 11	P 0.00 to P 8.01		P 9.99
◆ **P 9.22**	Block Transfer Parameter 12	P 0.00 to P 8.01		P 9.99
◆ **P 9.23**	Block Transfer Parameter 13	P 0.00 to P 8.01		P 9.99
◆ **P 9.24**	Block Transfer Parameter 14	P 0.00 to P 8.01		P 9.99
◆ **P 9.25**	Block Transfer Parameter 15	P 0.00 to P 8.01		P 9.99
◆ **P 9.26**	RS485 Speed Reference	0.0 to 400.0 Hz		60.0
◆ **P 9.27**	RUN Command	00: Stop	01:Run	00
◆ **P 9.28**	Direction Command	00: Forward	01:Reverse	00
◆ **P 9.29**	External Fault	00: No fault	01:External fault	00
◆ **P 9.30**	Fault Reset	00: No action	01:Fault Reset	00
◆ **P 9.31**	JOG Command	00: Stop	01:Jog	00
P 9.41	GS Series Number	01: GS1 02: GS2 03: GS3 04: GS4		##
P 9.42	Manufacturer Model Information	00: GS2-20P5 (230V 1ph/3ph 0.5HP) 01: GS2-21P0 (230V 1ph/3ph 1.0HP) 02: GS2-22P0 (230V 1ph/3ph 2.0HP) 03: GS2-23P0 (230V 1ph/3ph 3.0HP) 04: GS2-25P0 (230V 3ph 5.0HP) 05: GS2-27P5 (230V 3ph 7.5HP) 06: Reserved 07: GS2-41P0 (460V 3ph 1.0HP) 08: GS2-42P0 (460V 3ph 2.0HP) 09: GS2-43P0 (460V 3ph 3.0HP) 10: GS2-45P0 (460V 3ph 5.0HP) 11: GS2-47P5 (460V 3ph 7.5HP) 12: GS2-4010 (460V 3ph 10HP)		##

◆ Parameter can be set during RUN Mode.

GS2 Status Addresses

The GS2 Series AC drive has status memory addresses that are used to monitor the AC drive. The status addresses and value definitions are listed below.

Status Addresses (Read Only)

Status Monitor	Memory Address 2100H

Error Codes:

00: No fault occurred
01: Over-current(oc)
02: Over-voltage(ov)
03: Overhear (oH)
04: Overload (oL)
05: Overload 1 (oL1)
06: Overload 2 (oL2)
07: External Fault (EF)
08: CPU failure 1 (CF1)
09: CPU failure 2 (CF2)
10: CPU failure 3 (CF3)
11: Hardware Protection Failure (HPF)
12: Over-current during accel (OCA)
13: Over-current during decel (Ocd)
14: Over-current during steady state (Ocd)
15: Ground fault or fuse failure (GFF)
16: Low voltage (Lv)
17: Input power 3-phase loss
18: External Base-Block (bb)
19: Auto adjust accel/decel failure (cFA)
20: Software protection code (codE)

Frequency Command F (XXX.X)	Memory Address 2102H
Output Frequency H (XXX.X)	Memory Address 2103H
Output Current A (XXX.X)	Memory Address 2104H
DC-BUS Voltage d (XXX.X)	Memory Address 2105H
Output Voltage U (XXX.X)	Memory Address 2106H
Power Factor Angle	Memory Address 210AH
Software Version	Memory Address 2110H

Communicating with *Direct*LOGIC PLCs

The following steps explain how to connect and communicate with the GS2 Series AC drives using ***Direct***LOGIC PLCs.

Step 1: Choose the Appropriate CPU.

The GS2 Series AC drives will communicate with the following ***Direct***LOGIC CPUs using MODBUS communications.

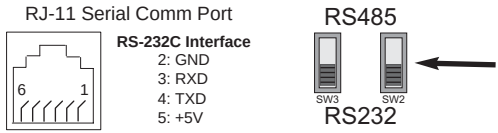
- DL05
- DL06
- DL250
- DL260
- DL350
- DL450

Step 2: Make the Connections

First you must decide what type of interface will work best for your application. The GS2 Comm Port can accomidate an RS232C or an RS 485 connection.

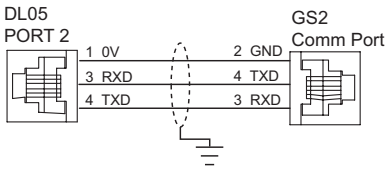
RS-232C

An RS-232C connection is somewhat limited. The maximum network cable length for an RS-232C connection is 15 meters (50 feet). In addtion, using the RS-232C interface will allow you to connect only one AC drive to one PLC. For and RS-232C connection, set the GS2 DIP switches SW2 and SW3 to RS232.

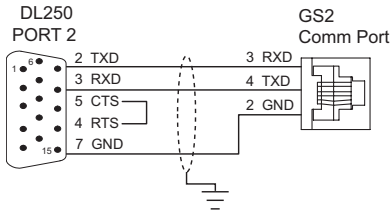


Use the following wiring diagrams to connect your ***Direct***LOGIC PLC to a GS2 Series AC drive with an RS-232C interface.

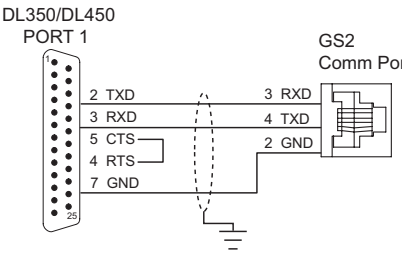
DL05: RS-232C Connection Wiring



DL250: RS-232C Connection Wiring

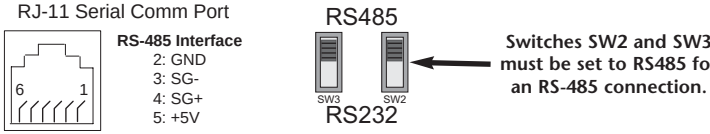


DL250: RS-232C Connection Wiring



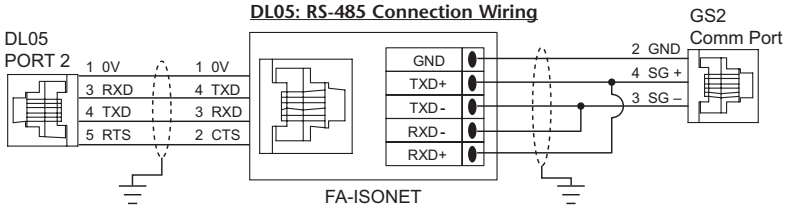
RS-485

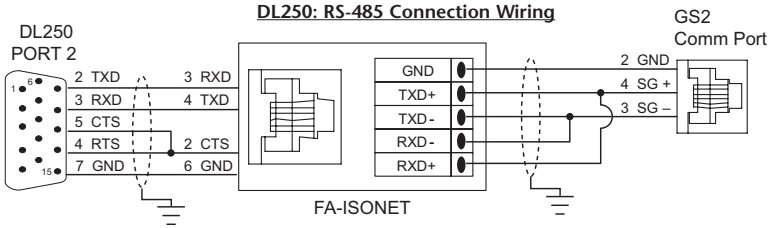
An RS-485 network cable can span up to 1000 meters (4000 feet). However, most ***Direct***LOGIC PLCs require an FA-ISONET (RS 232C to RS422/485 network adapter) in order to make this type of connection. For an RS-485 connection, set the GS2 DIP switches SW2 and SW3 to RS485.

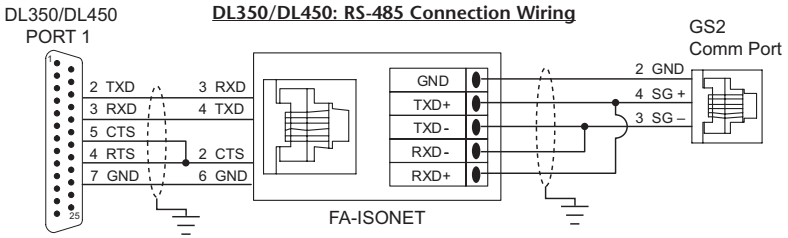


Use the following wiring diagrams to connect your ***Direct***LOGIC PLC to a GS2 Series AC drive with an RS-485 interface.

Note: If an FA-ISONET module is used in your connection, make sure the jumpers are set for RS485 communications.







Step 3: Set AC Drive Parameters

The following parameters need to be set as shown in order to communicate properly.

P 3.00: 03 or 04 – Operation Determined by RS232C/RS485 interface. Keypad STOP is enabled (03) or disabled (04).

P 4.00: 05 – Frequency determined by RS232/RS485 communication interface

P 9.00: xx – Communication address 1-254 (unique for each device, see P 9.00)

P 9.01: 01 – 9600 baud data transmission speed

P 9.02: 05 – MODBUS RTU mode <8 data bits, odd parity, 1 stop bit>

*Note: The previous list of parameter settings are the minimum required to communicate with a **Direct**LOGIC PLC. There may be other parameters that need to be set to meet the needs of your application.*

Step 4: Configure the *Direct*LOGIC CPUs

The ***Direct***LOGIC CPUs must be configured to communicate with the GS2 Series AC drives. This set up includes setting up the communication port and adding instructions to your logic program.

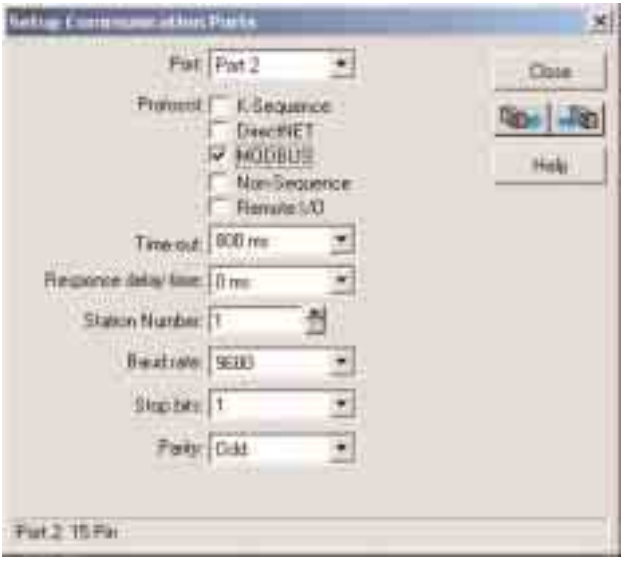
The set up for all of the ***Direct***LOGIC CPUs is very similar. However, there may be some subtle differences between CPUs. Refer to the appropriate CPU User Manual for the specifics on your ***Direct***LOGIC CPU.

Note: For instructions on MODBUS Configuration for your specific CPU, refer to the appropriate CPU User Manual.

***Direct*LOGIC MODBUS Port Configuration**

The following configuration example is specific to the DL250 CPU. Refer to the appropriate CPU User Manual for the specifics on your ***Direct*LOGIC CPU.

- In ***Direct*SOFT, choose the PLC menu, then Setup, then "Secondary Comm Port".
- From the **Port** list box, choose "Port 2".
- For the protocol, select "MODBUS".



- In the **Timeout** list box, select "800 mS".
- **Response Delay Time** should be "0 mS".
- The **Station Number** should be set to "1" to make the DL250 CPU a MODBUS master.

Note: The DL250 network instructions used in Master mode will access only slaves 1 to 90. Each slave must have a unique number.

- The **Baud Rate** should be set at "9600".
- In the **Stop Bits** list box, choose "1".
- In the **Parity** list box, choose "Odd".

*Direct*LOGIC MODBUS Ladder Programming

The set up for all of the ***Direct***LOGIC CPUs is very similar. However, there may be some subtle differences between CPUs. Refer to the appropriate CPU User Manual for the specifics on your ***Direct***LOGIC CPU.

The following ladder program shows some examples of how to control the GS2 AC drive through MODBUS RTU. The drive should be setup and tested for communications before it is connected to a load.

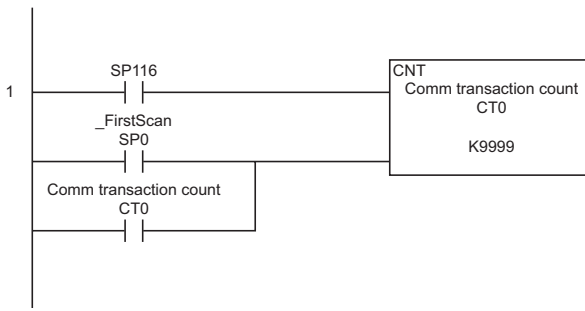
WARNING: A drive should never be connected to a load until any applicable communication programs have been proven.

Note:This program is for illustration purposes only and not intended for a true application.

In many drive applications, electromagnetic interference can at times cause frequent, short duration communication errors. Unless the application environment is perfect, an occasional communication error will occur. In order to distinguish between these non-fatal transients and a genuine communication failure, you may want to use the instructions as shown in Rungs 1 through 4.

Rung 1 monitors the number of times that the PLC attemts to communicate with the AC drive. When the PLC's communication attempts are successful, SP116 will count up and SP117 will not count. Once the count reaches 9999, the counter will reset and resume counting.

DirectSOFT



Note: SP116 and SP117 are special relays in the ***Direct***LOGIC *CPUs that monitor the PLC's commnunications. SP116 is on when Port 2 is communicating with another device. SP117 is on when Port 2 has encountered a communication error.*

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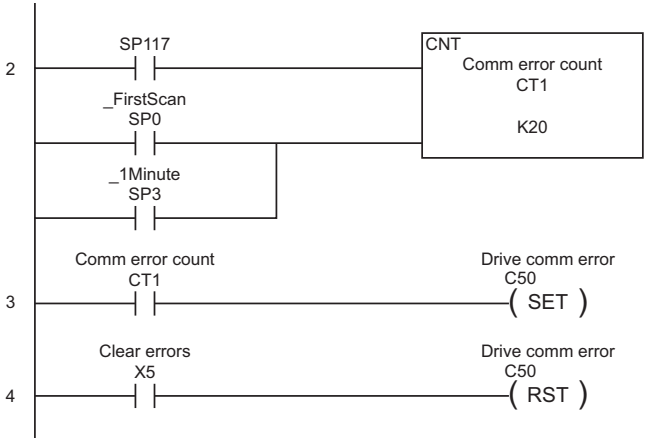
***Direct*LOGIC MODBUS Ladder Programming (cont.)**

Rungs 2 through 4 monitor the number of times the PLC fails in communicating with the AC drive. These instructions set the C50 bit (to be used for alarm or shut-down) based on the number of times the SP117 bit is active in one minute. In this example the C50 bit will be set if the number of errors exceed 20 in one minute.



Block Transfer

There is a group of block transfer parameters available in the GS2 AC drive (P 9.11 to P 9.25). This contiguous block of parameters can be used to "group" miscellaneous parameters throughout the drive. This will allow you to update these miscellaneous parameters in one block instead of having to use multiple WX or RX commands.

For example: If you need to change the PID setpoint (P 7.11), accel time (P 1.01), decel time (P 1.02), and multi-speed 1 (P 5.01), this would typically take three different WX commands because the parameters are non-contiguous. If you set P 9.11 to P 7.11, P 9.12 to P 1.01, P 9.13 to P 1.02, and P 9.14 to P 5.01, then all of these parameters could be controlled using one WX command.

Rung 5 writes the values from V2000 to V2023 to the drive parameters P 9.11 to P 9.25. In the WX box, the value is V4413. 4413 is an octal number like all addresses in the ***Direct*LOGIC** PLCs. If you convert 4413 octal to hex, you get 90B. 90B is the address for parameter P 9.11.

Note: Refer to your PLC User Manual for more specifics on MODBUS addressing and address conversions.

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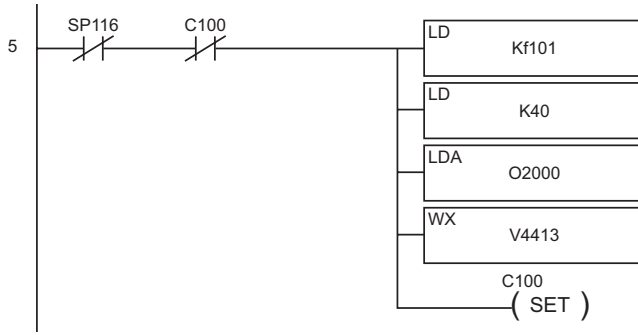
***Direct*LOGIC MODBUS Ladder Programming (cont.)**

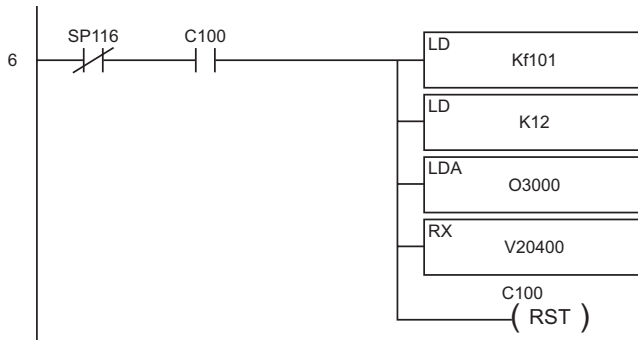
If you only want to control the start/stop and speed reference of the drive, simply change the second LD command of this rung to K4 and WX command to V4432. Then V2000 would be your speed reference location and V2001 would be your start/stop location.



Rung 6 is used to read the status of the GS2 AC drive. These instructions read the values from the GS2 status addresses, 2100 to 2105, and places the values into the PLC memory addresses, V3000 to V3005.

Notice the number in the RX box - V20400. 20400 is an octal number as are all address references in the ***Direct*LOGIC** PLCs. 20400 octal converted to hex gives you 2100 - the first status address for the GS2 AC drive.

Note: Refer to your PLC User Manual for more specifics on MODBUS addressing and address conversions.



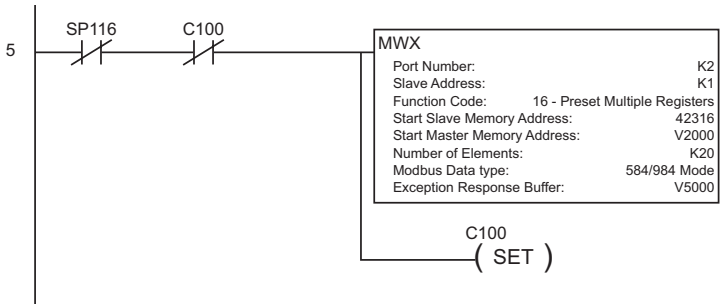
Alternate MODBUS Ladder Programming

The Read and Write commands for the DL260 and DL06 CPUs are different from other ***Direct***LOGIC CPUs. Rungs 5 and 6 are shown below as they relate to DL260 and DL06 CPUs.

Rung 5 writes the values from V2000 to V2023 to the drive parameters P 9.11 to P 9.30. In the MWX box, the Start Slave Memory Address value is 42316. 42316 is a MODBUS decimal number. To convert 42316 decimal to hex, you first subtract 40001, and then convert the remainder to hex (90B). 90B is the address for parameter P 9.11.

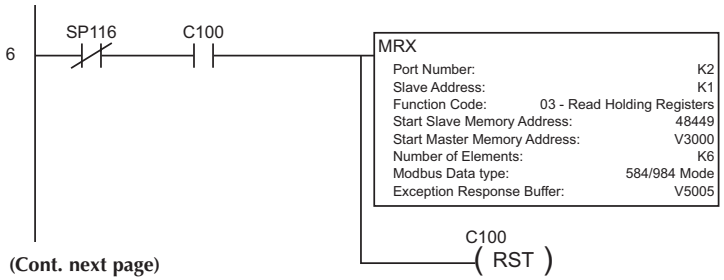
Note: Refer to your PLC User Manual for more specifics on MODBUS addressing and address conversions.

If you only want to control the start/stop and speed reference of the drive, simply change the number of elements to K2 and the slave memory address to 42331. Then V2000 would be your speed reference location and V2001 would be your start/stop location.



Rung 6 is used to read the status of the GS2 AC drive. These instructions read the values from the GS2 status addresses, 2100 to 2105, and places the values into the PLC memory addresses, V3000 to V3005.

The Start Slave Memory Address in the MRX box is 48449. 48449 is a MODBUS decimal number. To convert 48449 decimal to hex, you first subtract 40001, and then convert the remainder to hex (2100). 2100 is the address for the GS2 Status Monitor.



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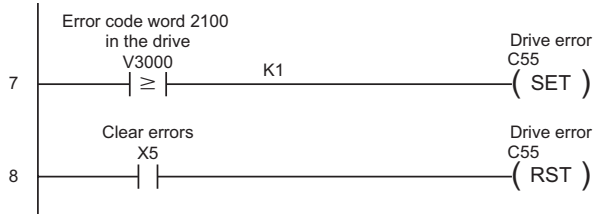
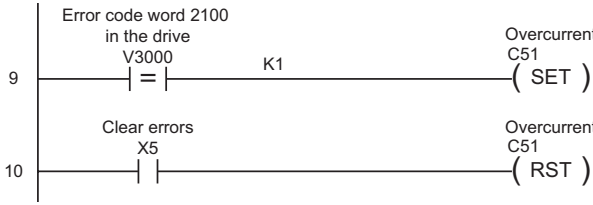
***Direct*LOGIC MODBUS Ladder Programming (cont.)**

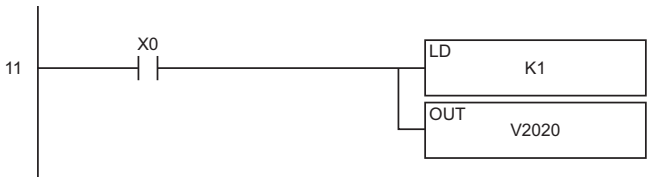
Rung 7 is used to set bit C55 if the AC drive has an error. Rung 8 will reset bit C55.



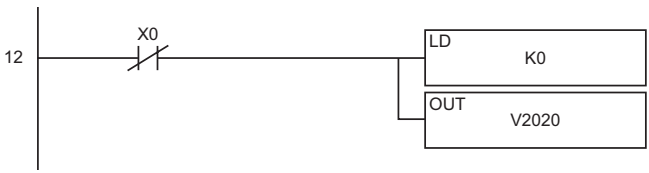
Rung 9 is used to set bit C51 if the AC drive has a specific error. In this example C51 will be set if the AC drive has an overcurrent error. Rung 10 will reset bit C51.



Rung 11 loads a value of 1 into drive parameter P 9.27. This is the signal to run. V2020 is the 17th V-memory register in the block of 20 that is being written to in the WX instruction in Rung 5.



Rung 12 loads a value of 0 into drive parameter P 9.27. This is the signal to stop. V2020 is the 17th V-memory register in the block of 20 that is being written to in the WX instruction in Rung 5.



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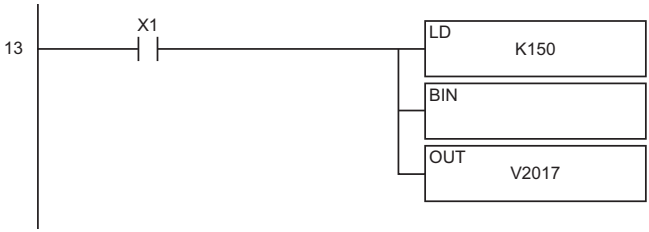
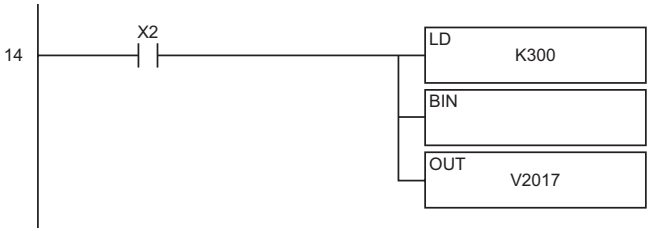
***Direct*LOGIC MODBUS Ladder Programming (cont.)**

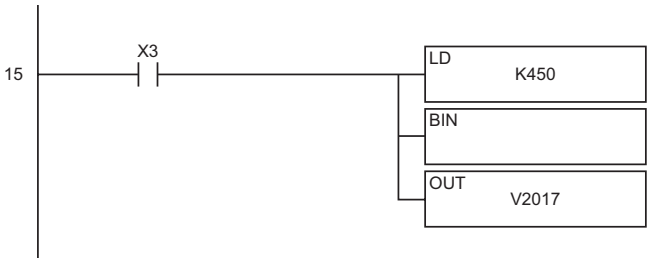
Rung 13 loads a decimal value of 150 into drive parameter P 9.26. The BIN instruction converts BCD/HEX to decimal. This tells the drive to run at 15.0Hz.



Rung 14 loads a decimal value of 300 into drive parameter P 9.26. The BIN instruction converts BCD/HEX to decimal. This tells the drive to run at 30.0Hz.



Rung 15 loads a decimal value of 450 into drive parameter P 9.26. The BIN instruction converts BCD/HEX to decimal. This tells the drive to run at 45.0Hz.



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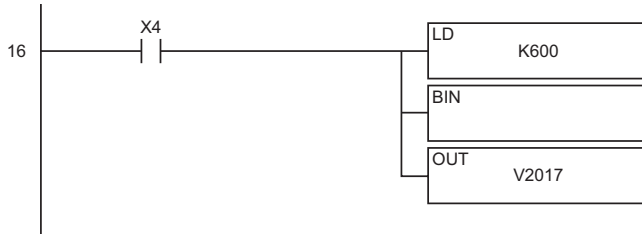
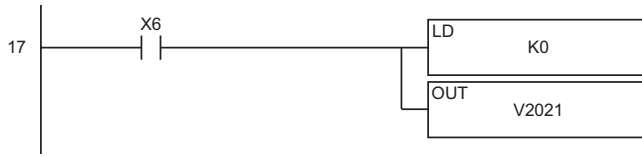
***Direct*LOGIC MODBUS Ladder Programming (cont.)**

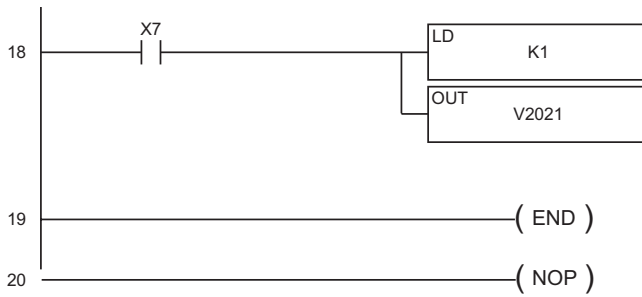
Rung 16 loads a decimal value of 600 into drive parameter P 9.26. The BIN instruction converts BCD/HEX to decimal. This tells the drive to run at 60.0Hz.



Rung 17 sets the motion of the drive to forward by loading a value of 0 into parameter P 9.28. V2021 is the 18th V-memory register in the block of 20 that is being written to in the WX instruction in Rung 5.



Rung 18 sets the motion of the drive to reverse by loading a value of 1 into parameter P 9.28. V2021 is the 18th V-memory register in the block of 20 that is being written to in the WX instruction in Rung 5.

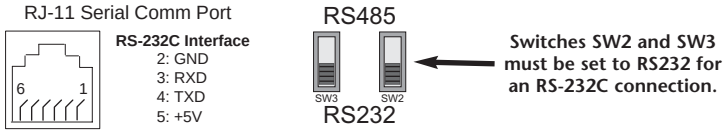


Communicating with Third-party Devices

First you must decide what type of interface will work best for your application. The GS2 RJ-11 Serial Comm Port can accomidate an RS232C or an RS 485 connection.

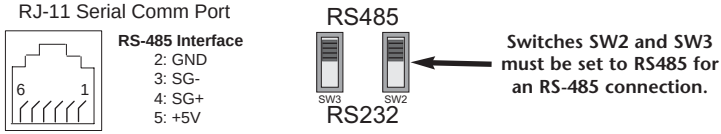
RS-232C

An RS-232C connection is somewhat limited. The maximum network cable length for an RS-232C connection is 15 meters (50 feet). In addtion, using the RS-232C interface will allow you to connect only one AC drive to one MODBUS device. For and RS-232C connection, set the GS2 DIP switches SW2 and SW3 to RS232.



RS-485

An RS-485 network cable can span up to 1000 meters (4000 feet). For an RS-485 connection, set the GS2 DIP switches SW2 and SW3 to RS485.



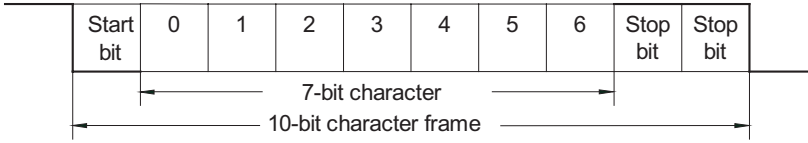
The GS2 Series AC drive communication address is specified by P 9.00. The third party device then controls each AC drive according to its communication address.

The GS2 Series AC drive can be setup to communicate on standard MODBUS networks using the following transmission modes: ASCII or RTU. Using the Communication Protocol parameter (P 9.02), you can select the desired mode, data bits, parity, and stop bits. The mode and serial parameters must be the same for all devices on a MODBUS network.

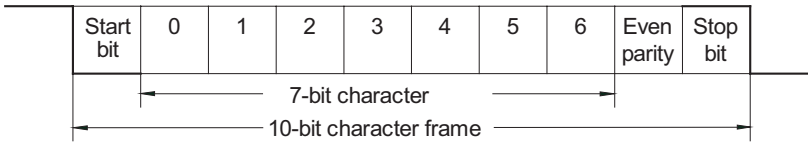
Data Format

ASCII Mode: 10-bit character frame (For 7-bit character):

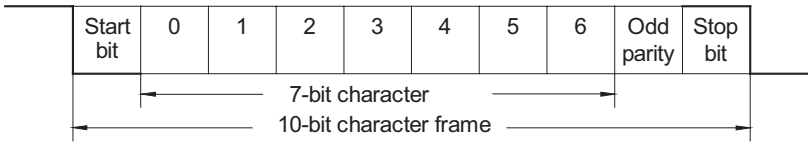
P 9.02 = 00 (7 data bits, no parity, 2 stop bits)



P 9.02 = 01 (7 data bits, even parity, 1 stop bit)

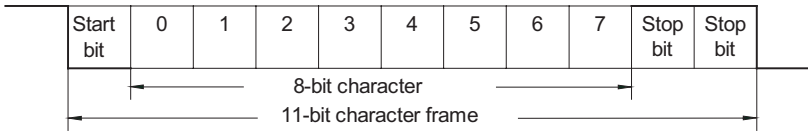


P 9.02 = 02 (7 data bits, odd parity, 1 stop bit)

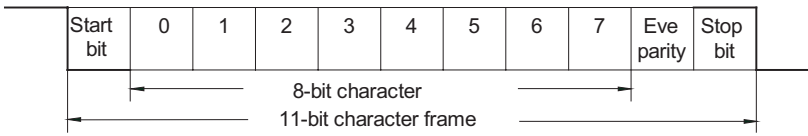


RTU Mode: 11-bit character frame (For 8-bit character):

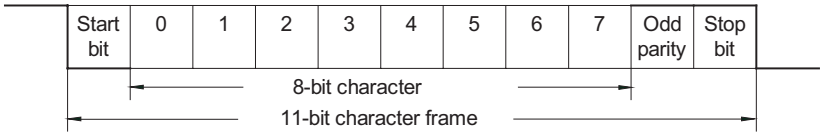
P 9.02 = 03 (8 data bits, no parity, 2 stop bit)



P 9.02 = 04 (8 data bits, even parity, 1 stop bit)



P 9.02 = 05 (8 data bits, odd parity, 1 stop bit)



Communication Protocol

ASCII Mode:

STX	Start Character: (3AH)
ADR 1	Communication Address: 8-bit address consists of 2 ASCII codes
ADR 0	
CMD 1	
CMD 0	
DATA (n-1)	Contents of data: n x 8-bit data consists of 2n ASCII codes. n[]25 maximum of 50 ASCII codes
.....	
DATA 0	
LRC CHK 1	LRC check sum: 8-bit check sum consists of 2 ASCII codes
LRC CHK 0	
END 1	END characters: END 1=CR (0DH), END 0 =LF (0AH)
END-0	

RTU Mode:

START	A silent interval of more than 10 ms
ADR	Communication Address: 8-bit address
CMD	
DATA (n-1)	Contents of data: n x 8-bit data,n<=25
.....	
DATA 0	
CRC CHK Low	CRC check sum: 16-bit check sum consists of 2 8-bit characters
CRC CHK High	
END	A silent interval of more than 10 ms

ADR (Communication Address)

Valid communication addresses are in the range of 0 to 254. Communication address equals to 0 means broadcast to all AC drives (AMD), in this case, the AMD will not reply any message to the master device.

For example, communication to AMD with address 16 decimal:

ASCII mode: (ADR 1, ADR 0)='1','0' => '1'=31H, '0'=30H
RTU mode: (ADR)=10H

CMD (Command code) and DATA (data characters)

The format of data characters depends on the command code. The available command codes are described as followed: Command code: 03H, read N words. The maximum value of N is 12. For example, reading continuous 2 words from starting address 2102H of AMD with address 01H.

ASCII mode:

Command Message	
STX	':'
ADR 1 ADR 0	'0' '1'
CMD 1 CMD 0	'0' '3'
Starting data address	'2' '1' '0' '2'
Number of data (Count by word)	'0' '0' '0' '2'
LRC CHK 1 LRC CHK 0	'D' '7'
END 1 END 0	CR LF

Response Message	
STX	':'
ADR 1 ADR 0	'0' '1'
CMD 1 CMD 0	'0' '3'
Number of data (Count by byte)	'0' '4'
Content of starting data address 2102H	'1' '7' '7' '0'
Content data address 2103H	'0' '0' '0' '0'
LRC CHK 1 LRC CHK 0	'7' '1'
END 1 END 0	CR LF

RTU mode:

Command Message	
ADR	01H
CMD	03H
Starting data address	21H 02H
Number of data (Count by word)	00H 02H
CRC CHK Low CRC CHK High	6FH F7H

Response Message	
ADR	01H
CMD	03H
Number of data (Count by byte)	04H
Content of data address 2102H	17H 70H
Content of data address 2103H	00H 02H
CRC CHK Low CRC CHK High	FEH 5CH

Command code: 06H, write 1 word

For example, writing 6000(1770H) to address 0100H of AMD with address 01H.

ASCII mode:

Command Message	
STX	':'
ADR 1 ADR 0	'0'
	'1'
CMD 1 CMD 0	'0'
	'6'
Data Address	'0'
	'1'
	'0'
	'0'
	'1'
	'7'
	'7'
	'0'
LRC CHK 1 LRC CHK 0	'7'
	'1'
END 1 END 0	CR
	LF

Response Message	
STX	':'
ADR 1 ADR 0	'0'
	'1'
CMD 1 CMD 0	'0'
	'6'
Data Address	'0'
	'1'
	'0'
	'0'
Data Content	'1'
	'7'
	'7'
	'0'
LRC CHK 1 LRC CHK 0	'7'
	'1'
END 1 END 0	CR
	LF

RTU mode:

This is an example of using function code 16 for writing to multiple registers.

Command Message	
ADR	01H
CMD	10H
Starting data address	20H
	00H
Number of data (Count by byte)	04H
Content of data address 2000H	00H
	02H
Content of data address 2001H	02H
	58H
CRC CHK Low CRC CHK High	CBH
	34H

Response Message	
ADR	01H
CMD	10H
Starting data address	20H
	00H
Number of data (Count by word)	00H
	02H
CRC CHK Low CRC CHK High	4AH
	08H

CHK (check sum)

ASCII Mode:

LRC (Longitudinal Redundancy Check) is calculated by summing up, module 256, the values of the bytes from ADR1 to last data character then calculating the hexadecimal representation of the 2's-complement negation of the sum.

For example, reading 1 word from address 0401H of the AC drive with address 01H.

Command Message	
STX	':'
ADR 1 ADR 0	'0' '1'
CMD 1 CMD 0	'0' '3'
Starting data address	'0' '4' '0' '1'
Number of data (Count by word)	'0' '0' '0' '1'
LRC CHK 1 LRC CHK 0	'F' '6'
END 1 END 0	CR LF

01H+03H+04H+01H+00H+01H=0AH,
the 2's complement negation of 0AH is F6H.

RTU Mode:

Response Message	
ADR	01H
CMD	03H
Starting data address	21H 02H
Number of data (Count by word)	00H 02H
CRC CHK Low CRC CHK High	6FH F7H

CRC (Cyclical Redundancy Check) is calculated by the following steps:

Step 1: Load a 16-bit register (called CRC register) with FFFFH.

Step 2: Exclusive OR the first 8-bit byte of the command message with the low order byte of the 16-bit CRC register, putting the result in the CRC register.

Step 3: Shift the CRC register one bit to the right with MSB zero filling. Extract and examine the LSB.

Step 4: If the LSB of CRC register is 0, repeat step 3, else Exclusive or the CRC register with the polynomial value A001H.

Step 5: Repeat step 3 and 4 until eight shifts have been performed. When this is done, a complete 8-bit byte will have been processed.

Step 6: Repeat steps 2 to 5 for the next 8-bit byte of the command message.

Continue doing this until all bytes have been processed. The final contents of the CRC register are the CRC value.

Note: When transmitting the CRC value in the message, the upper and lower bytes of the CRC value must be swapped, i.e. the lower order byte will be transmitted first.

The following is an example of CRC generation using C language. The function takes two arguments:

Unsigned char* data ← a pointer to the message buffer
Unsigned char length ← the quantity of bytes in the message buffer

The function returns the CRC value as a type of unsigned integer.

```
Unsigned int crc_chk(unsigned char* data, unsigned char length){
  int j;
  unsigned int reg_crc=0xFFFF;
  while(length--){
    reg_crc ^= *data++;
    for(j=0;j<8;j++){
      if(reg_crc & 0x01){  /* LSB(b0)=1 */
        reg_crc=(reg_crc>>1) ^ 0xA001;
      }else{
        reg_crc=reg_crc >>1;
      }
    }
  }
 return reg_crc;
}
```

Chapter 6

Maintenance and Troubleshooting

In This Chapter...

Maintenance and Inspection 6–2
Troubleshooting 6–3

Maintenance and Inspection

Modern AC drives are based on solid state electronics technology. Preventive maintenance is required to operate the AC drive in its optimal condition, and to ensure a long life. It is recommended that a qualified technician perform a regular inspection of the AC drive. Some items should be checked once a month, and some items should be checked yearly. Before the inspection, always turn off the AC Input Power to the unit. Wait at least 2 minutes after all display lamps have turned off, and then confirm that the capacitors have fully discharged by measuring the voltage between B1 and Frame Ground using a multimeter set to measure DC voltage.

WARNING! Disconnect AC power and ensure that the internal capacitors have fully discharged before inspecting the AC drive!

Monthly Inspection:

Check the following items at least once a month.

1. Make sure the motors are operating as expected.
2. Make sure the installation environment is normal.
3. Make sure the cooling system is operating as expected.
4. Check for irregular vibrations or sounds during operation.
5. Make sure the motors are not overheating during operation.
6. Check the input voltage of the AC drive and make sure the voltage is within the operating range. Check the voltage with a voltmeter.

Annual Inspection

Check the following items once annually.

1. Tighten and reinforce the screws of the AC drive if necessary. They may loosen due to vibration or changing temperatures.
2. Make sure the conductors and insulators are not corroded and damaged.
3. Check the resistance of the insulation with Megaohmeter.
4. Check the the capacitors and relays, and replace if necessary.
5. Clean off any dust and dirt with a vacuum cleaner. Pay special attention to cleaning the ventilation ports and PCBs. Always keep these areas clean. Accumulation of dust and dirt in these areas can cause unforeseen failures.

If the AC drive is not used for a long period of time, turn the power on at least once every two years and confirm that it still functions properly. To confirm functionality, disconnect the motor and energize the AC drive for 5 hours or more before attempting to run a motor with it.

Troubleshooting

Fault Codes

The AC drive has a comprehensive fault diagnostic system that includes several different alarms and fault messages. Once a fault is detected, the corresponding protective functions will be activated. The fault codes are then displayed on the digital keypad display. The three most recent faults can be read on the digital keypad display by viewing P 6.17 to P 6.19.

NOTE: Faults can be cleared by a reset from the keypad or input terminal.

Fault Codes		
Fault Name	**Fault Descriptions**	**Corrective Actions**
oc	The AC drive detects an abnormal increase in current.	1. Check whether the motor's horsepower corresponds to the AC drive output power. 2. Check the wiring connections between the AC drive and motor for possible short circuits. 3. Increase the Acceleration time (P 1.01 or P 1.05). 4. Check for possible excessive loading conditions at the motor. 5. If there are any abnormal conditions when operating the AC drive after short-circuit is removed, the AC drive should be sent back to the manufacturer.
ou	The AC drive detects that the DC bus voltage has exceeded its maximum allowable value.	1. Check whether the input voltage falls within the rated AC drive input voltage. 2. Check for possible voltage transients. 3. Bus over-voltage may also be caused by motor regeneration. Either increase the decel time or add an optional braking resistor. 4. Check whether the required braking power is within the specified limits.
oH	The AC drive temperature sensor detects excessive heat.	1. Ensure that the ambient temperature falls within the specified temperature range. 2. Make sure that the ventilation holes are not obstructed. 3. Remove any foreign objects on the heatsinks and check for possible dirty heat sink fins. 4. Provide enough spacing for adequate ventilation.
Lu	The AC drive detects that the DC bus voltage has fallen below its minimum value.	Check whether the input voltage falls within the AC drive's rated input voltage.
oL	The AC drive detects excessive drive output current. Note: The AC drive can withstand up to 150% of the rated current for a maximum of 60 seconds.	1. Check whether the motor is overloaded. 2. Reduce torque compensation setting as set in P 2.02. 3. Increase the AC drive's output capacity.

Fault Codes (cont.)		
Fault Name	**Fault Descriptions**	**Corrective Actions**
oL1	Internal electronic overload trip	1. Check for possible motor overload. 2. Check electronic thermal overload setting. 3. Increase motor capacity. 4. Reduce the current level so that the AC drive output current does not exceed the value set by the Motor Rated Current P 0.01.
oL2	Motor overload. Check the parameter settings (P 6.07 to P 6.09)	1. Reduce the motor load. 2. Adjust the over-torque detection setting to an appropriate level.
ocA	Over-current during acceleration: 1. Short-circuit at motor output. 2. Torque boost too high. 3. Acceleration time too short. 4. AC drive output capacity is too small.	1. Check for possible poor insulation at the output line. 2. Decrease the torque boost setting in P 2.02. 3. Increase the acceleration time. 4. Replace with the AC drive with one that has a higher output capacity (next HP size).
ocd	Over-current during deceleration 1. Short-circuit at motor output. 2. Deceleration time too short. 3. AC drive output capacity is too small.	1. Check for possible poor insulation at the output line. 2. Increase the deceleration time. 3. Replace with the AC drive with one that has a higher output capacity (next HP size).
ocn	Over-current during steady state operation: 1. Short-circuit at motor output. 2. Sudden increase in motor loading. 3. AC drive output capacity is too small.	1. Check for possible poor insulation at the output line. 2. Check for possible motor stall. 3. Replace with the AC drive with one that has a higher output capacity (next HP size).
cFI	Internal memory IC cannot be programmed.	1. Switch off power supply. 2. Check whether the input voltage falls within the AC drive's rated input voltage. 3. Switch the AC drive back on.
cF2	Internal memory IC can not be read.	1. Check the connections between the main control board and the power board. 2. Reset drive to factory defaults.
HPF	Hardware protection failure	Return to the factory.
codE	Software protection failure	Return to the factory.
cF3	AC Drive's internal circuitry abnormal.	1. Switch off power supply. 2. Check whether the input voltage falls within the rated AC drive input voltage. Switch on the AC drive.
EF	The external terminal EF-GND goes from OFF to ON.	When external terminal EF-GND is closed, the output will be turned off (under N.O. E.F.).
cFA	Auto accel/decel failure	Don't use the function of auto acceleration/ deceleration.

Fault Codes (cont.)		
Fault Name	**Fault Descriptions**	**Corrective Actions**
	Ground fault : The AC drive output is abnormal. When the output terminal is grounded (short circuit current is 50% more than the AC drive rated current), the AC drive power module may be damaged. The short circuit protection is provided for AC drive protection, not user protection.	Ground fault : 1. Check whether the IGBT power module is damaged. 2. Check for possible poor insulation at the output line.
	External Base Block: AC drive output is turned off.	1. When the external input terminal (base-block) is active, the AC drive output will be turned off. 2. Disable this connection and the AC drive will begin to work again.
	Input Power 3 phase loss: One phase of the input power is lost.	1. Check for possible poor connection on the input power line. 2. Check for possible loss of phase on input power line.

Warning Messages

There are several Warning Messages that GS2 AC Drive may give. The GS2 AC Drive allows you to decide how the AC drive should react to these messages. The descriptions of the Warning Messages are listed below.

Warning Messages		
Warning Name	**Warning Descriptions**	**Corrective Actions**
	Communications Warning: Illegal command code - The command code received in the command message is not available for the AC drive.	The corrective action can be set with the Transmission Fault Treatment parameter (P9.03). The available settings are: 00 - Display fault and continue operating 01 - Display fault and RAMP to stop 02 - Display fault and COAST to stop 03 - No fault displayed and continue operating The default setting is 00.
	Communications Warning: Illegal data address - The data address received in the command message is not available for the AC drive.	
	Communications Warning: Illegal data value - The data value received in the command message is not available for the AC drive.	
	Communications Warning: Slave device failure - The AC drive is unable to perform the requested action.	
	Communications Warning: Communication Time Out	
	PID Warning: PID Feedback Loss - The 4-20mA PID signal has been lost.	The corrective action can be set with the PID Feedback Loss parameter (P7.27). The available settings are: 00 - Warn and AC Drive Stop 01 - Warn and Continue The default setting is 00.

Appendix A

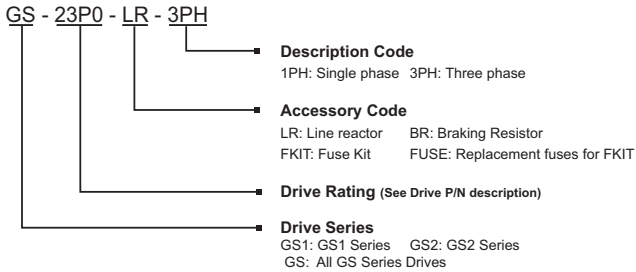
Accessories

In This Appendix...

Accessories Part Numbering A–2
Line Reactors A–2
Braking Resistors A–7
EMI Input Filters A–9
Circuit Protection Devices A–13
Fuse Kits A–13
Miscellaneous Accessories A–16

Accessories Part Numbering

All GS2 Series accessories part numbers, with the exception of EMI Filters, incorporate the part numbers of AC Drives for which they are compatible. Each accessory part number begins with the compatible AC Drive series and rating. This is followed by an accessory code. Following the accessory code, you will find a description code when applicable. The diagram below shows the accessory part numbering scheme.



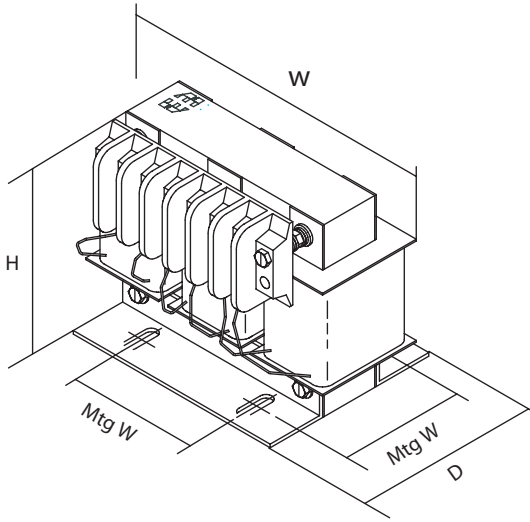
Line Reactors

200-240 VOLT Single Phase					
Part Number	**Rated HP**	**Rated Amps**	**Impedance**	**Inductance**	**Watts Loss**
GS-20P5-LR-1PH	0.5	4	3%	6.50mH	13W
GS-21P0-LR-1PH	1	4	3%	6.50mH	13W
GS-22P0-LR-1PH	2	8	3%	3.00mH	25W
GS-23P0-LR-1PH	3	12	3%	2.50mH	26W

200-240 VOLT Three Phase					
Part Number	**Rated HP**	**Rated Amps**	**Impedance**	**Inductance**	**Watts Loss**
GS-20P5-LR-3PH	0.5	4	3%	6.50mH	13W
GS-21P0-LR-3PH	1	4	3%	3.00mH	7W
GS-22P0-LR-3PH	2	8	3%	1.50mH	11W
GS-23P0-LR-3PH	3	12	3%	1.30mH	23W
GS-25P0-LR	5	18	3%	0.80mH	19W
GS-27P5-LR	7.5	25	3%	0.50mH	23W

380-480 VOLT Three Phase					
Part Number	**Rated HP**	**Rated Amps**	**Impedance**	**Inductance**	**Watts Loss**
GS-41P0-LR	1	2	3%	12.0mH	7
GS-42P0-LR	2	4	3%	6.50mH	13
GS-43P0-LR	3	8	3%	5.00mH	31
GS-45P0-LR	5	8	3%	3.00mH	25
GS-47P5-LR	7.5	12	3%	2.50mH	26
GS-4010-LR	10	18	3%	1.50mH	29

Line Reactor Dimensions



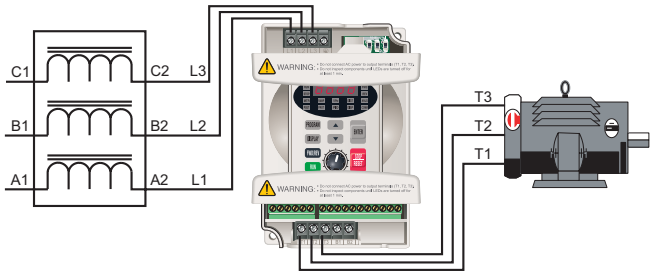
AC Line Reactor Dimensions*							
Part Number	H	W	D	Mtg.D	Mtg. W	Mtg Slot Hole Size	Weight (lbs)
GS-20P5-LR-1PH	3.40	4.40	2.83	1.77	1.44	.28 X .63	2.80
GS-20P5-LR-3PH	3.40	4.40	2.83	1.77	1.44	.28 X .63	2.80
GS-21P0-LR-1PH	3.40	4.40	2.83	1.77	1.44	.28 X .63	2.80
GS-21P0-LR-3PH	3.40	4.40	2.83	1.77	1.44	.28 X .63	2.30
GS-22P0-LR-1PH	3.40	4.40	2.83	1.77	2.00	.28 X .63	3.10
GS-22P0-LR-3PH	3.40	4.40	2.83	1.77	2.00	.28 X .63	2.80
GS-23P0-LR-1PH	4.80	6.00	3.30	2.09	2.00	.28 X .63	7.50
GS-23P0-LR-3PH	3.40	4.40	2.83	1.77	2.00	.28 X .63	2.90
GS-25P0-LR	4.80	6.00	3.30	2.09	2.00	.28 X .63	7.10
GS-27P5-LR	5.70	6.00	3.09	2.09	3.00	.28 X .63	7.00
GS-41P0-LR	3.40	4.40	2.83	1.77	1.44	.28 X .63	2.30
GS-42P0-LR	3.40	4.40	2.83	1.77	1.44	.28 X .63	2.80
GS-43P0-LR	3.40	4.40	3.39	2.39	2.00	.28 X .63	4.30
GS-45P0-LR	3.40	4.40	2.83	1.77	2.00	.28 X .63	3.10
GS-47P5-LR	4.80	6.00	3.30	2.09	2.00	.28 X .63	7.50
GS-4010-LR	4.80	6.30	3.55	2.34	2.00	.28 X .63	9.10

***Dimensions in millimeters**

Line Reactor Applications and Connections

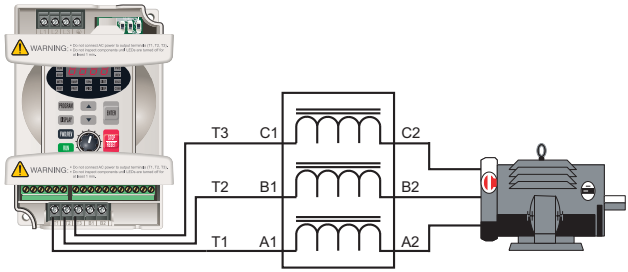
Input Side of AC Drive

When installed on the input side of the AC Drive, line reactors will reduce line notching, limit current and voltage spikes and surges from the incoming line. The line reactors will also reduce harmonic distortion from the AC Drive onto the line. Units are installed in front of the AC Drive as shown.



Output Side of AC Drive

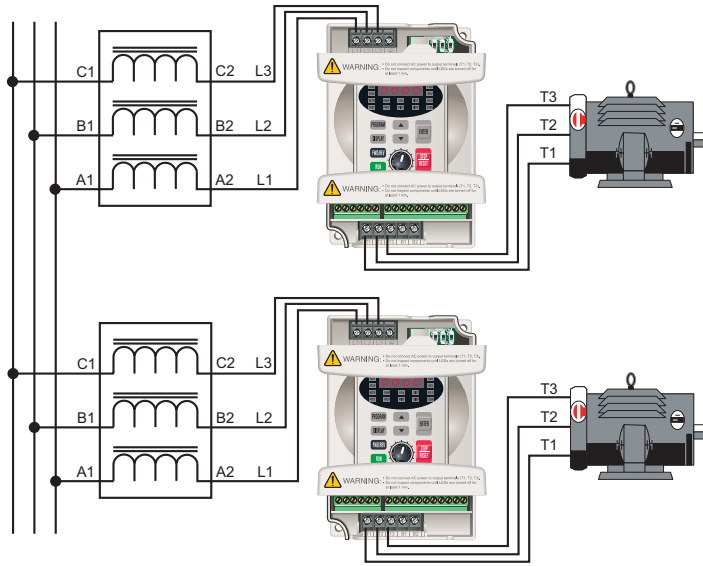
When installed on the output side of the AC Drive, line reactors protect the AC Drive from short circuits at the load. Voltage and current waveforms from the AC Drive are enhanced, reducing motor overheating and noise emissions.



Note: Single phase line reactors should not be installed on the output of the AC Drive. Use three-phase only.

Multiple AC Drives

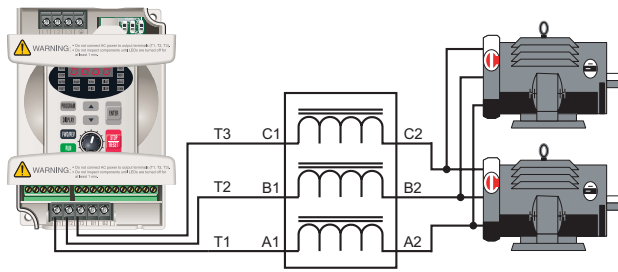
Individual line reactors are recommended when installing multiple AC Drives on the same power line. Individual line reactors eliminate cross-talk between multiple AC Drives and provide isolated protection for each AC Drive for its own specific load.



Multiple Motors

A single reactor can be used when the application calls for multiple motors on the same AC Drive. The reactor is sized based on the total horsepower of all the motors.

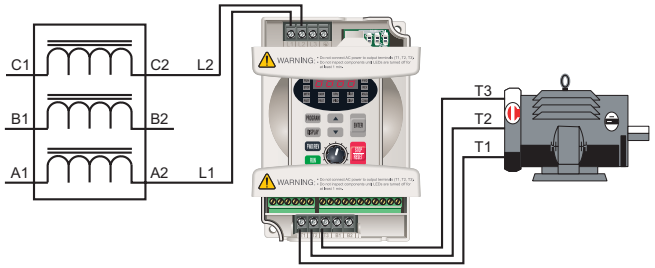
Note: A single reactor should only be used with multiple motors when the motors will operate simultaneously.



Single-phase Applications

Some of the line reactors are listed for use with single-phase input power. Follow the connection diagram below. Make sure that terminals B1 and B2 are properly insulated before any connections are made.

WARNING: Please ensure you properly insulate terminals B1 and B2 before making any connections to single-phase power.



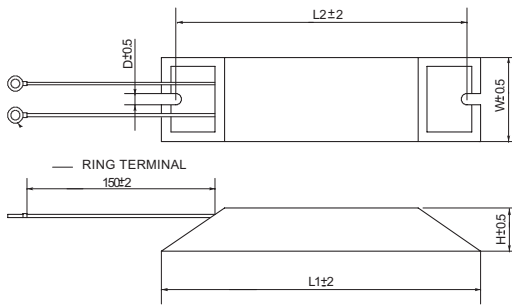
Braking Resistors

Braking resistors are used to increase the control torque of the AC Drive, for frequently repeated ON-OFF cycles of the AC Drive, or for decelerating a load with large inertia.

Note: The use of braking resistors with GS2 Series AC drives requires no parameter setup. The AC drive will automatically sense the presence of a braking resistor.

Braking Resistor Specifications				
Part Number	**Braking Torque**	**Type**	**W**	**Duty Cycle**
GS-20P5-BR	270%	200Ω	80	10%
GS-21P0-BR	125%	200Ω	80	10%
GS-22P0-BR	125%	100Ω	300	10%
GS-23P0-BR	125%	70Ω	300	10%
GS-25P0-BR	125%	40Ω	400	10%
GS-27P5-BR	125%	30Ω	500	10%
GS-41P0-BR	125%	750Ω	80	10%
GS-42P0-BR	125%	400Ω	300	10%
GS-43P0-BR	125%	250Ω	300	10%
GS-45P0-BR	125%	150Ω	400	10%
GS-47P5-BR	125%	100Ω	500	10%
GS-4010-BR	125%	75Ω	1000	10%

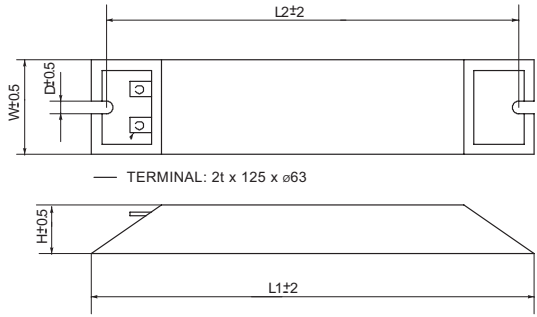
Dimensions



Braking Resistor Dimensions*						
Part Number	**L1**	**L2**	**H**	**D**	**W**	**Maximum weight (g)**
GS-27P5-BR	335	320	30	5.3	60	1100
GS-47P5-BR	335	320	30	5.3	60	1100
GS-4010-BR	400	385	50	5.3	100	2800

***Dimensions in millimeters**

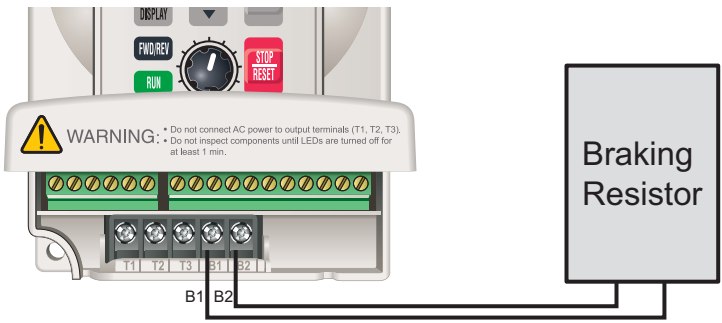
Dimensions (cont.)



Braking Resistor Dimensions*						
Part Number	L1	L2	H	D	W	Maximum weight (g)
GS-20P5-BR	140	125	20	5.3	60	160
GS-21P0-BR	140	125	20	5.3	60	160
GS-22P0-BR	215	200	30	5.3	60	750
GS-23P0-BR	215	200	30	5.3	60	750
GS-25P0-BR	265	250	30	5.3	60	930
GS-41P0-BR	140	125	20	5.3	60	160
GS-42P0-BR	215	200	30	5.3	60	750
GS-43P0-BR	215	200	30	5.3	60	750
GS-45P0-BR	265	250	30	5.3	60	930

***Dimensions in millimeters**

Braking Resistor Connections



EMI Input Filters

The EC Declaration of Conformity for the GS2 Series AC Drives was completed in conjunction with EMI Filters listed below. Use the following table to specify the corresponding EMI Filter for each AC Drive model.

Note: CE compliance requires the use of EMI filters.

EMI Input Filter Specifications			
AC Drive Model	**EMI Filter Model**	**Input Power**	**Dimensions**
GS2-20P5	**20DRT1W3S**	250V, 1-phase, 20A	Figure 1
GS2-21P0			
GS2-22P0			
GS2-23P0	**32DRT1W3C**	250V, 1-phase, 32A	Figure 2
GS2-25P0	**40TDS4W4B**	250V, 3-phase, 40A	Figure 3
GS2-27P5			
GS2-41P0	**11TDT1W4S**	480V, 3-phase, 11A	Figure 4
GS2-42P0			
GS2-43P0			
GS2-45P0	**17TDT1W44**	480V, 3-phase, 17A	Figure 5
GS2-47P5			
GS2-4010	**26TDT1W4B4**	480V, 3-phase, 26A	Figure 6

Dimensions

Figure 1

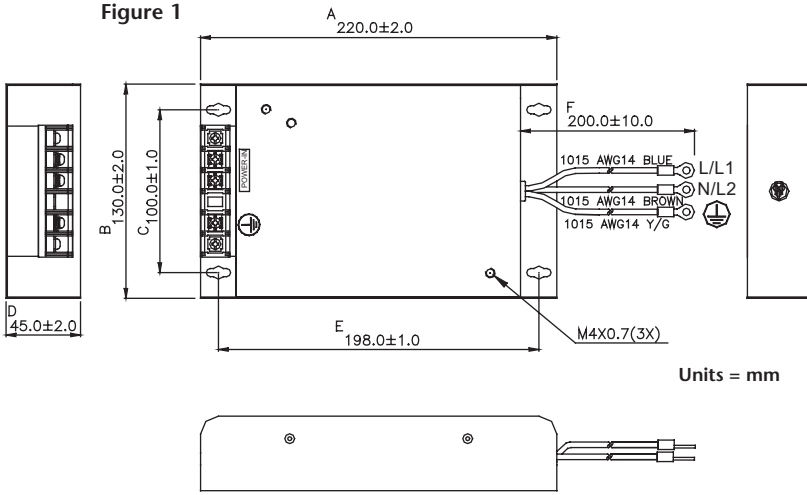
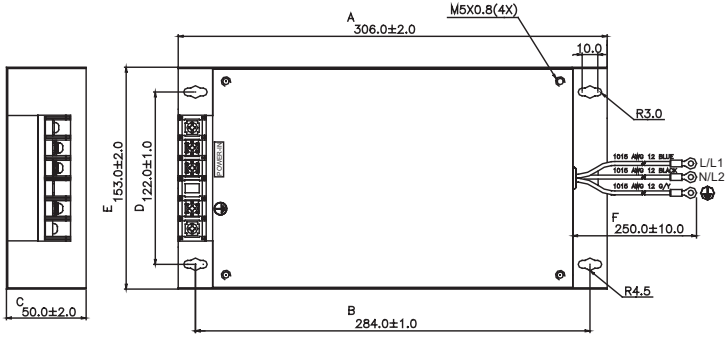
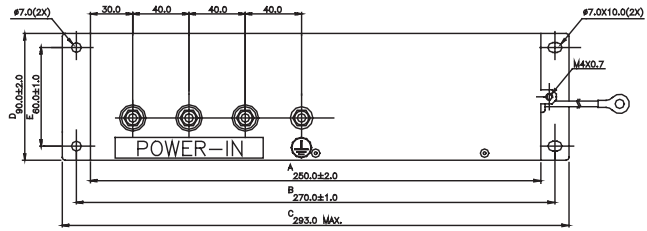


Figure 2



Units = mm

Figure 3



Units = mm

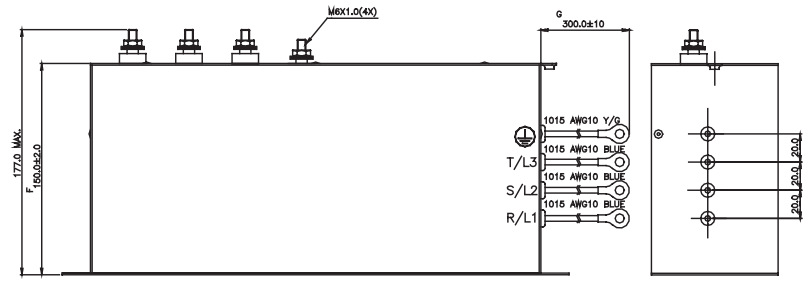
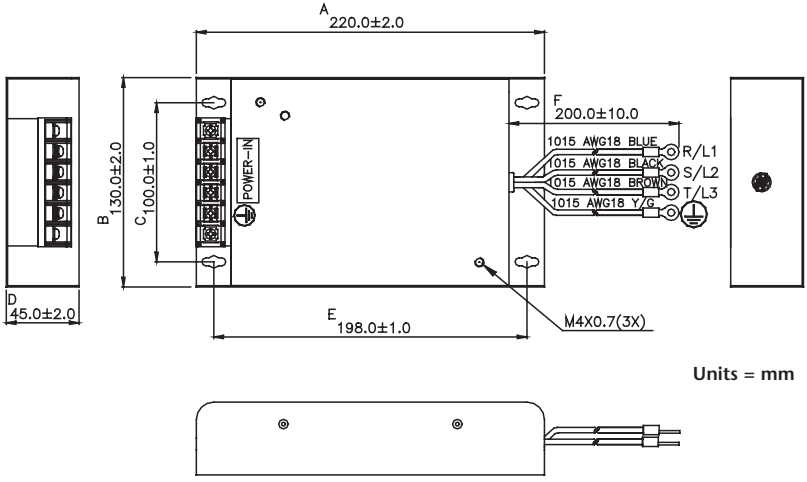
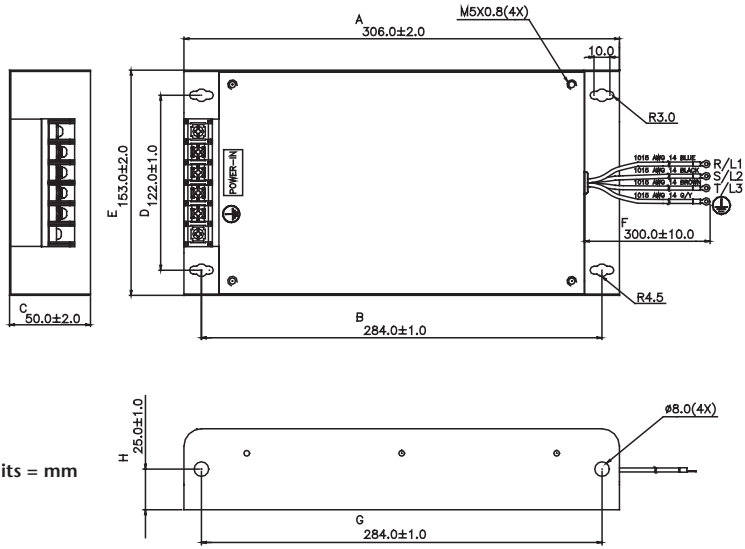


Figure 4



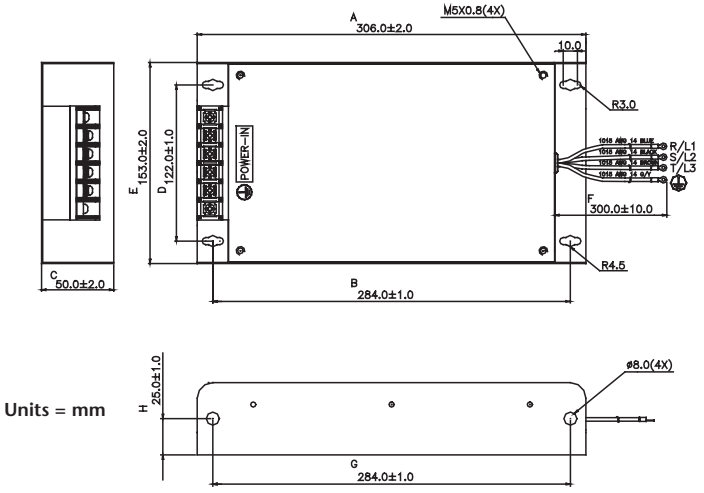
Units = mm

Figure 5



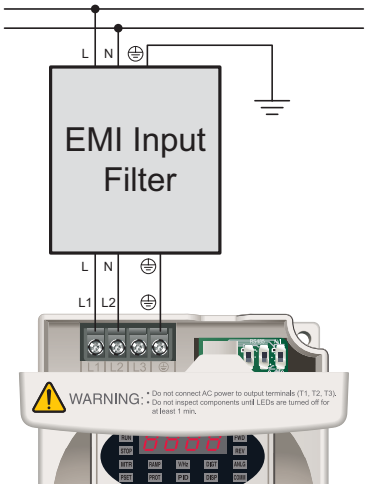
Units = mm

Figure 6

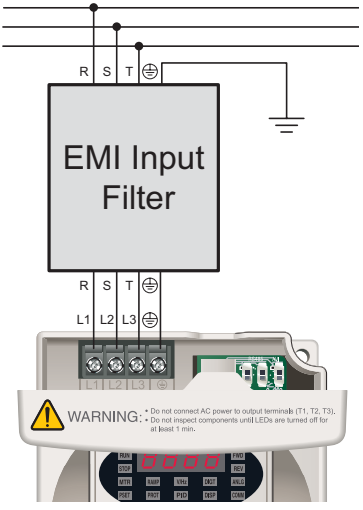


EMI Filter Connections

1-phase Input Power



3-phase Input Power



Circuit Protection Devices

Circuit protection devices are essential to prevent costly damage to your AC Drive application equipment. Fuse kits are available from AutomationDirect for the GS2 Series AC Drives, and their specifications are found below. Specifications for other circuit protection devices used in conjuction with the GS2 AC Drives can be found on the next few pages.

Fuse Kits

The following fuse kits consist of one fuse block and fuses sized to match each GS2 Series AC Drive. Replacement fuses are also available, and their part numbers are listed in the table below.

Fuse Kit Specifications

Part Number	Fuse Block	Wire Range	Fuse Type	Dimensions	Fuse Rating	Replacement Fuses
GS-20P5-FKIT-1PH	Two-pole	Al/Cu #2-14	A3T	Figure 1	300V@20A	**GS-20P5-FUSE-1PH**
GS-20P5-FKIT-3PH	Three-pole			Figure 2	300V@10A	**GS-20P5-FUSE-3PH**
GS-21P0-FKIT-1PH	Two-pole			Figure 1	300V@30A	**GS-21P0-FUSE-1PH**
GS-21P0-FKIT-3PH	Three-pole			Figure 2	300V@20A	**GS-21P0-FUSE-3PH**
GS-22P0-FKIT-1PH	Two-pole			Figure 1	300V@45A	**GS-22P0-FUSE-1PH**
GS-22P0-FKIT-3PH	Three-pole			Figure 2	300V@25A	**GS-22P0-FUSE-3PH**
GS-23P0-FKIT-1PH	Two-pole			Figure 1	300V@60A	**GS-23P0-FUSE-1PH**
GS-23P0-FKIT-3PH	Three-pole			Figure 2	300V@40A	**GS-23P0-FUSE-3PH**
GS-25P0-FKIT	Three-pole			Figure 2	300V@60A	**GS-25P0-FUSE**
GS-27P5-FKIT	Three-pole	Al/Cu 2/0-#6		Figure 3	300V@100A	**GS-27P5-FUSE**
GS-41P0-FKIT	Three-pole	Al/Cu #2-14	A6T	Figure 4	600V@10A	**GS-41P0-FUSE**
GS-42P0-FKIT	Three-pole				600V@15A	**GS-42P0-FUSE**
GS-43P0-FKIT	Three-pole				600V@20A	**GS-43P0-FUSE**
GS-45P0-FKIT	Three-pole				600V@30A	**GS-45P0-FUSE**
GS-47P5-FKIT	Three-pole			Figure 5	600V@50A	**GS-47P5-FUSE**
GS-4010-FKIT	Three-pole	Al/Cu 2/0-#6		Figure 6	600V@70A	**GS-4010-FUSE**

Fuse Kit Dimensions

Figure 1

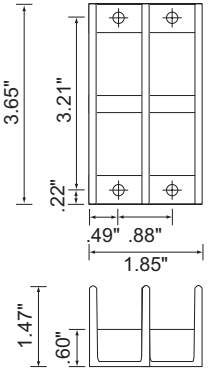


Figure 2

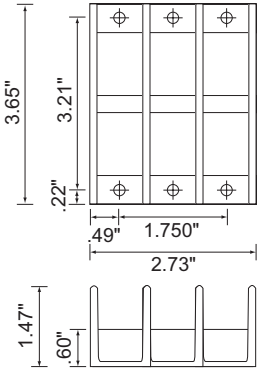


Figure 3

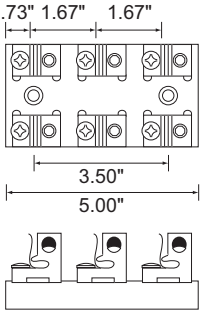


Figure 4

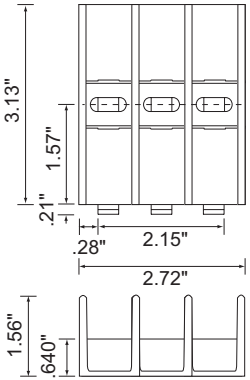


Figure 5

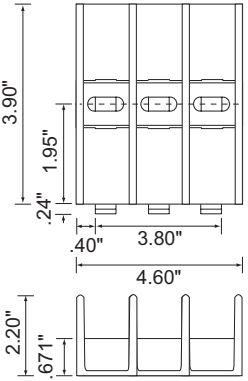
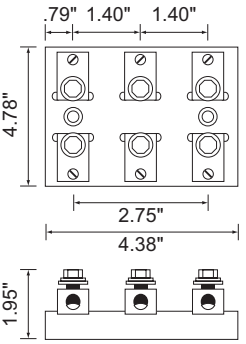


Figure 6



*Units = inches

Non-fuse Circuit Breaker Chart

If you choose to use a non-fuse circuit breaker in your application, refer to the chart below for sizing.

1. For 1-phase AC Drives with input currents of 100A or less, the current rating of the breaker shall be four times the maximum of **input** current rating.
2. For 3-phase AC Drives with output currents of 100A or less, the current rating of the breaker shall be four times the maximum of **output** current rating.

Non-fuse Circuit Breaker Chart			
AC Drive Model	**Input Current**	**Output Current**	**Recommended Breaker Size**
GS2-20P5 (1 Ø/3 Ø)*	6.3A	2.5A	25A/10A
GS2-21P0 (1 Ø/3 Ø)*	11.5A	5.0A	45A/20A
GS2-22P0 (1 Ø/3 Ø)*	15.7A	7.0A	60A/25A
GS2-23P0 (1 Ø/3 Ø)*	27A	10A	100A/40A
GS2-25P0	19.6A	17A	60A
GS2-27P5	32A	25A	100A
GS2-41P0	4.2A	3.0A	10A
GS2-42P0	5.7A	4.0A	15A
GS2-43P0	7.0A	5.0A	20A
GS2-45P0	8.5A	8.2A	30A
GS2-47P5	14A	13A	50A
GS2-4010	19A	18A	70A

* Circuit breaker size is dependant on input power phase.

Fuse Specification Chart

The chart below gives the recommend fuse sizes for the GS2 Series AC Drives. Smaller fuses than those shown in the table are permitted.

Fuse Specification Chart			
AC Drive Model	**Input Current**	**Output Current**	**Recommended Fuse Size**
GS2-20P5 (1 Ø/3 Ø)*	6.3A	2.5A	20A/10A
GS2-21P0 (1 Ø/3 Ø)*	11.5A	5.0A	30A/20A
GS2-22P0 (1 Ø/3 Ø)*	15.7A	7.0A	45A/25A
GS2-23P0 (1 Ø/3 Ø)*	27A	10A	60A/40A
GS2-25P0	19.6A	17A	60A
GS2-27P5	32A	25A	100A
GS2-41P0	4.2A	3.0A	10A
GS2-42P0	5.7A	4.0A	15A
GS2-43P0	7.0A	5.0A	20A
GS2-45P0	8.5A	8.2A	30A
GS2-47P5	14A	13A	50A
GS2-4010	19A	18A	70A

* Ø=phase
Fuse size is dependant on input power phase.

Miscellaneous Accessories

Spare Keypad

GS2-KPD

Spare or replacement keypad for GS2 AC drives

GS2-KPD

Keypad Cables

GS-CBL2-1L

1 meter keypad cable

GS-CBL2-3L

3 meter keypad cable

GS-CBL2-5L

5 meter keypad cable

GS-CBL2-1L **GS-CBL2-3L** **GS-CBL2-5L**

Communication Distribution Blocks

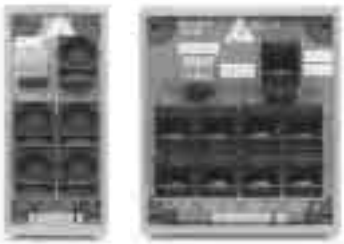
GS-RS485-4

4 port RS485 Communication Distribution Block

GS-RS485-8

8 port RS485 Communication Distribution Block

GS-RS485-4 **GS-RS485-8**



USING GS2 AC DRIVES WITH *DIRECT*LOGIC PLCS

APPENDIX B

In This Appendix...

Compatible *Direct*LOGIC PLCs and Modules B–2
Typical Connections to the GS2 Series AC Drive . .B–6

Compatible *Direct*LOGIC PLCs and Modules

The following tables show which *Direct*LOGIC PLCs and modules can be used with the GS2 Series AC Drive.

*Direct*LOGIC PLC Modules for Use with GS2 AC Drives	
DL05 PLCs	
D0-05AR	DL05 CPU, 8 AC in / 6 Relay out, 110/220VAC Power Supply. Inputs: 8 AC inputs, 90-120 VAC, 2 isolated commons. Outputs: 6 Relay outputs, 6-27 VDC, 6-240 VAC, 2A/pt. max., 2 isolated commons
D0-05DR	DL05 CPU, 8 DC in / 6 Relay out, 110/220VAC Power Supply. Inputs: 8 DC inputs, 12-24 VDC current sinking/sourcing, 2 isolated commons. Outputs: 6 Relay outputs, 6-27 VDC, 6-240 VAC, 2A/pt. max., 2 isolated commons
D0-05DD	DL05 CPU, 8 DC in / 6 DC out, 110/220VAC Power Supply. Inputs: 8 DC inputs, 12-24 VDC current sinking/sourcing, 2 isolated commons. Outputs: 6 DC outputs, 6-27 VDC current sinking, 1.0A/pt. max.
D0-05DD-D	DL05 CPU, 8 DC in / 6 DC out, 12/24VDC Power Supply. Inputs: 8 DC inputs, 12-24 VDC current sinking/sourcing, 2 isolated commons. Outputs: 6 DC outputs, 6-27 VDC current sinking, 1.0A/pt. max.
D0-05DR-D	DL05 CPU, 8 DC in / 6 Relay out, 12/24VDC Power Supply. Inputs: 8 DC inputs, 12-24 VDC current sinking/sourcing, 2 isolated commons. Outputs: 6 Relay outputs, 6-27 VDC, 6-240 VAC, 2A/pt. max., 2 isolated commons
DL06 PLCs	
D0-06DD1	DL06 CPU, 20 DC in / 16 DC out, 110/220VAC Power Supply, with 0.3A 24VDC Auxiliary Device Power Supply. Inputs: 20 DC inputs, 12-24 VDC current sinking/sourcing, 5 isolated commons (4 inputs per common). Outputs: 16 DC outputs, 12-24 VDC current sinking, 1.0A/pt. max., 4 commons non-isolated (4 points per common).
D0-06DR	DL06 CPU, 20 DC in / 16 Relay out, 110/220VAC Power Supply, with 0.3A 24VDC Auxiliary Device Power Supply. Inputs: 20 DC inputs, 12-24 VDC current sinking/sourcing, 5 isolated commons (4 inputs per common). Outputs: 16 Relay outputs, 6-27 VDC, 6-240 VAC, 2A/pt. max., 4 isolated commons (4 points per common).
D0-06AR	DL06 CPU, 16 AC in / 20 Relay out, 110/220VAC power supply, with 0.3A 24VDC auxiliary device power supply. Inputs: 20 AC inputs, 90-120 VAC, 5 isolated commons (4 inputs per common). Outputs: 16 Relay outputs, 6-27 VDC, 6-240 VAC, 2A/pt. max., 4 isolated commons (4 points per common).
D0-06DD1-D	DL06 CPU, 20 DC in / 16 DC out, 12/24VDC Power Supply. Inputs: 20 DC inputs, 12-24 VDC current sinking/sourcing, 5 isolated commons (4 inputs per common). Outputs: 16 DC outputs, 12-24 VDC current sinking, 1.0A/pt. max., 4 commons non-isolated (4 points per common).
D0-06DR-D	DL06 CPU, 20 DC in / 16 Relay out, 110/220VAC Power Supply. Inputs: 20 DC inputs, 12-24 VDC current sinking/sourcing, 5 isolated commons (4 inputs per common). Outputs: 16 Relay outputs, 6-27 VDC, 6-240 VAC, 2A/pt. max., 4 isolated commons (4 points per common).
DL05/DL06 DC Input/Output Module	
D0-08CDD1	4 pt. 12-24VDC current sinking/sourcing input, 1 common, 4 pt. 12-24VDC sinking output, 0.3A/point, 1.2A/module, removable terminal, no fuse
DL05/DL06 DC Output Modules	
D0-10TD1	10 pt. 12-24 VDC current sinking output module, 2 commons non-isolated (5 pts. per common), 0.3A/point, 1.5A/common, removable terminal, no fuse
D0-16TD1	16 pt. 12-24 VDC current sinking output module, 2 commons non-isolated (5 pts. per common), 0.3A/point, 1.5A/common, removable terminal, no fuse.

*Direct*LOGIC PLC Modules for Use with GS2 AC Drives (cont.)	
DL05/DL06 Analog Module	
F0-2AD2DA-2	2 channel in, 2 channel out voltage analog option card; 0-5V, 0-10V
F0-4AD2DA-2	4 channel in, 2 channel out voltage analog option card; 0-5V, 0-10V
F0-4AD2DA-1	4 channel in, 2 channel sourcing out current analog option card; 4-20mA
DL105 PLCs	
F1-130DR	DL130 CPU, 10 DC in / 8 Relay out, 110/220VAC Power Supply. Inputs: 10 DC inputs, 12-24 VDC current sinking/sourcing, Outputs: 8 Relay outputs, 12-30 VDC, 12-250VAC, 7A/pt. max., 4 isolated commons
F1-130DD-D	DL130 CPU, 10 DC in / 8 DC out, 12/24VDC Power Supply. Inputs: 10 DC inputs, 12-24 VDC current sinking/sourcing, 3 isolated commons. Outputs: 8 DC outputs, 5-30VDC current sinking, 0.5A/pt. max, 3 internally connected commons.
F1-130DR-D	DL130 CPU, 10 DC in / 8 Relay out, 12/24VDC Power Supply. Inputs: 10 DC inputs, 12-24 VDC current sinking/sourcing, 3 isolated commons. Outputs: 8 relay outputs, 12-30 VDC, 12-250VAC, 7A/pt. max., 4 isolated commons
F1-130DD-D	DL130 CPU, 10 DC in / 8 DC out, 12/24VDC Power Supply. Inputs: 10 DC inputs, 12-24 VDC current sinking/sourcing, 3 isolated commons. Outputs: 8 DC outputs, 5-30VDC current sinking, 0.5A/pt. max, 3 internally connected commons.
DL205 DC Output Module	
D2-16TD1-2	16 pt. 12-24 VDC current sinking output module, 1 common (2 common terminals), 0.1A/point, 1.6A/module, no fuse, European type removable terminal
D2-32TD1	32 pt. 12-24 VDC current sinking output module. 1 common (4 common terminals), 0.1A/point, 3.2A/module, no fuse.
DL205 Relay Output Modules	
D2-04TRS	4-pt. 5-30 VDC or 5-240 VAC isolated relay output module, 4 Form A (SPST) relays, 4 commons, 4A/point, 8.0A/module, replaceable fuse, removable terminal
D2-08TR	8-pt. 5-30 VDC or 5-240 VAC output module, 8 Form A (SPST) relays, 1 common (2 common terminals), 1A/point, 4.0A/module, replaceable fuse, removable terminal
F2-08TR	8-pt relay output, 10A/common, 5-30VDC or 5-240VAC
F2-08TRS	8-pt. 12-28 VDC or 12-240 VAC output module, 5 Form A (SPST) relays, 3 Form C (SPDT) relays, 8 isolated commons, 7A/point max., no fuses, removable terminal
D2-12TR	12 pt. 5-30 VDC or 5-240 VAC relay output module, 12 Form A (SPST) relays, 2 commons, 1.5A/point max., 3.0A/common, 2 replaceable fuses, removable terminal
DL205 DC Input/Output Modules	
D2-08CDR	4 pt. 24VDC sinking/sourcing input, 1 common, 4 pt. relay output, 1A/pt., 4A/module, 1 common, replaceable fuse
DL205 Analog Output Module	
F2-02DAS-1	2 channel, 16-bit resolution, Isolated 4-20mA sourcing (2 isolated commons). Designed to operate with 24 VDC user-supplied power supply.
F2-02DAS-2	2 channel analog output, 16 bit resolution, isolated, range: 0-5V, 0-10V (2 isolated commons). Designed to operate with 24 VDC user-supplied power supply.
F2-08DA-1	8 channel analog output module, 12 bit resolution, range: 4-20mA, sink or source output configurable. Designed to operate with 24 VDC user-supplied power supply.
F2-02DA-2	2 channel analog output module, 12 bit resolution, ranges: 0-5V, 0-10V, -5 to +5V, -10 to +10V. Designed to operate with 24 VDC user-supplied power supply.
F2-08DA-2	8 channel analog output module, 12 bit resolution, ranges: 0-5V, 0-10V. " Designed to operate with 24 VDC user-supplied power supply.

*Direct*LOGIC PLC Modules for Use with GS2 AC Drives (cont.)	
DL205 Analog Input Modules	
F2-04AD-2	4 channel, 12-bit, 0-5V, 0-10V, -5 to +5V, -10 to +10V.. Designed to operate with a 24VDC user supplied power supply.
F2-08AD-2	8 channel, 12-bit, 0-5V, 0-10V, -5 to +5V, -10 to +10V.. Designed to operate with a 24VDC user supplied power supply.
DL305 AC/DC Ouput Modules	
D3-08TR	8 pt. 5-30 VDC or 5-220 VAC output module, 5A/point DC or 4A/point AC, 8 Form A relays (SPST), 2 commons (isolated), non-removable terminal, 2 user replaceable fuses
D3-16TR	16 pt. 5-30 VDC or 5-220 VAC output module, 2A/point,16 Form A relays (SPST), 2 commons (isolated), removable terminal, no internal fuses
DL305 Analog Input Modules	
F3-04ADS	4 channel isolated analog input module,12 bit resolution, ranges: 0 to 5V, 0 to 10V, -5 to +5V, -10 to +10V, 1 to 5V, 0 to 20mA, 4 to 20mA, -750 to +750 VDC channel-to-channel isolation
F3-16AD	16 channel analog input module, 12 bit resolution, ranges: -5 to +5V, -10 to +10V, 0 to 10V, 0 to 20mA. Each point can be either a voltage or current input.
DL305 Analog Output Modules	
F3-04DAS	4 channel isolated analog output module, 12 bit resolution, ranges: 0 to 5V, 0 to 10V, -5 to +5V, -10 to +10V, 4 to 20mA, 0 to 20mA. -750 to +750 VDC channel to channel isolation
DL405 DC Ouput Modules	
D4-08TD1	8 pt. 12-24 VDC current sinking output module, 2 commons (internally connected), 2A/point, 5A/common, removable terminal
D4-16TD1	16 pt. 5-24 VDC current sinking output module, 2 commons (internally connected), 0.5A/point, 3A/common, removable terminal
D4-32TD1	32 pt. 5-24 VDC current sinking output module, 4 commons (isolated), 0.2A/point, 1.6A/common. Requires one connector, sold separately.
DL405 AC/DC Ouput Modules	
D4-08TR	8 pt. 5-30 VDC or 5-250 VAC output module, 8 Form A (SPST) relays, 2 commons (isolated), 2A/point, 5A/common, removable terminal
F4-08TRS-1	8 pt. 12-30 VDC or 12-250 VAC isolated output module, 4 Form A (SPST) and 4 Form C (SPDT) relays, 8 commons (isolated), 10A/point, 40A/module, removable terminal.
F4-08TRS-2	8 pt. 12-30 VDC or 12-250 VAC isolated output module, 4 Form A (SPST) relays and 4 Form C (SPDT) relays, 8 commons (isolated), 5A/point, 40A/module, replaceable fuses, removable terminals.
D4-16TR	16 pt. 5-30 VDC or 5-250 VAC output module, 8 Form A (SPST) relays, 2 commons (isolated), 1A/point, 5A/common, removable terminals.
DL405 Analog Input Modules	
F4-04ADS	4 channel isolated analog input module, 12 bit resolution, ranges: 0 - 5V, 0 - 10V, 1 - 5V, -5V to +5V, -10V to +10V, 0 - 20mA, 4 - 20mA.
F4-08AD	8 channel analog input module, 12 bit resolution, ranges: 4 to 20mA, 1 to 5V, 0 to 20mA, 0 to 5V, 0 to 10V, -5V to +5V, -10V to +10V.
F4-16AD-2	16 channel analog input module, 12 bit resolution, ranges: 0-5V, 0-10V.
DL405 Analog Output Modules	
F4-04DAS-1	4 channel analog output module, 16 bit resolution, isolated, range: 4 to 20mA current sourcing.
F4-04DAS-2	4 channel analog output module, 16 bit resolution, isolated, range: 0-5V, 0-10V.
F4-08DA-2	8 channel analog output module, 12 bit resolution, range: 0-5V or 0-10V
F4-16DA-2	16 channel analog output module, 12 bit resolution, range: 0-5V or 0-10V.

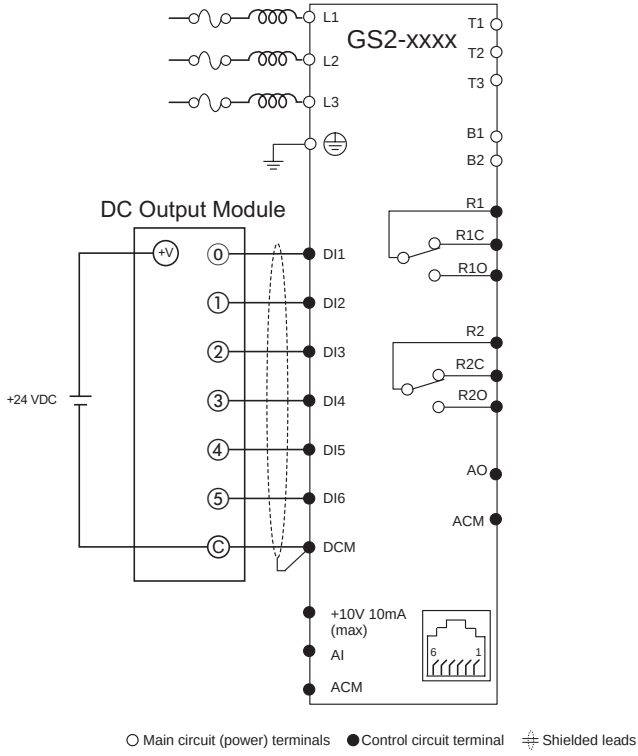
*Direct*LOGIC PLC Modules for Use with GS2 AC Drives (cont.)	
Terminator I/O DC Ouput Modules	
T1K-08TD1	8 pt. 12-24 VDC current sinking output module, 4 points per common, 1.0A/point, 2 replaceable fuses (T1K-FUSE-1). (use with T1K-08B or T1K-08B-1 terminal base)
T1K-16TD1	16 pt. 12-24 VDC current sinking output module, 4 points per common, 1.0A/point, 4 replaceable fuses (T1K-FUSE-1). (use with T1K-16B or T1K-16B-1 terminal base)
Terminator I/O AC/DC Ouput Modules	
T1K-08TR	8 pt. 5-30 VDC or 5-240 VAC output module, 8 Form A (SPST) relays, 4 points per common, 2.0A/point max., 2 replaceable fuses (T1K-FUSE-2). (use with T1K-08B or T1K-08B-1 terminal base)
T1K-16TR	16 pt. 5-30 VDC or 5-240 VAC output module, 16 Form A (SPST) relays, 4 points per common, 2.0A/point max., 4 replaceable fuses (T1K-FUSE-2). (use with T1K-16B or T1K-16B-1 terminal base)
T1K-08TRS	8 pt. 5-30 VDC or 5-240 VAC isolated relay output module, 8 Form A (SPST) relays, 1 point per common, 7.0A/point max., 8 replaceable fuses (T1K-FUSE-3). (isolation requires use of T1K-16B or T1K-16B-1 terminal base)
Terminator I/O Analog Input Modules	
T1F-08AD-2	8 channel analog input module, 14 bit resolution (13 bit plus sign bit), range: 0-5VDC, 0-10VDC, +/-5VDC, +/-10VDC. (use with T1K-08B or T1K-08B-1 terminal base)
T1F-16AD-2	16 channel analog input module, 14 bit resolution (13 bit plus sign bit), range: 0-5VDC, 0-10VDC. (use with T1K-16B or T1K-16B-1 terminal base)
Terminator I/O Analog Output Modules	
T1F-08DA-2	8 channel analog output, 12 bit resolution, range: 0-5VDC, 0-10VDC, +/-5VDC, +/-10VDC. (use with T1K-08B or T1K-08B-1 terminal base)
T1F-16DA-2	16 channel analog output, 12 bit resolution, range: 1-5VDC, 1-10VDC, +/-5VDC, +/-10VDC. (use with T1K-16B or T1K-16B-1 terminal base)
Terminator I/O Analog Input/Output Modules	
T1F-8AD4DA-1	8 channel analog input module and 4 channel analog output module. Inputs: 14 bit resolution (13 bit plus sign bit), range: -20 to 20mA, 0-20mA, 4-20mA. Outputs: 12 bit resolution, range:4-20mA, sinking or sourcing compatible. (use with T1K-08B or T1K-08B-1 terminal base).
T1F-8AD4DA-2	8 channel analog input module and 4 channel analog output module. Inputs: 14 bit resolution (13 bit plus sign bit), range: 0-5VDC, 0-10VDC, +/-5VDC, +/-10VDC. Outputs: 12 bit resolution, range: 0-5VDC, 0-10VDC, +/-5VDC, +/-10VDC. (use with T1K-08B or T1K-08B-1 terminal base).

Typical Connections to the GS2 Series AC Drive

The following drawings show some typical connections between the GS2 Series AC Drive and DirectLOGIC PLCs and modules.

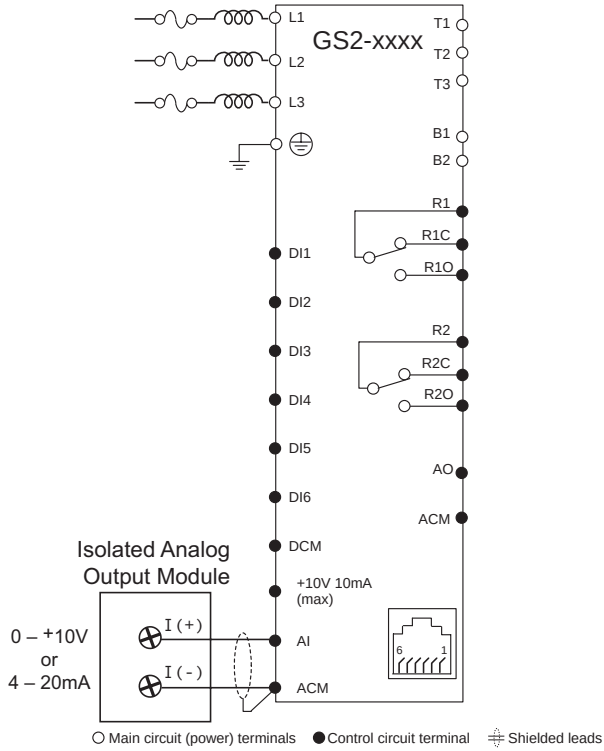
DC Output Modules

- D0-05DD
- D0-05DD-D
- D0-06DD1
- D0-06DD1-D
- D0-10TD1
- D0-16TD1
- D2-16TD1-2
- D2-32TD1
- D4-08TD1
- D4-16TD1
- D4-32TD1
- T1K-08TD1
- T1K-16TD1



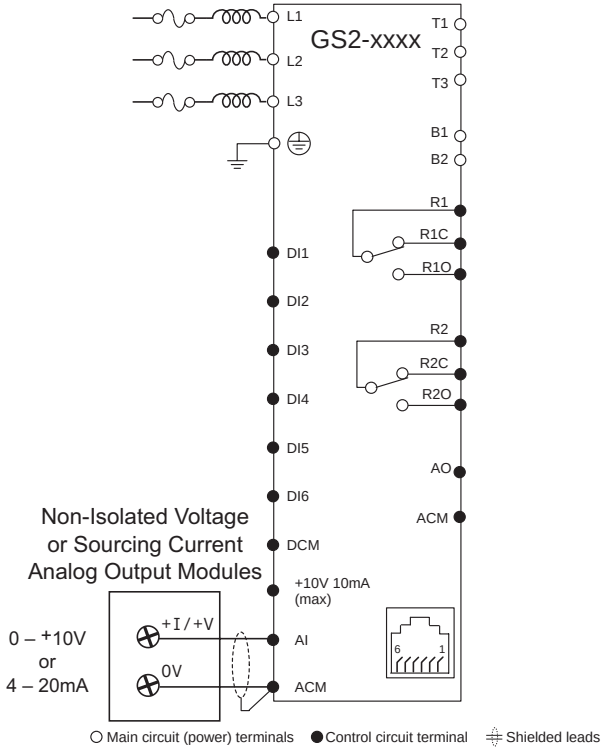
Isolated Analog Output Modules

- F2-02DAS-1
- F2-02DAS-2
- F4-04DAS-1
- F4-04DAS-2



Non-Isolated Voltage or Sourcing Current Analog Ouput Modules

- F0-02AD2DA-2
- F0-04AD2DA-1
- F0-04AD2DA-2
- F2-02DAS-1
- F2-02DAS-2
- F2-08DA-1
- F2-02DA-2
- F2-08DA-2
- F4-08DA-2
- F4-16DA-2
- T1F-08DA-2
- T1F-16DA-2
- T1F-8AD4DA-1
- T1F-8AD4DA-2



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G S 2 - M

380 VAC, 3 PHASE, 4P. 50Hz
25 AMP

N L1 L2 L3 GND

1DS

GROUND PANEL/MACHINE TO GROUNDING ROD WITH #8 AWG COPPER CONDUCTOR.

SIZE OF CONDUCTORS FROM THE MAIN DISCONNECT TO THE BRANCH DISTRIBUTION TERMINALS OR DISTRIBUTION BLOCK TO BE: #10 AWG BLACK FOR 30 AMP RATED MAINS, #6 AWG BLACK FOR 60 AMP RATED MAINS. DISTRIBUTION TERMINALS OR DISTRIBUTION BLOCKS TO BE AT LEAST EQUAL IN RATING TO THE MAINS (30 OR 60 AMPS).

CB1
2.5-4A/3

181
182
183

3-18BLK

1VFD
VSD DRIVE
SEE DWG. E-4 FOR DETAILS

191
192
193

MS1

P1
Manifold Pump
0.55 KW

194
195
196

MS2

P2
Mixer Motor
0.55 KW

N

Heater 1, Element 1
Heater 1, Element 2
Heater 2, Element 1
Heater 2, Element 2
Heater 3, Element 1
Heater 3, Element 2
Heater 4, Element 1
Heater 4, Element 2
Heater 5, Element 1
Heater 5, Element 2
Heater 6, Element 1
Heater 6, Element 2

CB2
20-25A/3

3-10BLK

281
282
283

MS3

291
292
293

CB3
2A/1

1-18BLK

391

400 V
230 V
-15 V
0 V
+15 V

T1

230V/24V Transformer

1-14GRN
1-18BLK
1-18WHT

N1

63 VA
CONTROL POWER
TRANSFORMER
230/24

500

CB4
2A/1

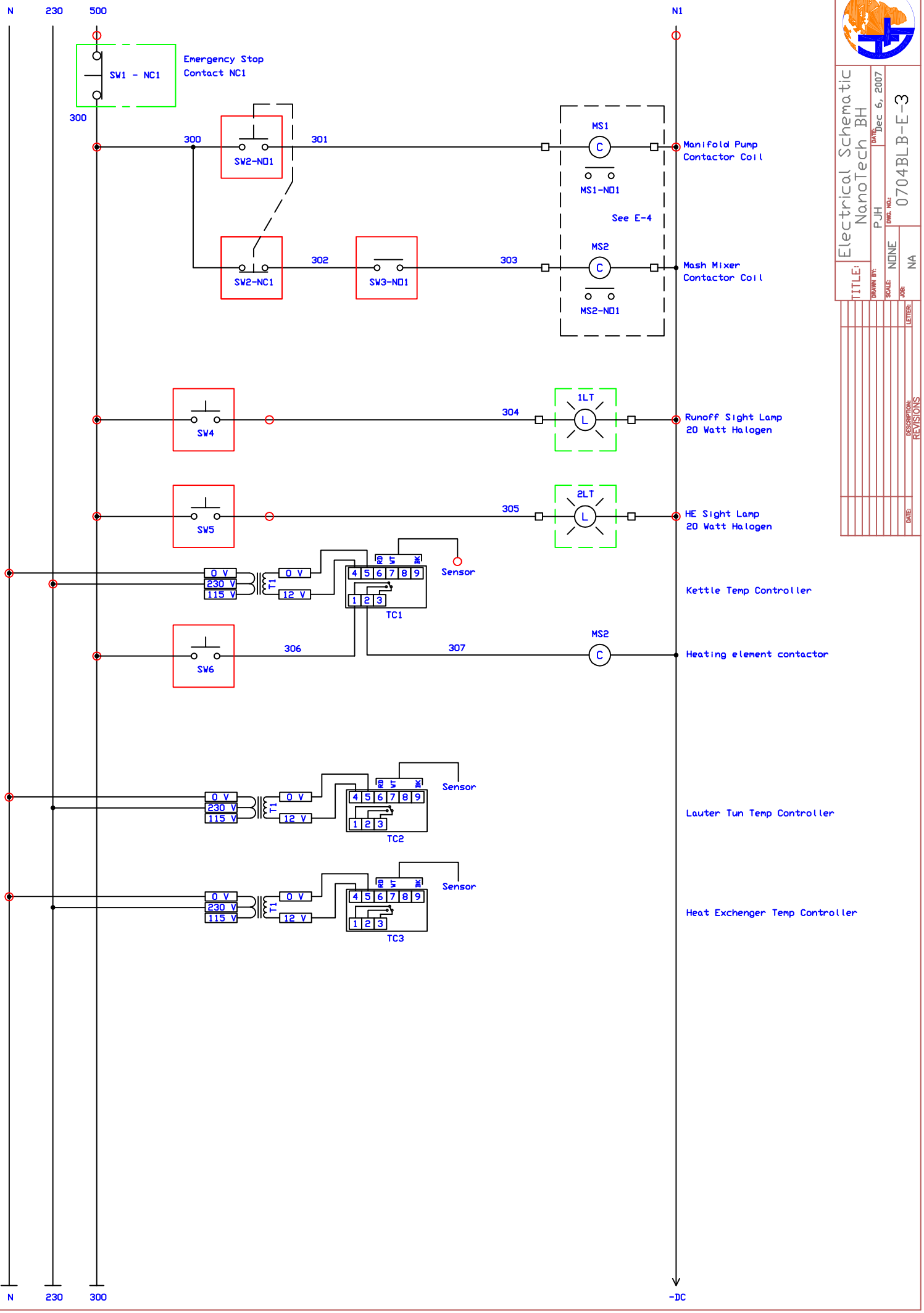
230V Mains

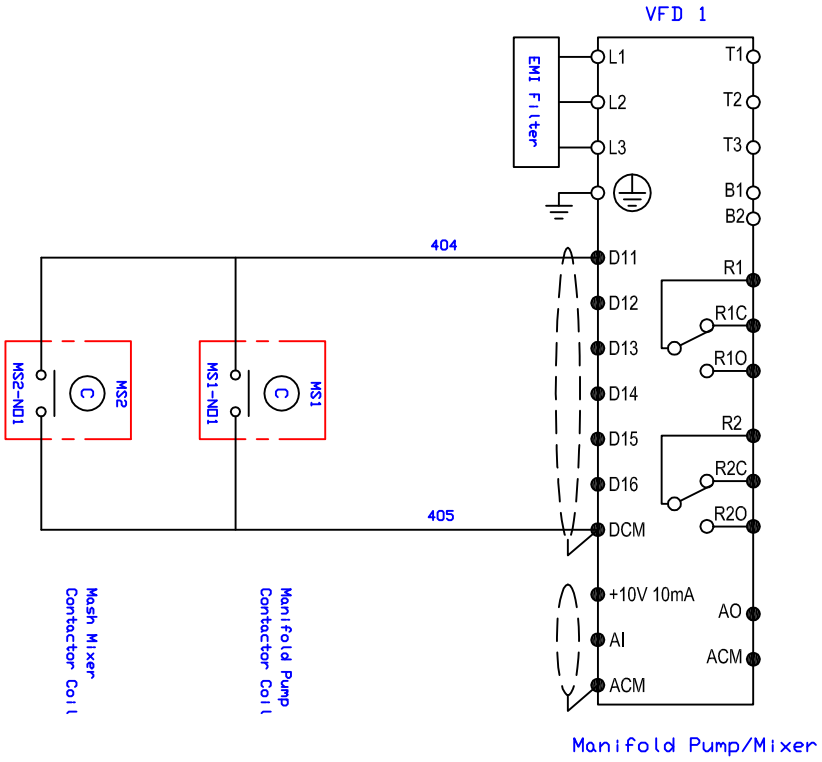
N L1 L2 L3 230

N

Electrical Schematic
NanoTech BH

DATE: Dec 6, 2007
DRAWN BY: PJH
DWG. NO.: 0704BLB-E-2
SCALE: NONE
JOB: NA
TITLE:
LETTER:
DESCRIPTION:
REVISIONS
DATE:


N
230
500
N1
SW1 - NC1
Emergency Stop
Contact NC1
300
300
SW2-NO1
301
MS1
C
MS1-NO1
See E-4
Manifold Pump
Contactor Coil
SW2-NC1
302
SW3-NO1
303
MS2
C
MS2-NO1
Mash Mixer
Contactor Coil
SW4
304
1LT
L
Runoff Sight Lamp
20 Watt Halogen
SW5
305
2LT
L
HE Sight Lamp
20 Watt Halogen
0 V
230 V
115 V
T1
0 V
12 V
RD WT BK
4 5 6 7 8 9
1 2 3
TC1
Sensor
Kettle Temp Controller
SW6
306
307
MS2
C
Heating element contactor
TC2
Sensor
Lauter Tun Temp Controller
TC3
Sensor
Heat Exchenger Temp Controller
N
230
300
-DC
Electrical Schematic
NanoTech BH
TITLE:
DRAWN BY:
PJH
DATE:
Dec 6, 2007
DWG. NO:
0704BLB-E-3
SCALE:
NONE
JOB:
NA
LETTER:
DESCRIPTION:
REVISIONS
DATE:



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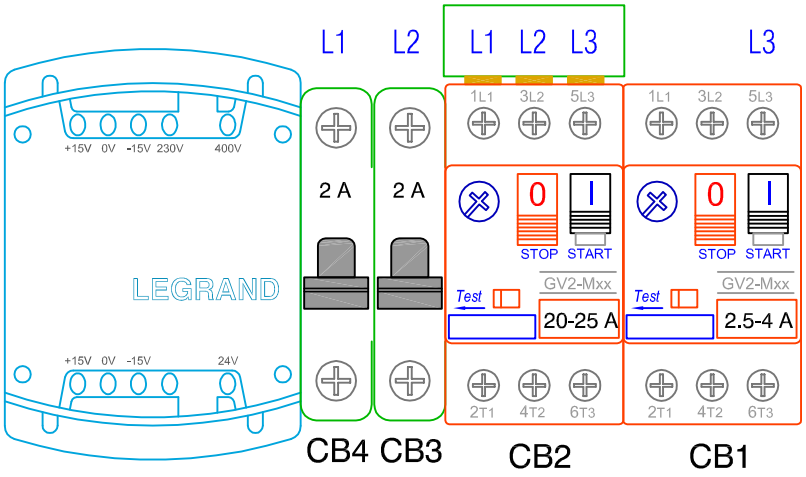
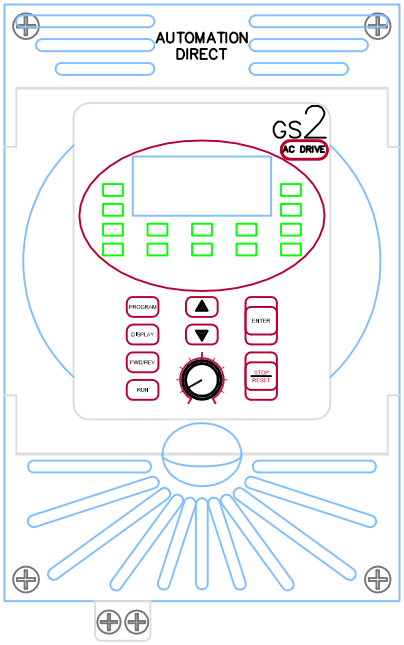
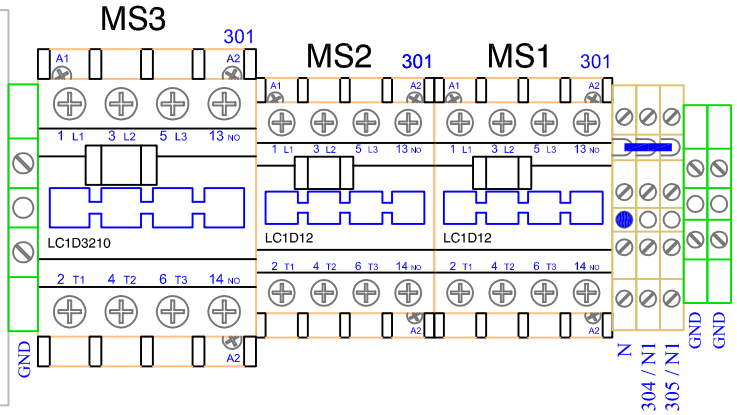
DRAWN BY:	PJH	DATE:	Dec 6, 2007
SCALE:	NONE	DWG. NO.:	0704BLB-E-4
JOB:	NA		

DATE:	DESCRIPTION:	LETTER:
	REVISIONS	





Temperature controller power supply