



DELTA-T
SYSTEMS

MAC INSTALLATION AND OPERATION MANUAL

ENGINE ROOM VENTILATION CONTROL SYSTEM



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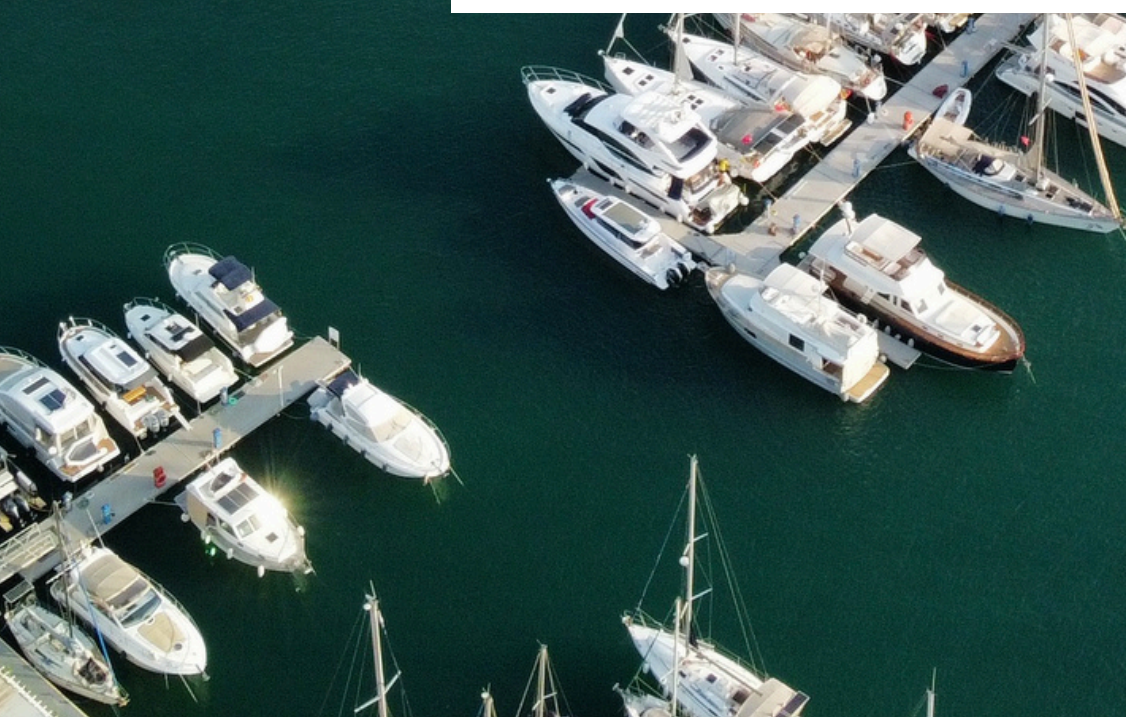


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SYSTEM OPERATION & MONITORING SYSTEM INTERFACE



THE MAC



The **MAC Control System** stands as the latest advancement in manual control systems by Delta T Systems, Inc., succeeding its predecessor, the C2 Plus. Specifically designed for variable speed control of one or more three-phase fans through a singular control station, the MAC System adapts to various power configurations, accepting either single or three-phase input power for the Adjustable Speed Drive(s). This adaptability ensures seamless integration into diverse vessel power setups.

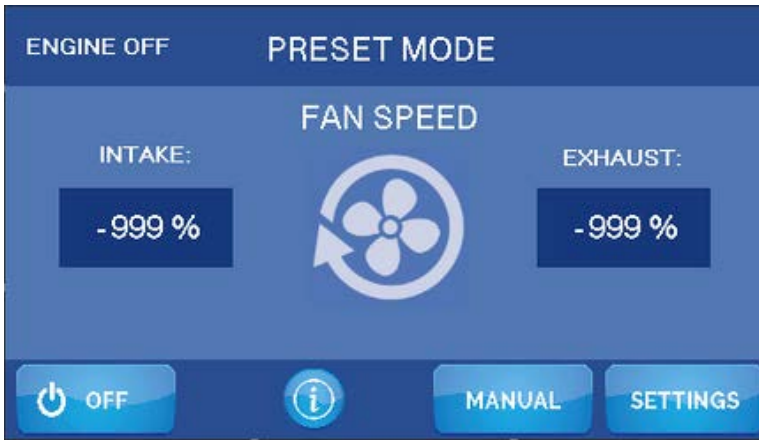
Noteworthy features include a safety mechanism, with a normally closed contact designed to halt all fan operations in the event of a fire extinguishing system discharge, enhancing the ventilation system's safety profile. The MAC Control System also incorporates dry contacts for Engine Run Signal and Emergency Shut Down switches.

A distinct advantage of the MAC System lies in its user-friendly implementation – no additional programming or configuration of the ASD(s) is required by either the installer or the end user. Follow these instructions diligently to ensure a proper installation, minimizing the risk of complications. The enclosed drawings provide precise wiring terminations, particularly crucial during the connection of power and control cables to the ASD(s).

System Components:

- **MCE (Main Control Enclosure):**
 - The central hub for the system, where all control cables are terminated.
- **FCI (Fan Control Interface):**
 - The primary touch screen control panel facilitating comprehensive control over the system's functions.
- **ASD (Adjustable Speed Drive):**
 - Also known as a Variable Frequency Drive (VFD), this unit governs the speed (rpm) of each fan motor connected to the MAC Control System.

MODES



Preset Mode

The fan speed will automatically adjust based on preset inputs upon engine startup and shutdown. Intake and exhaust fan speeds can be individually set for the engine-on condition. All fans will either turn off or run at the same speed when the engine is off.

Manual Mode

Manual Mode: Take control in manual mode. You have complete authority over the system. Adjust the fan speed for intake and exhaust fan individually, ranging from 20% to 100%, according to your requirements. You can also select the direction of rotation (forward/reverse) for each fan and start or stop them as needed. The speed settings remain in effect until you choose to modify them.



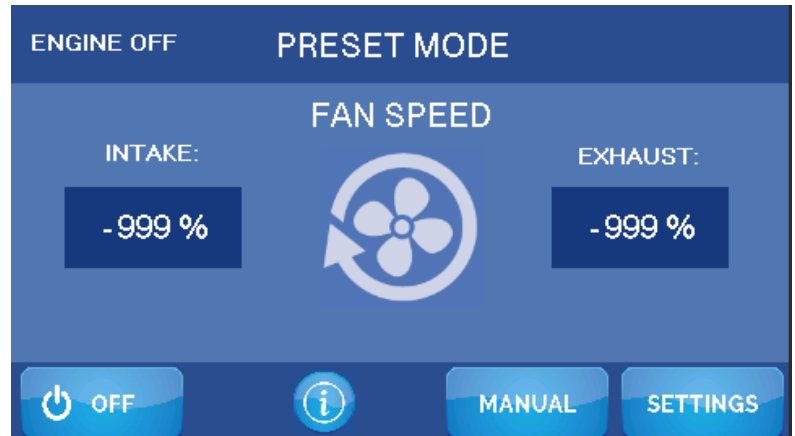
PRESET MODE

Preset Operation – Power Up Screen

It is recommended that the system remains powered up even while at the dock. This allows Preset mode to remain functioning.

Viewing Preset Run Mode System Status

The Preset Run Mode screen will allow the operator to view the System Status and fan speed.



Preset Startup

When the main engines start, the ventilation control system switches to Preset Run Mode.

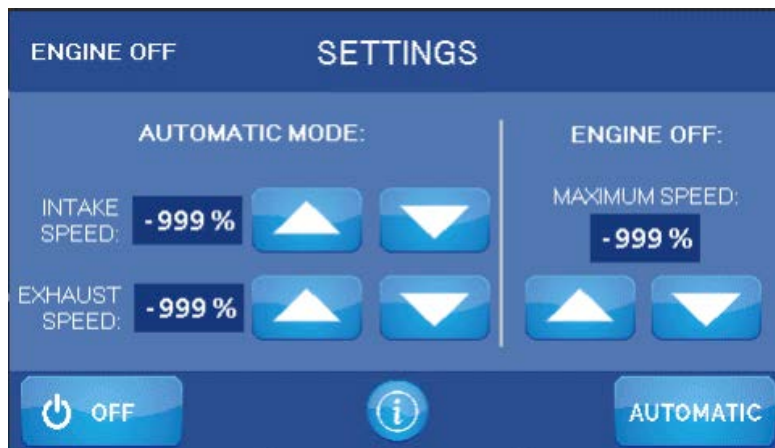
Preset Run Mode Settings

Starting from the Main Screen, press the Settings button. This allows the operator to change the settings that control the Preset Run Mode operation. To change the values, use the arrows to the right of the value.

Engine off- Set the desired fan speed for when the engine is off. Set the fan speed to 0% to turn the fans off.

Engine on- Set the desired fan speed for when the engine is running.

The system will automatically toggle between the set speeds.



MANUAL MODE



Manual Mode

To activate Manual Mode, press the Manual button on the main screen in the bottom right corner. Upon selection, the fans will begin to run the user-defined speed. In this mode, you have independent control over the fan speed and direction. Use the up or down arrows to adjust the fan speed in increments of 5%. To change the fan direction, simply press the Forward or Reverse buttons. There's no need to stop the fans before changing direction. The Variable Speed Drives (VSDs) will gradually slow down and reverse the fans without causing significant load changes on the electrical system.





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SYSTEM COMPONENT INSTALLATION

GENERAL INSTRUCTIONS

Read entire instruction document before starting installation.

Reading all the instructions will allow you to become familiar with the arrangement and components of the system before the actual installation.

The Control Cables specified for connecting the VSDs to the **600-MAC** can be seen on page 15. All conductors of the recommended cables are colored black or red. On the multi-pair cables, the pair number is stamped on each conductor at one-inch intervals. All wiring diagrams supplied with this system refer to this color code. If other cables are used, you must establish your own color code. Most of the wiring and termination points associated with this equipment are small, as are the pair numbers stamped on each conductor of the multi-pair cables.

Ensure the correct conductors are connected to the correct terminals. A wiring error could lead to permanent, irreparable damage to components of this system. Such damage is not covered under warranty.

IMPORTANT: You must refer to the System Block Diagram drawing located on page 14 when proceeding with this section. This drawing is your road map to the location and relationship of the components. Failure to closely follow this drawing may result in incorrect component locations which may cause costly rework and additional installation time.



FIRE SYSTEM DISCHARGE & REMOTE STOP SWITCH

The Fire System Discharge Switch is customer supplied. The switch must have a **normally closed contact** set and this contact must open upon discharge of the fire extinguishing system. It is recommended that the switch be compatible with the existing fire extinguishing equipment and that it be installed by a certified fire system technician to maintain the system integrity and appropriate agency system approvals.

WARNING - This system does not automatically shut any fire dampers!

- **NEVER** defeat the purpose of the fire extinguisher discharge switch.
- **NEVER** operate the ventilation system, under any circumstances, if the fire extinguishing system protecting the ventilated space is in an inoperative or discharged condition.

Failure to observe the above precautions in the event of a fire in the ventilated space may result in serious property damage, personal injury, loss of the vessel or loss of life.

The Main Engine Run Input is utilized to signal the ventilation control system when the engines are running. This input requires an isolated, **normally open contact** that closes when the main engine(s) start. You can easily achieve this by using an oil or fuel pressure switch with an isolated (non-grounding) contact. It is necessary to install a switch for each main engine to enable proper system functionality. Connect the switches in parallel so that either engine starting will activate the ventilation system.

E-STOP is optional and customer supplied. Some classification societies may require a remote, emergency manual disconnect for the fan operation. One type of switch suitable for this purpose is a snap action, maintained position with a push-pull mushroom type head. The switch must have at least one **normally open contact** set and must latch closed when the switch is pushed. This switch must latch. It cannot be momentary. It must be distinctive, suitable for its purpose, and clearly marked as to its function and operation.





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SYSTEM WIRING INSTRUCTIONS



CABLES

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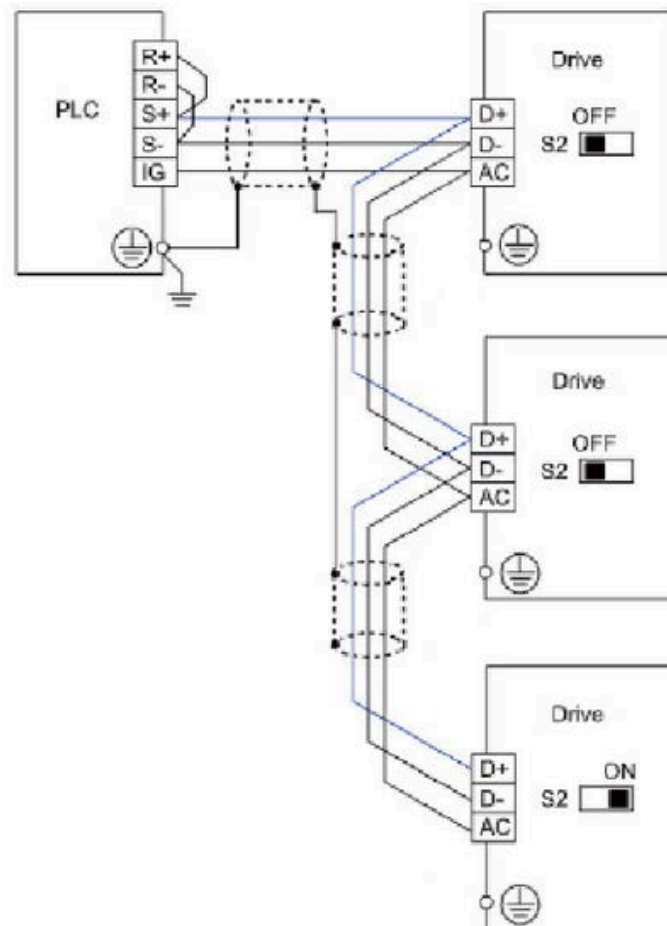
The following cables need to be pulled to the MAC before any connections are made:

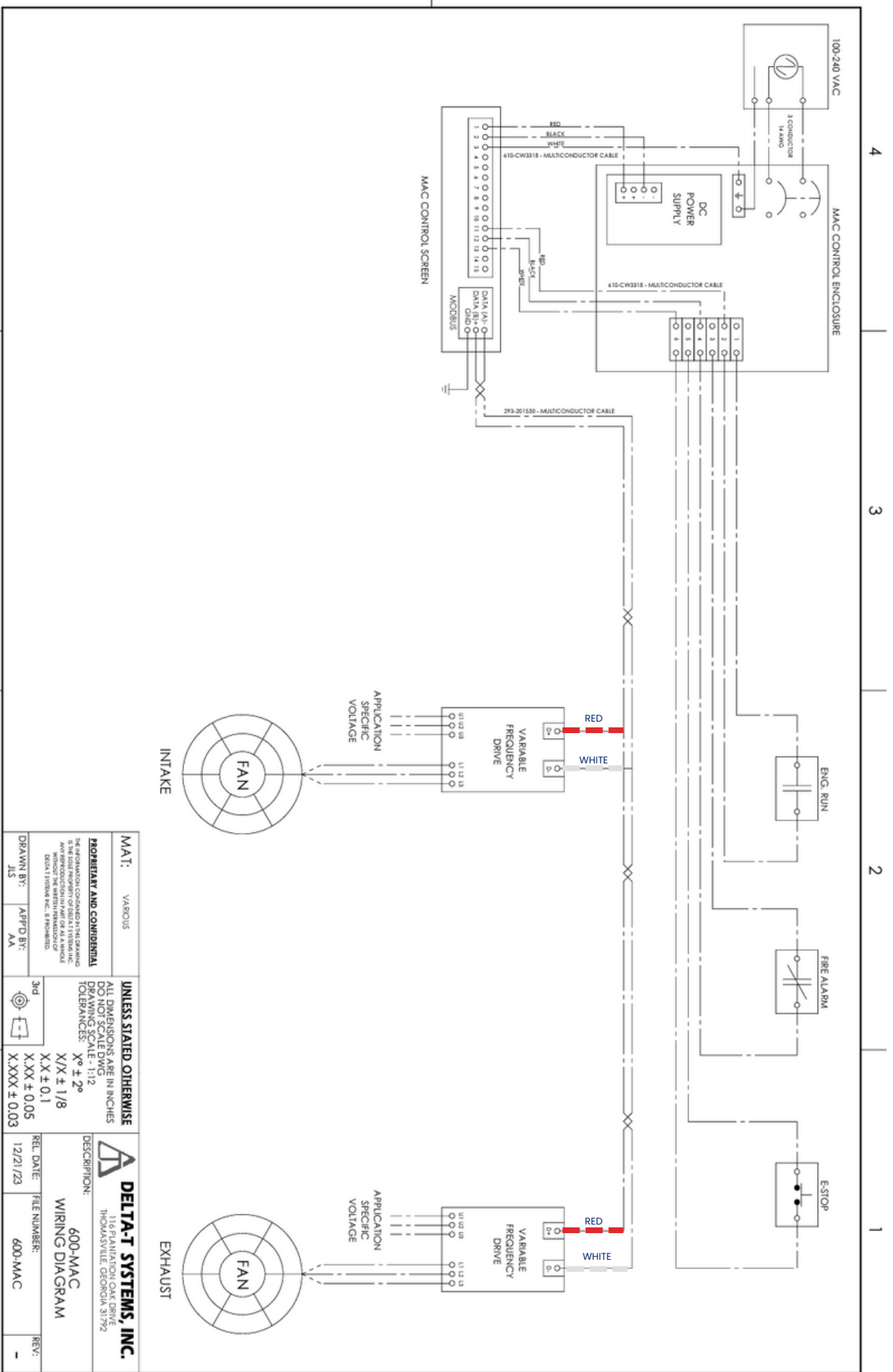
MAC Power	3 Conductors - Line, Neutral, GND - Customer Supplied
E-Stop (Optional)	2 Conductors - Customer Supplied
Fire Extinguisher Input	2 Conductors - Customer Supplied
Main Engine Run Input	2 Conductors - Customer Supplied
Intake/ Exhaust Fan Control Bus	Multiconductor Cable 293-201530 - 100' Total Included
Display Power	3 Conductor Cable 610-CW3318- Included
Display Signals	3 Conductor Cable 610-CW3318- Included

The control bus is wired in a daisy chain configuration to each Variable Speed Drive (VSD). In this setup, the S2 dip switch (terminating resistor) is integrated and intended for use specifically on the final VSD in the daisy chain. Refer to diagram to the right for clarity.

For VSD power cable and breaker sizes, refer to the System Block Diagram. The intake and exhaust VSDs are connected in the same way. Use caution not to confuse the intake and exhaust VSD connections. The drives are clearly marked on the side of the heatsink. The cables that need to be pulled to the VSDs are:

- Main supply power from circuit breaker
- Power feed from the VSD to the fan motor
- Control cable from MAC

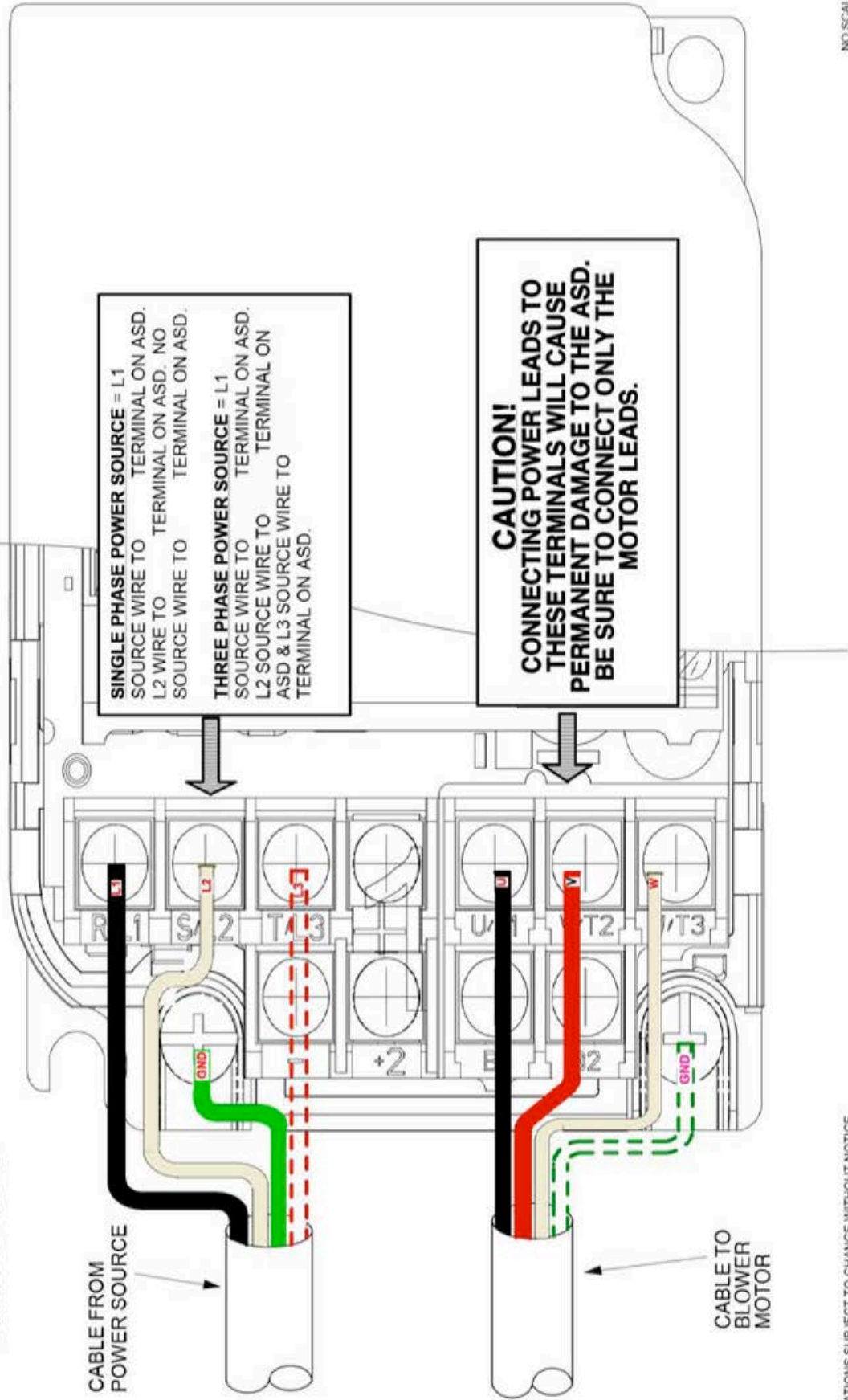




MAT: VARIOUS	UNLESS STATED OTHERWISE ALL DIMENSIONS ARE IN INCHES DO NOT SCALE DWG DRAWING SCALE - 1:12 TOLERANCES: X ^o ± 2 ^o X/X ± 1/8 X.XX ± 0.1 X.XXX ± 0.05 X.XXX ± 0.03	DELTA-T SYSTEMS, INC. 116 PLANTATION OAK DRIVE THOMASVILLE, GEORGIA 31792
PROPRIETARY AND CONFIDENTIAL THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF DELTA-T SYSTEMS, INC. IT IS TO BE KEPT CONFIDENTIAL AND NOT TO BE REPRODUCED OR TRANSMITTED IN ANY FORM OR BY ANY MEANS, WITHOUT THE WRITTEN PERMISSION OF DELTA-T SYSTEMS, INC. © FROBENIUS	3rd 	DESCRIPTION: 600-MAC WIRING DIAGRAM
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MAC INTEGRATED SCREEN WIRING DIAGRAM

FIGURE 12
ASD POWER AND MOTOR
CONNECTIONS



SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE



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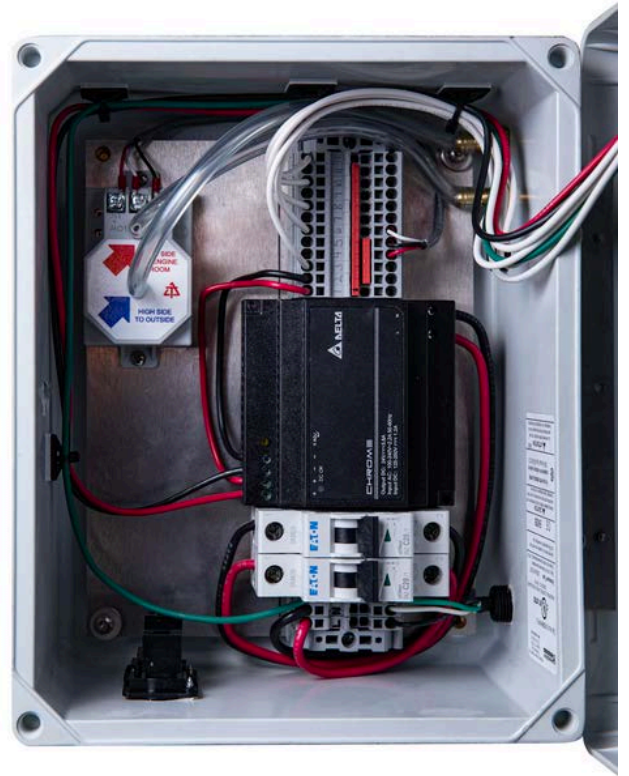
INITIAL SYSTEM STARTUP

INITIAL SET UP CHECK

During the initial startup of a ventilation control system, it is crucial to perform certain checks to ensure correct wiring before putting the vessel into service. **These checks, known as dock trials, need to be completed before any sea trials.**

The procedure for the initial system startup:

- **First Power Up:**
 - All components of the ventilation control system and related equipment have been fully wired, bench-tested, and run in the assembly and testing facility before being shipped to the customer.
 - Prior to powering any components of the ventilation system, carefully inspect and verify all wiring connections according to the instructions provided in the Installation Section and accompanying wiring drawings.
 - **Many problems encountered in the initial startup of this type of ventilation control system are related to simple errors in wiring from one component to another.**



Step 1 – Powering the MAC and display:

- a. The wiring in the MAC must be complete including the comm cable and the power cable that run to the display touch screen display.
- b. Turn on the control power circuit breaker to the MAC and turn on the power to the VSDs. Observe the screen display as it performs its initialization.
- c. Hit the information button in the center of the screen to see system information such as model number, sales order number, and the revision number of the product.



STEP 2 - CHECKING MANUAL OPERATION AND FAN ROTATION

IMPORTANT: Before proceeding, check that all fans are free turning and that nothing has become lodged or jammed in the blades during vessel construction. Be sure any fire/smoke dampers are open and clear. Ensure that proper safety guards are in place at all times and that necessary safety precautions are taken if personnel are working within the engine room or on the ventilation equipment and fans!

- Go back to the Main screen by touching the Back button. From the Main Screen touch the Manual button to put the system into Manual Mode.
- Open a hatch or door to the exterior to allow air to escape from the space.
- Tap both “Stop” buttons and use the down buttons to adjust speeds to 20%.
- Check fan flow direction for both intake and exhaust fans. Raise the intake fan(s) speed to 100% in the Forward direction. Check to make sure the air is coming into (pressurizing) the space and there is no excessive vibration or noise from the fan(s). The intake VSD display(s) will read 50.00 or 60.00 Hz depending on the fan(s) installed. Slow the intake fan speed to 50% on the display by repeatedly pressing the Down arrow and the intake VSDs should read half of the maximum value previously observed. If a fan is found to be operating in the wrong direction, it is important to determine whether the fan is physically installed backwards, or simply rotating in the wrong direction. If the fan is installed backwards or changing the rotation will not correct the problem, as an axial flow fan is only capable of about 65% of its rated airflow when running in reverse. If this happens, the fan will not be able to keep up with exhaust and combustion demands, and a low-pressure situation will occur with the engines at high RPM. If the fan is physically installed correctly but rotating backwards, the direction can be changed by switching any two of the wires going from the VSD output to the fan motor.
- Turn off the Intake fan with the Down arrow and do the same check for the exhaust fan(s). In Forward, the exhaust fan should be exhausting (extracting) air from the space.





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TROUBLESHOOTING



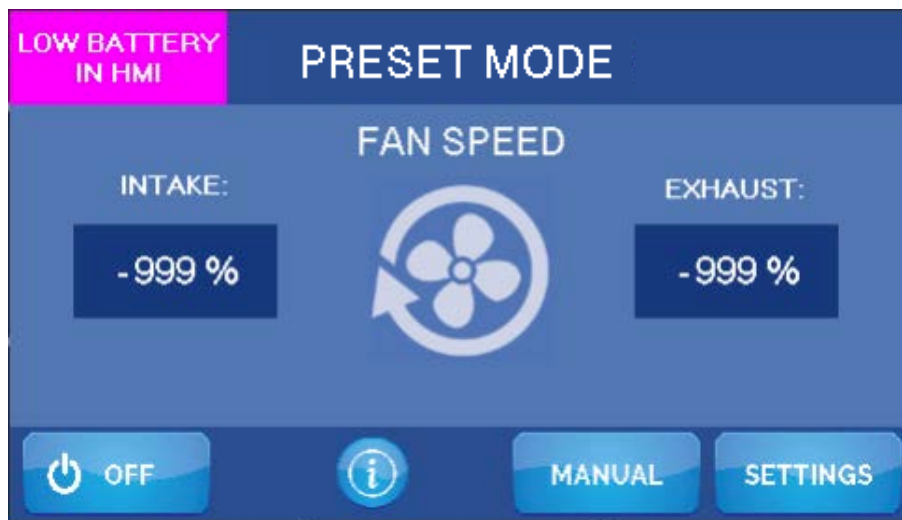
LOW BATTERY IN HMI

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The Low Battery in HMI (Human Machine Interface) alarm alerts users when the battery level of the HMI device falls below a critical threshold. The HMI device is a user interface that allows operators to interact with a system or machine, providing real-time data, control functions, and visualization capabilities. When the battery level is low, it is essential to take appropriate action to prevent data loss, system downtime, or potential malfunctions.

This section of the manual will guide users on how to address a Low Battery in HMI alarm:

- 1. Alarm Indication:** The Low Battery in HMI alarm is displayed in the top left corner of the screen with a pink box. When this alarm is triggered, it is crucial to address it promptly to avoid potential disruptions.
- 2. Battery Status Check:** Begin by checking the current battery status on the HMI device.



- 3. Battery Replacement:** Replace the battery with power connected and controller on. The battery type used is a CR 2450N. Use a direct replacement battery to ensure function.
- 4.** Cycle power to HMI by turning the circuit breakers off for 10 seconds and turning them back on.
- 5. Contact Technical Support:** If the Low Battery in HMI alarm persists despite following the above steps, or if you require additional assistance, contact Delta T's technical support.

NOT TURNING ON?



If the system will not power up, use the following guide to help determine the cause:

- 1.** Touch the display screen to make sure it is functioning.
- 2.** Check all main power breakers supplying power to the system and ensure they are on.
- 3.** Use a voltmeter to ensure there is voltage present at the terminals on the back of the display. If proper voltage is present and there is no DC ON indicator, it is likely the 24VDC power supply is defective.
- 4.** Check to see if the power is on by looking if the screen lights up.
- 5.** If everything in the MAC is functioning properly but the display is not working, it will be necessary to check the incoming power on the back of the display. On the left-hand side of the display there are terminals marked + and -. There should be 24VDC across these terminals. If no voltage is present, check your power source for the display. If there is power but no display, it is likely the display has failed. Contact Delta T Systems to troubleshoot further. 120 V or 240 V Required at the breakers for functionality.



COMM LOSS

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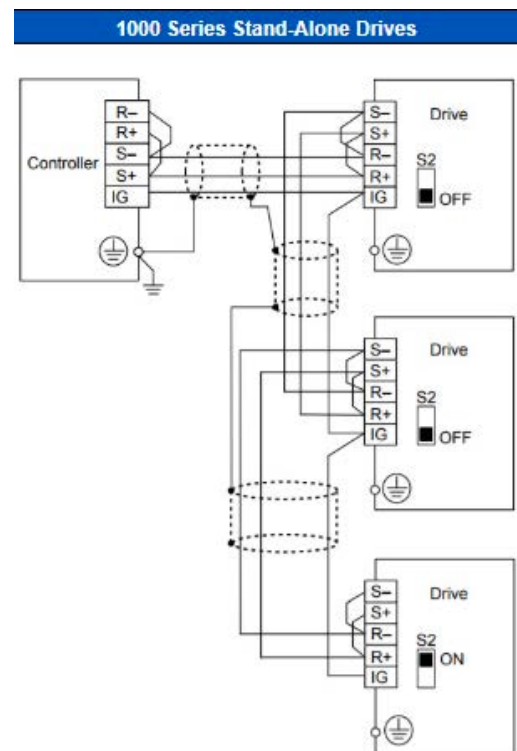
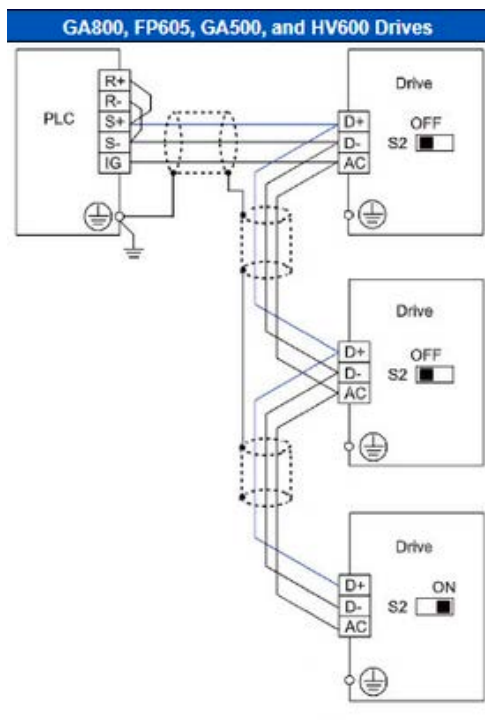
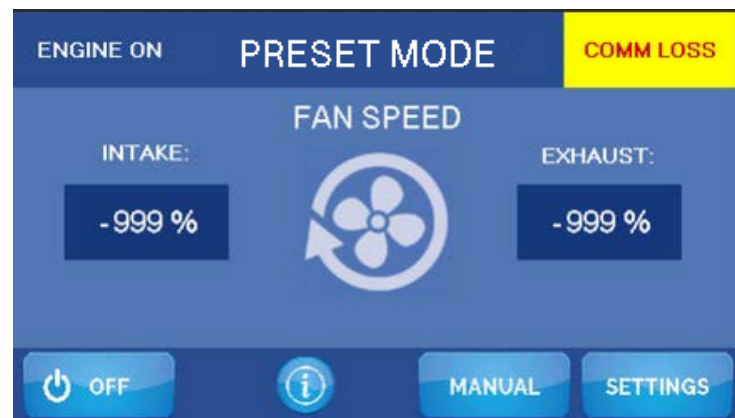
The Comm Loss (Communication Loss) alarm indicates a loss of communication between different components or devices in a system. This alarm is triggered when the system fails to establish or maintain communication links, which can have various causes such as network disruptions, cable failures, or configuration issues.

Identifying the specific cause of a Comm Loss alarm requires a systematic approach to troubleshooting. Here's a section that explains the steps to follow when encountering a Comm Loss alarm:

1. **Alarm Indication:** The Comm Loss alarm is displayed through an error message on a screen. Take immediate action to resolve the communication issue and restore normal operation.

2. **Initial Checks:** Start by conducting initial checks to ensure that the issue is not a temporary glitch or a simple fix.

- **Verify all connections:** Check the physical connections between devices involved in the communication. Ensure that cables are securely plugged in and not damaged or disconnected.
- **Power cycle the devices:** Turn devices experiencing comm loss off, wait for a few seconds, and then turn them back on. Sometimes, a power reset can resolve minor communication issues.
- **Consider utilizing an alternative wire,** as interference may lead to communication issues.

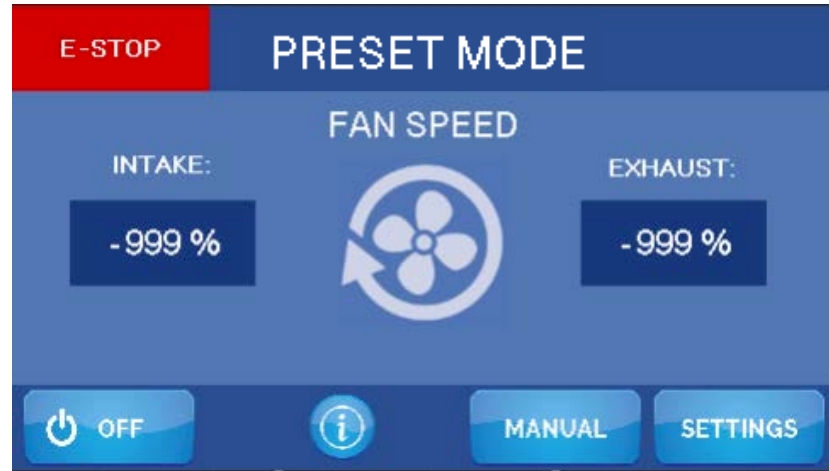


E-STOP ALARM & FIRE ALARM

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The E-Stop (Emergency Stop) alarm indicates the activation of an emergency stop button or switch. The E-Stop is a safety mechanism designed to quickly halt the operation of fans in emergency situations, ensuring the protection of personnel and preventing potential hazards. The E-Stop is manually activated as per a switch described earlier in this manual.

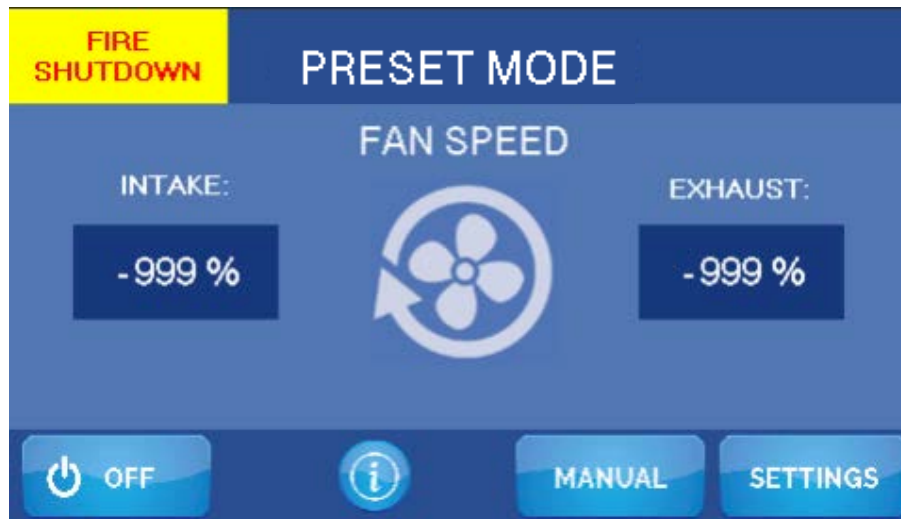
If the E-Stop is indicated, the fans have been shut down. Investigate the cause and ensure no safety hazards exist before restoring operation of the fans.



The Fire Shutdown Alarm is generated when the switch on the fire suppression system opens. In this condition, the fans will stop. The only way to clear this alarm is to reset the fire system discharge switch located on the fire extinguishing system.

IMPORTANT:

THE SCREEN IN THE PHOTO BELOW INDICATES THAT A FIRE SHUTDOWN HAS OCCURRED WITHIN THE ENGINE ROOM SPACE AND THAT A POTENTIALLY LIFE-THREATENING SITUATION MAY EXIST! USE CAUTION AND APPROPRIATE SAFETY MEASURES WHEN ENTERING THE ENGINE ROOM!



VARIABLE SPEED DRIVE TROUBLESHOOTING

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VSD Overview

The Variable Speed Drives are used to supply AC power with a variable frequency to the fan motors to change the speed. The VSD works by taking the AC input from the electrical system, converting it to DC voltage, then converting it back into a variable AC output, which is then supplied to the fan motors. The DC section in the drive contains large power storage capacitors operating at high, potentially deadly DC voltages to smooth out power fluctuations and changes in motor load. These capacitors can store energy for a period of time after power has been removed from the drive. To avoid shock, you should wait several minutes after turning off the breaker to the VSDs before removing the cover. There is a red LED charge indicator inside the VSD; work should never be performed on the VSD while this is lit! The input to the VSD can be single or three phase. Regardless of electrical system on the boat, the output of the VSD to the fan motor is three phase. They are very reliable and require very little, if any, maintenance; it is advisable, however, to occasionally clean dust off the heat sinks and fans on the back of the VSD by blowing compressed air through them. In the event of an VSD fault, the display will display an VSD Fault message that specifies which VSD has faulted. To diagnose the fault, it will be necessary to read the alarm code from the VSD display. Take note of the fault before pressing the Reset button on the display. The following section covers the alarms that are generated by the VSDs and how to monitor operating conditions.

VSD Alarm Code Quick Check List

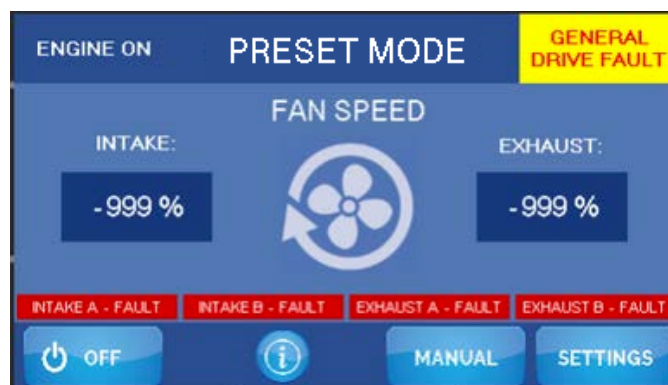
- GF Ground Fault, Current shorted to ground exceeded 50% of rated current on output side of the drive.
- LF Output Phase Loss, Phase loss on the output side of drive.
- LF2 Output Current Imbalance, one or more of the phases in the output current is lost.
- oC Over Current, Sensors have detected an output current greater than the specified over current level.
- oH Heat sink Overheat, the temperature of the heat sink exceeded the value set.
- oL Motor Overload, make sure the VSD is properly sized for the fan.
- Uu Low voltage at Drive Input from ship's supply.
- PF Power Fault. One of the phases is missing from the ship's supply.
- oU High voltage at drive input from ship's supply.
- CE Comm Error.

GENERAL DRIVE FAULT

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A General Drive Fault alarm is a notification that indicates a problem with one or more drives in a system. To fix the specific drive that is faulting, you will need to follow a manual process that involves several steps.

- 1. Locate the alarm:** The General Drive Fault is displayed through an error message on a screen. When this alarm is triggered, take immediate action to resolve the issue and restore normal operation.
- 2. Initial Checks:** Start by conducting some initial checks to ensure that the issue is not a temporary glitch or a simple fix. Perform the following steps and see the comm loss page:
 - a. **Verify all connections:** Check the physical connections between devices involved. Ensure that cables are securely plugged in and not damaged or disconnected.
 - b. **Power cycle the devices:** Power cycle the devices experiencing the communication loss. This involves turning them off, waiting for a few seconds, and then turning them back on. Sometimes, a power reset can resolve minor communication issues.
- 3. Identify the faulty drive:** Examine the drive information to identify the specific drive that corresponds to the General Drive Fault alarm. This information is displayed with a unique identifier, a red box on the bottom of the screen with a label.
- 4. Cross-reference the information:** Compare the details of the faulty drive obtained from the drive information with the physical drives in the system. This may involve visually inspecting the drives, checking their labels or serial numbers, or referring to documentation or diagrams that indicate the drive's location and wiring procedure.
- 5. Verify the fault:** Once you have identified the potential faulty drive, verify the fault by conducting further tests or diagnostics. The most common drive fault is due to wiring issues. Ensure the wiring has been completed correctly, as this step ensures that you don't replace a functional drive.
- 6. Resetting a fault:** To reset a faulted drive, first turn the MAC unit off, using the off button. Then press the reset button on the faulted drive or remove the power for 30 seconds and turn the drive back on.
- 7. Replace or repair the faulty drive:** If the fault is confirmed, resolve the issue by contacting, Delta T systems. Depending on the system and the nature of the fault, this might involve replacing the faulty drive with a new one or performing repairs on the existing drive.



VSD ALARMS

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Retrieving VSD Alarm Fault Information

If an VSD alarm occurs, it may be necessary to call Delta T Systems for assistance. Note the conditions when the fault occurred and write it down before calling Delta T Systems for technical support on drive problems if possible!

VSD Over Current Alarm

The Over Current alarms are generated when the drive output current exceeds settings placed in the drive by Delta T Systems to protect the drives and motors. If this alarm occurs the possible causes are:

- Faulty VSD output to motor wiring creating an intermittent short. If the alarm is occurring below maximum output frequency, this is very likely the cause. Disconnect wires from the drive and use a Mega Ohmmeter to test the wiring from the VSD to the motor windings. DO NOT use the Mega Ohmmeter with the wires connected to the VSD! Doing so can cause permanent damage to the VSD.
- VSD connected to the incorrect fan (Reverse installation of the Intake and Exhaust VSDs is a common problem on new systems). Verify that the rated drive HP on the Delta T Systems label matches the fan HP!
- Possible defective fan motor. Checked the fan for free rotation and unusual noise while operating. The Mega Ohmmeter can be used to check the windings for short circuits.
- Improper wire size used in installation. The VSDs are very sensitive to wire size due to the harmonics generated when changing the DC voltage back to AC. Using wire smaller than specified in the System Block Diagram can cause an increase in apparent current. This is the case with any variable frequency drive and is most apparent on vessels with a non-conductive hull because of the grounding arrangement.

VSD Over/Under Voltage Alarm

The VSD has circuitry that constantly monitors the condition of the DC section in the drive. If an abnormal voltage is sensed, the VSD will shut down and generate an alarm. The abnormal condition is usually caused by incoming power that is not at the correct voltage. Possible causes are:

- Defective voltage regulator or incorrect output voltage at generator(s)
- Loose connections or circuit breakers
- Improper power supply from shore power input

The Over Voltage alarm can also be caused when the system is in Manual Mode and the exhaust fan is overdriven by the intake fan. Running the intake fan at high speeds with the space sealed effectively turns the exhaust fan into a generator. The power generated has no place to go and causes the DC bus on the VSD to go over voltage. If this happens, reset the alarm and open a hatch or door to the exterior to allow air to escape the engine room while in the Manual Mode.

DELTA T SYSTEMS

LET'S WORK TOGETHER

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