Blower Drive Checkout for 3GIBC1 Systems

Introduction

This document covers troubleshooting of the interface between the Generation 3 version of the ISIBC1 Internal Bubble Cooling control system and the variable speed drives that operate the inlet and outlet blowers.

Background

The IBC system uses a simple interface system to communicate with the IBC blower drives. The interface is designed this way so that connection with nearly any variable frequency drive is possible without the use of custom designed interfaces and protocols. The IBC system uses state management and speed forecast systems to keep track of what speeds the blowers are running, eliminating the need for costly speed feedback signals. In order for the interface to function properly it is important that the interface wiring is correct and the frequency drives are programmed correctly. The following testing procedures will help you determine if the variable speed drives are working properly under all possible circumstances.

Drive Operations

Inlet ON + Outlet OFF	Inlet Blower ramps to [typically] 50% of set IBC exchange rate [MSR setting]
Inlet ON + Outlet ON	Outlet ramps to near Inlet speed, at which point both ramp together with the Outlet speed matching the set [MSR] speed and the Inlet speed ramping to a calculated [per ABB ratio] speed
Inlet OFF + Outlet ON	Outlet will NOT start without the Inlet already running
Inlet On + Outlet ON Outlet Switched OFF	Inlet slows to [typically] 50% of set IBC exchange rate and Outlet coasts to stop
Inlet ON + Outlet ON Inlet Switched OFF	Both Inlet and Outlet coast to stop

Drive Wiring

Refer to Figure 1 on the following page for a diagram of the drive terminations. Each is identical and each uses 3 pairs of control wires:

- One pair is used to start/stop the drive
- One pair is used to report the drive state
- One pair is used to send the DC speed reference

These connections to the Variable Frequency Drives (VFD) are done through the supplied and uniquely keyed drive cables from D. R. Joseph.

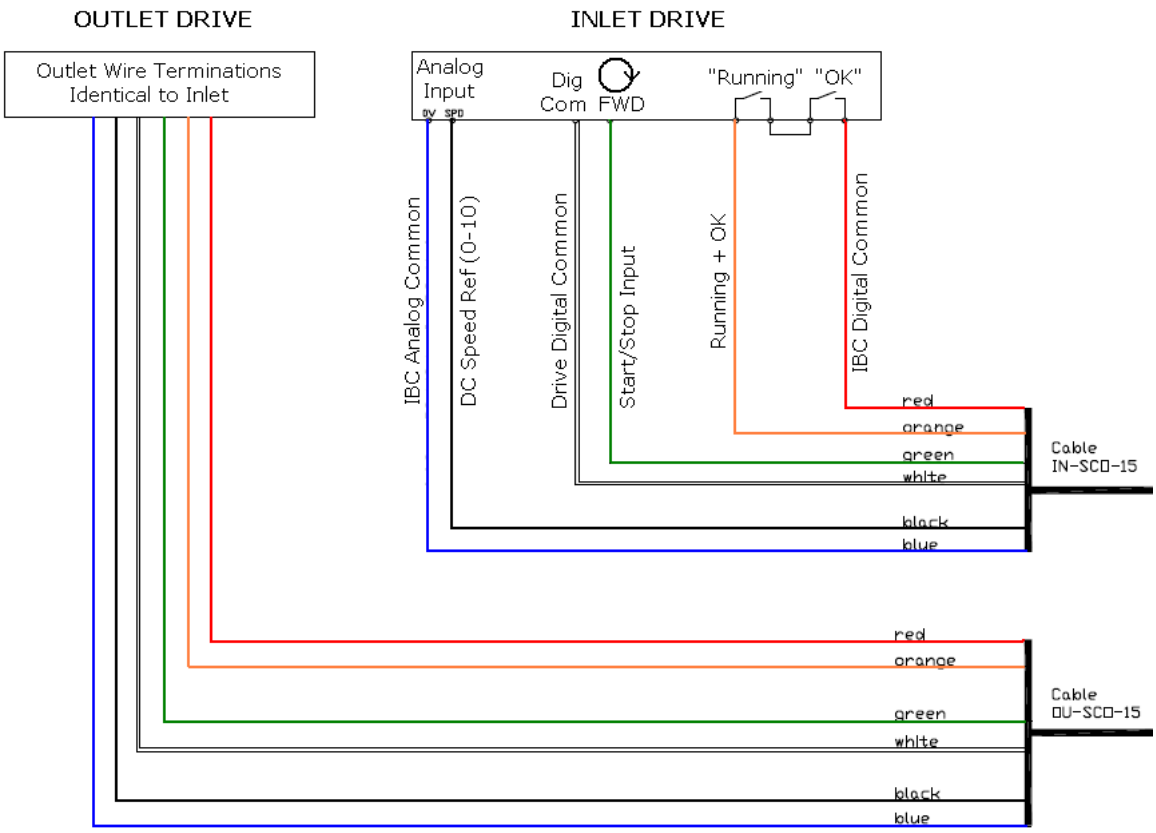


Figure 1

Drive Start/Stop Signaling

The Start/Stop function of the IBC system uses 2 wire initialization. The IBC system, via the Dry Contact Relay module, simply provides the electronic wire path necessary to send the proper drive produced potential to the required drive input to start the drive. This is done using the Green and White wires of the supplied DRJ cable. Removing this signal will then stop the drive. Some drives may provide a ground (sink) signal while most will provide a positive (typically 24 VDC) voltage signal (source). When the drive sees this signal at its Start terminal, the drive will start.

Drive Speed Reference

The IBC system provides the necessary speed references to both the Inlet and Outlet Drives. The Black (+speed) and Blue (analog ground) wires of the DRJ cable send this signal. However, in the case of the Inlet only, this analog signal is not provided until the IBC system first acknowledges that the Inlet drive is indeed running. Note that the displayed speeds on the Blower Popup are not return signals from the drives themselves, but rather the forecasted speeds of each drive as calculated by the IBC controller.

Drive State Signaling

The IBC system **must** detect the Running/Stopped state of each drive. This is done by sending, via the respective DRJ supplied drive cable Red wire, an IBC system *ground* potential to one side of a bank of [typically 2] drive status contactors. One of these relays will be programmed to close when "Running" while the other will typically be programmed to open when "Fault". These 2 relays are in turn jumpered together in series, with the return signal sent back to the IBC system via the drive cable Orange wire. If the IBC system detects this ground potential, it knows the relays are closed and therefore the drives running.

Just as important as the requirement for the IBC system to detect that the drive(s) are running is the requirement for the IBC system to detect that the drive(s) has stopped. Therefore the "Running" (or "No Fault" if fault occurrence) relay MUST open for the IBC system to properly acknowledge a stopped state.

Basic Trouble Shooting

Inlet Blower Will Not Start

Verify there is a DC reference signal between the Black and Blue wires terminated at the drive speed input. This signal is produced at pins 3 and 4 of the IBC controller resident Analog Output module. (See the "Speed Reference" block shown in Figure 2.)

- If there is a signal, the problem is within the drive (note that it may be a parameter setting.)
- If there is no signal, the Inlet drive may not have set its Running Relay to the "Running" status, and/or the Health Relay to the normal "No Fault" closed position. Check to see that the relays are closed by confirming a short, or no difference in potential, between the Red and Orange wires terminated at the drive state relays. This "Running" and "No Fault" status signal is read at terminal **P9 pin 7** of the IBC main controller board set. A lit LED signifies a returned "Running" and "No Fault" state. (See the "Drive States" block shown in Figure 2.)

Outlet Blower Will Not Start

Verify there is a DC reference signal between the Black and Blue wires terminated at the drive speed input. This signal is produced at pins 7 and 8 of the IBC controller resident Analog Output module. (See the "Speed Reference" block shown in Figure 2.) Note that, unlike the Inlet Drive reference, the DC speed reference for the Outlet Drive is always present at pins 7 and 8, and likewise should always be present at the Black and Blue drive terminated wires.

Reviewing the “Operations” heading on page 1 of this document, it is known that the IBC will DISALLOW the starting of the Outlet Drive until the *Inlet* Drive is acknowledged to be running. Therefore IBC system will not even display the “START” button for the Outlet unless it has been acknowledged that the Inlet is running. The

Inlet Blower Will Not Ramp When Outlet is Started

Reviewing the “Operations” heading on page 1 of this document, it is known that the Inlet will only ramp to [typically] 50% of the set [MSR] speed if the Outlet is not running. Therefore if the Inlet is not ramping to full calculated speed once the Outlet is started, it is because the IBC system does not know that the Outlet is running. And this is most likely because the Outlet Drive did not set its Running Relay to the “Running” status, and/or the Health Relay to the normal “No Fault” closed position, or the signal did not reach the IBC controller. Check to see that the relays are closed by confirming a short, or no difference in potential, between the Red and Orange wires terminated at the Outlet drive state relays. This “Running” and “No Fault” status signal for the Outlet is read at terminal **P9 pin 6** of the IBC main controller board set. A lit LED properly signifies a returned “Running” and “No Fault” state. (See the “Drive States” block shown in Figure 2.)

Note again that unlike the Inlet Drive, the Outlet Drive does have a speed reference present at all times. Therefore the Outlet Drive will be allowed to run as long as the IBC system acknowledges the Inlet Drive to be running, regardless of whether or not the IBC system acknowledges the Outlet to be running.

Drive Programming

Regardless of the type of VFD that is installed, the VFD must be a digital device to function properly. That is, the VFD must be programmable using a digital interface. Following are the minimum parameter requirements: The Inlet and Outlet drive parameter sets are identical WITH ONE VERY IMPORTANT EXCEPTION! That exception is the ramp rate, or *Accel and *Decel time.

***Inlet Accel Time = 30 seconds**	***Outlet Accel Time = 85 seconds**
***Inlet Decel Time = 30 seconds**	***Outlet Decel Time = 85 seconds**

Other REQUIRED parameters (identical for both Inlet and Outlet Drives)
Accel/Decel Type = Linear
Stop Method = Coast to Stop
Speed Reference Input = 0 – 10 VDC
At least 1 Relay = Closed when “Running”, Open when “Stopped”
Recommended additional Relay = Closed when “No Fault”, Open when “Fault”

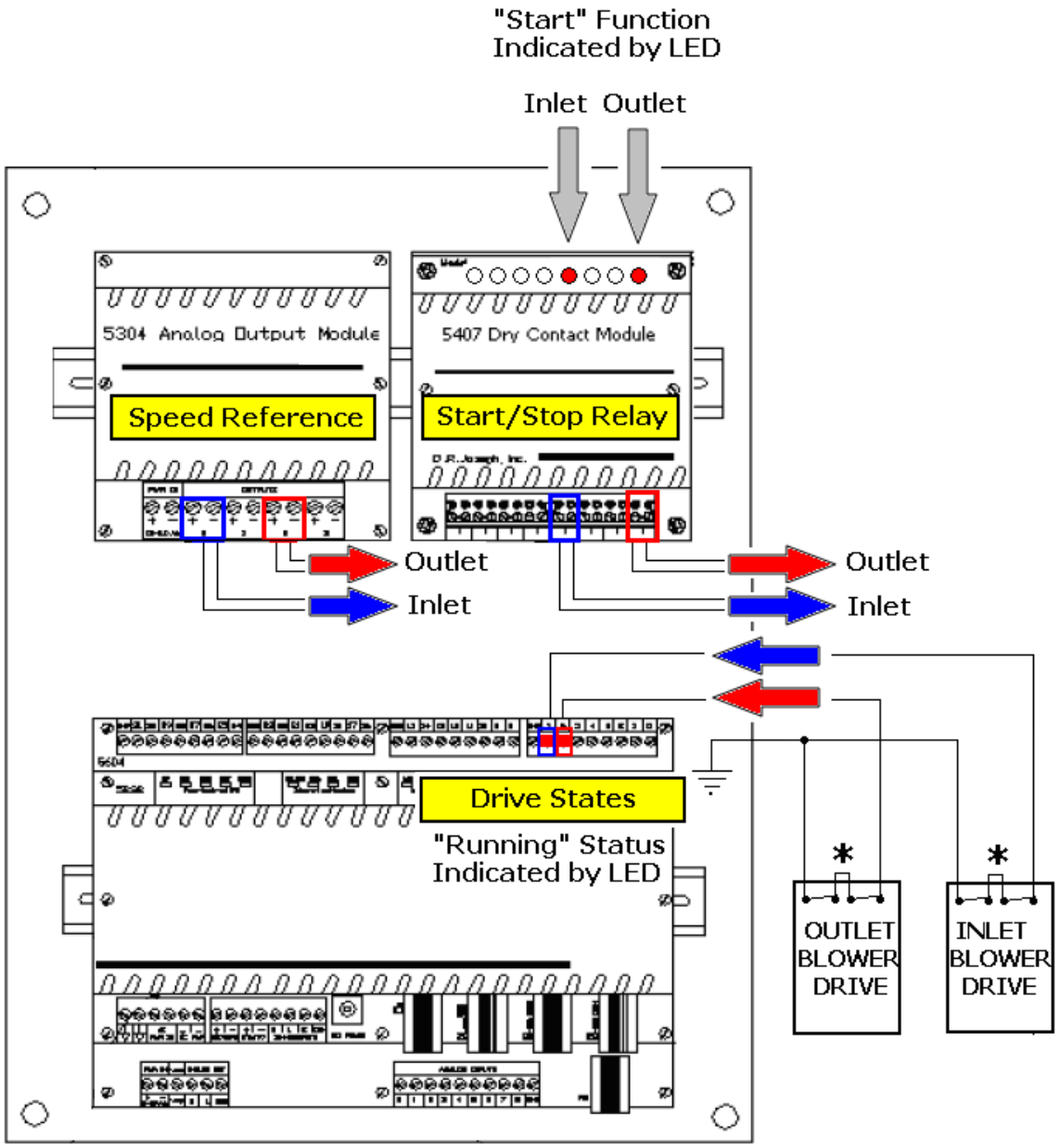


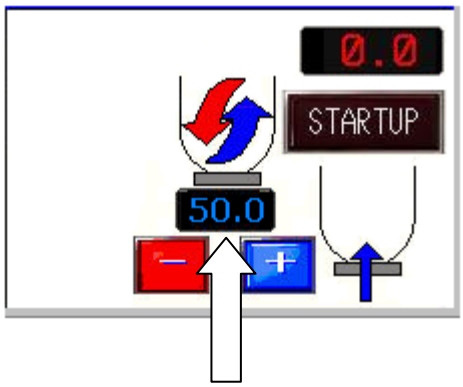
Figure 2

Testing the Blowers

The following is a comprehensive procedure for testing the operation of the VFD interface. All checks must succeed for the IBC system to operate properly. Before starting, verify that power to the IBC system and both VFDs is on. Also confirm that the VFDs are set for REMOTE control

Refer to Figure 2 regarding the Inlet and Outlet Start circuits. When the Inlet Start button is pushed on the IBC local, remote, or OEM Touchscreen, the LED for Inlet Start (channel 4) will light, indicating the dry contact relay for that channel has closed. The same is true for the Outlet Start LED (channel 7). These LEDs will continue to stay lit, and the Start Relay closed, as long as the drive is running. However, if the IBC system does not receive a "Running" signal back from the respective drive (addressed following) the LED will go out after approximately 2 seconds, indicating the drive start relay on the IBC system Dry Contact module has turned off, or is again in the open state.

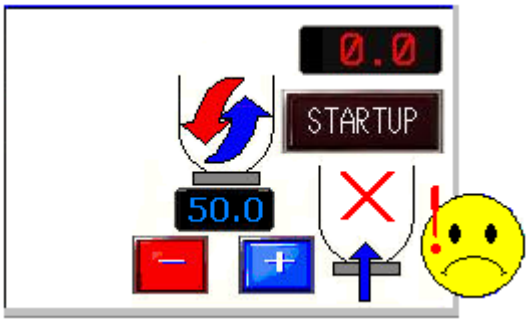
1. Start from the Blower Popup screen with both the Inlet and the Outlet Blowers OFF



2. Set the Master Speed Reference [MSR] to 50.0%. Do this via a keypad that opens by tapping on the small Reference display

3. Press the "STARTUP" button to start the Inlet. The speed display above the Start Button will immediately begin to increase to approximately 25%, which is half the set MSR. (The amount of the MSR that the Inlet ramps to is a factory set parameter of 50%. That is, in this case, 50% of 50% = 25%. Note for now that this parameter may be set to something other than 50%. For the purposes of trouble-shooting the important thing is that the Inlet starts.)

4. If the Inlet does not start, a Frown Face and red "X" will popup. Check the LED at P9 pin 7 (see the Drive States module in Figure 2). This LED should be ON. If not, refer to the "Inlet Blower will not Start" section of this document.



5. Turn the Inlet Blower OFF. The speed display will drop to 0, but it is only a forecasted speed. The actual speed may be checked at the drive itself (frequency output should be 0), or at the Drive States LEDs shown in Figure 2. If the "Running" status LED does not turn off until after the Inlet has finished ramping down to zero speed, the VFD must be re-programmed for "Coast to Stop".

6. Turn the Inlet Blower ON and wait until speed has reached a steady point

7. Now the Outlet Start Button will appear in the Popup panel. Turn the Outlet Blower ON. If the Outlet does not start, a Frown Face and red "X" will popup under the Outlet Start Button. Check the LED at P9 pin 6 (see the Drive States module in Figure 2). This LED should be ON. If not, refer to the "Outlet Blower will not Start" section of this document.

8. Once running, the Outlet should begin to increase in speed until it gets close to the speed of the Inlet Blower, at which point the Inlet Blower will increase in speed. If the Inlet Blower does not increase in speed, check the LED at P9 pin 6 (see the Drive States module in Figure 2). This LED should be ON. If not, refer to the "Inlet Blower Will Not Ramp When Outlet is Started" section of this document.

9. After the Outlet Blower has reached the final speed, turn it OFF. If the Inlet speed does not IMMEDIATELY begin to slow to again 25%, confirm that the Outlet Stop Method is set to "Coast to Stop". If the Inlet never starts to decrease in speed, make sure that the Outlet is now in the "Stopped" state, and the "Running" relay is now open. The LED at P9 pin 7 should turn OFF IMMEDIATELY.

CONSIDERATIONS

It is possible for faulty wiring or an intermittent drive contactor to cause a false transition to a state. The IBC system has a built in delay to ignore such occurrences, as long as the false state lasts less than 500 milliseconds. If the false state lasts longer than that, the IBC system will assume that the Blower has been turned off. Please refer to the "Drive Operations" section of the manual for expected results. If loose or compromised wiring is not the issue, it may be necessary to locate another available state relay on the drive. Also consider that contactor intermittencies may be exacerbated with heat.

If either VFD trips because of an over current or DC bus over voltage, refer to the VFD manual to make the necessary adjustments to correct the condition. **Do not change the Accel or Decel rates on either VFD**. The IBC system provides conservatively ramped signals for all speed change requests and is not the source of drive fault issues. It may be necessary to install dynamic braking resistors on the VFD to prevent deceleration related VFD faults. If either VFD cannot be made to perform these tests, also check the fan and motor assembly to ensure there are no mechanical problems causing the drive fault. If there are no mechanical problems, then it will be necessary to replace the drive with a unit capable of handling the requirements. Contact D.R. Joseph for assistance in selecting an appropriate VFD.

It is normal that if the IBC system loses power while either or both the blowers are running, the IBC system will not automatically restart the blowers until the Touchscreen switches are manually turned off and then turned back on. This is a safety feature that ensures that blowers will not start unexpectedly.

Blower Troubleshooting Quick Reference

Drive Terminals	IBC Terminals
Inlet Blower Will Not Start	
Verify DC speed reference voltage is present at Inlet Drive "+ SPEED" terminal. At Inlet Drive, verify "RUNNING" and "NO FAULT" Contactors are closed. There should be continuity or equal potential across the terminals.	Verify DC speed reference voltage is present at Analog Output Board between Pins 3 and 4. LED @ P9 – 7 ON proves Drive Contactors are completing the circuit for Inlet Drive is" RUNNING"
Inlet Blower will Not Ramp When Outlet is Started	
At Outlet Drive verify "Running" and "NO FAULT" Contactors are closed. There should be continuity or equal potential across the terminals.	LED @ P9 – 6 ON proves Drive Contactors are completing the circuit for Outlet Drive is "RUNNING"
Outlet Blower will Not Start	
At Inlet Drive, verify "RUNNING" and "NO FAULT" contactors are closed. There should be continuity or equal potential across the terminals.	LED @ P9 – 7 ON proves Drive Contactors are completing the circuit for Inlet Drive is" RUNNING"