
Smart - Speed - Control

DESCRIPTION

The Smart Speed Control is an electronic device with a remote panel connected to the BD35 or BD50 controller with a multi-core cable. The remote panel can be flush-mounted (requires a 2-5/8" x 1-7/8" cut-out) or mounted in its own housing. The housing can be used for protection of the rear of the panel when it is flush mounted. The panel has a six speed bar graph to display the current speed setting, together with "Auto" & "Manual" LED's to indicate in which mode the system is operating. The appropriate "Auto" or "Manual" LED will be green when the compressor is running and will change to orange when the thermostat is "off" and the compressor is idle. A push-button is provided to change the operating mode, and also to enable speed selection in the "Manual" mode. There is a separate LED that will flash a fault code in the event of a malfunction, and a power terminal multiplier to accommodate multiple connections to the +ve & -ve terminals. The SSC is connected to the system in addition to the Danfoss controller and a thermostat and does not replace these items.

PRINCIPLES OF OPERATION

DANFOSS BD35 and BD 50 COMPRESSORS

The Danfoss BD35 and BD50 compressors are internally driven by what are basically 3 phase motors that can be run at any speed between 2000 rpm and 3500 rpm depending on the frequency of the signal applied to the windings. The Danfoss controller that is attached to the compressor housing converts the incoming 12 or 24 volt dc power into the modified dc that is needed to run the motor, and the speed of the motor is determined by the value of a resistor connected in series with the thermostat lead. All but the smallest Frigoboat systems are supplied with a 4-Speed selector panel that mounts on the controller, and this can stay in situ for use in the case of a malfunction with the SSC. AH and AV models have a "Master Control" that incorporates a speed choice, and this too remains connected when the SSC is installed. Other manufacturers may mount resistors somewhere in the thermostat circuit to force the compressor to run at a speed predetermined for the size and type of evaporator and condenser used. This avoids over-capacity and component stress and also reduces current draw to a safer, more acceptable level, but is not easily adjustable. If a thermostat is connected directly to the controller, without any resistor, the compressor will run at the slowest speed, 2000 rpm.

FRIGOBOAT SMART SPEED CONTROLLER (SSC)

The overall efficiency of a refrigeration system is determined by its Coefficient Of Performance (COP). The higher the COP the greater the efficiency of the system, and the highest COP is achieved by running the compressor at the slowest possible speed for the longest possible time. Also, by altering the speed of the compressor, the system capacity can be adjusted to match the application and conditions, and the current draw kept to an acceptable and safe level.

MODES

AUTO MODE

In the "Auto" mode, after a few cycles the SSC will adjust the compressor speed to run at the most efficient one of the six available dependent on parameters set by the SSC. If ambient, box, and power supply conditions do not change significantly, the speed will not alter on consecutive cycles, but as conditions change so will the speed setting to maintain the highest possible COP and efficiency.

MANUAL MODE

In the "Manual" mode, the compressor speed can be set to a fixed speed that will not change unless altered manually.

FEATURES

AUTOMATIC SPEED SELECTION

The “Automatic Speed Selection” feature ensures that the most efficient compressor speed is engaged dependent on the prevailing conditions as described above.

SAFETY START

The “Safety Start” feature ensures that when power is supplied and the system is started initially, under warm box conditions, the SSC will start in “Auto” mode at a medium speed to protect the electronics from being overloaded. After a short period of time the speed will be increased incrementally until the maximum speed is reached or the thermostat turns the system off, and then continue the “Auto” sequence for the subsequent cycles. If the thermostat is off when power is supplied to the system (i.e. box is cold), the SSC will start in the “Auto” mode at maximum speed and then continue the “Auto” sequence for the subsequent cycles.

BOX RESTOCKING

The “Box Restocking” feature provides a means to activate the maximum capacity of the system whenever warm goods are stocked into a cold box or rapid cooling is required. This is accomplished by switching to “Manual”, selecting the highest speed, and then reverting to “Auto” mode.

FAULT DIAGNOSIS

The “Fault Diagnostic” feature will flash the “Fault” LED up to 5 times every 5 seconds in the case of one of five fault conditions.

1 Flash;	Supply voltage low, below 10.4v (12V) or 22.8 (24v)
2 Flashes;	Excessive load on “Fan” terminals, above 0.7 amps
3 Flashes;	Compressor non-start
4 Flashes;	Compressor speed below 1900 RPM
5 Flashes;	Controller heat-sink temp too high. Re-sets on cool-down

INSTALLATION

The SSC is designed to be installed on Frigoboat systems, and some wiring and other changes may have to be made for installation to other manufacturers systems, where any resistors connected in series with the thermostat will need to be removed. The SSC will only perform as designed if the thermostat is a mechanical model, and without a resistor in the circuit.

The electrical connections should be made in accordance with the wiring diagram, and, upon completion, all connections should be inspected for integrity and safety. If a Frigoboat 4-Speed selector board is fitted or a “Master Control” connected to the system (AV & AH models) these can remain in place and the “C” & “T” leads of the SSC are then connected to the “C” & “2000” terminals respectfully, and not directly to the Danfoss controller.

The SSC remote panel should be mounted in a convenient location and the rear of the panel protected from physical and water damage.

OPERATION

On initial power-up, the SSC will start in the “Auto” mode and with the “Safety Start” feature enabled. If the power is not interrupted and the push-button not depressed, the system will continue in the “Auto” mode to find the most efficient running speed after a few cycles. Depressing the push-button for one second or longer changes the mode from “Auto” to “Manual” or vice versa. When in the “Manual” mode, depressing the push-button for less than one second changes the speed setting in ascending order, (from speed 6 it will revert to speed 1) . When the mode is changed from “Manual” to “Auto”, the “Auto” sequence will be started at the speed that was set in the “Manual” mode. When the “Box Restocking” feature is required, switching to the “Manual” mode, setting the speed to the highest setting, and then changing back to “Auto” mode restarts the “Auto” sequence at maximum capacity.

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