SO-LOW Environmental Equipment Co
10310 Spartan Dr.
Cincinnati, Ohio 45215 USA
Phone: (513) 772-9410

General Purpose Laboratory Refrigerator With Alarm

Models:

DHF4-27GDAO, DHF4-27SDAO

DHF4-30GD

LT1982X3 • Rev. A

Table of Contents

Introduction

Alert Signals

Warning
Warnings alert you to a possibility of personal injury.

Caution
Cautions alert you to a possibility of damage to the equipment.

Note
Notes alert you to pertinent facts and conditions.

Hot Surface
Hot surfaces alert you to a possibility of personal injury if you come in contact with a surface during use or for a period of time after use.

Warning
As a routine laboratory precaution, always wear safety glasses when working with this apparatus.

Warning
This product is not approved for storage of flammable or explosive materials. Also, it is not approved for use in hazardous locations containing explosive atmospheres.

Warning
High voltage is supplied to PC board when key switch is OFF.

DANGER: RISK OF CHILD ENTRAPMENT. BEFORE YOU THROW AWAY YOUR OLD REFRIGERATOR OR FREEZER:

- TAKE OFF DOORS
- LEAVE THE SHELVES IN THE PLACE SO THAT CHILDREN MAY NOT EASILY CLIMB INSIDE.

This manual is intended to provide installation and operating instructions for SO-LOW alarm version refrigerators. The alarm version control system provides both audible and visual indication of alarm conditions in an easy to read display format. In addition, there are two sets of contacts available for remote alarm switching.

Temperature and alarm set points are directly entered in °C or °F. More about setting up the controller and all the options are discussed in the *Operation* section of this manual.

Safety Precautions

Your satisfaction and safety are important, a complete understanding of this unit is necessary to attain these objectives.

As the ultimate user of this apparatus, it is your responsibility to understand its proper function and operational characteristics. This instruction manual should be thoroughly read and all operators given adequate training before attempting to place this unit in service. Awareness of the stated cautions and warnings, and compliance with recommended operating parameters – together with maintenance requirements – are important for safe and satisfactory operation. The unit should be used for its intended application; alterations or modifications will void the Warranty.

This product is not intended, nor can it be used, as a sterile or patient connected device. In addition, this apparatus is not designed for use in Class I, II or III locations as defined by the National Electrical Code, unless otherwise noted.

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Performance Characteristics

Temperature Range: 1.0°C to 12.0°C (33.8°F to 53.6°F)
Temperature Stability: ±3°C

Unpacking

Save all packing material if apparatus is received damaged. This merchandise was carefully packed and thoroughly inspected before leaving our factory.

Responsibility for its safe delivery was assumed by the carrier upon acceptance of the shipment; therefore, claims for loss or damage sustained in transit must be made upon the carrier by the recipient as follows:

Visible Loss or Damage

Note any external evidence of loss or damage on the freight bill, or express receipt, and have it signed by the carrier's agent. Failure to adequately describe such external evidence of loss or damage may result in the carrier's refusing to honor your damage claim. The form required to file such a claim will be supplied by the carrier.

Concealed Loss or Damage

Concealed loss or damage refers to loss or damage, which does not become apparent until the merchandise has been unpacked and inspected. Should either occur, make a written request for the carrier's agent within 15 days of the delivery date; then file a claim with the carrier since the damage is the carrier's responsibility.

If you follow the above instructions carefully, we will guarantee our full support of your claim to be compensated for loss from concealed damage.

DO NOT – FOR ANY REASON – RETURN THIS UNIT WITHOUT FIRST OBTAINING AUTHORIZATION

Packing List

The following items are packed in the envelope located inside the refrigerator chamber. If any of the following items are not present, report the missing item to your local SOLOW representative.

1. Instruction Manual
2. Door Lock Key
3. Power Switch Key

Installation

Selecting a Location

Choose a location for the refrigerator that will provide at least two inches of clearance between the cabinet and any adjacent vertical surface at the sides and rear. Appropriate electrical power must be available. Locate the refrigerator within 6 feet of the power outlet so that no extension cord is required.

Note

The refrigerator must be level in order to provide adequate condensation drainage as well as proper door alignment and operation. The refrigerator should be in its final operating location and set so that it is firmly positioned on the floor.

Leveling the Unit

The refrigerator must be level in order to provide adequate condensation drainage as well as proper door alignment and operation. The refrigerator should be in its final operating location and set so that it is firmly positioned on the floor. There are four leveling screws, one on each corner. Level the cabinet front to rear and side to side using the corner leveling screws. The leveling screws are accessed by removing the base grille, as described below.

1. Remove the lower grille attaching screws.
2. Grasp the grille with both hands.
3. Tilt the lower end of the base grille toward you.
4. Pull grille away from the refrigerator

Door Handles

(Some Swinging Door Models Only)

Door handles are packed inside each refrigerator. To mount the handle, lift the door gasket behind the two screws on the front of the door. Attach handle with offset away from the cabinet corner and tighten the screws.

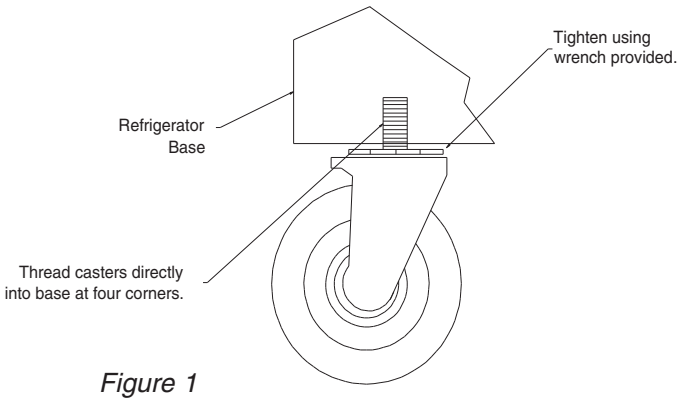


Figure 1

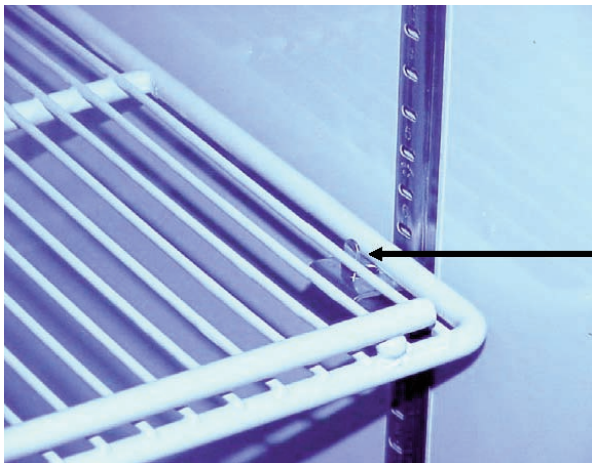
Installing and Leveling Casters

Some refrigerators and freezers come with four casters, which thread into the base of the unit, one in each corner. Use the wrench provided to thread the casters completely into the base of the unit. Back the casters in or out until the unit is level and resting on all four casters. See Figure 1.

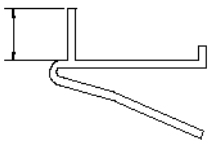
Shelves

Shipped inside each cabinet are shelves packed in plastic and a bag of shelf supports. Two different types of shelf supports are used. The shelf supports have tab lengths of 1/4 inch and 1/2 inch. The 1/4 inch versions are used in the front of the shelf (See Figure 2) and the 1/2" shelf supports are used in the rear.

Figure 2



Use 1/4" support on front ends shelves



Shelf Support

Tab Length

Warning
If the unit was tilted in excess of 30 degrees, level it and do not apply electrical power for a minimum of 12 hours.

Caution
Be sure that the power supply is the same voltage that is specified on the refrigerator data plate.

Warning
For personal safety this unit must be properly grounded. DO NOT under any circumstance cut or remove the ground prong from the power cord. DO NOT use a plug adapter that eliminates the ground prong.

Caution
Do not use an extension cord. Use of an ungrounded cord or an overloaded circuit VOIDS the compressor warranty.

Electrical Connection

Determine the total amount of current presently being used by other apparatus connected to the circuit that will be used by this refrigerator. **It is critical that this added current demand and other equipment on this circuit not exceed the rating of the fuse or circuit breaker in use.**

The frequency and nominal voltage requirements for the unit are specified on the data plate, which is located on the interior upper left side. Plug the unit only into a power source that meets these requirements. Low line voltage is often the cause of service complaints. With the unit running, check that the line voltage is within ±5% of that specified on the data plate.

The customer should have the wall receptacle and circuit checked by a qualified electrician to verify the receptacle is properly grounded and is connected to the proper power supply. The refrigerators require a NEMA 5-15P or 5-20P depending on current draw.

Panel Controls

Displays and Features

Before operation, it is necessary to become familiar with the refrigerator controls. All the refrigerator controls are located on the header panel. A layout of the controller and LED's are given below.

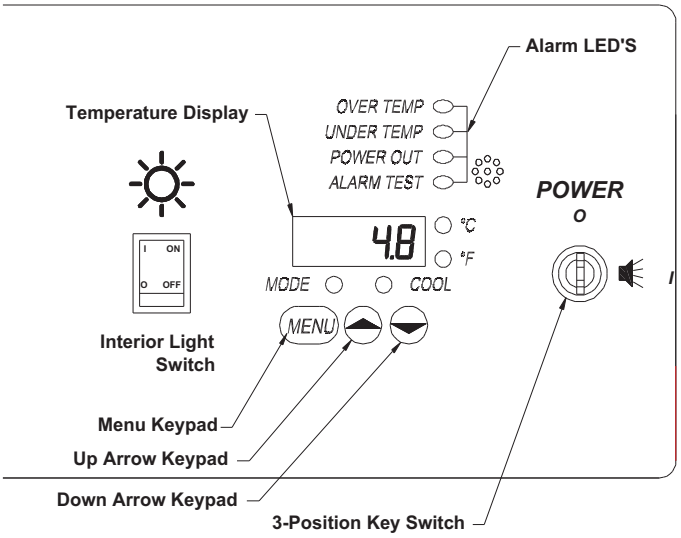


Figure 3

On the right side of the header panel is the key switch. The key switch has three positions, OFF (O), Set-up (I) and Alarm Enable (🔊). With the refrigerator is plugged in and the key switch in the OFF position, the displays and refrigeration system are off. The control board remains energized in order to supply a charge to the battery.

Warning
High voltage is supplied to PC board when key switch is OFF.

Key Switch

Turning the key switch to the middle position energizes the circulation fans and the controller display. When the controller is in the Set Up mode, the menu items can be set to the desired values. See *Controller Set Up* for a description of each. Once all menu items are set, the refrigerator can then be switched to the Alarm Enable position. While in the Alarm Enable position, the menu items can be viewed but not changed. The key can then be pulled to secure the values entered.

Note
The key can be pulled in the Off or the Alarm Enable Position only.

Temperature Display

The temperature display indicates chamber temperature while in the control mode of operation and menu titles and values while entering menu items (see Menus).

Unit's LED's

The temperature display indicates chamber temperature in both °C and °F. The current units are indicated by the corresponding LED located to the right of the temperature display.

Mode LED

The Mode LED is lit when the Menu keypad has been pressed. It indicates to the user that the controller is in the menu selection mode.

Cool LED

The Cool LED is lit when the controller calls for cooling. When this LED comes on the compressor should energize.

Alarm LED's

Over Temp – Indicates the current chamber temperature exceeds the high alarm temperature set point.

Under Temp – Indicates the current chamber temperature is lower than the low alarm temperature set point.

Power Out – Indicates AC power to the refrigerator is interrupted.

Alarm Test – Indicates the controller is running an alarm test.

Keypads

Menu Keypad – Pressing the Menu keypad enters the controller into the menu selection mode, designated by the illumination of the MODE LED. Repeatedly pressing the Menu keypad cycles through the list of menu items (see Menus). After the final menu, the controller returns to the control mode and the MODE LED turns off.

Up Arrow Keypad – Increases or changes menu values.

Down Arrow Keypad - Decreases or changes menu values.

Interior Light Switch

The interior lamp(s) is controlled by a rocker switch located on the header panel. This light may be operated any time the cabinet power is turned on at the keyed power switch. If the interior lamp fails, replace with the same size and wattage lamp. DO NOT USE REDUCED WATTAGE LAMPS. The reduced wattage lamps generally fail to light below 60°F (15°C).

Operation

Note
The *Pout* display is a normal occurrence when power is first applied to the controller. Press any key to clear it.

The refrigerator is started by inserting the power switch key, which is found in the envelope inside the unit, into the key switch. Turn the key to the first (set up) position. The internal fans will start and the display will flash between Pout and the current chamber temperature. The Pout (power out) display indicates to the user that the controller has sensed a low voltage condition. This condition is normal during any start-up. See the Alarms section for details on the Pout message. Press any keypad to clear the Pout.

Controller Set-Up (Menus)

During normal operation (control mode), the refrigerator temperature is displayed on the 4-character display. The compressor cycles on and off to control the chamber temperature between 1.0° and 12.0°C (33.8 to 53.6°F), selectable by the user. The temperature set point, high and low alarm set-points, units and display offset can be changed while the key switch is in the setup (middle) position. These values can be viewed but not changed with the key switch is in the alarm position. The menu options are explained in the following sections.

There are 7 menus to select from, each can be accessed by pressing the Menu keypad. Pressing the Menu keypad once brings up the first menu, which is the temperature set point. The displays initially flash SP followed by the last set temperature value. Pressing the Menu keypad again, accepts the value and displays the next menu. Each menu value is entered this way. The menus can be changed only while the key switch is in the set up (**I**) position. They can be viewed but not changed while the key switch is in the alarm enable (🔈) position. The individual menus are described below.

Temperature Set Point

Temperature Set Point (**SP**) – Adjustable from 1.0°C to 12.0°C or 33.8 to 53.6°F. Use the *Up/Down Arrow* keypads to change the temperature and the *Menu* keypad to enter the value and switch to the next menu.

Display Offset

Display Offset (**oS**) – Use the Up/Down Arrow keypads to adjust the offset value. Adjustable to ±5.0°C (± 9.0°F). This value is added to the temperature display to correct for differences between actual and displayed chamber temperature. See *Calibration* for details. Press the Menu keypad to enter the new value or to continue to the next menu.

Units

Units select (**C,F**) – Selects the desired temperature display units in °C or °F. Use the *Up Arrow* keypad to change the units from C to F. Use the *Down Arrow* keypad to switch from F to C. Press the *Menu* keypad to enter the units value and continue. The appropriate *units LED* will indicate the selected units.

High Alarm Set Point

High Alarm Set Point (**AH**) – Use the *Up/Down Arrow* keypad to adjust the value that triggers a high alarm condition if the chamber temperature rises above it. The high alarm temperature range is from -33.0°C (-27.4°F) to 37.0°C (98.6°F).

Low Alarm Set Point

Low Alarm Set Point (**AL**) – Use the *Up/Down Arrow* keypad to adjust the value that triggers a low alarm condition. The low alarm condition exists when the actual chamber temperature drops below the *Low Alarm Set Point*. The low alarm range is from -36°C (-32.8°F) to 34.0°C (93.2°F).

Alarm Silencing Menu

Alarm Silencing (**AS**) – During an alarm condition, while the key switch is in the *Alarm Enable Mode*, this menu allows the user to silence the audible alarm for 5 minutes. After the AS stops flashing, the display will show **n**, press the *Up Arrow* keypad to change the display to **y**. Press the *Menu Keypad* and the audible alarm will turn off for 5 minutes.

Alarm Test Menu

Alarm Test (**At**) – Use the *Up Arrow* keypad to change the **n** to **H**. By subsequently pressing the *Menu Keypad* the controller will perform a High Alarm Test (see Alarm Test in *Alarms* section). Use the *Down Arrow Keypad* to change the display to **L**. Pressing the *Menu Keypad* will activate the *Low Alarm Test*. Pressing the *Menu Keypad* while the display shows **n** returns the unit to control mode (MODE LED off).

Note
While in any of the above menu options, the controller will wait 15 seconds for a new value to be entered. If there is no keypad activity within 15 seconds, the refrigerator will automatically shift to the Control Mode and the Mode LED will turn off.

The two final menu items, calibration *offset* and *hold-off* time (oS and Ho), are not accessible from the main menu. In order to view and/or change them, the Menu keypad must be pressed and held for 5 seconds.

Calibration Offset

The two final menu items, calibration offset and hold-off time (oS and Ho), are not accessible from the main menu. In order to view and/or change them, the Menu keypad must be pressed and held for 5 seconds. The calibration offset (oS) menu will then be displayed briefly followed by the most recent offset value.

- Display Offset (oS) – Use the Up/Down Arrow keypads to adjust the offset value. Adjustable to +/- 5.0°C (+/- 9.0°F). This value is added to the temperature display to correct for differences between actual and displayed chamber temperature. See Calibration… for details. Press the Menu keypad to enter the new value or to continue to the next menu.

Hold-Off Time

- Hold-Off (Ho) – Use the Up/Down Arrow key-pads to adjust the Hold-Off time in minutes. Adjustable from 3 to 10. This value represents the delay time between compressor activations. Increasing the Hold-Off time can help prevent evaporator freeze-up by increasing the defrost cycle time. Press the Menu keypad to enter the new value and return to temperature control mode.

Control Mode

The Control Mode of operation is indicated when the Mode LED is OFF. With the desired temperature set point and alarm values entered, the refrigerator will then begin to control to the set temperature. There is a 3-minute delay between compressor activations. This delay begins the moment the controller is energized or the moment the compressor turns off during normal operation. The delay is added to provide time for the system pressure to drop before the compressor tries to start again.

Loading

Follow the guidelines below in order to provide optimal refrigerator performance:

- When loading with critical samples, verify all alarms and features are operating properly.
- Space samples uniformly in the chamber.
- Keep samples away from the back wall that may obstruct airflow.
- It is best to load the refrigerator from bottom to top. Keeping the area next to the air intake and exhaust clear will help assure proper airflow.

Temperature Digression

By pressing the Increase keypad while the refrigerator is in the *Control Mode*, the display will show the warmest temperature recorded since the unit was energized or the digression values were reset. Pressing the Decrease keypad will display the coldest temperature recorded since the unit was energized or the digression values were reset.

To reset the temperature digression values, simply press the Increase and Decrease keypads at the same time. The display will show ***Clr***, indicating the controller will begin recording new warm and cold digressions once more.

Alarms

Alarm Version Refrigerators are equipped with audible and visual alarms. They also feature remote alarm contacts. The key switch must be in the Alarm Enable position for the audible alarm and remote alarm contacts to activate. Alarm messages are shown on both the temperature display and in the row of Alarm LED's located above the temperature display. The following conditions will trigger an alarm:

- Chamber temperature is greater than the high alarm set point.
- Chamber temperature is less than the low alarm set point.
- Door has been left open for 3 minutes or more. (Not applicable to all models.)
- AC power has been interrupted to the refrigerator.
- Open sensor.

Over Temp Alarm

If the refrigerator chamber temperature rises above the *High Alarm Set Point*, the display will alternately flash the refrigerator chamber temperature and “HigH”. The *Over Temp* LED will be lit, the audible alarm will sound and the remote contacts will change state.

Under Temp Alarm

If the refrigerator chamber temperature falls below the *Low Alarm Set Point*, the display will alternately flash the refrigerator chamber temperature and “Lo”. The *Under Temp* LED will be lit, the audible alarm will sound and the remote contacts will change state.

Door Ajar Alarm (not available on all models)

When a swinging door is opened, the Door Ajar LED lights and the display alternately flashes between the refrigerator temperature and “door”. If a door is opened for 3 minutes, the audible alarm will sound and the remote alarm contacts change state.

Power Loss Alarm

When AC power is lost, the display will alternately flash between the current refrigerator temperature and “Pout”, the *Power Out* LED will light, the audible alarm will sound and the remote contacts will change state. When power is restored, the display will continue flashing the “*Pout*” message until it is cleared by the user by pressing any of the keypads.

Alarm Silencing

The audible alarm can be silenced by deactivating it at the *Alarm Silence Menu*. The audible alarm will silence for 5 minutes. It will sound again at the end of the 5 minutes if the alarm condition persists. Alarm silencing does not affect the visual alarms.

Alarm Test

The *Alarm Test* feature is used to verify proper alarm operation by simulating an increase or decrease in chamber temperature. The alarm test function will work for any

value of high or low alarm set points. With the key switch in the *Set Up Position* the remote and audible alarms are not activated during an alarm test, as is the case in an actual alarm condition.

The procedure for testing the alarms is simple. Press the *Menu Keypad* repeatedly until the display shows **At** (alarm test). Momentarily, the display will change to **n**. Press the *Up Arrow Keypad* to change the display from **n** to **H** in order to perform a *high alarm test*. With the display showing **H**, press the *Menu Keypad* again and the temperature display will begin to rise until it reaches the *High Alarm Set Point*. Once the set point is reached, both audible and visual alarms should be activated (with the key switch in alarm enable position) and the remote alarm contacts should change state. To perform a *Low Alarm Test*, simply press the *Down Arrow Keypad* when the display shows **n**. The display will then show **L**. Press the *Menu Keypad* again in order to activate the low alarm test.

During an *Alarm Test*, the *Alarm Test* LED is lit. The *Alarm Test* can be terminated at any time by pressing any of the keypads.

Note
The key switch should be in the Alarm Enable Position in order to test all alarm features.

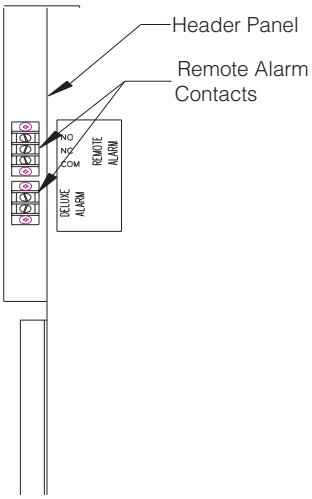


Figure 4

Remote Alarm Contacts

In addition to the audible and visual alarms, there are two sets of remote contacts on the side of the header panel, which change state during an alarm. The upper set of contacts provides both normally open and normally closed switching. The lower set of contacts is used only for normally closed contact switching.

All contacts are capable of switching 24V AC/DC @ 2 amps. The common (**C**) and normally closed (**NC**) contacts *open* during an alarm. The common (**C**) and normally open (**NO**) contacts *close* during and alarm. Figure 4 shows the location of the remote and deluxe alarm contacts. **The remote alarm contacts are rated for 24 volts MAXIMUM at 2 amps.**

Remote alarm contacts are active only with the key switch in the Alarm Enable position.

Open Sensor

When the controller is unable to read from the sensor, the display will show ***SnSr***, indicating that a sensor error exists. When a sensor error occurs, the controller will delay before activating a *High Alarm* condition. The *High Alarm* follows the sensor (**SnSr**) error since the temperature of an open sensor is interpreted as a temperature too high for the controller to read. The display will then alternately flash "**SnSr**" and "**HigH**".

Battery Back Up

The SO-LOW Alarm Version Refrigerators are supplied with a rechargeable battery back up. The battery will continue to supply power to the controller and alarm features in the event of a power outage. A fully charged battery can continue powering the controller for up to 6 hours.

The battery back up is recharged by the temperature controller during normal operation. The battery should be checked every six months and replaced when necessary. Check the battery by unplugging the refrigerator and monitoring the controller operation. If the controller does not properly activate the alarm features for 2 hours, replace the battery. Under normal operation, the battery back up should last up to four years or 200 charge/discharge .

Caution
INCREASING the offset value DECREASES the temperature at which the system controls. If the offset is inadvertently set too high, the chamber temperature can fall below zero and lead to evaporator freeze-up.

Calibration Using Temperature Offset

In the event the refrigerator needs to be calibrated, a simple routine is available to adjust the display and control point to a referenced standard. To set a temperature offset while in the Control Mode (mode LED off), simply press and hold the Menu key. The display will flash oS followed by the last temperature offset value. The factory setting is 0.0. To change the offset value, press the Increase or Decrease keypad to the value which when algebraically added to the last displayed temperature, will agree with the reference temperature. Next, press the Menu key until the Mode LED turns off.

For Example:
The display indicates 4°C but a reference thermometer in the refrigerator chamber indicates 6°C. The operator presses and holds the Menu KEY and changes the offset (oS) display value from 0.0 to 2.0. The Menu key is pressed repeatedly until the Mode LED turns off. Now the display indicates a chamber temperature of °6.0 C (approx.) and the controller begins to cool to the desired temperature of 4.0°C.

Allow an additional 30 to 40 minutes for the refrigerator to again stabilize. If the display is still inaccurate, repeat the calibration procedure.

Chart Recorder Operation and Maintenance

Caution
It is important that these instructions be read before operating the instrument. Keep these instructions on file for future reference.

Note
Units are factory equipped with a 9VDC Alkaline battery, however, the battery is not connected electrically. Please refer to battery location and replacement instructions for information on locating and connecting the battery upon unit installation.

Warning
The chart recorder battery backup feature does not supply the refrigeration system with required power for continuous operation. Precautions should be taken to prevent any sample loss.

The recorder is installed to provide air temperature readings inside the unit. The recorder will swing up and down with the unit's air temperature. The customer is responsible for evaluating the normal swings of the unit for suitability for samples stored in the unit. The average temperature in the unit is in the middle of the band for the temperature swings, units with automatic defrost will have a spike during the defrost cycle. The sample mass will determine the actual swing of the sample. (Small samples will swing more than large samples.)

Chart Recorder Power Supply

The recorder functions from AC power when the unit is operating normally. The recorder is also equipped with a backup battery, installed in the bracket just inside the door of the recorder. In the event of an AC power interruption the battery backup will allow the recorder to continue to operate. The green LED will begin "flashing" to indicate that there is an interruption in the main power supply. In normal operating mode, the green LED is illuminated continuously. (See Figure 7.)

Changing the Chart Paper

Press and hold the "chart change" button (#3) for approximately one second until the pen begins to move to the left of the chart and then release the button. Wait until the pen has moved completely off of the chart. To remove the chart paper, unscrew (counter-clockwise) the chart "hub" knob at the center of the chart. Remove the old chart paper and position the new one so that the correct time line coincides with the time line groove on the chart plate. Refer to Figure 7 for the location of the time line groove. Re-attach the chart "hub" knob and screw securely (by hand) against the chart. Press and hold the "chart change" button (#3) again for approximately one second until the pen begins to move back onto the chart and then release the button. Check to make sure that the pen is marking on the chart paper. If it is not, then carefully adjust the pen arm to establish contact with the paper.

Marking Systems: Mark-A-Matic II Inking System

This type of pen consists of a self-contained ink reservoir with a porous plastic stylus, which is snapped around the outer edge of the metal pen arm.

A pen cap is provided to extend the life of the ink pen during shipping or when the recording unit is not in service. To remove the pen cap, gently lift the pen arm away from the chart paper. Remove the black plastic pen cap to expose the fiber tip of the ink pen and gently place the pen back onto the chart paper. Do not let the pen arm "snap" back onto the chart paper. This will flatten the fiber tip of the pen and will no longer give you a fine line marking on the chart paper. Place the pen cap in a safe place for future use.

If the stylus does not touch the chart, adjustment can be made by slightly bending the metal pen arm in the center towards the chart paper. Do not use more pressure than is necessary to create a fine line marking on the chart paper.

Note
As the pen ink supply runs out, the pen color will become lighter. This indicates that the pen should be replaced.

Replacement of Pen

Recorders Equipped with Fiber Tipped Cartridge

The pen cartridge is securely fastened to the metal pen arm using a special "U" clip tab.For ease of replacement, it is suggested that the two screws that hold the pen arm be loosened and the pen cartridge and metal pen arm to be removed as an assembly. Refer to Figure 7 for the location of the pen arm screws. Unsnap the plastic "U" clip tab of the pen cartridge from the metal pen arm, remove and discard the old pen cartridge. Replace the new cartridge by opening the hinge and snapping it securely around the metal pen arm. Refer to Figure 5.

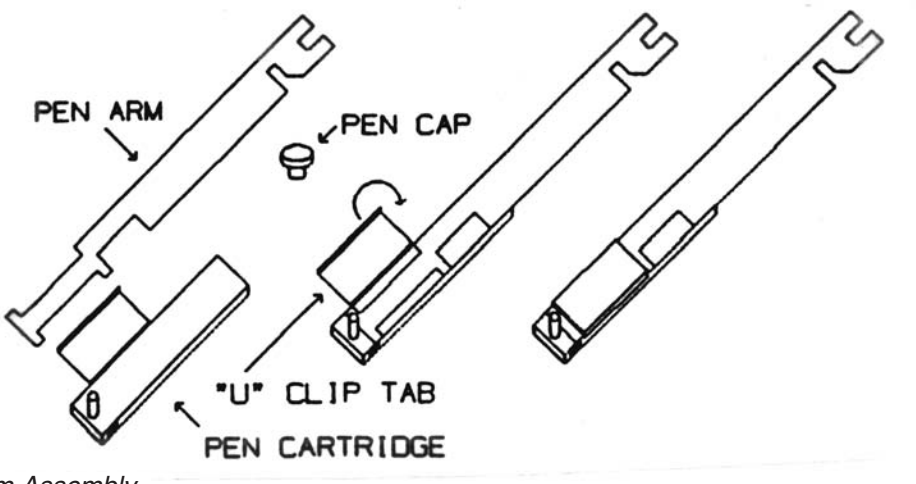


Figure 5: Pen Arm Assembly

Pen Arm Calibration

When the unit is first powered on, the pen arm(s) will move off of the chart and then move back onto the chart briefly stopping at the outer most temperature graduation ring of the chart paper. If the pen does not stop exactly at this location on the chart, it can be adjusted or "calibrated" by using the left (#1) or right (#2) arrow buttons (refer to Figure 6). When the pen moves back onto the chart and briefly stops, you will have approximately five seconds in which to adjust the pen's position using the left and right arrow buttons of Figure 6.

To check and/or adjust the pen's alignment to the outer most temperature graduation ring, press and hold the chart change (#3) button until the pen begins to move off of the chart. Once the pen(s) has moved off of the chart, again press and hold the chart change (#3) button until the pen begins to move back onto the chart. The pen will briefly stop at the outer most temperature graduation ring before continuing onto the chart to begin recording.

Each time the chart paper or fiber tip pen cartridge is changed, you should make sure that the pen stops at the outer most temperature graduation ring of the chart paper. Otherwise, this pen offset will cause the unit to record an incorrect temperature on the chart.

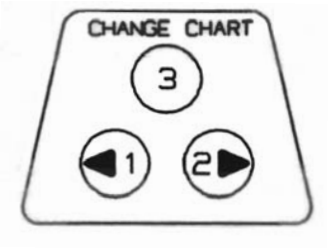


Figure 6: Push Buttons

Temperature Recorder Calibration Check

This recorder has been accurately calibrated at the factory. Before making any adjustments, this instrument should be in service for 24 hours. Thereafter, if any adjustment is required, perform the following procedure:

1. Place a Certified Test Thermometer(s) in a solution bottle(s) alongside the recorder's sensor probe(s).

2. Once the temperature has leveled out, compare the position of the pen on the recorder to the test thermometer's reading.

3. If an adjustment is required, use the left (#1) and right (#2) arrow pushbuttons on the recorder to calibrate (or move) the pen's position on the chart to correspond to the temperature of the solution. The arrow buttons must be held for approximately five seconds before the pen will begin to move.

Chart Rotation Speed

To change the chart rotation speed, first unplug the unit from the main power supply and disconnect the battery (if the recorder has the optional battery back-up feature). Next, press and hold the "chart change" button (#3) and re-connect the recorder to the main power supply. Once power to the recorder has been established, release the "change chart" button (#3). NOTE: The pen(s) will not be moving if this step is successfully completed. The LED will begin flashing in sequence to show the current chart rotation speed that is configured for the recorder:

Flash 1 time – 24 Hour
Flash 2 times – 7 Day

To change the chart rotation speed (of the current range only), press and release the left button (#1) to select 24 hour rotation and press and release the right button (#2) to select 7 day rotation.

The LED will flash the appropriate number of times to show the chart rotation speed that is selected. To permanently save the chart rotation speed that has been selected, press and release the “chart change” button (#3) and the recorder will resume normal operation.

Battery Back-Up

The LED remains a constant green color indicating that both the battery and the main power to the unit are good. Refer to Figure 7 for the location of the LED. If the AC power were to fail or the battery becomes weak, then the LED will begin “flashing” indicating that either you have lost the main power to the unit or it is time to replace the battery. Having a 9 volt DC battery back-up in place will allow the recorder to continue to function normally for approximately 24 hours in the event of a power failure. (Alarming units will drain battery much quicker).

Warning
The chart recorder battery backup feature does not supply the refrigeration system with required power for continuous operation. Precautions should be taken to prevent any sample loss.

Battery Location and Replacement

To replace the battery, first open the recorder case door. The battery will be located in the upper right hand corner of the unit. Remove the battery from the holder clips. Disconnect the battery strap. Install a NEW 9 volt alkaline replacement battery.

Optional Alarm/Control Relay

(For all models equipped with panel mounted chart recorder **with alarm feature**)

Warning
DO NOT ATTEMPT to make relay connections while the unit is connected to the main AC power supply. To avoid the risk of possible electric shock, unplug or disconnect the unit from the main power supply before attempting to access the alarm cable assembly. Disconnect the 9 Volt battery to avoid damaging the recorder and draining the battery.

Connection to the Relay

Recorders with the optional alarm relays provide two outputs. First a built in audible 85 db alarm. Second a cable to connect to a set of NO/NC relay contacts for connecting to a central system. Proper maintenance/electrician should be consulted to connect these contacts.

The toggle switch mounted on the chart plate turns the alarm on or off. Toggle the switch up to turn alarms on. Toggle the switch down to turn the alarms off.

The relays that are used in this recording unit are latching type relays. That is the contacts of the relay will remain either closed or open (even when there is no power applied to the recorder) until the relay is pulsed with a signal from the recorder to change the position of the contacts.

Alarm contacts are available through a 3-conductor cable on the back of the recorder. Due to the many models the recorder is installed, the details of removing the panel is not included here. A visual inspection should define several screws to remove first. Models which the screws are removed and the panel does not come loose, carefully push up about 1/2" and release keyhole type screws. The black wire is the common. The red wire is the normally open side of the relay contact. The white wire is the normally closed side of the relay contact.

Note
The cable runs to J2 on the recorder PCB Wires are connected top to bottom as White(NC), Black (COM), and Red (NO).

Caution
Damage to the recording unit may result if the ratings for the relays are exceeded.

The relays are rated for the following maximum values:

2.0 AMP at 30 V DC
0.6 AMP at 30V AC

Setting the Alarms

To set the alarms, follow these instructions:

Press and hold the "chart change" button (#3) until the pen arm begins to move off of the chart and then release the button. Wait until the pen has moved completely off of the chart. When the "chart change" button (#3) is pressed again, the pen will begin to move back onto the chart briefly stopping at the edge of the chart. (Verify the pen is on the edge of the chart.)

The pen arm will then move to the first control point position and the green LED will turn off. The pen will remain at this position for a period of approximately five seconds during which time high-alarm point can be adjusted using the left arrow (#1) or the right arrow (#2) push buttons. Refer to Figure 6 for a diagram of the pushbuttons. When the time has expired for adjusting the high alarm point, the green LED will turn back on and move to the low alarm point. The pen will remain at this position for a period of approximately five seconds during which time the low alarm point can be adjusted using the left arrow (#1) or the right arrow (#2) push buttons. The LED will turn solid green and the pen arm will move to indicate the probe's temperature and the unit will begin recording.

Note
The recorder alarms will activate when the recorder temperature is outside the high and low alarm points explained above. Do not activate the alarm until the temperature inside the equipment is between the adjustable limits.

Chart Range Selection

If the recorder has a range sticker (that lists several temperature ranges) mounted on the front of the chart plate, under the chart, then the following section will apply to you.

This recording unit has the option for the user to select from several temperature ranges that are programmed into the recorder. NOTE: The chart paper that is used on the recording unit must match the *range* that is selected for the recorder. Otherwise, the pens position on the chart paper will not correspond to the temperature that is measured.

Also, if the pen moves to the center of the outer edge of the chart and remains there while the unit is powered on, then this may be an indication that the current range selected for the unit is incorrect. The recorder has a built in safety mechanism that will always move the pen to the highest temperature on the chart when the current temperature that is measured is not within the selected range.

To select from the ranges available, press and hold the "change chart" button (#3) while in normal operating mode, until the pen arm begins to move off the chart. Once the pen has moved off the chart, press and hold the left arrow (#1) or right arrow (#2) button for approximately five (5) seconds and then release the button. Refer to Figure 6.

The green LED light will begin flashing one time if range #1 is selected or will flash two times if range #2 is selected and so on. Press the left arrow key (#1) to increase the range number or press the right arrow button (#2) to decrease the range number that is selected for the recorder. When finished selecting the range, press and hold the "chart change" button (#3) until pen begins to move back onto the chart and the selected range will be saved into the recorder's permanent memory.

Recorder Specifications

Input

Nominal Input Voltage: Single Phase 115/230VAC.
Nominal Input Current: 0.40mA/0.20mA
Nominal Input Frequency: 50-60 Hz.

Battery

Battery Type: 9 Volt Alkaline
Low Battery Signaling: Flashing LED

Replacement Parts

-40 to 60°C	Charts	SPN104116
-5 to 25°C	Charts	SPN107434
-45 to 0°C	Charts	SPN107435
Replacement Pens		SPN104117

Operating Environment

0°C-40°C (32°F-104°F); 0-95% RH, Non-condensing

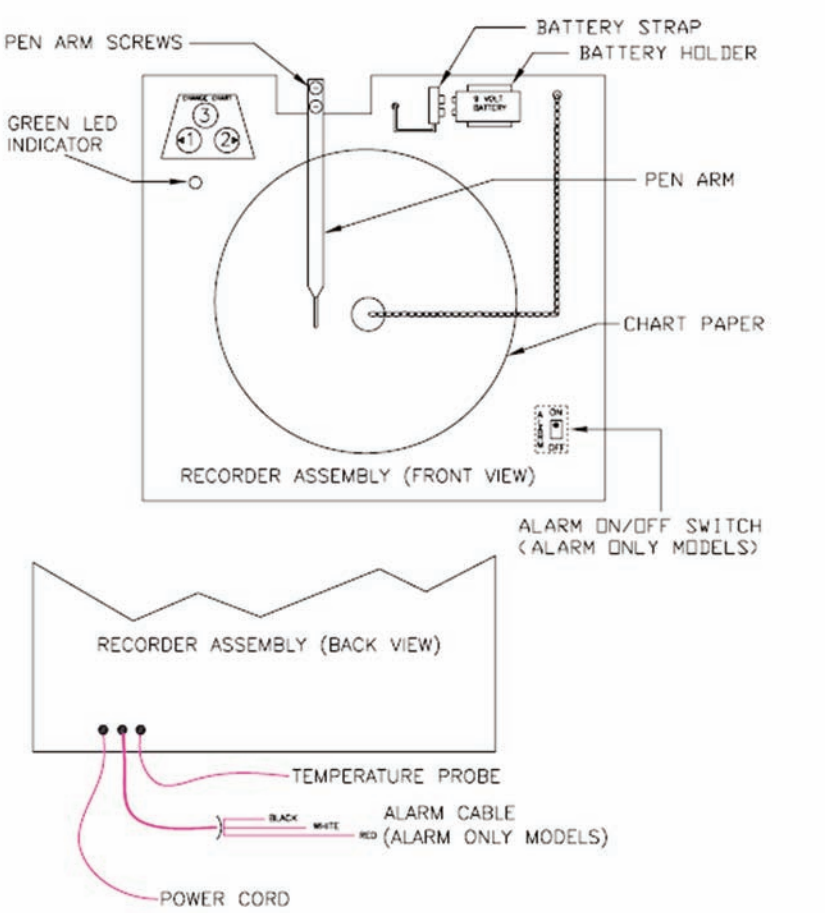


Figure 7: Recorder Assembly

Maintenance

Caution
When servicing the unit, disconnect plug from the electrical power source

Caution
Do not use any type of abrasive such as steel wool or fluids such as gasoline, naphtha, or paint thinner that could be harmful to plastic materials, door gasket and painted surfaces.

Caution
Accessing and cleaning the condensate coil or pan should be done by qualified personnel.

Cabinet Cleaning

The cabinet interior should be cleaned frequently. Any spilled liquid should be wiped off immediately. Stains resulting from some spills can be permanent if not quickly removed. The cabinet exterior should be cleaned occasionally. A mild detergent and lukewarm water or a solution of bicarbonate of soda (1 tablespoon per gallon of water) is recommended for cleaning the interior and exterior of the cabinet. All surfaces should be rinsed and thoroughly dried.

Cleaning the Condenser

The condenser is located in front of the compressor fan, which is on the top, left side of the swinging door model refrigerators, and behind the base grill of the sliding door model refrigerators. The condenser should be cleaned before becoming clogged with dirt/dust. Construction or other dirt causing environments may significantly increase the required frequency. The condenser should be cleaned at least once a year

Condensate Evaporator Pan

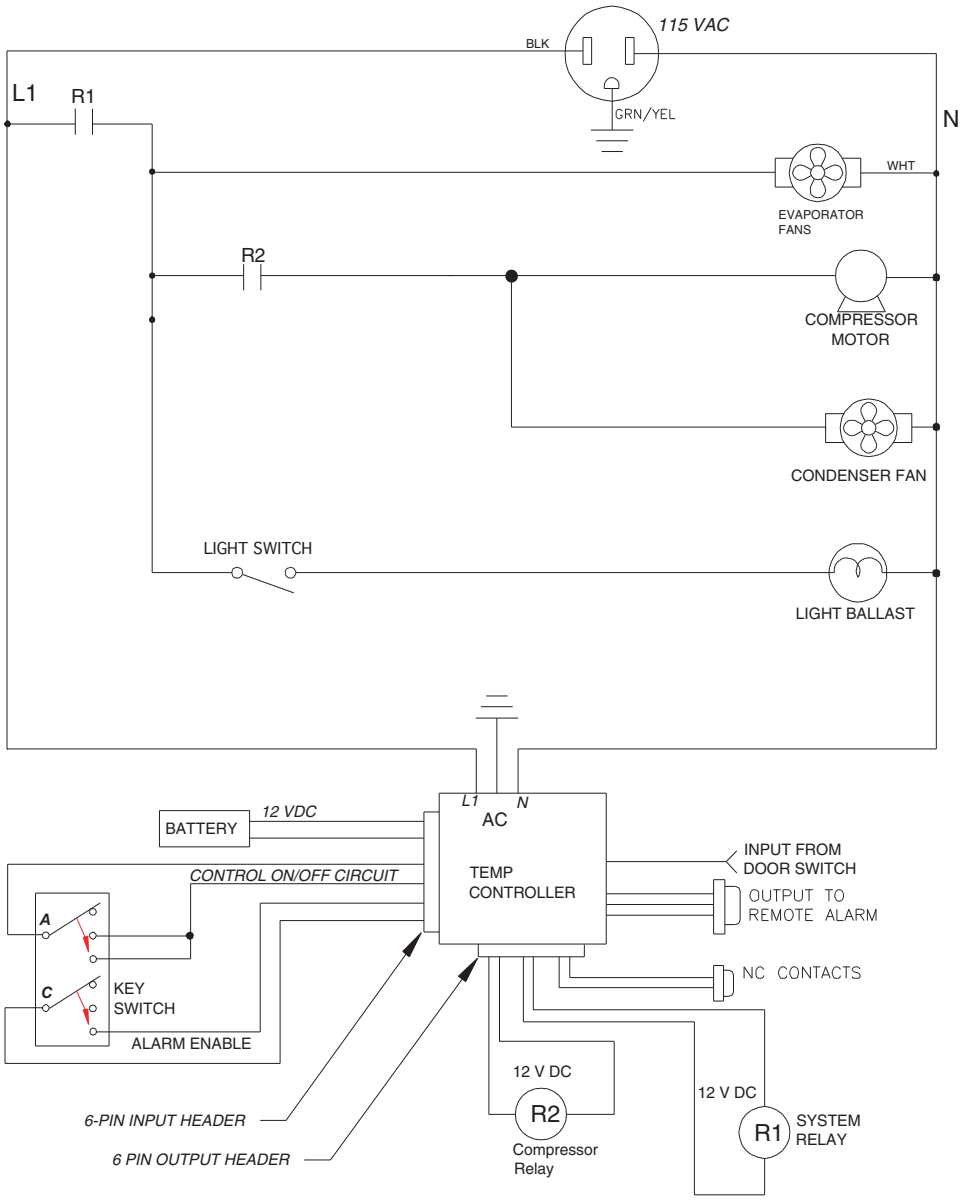
The condensate evaporator pan is located behind the compressor fan, which is on the top, left side of the swinging door model refrigerators, and behind the base grill of the sliding door model refrigerators. **This pan should be cleaned at least once a year to prevent foul odors and operate efficiently.** Vacuum clean if dry, or sponge clean with soapy water..

Troubleshooting

This table is intended to assist in resolving user-correctable refrigerator problems by relating symptoms to their likely causes. If service beyond the scope of this table is required, contact Service Division at 1-800-438-4851.

Symptom	Probable Cause	Action
Does Not Run	Unit Unplugged.	Plug in Unit.
	Blown fuse or tripped circuit breaker.	Check fuse or circuit breaker at breaker box.
Runs Continuously	Frost buildup on refrigeration coils.	Turn unit off and allow it to defrost.
	Refrigerator over-loaded.	Remove contents from top shelf of unit.
Clicking Sound	The compressor is equipped with a thermal protector. This device shuts off the compressor when it becomes too hot. A clicking sound occurring about every 30 seconds indicates this protector is working.	Disconnect power and allow unit to sit for about an hour, then retry. If condition persists, call for service.
Insufficient Cooling	Set temp is too high.	Reduce temperature setting, verify COOL LED turns on in 3 minutes.
	Offset (oS) value is too low.	Increase offset value.
	Condenser coil dirty.	Clean condenser coil with a vacuum cleaner.
	Unit frosted.	Defrost unit.
	Circulating fans not on.	Verify doors are completely closed.
	Defrost mode activated.	Allow enough time for defrost mode to end (2 hours max.).

Wiring Diagrams



Warranty

Laboratory instruments and equipment manufactured for So-Low Environmental (hereinafter called “the Company”) are warranted only as stated below.

Subject to the exceptions and upon the conditions specified below, the Company agrees, at its election, to correct by repair, by replacement, or by credit to the purchaser, any defect of materials or workmanship which develops within two years from the date of purchase by the original purchaser by the Company or by an authorized dealer of the Company provided that investigation or factory inspection by the Company discloses that such defect developed under normal and proper use.

The exceptions and conditions mentioned above are the following:

a. The Company makes no warranty concerning components or accessories not manufactured by it, such as tubes, batteries, etc. However, in the event of the failure of any component or accessory not manufactured by the Company, the Company will give reasonable assistance to the purchaser in obtaining from the respective manufacturer whatever adjustment is reasonable in the light of the manufacturer’s own warranty.

b. The Company shall be released from all obligations under its warranty in the event repairs or modifications are made by persons other than its own service personnel or authorized dealer personnel unless such repairs by others are made with the written consent of the Company,

c. THE COMPANY MAKES NO WARRANTY OF MERCHANTABILITY, FITNESS FOR ANY PARTICULAR PURPOSE, OR ANY OTHER WARRANTY, EXPRESS OR IMPLIED, EITHER IN FACT OF BY OPERATION OF LAW, …STATUTORY OR OTHERWISE.

d. The above warranty and the above obligations to repair, replace, or credit are complete and exclusive and the Company expressly disclaims liability for lost profits or for special, indirect, incidental, consequential, or exemplary damages of any nature whether attributable to contract warranty, negligence, strict liability, or otherwise even if the Company has been advised of the possibility of such damages.

e. Representations and warranties made by any person, including dealers and representatives of the Company, which are inconsistent or in conflict with the foregoing warranty shall not be binding upon the Company unless reduced to writing and signed by an officer of the Company.

So-Low Environmental
10310 Spartan Dr.
Cincinnati, OH 45215
Phone: (513) 772-9410
Fax: (513) 772-0570
www.so-low.com