Service Manual

Ultra-Low Temperature Freezers

innova® VIP Range

(with Vacuum Insulation Panel technology)

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Revision B
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⚠ *CAUTION!*

This equipment *must* be operated as described in this manual. If operational guidelines are not followed, equipment damage and personal injury *can* occur.

Please read the entire User's Guide before attempting to use this unit.

HEALTH AND SAFETY AT WORK ACT 1974

(FOR THE UNITED KINGDOM)

New Brunswick Scientific, as manufacturers and suppliers of laboratory equipment, are obliged under the terms of the above Act to provide our users with instructions on the safe installation, operation and maintenance of our equipment.

Our equipment is designed to acceptable standards and does not entail any hazard if used, as advised in the attached instructions.

No one but a Service Technician or Service Engineer authorized by New Brunswick Scientific may service this equipment.

The following safety precautions should be observed by all personnel authorized to service this equipment:-

1. Read and understand this manual. If in doubt, contact one of the New Brunswick Scientific Companies listed.

2. Do not remove any covers until all electrical power is disconnected. There are voltages in excess of 41.5 volts AC behind the covers.

3. Use freezer gloves at all times when loading or unloading the equipment. The temperature of operation is such that direct contact with the cold contents or inside the equipment can burn unprotected skin.

WARNINGS AND CAUTIONS

Misuse of the equipment and failure to comply with the operating and servicing instructions supplied by New Brunswick Scientific can be dangerous.

The equipment described in this manual operates FROM 240 VOLT ELECTRICAL SUPPLY. An unprotected encounter with 240 Volts of electricity can be LETHAL. Before working on electrical circuits, ensure that the power source has been disconnected or isolated.

All gas charges specified on the serial label of the freezer must be strictly adhered to and accurately measured, preferably by weighing. New Brunswick Scientific can accept no responsibility for the consequences of using inaccurately measured charges.

Equipment maintenance, replacement of components and internal adjustments must ONLY be carried out by qualified and experienced personnel who have been authorized to undertake such work by New Brunswick Scientific or its authorized agents.

The removal of any parts or panels from the freezer by anyone other than a qualified service engineer, approved by New Brunswick Scientific or its authorized agents, may affect the warranty.

Safety at Work

Personnel are responsible for familiarizing themselves with the equipment owner's safety policy and regulations.

Use of the Manual

This Service Manual is to be used in conjunction with the related User's Guide, part number M1288-0052.

Copyright Notice

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Disclaimer Notice

New Brunswick Scientific Co., Inc. reserves the right to change information in this document without notice. Updates to information in this document reflect our commitment to continuing product development and improvement.

Manual Conventions

NOTE:	**Notes contain essential information that deserves special attention.**
CAUTION!	***Caution* messages appear before procedures which, if caution is not observed, could result in damage to the equipment.**
WARNING!	***Warning* messages alert you to specific procedures or practices which, if not followed correctly, could result in serious personal injury.**
Bold	**Text in boldface type emphasizes key words or phrases.**
	**This particular *Warning* message, whether found in the manual or on the unit, means HOT SURFACE–and therefore represents a potential danger to touch.**
 ***CRUSH WARNING!***	***Crush Warning* messages alert you to specific procedures or practices <u>regarding heavy objects</u> which, if not followed correctly, could result in serious personal injury .**

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1 VIEWS

Figure 1a: Upright Freezer—Side and Front Views

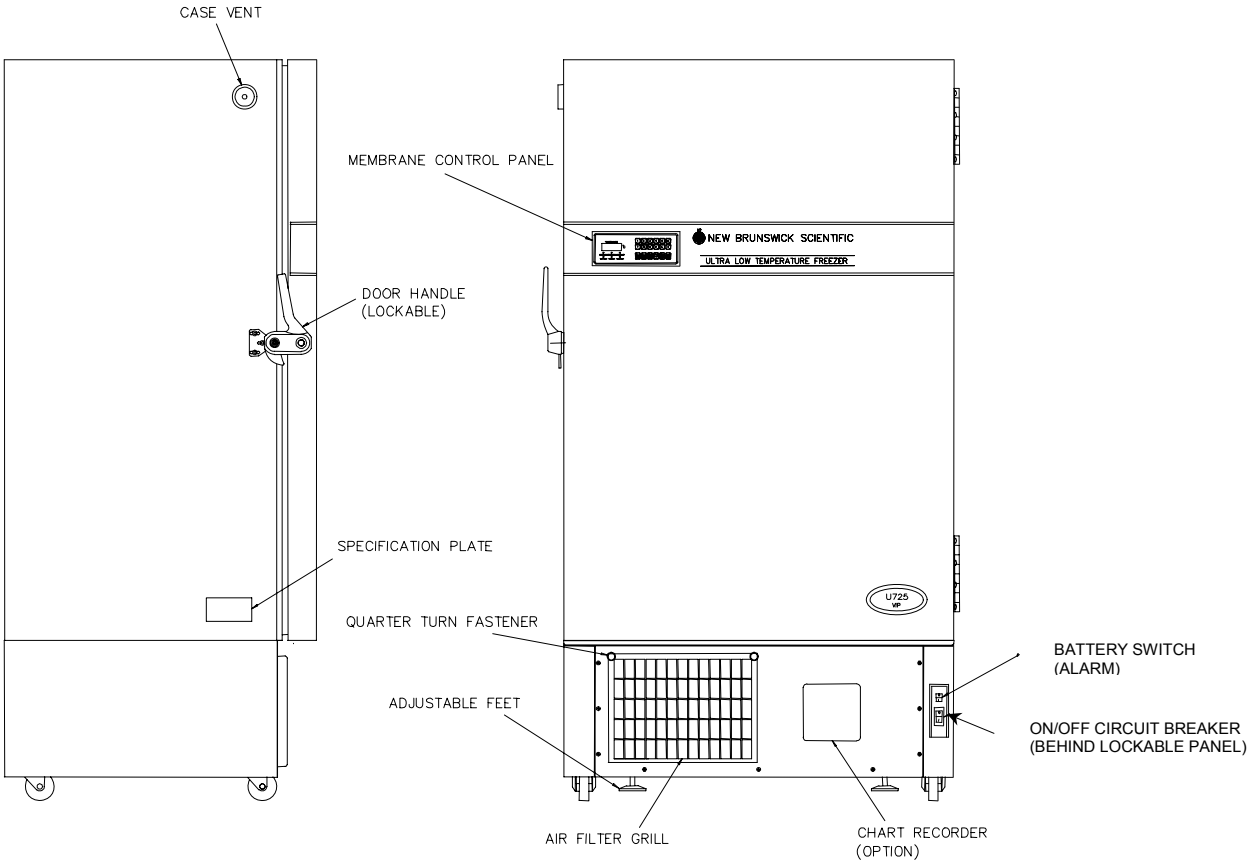


Figure 1b: Upright Freezer—Inside View

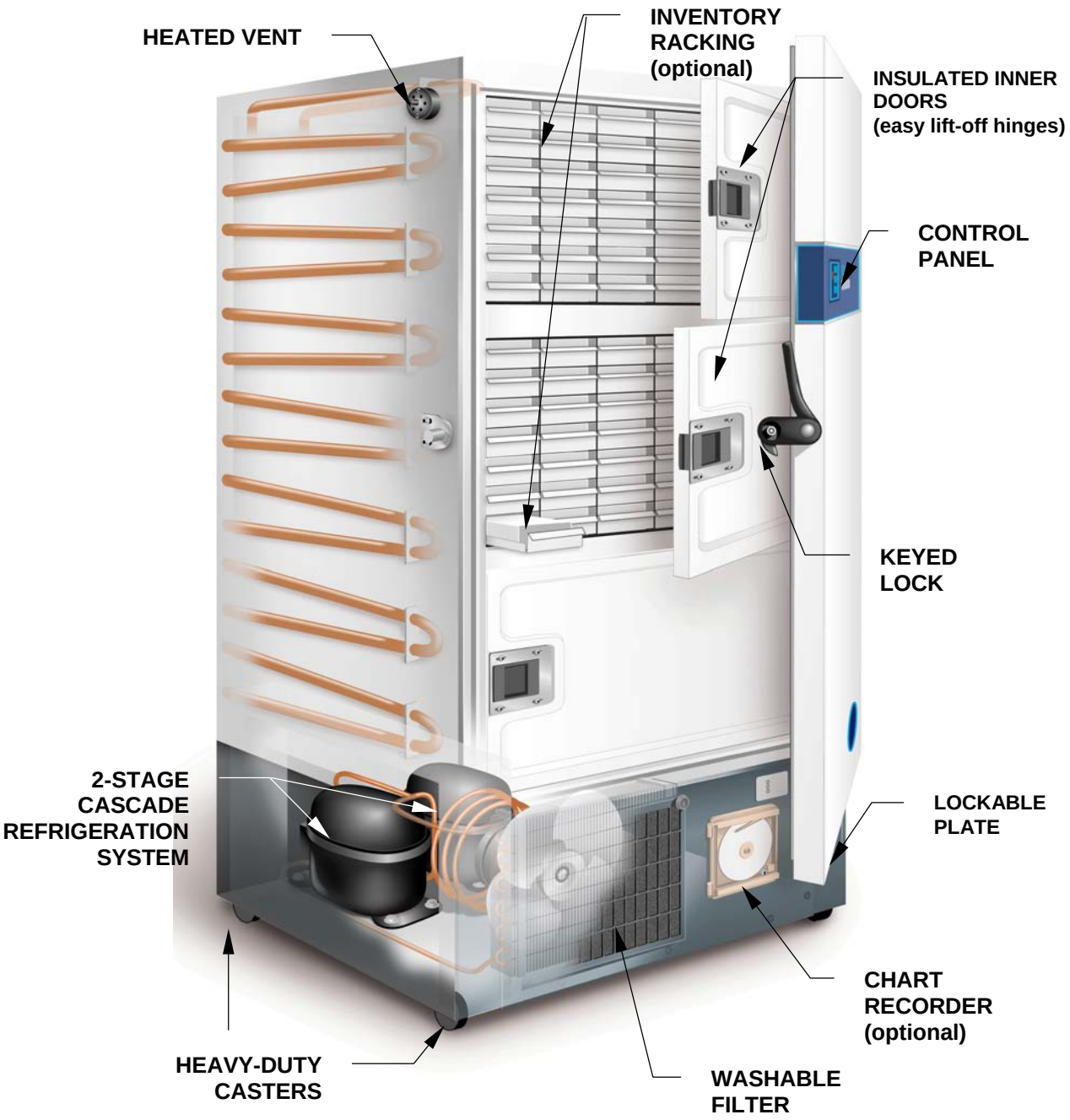


Figure 2: Chest Freezer—Side and Front Views

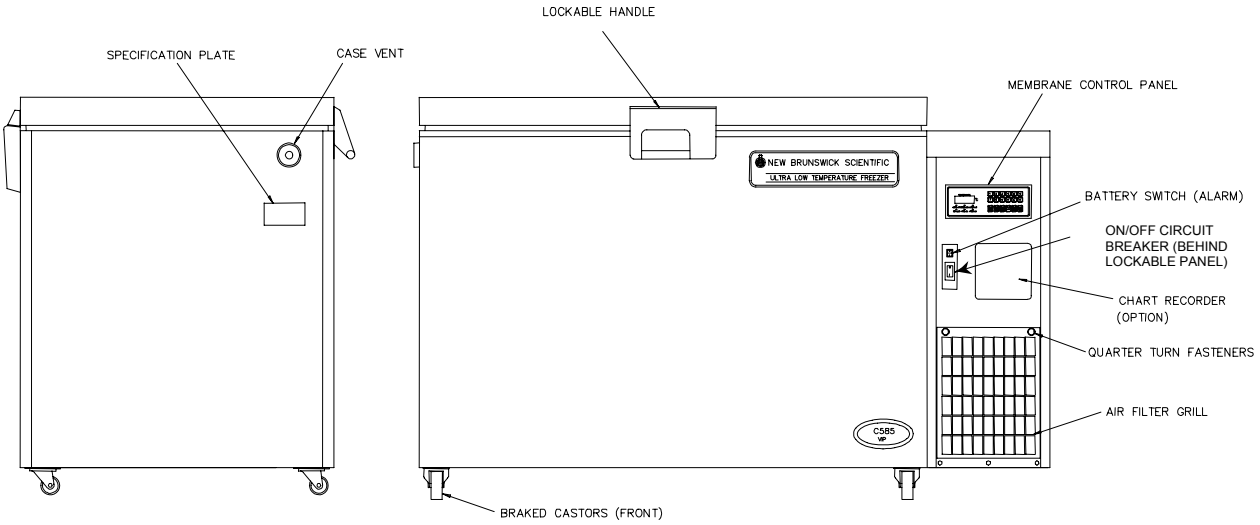


Figure 3: U101 Freezer—Side and Front Views

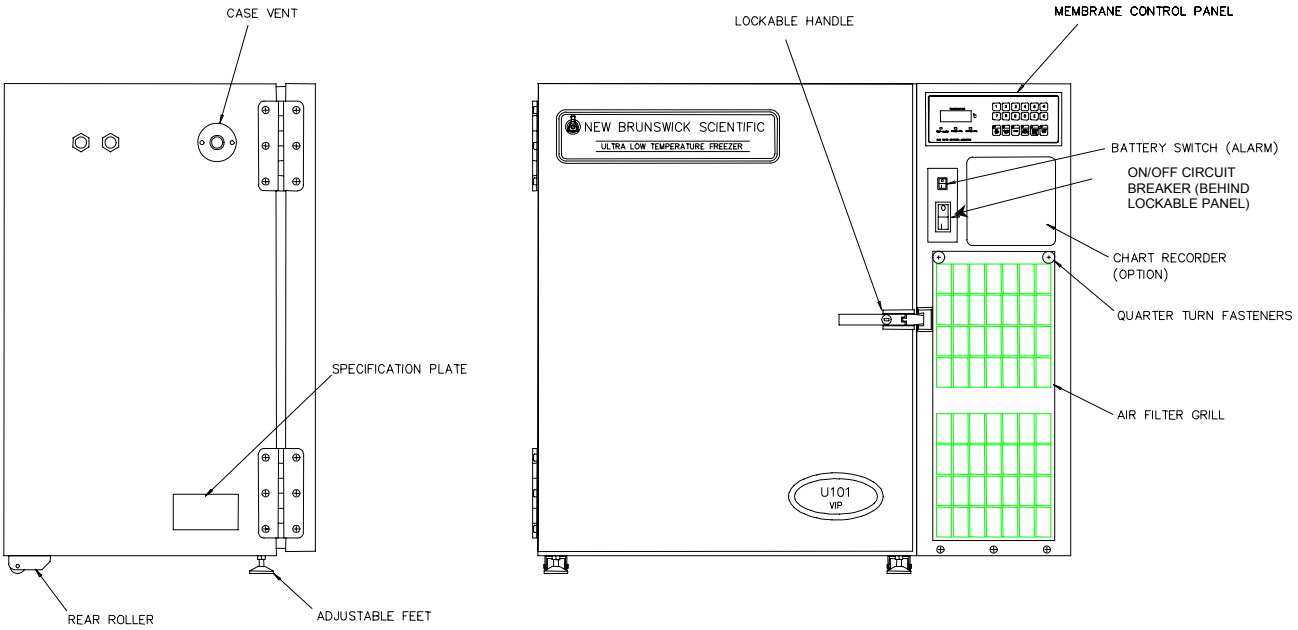
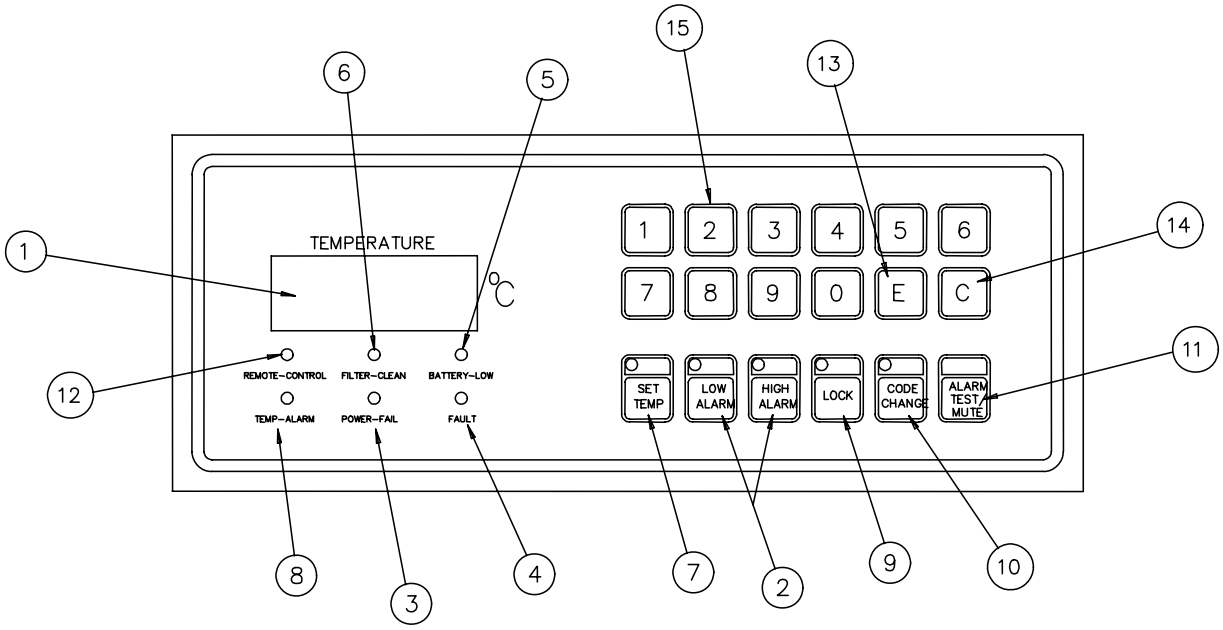


Figure 4: Display Panel & Keypad



Item	*Name*	*Item*	*Name*
1	Display	9	Lock button
2	High/Low Alarm keys	10	Code Change button
3	Power-Fail indicator	11	Alarm Test/Mute button
4	Fault indicator	12	Remote-Control indicator
5	Battery-Low indicator	13	Enter button
6	Filter-Clean indicator	14	Cancel button
7	Set Temp key	15	Numerical keys
8	Temp-Alarm indicator		

Figure 5: Remote Alarm Socket—Chest Freezers & U101

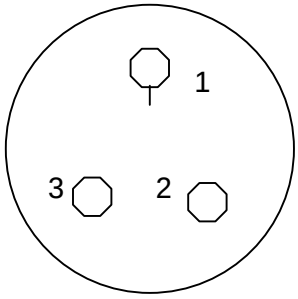
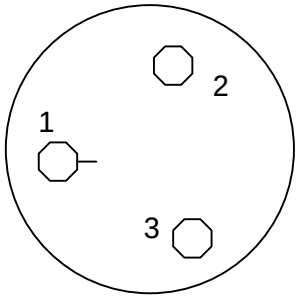


Figure 6: Remote Alarm Socket—Upright Freezers (except U101)



The freezers are provided with an alarm monitoring socket at the rear of the freezer and a matching plug for external monitoring purposes. This plug can be connected either to a central monitoring system or to a remote alarm via an auto-dialer. The configuration of the socket is shown in Figures 5 & 6 as viewed from the rear of the freezer.

Within the freezer, the socket is connected to voltage-free contacts rated at 24 volts, 3 amps. In normal operation, with the power on, relay RL1 on the control PCB is energized, connecting pin 1 to pin 2 on the alarm monitor socket (N/C), while in the alarm condition, power off, relay RL1 is de-energized, connecting pin 1 to pin 3 on the socket (N/O).

2 OPERATING CONTROLS & DISPLAYS

2.1 Operating Controls

Switch the freezer on using the **ON/OFF** circuit breaker at the front of the equipment. On upright models, this is located behind the locked panel, low on the right-hand side. On chest models, it is located behind the locked panel on the right-hand side, adjacent to the control panel. (*See Figures 1 & 2 in the previous section.*)

Operating controls are located on a membrane panel mounted in the door of the upright models U725 and 535. The same panel is located on the right-hand side of all chest freezers and the U101 underbench model.

The available functions, identified by Item numbers called out in Figure 4 (*in the previous section*), are described in the sections below.

2.1.1 Temperature ºC Display

Item	*Name*	*Function*
1	**TEMPERATURE °C**	The digital display normally shows the current internal temperature of the freezer. Temperature is displayed in 1°C increments. When certain switches are depressed, the display is used for other purposes.

2.1.2 High Alarm/Low Alarm Lights

Item	*Name*	*Function*
2	**HIGH ALARM/ LOW ALARM**	Illuminates if the freezer's internal temperature is above/below the user-selected alarm setpoints. Illuminates as soon as the setpoint is passed. The audible alarm, however, does not sound until the freezer temperature has been beyond alarm setpoint for 30 minutes. After the temperature returns to the normal range, the **ALARM** switches off & the audible warning stops.

NOTE:

The audible alarm can be turned off by pressing the ALARM TEST/MUTE KEY. If, after 30 minutes, the temperature has not returned to normal range, the audible warning will sound again. This pattern will continue to repeat until the temperature returns to normal.

2.1.3 Temp-Alarm Light

Item	*Name*	*Function*
8	**[HIGH/LOW] TEMP-ALARM**	Should a power failure cause the temperature to surpass the alarm setpoint, the **TEMP-ALARM** illuminates. (The audible alarm will already be sounding due to the power failure). The **TEMP-ALARM** will stay on after the temperature returns to normal range, to indicate that a power failure has occurred. Temperature-sensitive samples stored in the freezer should be checked for deterioration. Cancel the **TEMP-ALARM** by pressing the **ALARM TEST/MUTE KEY**.

2.1.4 Power-Fail Light

Item	*Name*	*Function*
3	**POWER-FAIL**	Illuminates if the power supply fails, flashing at approximately 10-second intervals, accompanied by an audible alarm. When power is restored, the indicator goes off and the audible alarm stops. (The battery must be switched on and charged for this indicator to operate.)

2.1.5 Fault Light

Item	*Name*	*Function*
4	**FAULT**	Illuminates if there is a system failure within the freezer. Using the diagnostics provided on the control panel, the fault can be determined. System failure is accompanied by an audible alarm. Correction of the fault extinguishes the light and audible alarm.

2.1.6 Battery-Low Light

Item	Name	Function
5	**BATTERY-LOW**	*With power ON:* illuminates if battery voltage is below 6 volts; starts flashing when voltage drops to 5 volts. *With power OFF:* should battery voltage drop below 5.5 volts, the fault indicator will stop functioning.

2.1.7 Filter-Clean Light

Item	Name	Function
6	**FILTER-CLEAN**	Illuminates, accompanied by an audible alarm, to indicate a potentially blocked or dirty filter. Filter is located on the front at the bottom of all freezers. Remove by turning the two thumbscrews on the filter holder a quarter turn. Clean filter by washing in mildly soapy water, then air dry. If the filter warning light does not go out after replacing the cleaned filter, contact your local New Brunswick Scientific service representative.

2.1.8 Remote Control Light

Item	Name	Function
12	**REMOTE CONTROL**	Indicates when freezer is operating under remote computer control via the optional RS-485 interface port.

2.1.9 Set Temp Key

Operation in normal mode with **LOCK** lamp off.

Item	Name	Function
7	**SET TEMP**	Displays current temperature setting. Used to change temperature settings.

2.1.10 High-Alarm/Low-Alarm Keys

Operation in normal mode with **LOCK** lamp off.

Item	Name	Function
2	**HIGH ALARM**	Displays current high alarm temperature setting.
2	**LOW ALARM**	Displays current low alarm temperature setting.

2.1.11 Lock Key

Normal mode is with **LOCK** lamp off.

Item	*Name*	*Function*
9	**LOCK**	Locks and unlocks the control panel for programming sequence. Setting the lock code to **0000** disables the lock.

2.1.12 Code Change Key

Item	*Name*	*Function*
10	**CODE CHANGE**	Used to change freezer lock codes (*see User Guide for procedure*). Inactive in normal mode.

NOTE:

If the customer should forget their Lock Code, telephone the nearest NBS office for assistance.

2.1.13 Alarm Test/Mute Key

Normal mode is with **LOCK** lamp off.

Item	*Name*	*Function*
11	**ALARM TEST/MUTE**	Sounds the audible alarm. If the audible alarm is on due to a fault condition, press this key to silence the alarm. The lamp LED lights can also be tested by pressing this key. The lights should all illuminate and the display should read "8888".

2.1.14 "E" Key

Normal mode is with **LOCK** lamp off.

Item	*Name*	*Function*
13	**E**	Used to enter data when programming.

2.1.15 "C" Key

Normal mode is with **LOCK** lamp off.

Item	*Name*	*Function*
14	**C**	Used to cancel data when programming.

2.1.16 Numerical Keys

Normal mode is with **LOCK** lamp off.

Item	*Name*	*Function*
15	**NUMERICAL KEYS (1-0)**	Used to input data when programming.

3 TECHNICAL DESCRIPTION

3.1 Introduction

These Ultra Low Temperature Freezers are based on a fully hermetic cascade concept, using commercial refrigeration components. It is essential that components be replaced only with identical spare parts, as changing to unauthorized parts will invalidate any guarantee and could adversely affect the safety, proper operation, durability and performance of the freezer.

The temperature and safety parameters are controlled electronically, by means of a custom-built control system. The control system monitors internal temperature via a PT100 probe and two thermistors. One of the thermistors is attached to the cascade condenser; it controls the Low Stage switching. The other monitors the condensing temperature of the High Stage. The electronics are self-diagnostic, for ease of repair.

3.2 Vacuum Panels

When servicing VIP freezers, great care should be taken not to cause damage to the foil envelope encasing the vacuum core material:

1. Avoid drilling holes in the freezer casing.
2. Back panel and vacuum panels are removable on upright models to allow servicing of the Low Stage capillary tube and filter drier. When replacing panels, care must be taken to avoid any metal shavings becoming trapped between the vacuum panel and the back panel or foam insulation.
3. When using brazing equipment or other heat sources close to the outer freezer casing, great care must be taken to protect the casing from excessive heating. The temperature of the outer casing will rise rapidly due to the high insulating quality of the vacuum panels and damage to the vacuum panel may occur.

URGENT!

The Environmental Protection Agency (EPA) now makes it illegal to deliberately release refrigerants into the atmosphere. On April 1, 1992, conservation of refrigerants during maintenance and decommissioning of refrigeration and air conditioning systems became a mandatory requirement.

3.2.1 Polyolester Oils

The compressors are lubricated by polyolester oils. Polyolester oils are more hygroscopic than mineral oils. When replacing a compressor or working on the refrigeration system, care must be taken to minimize exposure of the oil to the atmosphere, to prevent contamination of the oil by moisture absorbed from the atmosphere. Oil containers must be capped at all times.

3.3 Control Function of Microprocessor

The control system consists of two parts:

1) The Main Control Board (the Microprocessor)
2) The Display Board

There are three inputs (probes) to the board:

Table 1: Probe Inputs to the Control System

Probe	*Type*	*Function*	*Display/Value*
P1	PT100	Monitors inner cabinet temperature (main control probe)	Current Cabinet Temperature ºC
P2	3000ΩThermistor	Monitors the temperature of the Low Stage condenser	In millivolts: Low Stage is not switched on until the value is below 104mV or 125mV*. To display, hold down button No 1.
P3	3000ΩThermistor	Monitors the temperature of the High Stage cascade condenser.	In millivolts

***NOTE:**

Low Stage switching value was altered to 125mV from May 11, 2001 onward, software version 2.2 or higher. Values can be verified by pressing button number 3 on display panel.

NOTE:

If P1 fails, the freezer will run continuously (*see Section 4, Self-Diagnostics*).

3.4 Energization: A Useful Guide

The sequence of energization may be used as a guide to indicate the sequence that should be employed during troubleshooting.

The process is as follows, below and on the following page:

Freezer is switched on

↓

Control board is energized via the transformer (9 volt AC output)

↓

Random delay

↓

Output from control board to the High Stage compressor via relay No. 1

↓

Low stage compressor switches on via relay No. 2 when High Stage compressor has cooled the cascade condenser to a value below 104 mV or 125mV*

NOTE: There is a 15-second delay to prohibit the High and Low Stages from switching on at the same time.

↓

Freezer continues to cool until 1ºC below pre-set value is reached

↓

Both compressors switched off

↓

High stage compressor switches on when cabinet temperature reaches 1ºC above pre-set value

↓

If temperature of cascade condenser is below 104mV or 125mV*, Low Stage compressor will switch on within 15 seconds.

After the freezer has cycled for the first time, an output to the heated accumulator is activated via the solid-state relay mounted on the control board. It activates when the Low Stage is switched and is timed on for 3 minutes, and then switched off for the remainder of the cycle*.

See* **NOTE *on following page.*

***NOTE:**

Low Stage switching value has been altered to 125mV from May 11, 2001 onward, software version 2.2 or higher. Values can be verified by pressing button number 3 on display panel.

The control system is self-diagnostic and will display probe faults and system faults (*see Section 4, Self-Diagnostics*).

3.5 High Stage Refrigeration System (Stage One) Operation

The High Stage system is protected electronically against over-temperature and a fault is displayed as a system fail on the control panel. This function is covered in the Self-Diagnostics chapter (*see Section 4.2*).

The High Stage refrigeration system cools the cascade condenser (Low Stage condenser) to a temperature sufficiently low enough to enable the Low Stage refrigerant to condense at low pressure. Commercially available compressors can then pump the resulting vapor around the Low Stage system. It consists of four main components:

1) Compressor
2) Air-Cooled Condenser
3) Fan
4) Evaporator

The compressed vapor is pumped from the compressor to the condenser where heat from the vapor is removed by the fan-cooled condenser. The condensed refrigerant then passes through a solid core drier. A capillary tube is brazed to the drier which meters refrigerant to the inner coil of the cascade condenser (the High Stage evaporator coil), where it is vaporized and returned to the compressor via a suction line accumulator.

A thermistor, fitted to the High Stage condenser (air-cooled condenser), senses the temperature, protecting the system against the high head pressure that could be induced by a blocked condenser, fan failure or a high ambient temperature.

This is a two-stage function. If the condenser filter becomes blocked, the electronics will trigger an audible alarm and the *filter clean* lamp will illuminate on the main control panel. The *filter clean* alarm will activate at 44ºC (42mv). This is a warning indicator and will not cause the system to shut down.

If the condensing temperature is allowed to rise to 54ºC (33mv), the system will shut down and allow the condenser to cool before restarting. An audible alarm will sound and a fault code will be displayed at the control panel (*see Section 4, Self-Diagnostics*).

NOTE:

The condition described above requires immediate attention. The system will allow the condenser to cool, plus a 3-minute delay. The system will then restart. This cycle will continue until the fault is rectified.

3.6 Low Stage System (Stage Two) Operation

The Low Stage system consists of four main components:

1) Compressor
2) Oil Separator
3) Condenser (Cascade Condenser)
4) Low stage evaporator
5) Accumulator (microprocessor-controlled heated accumulator, *see Section 11*.)

The compressed vapor is pumped by the Low Stage compressor to the oil separator via a de-superheating coil. The vapor then passes into the Low Stage condenser, where the heat is removed by the cooling of the High Stage system via the cascade condenser. The condensed refrigerant passes through a filter drier and into a capillary tube that is brazed between the filter drier and the Low Stage evaporator. The capillary tube meters the refrigerant that passes into the Low Stage evaporator, where it is vaporized and returned to the compressor via a suction line accumulator.

The electronics are self-diagnostic, for ease of repair.

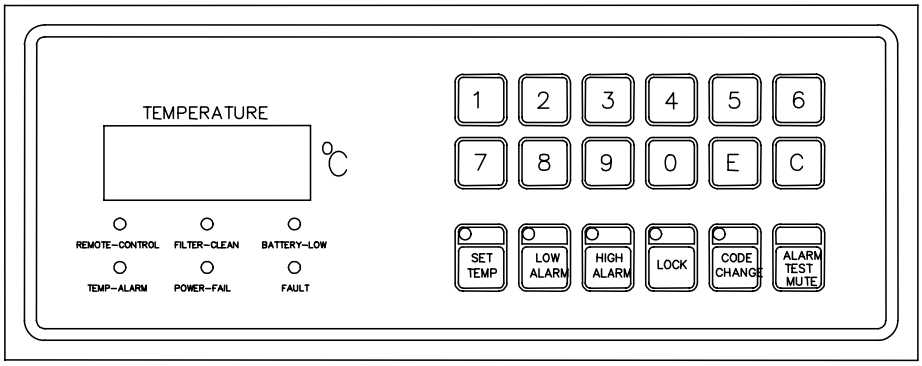
4 SELF-DIAGNOSTICS

The freezers are electronically controlled. They incorporate self-diagnostic features to diagnose faults in electronic systems, probes and/or refrigeration system.

4.1 Fault Indicator

The fault indicator will illuminate when system faults occur. It will also be active with other warning indicators.

Figure 4: Display Panel & Keypad



4.1.1 Probe Fail

If any probe fails due to a poor connection or a probe defect, a fault code is displayed on the control panel and an LED will illuminate on the circuit board.

4.1.2 Probe No. 1

- Probe No. 1 is the PT100 probe located in the freezer chamber.
- Fault displayed on circuit board: P1 LED illuminates and audible alarm sounds.
- Fault displayed on control panel: E-01 plus fault LED.

4.1.3 Probe No. 2

- Probe No. 2 is the thermistor located on the Low Stage cascade condenser.
- Fault displayed on circuit board: P2 LED illuminates and audible alarm sounds.
- Fault displayed on control panel: E-02 plus fault LED.

4.1.4 Probe No. 3

- Probe No. 3 is a thermistor located on the High Stage air-cooled condenser.
- Fault displayed on circuit board: P3 LED illuminates and audible alarm sounds.
- Fault displayed on control panel: E-03 plus fault LED.

4.2 High Stage Compressor Over-Temperature Cutout

- Probe No. 3 is the thermistor located on the High Stage condenser.
- Fault displayed on circuit board: CH LED illuminates and audible alarm sounds.
- Fault displayed on control panel: E-04 plus fault LED.
- Will activate if value on button No. 4 is 33 or below. Refrigeration system will switch off until condenser cools, plus a three-minute delay, before restarting.

4.3 Filter Clean Warning

- Probe No. 3 is the thermistor located on the High Stage condenser.
- Fault displayed on circuit board: CH LED illuminates and audible alarm sounds.
- Fault displayed on control panel: Filter Clean LED flashes.
- Filter Clean warning activates if value on button No. 4 is below 42, and resets at 44. The freezer will continue to run. The alarm can be cancelled by pressing Alarm Test/Mute button.

NOTE:

Alarm will reactivate after 30 minutes if the fault has not been rectified.

NOTE:

All alarm conditions are output to the remote alarm socket.

4.4 Cycle LED

The Cycle LED will illuminate for one minute when the freezer is switched on or is in fault condition (*see Table 2 below*).

Table 2: High Stage Cycle LED Values

Value Displayed	*Equivalent Temp ºC
33	54
38	50
42	46
44	44
55	40
74	30
86	25
100	20

Value 33 is a pre-set value on button No. 5.
*Refers to condensing temperature, not ambient temperature.

5 CHECKING STAGE ONE/HIGH STAGE SYSTEM PRESSURES

5.1 Access to the Refrigeration System

On Upright Models, remove the lower rear panel. On Chest Models, remove the side panel.

5.2 Connecting the Gauge

Connect the gauge set to the suction and discharge access ports of the system (see refrigeration schematic). Observe the pressures. They should comply with the data in Tables 3a or 3b below. The data in these tables was taken from a **U725, 50 Hz** model and a **U535, 208 V 60 Hz** model operating in an ambient temperature of 23ºC. Pressure will vary with the change of ambient temperature and the model of freezer. Contact your distributor for up-to-date pressure charts for individual models.

NOTE:

When connecting the gauge set, make sure that air does not enter and that refrigerant does not escape from the system.

Table 3a: High Stage Pull-Down & Pressure Chart (model U725, 50Hz)

Time Lapse (mins)	Chamber Temperature (ºC)	Suction Pressure Barg (PSIG)	Discharge Pressure Barg (PSIG)
0	24	5.2 (75.4)	5.2 (75.4)
10	24	0.53 (7.6)	14.0 (203)
20	21	0.58 (8.4)	14.2 (206)
30	16	0.63 (9.1)	14.5 (210)
40	9	0.66 (9.6)	14.6 (212)
60	-23.5	0.75 (10.8)	15.0 (218)
80	-38	0.65 (9.4)	14.8 (215)
100	-47.5	0.60 (8.7)	14.7 (213)
120	-54.5	0.58 (8.4)	14.7 (213)
140	-60	0.57 (8.3)	14.6 (212)
160	-64.5	0.55 (8.0)	14.6 (212)
180	-68.5	0.53 (7.6)	14.5 (210)
200	-71.5	0.5 (7.2)	14.4 (209)

…continued…

Time Lapse (mins)	Chamber Temperature (ºC)	Suction Pressure Barg (PSIG)	Discharge Pressure Barg (Psig)
220	-74.5	0.42 (7.0)	13.5 (196)
240	-76.5	0.38 (5.5)	13.3 (193)
260	-78	0.32 (4.6)	13.0 (188)
280	-79.5	0.30 (4.4)	12.8 (186)
300	-80.5	0.30 (4.4)	12.8 (186)
320	-81.5	0.28 (4.1)	12.8 (186)
340	-82.5	0.25 (3.6)	12.7 (184)
360	-83	0.22 (3.2)	12.6 (183)
380	-84	0.20 (2.9)	12.5 (181)
400	-84.5	0.18 (2.6)	12.4 (180)
420	-85	0.17 (2.5)	12.3 (178)

Table 3b: High Stage Pull-Down & Pressure Chart (model U535, 208V 60Hz)

Time Lapse (mins)	Chamber Temperature (ºC)	Suction Pressure PSIG	Discharge Pressure PSIG
0	23.28	99.35	100.37
10	22.91	4.50	192.90
20	14.07	6.24	206.39
30	6.45	7.40	209.00
40	-7.4	7.54	213.79
60	-24.23	6.82	208.71
80	-36.84	5.80	201.03
100	-47.39	5.22	202.19
120	-55.23	4.64	200.01
140	-61.25	3.77	193.19
160	-66.09	3.19	187.83
180	-70.66	3.19	193.48
200	-74.16	2.61	189.86
220	-77	2.32	188.84
240	-79.31	1.89	184.20
260	-81.2	1.02	182.03
280	-82.25	0.58	183.33
300	-83.57	0.00	178.83
319	-85.1	*4.40**	180.86

*inches of mercury (in/Hg)

NOTE:

Be sure to consult periodic Service Bulletins for any updates in the above values.

CAUTION!

All gas charges shown on the freezer's serial number label must be strictly adhered to and accurately measured (by weighing).

NOTE:

A Low Stage system oil separator must be replaced in the case of oil contamination or if a burn-out has occurred.

After fitting new components, pressure-test the system using nitrogen at 10 barg to check for leaks. For further information please refer to Section 9.

6 TROUBLESHOOTING THE STAGE ONE/HIGH STAGE SYSTEM

Symptom(s)	Probable Causes	Solution(s)
HIGH STAGE (Stage One):		
Condensing temperature and/or pressure too high	Air intake filter or condenser blocked or partly blocked with dust	• Wash filter with cool water. • Use soft brush or vacuum cleaner to remove dust from condenser
	Fan motor or fan blade defective	• Check fan blade for damage; check fan motor runs freely, and the motor is not excessively hot. • To check fan bearings, turn freezer off; the fan should slow down gradually. If it stops suddenly, the bearings are tight. This may cause the fan to run at a slower speed, which will cause an increase in condensing pressure.
	System overcharged	• Check system pressures against High Stage pressure chart. This condition should only occur if a new component or additional refrigerant has been added to the system. • Connect gauge set to High Stage system and observe pressures. (**Note:** make sure that fan and filter are clean and working correctly before making adjustments to pressures). • Check that ambient temperature is not too high. • There may be overfeeding of refrigerant at the suction return to the compressor, and signs of ice around stub. **…continued…**

Symptom(s)	Probable Causes	Solution(s)
(continued) Condensing temperature and/or pressure too high	**(continued)** Suction pressure abnormally high	**(continued…)** At high suction pressure, Stage One will cause the discharge pressure of the Low Stage to remain higher than normal. To rectify this: • Remove some refrigerant from Stage One; the discharge and suction pressures should decrease, and the Stage Two discharge pressure should also decrease. (Refer to Table 3)
High Discharge Pressure Non condensable Gas in system	Air entering the refrigeration system, or contamination during charging or connecting of gauge sets to the system.	Check system for contamination. This will be evident if the discharge pressure is considerably higher than the corresponding condensing temperature. Do not confuse this with an overcharged system, Clean and eliminate source of contam-ination. Evacuate and recharge system (refer to Section 9).
Discharge and Suction Pressures are lower than normal	Loss of refrigerant due to leak in either suction or discharge side of the system. If leak is in suction side of the system, air may enter system; if suction pressure is below atmospheric pressure, depending on amount of refrigerant lost and the amount of air that has entered the system, the discharge pressure may increase or decrease. Usually the system fails to cycle due to the drop in performance caused by the leak; as the system runs continuously, more air enters. As air will not condense within the system, the discharge pressure and temperature increase. The suction pressure may decrease due to flash gas in the capillary tube, and moisture from the air freezing in the capillary tube.	To rectify this, you must determine where the leak is and repair it. Due to the moisture in air, the oil in the compressor and system must be flushed out and replaced with new oil. Also replace the filter drier. (**NOTE:** in the case of prolonged operation in this condition, a reaction between the oil and moisture may result in the formation of acid. Check the old oil: if oil is acidic, flush system and renew compressor.) In severe cases, the acid and the lack of cooling from the suction gas can cause damage to the motor windings, resulting in a burnout. Should this happen, replace the compressor (refer to Section 9).

Symptom(s)	Probable Causes	Solution(s)
Low Discharge and Suction Pressures	• Loss of refrigerant*	Check for leak and repair as necessary, pressure test system and recharge. If the leak was in the discharge side of the system (high-pressure side) air will not enter the system; if the leak was found to be in the suction side (low-pressure side), refer to *Discharge and Suction Pressures are lower than normal* above.
	• Restriction in the capillary tube* *If you are in doubt as to whether it is a restriction or loss of refrigerant: with the system running, add a small amount of refrigerant (20-40 grams). If it was a case of refrigerant loss, you should see a positive response when you add the refrigerant. If there is a restriction, the increase in pressure when you add refrigerant will be brief, then the pressure will fall back to approximately the same level as before.	This will result in reduced suction pressure. To check whether there is a restriction, switch freezer off. The pressures should balance within approximately 3-4 minutes, depending on freezer model. If it takes much longer to balance, this would indicate a partial restriction. If capillary tube is completely restricted, the system will not balance through the capillary tube. With a complete blockage, the head pressure may increase due to the amount of refrigerant backing up in the condenser. (**NOTE:** this is not the case for the Stage Two system. See *Section 8*, below).

…continued…

NOTE:

Check for leaks; repair and re-gas as necessary.

NOTE:

Take care not to overcharge the system.

Symptom(s)	Probable Causes	Solution(s)
(continued) Low Discharge and Suction Pressures	• Restriction in the filter drier* *see asterisked inset note on the previous page	This can give results similar to the above; in this case, however, you may notice that the filter is cooler than the condensed refrigerant just before the filter when the system is in operation, due to additional pressure drop caused by the restriction. (**NOTE**: cooling at the filter drier may occur during the off cycle due to the flashing off of the refrigerant as the pressures balance).
	• Poor performance or defect within the Stage Two system.	The pressures will appear low due to reduced loading on Stage One; this will reflect in the poor performance or inability of the freezer to maintain temperature. In this case, do not adjust Stage One; check Stage Two for fault: see *Section 8,* below.

6.1 Troubleshooting the High Stage Compressor

Symptom(s)	Probable Causes	Solution(s)
High/Stage One Compressor fails to start	No power	• Check that power supply is connected. • Check that thermal circuit breaker is turned ON.
	Blown fuse	• Check fuse on circuit board (FS1 2-amp quick-acting F-type fuse, PN K0620-0610) • Check anti-surge fuse (FS3 lamp 20x5mm T 250V ceramic type)
	AC transformer problem	Check outputs from 6.0-volt and 9.0-volt AC transformers.
	Wiring problem	**DISCONNECT POWER**, then check the wiring.
	Microboard failure	**SWITCH OFF BATTERY**, then check that 6.6-7.0 volts DC are present across the microboard's + and – battery terminals. If voltage is not present or is incorrect, replace the microboard.

…continued…

Symptom(s)	Probable Causes	Solution(s)
(continued) High/Stage One Compressor fails to start	Circuit board failure	Check the cycle LED on the circuit board. It should remain illuminated for approximately one minute after switching on. • If the compressor does not start when the LED extinguishes, check that the green relay output D9 is illuminated and that the 11-12 volt DC output from the circuit board to relay No 1 (TB1 pins 5-6) is present. • If there is no output, change the circuit board.
	Power Voltage Relay problem	If the output from the circuit board is correct and the compressor still fails to start, check that the relay is switching power voltage, as stated on serial number label. (*See Table 4: Button 1 [Cascade Condenser] Temperature & Switching Points*)
	Start Relay, Start Capacitor or compressor lock-up problem	If relay operates correctly, but the compressor still fails to start, trace the power supply to the compressor start relay. • Check start relay and start capacitor. Use a clamp meter to check that the compressor has not locked or seized. This would indicate a prolonged high current in excess of 10 amps. **NOTE:** If the compressor shell is still warm and no current flow is present, make sure that the internal motor protection device is not in operation. Allow the compressor to cool while observing the current meter. • If a high current is observed and the compressor fails to start or cuts out on the internal protector, check the start capacitor and start device before changing the compressor. A faulty capacitor will give a high current reading and cause a failure. **NOTE:** Compressors have been known to operate intermittently. When the freezer has been switched off for some time and the compressors are cold, they may work when the system is switched on, but may fail to restart when the compressor motor reaches operating temperature. This can indicate a faulty start capacitor.

…continued…

Symptom(s)	Probable Causes	Solution(s)
(continued)	**(continued)**	
High/Stage One Compressor fails to start	Start Relay, Start Capacitor or compressor lock-up problem	The freezer may operate until it cycles, but then fails to start again. Allow the freezer to run for a while, then turn it off. Switch it on again and check whether it starts.

7 CHECKING STAGE TWO/LOW STAGE SYSTEM PRESSURES

7.1 Access to the Refrigeration System

On Upright Models, remove the lower rear panel. On Chest Models, remove the side panel.

7.2 Compressor Fails to Start

Make sure that the High Stage compressor is working correctly and the cascade condenser is at a low enough temperature to start. This can be checked by pressing button No. 1 on the control panel. A reading will appear on the digital display (*see Table 4 on the following page*).

Take note of this reading (holding down the button will not affect the running of the freezer). The value of this reading should be below 104mV or 125mV* for the Low Stage compressor to start. If the value is above 104mV or 125mV* and will not decrease, check that the High Stage system is operating correctly.

If the value is below 104mV or 125mV* and the Low Stage system fails to start, check the following :

1. Press button No. 3. Reading should be 104mV or 125mV* pre-set value.
2. This checks that the pre-set values of the processor are correct.
3. If the readings are correct and the system still fails to start, check the electrical system as described for the High Stage system. (**Note:** relay output from control board to Low Stage relay is via green LED D14 and 11-12 volt DC output from TB1 pins 7-8).
4. If the readings are incorrect, change the control circuit board.

***NOTE:**

Low Stage switching value has been altered to 125mV from May 11, 2001 onward, software version 2.2 or higher. Values can be verified by pressing button number 3 on display panel.

Table 4: Button 1 (Cascade Condenser) Temperature & Switching Points

Value	Temperature ºC	Represents
43	-40ºC	
52	-37ºC	
70	-30ºC	
98	-20ºC	
104 125	-18ºC -11ºC	*Switch-on value of Low Stage
126	-10ºC	
150	0ºC	
168	+8ºC	Switch-off value of Low Stage

***** see **NOTE** on previous page

7.3 Low Stage Compressor Fails to Cool

The Low Stage compressor is running, but it is not adequately cooling the freezer chamber:

Connect gauge set to suction and discharge access ports as described for the High Stage system. Tables 5a & 5b give pressures and temperatures of the Low Stage refrigeration system. The High Stage system must be working correctly to obtain accurate readings of the Low Stage system (*see Troubleshooting: Low Stage, Section 8.1*).

Table 5a: Low Stage Pull-Down & Pressure Chart (model U725, 50 Hz)

Time Lapse (mins)	Chamber Temperature (ºC)	Suction Pressure Bars (PSIG)	Discharge Pressure Bars (PSIG)
0	24	6.3 (91.4)	6.3 (91.4)
10	24	0.48 (6.9)	15 (218)
20	21	0.5 (7.2)	14.6 (212)
30	16	0.48 (6.9)	14.1 (205)
40	9	0.45 (6.5)	13.6 (197)
60	-23.5	0.37 (5.3)	12.5 (181)
80	-38	0.20 (3.0)	11.4 (165)
100	-47.5	0.17 (2.5)	10.9 (158)
120	-54.5	0.14 (2.0)	10.7 (155)
140	-60	0.11 (1.6)	10.6 (153)
160	-64.5	0.08 (1.2)	10.4 (151)
180	-68.5	0.06 (0.9)	10.2 (148)
200	-71.5	0.02 (0.3)	9.9 (144)

…continued…

Time Lapse (mins)	Chamber Temperature (ºC)	Suction Pressure Bars (PSIG)	Discharge Pressure Bars (PSIG)
220	-74.5	-0.02 (0.6*)	9.5 (138)
240	-76.5	-0.04 (1.2*)	9.2 (133)
260	-78	-0.10 (2.9*)	8.9 (129)
280	-79.5	-0.11 (3.2*)	8.6 (125)
300	-80.5	-0.12 (3.5*)	8.5 (123)
320	-81.5	-0.17 (4.9*)	8.3 (120)
340	-82.5	-0.20 (5.8*)	8.1 (117)
360	-83	-0.22 (6.4*)	7.9 (115)
380	-84	-0.24 (7.0*)	7.8 (113)
400	-84.5	-0.25 (7.3*)	7.7 (112)
420	-85	-0.27 (7.8*)	7.6 (110)

* inches of mercury (in/Hg)

Table 5b: Low Stage Pull-Down & Pressure Chart (model U535, 208V 60 Hz)

Time Lapse (mins)	Chamber Temperature (ºC)	Suction Pressure (PSIG)	Discharge Pressure (PSIG)
0	23.28	98.77	98.48
10	22.91	2.32	130.54
20	14.07	1.60	139.24
30	6.45	2.47	148.52
40	-7.4	2.18	148.09
60	-24.23	1.60	143.01
80	-36.84	1.02	135.90
100	-47.39	0.58	131.99
120	-55.23	0.00	127.93
140	-61.25	*0.89**	122.56
160	-66.09	*1.77**	118.64
180	-70.66	*2.66**	117.63
200	-74.16	*3.54**	114.44
220	-77	*4.13**	111.97
240	-79.31	*5.02**	109.51
260	-81.2	*5.61**	103.56
280	-82.25	*6.20**	100.95
300	-83.57	*7.38**	97.18
319	-85.1	*8.27**	95.87

* inches of mercury (in/Hg)

See important **NOTE** on the following page.

NOTE:

When the freezer is at operating temperature, the static pressure is quite low (in the region of 0.8 to 1.7 bars gauge when the freezer chamber is at –85ºC). Care must be taken not to overcharge the system with refrigerant. This could lead to excessive pressures at ambient temperature.

8 TROUBLESHOOTING THE STAGE TWO/LOW STAGE SYSTEM

Symptom(s)	Probable Causes	Solution(s)
Low/Stage Two Compressor fails to start, but High/Stage One Compressor is running.	Refrigeration problem	• Check that the High Stage has cooled the cascade condenser sufficiently. To check this, press button No. 1 on the display panel. The reading is displayed in millivolts and should be below 104mv or 125mV* before the Low Stage is switched on. • If this value is above 104mv or 125 mV*, hold button No. 1 continuously and observe whether the displayed value decreases, which should normally be one digit every 1-2 minutes. If there is no decrease in the displayed value, check for a refrigeration fault (*see Section 6,Troubleshooting the High Stage System*).
	Circuit board failure	• If the displayed value is below 104mv or 125mV*, an output should be present to the green relay LED D14. If it is present and the compressor still fails to start, check for 11-12 volt DC output from TB 1 pins (7-8) on the circuit board. If there is no output, change the circuit board. If output is present, refer to Section 6.1 to trace fault from power relay to compressor.

***NOTE:**

Low Stage switching value altered to 125mV from May 11, 2001 onward, software version 2.2 or higher. Values can be verified by pressing button number 3 on display panel.

8.1 Troubleshooting the Low Stage System

Symptom(s)	Probable Causes	Solution(s)
LOW STAGE (Stage Two):		
High discharge, and/or suction pressures. (Refer to Table 4: *Button 1 [Cascade Condenser] Temperature & Switching Points*)	May be due to: • Overcharged system • Poor performance of the Stage One system • High ambient temperature and/or high product load	To check for overcharging of the system, connect system analyzers (gauge sets) to Stage One and Two systems, and use the pressure charts in this manual as a guide to the relevant pressure. (**NOTE:** pressures will differ between models and with different ambient temperatures). Before making any adjustments to the Stage Two system, Stage One must be performing correctly. An overcharge should only occur if new components have been fitted or the system has been recharged. To readjust the pressures, remove some refrigerant (**NOTE**: in accordance to local legislation); observe the reading on button No. 1: this should decrease as the cascade condenser cools to a lower temperature. At an operating temperature of -80°C, this value should be between 60-40 mV (refer to Table 4).
	May be due to: • Overcharged system • Poor performance of the Stage One system • High ambient temperature and/or high product load	If pressures are correct, the freezer should now cycle. To fine tune the system pressures, allow freezer to cycle once or twice; observe the displayed temperature. It should not fall back more than 1-2º C during normal cycling. (**NOTE:** if product has been recently loaded into a freezer, this will increase the pressures, and cause fallback to increase until product has cooled).

…continued…

Symptom(s)	Probable Causes	Solution(s)
(continued) High discharge, and/or suction pressures. (Refer to Table 4: *Button 1 [Cascade Condenser] Temperature & Switching Points*)	• Air in system	Cause and symptoms are similar to Stage One (see *Stage One* above). The only difference with the Stage Two system is that when air enters the system due to the lower operating temperature, the moisture will freeze in the capillary tube more readily.
	• Oil separator short circuiting	High suction pressure or fluctuation in suction pressure may be caused by an defective oil separator float valve not closing properly, or by intermittent operation of the valve.
Suction pressure is higher than normal; discharge pressure is lower.	Faulty oil separator valve: the oil separator return pipe may appear warm and you may hear a hissing sound from the gas bypassing back to the compressor	Replace the oil separator. Even though you may be able to get the valve to close by tapping on the separator, in our experience the valve will fail again unless replaced.
Low suction pressure	• Refrigerant loss or shortage	Connect system analyzer (gauge set) to Stage One and Two systems; add a small amount of refrigerant (see label on freezer for refrigerant type)—approximately 10-20 grams. The suction and discharge pressures of Stage Two should increase. **NOTE:** the pressures may peak then fall, but they should remain at an higher level than before refrigerant was added. Add more refrigerant until correct performance is maintained. (See *using electronics to diagnose refrigeration system*).
	• Restriction in the capillary	As with shortage of refrigerant (see above), the pressures will appear low. To determine whether the cause is a restriction or a loss of refrigerant, add some refrigerant to the system (10-20 grams; check label on freezer for refrigerant type). If there is a restriction, you will note that the pressures rise and then fall to the same level with no improvement in performance.

…continued…

Symptom(s)	Probable Causes	Solution(s)
(continued) Low suction pressure	**(continued)** • Restriction in the capillary	**(continued)** Do not continue to add refrigerant as this will only condense in the cascade condenser. Unlike the Stage One condenser, if refrigerant backs up, the discharge pressure will not necessarily increase; due to the decreasing load on Stage One, the cascade condenser temperature will continue to fall. The danger in overcharging the cascade condenser is when the freezer is switched off and warms up to ambient temperature, the static pressure will be excessive.
	• Excessive amount of oil in the capillary tube and evaporator	With the new polyolester oils and high efficiency oil separators, this is not a common fault. It can occur, however, if the float valve in the oil separator fails to open. The oil is unable to return to the compressor and the oil overflows into the cascade condenser and evaporator. In this case, the large amount of oil passing from the cascade condenser to the evaporator via the capillary tube usually causes a restriction in the capillary due to the thickening of the oil. It is possible for the oil to accumulate in the evaporator. Given the right operating conditions, the symptoms are low suction pressure and poor performance (similar to a restricted capillary tube).

…continued…

Symptom(s)	Probable Causes	Solution(s)
(continued) Low suction pressure	**(continued)** • Excessive amount of oil in the capillary tube and evaporator	**(continued)** If the freezer has been running for some time with the oil return valve stuck closed, the compressor can seize or excessive wear can take place due to the low level of oil remaining in the compressor (see *Replacing a Compressor* section, below).

9 REPAIR: REPLACING A COMPRESSOR

9.1 Replacing a High Stage or Low Stage Compressor

To replace a High Stage or Low Stage compressor:

1. Remove refrigerant from system using an appropriate recovery unit (IN ACCORDANCE WITH LOCAL LEGISLATION).
2. The recovery unit should have reduced the system pressure to a negative pressure; if not, use a two-stage vacuum pump to achieve a pressure of -0.2 to -0.5 bar (10-15in/Hg).
3. Backfill the system with nitrogen to atmospheric pressure.
4. Disconnect compressor wiring and starter box.
5. Remove service valves before removing pipe work from compressor.
6. Slide pipe insulation away from compressor stub. Use a pipe clamp to hold insulation back when sweating out suction line; the clamp will act as a heat sink, reducing the risk of burning the insulation.
7. When removing the High Stage compressor, it is only necessary to remove the discharge and suction pipes, as the service pipe will come out with the compressor and can be changed over to the new compressor before refitting.
8. Allow pipes to cool, and seal ends with caps or tape to prevent moisture from entering system.

NOTE:

Freezer and system components must be at ambient temperature. The heat exchanger temperature can be checked by pressing button 1 on the control panel. *See Table 4*.

9. With the compressor removed, examine the condition and quantity of the oil.
10. If the oil is clean and free from contamination, and there is a sufficient amount present to lubricate the compressor (see Section 9.3.1), a new compressor can be fitted.

NOTE:

It is advisable to fit a new filter drier when replacing a major system component.

11. If the oil is contaminated, either with metallic particles or due to a burnout, the system must be thoroughly flushed out using a suitable flushing fluid.

NOTE:

Flushing fluid must be COMPLETELY REMOVED from the system before installing new components. Use nitrogen to remove excess flushing fluid from the system).

12. If the contamination is on the Low Stage system, the oil separator must be replaced.
13. If the compressor is found to be low on oil, you must determine which part of the system the oil has accumulated in: it may be in the oil separator, evaporator or heat exchanger.
14. Before replacing the old compressor with a new one, the fault that led to a low oil level must be located and rectified.
15. When you are satisfied that there are no system faults that may cause the new compressor to fail prematurely, proceed with the fitting of the new compressor.
16. When brazing on any component, nitrogen must be used at all times. Be sure to avoid pressurization of the system, particularly when brazing the last joint; you can, at this stage, disconnect the nitrogen and complete the last joint.
17. It is advisable to pressure test the system with nitrogen to check for leaks before evacuating the system.
18. A proper evacuation process ensures that the air and moisture contents are below the allowed limits.
19. The introduction of new refrigerants requires the use of new polyester oils with characteristics of high hygroscopicity, which will require the greatest care in system evacuation. Connect the gauge analyzer to both of the service ports, and then evacuate system until a vacuum of 0.15 mbar (200 microns Hg) is achieved.
20. To improve the speed of evacuation, purge the system with nitrogen, evacuate for 20-30 minutes, then purge system to 0.35 bar (5 PSIG), then release nitrogen and continue to evacuate.
21. While the evacuation is taking place, replace the new starter box and connect wires to the compressor. Make good and reseal pipe insulation. Check that pipe work is securely fixed to base to avoid vibration.

NOTE:

- **Do not use old starter electrics.**
- **Do not start or run the compressor while it is under a vacuum.**

9.2 Charging the High Stage System

> ***CAUTION!***
> **All gas charges shown on the freezer's serial number label must be strictly adhered to and accurately measured (by weighing).**

After correct evacuation, you are now ready to charge the system. The type and quantity of refrigerant are stated on the freezer serial plate; strictly adhere to these specifications. **The High Stage refrigerant must be charged in liquid form.** The charge must be weighed in, using electronic scales with 2-gram graduation.

1. Charge into the suction service port until correct amount of refrigerant is reached, or the system pressure is equal to refrigerant cylinder pressure. Close valve on gauge analyzer and, depending on the refrigerant quantity and the ambient temperature, allow liquid refrigerant 5-10 minutes to evaporate before starting compressor.
2. Start compressor.

> **NOTE:**
> **Allow the compressor to run for one minute before continuing to add refrigerant. Damage may occur if the liquid slug enters the compressor. Add refrigerant slowly into the compressor.**

3. If system pressure was equal to cylinder pressure and stated weight has not been charged into system, continue to charge refrigerant with compressor running until correct weight is achieved.

9.3 Charging the Low Stage System

The high-pressure refrigerant R508B, used in the Low Stage system, is in vapor form; always refer to the freezer serial plate for type and quantity.

> ***WARNING!***
> **R290 is in liquid form and highly flammable, so care must be taken when adding it to the system.**

(See important **NOTE** on the following page.)

NOTE:

Cylinders containing R508B are under high pressure, 400 to 800 PSIG. A pressure-reducing regulator must be used to avoid damage to gauge analyzer.

When charging freezers requiring a small amount of R290, this should be charged into the system **before** adding R508B.

1. Set regulator to 150 PSIG (10.4 barg).
2. Place cylinder on scales, use vacuum pump to remove air from refrigerant line, with all gauge analyzer valves closed, open cylinder valve allow pressure in refrigerant line to rise (If refrigerant line is under tension it can result in an inaccurate charge).
3. Open suction service valve slowly, taking care not to move gauge analyzer or refrigerant line. Observe reading on scale, close valve when correct amount is charged into system.
4. If the charging procedure is correctly and accurately performed, the freezer will function correctly with little or no further adjustment.

9.3.1 About Compressor Oil

Table 6: Compressor Oil Type & Identification

Compressor Series Aspera	Oil type	Identification mark (Compressor top)	Oil quantity
T – J units manufactured Before December 1, 1996	Mobil Arctic EAL46 Polyolester	Red	T series 580cc J series 890cc
T – J units manufactured After December 1, 1996	ICI Emkarate RL22HB Polyolester	Yellow	T series 580cc J series 890cc
Danfoss SC10ClX	ICI Emkarate RL22HB Polyolester		SC10CLX 600cc

NOTE: Respect minimum oil quantities. See the table below.

Table 7: Minimum Oil Quantity

Minimum Oil Quantity*	
Compressor Series	Minimum quantity
Aspera T	300cc
Aspera J	500cc
Danfoss compressors	Data not available

* the minimum quantity of oil that will still guarantee proper lubrication of the compressor

10 TROUBLESHOOTING CONTROL ELECTRONICS

Symptom(s)	Probable Causes	Solution(s)
Freezer fails to run, although power switch/ thermal circuit is in the ON position.	No power	Check that power supply is switched on and present at the input to the freezer.
Freezer fails to run, although power switch/ thermal circuit is in the ON position, *and the display is blank*.	Power continuity problem (fuse, transformer, wiring), or possible failure of microboard or display.	1. Check the fuses on the microboard (T 2-amp) PN K0380-0610. 2. Check the 6-volt and 9-volt transformer outputs 3. With POWER DISCONNECTED, check the wiring. 4. Switch off the battery. Check for the presence of 6.6 to 7.0 volts across the + and - battery terminals of the microboard; if the voltage is not present and correct, change the microboard. 5. If the LED on the microboard illuminates, but the display remains blank, change the display board or the connecting lead.
Freezer is running, microboard and display operate correctly, but a Warning is displayed. **…continued…**	• SYSTEM FAIL	1. Remove the electrical cover and observe the LEDs on the microboard. 2. With one or more probe light(s) illuminated, check terminations on the board. If the terminations are good, change the probe. 3. If all probe lights are illuminated, change the board. (Refer to Section 4, probe fail diagnostics)

Symptom(s)	Probable Causes	Solution(s)
…continued… Freezer is running, microboard and display operate correctly, but a Warning is displayed.	• TEMP LOW	1. Check that power is being supplied from the relays and is reaching the compressors. If necessary, check the wiring. 2. If the relays are not working, check that the input voltage of 11-12 volts is present. If the voltage is present, change the relay. If the voltages are not correct, check the transformer voltage to the driver board; it should be 9-10 volts AC. If the AC voltage is not present, change the microboard.
	• BATT LOW	1. Check that the power supply is present. 2. POWER DISCONNECTED, check the wiring.
	• POWER LOW	1. Replace battery.
No response to keyboard commands		1. Check that the keyboard is unlocked. 2. Check the cable to the display microboard. 3. If the cable is not faulty, change the display microboard.

10.1 Troubleshooting Vent Heater

Symptom(s)	Probable Causes	Solution(s)
Vent heater blocked with ice	Power continuity problem	1. Check the fuse (F800ma). Replace if necessary (PN K0380-0560). 2. Check the output of the heater transformer. It should be between 5.5-6.5 volts. If defective, replace with PN K0420-0080. 3. Check Vent Heater continuity. If the circuit is open, replace with new heater, PN K0620-0650.

11 MICROPROCESSOR-CONTROLLED HEATED ACCUMULATOR

This feature is only available on the VIP range of freezers.

A heater is attached to the Low Stage accumulator. The heater switches on at the beginning of the Low Stage cycle or when the cabinet temperature rises more than 5° C above the temperature setpoint. This heating causes the liquid refrigerant in the accumulator to evaporate and return to the compressor. The added refrigerant in the compressor causes the discharge and suction pressures to rise, increasing system capacity to provide additional cooling.

The microprocessor control board, via solid state relay, controls both power to the heater (to switch it on and off) and the timing of that power feed. There is an amber-colored LED (D18) on the control board to indicate the switching of the solid state relay.
Output to the heater is via terminal block TB5, located next to the solid state relay; output from TB5 is the same as the unit's power supply voltage.

Operation of the heated accumulator is simple, consisting of only three components: a heater, an accumulator and a solid state relay. The accumulator should not require any routine maintenance. Should the heater or relay fail, the refrigeration system would still function normally; the difference is that there would be an increase in cycle time and temperature fall-back during each cycle.

11.1.1 Troubleshooting the Heated Accumulator

1. Check wiring connections (Refer to VIP schematic A1200)

NOTE:

Live power supply is switched by SSR.

2. Check fuse FS2. If the fuse has blown, check heater and wiring before installing a new fuse.
3. Check output from micro-control board terminal block TB5 output only present when LED D18 illuminates. If no output is present, change the control board.
4. Check heater wires and heater (heater resistance at 23°C is 500 ohms for a 230V heater and 125 ohms for a 115V heater. If defective, replace as necessary (*see Section 11.1.2, Replacing the Accumulator Heater, below*).

5. To check the operation of the heated accumulator using a system analyzer (gauge set): when the Low Stage cycles on, observe suction and discharge pressures. If heated accumulator is working correctly, you will notice that the suction pressure will increase at a steady rate for the timed duration, then return to normal pressure for the remainder of the ON cycle. If the heater is not working, you will see that the suction pressure falls to a low level for a prolonged time before recovering (considerably longer than the 3-minute timed cycle). As mentioned previously, this will prolong the ON cycle and may cause an increase in temperature fall-back (more than 2° C).

11.1.2 Replacing the Accumulator Heater

Upright Freezers

1. Remove freezer cabinet back panel by carefully drilling out pop rivets, using a drill stop to prevent the drill from penetrating too far into the cabinet (**maximum depth: 15mm**).
2. The back panel is sealed with mastic. Carefully break the seal and remove the panel. Remove the vacuum panels to expose the heated accumulator. Take care when handling vacuum panels; be certain not to place them on or near sharp objects that could damage them.
3. The accumulator is located at the bottom of the cabinet; you should be able to see the red heater mat close to the surface of the foam insulation. Carefully cut the foam around the accumulator to a depth of 45mm, to expose the heater.
4. The heater mat has a self-adhesive coating. After noting its position, remove the old heater from the accumulator, disconnect the heater wires the outside of the cabinet, and attach a pull- through wire to the end of the old heater wires. Pull out the old heater.
5. To install a new heater, attach the heater's wires to the pull-through wire. Carefully pull the wires through the insulation; peel off the backing from the heater mat and attach it to the accumulator in the same position as the old heater.
6. Relocate accumulator and make good insulation around accumulator, replace vacuum panels and reseal and re-rivet back panel.

NOTE:

It is very important to seal the back panel to keep out all moisture.

Chest Freezer.

1. Remove casters.
2. Remove the cabinet's bottom panel by carefully drilling out pop rivets, using a drill stop to prevent the drill from penetrating too far into the cabinet (**maximum depth: 15mm**). The accumulator is located close to the compressor end of the cabinet at a depth of approximately 50-60mm. Cut away foam around heater.
3. The heater mat has a self-adhesive coating. After noting its position, remove the old heater from the accumulator, disconnect the heater wires the outside of the cabinet, and attach a pull- through wire to the end of the old heater wires. Pull out the old heater.
4. To install a new heater, attach the heater's wires to the pull-through wire. Carefully pull the wires through the insulation; peel off the backing from the heater mat and attach it to the accumulator in the same position as the old heater.
5. Relocate accumulator and make good insulation around accumulator, replace vacuum panels and reseal and re-rivet back panel.
6. Reinstall casters.

12 CONTROL BOARD CALIBRATION

12.1 Access to Control Board

Upright Models: Remove lower right-hand panel.
Chest Models: Remove right-hand end panel.

12.2 Equipment Required

- **Digital voltmeter or multi-meter**

  Range 200mV or higher with a minimum resolution of 0.1mV
  Range 10V or higher with minimum resolution of 1mV
  Accuracy of 0.3% ± 1 digit.

- **Resistors**

  100 Ohms 0.1%
  50 Ohms 0.1%
  127 Ohms 0.1%
  All 0.25 Watt precision metal film.

  A resistance substitution box or a multiturn cermet trimmer (200 Ω) can be used to provide these resistors.

- **Test Jig**

  A test jig, containing the resistors, selector switches and connectors to plug into the probe terminal strips, is available from the suppliers of the freezer (PN K0620-1290).

12.3 Battery Charging Voltage

To check the battery charging voltage:

1. Isolate the battery from the system using the front panel Battery Switch. Connect a voltmeter across pins 3 and 4 on **TB1** with negative to pin 4 (*see Figure 7 on the following page*).

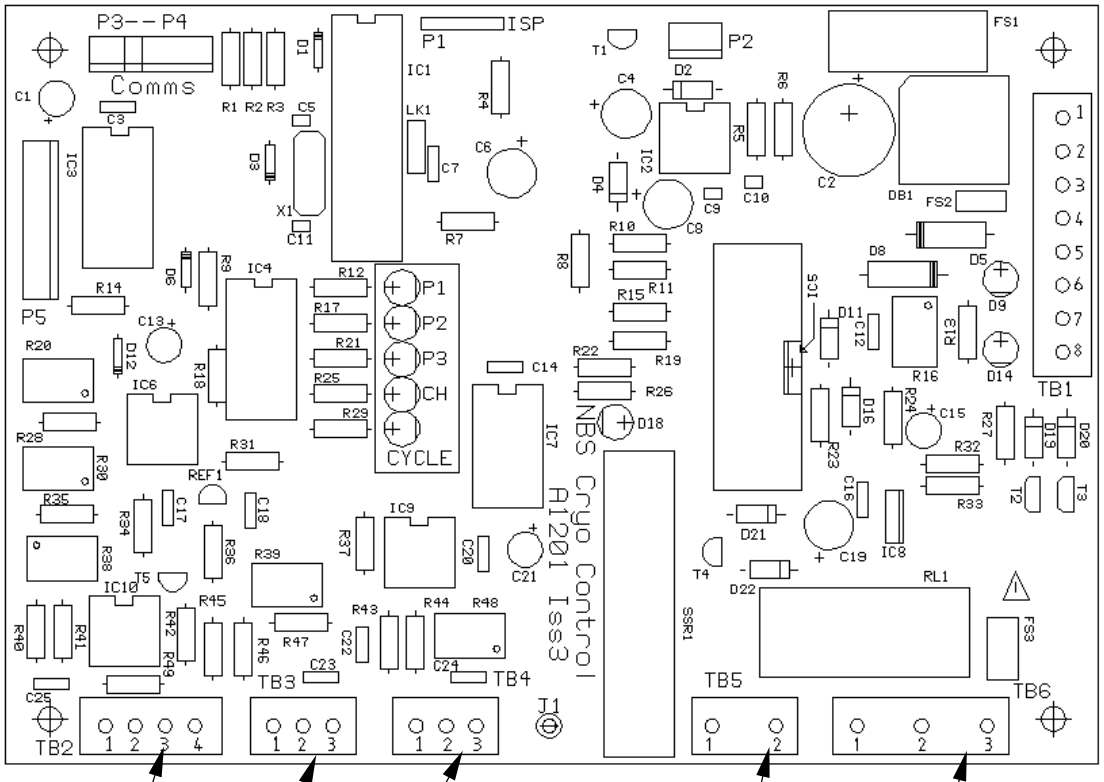
2. Depress the **ALARM TEST/MUTE** button and adjust **R16** to give a reading of 6.81 volts.
3. Release the button, disconnect the meter and reconnect the battery.

12.4 Probe Calibration

The calibration must be carried out in the order specified below:

1. Disconnect the probes from **TB2, TB3** and **TB4.**
2. Connect a resistor of 100 Ohms between pins 2 and 3 of **TB2.** Connect pins 1 and 2 together. Connect a voltmeter across the resistor, negative to pin 3. Adjust **R38** to give a reading of 100mV. Disconnect the meter.
3. Connect a resistor of 50 Ohms to **TB2** in place of the one above. Adjust **R30** to give a reading of -125ºC on the display.
4. Connect a resistor of 127 Ohms to **TB2** in place of the one above. Adjust **R20** to give a reading of 70ºC on the display. Reconnect the 100 Ohms resistor to **TB2**. The display should read 0ºC. If it does not, repeat steps 1 to 4.

Figure 7: Main Control Board Components & Terminal Layout



13 MAINTENANCE

Cleaning instructions are provided in the User's Guide.

> ***CAUTION!***
>
> **Serious damage to the freezer may result if the air intake is allowed to become blocked. Check that there is no obstruction of the airflow to the freezer.**
>
> **The air intake filter must also be cleaned regularly. Remove the filter from behind the grill by turning the thumbscrews ¼ turn and opening grill downward. The filter should be washed in warm, soapy water and left to air dry before replacing.**

13.1 Electrical Components

13.1.1 Lamps

Regularly check the indicator lamps by pressing the **ALARM TEST/MUTE** key. The **POWER-FAIL**, **TEMP-ALARM** and **FAULT** indicators should illuminate, and the display should read **8888**.

13.1.2 Alarms

Regularly check the alarm by pressing the **ALARM TEST/MUTE** key. The **TEMP** indicator should illuminate and the audible alarm should sound. To test power fail and remote alarm socket, switch freezer off to activate alarms.

13.1.3 Battery Replacement

The YUASA–NP6V 2.8Ah battery is mounted on the electrical panel. This is located (a) behind the right-hand base cover on the upright freezers, or (b) in the compressor housing on the chest freezers.

> ***WARNING!***
>
> **Use only a replacement battery of the correct type and part number. The battery must be fitted so the terminals correspond to the polarity labels on the electrical panel.**

To replace the battery, first switch off the power switch and disconnect the power supply. Remove the side cover and the battery clamp securing the battery to the electrical panel. Disconnect the battery terminals.

Be certain, when reconnecting the battery, to respect the correct polarity (red is + positive and black is – negative).

13.1.4 Fuses

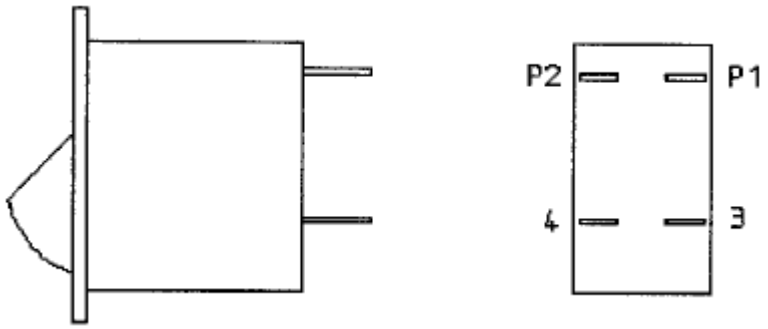
The following are the specifications for the fuses required by the freezers:

Main Power Supply Plug	13A Bussmann 1 x ¼"
†Control Panel	FS1 - 800mA 20x5mm Quick Acting (F) 250V ceramic FS2 - 1A 20x5mm Anti-Surge (T) 250V ceramic FS3 – 1A 20 x5mm Anti-Surge (T) 250V ceramic
†PCB A1201	FS1 - 2A 20x5mm Quick Acting (F) 250V glass

† These fuses must be replaced by an NBS-approved service engineer.

13.2 Power Cord Replacement

Figure 8: Power Switch SW1



When replacing the power cable to SW1, ensure that the connections are as follows:

- Switch marking P1 live out (brown)
- Switch marking P2 neutral out (blue)
- Terminal 3 live in (brown)
- Terminal 4 neutral in (blue)

The ground wire to the adjacent ground stud should be long enough to take the strain last, in the event of failure of the cable gland.

URGENT!

The Environmental Protection Agency (EPA) now makes it illegal to deliberately release refrigerants into the atmosphere. On April 1, 1992, conservation of refrigerants during maintenance and decommissioning of refrigeration and air conditioning systems became a mandatory requirement.

13.3 Polyolester Oils (POE)

The compressors are lubricated by polyolester oils. Polyolester oils are more hygroscopic than mineral oils. When replacing a compressor or working on the refrigeration system, care must be taken to keep exposure of the oil to the atmosphere to a minimum, to prevent contamination of the oil by moisture absorbed from the atmosphere. Oil containers must be capped at all times.

Oil type used: ICI Emkarate RL 22Hb

NOTE:

Be sure to use ONLY the recommended oil type and viscosity (see Section 9.3.1).

13.4 Lubrication and Adjustment

We recommend that freezer handles and hinges are checked for adjustment and lubricated at least every 12 months. Check outer door gasket for signs of damage and adjust to form an airtight seal. Check inner doors for damage and adjust if necessary to ensure proper operation. Do not lubricate inner door hinges or latches.

Lubricate moving parts with Invisi-lube heavy duty clear aerosol grease for best results. This product does not cause discoloration of paintwork. If this is not available, light oil is acceptable. To obtain Invisi-lube from New Brunswick Scientific, please order through your local distributor.

14 ACCESSORIES & SPARE PARTS

See the User's Guide (M1288-0052) for additional information.

14.1 Installed Spare Parts & Accessories

Only a qualified and authorized service engineer may install the following spare parts and accessories:

NBS Part No.	*Cryo Part No.*	*Description*	*Used On*
K0160-0067	UT9440-2020-002	Handle Latch Plate Assembly	U535/U725
K0160-0082	CT0160-0001-002	Key & Lock	All/Switch Plate
P0625-0111	CT0160-0001-001	Spare Key - No. 850	All/Switch Plate
K0160-0085	UT9420-1001-001	Key Switch Plate - Ash grey	U101
P0625-0170	UT9420-1001-002	Key switch plate - Charcoal	U535/U725/C585/C760
P0625-0130	CT0160-0008-004	Adjustable Foot M10	U101
K0160-0995	CT0160-0008-002	Adjustable Foot M12	U535/U725
K0160-0135	UT9410-1002-001	Chest Handle Assembly	C585/C760
K0160-0545	UT9420-2036-500	Outer Door Hinge - Painted	U101
K0160-0546	UT9440-2014-500	Outer Door Hinge - Painted	U535/U725
K0160-0735	CT0160-0019-500	Castor Swivel	U535/U725/C585/C760
K0160-0737	CT0160-0019-501	Castor Swivel Lock	C585/C760
K0160-0775	CT0160-0009-005	Chest Lid Hinge	C585/C760
K0160-0776	CT0160-0023-001	Chest Inner Lid	C760
K0160-0777	CT0160-0023-002	Chest Inner Lid	C585
K0160-0992	UT9420-1006-001	Rear Roller Assembly	U101
K0200-0350	CT0160-0006-001	Oil Separator	All
K0200-0055	CT9999-0000-009	Oil Separator (spare only)	U101 Serial No 1-13
K0200-0505	UT9420-2031-500	Air Filter Guard	U101
K0200-0506	UT9420-1007-500	Air Filter	U101
K0200-0510	UT9440-1005-001	Air Filter Guard	U535/U725
K0200-0511	UT9440-1007-500	Air Filter	U535/U725
K0200-0515	UT9410-1001-500	Air Filter Guard	C585/C760
K0200-0516	UT9410-1007-500	Air Filter	C585/C760
P0625-0113	CT0160-0001-003	Key Lock - Handle	U535/U725
K0220-0425	CT0160-0001-004	Key Lock - Handle	C585/C760
P0625-0640	CT0160-0001-008	Spare Key – No. 100	U535/U725
P0625-0110	CT0160-0001-006	Spare Key - No. 325	C585/C760 Handle
K0220-0428	CT0160-0017-002	Handle - Latch	U101
K0160-1500	CT0160-0001-007	Spare Key - No. 751	U101 Handle
K0220-0432	CT0160-0017-001	Handle (MOULD ONLY)	U535/U725
K0220-0430	UT9440-1006-001	Handle, complete kit of parts	U535/U725

…continued…

NBS Part No.	Cryo Part No.	Description	Used On
K0280-0550	UT9999-0000-141	Shelf Clips Pack of 4	U535/U725
K0280-0570	CT0240-0002-001	Silicon Cord per meter	All
K0280-1034	UT9430-2008-888	U535 Inner Shelf c/w clips	U535
K0280-1036	UT9440-2008-888	U725 Inner Shelf c/w clips	U725
K0280-1100	UT9420-2029-500	Inner Shelf	U101
K0280-1001	UT9430-2003-002	Inner Door GRP	U535
NEW	UT9430-2003-003	Inner Door ABS	U535
K0280-1002	UT9440-2003-002	Inner Door GRP	U725
NEW	UT9440-2003-003	Inner Door ABS	U725
K0280-1003	UT9420-2004-002	Inner Door GRP	U101
K0340-0040	CT0380-0023-001	Thermistor 3K	All
K0380-0560	UT9999-0000-143	Fuse 20mm 800mA Pack of 5	All De-ice Heater
K0380-0565	UT9999-0000-144	Fuse 20mm 1A Pack of 5	All General Power
K0380-0570	UT9999-0000-145	Fuse 1 x 1/4" 13A Pack of 5	All Power I/P UK
P0625-1240	UT9999-0000-190	Fuse 20mm 2A Pack of 5	All Control PCB
K0400-0345	CT0380-0015-001	Membrane Switch	All
K0400-0460	CT0380-0010-001	Power Switch 12A 240V	All 230v
K0400-0461	CT0380-0010-002	Power Switch 15A 208V	All 208v + U101 115v
K0400-0461	CT0380-0010-006	Power Switch 20A 115V	All 115v
K0400-0465	CT0380-0018-001	Mains EMI Filter	All
K0400-0481	CT0460-0001-000	Contact Suppressor	All
K0400-0482	UT9999-0000-200	Surge Protector - 230v	All
K0400-0483	UT9999-0000-201	Surge Protector - 115v	All
K0400-0562	CT0380-0016-001	Relay 30A DPNO 12V	All
K0420-0080	UT9999-0000-197	Transformer 230V	All
k0420-0082	UT9999-0000-198	Transformer 115V - USA	All
K0440-0280	UT9999-0000-199	Sounder	All
K0460-0220	UT9420-3002-001	Control PCB Assembly	All
K0460-0221	UT9420-2007-001	Display PCB Assembly	All
K0480-0170	CT0480-0001-001	Battery 6V 2.8Ah	All
K0480-0175	CT0380-0011-001	Battery Switch	All
P0625-0400	CT0380-0025-004	Silicon Matt Heater 230v/115v	All
K0620-0650	UT9420-2006-001	Vent Heater - VIP	All
K0620-0651	UT9999-0000-139	Vent Cover / Plunger Kit	All
K0620-1150	CT0620-0003-001	Compressor T2178GK 230V 50Hz	U535
K0620-1151	CT0620-0003-002	Compressor T2178GK 208V 60Hz	U535
K0620-1152	CT0620-0001-001	Compressor DANFOSS SC10CL 230V 50Hz	U101
K0620-1153	CT0620-0001-002	Compressor DANFOSS SC10CL 208V 60Hz	U101 Spare only
K0620-1154	CT0620-0001-003	Compressor DANFOSS SC10CL 115V 60Hz	U101
K0620-1155	CT0620-0003-003	Compressor T2178GK 115V 60Hz	U535

…continued…

NBS Part No.	Cryo Part No.	Description	Used On
K0620-1156	CT0620-0002-001	Compressor J2192GK 230V 50Hz	U725/C760
K0620-1157	CT0620-0002-002	Compressor J2192GK 208V 60Hz	U725/C760
K0620-1158	CT0620-0004-001	Compressor T2180GK 230V 50Hz	C585
K0620-1159	CT0620-0004-002	Compressor T2180GK 208V 60Hz	C585
K0620-1161	CT0620-0004-003	Compressor T2180GK 115V 60Hz	C585
P0625-0066	CT0620-0003-011	Compressor Starter Kit	T2178GK 230v 50Hz
P0625-0065	CT0620-0003-012	Compressor Starter Kit	T2178GK 208v 60Hz
P0625-0064	CT0620-0003-013	Compressor Starter Kit	T2178GK 115v 60Hz
P0625-0063	CT0620-0004-011	Compressor Starter Kit	T2180GK 230v 50Hz
P0625-0062	CT0620-0004-012	Compressor Starter Kit	T2180GK 208v 60Hz
P0625-0061	CT0620-0004-013	Compressor Starter Kit	T2180GK 115v 60Hz
P0625-0067	CT0620-0002-011	Compressor Starter Kit	J2192GK 230v 50Hz
P0625-0010	CT0620-0002-013	Compressor Starter Kit	J2192GK 208v 060Hz
K0380-0335	CT0620-0001-004	Compressor Start Capacitor 230v	SC10CL - 117U5017
K0380-0330	CT0620-0001-006	Compressor Start Relay 230v	SC10CL - 117U6003
P0625-0070	CT0620-0001-005	Compressor Start Capacitor 115v	SC10CL - 117U5023
P0625-0080	CT0620-0001-008	Compressor Start Relay 115v	SC10CL - 117U6020
P0625-0042	CT0380-0004-001	Fan ebm 230v 50Hz	U101
K0620-1176	CT0380-0004-002	Fan ebm 115v 60Hz	U101
P0625-0450	UT9440-1011-001	Fan Motor Kit 208/230V	U535/U725/C585/C760
P0625-0451	UT9440-1011-002	Fan Motor Kit 115V - USA	U535/C585
K0620-1190	CT0160-0007-001	Filter Dryer Sporlon C032	All
K0620-1200	CT0160-0004-004	Condensor STN9327	U535 U725
K0620-1202	CT0160-0004-001	Condensor STFT12218R	U101
K0620-1204	CT0160-0004-002	Condensor STFT18227	U725 MK1 Only
K0620-1206	CT0160-0004-003	Condensor STFT16224R	C585/C760
P0625-0740	UT9999-0000-173	Outer Door Gasket Kit	U101
P0625-0742	UT9999-0000-175	Outer Door Gasket Kit	U535
P0625-0743	UT9999-0000-176	Outer Door Gasket Kit	U725
P0625-0744	UT9999-0000-177	Lid Gasket Kit	C585
P0625-0745	UT9999-0000-178	Lid Gasket Kit	C760
K0720-0170	CT0380-0024-001	Platinum Probe PT100	All
K0740-0330	CT0240-0001-001	Hole Plug - CO2/LN2 pack of 2	All
K0860-0092	CT0870-0007-000	Oil Emkarate per 5 litres	All
NEW	UT9440-4001-002	Voltage Stabiliser – Built in 115v	U535/C585
NEW	UT9440-4001-003	Voltage Stabiliser – Built in 208v	U535/U725/C585/C760
P0625-0354	CT0720-1000-123	Power Cord 115v C19 Nema 5-20	U535/C585
P0625-0355	CT0720-1000-121	Power Cord 115v C19 Nema 5-15	U101
P0625-0356	CT0720-1000-122	Power Cord 230v EU Schuko	All
P0625-0357	CT0720-1000-120	Power Cord 230v UK	All
P0625-0358	CT0720-1000-128	Power Cord 208v C19 Nema 6-15	U535/U725/C585/C760
P0625-0580	UT9999-0000-122	Replacement Door Cable	U535/U725
P0625-0590	CT0160-0031-001	Plastic Fan Cowl	U535/U725

15 RETURN MATERIAL AUTHORIZATION POLICY

No returned material or equipment will be accepted without a return authorization previously issued by the service department (of the office to which the material or equipment is returned).

The Return Number must appear on the outside of all cartons and/or packages.

When returning any material or equipment, quote both the part number and its serial number.

For return authorization, contact the Service Department at one of these locations:

New Brunswick Scientific (UK) Ltd
17 Alban Park
Alban Park
Herts AL4 0JJ
UK

Tel: +44 (0)1727 853855 or 0800 581331
Fax: +44 (0)1727 835666
email: service@nbsuk.co.uk

New Brunswick Scientific BV
Kerkenbos 1101
6546 BC Nijmegen
The Netherlands

Tel: +31 (0)24 3717 600
Fax: +31 (0)24 3717 640
email: sales@nbsbv.nl

New Brunswick Scientific NV/SA
Stationstraat 180/4
3110 Rotselaar
België/Belgium

Tel: +32 (0)16 56 28 31
Fax: +32 (0)16 57 27 53
email: sales@nbsnv-sa.be

New Brunswick Scientific S.A.R.L.
12-14, Rond Point des Champs Elysées
75008 Paris
France

Tel: +33 (0)1 53 53 15 11
Fax: +33 (0)1 53 53 15 57
email: sales@nbssarl.fr

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In der Au 14
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44 Talmadge Road
Edison, NJ 08818-4005
U.S.A.

Tel: +1 732-287-1200
Fax: +1 732-287-4222
email: bioinfo@nbsc.com

16 SPECIFICATIONS

16.1 Upright Freezers

Model No.	*U101*	*U535*	*U725*
Part No.	U9420-000**X***	U9430-000**X***	U9440-000**X***
Internal Dimensions: Height x Width x Depth	640 x 480 x 330 mm 25.2 x 18.9 x 13 in.	1365 x 640 x 615 mm 53.7 x 25.2 x 24.2 in.	1365 x 865 x 615 mm 53.7 x 34.1 x 24.2 in.
External Dimensions: Height x Width x Depth	830 x 900 x 566 mm 32.7 x 35.4 x 22.3 in.	1950 x 800 x 867 mm 76.8 x 31.5 x 34.1 in.	1950 x 1025 x 867 mm 76.8 x 40.4 x 34.1 in.
Capacity	101 Liters 3.6 cubic feet	535 Liters 18.9 cubic feet	725 Liters 25.6 cubic feet
Net Weight	116 Kg 256 lb	250 Kg 551 lb	315 Kg 694 lb
Lock	**Standard**	**Standard**	**Standard**
No. Compartments	2	3	3
Interior	Stainless steel grade 304L		
Alarms	Hi/Low temperature, power fail, battery low, filter clean, fault,		
Insulation Material	Vacuum Insulation Panels and urethane foam		
Refrigerants	High Stage Refrigerant: R404A / Low Stage Refrigerant: R508B		
Remote alarm port	Standard	Standard	Standard
RS-485 interface	Optional	Optional	Optional
‡Power Consumption:			
• **115V elec. supply**	530 Watts	550 Watts	N/A
• **220V elec. supply**	N/A	550 Watts	685 Watts
• **240V elec. supply**	530 Watts	509 Watts	660 Watts
Power Source (USA)	100-120V 60Hz single phase		N/A
Power Source (USA)	N/A	208-220V 60 Hz single phase	
Power Source (EU)	220-240V 50Hz single phase		
Current Rating (USA)	115V 13 amps	115V 16.5 amps	N/A
Current Rating (USA)		220V 9 amps	220V 10 amps
Current Rating (EU)	230V 5 amps	230V 5 amps	230V 6.5 amps
Pull Down Time From +25°C to –85°C (freezer empty; 240V, 50Hz electrical supply)**	4.1 hours	5.0 hours	5.2 hours
Performance	-50°C to -86°C at +32°C ambient maximum operating temperature		
Operating Environment	All freezers are designed for: • Indoor use • Altitude up to 2000m • Ambient temperature range 5°C to 40°C • Maximum relative humidity 80% for temperatures up to 31°C, decreasing linearly to 50% relative humidity at 40°C • Power supply voltage fluctuations not to exceed ± 10% nominal voltage • Installation category II (UK only) • Pollution degree 2 (UK only)		

* **X** = 0 for 100-120V, 2 for 208-220V (N/A for U101) or 1 for 220-240V

**120V & 220V: TBA ‡ Freezer set to –80°C, ambient 20-25°C at rated electrical supply

16.2 Chest Freezers

Model No.	***C585***	***C760***
Part No.	U9400-0000, -0002, -0001	U9410-0001, -0002,
Type	Chest	Chest
Internal Dimensions: **Height x Width x Depth**	780 x 1200 x 625 mm 30.7 x 47.2 x 24.6 inches	780 x 1560 x 625 mm 30.7 x 61.4 x 24.6 inches
External Dimensions: **Height x Width x Depth**	1092 x 1690 x 785 mm 43 x 66.5 x 30.9 inches	1092 x 2050 x 785 mm 43 x 80.7 x 30.9 inches
Capacity	585 Liters 20.7 cubic feet	760 Liters 26.9 cubic feet
Net Weight	240 Kg 529 lb	285 Kg 628 lb
Lock	Standard	Standard
No. Compartments	N/A	N/A
Interior	Stainless steel grade 304L	
Alarms	Hi/Low temperature, power fail, battery low, filter clean, fault.	
Insulation Material	Vacuum Insulation Panels and urethane foam	
Refrigerants	High Stage Refrigerant: R404A / Low Stage Refrigerant: R508B	
Remote alarm port	Standard	Standard
RS-485 interface	Optional	Optional
‡Power Consumption:		
• **115V electrical supply**	580 Watts	N/A
• **220V electrical supply**	580 Watts	698 Watts
• **240V electrical supply**	565 Watts	665 Watts
Power Source (USA)	100-120V 60Hz single phase	N/A
Power Source (USA)	208-220V 60Hz single phase	
Power Source (EU)	220-240V 50Hz single phase	
Current Rating (USA)	115V 16.5 amps	N/A
Current Rating (USA)	220V 9 amps	220V 10 amps
Current Rating (EU)	230V 5.5 amps	230V 6 amps
Pull Down Time **From +25°C to –85°C** **(freezer empty; 240V 50Hz electrical supply*)**	4.5 hours	5.8 hours
Performance	-50°C to -86°C at +32°C ambient maximum operating temperature	
Operating Environment	All freezers are designed for: • Indoor use • Altitude up to 2000m • Temperature range 5°C to 40°C • Maximum relative humidity 80% for temperatures up to 31°C, decreasing linearly to 50% relative humidity at 40°C • Power supply voltage fluctuations not to exceed ± 10% of the nominal voltage • Installation category II (UK only) • Pollution degree 2 (UK only)	

*120V & 220V: TBA ‡ Freezer set to –80°C, ambient 20-25°C at rated electrical supply

17 DRAWINGS

17.1 Circuit Diagram/Wiring Schematic

Figure 9: Circuit Diagram/Schematic for U535, U725, C585 & C760 Models (115/220V, 60 Hz)

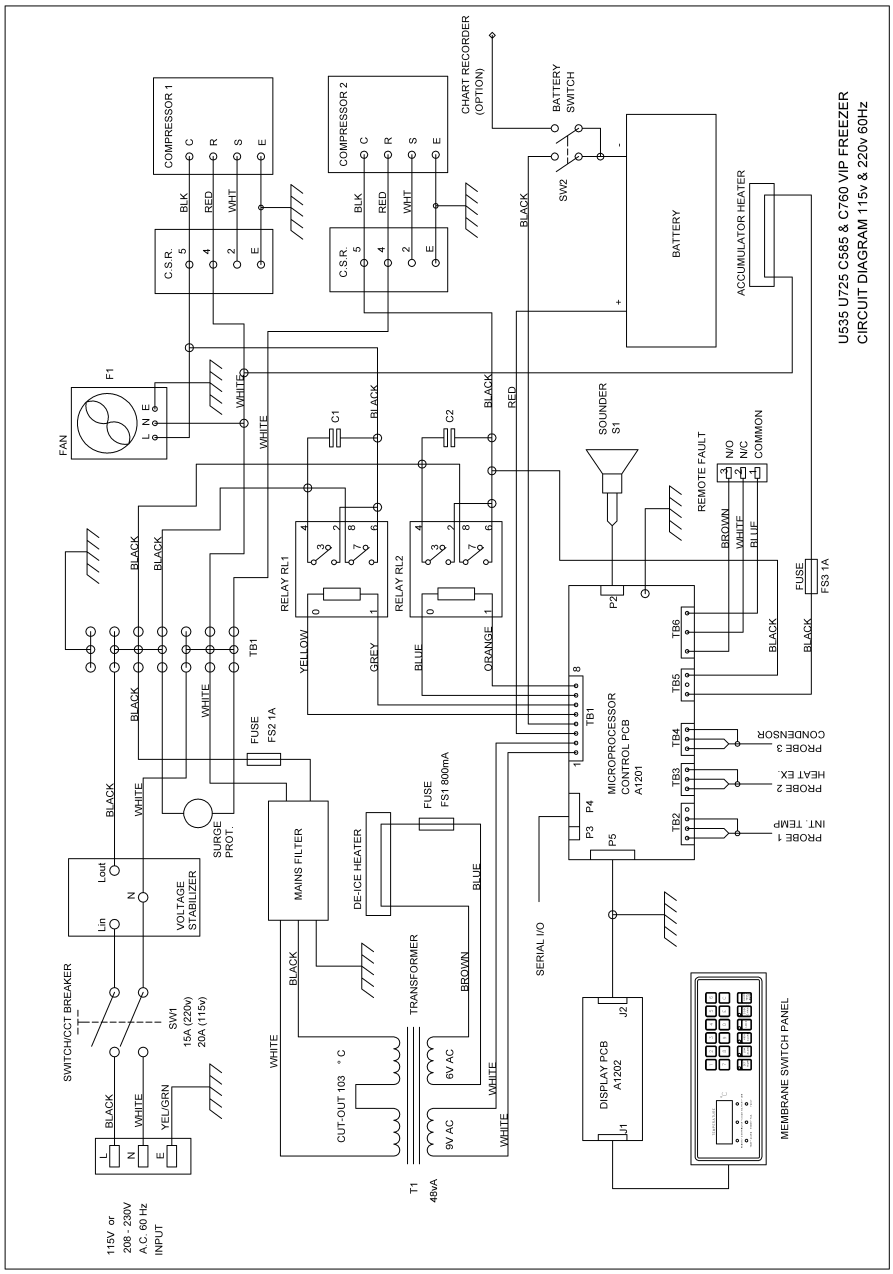


Figure 10: Circuit Diagram/Schematic for U535, U725, C585 & C760 Models (230V, 50Hz)

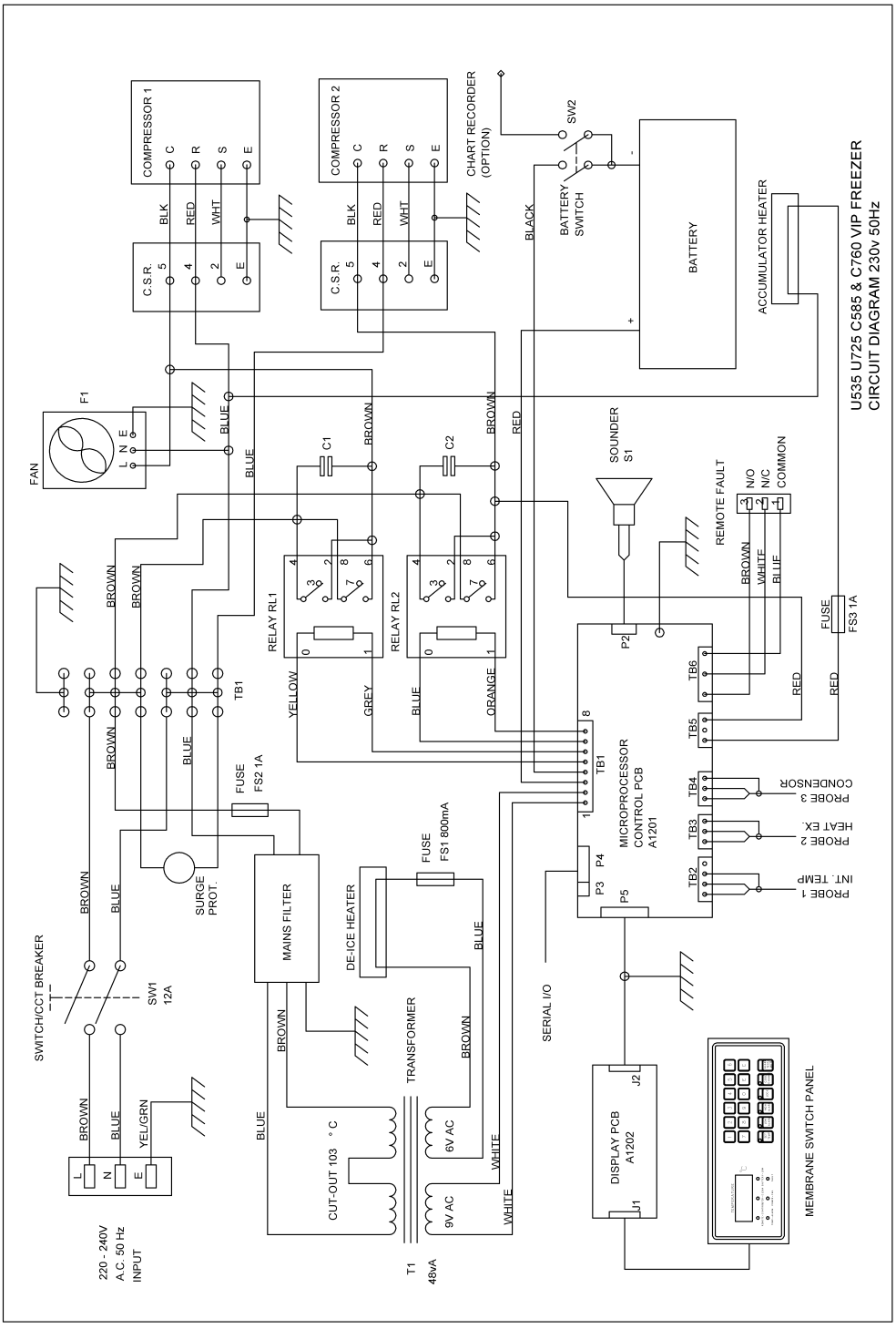


Figure 11: Circuit Diagram/Schematic for U101 Model (115V/220V, 60Hz)

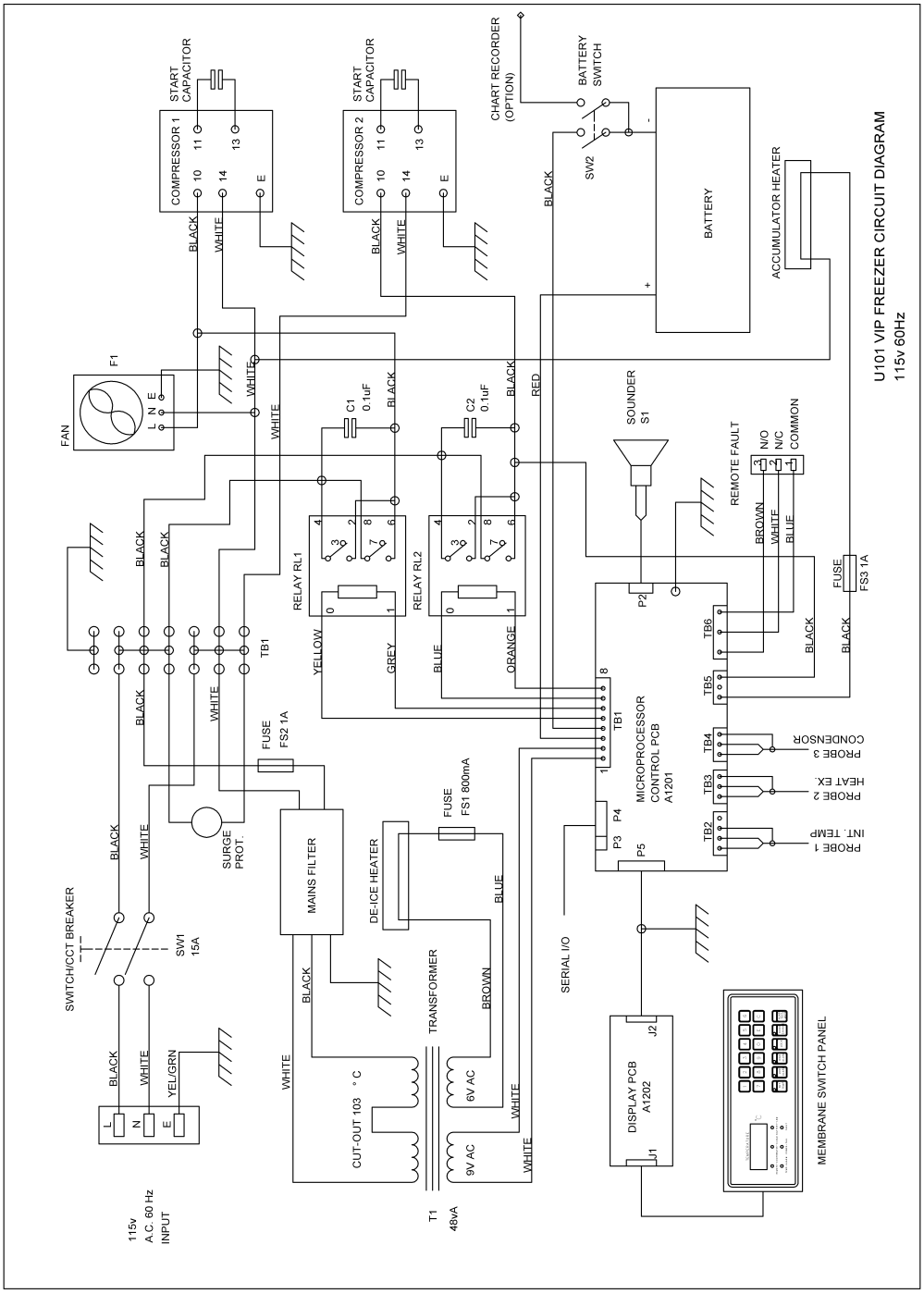


Figure 12: Circuit Diagram/Schematic for U101 Model (230V, 50Hz)

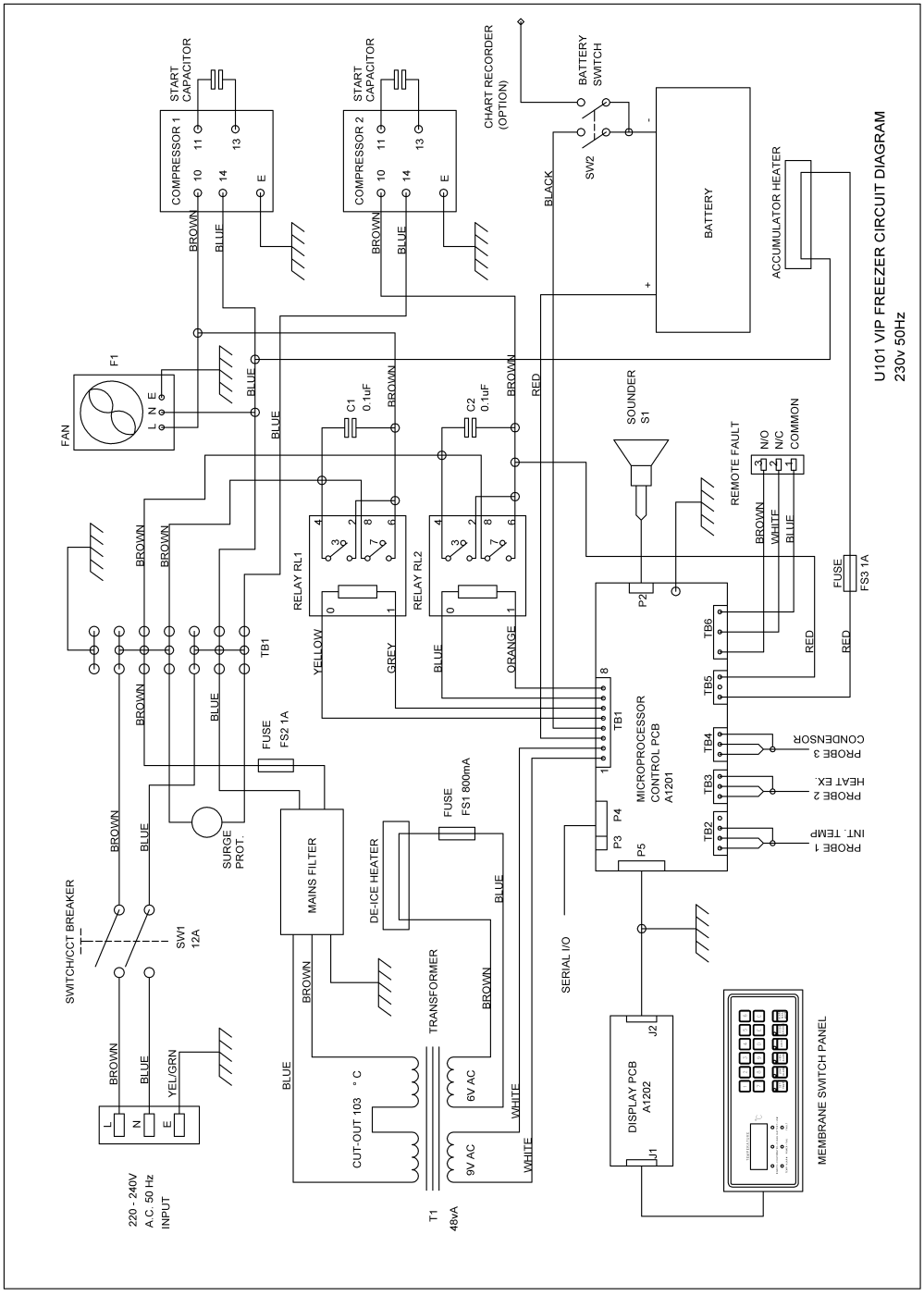
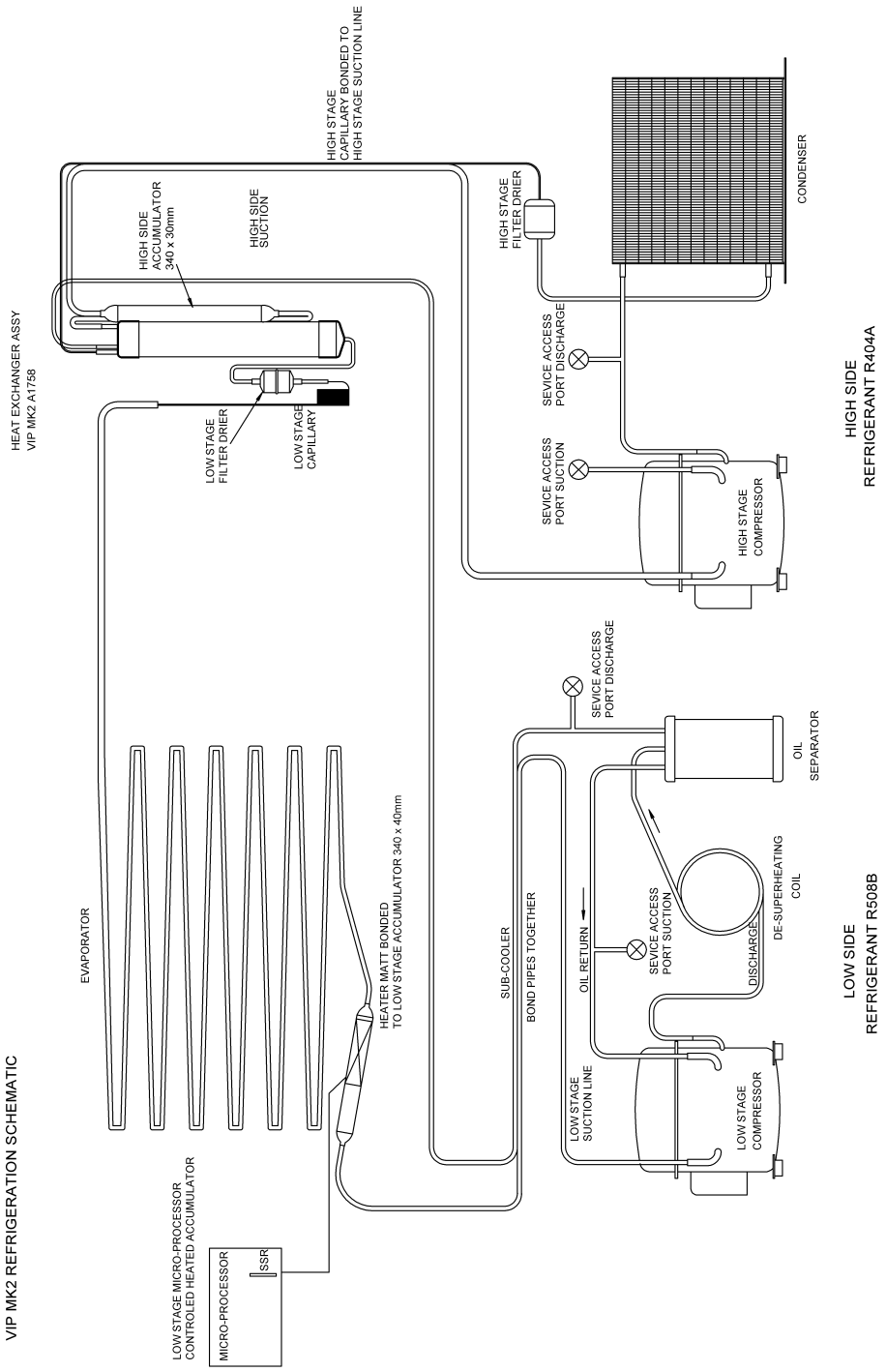


Figure 13: Two-Stage Cascade Refrigeration System



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