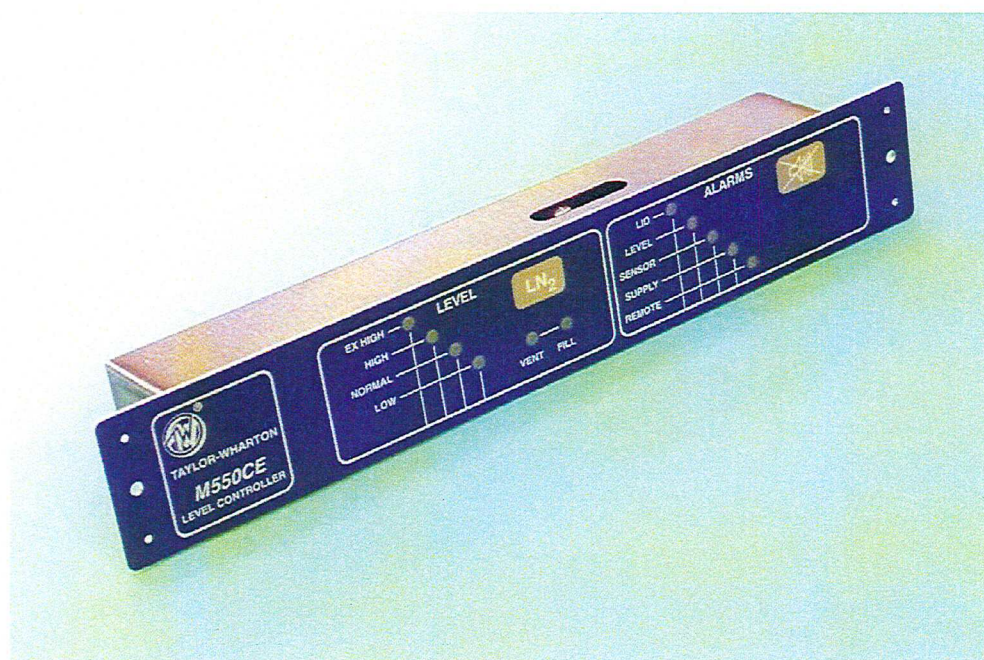


Type M550CE Liquid Nitrogen Level Control System Installation and Operating Instructions

Revision Status

Rev	Date	Revision Details	By	Checked	Approved
1	29/9/06	First Production	GHL	NM	<i>A. Maclean</i>



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1. Introduction

The M550CE is a microprocessor based LN₂ Level Control System with the following features and functions:-

- * Monitoring and LED display of level
- * Manual and automatic filling of refrigerators.
- * Local and remote alarms for
 - High or Low liquid levels
 - Sensor fault
 - Failure of liquid nitrogen supply
 - Lid left open.
- * Automatic 'Defogging' on lid opening
- * Fast temperature recovery on lid closure. ('Quick Chill')
- * Easy on-site update of operating firmware using a PC and download cable

2. Description

The M550CE LN₂ Level Control System has two variants.

The standard version (Figs 1a & 1b) is designed for fitting to 'boxed' K Series Refrigerators. The electronics are housed under a stainless steel cover to the back of the fascia.

It is made up from the following components: -

Controller	Mowden Part No. M551CE
Wall Mounted Connector Box and PSU	Mowden Part No. M507CE
Sensor Assembly	Mowden Part No. M508CE
Connecting Cables etc	Mowden Part No. M559CE

The boxed version (Fig 2) is designed for fitting to other refrigerator types, or may alternatively be wall mounted.

It is made up from the following components: -

Controller	Mowden Part No. M551CE-B
Wall Mounted Connector Box and PSU	Mowden Part No. M507CE
Sensor Assembly	Mowden Part No. M508CE
Connecting Cables etc	Mowden Part No. M558CE

2.1 Controller (M551CE and M551CE-B)

The fascia panel incorporates two switches and eleven LEDs.

The LN₂ switch allows the Fill Solenoid Valve to be turned 'On' or 'Off', and the other 'Mutes' the audible alarm. Holding down the 'Mute' switch also allows testing of the Remote Alarm Relay.

The left hand diagonal row of LEDs gives an indication of the liquid level, and the right hand diagonal row an indication of alarm conditions.

The two LEDs under the LN₂ switch indicate when filling or venting ('Gas Bypass') is taking place.

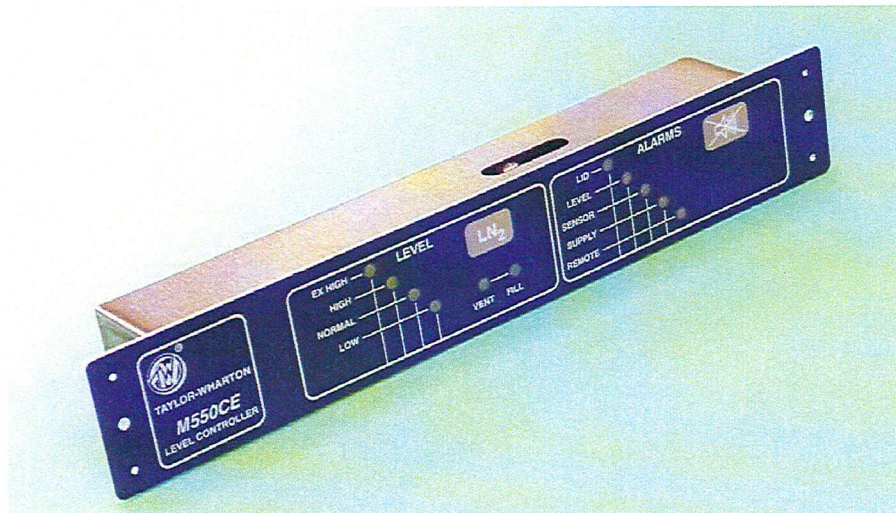


Fig 1a M551CE Controller (Standard Version).

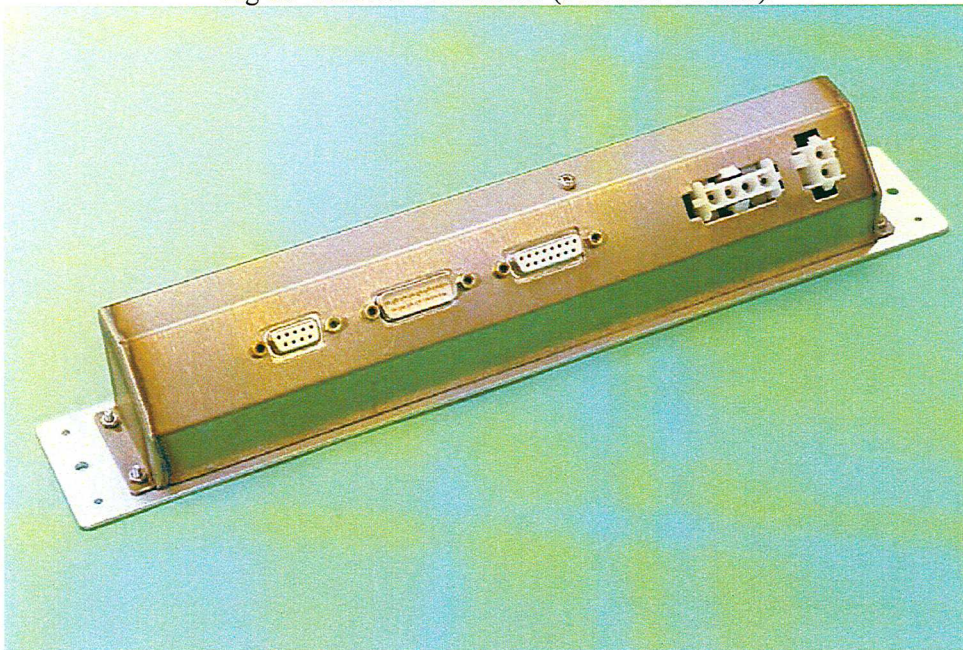


Fig 1b M551CE Controller (Back view showing connectors)



Fig 2 M551CE-B Controller (Boxed Version)

2.2 Wall Mounted Connector Box and PSU (M507CE)

The system power supply and all external connections (screw terminals) are housed in a wall mountable steel case (Figs 2). Overall size (including mounting brackets and cable glands) is 285x170x80mm.

The built in Safety Isolating Transformer provides the power to drive up to two 24V ac solenoid valves and also provides 12Vdc to power the Controller electronics. Screw terminal connectors are provided for connection to the Remote Alarm Contact and Gas Bypass Controller.

Additional screw terminal connectors are retained to allow upgrading to the M505 Controller at a later date.

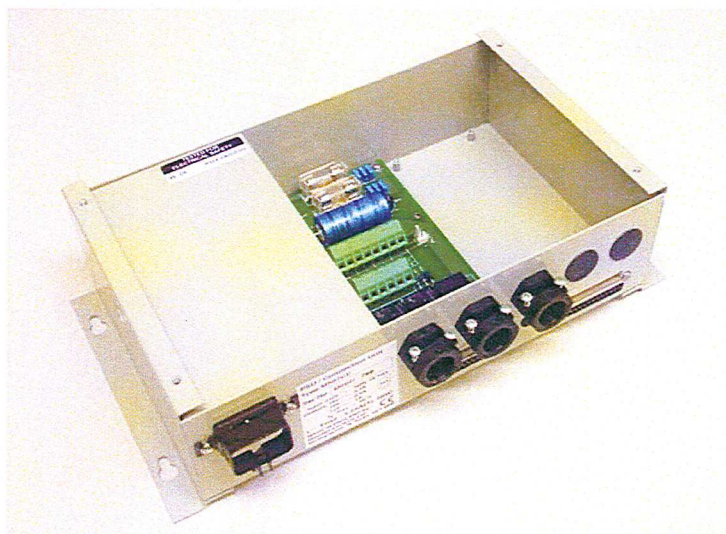


Fig 3 M507CE Connection Box and PSU (Cover removed).

2.3 Sensor Assembly (M508CE)

This standard Sensor Assembly contains four thermistors and a thermocouple*.

The thermistor sensors are designated: *Extra Low*
Normal
High
Extra High

The level is maintained between the Normal and High sensors. The Extra Low and Extra High sensors are used to activate alarms and to drive hardware interlocks.

The distance between the Extra Low and Normal sensors is fixed at 2.5cm. The other sensors may be adjusted relative to each other.

The sensor leads and thermocouple are terminated to a 15 way D-Type connector which also houses electronics to compensate for ambient temperature fluctuations.

** Note: The Thermocouple is not used on the M550 Control System but is retained to allow upgrading to the M505 system if required at a later date.*

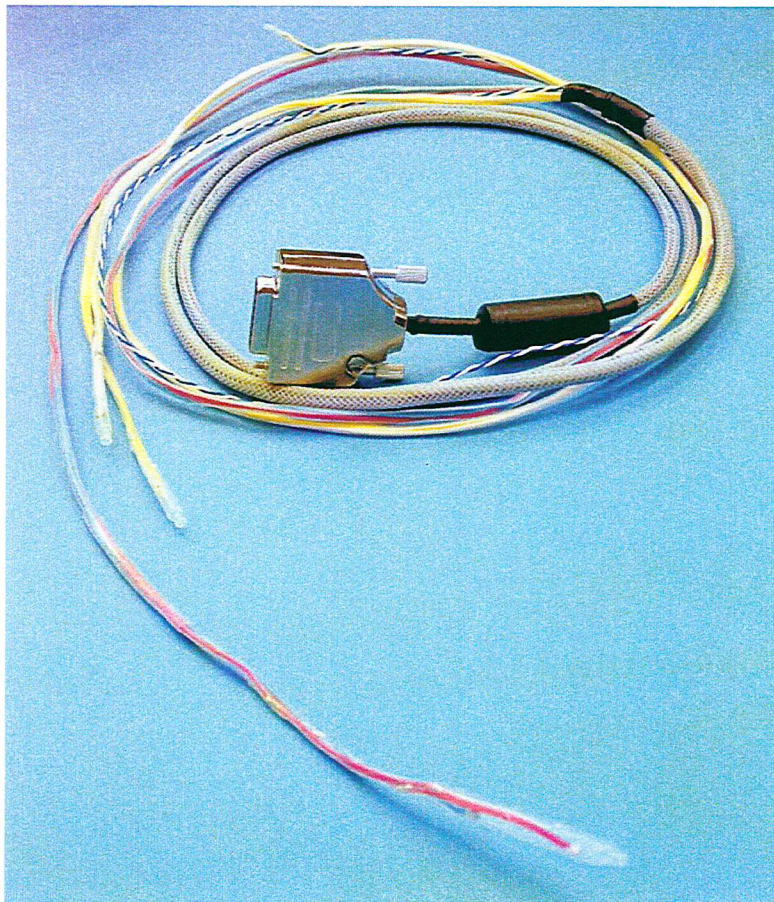


Fig 4. M508CE Sensor Assembly

2.4 Cable Assemblies

A cable is used to link the Controller to the Connector Box and PSU. The cable is fitted with 15 way D type connectors to allow easy disconnection and reconnection for maintenance purposes. The standard cable is 3 metres long. It is supplied with a modified access plate for routing the cable through the rear of the refrigerator cabinet. The access plate is not supplied with the M551CE-B.

The M551CE is supplied with a cable for connecting the Solenoid and Lid Switch. (Fig 5). On the M551CE-B the cable is wired in.

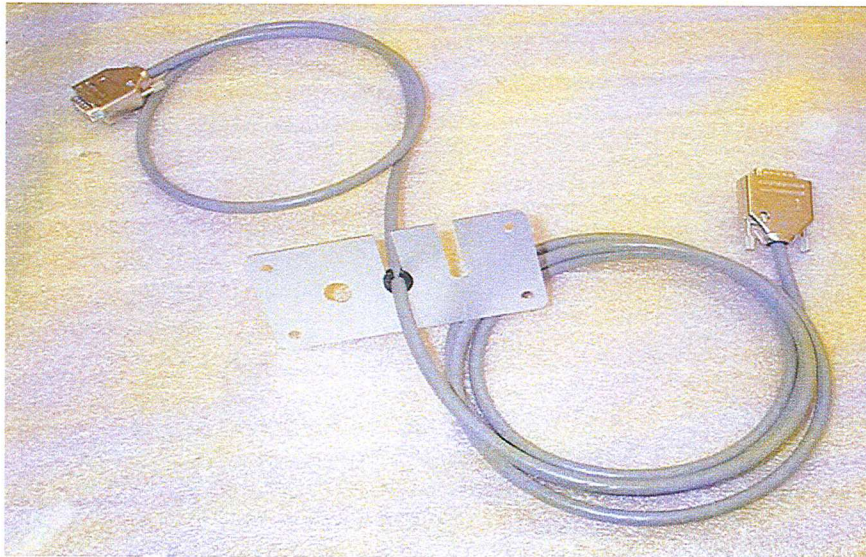


Fig 4 - 15 way Cable assembly.
(Note modified access plate and split grommet used to protect cable)

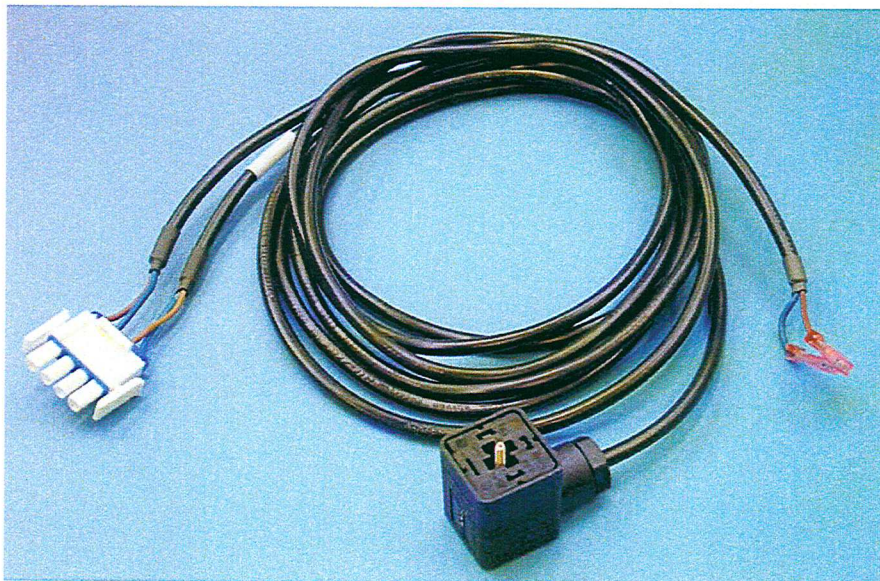


Fig 5. - Solenoid and Lid Switch cable

2.5 Optional Accessories.

The following accessories are available as optional extras:

M513CE Mounting tray with Cover.

Allows fitting of the M507CE to the rear of the refrigerator as an alternative to wall mounting. For 38K refrigerators a bracket kit is also required. (See below).

M514CE Bracket kit for M513CE Mounting tray

Allows fitting of M513 Mounting Tray to 38K refrigerators.

3. Installation

The standard M550CE Kit contains all parts for installation into boxed 10K and 24K Refrigerators.

Before installation the various timer option settings should be selected by means of the 10 way switch. This is accessed via a slot in the cover of the M551CE (see Fig 1a) or by removing the lid of the M551CE-B.

See Appendix for details of the available options and default settings.

When the settings have been finalised the slot in the cover of the M551CE should be covered with the strip of adhesive foil tape supplied.

3.1 Installation of M551CE in 10K and 24K Refrigerators

These notes assume a standard installation, i.e. the M507CE is wall mounted and none of the optional accessories are fitted. They also assume that the required plumbing kit and solenoid valve(s) have been fitted as per the relevant Taylor Wharton Manual.

- 3.1.1 Remove the bezel and blanking plate from the cut-out where the controller is to be installed. Retain the fixing screws. Raise the hinged lid of the refrigerator and remove the screws securing the lid surround/top moulding. Raise and prop the surround. Do not remove the hinged lid.
- 3.1.2 Route the 15 way Cable Assembly through the small access panel at the back of the refrigerator cabinet leaving sufficient slack for connection to the Controller. A slotted gland plate and split grommet are provided for this purpose (Fig 4). If there is a possibility that the system will be upgraded to an M505 at a future date it is recommended at this stage that the 25 way cable is also routed through the cabinet and gland plate. It is suggested that the loose connector is protected with a plastic bag or similar.
- 3.1.3 Fit and position the M508CE Sensor Assembly in the sensor tube. For information on sensor and thermocouple positioning refer to Appendix A.
- 3.1.4 Route the Lid switch cable and Solenoid cable(s) through the refrigerator body and connect to the Valve and Switch. If an extra external solenoid valve is to be fitted the cable for this should be taken through the spare hole in the gland plate using a cable gland or grommet to protect it.
- 3.1.5 Feed the cables through the opening in the lid surround. Refit the lid surround.
- 3.1.6 Plug the 15 way Cable Assembly and M508CE Sensor Assembly into the D Type connectors on the controller. Tighten the jackscrews on both connectors. The Solenoid and Lid switch cable plugs into the moulded 4 way connector. Make sure the latches engage.
- 3.1.7 Fit the fascia panel using the two larger screws retained from the blanking plate and refit the bezel using the four self tapping screws.

- 3.1.8 Mount the M507CE Connector Box and PSU on a wall or other vertical surface within 1.5m of the refrigerator and close to a 230V power outlet.
- 3.1.9 If required, Remote Alarm connections should be made to the terminal blocks in the M507CE. For details refer Appendix B.
- 3.1.10 Plug the 15 way Cable Assembly into the connector on the M507CE. Tighten the jackscrews to ensure a secure connection.

3.2 Installation of M551CE-B on 38K Refrigerators

- 3.2.1 Fit two off angle brackets to the case using M3.5 x 6 countersunk screws
There are two threaded bushes for this purpose.
Fasten the controller to the refrigerator body using the fixing points provided
Alternatively use the wall mount brackets to fix the controller to a suitable surface.
If wall/surface mounting set the DIL switches first (see Appendix B) as they are not accessible once mounted
- 3.2.2 Fit and position the sensor assembly in the sensor tube. For information on sensor and thermocouple positioning see appendix A.
- 3.3.4 Plug the 15 way Cable Assembly and M508CE Sensor Assembly into the D Type connectors on the controller. Tighten the jackscrews on both connectors.
- 3.3.5 Connect the Solenoid and lid switch cables.

The remainder of the installation is the same as for 10K and 24K refrigerators.
See sections 3.1.8 to 3.1.10.

4. Installing Firmware

The M550CE Control System is shipped with a Control Program (Firmware) preloaded at the factory and should be ready to run.

If it is necessary to update to a newer version this can be done using a PC and a standard 9 way Serial Cable.

The latest firmware version may be obtained by E-mail

Contact Enquiries@Mowden.co.uk for details of the current version and/or to obtain an update.

Installation instructions will be sent with all updates

5 Powering Up and Initial Filling.

Once installation is complete the Controller must be powered up to fill the refrigerator.

Plug the M507CE Connector Box and PSU into the mains supply and switch on.

Initially the LEVEL and SENSOR alarms will sound. This is normal. They may be muted and ignored. As the refrigerator fills both alarms should cease.

Depending on the supply pipework and pressure it may take some time to fill. If the supply alarm sounds during this time it should be muted and ignored.

Make sure that filling stops when the HIGH Level LED comes on.

If a LID switch is fitted check its operation by noting that the Fill Solenoid operates for 'Defogging' and 'Quick Chill' as the lid is opened and closed.

Check that the Lid Open alarm functions correctly.

Note: It is possible that on initial filling that the Fill timer will time out and switch off the Fill Solenoid. This is indicated by an alarm and slow flashing of the green Fill LED.

*If this happens, reset the fill timer and restart filling by pressing the LN₂ switch **twice**.*

6. Normal Operation

During normal operation of the controller the LED Display shows the liquid level relative to the sensors.

Filling takes place automatically to compensate for evaporative losses of LN₂.

The LN₂ switch may be used to top up the liquid level or for 'Defogging' the chamber.

When the Fill solenoid is active a green light below the LN₂ switch is illuminated.

When the lid is opened Liquid Nitrogen is allowed into the refrigerator for a preset time. This has the effect of dispersing the fog within the vessel. (Auto Defog). A lid switch must be fitted if this function is required.

When the lid is closed Liquid Nitrogen is allowed into the refrigerator for a preset time. This has the effect of rapidly cooling the vessel.
A lid switch must be fitted if this function is required. ('Quick Chill').

'Defogging' and 'Quick Chill' times are set by the 10 way switch (see Appendix B)

7. Alarms

If an alarm occurs one of the red LEDs on the right hand side of the panel will flash and the sounder will operate.

The following alarm conditions are possible:-

7.1 Lid Alarm

If the lid is left open for longer than a preset time the Lid Alarm will sound.

The Lid Alarm timer setting is selected by switch S3 (See Appendix B).

7.2 Level Alarm

If the liquid level falls below the 'Extra Low' Sensor or rises above the 'Extra High' Sensor a Level Alarm will be indicated.

From Firmware version 1.2 (Future release)

Occasionally during Filling, turbulence caused by Gas entering the Refrigerator can cause liquid to splash onto the 'Extra High' Sensor. This may give intermittent Level Alarms.

To avoid these nuisance alarms there will be a short delay (2-5 minutes) between the sensor detecting liquid and the level alarm being activated.

This will allow time for liquid to evaporate off from the Extra High Sensor. If the Extra High Sensor still detects Liquid at the end of the delay period a Level Alarm will be given as normal.

7.3 Sensor Alarm

The thermistor sensors are continuously monitored for a good condition.

If an open circuit ($>50K\Omega$) or short circuit ($<20\Omega$) is detected a Sensor alarm will be indicated.

Depending on which sensor is faulty a Level Alarm may also be indicated.

Note: At room temperature the resistance of the thermistors will fall to a low value and a sensor alarm will be indicated. This is normal and will occur if the freezer is dry or if the sensor assembly is removed for maintenance.

7.4 Supply Alarm

If the Controller calls for Liquid Nitrogen and the Solenoid valve is operated for longer than a preset time a Supply Alarm will be indicated.

The Fill timer setting is selected by switch S6 (See Appendix B).

The behaviour of the Controller when a Supply Alarm occurs depends upon the setting of switch S10.

7.4.1 Supply Alarm – S10 off

When a Supply Alarm occurs the Controller will leave the Solenoid valve switched on. If the Liquid Nitrogen level eventually reaches the High Sensor it will switch off the Solenoid Valve and cancel the alarm.

7.4.2 Supply Alarm – S10 on

When a Supply Alarm occurs the Solenoid valve will be switched off. This has the following advantages:-

Switching off the Solenoid Valve reduces the risk of it overheating if the LN2 supply fails.

It is a safeguard against possible masking of the sensors by a build-up of ice. This situation could cause overfilling of the refrigerator.

If the supply tank is empty but still contains Nitrogen gas under pressure the warm gas could boil off Liquid Nitrogen from the refrigerator, causing it to dry out. Switching off the Solenoid Valve prevents this.

To cancel the Alarm the LN2 switch must be pressed.

7.5 Remote Alarm

If any alarm persists for longer than a preset time the Remote Alarm relay is de-energised.

The Remote timer setting is selected by switch S4. This determines the time that will elapse between the occurrence of the first alarm and activation of the Remote Alarm.

In the case of an Extra High level alarm the Remote Alarm timer defaults to 5 minutes maximum irrespective of the position of S4.

The Remote Alarm condition is indicated by a steady 'Remote' LED (Not Flashing).

7.6 Alarm Muting

The audible alarm may be silenced by pressing the Mute switch.

The alarm LED(s) will change from flashing to a steady state and will remain on for as long as the alarm condition is present.

The exception to this is the Low Level Alarm. If a Low Level Alarm is muted the sounder will reactivate and the 'LEVEL' LED will revert to flashing after a 30 minute delay.

If new alarm conditions occur they will reactivate the audible alarm.

Clearing the alarm condition(s) will switch off the alarm lamp(s) and audible alarm.

Appendix A – Sensor Positioning

Sensor Positioning

The position of the sensors in the sensor tube determines the level of Liquid Nitrogen to be maintained.

Sensor position is determined by measuring the distance from the top of the sensor tube to the bottom of the refrigerator, then subtracting the desired liquid level.

The result is used to position the sensors at the correct level.

The longest lead with a single sensor pod is the low level sensor assembly. The upper bead in the pod is the Normal sensor and the lower bead is the Extra Low sensor.

The lead with two pods is the high level sensor assembly, consisting of the High and Extra High sensors.

The Normal and High sensors must be separately positioned to set the liquid levels at which the controller will start and terminate each fill cycle.

Determination of the liquid level to be maintained depends upon the application and the product being stored, and is beyond the scope of this manual.

For the M550CE Controller the thermocouple is not used and its position is not critical. If positioning the thermocouple with a view to possible future upgrading, refer to the M505 Instruction manual.

APPENDIX B - SWITCH SETTINGS

A 10 way switch is used to set the various timers etc. The function of each switch is detailed below. The factory default settings are given at the end of appendix B.

The switch is located on the rear of the fascia PCB and is accessed by removing the cover of the M551CE-B or via a slot in the cover of the M551CE.

Use a pen or a small screwdriver to alter the switches.

The options and switch settings are as follows:-

S1 – Sounder on/off

Used for factory test and servicing. This switch should be left in the ON position otherwise the sounder will not operate

S2 – Spare

S3 – Lid timer

If the lid of the refrigerator is left open for longer than a preset time a LID ALARM is activated. The time is selected by S3.

The options are 5 minutes (S3 off) or 15 minutes (S3 on).

S4 – Remote Timer

If any alarm is present for longer than a preset time the REMOTE ALARM is activated. The time is selected by S4

The options are 30 minutes (S4 off) or 60 minutes (S4 on).

In the case of a High Level alarm this setting is overridden and the Remote Alarm will activate within 5 minutes.

S5 – Lid Switch Function

For Normally open switches S5 must be set to OFF

For Normally Closed switches e.g. magnetic reed types S5 must be set to ON

APPENDIX B (cont).

S6 – Fill Timer

If the Fill Solenoid Valve remains operated for longer than a preset time the SUPPLY alarm is activated to indicate that Liquid Nitrogen is not entering the refrigerator.

The time is selected by S6

The options are 30 minutes (S6 off) or 60 minutes (S6 on).

S7, S8 Defog/Chill Timer

When the lid is opened the Fill Solenoid is activated for a preset time to Defog the refrigerator. When the lid is closed the Fill Solenoid is activated for a preset time to Chill the refrigerator. The times are selected by S7 and S8.

The options are:

5 seconds	(S7 off, S8 off)
15 seconds	(S7 on, S8 off)
30 seconds	(S7 off, S8 on)
60 seconds	(S7 on, S8 on)

S9 – Test

S9 is used for factory test purpose should be left in the off position.

S10 - Action of Solenoid Valve on Fill time-out

Switch S10 determines whether the Solenoid Valve is switched off or remains on when a Supply alarm occurs.

The options are:

Valve remains switched on	(S10 off)
Valve switches off	(S10 on)

Default (Factory) Switch settings

S1	on	Sounder enabled	S6	off	Fill Timer = 30 mins
S2	off	Spare	S7	off	Defog/Chill Timer = 5 seconds
S3	off	Lid timer = 5 minutes	S8	off	
S4	off	Remote timer = 30 mins.	S9	off	
S5	on	Lid switch Normally Closed <i>e.g. magnetic reed switch.</i>	S10	on	Solenoid Valve switches off on time-out of Fill timer

Appendix C – Remote Alarm Connection and Testing

A changeover relay contact is provided (Terminals 12, 13 and 14 of the M507CE) to facilitate reporting of an alarm condition at a point remote from the refrigerator.

In the 'good' condition the relay is energised. i.e. The Normally Open (NO) contact is closed and the Normally Closed (NC) contact is open.

If the remote alarm is activated or there is a power failure the relay is released and the contact changes over.

For safety reasons the relay should switch no more than 2 Amps at 50V AC/DC. (Resistive load).

A test facility is provided to enable testing of the Controller and the remote alarm connection. To perform the test:-

Press and hold the Mute switch. After 5 seconds approx the LID, LEVEL, SENSOR and supply LEDS should begin to flash and the alarm should sound.

If the switch is held for a further 8-10 seconds the Remote Alarm Relay should drop out and the REMOTE LED should light.

Release the Mute switch. The alarms should remain on for a few seconds, after which the Controller should revert to normal operation. The Remote Relay should re-energise.

Appendix D – Additional Technical Data

Input Power Requirements

230Vac +/-10%, 1 Amp Maximum

Replacement Fuses

Equipment Type	Fuse type and rating	Location
M550CE Level Controller	1.25A(T) HRC Ceramic	M507 PSU, Power inlet
	1A(T) Glass	M507 PSU, PCB
	3.15A(T) Glass	M507 PSU, PCB

Note that ceramic fuses of equivalent rating may be used in place of glass ones but glass fuses should not be used where a ceramic type is specified.

There are no fuses within the M551CE Controller

Note for UK equipment only:

Fused Mains Plugs fitted to UK Equipment are fitted with a 3 Amp fuse (1" x ¼)

Appendix E – Declaration of Conformity

DECLARATION OF CONFORMITY



Manufacturer: Mowden Controls Limited
Northallerton
U.K.
DL6 2YD

Declares that the following product:

Product Description: *Liquid Nitrogen Level Control System Type M550CE*

Type Nos: *M551CE or M551CE-B (Controller)*

M507CE (Connector Box and PSU)

M508CE (Sensor Assembly)


M558CE or M559CE (Cable Assemblies)

when installed in accordance with the instructions conforms to the following
Directive(s) and Norm(s)

89/336/EEC, and 93/42/EEC (Safety)

EN61326 (EMC – Equipment for measurement, control
and laboratory use)

EN60101-1-1 (Electrical Safety – Medical Devices)

Signed.....


N Maclean
Technical Director
Mowden Controls Limited