Product Specification for the Type M505CE
Liquid Nitrogen Level Controller

Revision Status

Rev	Date	Revision Details	By	Checked	App.
A	25/5/00	First Issued	GHL	**NM**	**NM**
1	4/12/01	Updated for V1.1 & V1.2 Firmware	GHL	**NM**	**NM**
2	11/9/03	Updated for M505CE-B, M507CE-I and V1.6 Firmware (F21/1535)	GHL	**NM**	**NM**
3	16/3/06	Temperature Readout tolerance added. Firmware now V2.0 (F21/1685)	GHL	*N M*	*N M*

1. Introduction

The M505CE is a Microprocessor based Liquid Nitrogen Level Controller designed to fit Taylor Wharton K Series Refrigerators.
The M505CE-B is a boxed version designed for the larger circular K series and for retro-fitting to Refrigerators of other manufacture.
The M505CE is a development of the M305CE controller with a number of improvements. These include: -

Fully enclosed Electronics for better environmental protection.

Wall mounted case for PSU and external connections. This gives a neater installation and easy connection and disconnection for maintenance.

All setting up can be done via the front panel (no internal switches).

Reduced size.

Password protected settings (no keys).

In system reprogramming for firmware updates (no EPROMs to change).

A full list of features is given in sections 3 and 4 of this specification.

Level monitoring and control is by the proven and reliable method of thermistor sensors.

2. Product Description

The M505CE Level Controller is made up from the following components: -

Controller	- Mowden Part No. M506CE
or (boxed version)	Mowden Part No. M506CE-B
Wall Mounted Connector Box and PSU	- Mowden Part No. M507CE
Sensor Assembly	- Mowden Part No. M508CE
Connecting Cables	- Mowden Part No. M509CE

Optionally these Controllers may be supplied with an 'Individual Gas Bypass feature.
For Individual Gas Bypass the M507CE in the above list becomes the M507CE-I

2.1 Controller (M506CE)

The Controller consists of a metal case which houses the microprocessor based electronic controls, and a separate fascia panel. The two are linked by a short cable. (See front cover picture).
The fascia panel incorporates a 2 line by 20-character LCD display, eight switches, two LEDs and a connector.

The LCD is fitted with a backlight to allow viewing in poor lighting conditions. The backlight and contrast are adjustable via the fascia switches. The display is a wide temperature range type and is compensated for temperature fluctuations typically caused by cold gas circulating in the refrigerator cabinet.

Four of the switches, in conjunction with the LCD allow the user to program the various settings for timers, alarms etc. The other switches allow the Fill Solenoid Valve to be turned on and off, the audible alarm to be muted, and display contrast to be adjusted. Six of the switches are numbered to allow 4 digit codes to be entered to control access.

One LED (Red) gives a visual indication of an alarm condition. The other LED (Green) is used to indicate when the Fill Solenoid Valve is energised.

The Front Panel connector allows the connection of a printer or PC.
When connected to a printer the data log for the controller can be printed out, either continuously as events or logging points occur, or on demand.
When connected to a PC the Data Log may be downloaded for storage/analysis.

A PC may also be connected to upload firmware to the controller allowing updates to be carried out in the field without changing Memory chips or removing the Controller.

2.2 Controller (M506CE)-B

The M506CE-B Combines the Fascia and Controller PCBs into a single case.
This is suitable for wall mounting or fastening to the refrigerator with brackets (provided).
The overall dimensions, excluding brackets are 252 (W) x 245 (L) x 53 (D).
See picture (over page).

M506CE-B

2.3 Connector Box and PSU (M507CE)

The Power Supply and terminal blocks for all external connections are housed in a wall mountable steel case (see below).
 Approximate size (not including mounting brackets) is 155 x 255 x 75mm.

The built in isolating transformer provides the power to drive one or two 24V ac Solenoid Valves and also provides a rectified and smoothed dc output to power the Controller electronics.
The mains connection is a wired in cable or (on later models) an IEC connector and cord set.

Screw terminal connectors are provided for:-

> Remote alarm contact
> External Fill (Simultaneous Fill) input/output
> Auxiliary relay contact
> Vent relay input (For connection to Gas Vent System – disables filling)

Connectors and mounting points are provided for the following optional boards:-

> **Isolated RS232/RS485 PCB** for communication to PC/Printer via permanent wiring. (M512CE).
> The RS485 feature enables the connection of several M505s to a PC for monitoring and data collection.
>
> **I/O PCB** with six Relay outputs and up to four opto-isolated inputs. (M517CE). The standard operating firmware uses the relays to indicate various alarm conditions but they could be used for other purposes.
>
> **Analogue Output termination PCB** (M510CE) for 0-10V and 4-20mA temperature output.
> (Analogue output PCB, M511CE is installed in the M506CE)

2.4 Connector Box and PSU with Gas Bypass Feature (M507CE-I)

The additional electronics for Gas Bypass are housed in the standard M507CE case. They consist of a Thermocouple amplifier plus Control Logic driving a Solenoid Valve for venting gas.
Because the additional circuitry occupies the space normally reserved for optional boards, the RS485 feature and terminations for an analogue output have been incorporated as standard in the M507CE-I.

The Relay output feature is not available for the M507CE-I

2.5 Sensor Assembly (M508CE)

The standard sensor assembly contains four thermistors and a thermocouple.

The thermistors 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 for the Solenoid Valve(s).
The distance between the Extra Low and Normal Thermistors is fixed at 2.5cm. The others may be adjusted relative to each other.

The sensor leads and thermocouple are terminated to a 15 way D connector which also houses electronics which compensate for the temperature of the thermocouple junction at the connector pin.

2.6 Connecting Cables (M509CE)

A cable is used to link the Controller to the Connector Box/PSU. The cable is fitted with 15 way D type connectors to allow easy disconnection and reconnection for maintenance purposes. The standard cable is 3.5 metres long. It is supplied with a modified access plate for routing the cable through the rear of the refrigerator cabinet.

Also supplied is a 25F- 25M Cable. This is used to connect the optional extra I/O boards if fitted.

3. Standard Features (Firmware version 2.0)

The M505CE Level Controller has the following features:

3.1   AUTOMATIC LEVEL CONTROL – When the level of Liquid Nitrogen falls
       below the Normal Thermistor filling is started by switching on a Fill Solenoid
       Valve. When the level of Liquid Nitrogen rises to the High Thermistor filling
       is stopped.
       A *Filling* LED indicates when the Fill Solenoid Valve is energised
       Filling may be started manually using a Fill Switch.

3.2   TEMPERATURE AND LEVEL DISPLAY – Temperature and Level are
       continuously displayed on the LCD display.
       Under alarm conditions the LCD can also be used to display messages and
       diagnostic information.
       Level is displayed as High/Low/Normal or cm.
       Temperature Resolution is 1ºC.
       Typical accuracy is +/- 1.5 ºC. approx. (Display reading of -194ºC - -197ºC
       in Liquid Nitrogen).
       Short term errors of up to 3ºC may occur during rapid temperature changes.

3.3   LID SWITCH – The Lid Switch monitors the position of the Lid (Open or
       Closed) and sounds an alarm after a user programmable pre-set time. The Lid
       Switch also controls the Defogging and Quick Chill Features (see below).

3.4   AUTOMATIC DEFOGGING – When the lid is opened the Fill Solenoid
       Valve is opened for a user programmable pre-set time to clear the fog caused
       by condensing atmospheric moisture.

3.5   QUICK CHILL (QUICK TEMPERATURE RECOVERY) – When the lid is
       closed the Fill Solenoid Valve is opened for a user programmable pre-set time
       to quickly lower the temperature inside the refrigerator.

3.6   TEMPERATURE CONTROL – If this option is enabled, the temperature is
       maintained below a user programmable limit. This is done by periodically
       opening the Fill Solenoid Valve to allow gas in the pipework to bubble
       through the Liquid Nitrogen in the refrigerator. The disturbance caused by this
       bubbling lowers the vapour temperature and reduces the temperature gradient.
       The On time and minimum interval between valve opening are both user
       programmable.

3.7   SIMULTANEOUS FILLING – An External Fill Input/Output allows the Fill
       cycles of two or more Refrigerators (20 max) to be synchronised. This
       requires a two wire connection between the Controllers.

3.8   DELAYED FILLING - The start of filling can be delayed by a user
       programmable pre-set time following the receipt of an External Fill Signal.
       This allows the refrigerators to be filled in sequence if required by selecting
       different delay times.

3.9   TIMED FILLING – This allows a fill to be programmed for a fixed time, once per 24 hours.

3.10   EXTRA SOLENOID VALVE OUTPUT – For safety reasons or to meet local regulations it may be necessary to provide a second Fill Solenoid Valve. An extra valve output is provided for this purpose.

3.11   FASCIA PANEL RS232 CONNECTOR – This gives a convenient connection point for a printer or PC. (The connector is mounted on the end of case on the M505CE-B).

3.12   EASY UPDATE OF FIRMWARE – The Control program (Firmware) for the M505 is stored in a programmable non volatile memory. If upgrading is necessary or extra features are added the new firmware can be loaded by means of a PC plugged into the fascia panel RS232 connector. No EPROM changes are necessary and updates can be e-mailed if required.

3.13   PASSWORD CONTROLLED ACCESS – Access may be controlled by giving authorised personnel a 4 digit code which must be entered before opening the lid. Unauthorised entry generates an alarm and is recorded in the data log.
       Up to 8 operators may be given individual codes which are recorded in the data log when the lid is opened.
       Entering a Supervisors code allows Controller settings to be changed and and the operators codes to be reprogrammed.
       This feature may be disabled if not required.

3.14   DATA LOGGING – Up to 20.000 temperature measurements and events may be stored in the memory of the M505CE. The logging interval is adjustable between 5 minutes and 24 hours.
       In addition to the fixed logging points all alarms and various events are recorded.

3.15   DATA DOWNLOAD SOFTWARE – '*CryoData*' Windows software is available to download data and generate reports.

3.16   PRINTER OUTPUT. . In Printer mode, events, alarms and Temperature/Level measurements are output to the printer as they occur.
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3.17   REMOTE ALARM – A volt free contact indicates when an alarm has occurred. The opening of the contact may be delayed. This delay is adjustable from 0 to 90 minutes. The exception is the High Level Alarm, which defaults to 5 minutes maximum.

3.18   LANGUAGE OPTIONS - English or German or French may be selected using the set-up menu.
       Other languages can be considered – Subject to demand and assistance with translation.

3.19   DELAYED HIGH LEVEL ALARM – Occasionally during Filling or removal
        and replacement of samples the Extra High sensor may be splashed with
        Liquid Nitrogen, causing a High Level Alarm. To prevent nuisance tripping of
        this alarm its activation may be delayed for up to 10 minutes (user
        programmable).

3.20   PRINT ON DEMAND – The data log may be printed out on demand. Options
        in the Print menu allow different subsets of the data to be printed in a suitable
        Format.

3.21   'Cryo-Print' SOFTWARE – In addition to the 'CRYO-DATA' software a
        Windows program to download and generate simple reports is available free
        of charge.

3.22   PROGRAMMABLE LID SWITCH FUNCTION – To allow the use of
        Normally Open or Normally Closed Lid Switches

3.23   Fast logging during a temperature alarm condition (So that highest
         temperature can be seen).

3.24   Reporting source of Fill Commands (Manual, Automatic, External etc).

3.25   'History Log' to record changes to settings.

Note that this list of features is not totally comprehensive. Improvements and
additions are made on an ongoing basis.