ems75sz (Sub-Zero)

Firmware: U09 n05
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www.elstatgroup.com

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1 EMS controller reference guide

EMS (energy management system) controllers from Elstat are used in a variety of drinks coolers, optimising energy savings, without compromising on drinks serving temperature.
A range of controllers are available to suit applications such as:

- Single door coolers
- Double door coolers
- Open front coolers
- Vending machines
- Sub-zero beer coolers

1.1 About this reference guide

The purpose of this guide is to explain in detail all information regarding Elstat controllers including the user interface, parameters, accessories and troubleshooting.
Complimentary information is also available from Elstat such as accessory lists, accessory data sheets and single sheet user guides.

2 Water ingress – advisory information for FMEA analysis

Elstat products have been designed to minimise any risks associated with water ingress and all controllers are IPX5 certified.
The OEM or installer is responsible to ensure that local/country laws and regulatory requirements are met.

3 What is an ems75sz (sub-zero)?

The ems75sz is designed for sub-zero beer coolers. The ems75sz consists of power supply module and a control display module connected by an interface cable. Example shown below.

3.1 Control Display Module (CDM)

The control display module is powered by a 12VDC supply from the power supply module. The control display module provides the following functionality.

Feature	Description
User interface	3-digit, 7-segment display that displays the product temperature and other information such as defrost and alarm conditions. Enables end-users to cancel alarms and service technicians to run test routines, view parameter settings, and so on.
Self-learning	Integrated motion sensor detects activity when someone moves in front of the cooler. An optional door switch can detect cooler activity when someone opens the cooler doors.
Serving temperature	Appliance sensor measures the air temperature of the refrigeration compartment. Self-learning determines when the product should be at the ready mode temperature (the optional serving temperature) or the saving mode temperature.
Refrigeration alarms	Refrigeration system alarms can alert to possible cooling problems and an optional condenser sensor can alert to problems such as blocked condensers.
Boosted defrost	Timed-based or temperature-based defrost can be boosted by a defrost heater or a hot gas defrost. An evaporator sensor is required for temperature-based defrost.

The control display module is available with either an integrated or a remote motion sensor. Additionally Elstat can supply and rectangular or curved CDM shape. All CDM variants are made from food grade plastics.

The integrated motion sensor varient should always be installed where it can 'see' activity and it is recommended that the CDM is installed externally on the cooler. An example of a CDM with integrated motion sensor:

The remote motion sensor varient of the CDM can be installed internally on the cooler. The remote motion sensor must be installed where it can 'see' activity. An example of a CDM with remote motion sensor:

See "How to mount a remote motion sensor" on page 55

3.2 Power Supply Module (PSM)

The power supply module contains the power supply for the control unit and the relays to switch the following cooler components:

Feature	Description
Compressor relay	Switches the compressor to manage the temperature of the refrigeration compartment.
Evaporator fan relay	Switches the evaporator fan to minimize heat transfer to products when the compressor is not running.
Auxiliary relay	Switches a defrost heater to a solenoid valve for hot gas defrosts.
Lights relay	Switches the cooler lights.

3.3 ems75sz user interface

The user interface of the ems75sz is as follows:

3.3.1 Push buttons:

Button	Name	Function
	Defrost	Starts a defrost cycle.
	Set	Selects menu options and scrolls through the parameters.
	Up	Increases the parameter values.
	Down	Scrolls down menus, decreases parameter values, and cancels alarms.

3.3.2 LED indicators:

	Indicator	Function	Colour
	Compressor	**On** when the compressor is running	Green
	Evaporator fan	**On** when evaporator fan is running.	Red
	Saving temperature disable	**On** if the saving mode temperature is disabled. The controller maintains *ready mode* temperature at all times.	Red
	Motion	**On** when motion is detected.	Red

3.4 ems75sz relay ratings

The table below details the relay ratings of the ems75sz:

Relay	Maximum IEC rating @100-240VAC	Maximum UL rating @ 120VAC
Compressor	10(10)A, p.f. 0.6	not applicable
Lights	4(4)A, p.f. 0.6	
Evaporator fan	6(6)A, p.f. 0.6	
Auxiliary	6(6)A, p.f. 0.6	

Note:

- The auxiliary relay is normally used to switch a defrost heater, or a solenoid valve, for hot gas defrosts.

3.5 Temperature input ranges

The table below shows the temperature input ranges of the EMS sub zero controllers for each sensor type:

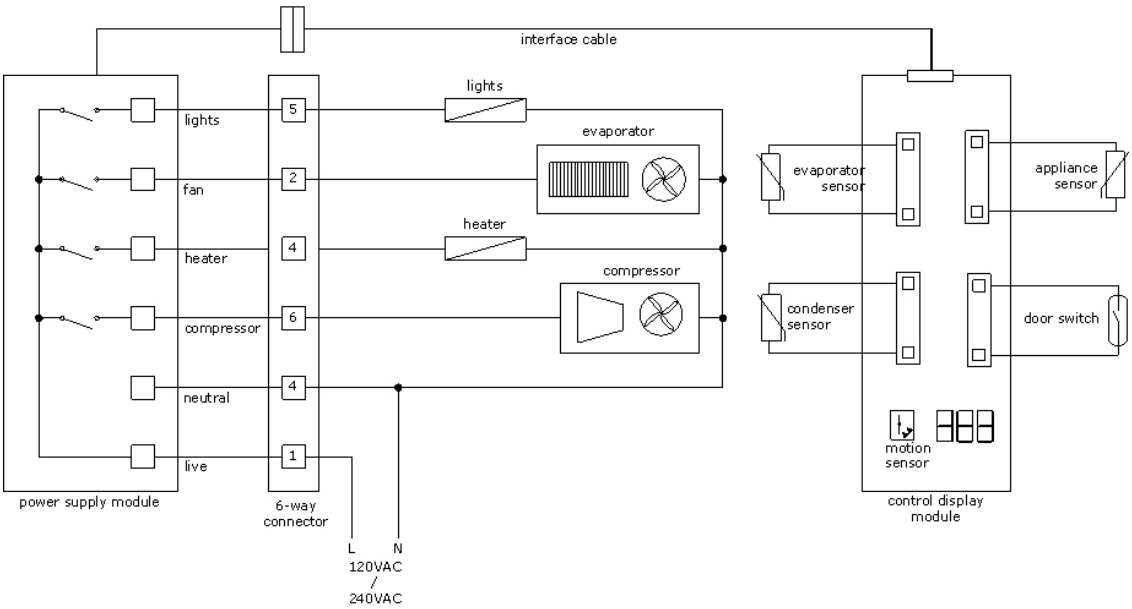
Sensor	Input range (°C)	Input range (°F)
Appliance sensor	-10°C to 23.3°C +/- 0.5°C	14°F to 74°F +/- 1°F
Condenser sensor	50°C to 125°C +/- 5.0°C	122°F to 257°F +/- 10°F
Evaporator sensor	-30°C to 15°C +/- 0.5°C	-22°F to 59°F +/- 1°F

Note:

- The NTC thermistor from Elstat is rated at -35°C to 125°C (-31°F to 257°F).

3.6 ems75sz wiring diagram

Wiring diagram for the ems75sz:



3.7 Power supply module

The power supply module (**PSM**), as shown below, contains the power supply and relays for controlling the compressor, lights, evaporator fan, and an auxiliary relay that can be used for boosted defrosts. The power supply module is fitted with the following cables:

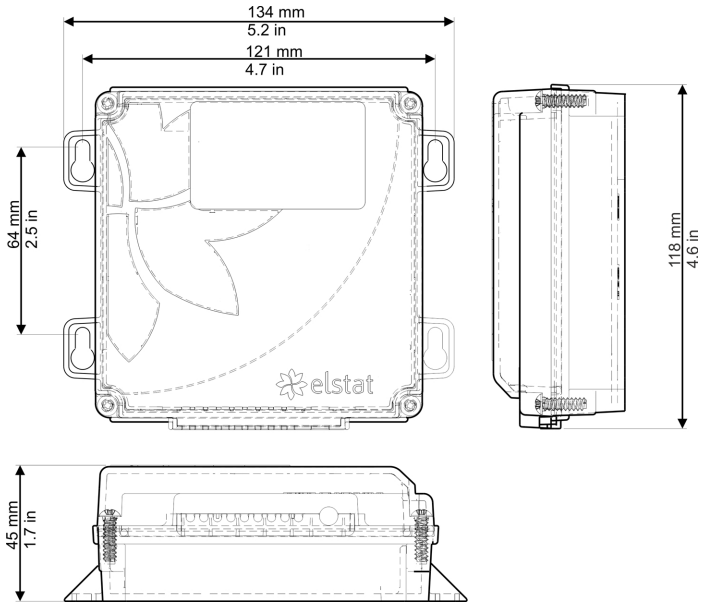
- High voltage cable terminated with 6-way connector for connecting to the compressor, lights, evaporator fan, and defrost heaters or valves.
- Interface cable that connects to interface cable of the control display module.

The power supply module must be mounted vertically with the cables exiting vertically downwards. The power supply module has an (Ingress Protection) IP rating of IPX5, which means the power supply module is protected against water jets.

Caution:

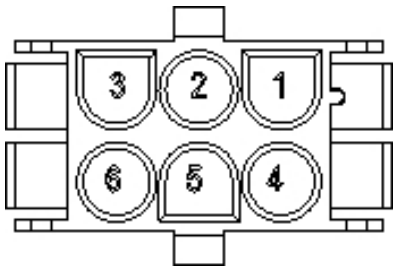
- The power supply module must be located in a non-refrigerated area of the cooler. The power supply module must not be:
  - Placed in the hot exhaust flow of the condenser
  - Exposed to temperatures greater than 50°C (122°F) or lower than 0°C (32°F).

The dimensions of the power supply module and the fixing holes are shown in the following diagram:



3.8 Power supply module – electrical connections

The electrical connections of the high voltage connector are as follows:

Pin	Description	Connector
1	Live	
2	Evaporator fan	
3	Defrost heater	
4	Neutral	
5	Lights	
6	Compressor	

3.9 How to mount the power supply module

The power supply module must be fixed using screws with the following characteristics:

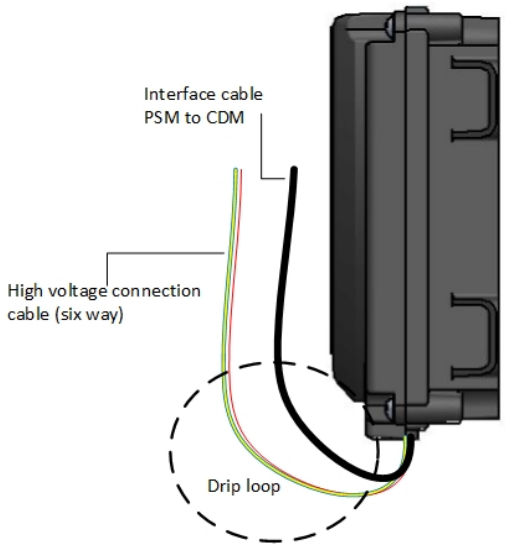
- Head: maximum diameter 7.8mm (0.31in) and minimum diameter 6.2mm (0.24in)
- Thread: maximum diameter 4.8mm (0.19in).

The screws must be tightened to a maximum torque of 0.5Nm (0.37lb$_f$ft).

Caution:

- Using rivets to mount the power supply module invalidates the warranty.

Cable routing to the EMS controller is critical as water can trace or follow the cable downwards. Therefore, immediately prior to the connection to the power supply module, a drip-loop must be formed in all wiring.

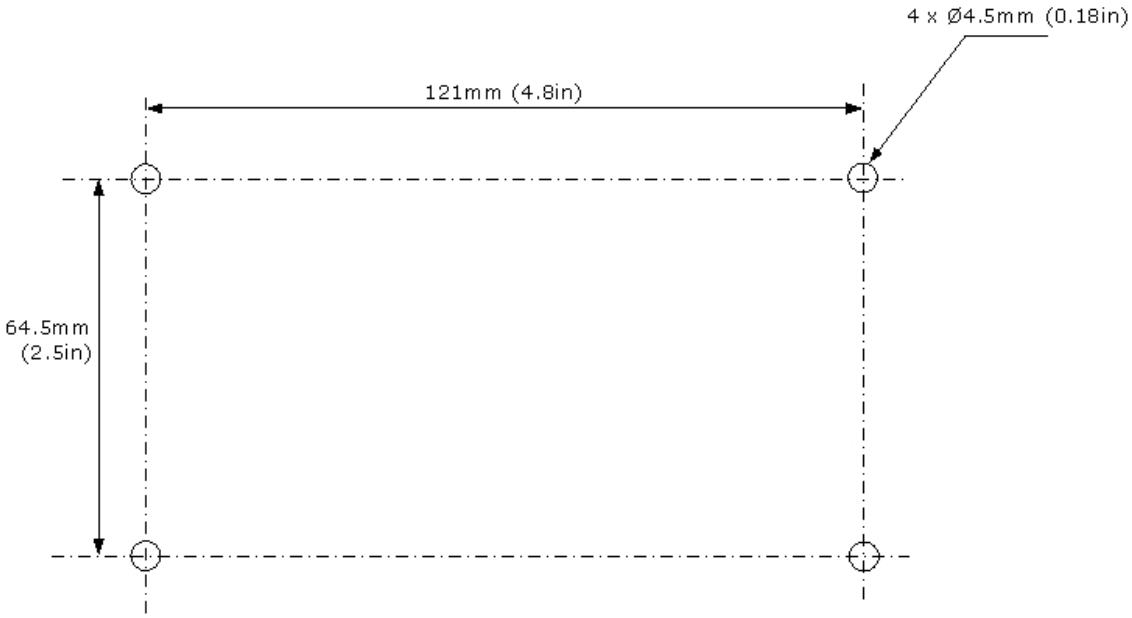


Attention:

- Cable routing looms must not be secured to hot pipes or vibrating components. Secure cable routing looms with clips where ever possible.

3.9.1 Power supply module dimensions

The dimensions of the fixing holes are shown below.



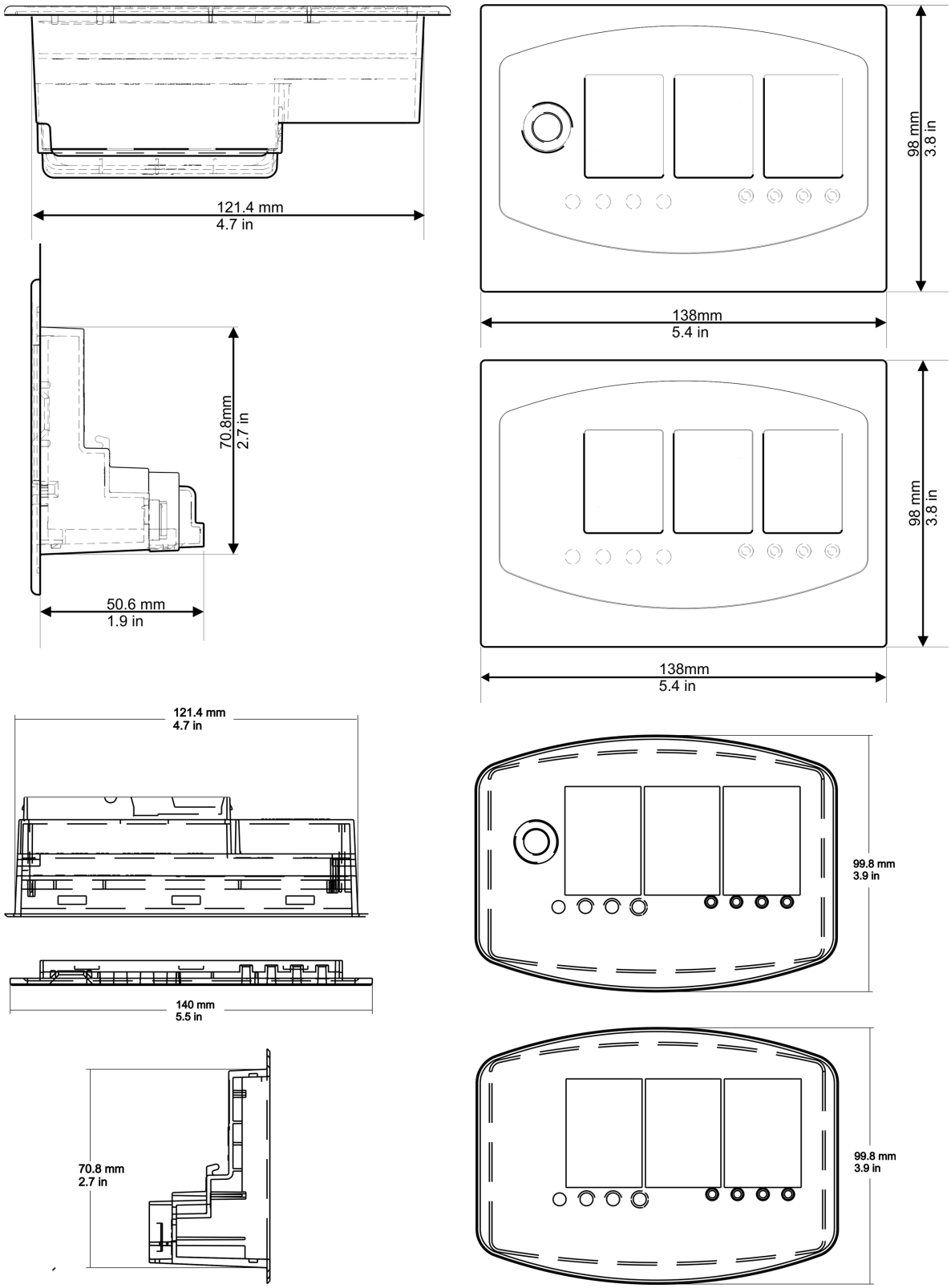
The following is an example of the Power Supply Module mounted, but not connected:

3.10 Control display module

The control display module, as shown in the following diagram, consists of the user interface, with a large 3-digit 7-segment LED display, and the temperature sensors and door switch inputs.

- The external variant of the control display module is designed to be mounted on the cooler with the display visible to outlet customers and includes an integrated motion sensor. For example, mount in the header panel of the cooler.
- The internal variant is designed to be mounted within the cooler cabinet and does not have an integrated motion sensor. For example, mount into an internal header panel.

The ems75sz controller display module is available in two styles as illustrated in the following dimensional diagrams:



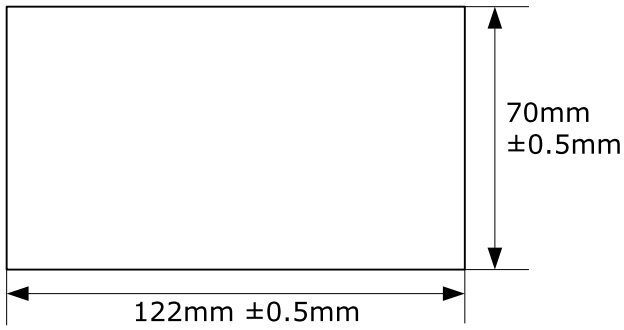
- ems75sz (controller display modules) CDMs are made from food grade materials and safe for internal installation.
- The control display module has an IP rating of IPX5 - protection against water jets.

Caution:

- The control display module must not be exposed to temperatures greater than 50°C (122°F) or lower than 0°C (32°F).

3.11 How to mount the control display module

The control display module is designed for panel mounting and is secured using the fitted clips.
The aperture dimensions are shown below.



To mount the control display module, remove the retaining clip and insert the control display module into the aperture, as shown below.

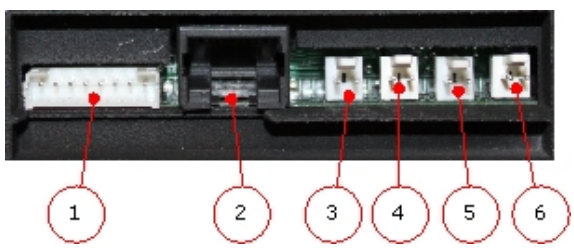
Then, place the retaining clip into position as shown below.

Finally, secure the retaining clip as shown below and ensure that the control display module is held firmly in position.

The image below shows the control display module fitted correctly into a header panel as seen from the front of the cooler.

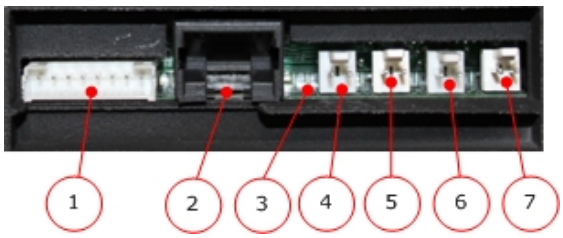
3.12 External control display module – electrical connections

The electrical connections of the external variant control display module as follows:

	Label	Description	Connectors
1		Interface cable - to power supply module	
2		Parameter programming port	
3	aux	Evaporator sensor	
4	door	Door switch	
5	ht	Condenser sensor	
6	app	Appliance sensor	

3.13 Internal control display module – electrical connections

The electrical connections of the external variant control display module as follows:

	Label	Description	Connectors
1		Interface cable - to power supply module	
2		Parameter programming port	
3		Remote motion sensor	
4	aux	Evaporator sensor	
5	door	Door switch	
6	ht	Condenser sensor	
7	app	Appliance sensor	

Note:

- The remote motion sensor has a micro connector.

3.14 Environmental ratings

The table below details the general characteristics of the ems75sz:

Characteristic	Power supply module	Control display module
IP rating	IPX5	IPX4
Maximum operating temperature	55°C (131°F)	55°C (131°F)
Minimum operating temperature	0°C (32°F)	0°C (32°F)
Housing material	Black polycarbonate	Black polycarbonate

Before beginning installation, remove all protective film from between the seals of the CDM (control display module). The seals are malleable, to ensure a water resistant seal around cables and prevent water ingress.

4 User guide

The user guide describes the power-up sequence and how to view parameters and statistics.
The user guide also describes how to:

- Perform a half-reset - to clear the self learning matrix only
- Run the test routine - for all relays and inputs

4.1 Power-up sequence

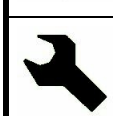
At the power up, the EMS controller displays the power-up sequence as follows:

1		**8.8.8.** to confirm that all segments of the display are functioning correctly
2		Platform type and firmware version. (example)
3		Checksum of the parameter set. (example)

The display then shows the appropriate display code. For example, the temperature or the word **USE**.

4.2 Function buttons - ems sub zero

The EMS controller buttons access the EMS controller menus to view parameter values, reset the EMS controller, and to run test routines. The EMS controller buttons perform the following functions:

Button	Name	Function - end user	Function - service engineer
	Defrost	Starts a defrost cycle.	Use as part of the controller password.
	Set		Use as part of the controller password. Selects menu options. Scrolls through the parameters.
	Up		Use as part of the controller password. Increases the parameter values.
	Down	Cancels alarms.	Use as part of the controller password. Scrolls down menus. Decreases parameter values

4.3 Indicators

The EMS controller LED indicators are as follows:

	Indicator	Function	Colour
	Compressor	**On** when the compressor is running.	Green
	Fan	**On** when the evaporator fan is running.	Green
	Saving temperature disable	**On** if the saving temperature is disabled. The EMS controller maintains the *ready mode* temperature at all times.	Red
	Motion	**On** when motion sensor detects motion. If the motion sensor is flashing continuously, the motion sensor may be faulty.	Red

4.4 Display codes

The table below details the display codes for EMS controllers.

Display	State	Description
	Ready mode	EMS controllers display the appliance sensor (cooler cabinet) temperature, or the word **USE** Also, the cooler lights are switched **on**. See "How to check that EMS controllers are working correctly" on page 57
	Saving mode	EMS controllers keep products at the saving mode temperature unless the saving temperature is disabled. The saving temperature LED shows whether the saving mode temperature is disabled. The cooler lights are **off** unless the light delay (**Ld**) parameter keeps the lights on for a short period after the EMS controller switches to the *saving mode*. The marketing mode (**Ar**) keeps the lights on for the duration of the *saving mode*.
	Defrost mode	EMS controllers switch off the compressor and switch on the fan, if applicable. The compressor LED should be **off** and the evaporator fan LED should be **on**.
	Door open	EMS controllers display **d0** to show that the cooler door is open.
	Alarm: Door open	EMS controllers sound an alarm buzzer if cooler door remain open for alarm delay (**Ad**) duration. If the cooler door is still open after the time defined by the buzzer

Display	State	Description
		duration (**b1**) parameter, the EMS controller switches **off** the compressor.
	**Alarm**: Freeze-up protection	EMS controllers disable the compressor to prevent over cooling and run the evaporator fan, if applicable, according to the evaporator fan cycle. Problems may occur if the ambient temperature falls below 0°C (32°F) or if the appliance sensor fails. See "How to troubleshoot problems with freeze-up protection (888)" on page 60
	**Alarm**: Refrigeration system failure	See "How to troubleshoot refrigeration system failure (rSF) alarms" on page 62
	**Alarm**: Appliance sensor failure	See "How to troubleshoot temperature sensor alarms" on page 63
	**Alarm**: Condenser sensor failure	
	**Alarm**: Evaporator sensor failure	

4.5 What are the menus?

The table below describes the EMS controller menus.
Use the **Down** button to scroll through the menu and the **Set** button to select.

Menu	Display	Description
Parameter list		Displays the parameters and the parameter values.
Test routine		Enters the test routine that tests the relays, temperature sensors, door switch, and motion sensor.
Faults		Displays the last three faults (alarms). See "How to view the last three alarms (FLt)" on page 27
Half reset		Clears the self-learning matrix.

Menu	Display	Description
Full reset		Elstat use only.
Data dump		Elstat use only.

Note:

- The full reset is accessed with a password supplied by Elstat. It is **not** recommended for the end user to have access to this option.
- The data dump is for Elstat use only for testing and development purposes.

4.6 How to access the menu EMS controllers

The password is a unique sequence of button operations.

The password is supplied to OEMs, installers, and service engineers separately.

Step	Action		Display
1	Press and hold the **Set** button		
2	The EMS display shows		
3	Press the **Set** button four times (x 4)		
4	Press the **Up** button once (x 1)		
5	Press the **Down** button twice (x 2)		
6	Press the **Defrost** button twice (x 2)		
7	The EMS display shows:		
	You have successfully entered the EMS menu.		

4.7 How to view the ems75sz parameter settings (PS)

View the parameter settings to check the values of the parameters as follows:

1. Press and hold the **Set** button until **PAS** is displayed.

2. Enter the button sequence of the password.
3. Ensure that **PS** is displayed.

4. Press and hold the **Set** button to view the parameter name and value alternately.
5. Keep the **Set** button pressed to scroll through the parameter settings.

No.	Parameter	Please see:	Notes:
1	CF	See "Celsius or Fahrenheit (CF)" on page 67	
2	SPC SPF	See "Set point (SPC or SPF)" on page 67	
3	dIF	See "Differential (dIF)" on page 67	
4	CA1	See "Calibration 1 (CA1)" on page 68	
5	CA2	See "Calibration 2 (CA2)" on page 68	
6	SSP	See "Saving set point (SSP)" on page 68	
7	Sd	See "Saving differential (Sd)" on page 69	
8	dtt	See "Freeze-up protection (dtt)" on page 69	
9	FSP	See "Fan set point (FSP)" on page 69	
10	Ht	See "Condenser high temperature (Ht)" on page 70	
11	ddt	See "Defrost activation temperature (ddt)" on page 70	
12	dtd	See "Defrost termination temperature (dtd)" on page 71	
13	rt	See "Compressor rest time (rt)" on page 71	
14	dS	See "Delay to saving (dS)" on page 72	
15	Ld	See "Learning period (LP)" on page 77	
16	Sr	See "Saving restart period (Sr)" on page 72	
17	Ct	See "Refrigeration system failure (Ct)" on page 72	

No.	Parameter	Please see:	Notes:
18		See "Defrost interval (dE)" on page 73	
19		See "Defrost duration (dd)" on page 73	
20		See "Defrost method (dF)" on page 73	
21		See "Defrost termination method (dtF)" on page 74	
22		See "Fan cycle on (FCO)" on page 74	
23		See "Fan cycle off (FCF)" on page 74	
24		See "Display stability (d2)" on page 75	
25		See "Buzzer enable (b0)" on page 75	
26		See "Buzzer duration (b1)" on page 76	
27		See "Alarm delay (Ad)" on page 76	
28		See "Activity frequency (AF)" on page 76	
29		See "Motion sensor enable (Sn)" on page 77	
30		See "Saving temperature disable (PEr)" on page 77	
31		See "Learning period (LP)" on page 77	
32		See "Display (dIS)" on page 78	
33		See "Marketing mode (Ar)" on page 78	
34		See "Defrost heater (dHr)" on page 78	Sub-zero exclusive parameter

4.8 How to run the test routine (tst)

The test routine tests the following:

- All load relays
- Analogue inputs (temperature sensors and door switch)
- Motion sensor.

Should a problem be suspected with the ems, it is recommended that the test routine is carried out before disconnecting or replacing the EMS controller. The test routine can detect any loose or disconnected cables and check that the EMS is connected properly to the lights, fan and compressor.

Step	Action		Display
1	Press and hold the **Set** button		
2	The EMS display shows:		
3	Enter the appropriate password to access the menu.		
4	The EMS display shows:		
5	Press the **Down** button and scroll to the test (tSt) menu		
6	The EMS display shows:		
7	Press the **Set** button to test the seven segment display		
8	The EMS display shows:		
9	Press the **Set** button to start the relay test		
10	The EMS display shows:		
11	Press the **Down** button to start the relay test:		

4.8.1 The relay test

Button	Display	Test	Check
		Compressor relay	Compressor is running and compressor LED is on
		Light relay	Cooler lights are on

Button	Display	Test	Check
▼	FAn	Evaporator fan relay	Evaporator fan is running
✱	OFF	Relay off	Relays are off

Note: To switch off the relays that are on, press the **Defrost** button.

Step	Action		Display
12	Press the **Set** and **Defrost** button together	🔧 ✱	
13	The EMS display shows:		rL2
14	Press the **Down** button to begin the Heater relay test:	▼	

4.8.2 The heater relay test

Button	Display	Test	Check
▲	Htr	Heater relay	Heating element or solenoid valve switches on
✱	OFF	Relay off	Relays are off

Note: To switch off the relays that are on, press the **defrost** button.

Step	Action		Display
15	Press the **Set** button and the **Defrost** button together	🔧 ✱	

Step	Action		Display
16	The EMS display shows:		
17	Press the **Up** button to begin the analogue input test:		

4.8.3 The analogue input test

Button	Display	Test	Check
		Appliance sensor temperature	Displayed temperature is correct
		Door switch	Door is open (**dO**) or closed (**CLO**)
		Condenser sensor temperature	Displayed temperature is correct. (Between 51.0 and 125°C)
		Evaporator sensor temperature	

4.8.4 The motion sensor test

Step	Action		Display
18	Press the **Set** button and the **Defrost** button together		
19	The EMS display shows:		

Step	Action		Display
20	Press the **Defrost** button		
21	Place your hand about 300mm from the motion sensor		
22	Move your hand from left to right.		
23	Check for the following:		
	The display count increments for each detected movement.		
	The motion LED flashes for each detected movement.		
24	Press the **Menu** button and the **Defrost** button together		
The test routine ends			

4.9 How to view the last three alarms (FLt)

It is possible to view the last alarms and understand problems that have occurred with the EMS controller.

Step	Action		Display
1	Press and hold the **Set**button		
2	The EMS display shows:		
3	Enter the appropriate password to access the menu		
4	The EMS display shows:		
5	Press the **Down** button and scroll to **FLt**		
6	The EMS display shows:		
7	Press the **Set**button to select		

Step	Action		Display
	The EMS displays the last three faults		

The last three faults, or alarms, to occur are displayed for example:	
	A condenser high temperature alarm has occurred
	An appliance sensor alarm has occurred
	A door open alarm has occurred

Please note:

- The alarms may have been cleared, or cancelled, by the retail outlet operators.

4.10 Passwords

The password to enter the EMS controller menu and perform a half reset is as follows:

Step	Action		Display
1	Press and hold the **Set** button		
2	The EMS display shows		
3	Press the **Set** button four times (x 4)		
4	Press the **Up** button once (x 1)		

Step	Action		Display
5	Press the **Down** button twice (x 2)		
6	Press the **Defrost** button twice (x 2)		
7	The EMS display shows:		
	You have successfully entered the EMS menu.		

4.11 How to perform a half reset (Hr)

Perform a half reset to clear the self-learning matrix if the EMS controller has been unable to detect activity correctly, for example, the view of the motion sensor was blocked, or if the cooler has been moved to a new location.

Step	Action		Display
1	Press and hold the **Set** button.		
2	The EMS displays shows:		
3	Enter the button sequence of the *menu entry* password:		
4	Press the **Set** button four times (x 4)		
5	Press the **Up** button once (x 1)		

Step	Action		Display
6	Press the **Down** button twice (x 2)		
7	Press the **Defrost** button twice (x 2)		
8	The EMS display shows:		
9	Press the **Down** button to scroll to the half re-set menu:		
10	Re-enter the *menu entry* password:		
11	Press the **Set** button four times (x 4)		
12	Press the **Up** button once (x 1)		
13	Press the **Down** button twice (x 2)		
14	Press the **Defrost** button twice (x 2)		
	The controller should reset and begin the power-up sequence.		

4.12 Statistics

Depending on the model, EMS controllers start gathering a variety of statistics when first powered up.
Statistics provide information on the following, dependent on firmware:

- **Activity**: Average number of motion counts and door openings.
- **Compressor**: Average number of compressor cycles and total compressor runtime.
- **Operation**: Settings of the activity frequency (**AF**) parameter and the saving temperature disable (**PEr**) parameter.
- **Temperature**: Lowest, highest, and average temperature measured on the appliance sensor.

Note:

- A full reset clears all the gathered statistics.
- Please see the following list which describes the statics available to view on your controller model.

4.13 How to view statistics

To view the statistics, press the **Up** and **Down** buttons simultaneously.

Statistics include door opening, average temperatures and activity counts.
The EMS controller then scrolls through the statistics pausing for 20 seconds at each statistic before returning to normal operation.
The 3-digit display can show values from 000 to 999.
For values of 1000 and above, the display shows the value as a rounded decimal number. For example, 1.1 represents 1100, 1.2 represents 1200, and so on.

Display	Statistic	Description
	Activity frequency	Value of the activity frequency **AF** parameter. Possible values are: 0, 1, 2 or 3. (0 = low, 2= high and 3 = automatic)
	Average temperature	Average temperature measured by the appliance sensor during the last 24 hours.
	Compressor cycles	Average number of compressor cycles per day (24 hour period) during the past 7 days (7 x 24 hour periods). Note that the average is a moving average.
	Compressor runtime	Total number of hours that the compressor has run since the EMS controller was first powered up or since the last full reset.
	Door openings	Average number of door openings per day (24 hour period) during the past 7 days (7 x 24 hour periods). Note that the average is moving average.
	Highest temperature	Highest temperature measured by the appliance sensor during the past 24 hours.
	Lowest temperature	Lowest temperature measured by the appliance sensor during the last 24 hours.
	Motion counts	Average number of motion counts per day (24 hour period) during the past 7 days (7 x 24 hour periods). Note that the average is moving average.
	Saving temperature disable	Value of the standby temperature disable **PEr** parameter. Possible values are: OFF or ON. OFF = Standby temperature disable is switched off. ON = Stanby temperature disable is switched on.

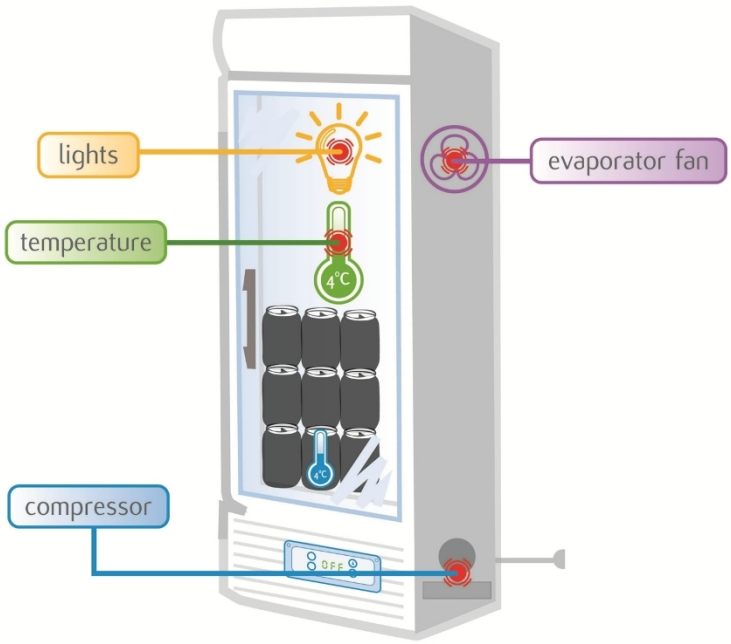
5 EMS controllers functionality

EMS controllers have the capability to manage the following:

- **Temperature**: EMS controllers measure the air temperature of the refrigeration compartment to control the temperature of the products. EMS controllers ensure that products are at the optimal serving temperature.
- **Condenser**: EMS controllers manage the temperature on the condenser to prevent high temperature.
  This is optional for EMS controllers, and dependent on controller specification.
- **Compressor**: EMS controllers switch the compressor to manage the performance of the compressor.
- **Evaporator fan**: EMS controllers switch the evaporator fan to manage the temperature of the refrigeration compartment.
  This is optional for EMS controllers, and dependent on controller specification.
- **Lights**: EMS controllers manage the cooler lights for marketing and energy saving purposes.

Note:

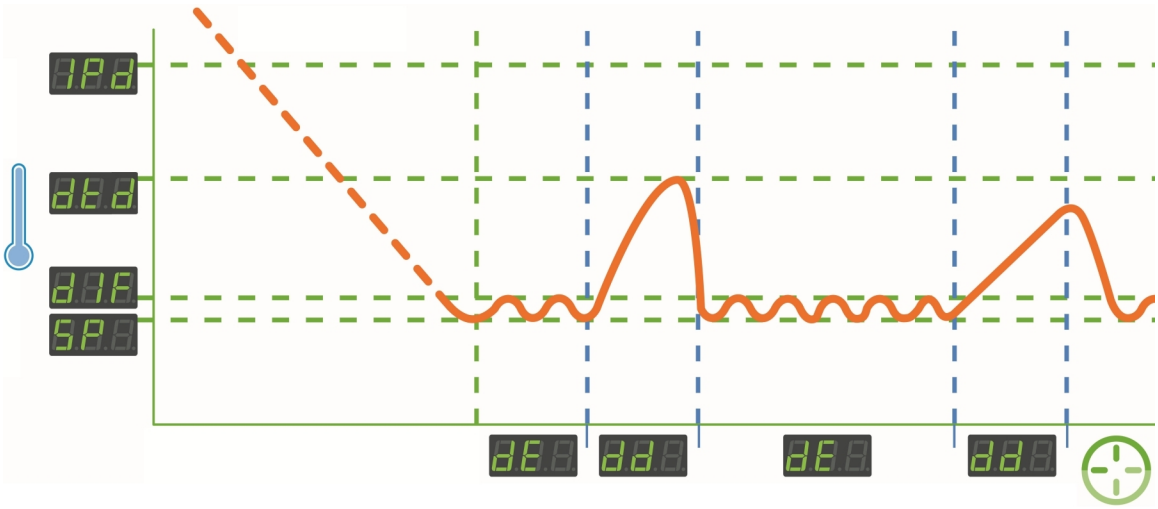
- Dependent on controller and sensor configuration.



5.1 Defrost - Glass Door Cooler (GDC firmware)

Defrost cycles minimizes the risk of the evaporator icing up.
The defrost cycle occurs periodically as defined by the defrost interval (**dE**).
The defrost interval starts when the EMS controller is powered up or at the end of an uninterrupted pull down.

Some EMS controllers also enable defrost cycles to be started manually.
The defrost cycle ends after the time defined by the defrost duration (**dd**) or on reaching the defrost termination temperature (**dtd**), as shown:



Note: Manual defrosts also end after the defrost duration (**dd**) or on reaching the defrost termination temperature (**dtd**).
For more information about the parameters used in *defrost*:

- See "Defrost duration (dd)" on page 73
- See "Defrost interval (dE)" on page 73
- See "Defrost termination temperature (dtd)" on page 71

5.2 Evaporator fan management

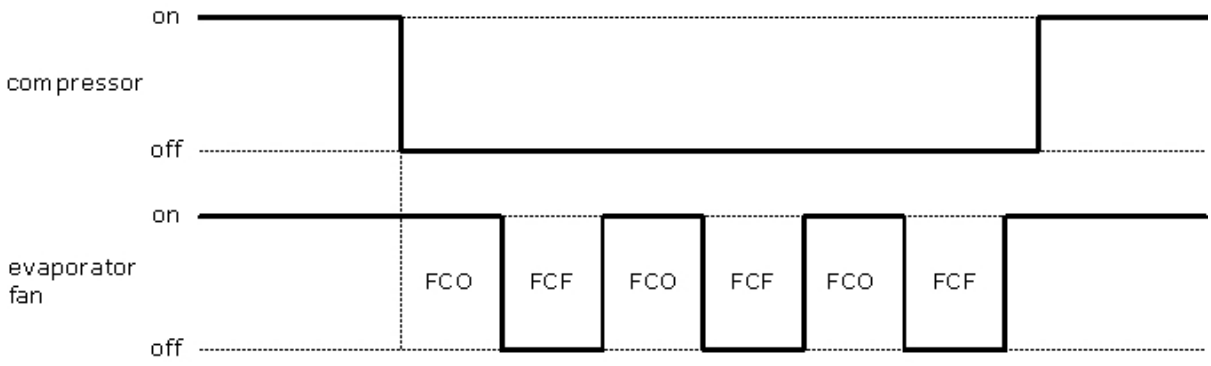
EMS controllers, depending on model, can be configured to manage the evaporator fan.

EMS controllers **always** run the evaporator fan when the compressor is running.

For periods that the compressor is not running, the EMS controllers run the evaporator fan according to the evaporator fan cycle.

Note:
- The evaporator fan cycle is not applied whilst the compressor is not running during a defrost period.

The evaporator fan cycle is defined by the fan cycle on (**FCO**) and fan cycle off (**FCF**) parameters.
The fan cycle starts with a fan cycle on (**FCO**) period as shown below.



EMS controllers stop the evaporator when the cooler door is opened.

To prevent excessive condensation on the evaporator in environments where warm, and presumed humid air is present, the controller runs the evaporator fan continuously if the temperature exceeds

the fan set point (**FSP**) temperature. EMS controllers run the evaporator fan, even if the cooler door is opened, and continues to run the evaporator fan until reaching the set point (**SP**) temperature.
For more information about the parameters used in *evaporator fan management*:

- See "Fan cycle off (FCF)" on page 74
- See "Fan cycle on (FCO)" on page 74
- See "Fan set point (FSP)" on page 69
- See "Set point (SPC or SPF)" on page 67

5.3 Lights management

In the saving mode, the cooler lights are usually off.

For marketing purposes, light delay (**Ld**) can keep the cooler lights on for a short period after the EMS controller switches to the *saving mode*.

Marketing mode (**Ar**) can keep the lights on for the duration of the *saving mode*.

For more information about the parameters used in *lights management*:

- See "Marketing mode (Ar)" on page 78
- See "Lights delay (Ld)" on page 72

5.4 Alarms

For alarm conditions, the EMS controller displays the appropriate alarm code and, optionally, sounds an alarm buzzer.

Buzzer enable (**b0**) defines whether to sound a warning buzzer for alarm conditions.
Buzzer duration (**b1**) defines the duration of the buzzer for alarm conditions.

Note:
- For door open alarms, the buzzer sounds regardless of the buzzer enable (**b0**) setting.

For more information about the parameters used in *alarms*:

- See "Buzzer enable (b0)" on page 75
- See "Buzzer duration (b1)" on page 76

5.5 Compressor management

EMS controllers manage the compressor to maintain the product temperature between the set point (**SP**) temperature and the set point (**SP**) plus differential (**dIF**) temperature in the *ready mode*or between the saving set point (**SSP**) temperature and the saving set point (**SSP**) plus the saving differential (**Sd**) temperature in the saving mode.

To ensure that the pressures within the refrigeration system have time to equalize during compressor off-cycles, the compressor rest time (**rt**) defines the minimum time that the compressor can be switched off.

Compressor manufacturers usually recommend a minimum compressor rest time.
The compressor rest time (**rt**) helps to avoid the following:

- Passing peak current through the windings of the compressor motor
- Switching off the refrigeration system on the thermal overload protection
- Short-cycling the refrigeration system.

However, if *ready mode* and *saving mode* differential temperatures are too small or if the compressor rest time (**rt**) is too short, the EMS controller cycles the compressor on the compressor rest time (**rt**) as the compressor rest time (**rt**) overrides the differential temperatures.

If the compressor runs continuously for too long without reaching the set point (**SP**) temperature, a refrigeration system failure (**rSF**) alarm activates alerting to possible problems with the refrigeration system.

EMS controllers can monitor the refrigeration system temperature using a condenser sensor. Monitoring the refrigeration system temperature can help detect problems, such as a blocked condenser.

If the temperature measured on the condenser sensor reaches the condenser high temperature (**Ct**), the EMS controller disables the compressor and activates the (**Ht**) alarm. The condenser high temperature (**Ct**) is set by measuring the refrigeration system temperature when the condenser is 75% blocked.

EMS controllers manage the failure of a temperature sensor as follows:

- Appliance sensor failures indicated by **PF1** alarms, EMS controllers stop running the compressor and then waits 60 seconds before rebooting (switch off and then switch on).
  If the fault continues, the EMS controller repeats and continues the cycle.
- Condenser sensor failures indicated by **PF2** alarms, EMS controllers continue running the compressor. EMS controllers alternate the display between **PF2** and the appliance sensor temperature.
- For evaporator failures indicated by **PF3** alarms, EMS controllers continue running the compressor. EMS controllers alternate the display between **PF3** and the appliance sensor temperature.

Note:
- **Ht** alarms do not apply to CO2 coolers

For more information about the parameters used in *compressor management*:

- See "Refrigeration system failure (Ct)" on page 72
- See "Differential (dIF)" on page 67
- See "Compressor rest time (rt)" on page 71
- See "Set point (SPC or SPF)" on page 67
- See "Saving set point (SSP)" on page 68

For trouble shooting information:

- See "How to troubleshoot refrigeration system failure (rSF) alarms" on page 62
- See "How to troubleshoot temperature sensor alarms" on page 63

5.6 Product temperature

EMS controllers manage the product temperature. EMS controllers use an appliance sensor to measure the air temperature of the refrigeration compartment.

The location of the appliance sensor within the refrigeration compartment depends on the cooler type.

However, to compensate for differences between the air temperature and the product temperature, calibration 1 (**CA1**) can add an offset to the temperature measured on the appliance sensor.

- See "Calibration 1 (CA1)" on page 68

EMS controllers can be set to use Celsius (°C) or Fahrenheit (°F) - set by the Celsius or Fahrenheit (**CF**) parameter.

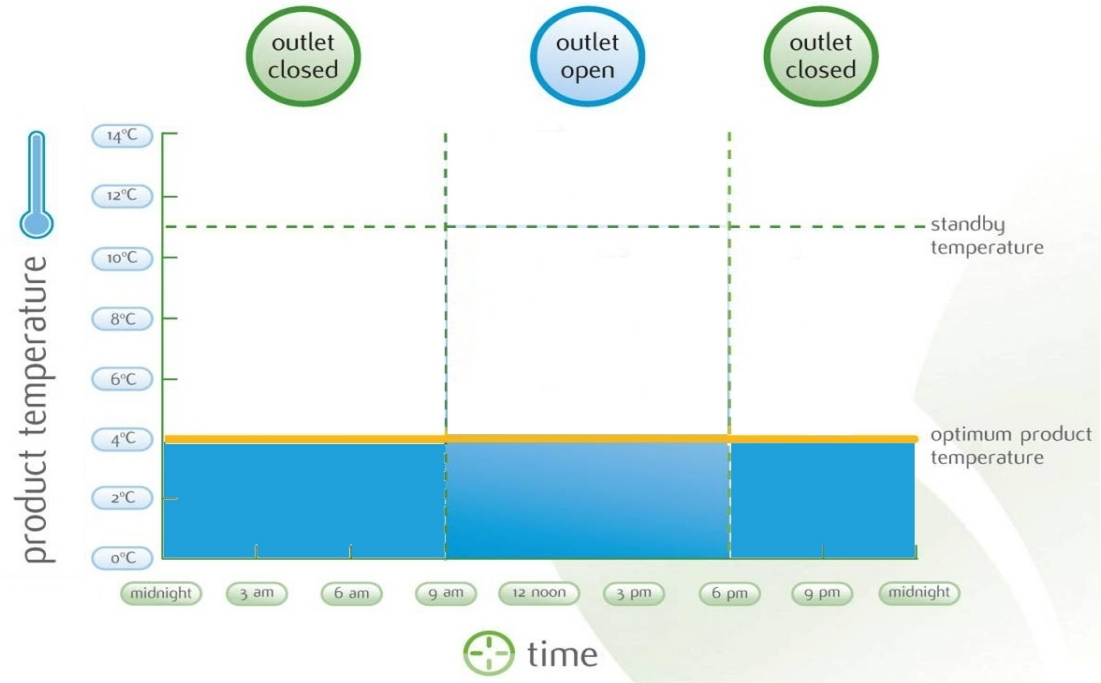
- See "Celsius or Fahrenheit (CF)" on page 67

6 How EMS controllers work - self-learning

EMS controllers monitor the cooler activity to record consumer patterns. EMS controllers use the learnt patterns to switch between the following modes:

- Ready mode the product is at the correct serving temperature and the cooler lights are on.
- Saving mode the product temperature is allowed to rise to save energy and the cooler lights are off. In the saving mode, the EMS controller is switched on and the saving temperature always stays within the pre-set limits to ensure that the cooler can lower to the ready mode temperature within the defined time.

To learn the cooler activity, EMS controllers start a learning period at first power-up. During the learning period, the EMS controller runs in the ready mode. Therefore, the product temperature is at the correct serving temperature and the cooler lights are on, as shown below.



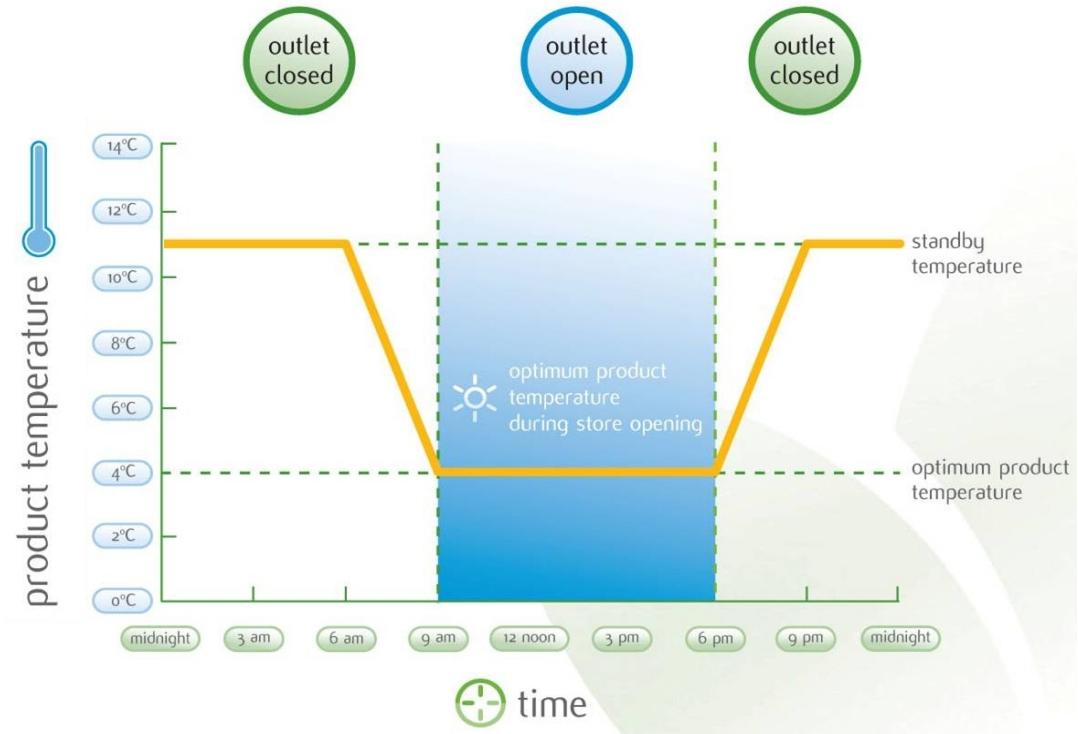
EMS controllers can use a 1-day or 7-day learning period as follows:

- 1-day learning period that is aimed for outlets with regular daily patterns, such as 7/11 shops. For a 1-day learning period, the EMS controller runs in the ready mode for the first day (24 hours).
- 7-day learning period that is aimed for outlets with varied opening hours such as working days, weekends, closed on Sundays, and so on. For a 7-day learning period, the EMS controller runs in the ready mode for the first 7 days.

During the learning period, EMS controllers learn the times of cooler activity. That is, times that consumers open the cooler doors and move in front of the cooler. The EMS controller stores the periods of activity in the self-learning matrix.
At the end of the learning period, EMS controllers then use the self-learning matrix to determine whether to run in the ready mode or the saving mode as follows:

- 1-day learning period, the EMS controller uses the self-learning matrix from day 1 for the next six days to build a complete 7-day self-learning matrix. The EMS controller then uses the complete self-learning matrix on day 8.
- 7-day learning period, the controller uses the complete self-learning matrix on day 8.

Controllers can then switch to the saving mode to allow the product temperature to rise during periods that outlets are closed and switch to the ready mode to ensure that the product is at the correct serving temperature when outlets open, as shown below.



After the learning period ends, controllers continuously update the self-learning matrix, therefore:

- If the cooler is moved, the controller updates the self-learning matrix from the previous location with the activity from the new location.
- If the outlet opening hours change, the controller updates the self-learning matrix with the activity for the new opening hours.
- If the time changes due to day light savings time, the controller updates the self-learning matrix with the activity for the new opening hours.

If power is lost for less than 3 days, controllers start working at the correct location in the self-learning matrix. However, if power is lost for more than 3 days, controllers clear the self-learning matrix when power is restored and starts from the learning period again.

6.1 How EMS controllers work - example

After the learning the activity patterns during the learning period, EMS controllers work as follows:

1. Prior to the outlet opening the EMS controller ensures that the products are at the correct serving temperature before the first sale.
2. The EMS controller sets the cooler into the ready mode when the outlet is open.
3. The EMS controller detects activity using the motion detector and door switch.
4. The EMS controller continually updates the activity patterns
5. The EMS controller manages the cooler temperature and lights to optimize energy savings without any manual intervention.
6. The EMS controller sets the cooler to the saving mode when the outlet closes.

6.2 Self-learning

EMS controllers start self-learning the moment the EMS controllers are first powered-up. EMS controllers then run in the *ready mode* whist the EMS controllers learn the activity pattern of outlets.

During self-learning, EMS controllers learn the periods that outlets are open or closed by measuring the activity.

EMS controllers have a self-learning matrix. The self-learning matrix is a 7-day (7 x 24 hour) matrix. Each 24 hour period consists of 48 30-minute periods.

EMS controllers then set each 30-minute period with activity or without activity according to the outlet opening and closing pattern.
The activity frequency (**AF**) parameter determines the amount of activity required to set a 30-minute periods as an **active** period.
The activity frequency (**AF**) parameter is usually set to require one door opening or one motion detected to set a 30-minute period to active.
However, for specific installations, the active frequency can be configured to require more activity to set a
30-minute period to ready.
The activity frequency (**AF**) parameter can also be set to automatically determine the optimal level of activity required to a set a 30-minute period to ready.
EMS controllers remain learning in the ready mode for the period defined by the learning period (**LP**).
The learning period (**LP**) sets EMS controllers to use a 1-day or 7-day learning period.
EMS controllers build the complete 7-day self-learning matrix as follows:

- **1-day learning period**: the EMS controller runs in *ready mode* for the first day (24 hours).
  The EMS controller then uses the self-learning matrix of day 1 for the next six days to build a complete 7-day self-learning matrix.
- **7-day learning period**: the EMS controller runs in the *ready mode* for the first 7 days to build a complete 7-day self-learning matrix.

To set the activity frequency (**AF**) automatically, EMS controllers run for 48 hours to determine the optimum activity frequency (**AF**). EMS controllers then start the learning period (**LP**) after the 48 hours required to set the activity frequency (**AF**).

Note:
- If the activity frequency is set to automatic, EMS controllers must be allowed to run (powered up) continuously for **48 hours** before the EMS controller starts to build the self-learning matrix.
  If power is lost during this period, EMS controllers start a new 48 hour learning period.

The table describes the total time that EMS controllers run in the ready mode only after being powered up.
This is the minimum time before EMS controllers switch to the *saving mode*.

learning period (LP)	activity frequency (AF)	minimum time in ready mode only
1 day	pre-set	1 day (24 hours)
1 day	automatic	3 days (72 hours)
7 days	pre-set	7 days
7 days	automatic	9 days

For more information about the parameters used in *self-learning*:

- See "Activity frequency (AF)" on page 76
- See "Learning period (LP)" on page 77

6.3 What is the self-learning matrix?

The self-learning matrix is a 7 day (7 x 24 hour), matrix with each 24 hour period divided into 48 30-minute periods. Each 30-minute period has a state that EMS controllers use to determine the mode as follows:

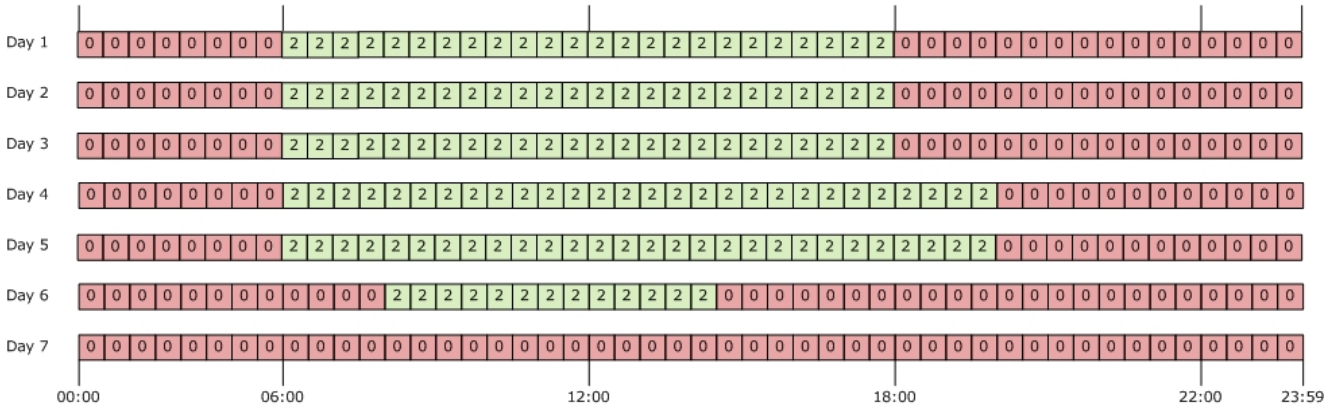
- 0 indicates no activity: EMS controllers normally run in the *saving mode*.
- 1 indicates a change in activity: EMS controllers run in the *ready mode*.
- 2 indicates activity: EMS controller run in the *ready mode*.

For example, the self-learning matrix below shows the following:

- Day 1 to day 3: the EMS controller runs in the *ready mode* from 06:00 to 18:00.
- Day 4 and day 5: the EMS controller runs in the *ready mode* from 06:00 to 20:00.
- Day 6: the EMS controller runs in the *ready mode* from 08:00 to 14:00.
- Day 7: the EMS controller remains in the *saving mode*.

Note:

- The self-learning matrix starts the moment the EMS controller is first switched on and is not synchronized with calendar days. However, the diagram below starts at 00:00 on Day 1 for clarity.



6.4 Activity

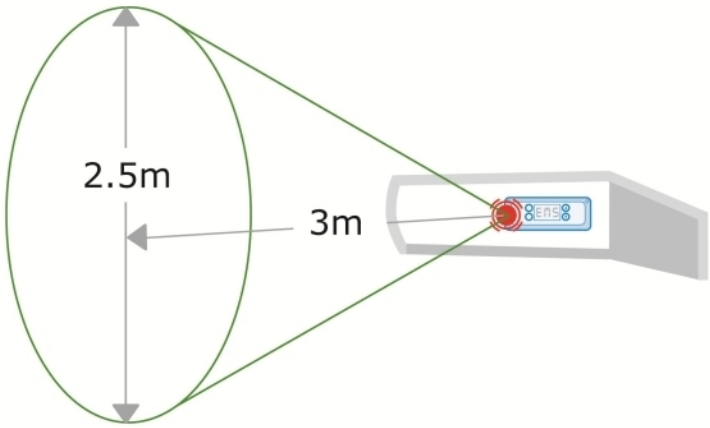
EMS controllers learn when retail outlets are open or closed by monitoring activity. For example, people opening and closing the cooler door to retrieve products or movements detected in front of the cooler. EMS controllers detect activity as follows:

- Door switch to detect door openings as customers open the cooler door to retrieve products.
- Motion sensor to detect movement in the front of the cooler.

Note:

- EMS controllers must be able to detect activity to work correctly. The motion detector should never be obstructed.

The diagram below shows the detection pattern of the motion sensor.



EMS controllers use activity to determine when retail outlets are open and closed. Periods with activity mean the retail outlet is open, and periods without activity mean the retail outlet is closed.

EMS controllers run coolers in the *ready mode* during periods with activity and the *saving mode* during periods without activity.

EMS controllers record the periods with and without activity in the self-learning matrix.

6.5 Activity frequency

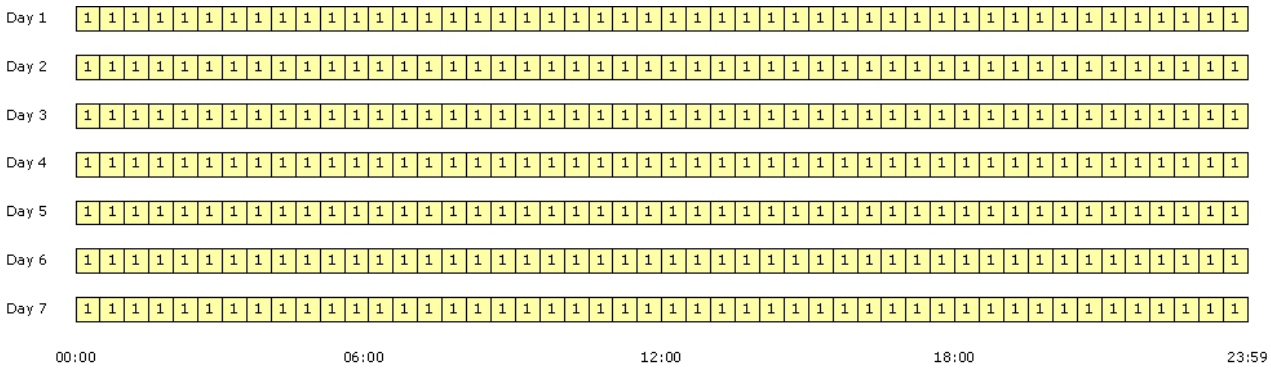
The activity frequency (**AF**) determines the amount activity required for the EMS controller to consider a 30-minute period as an active period. The activity frequency (**AF**) is normally set to require one door opening or one motion detected to set a 30-minute period.

The activity frequency (**AF**) can automatically determine the most appropriate activity frequency. EMS controllers using The EMS controller then starts the learning period after the 48 hours required to determine the activity frequency. The EMS controller must be powered up for the complete 48 hour period.

If power is lost during the 48 hour period, the EMS controller restarts determining the activity frequency again.

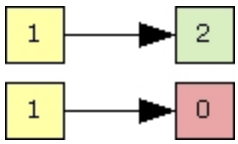
6.6 How a 1-day learning period works

EMS controllers with a one day learning period, **LP** set to 0, run in the *ready mode* for 1 day, (24 hours), whilst the EMS controller learns the outlet activity pattern such as opening and closing times. EMS controllers start self-learning the moment the EMS controllers are first powered-up.
At power-up, all the 30 minute periods are set to monitor (1) as shown in the following example matrix.
For periods set to monitor (1), EMS controllers run in the *ready mode*.



EMS controllers then update the self-learning matrix depending on how much activity is detected in each 30 minute period as follows:

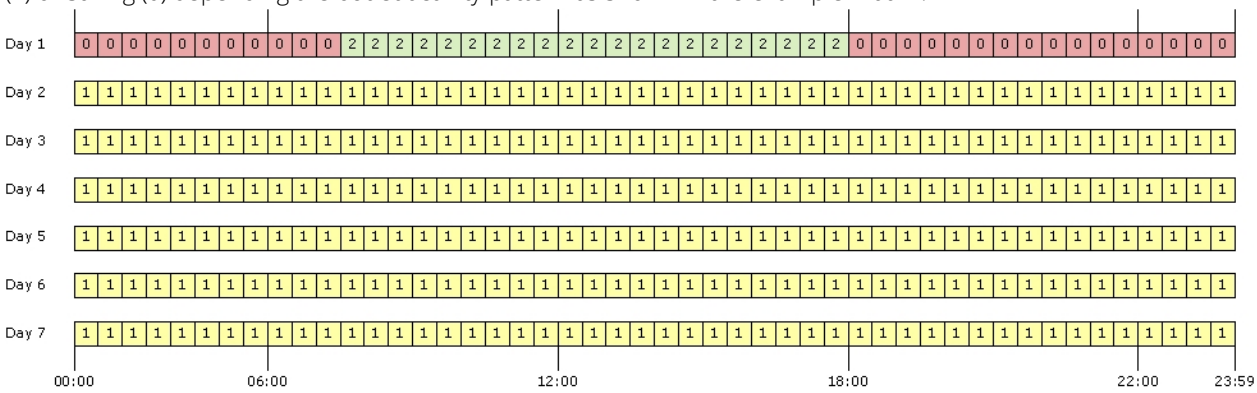
- If the EMS controller detects activity during a 30 minute period, the EMS controller changes the state from monitor (1) to ready (2)
- If the EMS controller does not detect activity, the EMS controllers changes the state from monitor (1) to saving (0).



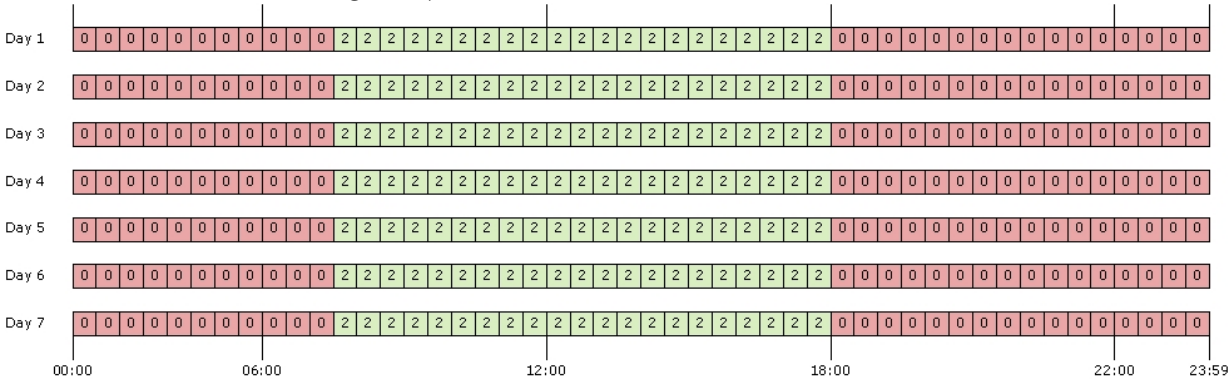
Note:

- The amount of activity required to change the state from monitor (1) to ready (2) depends on the setting of the activity frequency (**AF**) parameter.

Therefore, at the end of day 1, (first 24 hours), the EMS controller has set all the 30 minutes to ready (2) or saving (0) depending the outlet activity pattern as shown in the example matrix:

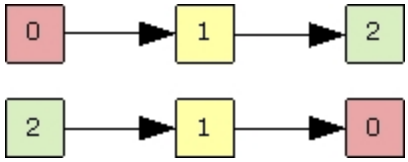


EMS controllers then copy the pattern learnt from day 1 to the *remaining six days* of the self-learning matrix, as shown in the following example matrix:

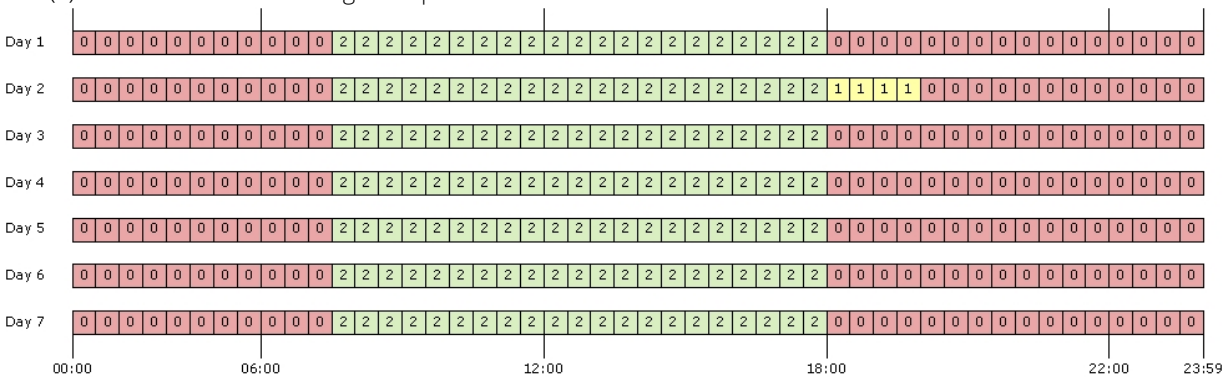


EMS controllers with a one day learning period start switching to the *saving mode* on the second day, (second 24 hours), if there are sufficient saving (0) periods. EMS controller then continue to update the self-learning matrix as follows:

- For periods set to ready (2), if no activity is detected change to monitor (1). Otherwise, keep the period set to ready (2).
- For periods set to saving (0), if activity is detected change to monitor (1). Otherwise, keep the period set to monitor (0).

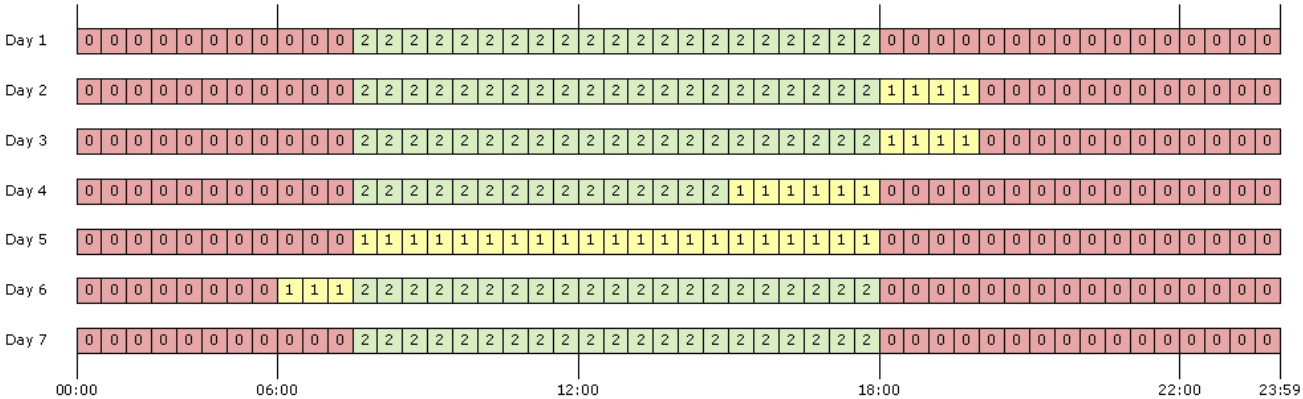


For example, the self-learning matrix shows that the outlet is open for longer on day 2 than day 1. Therefore, the EMS controller has changed the state of the periods that were set to saving (0) to monitor (1) as shown in the following example matrix.



At the end of week 1, the EMS controller has updated the self-learning matrix for the outlet activity pattern.

Note that differences for activity patterns learnt on day 2 take *two weeks* to be implemented. Therefore, 1 day learning periods are recommended only for outlets with regular patterns every day of the week.

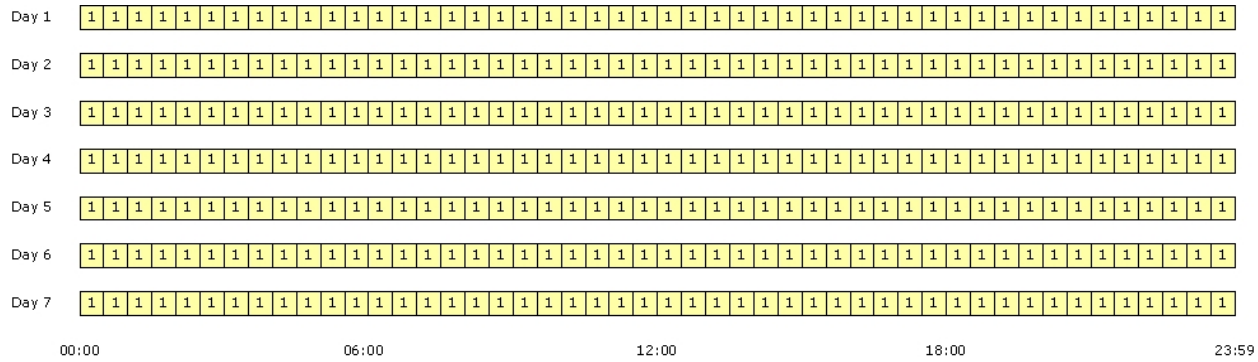


6.7 How a 7-day learning period works

EMS controllers with a seven day learning period, **LP** set to 1, run in the *ready mode* for 7 days (7 x 24 hours), whilst the EMS controller learns the outlet activity pattern such as opening and closing times. EMS controllers start self-learning the moment the EMS controllers are first powered-up.

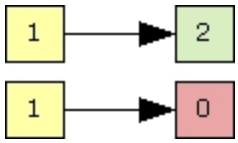
At power-up, all the 30 minute periods are set to monitor (1) as shown in the following example

matrix.
For periods set to monitor (1), EMS controllers run in the *ready mode*.



EMS controllers then update the self-learning matrix depending on how much activity is detected in each 30 minute period as follows:

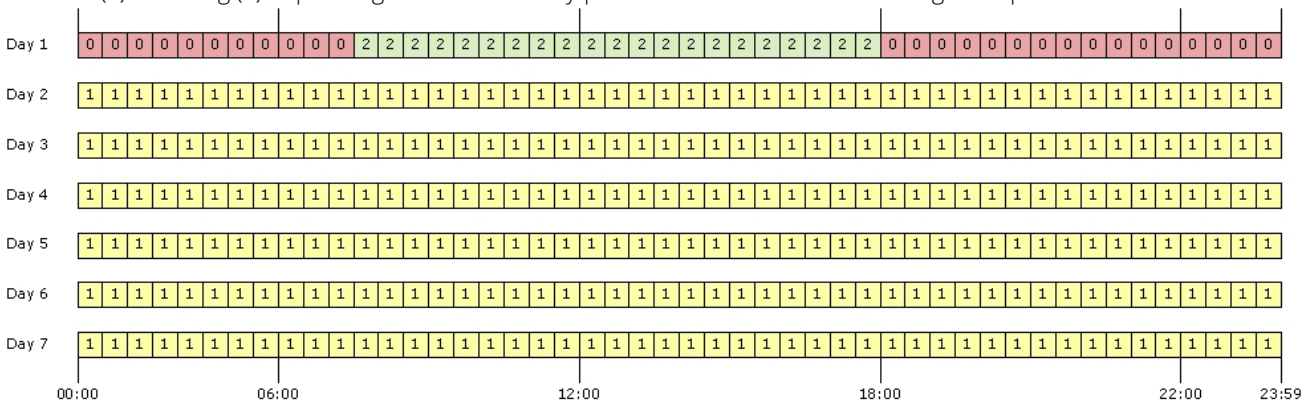
- If the EMS controller detects activity during a 30 minute period, the EMS controller changes the state from monitor (1) to ready (2)
- If the EMS controller does not detect activity, the EMS controllers changes the state from monitor (1) to saving (0).



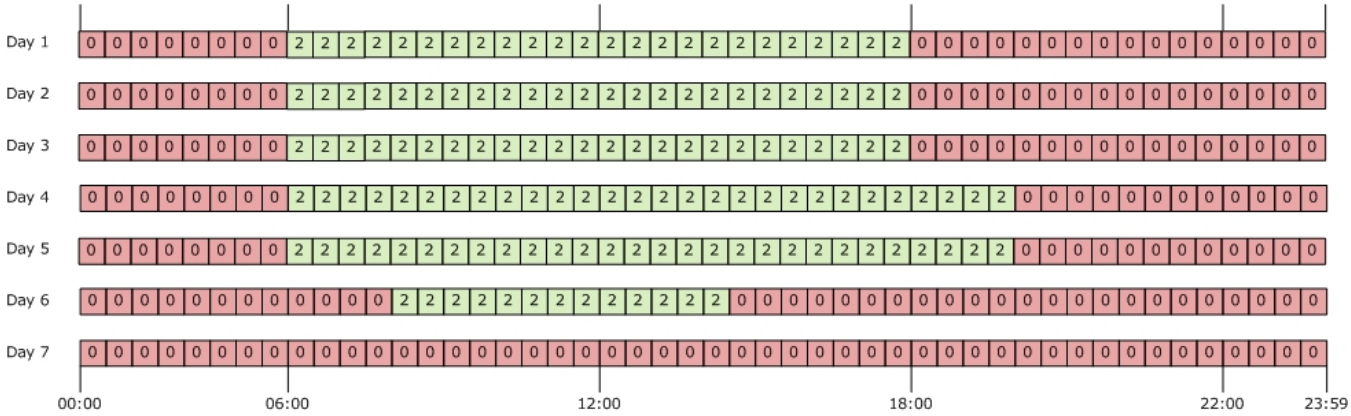
Note:

- The amount of activity required to change the state from monitor (1) to ready (2)depends on the setting of the activity frequency (**AF**) parameter.

Therefore, at the end of day 1 (first 24 hours), the EMS controller has set all the 30 minutes to ready (2) or saving (0) depending the outlet activity pattern as shown in the following example matrix:



The EMS controller then continues to run in the *ready mode* for the remainder of the 7 day learning period whilst updating the self-learning matrix.
At the end of the 7 day learning period, the EMS controller has a complete self-learning matrix as shown in the following example matrix:

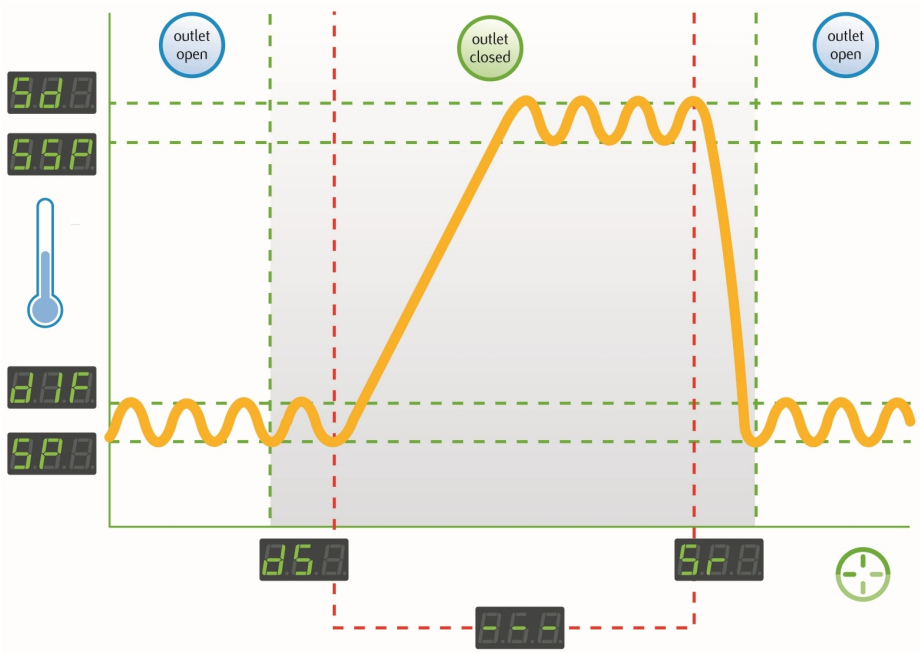


6.8 Saving mode

EMS controllers run in the *saving mode* when retail outlets are closed.

In the *saving mode*, the product temperature is allowed to rise to a predefined temperature. The *saving mode* temperature range is defined by saving set point (**SSP**) and the saving differential (**Sd**).

The compressor runs until the saving set point (**SSP**) temperature is reached and then stops until the measured temperature reaches the saving set point (**SSP**) plus saving differential (**Sd**) temperature.



The *saving mode* temperature is set to ensure that the cooler has sufficient time to lower the product to the *ready mode* temperature. The EMS controller starts lowering the product temperature by the saving restart period (**Sr**) before the *ready mode* starts ensuring that the cooler has sufficient time to reach the *ready mode* temperature from the *saving mode* temperature.

However, the saving temperature disable (**PEr**) can set EMS controllers to maintain the *ready mode* temperature at all times.

During the *saving mode*, the controller displays three dashes, (**---**), and the cooler lights are usually switched off.

If the cooler door is opened or the motion sensor detects activity during the saving mode, EMS controllers switch on the cooler lights for the remainder of the current 30-minute period, but do not start cooling cycle.

For more information about the parameters used in *saving mode*:

- See "Saving temperature disable (PEr)" on page 77
- See "Saving differential (Sd)" on page 69
- See "Saving restart period (Sr)" on page 72
- See "Saving set point (SSP)" on page 68

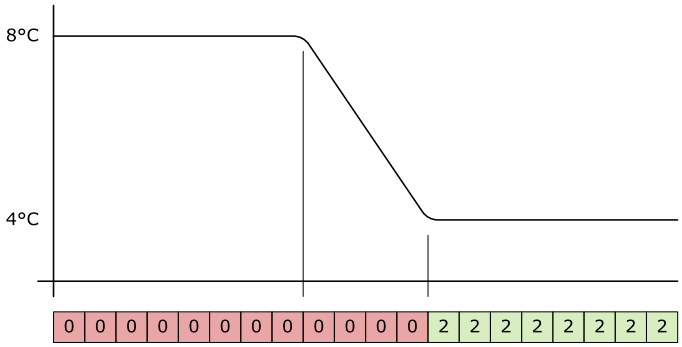
6.9 How EMS controllers switch between the ready and saving mode

A key characteristic of an EMS controller is the saving restart period.
The saving restart period is time allocated for the cooler to lower the product temperature to the *ready mode* temperature from the *saving mode* temperature.

A typical saving restart period is 120 minutes.

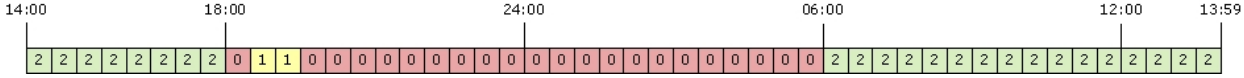
Whist in the *saving mode*, the EMS controller must look ahead in the self-learning matrix for a ready period by the time defined by the saving restart period (**Sr**). For example, the EMS controller looks 2 hours ahead.

If the EMS controller detects an ready period, the EMS controller starts to lower the product temperature, as shown below.



The EMS controller switches to the *saving mode* if there are no ready periods within the next 2 hours as defined by the saving restart time (**Sr**).
The EMS controller ignores periods of inactivity if the time to the next active period is less than the saving restart time.

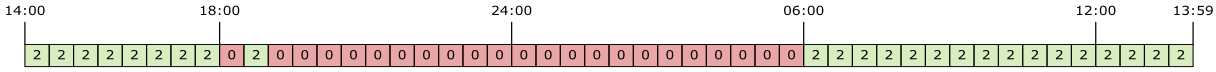
For example, the diagram below shows a period of inactivity, saving (0) at 18:00 followed by two monitor (1) periods. In this instance, the EMS controller would ignore the saving (0) at 18:00 and switch to the saving mode at 19:30.



Note:

- EMS controllers always run in the *ready mode* for periods in the self-learning matrix that are set to 1 (monitor) or 2 (ready).

In the following example matrix, the EMS controller will start to cool by the saving restart period before the ready period (2), run in the ready mode for 30 minutes, and then switch to the *saving mode* (assuming no delay to saving **ds**parameter is in operation).



For more information about the parameters used:

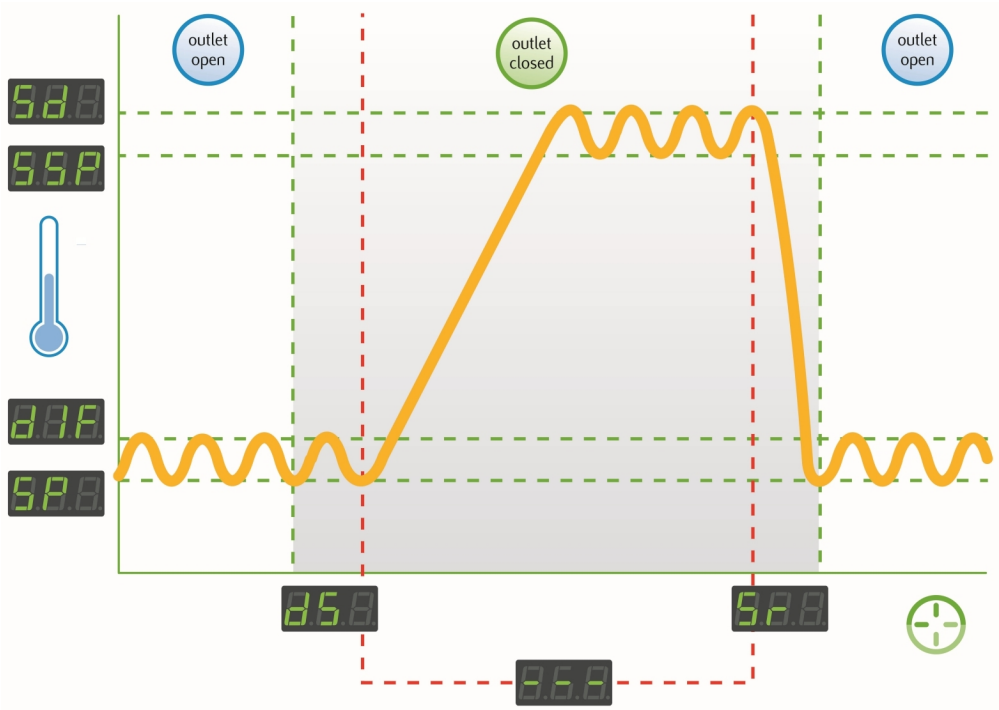
- See "Delay to saving (dS)" on page 72
- See "Saving restart period (Sr)" on page 72

6.10 Ready mode

EMS controllers run in the *ready mode* when outlets are open.

In the *ready mode*, the product is at the correct serving temperature and the cooler lights are on. EMS controllers ensure that the product is at the correct serving temperature by keeping the product temperature within the range defined by set point (**SP**) parameter and the differential (**dIF**) parameter.

The EMS controller runs the compressor until the set point (**SP**) temperature is reached. The compressor is then stopped until the measured temperature reaches the set point (**SP**) plus differential (**dIF**) temperature.



During the *ready mode*, EMS controllers display appliance sensor temperature 3.0, for example or the word **USE** as defined by display (**dIS**) parameter.

If the EMS controller displays the appliance sensor temperature, the display stability (**d2**) parameter can dampen the rate of change of the displayed temperature.
For example, to filter short fluctuations in the air temperature due to the door opening, which has no affect on the product temperature.

At the end of the *ready mode*, EMS controllers switch to the *saving mode*. However, the delay to saving (**dS**) parameter can delay the switch to the saving mode. The delay helps ensure that, for example, the EMS controller remains in the *ready mode* during periods without activity immediately prior to outlets closing for marketing purposes.

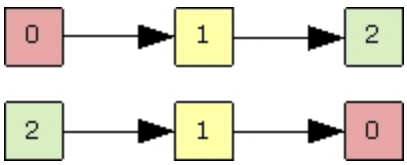
For more information about the parameters used in *ready mode*:

- See "Display stability (d2)" on page 75
- See "Differential (dIF)" on page 67
- See "Display (dIS)" on page 78
- See "Delay to saving (dS)" on page 72
- See "Set point (SPC or SPF)" on page 67

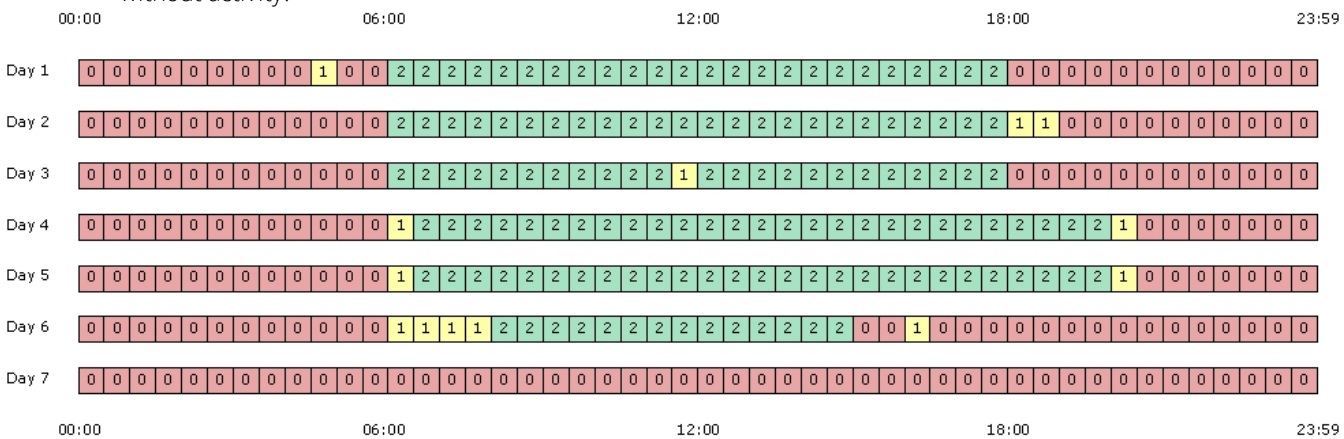
6.11 How the self-learning matrix updates after the learning period

EMS controllers continuously updates the self-learning matrix after the learning period as follows:

- If a ready period (2) does not have the minimum number of door openings or motion counts, the EMS controller sets the period to monitor (1).
  The EMS controller runs in the *ready mode* for periods set to monitor.
- If a monitored period (1) does not have the minimum number of door openings or motion counts, the EMS controller sets the period to saving (0). Otherwise, the EMS controller sets the period to ready (2).
- If a saving period (0) reaches the minimum number of door openings or motion counts, the EMS controller sets the period to monitor (1).



For example, the self-learning matrix below shows monitor (1) periods during periods with and without activity.



Note:

- If activity occurs in a saving period (0), such as a motion detection or a door opening, the EMS controller switches the cooler lights **on** and sets the period to monitor (1).
  However, the EMS controller does not start the compressor to cool the product.

7 What are the accessories?

The accessories for EMS controllers are as follows:

- Temperature sensors
- Motion sensors
- Door switches
- Safety isolating transformers - **if applicable**

The accessories list defines the items used with EMS controllers such as the parameter programming tool, temperature sensors, door switches, transformers, covers, and so on.
Each item in the accessories list has short description and part number. The part number is required to order accessories.

7.1 Temperature sensors

Temperature sensors are available from Elstat with various cable lengths. To help identify sensor cables during the installation, Elstat can supply sensor cables with blue identification sleeves. For example, if the appliance sensor cable is plain black and the condenser sensor cable can have a blue identification sleeve.

The sensor circuit is designed for safety extra low voltage (SELV). Therefore, if the sensor cable needs to be joined during production or maintenance, only connectors normally used in SELV circuits can be used.

Caution:

- Connectors designed to carry mains voltages must not be used to join cables to the sensor circuit.

The temperature sensors have a negative temperature coefficient (NTC).

Each make and type of sensor has a specific resistance versus temperature curve. Therefore, only sensors supplied by Elstat should be used.

The NTC thermistor is rated from -35ºC to 125ºC (-31ºF to 257ºF).

The table below shows the temperature input ranges of the EMS controller for each sensor type.

Sensor	Input range (ºC)	Input range (ºF)
Appliance sensor	-10ºC to 23.5ºC +/- 0.5ºC	14ºF to 74ºF +/- 1ºF
Condenser sensor	50ºC to 125ºC +/- 5.0ºC	122ºF to 257ºF +/- 10ºF
Evaporator sensor	-30ºC to 15ºC +/- 1.0ºC	-22ºF to 59ºF +/- 2ºF

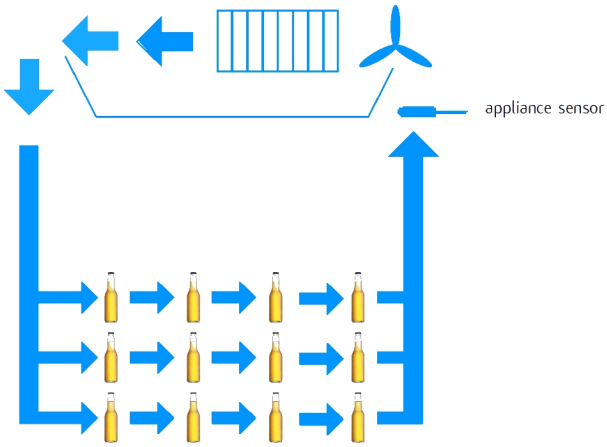
7.2 Temperature sensor - where used

The table below is an at-a-glance view of which controllers (and firmware if applicable) require which sensor in order to operate effectively:

Sensor	ems25 *Plus*	ems25 *advanced*	ems55*advanced* ems55R*advanced*	ems55*advanced* ems55R*advanced*	ems75sz
			Firmware type: GDC	Firmware type: OFC	
Appliance sensor	✓	✓	✓	✓	✓
Condenser sensor	✓	✓	✓	✓	✓
Evaporator sensor				✓	✓

7.3 How to mount the appliance sensor

The appliance sensor measures air temperature of the refrigerated compartment by measuring the return air temperature.
The diagram below shows the recommended position of the appliance sensor. The appliance sensor measures the air temperature after the air has been drawn over the products. The return air provides a close approximation of the product temperature.



To measure the return air temperature, secure the sensor to allow air to flow over the sensor head.
The sensor head should be placed at a right-angle to the air flow and secured using a P-clip.
The sensor head should not be completely covered by the P-clip or the sensor will not function correctly.

Caution:

- The sensor head is fragile and can easily be damaged. Using cable ties to secure the sensor head or sensor cable is not recommended and invalidates the warranty.

To help place the appliance sensor, the parameter calibration 1 (**CA1**) defines an offset temperature.

- See "Calibration 1 (CA1)" on page 68

7.4 How to mount the condenser sensor

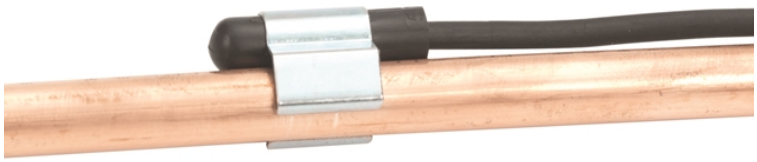
This sensor measures the temperature of the refrigeration system. Excessive condenser temperature is usually due to poor preventive maintenance, i.e poorly cleaned condenser, or condenser fan failure.

7.4.1 Condenser sensor

EMS controllers can generate alarms if the refrigeration system temperature rises too high.
The value of the high temperature is set by measuring the refrigeration system temperature, when the condenser is approximately 75% blocked. The temperature is then set as the value of the condenser high temperature (**Ht**) parameter.

- See "Condenser high temperature (Ht)" on page 70

For example, fix using a metal pipe clip or direct fitting, as shown below.
Elstat can supply pipe clips for 6-8mm and 8-10mm pipes.

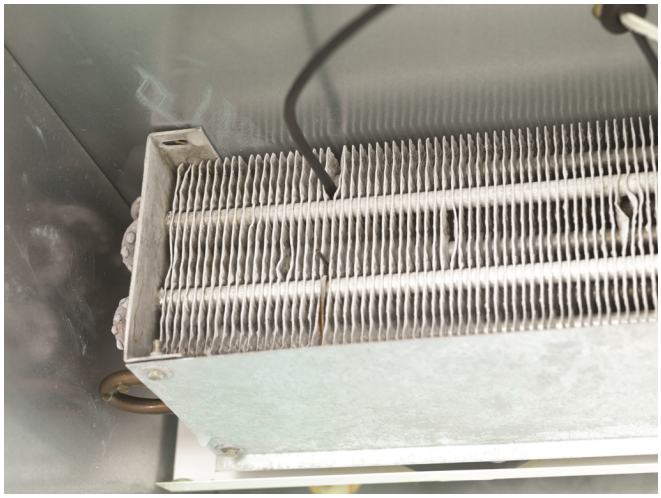


Caution:

- Do not use cable ties.
  The head of the sensor is fragile and can be easily damaged. Using cable ties to secure the sensor head or sensor cable invalidates the warranty.
- Do not attach sensor cables to hot pipes or allow the sensor cables to come into contact with hot pipes.

7.5 How to mount the evaporator sensor

The evaporator sensor measures the temperature of the evaporator. EMS controllers use the temperature of the evaporator to activate and terminate defrost cycles.
The evaporator sensor should be placed in the immediate proximity of the evaporator. Mount the sensor head inside the evaporator cooling fins, as shown below.
The sensor head must be mounted securely to prevent being dislodged due to vibration.



For coolers fitted with a defrost heater, the evaporator sensor should be placed as far away as possible from the heating element, i.e. at the opposite end of the evaporator.
If the evaporator sensor measures the localized heating from the heating element, defrost cycles will terminate before the whole evaporator has had the opportunity to defrost.

Caution:

- **Do not** use cable ties.
  The head of the sensor is fragile and can be easily damaged. Using cable ties to secure the sensor head, or sensor cable, invalidates the warranty.
- Evaporator sensors are used in place of door switches on Open Front Coolers (OFC Firmware). The controller label states which firmware is programmed onto the controller.

7.6 Door switch

Door switches are used to detect door openings. Door switches are SELV (safety extra low voltage) components that are able to create an open and closed circuit.
The enhanced door switch, and activator, are SELV (safety extra low voltage) components, over-moulded for strengthened physical protection and resistance to water ingress, and create an open and closed circuit.
Door switches must be used with the corresponding activator.
Door switches are available in various lengths

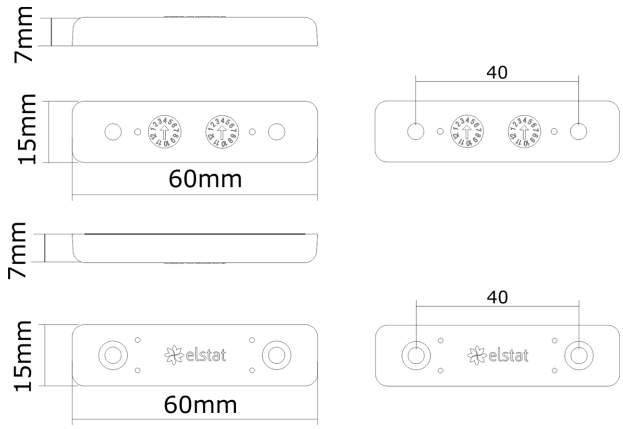
7.7 How to mount the door switch

Door switches are usually mounted with the door switch on the cooler and the activator on the door.
Door switches and activators must be fixed using counter sunk screws or bolts with the following characteristics:

- Head: countersunk head maximum diameter 6.0mm (0.236in) and minimum diameter 5.0mm (0.196 in).
- Thread: maximum diameter 3.0mm (0.118in).

The screws must be tightened to a maximum torque of 0.5Nm (0.37lb$_f$ft).

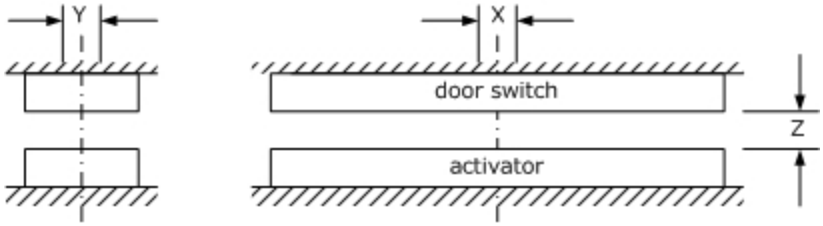
Caution:
Door switch kits supplied by Elstat must not be installed using rivets. Using rivets invalidates the warranty.



The alignment of the door switch and activator is critical for the correct operation of the door switch. The table below details the alignment tolerances.

	Alignment	Dimensions	Notes
X	Horizontal	0mm (0in) +/- 20mm (0.7in)	Measured when the door is closed and the gap (z-dimension) is correct.
Y	Vertical	0mm (0in) +/- 10mm (0.4in)	Measured when the door is closed and the gap (z-dimension) is correct.
Z	Gap	0mm (0in) to 5mm (0.2in) +/- 2mm (0.07in)	

The diagram below shows the horizontal, vertical, and gap alignment between the door switch and the activator for open and closed doors.



For best results, Elstat recommends that enhanced door switches are used with enhanced door switch activators. Performance will not be guaranteed if:

- Enhanced activators are paired with current door switches
- Enhanced door switches are paired with current activators.

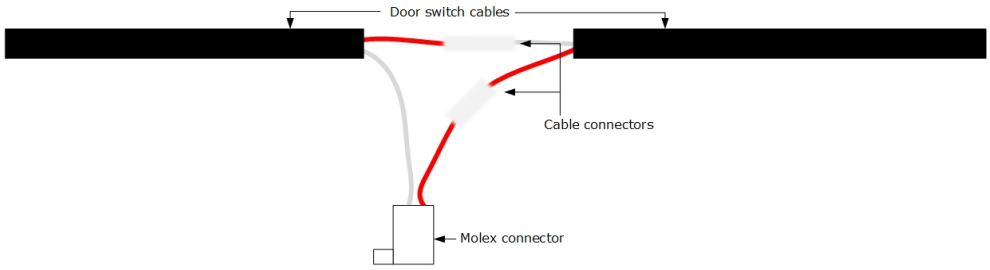
Enhanced door switches and enhanced activators must be used as a set.

7.8 How to mount door switches on double-door coolers

For double-door coolers, two door switches must be connected in series.
Connect two door switches in series as follows:

1. Remove the two wires from one of the connectors. Be careful not to damage the terminals.
2. Remove the white wire from the second connector. Again, be careful not to damage the terminal.
3. Insert the white wire of the first cable into the connector of the second cable ensuring that the terminal is in the correct orientation.
4. Connect the red wire from the first cable and the white wire from the second cable together using a butt splice or similar.

The image below shows two door switches connected in series.



7.9 Motion sensor - ems75sz

The motion sensor is a passive infra-red (**PIR**) motion detector and is available integrated into the Controller Display Module, or remote to the Controller Display Module as shown in the examples below:

Integrated motion sensor as shown below:

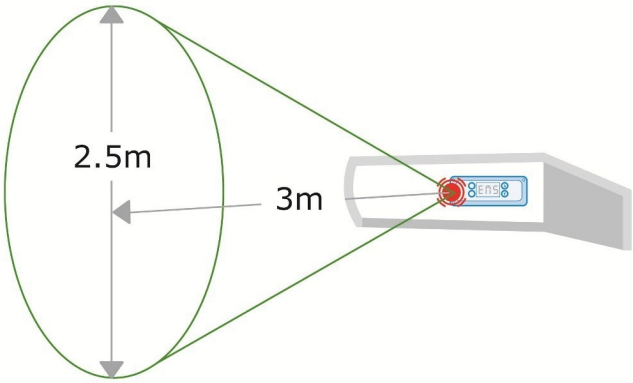
Remote motion sensor as shown below:

As the motion sensor cannot monitor activity through glass or plastics, the remote motion sensor varient of the ems75sz CDM has been designed to be installed into header panels inside the cooler cabinet. The remote motion sensor may then be installed where it will be able to 'view' activity.

- The CDM is manufactured from food grade plastics.

7.10 Motion sensor

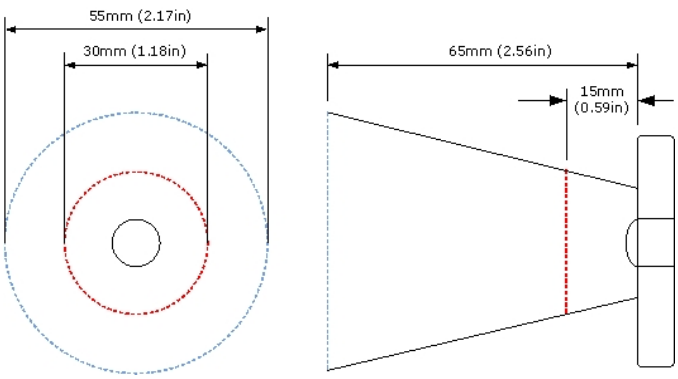
Motion sensors are passive infra-red (PIR) devices that detect activity. The diagram below shows the detection pattern of motion sensors.



The motion sensor must have an uninterrupted view directly in-front and to the sides. The preferred location of the motion sensor is in the upper section or in header panel of the cooler to ensure the best motion detection and to lower the risk of the motion sensor being blocked by objects such as packages.
For EMS controllers with integrated motion sensors, a remote motion sensor can be used. The motion sensor head is supplied detached from the cable to allow the cable to be easily routed through holes or foamed into place as required by the OEM or installer.

7.11 How to mount a remote motion sensor

The motion sensor should be mounted vertically with the connector at the bottom for optimal performance. Mounting horizontally with the connector at the sides results in the motion sensor being less sensitive. However, the motion sensor still works correctly.
The motion sensor must not be located behind any material such as glass or polycarbonate.
For a motion sensor that is not mounted flush with the panel, the diagram below shows the minimum recommended clearances to ensure motion detection. For example, if the motion sensor is mounted 15mm behind the panel, a 30mm diameter aperture is required.

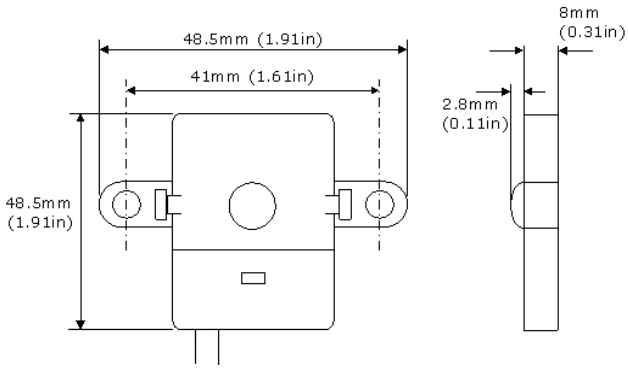


The motion sensor head must be fixed using counter sunk screws or bolts with the following characteristics:

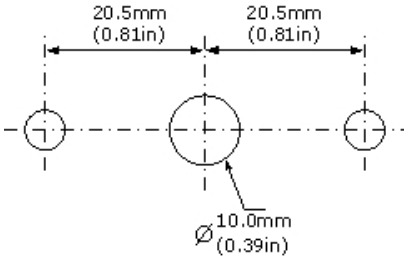
- Head: countersunk maximum diameter 6.0mm (0.24in)
- Thread: maximum diameter 4.0mm (0.16in).

The screws must be tightened to a maximum torque of 0.5Nm (0.37lbfft).

Caution: Using rivets invalidates the warranty.
The dimensions and drilling details of the motion sensor are shown below.



The dimensions of the mounting holes are shown below.



8 How to troubleshoot ems75sz

Various messages are displayed on EMS controllers to indicate alarm conditions, use the following section to troubleshoot EMS controllers with displays:

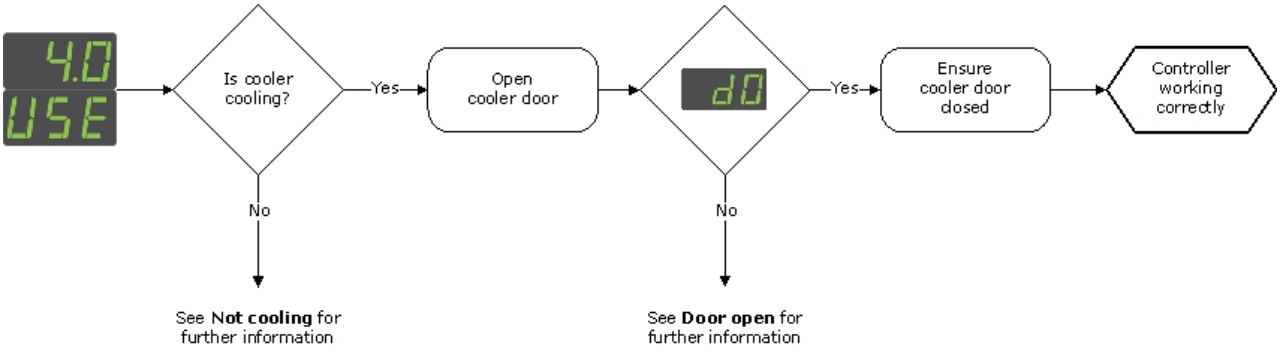
8.1 Troubleshooting

The following table shows the display for alarm conditions. EMS controllers can be programmed to sound a buzzer with alarm conditions.

Problem or Alarm	Meaning	Action
	Door open	• See "How to troubleshoot door alarms (door switch fitted)" on page 59 • See "How to troubleshoot door alarms (no door switch fitted)" on page 59
	Refrigeration system failure	• See "How to troubleshoot refrigeration system failure (rSF) alarms" on page 62
	Sensor failures	• Appliance sensor (**PF1**) • Condenser sensor (**PF2**): display alternates between **PF2** and the appliance sensor temperature • Evaporator sensor (**PF3**): display alternates between **PF3** and the appliance sensor temperature. • See "How to troubleshoot temperature sensor alarms" on page 63
Motion detection LED flashing continuously	Motion sensor problem	• See "How to troubleshoot motion sensor alarms" on page 61
Cooler not cooling		• See "How to troubleshoot not cooling problems" on page 61
Cooler lights do not switch on		If the EMS controller is in the ready mode, check the lights switch inside the cooler. **Note**That EMS controllers normally switch the cooler lights off in the saving mode.

8.2 How to check that EMS controllers are working correctly

During the ready mode, the EMS controller displays the appliance sensor temperature, such as **4.0**, or the word **USE** as shown below.
The option to display the temperature or the word **USE** is set by the display (**dIS**) parameter.
Follow the chart to ensure that the EMS controller is working correctly in the *ready mode* for coolers with door switches fitted.



For information about the display **(dIS)** parameter:

- See "Display (dIS)" on page 78

8.3 How to troubleshoot condenser high temperature (Ht) alarms

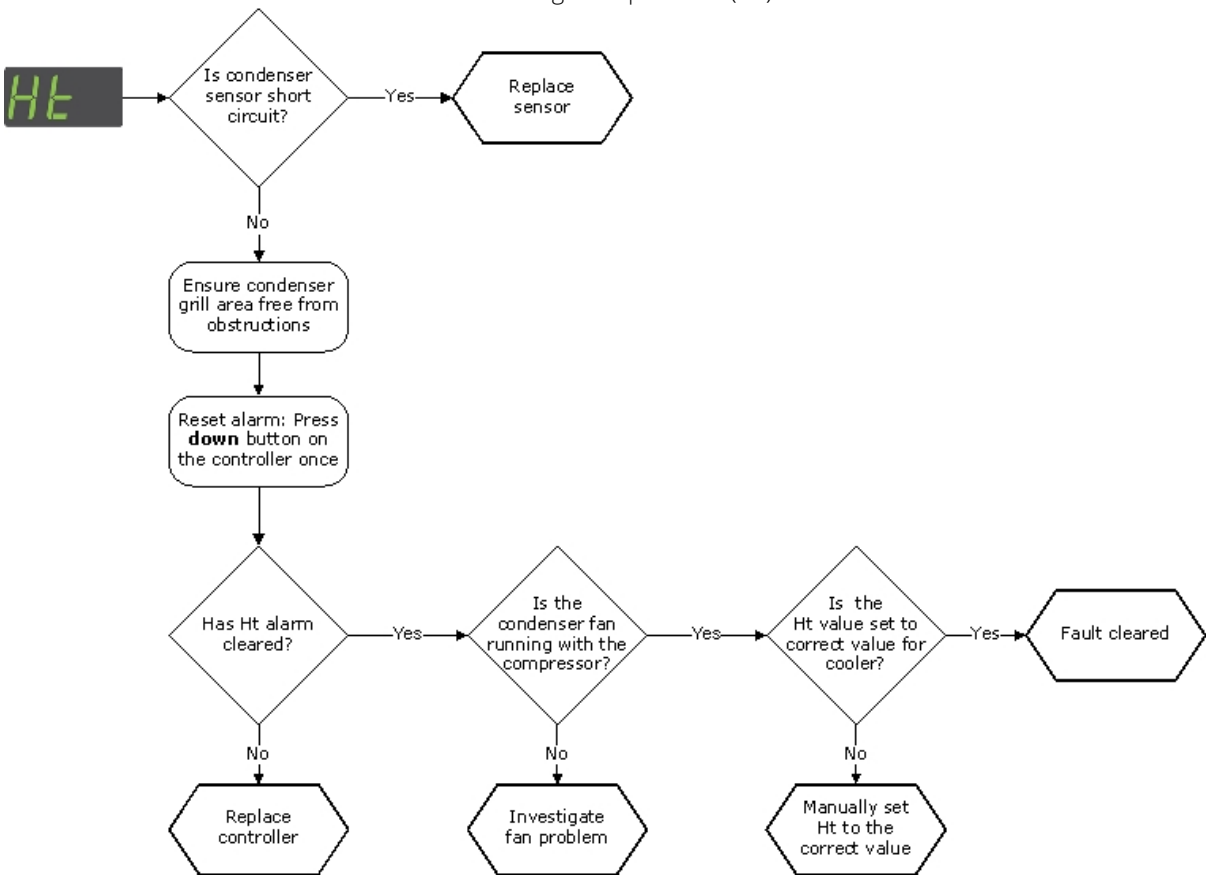
Condenser high temperature (Ht) alert to problems with the refrigeration system such as a blocked condenser or faulty condenser fan.

Note: This alarm is not applicable with CO2 coolers and the ems55*advanced* CO2, see CO2 alarms for more information.

For information about the condenser high temperature **(Ht)** parameter:

- See "Condenser high temperature (Ht)" on page 70

Follow the chart to troubleshoot condenser high temperature (**Ht**) alarms.



8.4 Door open alarm - display

The EMS controller displays **dO** to show that the cooler door is open. However, if the door remains open for the duration of alarm delay (**Ad**), an alarm buzzer sounds. Then, if the door is still open after

the time defined by the buzzer duration (**b1**) parameter, the EMS controller switches off the compressor and displays three horizontal bars, as shown below.

Closing the door clears the alarm. However, if the alarm continues follow the appropriate flowchart for coolers fitted with door switches or coolers not fitted with door switches.

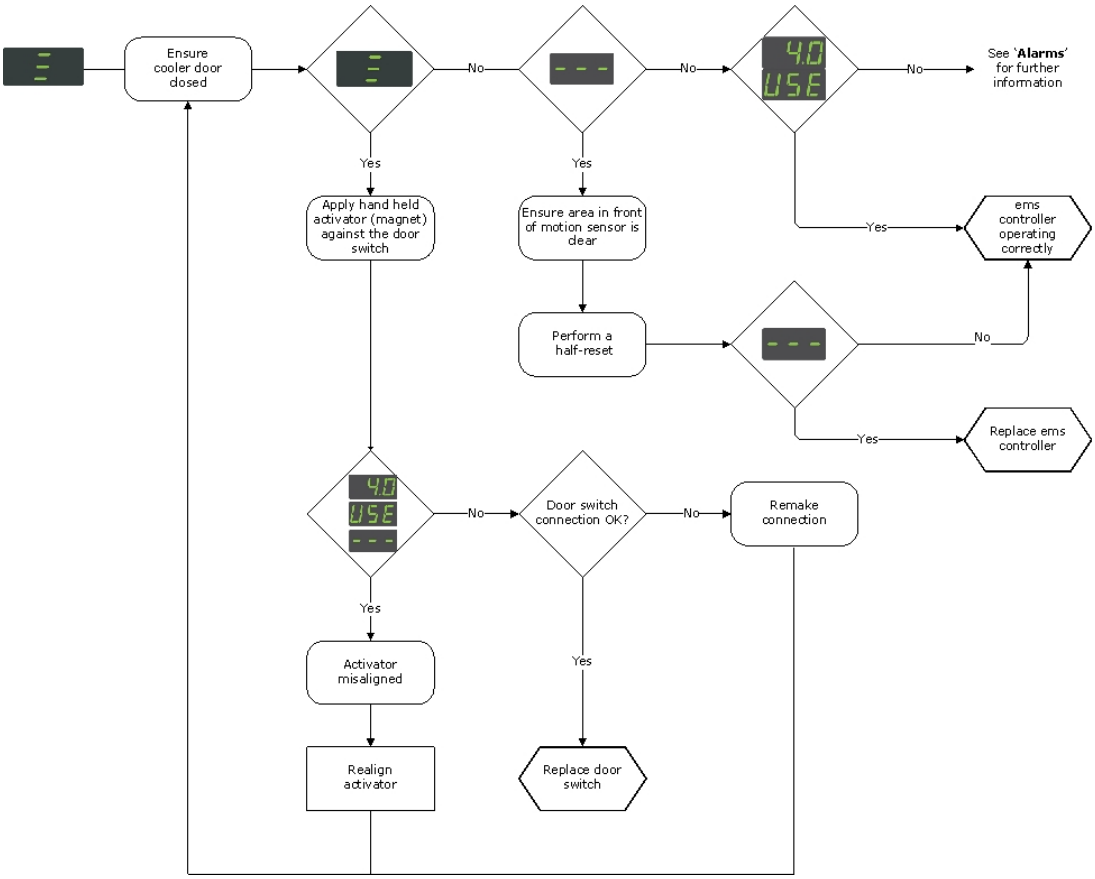
8.5 How to troubleshoot door alarms (door switch fitted)

Door open alarms are triggered if the cooler door is left open for longer than the time defined by the alarm delay (**Ad**) parameter.
If the door is closed, and a door open alarm is registered, this may indicate problems with the cooler door or the door switch.

For information about the alarm delay **(Ad)** parameter:

- See "Alarm delay (Ad)" on page 76

Follow the chart to troubleshoot door open alarms on coolers with a door switch.



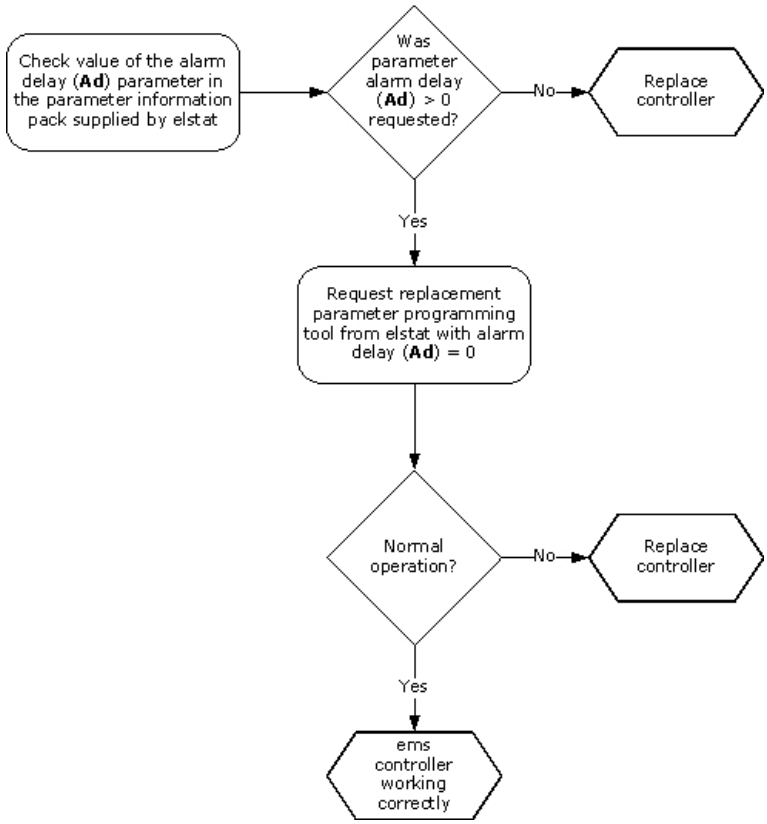
8.6 How to troubleshoot door alarms (no door switch fitted)

Door alarms with coolers without a door switch fitted usually indicates that the EMS controller has an incorrect parameter set.

For information about the alarm delay **(Ad)** parameter:

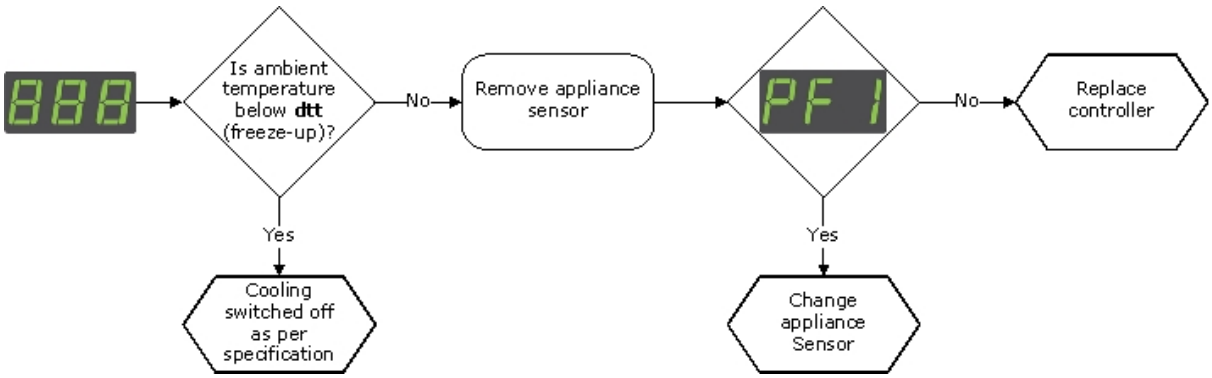
- See "Alarm delay (Ad)" on page 76

Follow the chart to troubleshoot door open alarms on coolers without a door switch fitted.



8.7 How to troubleshoot problems with freeze-up protection (888)

Problems with freeze-up protection may occur if the ambient temperature falls below 0°C (32°F) or if the appliance sensor fails.



For information about the freeze-up protection **(dtt)** parameter:

- See "Freeze-up protection (dtt)" on page 69

8.8 How to troubleshoot motion sensor alarms

The motion detection LED flashes to indicate that movement has been detected.
However, a motion sensor LED flashing continuously may indicate that the motion sensor is faulty or, if a motion sensor is not fitted, that the parameter settings are incorrect.

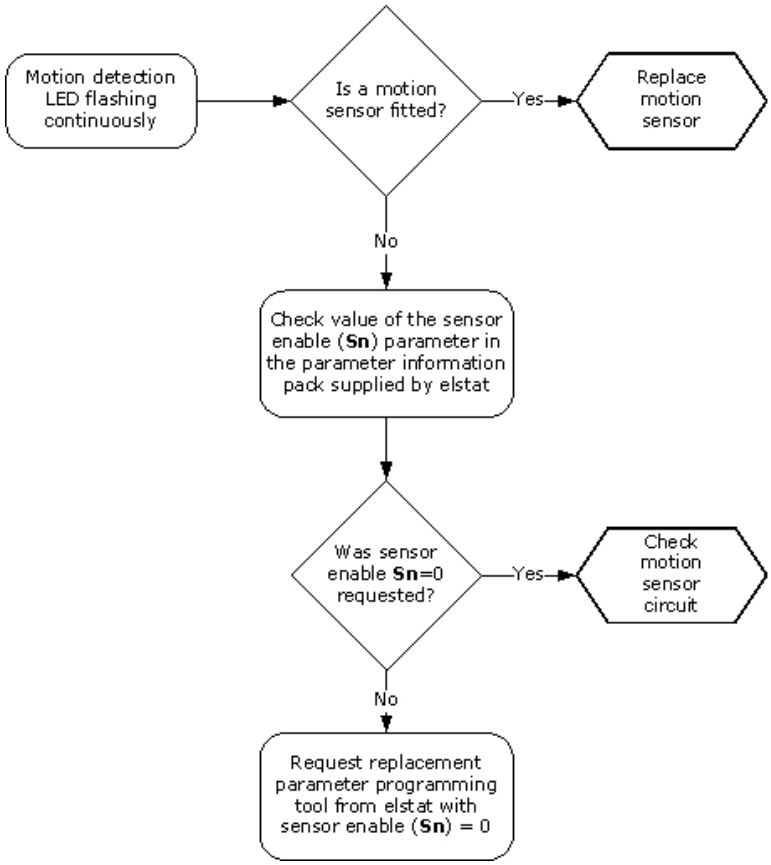
Note:

- The EMS controller stays in the ready mode if the motion detection LED is flashing continuously.

For information about the motion sensor enable **(Sn)** parameter:

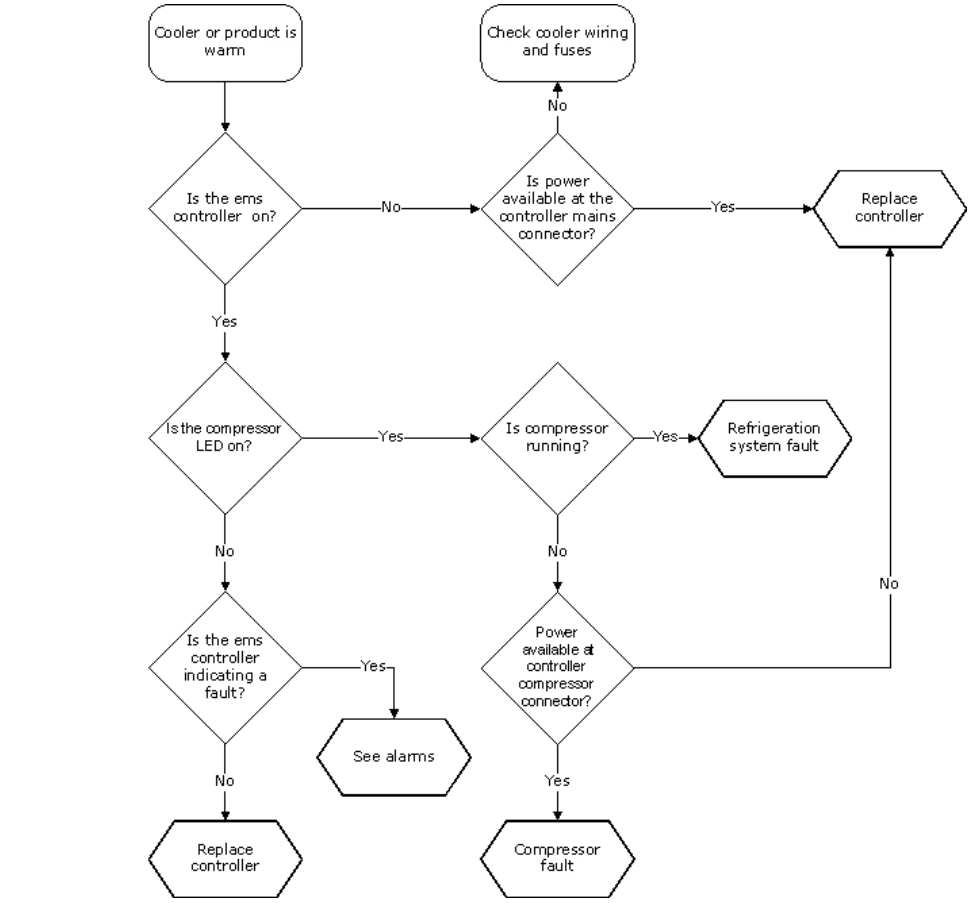
- See "Motion sensor enable (Sn)" on page 77

Follow the chart to troubleshoot problems with the motion sensor.



8.9 How to troubleshoot not cooling problems

Follow the chart below to troubleshoot problems of the cooler not cooling, i.e. the cooler or product is warm.



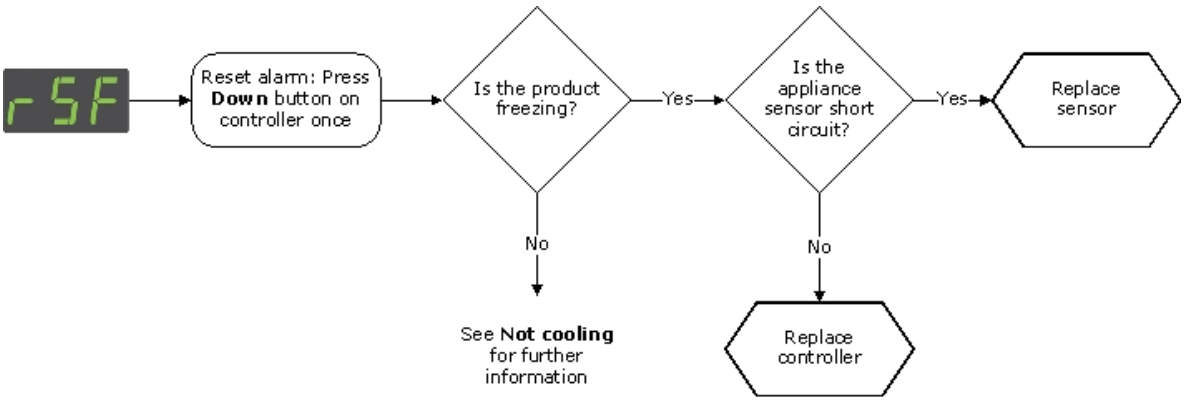
8.10 How to troubleshoot refrigeration system failure (rSF) alarms

Refrigeration system failure (**rSF**) alarms trigger if the set point (**SP**) temperature is not reached within the time defined by the compressor runtime (**Ct**) parameter.

For information about the set point and compressor run time parameters:

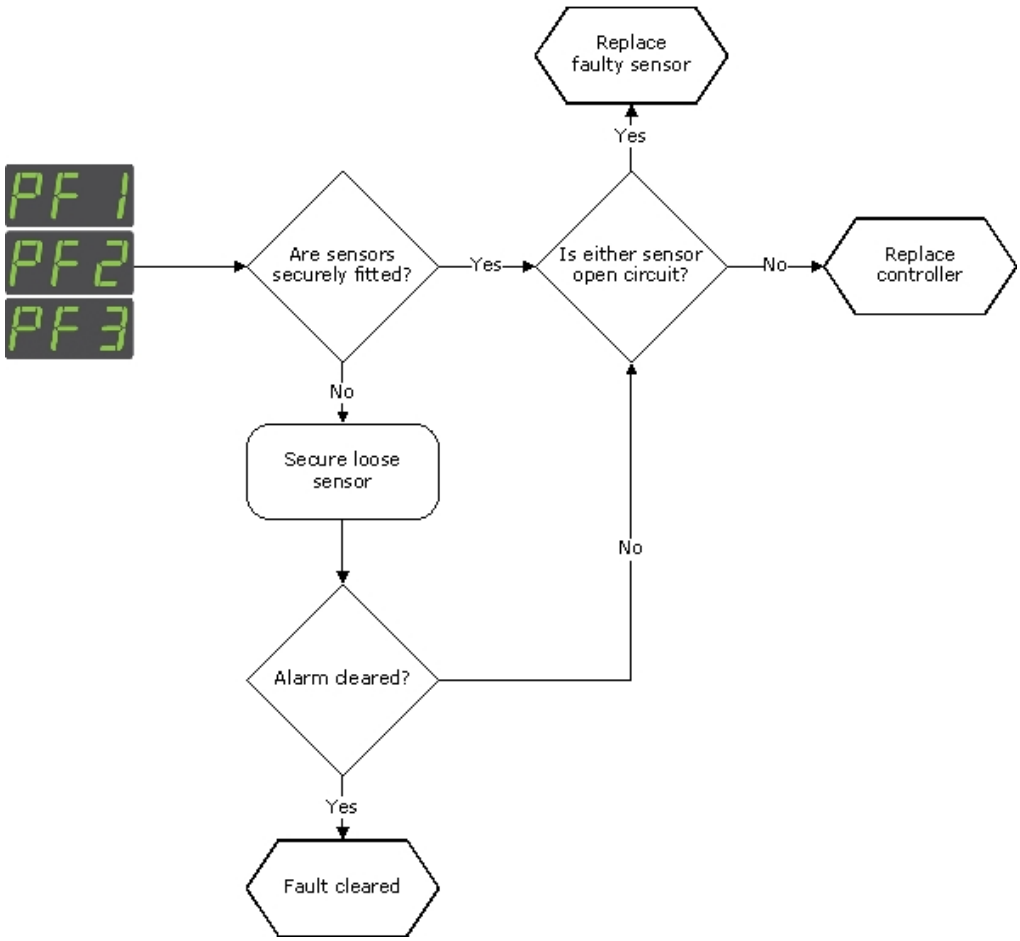
- See "Refrigeration system failure (Ct)" on page 72
- See "Set point (SPC or SPF)" on page 67

Follow the chart to troubleshoot refrigeration system failure.



8.11 Sensor failure

Follow the chart to troubleshoot problems with the temperature sensors.



PF1, PF2 and PF3 on a controller displays always indicates a sensor failure.

8.12 How to troubleshoot temperature sensor alarms

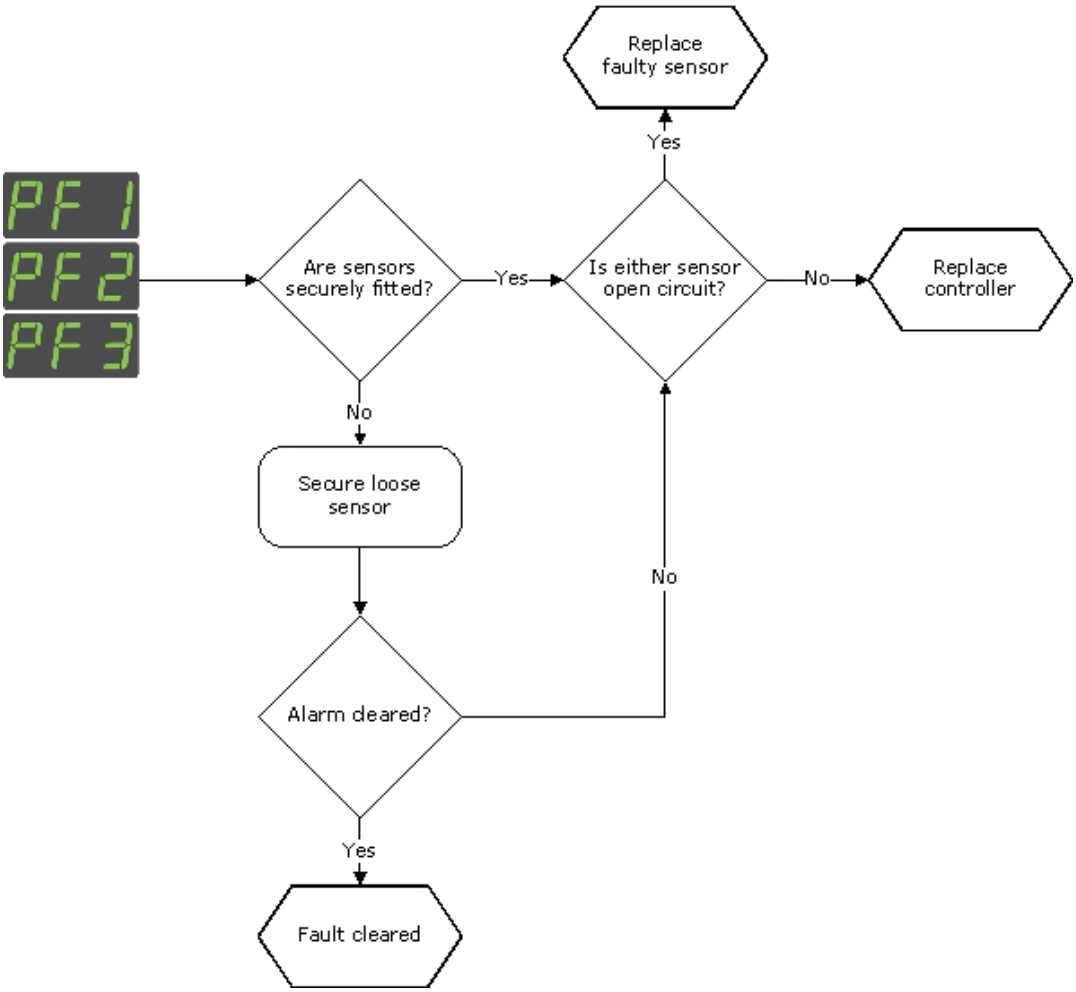
Elstat controllers manage sensor failures as follows:

- **PF1** alarms: EMS controllers stop running the compressor and then waits 60 seconds before re-starting (switch off and then switch on).
  If the fault continues, the EMS controller repeats and continues the cycle until the fault corrected.
- **PF2** alarms: EMS controllers continue running the compressor. EMS controllers alternate the display between **PF2**and the appliance sensor temperature
  indicating a fault.
- **PF3** alarms: EMS controllers continue to run the compressor normally and alternate the display **PF3** and the appliance sensor temperature.

Sensor faults may also be identified by using the input test within the test routine:

- See "How to run the test routine (tst)" on page 23

Follow the chart to troubleshoot problems with the appliance sensor, condenser sensor, evaporator sensor or gas cooler sensor.


PF 1
PF 2
PF 3
Are sensors securely fitted?
Yes
No
Is either sensor open circuit?
Yes
No
Replace faulty sensor
Replace controller
Secure loose sensor
Alarm cleared?
No
Yes
Fault cleared

9 Parameter reference

The parameter reference lists all the parameters alphabetically and describes each parameter in full. The parameters are also listed in the following groups:

- Function: groups the parameters by functionality such as product temperature, defrost, and so on.
- Owners: groups the parameters by organization, such as OEM, responsible for defining the parameter values.

The parameter values vary between different cooler types, cooler characteristics, operating environments, brand requirements, and operational preferences.

Parameter settings are defined by customers - OEMs, Bottlers and Brands - using an XML request form, and supplied in the relevant parameter information (PI) provided by Elstat.

9.1 Parameter by owners

The parameter owners are usually defined as performance, design, and operational parameters with different organizations being responsible for each set.

Performance (brand)	Set point (**SP**) and Differential (**dIF**) Saving set point (**SSP**) and Saving differential (**Sd**) Saving restart (**Sr**)
Design (OEMs)	Defrost method (**dF**) and (if applicable) Defrost termination method (**dtF**) Defrost interval (**dE**) and Defrost duration (**dd**) Defrost activation temperature (**ddt**) and Defrost termination temperature (**dtd**) Defrost heater (**dHr**) Compressor rest time (**rt**) Fan cycle on (**FCO**) and Fan cycle off (**FCF**) Calibration 1 (**CA1**) and Calibration 2 (**CA2**) Uninterrupted pull down (**IPd**) (if applicable)
Operation (operators)	Celsius or Fahrenheit (**CF**) Saving temperature disable (**PEr**) Freeze-up protection (**dtt**) Delay to saving mode (**dS**) Learning period (**LP**) and Activity frequency (**AF**) Display (**dIS**) and Display stability (**d2**) Light delay (**Ld**) and Marketing mode (**Ar**) Fan set point (**FSP**) Alarm delay (**Ad**), buzzer enable (**b0**) and buzzer duration (**b1**) Refrigeration system failure (**Ct**) Condenser high temperature (**Ht**)

9.2 Controller parameters

All EMS controllers require parameters to operate correctly. The below information is general and not specific to any controller model. It is for *reference* only and it is advised that you check the parameter listing for your controller model in this manual.

9.2.1 Firmware variants

Currently there are four variants of firmware used:

- **GDC** Firmware - optimised for coolers with doors fitted (Glass Door Coolers). Use the *aux* input for a door switch.
- **OFC** Firmware - optimised for Open Front Coolers. Use the *aux* input for the evaporator fan sensor.
- **SZ** Firmware- optimised for sub zero coolers. Use the *aux* input for the evaporator sensor, an additional input is available for the door switch.
- **CO2** Firmware - optimised for **CO2 (R744)** ready coolers with the addition of CO2 parameters.

9.2.2 ems25 series and GDC firmware defrost parameter exceptions

ems25 series controllers and ems55 series controllers with GDC firmware **do not** have the **dtF** (Defrost Termination Method) parameter. This means it is **not** possible to select a defrost on demand function.Defrost cycles will end *either* at the end of a defrost interval, or when the defrost termination temperature (**dtd**) is reached.

9.2.3 New or revised parameters

New parameters have been added to the **GDC** firmware:

- Sensor enable (**Sn**)
- Marketing mode (**Ar**)

Note:

- The above applies to ems55*advanced* controllers manufactured after July 2012

Revisions have been made to the Ar parameter for selected controllers during 2014. The following controllers have the enhanced functionality:

- ems25*Plus*
- ems25*Plus* CO2
- ems25^{+} CO2 CQC

Please refer to controller user manual for further details.

In order to determine which parameters are used, refer to the XML file. The XML file lists parameters by cooler manufacturer, model and region, as well as the controller model.

9.3 Temperature setting rules

For correct operation, the parameters that define the temperatures must not create conflicting conditions.

For example, as the EMS controller aims to keep the ready mode temperature between the set point (**SP**) temperature and the set point (**SP**) plus differential (**dIF**) temperature, the freeze-up protection (**dtt**) temperature must be lower than the set point (**SP**) temperature.

Otherwise, the EMS controller would activate freeze-up protection under normal operating conditions.
Rules for the temperature settings:

- **IPd** must be higher than **SSP** + **Sd**.
- **IPd** must be higher than **dtd**.
- **dtd** must be higher than **SP** + **dIF**.
- **SSP** must be higher than **SP**.
- **dtt** must be lower than **SP**.

9.4 Celsius or Fahrenheit (CF)

The table below details the Celsius or Fahrenheit parameter (**CF**).

Display	
Description	Option to set the EMS controller to Celsius (°C) or Fahrenheit (°F).
Considerations	• A global reset sets EMS controllers using Fahrenheit (°F) to Celsius (°C). • Applies to all temperature settings and values. • May not appear in all **OFC** firmware
Range	00 (°C) or 01 (°F)
Global default	00 (°C)

9.5 Set point (SPC or SPF)

The table below details the set point (**SPC** or **SPF**) parameter.

Display	
Description	Defines the compressor cut-out temperature during the ready mode. The set point (**SP**) temperature is the lowest measured temperature under normal operating conditions. The set point is displayed as **SPC** (set point Celsius) or **SPF** (set point Fahrenheit) depending on whether the EMS controller is set to use Celsius or Fahrenheit.
Considerations	Must be above the freeze-up protection (**dtt**) temperature.
Range	-9.9 to 9.9°C (14 to 50°F)
Global default	3.0°C (37°F) **ems75sz:** -3.0°C (27°F)

9.6 Differential (dIF)

The table below details the differential (**dIF**) parameter.

Display	
Description	Defines the compressor cut-in temperature when added to the set point (**SPC** or **SPF**) temperature during the ready mode.
Considerations	If the differential (**dIF**) is set too low, for example, less than **2.0°C**the compressor may cycle on the minimum compressor rest time (**rt**).
Range	0.0 to 9.9°C (0 to 18°F)
Global default	4.0°C (7°F) ems75sz: 3.0°C (5°F)

9.7 Calibration 1 (CA1)

The table below details the calibration 1 (**CA1**) parameter.

Display	
Description	Calibrates or adds an offset to temperatures measured by the appliance sensor.
Considerations	Applied to all temperatures measured on the appliance sensor.
Range	-9.9 to 9.9°C (-18 to 18°F) -9.9 to 4.0°C (-18 to 18°F) - ems55*advanced* (UFF d42 firmware **only**)
Global default	0.0°C (0°F)

9.8 Calibration 2 (CA2)

The table below details the calibration (**CA2**) parameter.

Display	
Description	Calibrates or adds an offset to temperatures measured by the evaporator sensor. The offset helps the positioning of the evaporator sensor.
Considerations	• Applied to all temperatures measured on the evaporator sensor. • Used with ems55*advanced* OFC firmware. • Used with the ems75sz controller.
Range	-9.9 to 9.9°C (-18 to 18°F)
Global default	0.0°C (0°F)

9.9 Saving set point (SSP)

The table below details the saving set point (**SSP**) parameter.

Display	
Description	Defines the compressor cut-out temperature during the saving mode.
Considerations	Must be set above the set point (**SP**) plus differential (**dIF**) temperature.
Range	0.0 to 9.9°C (32 to 50°F) **ems75sz**: -9.9 to 9.9°C (14 to 50°F)
Global default	all except ems75sz: 7.0°C (45°F) **ems75sz:** 3.0°C (37°F)

9.10 Saving differential (Sd)

The table below details the saving differential (**Sd**) parameter.

Display	
Description	Defines the compressor cut-in temperature, when added to the saving set point (**SSP**) temperature, during the *saving mode*.
Considerations	If the saving differential (**Sd**) is set too low, for example less than 2.0°C, the compressor may cycle on the minimum compressor rest time (**rt**).
Range	0.0 to 9.9°C (0 to 18°F)
Global default	4.0°C (7°F) ems75sz: 3.0°C (5°F)

9.11 Freeze-up protection (dtt)

The table below details the freeze-up protection (**dtt**) parameter.

Display	
Description	Defines the temperature to stop further cooling to prevent freeze-up due to low temperature.
Considerations	Must be set below the set point (**SP**) temperature.
Range	-15 to 10°C (5 to 50°F)
Global default	0.0°C (32°F) -6.0°C (21°F) - **SZ** fimrware

9.12 Fan set point (FSP)

The table below details the fan set point (**FSP**) parameter.

Display	
Description	Prevents excessive condensation on the evaporator in environments where warm, and presumed humid, air is present by operating the evaporator fan. If the fan set point (**FSP**) temperature is exceeded, the evaporator fan runs continuously even if the door is opened. On reaching set point (**SP**) temperature, the evaporator fan switches off during door openings.
Considerations	Not related to fan cycle on (**FCO**) or fan cycle off (**FCF**). Not used on ems55*advanced* and ems55R*advanced* **OFC** firmware
Range	01 to 30°C (33 to 86°F)
Global default	15°C (59°F)

9.13 Condenser high temperature (Ht)

The table below details the condenser high temperature (**Ht**) parameter.

Display	
Description	Defines the maximum temperature measured in the refrigeration system by monitoring the condenser sensor. On reaching the condenser high temperature (**Ht**), the EMS controller disables the compressor and activates an alarm.
Considerations	1. Is **not** used with CO2 (R744) coolers. 2. Requires a condenser sensor. 3. To set the condenser high temperature (**Ht**), measure the refrigeration system temperature when the condenser is 75% blocked. 4. To disable, set below 50°C or 122°F.
Range	0.0 to 125°C (32 to 257°F)
Global default	0.0°C (32°F) - disabled.

9.14 Defrost activation temperature (ddt)

The table below details the defrost activation temperature (**ddt**) parameter.

Display	
Description	Defines the temperature measured on the evaporator sensor that activates an off-cycle defrost. The defrost activation temperature minimizes the risk of evaporator icing up.
Considerations	Defrost method (**dF**) must be set to **1** to start defrost cycles on the defrost activation temperature. Available **only** with the ems55 series using **OFC** (*Open Front Cooler*) firmware and the ems75sz.

Range	-30 to 5ºC (-22 to 41ºF)
Global default	-6ºC (21ºF) ems75sz: -15ºC (5ºF)

9.15 Defrost termination temperature (dtd)

The table below details the defrost temperature duration (**dtd**) parameter.

Display	
Description	Defines the temperature to end the defrost cycle. Ending defrost cycles on temperature minimizes the duration of defrost cycles. The temperature is measured as follows: • **OFC** and sub-zero coolers: the temperature is measured on the evaporator sensor. • **GDC** coolers: the temperature is measured on the appliance sensor.
Considerations	• Must be set above the set point (**SP**) plus differential (**dIF**) temperature. • Must be set below **IPd**. • If icing up occurs, review the values of the defrost parameters.
Range	1 to 30ºC (33 to 86ºF) ems75sz: -5 to 22ºC (23 to 71ºF)
Global default	9.0ºC (48ºF) - **OFC** firmware 10.0°C (50°F) - Firmware excluding **OFC** and **SZ** 15.0ºC (59ºF) - **SZ** firmware

9.16 Compressor rest time (rt)

The table below details the compressor rest time (**rt**) parameter.

Display	
Description	Defines the minimum time between compressor cycles. The compressor rest time ensures that the pressures in the refrigeration system have time to equalize during compressor off-cycles. The compressor rest time (**rt**) helps to avoid the following: • passing peak current through the windings of the compressor motor • switching off the system on the thermal overload protection • short cycling of the system.
Considerations	If set too low, the compressor rest time may cycle on the set point (**SP**) and differential (**dIF**) temperatures or the saving set point (**SSP**) and saving differential (**Sd**) temperatures.
Range	1 to 30 minutes
Global default	3 minutes

9.17 Delay to saving (dS)

The table below details the delay to saving (**dS**) parameter.

Display	
Description	Defines the delay in switching to the *saving mode* from *ready mode*. The delay starts at the end of the last active 30 minute period of the *ready mode*.
Considerations	Must be set in multiples of 30 minutes.
Range	0 to 120 minutes (in multiples of 30 minutes)
Global default	00 (no delay)

9.18 Lights delay (Ld)

The table below details the light delay (**Ld**) parameter.

Display	
Description	Defines the delay to switch off the cooler lights after the EMS controller switches to the *saving mode*.
Considerations	• Must be set in multiples of 30. • Should only take affect once Delay to saving (**dS**) has completed.
Range	0 to 120 minutes
Global default	00 (no delay)

9.19 Saving restart period (Sr)

The table below details the saving restart period (**Sr**) parameter.

Display	
Description	Cooler runs at the *ready mode* temperature for the duration of this period to ensure that the cooler is at the set point prior to retail outlet opening time.
Considerations	• Set and verified by OEMs through the test protocol to ensure that product temperatures are within specification when outlets open. • Must be set in multiples of 30 minutes. • Depending on Ar setting, the cooler lights would normally be on.
Range	0 to 240 minutes (in multiples of 30 minutes)
Global default	120 minutes

9.20 Refrigeration system failure (Ct)

The table below details the refrigeration system failure (**Ct**) parameter.

Display	
Description	Defines the maximum continuous runtime of the compressor without reaching the set point (**SP**) temperature. If the set point (**SP**) temperature is not reached within this time, the EMS controller switches off the compressor and activates the refrigeration system (**rSF**) alarm.
Considerations	None
Range	00 to 100 hours
Global default	72 hours

9.21 Defrost interval (dE)

The table below details the defrost interval (**dE**) parameter.

Display	
Description	Defines the period between the end of defrost cycle and beginning of the next defrost cycle. A time-based defrost cycle helps improve evaporator efficiency.
Considerations	• In the event of power loss, the defrost duration (**dE**) is not maintained. The defrost interval is reset. • If icing up occurs, review the values of the defrost parameters.
Range	0 to 199 hours
Global default	06 hours

9.22 Defrost duration (dd)

The table below details the defrost duration (**dd**) parameter.

Display	
Description	Defines the maximum time of a defrost cycle.
Considerations	If icing up occurs, review the values of the defrost parameters.
Range	1 to 199 minutes
Global default	15 minutes

9.23 Defrost method (dF)

The table below details the defrost method (**dF**) parameter.

Display	
Description	Provides the option for a time-based or temperature-based defrost cycle.
Considerations	None Available **only** with the ems55 series using **OFC** (*Open Front Cooler*) firmware and the ems75sz.
Range	00 (time-based) or 01 (temperature-based)
Global default	00 (time-based)

9.24 Defrost termination method (dtF)

The table below details the defrost termination method (**dtF**) parameter.

Display	
Description	Provides the option to end a defrost cycle as follows: • on the defrost duration (**dd**) only • on defrost duration (**dd**) or defrost termination temperature (**dtd**). If the defrost termination method (**dtF**) is set to use the defrost duration (**dd**) or the defrost termination temperature (**dtd**), the EMS controller ends the defrost cycle on the first to occur.
Considerations	Defrost method (**dF**) must be set to 0 Available **only** with the ems55 series using **OFC** (*Open Front Cooler*) firmware and the ems75sz.
Range	00 (time[**dd**]) or 01 (time[**dd**] or temperature[**dtd**])
Global default	01 (time or temperature)

9.25 Fan cycle on (FCO)

The table below details the fan cycle on (**FCO**) parameter.

Display	
Description	Defines the active period of the evaporator fan while the compressor is switched off.
Considerations	Fan cycle is the fan cycle on (**FCO**) time + the fan cycle off (**FCF**) time.
Range	1 to 30 minutes
Global default	30 minutes **ems75sz**: 5 minutes

9.26 Fan cycle off (FCF)

The table below details the fan cycle off (**FCF**) parameter.

Display	
Description	Defines the inactive period of the evaporator fan while the compressor is switched off.
Considerations	Fan cycle is the fan cycle on (**FCO**) time + the fan cycle off (**FCF**) time.
Range	1 to 30 minutes
Global default	0 minutes 20 minutes - **SZ** firmware

9.27 Display stability (d2)

The table below details the display stability (**d2**) parameter.

Display	
Description	Defines the rate of change of the displayed temperature. Limiting the rate of change provides a dampening effect so as not to concern users should the air temperature rise quickly due to a door opening. Increasing the value for the display stability (**d2**) slows the rate of change of the displayed temperature.
Considerations	Use the global default value for normal operation.
Range	1 to 254
Global default	2

9.28 Buzzer enable (b0)

The table below detail the buzzer enable (**b0**) parameter.

Display	
Description	Enables or disables a warning buzzer for alarm conditions. Door open alarms **always** sound the warning buzzer.
Considerations	Following alarm conditions trigger the buzzer: • Refrigeration system failure (**rSF**) • Sensor failure (**PF1**, **PF2**, and **PF3**). • Gas cooler high temperature alarm • CO2 lock out alarm • Ht alarms • CO2 alarms - for ems CO2 firmware **only** Door alarms sound the buzzer as standard.
Range	00 (disabled) or 01 (enabled)
Global default	01 (enabled)

9.29 Buzzer duration (b1)

The table below details the buzzer duration (**b1**) parameter.

Display	
Description	Defines the duration of the buzzer for door open alarm conditions. If the door remains open after the buzzer duration (b1), the EMS controller switches off the compressor.
Considerations	The EMS controller switches off the compressor after the duration defined by alarm delay (**Ad**) + buzzer duration (**b1**). Not used on ems55*advanced* and ems55R*advanced* **OFC** firmware
Range	1 to 254 seconds
Global default	60 seconds

9.30 Alarm delay (Ad)

The table below details the alarm delay (**Ad**) parameter.

Display	
Description	Defines the maximum time the cooler door can be open before sounding the alarm buzzer.
Considerations	If disabled, the door switch is also disabled. The EMS controller does not detect door openings, therefore, the EMS controller does not: • update the self-learning matrix for door activity. • manage the evaporator fan management for door activity. • sound door alarms if the door is left open.
Range	00 to 30 minutes
Global default	00 (disabled)

9.31 Activity frequency (AF)

The table below details the activity frequency (**AF**) parameter.

Display	
Description	Defines the minimum number of door openings or motion counts to indicate an active 30 minute period in the self-learning matrix, as described below.
Considerations	See below.
Range	See below
Global default	00 (low frequency)

The table below describes the values for activity frequency (**AF**).

Value	Name	Description
00	Low frequency	1 door opening or 1 motion count
01	Medium frequency	1 door opening or 3 motion counts
02	High frequency	2 door openings or 6 motion counts
03	Automatic	The EMS controller runs continuously for 48 hours in the ready mode. After 48 hours, the EMS controller sets the value of the activity frequency to 0, 1, or 2.

Note:

- If **AF** is set to 3, the EMS controller must run continuously for 48 hours to set the value of the activity frequency. If power is lost during the 48 hour period, the EMS controller restarts the 48 hour period.
  The EMS controller must complete the 48 hour period to determine the activity frequency before starting the 1-day or 7-day learning period.

9.32 Motion sensor enable (Sn)

The table below details the motion sensor enable (**Sn**) parameter.

Display	
Description	Enables the input from the motion sensor.
Considerations	Must be disabled if a motion sensor is not fitted.
Range	00 (disabled) or 01 (enabled)
Global default	01 (enabled)

9.33 Saving temperature disable (PEr)

The table below details the saving temperature disable (**PEr**) parameter.

Display	
Description	Disables the saving mode temperature so that the EMS controller maintains the *ready mode* temperature at all times. Disabling the saving mode temperature does not affect the light functionality.
Considerations	None
Range	00 (off) or 01 (on)
Global default	00 (off)

9.34 Learning period (LP)

The table below details the learning period (**LP**) parameter.

Display	
Description	Defines whether the EMS controller uses a 1-day or a 7-day learning period.
Considerations	None
Range	00 (1 day) or 01 (7 days)
Global default	00 (1 day)

9.35 Display (dIS)

The table below details the display (**dIS**) parameter.

Display	
Description	Defines whether the EMS controller displays the temperature **3.0**, or the word **USE** during the ready mode. EMS controllers always display alarms.
Considerations	None
Range	00 (**USE**) or 01 (temperature)
Global default	01 (temperature)

9.36 Marketing mode (Ar)

The table below details the marketing mode (**Ar**) parameter.

Display	
Description	Sets the cooler lights to remain **on** at all times for display purposes. The coolers lights will remain **on** during *saving mode*.
Considerations	Does not affect saving temperature. **Only** applies to the following controllers: • ems55*advanced* and ems55R*advanced* - **GDC** • ems55*advanced* and ems55R*advanced* - **CO2** • ems75sz (sub zero) • ems55sz (sub zero)
Range	00 (off) or 01 (on)
Global default	00 (off)

9.37 Defrost heater (dHr)

The table below details the defrost heater (**dHr**) parameter.

Display	
Description	Enables the use of an auxiliary relay to switch a defrost heater or solenoid valve. The defrost heater is a heating element located below the evaporator.
Considerations	None
Range	**00**: Do not use a defrost heater. **01**: Switch on the defrost heater during the defrost cycle and run the evaporator fan. **02**: Switch on the defrost heater during the defrost cycle and do not run the evaporator fan. **03**: Switch on the defrost heater during the defrost cycle and do not run the evaporator fan. The evaporator fan then remains off for one minute after the end of the defrost cycle. **04**: Switch on the defrost heater during the defrost cycle and do not run the evaporator fan. The evaporator fan then remains off for two minutes after the end of the defrost cycle. **05**: Switch on the defrost heater during the defrost cycle and do not run the evaporator fan. The evaporator fan then remains off for three minutes after the end of the defrost cycle. **06**: Hot gas defrost. That is, the relay switches a solenoid valve.
Global default	00

10 What variations of the ems75sz (sub zero) can I order?

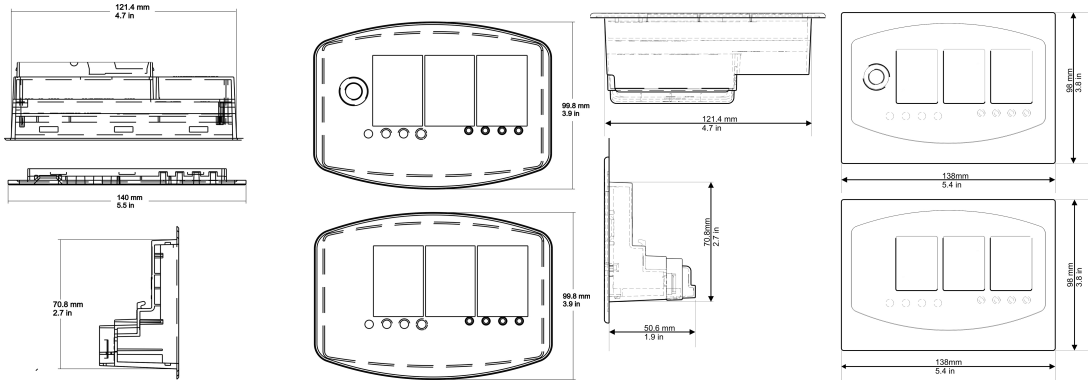
Marketing type text here:

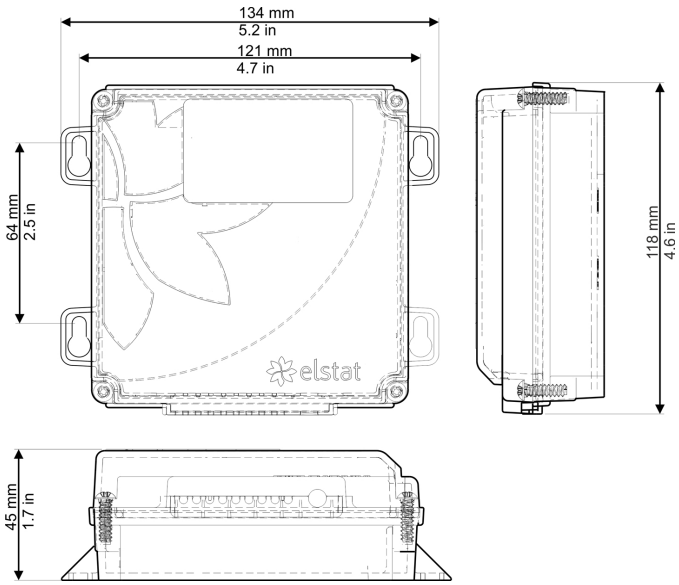
LED colour	Membrane colour	Curved CDM	Rectangular CDM	Availability	Lead time
Red	Black	✓	✓	Approved for sale	e.g.16 days
Green	Black	✓	✓	Development product	
Pure Green	Black	✓	✓		
Blue	Black	✓	✓		
White	Black	✓	✓		
Red	Blue	✓	✓		
Green	Blue	✓	✓		
Pure Green	Blue	✓	✓		
Blue	Blue	✓	✓		
White	Blue	✓	✓		
Red	Green	✓	✓		
Green	Green	✓	✓		
Pure Green	Green	✓	✓		
Blue	Green	✓	✓		
White	Green	✓	✓		
Red	Red	✓	✓		
Green	Red	✓	✓		
Pure Green	Red	✓	✓		
Blue	Red	✓	✓		
White	Red	✓	✓		
Red	Silver	✓	✓		
Green	Silver	✓	✓		
Pure Green	Silver	✓	✓		
Blue	Silver	✓	✓		
White	Silver	✓	✓		
Red	Yellow	✓	✓		
Green	Yellow	✓	✓		
Pure Green	Yellow	✓	✓		
Blue	Yellow	✓	✓		
White	Yellow	✓	✓		

10.1 Examples of CDM colours

11 Technical data ems75sz

11.1 Dimensional drawings:





11.2 Controller relays:

Relay	IEC 60730 rating @ 100-120VAC and 220-240VAC 50/60Hz
Compressor	10 (10) A, p.f. 0.6
Light	4 (4) A, p.f. 0.6
Evaporator fan	6 (6) A, p.f. 0.6
Auxiliary*	6 (6) A, p.f. 0.6

*relay used for defrost functionality

11.3 Temperature sensors:

Sensor	Input range (^{O}C)	Input range (^{O}F)
Appliance sensor	-10^{O}C to 23.3^{O}C	14^{O}F to 74^{O}F

Sensor	Input range (^{O}C)	Input range (^{O}F)
	+/- 0.5^{O}C	+/- 1^{O}C
Condenser sensor	-10^{O}C to 23.3^{O}C +/- 5^{O}C	122^{O}F to 257^{O}F +/- 10^{O}F

11.4 Environmental ratings:

Characteristic	Value
IP (Ingress Protection):	
• Controller display module **CDM**	IPX5
• Power supply module **PSM**	IPX5
Maximum ambient temperature	50^{O}C (122^{O}F)

11.5 Product approvals:

	EN60730-1 EN60730-2-9
European Norms Electrical Certification	
	IEC60730-1 IEC60730-2-9 Glow wire: IEC60335-1
International Electrotechnical Commission	

Please note:

	CE (Conformité Européene / European Conformity)
Replaces:	
	RoHS (Restriction of Hazardous Substances)
On controller labelling as of January 2013	

12 Glossary of terms

12.1 Acronyms

The table below explains the meanings of the most common acronyms used in this manual:

Acronym	Meaning	
ems or **EMS**	**E**nergy **M**anagement **S**ystem	The Elstat range of products in this group are all energy management systems.
OFC	**O**pen **F**ront **C**ooler	A cooler type which determines a firmware varient Elstat uses on certain products.
GDC	**G**lass **D**oor **C**ooler	A cooler type which determines a firmware varient Elstat uses on certain products.
XML	E**x**tensible **M**arkup **L**anguage	XMLs are used by Elstat to transfer parameter sets to EMS controllers. The XMLs (parameter sets) determine how a controller will operate.
GUI	**G**raphical **U**ser **I**nterface	Used to view XMLs (parameter sets) and supplied by Elstat as part of the the Parameter Information documents.
SELV	**S**afety **E**xtra **L**ow **V**oltage	**IEC** defines a **SELV** system as "an electrical system in which the voltage cannot exceed **ELV** under normal conditions, and under single-fault conditions, including earth faults in other circuits".
		Safety Extra Low Voltage as described in **BS EN 60335** *Household and similar electrical appliances - Safety* standards.
IEC	**I**nternational **E**lectrotechnical **C**ommission	Publisher of international standards for all electrical, electronic and related technologies.
IP	**I**ngress **P**rotection	A protection rating achieved by the controller preventing intrusion and water into the housing of the controller.

12.2 Controller and accessory terms

The table below describes the meanings of some of the terms used frequently within the manual in relation to the controller and accessories:

Term	Meaning
Ready mode	The cooler is operational and cooling products at the set point.
Saving mode	The cooler is saving energy and the product is at the saving set point.
Appliance sensor	A sensor which measures the temperature inside the cooler cabinet to give an approximation of the product temperature inside.
Self-learning	How the EMS learns ready and saving periods.

Term	Meaning
matrix	The matrix is populated according to activity levels and the EMS manages the cooling system accordingly.
microRMD	A remote motion detector (sensor) supplied with controllers which do not have an integrated motion detector. The microRMD can be fitted anywhere it can detect motion allowing the controller to be installed out of sight.
Firmware	The code written into the EMS microcontroller containing the rules and algorithms of operation. Every controller contains firmware and the version of firmware is identified during power up by two, three digit numbers.
Checksum	The checksum is a 'sum' which identifies which parameter set - or XML file - has been loaded onto a controller. It is unique to each parameter set.

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