INSTALLATION AND PROGRAMMING
Phasefale's TACm

General Overview and Introduction

Phasefale's TACm is extremely simple to set up and operate. The temperature is shown on the LED display. If cooling or heating operations are occurring a point is displayed at the end of the temperature display. Flashing of the temperature indicates an alarm situation. During defrost, **dF** is displayed. The programmed settings may be viewed by pressing and holding the � button for 2 seconds.

1. INSTALLATION

Enclosure Installation
The Enclosure can be mounted in any position, and is splash proof. Mount the base and fit two of the mounting screws in the lid. The lid can then be hinged out to allow the electrical connections to be made.

Temperature Sensor (M Probe) Installation
The temperature sensor is an NTC thermistor of extreme accuracy (0.2°C), and it has a non-linear resistance-temperature characteristic (see chart below). It is ideally mounted in a position where refrigerated air is circulating.
At least 150mm of the sensor cable needs to be in the refrigerated space to ensure accurate temperature sensing.
If the sensor cable is open or short circuit, the TACm will display **Er** to indicate the fault. If a defrost terminate probe is used it should be mounted in the evaporator coil.
The sensor cable is double insulated and therefore does not need to be enclosed in a conduit. There is no polarity to the sensor connection. It may be extended up to 100 metres by joining an extra cable (use double insulated cable) *but the join must be well insulated and away from any dirt or moisture.*
Dirt or moisture at the join will reduce the resistance of the probe and result in a higher temperature reading than normal.

Electrical Installation
Refer also to the electrical wiring diagram for connection details. The

M Probe-
Resistance vs Temp. (Celsius)

Extend M Probe to 100m.
using Heatshrink on joins
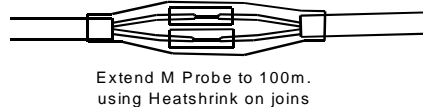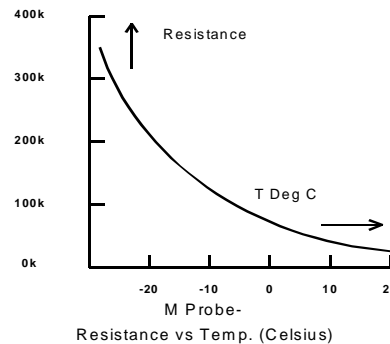
Active supply to the unit should be fused with a maximum rating of 10A. The control and light outputs are rated at 10A resistive. *Motors larger than 1 HP MUST be switched via a relay or contactor* (available from Phasefale).
The dialler output provides alarm contacts which open on alarm or power loss. The contacts can be connected to Phasefale's AD2 telephone dialler to provide a remote alarm using existing phone lines.
If an AD2 is connected, the 2-way connector labelled "dialler" can be used to supply 12V DC to the dialler. The correct polarity is indicated on the wiring diagram. If a battery is fitted, connect to the battery.
TACmb is supplied with the battery back-up disconnected. Reconnect once mains power is connected.
If the **mdPCB** option for heater and fan outputs is to be fitted, follow the instructions supplied with it.
The optional toggle defrost, synchronising time, terminate defrost, distress, clear memory and acknowledge inputs are extra low voltage inputs and require voltage free contacts. Closing the contacts momentarily will initiate the function. Refer to the wiring diagram for correct wiring of these inputs.
The optional Alarm Isolate input requires voltage free contacts and is active while the contacts remain closed.
The **complog** interface wiring is described separately.

Installation Self-Test
Press ⌧ and ⊗ together for 5 seconds. The TACm automatically cycles its outputs in the following sequence:

Display	Action	sec.
CO/CF	Control On&Off	10/4
LO/LF	Light On&Off	4/4
dO/dF	Dialler+Buzzer	4/4
HO/HF	Heater On&Off	4/4
FO/FF	Fan On&Off	4/4

2. PROGRAMMING

The basic programming steps are:
- *"Unlock" the TACm permanent memory for programming*
- *Select the setting to be adjusted.*
- *Alter the setting to your desired value.*
- *Store the changed value.*
- *Return to normal operation.*

a) To unlock the TACm and alter the settings, press ⌧ and ⌨ together for 5 seconds. **UL** will be displayed to indicate that the system is unlocked.

b) After the TACm is unlocked press ⌧ until the setting you wish to alter is displayed. The settings and values are displayed in the table below:

Setting	Default	Display adjustment range
SP	0.0	Control Setpoint °C (-35 ~ +55°C)
dI	Ec	Differential Temp °C 0.5~5°C, Ec: economy
AH	13	High Alarm Temp. °C (-30~ +60°C)
AL	-5.0	Low Alarm Temp. °C (-40~+50°C)

At	90	Alarm Time Delay (0~99 minutes)
nd	1	Number of defrosts per 24hr (0~6)
dd	30	Defrost duration (1~99minutes)

c) After the setting to be adjusted is displayed, you can increase or decrease the setting by pressing ⊗ or ⊘ until the numerical value required is displayed.

d) To store the changed value, press the ⌨ keypad. The new value is now stored indefinitely and will remain during power loss.

e) If no keypad is pressed for 60 seconds the TACm will once again lock itself and further alterations will be disallowed until unlocked again. This will also occur if the ⟩⟩ key is pressed during the programming operation.

Remember! *you must store each altered value using* ⌨

2a. ADVANCED *[AAmenu]* PROGRAMMING OPTIONS

A further series of functions and commands can be accessed during the Unlocking stage by simply pressing the ⌨ and ⟩⟩ keys for a total of 10 seconds, at which time the symbol **AA** is displayed. Program items which can be accessed in the advanced menu are indicated in the following table and are explained under their appropriate function headings.

Sett-ing	Def-ault	Value Shown (adjustment range)
AA	14	Alarm Acknowledge/ Limit Start Time
tr	5	Defrost Terminate or Range °C (2.5,5,7.5,10°C)
Co/He	Co	Cooling or heating mode
dt	1	Heater drain period (0~12minutes)
Ft	1	Fan delay/ Pump down time (0.0~4.0 min.)
dE/dg	dE	Electric or Hotgas defrost
tE/rA	tE	S2 input as **te**mperature sensor defrost terminate or **rA**nge via external potentiometer
Sd/Hd	Sd	Show/Hide temperature display during defrost
St	3	Time of first defrost (0~23)
CA	0.0	Calibration Offset (-9.9 to 9.9°C)

2b. A PROGRAMMING EXAMPLE

A small fruit room needs to be controlled at 1.0°C. We want a high alarm at 9.0°C and a low alarm at -2.0°C to prevent the fruit from freezing. Being a small room, we will set the alarm time to 60 minutes. As we are energy conscious, we will use the economy mode of operation. We want two 45 minute defrosts per day.

Step 1 Use the auto-setup to load suitable settings:
- Unlock the TACm using ⌨ and ⟩⟩ keys. Display reads **UL**, then...
- Display shows **SP** eg. 5.0.
- Decrease the setpoint by pressing ⊘ until 1.0 is displayed.
- Store the new setpoint with ⌨.
- **dl** (for differential) then **Ec** (Economy mode*) is displayed.
- Press ⊘ and **AU** (Automatic mode*) is displayed.
- Store the automatic setting with ⌨ key.

** There are three programming options in differential **dl** :*
Ec Economy mode - a method to reduce energy usage whilst using the internal limit start timer to protect the compressor.
AU Auto setup - Default settings (for all the programmable values) based on your setpoint are loaded into the TACm's memory.
0.5 to 5.0 Differential Temperature in °C - The specific temperature required for the control. (See Cooling and Heating Operations)

Step 2 The TACm has stored close values, but we now "fine tune" the settings for our application:
- Unlock the TACm: ⌨ and ⟩⟩
- Display **UL**.
- **SP** then 1.0 is displayed, press ⌨
- **dl** then **EC** is displayed, press ⌨.
- **AH** then 14 is displayed, decrease the high alarm to 9.0 using ⊘ Store the new high alarm setting with ⌨.
- **AL** then -4.0 is displayed, increase the low alarm setting to -2.0 using ⊗
- Store the new low setting using ⌨
- **At** then 90 is displayed, decrease the alarm time delay to 60 using ⊘, then store with ⌨.

- **nd** then 1 is displayed. We want 2 defrosts so press ⊗ then ⌨ to store.
- **dd** then 30 is displayed, set the defrost duration to 45 and store with ⌨ .

Step 3 Check our Settings
Press ⌨ for 2 seconds, and our stored values are automatically displayed.
The TACm is now ready for operation.

3. COOLING AND HEATING OPERATIONS

Heating and cooling control is between the setpoint **SP** (cut in) and the setpoint minus the differential **dl** (cut out). For example: **SP** =10°C, **dl** =1.0°C: control between 9.0°C and 10°C. Another example: **SP** = -10°C, **dl** =3.0°C: control between -10°C and -13°C.

The Heating and Cooling options **HE** and **Co** *[AA menu]* select whether the C1/C2 output controls heaters or coolers. In heating mode there is no limit start timer or defrost function and programming options which relate to defrosts will be skipped. If Cooling is selected, a limit start timer protects against short cycling the compressor. The timer will prevent the cooling output turning on for a period starting the previous time the cooling output turned on. Once this period has elapsed the output is free to turn on as required. The limit start period is the units part of the **AA** (alarm acknowledge) setting. For example **AA**=4,14,24 etc. means a limit start period of 4 minutes, **AA**=9,19,29,39 etc. means 9 minutes, **AA**=10,20,30 etc means 0 minutes or no limit start delay.

C1/C2 comes on when cooling is required.

The terminate/range temperature function **tE/rA** *[AA menu]* sets a temperature terminated defrost **tE** if a probe is connected (See Defrost), *or* it sets the range offset **rA** as described below:

An external trimpot of 100kΩ value may be used to modify the control temperature up or down by 2.5, 5.0, 7.5 or 10°C as set by the **tr** setting. The programmed value **SP** then becomes the "midpoint" of the setpoint range. 0kΩ gives the minimum, 100kΩ gives the maximum and 50kΩ leaves the setpoint unchanged. If no trimpot is connected, the setpoint remains unaltered. The high

and low alarm temperatures **AH**, **AL** will be shifted in conjunction with the setpoint **SP**. Note that **SP**, **AH** and **AL** will reflect the altered setpoints when viewed by pressing ⓜ from normal operations. By using fixed resistors, specific temperature setpoints can be set up using a rotary switch or time clock.

4. ALARM

The Alarm function has a high temperature (in °C) setpoint, **AH**, a low temperature (in °C), **AL**, and a time delay, **At**. If either setpoint is exceeded for longer than the time delay an alarm will occur. If cooling mode is selected the low alarm will occur in $^1/_4$ of the time delay **At**. The optional distress alarm will initiate an alarm immediately if connected, as will a power failure if the internal battery backup option is used.

An Alarm is indicated by the temperature display flashing accompanied by the sounding of a buzzer, a flashing alarm light and/or a dial signal if these accessories are connected.

An alarm may be acknowledged by pressing ⓓ momentarily or via an external switch. The light will then be steady on and the buzzer and dialler off for the period set by **AA** *[AA menu].* The alarm will reoccur after this period of time unless the temperature returns to normal.

An Alarm Memory is shown by the display flashing but no other alarm indications. This indicates that an alarm has occurred but that the temperature has since returned to normal. It may be cleared by pressing the ⓓ button.

If a hot gas defrost is used [d**g** in advanced menu], the light output cannot be used as an alarm light, the buzzer and dialler outputs still operate as normal during alarm.

5. DEFROST

The defrost duration **dd** is the time in minutes in which the refrigeration is switched off and the heaters are on. Defrosts are spaced at equal periods during the day and the number per day is set by **nd**. For example, if **nd** = 2 a defrost will occur every 12 hours.

A 24 hour clock sets the time of day for defrosts. The optional synchronise input will set the clock to midnight if closed.

Press ⊗ to find out when the next defrost will occur, **td** is displayed, followed by the number of hours until the next defrost. Similarly, pressing ⊖ displays **Fd** followed by the number of hours since the last defrost occurred. The decimal place represents 10 minutes, ie 2.4 is 2 hours and 40 minutes.

To initiate a Toggle Defrost, hold the ⓓ button for 1 second and either **dF** or **Co** will be displayed, to indicate whether the refrigeration is presently in defrost or cooling mode. Press the ⊗ button followed by ⓜ to initiate a defrost or press the ⊖ button followed by ⓜ to terminate a defrost. This function can also be accomplished with an external toggle defrost switch (which will alternate the status between defrost and cooling when closed) or via the terminate defrost input (which will terminate a defrost and initiate a drain period).

Further defrost functions can be accessed via *[AA menu]*. The **Sd** (Show defrost) function alternates the display between **dF** and the temperature during defrosts, whilst **Hd** (Hide defrost) causes the display to show only **dF** during defrost.

Also accessible *[AA menu]*, **St** refers to the Start Time of the first defrost. Defrosts will then occur at periods evenly spaced during the day as set by **nd**. So, groups of TACm's may be set to stage defrosts between them by selecting different start times for each unit, and synchronising the time with a master clock via the synchronise input.

The Heater Drain Time **dt** *[AA menu]* sets the period in minutes from the end of the defrost period **dd** until the cooling output is allowed to operate.

The **Ft** Fan Delay Time sets the period in minutes from the end of the drain time when cooling comes on to the time when the fans are allowed to operate. The decimal place represents 10 seconds, ie 1.3 is 1 minute 30 seconds.

The **dE/dg** (Electric/hot Gas defrost) *[AA menu]* allows the unit to control Electric (Liquid,Heater and Fan) or Hot Gas (Liquid,Suction,Hot Gas and Fan) defrosts.

A Hot Gas defrost uses the Light output as the Suction solenoid control and the **Ft** setting as a pump down time. The Hot Gas output sequence is as follows..
HOT GAS SEQUENCE

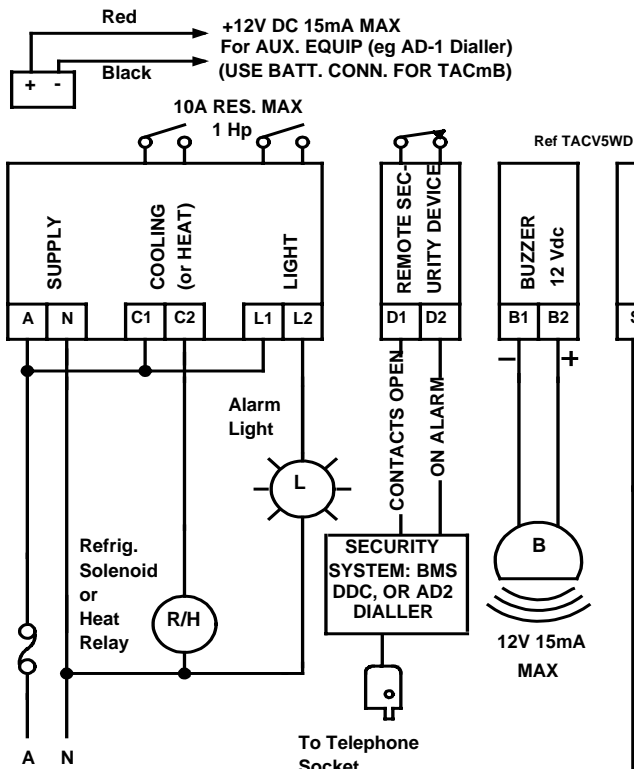| Output	C	L	H	F	time
Representing;Liquid ; Suction;Heater; Fan					
Cooling	on/off	on	off	on	
P/D	off	on	off	on	**Ft**
Defrost	off	off	on	off	**dd**
Drain	off	off	off	off	**dt**
Fan	on/off	on	off	on	**Ft**
Cooling	on/off	on	off	on	

A second **M Probe** may be used as a temperature termination sensor for the defrost. It is used between the S & S2 outputs. The **tE/rA** setting should be set to **tE** and the defrost terminate temperature set by **tr** at 2.5, 5.0, 7.5 or 10° C.
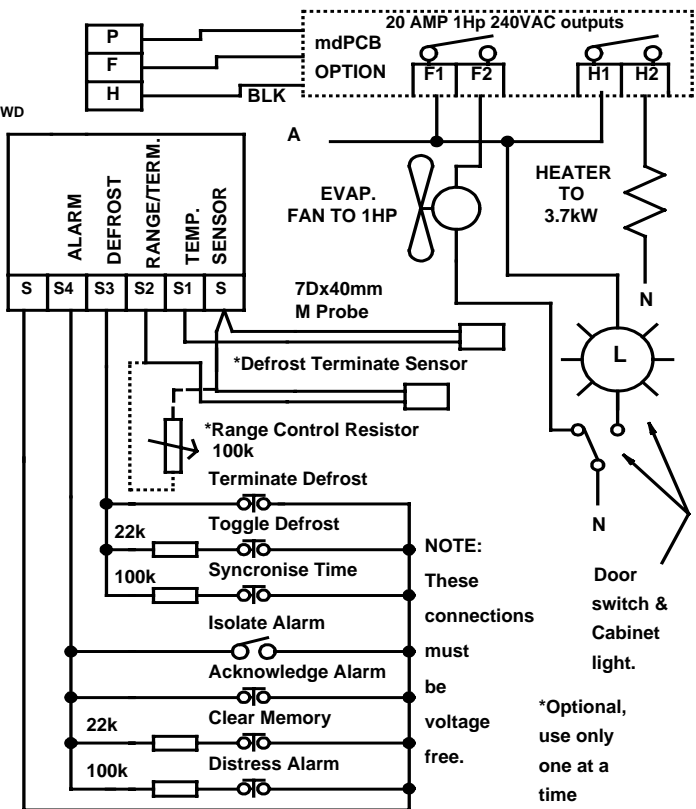
6. TEMPERATURE LOGGING

Press both ⊗ and ⊖ buttons together. **Lo** (Logging) is displayed. Pressing ⊗ will show the highest temperature in the last hour, continue pressing ⊗ and the previous hour's highest is indicated - up to 99 hours. **PL** indicates that a power loss occurred. If you wish to know how many hours ago a record was stored, press ⊗ and ⊖ together to show the hours since the record was made. Once again, pressing ⓓ will return you to normal operation.

Repeat the above sequence but press ⊖ and the lowest temperatures will be shown.

7. ALPHABETICAL LIST OF DISPLAY INDICATIONS

		Def				Def			Def
AA	Alarm Ack./Limit Start	14	dl	Differential °C	Ec	Lo	Logging	-
AC	AC Mains Failure	-	dO	Dialler ON	-	LO	Light OFF	-
AH	High Alarm temp.°C	13	dt	Heater drain time mins	1	n6	software version 5.6	-
AL	Low Alarm temp °C	-5	Ec	Economy mode	Ec	nd	number of defrosts	-
At	Alarm time delay mins	90	Er	Probe Error(open/short)	-	PL	Power Loss	-
AU	Automatic setup	-	Fd	from last defrost hours	-	rA	Range (via pot.)	tE
CA	Calibrate	0	FF	Fan OFF	-	Sd	Show temp during defrost	Sd
Co	Cooling mode	Co	FO	Fan ON	-	SP	Setpoint temperature	0.0
CO	Cooling ON	-	Ft	Fan delay time mins	1	td	time to next defrost hours	-
CF	Cooling OFF	-	Hd	Hide defrost temp °C	Sd	tE	temperature terminate	tE
dd	defrost duration mins	30	HE	Heating mode	Co	tr	defrost termination/range°C	5
dE	Electric defrost	dE	HF	Heater OFF	-	UL	programming unlocked	-
dF	Defrost or Dialler OFF	-	H0	Heater ON	-			
dg	Gas defrost	dE	LF	Light OFF	-	*Def is the default setting*		

8. TACm WIRING DIAGRAM