ADVANCED TEMPERATURE CONTROL
TRUCK REFRIGERATION SYSTEMS

CONTROLLER MANUAL

FOR ALL REFRIGERATION UNITS

ADVANCED TEMPERATURE CONTROL
1416 GRAHAM'S LANE
BURLINGTON, ONTARIO
CANADA
L7S 1W3

Manual P.N **M960144**
Manual Revision **G, June 2, 2021**
Controller Software **3.0**
ECU Software **1.7**

Contents

1) INTRODUCTION 3
2) SYSTEM OPERATION 4
2.1) Control Panel 4
2.2) Power 4
2.3) Default Display Temperature 5
2.4) Graphical display 5
2.5) Buzzer 5
2.6) Temperature sensors 6
2.7) Setpoint 6
2.8) Ventilation / Blower Output 7
2.9) Cooling 8
2.10) Heating 10
2.11) Condenser 11
2.12) Defrost 13
2.13) Dripping 16
2.14) Drain Time 16
2.15) Voltage monitoring 16
2.16) Door Sensor 16
3) ADDITIONAL FEATURES 17
3.1) Time and Date 17
3.2) Data Logging 18
3.3) Log File 19
3.4) System Parameters 19
3.5) Saving and Loading Parameters through USB disk 26
3.6) Inputs and Outputs Visualization 27
3.7) Test Mode 29
3.8) Parameter Resetting 31
3.9) Temperature Unit 32
3.10) Faults and Alarms 33
3.11) Hourmeters 36
3.12) Op.Mode Settings 37
4) OPERABILITY 39
5) REVISON HISTORY 40

1) INTRODUCTION

The electronic refrigeration controller **M910165** is a microprocessor-based controller, designed to control a refrigeration and defrost system. It can operate in a temperature range of -40°C to +80°C. The **M910165** communicates with the input/output (I/O) module, **M910167**, through one wire communication. The controller + module monitor nine inputs: high- and low-pressure transducers (or digital switches), door sensor, electric standby input, ignition input, proximity sensor and three temperature sensors; return, evaporator and condenser temperature sensors. In addition, it monitors seven digital outputs; compressor cutch, heating, evaporator blower(s), hot gas solenoid valve, electrical heating strips and a PWM output for the condenser fan(s). The **M910167** PWM output operates with the **M920165** (condenser fan speed module). The I/O module also has a USB port for data logging.

2) SYSTEM OPERATION

2.1) Control Panel

The controller contains a main CPU and is composed of a keyboard for programming and controlling of the refrigeration system, a buzzer for warnings and a screen for viewing parameters, operating status, battery voltage and temperature.

2.2) Power

Controller operation will start when the controller is supplied either 12VDC or 24VDC, however temperature control begins only after the controller finishes monitoring two input signals: electric standby and ignition. If both signals are ever ON at the same time, the controller will alert the operator by flashing a "**SBY"** fault on the display, ringing the internal buzzer and beginning temperature control following standby logic. Ignition road compressor operation will only start if the ignition input is ON **and** the electric standby input is OFF. The alarm and fault warning will only stop when only **one** of the signals is detected (engine turned off or wall plug unplugged). Note that the controllers **EI+Ign.Alm** parameter controls this safety feature and by default is set to **Enable.**

The controller begins temperature control based on the setting used for the **Init.State** parameter. The three different settings for **Init.State** are: **OFF, ON, and Last State**.

When **Init.State** is set to **OFF**, and an input signal (either electric input from wall plug or ignition input) is active, the controller will turn on in standby mode. During standby mode, the display will be off and only the key will be on. To turn the controller ON and begin temperature control, press the key once. The ATC logo and controller software version will flash on the screen, prior to the screen displaying either the setpoint or return temperature (depending on the adjustable parameter **Temp.Shown**) and initiating temperature control. To return to standby mode, press the key down once.

When the parameter **Init.State** is set to **ON**, the controller will automatically turn on and initiate cooling if at least one of the signals (either electric or ignition) is active. This mode prevents the operator from turning off temperature control. If the key is pressed, the controller will momentarily turn off before automatically turning back on and resuming temperature control.

When the parameter **Init.State** is set to **Last State**, the product will start to operate according to the last state from the last power cycle. This means the controller will continue cooling if it was last cooling or it will remain in standby, if it was last in standby. By default, all controllers are programmed to be **Last State**.

2.3) Default Display Temperature

The default display temperature on the controller display for startup and system operation can be set to either the **Return or Setpoint temperature**. The display temperature is configured using the **Temp.Shown** parameter. Instructions for changing parameters is discussed in section 3.4 “System Parameters”.

2.4) Graphical display

The screen displays the setpoint value and active control state. It also allows the user to visualize the various temperature probe readings, transducer pressure readings as well as other parameters. In addition, it is used to warn users of any system faults/failures.

2.5) Buzzer

The controller has an internal buzzer that is used to alert and communicate specific conditions to the operator. The buzzer will ring if any of these conditions occur:

- Door sensor is installed, the door is open and the parameter **DoorOp.Alm** is set to **Enable**
- Proximity sensor is installed, an object triggers the sensor and the parameter **RoofPr.Alm** is set to **Enable**
- Electrical and Ignition inputs are active at the same time and the parameter **El+Ign.Alm** is set to **Enable**

The controller display will also warn the operator if any faults are occurring. Refer to section 3.10 “Faults and Alarms” for more details.

2.6) Temperature sensors

The controller uses three temperatures sensors: Return, Evaporator coil/Serpentine and a Condenser temperature sensor. The key can be used to toggle through these temperatures. Once the desired temperature has been viewed, do not click anything as the system will automatically timeout and return to the default display temperature.

The two-letter codes shown below can be used to identify the temperature being displayed.

- **SP** – Setpoint
- **RT** – Return
- **EV** – Evaporator
- **CD** – Condenser

In addition, there are 3 parameters available for temperature sensors requiring further calibration/tuning.

- **Ret.Offset** allows an offset for calibrating the return temperature reading
- **Ev.Offset** allows an offset for calibrating the evaporator temperature reading
- **Con.Offset** allows an offset for calibrating the condenser temperature reading

Problems with the sensors will trigger a fault, which will be shown on the controller display, in the data log and within the fault's menu. These faults are covered in more detail in section 3.10 "Faults and Alarms".

2.7) Setpoint

The Setpoint is the desired temperature inside the cabin. To adjust, press the or key. Initially, the setpoint temperature will flash on the display, after which it will increment or decrease depending on which key is used. Continue to use or , stopping when the desired setpoint is reached.

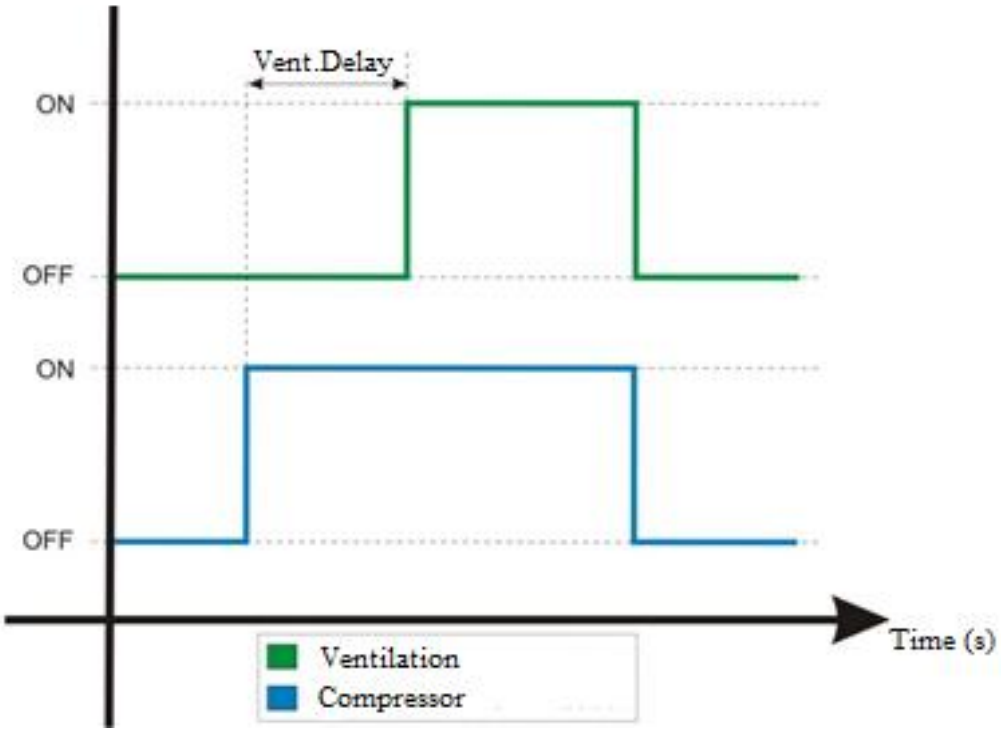
If the **SetP.Block** parameter is set to **Enable** and the or key is pressed, the display will show a **BLK** message indicating that setpoint changes are blocked. **SetP.Block** can be used to control the operators ability to alter system temperature.

2.8) Ventilation / Blower Output

The evaporator blower initiates after a short delay following compressor activation. This delay can be adjusted with the **Vent.Delay** parameter. Ventilation logic can also be customized for when the cabin door is opened or when the compressor is off.

Ventilation by default is on when the refrigeration door is opened, this setting is adjusted using the parameter **V.Door.Open**. If **V.Door.Open** is set to **Disable**, ventilation will be off while the door is opened and if **V.Door.Open** is set to **Enable**, ventilation will remain on when the door is opened. Note that this default is chosen, since this feature can only be used if a door sensor/switch has been installed.

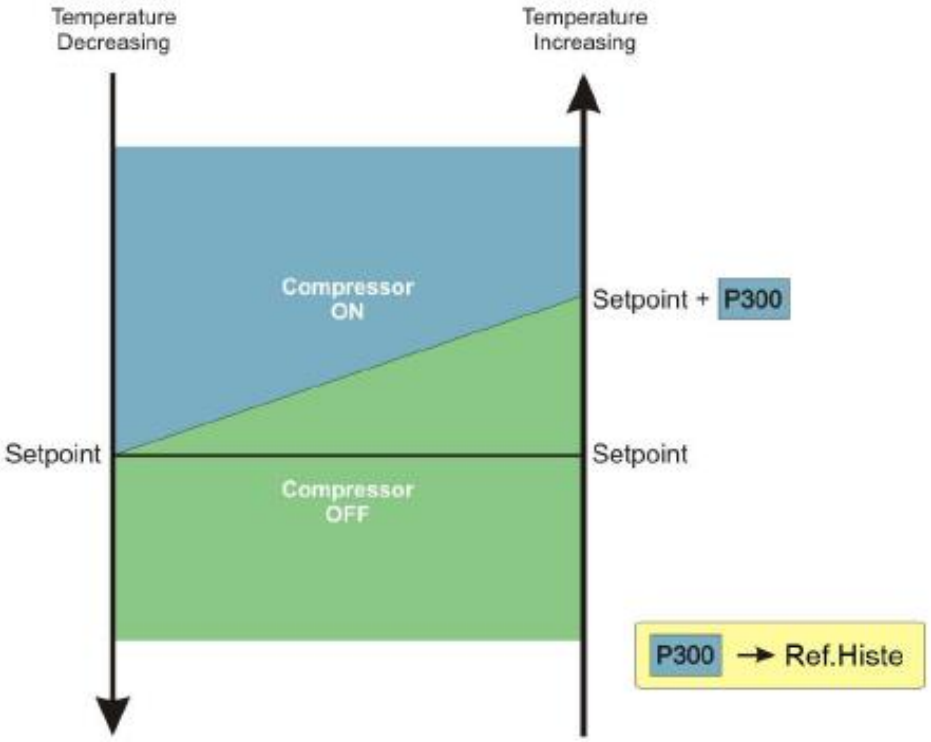
By default, ventilation will be ON regardless of the compressor state. This can be adjusted using the parameter **V.Comp.Off**. When set to **ON**, ventilation can still occur when the compressor is off. If changed to **OFF**, ventilation will never occur if the compressor is in the off state. However, during defrost, ventilation will behave based on the set point for **Op.Mode**. This is covered in section 2.12 “Defrost”.



Note: During a Communication Failure (CF). The controller turns off all outputs after 30 seconds.

2.9) Cooling

The controller will turn on and follow **Init.State** as described previously in section 2.2 “Power”. Cooling will then begin when the return temperature is higher than the desired **setpoint** + **Ref.Histe**, where **Ref.Histe** is the cooling differential, a programmable parameter. Cooling will turn off whenever the return temperature reaches the **setpoint**. A visual representation is shown below.



To completely turn off temperature control, press once. Recall, temperature control cannot be turned off when **Init.State** is set to **ON**. In addition, it is important to recall that there is a 30 second protection to protect the compressor if it is repeatedly turned on and off with .

The system operates with either two digital pressure switches or transducers (for high and low side pressures). The choice between is set using the **Press.Type** parameter, where **Digital P** represents a pressure switch and **Transduc** represents a transducer.

Pressure switches are on/off according to their manufacturing specifications, connecting to VDD when there are no faults and open when a pressure switch has occurred. Meanwhile, transducer operation is controlled by the controller, using the parameters **CinLPress, CoutLPress** for the low-pressure transducer, and parameters **CinHPress and CoutHPress** for the high-pressure transducer.

The parameter **CoutLPress** is the low side pressure where the compressor will cut-out (turn off). The system will remain off, while safety measures attempt to bring the pressure up to the cut-in pressure set in **CinLPress.**

The parameter **CoutHPress** is the high side pressure where the compressor will cut-out (turn off). The compressor will remain off until the high side pressure comes down to the cut-in pressure set in **CinHPress.**

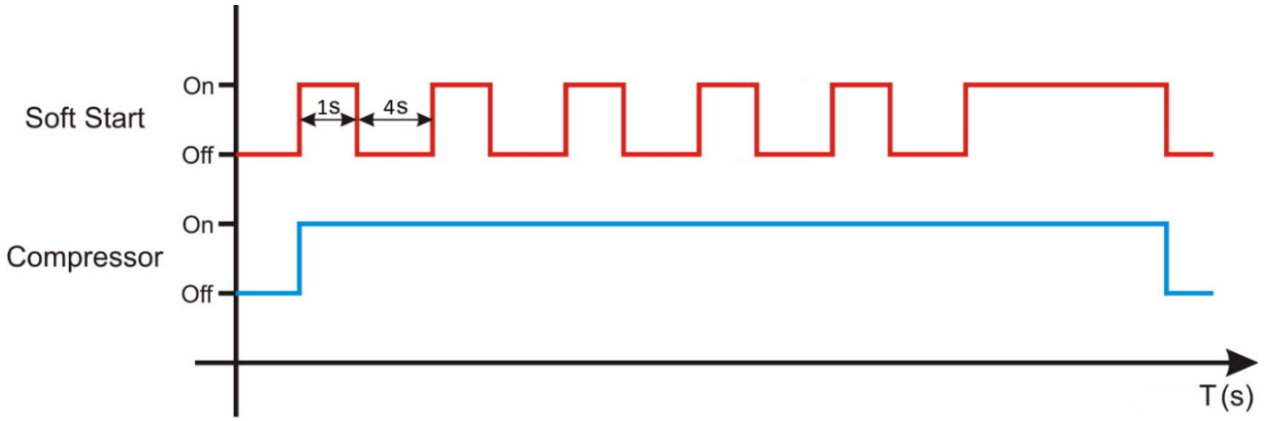
When using transducers, the key can be pressed at any time to view the low and high side pressures, corresponding to the location of the transducers. This minimizes the need for installing pressure gauges during service.

General system safety:

- If any pressure fault occurs, the system will operate as explained in the section 3.10 “Faults”
- If the return sensor fails, the system will continue operation in open loop (explained in section 3.10)
- Pressure transducers must be installed for PWM operation (explained in section 2.11 “Condenser”)
- In the case of communication failures (CF), the system will turn off all outputs after 30 seconds

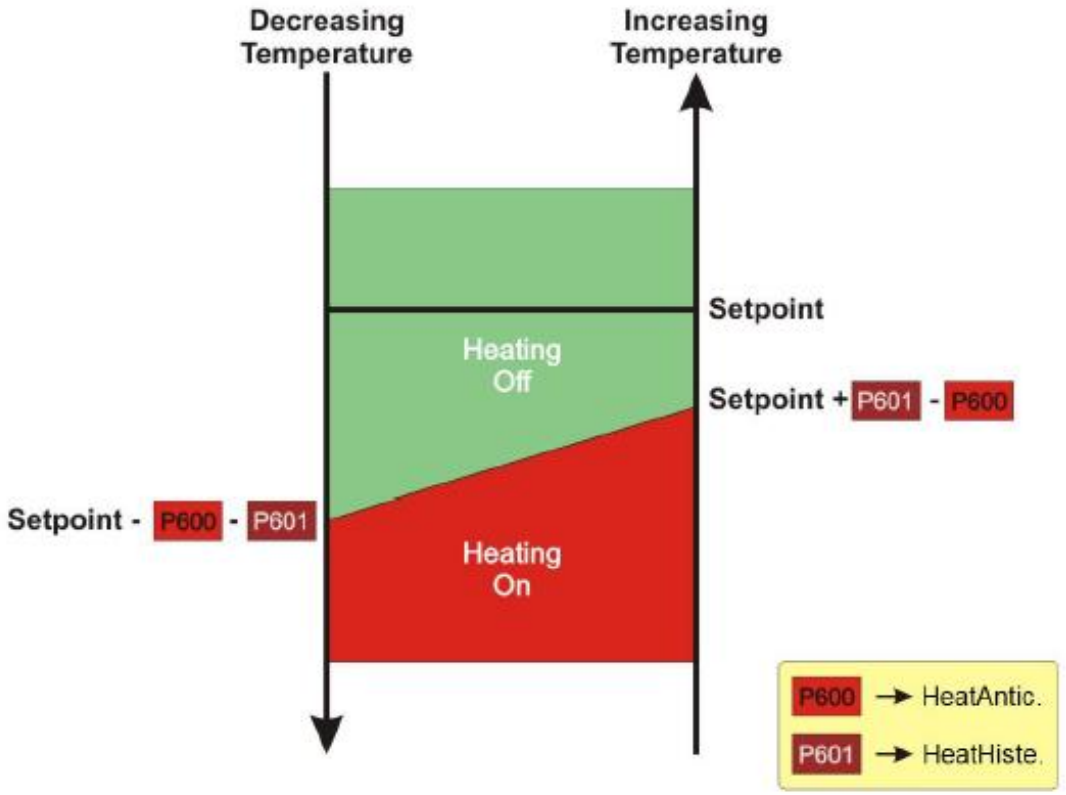
Bump Start:

When using the ignition (road compressor) for cooling, at initial startup for the first cooling cycle the system can implement the **Bump Start** feature to avoid flooded starts. **Bump Start** works to protect the engine compressor from liquid sludge buildup at startup. This is done by turning the compressor on for 1 second and then off for 4 seconds for a total of 5 cycles (20 seconds), as shown below. Set **Bump Start** to **Disable** if this operation is not desired. By default, all controllers are programmed to use the **Bump Start** safety when using the road compressor. Bump start is only active for the **first ignition start up** or the **first shift from standby to ignition operation**.



2.10) Heating

The system will automatically begin heating when the return temperature is lower than the **setpoint - Heat Antic- Heat Histe**, where **Heat Histe** and **Heat Antic** are programmable heating differentials. Heating will automatically turn off when the return temperature is higher than **setpoint + Heat Histe- Heat Antic**. The following graph illustrates heating logic.



Note: When operating in R-404 HG mode the compressor and hot gas solenoid also engage to further increase heating. Refer to the table below for a breakdown of the heating logic for the various Op.Modes.

Op.Mode	R-134a Med Temp	R-134a Low Temp	R-404A Low Temp	R-404 HG
Heating	Heating **ON** Evap Blower **ON** Compressor **OFF** Condenser **OFF** Hot Gas **OFF**			Heating **ON** Evap Blower **ON** Compressor **ON** Condenser **OFF** Hot Gas **ON**

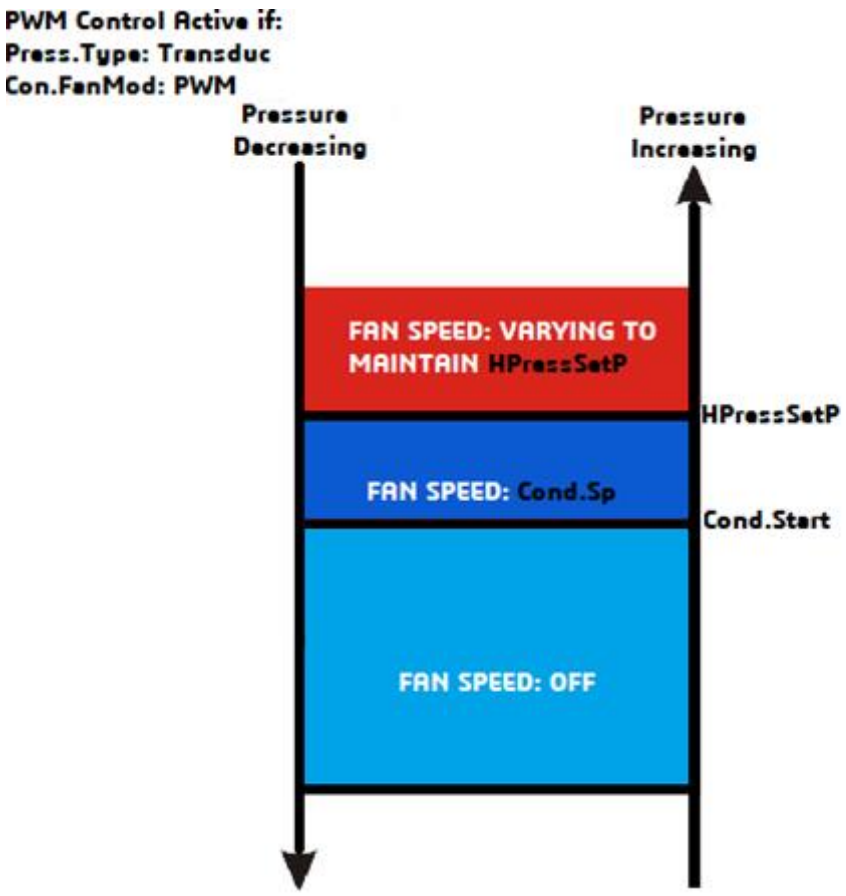
2.11) Condenser

When using pressure switches (**Press.Type** set to **Digital P)**, the parameter **Con.FanMod** should be set to **Digital**. The Condenser fan(s) will then operate as ON/OFF. The condenser fan(s) will turn ON and OFF depending on the rating of the pressure switch.

When using transducers (**Press.Type** set to **Transduc)**, **Con.FanMod** should be set to **PWM**. The condenser fan(s) will then operate with PWM control, meaning condenser fan speed is controlled depending on the high-pressure transducer readings.

PWM control operates as explained below:

The condenser fan will remain off (PWM of 0) until the start pressure set in **Cond.Start** is reached. Once **Cond.Start** is reached, condenser fan(s) will start at a speed of **Cond.Sp**. (default 30%). If the pressure continues to rise and reaches the pressure set in **HPressSetP**, fan speed will begin to increase or decrease as necessary to maintain the system pressure at **HPressSetP**. PWM fan control is only active while the compressor is on, or if a high-pressure fault is triggered. Refer to the figure below for a visual of PWM operation.



HPressSetP is maintained using PID logic through the parameters **PID KP**, **PID KI** and **PID TA**. These values are preselected by ATC and should not be changed.

Refer to the table below for the **Cond.Start**, **Cond.Sp** and **HPressSetP** default values for the different refrigerant systems.

Op.Mode	R-134M	R-134L	R-404L	R-404HG
Cond.Start (PSI)	170	170	190	190
Cond.Sp (% PWM)	30% PWM	30% PWM	30% PWM	30% PWM
HPressSetP (PSI)	200	200	225	225

Safety measures:

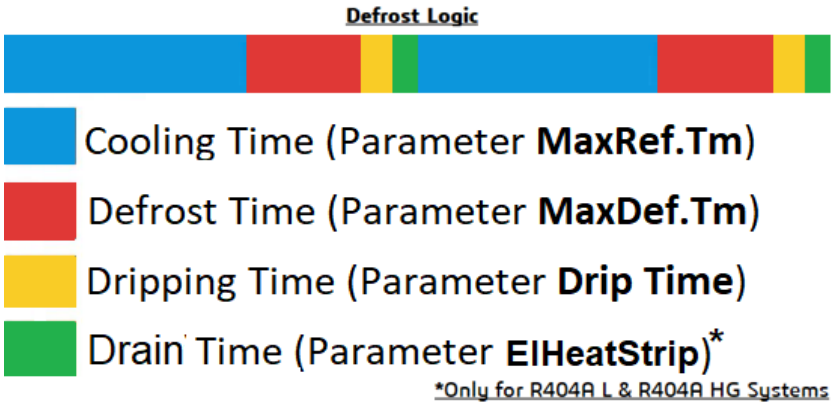
****Note**:** Like all outputs, the condenser output will turn off 30 seconds after any communication failure.

2.12) Defrost

The controller varies defrost operation depending on whether the ATC unit is for a R-134 or R-404 system, and whether the system has a medium or low temperature application. The unit type is preprogrammed at ATC, using the **Op.Mode** parameter. The table below describes how defrost operation changes for each refrigerant mode. In addition, the illustration below provides a visual of the overall defrost loop. Note: For all R-134a systems operating with default settings, the drain period is skipped.

Op.Mode	R-134a Med Temp	R-134a Low Temp	R-404A Low Temp	R-404 HG
Cooling	Normal	Normal	Normal	Normal
Defrost	Blower **ON** Compressor. **OFF**	Blower **OFF** Hot Gas **ON** Compressor **ON**	Blower **OFF** Hot Gas **ON** Compressor **ON** Heat Strip **ON**	Blower **OFF** Hot Gas **ON** Compressor **ON** Heat Strip **ON**
Dripping	Blower **OFF** Compressor **ON**	Blower **OFF** Hot Gas **OFF** Compressor **ON**	Blower **OFF** Hot Gas **OFF** Compressor **ON** Heat Strip **ON**	Blower **OFF** Hot Gas **OFF** Compressor **ON** Heat Strip **ON**
Cooling	Normal	Normal	Normal + Heat Strip*	Normal + Heat Strip*

***Heat Strip represents the heatstrip parameter and controls the additional time that the heat strips remain active after a R-404A dripping period. This function is further discussed in the "Drain Time" section.**



By default, when defrosting is enabled, the display temperature (return or setpoint temperature) reading will be blocked and a **"DEF"** message will be displayed on the controller. Although the display is blocked, the key can still be used to view temperature probe readings. If the **"DEF"** message is undesired, the parameter **Def.Tp.Blk** should be set to **Disable**.

2.12.1) Automatic Defrost

Whether the parameter **Def.S.Mode** is set to **time** , **temperature** or there is a fault with the coil sensor, automatic defrost initiates based on the timer set in the adjustable parameter **MaxRef.Tm**. Once the evaporator temperature reaches the **Def.S.Temp**, the internal timer begins counting. Defrost then starts after the counter reaches the time set in **MaxRef.Tm**. Defrost remains active until a specific temperature (**Def.E.Temp**) or time (**Max.Def.Tm**) depending on the defrost mode selected in **Def.S.Mode**. In addition, if the evaporator temperature reaches **Def.S.Temp** but then begins to drastically rise and exceed the defrost exit temperature **Def.E.Temp,** the timer will be saved and paused. The timer will continue from the saved time, the next time **Def.S.Temp** is reached.

2.12.1.A) Time-based defrost

When **Def.S.Mode** is set to **time**, defrost remains enabled until the time set in **MaxDef.Tm.**

Small clock next to the icon indicates a time based defrost.

2.12.1.B) Temperature-based defrost

When **Def.S.Mode** is set to **temperature**, defrost remains enabled for the time programmed in **MaxDef.Tm** or until the evaporator coil temperature reaches the defrost end temperature set in **Def.E.Temp**. Defrost will end based on whichever occurs first.

Small thermometer next to the icon indicates a temperature based defrost

2.12.2) Manual Defrost

Defrost can also be manually started by the operator. Hold the key down for 3 seconds to attempt a manual defrost. However, like automatic defrost, manual defrost operation is dependent on whether **Def.S.Mode** is set to **time or temperature mode**.

The controller indicates a manual defrost with the icon and “Ma” text.

2.12.2.A) Time-based defrost

If **Def.S.Mode** is set to **time**, manual defrost may be enabled at any time by pressing the key for 3 seconds. Defrost will remain enabled for the time programmed in **MaxDef.Tm**.

2.12.2.B) Temperature-based defrost

When **Def.S.Mode** is set to **temperature**, defrost can be manually attempted at any time but will only be enabled if the evaporator coil temperature is lower than **Def.E.Temp**. When a manual defrost is attempted and the coil temperature is still above **Def.E.Temp**, the warning message **“ADT EVP”** will flash on the display. However, if the evaporator temperature criteria is satisfied, defrost will begin and remain enabled for the time programmed in **MaxDef.Tm**, or until the coil temperature reaches **Def.E.Temp**. Defrost will end based on whichever one of these conditions occurs first.

2.13) Dripping

After each defrost the system goes into dripping mode to prevent coil damage. Drip mode ensures that ventilation is not enabled until the time set in the parameter **Drip Time** elapses. The Got icon is displayed while drip mode is enabled.

2.14) Drain Time

For any system that uses R-404 refrigerant (**Op.Mode** set to **R-404L or R-404HG**) and **HeatStMode** is set to **Timed**, the heat strips will initiate immediately after the dripping period elapses. During this period, the heat strips in the R-404 evaporator will remain active for the time set in the parameter **Heat Strip**. This additional time is used to drain leftover defrost water so that it does not solidify in the drain ducts.

The parameter **HeatStMode** controls heat strip operation. By default, this parameter is set to **Timed**, where the heat strips will follow the default logic as explained above. For more extensive coil safety, the parameter **HeatStMode** can be set to **On**. This ensures the heat strips are always **On**, regardless if it is a R-134 or R-404 system and regardless if the controller is refrigerating, heating or defrosting. Lastly, **HeatStMode** can be set to **off**, in which case the heat strips will be **off** throughout system operation.

2.15) Voltage monitoring

The controller is always measuring the connected voltage, refer to section 3.6 “Inputs and Outputs Visualization” for information on observing this measurement.

2.16) Door Sensor

The controller I/O module features a digital input to monitor the truck/chamber door. If this feature is desired the parameter **DoorOp.Alm** should be set to **enable** and the installer should acquire and connect a door sensor. This feature operates with a negative input. When the door is closed, the input should be **“GND”**. When the door is open, there is an open contact at the same input. The ventilation while the door is open is controlled with the **V.DoorOpen** parameter as explained earlier in section 2.8 “Ventilation/Blower Output”.

In addition, whenever the door input is triggered the controller will warn the operator by buzzing and flashing a **“D”** in the center and bottom right corner of the display, along with generating a log file. This warning will remain active until the door is closed. An example of the warning message is shown below.

3) ADDITIONAL FEATURES

3.1) Time and Date

Contact ATC for information on changing the date and time of the M910165 controller.

3.2) Data Logging

If data logging is desired, the **Datalogger** parameter should be left to the default **Enable** setting. The I/O module will then generate and save a log file every time a USB drive is inserted into the I/O module. When the USB drive is connected, the module automatically starts downloading the log, which will also be indicated on the controller display. When all data is collected, a message on the controller display will prompt that the USB may be removed. The module generates a file named **"LOGRXXXX.csv"** where XXXX starts at 0000 and increases so that old log files on the USB are not overwritten.

Logs are generated based on both fixed time intervals and event triggers. Any changes to parameters such as: setpoint, control state (cooling, heating , defrost, drain , off), system faults, and door, ignition or electric standby inputs are events that trigger a new log line.

The fixed time interval for log generation can be changed using the **Log Freq** parameter. The parameter can be set to any time interval between **0 to 60 minutes (default is 5 minutes)**. If it is desired that logs are only generated based on event triggers, **Log Freq** should be set to **0**.

The log generated by the module contains the following information:

- Date
- Time
- Return temperature
- Evaporator temperature
- Condenser temperature
- Setpoint
- Compressor status
- Product hourmeter
- Standby hourmeter
- Compressor hourmeter
- Pressure transducers
- Hot gas defrost status
- Electric input status
- Condenser PWM
- Events (alarms & faults)

The main menu features a **data log** screen, where you can view the log status. If **datalogger** is set to **Enable** it will indicate that the log is generating, if it is not enabled it indicates that the log is not being written.

- To access the data log screen, simultaneously hold the and keys for 3 seconds
- Use the and keys to scroll through main menu and the key to select the **data log** option

- To return to the main menu screen press . Exit the main menu by pressing again or by waiting 30 seconds.

The data log can also be reset by accessing the **Reset Parameters** feature in the menu.

Contact ATC for information on resetting the data log for the M910165 controller.

3.3) Log File

The ".csv" data log file generated by the I/O module uses the controller date and time to provide time stamps for all recorded logs. The log file provides information such as Setpoint, Control state (Cooling, Heating, Defrost, Off…), product hour meters, door status and system faults.

3.4) System Parameters

Contact ATC for information on changing parameter settings for the M910165 controller.

Shown on the next page is the various adjustable parameters:

3.4.1) Adjustable Parameters Table (°F)

Parameters	Description	Default				Minimum	Maximum
		R134A Medium	R134A Low	R404 Low	R404 HG		
Op. Mode	Operation mode	**R134A Medium**	**R134A Low**	**R404 Low**	**R404 HG**		
Ret.Offset (°F)	Return temperature Sensor off-set	0°F	0°F	0°F	0°F	-9	9
Ev.Offset (°F)	Evaporator temperature sensor off-set	0°F	0°F	0°F	0°F	-9	9
Con.Offset (°F)	Condenser temperature sensor off-set	0°F	0°F	0°F	0°F	-9	9
DataLogger	Data logger status	Enable	Enable	Enable	Enable	Disable	Enable
Log Freq. (min)	Log frequency	5	5	5	5	0	60
Def.S.Temp (°F)	Defrost start temperature	26°F	26°F	26°F	26°F	-13	40
Def.E.Temp (°F)	Defrost end temperature	39°F	36°F	40°F	40°F	30	59
MaxDef.Tm (min)	Maximum defrost time	20	15	15	15	1	60
Drip Time (sec)	Drip time	60	60	60	60	0	240
Heat Strip (min)	Heat strip operating time	5	5	5	5	1	240
HeatStmode	Heat strip operating mode	Off	Off	Timed	Timed	Off	On
MaxRef.Tm (min)	Maximum refrigeration time	40	40	40	40	10	600
Ref.Histe. (°F)	Refrigeration hysteresis	2°F	2°F	2°F	2°F	1	15
HeatHiste. (°F)	Heating hysteresis	2°F	2°F	2°F	2°F	1	11
HeatAntic. (°F)	Heat anticipation	2°F	2°F	2°F	2°F	1	7
Temp.Shown	Default Display Temperature	Temperatu.	Temperatu.	Temperatu.	Temperatu.	Temperatu.	Setpoint
Init.State	Initial state	Last State	Last State	Last State	Last State	Off	Last State
Def.S.Mode	Defrost start mode	Temperatu.	Temperatu.	Temperatu.	Temperatu.	Temperatu.	Time

Parameters	Description	Default				Minimum	Maximum
		R134A Medium	R134A Low	R404 Low	R404 HG		
V.Comp.Off	Ventilation while compressor off	On	On	On	On	Off	On
SetP.Block	Setpoint block	Disable	Disable	Disable	Disable	Disable	Enable
Def.Tp.Blk	Temperature Block During Defrost	Enable	Enable	Enable	Enable	Disable	Enable
Ev.Blk.Tm (min)	During DEF Evap temp block time	5	5	5	5	0	60
Min.SetP (°F)	Minimum setpoint	33°F	0°F	-20°F	-20°F	-40	**Max.SetP**
Max.SetP (°F)	Maximum setpoint	80°F	80°F	80°F	80°F	**Min.SetP**	87
Vent.Delay (sec)	Ventilation start delay	3	3	3	3	0	10
Language	Language	English	English	English	English	Portuguese	English
V.DoorOpen	Ventilation while door open	Enable	Enable	Enable	Enable	Disable	Enable
Con.FanMod	Condenser fan mode	PWM	PWM	PWM	PWM	On/Off	PWM
Press.Type	Pressure input type	Transducer	Transducer	Transducer	Transducer	Switch	Transducer
DoorOp.Alm	Door open alarm	Disable	Disable	Disable	Disable	Disable	Enable
RoofPr.Alm	Roof proximity alarm	Enable	Enable	Enable	Enable	Disable	Enable
El+Ign.Alm	Electric standby plugged in with ignition alarm	Enable	Enable	Enable	Enable	Disable	Enable
Bump Start	Bump start	Enable	Enable	Enable	Enable	Disable	Enable
CoutLPress (PSI)	Cut out suction pressure	-5	-5	-5	-5	-10	20
CinLPress (PSI)	Cut in suction pressure	20	20	20	20	5	50
CoutHPress (PSI)	Cut out discharge pressure	300	300	425	425	100	500
CinHPress (PSI)	Cut in discharge pressure	200	200	325	325	100	500
HpressSetP (PSI)	Condenser PWM pressure setpoint	200	200	225	225	100	500
Cond.Start (PSI)	Condenser Fan Start Pressure.	170	170	190	190	120	250
Cond.Spd. (%PWM)	PWM normal speed	30	30	30	30	10	50
HPr.Offset (PSI)	Discharge pressure offset	0.0	0.0	0.0	0.0	-9.9	9.9
LPr.Offset (PSI)	Suction pressure offset	0.0	0.0	0.0	0.0	-9.9	9.9

Parameters	Description	Default				Minimum	Maximum
		R134A Medium	R134A Low	R404 Low	R404 HG		
PID KP.	Condenser PWM control proportional	30.0	30.0	30.0	30.0	0.1	99.9
PID KI.	Condenser PWM control integral	3.0	3.0	3.0	3.0	0.1	99.9
PID TS.	Condenser PWM control time sample	1	1	1	1	1	100

Note:

Changing the Op.Mode parameter will automatically change refrigerant related parameters to their default values displayed in this table (this is further covered in section 3.12 "Op.Mode")

****As indicated in section 3.12, for Op.Mode programming of R-134A Medium units, manually change Def.S.Temp to 26°F or -3°C****

3.4.2) Adjustable Parameters Table (°C)

Parameters	Description	Default				Minimum	Maximum
		R134A Medium	R134A Low	R404 Low	R404 HG		
Op. Mode	Operation mode	**R134A Medium**	**R134A Low**	**R404 Low**	**R404 HG**		
Ret.Offset (°C)	Return temperature Sensor off-set	0°C	0°C	0°C	0°C	-5	5
Ev.Offset (°C)	Evaporator temperature sensor off-set	0°C	0°C	0°C	0°C	-5	5
Con.Offset (°C)	Condenser temperature sensor off-set	0°C	0°C	0°C	0°C	-5	5
DataLogger	Data logger status	Enable	Enable	Enable	Enable	Disable	Enable
Log Freq. (min)	Log frequency	5	5	5	5	1	60
Def.S.Temp (°C)	Defost start temperature	-3°C	-3°C	-3°C	-3°C	-25	4
Def.E.Temp (°C)	Defrost end temperature	3°C	2°C	4°C	4°C	4	15
MaxDef.Tm (min)	Maximum defrost time	20	15	15	15	1	60
Drip Time (sec)	Drip time	60	60	60	60	0	240
Heat Strip (min)	Heat strip operating time	5	5	5	5	1	240
HeatStmode	Heat strip operating mode	Off	Off	Timed	Timed	Off	On
MaxRef.Tm (min)	Maximum refrigeration time	40	40	40	40	10	600
Ref.Histe. (°C)	Refrigeration hysteresis	1°C	1°C	1°C	1°C	0	8
HeatHiste. (°C)	Heating hysteresis	1°C	1°C	1°C	1°C	0	6
HeatAntic. (°C)	Heat anticipation	1°C	1°C	1°C	1°C	0	4
Temp.Shown	Default Display Temperature	Temperatu.	Temperatu.	Temperatu.	Temperatu.	Temperatu.	Setpoint
Init.State	Initial state	Last State	Last State	Last State	Last State	Off	Last State
Def.S.Mode	Defrost start mode	Temperatu.	Temperatu.	Temperatu.	Temperatu.	Temperatu.	Time

Parameters	Description	Default				Minimum	Maximum
		R134A Medium	R134A Low	R404 Low	R404 HG		
V.Comp.Off	Ventilation while compressor off	On	On	On	On	Off	On
SetP.Block	Setpoint block	Disable	Disable	Disable	Disable	Disable	Enable
Def.Tp.Blk	Temperature Block During Defrost	Enable	Enable	Enable	Enable	Disable	Enable
Ev.Blk.Tm (min)	During DEF Evap temp block time	5	5	5	5	0	60
Min.SetP (°C)	Minimum setpoint	0°C	-17°C	-28°C	-28°C	-40	**Max.SetP**
Max.SetP (°C)	Maximum setpoint	26°C	26°C	26°C	26°C	**Min.SetP**	30
Vent.Delay (sec)	Ventilation start delay	3	3	3	3	0	10
Language	Language	English	English	English	English	Portuguese	English
V.DoorOpen	Ventilation while door open	Enable	Enable	Enable	Enable	Disable	Enable
Con.FanMod	Condenser fan mode	PWM	PWM	PWM	PWM	On/Off	PWM
Press.Type	Pressure input type	Transducer	Transducer	Transducer	Transducer	Switch	Transducer
DoorOp.Alm	Door open alarm	Disable	Disable	Disable	Disable	Disable	Enable
RoofPr.Alm	Roof proximity alarm	Enable	Enable	Enable	Enable	Disable	Enable
El+Ign.Alm	Electric standby plugged in with ignition alarm	Enable	Enable	Enable	Enable	Disable	Enable
Bump Start	Bump start	Enable	Enable	Enable	Enable	Disable	Enable
CoutLPress (PSI)	Cut out suction pressure	-5	-5	-5	-5	-10	20
CinLPress (PSI)	Cut in suction pressure	20	20	20	20	5	50
CoutHPress (PSI)	Cut out discharge pressure	300	300	425	425	100	500
CinHPress (PSI)	Cut in discharge pressure	200	200	325	325	100	500
HpressSetP (PSI)	Condenser PWM pressure setpoint	200	200	225	225	100	500
Cond.Start (PSI)	Condenser Fan Start Pressure.	170	170	190	190	120	250
Cond.Spd. (%PWM)	PWM normal speed	30	30	30	30	10	50
HPr.Offset (PSI)	Discharge pressure offset	0	0	0	0	-9.9	9.9
LPr.Offset (PSI)	Suction pressure offset	0	0	0	0	-9.9	9.9

Parameters	Description	Default				Minimum	Maximum
		R134A Medium	R134A Low	R404 Low	R404 HG		
PID KP.	Condenser PWM control proportional	30.0	30.0	30.0	30.0	0.1	99.9
PID KI.	Condenser PWM control integral	3.0	3.0	3.0	3.0	0.1	99.9
PID TS.	Condenser PWM control time sample	1	1	1	1	1	100

Note:

Changing the Op.Mode parameter will automatically change refrigerant related parameters to their default values displayed in this table (this is further covered in section 3.12 "Op.Mode")

****As indicated in section 3.12, for Op.Mode programming of R-134A Medium units, manually change Def.S.Temp to 26°F or -3°C****

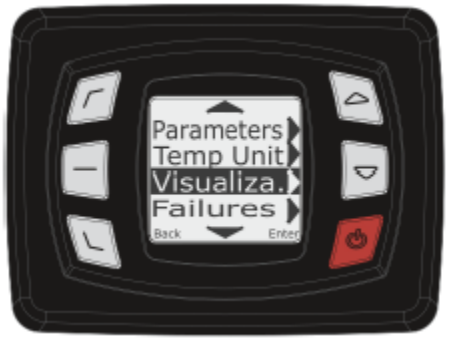
3.5) Saving and Loading Parameters through USB disk

Contact ATC for information on saving and loading parameters using a USB.

3.6) Inputs and Outputs Visualization

This setting can be used for servicing or troubleshooting the system. It allows the user to view the real time status of various inputs and outputs being detected by the I/O module.

- To access the input and outputs, simultaneously hold the and keys for 3 seconds
- Use the and keys to scroll through main menu and the key to select the **Visualiza.** option



- When prompted for a passcode input **11**
  - Use to increment the first digit
  - Use to increment the second digit.
  - Press to enter passcode

- The first value shown is the ReturnT, to scroll through the viewable inputs and outputs use and (a list of all inputs and outputs are provided on the following page).
- To return to the main menu screen press . Exit the main menu by pressing again or by waiting 30 seconds

Shown below is the list of inputs and values which can be viewed.

Indication	Description
ReturnT	Return temperature input
Evap.T.	Evaporator temperature input
Cond.T.	Condenser temperature input
H.Strip	Electric heat strip output
Heating	Heating output
Ev.Fan	Evaporator fan output
Hot Gas	Solenoid output
Comp.	Compressor output
CondFan	Condenser fan output
H.Press	High pressure transducer input
L.Press	Low pressure transducer input
Ign.Sw.	Ignition switch input
DoorOp.	Door open input
El.Stby	Electric standby input
Proxim.	Proximity sensor input
BLoader	Boot loader software version
ECU SW	ECU software version
S.Volt.	Controller Supply Voltage
BLE V.	Bluetooth modem version
BLE S.	Bluetooth status
Buzzer	Buzzer

Use the table below to understand the various values which might be present for the inputs and output shown in the **Visualization** setting.

Indication	Meaning
XXX	Value read
On	Input with signal / Output on
Off	Input without signal / Output off
F!	Fault this variable, check Failure menu
FC	Communication failure and variable is at remote module

3.7) Test Mode

Test mode can be used to troubleshoot controller features and to test some aspects of the refrigeration system.

- To access test mode, simultaneously hold the and keys for 3 seconds
- Use the and keys to scroll through main menu and the key to select the **Test Mode** option

- When prompted for a passcode input **86**
  - Use to increment the first digit
  - Use to increment the second digit.
  - Press to enter passcode

- The first testable parameter shown is ReturnT. To scroll through testable parameters, use the and keys. Press to toggle values for the test.
- To return to the main menu screen press . Exit the main menu by pressing again or by waiting 30 seconds

Shown below is a complete list of parameters which can be tested with test mode

Indication	Description
ReturnT	Return temperature
Evap.T.	Evaporator temperature
Cond.T.	Condenser temperature
H.Strip	Electric heat strip output
Heating	Heating output
Ev.Fan	Evaporator fan output
Hot Gas	Solenoid output
Gas Ch.	Compressor output (turns on comp & cond/evap fans)
CondFan	Condenser fan output
H.Press	High pressure transducer input
L.Press	Low pressure transducer input
Ign.Sw.	Ignition switch
DoorOp.	Door open input
El.Stby	Electric standby input
Proxim.	Proximity sensor
BLoader	Boot loader software version
ECU SW	ECU software version
S.Volt.	Controller Supply Voltage
B.Light	Backlight
Keys	Keys and .
BLE V.	Bluetooth modem version
BLE S.	Bluetooth status
Clock	Seconds running

Use the table below to understand the values which might be present for the tests conducted during test mode.

Indication	Meaning
XXX	Value read
On	Input with signal / Output on
Off	Input without signal / Output off
F!	Variable Fault, check Failure menu
FC	Communication failure and variable is at remote module

3.8) Parameter Resetting

Contact ATC for information on resetting parameter settings for the M910165 controller.

3.9) Temperature Unit

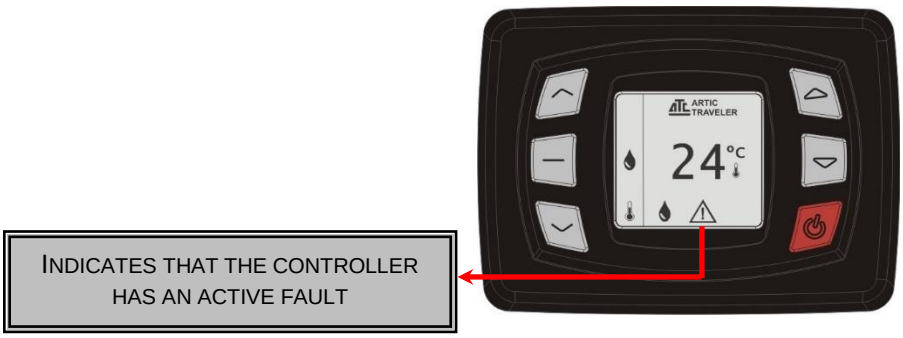
This option is used to change the controller temperature units to either Fahrenheit (°F) or Celsius (°C). By default, the controller is programmed to display °F.

- To access the temperature unit screen, simultaneously hold the and keys for 3 seconds
- Use the and keys to scroll through main menu and the key to select the **Temp Unit** option

- Use the and keys to scroll through °F or °C and the key to verify the temperature unit
- To return to the main menu screen press . Exit the main menu by pressing again or by waiting 30 seconds

3.10) Faults and Alarms

In the case of any system faults, an alert icon will blink on the display. The fault screen in the main menu can be used to view all current system faults



- To access the fault screen, simultaneously hold the and keys for 3 seconds
- Use the and keys to scroll through main menu and the key to select the **Failures** option

- The next screen displays the active faults. Use the and keys to scroll through active faults and the key for more details on specific faults
- Press to return to the faults screen

- To return to the main menu screen press . Exit the main menu by pressing again or by waiting 30 seconds

Refer to the legend below to identify faults.

Indication	Description	Action
RTO	Return temperature sensor open	(*) Temperature control will follow open loop according to the table below
RTS	Return temperature sensor short circuit	
EVO	Evaporator coil temperature sensor open	(**) Defrost control will allow manual defrosts (user requested) and will continue to perform defrosts based on time (**MaxRef.Tm**)
EVS	Evaporator coil temperature sensor short circuit	
CDO	Condenser temperature sensor open	Faults are displayed but no influence on controller performance
CDS	Condenser temperature sensor short circuit	
ADT	Above defrost temperature	Warning displayed when the user attempts a manual defrost at temperature higher than **Def.E.Temp**
HT	Evaporator temperature above 59°F	Indicator if evaporator temperature exceeds 59°F (will not flash on display)
BLK	Setpoint Changes Blocked	Warning when the user attempts a setpoint change, while manual setpoint changes are blocked
CF	Communication failure	**(***)**Critical system fault, problem with module and controller communication. Check wires and connections. I/O Module outputs will turn off after 30 seconds without communication.
D	Door open	Warning shown on display, buzzer rings and logs generated until door closed
HPF	High pressure failure	Compressor off until high pressure lowers, 3 min delay after fix for compressor to turn on
LPF	Low pressure failure	Compressor off until low pressure rises, 3 min delay after fix for compressor to turn on
RPA	Roof proximity alarm	Object close to sensor. Warning shown on display, buzzer rings and log generated.
SBY	Electric stand by connected	Warning shown on display, buzzer rings and logs generated until one power supply turned off.
DG	Already defrosting	Warning if manual defrost attempted while a defrost is already happening
HTF	High pressure transducer fault	HP Transducer signal lost, PWM set to max and 30 sec delay after a fix for compressor to turn on
LTF	Low pressure transducer fault	LP transducer signal lost, system enters LPF logic until connection/ transducer fixed
PS	Pressure sensor disconnection fault	Compressor turns off until the transducer supply voltage is higher than 0V for 5 seconds.

(*) During a return sensor fault, the controller will take control of cooling as shown below. Starting at the “ON “ cycle.

(**) The coil temperature sensor fault occurs only when the **Def.S.Mode** parameter is equal to **Temperatu**.

(***) In the event of a system communication failure (CF), the system will turn off all outputs for 30 seconds.

*In case there is a fault with the feedback of the return temperature sensor, the controller will take control of cooling as shown below. The control will begin with the “ON” cycle.

Operating Range	Setpoint		Cooling ON	Cooling OFF
	°C	°F		
Range #4	> 10 ºC	>18°F	9 min.	21 min.
Range #3	10 ºC	18°F	15 min.	15 min.
	9 ºC	16°F		
	8 ºC	14°F		
	7 ºC	13°F		
	6 ºC	11°F		
Range #2	5 ºC	9°F	21 min.	9 min.
	4 ºC	7°F		
	3 ºC	5°F		
	2 ºC	4°F		
	1 ºC	2°F		
Range #1	< 1 ºC	<2°F	Always on	-
The defrosting control remains unchanged.				

Evaporator coil sensor faults will only be shown if **Def.S.Mode is set to **Temperature**.

Obs: In case the evaporator coil sensor faults, defrost control will continue in time-based mode, and will still allow manual defrost with time based operation.

3.11) Hourmeters

There are 3 separate hour meters that are logged to keep track of runtime.

- The road compressor hour meter increments when ignition is ON and the control is in cooling.
- The standby compressor hour meter increments when electric input is ON and cooling
- The controller hour meter increments whenever the controller is ON.

- To access the hour meters, simultaneously hold the and keys for 3 seconds
- Use the and keys to scroll through main menu and the key to select the **Hourmeter** option

- The next screen shows the cumulative time for each hour meter;

- To return to the main menu screen press . Exit the main menu by pressing again or by waiting 30 seconds.

To clear hour meters:

Contact ATC for information on clearing hour meters for the M910165 controller.

3.12) Op.Mode Settings

For ease in programming different refrigerant systems, changing the **Op.Mode** refrigerant setting will automatically adjust the following controller parameters to the shown default values.

****For Op.Mode programming of R-134A Medium units, manually change Def.S.Temp to 26°F or -3°C****

3.12.1) Op.Mode Default Parameters Table (°F)

Parameters	Description	Default				Minimum	Maximum
		R134A Medium	R134A Low	R404 Low	R404 HG		
Op. Mode	**Operation mode**	**R134A Medium**	**R134A Low**	**R404 Low**	**R404 HG**		
Def.S.Temp (°F)	Defost start temperature	~~40°F~~ 26°F	26°F	26°F	26°F	-13	40
Def.E.Temp (°F)	Defrost end temperature	39°F	36°F	40°F	40°F	30	59
MaxDef.Tm (min)	Maximum defrost time	20	15	15	15	1	60
Drip Time (sec)	Drip time	60	60	60	60	0	240
Heat Strip (min)	Heat strip Operating Time	5	5	5	5	1	240
HeatStmode	Heat strip Operating Mode	Off	Off	Timed	Timed	Off	On
MaxRef.Tm (min)	Maximum refrigeration time	40	40	40	40	10	600
Init.State	Initial state	Last State	Last State	Last State	Last State	Off	Last State
Def.S.Mode	Defrost start mode	Temperatu.	Temperatu.	Temperatu.	Temperatu.	Temperatu.	Time
V.Comp.Off	Ventilation while compressor off	On	On	On	On	Off	On
Def.Tp.Blk	Temperature Block During Defrost	Enable	Enable	Enable	Enable	Disable	Enable
Min.SetP (°F)	Minimum setpoint	33°F	0°F	-20°F	-20°F	-40	**Max.SetP**
Max.SetP (°F)	Maximum setpoint	80°F	80°F	80°F	80°F	**Min.SetP**	87
CoutLPress (PSI)	Cut out suction pressure	-5	-5	-5	-5	-10	20
CinLPress (PSI)	Cut in suction pressure	20	20	20	20	5	50
CoutHPress (PSI)	Cut out discharge pressure	300	300	425	425	100	500
CinHPress (PSI)	Cut in discharge pressure	200	200	325	325	100	500
HpressSetP (PSI)	Condenser PWM pressure setpoint	200	200	225	225	100	500
Cond.Start (PSI)	Condenser Fan Start Pressure.	170	170	190	190	120	250
Cond.Spd. (%PWM)	PWM normal speed	30	30	30	30	10	50

****For Op.Mode programming of R-134A Medium units, manually change Def.S.Temp to 26°F or -3°C****

3.12.2) Op.Mode Default Parameters Table (°C)

Parameters	Description	Default				Minimum	Maximum
		R134A Medium	R134A Low	R404 Low	R404 HG		
Op. Mode	**Operation mode**	**R134A Medium**	**R134A Low**	**R404 Low**	**R404 HG**		
Def.S.Temp (°C)	Defost start temperature	~~3°C~~ -3°C	-3°C	-3°C	-3°C	-25	4
Def.E.Temp (°C)	Defrost end temperature	3°C	2°C	4°C	4°C	4	15
MaxDef.Tm (min)	Maximum defrost time	20	15	15	15	1	60
Drip Time (sec)	Drip time	60	60	60	60	0	240
Heat Strip (min)	Heat strip Operating Time	5	5	5	5	1	240
HeatStmode	Heat strip Operating Mode	Off	Off	Timed	Timed	Off	On
MaxRef.Tm (min)	Maximum refrigeration time	40	40	40	40	10	600
Init.State	Initial state	Last State	Last State	Last State	Last State	Off	Last State
Def.S.Mode	Defrost start mode	Temperatu.	Temperatu.	Temperatu.	Temperatu.	Temperatu.	Time
V.Comp.Off	Ventilation while compressor off	On	On	On	On	Off	On
Def.Tp.Blk	Temperature Block During Defrost	Enable	Enable	Enable	Enable	Disable	Enable
Min.SetP (°C)	Minimum setpoint	0°C	-17°C	-28°C	-28°C	-40	**Max.SetP**
Max.SetP (°C)	Maximum setpoint	26°C	26°C	26°C	26°C	**Min.SetP**	30
CoutLPress (PSI)	Cut out suction pressure	-5	-5	-5	-5	-10	20
CinLPress (PSI)	Cut in suction pressure	30	20	20	20	5	50
CoutHPress (PSI)	Cut out discharge pressure	300	300	425	425	100	500
CinHPress (PSI)	Cut in discharge pressure	200	200	325	325	100	500
HpressSetP (PSI)	Condenser PWM pressure setpoint	200	200	225	225	100	500
Cond.Start (PSI)	Condenser Fan Start Pressure.	170	170	190	190	120	250
Cond.Spd. (%PWM)	PWM normal speed	30	30	30	30	10	50

4) OPERABILITY

- This controller can operate from -40C to 80C
- This controller operates under nominal voltages 12 VDC and 24 VDC
- In continuous operation, controller should operate under voltage range from 10VDC to 30 VDC, preserving the integrity of all functions
- The electronics should withstand 32 VDC for 5 minutes without being permanently damaged
- The control circuit should withstand -12VDC/-24 VDC polarity reversal for an indefinite period without being permanently damaged

5) REVISON HISTORY

REV	Date	Description	Author
A	08/16/2017	GL-P4RAT003 - v1.0 e GL-M1RAT001 - v1.0	PB
B	14/11/2019	Spelling for test mode table & removed min and max for Op.Mode in parameter table	PB
C	19/03/2020	Updated: • Controller now version **2.5** • section **3.4** by adding 4 op.modes as column and changing the default values for Min.SetP, V.DoorOpen and Door.Op.Alm • Section **2.2** ignition + sby operation priority • Section **2.8** bump start behaviour	PB
D	15/5/2020	Updated: • Controller now version 2.7 • Section **3.4.1**, **3.4.2**, **3.12.1** and **3.12.2** by updating parameter tables. o Updated: default setpoints for Def.E.Temp, units & min/max for Heat Strip and min/max for Def.E.Temp, o Updated: degrees Celsius parameter values	PB
E	29/7/2020	Updated: • Section **3.4.1**, **3.4.2**, **3.12.1** and **3.12.2** by updating parameters tables. o Corrected default setting of Def.S.Temp to 26°F and -3°C whereever displayed o Made a reminder to manually change Def.S.Temp to 26°F or-3°C whenever using Op.Mode to program R-134A medium units to their default settings	PB
F	30/7/2020	Updated: • Section **3.6** & **3.7** tables for test mode and visualization o Indicated hot gas output tests solenoid o Indicated Gas Ch. turns on comp + all fans (evap and cond)	PB
G	2/06/2021	Corrected: • Section **3.10** table for faults and alarms Updated: • Section **3.4.1**, **3.4.2**, **3.12.1** and **3.12.2** parameters tables o CoutHPress updated to 425 PSI was 375 PSI o CinHPress updated to 325 PSI to was 275 PSI HPF comp delay updated to 3 min from 30 sec	PB