MICRO THERMO TECHNOLOGIES

MT Alliance – MT-EEPR User Manual

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MICRO THERMO TECHNOLOGIES

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1. Preface

1.1 Scope of this manual

This manual is intended for refrigeration specialists installing EEPR (**Electric Evaporator Pressure Regulator**) valves. It addresses specifically EEPR boards running the EEPR software. Dual-Temp applications require a separate thermostat and control to achieve the medium temperature.

Prerequisites include a knowledge of refrigeration practices in supermarkets and experience with the basic tools of the MT Alliance system. It is assumed that the user is familiar with the MT Alliance software (menus, views, toolbars, etc.), and with Micro Thermo plug-ins. The ***MT Alliance User Manual (71-GEN-0007)*** and the ***MT Alliance Installation Manual (71-GEN-0094)*** cover these basic skills.

The ***Installation Guide of the MT-EEPR Module for Original Equipment Manufacturers (OEM) (71-GEN-0099)*** complements this document. It explains how to use the local interface (buttons and views on the electronic board) and how to install the MT-EEPR module, whereas the present document deals mainly with the Windows software. Some basic issues concerning valve installation are summarized in Appendix II of this document (page 46).

The ***MT-EEPR Quick Start Guide*** describes the main steps for implementing temperature controls with the MT-EEPR, without going into detail.

The following versions are current as of this writing :

- Hardware : P/N 950-636A r 02
- Alliance and plug-in : version 4.1.3
- Neuron firmware : version 2.1
- PIC firmware : version .13.

1.2 Conventions used in this manual

For your convenience, several screen captures have been added to describe the procedures. Certain images also contain numbered balloons referring to the corresponding procedure.

Lastly, some terms are in bold to emphasize important points.

2. Components and Operation of the Temperature Control Process

The Temperature Control system is based on a direct reading of the air temperature in refrigerated cases. It positions automatically the EEPR valve that throttles the suction on the evaporators. This throttling action increases the evaporating pressure/temperature with respect to the pressure in the suction manifold.

The figure on the next page shows the role of the EEPR valves in a typical refrigeration system.

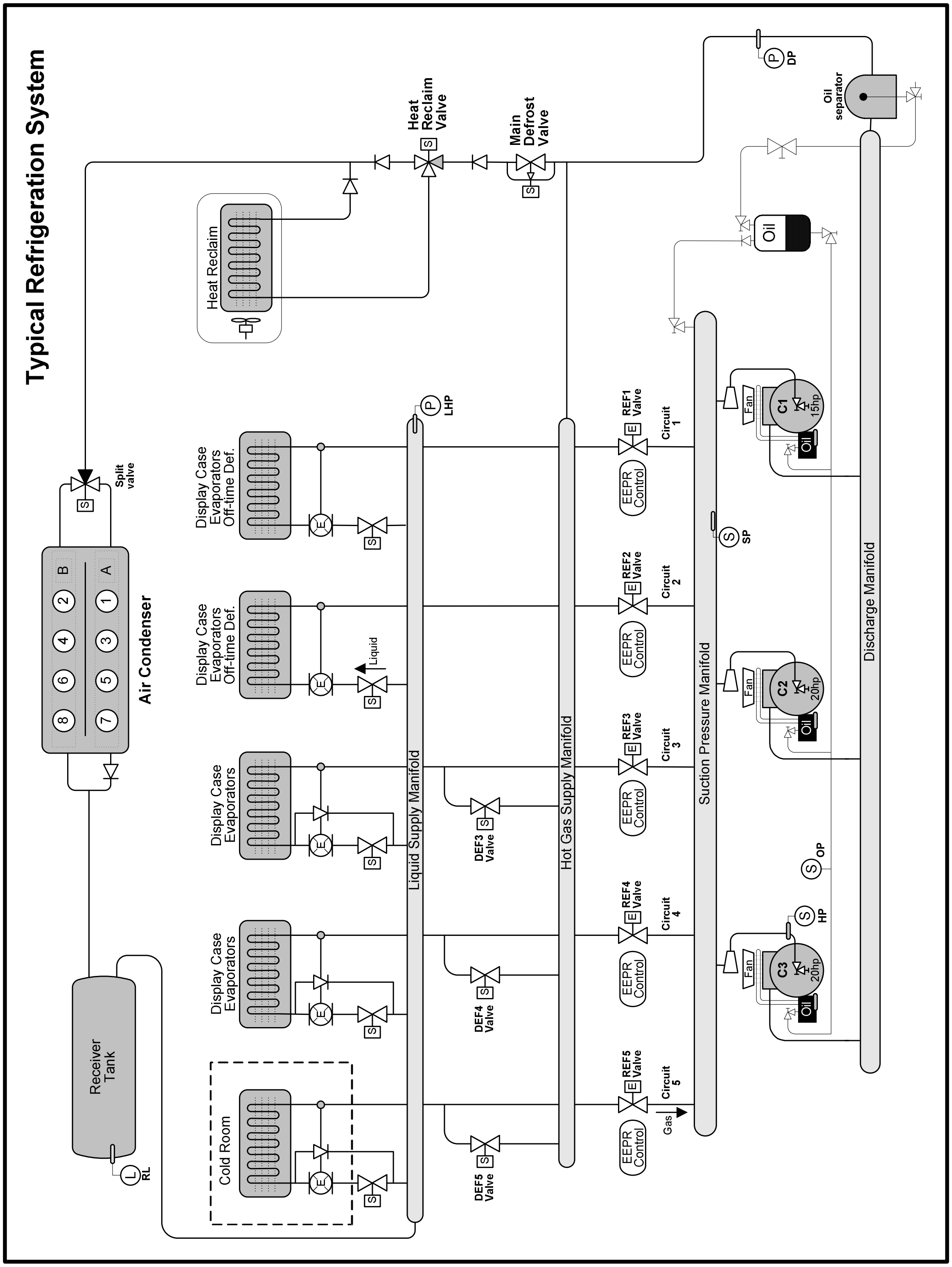


Figure 1 – Typical Refrigeration System

2.1 Mechanical Components Involved in the Process

A typical **circuit** includes a liquid inlet solenoid valve, one or several **refrigerated cases** and an **EEPR valve**.

- The **EEPR valve** connects the circuit to the suction manifold. During the refrigeration cycle, it is used to control temperature. It closes during a defrost. The position of the EEPR valve is maintained by a sealed step motor immersed in the refrigerant gas. The valve is thus lubricated by the lubricant circulating with the refrigerant.

The main mechanical components of a refrigerated case are the **evaporator** and the **thermostatic expansion valve**.

- The **evaporator** is used to cool the refrigerated case. The refrigerant evaporates in it while absorbing the case's heat. Evaporation occurs at the saturated temperature of the evaporator that, for a given refrigerant, depends essentially on the evaporator pressure. It is this evaporator pressure that the EEPR valve influences.
- The **thermostatic expansion valve** has two main functions. First, it creates a sharp pressure drop of the refrigerant coming from the liquid header, distributing a cold gas/liquid mix that will finish evaporating to cool the refrigerated case. Second, it maintains a constant superheat.

The temperature control of the cooling circuit is based on a direct reading of the air temperature in refrigerated cases, which determines the automatic positioning of the EEPR valve. The valve increases slightly the evaporating pressure/temperature of evaporators with respect to the pressure/temperature in the suction manifold.

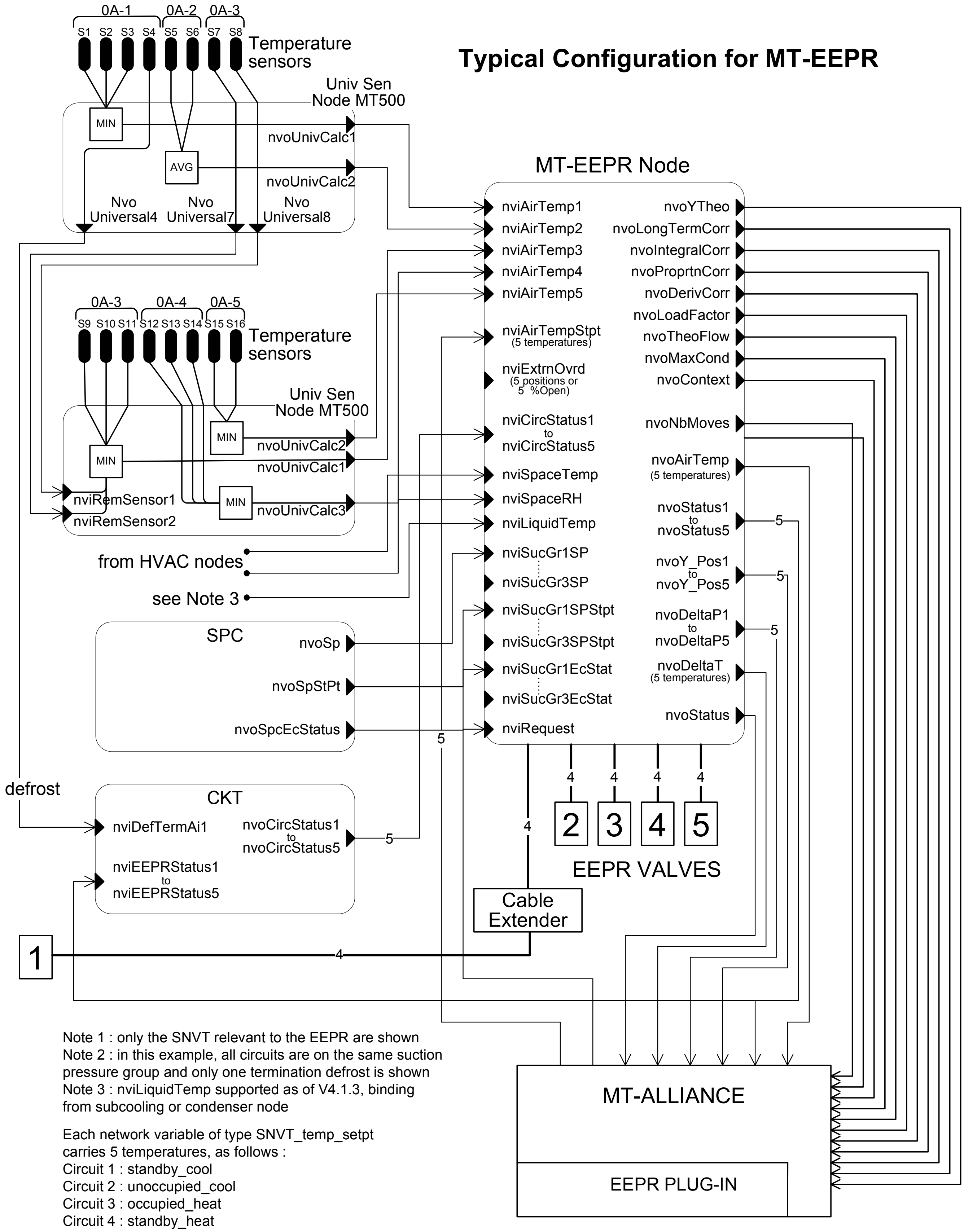
Different techniques are used to **defrost** cases: you can simply stop refrigeration and wait until the evaporator heats up, or inject hot gas in the circuit based on various methods (one of which is illustrated in the figure on the previous page). Electrical heating elements are used in some installations. Refrigeration resumes after a predetermined period or when the evaporator temperature indicates that the ice has melted.

Whatever the method used, the EEPR valve works closely with the other mechanical elements of the circuit to ensure defrost. During a hot gas defrost, for instance, the valve opens for a minute or two to finish evaporating the liquid refrigerant and then closes to allow the hot gas to do its work. Once defrosting is completed, the EEPR valve opens gradually while liquid refrigerant is readmitted into the evaporators. The EEPR controller disregards the entering air temperature during defrost and deals differently with it during the recovery period (about 45 minutes) that follows.

The **circuit controller** knows the schedule and conducts defrost operations, while the corresponding **EEPR controller** plays the role of slave.

The EEPR valves are considerably more precise than mechanical EPR valves, allowing you to regulate the average temperature to within ± 0.1°C or better. Moreover, the set point can be modified through a simple software command in MT Alliance.

The figure on the following page shows the various LonWorks controllers of the distributed control system that interact directly with the EEPR module.



Note 1 : only the SNVT relevant to the EEPR are shown
Note 2 : in this example, all circuits are on the same suction pressure group and only one termination defrost is shown
Note 3 : nviLiquidTemp supported as of V4.1.3, binding from subcooling or condenser node

Each network variable of type SNVT_temp_setpt carries 5 temperatures, as follows :
Circuit 1 : standby_cool
Circuit 2 : unoccupied_cool
Circuit 3 : occupied_heat
Circuit 4 : standby_heat
Circuit 5 : unoccupied_heat

EEPR2_Bindings_Spec62.vsd
Last edit : 22 avril 2004

Figure 2 – EEPR Distributed System

2.2 The Distributed Control System

The distributed temperature control system consists of various LonWorks controllers from Micro Thermo:

- The MT-EEPR controller itself;
- The sensor nodes (MT-500 **Sensor Node**);
- The suction pressure controller (MT-SPC);
- The circuit controller (MT-CKT).

In addition to these, the EEPR module receives temperature and humidity data from other sources (HVAC node, condenser node or subcooling node). This information is used for environmental corrections.

The **sensor node** (MT-500) measures the temperature of the air entering the refrigerated case, out of the evaporator. Thermistors are generally used. Any given circuit usually involves 1 to 6 refrigerated cases. Each case is equipped with one or more temperature sensors.

The sensor node contains calculation blocks that enable the system to calculate the temperature minimum, average or maximum of the various sensors on a circuit. This **representative temperature** is transmitted to the MT-EEPR controller via the network variable nvoUnivCalc*N* → nviAirTemp*X* connection illustrated on the previous page. *X* can take on values from 1 to 5 and represents the circuit index. *N* identifies the calculation block. It is desirable, but not necessary, that all sensors on a circuit be on the same MT-500 node. In the figure on the previous page, for example, the MT-EEPR nviAirTemp3 input is calculated from sensors that are split between the first and the second sensor nodes.

An MT-500 calculation block can use a sensor belonging to another node, and the output of any calculation block. Network connections between MT-500 nodes are created automatically by MT Alliance.

When a circuit uses a single temperature sensor, the corresponding network variable may be connected directly to the MT-EEPR input; no calculation block is needed.

The **suction pressure controller** (SPC) is mainly responsible for turning compressors on and off. It regulates the average suction pressure. The resulting cycle generates variations in the refrigerant flow. These unavoidable variations play a significant role in the short-term stability of the evaporator temperature. A complete cycle typically lasts some 15 minutes, unless a particular combination of compressors meets the thermal load exactly.

The SPC informs the MT-EEPR controller of:

- The suction pressure, via the nvoSp → nviSucGr*Z*SP connection: this value, which can change rapidly, is used to react quickly in certain circumstances. *Z* can take on values from 1 to 3 depending on the suction group involved.
- The suction pressure set point via the nvoSpStPt → nviSucGr*Z*SPStPt connection.
- The load shed status of the suction group via the nvoSpcEcStatus → nviSucGr*Z*EcStat connection.

The **circuit controller** (MT-CKT) controls the refrigeration and defrost cycle of refrigerated cases connected to a circuit. It knows the schedule, the type of defrost and the strategy used for each of the 5 circuits under its control. All the cases on any given circuit defrost simultaneously. One MT-CKT relay controls the liquid solenoid valve, the other controls the injection of hot gas. These relays may be used or not, depending on the type of defrost.

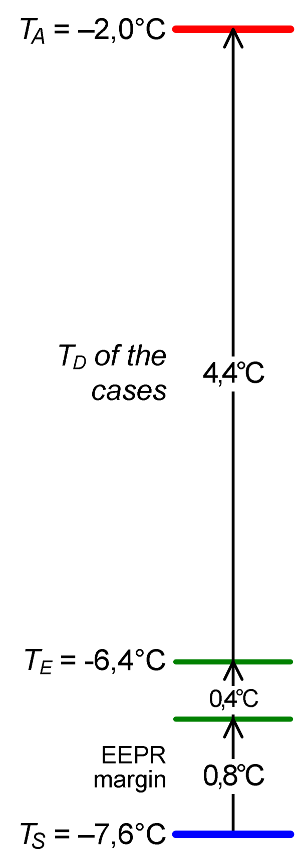
During defrost, the MT-EEPR acts as a slave to the MT-CKT. The network variable connection nvoCircStatus$X \rightarrow$ nviCircStatus$X$ is used to specify to the EEPR module the current defrost phase for circuit X, while the nvoStatus$Y \rightarrow$ nviEEPRStatus$X$ connection informs the CKT module of the position of EEPR valve Y used on circuit X. The EEPR valve **must** be closed while hot gas is injected, to avoid compressor damage.

A typical (hot gas) defrost involves the following steps:

1. Closing the liquid valve and pumping the residual refrigerant (**Pumpdown**).
2. Closing the EEPR valve, then injecting hot gas; it's the defrost process itself.
3. Terminating the injection of hot gas, and waiting for water evacuation (**Drip Time**).
4. Opening the liquid intake valve while gradually opening the EEPR valve.
5. Resuming refrigeration. During a recovery period of about 45 minutes, the temperature errors are not accumulated; integral corrections are based on errors established before the defrost. This avoids any distortions to the integral and long term PID corrections. The instant correction ensures a quick recovery.

In addition to moving valves and co-ordinating itself with the CKT module for defrost, the EEPR module continuously informs MT Alliance on several process variables: temperatures, statuses and %Open of valves, calculation results, strategies used, etc. Output network variables are shown in the figure on page 5.

2.3 Operation of the Temperature Control System



This figure shows the relationships that exist, at a given moment, between the various pressures and temperatures of a circuit that supplies cases of fresh meat, for example. Pressures are expressed in equivalent saturated temperatures.

T_S represents the suction manifold pressure and T_E represents the pressure of the evaporator. T_A is the measured temperature, i.e. that of the cool air injected into the food storage compartment. With an air temperature of -2°C, a typical case will keep the meat slightly above the freezing point.

All of these values vary in time. The suction pressure varies, mainly because energy efficiency dictates that compressors be cycled. Pressure drops in the suction piping vary with gas flow. Even the T_D of the cases varies, depending on ambient conditions.

2.3.1 What the EEPR valve cannot do

First, the EEPR valve cannot bring the evaporator pressure below the suction pressure. To do so would require a turbine. A minimum pressure drop in the valve, even fully open, adds to the losses in the suction piping. Thus, the suction pressure should be set sufficiently low in the SPC to leave some margin for the EEPR valve. A margin of the order of 1°C is needed for the coldest circuit of any suction group; substantially higher values (up to 10°C) may result for other circuits.

One might think that when the suction manifold pressure varies, the EEPR valve would be able to adjust accordingly to maintain a constant air temperature T_A in the case. While this is possible in theory, it will not be done in practice.

To maintain a constant temperature in the cases (under stable environmental conditions), we would have to maintain both the flow of refrigerant and the evaporator pressure. This is technically possible by running a sufficient number of compressors and closing the EEPR valves to increase the evaporator pressure of the corresponding circuits to the desired values.

This solution is ideal, technically speaking: the temperature would remain constant and the compressors would not cycle (unless the thermal loads changed considerably). It is never used in practice, however, because too much energy would be wasted in the valves.

This economic constraint also exists for the mechanical EPR valve, with more drastic consequences, as it leads to variations of the average temperature. Mechanical EPRs cannot compensate effectively for variations of the thermal load and the cycling of compressors. The EEPR valve is superior because it succeeds in regulating the **average air temperature**.

2.3.2 What does the EEPR valve really do?

In the previous section, we saw that the EEPR valve has no magical properties. It yields excellent results, however, if the global system operation is understood. The interactions between the various circuits of a same suction group are very significant.

Compressor cycling being unavoidable for economical reasons, the SPC toggles between two compressor combinations: the combination just above the ideal value (Combination A) and the one just below (Combination B).

When Combination B is running, the flow of refrigerant being insufficient, the evaporators begin to warm up. The EEPR valves open up slightly to compensate, but the flow remains inadequate.

When Combination A is active, the resulting flow is higher than normal and the evaporators cool down. The EEPR valves close slightly to mitigate this cooling process, thus extending the compressor cycle.

This results in a good compromise between temperature stability, compressor cycling and energy efficiency.

EEPR valves represent an improvement over their mechanical counterparts for two major reasons. Firstly, the PID of the EEPR controller averages circuit temperature over time and uses the result to position the valve. Secondly, some circuits can be sacrificed to the benefit of other, more critical circuits.

The case and its content have considerable thermal inertia, so that the average air temperature is more critical than its instantaneous value. Regulating precisely the average air temperature represents the most important criterion as regards food temperature.

Under typical conditions, with the EEPR controller, the instant temperature may vary from ±0.5°C (±1°F), but the average temperature remains within ±0.05°C (±0.1°F) of the set point. The temperature varies around the set point, regardless of the thermal loads and outside disturbances.

The second point is related to the fact that circuits can be treated differently, according to the type of food. When Combination B is running and the flow of refrigerant is insufficient to meet all requirements, some circuits may be sacrificed. The more critical circuits benefit. It is possible, for instance, to minimise the impact of compressor cycling on the fresh meat cases. This function is presently available and its use is highly recommended.

2.4 EEPR Module Hardware and Interface

The controller has a local interface (buttons and indicators) permitting you to position the valves manually, even without MT Alliance. The use of this local interface is described in the manual ***MT-EEPR Module Installation Guide for Original Equipment Manufacturers (OEM) (71-GEN-0099)***. The same document describes the physical connections and their requirements.

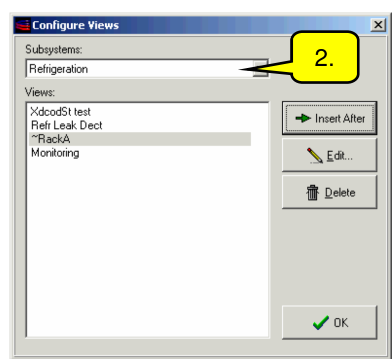
3. Set Up Using MT Alliance

After the electrical connection of the power supply, the network and the individual valves has been completed, you may:

- Logically install the MT-EEPR module.
- Load the application program.
- Establish the network variable connections (bindings).
- Configure the EEPR node using the plug-in.
- Set the various set points.

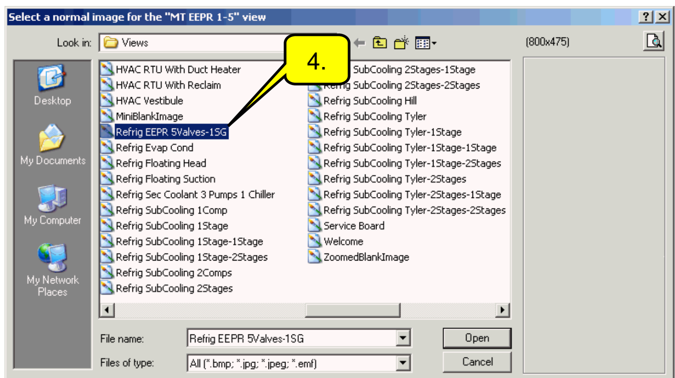
3.1 Adding the EEPR Valve System View

A view is added for each EEPR module. The node, the plug-in and the relevant measure and command points are dropped onto this view.

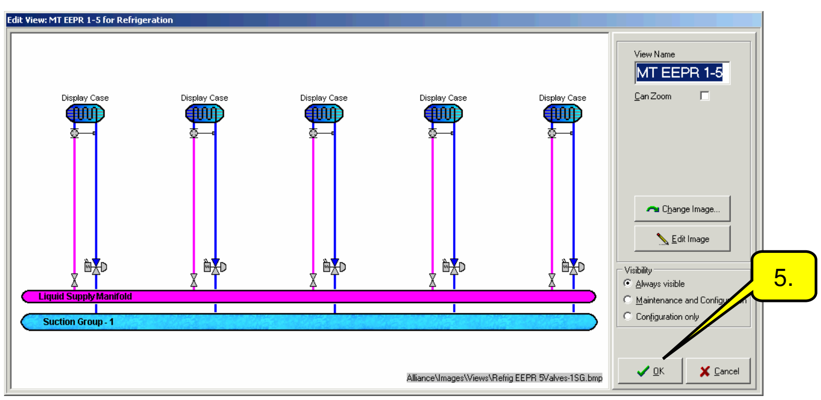


1. In the **Configure** menu, select **Views…**
2. Select **Refrigeration** in the **Subsystems** dropdown list. Click **~RackA** and the **Insert After** button.
3. In the **View Name** field, type the view name (ex: MT EEPR 1-5) and click **Change image...** to select the image to use.

4. Select the file Refrig EEPR 5Valves-1SG and click Open.



5. Click **OK** to finish.



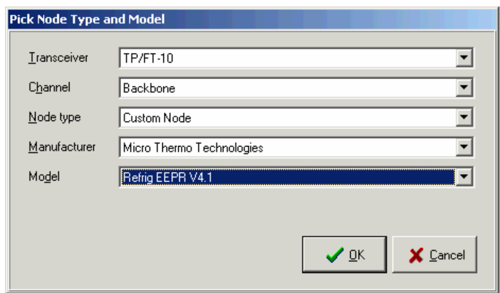
3.2 Dropping the EEPR node

1- In the **Subsystem** menu, select refrigeration subsystem or click on the **Refrigeration** button. In the **Mode** menu, select the **Configuration** mode. Upon entering this mode, a **components** toolbar appears in the bottom right corner of the window. It contains all of the components that can be placed on the view.

2- Select the view created in step 3.1 (Ex: MT-EEPR1-5)

3- Drag and drop a **Node** type icon from the toolbar onto this view. The **Pick Node Type and Model** window opens to allow you to define the node.

4- In the **Manufacturer** and **Model** dropdown lists, select the specific node you wish to install. Click **OK** to finish or **Cancel** to clear the node.



Note: An icon can be moved with the left mouse button while holding the **Ctrl** key.

After dropping the node representation, you may associate it to the physical module.

1- Click the node icon to open the **Custom Node Information** dialog box.

2- Select the **Details** tab.

3- Type a unique descriptive name in the **Identification** field and, if you wish, you may also enter a note in the **Notes** field.

4- Select the **Commands/Status** tab.

5- In the **Installation** group, click **Install**.

6- The **Install Custom Node** dialog box opens and prompts you to press the ***Service Pin***[1] of the EEPR node. Loading of the firmware begins; .after several minutes, loading is complete and the buttons are enabled.

7- Click **OK** to exit the window.

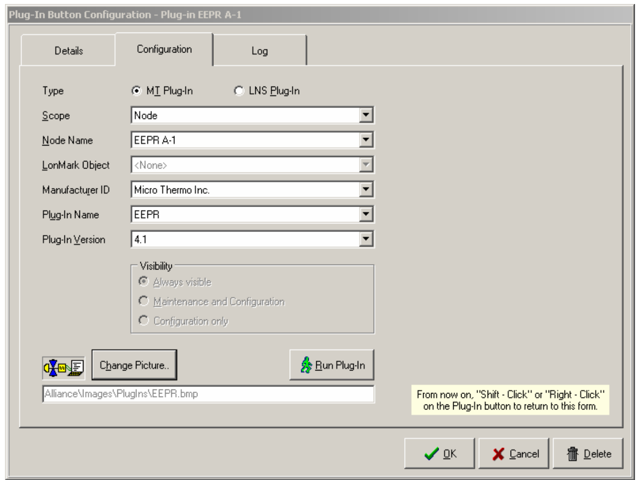
8- Accept to save the changes.

[1] If the node is not accessible, it is possible to type the neuron identification number manually, as explained in the *Node Installation* manual.

3.3 Adding the Plug-in

At this stage, the EEPR module contains the software but no site-specific settings. To configure the settings, you must first install a plug-in.

1- Drag and drop a plug-in icon from the toolbar to the desired location on the view created in step 3.1. Click the plug-in icon to open it.



2- The **Plug-In Button Configuration** dialog box opens. Enter the information as indicated in the table below.

Details – General group Tab	
Identification	Enter a unique descriptive name
Configuration Tab	
Type	**MT Plug-In**
Scope	**Node**
Node Name	Use the name you have given to the node
Manufacturer ID	**Micro Thermo Inc.**
Plug-In Name	**EEPR**
Plug-In Version	4.1 (or more recent)

3- Click **OK** to close the dialog box and save the settings.

3.4 Network Variable Connections

The EEPR module interacts with several other nodes: the corresponding circuit controller, the suction pressure controller, the MT-500 sensor nodes, an RTU node (or other) of the HVAC system, the condenser node (or the subcooler node.)

The figure showing the EEPR distributed system, on page 5, shows an example of connection diagram. The connections between MT-500 nodes are done automatically, but the other bindings must be performed manually using the MT Alliance connection tool. The table below gives the list of connections to establish.

Note: In the table below, *X* represents the circuit index, from 1 to 5 for each of the EEPR nodes. In this example, the circuit index is the same in the ~RackA.CkC1 module and in the corresponding EEPR module. *Z* represents the number (from 1 to 3) of the suction group to which the EEPR valve is connected. *Y* represents the index (connector used on the module, from 1 to 5) of the valve servicing this circuit. *N* identifies the calculation block used for circuit *X*.

Node	nv source	Node	nv destination
~RackA.SGr1	nvoSP	EEPR	nviSucGr*Z*SP
~RackA.SGr1	nvoSpStPt	EEPR	nviSucGr*Z*SPStPt
~RackA.SGr1	nvoSpcEcStatus	EEPR	nviSucGr*Z*EcStat
MT-500	nvoUnivCalc*N*	EEPR	nviAirTemp*X*
~RackA.CkC1	nvoCircStatus*X*	EEPR	nviCircStatus*X*
EEPR	nvoStatus*Y*	~RackA.CkC1	nviEEPRStatus*X*
(may vary)*	nvoLiquidTemp	EEPR	nviLiquidTemp
RTU	nvoSpaceTemp	EEPR	nviSpaceTemp
RTU	nvoRH	EEPR	nviSpaceRH

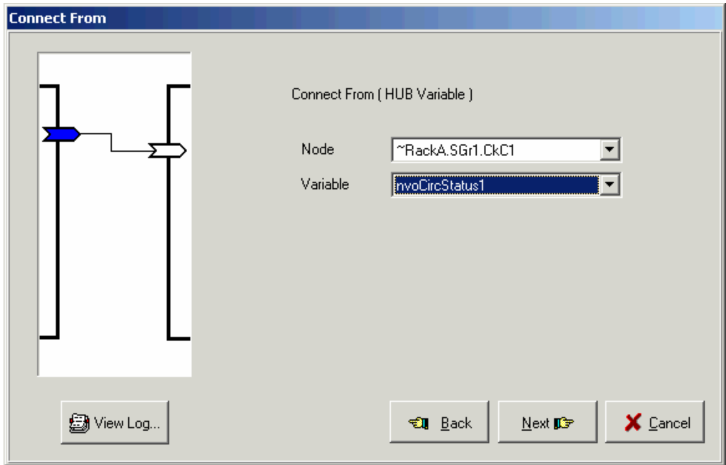
* Use the variable that is most representative of the temperature of the liquid entering the evaporators. This value is available from the subcooling node or, in the absence of subcooling, the drop leg temperature from the condenser node may be used. This binding may be omitted if no suitable network variable is available. Available from V4.1.3.

When a circuit uses more than one valve (in parallel), you need only make one nvoStatus*Y* network connection, from any one valve to the Circuit node.

Connections are made using the procedure below:

1- In the **Network** menu, select **Network Connections…**
2- The **Network Variable Connections** window opens.
3- Click **+Connect**.
4- The **Connection Type** window opens.
5- Select **Connect one output to one input** since, in this context, all the connections to be defined are one to one.

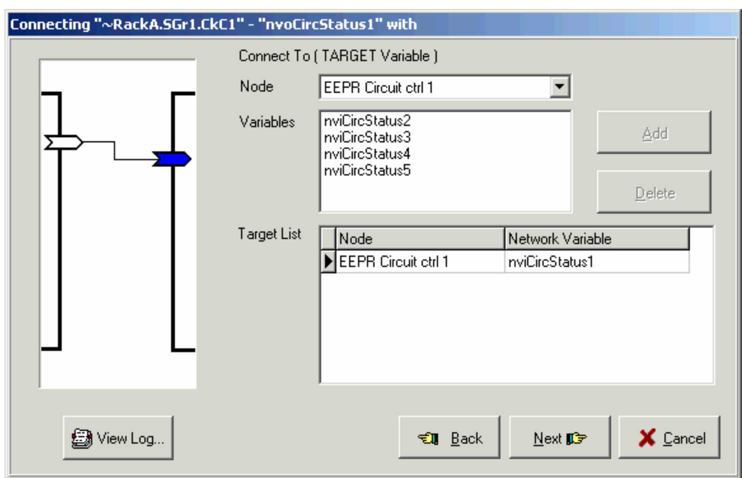
6- In the **Node** dropdown list of the **Connect From** dialog box, select the circuit controller node (**~RackA.SGr1.CkC1** for the first one).



7- Select **nvoCircStatus1** in the Variables dropdown list.

8- Click **Next**.

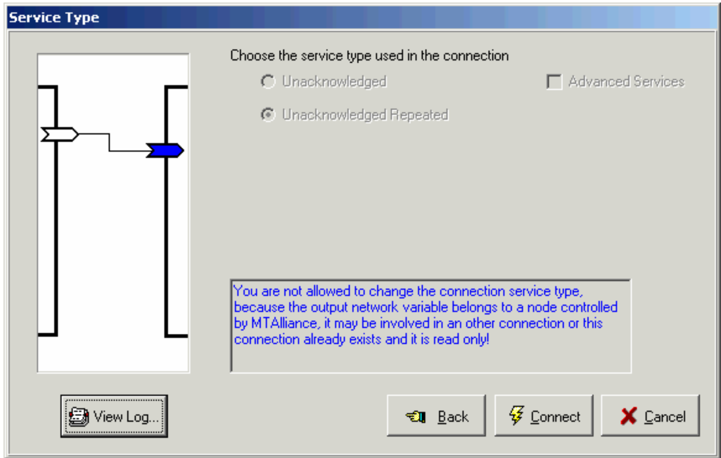
9- The window that opens allows you to choose the input variable to connect **nvoCircStatus1**. Select the MT-EEPR node (**EEPR Circuit ctrl 1** in this example) in the dropdown list.



10- Then select the relevant variable (**nviCircStatus1**) in the list.

11- Click **Add**. The variable is moved to the **Target List** window.

12- Click **Next** to open the **Service Type** window.



13- Click **Connect** to establish the connection.

14- Repeat the procedure for any remaining connections.

15- Repeat the whole procedure to connect the network variables of the other EEPR nodes.

4. EEPR Plug-in

The board's manual controls always have precedence over the plug-in, unless they are disabled as described on page 17. For safety considerations, a valve in manual mode cannot be recovered by the plug-in. The **MANUAL WARNING** red LED, in the upper right hand corner of the EEPR module, turns on to notify the user if one of the five valves is in manual mode. The user may check that this LED is off before leaving the site, to make sure that he will be able to control the valves remotely.

The EEPR plug-in allows the user to:

- Configure the EEPR controller.
- Load the parameters into the node.
- Validate network connections (*bindings*).
- Specify default values for certain set points.
- Monitor the control process.
- Change the the node's internal mode of operation.
- Perform specific commands.

The plug-in icon is visible in all modes (**Overview**, **Maintenance** and **Configuration**).

Certain sections are visible only for "technical" users.

<u>In **Overview** mode</u>:

You can:
- View all **System**, **Process** and **Log** tabs.
- Add an entry in the log.
- View or print reports.
- Consult the graphs of all points available in the **Process** tab.

<u>In **Maintenance** mode:</u>

You have the privileges of the **Overview** mode. In addition, you can:

- View the **Circuit**, **Valves** and **Board Layout** tabs.
- Override any automatic valves to a value *x*, for a time *y*.

<u>In **Configuration** mode:</u>

You may do anything (except for specific operations reserved for **Super Technicians**).

4.1 Basic Plug-In Operations

4.1.1 Status

The plug-in gives a quick overview of the EEPR status. Geometric shapes of different colours are used to indicate exceptional situations.

Red indicates that one or several connections are missing.

Aqua indicates that a variable was overridden.

A yellow diamond indicates an incomplete configuration.

The colored symbol is added to the relevant tab, as a help in locating the exception.

4.1.2 Applying or Cancelling Changes

When any changes are made to the plug-in, the **Apply** button gets enabled. The options are as follows:

Apply – brings up a confirmation dialog box. If you accept, the plug-in saves values, adds them to the system log and attempts to send them to the node. Once the operation completed, the **Apply** button turns to grey and the plug-in remains open. If you refuse, the save operation is cancelled and no action is taken. The node may not function properly if errors are detected during transmission.

OK – this button performs as **Apply**, except that the plug-in closes afterwards.

Cancel – select **Yes** to cancel all changes and close the plug-in. Click **No** to return to the previous screen and undo the cancel operation.

Upon clicking **Apply** or **OK**, the plug-in normally transmits to the node only those parameters that were changed.

4.1.3 Current Values

The **Current Values** button is used to get details about a particular valve or circuit.

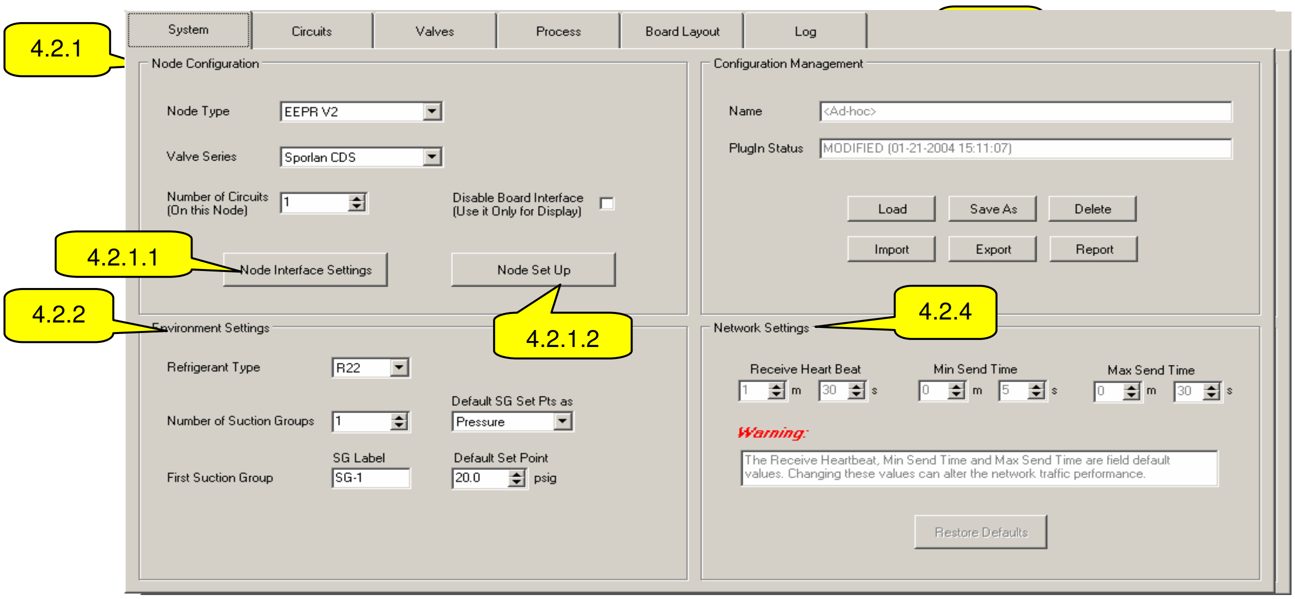
4.1.4 Send all CPs

This box provides additional safety. The **Send All CPs** box is used to transmit all parameters to the node, whether they were changed or not. They are sent upon clicking on **Apply** or

OK. This box should be checked if the synchronisation of the node and the plug-in is questionable.

4.2 System Tab

The **System** tab shown below includes settings that affect all circuits and valves.



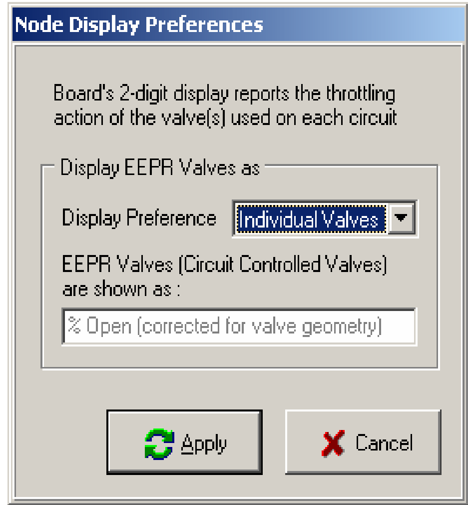
4.2.1 Node Configuration

- **Node Type**: EEPR V2 (or later).
- **Valve Series**: allows the user to specify the electrical characteristics of the EEPR valves used on the site. The Sporlan CDS valves are recommended. The 12 volts (400mA) and 24 volts (200mA) ESR valves made by Alco are supported.
- **Number of Circuits**: indicates the number of circuits used on the same module. Possibility of 1 to 5 circuits.
- **Disable Board Interface**: prevents using the board switches to change the control mode of any valve from automatic to manual. Upon attempting to do so, “no” is displayed. It remains possible to select valves and to read their percentage of opening. In case of emergency, the local interface can be unlocked temporarily (for one minute) by pressing the Open and Close buttons at the same time for 2 seconds, while the valve is manually selected (i.e. while the scan is stopped).

4.2.1.1 Display modes for circuits and valves

The **Node Interface Settings** button opens the **Node Display Preferences** dialog box to configure the 2-digit display of the local interface of the MT-EEPR module.

1- <u>Display by individual valve</u>:



When **Individual Valves** is selected in the drop-down list, the dispaly indicates the position of each valve in percentage of opening.

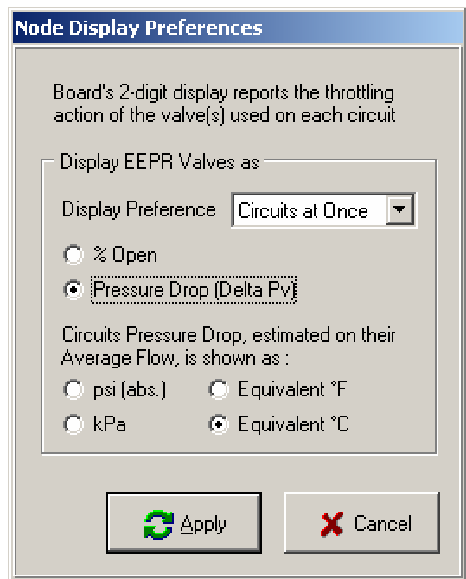
Example of a display sequence with 5 valves installed:

23. → 12. → 9.4 → 54. → 33 → y.

The y displayed at the end of the sequence identifies the display mode as being the %Open[2] (percentage of opening) of a valve.

The decimal point flashes for an external valve controlled in relative position.

2- <u>Display by circuit</u>:



If **Circuit at Once** is selected in the dropdown list, the following options appear:

a) **%Open**: The percentage of opening is preceded briefly by the circuit number.

Example of a display with only three circuits:

31, 12. → 32, 12. → 33, 9.4 → Cy.

The circuit number appears briefly, without a decimal point. The percentage of opening follows. If the circuit uses many valves in parallel, the complete circuit displays only once and all corresponding LEDs blink at the same time.

b) **Pressure Drop**: the calculated valve pressure drop is displayed; it is estimated on the basis of the average refrigerant flow for this circuit. The circuit number precedes it briefly.

This pressure drop display is most significant with respect to the process. When the valve opens, its value decreases. In this mode, "OP" is displayed when the circuit reaches 100% Open.

The following shows an example of a display sequence of the estimated pressure drops, with the "°C" option:

31, 0.8 → 32, 5.5 → 33, 4.2 → 34, 0.5 → 35, 0.7 → °C.

This sequence is interpreted as follows: the first circuit, identified by the number 31, has a pressure drop of 0.8°C. For circuit #32, the pressure drop is estimated at 5.5°C, and so forth.

[2] The %Open value corresponds to the valve's percentage of opening corrected for geometry. It is proportional to the flow, for a given pressure drop.

The units are indicated when the board is selected at the end of the cycle: "PS" for pounds by square inch (psi), "Pa" for kilopascal, "°F" for degrees Fahrenheit and "°C" for degrees Celsius.

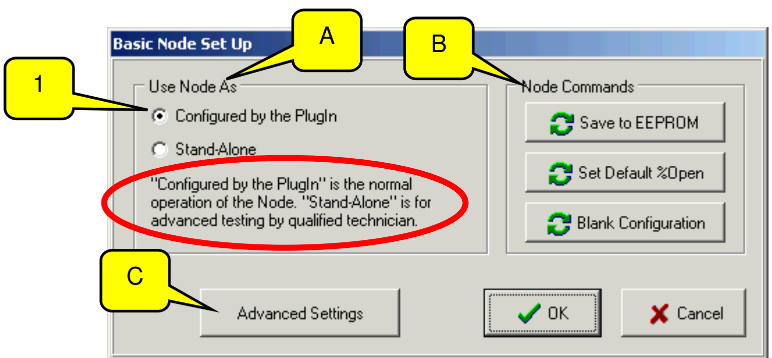
It is advantageous to express the valve opening in equivalent temperature, because it predicts directly the effect of any valve motion on the cases' temperature. If, for example, the valve gets closed to increase the display by 1°C, the air temperature will increase by that much after a few minutes (disregarding any disturbances.)

Important: the pressure drop displayed is not measured directly; it is calculated based on the average refrigerant flow, as estimated in accordance with the thermal load corrected for environmental conditions. It is reliable under equilibrium conditions, when the actual flow is not too different from the calculated average flow. If the valve is closing (for a defrost operation, for instance), the displayed value of ΔP becomes very large, due to the decrease of the actual flow; this does not represent a real pressure increase. Even though the 2-digit display shows a large ΔP the actual pressure drop remains relatively small since the real flow is almost non-existent.

4.2.1.2 Module Configuration Modes

When you click on 

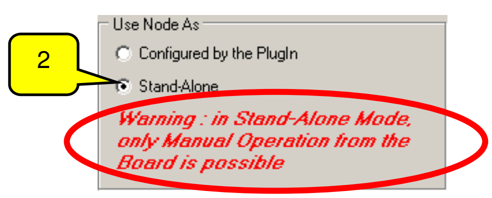
a window appears as shown below, to define the operating mode of the MT-EEPR module:



A) **Use Node As** allows to specify the basic operating mode of the EEPR node.

1) If **Configured by the Plug-In** is selected, the configuration defined in the plug-in will be sent to the node on the next **Apply** to make it work normally.

2) When **Stand-Alone** is selected, the configuration is also sent, but the node will ignore it. This makes it possible to place a node which is already configured in a state similar to its original state, without deleting the permanent memory (EEPROM) of the PIC (microcontroller that manages directly the valves and the local interface), nor destroying the existing configuration. In this state, the circuits are not defined at the node level, but the valves can be controlled from the local interface in manual mode. The plug-in still displays the percentage of opening of the existing and configured valves, but their status is not refreshed. The temperatures that were measured when the node was placed in **Stand Alone** mode are still updated on the process page.



B) **Node Commands**

These three commands are used only under the specific conditions described below.

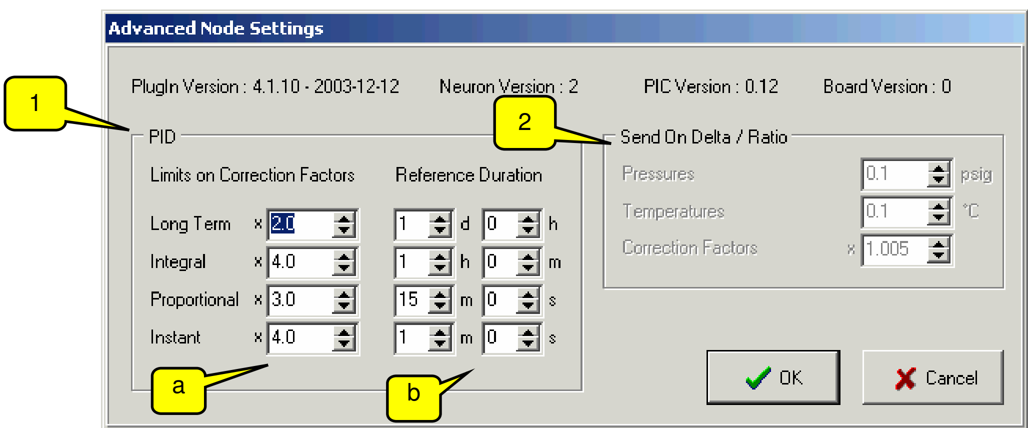
1) **Save to EEPROM**: asks the module to save its critical data (especially the usual position of the valves). This is a useful precaution before changing the software version of the neuron, so that the valves return to their usual position immediately after the node resets. Data are saved in the PIC's EEPROM and will survive loading the node's software.

2) **Set Default %Open**: preloads the PIC with default values of %Open. The values are taken from the **Corrections Adjustment** dialog box of the **Circuits** tab (page 29). This command, among others, is useful when replacing an EEPR node: the new node is preloaded with valid %Open values, so that the valves get positioned reasonably by the PIC, as soon as the controller is activated, and even before the node software is loaded. These values of %Open replace the values stored as a result of the normal operation of the node. A new node has default %Open values equal to 10%.

3) **Blank Configuration**: resets the PIC's EEPROM memory to its original state. This command may be used before using an EEPR controller on a new site. This command leaves the controller in **Stand-Alone** mode.

C) Clicking on 

brings up the window shown below:



1) **PID** allows you to configure the feedback settings. (Please see Section 4.3.2.2 for an explanation. They usually do not need to be modified.)

a) **Limits on Correction Factors**: indicates the maximum correction factor. For example, a value of 2 means that the correction will be limited between 0.5 and 2.

b) **Reference Duration**: specifies the integration time constant for the two integral corrections (**Long-Term** and **Integral**), the period used to calculate the average error for the proportional correction, and the latency. The latency is the time after which a valve should be adjusted, simply because it has not moved for a while.

2) **Send On Delta/Ratio**. These settings[3] limit traffic on the network; they prevent network variables from being sent too frequently. In the case of pressures and temperatures, the **Send On Delta** represents an increment (increase or decrease); for correction factors, the criterion is the ratio between the updated value and the old value. Values are sent at **MinSendTime** if the threshold has been exceeded. If not, the node waits longer, until **MaxSendTime**.

D) **Remote Valves Controlled by** (available only to the Super Technician. See page 32)

1) **%Open (Refrigerant Flow/Max Flow)**: used only for an external valve controlled in percentage of opening.

2) **%Position (Number of Steps/Max Steps)**: used only for an external valve directly controlled in position, without any correction for the valve profile.

4.2.2 Process Related Parameters

Process related parameters are entered in the **Environment Settings** section, of the **System tab** shown on page 17.

- **Refrigerant Type**: R22, R404a and R507 are supported as of this writing. Any given EEPR controller supports **only one** refrigerant.
- **Number of Suction Groups**: the EEPR controller can be linked to a maximum of 3 SPCs (Suction Pressure Controllers).
- **SG Label**: identifies each suction group involved with the valves on this EEPR node.
- **Default SG Set Pts As**: offers a choice of pressure units or equivalent temperatures, to display and enter the default set point.
- **Default Set Point**: default suction pressure. This value is used for certain internal calculations and as a safeguard, in case of communication failure between the SPC and the EEPR node.

4.2.3 Configuration Management

A **Configuration** represents the set of parameters needed for a module's operation. The descriptions below refer to the **Configuration Management** section of the **System** tab shown on page 17.

- **Name**: indicates the name of the current configuration. If no configuration was saved, it displays <Ad-hoc>.
- **PlugIn Status**: indicates the relationship between the time stamp of the last plug-in save (shown in parentheses) and the time stamp of the configuration.

    If ConfigDateTime = PlugInDateTime : Status is 'SYNCHRONIZED'

    If ConfigDateTime < PlugInDateTime : Status is 'MODIFIED'

[3] These values are read-only (greyed fields) since they require an extensive knowledge of the network configuration. Any change, even on a single node, can lead to a catastrophic degradation of the performance of the whole network. For this reason, only users who log on with a Super Technician code are entitled to change these settings.

If ConfigDateTime > PlugInDateTime : Status is 'OUT OF DATE'

Copying an identical or a slightly different configuration may help to install other controllers or controllers on another site. The configuration management options are described below.

- **Load**: opens a dialog box to select and load a configuration in a list of previously saved or imported configurations. The list is empty if no configurations were saved or imported.
- **Save As**: opens a dialog box to save the current configuration and insert it in the site's current configuration list. New configurations can be created. It is possible to overwrite an existing configuration by saving under its name.
- **Delete**: opens a dialog box allowing the user to delete configurations included in the configuration list.
- **Import**: allows the user to transfer one or several configurations contained in a text file (previously created with the **Export** command) to the list of configurations available on the site. If a configuration with the same name already exists, the user can overwrite the existing version.
- **Export**: allows the user to transfer one or several configurations contained in the list of saved configurations to a text file. The export and import functions are used to transfer configurations from one site to another. Since the text file is small, it is possible to copy the file on a floppy disk or to send it via modem or e-mail to another site.
- **Report**: generates on screen a complete report of the active configuration. The report can be redirected to a Windows-defined printer. We recommend that you print a configuration report and keep it with the rest of the refrigeration system documentation.

4.2.4 Network Settings

This group displays several settings that determine the MT-EEPR module's performance as a component of the LonWorks network. These values are read-only (greyed fields), since changes can lead to a degradation of the network performance. In order to change these settings, you must open the session as a Super Technician.

The descriptions below refer to the **Network Settings** section, of the the **System** tab shown on page 17.

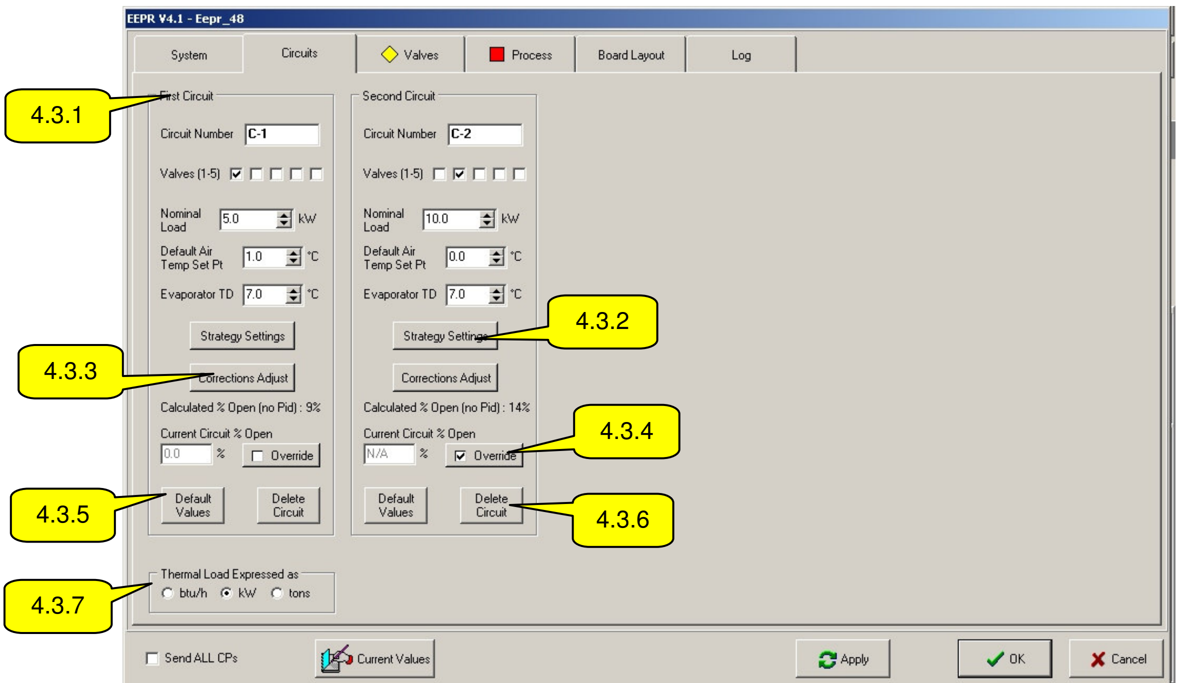
- **Receive Heartbeat**: if the module hasn't received any update for an input network variable it considers, after Receive Heartbeat, that the message sender is unavailable. In most cases, a default value will be substituted for the missing variable.
- **Min Send Time**: this setting is used to reduce network traffic by limiting the update of network variables. It is the minimum delay between successive transmissions of any given variable.
- **Max Send Time**: even if the value of a network variable remains the same, the node will send a confirmation after Max Send Time. This prevents other nodes from falling back to the default value.
- **Restore Defaults**: restores the default values of the above three network settings.

A relation should be respected between the **Max Send Time** of the sending node and the **Receive Heart Beat** of the receiving node. The recommended relation is:

Max Send Time = Receive Heart Beat/3.

4.3 Circuits Tab

The following figure shows the **Circuits** tab, as it appears when only two circuits are defined. The block representing a circuit is repeated, up to 5 times, according to the number of circuits declared in the **System** tab, on page 17.



4.3.1 Circuits Properties

- **Circuit number**: identifies the circuit. The name should include a number between 0 and 99. For example: C-1, Cir-39, C-4A, etc. This number appears on the 2-digit display, just before the percentage of opening of the circuits. It is suggested to use the same name as in the refrigeration schedule.

- **Valves (1-5)**: specifies which valve controls the flow for this circuit. It is recommended to use valve 1 for circuit 1, and so forth. If multiple valves are declared for the same circuit, the controller considers that they are in parallel and it will position them accordingly. The valves will move one after the other, to identical target %Open.

- **Nominal Load**: the load as specified by the case manufacturer. This value normally corresponds to the worst operating conditions (typically 75°F and 55% of relative humidity inside the store).

  Cold storage rooms represent a specific problem, as the construction of the chamber and the frequency of door openings will affect the thermal load. It may differ substantially from the installed refrigeration power. If the cold storage room includes an exterior wall, the thermal load will depend on ambient conditions, especially on outside temperature.

The thermal load should be entered here as it appears in the refrigeration schedule. If needed, it can be adjusted later in the **Strategy Settings** window (page 25).

Evap Temp at which Heat Load is Specified in **Circuit Advanced Settings**, on page 28, influences the effective heat load.

When a case is used alternately in freezing and cooling applications (**Dual Temp** cases, see page 41), the thermal load won't be the same for the two applications. The following applies to the situation where a local, independent control is used to limit the refrigerant flow or the suction. The EEPR node is not warned of the changes in set points. You should use the set point for the freezer application, and the corresponding thermal load, as the EEPR will be in control in that situation. When the case is switched to the medium temperature set point, the overestimated thermal load will be compensated for by the PID.

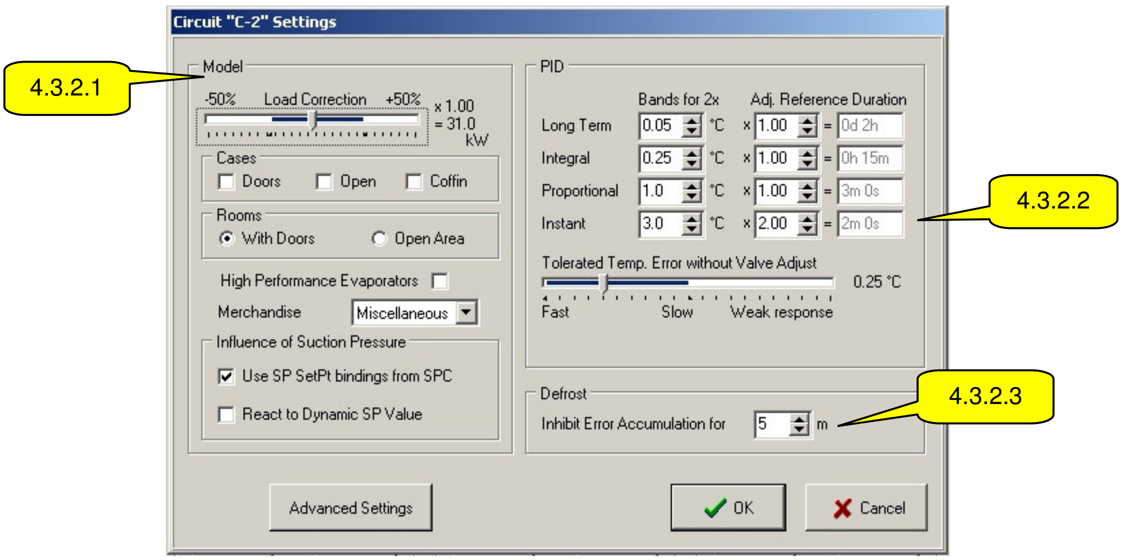
- **Default Air Temperature Set Point**: this value is used in some of the less critical calculations. It gets used for all calculations when the command point set in MT Alliance is unavailable. It is stored in the neuron's permanent memory, so that it is available immediately after a reset.
- **Evaporator TD**: defined as the difference between the sensor temperature and the saturated temperature of the evaporator. Enter the value measured under the worst operating conditions (typically 75°F and 55% of humidity inside the store). This is the value quoted by case manufacturers, usually. For cold storage rooms, the appropriate value is somewhat higher than the TD of the evaporators themselves, because the temperature sensors are usually located in the return air.

  The setting of the thermal expansion valve (TEV) influences the TD; an unusualy high superheat implies an incompletely filled evaporator that leads to a higher TD.
- **Calculated %Open (no PID)**: displays the theoretical value of the percentage of opening based on the model's calculation, with environmental corrections but without any PID corrections.
- **Current Circuit %Open**: displays the current value of %Open for the circuit. Available even if the valve is controlled manually, as long as the communication is established with the node.

4.3.2 Strategy Settings

When clicking on 

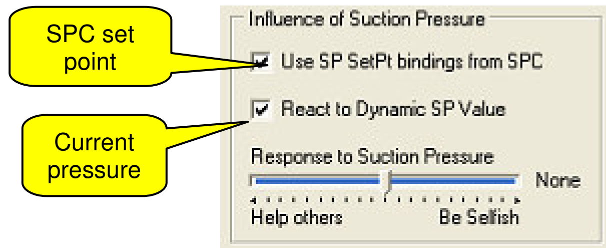
the window below is displayed. The parameters of the model and the settings of the PID can be edited for the selected circuit:



4.3.2.1 Model Parameters

- **Load Correction**: a correction factor to the nominal thermal load (up to ± 50%, but the setting should remain within the blue zone, except under special circumstances.) An adjustment to the thermal load can thus be made while keeping the nominal value unchanged in the Circuits tab.
- **Cases**: select the type of cases used on the circuit. Check all relevant boxes.
- **Rooms**: select the type of cold storage room controlled by the circuit.
- **High Performance Evaporator**: check this box if the circuit is equipped with high performance evaporators (ex.: Tyler T/C Coil). This reduces the TD suggested by the plug-in for the evaporators, provided it has never been modified.
- **Merchandise**: specify the type of food kept in the cases or in the cold storage room. This influences some strategies proposed by default.
- **Use SP SetPt binding from SPC**: check this box to allow the EEPR module to use the suction pressure set point from the SPC module. This box is normally checked.

- **React to Dynamic SP Value**: if this box is checked, the instant reaction to the suction pressure variations (dynamic pressure) will be activated.

  This option can be used in two opposite ways. When the cursor is moved to the right (in **Be Selfish** position), the node uses the suction pressure to improve the short-term stability of the cases' temperature. This option is used for critical circuits, i.e. the ones containing food very sensitive to temperature fluctuations (ex. fresh meat). When the cursor is moved to the left (**Help Others**), the node sacrifices this circuit to the benefit of others.

  The proper use of these settings is explained on page 44.

4.3.2.2 PID Corrections

The PID (standing for Proportional-Integral-Derivative, the feedback mechanism) uses four corrections which **multiply** one another; they are not additive.

The most important feature of the PID is that the default settings will function properly in most situations: it should not require any tuning, in most installations. The EEPR controller uses a model to calculate the percentage of opening. The PID is not critical, since the model does most of the work.

The **Long Term** correction compensates for permanent perturbations such as an offset of the pressure sensor that has not been corrected in the sensor node itself.

The **Integral** correction takes care of perturbations that last one hour or so, such as the fluctuation of the number of customers.

The **Proportional** correction reacts more quickly than the integral corrections while remaining relative insensitivity to the variations of suction pressure induced by compressor cycling.

The **Instant** correction reacts almost immediately to reduce changes in temperature. It cannot eliminate variations completely, for two reasons:

- during part of the compressor cycle, there is not enough refrigerant flow to satisfy the needs of all the evaporators. This is not a question of control but rather a physical limitation of the process;
- the feedback system is relatively slow, compared to the process itself. As result, the gain must remain very low, in order to avoid oscillations.

The PID has two types of settings: gains and time constants. **Gains** are completely defined in the **Circuit Settings** dialog box (page 25). The **Reference Durations** are the result of a basic value defined in **Advanced Node Settings** (page 20) and a modifying factor, specific to the circuit, which is entered in **Circuit Settings**.

Depending on the type of food, certain default values proposed in the dialog box may vary.

Gains are expressed in terms of the band (**Band for 2×**). The band corresponds to the temperature error that would provoke an increase, by a factor of 2, of the %Open of the valve. The narrower the band, the higher the gain. Too large a gain can cause the circuit to oscillate. An oscillating circuit incurs cyclic temperature variations that are usually **not** coordinated with the compressors' cycle.

For the long-term and for the integral corrections, the **Reference Duration** is the integration time constant. In the case of the proportional correction, the temperature is averaged over a duration[4] corresponding to the compressor cycle. For the instant correction, the **Reference Duration** corresponds to a latency period during which we refrain from readjusting a valve that just moved. The valve may still move under certain circumstances (as a result, for example, of a sudden change in suction pressure).

- **Tolerated Temp Error without Valve Adjust**: this temperature difference defines what can be considered as a large enough error to justify an immediate valve adjustment. This is one of several factors affecting the valve's priority.

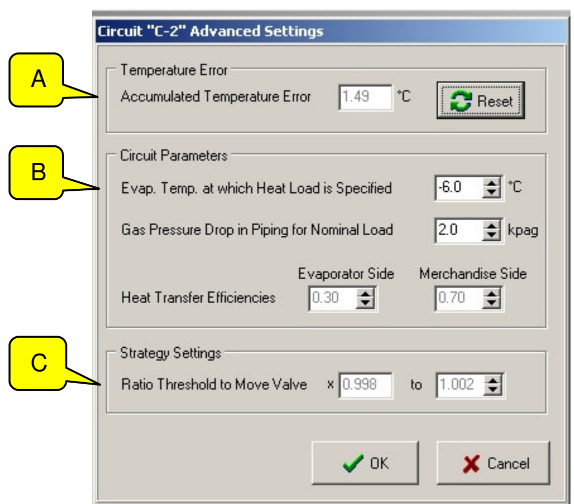
4.3.2.3 Error Accumulation Inhibited After a Defrost or a Load Shed

- **Inhibit error accumulation for**: immediately after a defrost or a load shed, the temperature errors are larger than normal and should not be accumulated for integral corrections. An inhibition period of 45 minutes is suggested, but some circuits can recover faster, depending on the type of defrost used.

4.3.2.4 Advanced Settings

When you click on 

the window below appears and allows you to do the configuration of the circuit's advanced settings:



A) **Accumulated Temperature Error**: shows the error accumulated by the integral correction. This variable is vital because it represents the **average deviation** of the measured temperature with respect to the set point. The average is calculated outside defrosts, using a period equivalent to the integration time of the integral correction (see **Reference Duration** in the **Circuit Settings** (page 25).

- The **Reset** button in **Advanced Settings** resets the accumulated errors for the integral corrections (both Integral and Long-Term); it can be used to flush corrections that were accumulated under abnormal conditions that no longer exist (for instance, when the cooling resumes after cleaning or a malfunction.) Any substantial change to the model's parameters (such as temperature set point, TD or thermal load) invalidates the accumulated errors and provokes their automatic reset. The

[4] Ideally, but the information is not available from the SPC as of this writing. You may choose a value that is close to your observations.

Reset button does not need to be followed by **Apply**; the command is immediately sent to the node and executed.

The error accumulated for the integral correction is also displayed in the **Current Values** as **Accum Temp Error** (page 35) and on the process page under the name **Delta T Mean** (page 33). The error accumulated for the long-term correction is not available, but the correction itself is displayed in the **Current Values** of the circuit. Note: when the integral errors are null, the corresponding correction equals 1 (a multiplication by 1 having no impact.)

B) **Circuit** Parameters:

- **Evap. Temp. At which Heat Load is Specified**: the evaporator temperature used by the manufacturer to measure the case's nominal thermal load (see page 23.) Its default value (suggested by the plug-in) is calculated depending on the temperature set point and the TD. It is generally accepted as is. This setting needs to be edited if the cases are used under conditions very different from those used by the manufacturer to specify the thermal load. If you are using, in a refrigeration application, cases that were characterised only as freezers, you can specify the thermal load corresponding to the freezing mode, and enter the corresponding temperature (for instance, -30°C) in **Evap. Temp. At which Heat Load is Specified**. The EEPR controller will implement all appropriate corrections (temperature and humidity) to support the cases in refrigeration mode.
- **Gas Pressure Drop in Piping for Nominal Load**: enter the pressure drop in the suction piping in order for the EEPR controller to calculate the corresponding correction. The pressure drop estimated from the nominal (i.e. worst case) thermal load should be used. The suggested value may be left in most cases. Certain sites with marginal piping will benefit from entering a higher value, however.
- **Heat Transfer Efficiencies**: internal settings[5] used in the modelling of cases and cold storage rooms. These values, which are different for cases and cold storage rooms, should not be edited unless otherwise indicated.

C) **Strategy Settings**

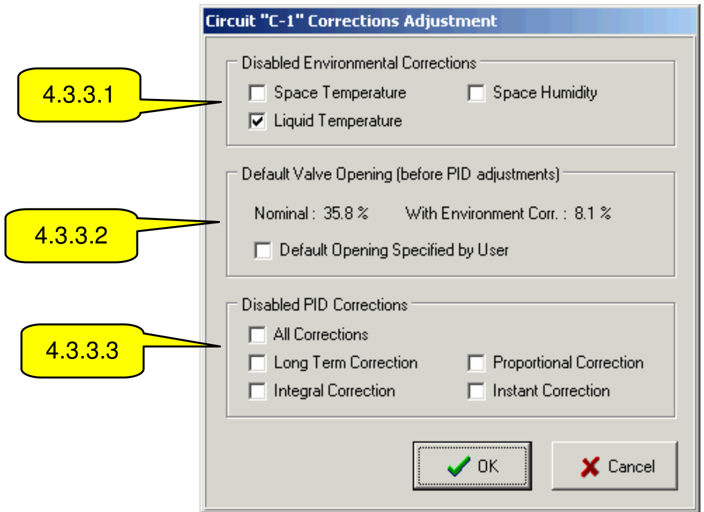
- **Ratio Threshold to Move Valve**: the valve won't move if the **ratio** between the calculated and actual values of %Open falls between the two limits indicated.
- **Pump Down %Open Factor**: a factor applied to the opening of the valve during the first stage of defrost. Default is ×2. Available when logged in as a Super Technician.

[5]You need to log in as a Super Technician to modify these values.

4.3.3 Environmental Corrections and PID Activation

Clicking on 

opens the window shown below.



4.3.3.1 Deactivation of Environmental Corrections

- **Disabled Environmental Corrections**: check these boxes if you need to deactivate any environmental corrections: the temperature and humidity inside the store, or the temperature of the liquid refrigerant. These variables are used in the model calculation of the theoretical %Open.

4.3.3.2 Percentage of Opening Calculated with the Model

- **Default Valve Opening (before PID Adjustment)**: shows the impact of environmental corrections on the result of the model calculations. It compares the result obtained with **Nominal** values to that obtained with live values received from the network (**With Environment. Corr.**) Nominal conditions are 20°C space temperature, 40% relative humidity and liquid refrigerant at 20°C.

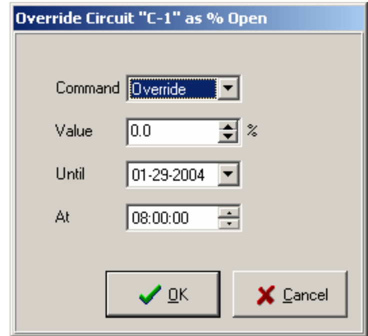
  Clicking on the **Default Opening Specified by User** box deactivates the model and you can supply your own value. This can be used for presetting the percentages of opening (see **Set Default %Open**, page 20.) but it is not recommended otherwise.

  The PID corrections are applied to the **With Environment. Corr**. values.

4.3.3.3 PID Corrections Deactivation

- **Disabled PID Corrections**: check the appropriate boxes to deactivate the corresponding PID corrections, or the four corrections. These deactivations are meant for for diagnostic purposes only.

4.3.4 Circuit Override



When you click on Override (**Circuits** tab, page 23), the **Override Circuit as %Open** window opens. The following commands are available.

- **No Override**: the %Open of the circuit is controlled by the strategy (model + PID).
- **Override** – the %Open of the circuit is forced according to **Value** until the specified date and time.

The **Override** button check box (page 23) is checked to indicate that an override has been requested. It will be executed at the next **Apply** and get marked by an aqua square. If the colour does not appear after the next **Apply**, the override probably failed. Factors of override failure include a valve in **manual** mode, an **uninstalled** valve or a node in **Stand-Alone** mode. Correcting the abnormal situation will allow the override to occur.

4.3.5 Circuit Reset

- The **Default Values** button of the Circuits tab (page 23) purges the configuration of a circuit. Consequently, all settings will return to their default value.

4.3.6 Circuit Deletion

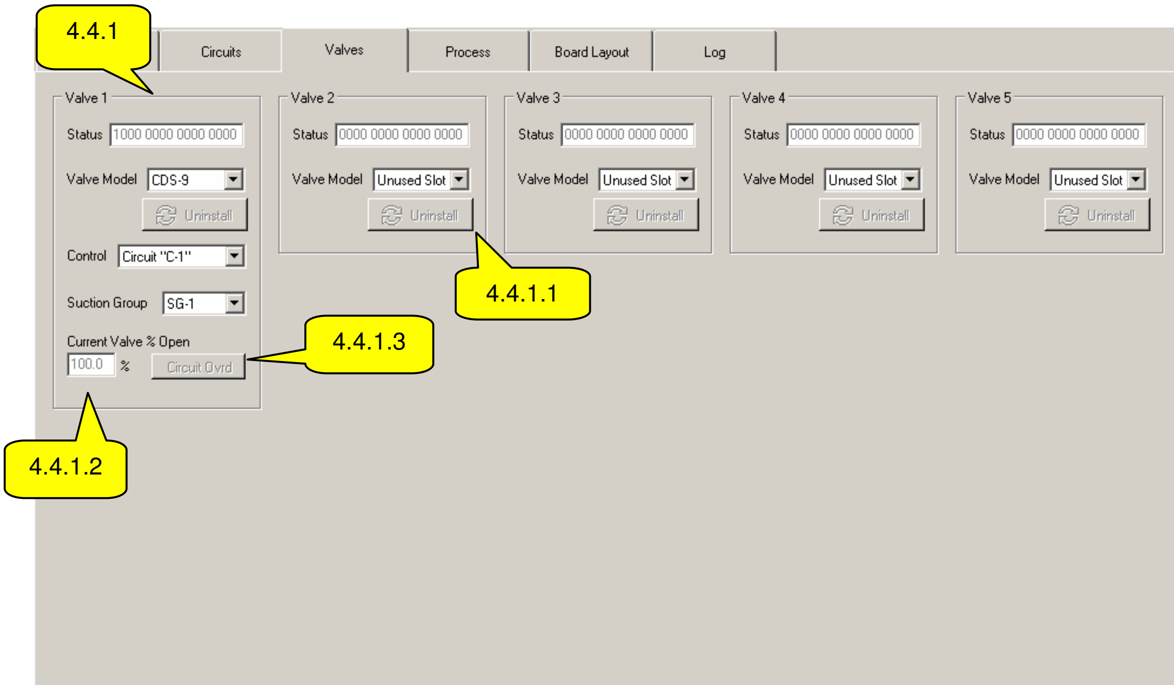
- The **Delete Circuit** button of the Circuits tab (page 23) deletes the circuit from the plug-in's configuration. When the settings are sent to the node (**OK** or **Apply** button), the circuit is also deleted from the EEPR module. The valve(s) assigned to this circuit are released and can receive a new assignment (assigned or not used).

4.3.7 Choice of Units for the Thermal Load

- **Thermal Load Expressed as**: determines the units used to display and enter the thermal load. The options are: kW, BTU/hour, tons of refrigeration.

4.4 Valves Tab

The figure on the next page shows the Valves tab, which serves mainly to specify the type of valve driven by each output connector. In this example only one valve is used.



4.4.1 Valve x (x = 1 to 5)

- **Status**: reports the status of the valve and of the circuit to which it is assigned. If you let the cursor rest on the box, the names of the active bits appear. The following table defines the bit assignments.

bit #	Interp.	Cursory description
0	Valve	Installed, valve detected
1	Circuit	*Pumpdown* (1st defrost stage)
2	Circuit	Ready for defrost (valve has just closed)
3	Circuit	Ready for *drip* (last defrost stage)
4	Valve	Inconsistency between the local valve installation and the configuration required by the plug-in
5	Valve	Gradual opening of valve after *drip*
6	Valve	Valve in manual mode (or inactive)
7	Circuit	All EEPR valves of the circuit are closed
8	Valve	Valve is opening
9	Valve	Valve is closing
10-15		Reserved
Bit 0 is the most significant (left bit)		

- **Valve Model**: selects the valve model. The drop-down list includes all models that belong to the group selected in the **System** page. Sporlan CDS-9, CDS-16, and CDS-17 valves are recommended. Alco ESR 12 and ESR 20 valves are also supported.
- **Control**: used to change the circuit, in the drop-down list, to which the valve is assigned (usually, this has already been done on the Circuits page).

  The user logged in as a Super Technician has access to other control modes: **Binding Control**, **Alliance Control** and **Plug-In Control**. These three control modes allow the user to control a valve via a network variable (in the case of a network connection), via a command point (Alliance) or via configuration property (plug-in). These options appear when the Super Technician declares an external valve in the **Basic Node Setup** dialog box (see page 21).
- **Suction Group**: select the suction group, in the drop-down list, to which the valve is connected.
- **Current Valve %Open**: displays the current value of the percentage of opening of the valve. N/A means **Not Available**.

4.4.1.1 Remote Installation

Depending on the circumstances the **Uninstall** or the **Reinstall** button may appear.

- **Uninstall**: this button allows the user to remotely uninstall a valve which, to the plug-in's knowledge, is not used. This valve may have been installed manually with the local interface, for example, then put in automatic mode (a valve in manual mode can only be addressed locally).

  A valve can also be uninstalled locally, provided the plug-in does not prohibit the use of the board interface (see page 17 concerning a disabled local interface.)
- **Reinstall**: this button allows the user to remotely reinstall a valve which, to the plug-in's knowledge, is in use. It may have been temporarily disconnected, or uninstalled by the local interface. A valve cable length exceeding 12m (40 ft) or an intermittent connection on the valve connector, for example, may result in this button coming up.

  Appendix II, on page 46, summarizes valve installation problems.

4.4.1.2 %Open Display

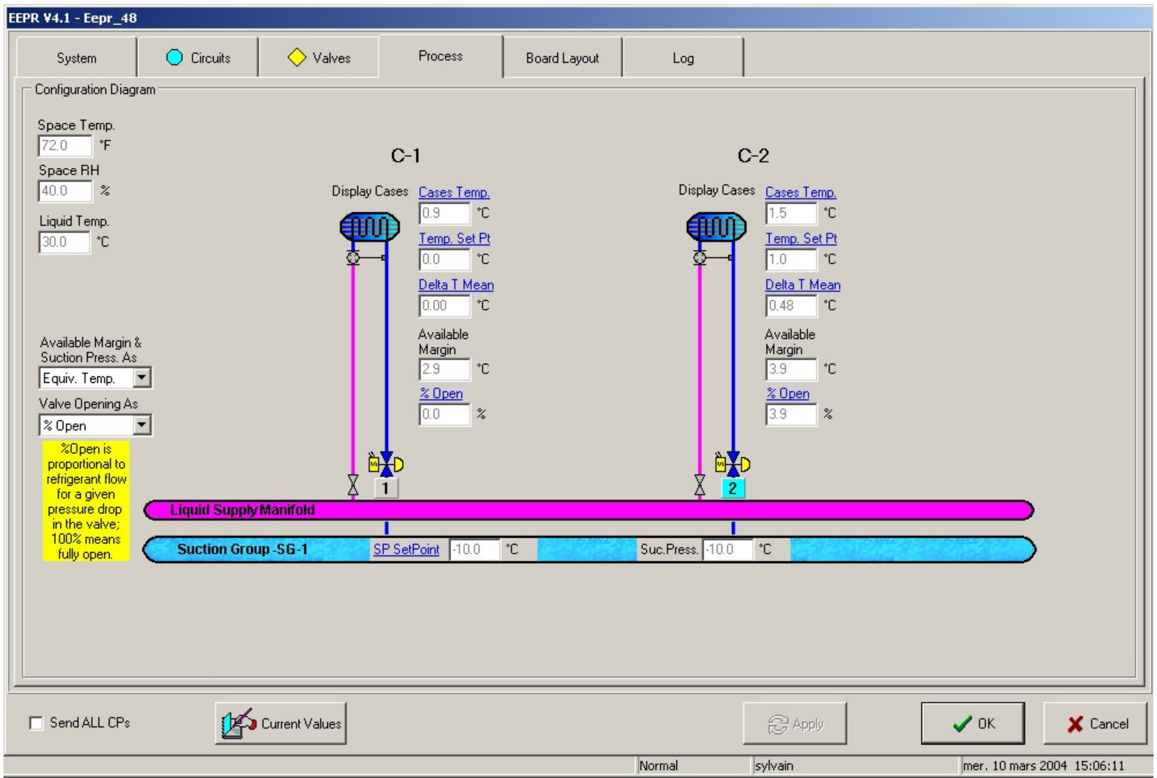
- **Current Valve %Open**: displays the actual %Open of each individual valve separately, even when a circuit is assigned more than one valve. For external valves that have been declared as controlled by position, the display represents the relative position directly (without any correction for valve geometry).

4.4.1.3 Valve Override

- **Circuit Override/Valve Override**: overriding proceeds through the circuit override described on page 30, if the valve is attributed to a circuit A similar timeout override function is also available for the valve itself if it was declared as an external valve.

4.5 Process Control

The **Process** tab includes important visual indications and several hyperlinks (blue, underlined) to plug-in and MT Alliance functions. The figure below reflects a configuration with two circuits, one valve per circuit and only one suction group.



The items displayed on this page are as follows:

- Warning of the **Stand-Alone** Mode activated (not shown)
- Notification of missing or incoherent network connections (not shown)
- Indication of the circuit status, showing the successive stages of a defrost (not shown).
- Indication of the valve status (not shown). **Manual** means that the valve is in manual mode, **Error** means that it has been uninstalled.
- Notification of the state of the valve:
  Normally: yellow and dark blue
  Closed valve[6] : blue and grey
  100% opened valve: red and light blue
  In active override: valve number appears in an aqua colored square
- **Space Temp.**: temperature inside the store, obtained as a network variable.
- **Space RH**: relative humidity inside the store, obtained as a network variable.

[6] Some valves (Alco) are automatically backed up several steps after being closed to 0% in order to prevent jamming during hot gas defrost. They are still considered completely closed and the local interface indicates ".0". The plug-in indicates the real %Open that is not null (for example, 0.1%).

- **Liquid Temp**.: temperature of the liquid refrigerant, obtained as a network variable. The node averages over 15 minutes to avoid responding too quickly, given the liquid's transit time, which varies from one circuit to another.
- **Available Margin & Suction Press As**: determines the units, of pressure or of equivalent temperature, used to display the available margin of the EEPR and the suction pressure.
- **Cases Temp**. (**Room Temp**.): representative case temperature, or temperature of the cold room, as received through the network variable nviAirTemp*X*, usually from the MT-500 **Sensor** node calculation blocks.
- **Temp Set Pt**: temperature set point, usually created as a command point in Alliance. Please see page 39.
- **Delta T Mean**: temperature error, averaged over an interval equal to the Reference Duration of the integral correction (usually 1 hour; see page 25.) This represents a good figure of merit of the accuracy of the food temperature. A value less than 0,05°C (0.1°F) is usually achieved, except under special conditions. It may fall below 0°C but only slightly, since the valve is capable of throttling the flow of refrigerant almost completely. Errors occurring during defrosts, load sheds, and immediately after are not taken into account in calculating the average (see page 27.)

  This important report is also available in **Current Values**, under the name **Accum. Temp. Error**.
- **Available Margin**: this can be used as a nice design tool. It predicts whether the proposed suction pressure set point is low enough to allow the system to maintain the set temperature under the worst conditions (high temperature and humidity.) The analysis is based on default values, given in the EEPR plug-in itself (for example, the proposed suction pressure specified in the System tab).

  A warning is issued when the configuration becomes critical, as defined in the following paragraph.
- Notification of problematic configuration if the available pressure margin is insufficient (not shown). **Marginal** means that the set temperature will be reached only under favorable conditions. **Erroneous** means that the set temperature will probably never be reached with the declared suction pressure set point, even with the valve 100% open.

  These warnings are meant as a help in detecting inconsistencies. You may want to check the default suction pressure (System Tab, page 17) and the default temperature set point (Circuits tab, page 23) when these warnings are issued.
- **Valve Opening As**: determines the method used to indicate the valve position. The options are similar to those presented on page 17 for the local interface. %Open displays the percentage of opening. The estimated pressure drop in the valve can be displayed instead. The choice of units includes kPa, psi, °C and °F (equivalent temperature).

- **%Open**: shows the current value. Can also display the calculated pressure drop in the valve, according to the selection made in **Valve Opening As**.
- **SP Set Point**: current value of the suction pressure set point, obtained from the SPC through a network variable.
- **Suc. Press.**: suction pressure current value, obtained from the SPC through a network variable.

4.6 Current Values

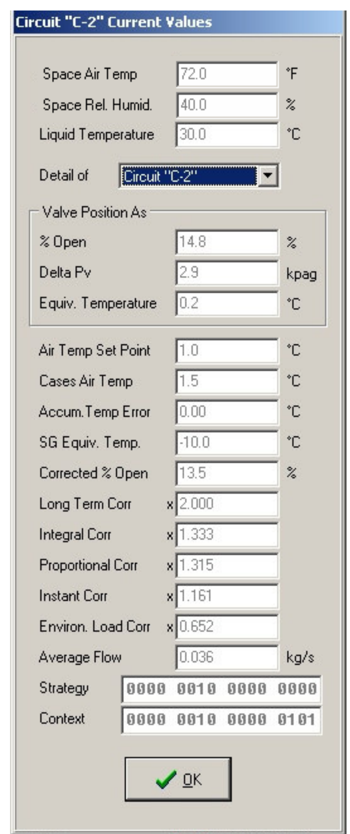
The **Current Values** button gives access to useful information about circuits and valves.

- **Space Air Temp.**: temperature inside the store, obtained by network variable and used for environmental corrections.
- **Space Rel Humid.**: relative humidity inside the store, obtained by network variable and used for environmental corrections.
- **Liquid Temperature**: instantaneous value of the temperature of the liquid refrigerant, as obtained by network variable. The node does a running average over 15 minutes.

The **Detail of** drop-down menu allows you to select the circuit or the valve for which you want to obtain information.

4.6.1 Circuit-Related Current Values

- **Valve Position As**: the circuit's %Open, as well as the pressure drop in the valve(s) estimated with the average flow, expressed in pressure units and as an equivalent temperature.
- **Air Temp Set Point**: the temperature set point.
- **Cases Air Temp**: repeats the cases or cold storage room representative temperature obtained by network variable. It usually comes from an MT-500 calculation block, which determines it from measured values (Minimum, Average or Maximum functions). A confirmation that the temperature was received by the node.
- **Accum. Temp. Error**: error accumulated for the integral correction. This is an excellent indication of the accuracy of the food temperature.
- **SG Equiv. Temp.**: the saturated temperature corresponding to the suction pressure.
- **Corrected %Open**: calculated with environmental corrections, but without any PID correction.



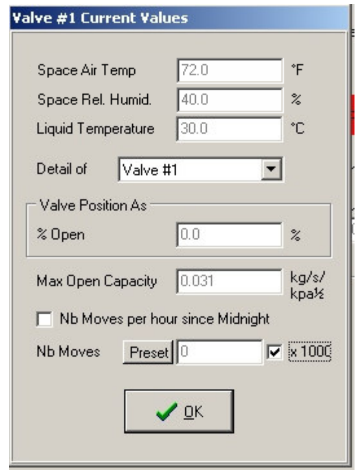
- **Long Term Corr**, **Integral Corr**, **Proportional Corr**, and **Instant Corr**: the values calculated for the four PID corrections, whether they are activated or not.
- **Environ. Load Corr**: the environmental correction factor as calculated and to be applied to the thermal load.
- **Average Flow**: the calculated mass flow of the refrigerant, in kg/s. This is the average flow calculated from the thermal load corrected for environmental factors (temperature and humidity inside the store, liquid refrigerant temperature).
- **Strategy**: summarises the user-defined strategy choices according to the table below.
- **Context**: summarises the strategy actually used by the node to position the valves. It is interpreted according to the table below. It depends on the strategy mentioned in the above paragraph and on the actual context.

  If, for example, the user asks for a correction based on the temperature inside the store but it is not available, the **Strategy** bit will show a value of 0, but the **Context** bit will be 1. Some situations that can disable the correction are as follows: a missing network connection, an invalid value (defective sensor) or a loss of communication.

  Keeping the cursor over the box displays the name of the active bits.

bit	Interpretation of Strategy and Context
0	The model is ignored, the theoretical position being provided by the user.
1	Calculations use the suction pressure default value
2	This circuit reacts to dynamic suction pressure changes
3	The default value of the temperature inside the store is used for calculations
4	The default value of the relative humidity inside the store is used
5	This bit is used for humidity correction (MSB)
6	This bit is used for humidity correction (LSB)
7	Long-term correction is deactivated
8	Integral correction is deactivated
9	Proportional correction is deactivated
10	Instant correction is deactivated
11	Cold storage rooms (rather than cases)
12	Low-temperature strategies (freezer as opposed to refrigerator)
13	The default value of the liquid temperature is used for calculation
14	The default temperature set point is used for calculations
15	Error accumulation is presently inhibited (defrost or load shed)
Bit 0 is the most significant (left bit)	

4.6.2 Valve-Related Current Values



- **Valve Position As** indicates the %Open of the valve. An external valve can be displayed in position (without any correction for the valve geometry) if the Super Technician specified that mode in **Node Setup**.
- **Max. Open Capacity**: indicates the maximum valve capacity in $\frac{\text{kg}}{\text{s} \cdot \sqrt{\text{kPa}}}$. These data come from a table in MT Alliance and are not to be modified by the user.
- **Nb Moves per hour since Midnight**: displays the valve activity in number of moves per hour, when this box is checked. The calculation is an average restarted each day at midnight, so that the data are not available for a while after midnight.

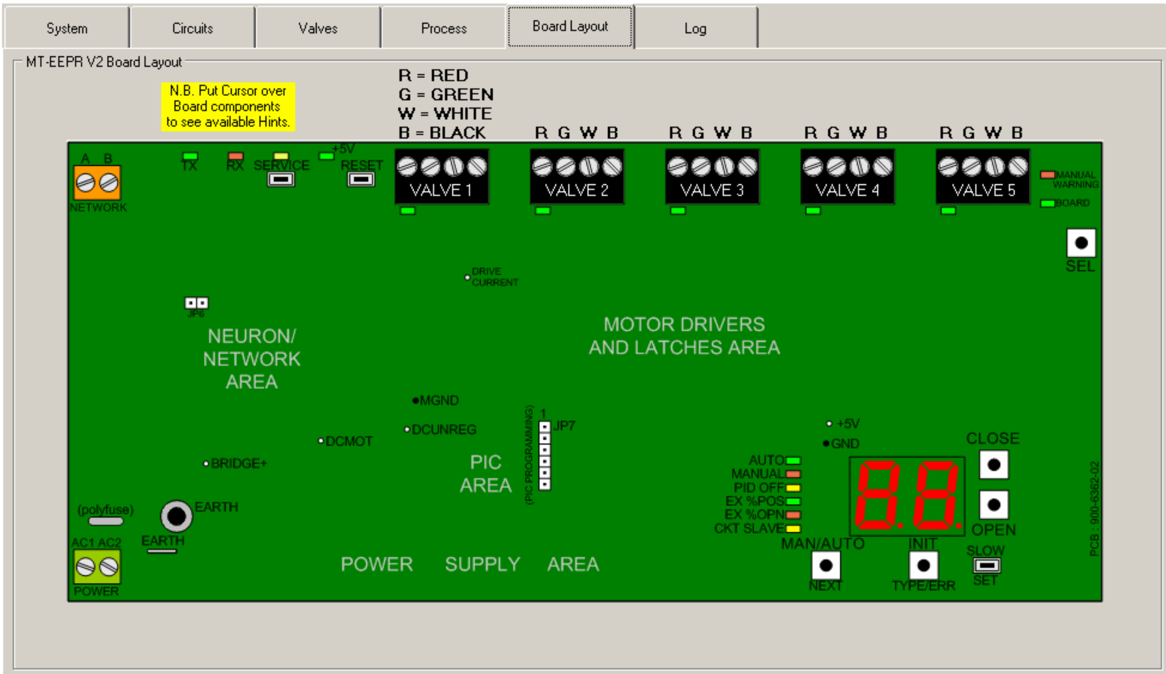
  If the box is not checked, the total number of valve moves (in thousands) is displayed. The value is kept in the PIC's EEPROM memory and it will be reset only by a Blank Configuration Command or by an update of the PIC's firmware.

  The **Preset** button is used to load a number of moves (in thousands) in a valve's counter. It may be used to preset the counter for a used valve.

4.7 Board Layout Tab

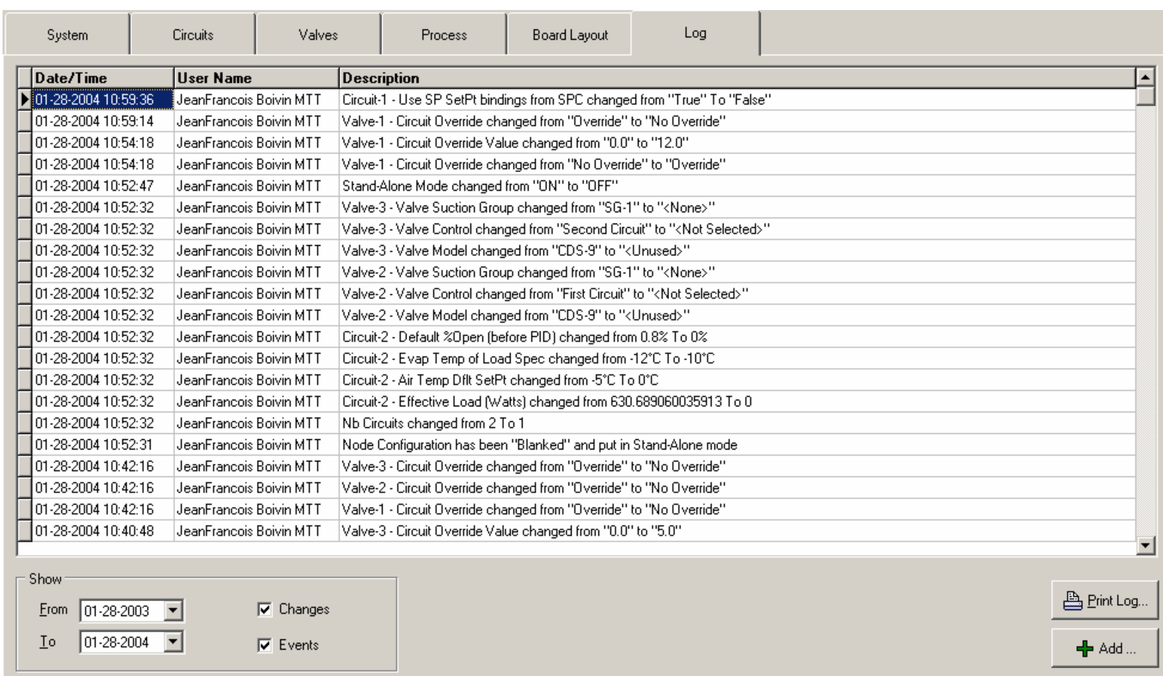
The **Board Layout** tab illustrated on the next page shows the MT-EEPR module. The components (buttons, connectors and indicators) are described using tooltips. Simply hold the cursor over an item to view its description.

This plug-in page is intended as a reminder of the usage of the local interface.



4.8 Log Tab

Changes made with the plug-in are recorded in the log, as illustrated in the example below. For each change, the log records the date and time, the name of the user who was logged in at the time the change was made, and a description of the change.



Date/Time	User Name	Description
01-28-2004 10:59:36	JeanFrancois Boivin MTT	Circuit-1 - Use SP SetPt bindings from SPC changed from "True" To "False"
01-28-2004 10:59:14	JeanFrancois Boivin MTT	Valve-1 - Circuit Override changed from "Override" to "No Override"
01-28-2004 10:54:18	JeanFrancois Boivin MTT	Valve-1 - Circuit Override Value changed from "0.0" to "12.0"
01-28-2004 10:54:18	JeanFrancois Boivin MTT	Valve-1 - Circuit Override changed from "No Override" to "Override"
01-28-2004 10:52:47	JeanFrancois Boivin MTT	Stand-Alone Mode changed from "ON" to "OFF"
01-28-2004 10:52:32	JeanFrancois Boivin MTT	Valve-3 - Valve Suction Group changed from "SG-1" to "<None>"
01-28-2004 10:52:32	JeanFrancois Boivin MTT	Valve-3 - Valve Control changed from "Second Circuit" to "<Not Selected>"
01-28-2004 10:52:32	JeanFrancois Boivin MTT	Valve-3 - Valve Model changed from "CDS-9" to "<Unused>"
01-28-2004 10:52:32	JeanFrancois Boivin MTT	Valve-2 - Valve Suction Group changed from "SG-1" to "<None>"
01-28-2004 10:52:32	JeanFrancois Boivin MTT	Valve-2 - Valve Control changed from "First Circuit" to "<Not Selected>"
01-28-2004 10:52:32	JeanFrancois Boivin MTT	Valve-2 - Valve Model changed from "CDS-9" to "<Unused>"
01-28-2004 10:52:32	JeanFrancois Boivin MTT	Circuit-2 - Default %Open (before PID) changed from 0.8% To 0%
01-28-2004 10:52:32	JeanFrancois Boivin MTT	Circuit-2 - Evap Temp of Load Spec changed from -12°C To -10°C
01-28-2004 10:52:32	JeanFrancois Boivin MTT	Circuit-2 - Air Temp Dflt SetPt changed from -5°C To 0°C
01-28-2004 10:52:32	JeanFrancois Boivin MTT	Circuit-2 - Effective Load (Watts) changed from 630.689060035913 To 0
01-28-2004 10:52:32	JeanFrancois Boivin MTT	Nb Circuits changed from 2 To 1
01-28-2004 10:52:31	JeanFrancois Boivin MTT	Node Configuration has been "Blanked" and put in Stand-Alone mode
01-28-2004 10:42:16	JeanFrancois Boivin MTT	Valve-3 - Circuit Override changed from "Override" to "No Override"
01-28-2004 10:42:16	JeanFrancois Boivin MTT	Valve-2 - Circuit Override changed from "Override" to "No Override"
01-28-2004 10:42:16	JeanFrancois Boivin MTT	Valve-1 - Circuit Override changed from "Override" to "No Override"
01-28-2004 10:40:48	JeanFrancois Boivin MTT	Valve-3 - Circuit Override Value changed from "0.0" to "5.0"

To view the log, the user can select a time period and apply a filter on the type of entry (change or event). Entries can be added to the log. A report can be generated and printed for tracking purposes.

5. Adding Command Points and Measure Points

Since the EEPR module is equipped with a plug-in that includes a process view, there are relatively few measure points to configure on the interface. The example below offers a suggestion. Appendix I shows a possible layout.

Circuit #1

Node	ID Name	Point type	Physical Type	nv
EEPRA1-5	A1 Setpoint	Command	Temperature	nviAirTempStPt.Standby_cool
EEPRA1-5	A1 Temp	Measure	Temperature	nvoAirTemp.Standby_cool
EEPRA1-5	A1 %Open	Measure	Percent	nvoY_Pos1

Circuit #2

Node	ID Name	Point type	Physical Type	nv
EEPRA1-5	A2 Setpoint	Command	Temperature	nviAirTempStPt.unoccupied_cool
EEPRA1-5	A2 Temp	Measure	Temperature	nvoAirTemp.unoccupied_cool
EEPRA1-5	A2 %Open	Measure	Percent	nvoY_Pos2

Circuit #3

Node	ID Name	Point type	Physical Type	nv
EEPRA1-5	A3 Setpoint	Command	Temperature	nviAirTempStPt.occupied_heat
EEPRA1-5	A3 Temp	Measure	Temperature	nvoAirTemp.occupied_heat
EEPRA1-5	A3 %Open	Measure	Percent	nvoY_Pos3

Circuit #4

Node	ID Name	Point type	Physical Type	nv
EEPRA1-5	A4 Setpoint	Command	Temperature	nviAirTempStPt.Standby_heat
EEPRA1-5	A4 Temp	Measure	Temperature	nvoAirTemp.Standby_heat
EEPRA1-5	A4 %Open	Measure	Percent	nvoY_Pos4

Circuit #5

Node	ID Name	Point type	Physical Type	nv
EEPRA1-5	A5 Setpoint	Command	Temperature	nviAirTempStPt.unoccupied_heat
EEPRA1-5	A5 Temp	Measure	Temperature	nvoAirTemp.unoccupied_heat
EEPRA1-5	A5 %Open	Measure	Percent	nvoY_Pos5

6. Control Strategies

The MT-EEPR module does a lot more than using a PID to control an output based on the error observed between a measurement and the corresponding set point. A model is created for each circuit, based on the values provided by the user for certain parameters. This model calculates the valve position. It also takes into account environmental conditions, such as humidity. A feedback mechanism similar to a PID finally corrects the valve opening based on the temperature errors observed.

6.1 Model Operation

The model calculates the theoretical %Open of the valve based on the following data:

- the thermal load;
- the TD (difference between the temperature at the sensor and the evaporator saturated temperature);
- the valve's characteristics;
- the properties of the refrigerant;
- the temperature and humidity inside the store;
- the liquid refrigerant temperature;
- the temperature set point;
- the pressure set point of the suction group;
- the dynamic suction pressure (optional);
- and others.

6.2 Feedback Corrections

The percentage of opening of the valve is calculated by the model and multiplied by four consecutive corrections based on past and present temperature errors. Each correction has its own rationale.

Since most circuits use more than one temperature sensor, the first step consists in extracting, from all the measurements, the most **representative** temperature. The MT-500 Sensor Node calculation blocks may be used for this purpose.

The four corrections of the PID are described below. The name "PID" was kept, out of habit, but this feedback controller does not work as a traditional PID.

- Instant correction:

This correction is based on the most recent case temperature measurement. It provides a **quick response** that attenuates, in particular, the fluctuations caused by compressor cycling. It also speeds up recovery after a defrost.

- Proportional correction:

This correction is based on the weighted average of errors observed during a relatively short time (15 min. by default). This period, ideally, should be set equal to the compressors' cycle. It is relatively insensitive to suction pressure variations, but it reacts quickly to perturbations such as the loading of cases with additional food.

- Integral correction:

This correction is based on the running average of temperature errors. The integration period is relatively long (1 hour by default). It compensates for variations in the **thermal load** created by customer traffic in the supermarket (disturbance of the air curtains or opening of the doors.)

- Long-term integral correction:

This correction uses an integration time much longer than the previous one. (24 hours by default). It compensates for such **permanent errors** as, for example, an inaccurate thermal load or an uncorrected calibration error of the suction pressure sensor.

6.3 Recommendations for Initial Installation and Configuration

The list below summarises the main elements on which to focus when configuring an EEPR temperature control system.

1- Specify the MT-EEPR as the temperature control mode by creating the circuit in the refrigeration tool (**RefSysConfig**). Declare no temperature sensor at this point.

2- Install measure points and MT-500 **Sensor** modules, and then configure calculation blocks to produce the representative temperature for each circuit.

3- Use the **Minimum** function in the MT-500 calculation block for refrigeration circuits. When food that has not been precooled is loaded into a case, the other cases may freeze if the **Average** or the **Maximum** functions are used.

4- It is necessary to choose the **Minimum** function for **Dual Temp** cases (see page 24). Thus, cases that are in refrigeration mode will be ignored in the calculation (their temperature being higher), and they will not disturb the cases used as freezers.

5- **Important**: the default value for **SendOnDelta** is 0,5°C (0.9°F), on the MT-500. It is advisable to reduce it to 0,2°C (0.4°F), or even 0,1°C (0.2°F), in order to benefit from the tighter control offered by the EEPR. Network traffic problems may arise, however. In case of doubt, you may decrease the **Send On Delta** value for the more critical circuits only. Sporadic **Node Test Failed** messages, that involve various nodes, are an indication of a crowded network.

6- Install and configure the MT-EEPR using the procedure found on page 9. Entering the parameters requires only a few minutes per module, initially. Enter the yellow, mandatory parameters, the case (or cold storage room) type and the food category. In most cases, there is no need to modify any other settings.

7- A bit more time is needed to establish network connections.

6.4 Troubleshooting and Site Tune-Up

This section suggests how to use the software as a diagnostic tool for the refrigeration process and how to adjust parameters to get the most out of the MT-EEPR controller. These suggestions could be made part of the commissioning of a site.

6.4.1 Locating Misadjusted Expansion Valves

Adjusting the superheat at the level of the thermal expansion valves is a tedious operation, given that the response is not immediate; one may have to wait about 15 minutes before assessing the effect of the mechanical adjustment.

Observing the circuit's behaviour, using the plug-in and the trendgraphs, helps in locating circuits whose expansion valves require special attention. Too high a superheat means insufficiently filled evaporators, the TD appearing higher than normal (given the conditions prevailing inside the store). The EEPR controller's PID will compensate by opening the valve more than the model predicts. **Integral** and **Long Term** corrections that build up substantially higher than 1 indicate that there may be a problem with the TEVs.

In most cases, any given circuit has more than one temperature sensor. If the valve's percentage of opening is close to the value predicted by the model, it is likely that the superheat is well adjusted in the area serviced by the coldest probe. The trendgraphs from other sensors on the same circuit will then reveal any misadjusted expansion valves; a sensor that runs systematically warmer than the others reveals an overly high superheat setting on the corresponding expansion valve. If the cases are of different types, however, this could be a perfectly normal situation.

The above suggestions do not replace the more traditional methods of checking and adjusting superheats. They only help in identifying the problem zones. They are valid to the extent that the circuit parameters are correct. Frequent door openings can invalidate them by increasing the thermal load. They do not apply to the same extent to cold storage rooms because their thermal loads are ill-defined and affected by many factors.

6.4.2 Tuning-up EEPR Controllers

When the site has been operating for some time and the superheats have been set properly, the performance of the MT-EEPR can be optimised.

The first[7] observation to make on a circuit is its long **Long Term Correction**, available in the **Current Values**. This value should be noted down because it will be destroyed as soon as any settings are changed.

- A long-term correction greater than 1 means that the TD and/or the thermal load have been underestimated.
- A long-term correction smaller than 1 means that the TD and/or the thermal load have been overestimated.
- A correction very close to unity does not necessarily mean a perfect setup; an overestimated TD could very well be compensated by an underestimated thermal load (or inversely). In most cases, however, no intervention should be necessary.

Once this first observation is done, the long term correction is no longer a good diagnostic tool because it takes too long to build up. The integral errors become the criterion of choice, as described in the next section.

6.4.3 Correction of the TD

No EEPR tuning should be attempted while the superheats are inadequate. It would likely ruin the setup.

The tuning methods described below involve adjusting the TD setting, assuming the thermal load is correct. This is generally what happens for cases. For cold storage rooms, the reverse is often true; we have a good idea of the TD, from experience, but the thermal load is not known as accurately. Therefore, it is best to modify the thermal load for cold storage rooms.

The thermal load of the cases needs to be checked, before making any changes on the TD. Three factors contribute to the thermal load, apart from the environmental corrections:

[7] The long-term correction is significant only if the model hasn't been modified in a while (48 hours) because it is automatically reset when a setting is changed.

- **Nominal Load** in the **Circuits** tab (page 23),
- **Load Correction** in the **Circuit Settings** (page 24) and
- **Evap. Temp. At which Load is Specified**, in **Circuit Advanced Settings** (page 27).

6.4.3.1 Method based on the Integral Error

Important: tuning is likely to disrupt the operation of the circuit; it may be worth checking periodically. Before starting, check that no defrost is impending for this circuit.

Click the **Reset** button in the **Circuit Advanced Settings** dialog box (page 27), in order to reset both the integral and the long-term errors.

Monitor the evolution of the integral error (**Accumulated Temperature Error**) during the next 15 minutes. The same value is also displayed in the process page under the appellation **Delta T Mean**.

If the integral error goes positive the TD needs increasing. Conversely, if the error goes negative, the TD has to be decreased.

Click **Apply** after changing the TD, to send the new value to the node.

Continue to monitor the evolution of the integral error. If the change was significant, it will resume from 0. Otherwise, the **Reset** button in the **Circuit Advanced Settings** dialog box should be used to provide a fresh start.

Note: It is possible to proceed very quickly by tuning several circuits simultaneously.

Suggestion: As a rule of thumb, increase or decrease the TD by a value equal to one quarter of the available margin for that circuit (see **Available Margin** on the **Process** page.)

6.4.3.2 Method based on the Calculation Capabilities of the Plug-in

The plug-in can be used to predict the correct TD setting, as explained below. It is faster than the above method, but it requires that the system has had a couple of days to stabilize after any significant changes were made.

1. Click on the **%Open** hyperlink on the Process page to access the Alliance trendgraph and review the **recent** history (the last several hours, excluding defrost periods) of the valve's %Open, to find out what the most probable value is.
2. The **Circuit Corrections Adjustment** dialog box (page 29) gives the result of the model calculation, with the environmental corrections (**Default Valve Opening/With Environment Corr.**).
3. If the valve's percentage of opening is around the value calculated by the model, no adjustment is required.
4. Otherwise, access the **Circuit** tab and change the TD so that the model calculates a result that is close to the observed %Open.
5. Other settings may also be adjusted, such as the pressure drop in the suction piping. The effect on the model can be assessed immediately.

Note: Adequate parameters will yield a circuit that responds better to disturbances and will operate very well under all conditions, but **perfection is not required**. The PID will do its job in any event.

6.4.4 Reaction to Dynamic Pressure

The plug-in proposes a default strategy that depends[8] on the type of food, but the person configuring the system has a better overall view of the suction group. He is in a good position to determine the reaction to changes in suction pressure.

A well-planned suction group (from an EEPR standpoint) includes critical circuits, such as those that supply the fresh meat cases, and some less critical ones (juice, beer or even dairy products). For the reasons mentioned on page 8, the flow of refrigerant available is not always sufficient to meet all the needs. The **React to Dynamic Suction Pressure** setting described on page 26 should be used to lessen the effect of the lack of refrigerant flow on the critical circuits. For optimum effect, one or several less critical circuits should be designated as scapegoats. The cursor may be set to the extreme right (100% **Be Selfish**) for a fresh meat case and to the extreme left (**Help Others**) for some less critical circuit(s). The setting should be mitigated (set to less than 100%) only if instabilities are observed.

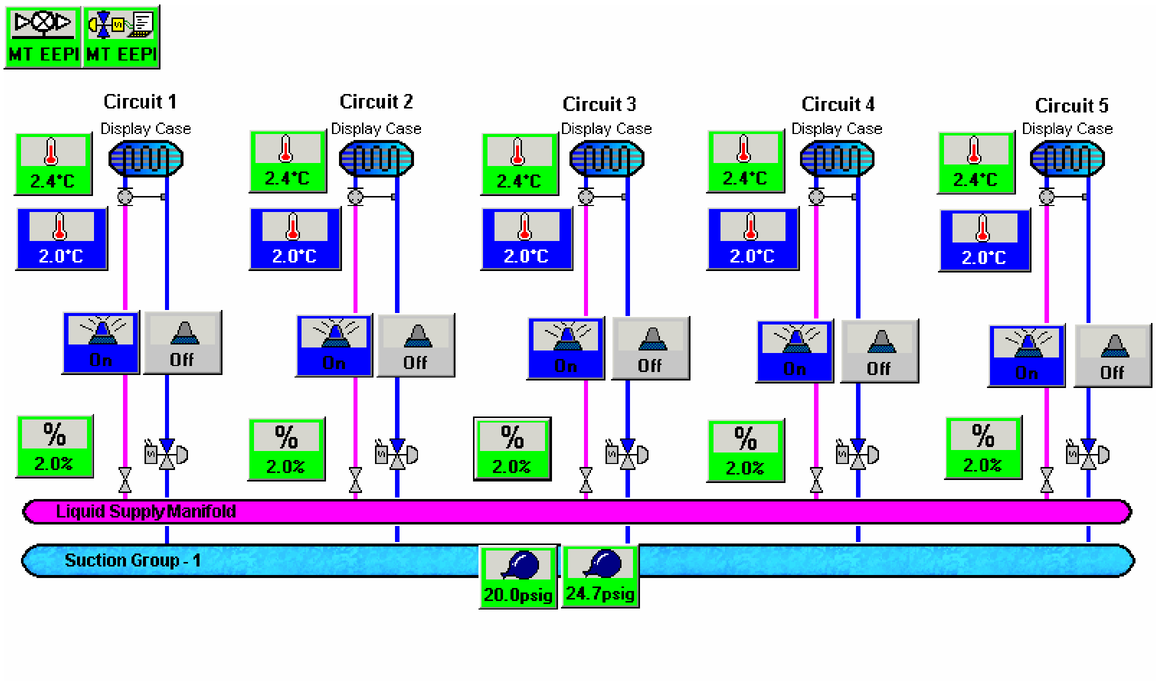
This results in a substantial reduction in short-term temperature variations for a fresh meat circuit, which typically drops from ±0,8°C to ±0,2°C.

You will get the best results if the thermal load of selfish circuits is of the same order as those of the sacrificed circuits.

The performance obtained will depend largely on the mechanical configuration of the suction group (number and power of compressors, etc.)

[8] The plug-in refrains from proposing changes to the default values of parameters after the user has edited those parameters for the same circuit.

Appendix I — Typical View of the MT-EEPR Module in Alliance



Appendix II — Valve Installation

Wiring

Valve installation is covered in detail in the OEM G***uide of the MT-EEPR (71-GEN-0099)***. Some important points concerning the installation of valves are summarized below.

A valve will not install if it is not detected by the hardware. For a valve to remain installed reliably, the cable length should be less than 40 ft, or a **Cable Extender Module** should be used. These cable extender modules provide the inductance that the circuit needs, when the inductance of the valve itself is too far away. They are designed for Sporlan CDS valves only. They are available from Micro Thermo.

Valves are current-driven. There is absolutely no advantage in using bigger wire when the cable is very long. Electrically speaking, AWG22 wire is adequate, but AWG18 is preferred because it offers more mechanical strength. Shielded[9] cable should be used, and the shield should be connected to earth ground.

In order to minimize electromagnetic interference, the valve cables should be kept separate from any sensor wiring and from the network wiring.

The Echelon network transceiver FTT-10A is rather sensitive to interference. This large black component sits at the right-hand top corner of the board. Avoid running any valve wires near it. The FT-X1, which is a more recent version of the transceiver, is relatively insensitive.

Logical valve installation

When the EEPR module runs for the very first time (after a Blank Configuration), it detects all the valves which are present and logically installs them. Then, after a reset, it only checks those valves that were already installed the last time it ran.

It is therefore very likely that you will need to install valves that have been added, replaced or just temporarily unplugged.

If you need to disconnect all the valves, it is a good idea to power the node down before you unplug them. Wait until the valves have been reconnected before powering up the module again. This will save you the trouble of having to reinstall any valves. The module will ignore that they have been unplugged, and it will reinitialize them without any manual intervention.

A valve can be installed using the **Reinstall** button of the plug-in, if the configuration specifies that it is in use. To that effect, see the instructions on page 32.

A valve can also be installed from the local interface. Make sure that the local interface is enabled (see page 17). Select the valve using the SEL button. Push INIT to install it, then INIT again to start the initialization process (if you push INIT a third time, holding it for 2 seconds, the valve will uninstall.) Put the valve in Automatic mode using the AUTO/MAN button, to make it available to the plug-in.

It is possible to reinstall globally all the valves that are in use, but that got uninstalled because they were unplugged. While in automatic scan, hold the INIT button for 2 seconds.

---

[9] Although shielded cable is generally preferable, there are situations where it is better not to connect the shield to earth ground.

Revisions History

REV	Description	Revised by	Date
1.0	Version obtained from document 71-GEN-0091-R2.0 translation	MAC	15-apr-04
1.1	Revised for title page copyright logo and MTAV	RL	16-avr-04
1.2	Revision from CB group	CB	13-may-04
2.0	Official Release	JG	21-may-04