TECHNICAL MANUAL

AERO

From monitoring performance, status and effectiveness of a single air compressor through to an entire local eco-system of air compressors, AIRMATICS™ provides up-to-the-minute intelligence that enables businesses to reduce power consumption, save energy costs and improve sustainability performance.

The future of compressed air monitoring, performance and control.

EMPOWERING THE COMPRESSED AIR USER.

AIRMATICS

1. Contents

2. Revision

Version	Date	Description	Author(s)	Review
V1.0	23 FEB 20	Initial	TVE	
V1.1	1 MAY 29	Corrections	TVE	
V1.2	24 APR 20	Merge	GC	
V2.0	30 AUG 21	Enhanced AirMatics configuration and system explanations	TVE	NS
V2.2	9 NOV 21	Corrections in connectivity chart	TVE	
V2.3	17 NOV 21	Add scheduling functional description – detail connections	TVE	

3. T1 – Sequencer methodology

This chapter focuses on the Functionality, Features and related Parameters to understand how the T1 controls the operation of the Assets.

We often refer to this as “Sequencer”: based on configuration parameters and measured operational system behavior, the T1 will “orchestrate” the operation of the underlying Assets: which Assets are to operate when and in which mode.

3.1 Pressure Control

The primary function of the T1’s pressure control strategy is to maintain system pressure between the ‘High Pressure’ set point (PH - adjustable) and the ‘Low Pressure’ set point (PL - adjustable) in conjunction with targeting optimum achievable system energy efficiency. The T1 calculates a ‘Target’ pressure level (PT), the mid-point between the two set points, which is used as the nominal ‘target’ pressure level for the system.

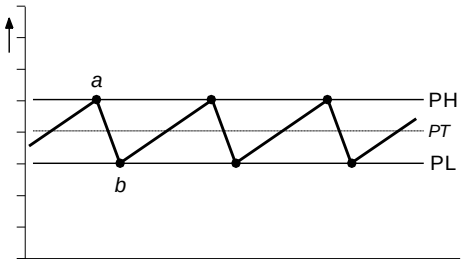


Figure 112 - Operation within PL - PH band

When system pressure increases to the High Pressure set point (a) a compressor is unloaded. Pressure is allowed to decrease to the Low Pressure set point (b) before a compressor is loaded again to add capacity output and increase pressure. This process will continue under a steady demand for air in a continuous stable cycle.

For systems that consist of a variable capacity (or variable speed) compressor, the compressor must be set, or controlled, to achieve and maintain the calculated system ‘Target’ pressure level (PT).

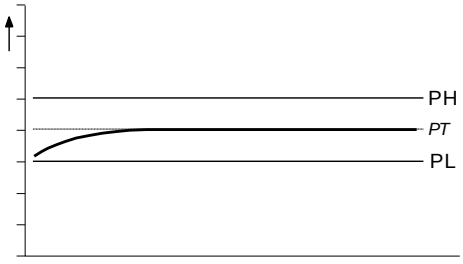


Figure 113 - Variable Speed compressor targets PT

Where abrupt, or significant, changes in air demand, beyond the capacity scope of the variable capacity compressor, are experienced, the loading and unloading of other compressors is implemented in exactly the same way as described above.

If demand for air is abruptly, or significantly, increased, and the capacity output of the compressor loaded at the Low Pressure set point (b) is insufficient, the pressure will continue to decrease at a reduced rate.

The T1 will accommodate for this event by loading an additional compressor.

The instance at which the additional compressor is loaded (c) is dynamically calculated and is determined by the rate of pressure decrease (the urgency or time limit) and the acceptable deviation of system pressure (the ‘Tolerance’) from the normal control limits.

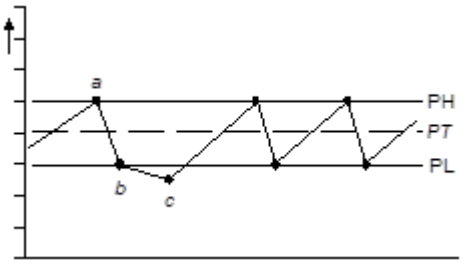


Figure 114 - Abrupt behavior

The same method is implemented in reverse (above the High Pressure set point) when an abrupt, or significant, decrease for air demand is experienced.

Rate of change of pressure, and the stability of pressure control, is largely determined by system volume and the scale, and/or abruptness, of air demand fluctuations; these characteristics will differ from installation to installation. To accommodate for variations in installation characteristics the ‘Tolerance’ pressure level (TO) and an influence on the dynamic reaction time (or ‘Damping’) of the T1 (DA) is adjustable.

3.2 Tolerance

Tolerance is a pressure band above and below the set pressure control levels that accommodates for an exceptional instance of abrupt and/or significant increase, or decrease, in demand without compromise to optimal energy efficient control.

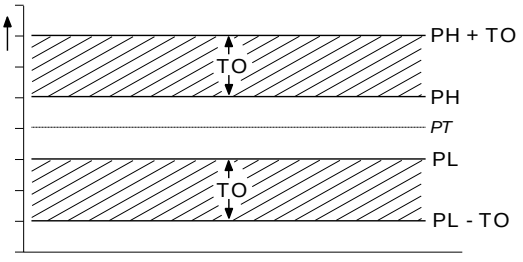


Figure 115 - The Tolerance Bands

Tolerance (TO) is expressed as a pressure defining the width of the tolerance 'band'.

For example; a tolerance setting of 3psi (0.2bar) means the XC will implement appropriate optimal energy efficient response(s) during a deviation of pressure 3psi below the set PL pressure level. If pressure ever deviates beyond the 'tolerance' limit the XC will proportionally increment an emergency response, abandoning optimum energy efficiency, until pressure is returned to normal levels.

If system volume is inadequate, and/or demand fluctuations are significantly large, it is advisable to increase the 'Tolerance' band to maintain optimum energy efficiency, and reduce over-reaction, during such transition periods.

If system volume is generous, rate of pressure change is slow and demand fluctuations are insignificant and gradual, the 'Tolerance' band can be reduced to improve pressure control without compromise to optimum energy efficiency.

3.3 Damping

In situations where the loading of an additional compressor, at the PL pressure set point, is inadequate to match a significant and/or abrupt increase in air demand the additional reaction of the T1, while pressure deviates into the 'tolerance' limit, is dynamically calculated. The time before an additional compressor is loaded, to increase generation capacity further, will vary in accordance with the urgency of the situation.

The T1's dynamic reaction algorithm is pre-set by default to accommodate for the majority of installation characteristics.

In some situations, of which the following are examples, the rate of pressure change may be aggressive and disproportionate:

a) Inadequate system volume
b) Excessive air treatment equipment pressure differential
c) Inadequately sized pipe work
d) Delayed compressor response

In such instances the T1 may over-react and attempt to load an additional compressor that may not be necessary once the initial compressor is running, loaded, and able to contribute adequate additional generation capacity. If an increase in the 'tolerance' band is insufficient, the T1's dynamic reaction response can be influenced by increasing the 'Damping' factor (DA) reducing tendency to over-react.

The 'Damping' factor is adjustable and scaled from 0.1 to 10 with a default factor of 1. A factor of 0.1 equates to 10 times faster than default and a factor of 10 equates to 10 times slower than default.

3.4 System Volume

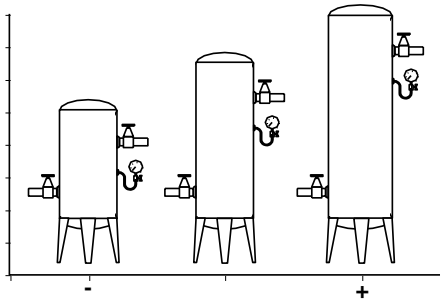


Figure 116 - System volume - various sizes

Pressure control of a system is a 'feedback loop' response derived from increasing, or decreasing, air generation output capacity. If output capacity is greater than demand for air the pressure in a system will increase, if demand is greater than output capacity system pressure will decrease. The rate of change of pressure to changing generation and demand capacity situations is largely dependent on system volume. If system volume is small in comparison to recommended size the rate of change of pressure will be fast and abrupt inhibiting effective control and compromising optimum system energy efficiency. If system volume is large the rate of change of pressure will be slow and gradual. In this instance an enhanced control of pressure can be achieved, the system response times can be reduced and optimum system energy efficiency will generally be increased as a result.

The rule below provides an approximation for recommended minimum system volume:

1) For systems comprising of fixed capacity output (or fixed speed) compressors:

$$m3 = m3\,min bar.g - 1$$

The approximation only works in metric units; convert psi and ft3 to metric units first.

1.0 m3	= 35.315 ft3
1.0 m3/min	= 35.315 cfm
1.0 bar	= 14.5 psi

Example: for a system that operates with a maximum normal demand air flow of 36m3/min at a nominal pressure of 7.0bar =

36m3/min / (7.0bar – 1) = 6.0 m3 (212 ft3)

2) For systems consisting of variable output capacity (or variable speed) compressor(s) the system volume should be doubled.

$$m3 = 2.m3\,min bar.g - 1$$

3.5 Sequence Control Strategies

The T1 provides three *basic sequence control strategies* or modes. Each *sequence control strategy* consists of two *sub strategies*:

1) The compressor 'Rotation' strategy
 The 'Rotation' strategy defines how the compressors are re-arranged, or re-ordered, in to a new sequence at each routine 'Rotation' event. Rotation events are triggered by a cyclic interval time, a set time of day each day, or a set time of day once a week.

2) The compressor load 'Control' strategy
 The compressor load 'Control' strategy defines how the compressors are utilised in response to variations in system pressure.

The following explanation is making use of a system consisting of 4 assets. Obviously in practical situations this quantity can be different (from 2 to 12).

Compressor Sequence Arrangements:

Each compressor in a system is initially assigned to the T1 with a fixed and *unchanging number reference*, "1" to "4".

The 'duty' that a compressor is assigned in any set 'Rotation' sequence arrangement is defined by a letter, "A" to "D".

A = the 'Duty' compressor, the first to be utilized.
B = The 'Standby' compressor, the second to be utilized.
C = The 'Second Standby' compressor, the third to be utilized.
D = The 'Third Standby' compressor, the forth to be utilized.

Compressor 'duty' assignments are reviewed, and re-arranged as appropriate in accordance with the selected rotation strategy, at each rotation event.

3.5.1 Equal Hours Run Mode

 Equal Hours Run Mode (EHR)

The primary function of EHR mode is to maintain a close relationship between the running hours of each compressor in the system. This provides an opportunity to service all compressors at the same time (providing the service interval times for all compressors are the same or similar).

 EHR is not an energy efficient focused mode of operation.

Rotation:
Each time the rotation interval elapses, or the rotation time is reached, the sequence order of compressors is reviewed and re-arranged dependant on the running hours recorded for each compressor. The compressor with the least recorded running hours is assigned as the 'duty' compressor, the compressor with the greatest recorded running hours is assigned as the 'last standby' compressor. For systems with more than two compressors, the remaining compressor(s) are assigned in accordance with their recorded running hours in the same way.

Example: The compressors in a four-compressor system have the following recorded running hours at the 'Rotation' time.

Compressor 1 = 2200 hrs
Compressor 2 = 2150 hrs
Compressor 3 = 2020 hrs
Compressor 4 = 2180 hrs

The new sequence order arrangement after a rotation event would be:

Compressor 1 = D
Compressor 2 = B
Compressor 3 = A
Compressor 4 = C

Compressor 3, that has the least recorded running hours, will now be utilised to a greater extent in the new sequence arrangement; potentially increasing the running hours at a faster rate.

The T1 continuously monitors the running status of each compressor and maintains a record of the accumulated running hours. These are available, and adjustable, in the T1's compressor running hour's menu. The T1 uses these values in EHR mode. The T1's running hours record should be routinely checked, and adjusted if necessary, to ensure a close match with the actual run hours displayed on each compressor.

 If a compressor is operated independently from the T1 the running hours record may not be accurately updated.

 The running hours meter display on most compressors are intended for approximate service interval indication only and may deviate in accuracy over a period of time.

Control:
Compressors are utilised, in response to changing demand, using a 'FILO' (First In, Last Out) strategy. The 'duty' compressor (A) is utilised first followed by (B) if demand is greater than the output capacity of (A). As demand increases (C) is utilised followed by (D) if

demand increases further. As demand reduces (D) is the first compressor to be unloaded, followed by (C) and then (B) if demand continuous to reduce. The last compressor to be unloaded, if demand reduces significantly, is (A). The compressor assigned as (A) in the sequence is the first to be loaded and the last to be unloaded.

3.5.2 Timer Rotation Mode

Timer Rotation Mode (TRM)

The primary function of Timer Rotation mode is to efficiently operate a compressed air system consisting of fixed capacity output compressors. The routine rotation assignments can be modified using 'Priority' settings to accommodate for a differentially sized or variable capacity output compressor(s).

Rotation:
Each time the rotation interval elapses, or the rotation time is reached, a sequence rotation occurs and the sequence assignment for each compressor is re-arranged. The compressor that was assigned for duty (A) is re-assigned as last standby (D) and all other compressor assignments are incremented by one.

	1	2	3	4
#1	A	B	C	D
#2	D	A	B	C
#3	C	D	A	B
#4	B	C	D	A

Figure 117 - How Timer Rotation Mode links Assets number to Duty

The sequence assignment pattern can be modified by 'Priority' settings.

Control:
Compressors are utilised, in response to changing demand, using a 'FILO' (First In, Last Out) strategy.

The 'duty' compressor (A) is utilised first followed by (B) if demand is greater than the output capacity of (A). As demand increases (C) is utilised followed by (D) if demand increases further.

As demand reduces (D) is the first compressor to be unloaded, followed by (C) and then (B) if demand continues to reduce.

The last compressor to be unloaded, if demand reduces significantly, is (A). The compressor assigned as (A) in the sequence is the first to be loaded and the last to be unloaded.

3.5.3 Energy Control Mode

Energy Control Mode (ECM)

The primary function of Energy Control mode is achieving and maintaining demand matched optimum system efficiency. Energy Control mode can accommodate differential capacity, variable capacity and variable speed air compressor types in any combination or configuration.

Control and Rotation:
Compressor control and utilisation is dynamically automated and is not based on pre-determined rotation configurations or time intervals.

The system management unit is aware of compressor capacity relationships and variable capacity capabilities, where applicable, and is able to dynamically implement and continuously review 'best fit' configurations as demand variations occur.

The basic principle of the Energy Control strategy is the efficient utilisation of available resources matched to fluctuations in demand.

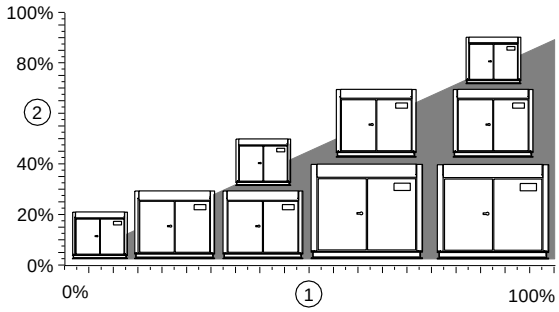
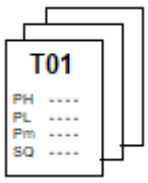


Figure 118 - Demand versus Generation in ECM

1: Demand
2: Generation
Not all potential combinations are shown.

Energy Control mode incorporates adaptive strategies and dynamic responses that continuously modify basic principles. With 'built-in' knowledge of individual compressor capabilities the management unit adapts to accommodate system characteristics under varying demand situations.

3.6 Tables



The T1 operates in accordance with settings that are programmed in to a number of menu 'Tables'. Each table defines the operational parameters and mode of operation of the T1.

The T1 can be instructed to change from one table to another at any time from an external remote source or from settings in the real time clock 'Pressure Schedule'

This functionality enables the T1 to switch from one set of operational parameters, and/or from one mode of operation, to another at any time without disruption to routine control.

Table Parameters:

Each table consists of the following parameters; the parameters can be set differently in each table.

1) PH: High pressure set point
2) PL: Low pressure set point
3) Pm: Minimum pressure warning level
4) SQ: Sequence rotation mode
5) 01: Compressor 1 Priority setting
6) 02: Compressor 2 Priority setting

to

16) 12: Compressor 12 Priority setting

The 'maximum' pressure fault level and the rotation interval, or rotation time, are set independently in a configuration menu and are unchanging regardless of Table selected.

Pressure Change Time:

When pressure set points change, a change from one 'Table' to another, the T1 will increase, or decrease, the pressure target levels towards the new table settings in a gradual transition over a period of time.

This feature is intended to allow the system to react to changes in pressure target levels in a smooth and energy efficient manner without abrupt overreaction.

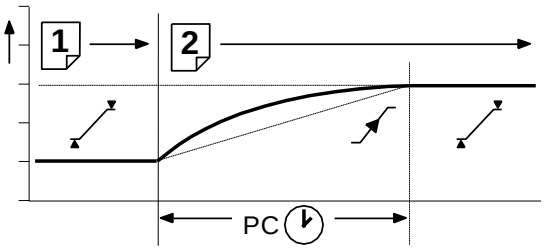


Figure 119 - The Pressure Change Time

The time the system will take to complete the transition from one pressure target to another is determined by the 'Pressure Change' time (PC). This value can be adjusted to accommodate installation characteristics to achieve the transition at optimal energy efficiency.

If the T1 is able to achieve the transition without compromising energy efficiency in a shorter time than set, the pressure change event time will be automatically reduced.

An aggressively short time setting will compromise system optimal energy efficiency.

3.7 Sequence Rotation

A sequence 'Rotation' event can be automatically triggered on a routine basis using a *pre-determined interval*, a *pre-determined time each day* or a *pre-determined day and time each week*.

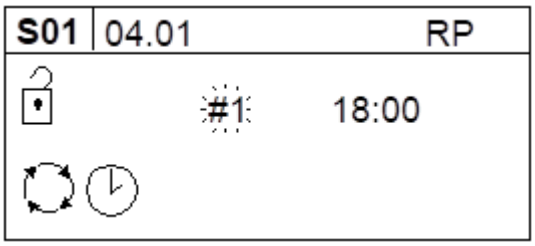


Figure 120 - Pre-determined day and time rotation

Select the 'day' or day function as required:

#1 = Monday to **#7** = Sunday
#8 = each working day of the week, excluding Saturday and Sunday
#9 = each working day of the week.
#- (dash) = deactivate

Select the required hour and minutes of the day(s) using the same method.

A day starts at 00:00hrs and ends at 23:59hrs (24hr clock system).

To define an interval time (more than one rotation event a day) select '**#t**' for the day function and press Enter:

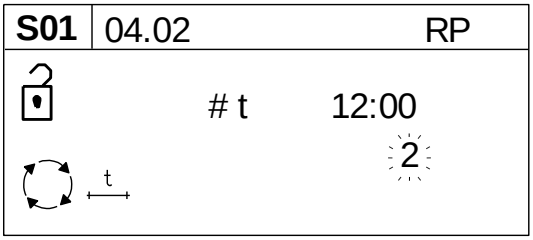


Figure 121 - Interval time rotation

An 'intervals per day' value will appear and flash. Select the required number of rotation events per day (1 to 96). The hour and minutes display will now show the interval time between each rotation event; 1 = every 24hrs to 96 = every 15 minutes (example: 2 = every 12hrs).

The first automated rotation event each day will occur at 00:00hrs and then every set rotation interval time throughout the day.

3.8 Priority Settings

Priority settings can be used to modify the 'Rotation' sequence assignment. Compressors can be assigned a 'priority' of 1 to 12; where 1 is the highest priority. Any compressor can be assigned any priority and any number of compressors can have the same priority.

Example 1:
For a four-compressor system, that includes a single variable speed compressor assigned as compressor number '1', it may be desirable to ensure the variable speed compressor is continuously utilised in any sequence arrangement as the 'duty' or 'top-up' unit.

To achieve this assign compressor number 1 with a higher priority than the remaining three fixed speed compressors.

Compressor 1 (variable speed) = priority 1
Compressors 2 to 4 (fixed speed) = priority 2

	1	2	3	4
	1	**2**	**2**	**2**
#1	A	B	C	D
#2	A	C	D	B
#3	A	D	B	C
#4	A	B	C	D

Figure 122 - Compressor Assets and Priority Settings – Example 1

Example 2:
For a four-compressor system, that includes a compressor (for example compressor 4) that is less efficient, or otherwise less desirable to operate for other reasons, it may be convenient to ensure the compressor is only utilised as an emergency backup. To achieve this assign compressor number 4 with a lower priority.

Compressors 1 to 3 = priority 1
Compressor 4 = priority 2

	1	2	3	4
	1	**1**	**1**	**2**
#1	A	B	C	D
#2	B	C	A	D
#3	C	A	B	D
#4	A	B	C	D

Figure 123 - Compressor Assets and Priority Settings – Example 2

Example 3:
For a four-compressor system that includes a variable speed compressor (compressor number 1) and a fixed speed compressor that is only required as an emergency backup (compressor number 4) it may be desirable to ensure the variable speed compressor is always utilised first, and the backup compressor utilised last, in any sequence arrangement.

Compressor 1 (variable speed) = priority 1
Compressors 2 and 3 = priority 2
Compressor 4 (back-up) = priority 3

	1	2	3	4
	1	**2**	**2**	**3**
#1	A	B	C	D
#2	A	C	B	D
#3	A	B	C	D
#4	A	C	B	D

Figure 124 - Compressor Assets and Priority Settings – Example 3

Example 4:
Compressors can be separated in to rotation groups. In this example compressors 1 and 2, of a four-compressor system, have been set as a high priority group and compressors 3 and 4 as a lower priority group. Compressors 1 and 2 will always be utilised first in any sequence arrangement and will be rotated at each 'Rotation' event. Compressors 3 and 4 will always be utilised as lower priority in any sequence arrangement and will be rotated at each 'Rotation' event.

	1	2	3	4
	1	**1**	**2**	**2**
#1	A	B	C	D
#2	B	A	D	C
#3	A	B	C	D
#4	B	A	D	C

Figure 125 - Compressor Assets and Priority Settings – Example 4

3.9 Prefill

The Prefill feature provides a controlled and energy efficient method of increasing pressure to normal operating levels at system start. This feature avoids the inefficient potential for all available system compressors to start and load before pressure reaches the normal operating level.

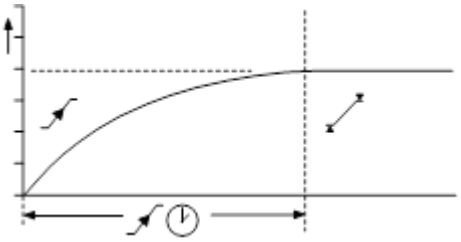


Figure 126 - Prefill function

At system start (manual start or automated start from standby) the T1 will only load compressors that have been pre-determined for prefill operation, for a pre-set period of time. The prefill time (PT) can be adjusted to suit system characteristics. The aim is to increase pressure to normal operational levels, using only the pre-determined compressors, prior to the prefill time expiring.

If normal operational pressure is reached prior to the set prefill time, the prefill function will automatically cease and normal operational control begin. If normal operational pressure is not reached by the end of the prefill time the T1 will utilise as many available compressors as required to achieve normal operational pressure as quickly as possible. Normal operational control will then begin.

Three prefill modes are available. 'Backup' and 'Standard' modes require compressor pre-selection and function in the same way; differing only in response to a failure, or loss, of a prefill compressor. Automatic mode requires no compressor pre-selection.

√ Backup Mode: Compressor(s) can be pre-selected as 'Primary Prefill' compressor(s) or 'Backup Prefill' compressor(s). If a primary prefill compressor experiences a shutdown, or is stopped, a pre-defined backup compressor replaces it and prefill continues.

√ !→X Standard Mode: If one or more of the pre-defined prefill compressors experiences a shutdown, or is stopped, the prefill function is cancelled and normal operation begins.

√ A^^ Automatic Mode: No Prefill compressor selection is necessary; any selection set is ignored. The management unit automatically selects compressor(s) dynamically to achieve pressure in accordance with the set Prefill time. If a compressor is stopped, or shuts down, it is automatically substituted with an alternative compressor.

To manually skip Prefill mode, press and hold Start for several seconds.

3.10 Start Function

The 'Start' function enables auxiliary equipment to be pre-started prior to utilisation of any compressors.

The function also monitors the auxiliary equipment during normal running operation.

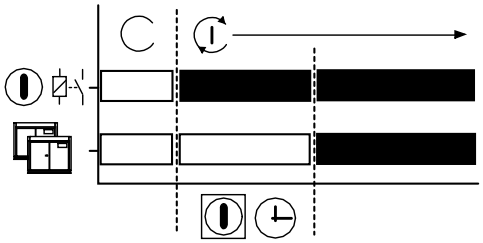


Figure 127 - Auxiliary equipment pre-started prior to compressor utilization

At system start-up (manual start or automated start from standby) any output relay set for the 'Start' function will energise. The management system will then wait for the set 'Start' time before utilising any system compressors. During this time the management system expects to receive a feedback on the 'Start Function Feedback Input'. The management system response to the feedback is dependent on the selected 'Start' function.
If feedback is not received by the end for the 'Start' time the management unit can be set to display an Alarm (Warning) and continue, or Shutdown.

If, at any time during normal operation, the feedback signal disappears the management unit can be set to display an Alarm (Warning) and continue, or Shutdown.

This function is intended for automated control and monitoring of auxiliary equipment critical to air compressor system operation; air dryer(s) or cooling water pump(s) for example.

3.11 Pressure Schedule

The T1 is equipped with a real time clock feature and pressure schedule facility. The 'Pressure Schedule' function can be used to provide automation of the system.

The pressure schedule consists of 28 individual settings that instruct the system to change from one 'Table' to another, or put the system in to 'Standby' mode, dependant on time of day and day of the week. The pressure schedule will cycle from 00:00 hours Monday (day #1) to 23:59 hours on Sunday (day #7) each calendar week.

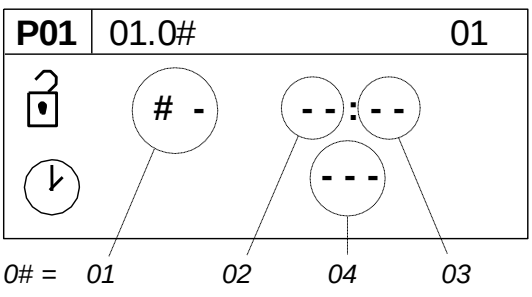


Figure 128 - Setting Pressure Schedules

01) Day of the Week
#1 = Monday to #7 = Sunday
#8 = every working day of the week; Monday to Friday, excluding Saturday and Sunday.
#9 = every working day of the week.

Select "-" (dash) and enter to delete a setting from the schedule.

02) Hours; time of day (24hr format)
03) Minutes; time of day
04) The required table, T01 to T06, or
"-X-" = Standby (unload all compressors).

Adjust the 'day of the week' sub-setting first and then press Enter to increment to the next setting. Repeat until all item sub-settings are entered. The complete 'Pressure Schedule' item will not be set in XC memory until the last sub-setting is entered. Press Escape to step back one sub-item if required.

3.12 Second Pressure Sensor

The T1 is equipped with a 4-20mA input dedicated for an optional second pressure sensor.

The second pressure sensor (P2) can be utilised for one of two available functions:

1) P1<>P2:

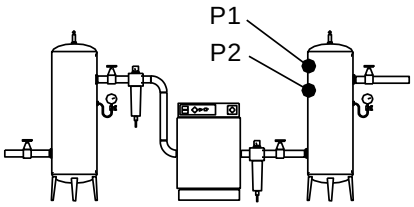


Figure 129 - 2nd Pressure Sensor - Backup Sensor mode

If the primary control pressure sensor (P1) fails, the management unit will automatically switch to the 'backup' pressure sensor (P2).

2) P2+>DP:

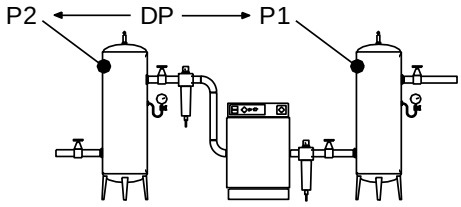


Figure 130 - 2nd Pressure Sensor - Differential mode

The second pressure sensor can be used to monitor pressure downstream, or upstream, of air treatment equipment. The pressure differential (DP) between the primary control pressure sensor (P1) and the second pressure sensor (P2) can be displayed on the screen. A pressure differential Alarm (Warning) level can also be set to indicate when differential pressure exceeds the set limit.

3.13 Airflow Sensor Monitoring

The T1 is equipped with a 4-20mA input dedicated for optional airflow sensor monitoring. Any airflow sensor, that is equipped with a 'loop powered' 4-20mA output, can be connected to the T1. The airflow sensor value can be displayed on the T1 screen and is available on remote communications.

3.14 Pressure Balance Function

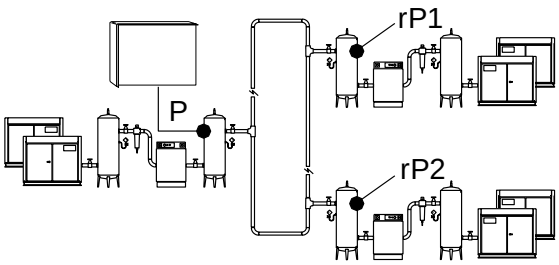


Figure 131 - Pressure Balance Function

The T1 has the capability to monitor up to two remote pressures from compatible compressor controllers, compressor integration units or other remote system automation units.

The remote pressure(s) can be integrated with the primary local pressure to generate a new control pressure value.

The T1 can be instructed to control from the lowest pressure, the highest pressure, or an average of local and remote the pressures.

This function can be used to 'balance' pressure control across a system that has multiple remote compressor rooms and/or where pressure differentials across a site system may vary.

3.15 Zone Control Function

Compressors can be assigned to one of three ‘zones’. The T1 will always attempt to balance utilisation across the zones to maintain, as near as possible, an equal number of utilised compressors in each zone.

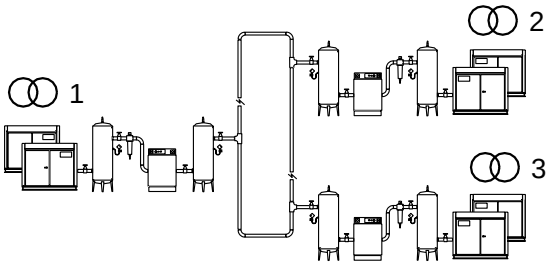


Figure 132 - Zone Control Function

This function is intended for installations that have multiple collections of compressor(s) distributed across a site.

In some instances, large pressure differentials can develop in remote areas of an air network if air generation is concentrated in one area. The aim of the ‘zone’ function is to facilitate a balanced pressure across a site air network by ensuring air generation is distributed.

The ‘zone’ function will operate with all available sequence strategy modes and will work in conjunction with the priority and/or pressure balance function.

The priority function will override ‘zone’ control where a conflict in compressor selection occurs. This may result in unexpected compressor utilisation; this should not be considered abnormal.

The ‘zone’ function can modify compressor selection when using ‘Energy Control’ mode. This may compromise optimum system efficiency in some instances – use ‘zone’ control with caution where system efficiency is important.

3.16 Insufficient Capacity Alarm

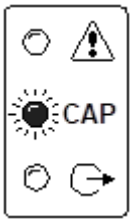


Figure 133 - Insufficient Capacity Alarm

The T1 is equipped with a dedicated ‘Insufficient Capacity’ Advisory Alarm (Warning) indication.

This indication will illuminate (inside of AERO) if all available compressors are loaded and system pressure is continuing to decrease. The indication will generally occur prior to any set low pressure Alarm (Warning) and is intended to provide an advanced warning of a potential ‘Low Pressure’ situation.

The ‘Insufficient Capacity’ advisory alarm is intended as an advanced warning and is not recorded in the fault history log but is included as a Group Alarm (Warning), or Group Fault item.

‘Insufficient Capacity’ is available as a dedicated data communications item and as a dedicated ‘virtual relay’ function.

The ‘Insufficient Capacity’ advisory alarm function can be de-activated. In this instance the unit’s Alarm indicator will still illuminate but no group alarm, group fault, ‘virtual relay’ or remote indication is generated.

3.17 Restricted Capacity Alarm

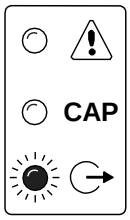


Figure 134 - Restricted Capacity Alarm

The T1 is equipped with a dedicated ‘Restricted Capacity’ Advisory Alarm (Warning) indication.

This indication (inside of AERO) will flash if all available compressors are loaded and further capacity is required but one, or more, compressors are:
a) inhibited from use in a ‘Table’ priority setting
b) inhibited from use by the short-term Service/Maintenance function
c) inhibited from use in the long term maintenance menu.

The ‘Restricted Capacity’ advisory alarm is intended to indicate that all available compressors are already loaded and further capacity is required but one, or more, system compressor(s) have been restricted from use.

The ‘Restricted Capacity’ advisory alarm is not recorded in the fault history log but is included as a Group Alarm (Warning), or Group Fault item.

‘Restricted Capacity’ is available as a dedicated data communications item and as a dedicated ‘virtual relay’ function.

 The ‘Restricted Capacity’ advisory alarm function can be de-activated. In this instance the unit’s Alarm indicator will still flash but no group alarm, group fault, ‘virtual relay’ or remote indication is generated.

3.18 Virtual Relay Technology

The T1 is equipped with Virtual Relay technology.

The ‘Virtual Relay’ concept is a configurable system wide automation system. The concept allows output relay functions to be configured to respond to any ‘virtual relay’ condition, status or signal function available in the unit or from another compatible unit on the system network.

4. Safety Precautions

ALWAYS EMPLOY SAFE WORKING PRACTICE AND PROCEDURES

When installing, commissioning, operating or carrying out service or maintenance on a product, personnel must use safe working practise and observe all relevant local health and safety requirements and regulations.

Electricity and compressed air have the potential to cause severe personal injury or property damage.

Operators of equipment should use common sense and good working practices while operating and maintaining this product and the associated system.

Installation & Maintenance must be performed by adequately qualified personnel that are equipped with the appropriate tools and personal protective equipment (PPE).

It is not possible to anticipate every circumstance that might represent a potential hazard. If the reader employs an operating procedure, an item of equipment or a method of working which is not specifically recommended the reader must ensure the product will not be damaged or made unsafe and that there is no risk to persons or property.
Failure to observe safety precautions or implement safe working practises may be considered dangerous practice or misuse of the product.

5. Installation

Installation work must only be carried out by a competent person under qualified supervision.

A fused isolation switch must be fitted between the main power supply and the product.

The product should be mounted in such a location as to allow operational and maintenance access without obstruction or hazard and to allow clear visibility of indicators at all times.

If raised platforms are required to provide access to the product they must not interfere with normal operation or obstruct access. Platforms and stairs should be of grid or plate construction with safety rails on all open sides.

6. Operation

The product must only be operated by competent personnel under qualified supervision.

Never remove or tamper with safety devices, guards or insulation materials fitted to the unit.

The product must only be operated at the supply voltage and frequency for which it is designed.

When mains power is switched on, lethal voltages are present in the electrical circuits and extreme caution must be exercised whenever it is necessary to carry out any work on the unit.

Do not open access panels or touch electrical components while voltage is applied unless it is necessary for measurements, tests or adjustments. This work must only be carried out by a qualified personnel equipped with the correct tools and appropriate protection against electrical hazards.

All air compressors and/or other machine equipment connected too, and controlled by, the product should have a warning sign attached stating ‘THIS UNIT MAY START WITHOUT WARNING’ next to the display panel.

If an air compressor and/or other device connected too, and controlled by, the product is to be started remotely, attach warning signs to the device stating ‘THIS UNIT CAN BE STARTED REMOTELY’ in a prominent location, one on the outside of the machine, the other inside the machine control compartment.

7. Service, Maintenance and Repair

Service, maintenance, repairs or modifications must only be carried out by qualified personnel.

If replacement parts are required use only genuine parts from the original equipment manufacturer, or an alternative approved source.

Carry out the following operations before opening or removing any access panels or carrying out any work on the product:

- Isolate from the main electrical power supply. Lock the isolator in the ‘OFF’ position and remove the fuses.
- Attach a label to the isolator switch and to the product stating ‘WORK IN PROGRESS - DO NOT APPLY VOLTAGE’. Do not switch on electrical power or attempt to start the unit if such a warning label is attached.

Ensure that all instructions concerning operation and maintenance are strictly followed and that the complete product, with all accessories and safety devices, is kept in good working order.

The accuracy of sensor devices must be checked on a regular basis. They must be renewed when acceptable tolerances are exceeded. Always ensure any pressure

within a compressed air system is safely vented to atmosphere before attempting to remove or install a sensor device.

The product must only be cleaned with a damp cloth, using mild detergents if necessary. Avoid the use of any substances containing corrosive acids or alkalis.

Do not paint the control facial or obscure any indications, controls, instructions or warnings.

8. About this Publication

The AIRMATICS™ product discussed in this publication forms part of an 'AIRMATICS™ System' which in turn, forms part a wider 'Compressed Air System'. These Systems will vary and thus It is not possible to anticipate every circumstance that can exist.

This publication makes reference to other AIRMATICS™ Products, AIRMATICS™ Services and other items of equipment associated with a Compressed Air System (e.g. Air compressor assets). These products, services and items may be necessary to install, operate, service, maintain and repair the product.

This publication has been arranged in synchronous order. It may be necessary to carry out installation of other AIRMATICS™ products before, during or after completing installation of the Product discussed herein.

9. Concepts, terminology

9.1 About AIRMATICS™

AIRMATICS™ is a simple cloud-based air compressor monitoring, performance and control solution that provides real time data, analytics and insights at the push of a button.

AERO is the brain behind AIRMATICS™, which is locally installed and can be connected via the cloud. Capable of managing a large number of interconnected fixed speed, variable speed or variable output air compressors, AERO responds to real time feedback and adjusts settings and performance levels automatically – 24 hours a day, 365 days a year.

AERO provides operators with 3 distinct and password protected ways to access the Product and System. Locally, the AERO Product features a 12.1" integrated colour touch display with 'display / power saving' provided via its door mounted proximity sensor.

Remote LAN connectivity is provided via a dedicated RJ45 Industrial connector that's connected to the local LAN. Operators with LAN access may remotely sign in to AERO using a suitable device and browser

Remote INTERNET (Cloud) connectivity is provided via a second dedicated RJ45 Industrial connector that's connected to the AIRMATICS ™ network gateway. In turn, the network gateway establishes a connection with the internet and Cloud, passing data to the AIRMATICS™ Aircloud server. Operators with internet access may sign in to the Aircloud server using a suitable device and browser.

Certain features and functions of the AERO product can only be accessed locally. This is intended to establish 'a physical barrier' between inaccessible features or functions used by AERO to 'Control' the compressed air system and accessible features or functions used by AERO that merely 'Monitor' the performance and health of the compressed air system.

9.2 Legacy – Compatibility

For over 30 years, CMC has been designing and manufacturing compressed air control, performance and monitoring solutions and is internationally recognised as an architect of world-class application software. With thousands of product in use worldwide, legacy compatibility is important.

AERO is legacy compatible with any AIRMASTER™ product that features AIRBUS 485™ communications.

AERO is also legacy compatible with any METACENTRE™ air compressor interface product that features AIRBUS 485™ communications.

Contact Support to enquire about specific legacy compatibility matters.

9.3 Assets

The term 'Assets' is used to describe air compressors controlled by AERO.

9.4 Compressed Air System

The term 'compressed air system' is used to describe the compressed air pipework, compressed air tank(s) sometimes referred to as a compressed air receiver(s) or reservoir(s) and compressed air filtration located prior to the compressed air pipework distribution network.

The terms 'supply side' and 'demand side' is used to distinguish between the 'compressed air system' and the 'pipework distribution network'.

A larger compressed air system can have multiple 'supply side' locations, however the pipework distribution network must be common.

AIRMATICS™ targets the compressed air system and is not intended for use as a Demand Side monitoring product.

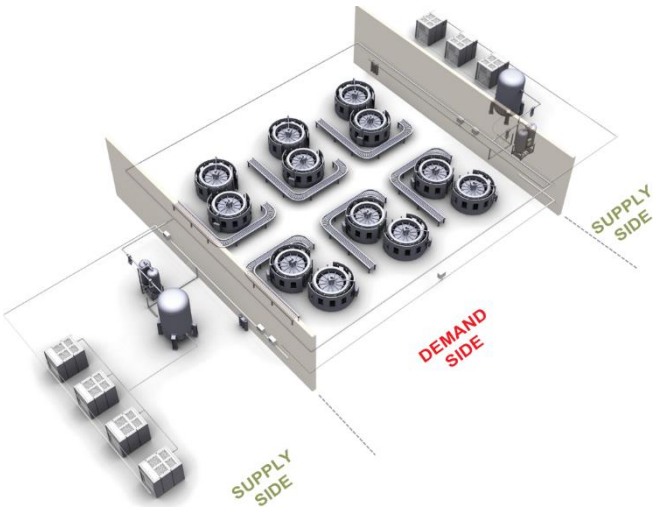


Figure 1 - Supply Side vs Demand Side

9.5 Local Area Network (LAN)

A local area network (LAN) is a computer network that interconnects devices (e.g. a PC) within Aircloud is a dedicated environment that consists of a Device Management and Data Transportation Layer, a durable, secure and scale-able Data Storage and Management Layer and an Operator interface Layer accessible using a suitable platform and browser.

AERO can be connected to a LAN. Operators with LAN access may remotely sign in to AERO using a suitable platform and browser.

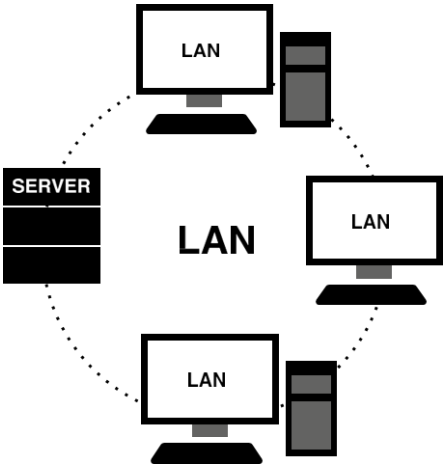


Figure 2 - LAN

9.6 Wide Area Network (WAN)

A wide area network (WAN) covers a larger geographic distance.

AERO can be connected to a dedicated WAN using an AIRMATICS™ network gateway. The AIRMATICS™ network gateway establishes
a dedicated connection with the internet and Cloud, passing data to the AIRMATICS™ AirCloud server. Operators with internet access may sign in to the AirCloud server using a suitable platform and browser.

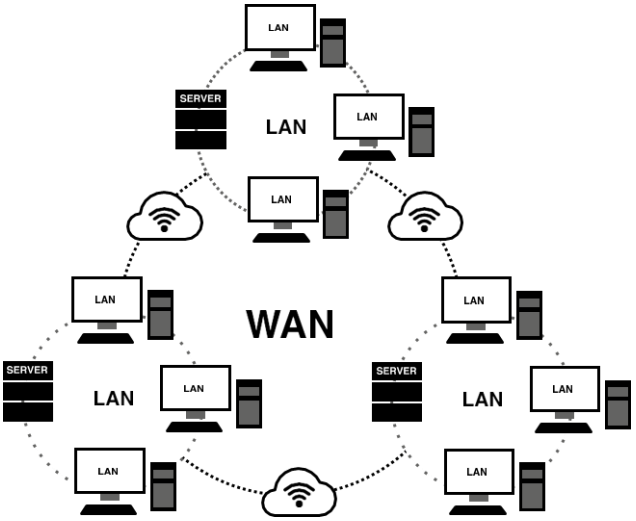


Figure 3 - WAN

9.7 AirCloud

AirCloud is a dedicated environment that consists of a Device Management and Data Transportation Layer, a durable, secure and scale-able Data Storage and Management Layer and an Operator interface Layer accessible using a suitable platform and browser.

The term ‘AirCloud’ is used to describe the Operator interface Layer. Other layers relate to ‘background services’ that support Operator Interface Layer and are not discussed in this publication.

Figure 4 - Screenshot of AirCloud user interface

10. Installing AERO

10.1 What is in the box

The AERO is shipped in a self-contained enclosure. Inside the enclosure a zip-lock bag containing 13 x 13.5mm (0.53 inch) cable entry glands and locknut, 3 x Industrial 10G plug assemblies and 1 x enclosure door key.

For transport and safe keeping, the zip-lock bag has been secured internally. When required to do so, remove the zip-lock bag from the enclosure, taking care not to damage any cables.

Figure 5 - Package of AERO

10.2 Enclosure

The AERO enclosure is a Totally insulated Poly-carbonate enclosure with front access door, Polyurethane door gasket and 2-point locking system finished in RAL7035 (light grey)

- Length: 500 mm (19.7 inch)
- Height: 220 mm (8.66 inch)
- Depth: 400 mm without glands (15.7 inch)
- Weight: 15.6 kg (34.4lb)

A larger enclosure diagram is annexed at the rear of this publication.

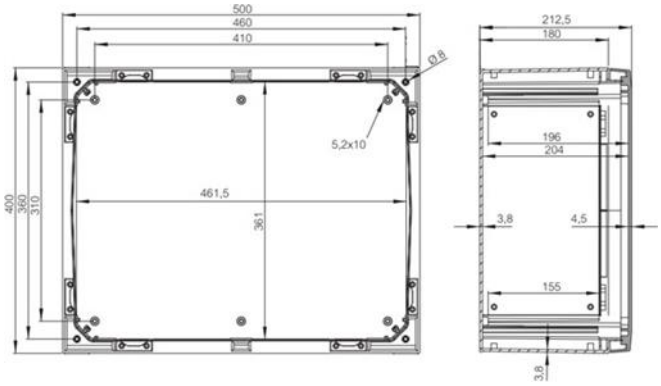


Figure 6 - AERO dimensions

10.3 Exterior

The AERO operator interface features a 12.1" Integrated color touch display, a proximity sensor used for display power saving and a 2-point locking system

Cable entry points can be found at the bottom of the enclosure.

Figure 7 - AERO enclosure, exterior

10.4 Interior

AERO components are arranged along its back-plate or door mounted.

10.4.1 Interior back-plate

AERO's back-plate contains the AERO's 'UNITAG', 'Di8R4', 'T1' and 'TERMINAL BLOCK RAIL' conveniently arranged alongside AERO's cable entry points.

These component terms are used throughout this publication.

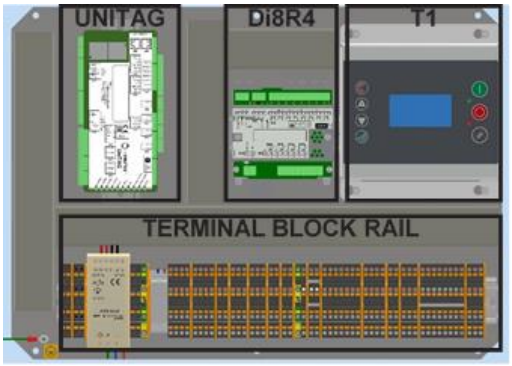


Figure 8 - Components located on the back-plate

10.4.2 Interior door

AERO's hinged door carries a diagnostic LED panel and an information label describing electrical terminal connections, LED diagnostic information and other useful information.

Components that support the 12.1” color touch display, proximity sensor as well as the LED diagnostics are concealed behind the door cover.

Figure 9 - AERO front - interior door

10.4.3 Identification Labels

AERO features a number of important hardware and software parts. The following table is provided to annotate your AERO’s identification. Labels are located on the interior or exterior of your AERO and may be necessary when seeking support.

AERO ID LABEL		PN:
	SN:	
	DOM:	
UNITAG ID LABEL	PN:	
	SN:	
	SW:	
	DOM:	
T1 ID LABEL	PN:	
	SN:	
	SW:	
	DOM;	
Di8R4 ID LABEL		PN:
	SN:	
	SW:	
	DOM:	

PN: Part number
SN: Serial number
SW: Software version
DOM: Date of manufacture

10.1 Location

Before locating the AERO, consider the following:

- AERO product and it’s enclosure specification
- The suitability of the environment where the AERO is to be location (dust, dirt or other airborne containments)
- AERO’s ambient temperature rating range of 0°C to + 40°C (32 °F to 104 °F)
- Do not locate AERO in direct sunlight!
- The provision of supply power to AERO
- The provision of signal and data cables to and from AERO
- AERO can be located remote from assets
- AERO must be located within 100 meters (328ft) ‘signal wire cable length’ of any control pressure sensor that’s connected directly to AERO’s TERMINAL BLOCK RAIL.

AERO is wall mounted using conventional wall plugs and screw fixings (not supplied).

4 x 0.8 Ø (0.3 inch) diameter holes exist within a cavity at each corner of the enclosure. The cavities are revealed with the enclosure door open!

Mount the AERO taking care to support the products weight and shape with the enclosure door open!

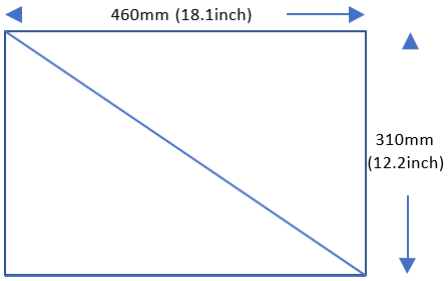


Figure 10 - Size occupied by AERO enclosure on wall

10.2 Cable Management

Use the provided cable entry holes, glands and lock-nuts to route external cable towards AERO’s terminal block rail.

Use the provided industrial 10G plug assemblies to route data cables to and from AERO!

High voltage power cables and high voltage switching devices are surrounded by electromagnetic fields and radiated interference. Radiated interference obeys an inverse square law; if the distance from an interference source is
doubled the interference level will reduce by a factor of four. Locate electronic control devices as far away as possible from strong sources of electromagnetic interference.

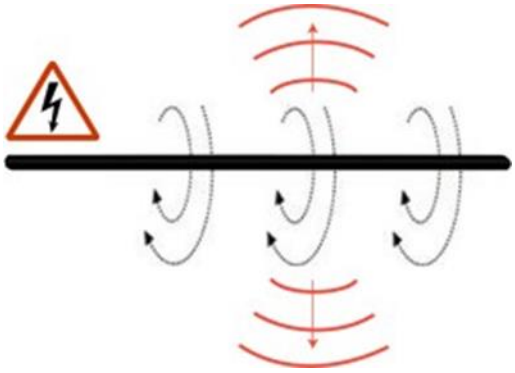


Figure 11 - Radiation emitted by cables

Electromagnetic interference from high voltage cables, switchgear and high frequency switching components, in particular variable speed/frequency drives (VSD / VFD), can disrupt the operation of electronic equipment. Care should be taken when locating electronic control devices and routing signal, data and low voltage control cabling.

Never route signal, data or control cables together with high voltage power cables. Never route signal or data cables together with control cables.

Figure 12 - How not to place cables

Never route an electronic device ground (earth) cable with high voltage power cables. Always ensure the electronic device ground (earth) cable is connected directly to the package main ground (earth) point and not looped from a ground (earth) terminal of another component.

Figure 13 - How not to place cables part 2

If it is necessary for a signal, data or control cable(s) to cross the path of a high voltage power cable(s), always cross at a right angle.

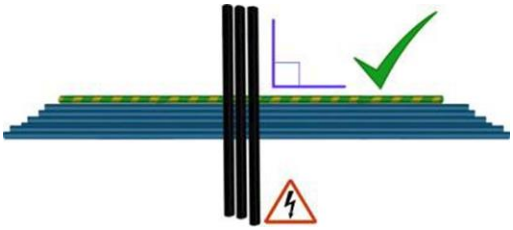


Figure 14 - A better way

10.3 Cable Preparation

All connections with AERO's Terminal Block Rail must be done using ferrules appropriately sized for the cable and crimped using a crimping tool.

See also 20 Connection with typical sensors for an overview of the connection of sensors, power and communication on the Terminal Block Rail

Figure 15 - Cable tooling

10.4 Supply Power

A source of supply power (100 - 240vAC, 50 / 60Hz) is required.

A fused switching isolator must be installed to the main incoming power supply, external to the AERO. The isolator must be fitted with a fuse of the correct rating to provide adequate protection to the power supply cable used (in accordance with local electrical and safety regulations).

AERO is internally fused. Fuses are located in fuse holders along the terminal block rail.

Fuses rating: 3.15A, 250V AC 'slow blow'
Fuse dimensions: 5mm (0.2inch) x 20mm (0.8inch)

Connect the source of supply power to the TERMINAL BLOCK RAIL.

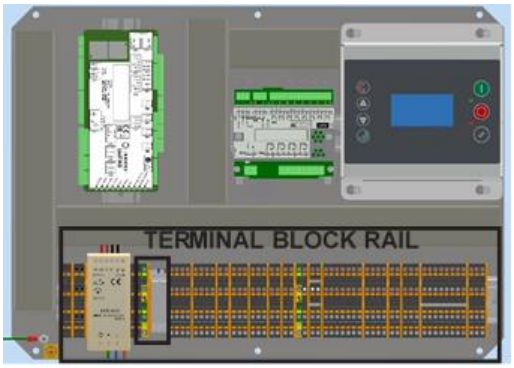


Figure 16 - power supply connection location

10.5 Data Communication

10.5.1 Serial RS485 'AirBUS'

The AERO is equipped with AIRBUS serial communications port using the RS485 standard.

Assets (e.g. Air compressor controllers) and legacy Metacentre equipment (e.g. compressor interface products such as the Airbus485 compressor connector) that support AIRBUS serial communications can be connected to AERO using this communications method.

Note:

- Polarity is important!
- Only use earth shielded 'twisted pair' cable to improve electromagnetic compatibility.
- Always securely bond to a good Earth at one end
- Refer to the asset manufacturers Operating manual for support relating to the configuration of Asset controllers
- Refer to the respective products Technical Manual for support relating to the configuration of legacy Metacentre products

10.5.2 LAN

The AERO is equipped with 3 dedicated LAN connections which in turn support 2 dedicated communication networks:

- PRIVATE LAN (IN and OUT)
- LOCAL LAN

Observe that assignment of the 3 industrial 10G LAN plugs is shown on the door information label. Additionally, cable markers mounted on internal cables assist with identification. To avoid any confusion, do not change the assignment of the industrial 10G plugs!

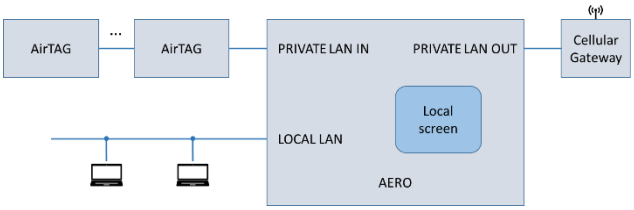


Figure 17 - LAN connections on the AERO

10.5.2.1 Private LAN In

AirMatics equipment (e.g. compressor interface products such as AirTAG and SmartTAG) can be connected to AERO using the PRIVATE LAN IN connection.

Refer to the respective products Technical Manual for support relating to the configuration of other Airmatics equipment.

10.5.2.2 Private LAN Out

AirMatics Cellular Gateways can be connected to AERO using the PRIVATE LAN OUT connection.

10.5.2.3 Local LAN

Use this connection to connect the AERO to the customer's LAN.

10.6 Signal Wire

A variety of signal wire connections can be made to AERO's TERMINAL BLOCK RAIL...

ANALOGUE DEVICES
(E.G. 'CONTROL' PRESSURE SENSOR(S))

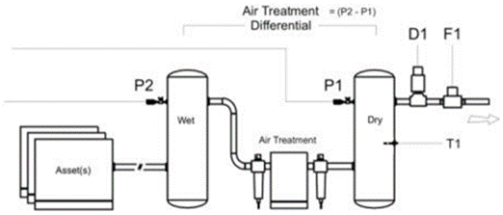


Figure 18 - Location of major analogue sensors

ID	Function	Signal type
P1	'Control' System pressure 1	4-20mA
P2	'Differential' System pressure 2	4-20mA
F1	System flow	4-20mA
D1	System dewpoint	4-20mA
T1	System temperature	PT1000
T2	Ambient temperature	PT1000

Other signal types are NOT SUPPORTED!

A ‘Control’ System pressure sensor must be connected to AERO. Differential System Pressure 2 is also recommended.

The ‘Control’ System pressure sensor range must be appropriate for the compressed air system that AERO will monitor (e.g. 0 - 16 bar / 0 - 232psi is most common).

Connect pressure sensors to AERO’S TERMINAL BLOCK RAIL. Check signal wire polarity!

Other analogue devices are optional (e.g. FLOW). Connect devices to AERO’S TERMINAL BLOCK RAIL as necessary. Again, check signal wire polarity!

10.6.1 Control Pressure Sensor Location

The ‘Control’ System pressure sensor (P) must be located in a position that will continuously experience pressure that is common to all assets.

Supply Side Pressure Control:

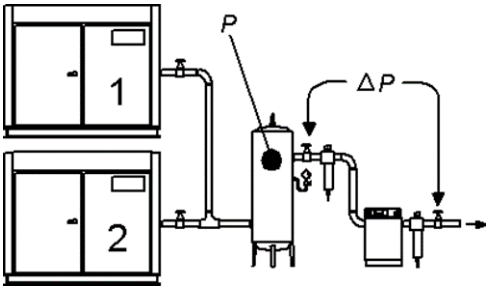


Figure 19 - Control Pressure Sensor Location, Supply side

System pressure will be lower than the set ‘supply’ pressure due to pressure differential losses across air treatment equipment. The nominal system pressure will reduce as the air treatment differential pressure increases.

System (Demand Side) Pressure Control:

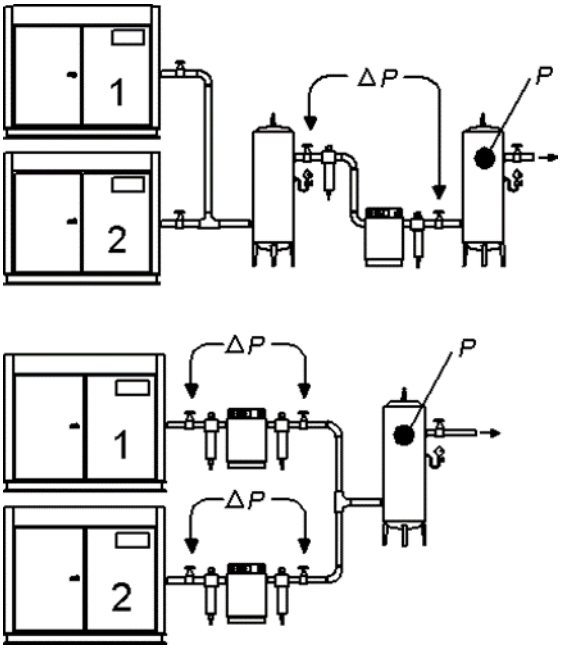


Figure 20 - Control Pressure Sensor Location, Demand side

Ensure each asset is equipped with independent excess pressure shut-down; an increase in pressure differential across air treatment equipment can result in excess asset discharge pressure.

Monitoring of Differential pressure across air treatment equipment is highly recommended.

10.7 Connecting Assets to AERO

Each asset to be managed by AERO is connected using data communications. Options are:

- RS485 SERIAL ‘AIRBUS’
- AirMatics ‘PRIVATE LAN’

Assets (e.g. Air compressor controllers) and legacy Metacentre equipment (e.g. compressor interface products such as the Airbus485 compressor connector) that support AIRBUIS serial communications can be connected to AERO using this communications method.

Refer to the asset manufacturers Operating manual for support relating to the configuration of Asset controllers

Refer to the respective products Technical Manual for support relating to the configuration of legacy Metacentre equipment

Establish an RS485 SERIAL ‘AIRBUS’ network between AERO, Assets and / or legacy Metacentre equipment

Wire polarity is important!

Figure 21 - RS485 - polarity of wire

Assets equipped with AirMatics interface (such as AirTAG and SmartTAG) need to be connected to AERO using the PRIVATE LAN IN & PRIVATE LAN OUT connections.

See also Figure 17 - LAN connections on the AERO

10.8 Remote Input Signals (optional)

AERO'S Terminal Block Rail is equipped with a number of remote 'digital' inputs.

The inputs are designed to detect a remote 'volt- free' switching contact (rated for a minimum 24VDC @ 10mA).

The 'ID' mentioned hereunder correspond with the connection number on the Terminal Block Rail.

Each input has a defined function:

ID	FUNCTION
103 - 104	Activates Table #1 when held closed
101 - 102	Activates Table #2 when held closed
99 - 100	Activates Table #3 when held closed
97 - 98	Activates Table #4 when held closed
77 - 78	Activates Table #5 when held closed
75 - 76	Activates Table #6 when held closed

Note: If more than one 'Table' input is held closed the lowest number Table will have priority. For example; Table #1 has priority over Table #2.

Standby has priority over any Table.

Remote inputs have priority over Pressure Schedule.

ID	FUNCTION
109 - 112	Start / Stop

Change in state from open to closed will simulate a Start button being pressed

Change in state from closed to open will simulate a Stop button being pressed

ID	FUNCTION
107 - 108	Force Sequence change

To force a change in sequence arrangement, close for 1 second minimum then open.

ID	FUNCTION
105 - 106	Standby

Closed: All assets will be forced to unload and remain offload.

Open: normal operation

10.9 Remote 'Virtual Relay' Function Inputs

AERO'S Terminal Block Rail is equipped with remote 'digital' inputs that can be used as 'input functions' for any Virtual Relay - local or remote.

ID	FUNCTION
71 - 72	Virtual Relay (Digital) Input 1
69 - 70	Virtual Relay (Digital) input 2
67 - 68	Virtual Relay (Digital) input 3
65 - 66	Virtual Relay (Digital) input 4

The inputs are designed to detect a remote 'volt- free' switching contact (rated for a minimum 24VDC @ 10mA).

10.10 Remote Output Signals (optional)

AERO'S Terminal Block Rail is equipped with 10 remote relay contact outputs

The function of each relay output is determined by the set-up of the equivalent 'Virtual Relay' (R01 to R10).

ID	FUNCTION
96	Output Relay 1
94	Output Relay 2
93	Output Relay 3
95	Output Relay 1, 2, 3, RC

Remote output relay 1,2,3 contacts are rated for 24Vac/dc @ 4A maximum

The maximum current on 'RC' must not exceed 8A.

The design and location of R1, R2 and R3 is ideally suited to enable 'Virtual Relay' outputs to directly activate function inputs.

For example:

Output Relay 1 can activate Table #3 by connecting the output terminals of R1 to the 'Force Table #3' inputs.

Output Relay 2 can activate standby mode by connecting the output to the 'Standby' input

ID	FUNCTION
91 - 92	Output Relay 4
89 - 90	Output Relay 5
87 - 88	Output Relay 6

85 - 86 Output Relay 10
83 – 84 Output Relay 9
81 - 82 Output Relay 8
79 - 80 Output Relay 7

R4 to R10 remote output relay contacts are rated for 240V ‘CE’ / 115V ‘UL’ @ 4A maximum.

As standard AERO is supplied with the following relay output defaults:

Relay 1 **Unit RUNNING**
ON: Standby or Start Time or Pre-Fill or Normal Operation
OFF: Stopped or Shut-down

Relay 2 **Control ON**
ON: Start Time or Pre-Fill or Normal Operation
OFF: Standby or Stopped or Shut-down

Relay 3 **General Trip (normally closed)**
ON: OK
OFF: System Trip or Compressor Trip

Relay 4 **Unit RUNNING**
ON: Standby or Start Time or Pre-Fill or Normal Operation
OFF: Stopped or Shut-down

Relay 5 **Control ON**
ON: Start Time or Pre-Fill or Normal Operation
OFF: Standby or Stopped or Shut-down

Relay 6 **General Trip**
ON: System Trip or Compressor Trip
OFF: OK

Relay 7 **General Fault**
ON: System Alarm/Trip or Compressor Alarm/Trip
OFF: OK

Relay 8 **Auxiliary Start Time Output**
ON: Start Time or Pre-Fill or Normal Operation
OFF: Stopped or Standby or Shut-down

Relay 9 **Low Pressure Alarm**
ON: Low Pressure Alarm
OFF: OK

Relay 10 **Differential Pressure Alarm**
ON: High Differential Pressure Alarm
OFF: OK

10.11 Terminal Block Rail

Remark on ModBus/Airbus naming
Equipment manufacturers are using various naming for RS-485 polarity. A de-facto standard (though not always respected):

'TX-/RX-', 'D-', 'RS485-','A’ or '-' as alternative for 'L1'
'TX+/RX+', 'D+', 'RS485+', ‘B’ or '+' as alternative for 'L2'

if you are uncertain about data line polarity, you can just try swapping the data lines to see the good communication can be achieved. The RS-485 device will not be damaged with reversed data lines, assuming the other parts of the system are correctly set up.

See for more details: 24.1 Terminal Block

11. Introduction to Configuring AERO

This chapter provides an introduction for the configuration of AERO installations. It serves as background information to better understand the steps to take while configuring the AERO.

Part of the content of this chapter is already provided above, this chapter is seen as a recapitulation.

11.1 View on total system

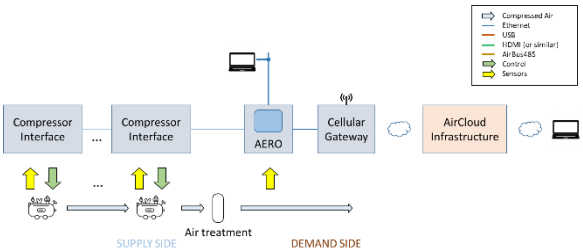


Figure 22 - Generic overview of total system

Hereby the following elements:

- Multiple compressors

Also referred to as “assets”
Essential parameters of these assets are monitored:

- Asset Power consumption
- Asset Delivery Pressure
- Asset Delivery Temperature
- Asset Output Air Flow
- Asset Status
- etc

Monitoring is done using Metacentre interfaces, optionally combined with AirTAGs, or SmartTAGs.

By controlling (on/off, % load, …) these assets, the Compressed Air system is behaving optimally. Controlling is done using Metacentre interfaces or SmartTags.

- Air Treatment / demand side

These are vessels, filters, dryers, etc.
In this domain Essential System Parameters are monitored:

- Generation Pressure
- System Pressure
- System Air Flow
- Dewpoint
- etc

- Compressor Interfaces

Each compressor has an interface which can be of various types.
This interface serves following purposes:

- Monitor physical parameters (such as pressure), translate this into an electrical signal and provide a means to communicate this information to the AERO.
- Retrieve control commands from the AERO and translate this into signals that interface with the underlying compressor

- AERO

Functionalities provided with the AERO:

- A local view on the monitored parameters. Both on asset and on system level.
- Control of the Assets with as aim to optimize the operation of the compressed air system
- A means to view monitored parameters on a local LAN segment (by using a PC)
- A means to put asset and system parameters in the Cloud (using AirCloud) allowing to monitor these parameters remotely

- Cellular Gateway

Communication gateway with the Cloud.

- Send measurement (asset and system) and event data towards the AirCloud infrastructure
- Allow for configuration and firmware updates

- AirCloud Infrastructure

A Cloud based infrastructure developed an operated by CMC NV providing:

- Storage of data retrieved from the AirMaster systems worldwide (such as each AERO installation)
- Means to view all this data using a PC browser
- Means to create reports
- etc

It is possible to have an “isolated AERO solution”: a solution where no data (measurements and events) is sent to AirCloud. This isolated solution prevents any data related to the operation of the company sent out of the company. However, CMC NV recommends to have a Cellular Gateway installed with any AERO installation for configuration and support purposes.

11.2 Compressor Interfaces – AERO ‘T1’ - METACENTRE™ air compressor interface products

Essential in any AERO setup is the AERO ‘T1’. This AERO ‘T1’ communicates with the compressor interfaces over AirBUS485 (CMC NV proprietary serial network over RS485). AERO is legacy compatible with any METACENTRE™ air compressor interface product that features AIRBUS 485™ communications.

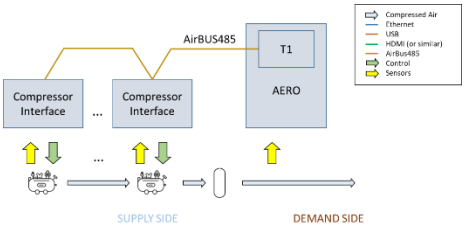


Figure 23 - AERO 'T1', AirBUS485, compressor interfaces

These compressor interfaces can be:

- VSB Box interface
- iPBC interface
- T1 (or similar) AirMaster compressor controller
- etc

Using these interfaces information of the assets is monitored (such as status, pressure, %load).
These interfaces also provide control capabilities towards the assets.
These compressor interfaces are mandatory for any installed asset.

11.3 Compressor Interfaces – optional AirTAG interfaces

Adding AirTAGs to an AERO system – though not mandatory – provides essential benefits:

- Precise power and flow measurements of the assets
  When using AERO 'T1' interfaces for Power and Flow data retrieval from the assets, this data is calculated based on the percentage operational load of the assets. For each asset one must configure maximum power and flow – and minimal power and flow – data.
  Percentage load combined with this data provides calculated power and flow.
  By adding AirTAGs, these essential parameters are actually measured, which allows for much more precise information.
- Asset parameter monitoring, dashboard (and other) view locally and in the cloud.
  installation of AirTAGs provides the capability to precisely monitor the operation of all the assets, either locally or in the cloud.

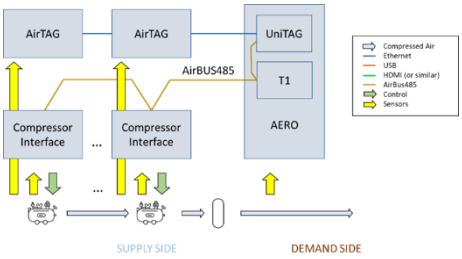


Figure 24 - Including AirTAGs

Information one can receive using the AirTAG:

- Power
- Flow
- Status (optional and only configurable by editing of the configuration file, done by highly skilled technicians only)

When AirTAGs are included in a system, all compressor assets need to be equipped with an AirTAG.

11.4 System Parameters

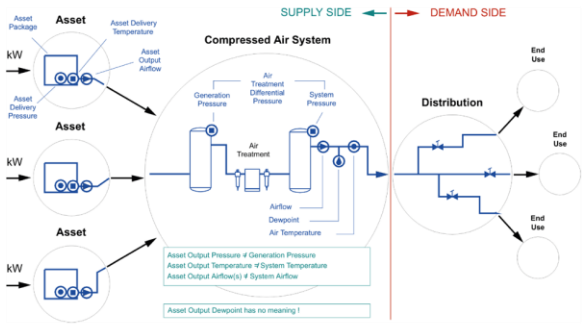


Figure 25 - System parameters

For optimal use of the AERO, Air System Parameters are essential:

- System Pressure
- Generation Pressure (remark: on the Dashboard views, Differential Pressure is provided, being 'Generation Pressure – System Pressure'. This provides the "loss" of pressure over the Air Treatment system and is from an informational perspective more valuable than Generation Pressure as such).
- System Air Flow
  It is recommended to install a System Air Flow meter. If this is not installed, the System Air Flow indicated on the dashboard will be the sum of the Air Flow information provided by the individual assets. Due to the fact that this does not take into account the impact of the Air Treatment elements, this can be misleading.
- System Dewpoint
- System Air Temperature

11.5 A closer look at the AERO internals

An AERO exist of a number of blocks

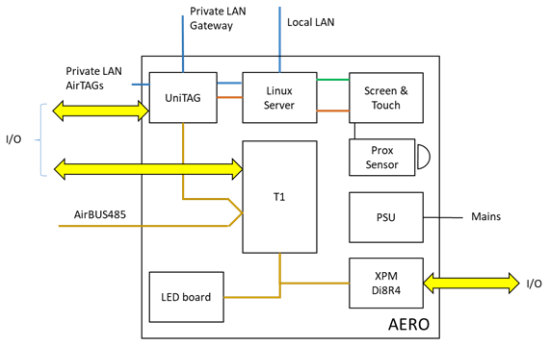


Figure 26 - AERO block diagram

- UniTAG
  System monitoring
- T1
  Sequencer
- Linux Server (AERO PC)
  Local Web Server platform
- Screen and Touch
  User interface on the AERO, using LCD screen
- Proximity sensor
  Senses the proximity of a user and as such controls the LCD screen backlight
- PSU
  Power Supply Unit
- Di8R4
  Connects with the T1 and provides extra I/O
- LED board
  Internal information panel

11.6 Storage of configuration information

Configuration information for AERO systems is stored on different locations and serves different but similar purposes.

- AERO PC (linux Server)

  Editing is done using the local AERO interface. It stores:
  - Users
    This is done from the local usage perspective. Hence users who log in on the local AERO screen or users who log in using their PC connected on the Local LAN
  - Sensor Configuration
    Controls how the gauges on the local AERO screen (and on PC connected to the Local LAN) appear
  - Group Members
    Manages how monitored information from the Assets is processed
  - Alert Settings
    Manages how gauges appear on the dashboard when certain values are surpassed
  - Scheduling
    Scheduling of Tables as defined in the T1

- UniTAG

  A configuration file (in the form of xml) imposes how the UniTAG operates . This configuration file can be adapted in various manners (see also further):
  - Direct editing (only for highly skilled technicians)
  - It is edited using the UniTAG Web Server (only for skilled technicians)
  - It is pushed from AirCloud
  - It is pushed from the local AERO UI

  This configuration file controls the complete functionality of the UniTAG. It takes is too far to describe this in detail, but some examples:
  - How it connects to the Cloud
  - How the assets are configured
  - How the sensors connected to the UniTAG are configured
  - How and when Alerts need to be generated
  - etc

- AirCloud

  Editing is done using the AirCloud user interface
  it stores:
  - Users (from the AirCloud usage perspective)
  - Sensor Configuration
    Where Sensor configuration on the AERO PC is focused on the local AERO gauges, here we also manage how sensors are used on the UniTAG (see “Push to Device”)
  - Group Members
    Similar to Group Members on AERO
  - Alert Settings
    this differs from Alert Settings on AERO PC as it also allows to trigger Events

  The following aspects are not directly related to the AERO installation configuration itself, but are worth mentioning:
  - AirTAG Configuration
    When AirTAGs are part of an AERO installation, these also need configuration, this is also done from AirCloud
  - Report configuration
    When you would like to generate reports for an AERO installation, this is also done from AirCloud.

11.7 The concept “Push To Device”

During configuration work – either locally on the AERO, either in AirCloud – you set up elements

controlling how the system will operate. Part of this data is relevant for the AirCloud, part is relevant for the Linux Server in the AERO (AERO PC), part is relevant for the UniTAG in the AERO.
The user needs to use the “Push to Device” operation to explicitly load data on the UniTAG in the AERO, either from the Linux PC in the AERO or from the AirCloud environment. Remark that a Push to Device from the AirCloud infrastructure goes over the Cloud.

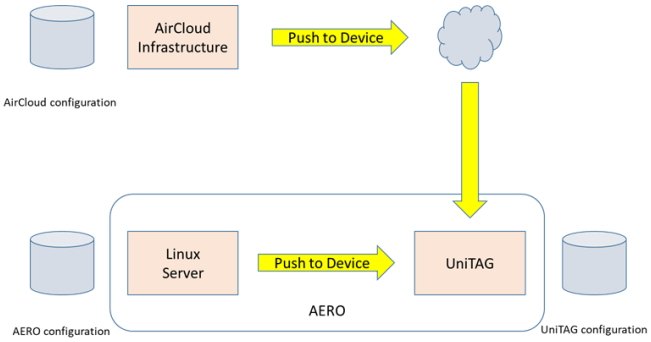


Figure 27 - Push to Device: load relevant configuration information on the UniTAG in the AERO

Remark that for editing of the Schedule, you also need a ‘Push to Device’. In this case, the T1 in the AERO is updated.

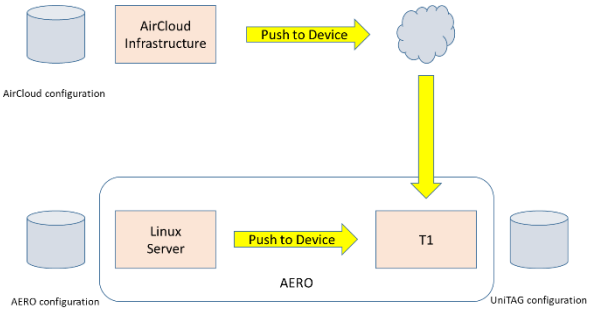


Figure 28 - Push to Device: load relevant configuration information on the T1 in tge AERO

It is essential to assure that there are no conflicts between the configuration as it is managed in AirCloud and the configuration as it is managed on the AERO.

12. LAN Connection

This chapter focuses on the connection of a PC (or Laptop … further referred to as “PC”) to AERO LAN and how to surf to the web server on the AERO.

12.1 Elements having impact

12.1.1 LAN connections on the AERO

The AERO is equipped with 3 dedicated LAN connections which in turn support 2 dedicated communication networks:
PRIVATE LAN (IN and OUT)
LOCAL LAN
PRIVATE LAN IN is intended to be used with AirMatics equipment (such as AirTAG and SmartTAG)
PRIVATE LAN OUT is intended to be used with the Gateway that provides cellular connectivity.
LOCAL LAN is intended to be used in connection to the user’s LAN infrastructure. On this LAN infrastructure, users can also have their PC connected.

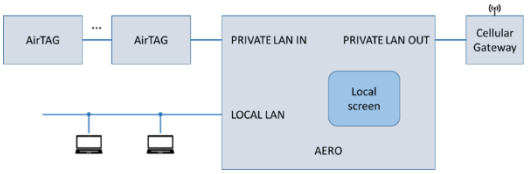


Figure 29 - – LAN connections on AERO – standard use

12.1.2 Gateway integration

The Gateway provides cellular connectivity. It is required to make use of all the AirCloud based functionalities. It is very important to mention that Gateway connectivity adds high value for remote servicing as well as firmware updates.
In case the user does not want data to be sent in the Cloud, the AERO (more specific: the UniTAG in the AERO) can be configured as such.

12.1.3 Availability of DHCP server

On the Local LAN a DHCP server is required in order for the AERO to receive an IP address. Set up of a fixed IP address on the Local LAN segment in the AERO is not supported.

12.1.4 Routers (and other network devices) on the user’s LAN infrastructure

The AERO makes use of mDNS (multicast DNS[1]). This mechanism provides a means to provide a unique URL without the necessity of specifically knowing the IP address of the AERO, which might be cumbersome as the IP address is provided via the DHCP server and as such can vary over time. The customer’s network infrastructure likely will limit the knowledge of the provided unique URL to a certain exposure. When there are for instance routers involved between LAN “segments” one will be capable of reaching the AERO with the provided URL on one LAN connection in a building and not on another LAN connection. Practically, using wireless LAN probably will not expose the URL.
If you know the IP address used by the Local LAN connection on the AERO, you are capable of reaching the AERO System dashboard using this IP addresse even when the mDNS URL is not exposed. However, you will not be capable to “click through” to the underlying AirTAG asset dashboards.

12.2 URL, IP addresses

Every AERO comes with a unique URL which is based on the following construction:
http://”*ArticleNumber*”-“*SerialNumber*”.local/

As an example, supposing:
Article number = Y18TICS77
Serial number = 1234
Then the URL to be used is:

http://Y18TICS77-1234.local/

The Operating System on your PC needs to support mDNS, a zero-configuration networking service (similar to Apple “Bonjour”).

At any moment in time, you can consult the IP addresses, article number and serial number in use by swiping with your finger from above the local AERO screen downwards into the screen.
This will bring up on top of the screen:

Figure 30 - AERO network information

[1] In computer networking, the multicast DNS protocol resolves hostnames to IP addresses within small networks that do not include a local name server. It is a zero-configuration service, using essentially the same programming interfaces, packet formats and operating semantics as unicast Domain Name Service.

Here you see the current IP addresses, the “ArticleNumber”-“SerialNumber”, the software version on the AERO PC.
Remark you can also go back to the dashboard. This is useful when click-through to underlying AirTAGs does not properly work – for instance during configuration of the AERO or if an underlying AirTAG cannot be reached.
The AERO Linux PC can also be restarted.

13. Configuration AERO – global approach

AERO's configuration is done in 3 distinct steps. Firstly, configuration of menus & parameters contained in AERO's T1. The T1 can be found on the interior back-plate. The T1 has a dedicated user interface.

Secondly, complete 'local' display configuration which is done using AERO's exterior 12.1" Touch display or using a PC connected to the Local LAN.

Finally, configure AERO's presence on AirCloud.

In case of an "isolated AERO solution", it is highly advised to still have a gateway for AirCloud connection for purposes of Support and Over The Air Software updates.

Before continuing:

- Physical Checks
  Before applying power to AERO, ensure that the power supply connections are correct and secure.
- Sensor connections
  Assure all sensor (Pressure, Flow, …) are properly connected
- RS485 connections
  Verify connections of RS485 connected devices
- AirTAG installation
  In case AirTAGs are installed, assure these are properly configured.
  They need to reside in the same Tenant as the UniTAG in the AERO
  You need to know their article number and serial number
- Gateway installation
  Assure you have good cellular connection and that UniTAG in AERO and AirTAGs can be viewed in AirCloud.

14. Step 1: Configure The AERO ‘T1’

Access to the AERO T1 requires opening the AERO Enclosure. Access the AERO enclosure at the operator interface using the supplied enclosure door KEYand the enclosures 2-point locking system.

Figure 31 - Access T1 by opening the enclosure

The location of the T1 is illustrated here (right top):

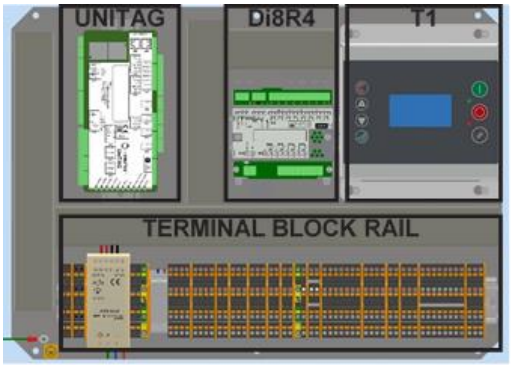


Figure 32 - location of T1

Setting up T1 is done using the keys and LCD screen on the T1.

Before successful basic operation can be established the following items must be set (in the order show) to suit installation requirements.

DESCRIPTION	MENU	ITEM
Sensor Offset Calibration	S04	1O
Sensor Range Calibration	S04	1R

Pressure Display

Check the displayed system pressure. If the pressure is incorrect, or inaccurate, check the range of the sensor and carry out the pressure sensor commissioning and calibration procedure.

DESCRIPTION	MENU	ITEM
Number of Assets	S02	NC
Max. Pressure Alarm	S02	PM
Stop Control Function	S02	CF
Real Time Clock Set	S01	Ct
Auto Restart Enable	S01	AR
Rotation Interval	S01	RP
Asset Configuration	C03	01 - 12
Asset Running Hours	C01	01 - 12
High Pressure Set Point	T01	PH
Low Pressure Set Point	T01	PL
Minimum Pressure Alarm	T01	Pm
Sequence Algorithm	T01	SQ
Compressor #1-12 Priority	T01	01 - 12

14.1 Optional Features and Functions

Individual installation requirements may involve the implementation of additional or optional functions and features; implement as required.

14.2 Menu navigation

Display Item Structure:

All operational system status and values are accessible from the normal User display. To view status or values, that are not normally visible on the default screen, press UP or DOWN. All standard User display items are view only and cannot be adjusted. The standard User display items are regarded as ‘Menu Page 00’ items.

All adjustable value, parameter or option item displays are grouped into ‘menu mode’ lists. Items are assigned to a list according to type and classification. Item lists are identified by page number (or menu number); All adjustable
parameters and options are assigned to menu mode pages ‘P01’ or higher.

Normal Operational Display (Menu Page P00):

At controller initialisation, all LED indicators are switched on for several seconds before initialisation is complete and the normal operating display (Page P00) is shown. In normal operational display mode, the main display will continuously show the detected system pressure and the Item display will show the first item of the ‘Page 00’ menu. User menu ‘Items’ can be selected using the Up or Down buttons at any time. Pressing the Enter button will lock any selected Item display and inhibit return to the defaultdisplay. When an Item display is locked the lock keysymbol will be shown. To unlock an Item display: press Up or Down to view an alternative Item displayor press Reset or Escape. No Item values, options or parameters can be adjusted in page ‘P00’. If a fault condition occurs the fault code becomes the first list item and the display will automatically jump to display the fault code. More than one active fault code item can exist at any one time and can be viewed by pressing UP or DOWN.

The most recent ‘active’ fault will be at the top of the list.

14.3 Access code

Access to adjustable menu page items is restricted by access code. To access menu mode pages press MENU (or UP and DOWN together); an access code entry display is shown and the first code character will flash.

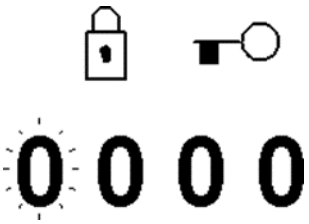


Figure 33 - Access code on T1

Use UP(plus) or DOWN(minus) to adjust the value of the first code character then press ENTER. The next code character will flash; use UP or DOWN to adjust then press ENTER. Repeat for all four code characters.

If the code number is less than 1000 then the first code character will be 0 (zero). To return to a previous code character press ESCAPE. When all four code characters have been set to an authorized code number press ENTER. An invalid code will return the display to normal operational mode; page ‘P00’.

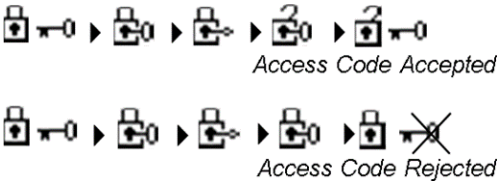


Figure 34 - Code accepted or not

Access Code Timeout:

When in menu mode, if no key activity is detected for a period of time the access code is cancelled and the display will automatically reset to the normal operational display.

14.4 Menu Navigation T1

Menu Mode Navigation:

In menu mode the menu ‘page’ number will be highlighted at the top of the display.

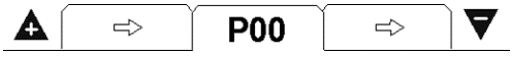


Figure 35 - Indication of Page on the T1 screen

To select a menu ‘page’ press UP or DOWN. To enter the highlighted menu ‘page’ press ENTER; the first item of the menu ‘page’ will be highlighted. Press UP or DOWN to scroll though the selected menu ‘page’ items.

To select an item value or parameter for modification press ENTER; an adjustment screen for the item will be displayed.

The value or option can now be modified by pressing UP(Plus) or DOWN(Minus). To enter a modified value or option in to memory press ENTER.

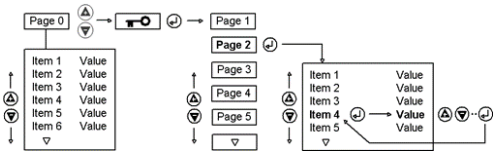


Figure 36 - Navigation in menus on T1

Press ESCAPE at any time in menu mode to step backwards one stage in the navigation process. Pressing ESCAPE when the page number is flashing will exit menu mode and return the display to normal operational mode.

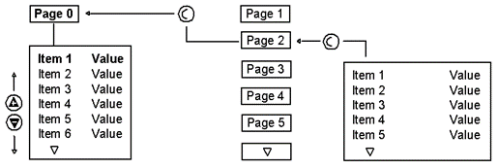


Figure 37 - Using ESC button

All menu items have a unique reference consisting of the menu page ID (a) and the menu page item number (b). Each item in a menu also has a unique two alphanumeric character code (c). All three references are visible at the top of every menu item display.

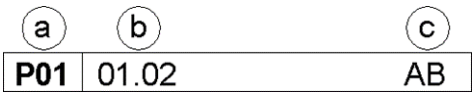


Figure 38 - T1 Menu Item reference

Some menu items may consist of several individual settings. Each setting of the menu item is also referenced as a sub-item number. For example: P01-01.02 references sub-item ‘02’ of menu item ‘01’ in menu page ‘P01’. Sub-item settings, where applicable, are always displayed together on the same ‘Item’ adjustment display screen. Most menu items are single value or single option only in which case the single item is referenced as sub-item number ‘01’ (for example: P01-01.01).

Reset button:

Press and hold RESET for several seconds at any time to immediately exit menu mode and return to the normal operational display. Any value or option adjustment that has not been confirmed and entered

into memory will be abandoned and the original setting maintained.

The T1 will retain an ‘access code’ for a short period after menu exit allowing the menu structure to be re-entered without the need to re-enter the access code again. To immediately clear access code retention press and hold RESET for several seconds.

The ‘locked symbol’

A ‘locked’ symbol displayed with any item indicates the item is locked and cannot be
modified. This will occur if the Item is view only (not adjustable) or in instances where the item cannot be adjusted while the AERO is in an operational state; stop the AERO first.

14.5 User Level Menus (default access code 0011)

MENU	ITEM	DESCRIPTION
T01 - 06	PH	High Pressure Set Point
T01 - 06	PL	Low Pressure Set Point
T01 - 06	Pm	Minimum Pressure Alarm
T01 - 06	SQ	Sequence Algorithm
T01 - 06	01 - 12	Asset #1 - #12 Priority
P02	PF	Pre fill Function
P02	PT	Pre fill Time
P02	PP	Pre fill Pressure
P02	01 - 12	Asset #1- #12
S01	Ct	Real Time Clock Set
S01	PS	Pressure Schedule Enable
S01	AR	Auto Restart Enable
S01	RP	Rotation Interval
S01	TS	Default Table Select
S01	BL	Display Backlit Adjust
C01	01 - 12	Asset #1 - #12 Running Hours
C02	01 - 12	Asset #1 - #12 Maintenance
E01	01 - 15	Fault Log #1 (9most recent) - #15

14.6 Service Level Menus (default access code 0021)

MENU	ITEM	DESCRIPTION
S02	P>	Pressure Units
S02	F>	Flow Units
S02	NC	Number Of Compressors
S02	PM	Maximum Pressure Alarm
S02	CF	Stop Control Function
S02	TO	Tolerance
S02	DA	Damping
S02	ST	Start Delay Time
S02	SF	Start Function
S02	PC	Pressure Change Time
S02	P2	Second Pressure Function
S02	DP	DP Setting
S02	DD	DP Delay Time
S02	CA	CAP Alarm Inhibit
S02	MA	Max Cap Restricted Alarm Inhibit
S02	ER	Error Log Reset
S04	1O	Pressure Offset
S04	1R	Pressure Range
S04	2O	Pressure 2 Offset
S04	2R	Pressure 2 Range
S05	AF	Aux. Pressure Function Select
S05	P1	Aux. Pressure #1 Source
S05	P2	Aux. Pressure #2 Source
S05	D1	Aux. Pressure #1 Deviation Limit
S05	D2	Aux. Pressure #2 Deviation Limit
S05	D+	Max + Aux. Pressure Deviation
S05	D-	Min - Aux. Pressure Deviation
S05	1O	Aux. Pressure #1 Offset
S05	1R	Aux. Pressure #1 Range
S05	2O	Aux. Pressure #2 Offset
S05	2R	Aux. Pressure #2 Range
C03	01 - 12	Asset #1 - #12, Configuration
C04	01 - 12	Asset #1 - #12, Zone Select

14.7 High Level Menus (default access code 0032)

MENU	ITEM	DESCRIPTION
R01	01 - 10	Relay #1 - #10 Function
R01	11 - 18	Virtual Relay #11 - #18 Function
R02	T1	Timer Relay #1
R02	T2	Timer Relay #2
R02	P1	Pulse Relay #1
R02	P2	Pulse Relay #2
R02	P3	Pulse Relay #3
R02	P4	Pulse Relay #4
R02	AF	Asset Available Relay
R02	RF	Asset Run Delay
R02	LF	Asset Load Delay
D01	D1 - D8	‘T1’ Digital Input #1 - #8
D01	R1 - R6	‘T1’ Output Relay #1 - #6
D01	A1	‘T1’ Analogue input #1
D01	A2	‘T1’ Analogue input #2
D01	A3	‘T1’ Analogue input #3
D01	AO	‘T1’ Analogue Output
D02	SI	Screen Invert
D02	LT	LED Panel Test
D03	D1 - D8	‘XPMDi8R4’ Digital input #1 - #8
D03	R1 - R4	‘XPMDi8R4’ Output Relay #1 - #4

14.8 Tables

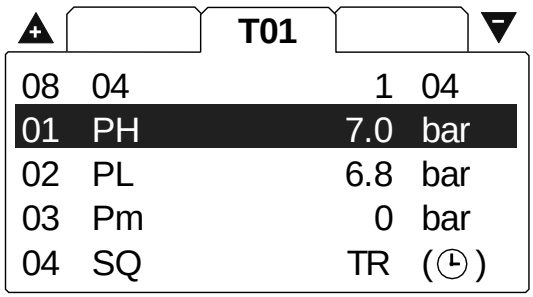


Figure 39 - Tables Menu

MENU	ITEM	DESCRIPTION
T0#	PH	High Pressure Set Point

The 'upper' or 'unload' pressure set point that will be used when the 'Table' is active.

T0#	PL	Low Pressure Set Point

The 'lower' or 'load' pressure set point that will be used when the 'Table' is active.

T0#	Pm	Minimum Pressure Alarm

The sequence control strategy mode that will be used when the table is active.

T0#	SQ	Sequence Algorithm
T0#	01 - 12	Asset #1 - #12 Priority
		The 'priority' setting for Asset number # that will be used when the table is active.
T0#	'n'	The 'priority' setting for compressor number 'n' that will be used when the table is active.

'n' = Number of Assets in the system

'#' = Table T01 - T06

14.9 Pre-Fill

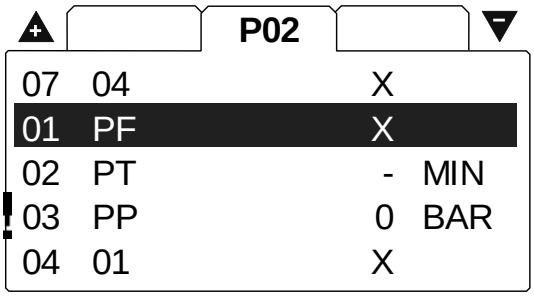


Figure 40 - Pre-Fill Menu

MENU	ITEM	DESCRIPTION
P02	PF	Pre-fill Function

Determines the 'Pre fill' strategy or function that will be used at system start-up.

X — Pre-fill function OFF

√ — Pre-fill, Back-up Mode

√ [!→X] — Pre-fill, Standard Mode

√ [A^^^] = Prefill, Automatic Mode

MENU	ITEM	DESCRIPTION
P02	PT	Pre-fill Time

Sets the maximum time allowed for a system 'Pre-fill' at start-up.

MENU	ITEM	DESCRIPTION
P02	PP	Pre-fill Pressure

If pressure is at, or above, this setting at system start-up the pre-fill function will be abandoned immediately and normal pressure control and sequence strategy will be implemented. This setting is intended to inhibit 'Pre-fill' operation if pressure is already at an acceptable level at system start-up.

MENU	ITEM	DESCRIPTION
P02	01 - 'n'	The function of Asset #1 to 'n' during the 'Pre-fill' period.

'n' = number of Assets in the system

X — Do not use

√ — Use for Primary pre-fill

! — Use for Emergency

These settings are applicable to Pre-fill 'Standard' and Pre-fill 'Back-up' modes only. In Automatic mode the system management unit dynamically utilises compressors as required.

Press and hold 'Start' for 5 seconds to manually skip Pre-fill mode at start-up.

14.10 Real Time Clock Set

It is NOT NECESSARY to configure the real time clock 'if' AERO has or will have internet access. Once Internet access is established, AERO will automatically configure the real time clock.

The following procedure can be used to configure the real time clock ‘if’ AERO does NOT have Internet access...

Figure 41 – RTC (ao) setting

MENU	ITEM	DESCRIPTION
S01	Ct	Real Time Clock Set

Adjustment for the internal real time clock (Hours, Minutes, Date, Month, Year) is done in ‘Ct’. The ‘Day of the Week’ (1= Monday to 7=Sunday) is automatically calculated and set in accordance with the Day, Month and Year.

14.10.1 Pressure Scheduling

Configuration of the Pressure Schedule itself is done in Step 2 and from the AERO Touch Display.

‘Enabling’ and ‘disabling’ the schedule function is done at the T1’s user interface.

MENU	ITEM	DESCRIPTION
S01	PS	INHIBIT
S01	PS	ENABLE

X = inhibit Pressure Schedule

√ = enable Pressure Schedule

See Figure 41 – RTC (ao) setting, Parameter ‘PS’

14.10.2 Enabling Auto Restart

MENU	ITEM	DESCRIPTION
S01	AR	INHIBIT
S01	AR	ENABLE

X = inhibit Power Failure Auto Restart

√ = enable Power Failure Auto Restart

The AERO will only auto re-start when power is restored if the AERO was in an operational ‘Started’ state when the power loss or disruption occurred.

See Figure 41 – RTC (ao) setting, Parameter ‘AR’

14.10.3 Rotation Interval

MENU	ITEM	DESCRIPTION
S01	RP	Sets the sequence ‘Rotation’ interval or time

14.11 Default Table Select

MENU	ITEM	DESCRIPTION
S01	TS	Determines the ‘Table’ that will be used by default when ‘Pressure Schedule’ is not active and no Table is selected remotely on a digital input.

14.12 Display Backlight Adjust

MENU	ITEM	DESCRIPTION
S01	BL	Adjustable: 1 to 7, default 5 The display will temporarily increase brightness by 2 levels when a key is pressed and return to normal setting after a period of no keypad activity. The default display back-light level has been set to enable a ‘continuous use service life’ in excess of 90000 hours while providing good readability in all ambient light conditions. LCD display ‘service life’ is defined as the time period before the back-light reduces to 50% of initial brightness. Typically the display will remain usable for a much longer period for time. Adjusting the back-light to high levels will reduce service life.

14.13 Equal Hours Run Mode

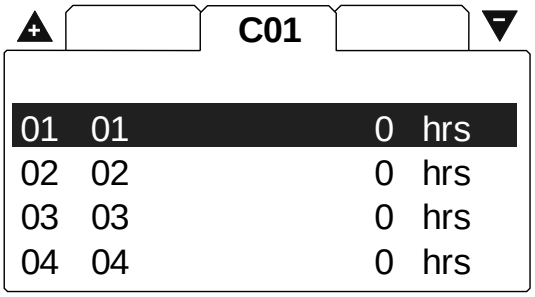


Figure 42 - Equal Hours Run mode

MENU	ITEM	DESCRIPTION
C01	01 - ‘n’	Record of detected ‘running’ hours for each Asset. The run hours value can be manually adjusted, at any time, to match the running hours meter/display value of each Asset.

14.14 Set Asset Availability

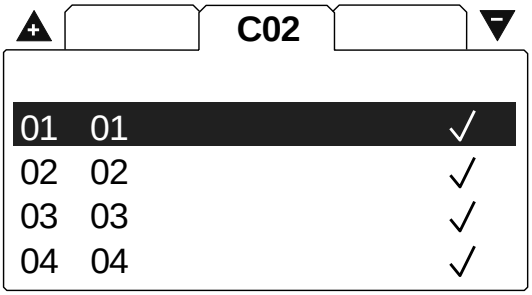


Figure 43 - Compressor Availability

MENU	ITEM	DESCRIPTION
C02	01 - ‘n’	Sets Asset availability.

For an Asset(s) that is unavailable for use for a pre-longed period for time due to maintenance or repair. The Asset will not be utilised under any circumstances; any Asset Alarm (Warning) or Trip (shut-down) condition will be ignored.

‘n’ = number of compressors in the system.

14.15 Error Log

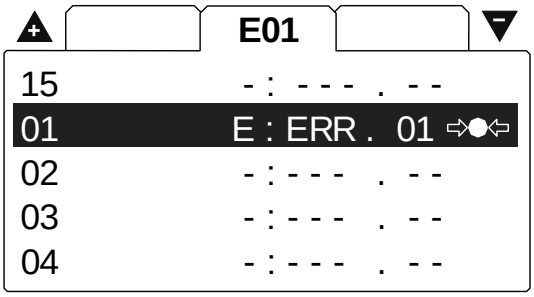


Figure 44 - Error Log page

MENU	ITEM	DESCRIPTION
E01	01 - 15	Error Log; presented in chronological order; entry 01 = most recent.

Each error log item will show the error code. To view details for the selected error log item press Enter.

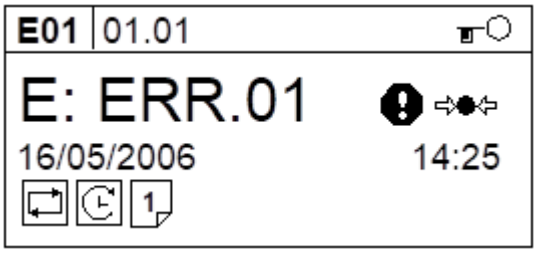


Figure 45 - Error log details

The first information display shows the:

- The Error Code
- Error Code symbols (if applicable)
- The date the error occurred
- The time the error occurred
- The active operational functions of the AERO
- at the time the error occurred; (see: AERO ‘T1’ Status Display)

To return to the main error log menu screen press Escape.

To view the second information screen press Enter.

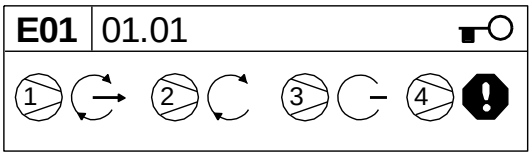


Figure 46 - Second information screen

The operational status of each Asset, at the time the error occurred, is displayed symbolically (see: Asset Status Displays).

To return to the first information screen press Enter or Escape.

14.16 Pressure Control – Tables

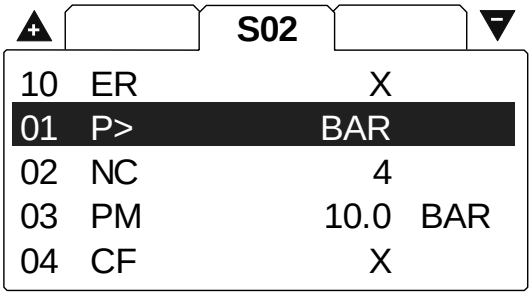


Figure 47 - Pressure Control ; Tables

MENU	ITEM	DESCRIPTION
S02	P>	Pressure Units

Selects the display pressure units:

Bar, psi or kPa.

MENU	ITEM	DESCRIPTION
S02	F>	Air Flow Meter Units

Selects the display units for the optional 4-20mA air flow sensor monitoring feature:

m^3/min: cubic meters per minute
cfm: cubic feet per minute

MENU	ITEM	DESCRIPTION
S02	NC	Number of Compressors

Sets the number of compressors connected to, and controlled by, the AERO. This value must be set to match the system at commissioning.

MENU	ITEM	DESCRIPTION
S02	PM	Maximum Pressure Alarm

High pressure 'Fault' level. This value remains active at all times and is the same for all 'Tables'. Set just below system pressure relief value(s) and below the maximum system pressure rating of all air system components.

MENU	ITEM	DESCRIPTION
S02	CF	Stop Control Function

Determines if the AERO maintains control of the compressors when the AERO is stopped.

╳ = Stop: return pressure control to the compressors.
√ = Standby: maintain control and continouosly hold compressors 'off load'.

MENU	ITEM	DESCRIPTION
S02	TO	Tolerance

The pressure control 'Tolerance' band setting

MENU	ITEM	DESCRIPTION
S02	DA	Damping

The pressure control 'Damping' setting.

MENU	ITEM	DESCRIPTION
S02	ST	Start Time

Sets the period of time, at system start, that the management unit will wait for ancillery equipment to start/respond before loading any compressor.

MENU	ITEM	DESCRIPTION
S02	SF	Start Function

Determines the function of the Start Time feature and the reaction of the management unit to a failure of ancillery equipment to respond within the Start Time.

╳ No Start Time Function

Management unit will wait for the full Start Time regardless of feedback. If feedback does not occur before Start Time expires the management unit will Trip (shutdown). If the feedback disappears at any time during operation the management unit will Trip (shutdown).

√ Management unit will wait for the full Start Time. The management unit will begine to utilise compressor(s) as soon as feedback is received. If feedback does not occur before Start Time expires the management unit will Trip (shutdown). If the feedback disappears at any time during operation the management unit will Trip (shutdown).

Management unit will wait for the full Start Time regardless of feedback.

If feedback does not occur before Start Time expires the management unit will show an Alarm (Warning) and begine to utilise compressor(s) as required. If the feedback disappears at any time during operation the management unit will show an Alarm (Warning).

√ Management unit will wait for the full Start Time. The management unit will begine to utilise compressor(s) as soon as feedback is received. If feedback does not occur before Start Time expires the management unit will show an Alarm (Warning) and begine to utilise compressor(s) as required. If the feedback disappears at any time during operation the management unit will show an Alarm (Warning).

MENU	ITEM	DESCRIPTION
S02	PC	Pressure Change Time

The time that the AERO will implement a smooth and controlled change from one 'target' pressure level to another when a table change is made.

MENU	ITEM	DESCRIPTION
S02	P2	Second P.Sensor Function

P2=X:
Second pressure sensor function inhibit; no sensor connected.

P1<>P2 :
The system management unit will automatically utilise the second pressure sensor (P2) in the event of a primary pressure sensor (P1) failure.

The primary and secondary pressure sensors must be installed to monitor the same pressure at the same location.

P2=>DP:
The management unit will monitor and display the differential pressure (DP) between the primary (P1) and secondary (P2) pressure sensors.

The differential is displayed as a positive value regardless of positive or negative relationship between the sensors.

The system management unit will use the primary pressure sensor (P1) for control.

MENU	ITEM	DESCRIPTION
S02	DP	DP Alarm Level

Differential pressure Alarm level when P2 set for 'P"=>DP' mode.

Set to 0(zero) to inhibit DP Alarm function.

MENU	ITEM	DESCRIPTION
S02	DD	DP Alarm Delay

Differential pressure Alarm delay time (seconds) when P2 set for 'P"=>DP' mode.
The set differential pressure must exceed, and remain above, the differential pressure Alarm level for the delay time.

MENU	ITEM	DESCRIPTION
S02	CA	Capacity Alarm Enable

╳ = inhibit Capacity Alarm
√ = enable Capacity Alarm

When inhibited the Capacity Alarm panel indication will still function; alarm code generation and remote alarm indications are inhibited.

MENU	ITEM	DESCRIPTION
S02	MA	Restricted Cap. Alarm Enable

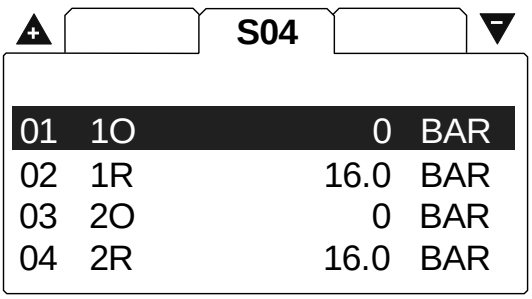
╳ = inhibit Restricted Capacity Alarm
√ = enable Restricted Capacity Alarm

When inhibited the Restricted Capacity Alarm panel indication will still function; alarm code generation and remote alarm indications are inhibited.

MENU	ITEM	DESCRIPTION
S02	ER	Error Log Reset

Clears and resets the 'Error Log'. Adjust the item setting to '√' and press ENTER. The display will return to the main menu and all existing entries in the error log will be perminantly deleted.

14.17 Sensor Calibration



MENU	ITEM	DESCRIPTION
S04	1O	Pressure Sensor Offset
S04	1R	Pressure Sensor Range
S04	2O	Pressure Sensor #2 Offset
S04	2R	Pressure Sensor #2 Range

1) Commissioning

Initially set the 'Offset' (minimum) to the minimum or lowest pressure value for the sensor. Set the 'Range' (maximum) to the maximum or highest value for the sensor.

For example:
If the pressure sensor is a 0 to 16bar (0 to 232psi) type set the 'offset' to 0bar (0psi) and the 'Range' to 16.0bar (232psi).

If the sensor is a –1.0 (minus one bar.g) to 15.0bar type, set the 'offset' to –1.0bar (minus one bar) and the range to 15.0bar.
Note: The 'range' value equates to the maximum value not the scope of the sensor.

Execute the calibration procedure.

2) Calibration Procedure

a) Offset: Expose the sensor to atmosphere and adjust the 'offset' setting (if necessary) until the detected pressure display shows 0.0bar (0psi).

b) Range: Apply an accurately know pressure to the pressure sensor and adjust the 'Range' setting until the detected pressure display matches the applied pressure. An applied pressure equal too, or greater than, the nominal system working pressure is recommended.

The detected pressure is displayed with the calibration menu item and will change to match the new calibration setting as the setting is adjusted.

There is no need for the applied pressure to be static; it can be dynamic and changing. This enables calibration to be carried out on a fully operational system where changing system pressure can be accurately verified from another source.

Correct pressure sensor set-up and calibration is critical for successful system operation. It is recommended that pressure sensor calibration is examined, and adjusted if necessary, annually or a pre-determined routine periodic basis.

14.18 Pressure Balance

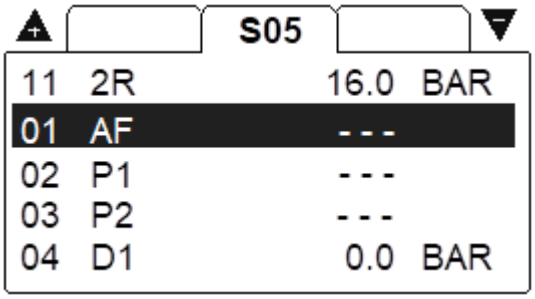
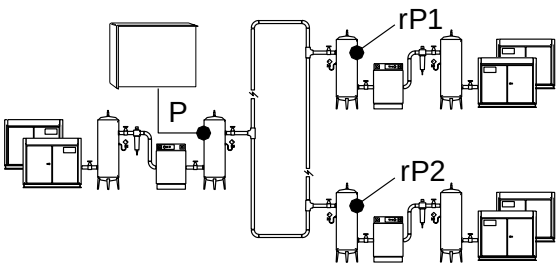


Figure 48 - Pressure Balance page

The pressure balance feature enables upto two additional remote pressures to be integrated with the primary detected pressure, using one of three available functions, to produce a calculated 'balanced' pressure that is used for pressure control.



Remote pressure references are transmitted on the RS485 network at maximum intervals of ten seconds. If RS485 communications is disrupted the management unit will automatically default to using the primary pressure for control.

MENU	ITEM	DESCRIPTION
S05	AF	Aux Pressure Function Select

The highest pressure
The average of all pressures
The lowest pressure

MENU	ITEM	DESCRIPTION
S05	P1	Aux Pressure #1 Source

Determines the source of the first remote pressure:

C01 to C12: Compressor 1 to 12
'-' no first remote pressure

MENU	ITEM	DESCRIPTION
S05	P2	Aux Pressure #2 Source

C01 to C12: Compressor 1 to 12
'-' no first remote pressure

MENU	ITEM	DESCRIPTION
S05	D1	Aux Pressure #1 Deviation Limit

Sets a '+/-' pressure tolerance limit that the first remote pressure can deviate from the detected local primary pressure. If the first remote pressure exceeds this limit it is ignored and not included in the final control pressure calcuation.

For example:
If D1 is set for 1.0bar, and the first remote pressure is 1.1bar above or below the primary pressure, the first remote pressure is ignored and not used in 'balanced' control pressure calculations.

MENU	ITEM	DESCRIPTION
S05	D2	Aux Pressure #2 Deviation Limit

Sets a '+/'- pressure tolerance limit that the second remote pressure can deviate from the detected local primary pressure. If the first remote pressure exceeds this limit it is ignored and not included in the final control pressure calcuation.

For example:
If D2 is set for 1.0bar, and the second remote pressure is 1.1bar above or below the primary pressure, the second remote pressure is ignored and not used in 'balanced' control pressure calculations.

MENU	ITEM	DESCRIPTION
S05	D+	Max +(plus) Aux Pressure Deviation

Sets a limit that the calculated 'balanced' pressure can deviate above the primary detected pressure. The calculated 'balanced' pressure is restricted from exceeding this limit.

For example:
If 'D+' is set for 0.5bar, the resulting calculated 'balanced' pressure (in accordance with the set function) is prevented from exceeding more than 0.5bar above the detected primary pressure.

MENU	ITEM	DESCRIPTION
S05		Max –(minus) Aux Pressure Deviation

Sets a limit that the calculated 'balanced' pressure can deviate below the primary detected pressure. The calculated 'balanced' pressure is restricted from exceeding this limit.

For example:
If 'D-' is set for 0.5bar, the resulting calculated 'balanced' pressure (in accordance with the set function) is prevented from exceeding more than 0.5bar below the detected primary pressure.

MENU	ITEM	DESCRIPTION
S05	1O	Aux Pressure #1 Offset

Offset calibration setting for the first remote pressure. Set to match the 'offset' calibration of the selected remote pressure source.

MENU	ITEM	DESCRIPTION
S05	1R	Aux Pressure #1 Range

Range calibration setting for the first remote pressure. Set to match the 'range' calibration of the selected remote pressure source.

MENU	ITEM	DESCRIPTION
S05	2O	Aux Pressure #2 Offset

Offset calibration setting for the second remote pressure. Set to match the 'offset' calibration of the selected remote pressure source.

MENU	ITEM	DESCRIPTION
S05	2R	Aux Pressure #2 Range

Range calibration setting for the second remote pressure. Set to match the 'range' calibration of the selected remote pressure source.

14.19 Asset Configuration

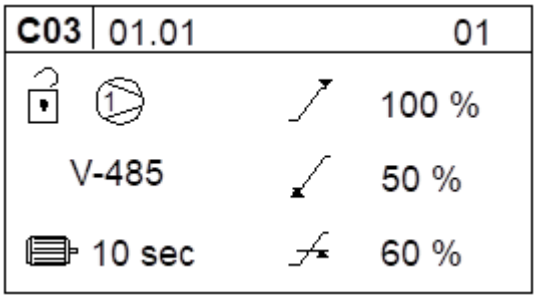


Figure 49 - T1 Display View for Asset Configuration

Compressor Connectivity:

I-485 Fixed speed, load/unload; connected to 'T1' in AERO on Multi485 network.
(0/100%) 0% or 100% regulation

V-485 Variable Capacity/Speed; connected to 'T1' in AERO on Multi485 network.
(0 . . 100%) variable %Load regulation

I-PCB Fixed speed, load/unload; connected to 'iX' Expansion Module (option)
(0/100%) 0% or 100% regulation

Compressor Start Time:

Set to match the time that the compressor takes to start it's main motor and load. This time will typically be equivalent to the compressors 'Star/Delta' time. If unknown, the time can be established by experiment; manually start the compressor, from a stopped condition, and determine the time from pressing the start button until the compressor loads and contributes capacity output to the system.

This time is used by the AERO for 'staggered starting' of multiple compressors and other operational calculations. An accurate time is important for successful AERO operation.

% Maximum Output Capacity

The maximum output capacity of each compressor must be set as a percentage with reference to the highest output capacity (the largest) compressor in the system. The heist output capacity compressor must be assigned with 100% capacity. Equal capacity (equal sized) compressors should be assigned the same % capacity value.

For example:

Compressor 1	5 m³/min	25%
Compressor 2	10 m³/min	50%
Compressor 3	12 m³/min	60%
Compressor 4	12 m³/min	60 %
Compressor 5	20 m³/min	100%
Compressor 6	20 m³/min	100%

% Minimum Output Capacity

Only applicable for a variable output compressor (V-485).

The minimum output capacity of a variable output compressor must be set as a percentage of the compressor's maximum output scaled in accordance with the % maximum capacity output value. Minimum output capacity is regarded as the output capacity at the lowest possible speed (variable speed compressor) or the minimal output achievable (stepping or other variable regulation control compressor).

For example 1:
For a variable speed compressor that has been assigned a maximum capacity output percentage of 100%, and is able to reduce speed to 50% of maximum speed:
Minimum Output Capacity = 50%

For example 2:
For a variable speed compressor that has been assigned a maximum capacity output percentage of 50%, and is able to reduce speed to 50% of maximum speed:
Minimum Output Capacity = 25%

For example 3:
For a 3-step (0/50/100) reciprocating compressor that has been assigned a maximum capacity output percentage of 60%, the minimum output capacity is the half-output regulation step:
Minimum Output Capacity = 30%

% Minimum Efficiency

Only applicable for a variable output compressor (V-485).

The minimum efficiency point is regarded as the speed, or step, below which another smaller capacity compressor in the system could achieve the equivalent output at a higher efficiency.

The percentage value is directly related, and scaled, to the maximum and minimum output percentage values.

For example:
For a variable speed compressor that is able to reduce speed to 50% of full speed, which has been assigned a maximum output capacity of 50% and a minimum output capacity of 25%.
If another compressor in the system is able to provide 60% of the compressor's full speed output more efficiently, set the % Minimum Efficiency value to 30%. This percentage value represents 60% of the full speed output of the compressor.

When the compressor is detected as operating below the % Minimum Efficiency value the system management unit will re-evaluate utilisation and re-configure, if possible, to utilise a smaller capacity compressor, or combination of compressors. This process is automatic and executed dynamically in accordance with prevailing operational conditions at the time.

The intent of this feature is to prevent a variable output capacity compressor operating at minimal speed, or minimal output, for prolonged periods of time.
Generally, a variable output compressor operating at minimal capacity is less efficient than a smaller capacity compressor that is able to achieve the same output at higher, or maximum, output capacity.

14.20 Zone Control

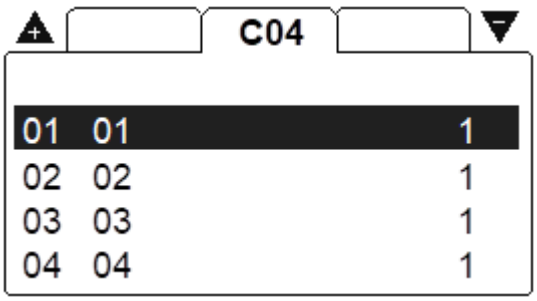


Figure 50 - Zone Control on T1

C04 - 01 Zone; Compressor 1
to
C04 – *'n'* Zone; Compressor *'n'*

'n' = number of compressors in the system.

Each compressor in a system can be assigned to one of three zones.

To inhibit zone control, set all compressors to zone '1'.

14.21 'T1' Diagnostics

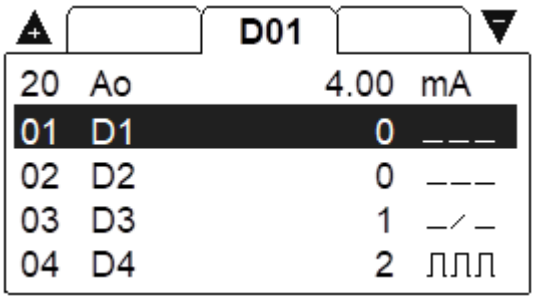


Figure 51 - Diagnostics on T1

The unit is equipped with comprehensive diagnostic functions. Each input can be examined individually and each output can be manually activated or manipulated individually.

'T1' Controller Diagnostics:

D1	Digital Input 1		
D2	Digital Input 2	___	ON
D3	Digital Input 3		
D4	Digital Input 4	_/_	OFF
D5	Digital Input 5		
D6	Digital Input 6	⎍⎍⎍	Pulsing
D7	Digital Input 7		
D8	Digital Input 8		
R1	Relay Output 1		
R2	Relay Output 2	0	OFF
R3	Relay Output 3		
R4	Relay Output 4		
R5	Relay Output 5	1	ON
R6	Relay Output 6		
A1	Analogue Input 1	**bar <> mA**	
A2	Analogue Input 2	**flow <> mA**	
A3	Analogue Input 3	**bar <> mA**	
Ao	Analogue Output	**0.0 to 20.0mA**	

Digital Inputs:

_/_ OFF (open circuit)

___ ON (closed circuit)

⎍⎍⎍ Pulsing

The pulse signal from an 'i-PCB' is 0V to 24VDC at 50/60Hz. A typical DC voltage meter, or multimeter, will detect this as 12VDC +-4V.

Relay Outputs:
Each relay output can be energised and de-energised manually by selecting the item. Use Up(plus) and Down(minus) to adjust and Enter.

Analogue Inputs:
The item will alternate between the detected value and the electrical measurement on the controller input terminals. An independent measuring device can be used to check the displayed electrical measurement.

A1: System Pressure, 4-20mA
A2: Air Flow Sensor, 4-20mA
A3: 2nd Pressure, 4-20mA

Analogue Output:
The analogue output can be manually adjusted. Use Up(plus) and Down(Minus) to adjust and Enter. The output will return to normal operational value upon menu exit.

14.21.1 'T1' Screen and LED Panel Diagnostics

MENU	ITEM	DESCRIPTION
D02	SI	Screen Invert
DO2	LT	LED Panel Test

0 = on test
1 = all on
2 = control test

14.21.2 'DI8RI4' Diagnostics

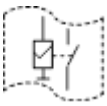
MENU	ITEM	DESCRIPTION
DO3	D1-D8	'XPMDi8R4' Digital input #1 - #8
D03	R1-R4	'XPMDi8R4' Output Relay #1 - #4

Follow 'T1' Diagnostics

14.21.3 Software Version

To display T1 software version: press and hold Reset Key the press Escape

14.22 Virtual Relay Automation



Virtual Relay automation is a configurable system wide automation feature. The feature allows output relay functions to be configured to respond to any 'virtual relay' condition, status or signal function available in the AERO or from another compatible unit on the network.

A separate 'Virtual Relay Automation' publication fully describes it's use as well as offering a number application examples / scenarios.

The Virtual Relay Automation feature requires a high level understanding of both 'application' and 'electrical automation'.

Contact SUPPORT for more information.

SUPPORT does NOT extend into designing virtual relay automation schemes or routines!

AERO owners / operators seeking assistance with designing virtual relay automation schemes or routines should contact SALES.

14.23 Following the Configuration

IN THE EVENT OF POWER FAILURE, SOME SETTINGS CAN BE LOST!

TO PREVENT THIS, FOLLOWING CONFIGURATION OF THE AERO T1, IT IS IMPORTANT TO 'POWER CYCLE' THE AERO.

BY POWER CYCLING THE AERO YOU ARE COMMITTING CONFIGURATION DATA FROM VOLATILE MEMORY INTO NON-VOLATILE MEMORY.

15. Step 2: Local AERO Configuration

Complete Step 1 ‘Configuring the AERO T1’ before proceeding to Step 2 or 3!

Whereas Step 1 focused on harnessing control of Assets, gathering additional data from around the system (e.g. Pressure data) and the deployment of the Asset & Pressure Control Strategy, Step 2 focuses on the local User Interface display settings.

Local display settings manage how information is displayed at both the local TOUCH display and via LAN access.

After describing local TOUCH display settings, this section continues to clarify how operators can use the LAN access feature as well as any differences.

The user interface is functionally the same on the local AERO screen as on a PC that is connected to the Local LAN and browses to the Dashboard of the AERO.

Remark: Screens shots taken in this document are made using a LAN connected PC.

⚠ As software is evolving continuously, screen shots in this documentation might slightly vary from what you see on your AERO screen.

15.1 Power up

With power applied the AERO Touch display will initialise it’s internal systems. During this time a series of boot sequences can be observed. Once complete AERO’s dashboard will display...

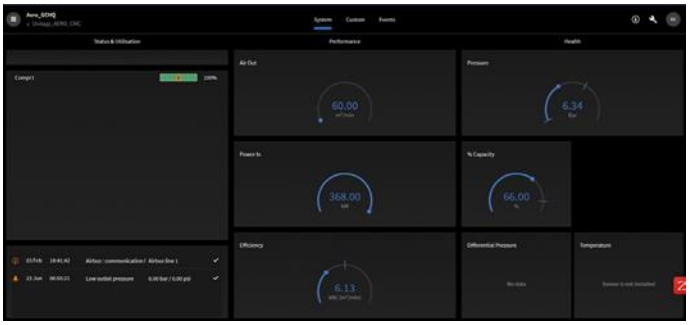


Figure 52 - Dashboard on AERO

Observe that variation in dashboard can exist relative to configuration settings

Information displayed is provided by the AERO ‘server PC’ which is concealed within the interior of the AERO door assembly.

The server PC...

- Sends and receives data with the ‘AERO T1’ and ‘UNI-TAG’ (both are housed within AERO itself!)
- Provides local TOUCH display access to configure some ‘AERO T1’ parameters (such as the ‘pressure schedule’ feature). Accessible ‘AERO T1’ parameters are limited to those used for ‘daily operation’
- Returns a web-page to USERS with LAN access to the AERO

It’s useful to understand that AERO Users are logging onto the ‘server PC’!

When any text or numeric data is to be entered or edited, an on-screen keyboard will appear...

Figure 53 - Local on screen keyboard

15.2 Logging in

A default ‘VIEW’ account exists to provide VIEW only access to AERO. Two further User types can exist; ‘USER’ and ‘ADMIN’.

AERO is pre-configured with a default VIEW and a single ADMIN account.

Using the user Avatar located top right of the display, enter your Login ID & Password details. Once logged in, you can use the user Avatar to view and edit the account profile and to log back out...

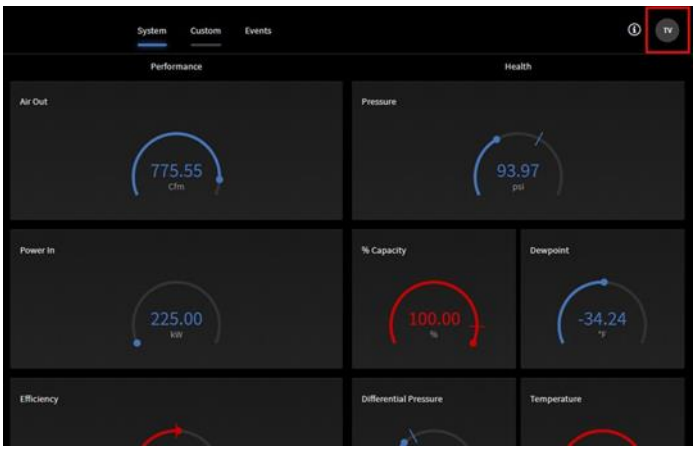


Figure 54 - Right Top: User button

Observe that...

- You need to be logged in as an ADMIN to complete Step 2, 'configuration of the Aero touch display'
- ADMIN Login & Passwords are initiated to "root" and "cmc_123".
- When first supplied, AERO is configured with a
- single ADMIN Login & Password
- After 30 minutes of inactivity the AERO will revert to default VIEW
- Users with ADMIN rights can create additional user accounts

15.3 Reaching the Configuration pages

Browse to the dashboard on the AERO:

Click the Menu button top right

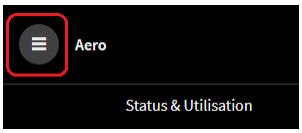


Figure 55 - AERO screen - the Menu button

Select "Devices":

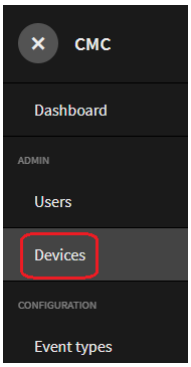


Figure 56 – Devices selection in the Menu bar

Click the Edit button (highlighted):

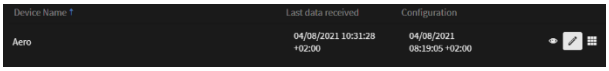


Figure 57 - Edit button for the AERO

Brings up the Edit Page:

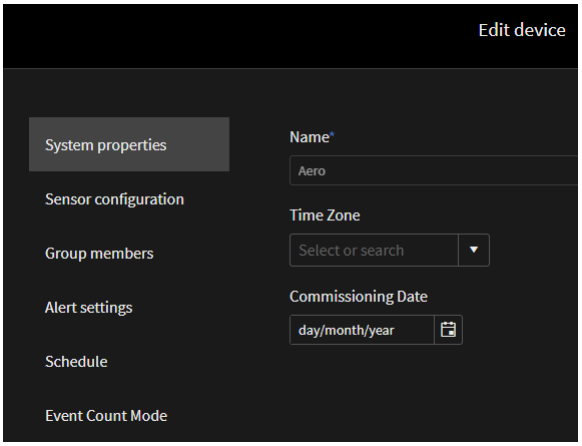


Figure 58 - Edit Page

Here you can select

- System properties
- Sensor Configuration
- Group members
- Alert settings
- Schedule
- Event Count Mode

These will be explained one by one in the next chapters.

15.4 System properties

See Figure 56 – Devices selection in the Menu bar

- Name: is fixed to "Aero" (cannot be adapted)
- Time Zone: fill in according to your time zone
- Commissioning Date: informative, fill in the date the system is commissioned

15.5 Sensor configuration

Local System management on AERO (nor in AirCloud) does not provide a manner to set up the hardware connectivity of sensors. For instance: setting up the range of a pressure sensor (0 … 16 bar or 0 … 32 bar). This is written directly in the configuration file which is done at the factory during the production of the AERO. If required, this can be adapted by CMC NV technical support and installation people.

In Local System management in AERO / Sensor configuration, you manage the appearance of the related gauges on the desktop.

The Sensor Configuration page:

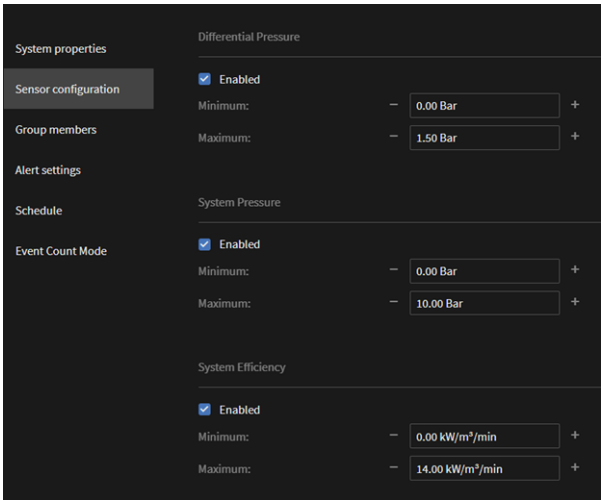


Figure 59 - Sensor configuration - local AERO interface - part 1

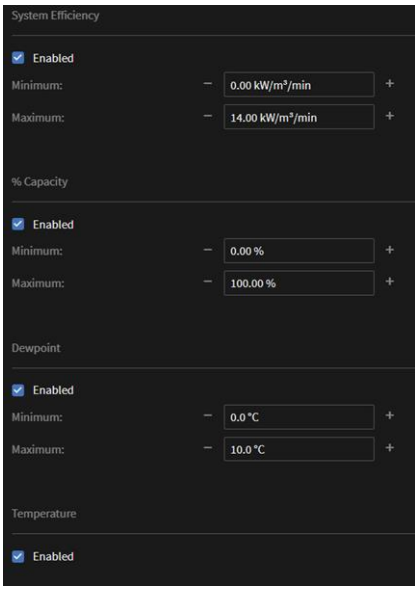


Figure 60 - Sensor configuration - local AERO interface - part 2

The “Enable” click button allows to make use or not of the related measurement
For instance, if we unselect the Enable button for the Dewpoint, we get on the dashboard:

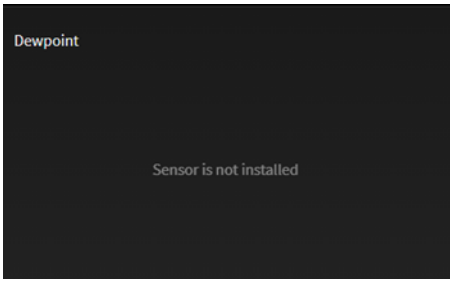


Figure 61 - Result of unselecting the Enable button related to a measurement

If Alert Setting levels (see further) might be set outside of the range defined in “Sensor configuration”, this will overrule the settings in Sensor configuration. For instance: suppose you set for Differential Pressure a Minimum on 0 Bar and a Maximum on 1.5 Bar in Sensor configuration, but you would set in Alert settings the alert level Maximum to 2 Bar, the gauge will be adapted accordingly, to also cover 2 Bar. However this should be considered “bad practice”.

15.5.1 Differential Pressure

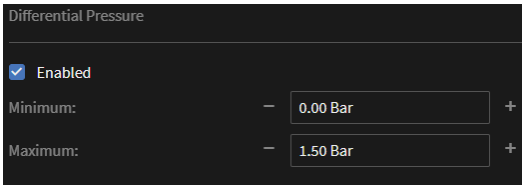


Figure 62 - Differential Pressure sensor configuration on local AERO interface

This allows to set the range of the gauge of the sensor:

Figure 63 - Gauge and related setting of the range as appearing on local AERO dashboard

Remark that automatically about 10% extra is range is provided at max.

Figure 64 - 10% reserve on top of Maximum

15.5.2 System Pressure

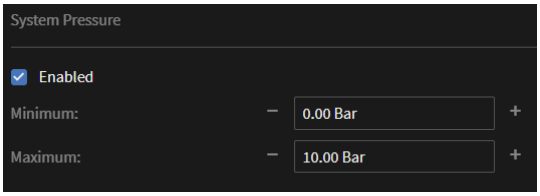


Figure 65 - System pressure sensor configuration on local AERO dashboard

Same rules apply as for the Differential Pressure sensor configuration.

15.5.3 Efficiency

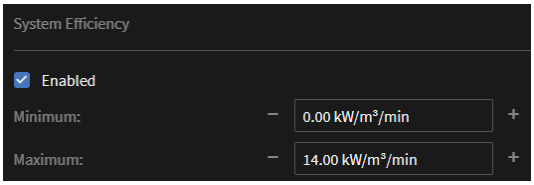


Figure 66 - Efficiency sensor configuration local AERO screen

Same rules apply as for the Differential Pressure sensor configuration.

15.5.4 % Capacity

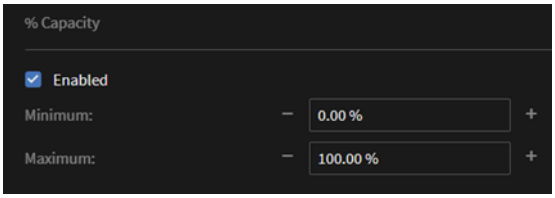


Figure 67 - % Capacity gauge configuration local AERO display

Same rules apply as for the Differential Pressure sensor configuration.

15.5.5 Dewpoint

Figure 68 - Dewpoint sensor configuration local AERO display

Same rules apply as for the Differential Pressure sensor configuration.

15.5.6 Temperature

The temperature gauge has a fixed range between -20 °C (-4 °F) and 100 °C (212 °F).

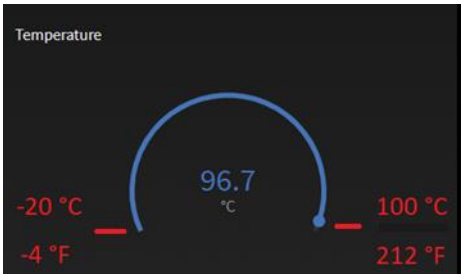


Figure 69 - Temperature gauge fixed range on the local AERO display

15.5.7 What about Air Out?

Air Out is provided in different manners, depending on the configuration of the system:

- If a System Air Flow meter (4..20mA) is installed, the information of this meter is provided
- If AirTAGs are installed, the System Air Flow is calculated as the sum of the Air Flows provided by the AirTAGs
- If no AirTAGs are installed, System Air Flow is calculated as a sum, making use of the Asset % load and Load capacity parameters.

On the local AERO dashboard, there is also a 'Air Out' gauge. However, it appears this is not configurable in this sensor configuration page. So how does it know its range?

The range is deducted from the settings in "Group Members" (see related chapter)
For instance, if we have:

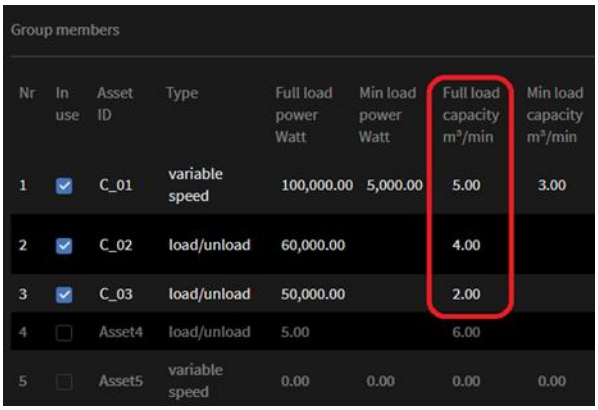


Figure 70 - sum of full load capacity defines max of Air Out gauge

The sum of all maximum fill load capacities here is 11 m3/min.
In this case, as a result, the corresponding gauge automatically ranges between 0 m3/min and 11 m3/min:

Figure 71 - relation of the member group settings to the range of the gauge

15.5.8 What about Power In?

On the local AERO dashboard, there is also a 'Power In' gauge. However, it appears this is not configurable

in this sensor configuration page. So how does it know its range?

The range is deducted from the settings in “Group Members” (see related chapter)
For instance, if we have:

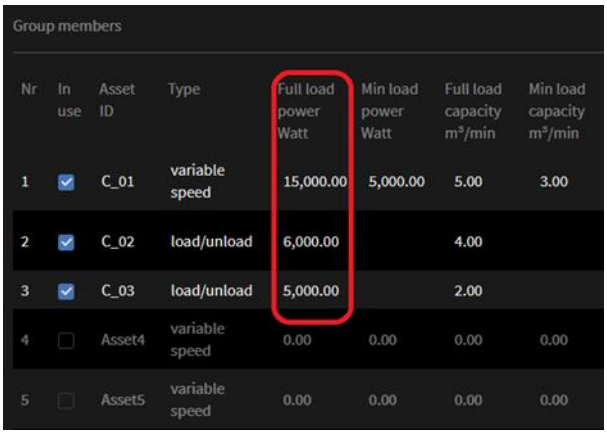


Figure 72 - How Group Member settings impact the range of the Power In gauge

Here, the sum of the Full Load Powers is 26 kW.
This results in the following rage:

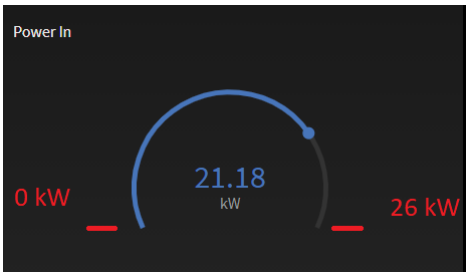


Figure 73 - Range of Power In gauge based on Group Members configuration

15.5.9 Push to Device

So far however, the UniTAG in the AERO is not updated yet (see also 11.7 The concept “Push To Device”). A “Push to Device” is needed.

Therefor take these steps:

- After having the save button click, you have:

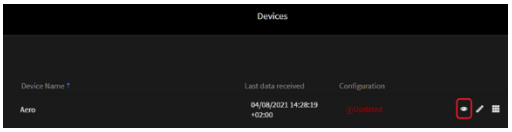


Figure 74 - Devices page

- Click on the “eye” button, you get:

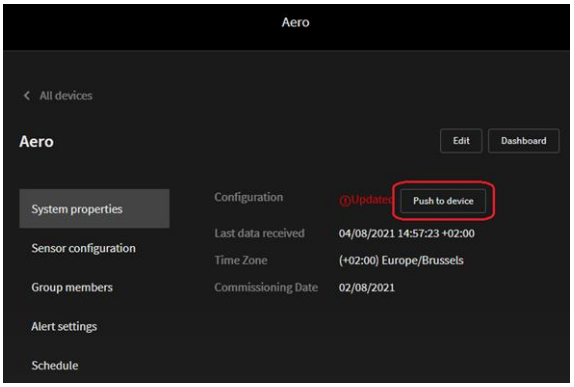


Figure 75 - Push to Device : store the settings on the UniTAG

- Push the button “Push to Device” to store the data in the UniTAG.

15.6 Group Members

The term ‘Group Members’ refers to the interfaces with the Assets used in the AERO system. Each of these is a ‘Member’, together they are the ‘Group’.

As a remark: It is assumed that the T1 in the AERO is properly configured.

An installation should either have all compressors equipped with an AirTAG or none of the compressors equipped with an AirTAG. A mixed mode is not supported.

Configuration Page:

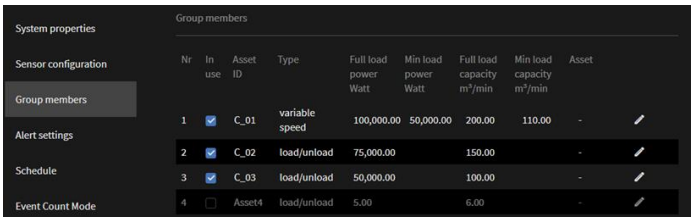


Figure 76- Configuration of Group Members

Fields used:

- Nr
  nr of the compressor asset as used in the T1
- In Use
  This check box is set if the compressor is in use
- Asset ID
  The name of the asset as used on the System Dashboard on the AERO
- Type
  An Asset is either “load/unload” or “variable”.
- Full load power
  See further
- Min load power
  See further
- Full load capacity
  See further
- Min load capacity
  See further

- Asset
  See further

15.6.1 Some words on Full and Min values

We refer to:

- Full load power
- Min load power
- Full load capacity
- Min load capacity

Essential is the way Power consumption (Power In gauge) and Flow (Air Out) are calculated on the AERO. There is a significant difference with and without AirTAGs installed.

15.6.1.1 Metacentre only

When we have no AirTAGs installed, the Metacentre provides at any moment in time, for each asset, a percentage.
The Status of the Asset (loaded / unloaded) is also provided.

When the Status of an Asset is Unloaded, power in and flow are 0.

When it is Loaded, the percentage value retrieved is used to calculate the actual Power In and Air Out interpolating between the related Min load and Max load numbers as provided in the referred values entered in the configuration page.

15.6.1.2 AirTAGs included

When AirTAGs are installed, the Power In and Air Out values are not calculated but they are directly retrieved from the installed AirTAGs.

How the AirTAGs retrieve these numbers is depending on their configuration.

15.6.1.3 Gauge Range

Note, the numbers edited in these fields are also used for the gauge ranges as explained in 15.5.7 What about Air Out? and 15.5.8 What about Power In?

15.6.2 How to configure the AirTAGs as Group Member

When you have an installation without AirTAGs, you have to leave all the 'Asset' fields empty (represented by '-').

When you have AirTAGs installed, you need to provide an identification for all of these AirTAGs.

This identification is constructed as such:

'*ArticleNumber*'-'*SerialNumber*'

Hence, suppose:

- Article Number = Y18TICS78
- Serial Number = 12345678

Then you need to fill in:

Y18TICS78-12345678

You can find this information on the Stickers on the AirTAGs.

15.6.3 How to edit the content of these fields

Of the compressor you want to edit: click the edit button on its line:

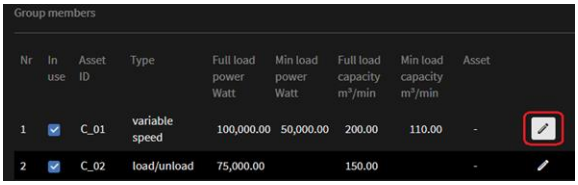


Figure 77 - Edit button for group member

You get:

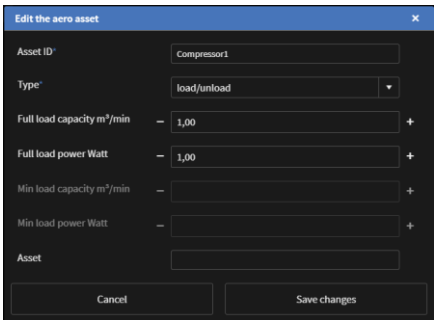


Figure 78 - Editing mode entered

Each of the fields can now be edited.
Once the fields you want to edit are done, you click the "Save changes" button for that Asset:

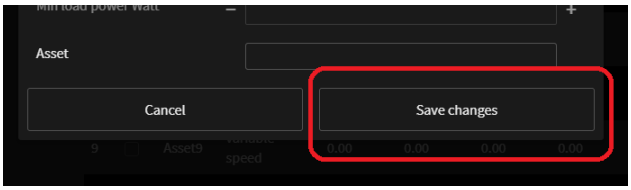


Figure 79 - Saving the adaptations for the Group Member

In case you are not sure … you can click the Cancel button for the Asset:

Figure 80 - Let's cancel what we tried

15.6.4 Push to Device

So far however, the UniTAG in the AERO is not updated yet (see also 11.7 The concept “Push To Device”). A “Push to Device” is needed.

Therefor take these steps:

- After having the save button click, you have:

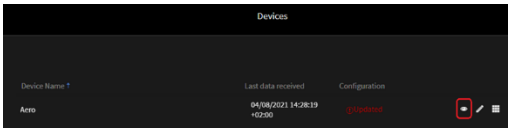


Figure 81 - Devices page

- Click on the “eye” button, you get:

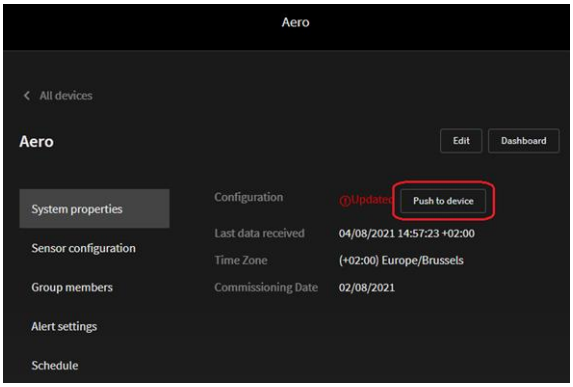


Figure 82 - Push to Device : store the settings on the UniTAG

- Push the button “Push to Device” to store the data in the UniTAG.

15.7 Alert settings (local AERO screen)

This page allows to control the behavior of a number of gauges on the screen of the AERO (or a PC connected to the Local LAN).

These alert settings do not trigger events. Events are triggered from AirCloud and hence configured there.

The configuration page:

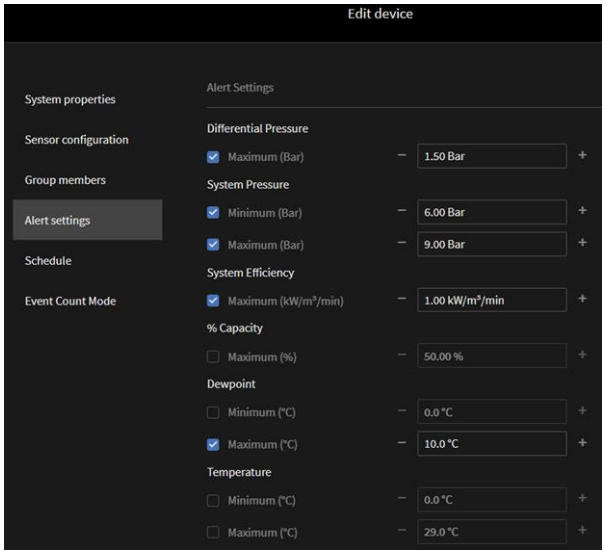


Figure 83 - Alert Settings page on AERO

Some measurements have a Max only, some have both Min and Max.

For instance, the above System Pressure (having both Min and Max) alert setting results in:

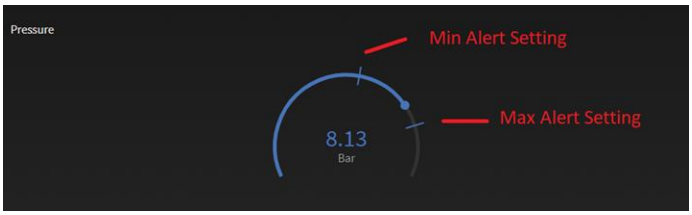


Figure 84 - Alert setting: both Minimum and Maximum Alert levels are set

If there is only one Alert level set (such as above with Dewpoint), we get:

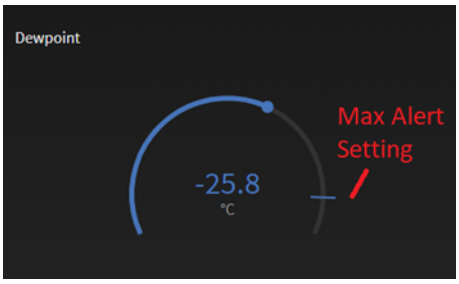


Figure 85 - Alert setting: Maximum Alert level is set

When the measured values is either below a Minimum Alert level or above a Maximum Alert setting, the gauge will color red, clearly indicating to the user that some values is beyond its limits. For example:

Figure 86 - Value below Minimum level

.. or :

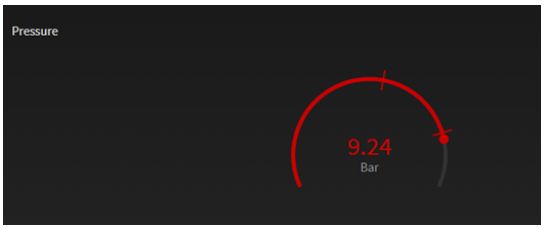


Figure 87 - Value above Maximum level

For these settings, Push to Device is not needed.

15.8 Tables

This page relates to the Table functionality.
See also **Error! Reference source not found. Error! Reference source not found.**.

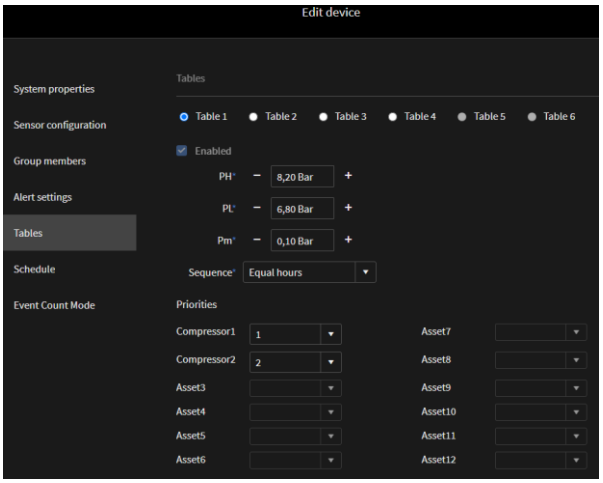


Figure 88 - Editing Pages on AERO local screen

- Each Table can be enabled
- Fill in the according settings in each enabled table.

Do not forget a Push to Device after the eding.

15.9 Schedule

This page relates to the Scheduling functionality.
It tells the system which Table (defined on the level of the T1 in the AERO) should be used when. These Tables are set up during the configuration of the T1.

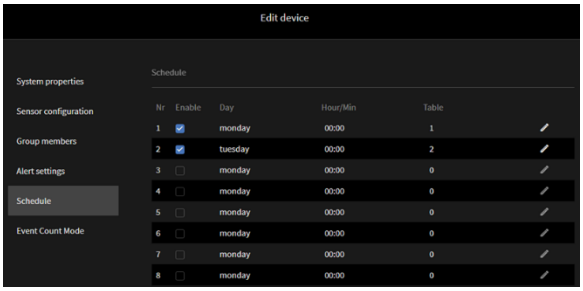


Figure 89 - The Schedule management page

Controlling these settings is similar to what is explained under “Group Members”

For instance:

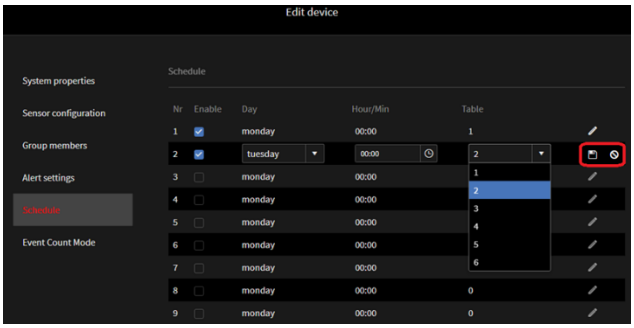


Figure 90 - how to set up Schedule

So far however, the T1 in the AERO is not updated yet (see also 11.7 The concept “Push To Device”). A “Push to Device” is needed.

Therefor take these steps:

- After having the save button click, you have:

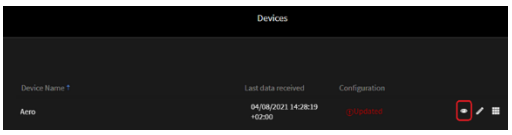


Figure 91 - Devices page

- Click on the “eye” button, you get:

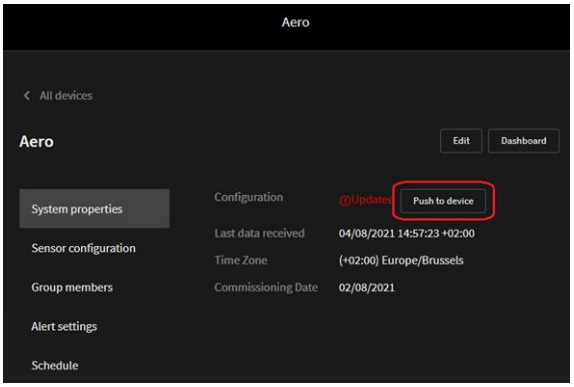


Figure 92 - Push to Device : store the settings on the T1

- Push the button “Push to Device” to store the data in the T1.

15.10 Event Count Mode

Not yet supported from AERO local interface. It is however supported from AirCloud.

It is advised to set up Event Count Mode in AirCloud.

16. Step 3: Configuration in AirCloud

To complete Step 3 you will require an Aircloud login ID and Password with access to the Tenant in which the AERO (and – if in use – the related AirTAGs) are installed. If you do not have an Aircloud login ID and Password, then contact your Airmatics service provider.

Using an internet connected PC and PC browser, navigate to the Aircloud login screen and login with your ID and Password.

Note that Step 3 requires ADMIN rights to the Aircloud environment.

Using Aircloud, an array of DEVICES including AERO combine to deliver a simple cloud based air compressor monitoring, performance and control solution that provides real time data, analytics and insights at the push of a button. Furthermore, Airmatics is a scale-able multi-tenant IOT platform meaning that it can provide login access to an array of devices and installations.

Herein, Step 3 focuses on Aircloud settings associated with AERO only!

After login, a list and map of accessible installations will display. Use the menu button located top left of the browser display to reveal the DEVICES menu

Next, use the Search tool to locate the AERO device requiring configuration...

Observe that

On Aircloud, SYSTEM PROPERTIES, GROUP MEMBERS, SENSOR CONFIGURATION and ALERT SETTINGS can be edited.

⚠ Some of the standard settings of the UniTAG will be irrelevant for an AERO implementation.
We assume you have a user account with admin rights on AirCloud
We assume you know the name of the UniTAG residing in the AERO you want to manage.

⚠ Assure that (when used) the AirTAGs reside under the same tenant as the UniTAG installed in the AERO.

⚠ Assure that (when used) all AirTAGs are properly configured (sensors, …)

Follow these steps to get to configuration:

- Using PC, using your preferred browsed, go to the AirCloud site (if you don't know the correct URL, contanct AirMatics Service Provider).
- Log in with your user name[2] and password

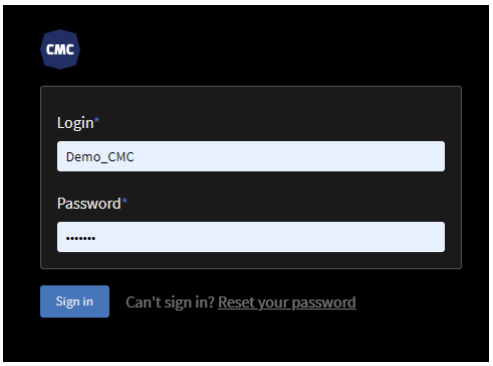


Figure 93 - Log in on AirCloud

- Go to the UniTAG dashboard using the following button:

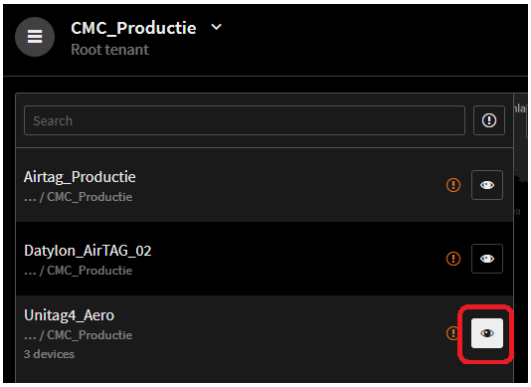


Figure 94 - Go to UniTAG dashboard

- Click the Device Settings button on the right top:

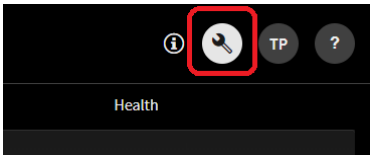
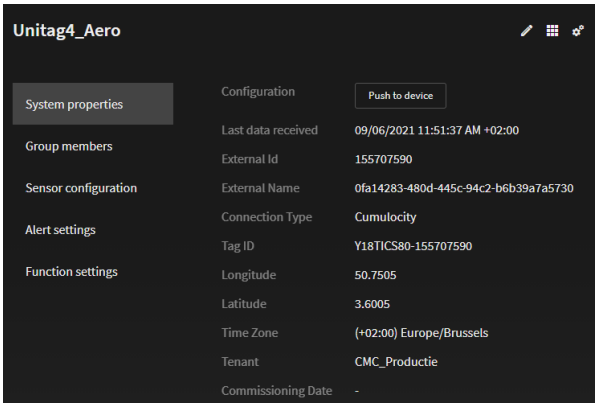


Figure 95 - Device Settings button on AirCloud

Which results in:



[2] Mind AirCloud does not support logging in with email address

Figure 96 - Settings page

- You are currently looking to the values of the settings, in order to be able to edit these, click the ‘Edit’ button.

This brings you to the page where you can edit the settings.

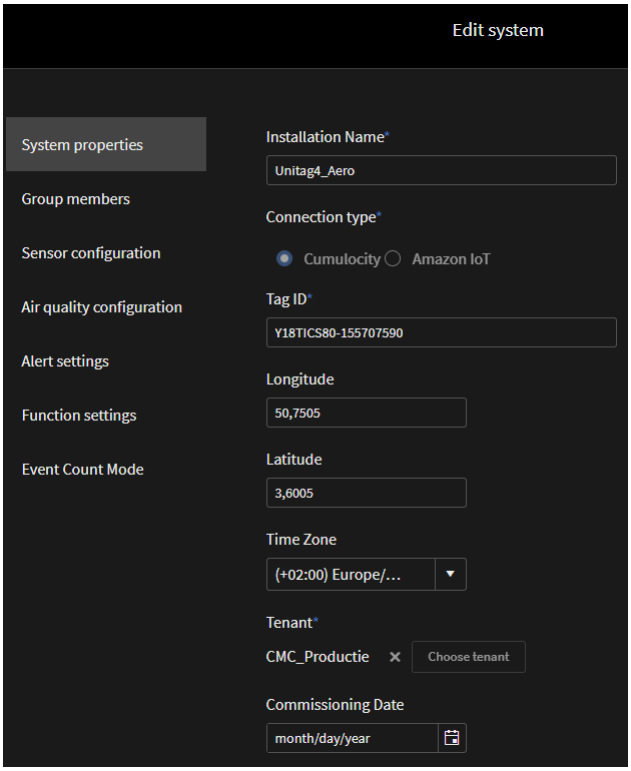


Figure 97 - Edit Page for UniTAG in AERO in AirCloud

On the left side, you have a bar with various sub-sets of configuration items you can select by clicking on it.

- System properties
- Group members
- Sensor configuration
- Air quality configuration (Not relevant in the context of UniTAG / AERO installations)
- Alert settings
- Function settings (Not relevant in the context of UniTAG / AERO installations)
- Event Count Mode (Not relevant in the context of UniTAG / AERO installations)

The relevant items will be handled one by one in the following paragraphs.

16.1 System properties

See Figure 97 - Edit Page for UniTAG in AERO in AirCloud.

16.1.1 Installation name

The Device name / Installation name is the name used to identify the device / Installation in list view.

16.1.2 Connection type

This is preconfigured when the device is manufactured. Leave untouched.

16.1.3 Tag ID

This is preconfigured when the device is manufactured. Leave untouched.

16.1.4 Longitude and Latitude

Many freely available browser based tools exist to help establish longitude and latitude values for a geographic location. Establish the latitude and longitude for the location of the AERO device and complete configuration. Doing so will accurately position the AERO device on map view!

16.1.5 Time Zone

Set up according to the Time Zone in which the AERO is installed.

16.1.6 Tenant

Tenants are used to associate the device with the correct branch or hierarchy and most often this has been factory configured.

16.1.7 Commissioning Date

Fill in the date of system commissioning.

Assure to click “Save” after configuration of these parameters is done.

16.2 Group Members

Figure 98 - Group Member configuration in AirCloud

It is worthwhile having a look at 15.6 Group Members where this is explained for local AERO configuration.

Configuration in AirCloud is similar, but having similar but also different purposes.

It is essential to keep data in AirCloud in sync with the data on the local AERO (for instance 'Name', Full load', etc).

In AirCloud, when an AirTAG asset is defined (see further), more items are dissembled when comparing this to the local AERO configuration. This is due to the fact that in AERO, these items are also used for other purposed (such as setting the range of some gauges on the local AERO dashboard).

Figure 98 - Group Member configuration in AirCloud is to some extend misleading as you have a mix of members with AirTAG and members without AirTAG (this is done for the sake of this documentation). Assure that when you save Group Member configuration settings either all Group Members are with or all Group Members are without AirTAGs.

The selection AirTAG based / Metacentre based always should be on Metacentre based:

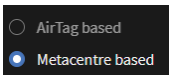


Figure 99 - For AERO : always select "Metacentre based"

Similar between AirCloud and local AERO:

- In Use: set identical in AirCloud as it is set on local AERO
- Type: set identical in AirCloud as it is set on local AERO
- Full Load capacity: set identical in AirCloud as it is set on local AERO (only editable when no AirTAG is selected under 'Asset')
- Full load power: set identical in AirCloud as it is set on local AERO (only editable when no AirTAG is selected under 'Asset')
- Min Load capacity: set identical in AirCloud as it is set on local AERO (only editable when no AirTAG is selected under 'Asset')
- Min load power: set identical in AirCloud as it is set on local AERO (only editable when no AirTAG is selected under 'Asset')

The 'Asset' field

This acts differently from local AERO configuration.

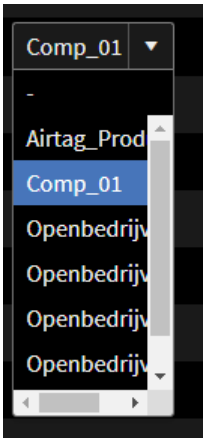


Figure 100 - Asset selection: drop down of available AirTAGs in the Tenant

The drop down provides a list of the available AirTAGs under the tenant in which the UniTAG resides.

Here you can select an AirTAG which is still available for selection (obviously an AirTAG can only be selected once).

Assure to click "Save" after configuration of these parameters is done.

When configuration is done properly before on the local AERO, a Push to Device is not required from the AirCloud environment. However, if everything between AirCloud and local AERO is in sync for Group Members, a Push to Device will not impact the operation of the system.

16.3 Sensor configuration

AERO sensor configuration covers the following...

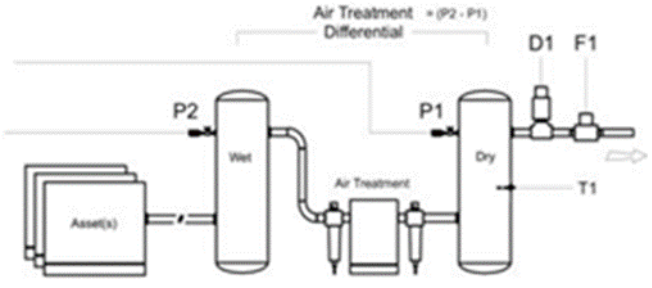


Figure 101 - Sensors configured - location in system

- P1: SYSTEM PRESSURE (MANDATORY)
- P2: GENERATION PRESSURE (OPTIONAL)
- D1: DEWPOINT SENSOR (OPTIONAL)
- F1: AIR FLOW SENSOR (OPTIONAL)
- T1: TEMPERATURE SENSOR (OPTIONAL)

The same impact on the gauge ranges (but then from AirCloud perspective) apply (see Figure 64 - 10% reserve on top of Maximum).

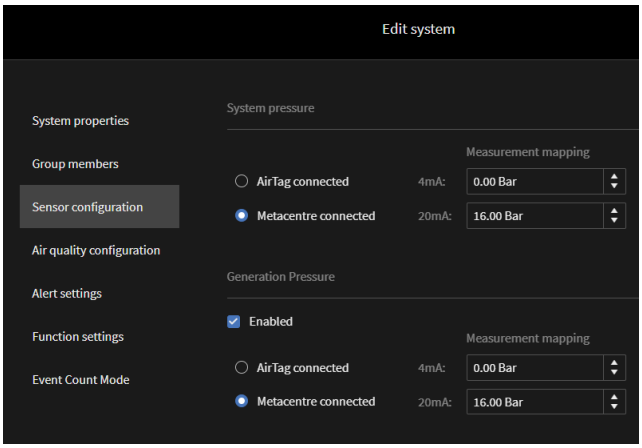


Figure 102 - AirCloud based Sensor configuration for UniTAG in AERO – part 1

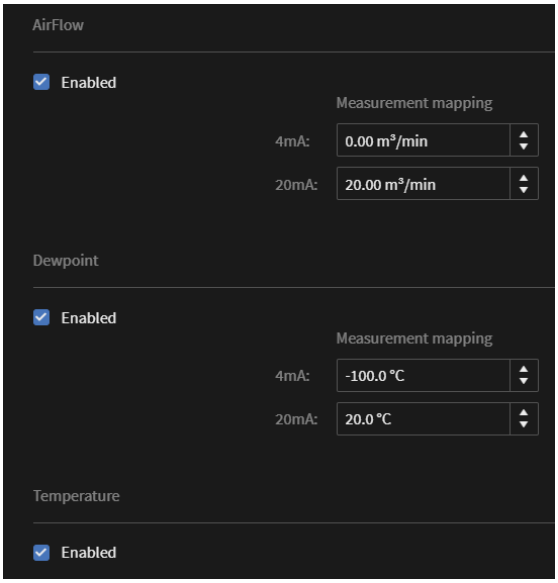


Figure 103 - AirCloud based Sensor configuration for UniTAG in AERO – part 2

16.3.1 System pressure

Always set to 'Metacentre connected'

Here you can also specify the range of the 4 – 20 mA sensor (min and max pressure levels).

16.3.2 Generation Pressure

Always set to 'Metacentre connected'

Here you can also specify the range of the 4 – 20 mA sensor (min and max pressure levels).

16.3.3 AirFlow

If a physical AirFlow sensor is installed and connected to the AERO, the 'Enabled' check box needs to be set.
If such AirFlow sensor is not installed, the 'Enabled' check box needs to be unset,

In the case no such sensor is installed, the value for AirFlow is either calculated from data provided by Metacentre or retrieved from the AirTAGs (if these are installed).

Here you can also specify the range of the 4 – 20 mA sensor (min and max flow levels).

See also 15.6.1 Some words on Full and Min values

16.3.4 Dewpoint

If a physical Dewpoint sensor is installed and connected to the AERO, the 'Enabled' check box needs to be set.
If such AirFlow sensor is not installed, the 'Enabled' check box needs to be unset,

16.3.5 Temperature

If a physical Temperature sensor is installed and connected to the AERO, the 'Enabled' check box needs to be set.
If such Temperature sensor is not installed, the 'Enabled' check box needs to be unset.

Scaling of the AirCloud based gauge is done automatically, see also 15.5.6 Temperature.

16.3.6 Push to Device

Assure to click "Save" after configuration of these parameters is done.

Sensor configuration needs to be "Pushed to Device".

Steps:

- After 'Save' has been pressed:

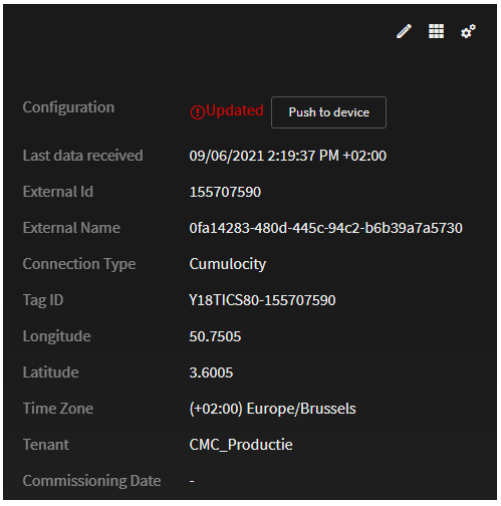


Figure 104 - After 'Save' : screen to apply a Push to Device

- Click the button 'Push to Device'
- And confirm:

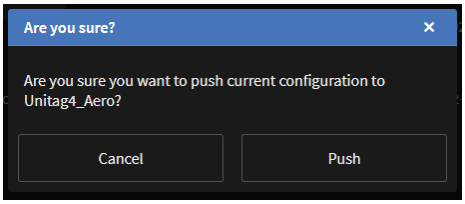


Figure 105 - Confirm you want to Push to Device

16.4 Alert Settings

See also 15.7 Alert settings (local AERO screen).

On the local AERO display you can also configure “Alert Settings’ (see 15.7 Alert settings (local AERO screen)). These settings control the color of the related gauge on the AERO. The Alert setting configuration from the AirCloud perspective also provide means to trigger related events and (if configured) email messages.

The Events will be listed in the “Events” tab on the AirCloud interface – both in AirCloud and on the local AERO display.

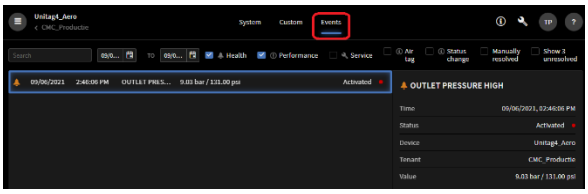


Figure 106 - Example of Event as seen on AirCloud Events tab

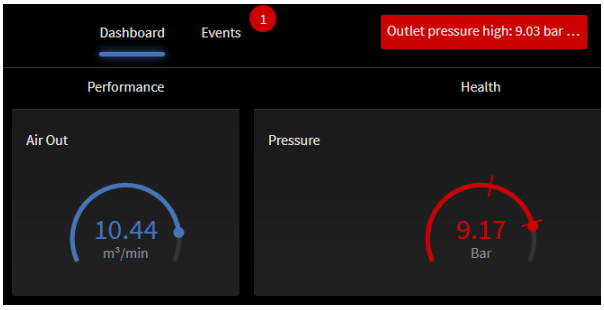


Figure 107 - On local AERO screen: indication of most recent event

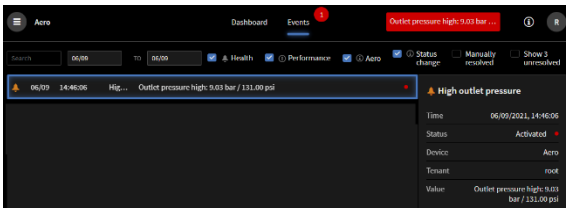


Figure 108 - Example of the same Event, now seen on the local AERO screen

The minimum and maximum settings will impact the color of the related gauge in the dashboard on AirCloud, similar to local AERO.

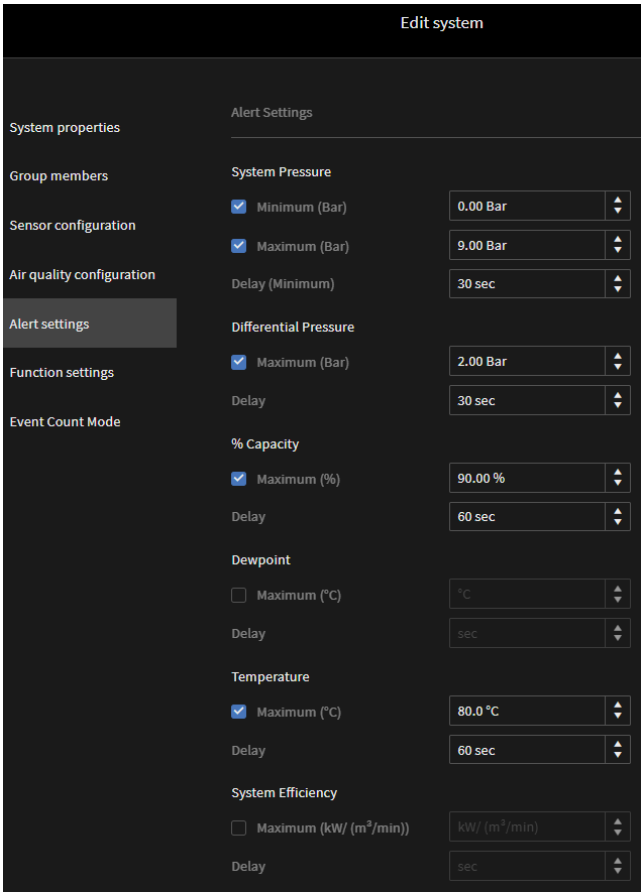


Figure 109 - Alert Settings - configuration in AirCloud

16.4.1 The purpose of ‘Delay’

In all Alert Settings measurements, you can set a ‘Delay’. This is used to filter condition accuracy.

For example, of you wanted to set a Minimum and/or Maximum System Pressure alarm condition and ignore small momentary minimum or maximum pressure alarm events, then set ‘Delay’ to an acceptable value.

16.4.2 Push to Device

Alerts are processed in the UniTAG in the AERO. Hence a Push to Device is required.
Assure to click “Save” after configuration of these parameters is done.

Sensor configuration needs to be “Pushed to Device”.

Steps:

- After ‘Save’ has been pressed:

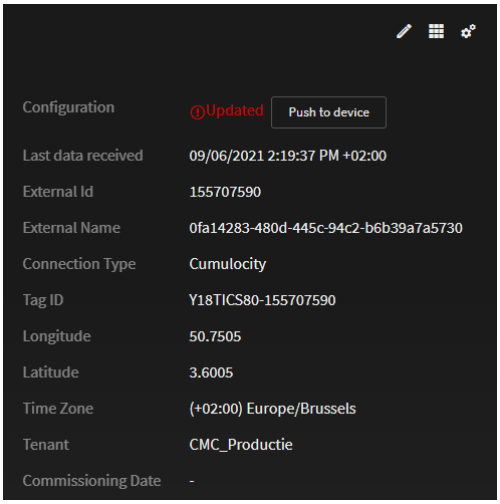


Figure 110 - After 'Save' : screen to apply a Push to Device

- Click the button ‘Push to Device’
- And confirm:

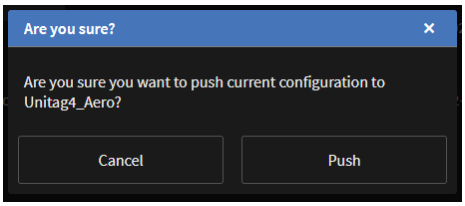


Figure 111 - Confirm you want to Push to Device

17. T1 – Sequencer methodology

This chapter focuses on the Functionality, Features and related Parameters to understand how the T1 controls the operation of the Assets.

We often refer to this as “Sequencer”: based on configuration parameters and measured operational system behavior, the T1 will “orchestrate” the operation of the underlying Assets: which Assets are to operate when and in which mode.

17.1 Pressure Control

The primary function of the T1’s pressure control strategy is to maintain system pressure between the ‘High Pressure’ set point (PH - adjustable) and the ‘Low Pressure’ set point (PL - adjustable) in conjunction with targeting optimum achievable system energy efficiency. The T1 calculates a ‘Target’ pressure level (PT), the mid-point between the two set points, which is used as the nominal ‘target’ pressure level for the system.

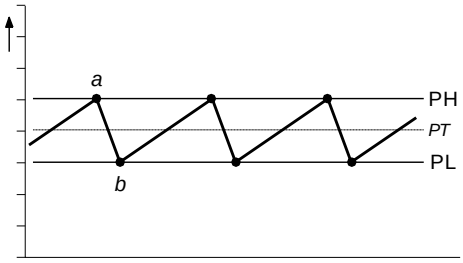


Figure 112 - Operation within PL - PH band

When system pressure increases to the High Pressure set point (a) a compressor is unloaded. Pressure is allowed to decrease to the Low Pressure set point (b) before a compressor is loaded again to add capacity output and increase pressure. This process will continue under a steady demand for air in a continuous stable cycle.

For systems that consist of a variable capacity (or variable speed) compressor, the compressor must be set, or controlled, to achieve and maintain the calculated system ‘Target’ pressure level (PT).

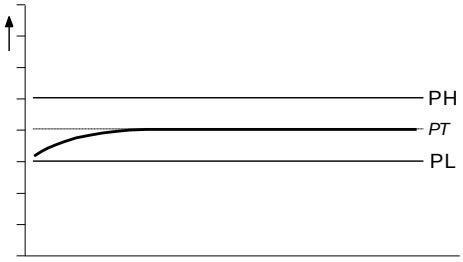


Figure 113 - Variable Speed compressor targets PT

Where abrupt, or significant, changes in air demand, beyond the capacity scope of the variable capacity compressor, are experienced, the loading and unloading of other compressors is implemented in exactly the same way as described above.

If demand for air is abruptly, or significantly, increased, and the capacity output of the compressor loaded at the Low Pressure set point (b) is insufficient, the pressure will continue to decrease at a reduced rate.

The T1 will accommodate for this event by loading an additional compressor.

The instance at which the additional compressor is loaded (c) is dynamically calculated and is determined by the rate of pressure decrease (the urgency or time limit) and the acceptable deviation of system pressure (the ‘Tolerance’) from the normal control limits.

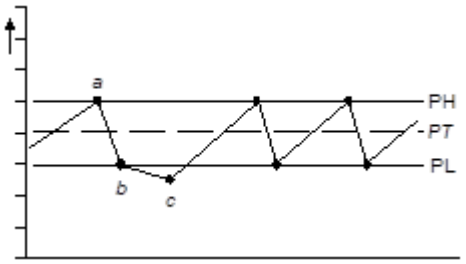


Figure 114 - Abrupt behavior

The same method is implemented in reverse (above the High Pressure set point) when an abrupt, or significant, decrease for air demand is experienced.

Rate of change of pressure, and the stability of pressure control, is largely determined by system volume and the scale, and/or abruptness, of air demand fluctuations; these characteristics will differ from installation to installation. To accommodate for variations in installation characteristics the ‘Tolerance’ pressure level (TO) and an influence on the dynamic reaction time (or ‘Damping’) of the T1 (DA) is adjustable.

17.2 Tolerance

Tolerance is a pressure band above and below the set pressure control levels that accommodates for an exceptional instance of abrupt and/or significant increase, or decrease, in demand without compromise to optimal energy efficient control.

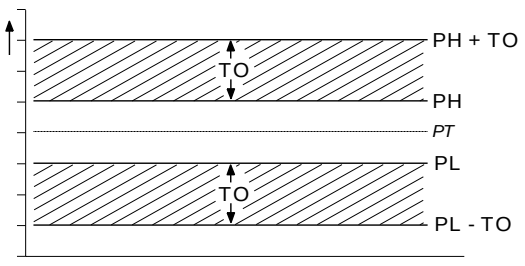


Figure 115 - The Tolerance Bands

Tolerance (TO) is expressed as a pressure defining the width of the tolerance 'band'.

For example; a tolerance setting of 3psi (0.2bar) means the XC will implement appropriate optimal energy efficient response(s) during a deviation of pressure 3psi below the set PL pressure level. If pressure ever deviates beyond the 'tolerance' limit the XC will proportionally increment an emergency response, abandoning optimum energy efficiency, until pressure is returned to normal levels.

If system volume is inadequate, and/or demand fluctuations are significantly large, it is advisable to increase the 'Tolerance' band to maintain optimum energy efficiency, and reduce over-reaction, during such transition periods.

If system volume is generous, rate of pressure change is slow and demand fluctuations are insignificant and gradual, the 'Tolerance' band can be reduced to improve pressure control without compromise to optimum energy efficiency.

17.3 Damping

In situations where the loading of an additional compressor, at the PL pressure set point, is inadequate to match a significant and/or abrupt increase in air demand the additional reaction of the T1, while pressure deviates into the 'tolerance' limit, is dynamically calculated. The time before an additional compressor is loaded, to increase generation capacity further, will vary in accordance with the urgency of the situation.

The T1's dynamic reaction algorithm is pre-set by default to accommodate for the majority of installation characteristics.

In some situations, of which the following are examples, the rate of pressure change may be aggressive and disproportionate:

e) Inadequate system volume
f) Excessive air treatment equipment pressure differential
g) Inadequately sized pipe work
h) Delayed compressor response

In such instances the T1 may over-react and attempt to load an additional compressor that may not be necessary once the initial compressor is running, loaded, and able to contribute adequate additional generation capacity. If an increase in the 'tolerance' band is insufficient, the T1's dynamic reaction response can be influenced by increasing the 'Damping' factor (DA) reducing tendency to over-react.

The 'Damping' factor is adjustable and scaled from 0.1 to 10 with a default factor of 1. A factor of 0.1 equates to 10 times faster than default and a factor of 10 equates to 10 times slower than default.

17.4 System Volume

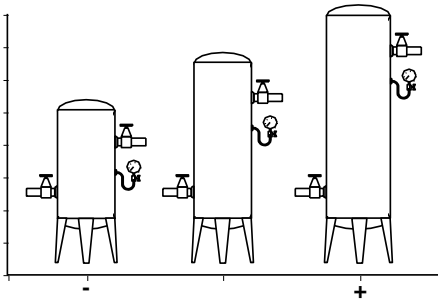


Figure 116 - System volume - various sizes

Pressure control of a system is a 'feedback loop' response derived from increasing, or decreasing, air generation output capacity. If output capacity is greater than demand for air the pressure in a system will increase, if demand is greater than output capacity system pressure will decrease. The rate of change of pressure to changing generation and demand capacity situations is largely dependent on system volume. If system volume is small in comparison to recommended size the rate of change of pressure will be fast and abrupt inhibiting effective control and compromising optimum system energy efficiency. If system volume is large the rate of change of pressure will be slow and gradual. In this instance an enhanced control of pressure can be achieved, the system response times can be reduced and optimum system energy efficiency will generally be increased as a result.

The rule below provides an approximation for recommended minimum system volume:

3) For systems comprising of fixed capacity output (or fixed speed) compressors:

$$m^3 = (m^3/min)/(bar.g - 1)$$

The approximation only works in metric units; convert psi and ft3 to metric units first.

1.0 m^3	= 35.315 ft^3
1.0 m^3/min	= 35.315 cfm
1.0 bar	= 14.5 psi

Example: for a system that operates with a maximum normal demand air flow of 36m^3/min at a nominal pressure of 7.0bar =

36m^3/min / (7.0bar – 1) = 6.0 m^3 (212 ft^3)

4) For systems consisting of variable output capacity (or variable speed) compressor(s) the system volume should be doubled.

$$m^3 = 2.((m^3/min)/(bar.g - 1))$$

17.5 Sequence Control Strategies

The T1 provides three *basic sequence control strategies* or modes. Each *sequence control strategy* consists of two *sub strategi*es:

3) The compressor 'Rotation' strategy
The 'Rotation' strategy defines how the compressors are re-arranged, or re-ordered, in to a new sequence at each routine 'Rotation' event. Rotation events are triggered by a cyclic interval time, a set time of day each day, or a set time of day once a week.

4) The compressor load 'Control' strategy
The compressor load 'Control' strategy defines how the compressors are utilised in response to variations in system pressure.

The following explanation is making use of a system consisting of 4 assets. Obviously in practical situations this quantity can be different (from 2 to 12).

Compressor Sequence Arrangements:

Each compressor in a system is initially assigned to the T1 with a fixed and *unchanging number reference*, "1" to "4".

The 'duty' that a compressor is assigned in any set 'Rotation' sequence arrangement is defined by a letter, "A" to "D".

A = the 'Duty' compressor, the first to be utilized.
B = The 'Standby' compressor, the second to be utilized.
C = The 'Second Standby' compressor, the third to be utilized.
D = The 'Third Standby' compressor, the forth to be utilized.

Compressor 'duty' assignments are reviewed, and re-arranged as appropriate in accordance with the selected rotation strategy, at each rotation event.

17.5.1 Equal Hours Run Mode

Equal Hours Run Mode (EHR)

The primary function of EHR mode is to maintain a close relationship between the running hours of each compressor in the system. This provides an opportunity to service all compressors at the same time (providing the service interval times for all compressors are the same or similar).

EHR is not an energy efficient focused mode of operation.

Rotation:
Each time the rotation interval elapses, or the rotation time is reached, the sequence order of compressors is reviewed and re-arranged dependant on the running hours recorded for each compressor. The compressor with the least recorded running hours is assigned as the 'duty' compressor, the compressor with the greatest recorded running hours is assigned as the 'last standby' compressor. For systems with more than two compressors, the remaining compressor(s) are assigned in accordance with their recorded running hours in the same way.

Example: The compressors in a four-compressor system have the following recorded running hours at the 'Rotation' time.

Compressor 1 = 2200 hrs
Compressor 2 = 2150 hrs
Compressor 3 = 2020 hrs
Compressor 4 = 2180 hrs

The new sequence order arrangement after a rotation event would be:

Compressor 1 = D
Compressor 2 = B
Compressor 3 = A
Compressor 4 = C

Compressor 3, that has the least recorded running hours, will now be utilised to a greater extent in the new sequence arrangement; potentially increasing the running hours at a faster rate.

The T1 continuously monitors the running status of each compressor and maintains a record of the accumulated running hours. These are available, and adjustable, in the T1's compressor running hour's menu. The T1 uses these values in EHR mode. The T1's running hours record should be routinely checked, and adjusted if necessary, to ensure a close match with the actual run hours displayed on each compressor.

If a compressor is operated independently from the T1 the running hours record may not be accurately updated.

The running hours meter display on most compressors are intended for approximate service interval indication only and may deviate in accuracy over a period of time.

Control:
Compressors are utilised, in response to changing demand, using a 'FILO' (First In, Last Out) strategy. The 'duty' compressor (A) is utilised first followed by (B) if demand is greater than the output capacity of (A). As demand increases (C) is utilised followed by (D) if

demand increases further. As demand reduces (D) is the first compressor to be unloaded, followed by (C) and then (B) if demand continuous to reduce. The last compressor to be unloaded, if demand reduces significantly, is (A). The compressor assigned as (A) in the sequence is the first to be loaded and the last to be unloaded.

17.5.2 Timer Rotation Mode

Timer Rotation Mode (TRM)

The primary function of Timer Rotation mode is to efficiently operate a compressed air system consisting of fixed capacity output compressors. The routine rotation assignments can be modified using 'Priority' settings to accommodate for a differentially sized or variable capacity output compressor(s).

Rotation:
Each time the rotation interval elapses, or the rotation time is reached, a sequence rotation occurs and the sequence assignment for each compressor is re-arranged. The compressor that was assigned for duty (A) is re-assigned as last standby (D) and all other compressor assignments are incremented by one.

	1	2	3	4
#1	A	B	C	D
#2	D	A	B	C
#3	C	D	A	B
#4	B	C	D	A

Figure 117 - How Timer Rotation Mode links Assets number to Duty

The sequence assignment pattern can be modified by 'Priority' settings.

Control:
Compressors are utilised, in response to changing demand, using a 'FILO' (First In, Last Out) strategy.

The 'duty' compressor (A) is utilised first followed by (B) if demand is greater than the output capacity of (A). As demand increases (C) is utilised followed by (D) if demand increases further.

As demand reduces (D) is the first compressor to be unloaded, followed by (C) and then (B) if demand continues to reduce.

The last compressor to be unloaded, if demand reduces significantly, is (A). The compressor assigned as (A) in the sequence is the first to be loaded and the last to be unloaded.

17.5.3 Energy Control Mode

Energy Control Mode (ECM)

The primary function of Energy Control mode is achieving and maintaining demand matched optimum system efficiency. Energy Control mode can accommodate differential capacity, variable capacity and variable speed air compressor types in any combination or configuration.

Control and Rotation:
Compressor control and utilisation is dynamically automated and is not based on pre-determined rotation configurations or time intervals.

The system management unit is aware of compressor capacity relationships and variable capacity capabilities, where applicable, and is able to dynamically implement and continuously review 'best fit' configurations as demand variations occur.

The basic principle of the Energy Control strategy is the efficient utilisation of available resources matched to fluctuations in demand.

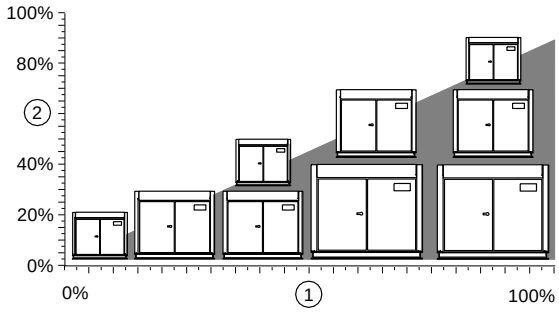
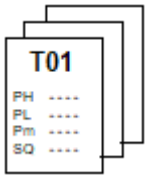


Figure 118 - Demand versus Generation in ECM

1: Demand
2: Generation
Not all potential combinations are shown.

Energy Control mode incorporates adaptive strategies and dynamic responses that continuously modify basic principles. With 'built-in' knowledge of individual compressor capabilities the management unit adapts to accommodate system characteristics under varying demand situations.

17.6 Tables



The T1 operates in accordance with settings that are programmed in to a number of menu 'Tables'. Each

table defines the operational parameters and mode of operation of the T1.
The T1 can be instructed to change from one table to another at any time from an external remote source or from settings in the real time clock 'Pressure Schedule'

This functionality enables the T1 to switch from one set of operational parameters, and/or from one mode of operation, to another at any time without disruption to routine control.

Table Parameters:

Each table consists of the following parameters; the parameters can be set differently in each table.

7) PH: High pressure set point
8) PL: Low pressure set point
9) Pm: Minimum pressure warning level
10) SQ: Sequence rotation mode
11) 01: Compressor 1 Priority setting
12) 02: Compressor 2 Priority setting
to
17) 12: Compressor 12 Priority setting

The 'maximum' pressure fault level and the rotation interval, or rotation time, are set independently in a configuration menu and are unchanging regardless of Table selected.

Pressure Change Time:

When pressure set points change, a change from one 'Table' to another, the T1 will increase, or decrease, the pressure target levels towards the new table settings in a gradual transition over a period of time.

This feature is intended to allow the system to react to changes in pressure target levels in a smooth and energy efficient manner without abrupt overreaction.

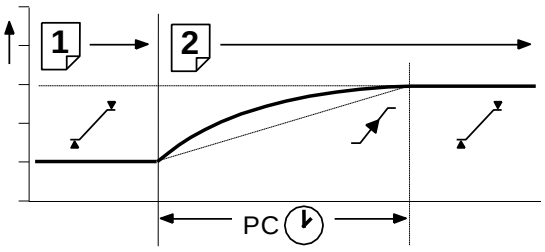


Figure 119 - The Pressure Change Time

The time the system will take to complete the transition from one pressure target to another is determined by the 'Pressure Change' time (PC). This value can be adjusted to accommodate installation characteristics to achieve the transition at optimal energy efficiency.

If the T1 is able to achieve the transition without compromising energy efficiency in a shorter time than set, the pressure change event time will be automatically reduced.

An aggressively short time setting will compromise system optimal energy efficiency.

17.7 Sequence Rotation

A sequence 'Rotation' event can be automatically triggered on a routine basis using a *pre-determined interval*, a *pre-determined time each day* or a *pre-determined day and time each week*.

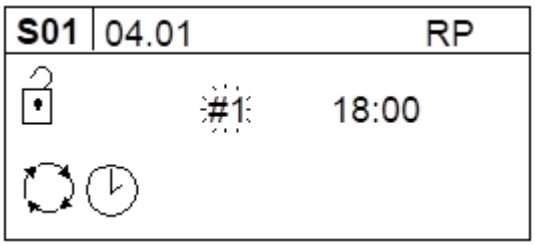


Figure 120 - Pre-determined day and time rotation

Select the 'day' or day function as required:

#1 = Monday to **#7** = Sunday
#8 = each working day of the week, excluding Saturday and Sunday
#9 = each working day of the week.
#- (dash) = deactivate

Select the required hour and minutes of the day(s) using the same method.

A day starts at 00:00hrs and ends at 23:59hrs (24hr clock system).

To define an interval time (more than one rotation event a day) select '**#t**' for the day function and press Enter:

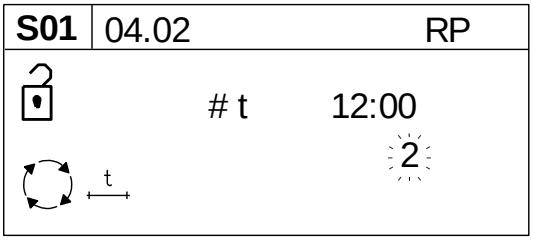


Figure 121 - Interval time rotation

An 'intervals per day' value will appear and flash. Select the required number of rotation events per day (1 to 96). The hour and minutes display will now show the interval time between each rotation event; 1 = every 24hrs to 96 = every 15 minutes (example: 2 = every 12hrs).

The first automated rotation event each day will occur at 00:00hrs and then every set rotation interval time throughout the day.

17.8 Priority Settings

Priority settings can be used to modify the 'Rotation' sequence assignment. Compressors can be assigned a 'priority' of 1 to 12; where 1 is the highest priority. Any compressor can be assigned any priority and any number of compressors can have the same priority.

Example 1:
For a four-compressor system, that includes a single variable speed compressor assigned as compressor number '1', it may be desirable to ensure the variable speed compressor is continuously utilised in any sequence arrangement as the 'duty' or 'top-up' unit.

To achieve this assign compressor number 1 with a higher priority than the remaining three fixed speed compressors.

Compressor 1 (variable speed) = priority 1
Compressors 2 to 4 (fixed speed) = priority 2

	1	2	3	4
	1	**2**	**2**	**2**
#1	A	B	C	D
#2	A	C	D	B
#3	A	D	B	C
#4	A	B	C	D

Figure 122 - Compressor Assets and Priority Settings – Example 1

Example 2:
For a four-compressor system, that includes a compressor (for example compressor 4) that is less efficient, or otherwise less desirable to operate for other reasons, it may be convenient to ensure the compressor is only utilised as an emergency backup. To achieve this assign compressor number 4 with a lower priority.

Compressors 1 to 3 = priority 1
Compressor 4 = priority 2

	1	2	3	4
	1	**1**	**1**	**2**
#1	A	B	C	D
#2	B	C	A	D
#3	C	A	B	D
#4	A	B	C	D

Figure 123 - Compressor Assets and Priority Settings – Example 2

Example 3:
For a four-compressor system that includes a variable speed compressor (compressor number 1) and a fixed speed compressor that is only required as an emergency backup (compressor number 4) it may be desirable to ensure the variable speed compressor is always utilised first, and the backup compressor utilised last, in any sequence arrangement.

Compressor 1 (variable speed) = priority 1
Compressors 2 and 3 = priority 2
Compressor 4 (back-up) = priority 3

	1	2	3	4
	1	**2**	**2**	**3**
#1	A	B	C	D
#2	A	C	B	D
#3	A	B	C	D
#4	A	C	B	D

Figure 124 - Compressor Assets and Priority Settings – Example 3

Example 4:
Compressors can be separated in to rotation groups. In this example compressors 1 and 2, of a four-compressor system, have been set as a high priority group and compressors 3 and 4 as a lower priority group. Compressors 1 and 2 will always be utilised first in any sequence arrangement and will be rotated at each 'Rotation' event. Compressors 3 and 4 will always be utilised as lower priority in any sequence arrangement and will be rotated at each 'Rotation' event.

	1	2	3	4
	1	**1**	**2**	**2**
#1	A	B	C	D
#2	B	A	D	C
#3	A	B	C	D
#4	B	A	D	C

Figure 125 - Compressor Assets and Priority Settings – Example 4

17.9 Prefill

The Prefill feature provides a controlled and energy efficient method of increasing pressure to normal operating levels at system start. This feature avoids the inefficient potential for all available system compressors to start and load before pressure reaches the normal operating level.

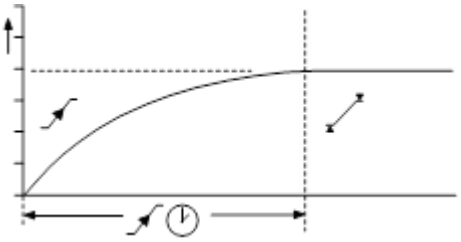


Figure 126 - Prefill function

At system start (manual start or automated start from standby) the T1 will only load compressors that have been pre-determined for prefill operation, for a pre-set period of time. The prefill time (PT) can be adjusted to suit system characteristics. The aim is to increase pressure to normal operational levels, using only the pre-determined compressors, prior to the prefill time expiring.

If normal operational pressure is reached prior to the set prefill time, the prefill function will automatically cease and normal operational control begin. If normal operational pressure is not reached by the end of the prefill time the T1 will utilise as many available compressors as required to achieve normal operational pressure as quickly as possible. Normal operational control will then begin.

Three prefill modes are available. 'Backup' and 'Standard' modes require compressor pre-selection and function in the same way; differing only in response to a failure, or loss, of a prefill compressor. Automatic mode requires no compressor pre-selection.

√ Backup Mode: Compressor(s) can be pre-selected as 'Primary Prefill' compressor(s) or 'Backup Prefill' compressor(s). If a primary prefill compressor experiences a shutdown, or is stopped, a pre-defined backup compressor replaces it and prefill continues.

√ !→X Standard Mode: If one or more of the pre-defined prefill compressors experiences a shutdown, or is stopped, the prefill function is cancelled and normal operation begins.

√ A^^ Automatic Mode: No Prefill compressor selection is necessary; any selection set is ignored. The management unit automatically selects compressor(s) dynamically to achieve pressure in accordance with the set Prefill time. If a compressor is stopped, or shuts down, it is automatically substituted with an alternative compressor.

To manually skip Prefill mode, press and hold Start for several seconds.

17.10 Start Function

The 'Start' function enables auxiliary equipment to be pre-started prior to utilisation of any compressors.

The function also monitors the auxiliary equipment during normal running operation.

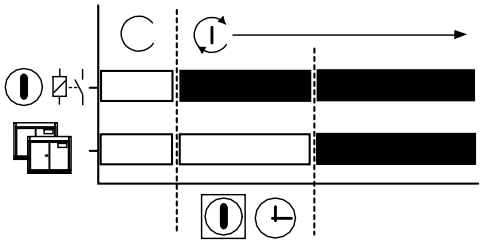


Figure 127 - Auxiliary equipment pre-started prior to compressor utilization

At system start-up (manual start or automated start from standby) any output relay set for the 'Start' function will energise. The management system will then wait for the set 'Start' time before utilising any system compressors. During this time the management system expects to receive a feedback on the 'Start Function Feedback Input'. The management system response to the feedback is dependent on the selected 'Start' function.
If feedback is not received by the end for the 'Start' time the management unit can be set to display an Alarm (Warning) and continue, or Shutdown.

If, at any time during normal operation, the feedback signal disappears the management unit can be set to display an Alarm (Warning) and continue, or Shutdown.

This function is intended for automated control and monitoring of auxiliary equipment critical to air compressor system operation; air dryer(s) or cooling water pump(s) for example.

17.11 Pressure Schedule

The T1 is equipped with a real time clock feature and pressure schedule facility. The 'Pressure Schedule' function can be used to provide automation of the system.

The pressure schedule consists of 28 individual settings that instruct the system to change from one 'Table' to another, or put the system in to 'Standby' mode, dependant on time of day and day of the week. The pressure schedule will cycle from 00:00 hours Monday (day #1) to 23:59 hours on Sunday (day #7) each calendar week.

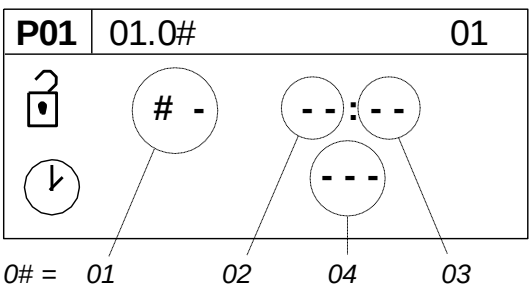


Figure 128 - Setting Pressure Schedules

01) Day of the Week
#1 = Monday to #7 = Sunday
#8 = every working day of the week; Monday to Friday, excluding Saturday and Sunday.
#9 = every working day of the week.

Select "-" (dash) and enter to delete a setting from the schedule.

02) Hours; time of day (24hr format)
03) Minutes; time of day
04) The required table, T01 to T06, or
"-X-" = Standby (unload all compressors).

Adjust the 'day of the week' sub-setting first and then press Enter to increment to the next setting. Repeat until all item sub-settings are entered. The complete 'Pressure Schedule' item will not be set in XC memory until the last sub-setting is entered. Press Escape to step back one sub-item if required.

17.12 Second Pressure Sensor

The T1 is equipped with a 4-20mA input dedicated for an optional second pressure sensor.

The second pressure sensor (P2) can be utilised for one of two available functions:

3) P1<>P2:

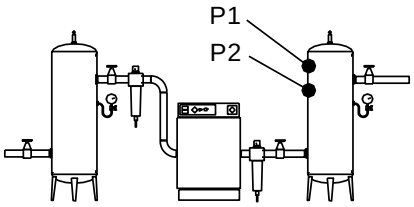


Figure 129 - 2nd Pressure Sensor - Backup Sensor mode

If the primary control pressure sensor (P1) fails, the management unit will automatically switch to the 'backup' pressure sensor (P2).

4) P2+>DP:

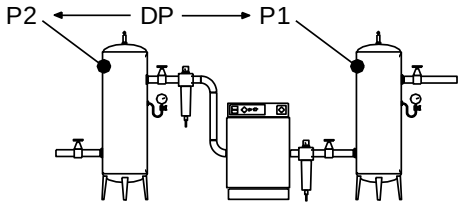


Figure 130 - 2nd Pressure Sensor - Differential mode

The second pressure sensor can be used to monitor pressure downstream, or upstream, of air treatment equipment. The pressure differential (DP) between the primary control pressure sensor (P1) and the second pressure sensor (P2) can be displayed on the screen. A pressure differential Alarm (Warning) level can also be set to indicate when differential pressure exceeds the set limit.

17.13 Airflow Sensor Monitoring

The T1 is equipped with a 4-20mA input dedicated for optional airflow sensor monitoring. Any airflow sensor, that is equipped with a 'loop powered' 4-20mA output, can be connected to the T1. The airflow sensor value can be displayed on the T1 screen and is available on remote communications.

17.14 Pressure Balance Function

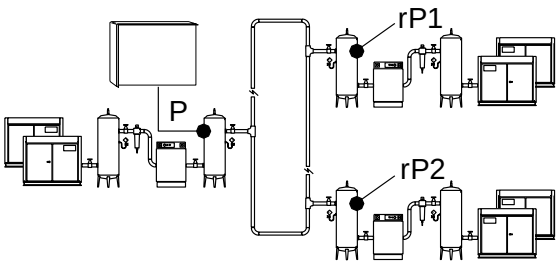


Figure 131 - Pressure Balance Function

The T1 has the capability to monitor up to two remote pressures from compatible compressor controllers, compressor integration units or other remote system automation units.

The remote pressure(s) can be integrated with the primary local pressure to generate a new control pressure value.

The T1 can be instructed to control from the lowest pressure, the highest pressure, or an average of local and remote the pressures.

This function can be used to 'balance' pressure control across a system that has multiple remote compressor rooms and/or where pressure differentials across a site system may vary.

17.15 Zone Control Function

Compressors can be assigned to one of three ‘zones’. The T1 will always attempt to balance utilisation across the zones to maintain, as near as possible, an equal number of utilised compressors in each zone.

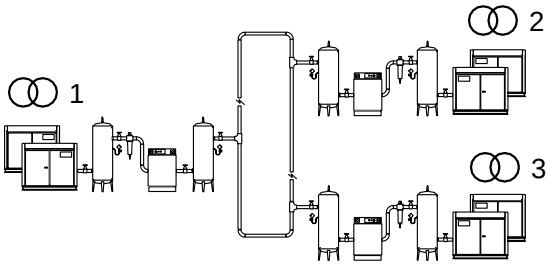


Figure 132 - Zone Control Function

This function is intended for installations that have multiple collections of compressor(s) distributed across a site.

In some instances, large pressure differentials can develop in remote areas of an air network if air generation is concentrated in one area. The aim of the ‘zone’ function is to facilitate a balanced pressure across a site air network by ensuring air generation is distributed.

The ‘zone’ function will operate with all available sequence strategy modes and will work in conjunction with the priority and/or pressure balance function.

The priority function will override ‘zone’ control where a conflict in compressor selection occurs. This may result in unexpected compressor utilisation; this should not be considered abnormal.

The ‘zone’ function can modify compressor selection when using ‘Energy Control’ mode. This may compromise optimum system efficiency in some instances – use ‘zone’ control with caution where system efficiency is important.

17.16 Insufficient Capacity Alarm

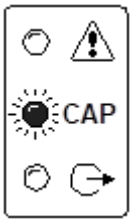


Figure 133 - Insufficient Capacity Alarm

The T1 is equipped with a dedicated ‘Insufficient Capacity’ Advisory Alarm (Warning) indication.

This indication will illuminate (inside of AERO) if all available compressors are loaded and system pressure is continuing to decrease. The indication will generally occur prior to any set low pressure Alarm (Warning) and is intended to provide an advanced warning of a potential ‘Low Pressure’ situation.

The ‘Insufficient Capacity’ advisory alarm is intended as an advanced warning and is not recorded in the fault history log but is included as a Group Alarm (Warning), or Group Fault item.

‘Insufficient Capacity’ is available as a dedicated data communications item and as a dedicated ‘virtual relay’ function.

The ‘Insufficient Capacity’ advisory alarm function can be de-activated. In this instance the unit’s Alarm indicator will still illuminate but no group alarm, group fault, ‘virtual relay’ or remote indication is generated.

17.17 Restricted Capacity Alarm

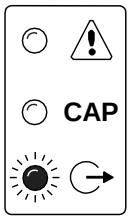


Figure 134 - Restricted Capacity Alarm

The T1 is equipped with a dedicated ‘Restricted Capacity’ Advisory Alarm (Warning) indication.

This indication (inside of AERO) will flash if all available compressors are loaded and further capacity is required but one, or more, compressors are:
a) inhibited from use in a ‘Table’ priority setting
b) inhibited from use by the short-term Service/Maintenance function
c) inhibited from use in the long term maintenance menu.

The ‘Restricted Capacity’ advisory alarm is intended to indicate that all available compressors are already loaded and further capacity is required but one, or more, system compressor(s) have been restricted from use.

The ‘Restricted Capacity’ advisory alarm is not recorded in the fault history log but is included as a Group Alarm (Warning), or Group Fault item.

‘Restricted Capacity’ is available as a dedicated data communications item and as a dedicated ‘virtual relay’ function.

The ‘Restricted Capacity’ advisory alarm function can be de-activated. In this instance the unit’s Alarm indicator will still flash but no group alarm, group fault, ‘virtual relay’ or remote indication is generated.

17.18 Virtual Relay Technology

The T1 is equipped with Virtual Relay technology.

The ‘Virtual Relay’ concept is a configurable system wide automation system. The concept allows output relay functions to be configured to respond to any ‘virtual relay’ condition, status or signal function available in the unit or from another compatible unit on the system network.

18. Operation – T1

18.1 'T1' User interface – Graphical display

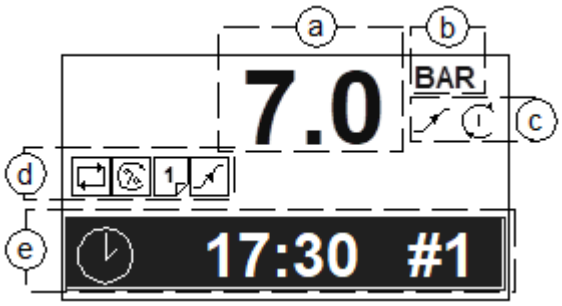


Figure 135 - 'T1' Display

a) System Pressure Value
b) System Pressure Units
c) Unit Status
d) Unit Active Functions
e) User Menu Item

18.2 'T1' Keypad

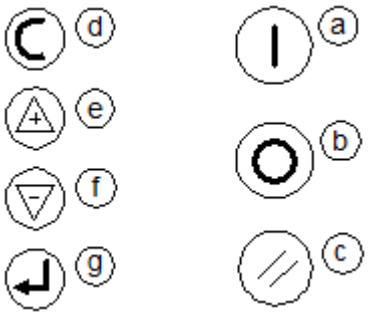


Figure 136 - Keys on the 'T1'

a) Start
b) Stop
c) Reset
d) Escape (Cancel)
e) Up (Plus)
f) Down (Minus)
g) Enter

18.3 Unit Status

System Pressure:

- Increasing to normal operational levels (Prefill, target pressure change or at system start)
- Below the active lower, or load, pressure set point
- Between the lower, or load, and upper, or unload, active pressure set points
- Above the upper, or unload, active pressure set point

Unit Status:

- Stopped
- Standby
- Started and Running
- Alarm (Warning)
- Shutdown (Trip)

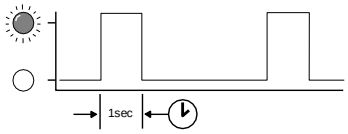
18.4 LED indicators

Indicators

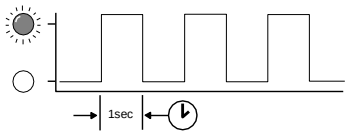
Off

On

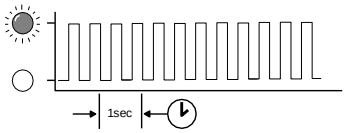
Intermittent:



Slow Flash:



Fast Flash:



18.5 'T1' Unit Indicators

Unit Run Indicator (Green LED)

- OFF – Not Active, Stopped
- Slow Flash: Active, Standby Mode
- ON – Active, Running

Unit Fault Indicator (Red LED)

- Fast Flash: Shutdown (Trip)
  Slow Flash: Alarm (Warning)

The AERO fault indicator does not indicate compressor fault states; see Compressor Status Indicators.

18.6 Asset Status Indicators

On the LED panel on the front door:

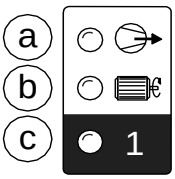


Figure 137 - Per asset - LED indicators

Each compressor in the system has a set of dedicated status indicators. The indicators will continuously show the status of each compressor at all times.

a) Load Status

- OFF – Not Loaded, Offload
- Slow Flash – The compressor has been requested to load but is not loaded (load or re-load delay period)
- ON – Loaded

b) Run Status

- OFF – Not Running
- Slow Flash – The compressor has been requested to load but is not running (blowdown delay or other start delay)
- ON – Running

c) Available (Started)

- OFF – No Compressor Connected
- Fast Flash – Not Available, Shutdown Fault or Stopped
- Slow Flash – Alarm (Warning)
- Intermittent Flash – The compressor has been intentionally removed from service.
- Available, OK

18.7 System alarms

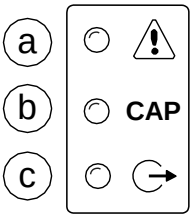


Figure 138 - System LEDs

a) Group Compressor Fault

- OFF – All Compressors OK
- Fast Flash – One or more compressors Not Available, Shutdown Fault or Stopped
- Slow Flash – One or more compressors Alarm (Warning)

b) Insufficient Capacity Alarm (Warning)

- On – Insufficient Capacity

c) Restricted Capacity Alarm (Warning)

- Slow Flash – Restricted Capacity

18.8 Unit Functions

Operating Mode:

- Equal Hours Run
- Timer Rotation
- Energy Control

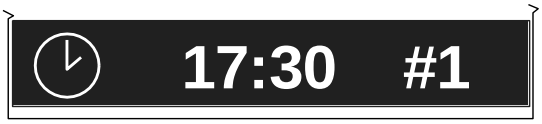
Active Functions:

- Power Failure Auto-Restart
- Table #1 Active
- Table #2 Active
- Table #3 Active
- Table #4 Active
- Table #5 Active
- Table #6 Active
- Standby Mode Active
- Prefill Function
- Zone Function
- Pressure Schedule
- Function Inhibited (manual override)
- Remote Manual Override

18.9 User Menu

A number of User menu information displays are available on the screen of the ‘T1’ that can be accessed directly from the front panel using the Up and Down navigation buttons.

18.9.1 Real Time Clock



17:30 (24hr system)
#1 = Monday to #7 = Sunday

18.9.2 Compressor Detailed Status

Compressor 1
'A' (Duty) sequence assignment
'100%' percentage load

Status Symbol:

Standby
Running, Offload
Running, Loaded

Removed From Service in Table Priority Selection (# = Table Number)

Removed From Service in Long Term Maintenance Menu

Removed From Service by Short Term I-PCB Maintenance Switch Function

Alarm (Warning)

Not Available, Shutdown (Trip), Stopped

Network Communications Error (RS485 connectivity only)

The detailed status of each compressor in the system is shown separately.

18.9.3 Primary Detected Pressure

The pressure detected on the unit's primary pressure sensor.

When using remote pressure balancing functions, the main display 'control' pressure may differ from the primary detected pressure.

18.9.4 Second Pressure Input

The second local pressure value.

18.9.5 Differential Pressure

The differential pressure between the Primary and 2nd Pressure sensor inputs.

Only displayed if the 2nd Pressure sensor function is selected for air treatment pressure differential monitoring.

18.9.6 Remote Pressure #1

The first remote pressure value from a remote source. Used for the Pressure Balance Function.

Only displayed if the Pressure Balance Function is activated and the first remote pressure has been selected.

18.9.7 Remote Pressure #2

The second remote pressure value from a remote source. Used for the Pressure Balance Function.

Only displayed if the Pressure Balance Function is activated and the second remote pressure has been selected.

18.9.8 Next Scheduled Sequence Rotation

The next scheduled sequence rotation:
00:00 Time (24hr system)
#1 Monday

A setting of zero hundred hours (00:00hrs) on Monday (#1) equates to a sequence rotation at one second past midnight on Sunday.

18.10 Information Displays

To view detailed information applicable to the selected User menu display item press Enter.

Press Escape to return to the normal user menu display items.

18.10.1 Real Time Clock

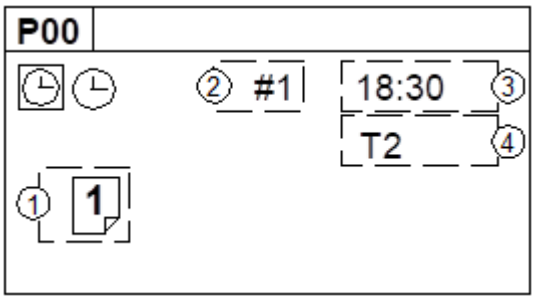


Figure 139 - Information Real Time Clock

Shows the next Pressure Schedule event.

1: The Current Active Table
2: Day (#1=Monday, #7=Sunday)
3: Time (24hr system)
4: Table

Items 2 and 3 show the day and time that the unit will change to use the 'Table' shown in item 4.

18.10.2 Compressor Status

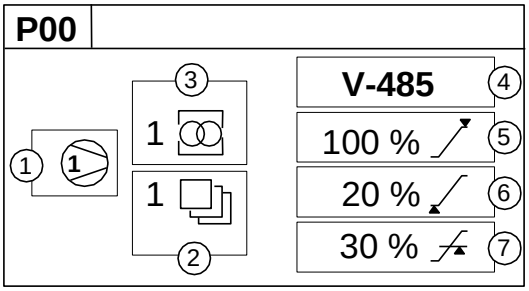


Figure 140 - Information Compressor Status

Compressor Number
2: Priority Setting
3: Zone Allocation Setting
4: Compressor/Connection Type
5: Maximum Capacity % Setting
6: Minimum Capacity % Setting
7: Minimum Efficiency % Setting

Item values 6 and 7 are only shown if compressor type is V-485 (variable capacity/speed).

18.10.3 Primary Detected Pressure

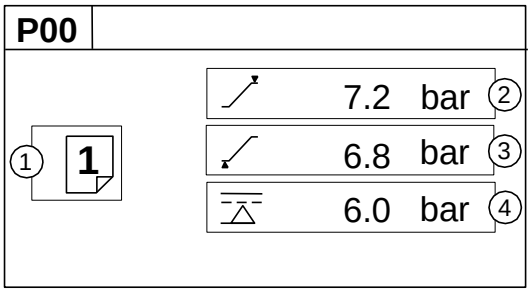


Figure 141 - Information Primary Detected Pressure

1: Active Table
2: Upper (Unload) Pressure Set Point
3: Lower (Load) Pressure Set Point
4: Minimum Pressure Alarm (Warning)

18.10.4 Differential Pressure

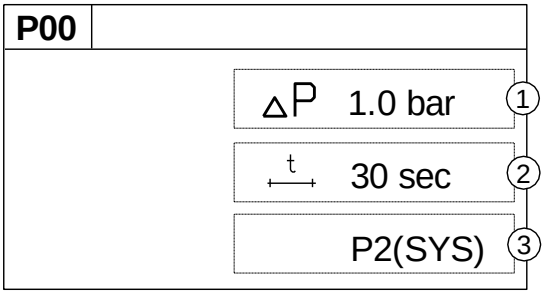


Figure 142 - Information Differential Pressure

1: Alarm (Warning) Level
2: Alarm (Warning) Delay Time
3: Source of 2nd Pressure

Only show if the 2nd pressure sensor is activated in air treatment pressure differential mode.

18.10.5 First Remote Pressure

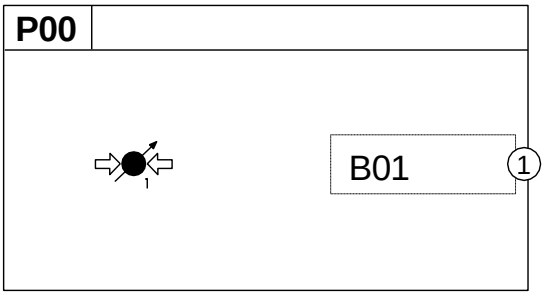


Figure 143 - Information 1st Remote Pressure

1: Source of 1st Remote Pressure

Only show if pressure balancing function active.

18.10.6 Second Remote Pressure

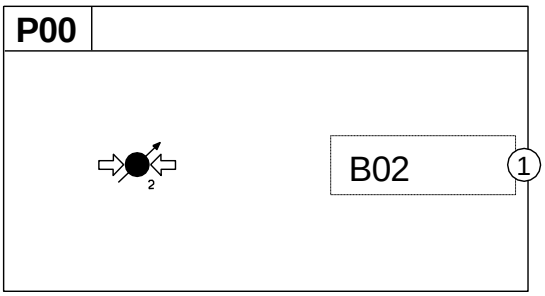


Figure 144 - Information 2nd Remote Pressure

1: Source of 2nd Remote Pressure

Only show if pressure balancing function active and 2nd remote pressure in use

18.10.7 Sequence Rotation

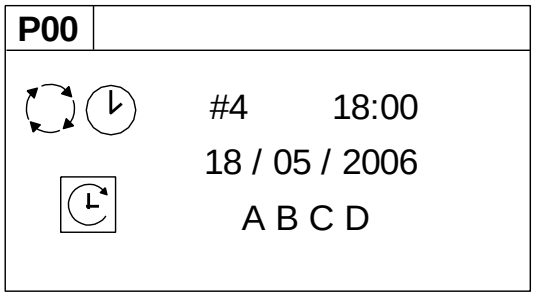


Figure 145 - Information - Sequence rotation

Day of the week (#4: Thursday), the time of day (18:00) and the date (18/05/2006) of the next automated sequence rotation event.

The active 'mode' of operation

"**ABCD**" The current active rotation sequence assignment.

18.11 Manual Sequence Rotation

The sequence assignment can be manually rotated at any time. When viewing the 'Sequence Rotation' information screen press Enter:

The manual rotation symbols will appear and flash. Press Enter again to execute a manual rotation or Escape to abandon the manual rotation.

Automated sequence rotation is not disrupted by a manual rotation; the next scheduled automated sequence rotation event will still occur.

18.12 Asset Identification

Each compressor connected to the AERO will have a unique assigned compressor identification number; starting at compressor 1 increasing sequentially to the number of compressors connected to the AERO.

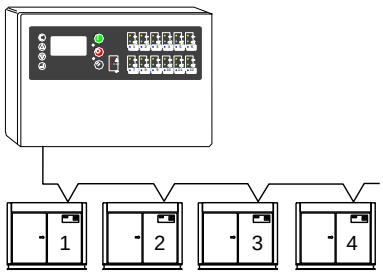


Figure 146 - Compressor identification for the T1

18.13 Stop

To stop the AERO press the Stop button.
The AERO will respond dependant on the setup of item ‘CF’ in menu S02:

✗ Pressure regulation control is automatically transferred back to each compressor. The compressor(s) will continue to operate using the pressure settings programmed or set in the individual compressor controller(s).

✓ The AERO will hold each compressor in an offload state. If the compressor is equipped with a main motor run-on-time function the compressor will run offload for a period of time and then stop in to a ‘standby’ or ‘auto restart’ state.

18.14 Start

To start the AERO press the Start button.
If the ‘Start Function’ is enabled there will be a period of time before any compressor is requested to load

To manually skip the Start function, press and hold Start for several seconds.

If the Prefill function is enabled, and system pressure is below the set prefill pressure, the system will enter Prefill mode for the set Prefill time.

18.15 Pre-Fill

To manually skip the Prefill function, press and hold Start for several seconds.

When Prefill is complete, if applicable, the AERO will enter normal operating mode.

The AERO will operate in accordance with the parameters and options set in the active ‘Table’.

General note: Each Asset in the system must be started (running or in a standby or auto restart condition) before AERO control of the Asset can be established.

18.16 Power Failure and Auto-Restart

If the power failure auto-restart function is enabled the AERO will automatically start, when power is restored after a disruption or failure, if the AERO was in a ‘started’ state when the power disruption or failure occurred.

The AERO will not automatically restart if the AERO was in a stopped state when the power disruption or failure occurred.

18.17 Failure Mode

If the AERO experiences a disruption to normal control, or an AERO shutdown fault occurs, pressure regulation control is automatically transferred back to each compressor. The compressor(s) will continue to operate using the pressure settings programmed or set in the individual compressor controller(s).

18.18 Reset

To reset an AERO Alarm (Warning) or Shutdown condition press Reset.

Compressor Alarm (Warning) conditions are automatically reset when the condition has been resolved and reset on the compressor.

Compressor Not Available (Shutdown, Trip) conditions are automatically reset when the condition has been resolved and reset on the compressor; and the compressor has been restarted.

18.19 Asset Fault Indications

Asset fault conditions are displayed by the Asset indicators and in the user menu status screen. Compressor fault conditions are not regarded as AERO unit fault conditions

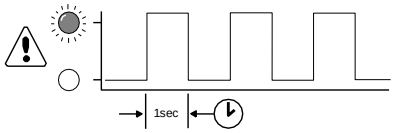
18.20 Fault Codes

Fault codes are separated in to unit faults ‘**ERR**’ and system Alarms (Warning) ‘**SYS**’.

ERR: Unit faults are errors with the AERO controller itself and are all conditions that prevent normal operation from continuing.
SYS: System faults are items that arise from conditions external to the AERO controller; the AERO itself continues to function correctly.

There are two types of Fault condition:

Alarm (Warning):

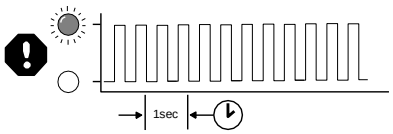


The Fault LED will ‘slow flash’ to indicate an Alarm (Warning) condition. An Alarm (Warning) indicates that the AERO is continuing with normal operation but user attention is required.

All Alarm (Warning) conditions are registered in the AERO Error Log.

All Alarm (Warning) conditions must be manually reset.

Trip (Shutdown):



The Fault LED will ‘fast flash’ to indicate a Trip (Shutdown) condition.

A Trip (Shutdown) condition will stop normal operation of the AERO. Pressure regulation control will automatically revert to the individual compressors that will continue to operate using the pressure settings for their own control systems.

All Trip (Shutdown) conditions are registered in the AERO Error Log. All Trip (Shutdown) conditions must be manually reset.

Codes:

Each individual fault has a unique numeric code.

ERR.01 Pressure Sensor Fault

The signal from the control pressure sensor is out-of-range (<3.5mA or >21.8mA).

ERR.02 Flow Sensor Fault

The signal from the airflow sensor is out-of-range (<3.5mA or >21.8mA).

ERR.03 2nd Pressure Sensor Fault

The signal from the 2nd pressure sensor is out-of-range (<3.5mA or >21.8mA).

ERR.04 Internal 24V Fault

The 24VDC power supply, internal to the unit’s controller, is below 19.2V (internal controller fault)

ERR.05 Emergency Stop

The wire link between terminals ‘+C’ and ‘C1’ of the unit’s controller is open circuit. These terminals are permanently connected together on the AERO Terminal PCB: this error will never occur in normal operational circumstances.

ERR.06 Real Time Clock Error

The Real Time Clock device, internal to the unit’s controller, has failed.

ERR.07 XPM-LED Module Error

Data communications with the internal XPM-LED (Status LED Display) module have been disrupted or lost.

ERR.08 XPM-Di8R4 Module

Data communications with the internal XPM-Di8R4 module have been disrupted or lost.

ERR.09 XPM-Di8R4 Module

Short Circuit condition detected on internal XPM-Di8R4 module.

ERR.10 I-PCB Expansion Module C1-4

Data communications with the external I-PCB Expansion module ‘C:1-4’ have been disrupted or lost.

ERR.11 I-PCB Expansion Module C1-4

Short Circuit condition detected on external I-PCB Expansion module ‘C:1-4’.

ERR.12 I-PCB Expansion Module C5-8

Data communications with the external I-PCB Expansion module ‘C:5-8’ have been disrupted or lost.

ERR.13 I-PCB Expansion Module C5-8

Short Circuit condition detected on external I-PCB Expansion module ‘C:5-8’.

ERR.14 I-PCB Expansion Module C9-12

Data communications with the external I-PCB Expansion module ‘C:9-12’ have been disrupted or lost.

ERR.15 I-PCB Expansion Module C9-12

Short Circuit condition detected on external I-PCB Expansion module ‘C:9-12’.

SYS.01 Excess Pressure (PM)

Pressure has exceeded the set Maximum Pressure Limit.

SYS.02 Min Pressure (Pm)

Pressure has fallen below the set Minimum Pressure Limit (see ‘Tables’)

SYS.03 Start Function Feedback

Start Function Feedback signal did not occur or has been lost during operation.

SYS.04 Capacity Alarm (Warning)

Insufficient Capacity; all available compressors are loaded and pressure is still decreasing.

SYS.05 Remote Alarm (Warning)

Auxiliary Input Function ‘AA’

The auxiliary Input is set for ‘Alarm (always active)’ function and is in a Fault condition.

SYS.06 Remote Alarm (Warning)

Auxiliary Input Function ‘AR’

The auxiliary Input is set for ‘Alarm (active when unit running)’ function and is in a Fault condition.

SYS.07 Remote Trip (Shutdown)

Auxiliary Input Function ‘TA’

The auxiliary Input is set for ‘Trip/Shutdown (always active)’ function and is in a Fault condition.

SYS.08 Remote Trip (Shutdown)

Auxiliary Input Function ‘TR’

The auxiliary Input is set for ‘Trip/Shutdown (active when unit is running)’ function and is in a Fault condition.

18.21 Internal ‘T1’ Fault Codes

‘**E**’ code errors are specific to the unit’s ‘internal to controller’ digital logic circuits and will only occur in the most exceptional of circumstances.

All ‘E’ code conditions are Trip (Shutdown) type faults. The ‘Fault’ (red) LED will ‘fast flash’ and the condition is registered in the Error Log. If an ‘E’ code fault condition persists, consult your product supplier for advice or renew the unit’s controller.

E0836 PLL Unlock; Internal failure or excessively high external electrical interference detected.

The main timing circuit (processor clock) has been disrupted and the processor is running on an ‘internal to chip’ back-up clock.

The back-up clock is intended to keep the processor running, at a much slower processing speed, to enable emergency actions to be taken. The controller is unable to continue running the main software application in this condition.

The unit will Shutdown; compressors will continue to operate using local pressure regulation.
The controller’s main power supply must be removed and re-applied to reset this condition.

E0866 Controller internal power supply fault

The low voltage logic processing power supply, internal to the unit’s controller, is below minimum operational levels; internal to controller fault. Renew the controller if this fault condition persists. The Trip must be manually reset from the keypad.

E5000 Internal memory map error

The unit’s controller has detected disruption to the internal operational memory storage (RAM). The integrity of the RAM memory contents are suspect; the

controller must be reset to clear and re-map the memory. Renew the controller if this fault condition persists.

The controller's main power supply must be removed and re-applied to reset this condition

E5001 Internal memory failure
The unit's controller has detected disruption to the internal permanent application memory storage (FLASH). The integrity of the FLASH memory contents is suspect. Re-load the main application software in the first instance; re-new the controller if the condition persists.
The controller's main power supply must be removed and re-applied to reset this condition.

19. Functionalities on Local AERO Screen

This chapter provides an brief overview of the functionalities provided by the local AERO screen.

19.1 Dashboard

Figure 147 - Standard dashboard

The default view is the “dashboard”

Note following areas:

1) Access to Menu
2) Status and Utilisation view of the Assets
    a. General status of the system on top
    b. Per asset: %load, Name
3) Tabs: Dashboard and Events
    a. By default Dashboard is shown
    b. Events overview can be accessed via Events tab
4) System Control
    a. Have control of the Assets or not
5) Performance gauges
    a. Parameters related to ‘Performance’; Flow, Power consumption and Efficiency
6) Health gauges
    a. Parameters related to System Pressure, % Capacity, Dewpoint, Differential Pressure, Temperature
7) User log on and settings

19.2 Trending view

When clicking on one of the gauges, one gets a view of the parameter over time.

On the local AERO, data is stored over 1 week.

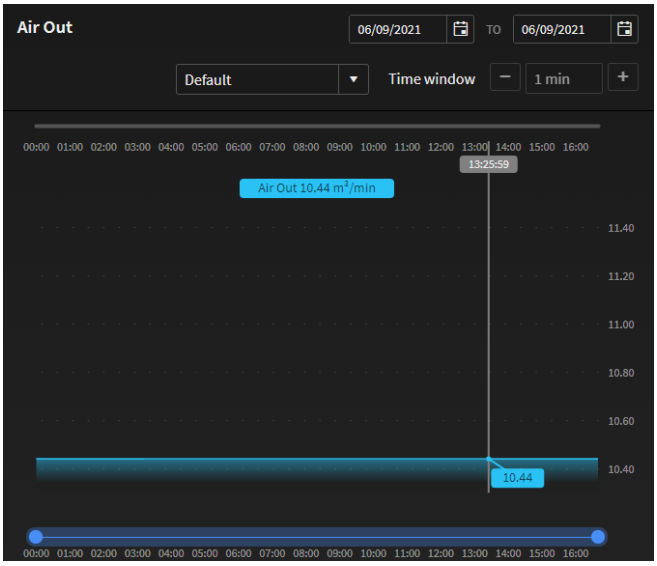


Figure 148 - Parameter - trending over time

You can select which time frame to look at (using the dates on right top)

You have normal view or averaged, minimum or maximum value view (using the drop down and the linked Time Window.

One can always return to the dashboard using “Back to Overview”

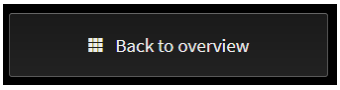


Figure 149 - Go back to the dashboard

19.3 The Menu Items

Seen as Admin:

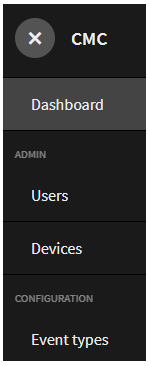


Figure 150 - Menu items for admin user

Seen as User level user:

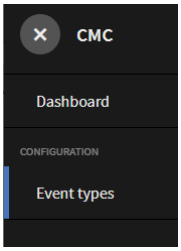


Figure 151 - Menu times for User level user

19.4 Users log on and off

Click the User log on and settings button:

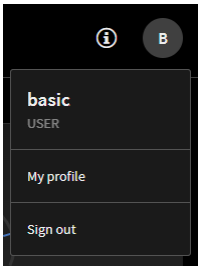


Figure 152 - Logging out ... see profile

When logging out, consequently you have to re-log on when working on a PC connected to the Local LAN or, only on the local physical LCD screen, you arrive on the dashboard in view-only mode.

You can also adapt your own user profile using “My profile”.

19.5 Devices

The Menu provides “Devices” (see Figure 150 - Menu items for admin user) for Admin Users.

All functionalities are explained in detail in 14 Step 1: Configure The AERO ‘T1’

19.6 Users

The Menu provides “Users” (see Figure 150 - Menu items for admin user) for Admin Users.

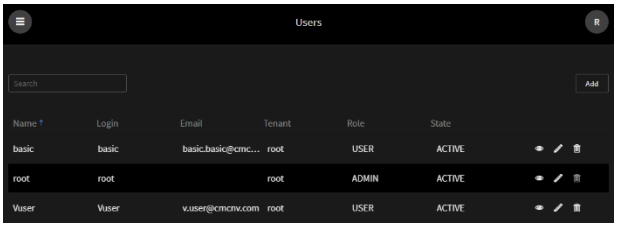
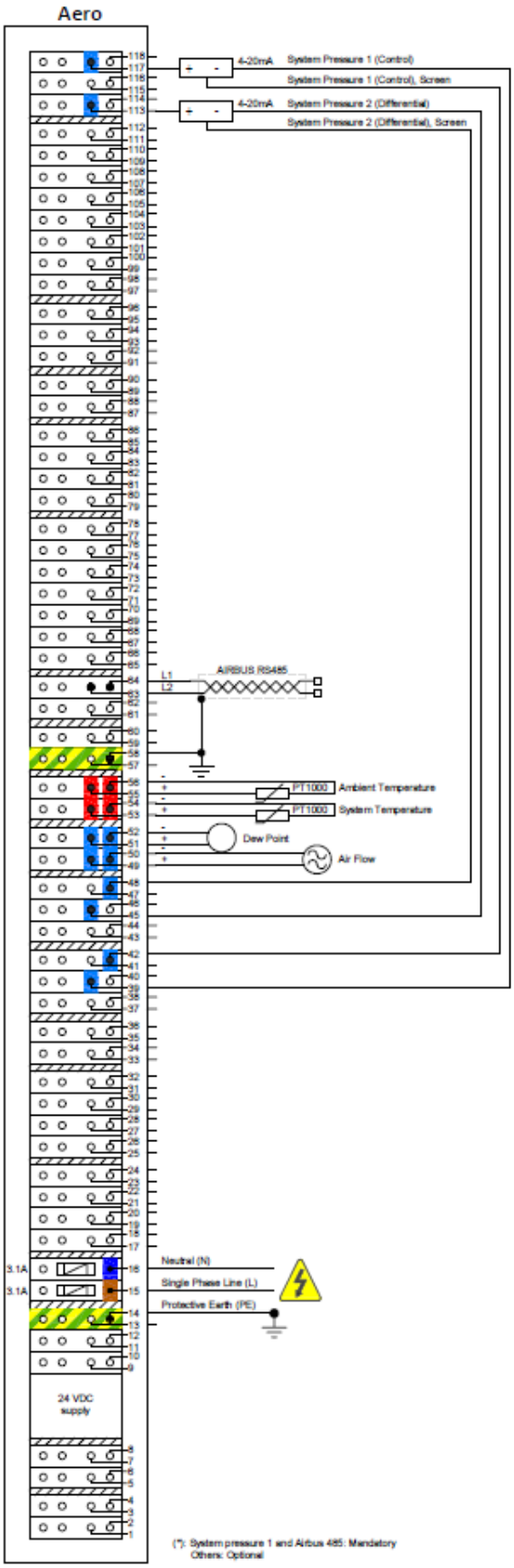


Figure 153 - User Management

You can:

- Add users using Add
- Look at user parameters using
- Edit user parameters using
- Delete a user using

20. Connection with typical sensors



21. Enclosure dimensions

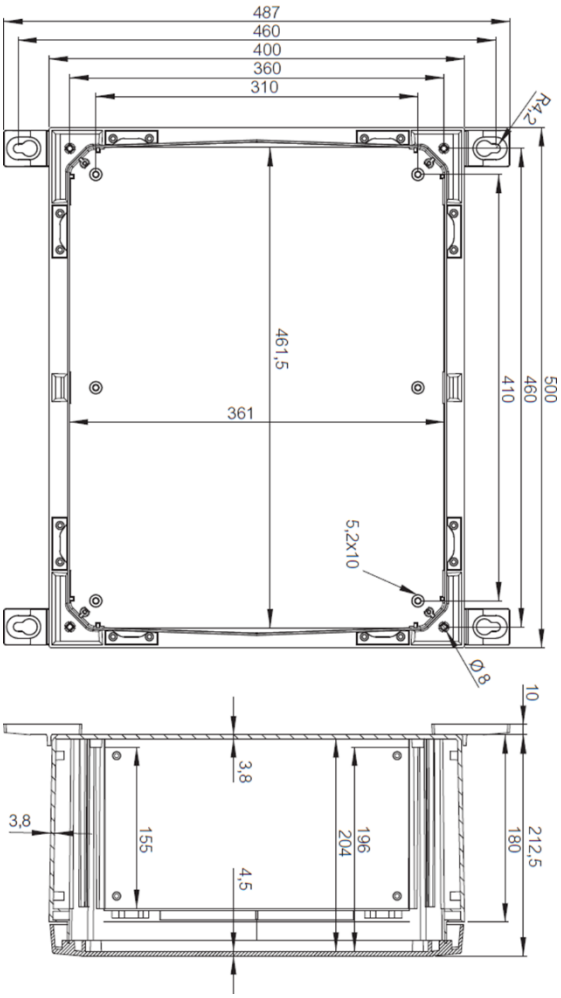


Figure 154 - Enclosure Dimensions

22. Asset Information

The following tables are provided to annotate information used as part of AERO's configuration. It's also a
useful aid memoir and may be necessary when seeking 3rd party assistance, support or service.

For up to 12 Assets, fill in following form

ASSET ID	TEXT
AERO 'T1' ADDRESS	NO
MANUFACTURER	TEXT
MODEL / TYPE	TEXT
WORKING PRESSURE	BAR/PSI
FULL LOAD CAPACITY	m³/min / cfm
FULL LOAD POWER	kW
MINIMUM LOAD CAPACITY	m³/min / cfm
MINIMUM LOAD POWER	kW
OFF LOAD POWER	kW

23. Tenant

Users, Devices (AirTAG, UniTAG) and related Data all reside within a "Tenant".

Tenants are physically separated data spaces with a separate URL, own users, separate application management and no sharing of data by default.

Users in a single tenant by default share the same URL and the same data space.

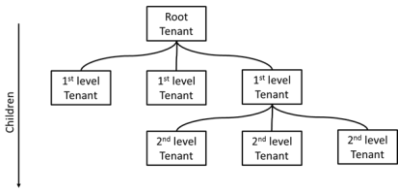


Figure 155 - Tenant Structure

24. Connections, main I/O

We first have a detailed look at the connections on the terminal block.

24.1 Terminal Block

ID	Assignment	ID	Assignment
1	V+ (+24V)	2	NOT USED
3	V+ (+24V)	4	NOT USED
5	V- (0V)	6	NOT USED
7	V- (0V)	8	NOT USED
9	LIVE (L)	10	LIVE (L)
11	NEUTRAL (N)	12	NEUTRAL (N)
13	PROTECTIVE EARTH (PE)	14	PROTECTIVE EARTH (PE)
15	SINGLE PHASE LIVE (L)	16	NEUTRAL (N)
17	UNI, X01, RELAY 1, C	18	UNI, X01, RELAY 1, NC
19	UNI, X01, RELAY 1, NO / RELAY 2, C	20	UNI, X02, RELAY 2, NC
21	UNI, X01, RELAY 2, NO	22	UNI, X01, RELAY 3, C
23	UNI, X01, RELAY 3, NO	24	NOT USED
25	UNI, X02, DIGITAL INPUT 1, + (+V)	26	UNI, X02, DIGITAL INPUT 1, - (0V)
27	UNI, X03, DIGITAL INPUT 2, + (+V)	28	UNI, X03, DIGITAL INPUT 2, - (0V)
29	UNI, X04, DIGITAL INPUT 3, + (+V)	30	UNI, X04, DIGITAL INPUT 3, - (0V)
31	UNI, X05, DIGITAL INPUT 4, + (+V)	32	UNI, X05, DIGITAL INPUT 4, - (0V)
33	UNI, X06, GROUND (FLOW SENSOR)	34	UNI, X06, 24V DC OUT (FLOW SENSOR)
35	UNI, X07, GROUND (GATEWAY)	36	UNI, X07, 24V DC OUT (GATEWAY)
37	NOT USED	38	NOT USED
39	UNI, X11, IIN1, SYSTEM PRESSURE 1 (CONTROL), -	40	NOT USED
41	NOT USED	42	UNI, X11, SYSTEM PRESSURE 1 (CONTROL), SCREEN
43	NOT USED	44	NOT USED
45	UNI, X12, IIN2, SYSTEM PRESSURE 2 (DIFF.), -	46	NOT USED
47	NOT USED	48	UNI, X12, SYSTEM PRESSURE 1 (DIFF.), SCREEN
49	UNI, X13, SYSTEM AIR FLOW +	50	UNI, X13, SYSTEM AIR FLOW, -
51	UNI, X13, SYSTEM DEW POINT, +	52	UNI, X13, SYSTEM DEW POINT, -
53	UNI, X16, SYSTEM TEMPERATURE, +	54	UNI, X16, SYSTEM TEMPERATURE, -
55	UNI, X16, AMBIENT TEMPERATURE, +	56	UNI, X16, AMBIENT TEMPERATURE, -
57	UNI, X17, SCREEN	58	UNI, X18, SCREEN
59	UNI, X18, L2 (/B) MODBUS	60	UNI, X18, L1 (/A) MODBUS
61	UNI, X17, L2 (/B) AIRBUS	62	UNI, X17, L1 (/A) AIRBUS
63	AERO, T1, X07, L2 (/B) AIRBUS	64	AERO, T1, X07, L1 (/A) AIRBUS
65	AERO, Di8R4, X03, VIRTUAL RELAY INPUT 4, C+	66	AERO, Di8R4, X03, VIRTUAL RELAY INPUT 4
67	AERO, Di8R4, X03, VIRTUAL RELAY INPUT 3, C+	68	AERO, Di8R4, X03, VIRTUAL RELAY INPUT 3
69	AERO, Di8R4, X03, VIRTUAL RELAY INPUT 2, C+	70	AERO, Di8R4, X03, VIRTUAL RELAY INPUT 2
71	AERO, Di8R4, X03, VIRTUAL RELAY INPUT 1, C+	72	AERO, Di8R4, X03, VIRTUAL RELAY INPUT 1
73	AERO, Di8R4, X03, START FEEDBACK, C+	74	AERO, Di8R4, X03, START FEEDBACK
75	AERO, Di8R4, X03, TABLE 6, C+	76	AERO, Di8R4, X03, TABLE 6
77	AERO, Di8R4, X03, TABLE 5, C+	78	AERO, Di8R4, X03, TABLE 5
79	AERO, Di8R4, X02 (R1), RELAY 7, C	80	AERO, Di8R4, X02 (R1), RELAY 7
81	AERO, Di8R4, X02 (R2), RELAY 8, C	82	AERO, Di8R4, X02 (R2), RELAY 8
83	AERO, Di8R4, X02 (R3), RELAY 9, C	84	AERO, Di8R4, X02 (R3), RELAY 9
85	AERO, Di8R4, X02 (R4), RELAY 10, C	86	AERO, Di8R4, X02 (R4), RELAY 10
87	AERO, T1, X02, RELAY 6	88	AERO, T1, X02, RELAY 6, C
89	AERO, T1, X02, RELAY 5	90	AERO, T1, X02, RELAY 5, C
91	AERO, T1, X03, RELAY 4	92	AERO, T1, X03, RELAY 4, C
93	AERO, T1, X03, RELAY 3	94	AERO, T1, X03, RELAY 2
95	AERO, T1, X03, RELAY 1, 2, 3 C	96	AERO, T1, X03, RELAY 1
97	AERO, T1, X04, TABLE 4, C+	98	AERO, T1, X04, TABLE 4
99	AERO, T1, X04, TABLE 3, C+	100	AERO, T1, X04, TABLE 3
101	AERO, T1, X04, TABLE 2, C+	102	AERO, T1, X04, TABLE 2
103	AERO, T1, X04, TABLE 1, C+	104	AERO, T1, X04, TABLE 1
105	AERO, T1, X04, STANDBY, C+	106	AERO, T1, X04, STANDBY
107	AERO, T1, X04, SEQUENCE CHANGE, C+	108	AERO, T1, X04, SEQUENCE CHANGE
109	AERO, T1, X04, REMOTE START, C+	110	AERO, T1, X04, REMOTE START
111	AERO, T1, X04, REMOTE STOP, C+	112	AERO, T1, X04, REMOTE STOP
113	AERO, T1, X05, SYSTEM PRESSURE 2 (DIFF.), +	114	NOT USED
115	NOT USED	116	NOT USED
117	AERO, T1, X05, SYSTEM PRESSURE 1 (CONTROL), +	118	NOT USED

24.2 UniTAG Connections

24.2.1 Relays UniTAG

17	UNI, X01, RELAY 1, C	18	UNI, X01, RELAY 1, NC
19	UNI, X01, RELAY 1, NO / RELAY 2, C	20	UNI, X02, RELAY 2, NC
21	UNI, X01, RELAY 2, NO	22	UNI, X01, RELAY 3, C
23	UNI, X01, RELAY 3, NO	24	NOT USED

Specifications: All relays: 240V max, 8A max

Functionality:

Relay 1 System Status
OFF: No Assets in the asset group detected as 'Running'
ON: One or more Assets are detected as 'Running'

Relay 2 Dewpoint management
Only available if Dewpoint sensor connected

Relay 3 Drain Valve (condensate management)

Relay operation is configured in AirCloud under "Edit System" – "Function Settings" (specific for Relay 2 and relay 3)

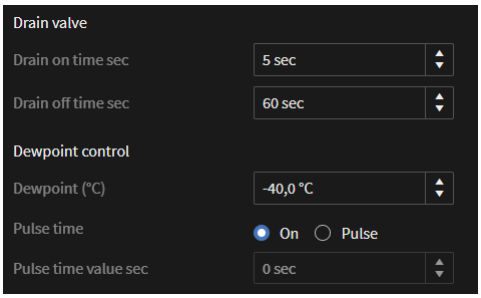


Figure 156 - Configuration of Relay 2 and 3 on UniTAG

Pulse time = ON
R2 will switch on, and remain on, while the detected dewpoint exceeds the set 'Dewpoint' setting.

Pulse time = PULSE
R2 with switch on for the set 'Pulse Time' when the detected dewpoint exceeds the 'Dewpoint' Setting. The detected dewpoint must first reduce to, or below, the set dewpoint setting before R2 will pulse again when the dewpoint increases.

If one or more assets are detected as 'Running' R3 continuously cycles on and off in accordance with the set 'Drain On Time' and 'Drain Off Time'. The cycle begins with the 'Drain On Time'.

24.2.2 Digital Inputs UniTAG

25	UNI, X02, DIGITAL INPUT 1, + (+V)	26	UNI, X02, DIGITAL INPUT 1, - (0V)
27	UNI, X03, DIGITAL INPUT 2, + (+V)	28	UNI, X03, DIGITAL INPUT 2, - (0V)
29	UNI, X04, DIGITAL INPUT 3, + (+V)	30	UNI, X04, DIGITAL INPUT 3, - (0V)
31	UNI, X05, DIGITAL INPUT 4, + (+V)	32	UNI, X05, DIGITAL INPUT 4, - (0V)

Specifications: Volt free contact, 24-240V AC/DC, CATIII

Digital Inputs will trigger an Alarm(warning) event when the Digital Input goes active.

Digital Input operation is configured in AirCloud under "Edit System" – "Function Settings"

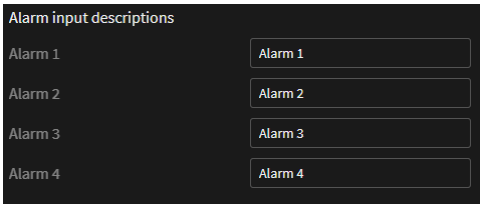


Figure 157 - Digital Input UniTAG configuration in AirCloud

24.2.3 Power out

33	UNI, X06, GROUND (FLOW SENSOR)	34	UNI, X06, 24V DC OUT (FLOW SENSOR)
35	UNI, X07, GROUND (GATEWAY)	36	UNI, X07, 24V DC OUT (GATEWAY)

2 power outputs are provided. Voltage value = 24V DC.
These outputs are specifically used for powering the Flow Sensor and the Gateway.

Specifications: The combined consumed power is 19 W maximum.

24.2.4 Pressure Sensors Inputs UniTAG

This topic is closely related to 24.4.3 Pressure Sensors T1

37	NOT USED	38	NOT USED
39	UNI, X11, IIN1, SYSTEM PRESSURE 1 (CONTROL), -	40	NOT USED
41	NOT USED	42	UNI, X11, SYSTEM PRESSURE 1 (CONTROL), SCREEN
43	NOT USED	44	NOT USED
45	UNI, X12, IIN2, SYSTEM PRESSURE 2 (DIFF.), -	46	NOT USED
47	NOT USED	48	UNI, X12, SYSTEM PRESSURE 1 (DIFF.), SCREEN

In AERO, Pressure Sensors are connected both to the UniTAG and to the T1, using the “floating input” capability of the UniTAG’s inputs X11 and X12.
Pressure sensors are 4..20 mA loop powered sensors only. The current these sensors generate are routed through the UniTAG and through the T1.

The “SCREEN” connections are to be used to connect pressure sensor cable screenings.

Specifications: Loop powered 4..20 mA sensors.
Recommended range: 0 .. 16 bar[3].

24.2.5 System Air Flow and Dewpoint inputs

49	UNI, X13, SYSTEM AIR FLOW +	50	UNI, X13, SYSTEM AIR FLOW, -
51	UNI, X13, SYSTEM DEW POINT, +	52	UNI, X13, SYSTEM DEW POINT, -

Specifications: Loop powered 4..20 mA sensors.

24.2.6 Temperature inputs

53	UNI, X16, SYSTEM TEMPERATURE, +	54	UNI, X16, SYSTEM TEMPERATURE, -
55	UNI, X16, AMBIENT TEMPERATURE, +	56	UNI, X16, AMBIENT TEMPERATURE, -

Specifications: PT1000 temperature sensor(s)

In AERO, there is one Temperature gauge (both on the local AERO screen and on AirCloud) which relates to System Temperature. Ambient Temperature sensor data is implemented for future use.

[3] Other ranges require configuration adaptation

24.2.7 RS485 Connections

57	UNI, X17, SCREEN	58	UNI, X18, SCREEN
59	UNI, X18, L2 (/B) MODBUS	60	UNI, X18, L1 (/A) MODBUS
61	UNI, X17, L2 (/B) AIRBUS	62	UNI, X17, L1 (/A) AIRBUS
63	AERO, T1, X07, L2 (/B) AIRBUS	64	AERO, T1, X07, L1 (/A) AIRBUS

The “SCREEN” connections are to be used to connect RS485 cable screenings.

The connection
“61 UNI, X17, L2 (/B) AIRBUS”
is internally connected to
“63 AERO, T1, X07, L2 (/B) AIRBUS“
Which is a connection of the T1.

The connection
“62 UNI, X17, L1 (/A) AIRBUS”
is internally connected to
“64 AERO, T1, X07, L1 (/A) AIRBUS”
Which is a connection of the T1.

The connections “61 UNI, X17, L2 (/B) AIRBUS” and “62 UNI, X17, L1 (/A) AIRBUS” are used for connecting Metacentre Interfaces.

The connections “59 “UNI, X18, L2 (/B) MODBUS“ and “60 UNI, X18, L1 (/A) MODBUS“ are used for connecting Modbus based sensors for UniTAG.

24.3 Di8R4 Connections

The Di8R4 can be seen as an extension to the T1, adding 8 digital inputs and 4 relay outputs used by T1.

24.3.1 Virtual Relay Inputs

65	AERO, Di8R4, X03, VIRTUAL RELAY INPUT 4, C+	66	AERO, Di8R4, X03, VIRTUAL RELAY INPUT 4
67	AERO, Di8R4, X03, VIRTUAL RELAY INPUT 3, C+	68	AERO, Di8R4, X03, VIRTUAL RELAY INPUT 3
69	AERO, Di8R4, X03, VIRTUAL RELAY INPUT 2, C+	70	AERO, Di8R4, X03, VIRTUAL RELAY INPUT 2
71	AERO, Di8R4, X03, VIRTUAL RELAY INPUT 1, C+	72	AERO, Di8R4, X03, VIRTUAL RELAY INPUT 1

The Di8R4 is equipped with four remote ‘digital’ inputs (D1 to D4) that can be used as ‘input functions’ for any Virtual Relay – local or remote.

Refer to the Virtual Relay Automation documentation

Specifications: Remote Volt Free switching contact, minimum 24 VDC @ 10 mA.

24.3.2 Functional Relay Inputs

These Inputs are closely related to 24.4.2 Digital Inputs T1

73	AERO, Di8R4, X03, START FEEDBACK, C+	74	AERO, Di8R4, X03, START FEEDBACK
75	AERO, Di8R4, X03, TABLE 6, C+	76	AERO, Di8R4, X03, TABLE 6
77	AERO, Di8R4, X03, TABLE 5, C+	78	AERO, Di8R4, X03, TABLE 5

Table #5: “77 AERO, Di8R4, X03, TABLE 5, C+” and “78 AERO, Di8R4, X03, TABLE 5”
Activates Table #5 when held closed.

Table #6: “75 AERO, Di8R4, X03, TABLE 6, C+” and “76 AERO, Di8R4, X03, TABLE 6”
Activates Table #6 when held closed.

Start Function Feedback Input: “73 AERO, Di8R4, X03, START FEEDBACK, C+” and “74 AERO, Di8R4, X03, START FEEDBACK”

Closed: Feedback
Open: Fault
See also 17.10 Start Function

Specifications: Remote Volt Free switching contact, minimum 24 VDC @ 10 mA.

24.3.3 Relay Outputs

79	AERO, Di8R4, X02 (R1), RELAY 7, C	80	AERO, Di8R4, X02 (R1), RELAY 7
81	AERO, Di8R4, X02 (R2), RELAY 8, C	82	AERO, Di8R4, X02 (R2), RELAY 8
83	AERO, Di8R4, X02 (R3), RELAY 9, C	84	AERO, Di8R4, X02 (R3), RELAY 9
85	AERO, Di8R4, X02 (R4), RELAY 10, C	86	AERO, Di8R4, X02 (R4), RELAY 10

As standard, the Xi8R4 is supplied with the following relay output defaults:

R7: General Fault
ON: System Alarm/Trip or Compressor Alarm/Trip
OFF: OK

R8: Auxiliary Start Time Output
ON: Start Time or Pre-Fill or Normal Operation
OFF: Stopped or Standby or Shutdown

R9: Low Pressure Alarm
ON: Low Pressure Alarm
OFF: OK

R10: Differential Pressure Alarm
ON: High Differential Pressure Alarm
OFF: OK

Specifications: remote output relay contacts are rated for 240V ‘CE’ / 115V ‘UL’ @ 4A maximum.

24.4 T1 Connections

24.4.1 Relays Outputs T1

87	AERO, T1, X02, RELAY 6	88	AERO, T1, X02, RELAY 6, C
89	AERO, T1, X02, RELAY 5	90	AERO, T1, X02, RELAY 5, C
91	AERO, T1, X03, RELAY 4	92	AERO, T1, X03, RELAY 4, C
93	AERO, T1, X03, RELAY 3	94	AERO, T1, X03, RELAY 2
95	AERO, T1, X03, RELAY 1, 2, 3 C	96	AERO, T1, X03, RELAY 1

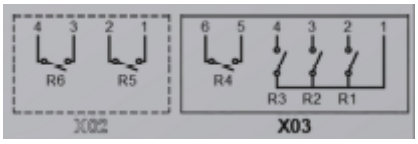


Figure 158 - Clarification relay in T1

As standard, the Xi8R4 is supplied with the following relay output defaults:

R1: Unit RUNNING
ON: Standby or Start Time or Pre-Fill or Normal Operation
OFF: Stopped or Shutdown

R2: Control ON
ON: Start Time or Pre-Fill or Normal Operation
OFF: Standby or Stopped or Shutdown

R3: General Trip (normally closed)
ON: OK
OFF: System Trip or Compressor Trip

R4: Unit RUNNING
ON: Standby or Start Time or Pre-Fill or Normal Operation
OFF: Stopped or Shutdown

R5: Control ON
ON: Start Time or Pre-Fill or Normal Operation
OFF: Standby or Stopped or Shutdown

R6: General Trip
ON: System Trip or Compressor Trip
OFF: OK

Specifications: R1, R2 and R3 remote output relay contacts are rated for 24Vac/dc @ 4A maximum. The maximum current on 'RC' must not exceed 8A.

24.4.2 Digital Inputs T1

These Inputs are closely related toFunctional Relay Inputs24.3.2 Functional Relay Inputs

97	AERO, T1, X04, TABLE 4, C+	98	AERO, T1, X04, TABLE 4
99	AERO, T1, X04, TABLE 3, C+	100	AERO, T1, X04, TABLE 3
101	AERO, T1, X04, TABLE 2, C+	102	AERO, T1, X04, TABLE 2
103	AERO, T1, X04, TABLE 1, C+	104	AERO, T1, X04, TABLE 1
105	AERO, T1, X04, STANDBY, C+	106	AERO, T1, X04, STANDBY
107	AERO, T1, X04, SEQUENCE CHANGE, C+	108	AERO, T1, X04, SEQUENCE CHANGE
109	AERO, T1, X04, REMOTE START, C+	110	AERO, T1, X04, REMOTE START
111	AERO, T1, X04, REMOTE STOP, C+	112	AERO, T1, X04, REMOTE STOP

Figure 159 - Clarification Digital Inputs T1

Specifications: The inputs are designed to detect a remote 'volt-free' switching contact (rated for a minimum 24VDC @ 10mA).

Table #4 "97 AERO, T1, X04, TABLE 4, C+" and "98 AERO, T1, X04, TABLE 4"
Activates Table #3 when held closed.

Table #3 "99 AERO, T1, X04, TABLE 3, C+" and "100 AERO, T1, X04, TABLE 3"
Activates Table #3 when held closed.

Table #2 "101 AERO, T1, X04, TABLE 2, C+" and "102 AERO, T1, X04, TABLE 2"
Activates Table #2 when held closed.

Table #1 "103 AERO, T1, X04, TABLE 1, C+" and "104 AERO, T1, X04, TABLE 1"
Activates Table #1 when held closed.

Standby "105 AERO, T1, X04, STANDBY, C+" and "106 AERO, T1, X04, STANDBY"
Closed: All compressors will be forced to unload and remain offload.
Open: normal operation

If more than one 'Table' input is held closed the lowest number Table will have priority. For example; Table #1 has priority over Table #2. Standby has priority over any Table. Remote inputs have priority over Pressure Schedule.

Sequence Change “107 AERO, T1, X04, SEQUENCE CHANGE, C+” and “108 AERO, T1, X04, SEQUENCE CHANGE”
To force a change in sequence arrangement, close for 1 second minimum then open.

Start / Stop
Change in state from open to closed will simulate a Start button press.
Change in state from closed to open will simulate a Stop button press.

Local and Communications Start and Stop remain active. If the Stop button is pressed while this input is held closed, the unit will stop.

24.4.3 Pressure Sensors T1

This topic is closely related to 24.2.4 Pressure Sensors Inputs

113	AERO, T1, X05, SYSTEM PRESSURE 2 (DIFF.), +	114	NOT USED
115	NOT USED	116	NOT USED
117	AERO, T1, X05, SYSTEM PRESSURE 1 (CONTROL), +	118	NOT USED

In AERO, Pressure Sensors are connected both to the UniTAG and to the T1, using the “floating input” capability of the UniTAG’s inputs X11 and X12.
Pressure sensors are 4..20 mA loop powered sensors only. The current these sensors generate are routed through the UniTAG and through the T1.

24.5 Main Sensors and Connections

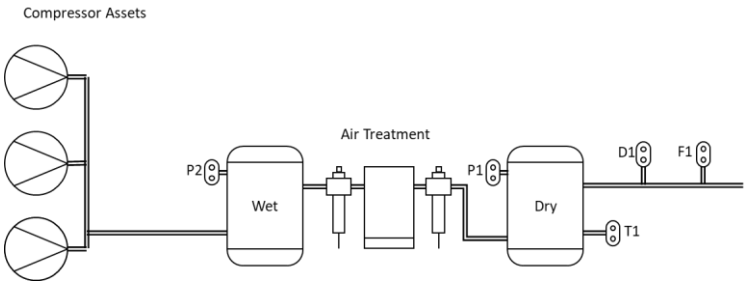


Figure 160 - What we mean with "main sensors"

Following sensors are illustrated in the above picture:

- P1: SYSTEM PRESSURE (MANDATORY)
- P2: GENERATION PRESSURE (OPTIONAL)
- D1: DEWPOINT SENSOR (OPTIONAL)
- F1: AIR FLOW SENSOR (OPTIONAL)
- T1: TEMPERATURE SENSOR (OPTIONAL)

Figure 161 - Dashboard view - relation with the main sensors

Not all sensors are installed for every installation

Specifically, for Flow (Air Out): it is not always necessary to install a dedicated Flow sensor. Air Out can also be calculated (details are not considered relevant in the context of this document).

24.5.1 Pressure Sensors P1 and P2

P1 and P2 are making use of the Floating input capability of the UniTAG (see also above).

As such, the connection of these sensors is as such:

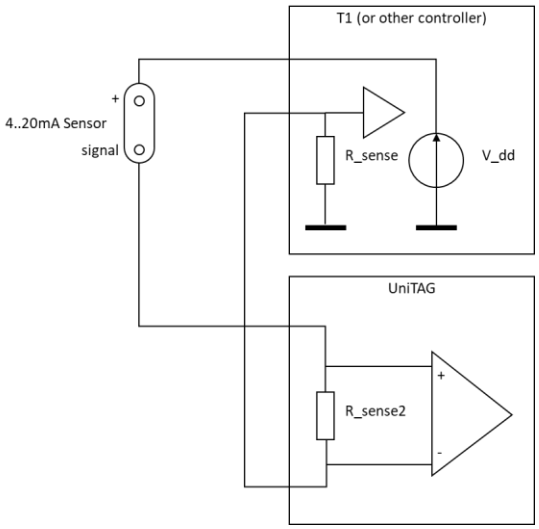


Figure 162 - Routing of the pressure sensor currents

The connection between T1 and UniTAG is done internally.

Connection of the sensors is:

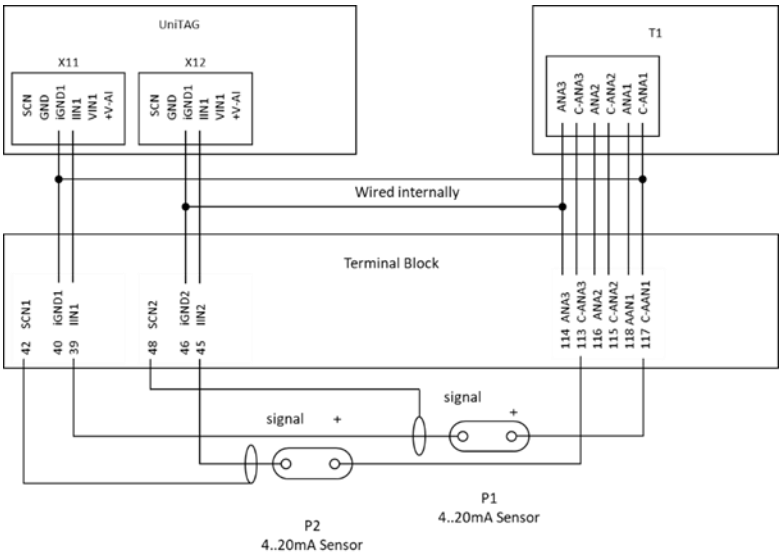


Figure 163 - Wiring of the P1 and P2 sensors

UniTAG receives P1 and P2 information over AIRBUS485 from the T1.

24.5.2 Dewpoint and System Air Flow Sensors

Dewpoint and System Air Flow sensors are loop powered 4.. 20mA sensors connected as such:

The screening of the cables can be connected to the SCN connections for P1 and P2, in parallel to the screening of the P1 and P2 cables (terminal block connections 42 and 48).

If a physical System Air Flow is not installed, AERO will calculate system flow based on the information available either through the T1 (metacentre peripherals) or through the AirTAGs. Remark a physical air flow meter is more accurate though.

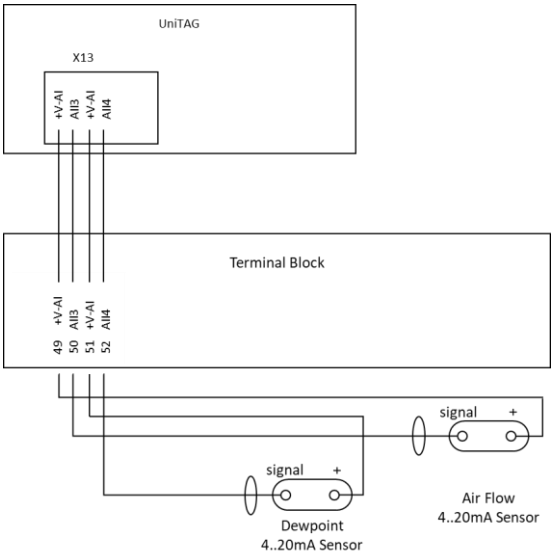


Figure 164 - Connection of Dewpoint and System Air Flow sensors.

24.5.3 Temperature sensor(s)

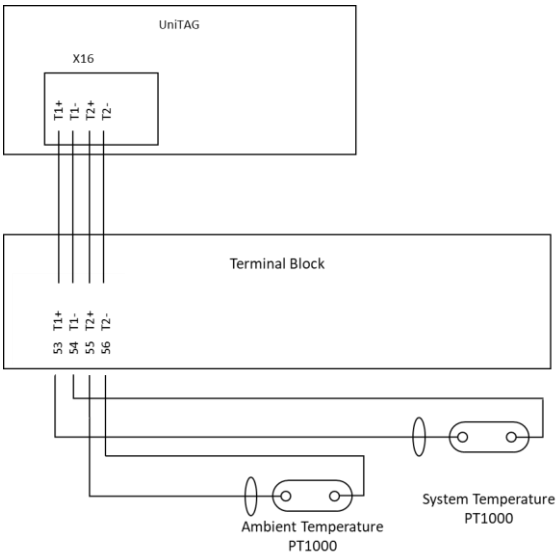


Figure 165 - Connection of Temperature Sensors

Ambient Temperature is not yet visualized; this sensor connection is intended for future use.

24.5.4 RS485 Connections

Use following connections:

63 AERO, T1, X07, L2 (/B) AIRBUS
64 AERO, T1, X07, L1 (/A) AIRBUS
58 UNI, X18, SCREEN

25. Glossary of used terms

Asset	Typically used to describe an Air Compressor or other pump that'smanaged by AERO
Data Cable	RS485 or LAN cable
Gauge	A dial used on the Dashboard view
Dashboard	Main view on the local AERO screen or on AirCloud. Gives overview of all main parameters such as Pressure, Power …
User	An account on local AERO or on AirCloud, has User Name and Password. Associated level is User or Admin,
Trending view	View on parameter (for instance Pressure) with evolution over time
Tenant	A structure managing the scope of Devices and Users
AirCloud	The CMC NV Cloud solution for monitoring and interacting with AirMatics solutions
AirTAG	Box installed with an Asset, monitoring and processing various parameters of the Asset and bringing the information to AirCloud.
UniTAG	Box installed with an Compressor Sysetm, monitoring and processing various parameters of the System and bringing the information to AirCloud.
SmartTAG	Box installed with an Asset, monitoring and processing various parameters of the Asset – as well as interacting with the Asset - and bringing the information to AirCloud.
Gateway	Device managing the cellular data communication from TAGs to and from AirCloud
Metacentre	CMC NV existing product portfolio for Compressor System management
AirMatics	a cloud-based air compressor monitoring, performance and control solution that provides real time data, analytics and insights.