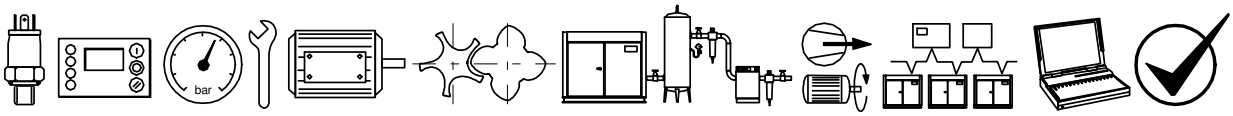

metacentre™

SX

EnergAir

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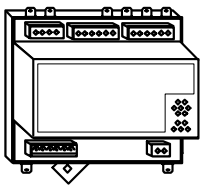
1. INTRODUCTION

The EnergAir Metacentre SX is a specialised supervisory and control product designed to provide energy efficient optimised pressure and sequence management of up to 12 air compressors operating on a common air system. The EnergAir Metacentre SX general operating mode can be modified by a number of adjustable parameters and priorities to enable operation to be matched to site requirements and characteristics.

1.1 Compressor Connectivity

Each air compressor in the system can be integrated with the SX using a number of methods:
1) Two wire data communications; for compressor controllers equipped with an RS485 port utilising the Multi485 protocol
2) One of several optional integration units designed to accommodate various types of compressor and regulation methods.
3) Direct connect utilising an interface module that is designed to enable connection to almost any positive displacement air compressor (regardless of make or manufacturer) that operates using a single pressure switch type control with a control voltage between 12V to 250V, 50 or 60Hz.



The direct connect interface module (i-PCB) is installed within the compressor control area and connected to the SX using a six-wire cable.

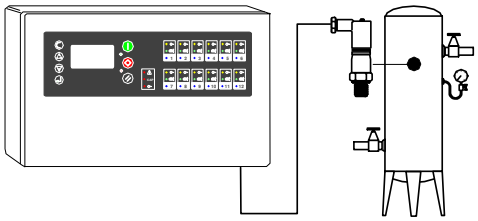
Each air compressor must be equipped with a load/unload regulation system and, if not regulated with a single electro-mechanical pressure switch, have a facility for a remote load/unload control with the ability to accept a volt free switching contact input for remote load/unload.

As default the SX is supplied with four direct connect terminals and a data communications network port enabling a further eight compressors to be integrated using remote integration modules. Further direct connect terminals (up to a maximum of 12 in total) can be added to the SX using optional local direct connect modules (iX Modules).

(!) Consult the air compressor manual or your air compressor supplier/specialist for details before installing the SX unit.

1.2 Pressure Detection and Control

The EnergAir Metacentre SX utilises the signal from an electronic pressure sensor that can be mounted remotely from the Metacentre SX in a suitable location in the compressed air system.

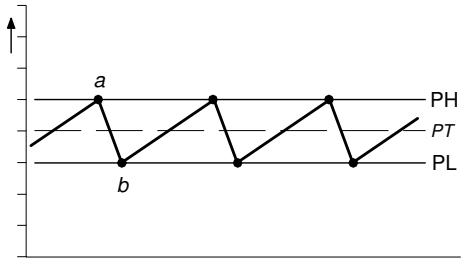


As default the EnergAir Metacentre SX is set-up for operation with a 16bar (232psi) pressure sensor but can accept input from any 4-20mA type pressure sensor with a range from 1.0bar (14.5psi) up to 600bar (8700psi).

2. Features and Functions

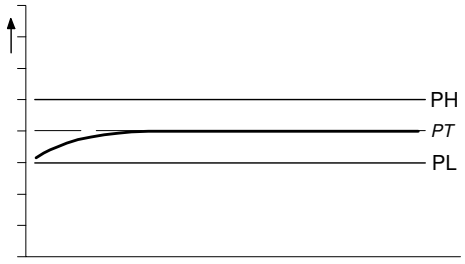
2.1 Pressure Control:

The primary function of the SX'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 SX 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.



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).

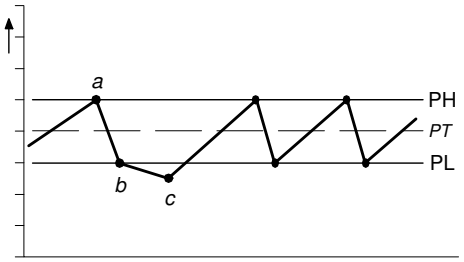


Where abrupt, or significant, changes in air demand, beyond the capacity scope of the variable capacity compressor, are experienced, the loading and unloading of other compressors is implemented in exactly the same way as described above.

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 SX 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.

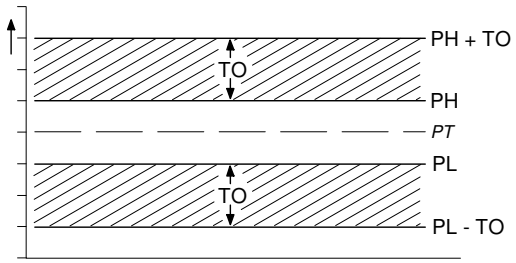


The same method is implemented in reverse (above the High Pressure set point) when an abrupt, or significant, decrease for air demand is experienced.

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 SX (DA) is adjustable.

2.2 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.



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 SX 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 SX 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.

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

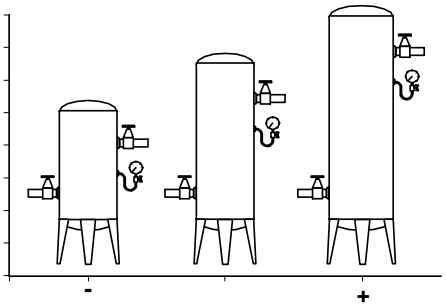
In some situations, of which the following are examples, the rate of pressure change may be aggressive and disproportionate:

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

In such instances the SX 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 SX'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.

2.4 System Volume:



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 dependant 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:

m^3 = (m^3/min) / (bar.g – 1)

The approximation only works in metric units; convert psi and ft^3 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*)

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

m^3 = 2 x ((m^3/min) / (bar.g – 1))

2.5 Sequence Control Strategies:

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

1) The compressor 'Rotation' strategy
2) The compressor load 'Control' 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.

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

Compressor Sequence Arrangements:

Each compressor in a system is initially assigned to the SX 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 utilised.
B = The 'Standby' compressor, the second to be utilised.
C = The 'Second Standby' compressor, the third to be utilised.
D = The 'Third Standby' compressor, the forth to be utilised.

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

Equal Hours Run Mode

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 there 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 SX continuously monitors the running status of each compressor and maintains a record of the accumulated running hours. These are available, and adjustable, in the SX's compressor running hour's menu. The SX uses these values in EHR mode. The SX'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 SX 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.

Timer Rotation Mode

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

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

Tables; 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.

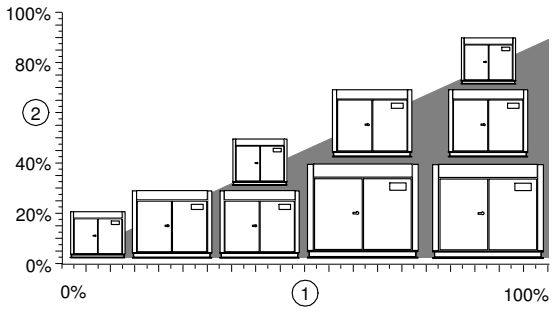
Energy Control Mode

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.

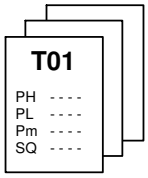
The basic principle of the Energy Control strategy is the efficient utilisation of available resources matched to fluctuations in demand.



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.

Tables:



The SX 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 SX.
The SX 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 SX 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.

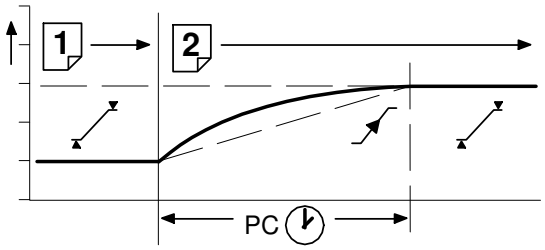
1) PH: High pressure set point
2) PL: Low pressure set point
3) Pm: Minimum pressure warning level
4) SQ: Sequence rotation mode
5) 01: Compressor 1 Priority setting
6) 02: Compressor 2 Priority setting
7) 03: Compressor 3 Priority setting
8) 04: Compressor 4 Priority setting

(!) 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 SX 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.



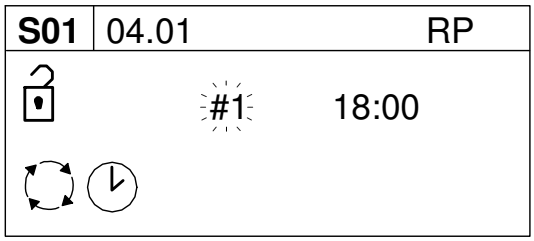
The time the system will take to complete the transition from one pressure target to another is determined by the 'Pressure Change' time (PC). This value can be adjusted to accommodate installation characteristics to achieve the transition at optimal energy efficiency.

If the SX 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.

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.



Enter the rotation period menu item (RP); the 'day' setting will flash.

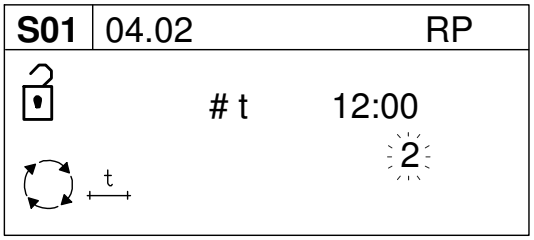
Select the 'day' or day function as required:

#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).

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



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.

2.6 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

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

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

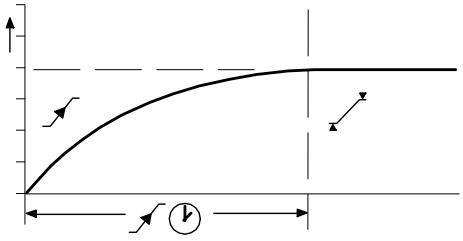
	1	2	3	4
	1	**2**	**2**	**3**
#1	A	B	C	D
#2	A	C	B	D
#3	A	B	C	D
#4	A	C	B	D

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

2.7 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.



At system start (manual start or automated start from standby) the SX 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 SX 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.

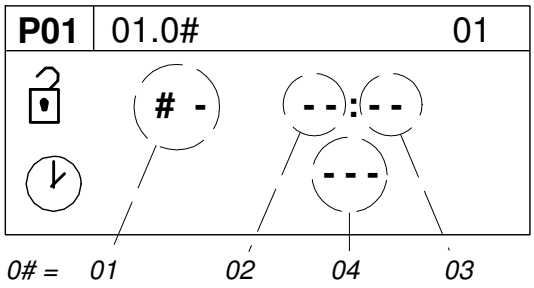
√ [A^^] Automatic Mode: No Prefill compressor selection is necessary; any selection set is ignored. The management unit automatically selects compressor(s) dynamically to achieve pressure in accordance with the set Prefill time. If a compressor is stopped, or shuts down, it is automatically substituted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

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

2.8 Pressure Schedule:

The SX 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.



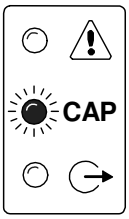
01) Day of the Week
#1 = Monday to #7 = Sunday
#8 = every working day of the week; Monday to Friday, eSXluding Saturday and Sunday.
#9 = every working day of the week.

ⓘ 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 T04, 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 SX memory until the last sub-setting is entered. Press Escape to step back one sub-item if required.

2.9 Insufficient Capacity Alarm



The Metacentre is equipped with a dedicated 'Insufficient Capacity' Advisory Alarm (Warning) indication.

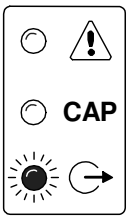
This indication will illuminate if all available compressors are loaded and system pressure is continuing to decrease. The indication will generally occur prior to any set low pressure Alarm (Warning) and is intended to provide an advanced warning of a potential 'Low Pressure' situation.

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.

2.10 Restricted Capacity Alarm



The Metacentre is equipped with a dedicated 'Restricted Capacity' Advisory Alarm (Warning) indication.

This indication 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.

3.0 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.

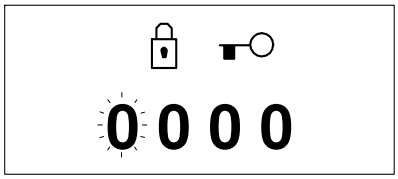
All adjustable value, parameter or option item displays are grouped into 'menu mode' lists. Items are assigned to a list according to type and classification. Item lists are identified by page number (or menu number); All adjustable parameters and options are assigned to menu mode pages 'P01' or higher.

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 default display. When an Item display is locked the lock key symbol will be shown. To unlock an Item display press Up or Down to view an alternative Item display or 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.

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.



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'.

Access Code Accepted

Access Code Rejected

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.

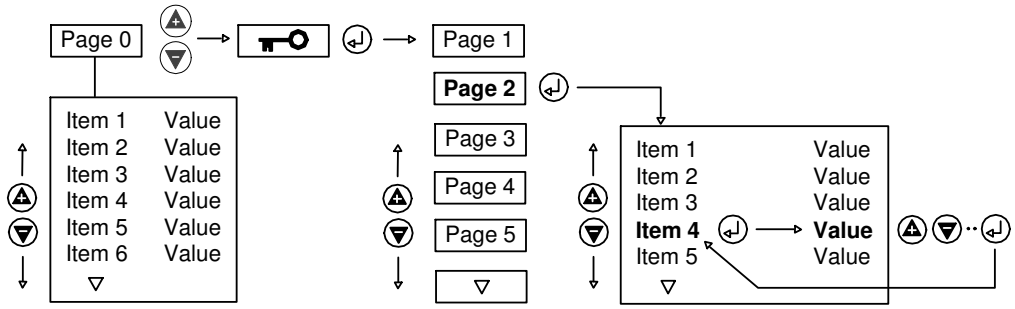
Menu Mode Navigation:

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

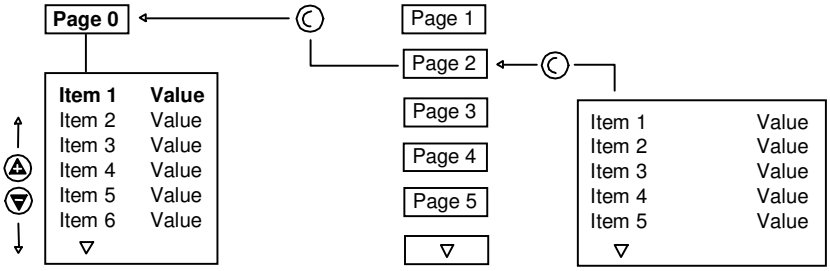
To select a menu 'page' press UP or DOWN. To enter the highlighted menu 'page' press ENTER; the first item of the menu 'page' will be highlighted. Press UP or DOWN to scroll though the selected menu 'page' items.

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

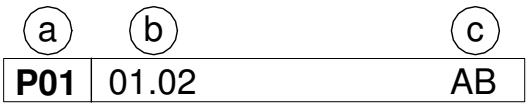
The value or option can now be modified by pressing UP(Plus) or DOWN(Minus). To enter a modified value or option in to memory press ENTER.



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.



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.



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).

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 SX 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.

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 SX is in an operational state; stop the SX first.

3.1 Menus

USER Level Menus *(0011)*

TABLE #1

T01

PH High Pressure Set Point
PL Low Pressure Set Point
Pm Minimum Pressure Alarm
SQ Sequence Algorithm
01 Compressor #1 Priority
to **12** Compressor #12 Priority

TABLE #2

T02

PH High Pressure Set Point
PL Low Pressure Set Point
Pm Minimum Pressure Alarm
SQ Sequence Algorithm
01 Compressor #1 Priority
to **12** Compressor #12 Priority

TABLE #3

T03

PH High Pressure Set Point
PL Low Pressure Set Point
Pm Minimum Pressure Alarm
SQ Sequence Algorithm
01 Compressor #1 Priority
to **12** Compressor #12 Priority

TABLE #4

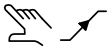
T04

PH High Pressure Set Point
PL Low Pressure Set Point
Pm Minimum Pressure Alarm
SQ Sequence Algorithm
01 Compressor #1 Priority
to **12** Compressor #12 Priority

Pressure Schedule

P01

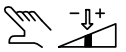
01 Schedule Setting #1
to **28** Schedule Setting #28



Prefill

P02

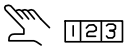
PF Prefill Function
PT Prefill Time
PP Prefill Pressure
01 Compressor #1
to **12** Compressor #12



User Configuration

S01

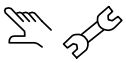
Ct Real Time Clock Set
PS Pressure Schedule Enable
AR Auto Restart Enable
RP Rotation Interval
TS Default Table Select
BL Display Backlit Adjust



Compressor Running Hours

C01

01 Compressor #1 Running Hours
to **12** Compressor #12 Running Hours



Compressor Maintenance

C02

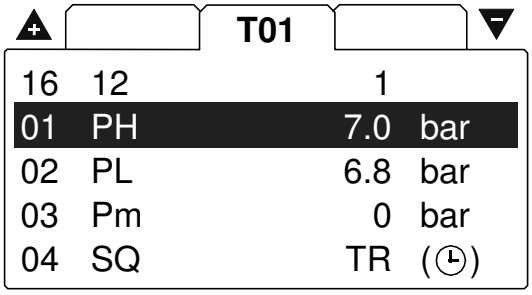
01 Compressor #1 Maintenance
to **12** Compressor #12 Maintenance

Fault Log

E01

01 Fault Log #1 (most recent)
to **15** Fault Log #15

3.2 Menu Items:



Tables

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 miniumum pressure 'Warning' or 'Alarm' level that will be used when the 'Table' is active.

T0# - SQ Sequence Strategy
The sequence control strategy mode that will be used when the table is active.

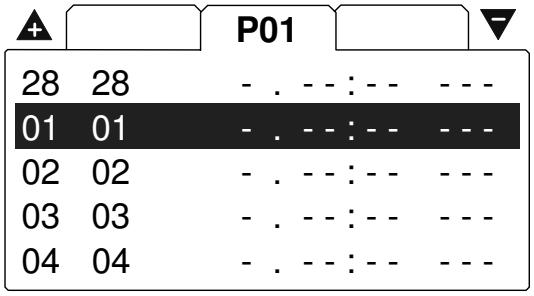
T0# - 01 Compressor #1 Priority
The 'priority' setting for compressor number 1 that will be used when the table is active.

T0# - 02 Compressor #2 Priority
The 'priority' setting for compressor number 2 that will be used when the table is active.

T0# - *'n'* Compressor #'n' Priority
The 'priority' setting for compressor number *'n'* that will be used when the table is active.

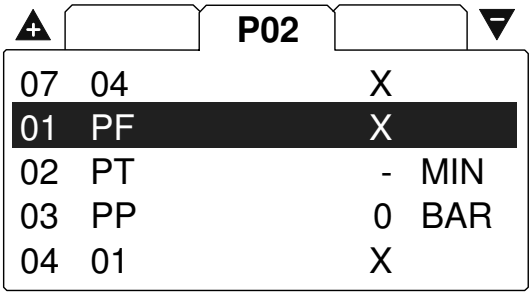
'n' = number of compressors in the system.
= *Table T01 to T04*

Priority Settings:
X: compressor(s) can be inhibited from use while a table is active by selecting "X" priority. The compressor will be held offload and will not be utilised under any circumstances.



Pressure Schedule

P01 – 01 to 28
The 'Pressure Schedule' items 01 to 28



Prefill

P02 - PF Prefill Function
Determines the 'Prefill' strategy or function that will be used at system startup.

X = Prefill function OFF
√ = Prefill, Back-up Mode
√ [!→X] = Prefill, Standard Mode
√ [A^^] = Prefill, Automatic Mode

P02 - PT Prefill Time
Sets the maximum time allowed for a system 'Prefill' at startup.

P02 - PP Prefill Pressure
If pressure is at, or above, this setting at system startup the prefill function will be abandoned immediately and normal pressure control and sequence strategy will be implemented. This setting is intended to inhibit 'Prefill' operation if pressure is already at an acceptible level at system startup.

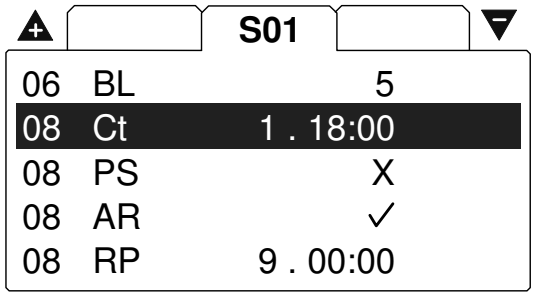
P02 – 01 to 04 Compressor 1 to *'n'*
The function of compressor 1 to *'n'* during the 'Prefill' period.

'n' = number of compressors in the system.

X = do not use
√ = use for primary prefill
! = use for emergency backup

(!) These settings are applicable to Prefill – Standard and Prefill - 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 Prefill mode at startup.



Features and Functions

S01 - Ct Real Time Clock Set
Adjustment for the internal real time clock. (Hours, Minutes, Date, Month, Year)
The 'Day of the Week' (1= Monday to 7=Sunday) is automatically calculated and set in accordance with the Day, Month and Year.

S01 - PS Pressure Schedule Enable
X = inhibit Pressure Schedule
√ = enable Pressure Schedule

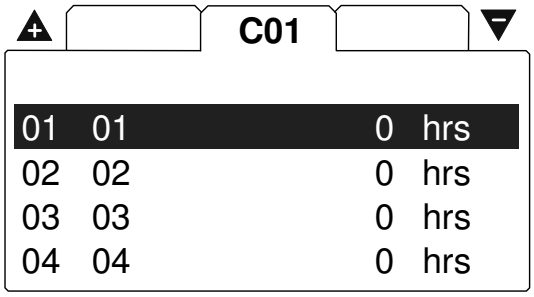
S01 - AR Auto Restart Enable
X = inhibit Power Failure Auto Restart
√ = enable Power Failure Auto Restart

The SX will only automatically restart when power is restored if the SX was in an operational 'Started' state when the power loss or disruption occurred.

S01 - RP Rotation Interval
Sets the sequence 'Rotation' interval or time.

S01 - TS Default Table Select
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.

S01 - BL Display Backlight Adjust
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 backlight 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 backlight reduces to 50% of initial brightness. Typically the display will remain usable for a much longer period for time. Adjusting the backlight to high levels will reduce service life.

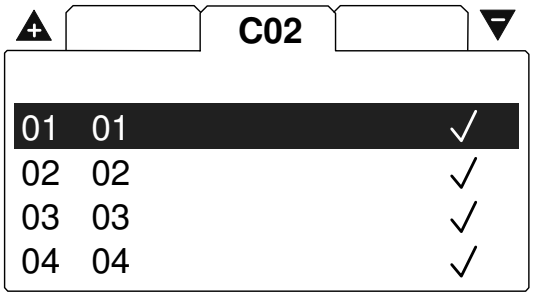


Control - Equal Hours Run Mode

Record of detected 'running' hours for each compressor. The run hours value can be manually adjusted, at any time, to match the running hours meter/display value of each compressor.

C01 - 01 Run Hours; Compressor 1
to
C01 – *'n'* Run Hours; Compressor *'n'*

'n' = number of compressors in the system.



✗ = Remove compressor from operation

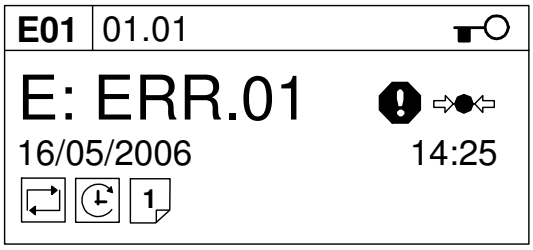
✓ = Compressor can be utilised

For a compressor(s) that is unavailable for use for a prelonged period for time due to maintenance or repair. The compressor will not be utilised under any circumtances; any Alarm (Warning) or Trip (shutdown) fault will be ignored.

E01 – 01 to 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.

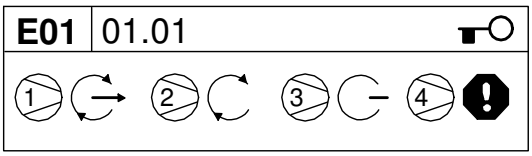


The first information display shows the:

a) The Error Code
b) Error Code symbols (if applicable)
c) The date the error occurred
d) The time the error occurred
e) The active operational functions of the SX at the time the error occurred; (see: SX Status Display)

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

To view the second information screen press Enter.



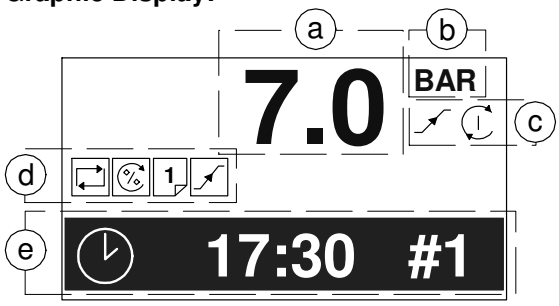
The operational status of each compressor, at the time the error occurred, is displayed symbollically (see: Compressor Status Displays).

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

4.0 OPERATION

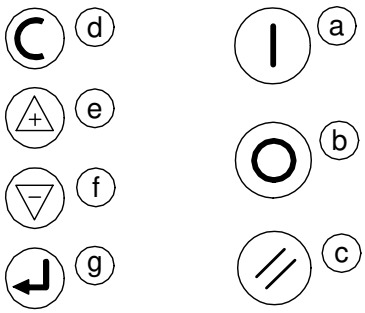
4.1 User Interface

Graphic Display:



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

Keypad:



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

4.2 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)

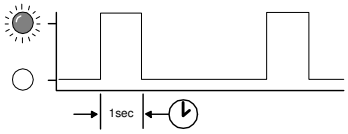
Shutdown (Trip)

Indicators

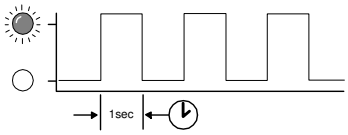
Off

On

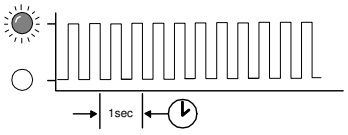
Intermittant:



Slow Flash:



Fast Flash:



Unit Indicators

Unit Run Indicator (Green LED)

OFF – Not Active, Stopped

Slow Flash: Active, Standby Mode

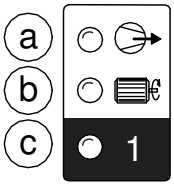
ON – Active, Running

Unit Fault Indicator (Red LED)

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

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

4.3 Compressor Status 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

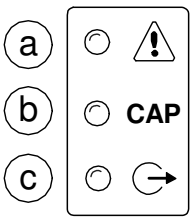
b) Run Status

- 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 Commpressor 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

4.4 System Alarms (Warnings):



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

4.5 Unit Functions:

Operating Mode:

- Equal Hours Run
- Timer Rotation
- Energy Control

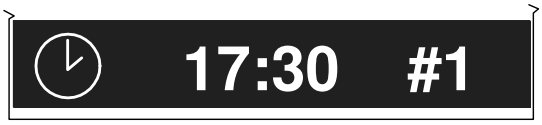
Active Functions:

- Power Failure Auto-Restart
- Table #1 Active
- Table #2 Active
- Table #3 Active
- Table #4 Active
- Standby Mode Active
- Prefill Function
- Pressure Schedule
- Function Inhibited (manual override)
- Remote Manual Override

4.6 User Menu

A number of User menu information displays are available that can be accessed directly from the front panel using the Up and Down navigation buttons.

Real Time Clock:



17:30 (24hr system)
#1 = Monday to #7 = Sunday

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.

Primary Detected Pressure:

The pressure detected on the unit's primary pressure sensor.

Next Scheduled Sequence Rotation:

The next scheduled sequence rotation:
00:00 Time (24hr system)
#1 Monday

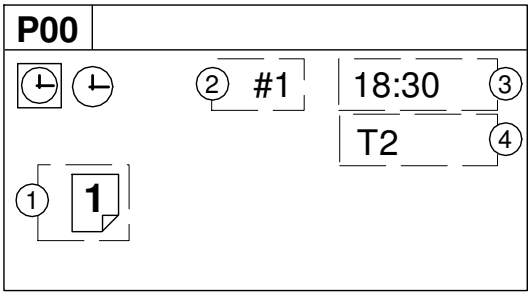
A setting of zero hundred hours (00:00hrs) on Monday (#1) equates to a sequence rotation at one second past midnight on Sunday.

4.7 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.

Real Time Clock:

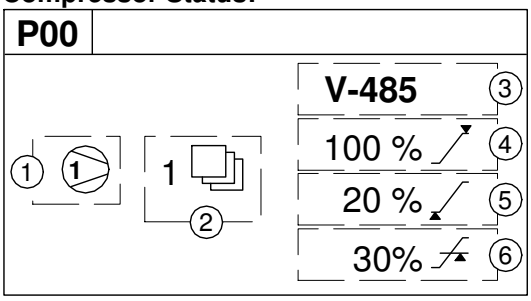


Shows the next Pressure Schedule event.

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.

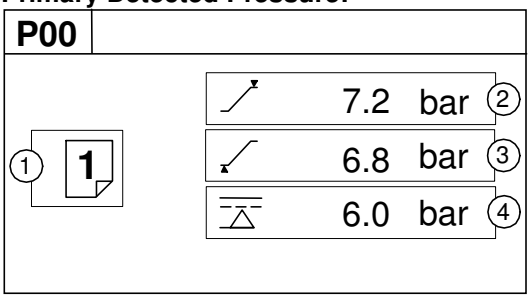
Compressor Status:



1: Compressor Number
2: Priority Setting
3: Compressor/Connection Type
4: Maximum Capacity % Setting
5: Minimum Capacity % Setting
6: Minimum Efficiency % Setting

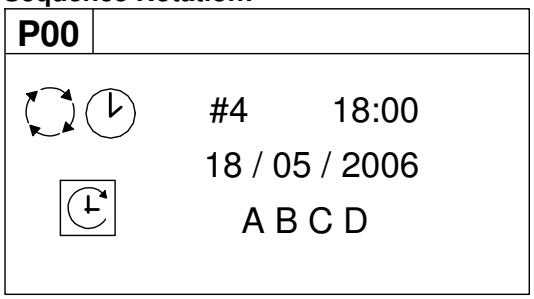
Item values 5 and 6 are only shown if compressor type is V-485 (variable capacity/speed).

Primary Detected Pressure:



1: Active Table
2: Upper (Unload) Pressure Set Point
3: Lower (Load) Pressure Set Point
4: Minimum Pressure Alarm (Warning)

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.

4.8 Manual Sequence Rotation:

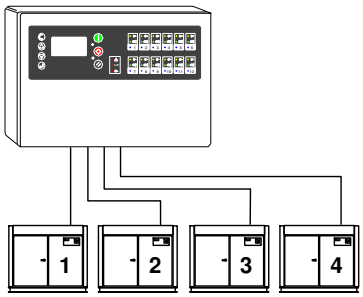
The sequence assignment can be manually rotated at any time. When viewing the 'Sequence Rotation' information screen press Enter:

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.

4.9 Compressor Identification

Each compressor connected to the SX will have a unique assigned compressor identification number; starting at compressor 1 increasing sequentially to the number of compressors connected to the SX.



4.10 Stop:

To stop the SX press Stop.
The SX will respond dependant on the setup of item 'CF' in menu S02:

X 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 SX 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.

The design of some air compressor control systems may inhibit automatic transfer of pressure regulation control to local operation mode. In this instance the compressor will not continue production of compressed air – consult the air compressor manual or your air compressor supplier / specialist for details before installing the SX.

4.11 Start:

To start the SX press Start.
If the 'Start Function' is enabled there will be a period of time before any compressor is requested to load.

Start Function

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.

Prefill

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

When Prefill is complete, if applicable, the SX will enter normal operating mode.

The SX will operate in accordance with the parameters and options set in the active 'Table'.

Tables

Each compressor in the system must be started (running or in a standby or auto restart condition) before SX control of the compressor can be established. The SX will not start a compressor that is in a stopped condition.

4.12 Power Failure Auto-Restart

If the power failure auto-restart function is enabled the SX will automatically start, when power is restored after a disruption or failure, if the SX was in a 'started' state when the power disruption or failure occurred.

The SX will not automatically restart if the SX was in a stopped state when the power disruption or failure occurred.

4.13 Failure Mode

If the SX experiences a disruption to normal control, or an SX 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).

4.14 Reset

To reset an SX 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.

4.15 Compressor Fault Indications

Compressor fault conditions are displayed by the compressor indicators and in the user user menu status screen. Compressor fault conditions are not regarded as SX unit fault conditions.

Compressor Status Sysmbols and Comressor Status Indicators

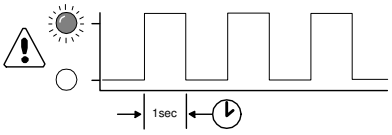
4.16 Fault Codes

Fault codes are separated in to unit faults '**ERR**' and system Alarms (Warning) '**SYS**'.

ERR: Unit faults are errors with the SX controller itself and are all conditions that prevent normal operation from continuing.
SYS: System faults are items that arise from conditions external to the SX controller; the SX itself continues to function correctly.

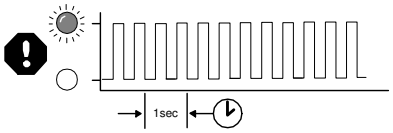
There are two types of Fault condition:

Alarm (Warning):



The Fault LED will 'slow flash' to indicate an Alarm (Warning) condition. An Alarm (Warning) indicates that the SX is continuing with normal operation but user attention is required. All Alarm (Warning) conditions are registered in the SX 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 SX. 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 SX Error Log. All Trip (Shutdown) conditions must be manually reset.

Fault 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.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 SX 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.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 eSXeeded the set Maximum Pressure Limit.

SYS.02 Min Pressure (Pm) Pressure has fallen below the set Minimum Pressure Limit (see 'Tables')

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.

Internal Controller Fault 'E' 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 advise 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.

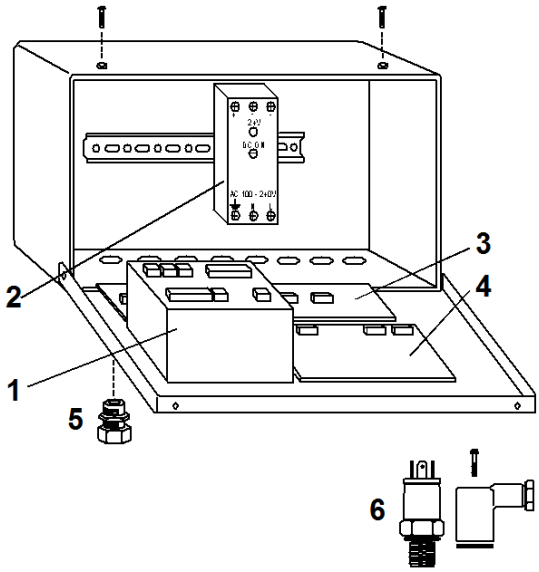
E5001: Internal memory failure
The unit's controller has detected disruption to the internal permanent application memory storage (FLASH). The integrity of the FLASH memory contents is suspect. Re-load the main application software in the first instance; re-new the controller if the condition persists.
The controller's main power supply must be removed and re-applied to reset this condition.

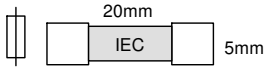
To Display the Software Version:

Press and hold Reset then press Escape.
The user menu display item will show the software version ID (example: "E01").

5.0 Parts List

Item	Part No.	Description
-	Y07ENER06.00	Metacentre SX
-	Y07ENER14.00	Manual, User CD
1	Y06CM36.00	Unit, Controller
2	Y17CM01.00	Unit, PSU – 24Vdc
3	KPY06AJ.01C	PCB, Terminal
4	Y05CM32.00	Unit, XPM-LED
5	Y07CM49.00	Gland, Set - Pg13.5
6	Y04CM29.00	Sensor, Pressure 4-20mA, 232psi (16bar)



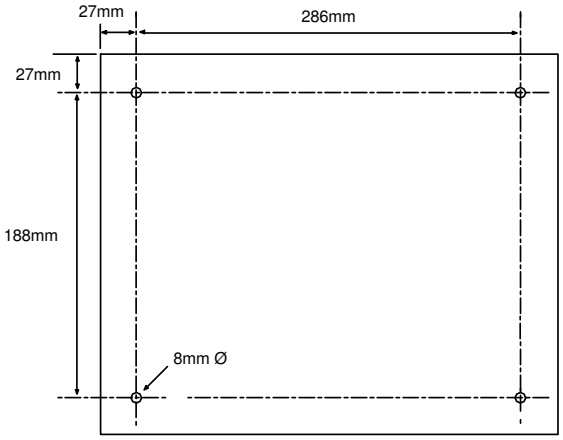


Qty	Part No.	Description
10	Y06CM42.00	IEC Fuse T1.0A
10	Y06CM43.00	IEC Fuse T1.6A
10	Y06CM44.00	IEC Fuse T3.15A

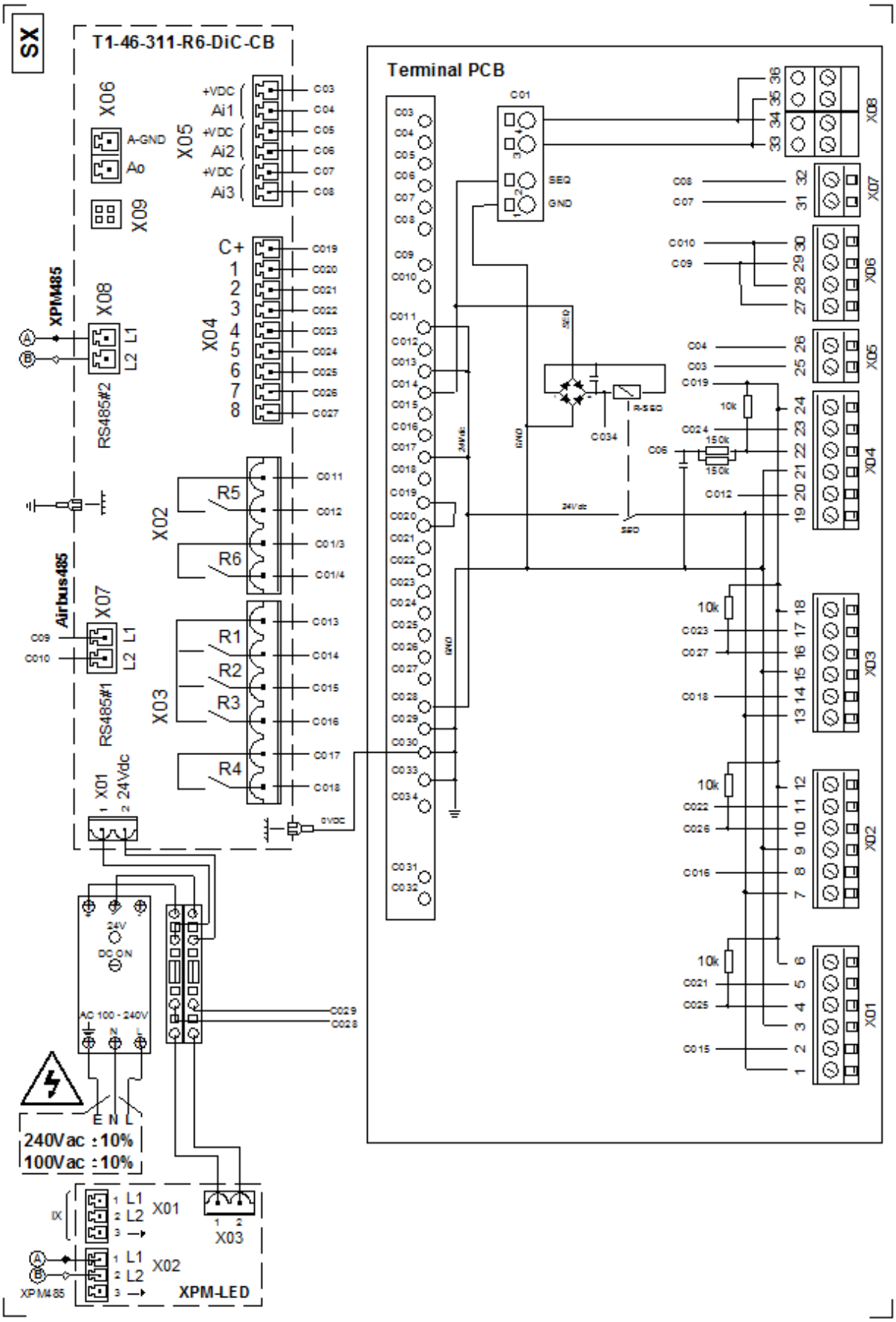
6.0 Technical Data

Dimensions	340mm x 241mm x 152mm 13.40” x 9.45” x 6.0”
Weight	7.5kg (16.5lb)
Mounting	wall, 4 x screw fixings
Enclosure	IP54, NEMA 12
Supply	230Vac +/- 10% 115Vac +/- 10%
Power	100VA
Temperature	0°C to 46°C (32°F to 115°F)
Humidity	95% RH, non-condensing

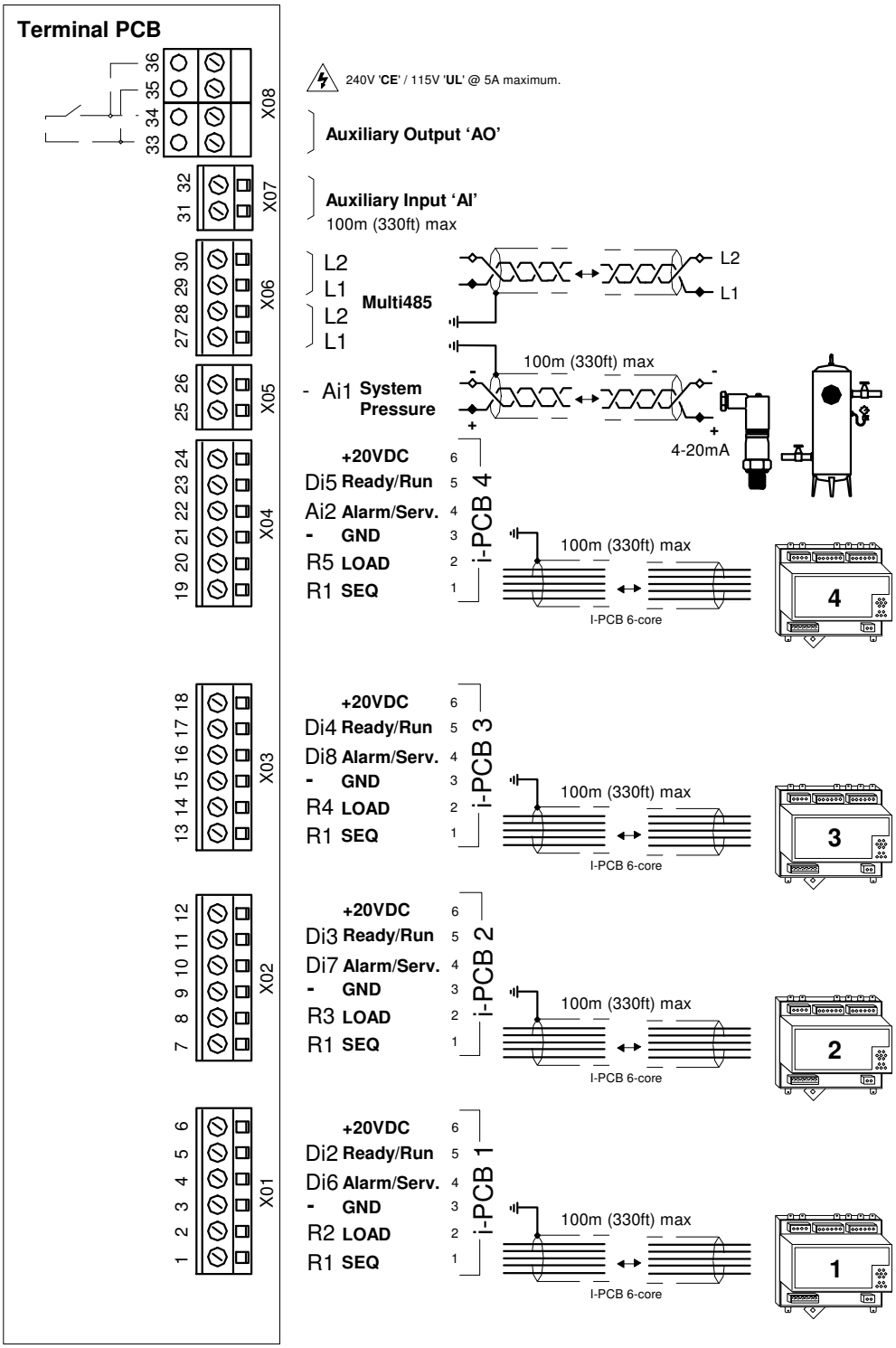
Mounting Dimensions:



7.0 Wiring Connection Diagram



SX


Terminal PCB
X08
X07
X06
X05
X04
X03
X02
X01
240V 'CE' / 115V 'UL' @ 5A maximum.
Auxiliary Output 'AO'
Auxiliary Input 'AI'
100m (330ft) max
L2
L1
Multi485
100m (330ft) max
- Ai1 System Pressure
4-20mA
+20VDC
Di5 Ready/Run
Ai2 Alarm/Serv.
GND
R5 LOAD
R1 SEQ
i-PCB 4
100m (330ft) max
I-PCB 6-core
4
+20VDC
Di4 Ready/Run
Di8 Alarm/Serv.
GND
R4 LOAD
R1 SEQ
i-PCB 3
100m (330ft) max
I-PCB 6-core
3
+20VDC
Di3 Ready/Run
Di7 Alarm/Serv.
GND
R3 LOAD
R1 SEQ
i-PCB 2
100m (330ft) max
I-PCB 6-core
2
+20VDC
Di2 Ready/Run
Di6 Alarm/Serv.
GND
R2 LOAD
R1 SEQ
i-PCB 1
100m (330ft) max
I-PCB 6-core
1