GARDNER DENVER

ENERGY STAR PARTNER

13-19-608
Version: 02
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AIRPLUS CONTROLLER

MAINTAIN COMPRESSOR RELIABILITY AND PERFORMANCE WITH GENUINE GARDNER DENVER® COMPRESSOR PARTS AND SUPPORT SERVICES

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HP	Parts List	Service Manual
5, 7.5 & 10 HP	13-19-506	13-19-610
15 HP	13-19-508	13-19-612
20 HP	13-19-510	13-19-614

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Section 1
GENERAL INFORMATION

Controller Model

The general default settings and tables shown in this manual are applicable to the AirPlus controller with specific reference to software version **S1BOTTST.E04**

Controller software version S1BOTTST.E04 has been specifically designed to control air compressors equipped with electromechanical pressure switch.

Controller hardware

8 digital inputs for:
- Emergency Stop Pushbutton contact (NOT used)
- Remote START/STOP contact
- Air Filter Vacuum Switch contact
- Motor Overload Relay contact
- Pressure Switch contact
- High Temperature contact
- Phases Monitoring Relay contact
- Pressure Switch contact

2 analogue inputs:
Input 1: 4-20mA (NOT used)
Input 2: KTY (used for oil temperature sensor)

6 relay contact outputs for:
- Main Contactor
- Star Contactor
- Delta Contactor
- Load/Unload Solenoid Valve
- Auxiliary Relay 1
- Auxiliary Relay 2

1 RS485 communications port

Controller Operation

The compressor starts and stops automatically. Automatic restarting can cause injury or death. Open, lockout and tagout main disconnect and any other circuits before servicing the unit.

In normal operation the pressure switch controls the load/unload of the compressor.

Loading and unloading via the pressure switch begins once the compressor has been started by pushing the start button or by a remote start command if enabled.

The controller will perform safety checks and starts the compressor if no inhibiting conditions are detected.

If a start inhibiting condition exists the compressor will not enter the started condition and a start inhibit message is displayed.

If a load request is present, coming from the pressure switch, the main motor is started in a star/delta sequence. When running in delta configuration, after the “star to delta time” (adjustable) has expired, the load “delay time” (adjustable) prevents loading for a period to allow motor speed to stabilize.

The load delay time can be set to one second if required.

When the load delay time has expired, the load valve output is energized and the compressor will load. If an unload request is present coming from the pressure switch, the load valve output is de-energized and the compressor will run offload for the “unload time” (adjustable) before the main motor stops and the compressor enters standby mode.

The compressor will load again if a load request is present before the unload time expires.

In the event of a motor stop, initiated by a stop command or when entering standby mode, a “blow down timer” (adjustable) is started.

If a start request is made during the blow down time the compressor will enter standby mode until the blow down time expires. If already in standby mode and a load request is present, the compressor will remain in standby mode until the blow down time has expired.

After an unload event a “load timer” (adjustable) is initiated preventing re-loading of the compressor. This time can be adjusted to a minimum of one second if required.

NOTICE

Short cycling the compressor package can cause excessive oil carryover.

Normal automated operation is ended by pushing the stop button, a remote stop command or in the event of a shutdown fault.

When stopped manually, or by a remote command, the load valve is de-energized and the main motor is allowed to run-on for the “stop run on time” (adjustable). This time can be adjusted to a minimum of one second if required.

Safety checks are made continuously. If there is a condition detected that presents a hazardous or damaging situation, an immediate stop is performed and the reason displayed as a shutdown error message.

If a warning condition is detected, an Alarm message is displayed and normal operation continues.

Main operating steps are shown in the figure below.

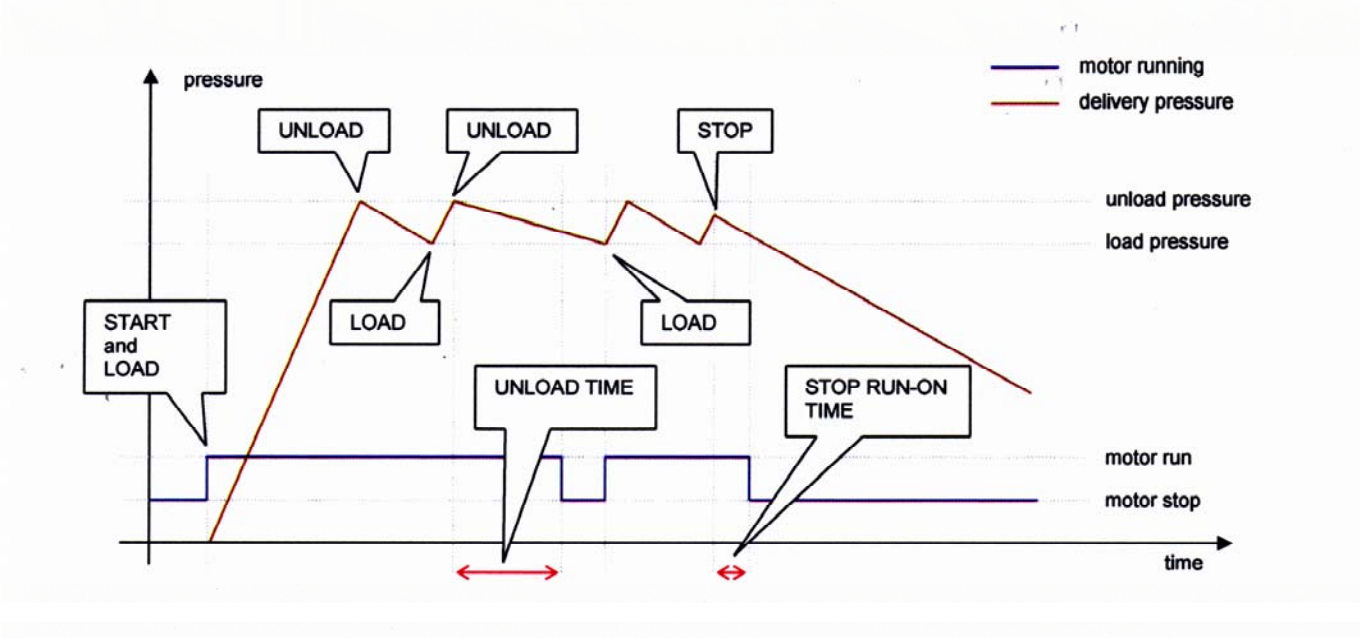


Figure 1- 1 – MAIN OPERATING STEPS

Input/Output Description

Digital Inputs

Connector X04:

Pin	Name	Function	Id	Active state	Status (*)
1	C+	Digital inputs common			
2	C1	Emergency stop	Digital input 1	fault if open	NOT Used
3	C2	Remote start/stop	Digital input 2	start if closed/stop if open	Used
4	C3	Air filter vacuum switch	Digital input 3	fault if closed	Used
5	C4	Motor overload relay	Digital input 4	fault if open	Used
6	C5	Safety pressure switch	Digital input 5	fault if open	Used
7	C6	Safety thermostat	Digital input 6	fault if open	Used
8	C7	Phase monitoring relay	Digital input 7	fault if open	Used
9	C8	Pressure switch	Digital input 8	load if closed, unload if open	Used

Connector: 9 pin with 3.81mm pitch

(*) Digital input classified as "NOT Used" are referred to optional functionalities NOT available on compressor.

Remote Start/Stop:

When the remote start/stop function is enabled via SS (menu P07), the compressor will execute a normal start sequence when the remote start/stop input changes from an open to a closed circuit. The compressor will execute a controlled stop (as if the stop button on the control panel has been pressed), when the remote start/stop input is an open circuit. If already closed, the remote start/stop input must be opened and closed again to initiate a remote start sequence.

NOTICE

When the remote start/stop function is enabled, local controller start is inhibited and only local stop is allowed.

Pressure switch:

The unit will load when the pressure switch contact is closed and unload when the pressure switch contact is opened.

DIGITAL OUTPUTS

Connector X03: relays

Connector type: 6 pin with 5mm pitch

Pin	Name	Function	Id	Active state	Status
1	C-R123	Common for star, delta and line contactor			
2	R1	Main (line) contactor	Digital output 1	energized	Used
3	R2	Star contactor	Digital output 2	energized	Used
4	R3	Delta contactor	Digital output 3	energized	Used
5	C-R4	Common for load solenoid valve			
6	R4	Load solenoid valve	Digital output 4	load when energized	Used

Connector X02: auxiliary relays

Connector type: 4 pin with 5mm pitch

Pin	Name	Function	Id	Active state	Status (*)
1	C-R5	Common Auxiliary Relay 1			
2	R5	Auxiliary Relay 1 Output	Digital output 5	de-energized	Used
3	C-R6	Common Auxiliary Relay 2			
4	R6	Auxiliary Relay 2 Ouput	Digital output 6	energized	Used

(*) By default configuration Auxiliary Relay 1 & 2 are used as follows:

- Auxiliary Relay 1: de-energized for any active shutdown fault

- Auxiliary Relay 2: energized for any service due alarm only

Auxiliary Relay 1 & 2 functions can be changed by modifying parameter “R5” & “R6” in menu P07

Analogue Inputs

Note: All analogue device inputs have open circuit, short circuit and out-of-range fault detection functions

Connector X05: analogue inputs

Connector type: 6 pin with 3.81mm pitch

Pin	Name	Function	id	Input type	Status (*)
1	C-ANA1	+V common			
2	ANA1	Signal	analogue input 1	4-20 mA	NOT Used
3	C-ANA2	0V common			
4	ANA2	Signal (menu setting + ACM type)	analogue input 2	KTY (-10°C/14°F ÷ 132°C/269.6°F)	Used
5	C-ANA3	n.a.	n.a.	n.a.	n.a.
6	ANA3	n.a.	n.a.	n.a.	n.a.

(*) Digital input classified as "NOT Used" are referred to optional functionalities NOT available on compressor.

Note 1:
Analogue Input 1 (not used): fixed 4-20mA type

Note 2:
Analogue inputs 2 (used for temp) and 3 (not used): the AirPlus controller uses plug-in analogue conditioning modules (ACM's) that allow different sensor and signal types to be accommodated; for a particular sensor type the correct ACM hardware must be fitted.

SECTION 2
CONTROLLER INFORMATION

Machine State Diagram

The controller operating logic is shown in the machine state diagram, Figure 2- 1, page 14. The diagram shows the function of the controller at any given time. The controller can only be in one state at any given time. The controller will move from state to state in accordance with the defined exit and entry conditions of machine state diagram, Figure 2- 1

Definitions

Fault

A detected abnormal condition that is indicated to the operator and that may require action by the operator, depending on the fault type and definition.

Start Inhibit Fault

A start inhibit fault is a condition that may present a danger or cause damage to the compressor if started while the condition is present. Start inhibit faults are only triggered if a compressor start from the ready to start condition is attempted. Start inhibit faults are not triggered during an automated motor start sequence from the standby condition. Start inhibit faults are self-resetting.

A start inhibit fault code is displayed when triggered but is not recorded in the fault log.

Run Inhibit Fault

A run inhibit fault is a condition that may present a danger or cause damage to the compressor if the main motor is started while the condition is present. Run inhibit faults are only triggered if a motor start sequence is initiated. Run inhibit faults are self-resetting and do not prevent the compressor from entering a started condition. A Run inhibit will hold the compressor in a standby state and will allow a motor start sequence when the condition is no longer present.

A Run inhibit fault code is displayed when triggered but is not recorded in the fault log.

Alarm Fault

An alarm fault is a warning condition that does not present an immediate danger or potential damage to the compressor. An alarm state will not shutdown the compressor or affect normal operation.

An alarm fault code is displayed that must be manually reset to clear once the condition has been resolved or no longer exists.

Shutdown Fault

A shutdown fault is a condition that may present danger or potential damage to the compressor if the condition persists. A shutdown fault will cause the controller to stop the compressor. A shutdown fault code is displayed that must be manually reset to clear once the condition has been resolved or no longer exists.

Two types of shutdown fault are definable

a) Non-emergency shutdown: a controlled stop is executed
b) Emergency shutdown: an instantaneous stop is executed.

Unload Pressure

The unload pressure is the pressure at which the pressure switch opens its contact. When the pressure switch contact changes from closed to open, the controller will de-energize the inlet valve solenoid and the compressor will unload.

Load Pressure

The load pressure is the pressure at which the pressure switch closes its contact. When pressure switch contact changes from open to closed, the controller will energize the inlet valve solenoid and the compressor will load.

If in the standby state after the unload time has expired, an automated main motor start sequence is triggered prior to load.

Main Motor Start Sequence

The controller will energize the STAR contactor output followed by the LINE contactor output 200ms later.

After the Star to Delta timer (adjustable) expires, the controller will execute an automated Star to Delta contactor output changeover with a 50ms star to delta transition time.

If a stop command is received during the start sequence, the controller will stop the motor accordingly to the value assigned to the Stop run-on time parameter.

Load Delay Time

The star to delta output transition is immediately followed by a load delay time (adjustable) that will inhibit the load solenoid output from energizing until the load delay time expires. This function is intended to allow the main motor speed to stabilize and other eventual pre-load functions to occur.

Reload Delay Time

The reload delay time (adjustable) is a period of time immediately following a load to unload cycle during which the inlet valve solenoid is not allowed to energize.

Blow Down Time

The blow down time (adjustable) immediately follows a main motor stop. During the blow down time a start request is recognized but is not initiated until the timer expires.

Unload-Time

When the compressor is unloaded the unload-timer will start. If the compressor remains in an unload condition and the timer expires the main motor will stop and the compressor will enter the Standby mode.

The compressor will automatically re-start and load as required. This function is intended to improve efficiency during low demand periods and to limit the number, and interval between, motor starts.

The remaining time in seconds is shown on the Information Item display.

Stop Run-On-Time

When stopped, (stop button, or remote stop command) the compressor will unload and the main motor continue to run for the stop run-on-time before stopping. This function is intended to allow for the internal pressure to vent and to limit the lubricant from foaming due to a rapid blowdown.

The remaining time in seconds is show on the Information Item display.

Started State

The unit has been started (start button, or remote start command) and is in an active condition ready to respond to changes in delivery pressure.

Running State

The unit is in the Started state and the main motor is running.

Loaded State

The unit is in the Started state and the main motor is running AND the inlet valve solenoid is energized.

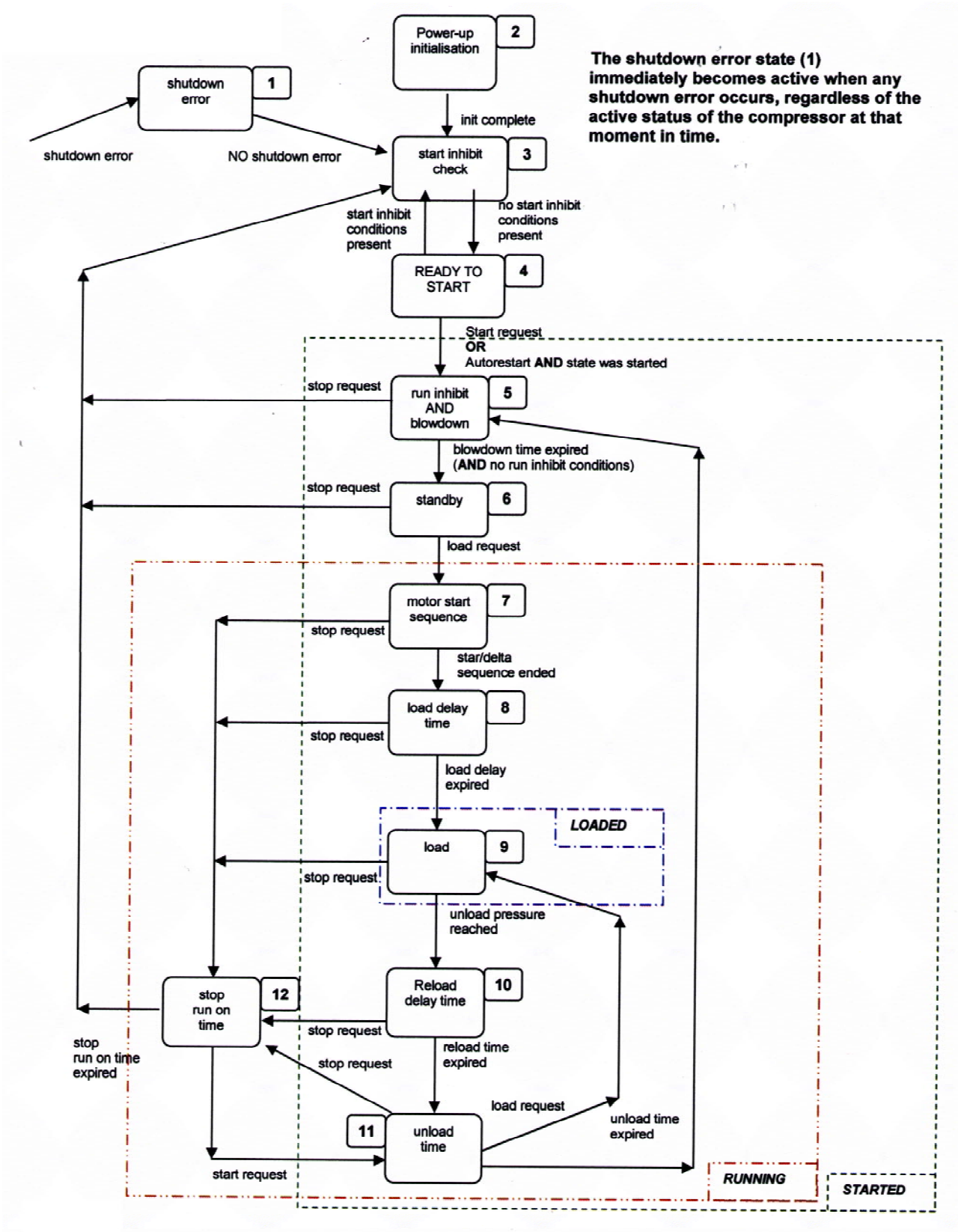


Figure 2- 1 – MACHINE STATE DIAGRAM

RESETTING THE SERVICE TIMERS ON AIRPLUS CONTROLLER

⚠ CAUTION

Be aware that other sensitive menus can be accessed with the service access code. Edits other than resetting service timers could result in injury or unit malfunction.

Figure 2-2 – Resetting Service Timers On AirPlus Controller

With unit in the off state hold the Up and Down buttons simultaneously and the screen will display:

00.0° f
CD: 0000

Push the Enter button to move the cursor and the Up and Down buttons to change values. Enter Access Code 0100

00.0° f
CD: 0100

When the code is completed push the Enter button until Menu P00 is flashing

P00
C) 0

Push the Down button until Menu P04 is flashing and push the Enter button.

Push the Down button to scroll thru the Service Timers. Timers include:

Oil	Air Filter	Oil Filter	Sep Element
P04 S1 0000	P04 S2 0000	P04 S3 0000	P04 S4 0000

Not Used	General Service	High Temp	High Press
P04 S5 0000	P04 S6 0000	P04 TD 0000	P04 PD 0000

Push the  **Enter button to enable reset. Push the**  **Up or**  **Down button to restore the service interval time value as shown in the manual.**

Push the  **Enter button to store the newly entered service interval value.**

Hold the  **Reset button in for two seconds to return to the normal display.**

SECTION 3
CONTROLLER NAVIGATION

User Interface

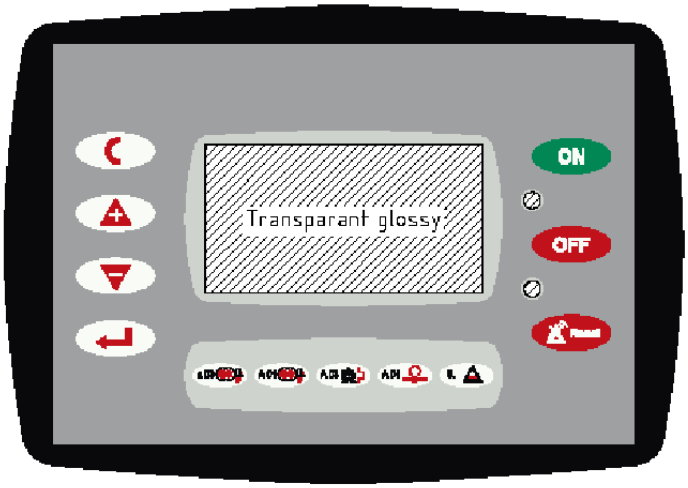


Figure 3-1 – CONTROLLER DISPLAY

Display : Custom backlit LCD
Indicators : 2 x LED
Controls : 7 x Tactile push buttons

Keypad

START:	Enter STARTED condition
STOP:	Exit STARTED condition
RESET:	Reset and clear fault conditions
ENTER:	Confirm selection or value adjustments
MINUS/DOWN:	Scroll down through menu, menu item options or decrease value
PLUS/UP:	Scroll up through menu, menu item options or increase value
ESCAPE (C):	Step back one menu navigation level

Start and Stop have one defined function and are not used for any other purpose.

Reset will initiate a display jump to the fault code item if a fault condition remains active or initiate a display jump to the information item if no active faults exist in normal display mode.

If pressed and held for longer than two seconds in menu mode, display will exit menu mode and go to the normal operational display mode.

Enter will lock a selected value display preventing return, after a short delay, to the default value display (see parameter IS menu P07).

When locked, the ‘key’ symbol will flash. To unlock, press Escape or Reset.

Escape will initiate a display jump to the information item in normal display mode.

Plus, Minus, Enter and Escape are used to navigate menu mode and adjust menu parameters.

Led Indicators

STATUS: Green, adjacent to Start and Stop buttons
FAULT: Red, adjacent to Stop and Reset buttons

Led indicator states key:

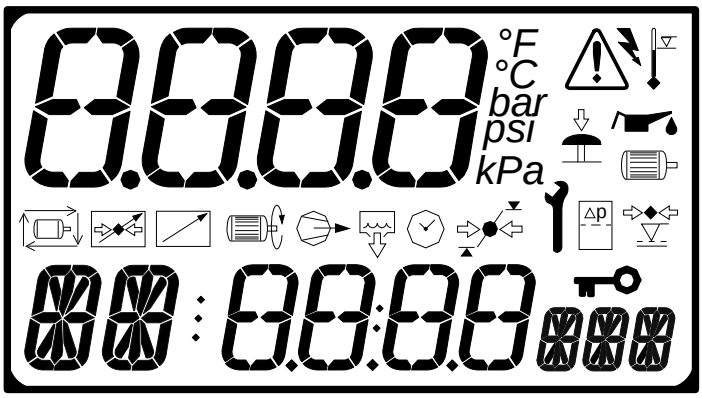
ON: Illuminated continuously.
FF: Fast Flash: on/off four times per second.
SF: Slow Flash: on/off once per second.
IF: Intermittent Flash: on/off every four seconds.
OFF: Extinguished continuously.

Machine State Number	**Machine State**	**Status** 🟢	**Fault** 🔴
1	Shutdown Error	OFF	FF
2	Startup Init	ON	ON
3	Start inhibit condition	FF	OFF *
4	Ready to Start	OFF	OFF **
5	Blowdown	if a load request is active FF otherwise IF	OFF **
6	Standby	IF	OFF **
7	Motor in Star/Delta	if a load request is active FF otherwise IF	OFF **
8	Load Delay	if a load request is active FF otherwise IF	OFF **
9	Load	ON	OFF **
10	Reload Delay Time	if a load request is active FF otherwise IF	OFF **
11	Unload Time	IF	OFF **
12	Stop Run on Time	SF	OFF **

🔴 * SF for Alarm fault active, FF for shutdown fault active

🔴 ** SF for Alarm fault active

Display



The display is divided in to 4 areas.

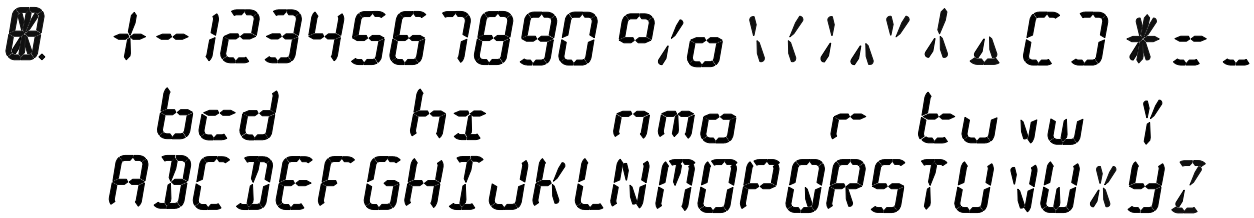
Top, Left: Display Field:
4 character numeric display, with unit symbols, used to continuously show oil temperature in normal operating mode or menu page number in menu mode.

Top, Right: Fault Symbol Field:
Symbolic icons used to indicate common general fault conditions

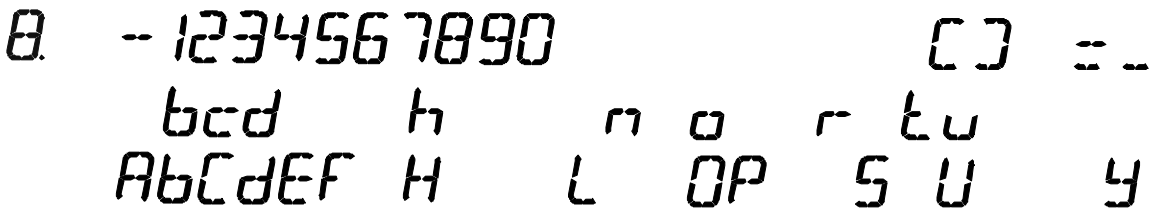
Middle: Symbolic icons used to reinforce meaning of selected item, or status information in normal operational mode.

Bottom: Item and Value Field:
Item identification: 2 character alphanumeric, 14 segment
Item Value: 4 character numeric, 7 segment
Item Unit: 3 character alphanumeric, 14 segment

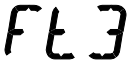
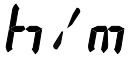
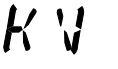
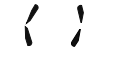
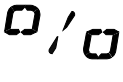
14 Segment Display Character Set



7 Segment Display Character Set



Display Character Examples Units

	bar		kPa		cfm		cfm
	psi		hour		m³/min		m³ cubic metres
	kW KiloWatt		minute		ft³ cubic feet		time hours/minutes
	kV KiloVolt		seconds		spm bearing monitoring		date day/month/year
	rpm		mA milliAmp		dBn spm unit		greater than less than
	ºC		mV milliVolt		+ positive		up down
	% percent		ºF		- negative		star delta

Operational Display Symbols Set

 Motor Running

 Loaded

 Amount of time, timer

 Air filter vacuum switch

 Pressure set point indication (NOT used)

 Condensate drain active (used only if condensate drain function is assigned to Auxiliary Relay 1 or 2)

 Auto-restart after power supply fault enabled (used only if auto-restart function is enabled in menu P07)

 Remote load or remote pressure regulation active (NOT used)

 Remote start/stop enabled (used only if remote start/stop function is enabled in menu P07)

 Normal Operational Mode: selected item locked as temporary default display
Menu Mode: page item locked, adjustment inhibited.

Fault Display Symbols Set

 General fault (NOT used)

 Emergency stop (NOT used)

 Excess pressure (NOT used)

 Power failure

 Above set temperature limit

 Lubrication, oil, oil level (NOT used)

 Dewpoint (NOT used)

 Motor

 Service due, maintenance

 Filter differential, filter service

Display Structure and Menu Navigation

Display Item Structure

All values, parameters or option selection displays are grouped into menu lists. Items are assigned to a list according to type and classification.

Items that can be used to select options or modify functions are assigned to 'menu mode' lists.

Items that an operator may require to view during routine operation, temperature values for example, are assigned to the normal operational mode list.

Lists are identified by page number; the normal operational display list is Page 00.

All parameters and options are assigned to menu mode pages 01 or higher.

All Page 00 items are view only and cannot be adjusted.

Normal Operational Mode (Page 00)

When the machine is powered up, all display elements and LED indicators on the controller are switched on for three seconds; the display will then show the software version code for a further 3 seconds before initialization is complete and the normal operating display (Page 00) is shown.

In page 00 'normal operational display mode' the Display Field will show the oil temperature continuously and the Item and Value Fields will show the Information Item selected (see menu P07).

All available Item and Value field option displays (temperatures, hours counters, service timers) can be selected using the Up or Down buttons at any time.

The Item and Value display will revert to the default item after 35 seconds if no further selection is made.

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 slow flash. To unlock an Item display, press Up or Down to view an alternative Item display or press Reset or Escape.

In page 00, Escape will select the Status Information Item display and Reset will select any active fault code display or the Status Information Item display if no faults are active.

Unless a selected Item display is locked, the display will automatically display the Status Information Item.

No Item values, options or parameters can be adjusted in page 00.

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.

Access Code

Access to page list displays higher than page 00 are restricted by access code.

To access menu mode pages, press UP and DOWN together: An access code entry display is shown and the first code character will flash. Use PLUS or 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. Access to certain menu mode pages is dependent on authority level determined by the access code used. An invalid code will return the display to normal operational mode; page 00.

The following pages and access levels are used:

ACCESS LEVEL = USER (code = 0100)	**ACCESS LEVEL = SERVICE 1**
P00, P01, P02	P00, P01, P02, P03, P04, P05, P06, P07, P08

Access Code Timeouts

When in menu mode, if no keys are depressed for a period of time, the display will automatically reset to the normal operational display; Page 00. The timeout period is dependant on the access code used:

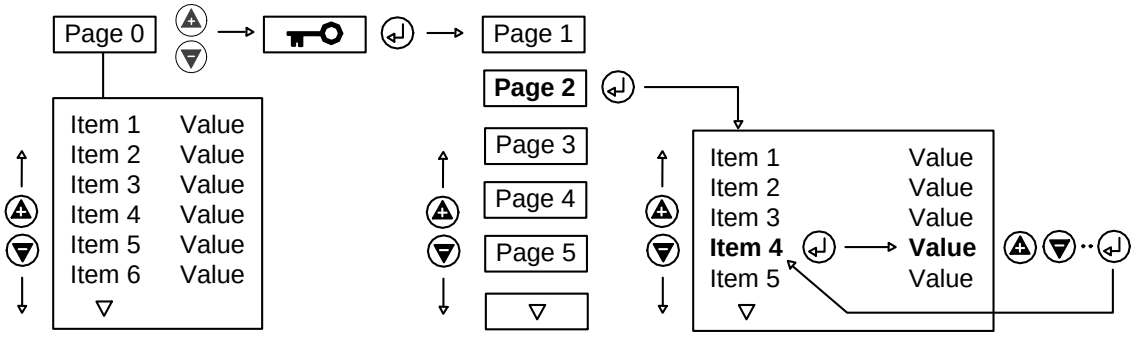
User: *1 minute* Service 1: *10 minutes*

Menu Mode Navigation

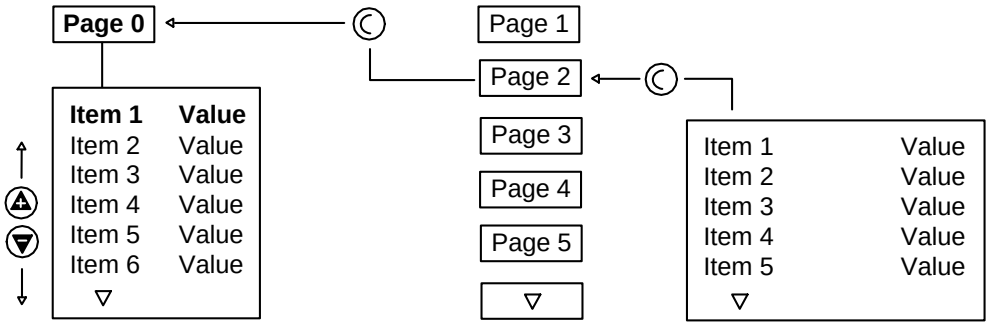
In menu mode, the Display Field will flash and show the Page number. To select a page, press UP or DOWN. For each page, the Item and Value field will display the first Item of the page list.

To view a page list, press ENTER; the Page number will stop flashing and the Item display will flash.

Press UP or DOWN to view the selected page list items. To select an Item value for modification, press ENTER; the Item display will stop flashing and the Value display will flash. The value or option can now be modified by pressing UP (Plus) or DOWN (Minus). To store in memory a modified value or option press ENTER; alternatively the modification can be abandoned, and the original setting maintained, by pressing ESCAPE.



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; page 00.

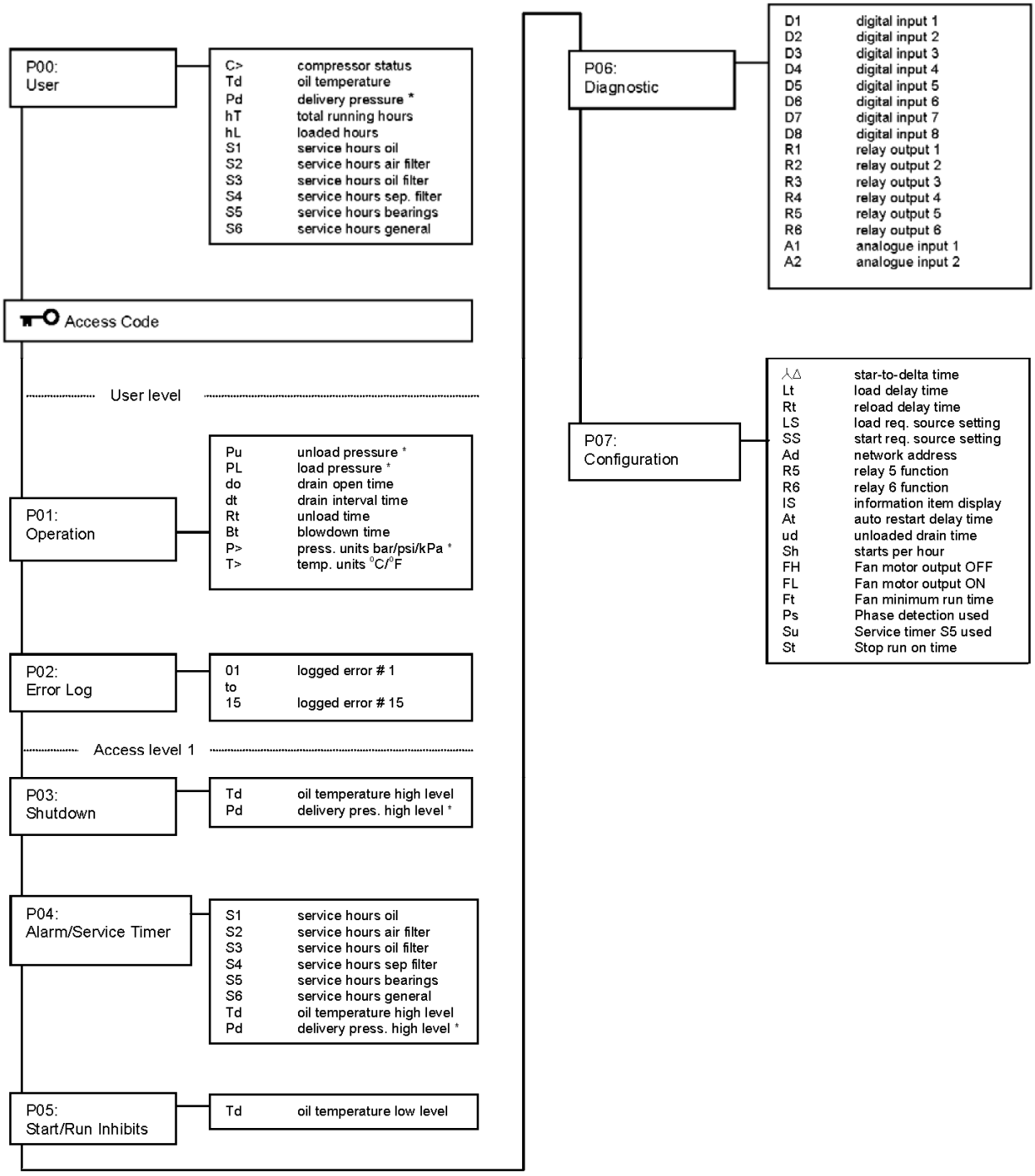


Press and hold RESET for two seconds at any time to immediately exit menu mode and return to the normal operational mode display. Any value or option adjustment that has not been confirmed and entered into memory will be abandoned and the original setting maintained.

A flashing Key symbol displayed with any Item indicates the Item is locked and cannot be modified. This will occur if the Item is view only (non adjustable) or in instances where the item cannot be adjusted while the compressor is in the operational STARTED state.

Menu Structure

*** = NOT used**



P00 User Menu

The User menu shows normal operational values and information displays. This is the default display menu; no access code is required.

Item #	Description	Units	Step	Min	Max	Default	Display
1	information screen	---	no_edit	---	---	**---**	**C>**
2	oil temperature	°C/°F	no_edit	---	---	**---**	**Td** 205 °F
3	Delivery pressure *	bar/psi	no_edit	---	---	**---**	---
4	running hours	h	no_edit	0	99999	**---**	**hT** 1430
5	loaded hours	h	no_edit	0	99999	**---**	**hL** 1275
6	service hours oil	h	no_edit	-9999	9999	**---**	**S1** 0570
7	service hours air filter	h	no_edit	-9999	9999	**---**	**S2** 0310
8	service hours oil filter	h	no_edit	-9999	9999	**---**	**S3** 0200
9	service hours sep filter	h	no_edit	-9999	9999	**---**	**S4** 0800
10	service hours bearings	h	no_edit	-9999	9999	**DISABLED**	**---**
11	service hours general	h	no_edit	-9999	9999	**---**	**S6** 1895

*** <u>NOT used</u>**

<u>Status Information Item Set</u>

The page 00 ‘Status Information Item’ provides a basic overview of status using symbols:


Main motor running


Compressor load


Delivery pressure relative to pressure set points **(<u>NOT used</u>)**


Pressure equal to, or below, load pressure set point **(<u>NOT used</u>)**


Pressure equal to, or above, unload pressure set point **(<u>NOT used</u>)**


Pressure between load and unload pressure set points **(<u>NOT used</u>)**

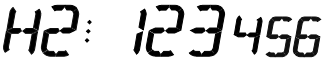

Condensate drain valve output is energized (if function enabled)


Countdown timer function is occurring (Unload-Time, Stop Run-On-Time, Blowdown Time). During a countdown, the remaining time in seconds is displayed.

Unless a timer function is active and the timer count is being displayed, the ‘units’ display field will show the selected Information item, see P07 ‘IS’ menu item.

Hours Display Items

Hours are displayed using the 'value and units' display fields together. This feature enables a maximum of 9999999 hours to be displayed.



('H2' = 123456 h)

Note: hour values less than 1000 are shown with leading zeros (10 hours = 0010)

P01 Operation Menu

Contains general operation parameters that may be modified by the User from time to time

Item#	Description	Units	Step	Min	Max	Default	Display
1	unload pressure *	---	---	---	---	---	**Pu**
2	load pressure *	---	---	---	---	---	**PL**
3	drain open time	S	1	1	30	**5**	**do** 5 s
4	drain interval time	S	1	30	3600	**60**	**dt** 60 s
5	unload time	s	1	1	3600	**180**	**Rt** 180 s
6	blowdown time	s	1	1	600	**20**	**Bt** 20 s
7	pressure units *	---	---	---	---	---	**P>**
8	temperature units **	°C/°F	1	0	1	**1**	**T>** 1 options: 0=^{0}C 1=^{0}F

*** NOT used**

** Pressure and Temperature Units

Selects the units for displayed values. Internally the controller operates using mBar (0.001bar) and mCelsius (0.001°C). The values displayed are calculated from the internal operating values.

P02 Error Log Menu

Contains the last 15 fault states in chronological order.

The most recent fault (alarm or shutdown) is stored as item 1.

Each item consists of two values: the fault code number and the running hours when the fault occurred.

The display will automatically alternate between these two values. All items are view only.

Item#	Description	Units	Step	Min	Max	Default	Display
1	logged error #1	---	no_edit	---	---	**---**	**01** . . . A.03 <> 12345 *****
2 to 15	logged error #2 to error #15	---	no_edit	---	---	**---**	**02 to 15**

***** Example: last detected error = Motor Overload (fault code A.03) at 12345 running hours

P03 Shutdown Menu

Settings that determine the level or condition at which a shutdown fault is generated.

Item#	Description	Units	Step	Min	Max	Default	Display
1	Oil temperature high level	°C/°F	1	176	266 *	**225**	**Td** 225 ^{0}F
2	delivery pressure high level **	---	---	---	---	---	**Pd**

* Value depends on sensor type

**** NOT used**

P04 Alarm Menu

Settings that determine the level or condition at which an alarm fault is generated.

Item #	Description	Units	Step	Min	Max	Default	Display
1	Service Timer Oil	hours	1	0	10000	**4000**	**S1** 4000
2	Service Timer Air Filter	hours	1	0	10000	**1500**	**S2** 1500
3	Service Timer Oil Filter	hours	1	0	10000	**1000**	**S3** 1000
4	Service Timer Separator	hours	1	0	10000	**3000**	**S4** 3000
5	Service Timer Bearings	hours	1	0	10000	**DISABLED**	**S5**
6	Service Timer General	hours	1	0	10000	**250**	**S6** 250
7	oil temperature high level	°C/°F	1	158	248	**220**	**Td** 220 ^{0}F
8	delivery pressure high level *	---	---	---	---	**---**	**Pd**

**** NOT used**

Service Countdown Timers

The service countdown timer will count down from the set value in accordance with running hours. When the item is viewed, the service hours value will reflect the current hours remaining until a routine maintenance service is due (zero hours).

When zero hours are reached, a service due alarm will be displayed.

Note: The alarm can only be reset when the service hours is adjusted above zero.

The service hour count will continue to count down in negative values until the timer is re-set. This function is intended to promote timely routine maintenance and indicate how many running hours have passed since service was due. The value can be manually adjusted back to the required maintenance interval time each time a maintenance service is completed.

P05 Start and Run Inhibit Menu

Settings that determine the level or condition at which a start or Run inhibit condition exists.

Item#	Description	Units	Step	Min	Max	Default	Display
1	oil temperature low level	°C/°F	1	-4	50	**14**	**Td** 14 °F

Oil Temperature Low Level: Run Inhibit active if temperature falls below set limit.

Note: There are no Start inhibits

P06 Diagnostic Menu

This menu allows a technician to check all inputs and test all outputs individually without running the compressor.

Item#	Description	Units	Step	Min	Max	Default	Display
1	digital input 1	---	no_edit	---	---	---	**D1** 0 _ _ _
2	digital input 2	---	no_edit	---	---	---	**D2** 1 _ _ _
3	digital input 3	---	no_edit	---	---	---	**D3** 0 _ / _
4	digital input 4	---	no_edit	---	---	---	**D4** 0 _ _ _
5	digital input 5	---	no_edit	---	---	---	**D5** 0 _ _ _
6	digital input 6	---	no_edit	---	---	---	**D6** 0 _ _ _
7	digital input 7	---	no_edit	---	---	---	**D7** 0 _ _ _
8	digital input 8	---	no_edit	---	---	---	**D8** 1 _ _ _
9	relay output 1	---	1	0	1	0	**R1** 0 _ / _
10	relay output 2	---	1	0	1	0	**R2** 0 _ / _
11	relay output 3	---	1	0	1	0	**R3** 0 _ / _
12	relay output 4	---	1	0	1	0	**R4** 0 _ / _
13	relay output 5	---	1	0	1	0	**R5** 1 _ _ _
14	relay output 6	---	1	0	1	0	**R6** 0 _ / _
15	analogue input 1	---	no_edit	---	---	---	**A1**
16	analogue input 2	---	no_edit	---	---	---	**A2**

Digital Inputs

The display will indicate the actual state of the input "_ ***/*** _" (open circuit) or "_ _ _" (closed circuit) and the status of the corresponding input function; active (1) or de-active (0).

Note: Value display number indicates function, not input state (example: Emergency Stop = 0 "_ _ _" the input is closed circuit and the Emergency Stop function is not active).

Relay Outputs

Relays can be energized (1) and de-energized (0). The motor starter relay outputs, 1 to 3, can only be energized one at a time, the output will de-energize when the selected Item is changed.

Analogue Inputs

Analogue input values will toggle (2 second) between associated engineering units set for the input and the actual mV(temperature or voltage inputs) or mA (current loop inputs) detected on the controller connector of the corresponding analogue input. The mV or mA value can be independently checked with a meter.

P07 Configuration Menu

Settings that determine the basic operating configuration.

Item#	Description	Units	Step	Min	Max	Default	Display
1	star/delta time	s	0.2	0	30	**0**	⅄△ 0 sec
2	load delay time	s	1	1	30	**2**	**Lt** 2.0 sec
3	reload delay time	s	1	1	10	**1**	**Rt** 1.0 sec
4	load request source setting	0=press.sensor 1=comm.req. 2=pressure switch	1	0	2	**2**	**LS** 2
5	start request source setting	0=keyboard 1=comm.req. 2=dig.inputs	1	0	2	**0**	**SS** 0
6	network address	---	1	1	99	**1**	**Ad** 1
7	relay 5 function setting	1 to 13 see Output Functions	1	1	13	**2**	**R5** 2
8	relay 6 function setting	1 to 13 see Output Functions	1	1	13	**5**	**R6** 5

Relay 5 and 6 Output Functions:

1 - Alarm — De-energized for any active Alarm fault (not including Start/Run Inhibit)

2 - Shutdown — De-energized for any active Shutdown fault (not including Start/Run Inhibit)

3 – Group Fault — De-energized for any active Alarm, Star/Run Inhibit or Shutdown fault

4 – Alarm Service — De-Energized for any Alarm fault or Service Due alarm (not including Start/Run Inhibit)

5 – Service — Energized for Service Due alarm only

6 – Heater — Energizes if detected oil temperature falls below +16°F

De-energizes if detected temperature increases above +18°F

Can be used to energize anti-condensate heater contactor or as low temperature warning auxiliary output.

7 – Drain — When loaded: cycle in accordance with drain open and drain interval time settings.

Elapsed interval time is stored in non-permanent memory when not loaded and the remaining interval time applied when loaded operation is resumed.

When not loaded AND in 'started' state (optional; active only if off-load drain time set above zero seconds, 0sec = offload drain function disabled).

Drain interval time = drain interval time x 10.

Drain open time = offload drain time setting.

Reset to start of interval time when status change to not loaded, then cycle.

8 – Fan — Energized in all RUNNING states except 'motor start' and 'load delay time'

Can be used to energize internal and/or external cooling fan motor contactor

9 – Standby — Energized in 'Standby' and 'Blowdown' states

10 – Running — Energized in all RUNNING state conditions

11 – Loaded — Energized in all LOADED state conditions

12 – Started — Energized in all STARTED state conditions

13 – Fan (temp ctl) — Enabled to operate in all RUNNING states except 'motor start' and 'load delay time'

If enabled to operate, the output will only energize if oil temperature exceeds the set 'Fan High' temperature setting. If oil temperature falls below the set 'Fan Low' temperature setting, the output will de-energize. Once energized, the output will remain energized for a minimum of the set 'Fan Minimum Run Time' regardless of oil temperature. This relay can be used to energize an internal or external cooling fan motor contactor; the minimum run time is intended as a means of limiting Fan motor starts-per-hour.

09	indication field function setting *	0=no indication 1=network address 2=machine state No. 3=average cycle time 4=max cycle time 5=# starts registered	1	0	5	5	IS 5
10	auto restart delay time	s	1	0	120	0	At 0 sec
11	Offload drain time	s	1	0	30	15	ud 15
12	starts per hour	---	1	0	20	6	Sh 6
13	Fan control ON temp	^{0}C	1	135	203	185	FH 185 °F
14	Fan control OFF temp	^{0}C	1	131	199	149	FL 149 °F
15	Fan minimum run time	s	1	10	300	20	Ft 20 sec
16	Phase control used	---	1	0	1	1	Ps 1
17	Service timer S5	0 = not used 1 = used	1	0	1	0	Su 0
18	stop run on time	s	1	0	60	1	St 1 s

* Indication Field Function Setting

The function of the number shown in the 'units' display field (bottom right of display) when the 'Status Information Item' is selected from the normal operational menu P00:

- Network Address – the set RS485 network address for the compressor

- Machine State Number – the current active status block condition (see machine state diagram)

- Average Cycle Time – the average controller software cycle time in mSecs

- Maximum Cycle Time – the maximum controller software cycle time in mSec

- Starts Registered – The number of motor start events that have occurred in the last one-hour period **(DEFAULT)**

Information field items are intended for general information or diagnostic purposes, to disable select (0).

Auto Restart Delay

If an auto restart delay time is specified, the controller will execute an automated restart after a power interruption if the controller was in the Started state when the power failure occurred. The delay time specifies the warning period after controller initialization before a re-start is executed. The time before restart is indicated on the controller display. No restart will occur if the controller was not in the started state prior to power disruption and a warning message will inform the user of the power interruption.

Starts per hour

Every time a main motor start event occurs, an entry is made in an array. The entry is made in the first available location in a FIFO register list. The entry is 3600 seconds, which is counted down from that point in time. For every motor start event to the maximum number of starts per hour allowed, an entry is made. When the first entry expires, the others, which were recorded at a later point in time, will be shifted forward one, and the number of registered motor starts is decremented.

If the number of motor starts registered (motor start events within the last one hour period) equals the number of starts allowed, an adjustment to the unload time is made. The new unload time is calculated so that the compressor will continue to run unload until the number of registered start events within the last one hour period reduces below the maximum number set, allowing another start event to occur.

The ‘starts per hour’ function only influences the unload time; it will not prevent the motor from being started. If a new start is performed after the maximum number of starts has already been registered, the oldest one is removed from the list, which causes the time to wait to increase.

To disable the function, and maintain the set unload time period regardless of motor start events, adjust the starts per hour setting to 0(zero).

Compressor Model types - Configuration Table

Selection of the model type: P09 item Mo

	Model Type 3	
P01		
Unload pressure	n.a.	
Load pressure	n.a.	
Drain open time	5	sec
Drain interval time	60	sec
Unload time	180	sec
Stop run on time	1	sec
Blowdown time	20	sec
Pressure unit	n.a.	
Temperature unit	1(°F)	
P02		
Errors logged	n.a.	
P03		
Oil temp high level	225(°F)	
Delivery pressure high level	n.a.	
P04		
Oil time	4000	hours
Air filter time	1500	hours
Oil filter time	1000	hours
Separator time	3000	hours
Service bearings	n.a.	
Service time	250	hours
Oil temp. high level	220(°F)	
Delivery press. high level	n.a.	
P05		
Oil temp. low level	-10	°C
P07		
Star delta time	0	sec
Load delay time	2	sec
Reload delay time	1	sec
Load req. source setting	2	=pressure switch
Start req. source setting	0	=local / controller
Network address	1	
Relay 5 function	2	=shutdown
Relay 6 function	5	=service only
Information item display	5	=starts/per hour
Auto restart delay time	Disabled	sec
Unloaded DRAIN time	15	sec
Starts/hour	6	
Fan motor output OFF	85	°C
Fan motor output ON	65	°C
FAN minimum run time	20	sec
PHASE detection used	1	=enabled
Service timer S5 used	0	=disabled

Temperature Sensor Adjustment Limits and Default Values

KTY Temperature °C	Min	Max	Default	Step
Alarm	70.0	131.0	110.0	0.5
Shutdown	71.0	132.0	120.0	0.5
Range	-10.0	132.0	-	-

Pressure Control

The pressure switch controls the load/unload of the compressor. See Service Manual (Service manuals are listed on page 2) for more details.

Fault Messages

Faults are abnormal operating condition states.

Alarms are fault states that indicate normal operating conditions have been exceeded but do not present an immediate hazard or potentially damaging condition. Alarms are intended as a warning only and will not stop the compressor or prevent the compressor from being started and run.

Start inhibits are faults that prevent the compressor from initially being starting.

Start inhibit faults are conditions that may present a hazard or damaging situation if the compressor was to be started. A start inhibit state will self reset when the condition being monitored returns to normal operational levels. Start inhibit conditions are only checked during the initial start procedure and will not stop the compressor once started and in the 'started' state. Start inhibit conditions are not checked during an automated motor start from Standby.

Run inhibits are faults that prevent the compressor from starting and running the main motor.

Run inhibit faults are conditions that may present a hazard or damaging situation if the main motor is run. A run inhibit state will self reset when the condition being monitored returns to normal operational levels and the compressor will then be allowed to exit the standby condition and run without further manual intervention. Run inhibit conditions are checked prior to a main motor start sequence and will not stop the compressor motor once started. Run inhibit conditions do not prevent the compressor from entering the 'started' state condition.

Shutdown trip errors are fault states that present a hazardous or damaging condition and the compressor is stopped immediately. The Shutdown trip error condition must be resolved, and the fault reset, before the compressor can be re-started.

Immediate Stop Shutdown Errors

Digital input errors

A.03	Motor Overload Relay
A.04	Phase Monitoring Relay
A.05	Emergency Stop (**NOT used**)
A.20	High Pressure Switch
A.25	High Temperature Switch
A.33	Power less while loaded (including voltage drop)
E.04	Power loss or low voltage

Analogue input errors

A.01	Oil temperature high
A.07	Temperature sensor fault
A.12	High Discharge Pressure (**NOT used**)
A.13	Pressure sensor fault (**NOT used**)

Special function errors

None

Controlled Stop Shutdown Errors

None

Alarms

Digital input alarms

A.01	Air Filter Vacuum Switch

Analogue input alarms

A.02	High Discharge Pressure (**NOT used**)
A.03	High Oil temperature

Special function alarms

None

Start Inhibits

None

Run Inhibits

1.01	Oil temperature Td below the set low temperature run inhibit level, controller will allow motor start when temperature increases above the set level

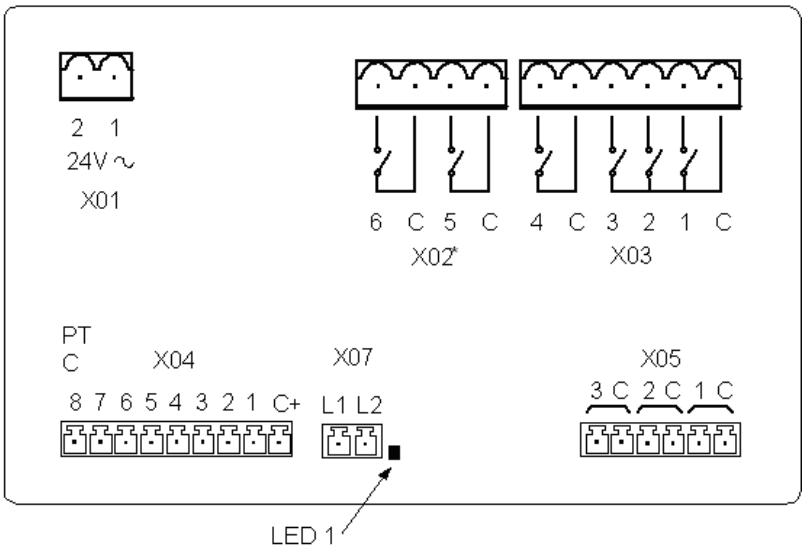
Service Alarms

Special function service alarms

S.01	service hours oil life exceeded, service due
S.02	service hours air filter life exceeded, service due
S.03	service hours oil filter life exceeded, service due
S.04	service hours air/oil separator life exceeded, service due
S.05	(**NOT used**)
S.06	service hours general maintenance life exceeded, service due

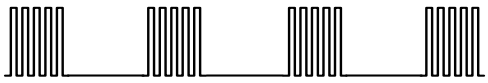
LED indication

LED 1 is located on the PCB between connectors X07 and X08 and can be seen from the rear of the controller without removing the rear enclosure housing.
This LED gives diagnostic information about different functions of the AirPlus controller.

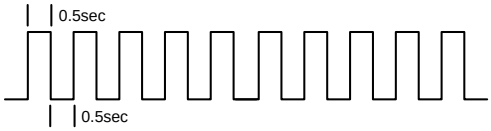


Production; Burn-in

Production; Test Mode

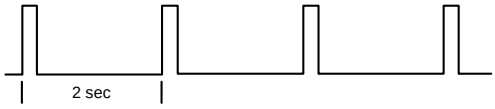


Normal Operating Mode
No Communications



Note: a two second interruption to this sequence will occur every 10 second as the AirPlus broadcasts output data on the RS485 communications port.

Normal Operating Mode
RS485#1 Communications



Example Configuration

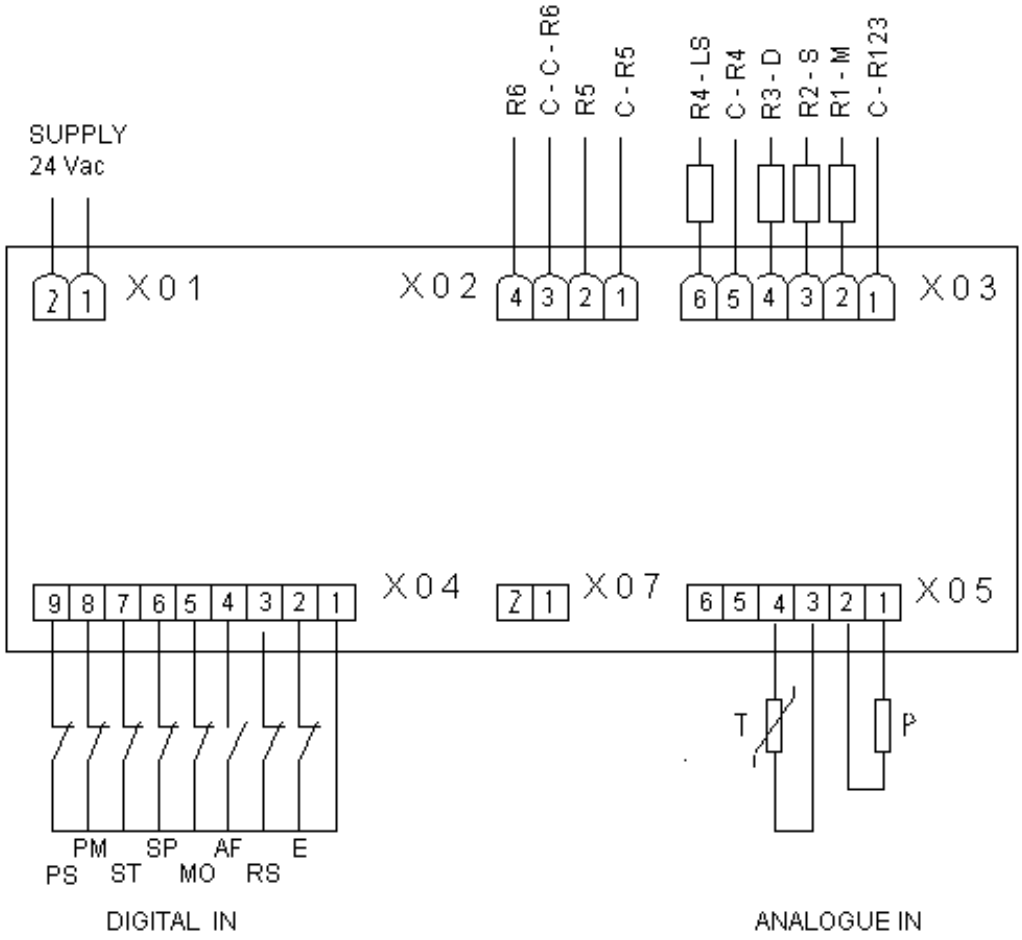


Figure 3-2 – VIEW OF CONTROLLER WIRING INPUTS & OUTPUTS

E	Emergency Stop Button **(NOT used)**
RS	Remote Start/Stop (start if closed, stop if open)
AF	Air Filter Vacuum Switch
MO	Motor Overload Relay
SP	High Pressure Shutdown
ST	High Temperature Shutdown
PM	Phase Monitoring Relay
PS	Pressure Switch
R1-M	Main (Line) Motor Contactor
R2-S	Star Motor Contactor
R3-D	Delta Motor Contactor
R4-LS	Load Solenoid Valve
R5	Auxiliary Relay 1
R6	Auxiliary Relay 2
Pd	Discharge Pressure Sensor **(NOT used)**
Td	Oil Temperature Sensor

Gardner Denver

ENERGY STAR PARTNER

For additional information contact your local representative or

ISO 9001 CERTIFIED

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1800 Gardner Expressway, Quincy, Illinois 62305

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