Carrier s.a.

Carrier

Subsidiary of Carrier Corporation

30H

Reciprocating Liquid Chillers, Flotronic II Electronic Control

Control and troubleshooting

Contents

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APPROVALS
BS 5750 PART 1
NF EN 29001
ISO 9001

Introduction

This catalogue includes information on electronic control, wiring, troubleshooting of the 30H water cooled liquid chillers and heat machines equipped with Flotronic II option.

This publication should be used together with standard IOM applicable to 30H standard units.

> *Caution :*
> ***Do not never modify wiring of 30H unit equipped with Flotronic II option. All start-up and installation procedures listed in these units standard IOM should be followed carefully.***
> ***Any error of wiring of electronic component can provoke immediate destruction of this device.***

Flotronic II system

30H series

The Flotronic II control system cycles compressors and compressors unloaders (if used) to maintain the selected leaving water temperature set point. It automatically position the EXV to maintain the specified refrigerant superheat entering the cylinders of the compressors. Safeties are continuously monitored to prevent the unit occupied/unoccupied schedule. The control also operates a Quick Test program that allows the operator to check input and output signals to the microprocessor.

The control system consists of a processor module PSIO, a low-voltage relay module DSIO (LV), an EXV driver module DSIO (EXV) keyboard and a display module HSIO, transducers and thermistors to provide analog inputs to the microprocessor. The software resides in the PSIO.

Processor module (PSIO)

Processor module controls overall unit operations. Its central executive routine controls a number of process simultaneously.

These include:

- Internal timers
- Reading inputs
- Analog to digital conversions
- Display control
- Diagnostic control
- Output relay control
- Demand limit
- Capacity control
- Head pressure control
- Temperature reset

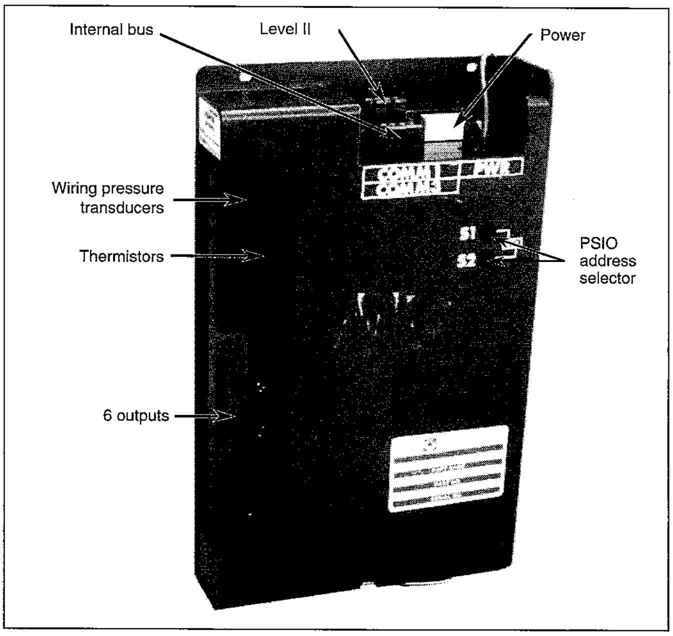


Fig. 1 PSIO module

Low-voltage relay module (24 Volts)

This module closes contacts to energize compressors and unloaders (if used). It also senses the condition of the compressor safeties and transmits this information to the processor module and monitors the status of 4 safety digital inputs (compressors).

EXV driver module

This EXV drive module operates the electronic expansion valves (based on commands from the processor) and monitors the status of 4 safety drive inputs (compressors).

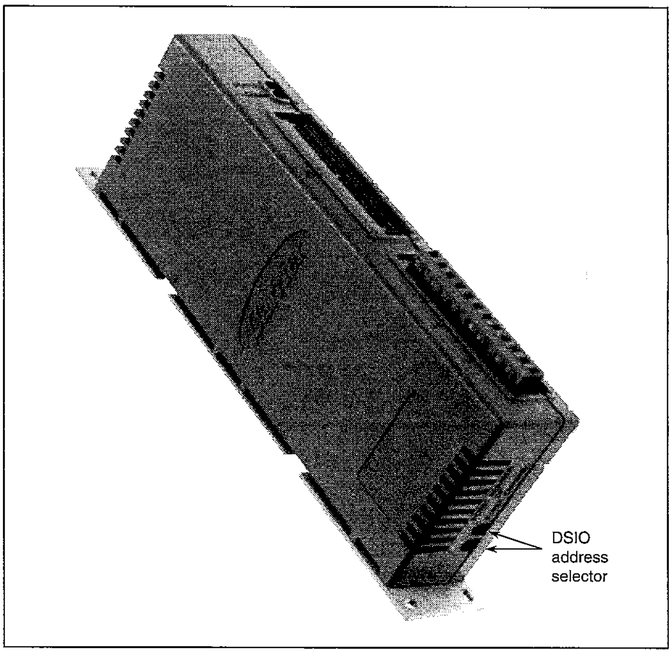


Fig. 2 DSIO module

HSIO keyboard/display module

Eight digit alphanumeric panel displays information on status, operating modes, alarms, plus set points, time of day and actual temperatures, pressures and superheats. This information is displayed in english or in anyone of the 6 following languages : Dutch, French, German, Italian, Spanish or Swedish. Set points, time schedules, reset limits, ramp loading rates and other operating parameters are entered through the keyboard function and digit keys with password protection. During normal operation, time of day, operating mode and number of alarms will alternate on the display.

Note:

Correct functionning of PSIO and HSIO modules is indicated through the red and green flashing self diagnostic emitting diodes (LED) situated on the top of the PSIO module and on the front of PSIO module.

This LED lights should send flashing signal all the time. For details see paragraph (pages 27, 28).

Thermistors and pressure transducers

Four thermistors are used for temperature sensing inputs to microprocessor (a fifth may be used as a remote temperature sensor for optional LCWT reset).

As an option, additional thermistors can be used to display condenser (and reclaim condenser) water leaving and entering temperature. This requires the use of an additional input/output module (options 137A and 137B).

R1 Cooler leaving chilled water temperature
R2 Cooler entering water (return temperature)
R3 Suction gas temperature - Circuit A
R4 Suction gas temperature - Circuit B
R5 Leaving hot water temperature (heat machines only) or optional leaving condenser water temperature
R6 Entering hot water temperature (heat machines only) or optional entering condenser water temperature.
R7 Optional heat reclaim condenser leaving water temperature.
R8 Optional heat reclaim condenser entering water temperature.
R10 Remote temperature sensor (accessory)

Six pressure transducers are used for control and safeties :

BP1 Discharge pressure Comp 1 Circuit A
BP2 Discharge pressure Comp 1 Circuit B
BP3 Suction pressure Comp 1 Circuit A
BP4 Suction pressure Comp 1 Circuit B
BP5 Oil pressure Comp 1 Circuit A
BP6 Oil pressure Comp 1 Circuit B

The microprocessor uses these pressures and temperatures to control capacity and electronic expansion valve (EXV) operation.

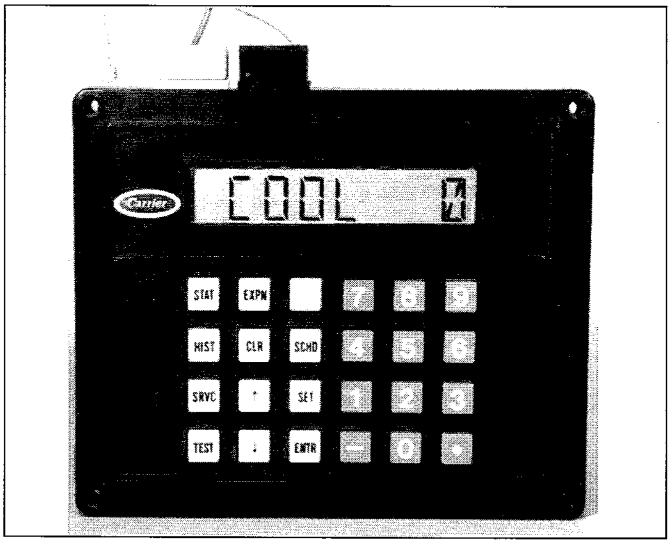
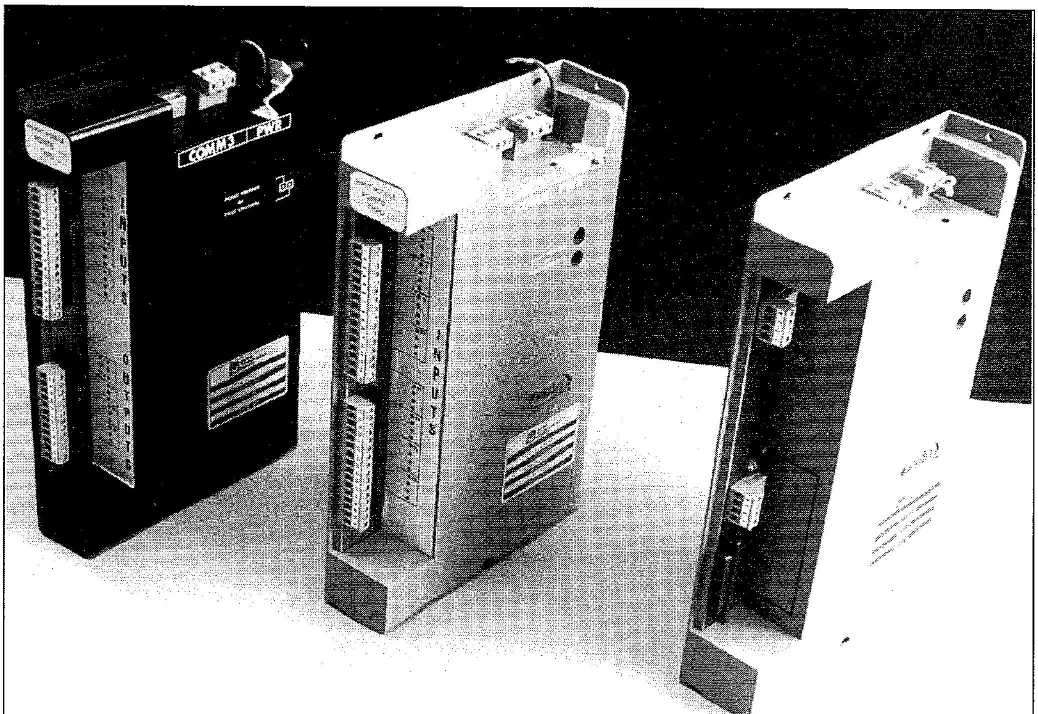


Fig. 3 HSIO module



"4x4" "8 IN" "Data port"

Fig. 33 4x4, 8 IN & Data port modules

Electronic expansion valve (EXV)

EXV's are actuated by an EXV driver module connected to the Main Processor Module.
To control flow of refrigerant for different operating conditions, EXV piston moves up and down over slot orifices through which refrigerant flows to modulate size of opening. Piston is moved by a stepper motor through 1500 discrete steps and its position is permanently stored in the microprocessor memory.
The EXV is used to control superheat in compressor. One pressure transducer and one thermistor, located in the lead compressor of each circuit are used to directly determine superheat. The EXV is controlled to maintain superheat entering pistons at approximately 8.3°C (15°F) to 11.1°C (20°F), which results in slightly superheated refrigerant leaving cooler.
The electronic control provides a prepurge and pumpout cycle each time the lead compressor in a circuit is started or stopped. These pumpout cycles minimize amount of excess refrigerant that can go to compressor on start-up and cause oil dilution which would result in eventual bearing wear.
The microprocessor software is programmed so that EXV functions as a MOP (maximum operating pressure) valve, limiting the suction temperatures to 12.8°C (55°F). This makes it possible to start unit at high water temperatures, up to 35°C (95°F), without overloading compressor. If necessary the MOP value can be readjusted.

Compressors protection and control

Each compressor of 30H unit is equipped with a ground current protection board (GPC). This safety device electronic sensor automatically shuts down the compressor if a phase imbalance greater than 2 or 3 amps occurs.
This prevents a contamination of the refrigerant circuit caused by compressor motor burn out and protects remaining compressors of this circuit from damage.
Each of compressor motor is protected by a discharge gaz thermostat (DGT).
When the discharge gaz temperature reaches a rated value, the sensor resistance will drastically increase and compressor module opens the circuit contactor to stop this compressor.
Please refer to the unit standard IOM catalogue for additionnal information on the compressor protection.

Start up

Initial check

Before starting up the unit, please refer to the standard IOM shipped with each 30H chiller or heat machine.

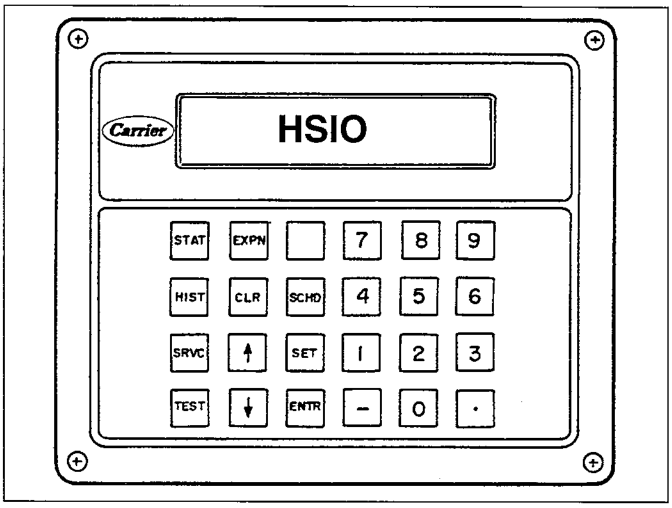


Fig. 5 Keyboard/display module

Digital display module

Allows to gather information on unit operation and to control unit contains operating modes through six keys.

Digital display

Information display on the small digital screen allows to know unit.

Information on unit operating modes

Function keys	Use
STAT	**Status** - Displaying diagnostic codes and current operating information about the machine
SRVC	**Historic** - Checking for run time, starts alarms

Setting unit operating modes

Function keys	Use
SRVC	**Service** - Entering specific unit configuration information
SET	**Setpoint** - Entering operating set points and day/time information
SCHD	**Schedule** - Entering occupied/unoccupied schedules for unit operation

Test function

Function keys	Use
TEST	**Quick test** - Checking inputs and outputs for proper operation

Other keys

Function keys	Use
EXPN	**Expand display** - Displaying a non-abbreviated expansion of the display
CLR	**Clear** - Clearing the screen of all displays
↑	**Up arrow** - Returning to previous display position
↓	**Down arrow** - Advancing to next display position
ENTR	**Entering data**

Table 1 HSIO keyborad/display module key usage

Whenever the keyboard has not been used for 10 minutes, the display will automatically switch to an alterning summary display. This display has 5 parts, shown below, which alternate in continuous rotating sequence :

Display	Expansion (EXPN)
Date/hour	Date (ex. TUE)/HOUR (ex. 12:50)
"n" mode	Operating modes
Cold or hot	Number of capacity steps
"n" stages	Number of stages
"n" alarms	"n" alarms detected

Each function key give an access to many subfunctions as shown page 6.
The following example explains keys usage :

Keyboard entry	*Display* : Expansion (EXPN)
6 STAT	***Temperatures*** : Temperature reading subfunction
To advance to next subfunction, use function key	
STAT	***Pressions*** : Pressions reading subfunction
The operator uses another function key to go to the first subfunction of this function	
HIST	***Run time*** : The machine operating hours are displayed
When the last subfunction has been activated, the operator uses the function key to go to the first subfunction	
3 HIST	***Alarms***
HIST	***Run time***

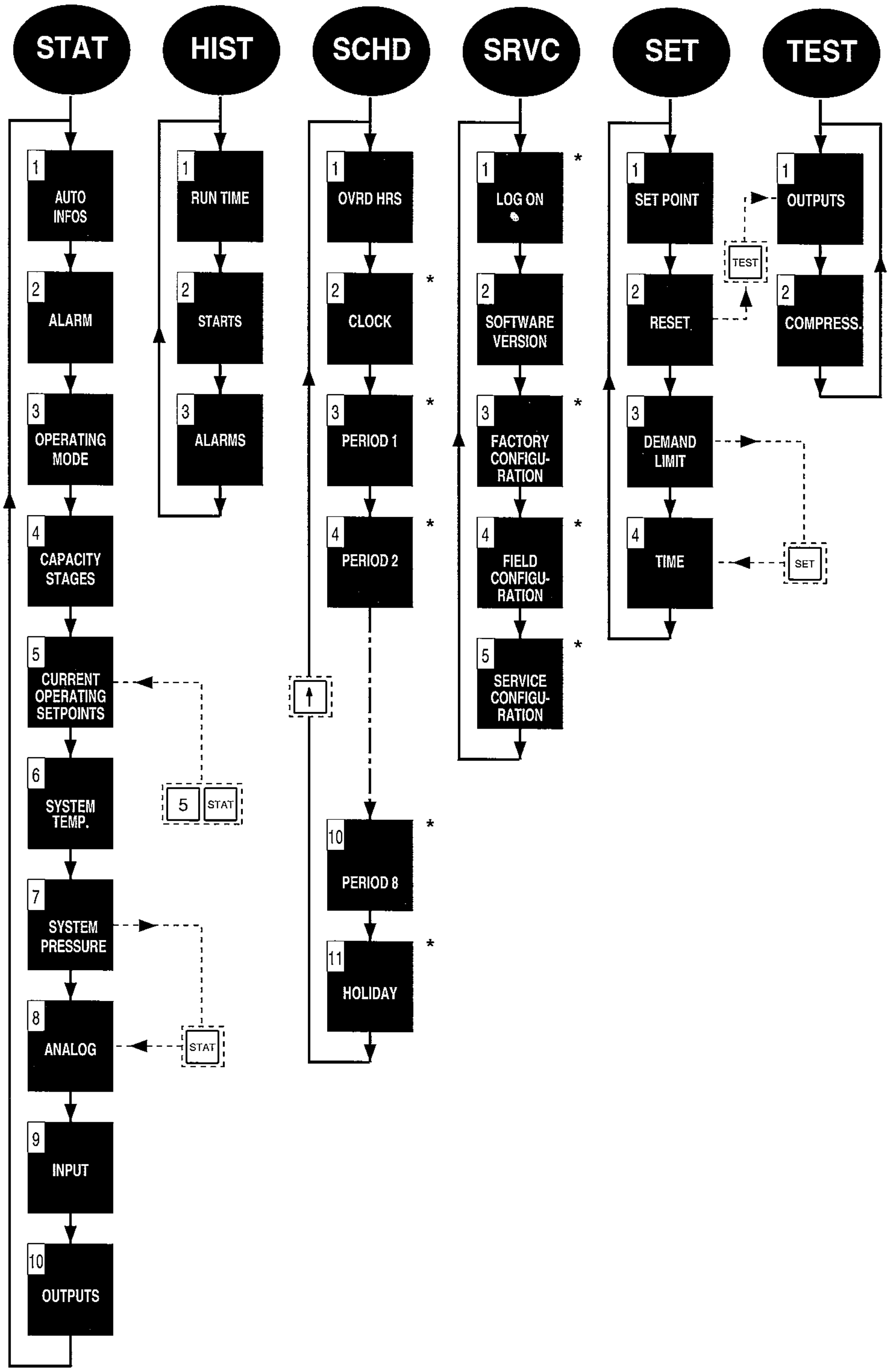
Example 1 Accessing functions and subfunctions

Each subfunction consists of different elements and all of them are described in this catalogue. To move to another sub function, scroll down using the arrow key ↓. When the last element of sub fonction is shown, scrolling down arrow key will display the first element of subfonction (see example 2 for details).

Keyboard entry	Display	Description
1 SET	SET POINT	Unit set point
↓	CSP 1	Cold set point 1
↓	CSP 2	Cold set point 2
↓	HSPA	Head pressure set point circuit A
↓	HSPB	Head pressure set point circuit B
↓	CRAMP	Number of heating steps
↓	SET POINT	System set point

Example 2 Accessing elements to subfunction Set

For details see, chart "Set subfonctions" on page 17.



Note :
** Password protected*

Chart 1 Flotronic II. HSIO tree structure - Functions and subfunctions

Status function

The status function shows the current status of alarm (diagnostic) codes, capacity stages, operating modes, chilled water set point, all measured system temperatures, superheat values, pressure switch positions and expansion valves positions. These subfunctions are defined below. Refer to charts 2a and 2b for additional information.

[1] [STAT] AUTO INFO (information). The display will automatically switch to an alternating summary display. This display has 5 parts, shown below, which alternate in continous rotating sequence.

Display	**Expansion (EXPN)**
Date/hour	
Local on/off	
"n" mode	Number of operating modes
"n" stages	Number of stages
"n" alarms	"n" alarms detected

[2] [STAT] ALARMS. Alarms are messages that one or more faults have been detected. Each fault is assigned a code number which is reported with the alarm. (See table 9 for code definitions). The code indicate failures that cause the unit to shut down, terminate an option (such as reset) or result in the use of a default value as setpoint.

Up to 5 alarm codes can be stored at once. To view them in sequence, press [1] [STAT] to enter the alarm displays and then press [↓] to move to the individual alarm displays.

Press [EXPN] after a code has been displayed and the meaning of the code will scroll across the screen.

When a diagnostic (alarm) code is stored in the display and the machine automatically resets, the code will be deleted. Codes for safeties which do not automatically reset will not be deleted until the problem is corrected and the machine is switched to STANDBY, then back to RUN.

When switching to STANDBY position, the alarms stay in memory up to switching to RUN.

Example 1 Reading alarm codes

Keyboard Entry	Display Response	Comment
[2] [STAT]	N* ALARMS	Number of alarms tripped
→ [↓]	ALARM 1	Compressor A1 fault
[↓]	ALARM 38	Failure to pumpdown CKT A
[↓]	ALARM 7	Compressor B3 fault
[↓]	ALARM 1	Compressor A1 fault

Note :
** Number of alarms*

[3] [STAT] OPERATING MODE. The operating mode codes are displayed to indicate the operating status of the unit at given time.

The modes are explained below :

Local off (1)
Unit off by switch

CCN off (2)
Unit off by CCN

Clock off (3)
Unit off by time clock

Local on (4)
Unit on by switch

CCN on (5)
Unit on by CCN

Clock on (6)
Unit on by clock

Unoccupied dual set point (7)

Temperature reset (8)
In this mode, the unit is using temperature reset to adjust the set point, and the unit is controlling to the modified set point. This means that the leaving water temperature may not equal the chilled water set point. The set point can be modified based on return water, outside air temperature or space temperature.

Demand limit active (9)
This indicates that the capacity of the unit being limited by the demand limit control option. The unit may not be able to produce the desired leaving water temperature because the unit may not load to full capacity.

Load limit active (10)

Low source protection (11)
Against the cooler water temperature becoming to low (used only on 30HQ units (heat machines).

Ramp load limited (12)
At initial start-up, this mode will limit the rate at which water temperature decreases to an adjustable limit to prevent high power usage and control point overshoot.

n HR times override (13)
This mode will substract (or add) stages of capacity if a sudden low change results in rapidly decreasing (or increasing) chilled water temperature (hot water or heating applications).

Evaporator low pressure (14)

To enter the modes subfunction, depress [3] [STAT] and use the [↓] key to determine if more than one mode applies. See example 2 to read current current mode with expansion.

Alarm display codes

Short Display	Long display (EXPN key)	Action taken by control	Reset method
Alarm 0	Emergency stop	Unit shut off	Manual
Alarm 1	Compressor A1 fault (leader)	Circuit A1 shut off	Manual
Alarm 2	Compressor A2 fault	Comp A2 shut off	Manual
Alarm 3	Compressor A3 fault	Comp A3 shut off	Manual
Alarm 5	Compressor B1 fault (leader)	Circuit B1 shut off	Manual
Alarm 6	Compressor B2 fault	Comp B2 shut off	Manual
Alarm 7	Compressor B3 fault	Comp B3 shut off	Manual
Alarm 9	Cooler leaving fluid thermistor failure *	Unit shut off	Auto
Alarm 10	Cooler entering fluid thermistor failure *	Unit shut off	Auto
Alarm 11	Condenser entering fluid thermistor failure *	Unit shut off	Auto
Alarm 12	Condenser leaving fluid thermistor failure *	Unit shut off	Auto
Alarm 13	Heat reclaim entering fluid thermistor failure *	Unit shut off	Auto
Alarm 14	Heat reclaim leaving fluid thermistor failure *	Unit shut off	Auto
Alarm 15	Circuit A condenser thermistor failure	Circuit A shut off	Auto
Alarm 16	Circuit B condenser thermistor failure	Circuit B shut off	Auto
Alarm 17	Circuit A cooler thermistor failure	Circuit A shut off	Auto
Alarm 18	Circuit B cooler thermistor failure	Circuit B shut off	Auto
Alarm 19	Compressor A1 thermistor failure	Circuit A shut off	Auto
Alarm 20	Compressor B thermistor failure	Circuit B shut off	Auto
Alarm 21	Reset thermistor failure	Stop reset	Auto
Alarm 22	Circuit A discharge transducer failure	Circuit A shut off	Auto
Alarm 23	Circuit B discharge transducer failure	Circuit B shut off	Auto
Alarm 24	Circuit A suction transducer failure	Circuit A shut off	Auto
Alarm 25	Circuit B suction transducer failure	Circuit B shut off	Auto
Alarm 26	Circuit A oil transducer failure	Circuit A shut off	Auto
Alarm 27	Circuit B oil transducer failure	Circuit B shut off	Auto
Alarm 28	5 Volt supply failure	Unit shut off	Auto
Alarm 29	Interlock switch failure	Unit shut off	Auto
Alarm 30	4-20 mA reset input failure	Unit shut off	Auto
Alarm 31	4-20 mA demand limit input failure	Unit shut off	Auto
Alarm 32	Loss of communications with DSIO-1	Unit shut off	Auto
Alarm 33	Loss of communications with DSIO-2	Unit shut off	Auto
Alarm 34	Loss of communications with options board-1	Unit shut off	Auto
Alarm 35	Loss of communications with options board-2	Unit shut off	Auto
Alarm 36	Low pressure circuit A failure	Circuit A shut off	Auto
Alarm 37	Low pressure circuit B failure	Circuit B shut off	Auto
Alarm 38	Failure to pumpdown circuit A	Circuit A shut off	Auto
Alarm 39	Failure to pumpdown circuit B	Circuit B shut off	Auto
Alarm 40	Low oil pressure circuit A	Circuit A shut off	Auto
Alarm 41	Low oil pressure circuit B	Circuit B shut off	Auto
Alarm 42	Cooler freeze protection	Unit shut off	Auto
Alarm 43	Low cooler flow	Unit shut off	Auto
Alarm 44	Low circuit A suction temperature	Circuit A shut off	Auto
Alarm 45	Low circuit B suction temperature	Circuit B shut off	Auto
Alarm 46	High circuit A suction superheat	Circuit A shut off	Auto
Alarm 47	High circuit B suction superheat	Circuit B shut off	Auto
Alarm 48	Low circuit A suction superheat	Circuit A shut off	Auto
Alarm 49	Low circuit B suction superheat	Circuit B shut off	Auto
Alarm 50	Illegal configuration	*Unit can not*	
Alarm 51	Unit configuration required	*start manually*	

*Alarms include the internal storage of the date and time that the alarm tripped for use by the Alarm POC** and Diagnostic Routine.*

Table 1bis Alarm display codes

Note :
** Chilled water or brine*
*** POC (see page 13)*

Keyboard Entry	Display Response	Comment
[3] [STAT]	N* MODES	Number of mode in effect
[↓]	MODE 7	Dual set point
[↓]	MODE 11	Low source protection

Note :
** Number of active modes*

Example 2 Reading current operating modes

Mode No.	Designation
7	Dual set point
8	Temperature reset
9	demand limit active
10	Load limit active
11	Low source protection
12	Ramp load limited
13	Nb. HR timed override
14	Low cooler suction

List of current operating modes

[4] [STAT] CAPACITY STAGES. This subfunction displays the capacity stage number, from 1 to 8. See table 3a and 3b page 15 for compressor loading sequence.

To enter the STAGES subfunction, depress [4] [STAT] and use the [↓] to display the stage number.

[5] [STAT] CURRENT OPERATING SET POINT. This subfunction displays the leaving water temperature and the leaving chilled water set point. If the unit is programmed for dual set point, the chilled water set point currently in effect (either occupied or unoccupied) will be displayed. If reset is in effect, the unit will be operating to the modified chilled water set point. This means that the leaving water temperature may not equal the chilled water set point. The modified chilled water set point will not be displayed in the status function. To read the modified chilled water set point, refer to the Set Point Function section, page 21.

To enter the set point subfunction, depress [5] [STAT] then use the [↓] key to display the leaving chilled water set point followed by the leaving water temperature.

[6] [STAT] SYSTEM TEMPERATURE. The temperature subfunction displays the readings at temperature sensing thermistores.

To read a temperature, enter [6] [STAT] then scroll to the desired temperature using the [↓] key. Chart 2b shows the order of the readouts.

[7] [STAT] SYSTEM PRESSURE. In this mode, the pressure transducer inputs is displayed in actual units. Note that all pressures are displayed in gauge units. A special mode is used to display high and low pressures on the same display. The display will show the high pressure in the 3 left display digits followed by a space and then 3 digits for the low side pressure.

[8] [STAT] ANALOG. This display mode is used to display analog inputs like the 4-20 mA inputs used for demand limit and reset. Items that are not used for a particular machine is not displayed.

[9] [STAT] INPUT. This display mode is used to display the switch inputs like the oil pressure switches, demand limit switch inputs, etc. Items that are not in use for a particular machine configuration is not shown.

[10] [STAT] OUTPUTS. This display mode is used to check the status of the outputs. All outputs except the compressor outputs can be checked by this option. Compressor status is checked through the CAPACITY STAGES function also under the STAT key.

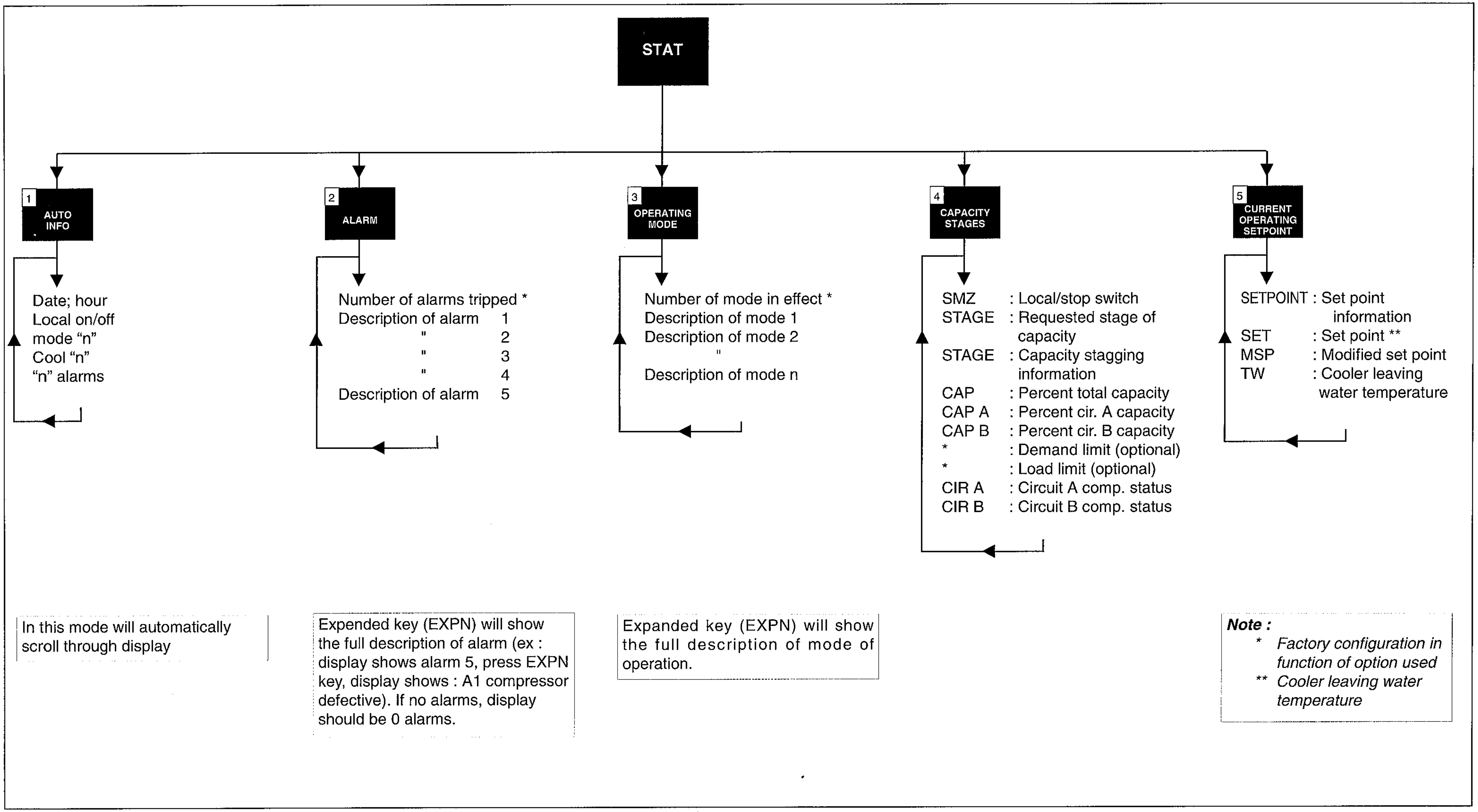


Chart 2a. STATUS subfunctions

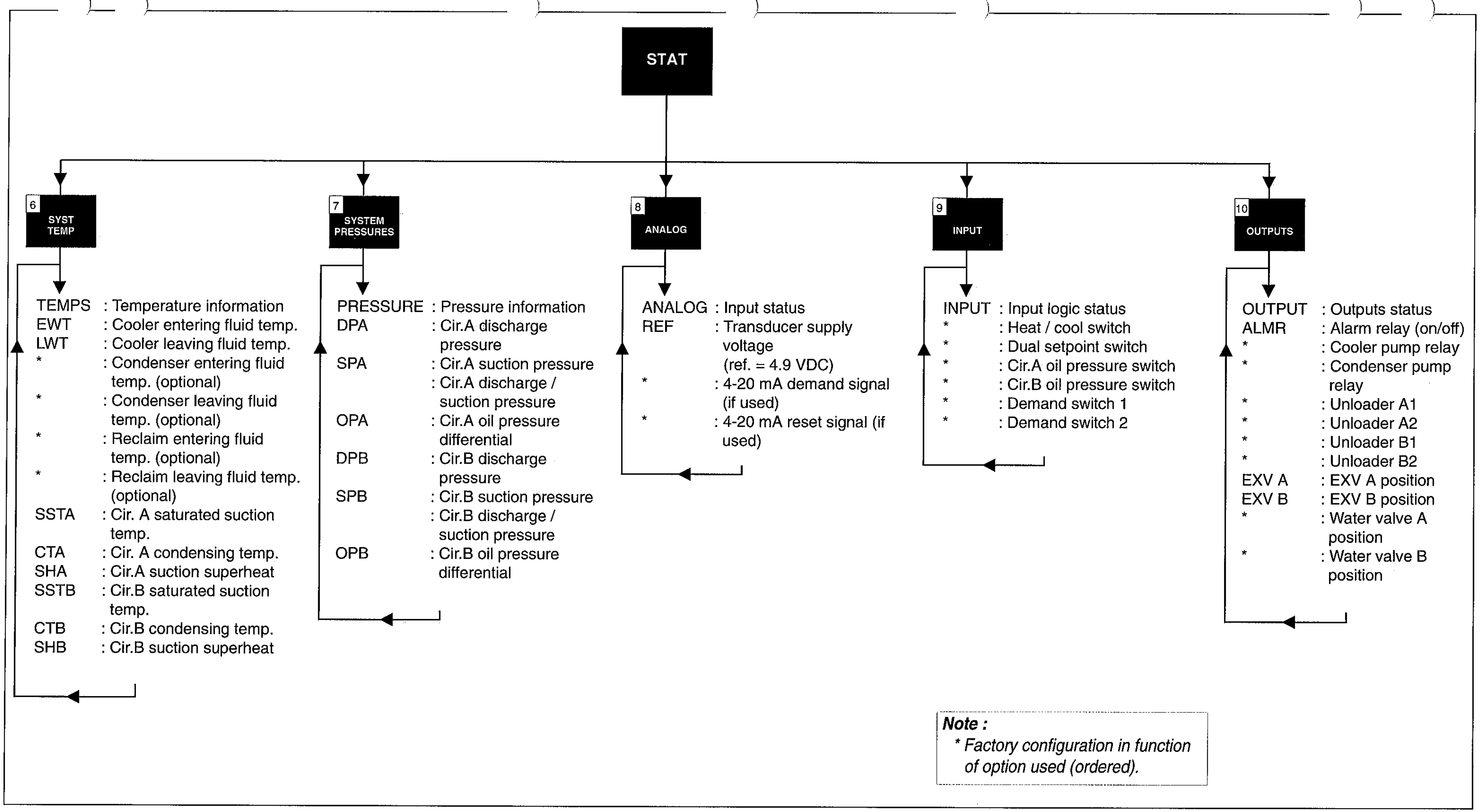


Chart 2b. STATUS subfunctions

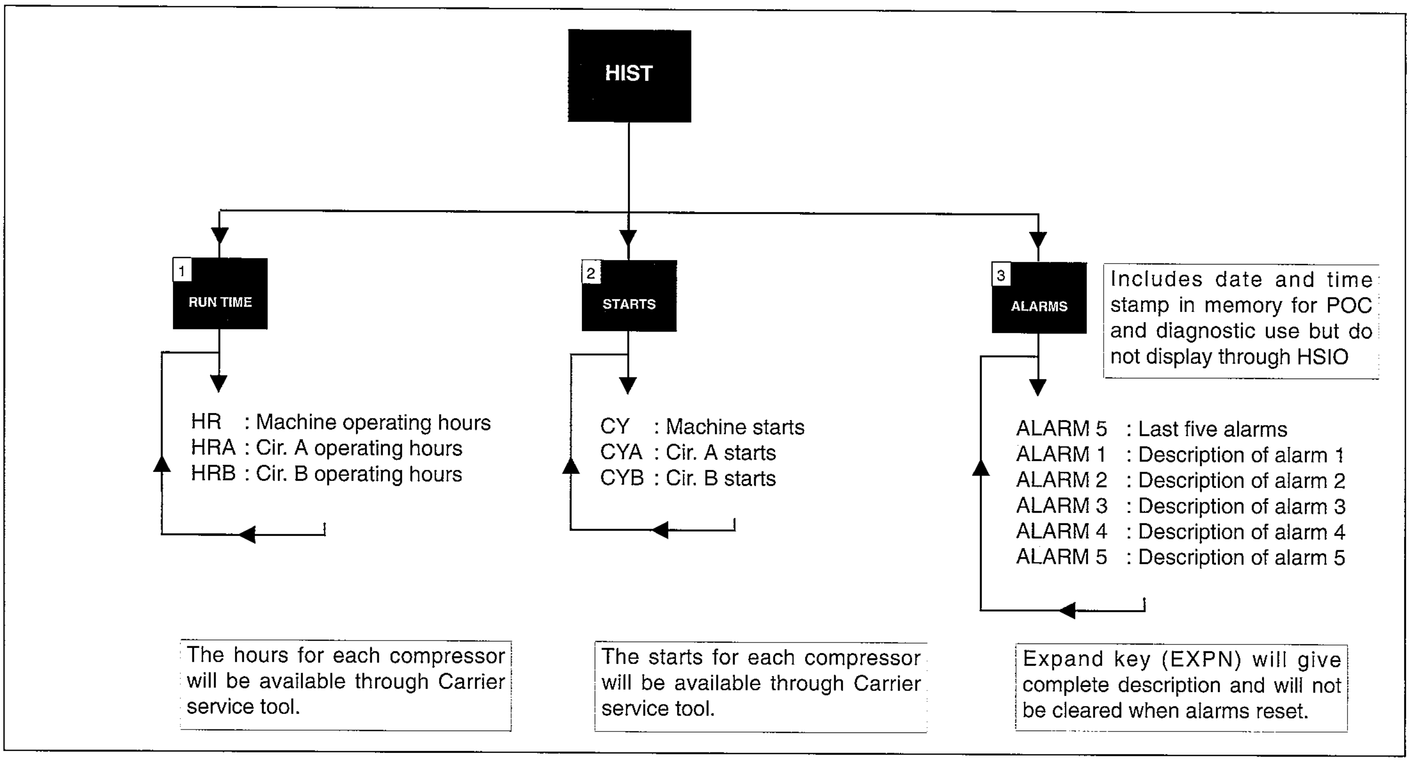


Chart 3. HISTORIC subfunctions

Historic function

This HIST function is used to display historical data such as machine or circuit run time, machine cycles and circuit cycles. Individual compressor runtime and cycles are stored in memory, but they will not be displayed through the HSIO. This information is available through the Carrier service Tool.

[1] [HIST] RUN TIME. In this mode the machine operating hours are displayed. The operating hours is the number of hours that compressor was running. Operating hours of each compressor is stored but they can only be displayed through the Carrier service tool.

[2] [HIST] STARTS. In this mode the number of machine starts is displayed. The number of machine starts is the number of times the unit goes from stage 0 to stage 1. Also the number of starts of each circuit is displayed. Starts for each compressor are stored in memory but they can only be displayed through Carrier service tool.

[3] [HIST] ALARMS. In this mode the last five alarms trips are displayed. When the EXPN key is pushed the display will show an expanded explanation plus the time at which safety tripped. Alarms are sent to History whenever an error is reset through the LOCAL/STOP/CCN switch.

Service Function

The service function allows the operator to verify factory configurations and read or change field configurations. The service subfunctions are listed below.

[1] [SRVC] LOG ON. The operator must use this subfunction to log on before performing any other subfunctions, and to log off after completing service subfunctions. System will log out if no key stroke in 30 minutes. Password is required for all write commands exept time override. Password is 1111 for all units. To logging off, push [SRVC] to obtain logged on, push [↓] , to obtain log off and push [ENTR] to valid this and [↓] to exit log. After using SRVC function, it is recommended to log off.

[2] [SRVC] SOFTWARE VERSION. Used to verify software version and language option.

[3] [SRVC] FACTORY CONFIGURATION. Used to verify factory configuration. Factory configuration is only adjustable through defined tables or code configuration.

[4] [SRVC] FIELD CONFIGURATION. Used to read or change field configuration for example number of unloaders, reset type or brine operation. Field configuration is adjustable through service tool or HSIO display. To learn how field configuration should be used, see example 3 to 5.

[5] [SRVC] SERVICE CONFIGURATION. Used to show the status of the service tool configuration items. They can only be configurated through the service tool or CCN network communication. For field configuration or service replacements the same code input method used for factory configuration is used for service configuration.

Example 3 Logging on and logging off - Service function

Keyboard Entry	Display Response	Comment
[1] [SRVC]	PASSWORD*	Enter password
[↓]	LOGGED ON	Connection approved
[↓]	LOG OFF	Disable protection
[↓]	EXIT LOG	Exit from logging

Note :

** Display "password". If password was not entered (password is 1111 for all units).*

Example 4 Reading software version

Keyboard Entry	Display Response	Comment
[2] [SRVC]	VERSION	Software information
[↓]	5000 12.01	Software part number
[↓]	Language	English

Example 5 Changing reset type

Keyboard Entry	Display Response	Comment
[2] [SRVC]	FLD CFG	Adjustable field configuration
[↓]	END1	CCN element address
⋮		
[↓]	ERTYPO	Cooling reset control selection
[2]	2	
[ENTR]	ERTYP 2	External reset selected

Example 6 Changing unloader count

Keyboard Entry	Display Response	Comment
[4] [SRVC]	FLD CFG	Adjust. field configuration
[↓]	END1	CCN element address
⋮		
[↓]	NULA	No. cir A unloaders
[1]	1	
[ENTR]	NULA1	1 unloaders, cir A

Table 2a Authorized field adjustment values

Display	Authorized values or range	Comments
END	0 - 239	CCN element address
BAUD	1200, 2400 4800, 9600	CCN baud rate
FLUIDWTR	0, 1, 3	0- Fluid water 1- Medium brine 3- Low brine
UNTENG	0, 1	0- Unit english 1- Metric
LANG**		Language selection
NULA	0 - 2	0- None 1- 1 unloader 2- 2 unloaders
NULB	0 - 2	0- None 1- 1 unloader 2- 2 unloaders (NA)*
HGB	0, 1	0- No 1- Yes
SEQT	1, 2	1- Equal circuit loading 2- Staged circuit loading
SEQF	1 - 3	1- Automatic 2- Manual, Cir A lead 3- Manual, Cir B lead
OPS	0, 1	0- Not used 1- Used
HEADT	0 - 2	0- None 1- Air cooled 2- Water cooled
HEADM	1 - 4	1- EXV control 2- Setpoint ctrl both Cir 3- Setpoint Cir A, EXV Cir B 4- Setpoint Cir B, EXV Cir A
MM	0 - 2	0- None 1- 4-20 mA motormaster 2- STD motormaster
CSPTYP	0 - 2	0- Single setpoint 1- Dual setpoint ; switch 2- Dual setpoint ; clock

Note :

** Not applicable*

*** Factory configuration only*

Table 2b Authorized field adjustment values

Display	Authorized values or range	Comments
BUS	0 - 239	BUS element address
CSPTYP	0 - 2	0- Single setpoint 1- Dual setpoint ; switch 2- Dual setpoint ; clock
HRTYP	0 - 3	0- No reset 1- Return reset 2- External reset 3- 4-20 mA reset
ERTYP	0 - 3	0- No reset 1- Return reset 2- External reset 3- 4-20 mA reset
RAMP	0 - 4	0- None 1- 2 step switch control 2- 4-20 mA control 3- Load limiting (multi unit) 4- CCN demand limiting
LOCK	0, 1	0- None 1- Enabled
CHWP	0 - 2	0- Not controlled 1- On/off control 2- Off when stage = 0
CDT	0, 1	0- Not used 1- Used
REFRIG	1 - 4	1- R-22 2- R-502 3- R-500 4- R-12
TDTYP	0 - 2	0- Not used 1- Suct. and disch. only 2- Suct., disch. & oil
OPS		6-20 psi
LPS		10-60 psig
FANTYP	1 - 4	1- Seperate Cir 2 stages 2- Seperate Cir 3 stages 3- Common Cir 2 stages 4- Common Cir 3 stages

Display	Field configuration
ENO	Element number origin
BUS	CCN bus number
BAUD	CCN baud rate
FLUID	Cooler fluid selection
UNT	Unit selection
LANG	Language selection
NUL A	No unloaders selection (circuit A)
NUL B	No unloaders selection (circuit B)
HGB	Hot gas by pass (N.A)
SEQT	Loading sequence selection
SEQF	Lead / lag sequence selection
OPS DSB	Oil pressure switch selection (disable)
HEAD T	Selection head pressure control type
HEAD M	Method selection of head pressure control
MM	Motormaster selection (air cooled units only)

Display	Field configuration
CSPTYP	Cooling reset control selection
ERTYP	External reset sensor selection
LSTYP	Demand limit control selection
RAMP	Ramp load selection
LOCK	Cooler pump interlock selection
CPC	Cooler pump control selection
CWP	Condenser pump control selection
CDT	Condenser water sensor selection
HSTYP	Heating set point control selection
HCS	Remote heat / cool switch selection
HRTYP	Heating reset control selection
CCN	Carrier comfort network
PIC	Product integrated control
POC	Product outboard control

Table 2c Signification of abreviations used

Lead-lag circuit sequence logic

This function will control the sequence of the two circuits. Each machine will always have two independent refrigerant circuits with one being labeled "A" and the other being labeled "B". The Lead-Lag sequence control should determine the order or sequence in which these two circuits should be used. Lead Circuit means the circuit (A or B) that will be used first for capacity changes when all other conditions have been met. For example when a machine is starting and the first stage of compression is being added then the circuit that will be started first will be the Lead Circuit.

Selection of the Lead-Lag control method will depend on the field selected configuration option Lead-Lag Sequence Control (seq-flg). There are three configurable modes which can be field configured. These options are :

Seq. flg	Meaning
1	automatic mode
2	manual, circuit A lead
3	manual, circuit B lead

Automatic mode
When the Automatic Mode has been selected the Lead-Lag Sequence determination uses the internal logic to optimize the Lead-Lag sequence.

Manual; circuit A lead
When this configuration option has been selected the lead circuit shall always be circuit A and will not change.

Manual; circuit B lead
When this configuration option has been selected the lead circuit shall always be circuit B and will not change.

Sequence type function
The order in wich circuit capacity is changed is determined by this function. The field configuration option Loading Sequence Type (seq-typ) will allow the following two options :
1. Equal Circuit Loading
2. Staged Circuit Loading

Equal circuit loading
If this sequence option has been selected the control logic will attempt to maintain equal capacity for circuit A and circuit B as the machine loads and unloads.

Staged circuit loading
If this option has been selected or the Equal Circuit Loading has been overridden then the logic will load the lead circuit completely before the lag circuit is started. When the load is decreasing the lag circuit will be unloaded first.

Unloader sequence (if used)
Table 3 shows basic logic of unit control capacity loading sequence (unloading is in the reversal sequence), when 1 unloader (option 94) is installed on each lead compressor of 30HR 225 unit.

Machine stage	Operating cylinders	Total unit comp. displ. %	Circuit A				Circuit B			
			Comp. A1	Comp. A2	Comp. A3	Unl. A1	Comp. B1	Comp. B2	Comp. B3	Unl. B3
0	0	0	0	0	0	0	0	0	0	0
1	4	11.11	1	0	0	1	0	0	0	0
2	6	16.67	1	0	0	0	0	0	0	0
3	10	27.77	1	0	0	0	1	0	0	1
4	12	33.33	1	0	0	0	1	0	0	0
5	16	44.44	1	1	0	1	1	0	0	0
6	18	50.00	1	1	0	0	1	0	0	0
7	22	61.11	1	1	0	0	1	1	0	1
8	24	67.67	1	1	0	0	1	1	0	0
9	28	77.78	1	1	1	1	1	1	0	0
10	30	83.33	1	1	1	0	1	1	0	0
11	34	94.45	1	1	1	0	1	1	1	1
12	36	100.00	1	1	1	0	1	1	1	0

Equal loading, increasing load

Machine stage	Operating cylinders	Total unit comp. displ. %	Circuit A				Circuit B			
			Comp. A1	Comp. A2	Comp. A3	Unl. A1	Comp. B1	Comp. B2	Comp. B3	Unl. B3
0	0	0	0	0	0	0	0	0	0	0
1	4	11.11	1	0	0	1	0	0	0	0
2	6	16.67	1	0	0	0	0	0	0	0
3	10	27.77	1	1	0	1	0	0	0	0
4	12	33.33	1	1	0	0	0	0	0	0
5	16	44.44	1	1	1	1	0	0	0	0
6	18	50.00	1	1	1	0	0	0	0	0
7	22	61.11	1	1	1	0	1	0	0	1
8	24	66.67	1	1	1	0	1	0	0	0
9	28	77.78	1	1	1	0	1	1	0	1
10	30	83.33	1	1	1	0	1	1	0	0
11	34	94.45	1	1	1	0	1	1	1	1
12	36	100.00	1	1	1	0	1	1	1	0

Staged loading, increasing load

Table 3 Example of loading sequence

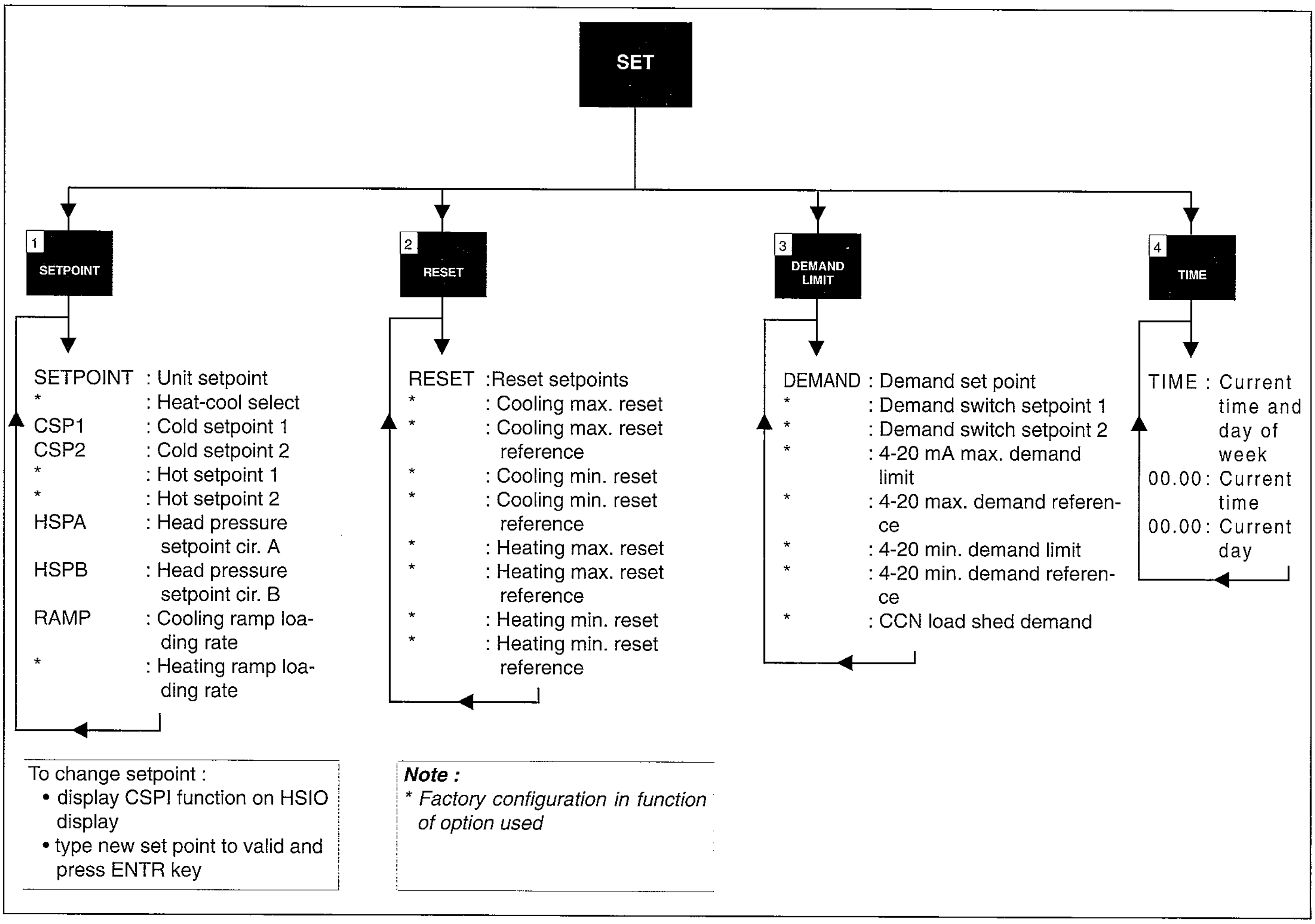


Chart 4. SET subfunctions

Set function

Set points are entered through the keyboard. Set points can be changed within the upper and lower limits, which are fixed. The modes are explained below.

Set points are grouped in subfunctions as follows :

[1] [SET] SET POINT. Displays chilled water set points.

a. The first value shown is the occupied chilled water set point.

b. The next value to be displayed depends on how the schedule function has been programmed (see page 12).

If dual set point has been selected, the next set point after [↓] has been pressed will be the unoccupied chilled water set point ; this will be followed by the modified chilled water set point.

If single set point or inactive schedule has been selected in the schedule function, then when [↓] is depressed, the display will show the modified chilled water set point.

c. The modified chilled water set point is determined by the microprocessor as a result of the reset function, and is displayed for reference only ; it can not be set or changed by the operator. If reset is not in effect, the modified set point will be the same as either the occupied or unoccupied chilled water set point, according to how the schedule function has been programmed.

[2] [SET] RESET. Displays the reset, reset limit and reset ratio set points. These set points are not accessible when reset type has been configured for none in the service function.

[3] [SET] DEMAND LIMIT. Displays the demand limit set points.

[4] [SET] TIME. Displays time of day and day of week.

Reading and changing set points

Example 10 shows how to read and change the chilled water set point. Other set points (except for modified set point, determined by the microprocessor), can be changed by following the same procedure. Refer to chart 6 for the sequence of display of set points in each subfunction.

Reading and changing time display

Time is entered and displayed in 24-hour time. The day of the week is entered as a number : 1 = MON, 2 = TUE, ...,7 = SUN.

The [↓] key is used as the colon when entering time. See example 11.

Example 9 Reading and changing chilled water set point

Keyboard Entry	Display Response	Comment
[1] [SET]	SET POINT	Unit set point
[↓]	CSP5.0	Occupied cold set point 1 is 5.0°C
[↓]	CSP6.0	Occupied cold set point 2 is 6.0°C
[7] [.] [0]	7.0	Type new set point 2
[ENTR]	CSP7.0	New cold set point 2 is 7.0°C
[↓]	HSPA	Head pressure setpoint, cir. A
⋮		
[↓]	RAMP	Cooling ramp loading rate

Example 10 Setting time of day and day of week

Keyboard Entry	Display Response	Comment
[4] [SET]	TIME	Present time and day of week
[↓]	TUE 11.25	Present day and time
[3] [.] [9] [.] [4] [5]	3.9.45	Type new day and time (day of week, hour, minutes)
[ENTR]	WED 9.45	New day and time
[↓]	JAN.30.90	Present date
[2] [.] [1] [.] [9] [0]	2.1.90	Type new date (day, month, year)
[ENTR]	FEB.1.90	New current date

Legend

Code	*Month*	*Code*	*Day*
1	*January*	*1*	*Monday*
2	*February*	*2*	*Tuesday*
3	*March*	*3*	*Wednesday*
4	*April*	*4*	*Thursday*
5	*May*	*5*	*Friday*
6	*June*	*6*	*Saturday*
7	*July*	*7*	*Sunday*
8	*August*		
9	*September*		
10	*October*		
11	*November*		
12	*December*		

Schedule function

The schedule function key is used to configure the occupancy schedules in a stand-alone PIC. It can also be used to configure the machine for use of one of the 2-99 CCN clocks, but time schedule configuration of these clocks routines can only be done through the CCN CPOC or other devices.
The schedule function is used for clock 1 which is the internal clock. This clock can be used in either the LOCAL or CCN control modes. The clock function can be used for unoccupied shutdown or unoccupied setback depending on the configuration selected as part of the reset subroutine. The SCHD will allow configuration of a timed override, up to 8 occupied/unoccupied periods, up to 30 holidays and configuration as to the type of scheduling.

[1] [SCHD] OVRD nHRS. This subfunction when selected will display the number of override hours with the display "OVRD 0HRS". Up to 4 hours may be entered by pressing [4] [ENTR]
Only integer numbers (0, 1, 2, 3 or 4) may be entered.
Note that this display is password protected and therefore the HSIO password has not been entered then the display will show "0".

[2] [SCHD] CLOCK. This subfunction will allow for the selection of the type of clock control. The three types are available :
0. No clock control (always on)
1. Local clock control (clock 1)
2-99 CCN clock control (where 2-99 is clock number)*.
Note :
** This option is not presently available.*

[3] [SCHD] - [10] [SCHD] PERIOD 1 to PERIOD 8. This function provides a means to automatically switch the chiller from an occupied mode to an unoccupied mode. The schedule key is used to configure the occupancy schedules.
The schedule consists of from one to eight occupied time periods, set by the operator. These time periods can be flagged to be in effect or not in effect on each day of week. The day begins at 00.00 and ends at 24.00. The machine will not be in unoccupied mode unless a scheduled time period is in effect. If an occupied period is to extend pass midnight, it must be programmed in the following manner : Occupied period must end at 24.00 hours (midnight) ; a new occupied period must be programmed to begin at 00.00 hours.
The time schedule can be overriden to keep the unit in the occupied mode for one, two, three or four hours.
Figure 7 shows a schedule for an office building with the chiller operating on a single set point schedule. The schedule is based on building occupancy with 3-hour off-peak cool down period from midnight to 3 am following the weekend shutdown. To learn how this sample schedule should be programmed, see example 9a below.
Note :
This schedule was designed to illustrate the programming of the schedule function and is not intended as a recommended schedule for chiller operation.

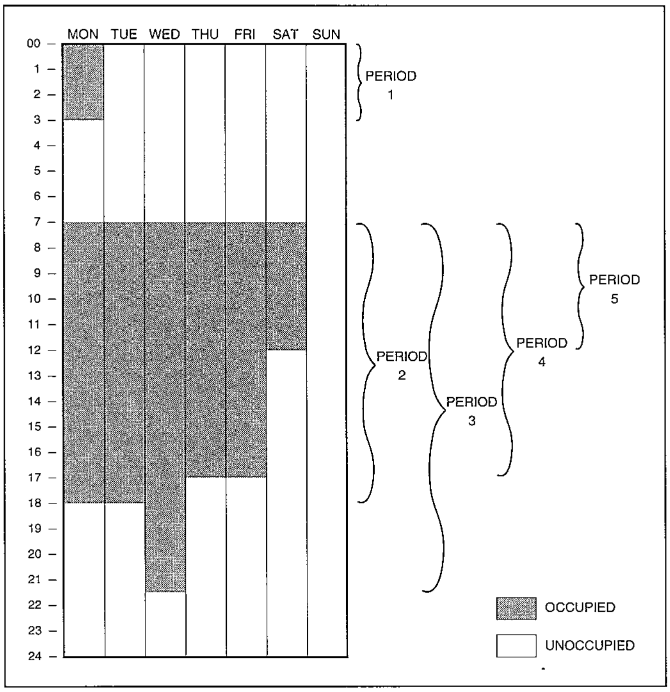


Fig. 6 Sample time schedule

Example 9a Using the schedule function

Keyboard Entry	Display Response	Comment
Setting schedule type:		
[2] [SCHD]	SCHTYP 0	Schedule function is programmed inactive.
[1] [ENTR]	SCHTYP 1	Schedule is set for a single set point operation.
* For dual set point operation keyboard entry would be 2 ENTR.		
Programming period 1:		
[3] [SCHD]	PERIOD 1	Define schedule period 1.
[↓]	OCC 00.00	Start of occupied time. For this example, first period should start here (at midnight) so no entry is needed.
[↓]	UNO 00.00	Start of unoccupied time (end of period). For this example, period 1 should end at 3:00 am.
[3] [.] [0] [0] [ENTR]	UNO 3.00	Period 1 ends at 3:00 am.
[↓]	MON NO	Monday is not flagged for period 1. To put period 1 into effect on Monday, Monday must be flagged yes.
[1] [ENTR]	MON YES	Monday is now flagged for period 1 to be in effect.
[↓]	TUE YES	For this example, period 1 is to be in effect on Monday only. All other days must be checked to be sure that they are flagged no. If any day is flagged yes, change to no.
[.] [ENTR]	TUE NO	Tuesday is now flagged no for period 1. Define schedule period 2.

Example 9b Using the schedule function (cont)

Keyboard Entry	Display Response	Comment
Programming period 2:		
For this example, period 2 is used on Monday and Tuesday		
[4] [SCHD]	PERIOD 2	Start of occupied time.
[↓]	OCC 00.00	
[7] [.] [0] [0] [ENTR]	OCC 7.00	Occupied time will start at 7:00 am.
[↓]	UNO 00.00	Start of unoccupied time (end of period) for this example, period 2 should end at 18:00 (6:00 pm).
[1] [8] [.] [0] [0] [ENTR]	UNO 18.00	Period 2 ends at 18:00 (6:00 pm)
[↓]	MON NO	Monday is not flagged for period 2. To put period 2 into effect on Monday, Monday must be flagged yes.
[1] [ENTR]	MON YES	Monday is now flagged for period 2 to be in effect.
	TUE NO	Tuesday is not flagged for period 2. To put period 2 into effect on Tuesday, Tuesday must be flagged yes.
[1] [ENTR]	TUE YES	Tuesday is now flagged for period 2 to be in effect.
[↓]	WED YES	For this example, period 2 is to be in effect only on Monday and Tuesday. All other days must be checked to be sure that they are flagged no. If any day is flagged yes, change to no.
[.] [ENTR]	WED NO	Wednesday is now flagged no for period 2.

Example 10 Using holiday function

Keyboard Entry	Display Response	Comment
[11] [SCHD]	DAT 00.00	Define calender holidays
→ [↓]	DAT 01.12	Holiday date 1
[ENTR]		
[↓]	DAT 03.23	Holiday date 2
[ENTR] ↵		

Example 9b Using the schedule function (cont)

Keyboard Entry	Display Response	Comment
Programming period 3:		
For this example, period 3 is used on Wednesday only		
[4] [SCHD]	OCC 00.00	Start of occupied time.
[7] [.] [0] [0] [ENTR]	OCC 7.00	Occupied time will start at 7:00 am.
[↓]	UNO 00.00	Start of unoccupied time (end of period 3). For this example, period 3 should end at 21:30 (9:30 pm).
[2] [1] [.] [3] [0] [ENTR]	UNO 21.30	Period 3 ends at 21:30 (9:30 pm)
[↓]	MON NO	Check to be sure that Monday and Tuesday are flagged no for period 3.
[↓]	TUE NO	
[↓]	WED NO	Wednesday is flagged no. Change to yes
[1] [ENTR]	WED YES	Wednesday is now flagged yes for period 3.
[↓]	THU NO	Check to be sure that all other days are flagged no.
[↓]	FRI NO	
[↓]	SAT NO	
[↓]	SUN NO	

Periods 4 and 5 can be programmed in the same manner, flagging Thirsday and Friday yes for period 4, and saturday yes for period 5. For this example, periods 6, 7 and 8 are not used ; they should be programmed OCC 00.00, UNO 00.00.

Note :

When a day is flagged yes for 2 overlapping periods, occupied time will take precedence over unoccupied time. Occupied times can overlap in the schedule with no consequence.

To extend an occupied mode beyond its normal termination for a one-time schedule override, program as shown below :

Keyboard Entry	Display Response	Comment
[1] [ENTR]	OVRD 0	Override is set for 0 ; enter the number of hours of override desired.
[3] [ENTR]	OVRD 3	Unit will now remain in occupied mode for an additional hours.

[11] [SCHD] HOLIDAY. Up to 30 holydays may be set as the last option of the schedule key. Holidays are entered as MM. DD. where MM is the month of the year and DD is the day of the month. If the current day is a holiday then the holiday schedule will be used. The example 4 explains how this sample schedule should be programmed.

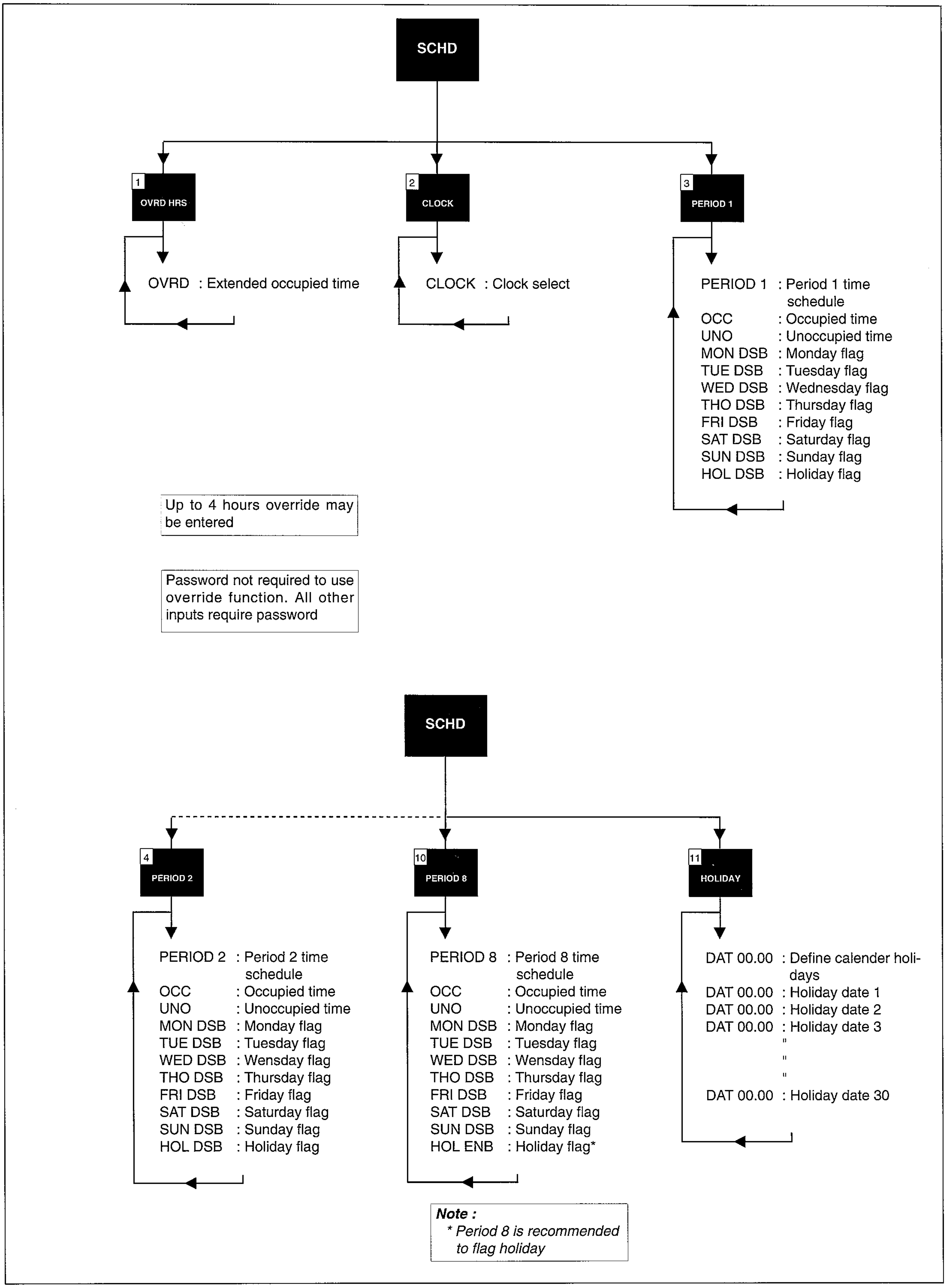


Chart 5. SCHEDULE subfunctions

Using control features
Temperature reset

This routine will adjust the controlled leaving water temperature based on type of temperature reset selected. The type of temperature resets are :

Reset Number	Reset Type
0	No reset
1	Return Water Reset
2	External Temperature Reset
3	4-20 mA reset

Both cooling and heating reset are available for 30HQ Heat Machines.
Temperature Reset is only intended for local machine control.
In addition to temperature reset, dual set point control can also be used. It can be used with temperature reset or independently from temperature reset. Control can be accomplished in one of two methods :

1. Switch controlled dual set point
2. Internal clock controlled dual set point

When external temperature reset is selected the leaving chilled water temperature should be controlled from a sensor connected to the optional board.

Example 11 Using return water temperature reset

Keyboard Entry	Display Response	Comment
SRVC	PASSWORD	Adjustable field config.
1 1 1 1 ENTR	LOGGED ON	CCN element address
4 SRVC	FLD CFG	Adjustable field config.
↓	END1	
⋮	CRTYP0	No reset
2 ENTR	CRTYP2	Return reset
2 SET	RESET	Reset set point
↓	CRST2 00	Present max reset is 0
1 0 ENTR	CRST2 10	New max reset is 10
↓	CREF2 00	Max signal reference
1 ENTR	CREF2 1	New max signal ref. is 1
↓	CRST1 00	Present min reset is 0
2 ENTR	CRST2 2	New min reset is 2
↓	CREF1 00	Present min signal ref. is 0
8 ENTR	CREF1 8	New min signal ref. is 8

Return Temperature Reset

The control system is capable of handling leaving water temperature reset based on return cooler water temperature, because the change in temperature through the cooler or condenser (Heat Machines) is a measure of the building load. The return water temperature reset is essentially an average building load reset method.
This option will automatically reset the leaving water temperature set point of the cooler or condenser water. Set point of the amount of reset is accomplished by entering data pairs. A data pairs consists of a reset value and a reference temperature difference between the entering and leaving water temperature. One pair represents the maximum reset and the other pair represents the minimum reset. If the cooler temperature difference is greater than minimum reset temperature difference then the reset is equal to 0°C. When the temperature difference is between the minimum reset and maximum reset temperature difference then the reset is to be determined by a linear interpolation between the maximum and minimum reset values. Below the maximum reset temperature difference the reset is fixed at the maximum reset value. Examples of various return reset schedules are shown in fig. 7 for cooling and fig. 8 for heating operations.

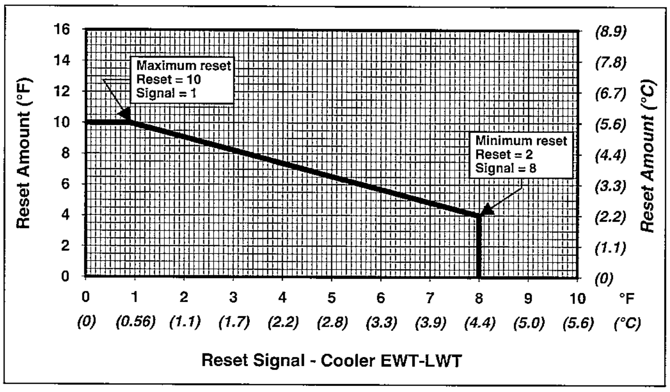


Fig. 7 Cooling return water reset

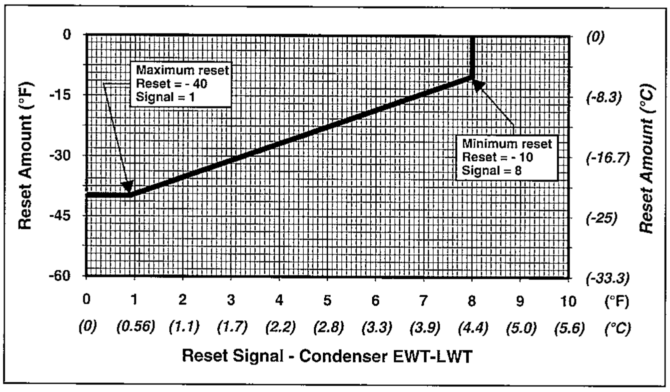


Fig. 8 Heating return water reset

External temperature reset

Outside or space temperature reset allow for the reset of the leaving water temperature based on an external temperature. Under normal operation, the chiller will maintain a constant leaving water temperature approximately equal to the chilled water temperature set point. This temperature is usually selected based on full-load conditions. At part-load conditions, it may be desirable to reset the leaving water set point higher to improve the efficiency of the chiller. The control is capable of resetting automatically the chilled water setpoint higher in response to an external temperature. This external temperature can be outside air or an internal building temperature (space temperature).
The external temperature reset is sensed through the accessory or optional reset sensor.
Outside or space temperature can be selected through HSIO.
The same basic logic is used for external temperature reset as return reset except the external temperature is substituted for the entering and leaving temperature difference. Samples of this logic are shown in fig. 9 and fig. 10.

Example 12 Using external temperature reset

Keyboard Entry	Display Response	Comment
[SRVC]	PASSWORD	Adjustable field config.
[1] [1] [1] [1] [ENTR]	LOGGED ON	CCN element address
[4] [SRVC]	FLD CFG	Adjustable field config.
[↓]	END1	
⋮	CRTYP0	No reset
[2] [ENTR]	CRTYP2	External reset
[↓]	ERTYP0	No external reset
[1] [ENTR]	ERTYP1	External sensor
[2] [SET]	RESET	Reset set point
[↓]	CRST2 00	Present max reset is 0
[1] [0] [ENTR]	CRST2 10	New max reset setpoint is 10
[↓]	CREF2 00	Present max signal ref. is 0
[2] [0] [ENTR]	CREF2 20	New max signal ref. is 20
[↓]	CRST1 00	Present min reset is 0
[2] [ENTR]	CRST2 2	New min reset set point is 2
[↓]	CREF1 00	Present min signal ref. is 0
[9] [0] [ENTR]	CREF1 8	New min signal ref. is 90

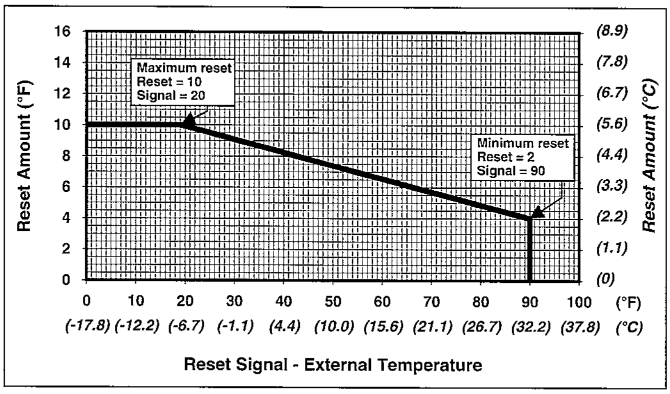


Fig. 9 Cooling external temperature reset Chiller application

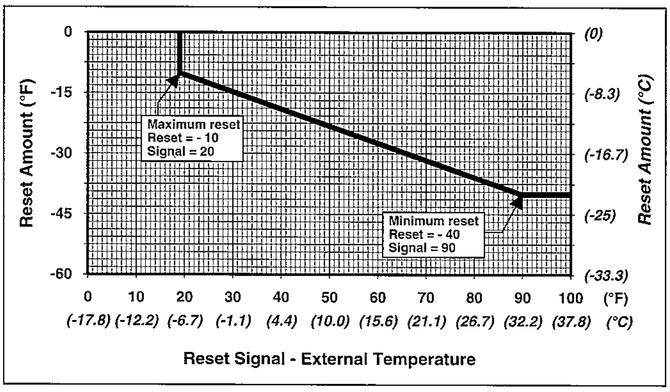


Fig. 10 Heating external temperature reset Heat pump application

4-20 mA Reset

This type of reset is controlled by an external 4-20 mA input. Again the same basic logic with data pairs is used for the 4-20 mA reset option except the reference reset signal points are based on the 4-20 mA input settings. Examples of this settings are shown in fig. 11 and fig. 12.

Example 13 Using 4-20 mA reset

Keyboard Entry	Display Response	Comment
SRVC	PASSWORD	Adjustable field config.
1 1 1 1 ENTR	LOGGED ON	CCN element address
4 SRVC	FLD CFG	Adjustable field config.
↓	END1	
:	ERTYP0	0 - No reset 1 - Return reset
2 ENTR	ERTYP2	2 - 4-20 mA reset
2 SET	RESET	Reset set point
↓	CRST2 00	Present max reset is 0
2 ENTR	CRST2 10	New max reset is 2
↓	CREF2 00	Present max signal ref. is 0
6 ENTR	CREF2 6	New max signal ref. is 6
↓	CRST1 00	Present min reset is 0
1 0 ENTR	CRST1 10	New min reset is 10
↓	CREF1 00	Present min signal ref. is 0
1 5 ENTR	CREF1 15	New min signal ref. is 15

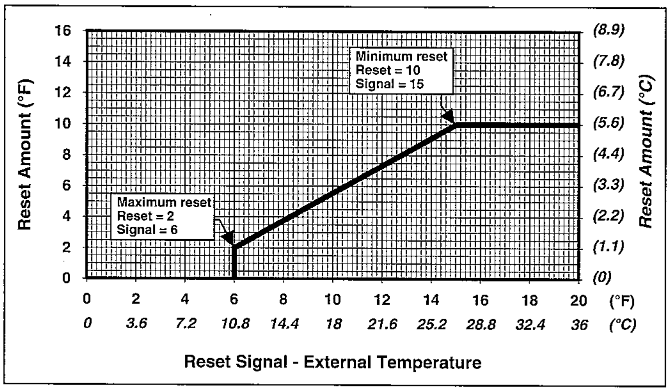


Fig. 11 4-20 mA cooling temperature reset Chiller application

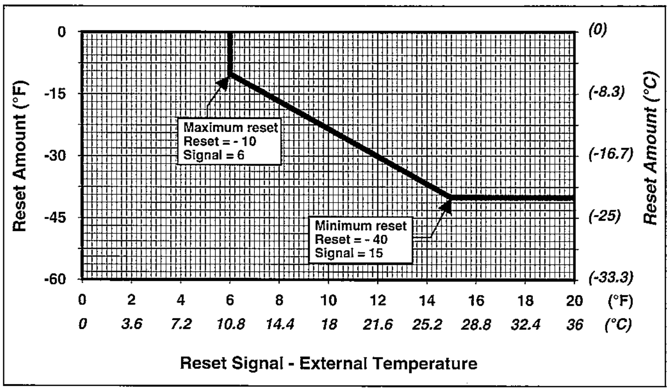


Fig. 12 4-20 mA heating temperature reset Heat pump application

Dual Setpoint Reset

This reset is used to allow for dual setpoint control for occupied/unoccupied setpoint control based on the time clock status, or through external dual setpoint switch if configured for its use.

If the unit is configured for switch control then the occupied set point is used if the switch is open and the unoccupied setting is used if the switch is closed. If the unit is also configured for clock operation the the unit will operate in the occupied mode and will shutdown in the unoccupied mode. Setpoint is independent of clock control. If the unit is configured for clock control setpoint then the occupied setpoint is used during the occupied mode and the unoccupied set point is used during the unoccupied mode.

Dual setpoint and reset can be used at the same time.

Example 14 Using dual setpoint

Keyboard Entry	Display Response	Comment
SRVC	PASSWORD	Adjustable field config.
1 1 1 1 ENTR	LOGGED ON	CCN element address
4 SRVC	FLD CFG	Adjustable field config.
↓	END1	
:	ERTYP0	0 - Single set point 1 - Dual set point switch
2 ENTR	ERTYP2	2 - Dual set point clock
1 SET	RESET	Reset set point
↓	CSP1 00	Present dual first set point clock is 0
6 . 7 ENTR	CSP1 6.7	New dual first set point ref. is 6.7
↓	CSP2 00	Present dual second set point ref. is 0
7 . 8 ENTR	CSP2 7.8	New dual second set point ref. is 7.8

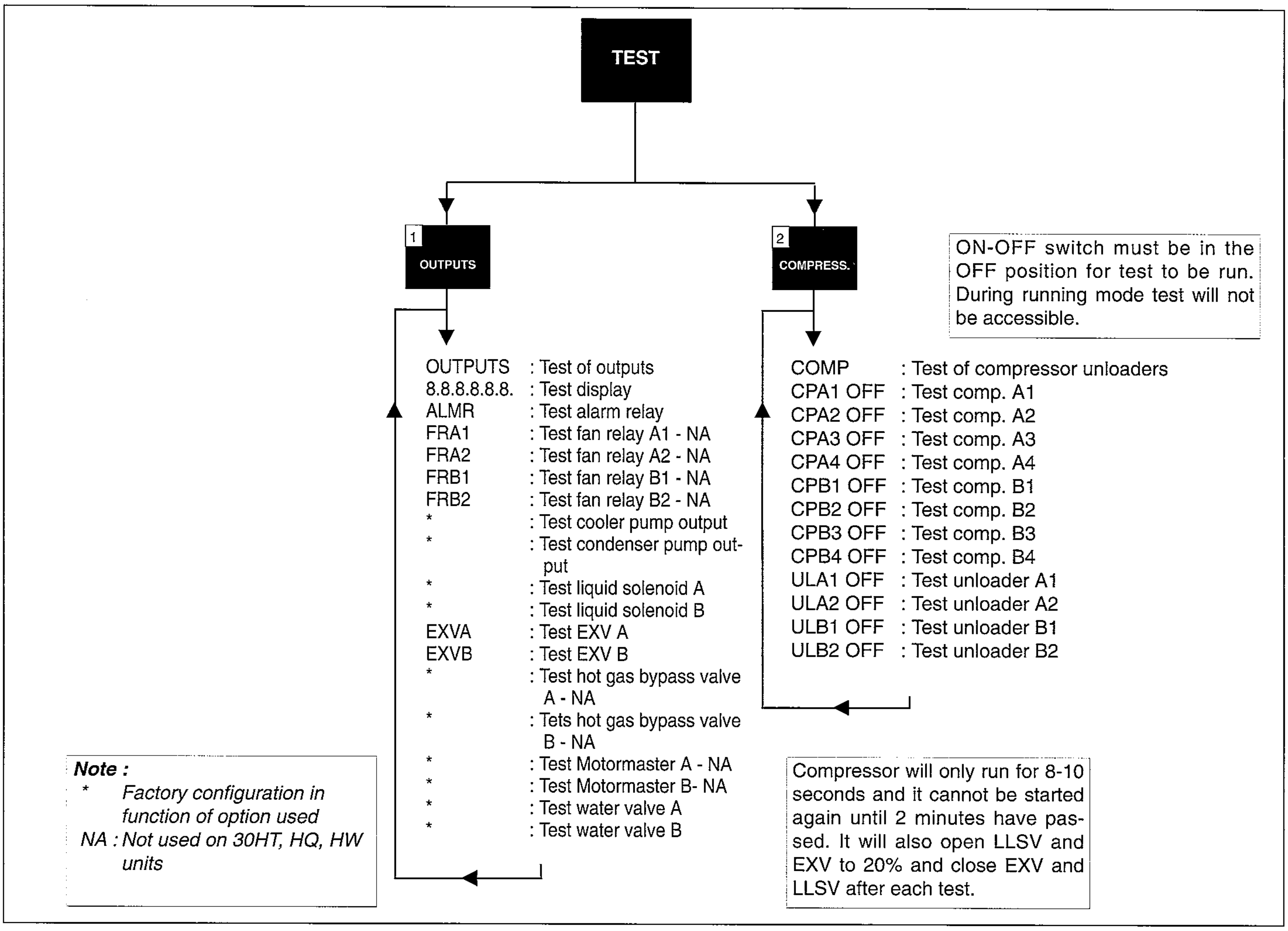


Chart 6. TEST subfunctions

Test Function

The test function operates the Quick Test diagnostic program. When the unit is in STANDBY mode, the test subfunctions will energize the electronic expansion valves, unloaders and compressors. The expansion valve will travel to fully open in one test and to fully closed in the next test. The compressors will energize from 8 to 10 seconds. The subfunctions are explained below and chart 7 shows all the elements in the subfunctions.

[1] [TEST] OUTPUTS. Tests all the outputs from the processor except for compressors. If the unit is in the off mode then the step will be allowed to cause the output to change state if required. The steps can be scrolled through using the keys until the correct step is reached.

The status of the display will be shown if you desire to execute the test then the [ENTR] key can be pushed. To stop the test use the [ENTR] key or the [↓] keys.

1. ***Test display.*** Display will show 8.8.8.8.8.8.8.8.
2. ***Alarm output.*** This step will turn the alarm relay on and off.
3. ***Cooler pump.*** This step will turn on the cooler pump relay.
4. ***Condenser pump.*** This step will turn on the condenser water pump (30HT, HQ units only).
5. ***Liquid line solenoid A.*** This step will energize the liquid line solenoid on TXV units. Direct control of LLSV's is not used on EXV units.
6. ***Liquid line solenoid B.*** This step will energize the liquid line solenoid on TXV units. Direct control of LLSV's is not used on EXV units.
7. ***EXV valve A test.*** This step will energize the EXV valve in circuit A. The valve should open in steps of 1% until the maximum position of 100% is reached or the test is terminated. The position will be output through display. When the Output subfunction ends the valves will be closed to 0.
8. ***EXV valve B test.*** This step will energize the EXV valve in circuit B. The valve should open in steps of 1% until the maximum position of 100% is reached or the test is terminated. The position will be output through display. When the Output subfunction ends the valves will be closed to 0.
9. ***Open water valve A.*** This step will open the condenser A water regulating valve. The valve should open at a rate of 1% per second in increments of 5% percent until the 100% is open or test is terminated.
10. ***Close water valve A.*** This step will close the condenser A water regulating valve. The valve should close at a rate of 1% per second in increments of 5% percent until the 100% is close or test is terminated.
11. ***Open water valve B.*** This step will open the condenser B water regulating valve. The valve should open at a rate of 1% per second in increments of 5% percent until the 100% is open or test is terminated.
12. ***Close water valve B.*** This step will close the condenser B water regulating valve. The valve should close at a rate of 1% per second in increments of 5% percent until the 100% is close or test is terminated.

[2] [TEST] COMPRESSORS TEST. This function is used to turn on the compressors and unloaders. Compressors will be energized for 8 to 10 seconds only. At the same time the EXV's will be opened to 20%. The control will check the status of the compressor voltage input and output and output the status to the display. After the test the EXV will be closed. Unloaders (if used) will be energized continuously until the last step is left. For units with less then 8 compressors or without unloaders the unused output will not be displayed.

To reach the particular test, enter its subfunction number and scroll to desired test with the [↓] key.
A test can be determined by pressing [↓] key.
Pressing the [↓] key after a test has started will advance the system to the next test, whether current test is operating or has timed out.
Once in next step you may start test by pressing [ENTR] or advance past it by pressing [↓].
While the unit is in Quick Test, you may access another display or function by depressing the appropriate keys. If the keyboard is not used for 10 minutes, the unit will automatically leave the Quick Test function.
To learn how QUICK TEST should be used, see examples 15a and 15b.

Example 15a Testing EXV

Keyboard Entry	Display Response	Comment
[1] [TEST]	OUTPUTS	Test of outputs
[↓]	8.8.8.8.8.8.8.8.	Test of display
⋮		
[↓]	EXVA0	Test EXVA
[2] [3]	23	Position 23% called
[ENTR]	EXVA 23	Valve open 23%
[↓]	EXV0	End of the test
[↓]	EXVB0	Test EXVB

Note :
- *When leaving EXV, position is in 0% (close)*
- *Pressing [ENTR] or [↓] keys will stop the test.*

Example 15b Testing CPA3

Keyboard Entry	Display Response	Comment
[2] [TEST]	COMP	
[↓]	CPA1 OFF	Test cir. A, compressor 1
⋮		
[↓]	CPA3 OFF	Test circuit A, compressor 3
[ENTR]	CPA3 ON	Pressing ENTR starts the test, when the compressor should be running, the display shows CPA3 ON*
	CPA3 OFF	If the test is allowed to time out, the display will show CPA3 OFF
[↓]	CPA4 OFF	Pressing the down arrow key advances the system
⋮		
[↓]	ULB2 OFF	Test unloader B2

Note :
** Compressor will only turn for 8-10 seconds and it can not be restarted until 2 minutes have passed.*

Control sequence

Off cycle

During unit off cycle, crankcase heaters are energized. Electronic expansion valves are closed.

Start-up

First circuit to start may be A or B (automatic or manual lead/lag selected). The controlled ramp loading feature limits compressor loading on start-up to reduce demand on start-up and unnecessary compressor usage. If ramp loading is selected, the microprocessor limits supply water temperature decrease to the selected rate (from 0.1 to 1.0°C/min).

Capacity control

On first call for cooling, microprocessor starts initial compressor on lead circuit. The electronic expansion valve remains closed permitting a pumpout on start-up until required low pressure is reached. After pumpout, the valves open. Crankcase heaters are de-energized when a compressor is started. As additional cooling is required, lag circuit starts. If further cooling is needed, compressors are added, alternating between lead and lag circuits (unless full loading of a circuit was selected). Speed at which capacity is added or decreased is controlled by temperature deviation from set point and rate of temperature change of chilled water.
As less cooling is required, circuits shut down (or unload), in an order that evens out each circuit's compressor run time. When no further cooling is called for, expansion valve closes and compressor continues to run while pumping down cooler.

Microprocessor controls capacity of chiller by cycling compressors on and off at a rate to satisfy actual dynamic load conditions. Control will maintain leaving water temperature set within ±0.5°C of setpoint entered on the keyboard on display board through intelligent cycling of compressors. Accuracy will depend on loop volume, loop flow rate, load, number of stages, and particular stage being cycled off. No adjustment for cooling range or cooler flow rate is required, because the control automatically compensates for cooling range by measuring both return water temperature and leaving water temperature. This is referred to as leaving water temperature control with return water temperature compensation.

The basic logic for determining when to add or remove a stage is a time band integration of deviation from set point plus rate of change of leaving water temperature. When leaving water temperature is close to set point and slowly moving closer, logic prevents addition of another stage. If leaving water temperature is less than 1.7°C (35°F) for water, or 3.3°C (6°F) below the set point for brine units, the unit is shut off until the water temperature goes to 3.3°C (6°F) above the set point, to protect against freezing.

If adjustable rate ramp loading control has been selected the microprocessor maintains the rate of change in leaving water temperature below the desired value (adjustable from 0.1 to 1.0°C/min).

The machine is allowed to start by switching the LOCAL/OFF/NETWORK switch to LOCAL. This switch is also used to reset the control should any safety requiring manual reset trip.

Electronic expansion valves

The EXV is used to control superheat in compressor. One pressure transducer and one thermistor, located in the lead compressor of each circuit are used to directly determine superheat. The EXV is controlled to maintain superheat entering pistons at approximately 8.3°C (15°F) to 13.9°C (20°F), which results in slightly superheated refrigerant leaving cooler.

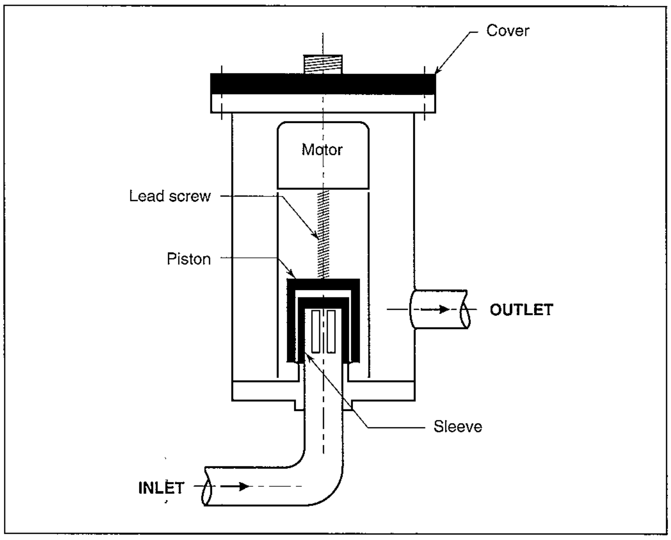


Fig. 13 Electronic expansion valve

A series of calibrated slots have been machined inside of orifice assembly. As refrigerant passes through orifice, pressure drops and refrigerant changes to a 2-phase condition (liquid and vapor). To control refrigerant flow for different operating conditions, piston moves up and down over orifice and modulates orifice size. Piston is moved by a linear stepper motor. Stepper motor moves in increments and is controlled directly by EXV module. As stepper motor rotates, motion is transferred into linear movement by lead screw. Through stepper motor and lead screw, 1500 discrete steps of motion are obtained. The large number of steps and long stroke results in very accurate control of refrigerant flow.

Control of valve is by microprocessor. One thermistor and one pressure transducer is used to determine superheat. Both are located in the lead compressor of each circuit. The difference between saturated temperature (based on suction line pressure) and actual temperature controls superheat. On a normal TXV system, superheat leaving evaporator is normally 5.6°C and motor then adds approximately 8 to 11°C resulting in approximately 16.7°C superheat entering cylinders. The EXV controls superheat entering cylinders to approximately 13.8°C. Thus superheat leaving cooler is approximately 2°C to 3°C, or less.

Because the EXVs are controlled by the processor module, it is possible to track valve position. During initial start-up, EXV is fully closed and performs pump down. After start-up, valve position is tracked by processor by constantly observing amount of valve movement.

The EXV is also used to limit cooler suction temperature to 13°C. This makes it possible for the chiller to start at higher cooler water temperatures without overloading compressor. This is commonly referred to as MOP (Maximum Operating Pressure).

If it appears that the electronic expansion valve is not properly controlling operating suction pressure or superheat, there are a number of checks that can be made using Quick Test features built into the microprocessor control.
Follow steps below to diagnose and correct EXV problems.

Abnormal conditions (alarm on the display board)

All control safeties in chiller operate through compressor protection board and microprocessor. High-pressure switch and compressor protection board directly shut down compressor(s) by de-energizing compressor contactor coil(s). For other safeties, microprocessor makes appropriate decision to shut down a compressor due to a safety trip or bad sensor reading. In both cases microprocessor energizes an alarm relay (an alarm message is displayed). Chiller holds safety mode until reset. It then reverts to normal control when unit is reset. Reset can be automatic or manual depending on the type of alarm. Previous defect remain stored in memory.

Safeties include :

- Low water flow (without the need of a flow switch)
- Too high or too low refrigerant pressures
- Too high or too low suction superheat
- Insufficient oil pressure (lead compressor of each circuit)
- Freeze of the evaporator
- Ground fault current protection
- High pressure switch
- Discharge gas temperature too high
- Internal motor temperature
- 5 V power supply failure (pressure transducers)
- Pump down failure
- Communication failure (between modules)

Unit shutoff

To shut unit off, move the RUN/STANDBY switch to the STANDBY position. Any refrigeration circuit that is operating at this time will continue to complete the pumpout cycle. (Lag compressors stop immediately, lead compressors run to pump out the refrigerant from evaporator as indicated by the low pressure transducer).

Complete unit stoppage can be caused by any of the following conditions :

a. General power failure
b. Control circuit breaker tripped out
c. Blown fuse in control power feed disconnect
d. Open control circuit fuse
e. Run/Standby switch moved to STANDBY
f. Freeze protection trip
g. Low flow protection trip
h. Open contacts in chilled water flow switch (optional)
i. Open contacts in any auxiliary interlock. (Terminals TB1-13 and TB1-14, jumpered from factory, are in series with the control switch. Opening the circuit between these terminals places the unit in STANDBY mode, just as turning the control switch to STANDBY would. The number of COOLING stage is displayed. The unit cannot start if these contacts are open, and if they open while unit is running, it will pump down and stop.

Single circuit stoppage can be caused by the following conditions:

a. Occurence of open contacts in lead compressor protection module
b. Refrigerant pressure in circuit A or B is too low
c. Compressor oil pressure is too low
d. Occurence of open contacts in lead compressor high-pressure switch
e. Too low or too high superheat
f. Compressor motor temperature too high in the lead compressor
g. Compressor discharge gas temperature too high in the lead compressor
h. Lead compressor high pressure switch occurence of opening

Stoppage of one circuit by a safety device action does not affect the other circuit. Besides stopping compressor(s), all devices listed will also close liquid line solenoid valve if used for that circuit.

> ***Important :***
> ***If stoppage occurs more than once as a result of any of the above safety devices, determine and correct the cause before attempting another start.***

Restart Procedure, after cause for stoppage is corrected.

- *General power failure*
  Unit will restart automatically when power is restored and unit LOCAL switch is placed to "OFF" and "ON" position.
- *Blown fuse in power feed disconnect*
  Replace fuse. Restart is automatic.
- *Low water temperature cutout*
  Move RUN/STANDBY switch to STANDBY, then back to RUN. Restart is automatic.
- *Auxiliary interlock*
  Automatic restart after condition is corrected.
- *Open control circuit breaker*
  Reset the breaker. Unit will restart automatically.
- *Freeze protection*
  Unit will automatically restart when leaving water temperature is 3.3 °C above the leaving water set point.
- *High-pressure switch, loss of charge system, compressor Krivan Module Switch and oil safety switch*
  Move the RUN/STANDBY switch to STANDBY, then back to RUN. Unit will restart automatically.

Note :
Compressor module, high pressure switch and ground current module are reset through switching the local/off/network switch to standby off and then pack to local.

Mode operating functionning lights

Red LED :
Blinking continuously at a 3 to 5 second rate indicates proper operation.

Lit continuously indicates a problem requiring replacement of the module.
Off continuously indicates the power should be checked. If there is no input power, check fuses. If fuse is bad, check for shorted secondary of transformer, or for bad module.

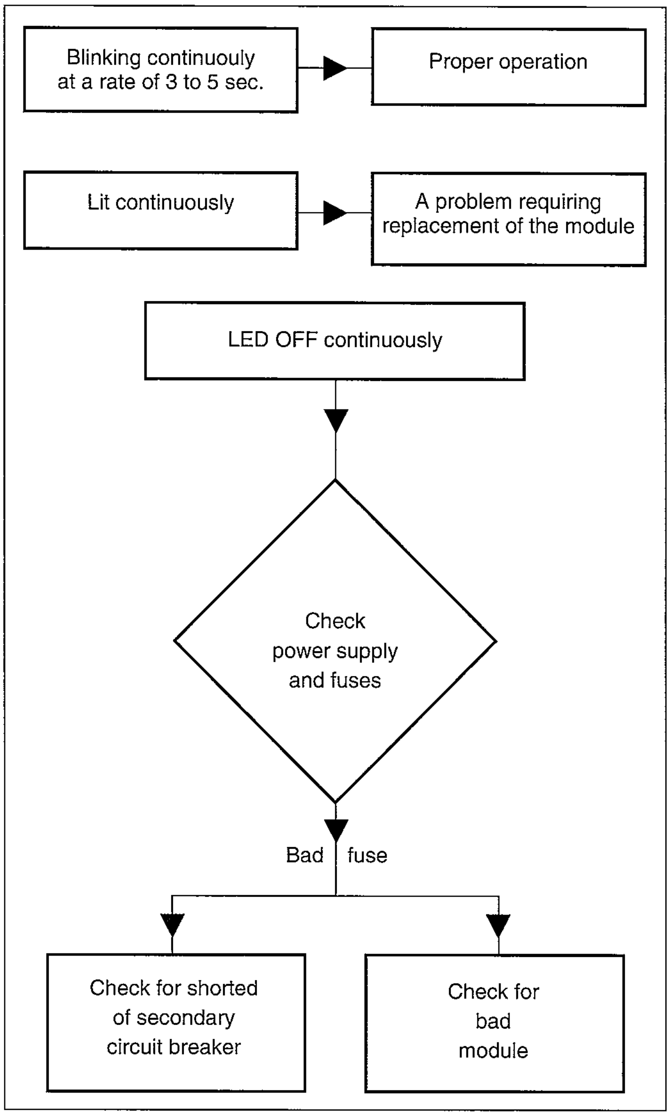


Fig. 14 PSIO module proper operation check

Green LED :
These are two green LED. First is located very close to COMM connectors (for details see Fig. 28 and 29) and it should always be blinking when power is on; it indicates that the modules are communicating properly. If a green LED is not blinking, check the red LED. If the red LED is normal, check the module address switches. See fig.

The proper addresses are :

PSIO	(Processor Module)	: 01 (used by CCN only)
DSIO	(Relay Module)	: 19
DSIO	(EXV Driver Module)	: 31
4x4	(Optional Module)	: 59
8IN	(Option 137 B)	: 51
Data Port	(Communication module)	: 6E

When CCN (Carrier Comfort Network) communication is used, PSIO processor module should be set at 01 through HSIO module (function Service, customer field configuration option). In case of lacke of communication indicated by the green LED please follow checking procedure as shown below.

When DSIO module indicates lack of communication please use below checking procedure to test this module.

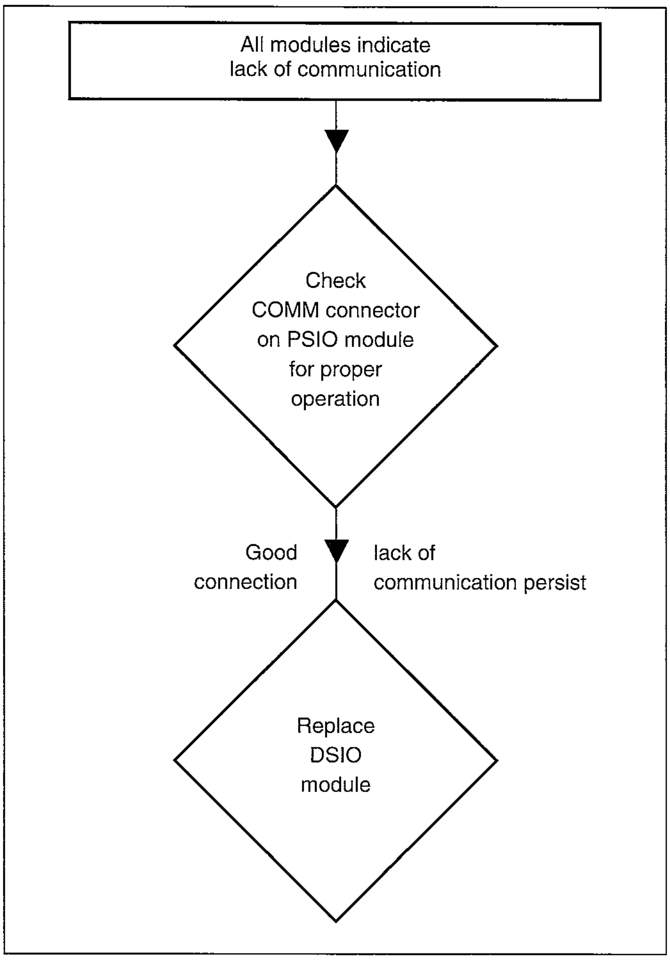


Fig. 15 DSIO module proper operation check

Communication between modules

The machine operator communicates with the microprocessor through the HSIO module (keyboard/display module). Communication between the PSIO and the other modules is accomplished by a 3-wire sensor bus.
These 3 wires run in parallel from module to module. Each module in a panel is numbered (1,2,3...). Each terminal strip on a module is labeled (J2,J3, J4...). The terminal strip number on the machine schematic combines the module and strip numbers. For example, 2J3 is terminal strip J3 on module 2. The module numbers can be found on the component arrangement label.
On the sensor bus terminal strips, terminal 1 of the PSIO module is connected to terminal 1 of each of the other modules ; terminal 2 and 3 are connected in the same manner. (see fig. 14) If a terminal 2 wire is connected to terminal 1, the system will not work.

In the 30HT/HQ/HW units, the processor module, low-voltage relay module, and keyboard/display module are all powered from a common 21 vac power source which connects to terminal 1 and 2 on the power input strip of each module. A separate source of 12.5 vac power is used to power the EXV driver module through terminals 1 and 2 on the power input strip.

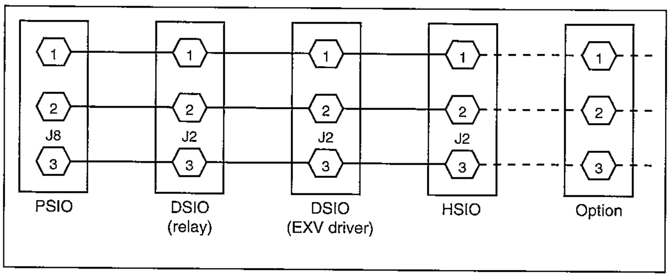


Fig. 16 Sensor bus wiring

Module inputs and outputs description

Processor module PSIO (see fig. 14)

Each input channel has 3 terminals; only 2 of 3 terminals are used. The application of the machine determines which terminals are used. 12 Inputs of this module are on I7 terminal and 6 outputs are located on I6 terminal.
Always refer to the unit individual wiring for terminal numbers.

Outputs

Most of outputs of PSIO are 20 VDC. This explains use of 20 VDC interface relays for the following applications:
- Alarm relay
- Evaporator pump relay
- Condenser pump relay

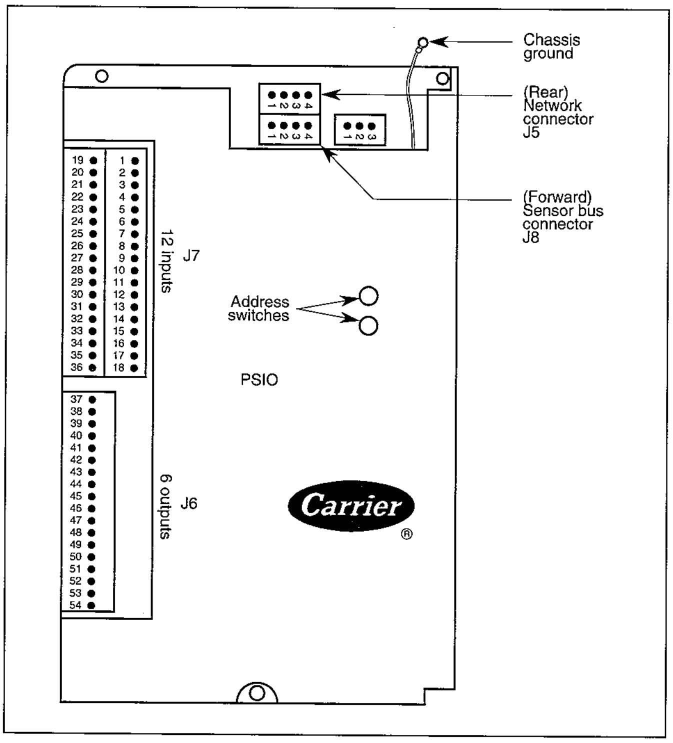


Fig. 17 Sensor bus wiring

Low voltage relay module (see fig. 18)

Inputs

Inputs on strip J3 are discrete inputs (ON-OFF). When 24 vac are applied across the 2 terminals in a channel it is read as an ON signal. Zero volts is read as an OFF signal.

Outputs

Terminal strips J4 and J5 are internal relays whose coils are powered-up and powered-off by a signal from the microprocessor. The relays switch the circuit to which they are connected. No power is supplied to these connections by the DSIO module.

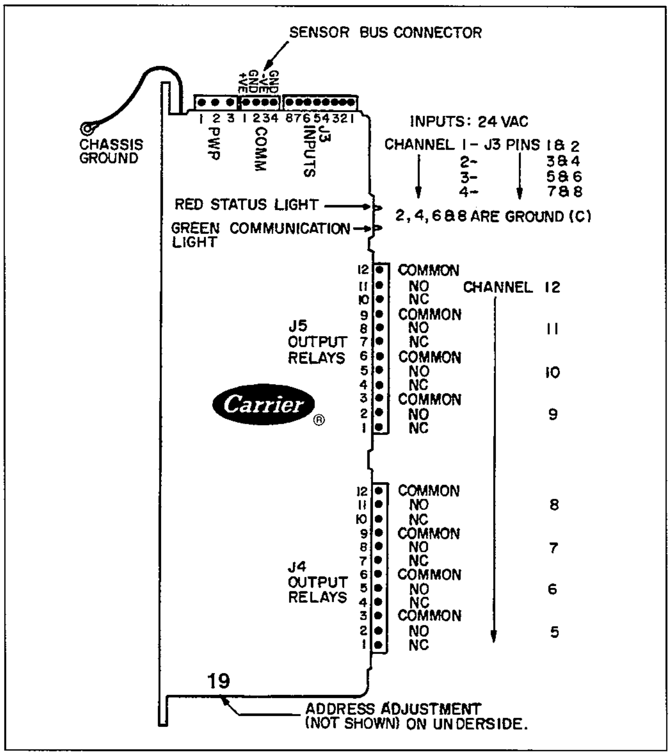


Fig.18 Low-voltage relay module (DSIO)

EXV driver module (see fig. 19)

Inputs

Input on strip J3 are discrete inputs (ON-OFF). When 24 vac are applied across the 2 terminals in a channel it is read as an ON signal. Zero volts is read as an OFF signal.

Outputs

Two stepper motor driver outputs are used to drive the electronic expansion valves. Terminals 1 and 7 supply voltage to the valves. Terminals 2 through 5 and 8 through 11 connect the individual coils (4 per valve) to neutral in a repeating sequence to drive the valves in incremental steps.

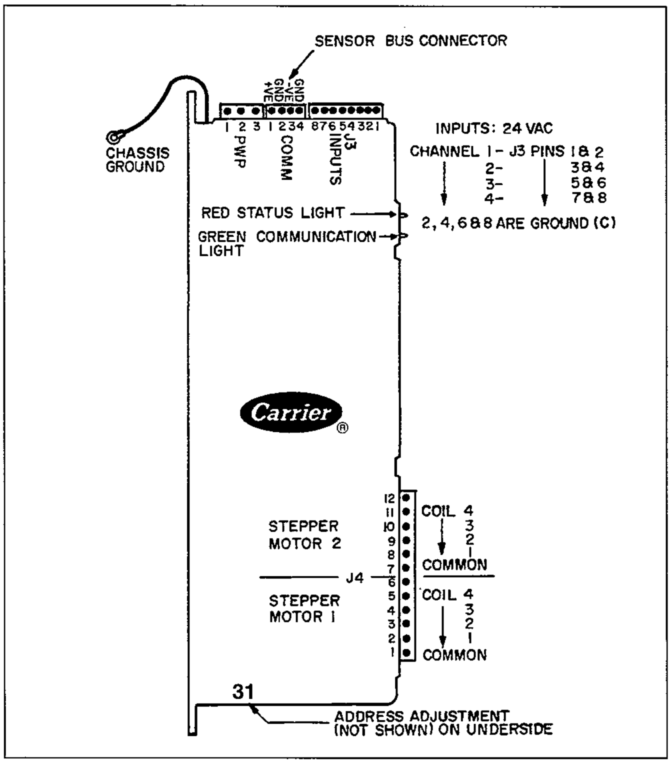


Fig. 19 EXV driver module (DSIO)

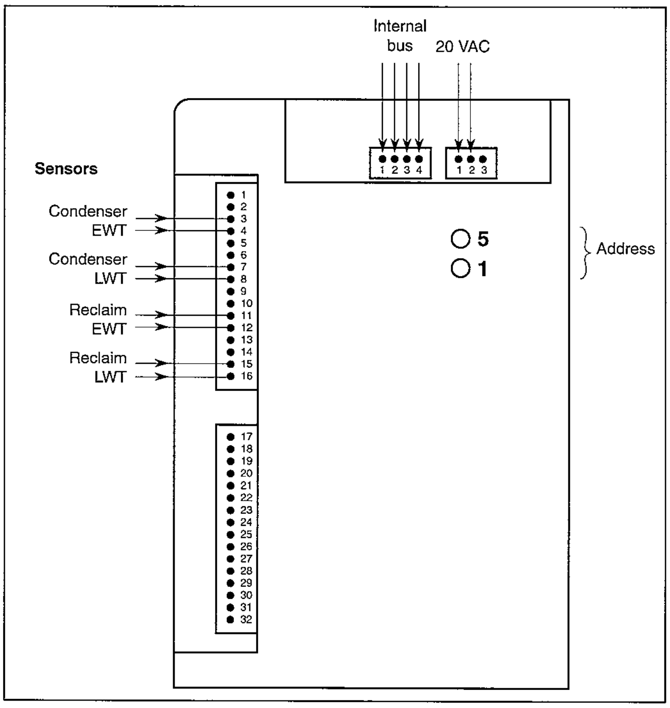


Fig. 20 "8 IN" option module (8 inputs)

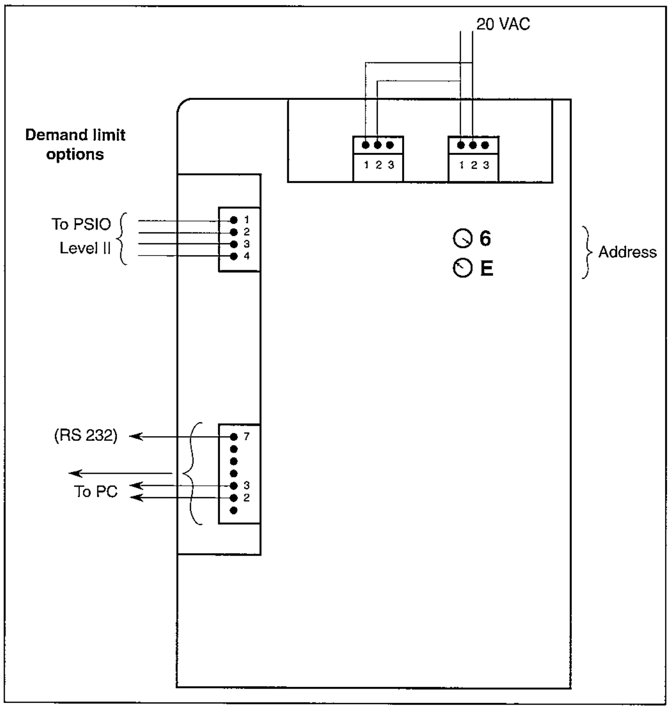


Fig. 22 Data port module

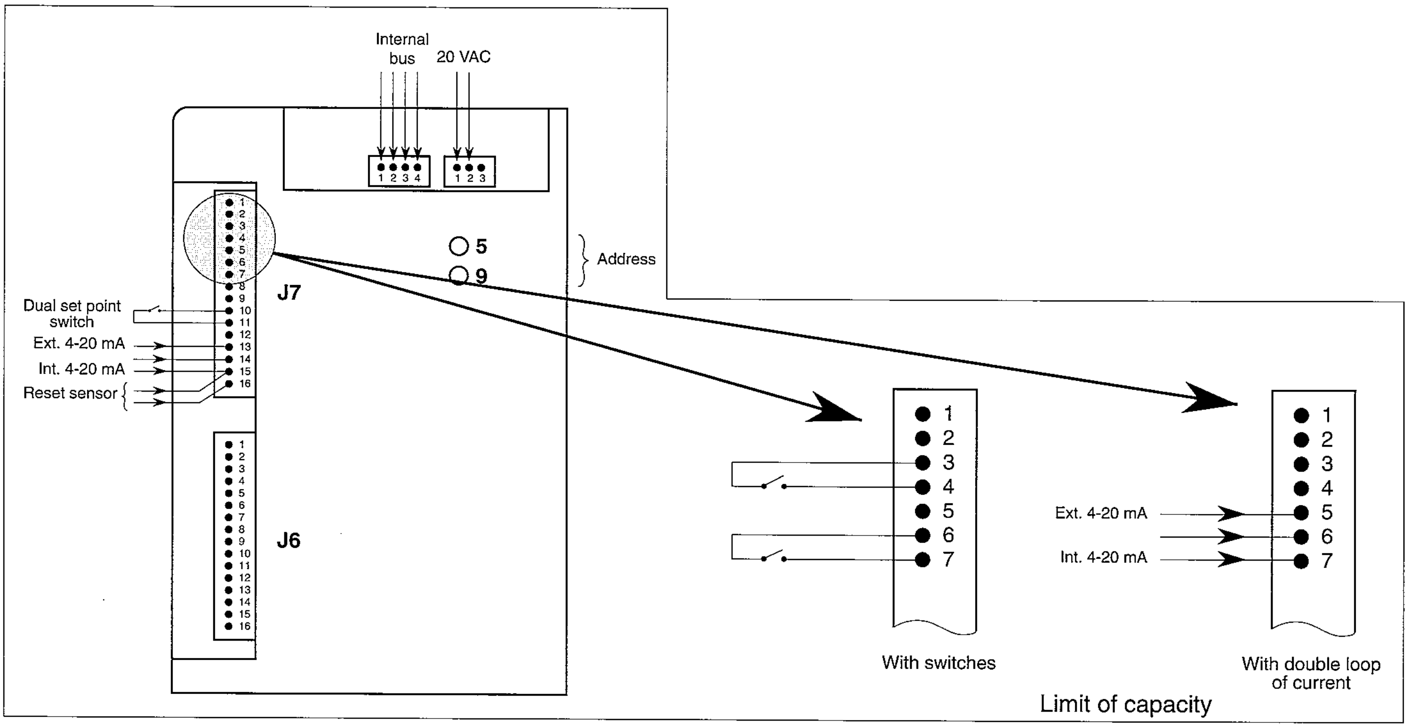


Fig. 21 "4x4" option module (4 inputs + 4 outputs)

Maintenance of electronic components

If it appears that the electronic expansion valve is not properly controlling operating suction pressure or superheat, there are a number of checks that can be made using Quick Test features built into the microprocessor control.
Follow steps below to diagnose and correct EXV problems.

EXV Driver Module

• Step 1. Check EXV Driver Outputs

Check EXV output signals at appropriate terminals on the EXV driver module (fig. 20) as follows :
Connect positive test lead to terminal 1 on EXV driver. Set meter for approximately 20 vdc. Enter outputs subfunction of test function by pressing 2 TEST, then advance to EXVA Open Quick Test by pressing 5 times. Press ENTR.
The driver should drive the EXV fully open. During the next several seconds connect the negative test lead to pins 2, 3, 4 and 5 in succession. Voltage should rise and fall at each pin. If it remains constant at a voltage or at zero volts, remove the connector to the valve and recheck.

Press key to reach the EXVQA Close Quick Test. If a problem still exists, replace the EXV driver.
If the voltage reading is correct, the expansion valve should be checked. Next, test EXVB. Connect the positive test lead to pin 7 and the negative to pin 8, 9, 10, 11 in succession during the EXVB Quick Test.

• Step 2. Check EXV Wiring

Check wiring to electronic expansion valves from terminal strip on EXV driver (fig. 23).

1. Check color coding and wire connections. Make sure they are connected to correct terminals at driver and EXV plug connections.
2. Check for continuity and tight connection at all pin terminals.
3. Check plug connections at driver and at EXVs. Be sure EXV connections are not crossed.

• Step 3. Check Resistance of EXV Motor Windings

Remove plug at J4 terminal strip and check resistance between common lead (red wire, terminal D) and remaining leads A, B, C and E (see fig. 23). Resistance should be 25 ohms ± 2 ohms.

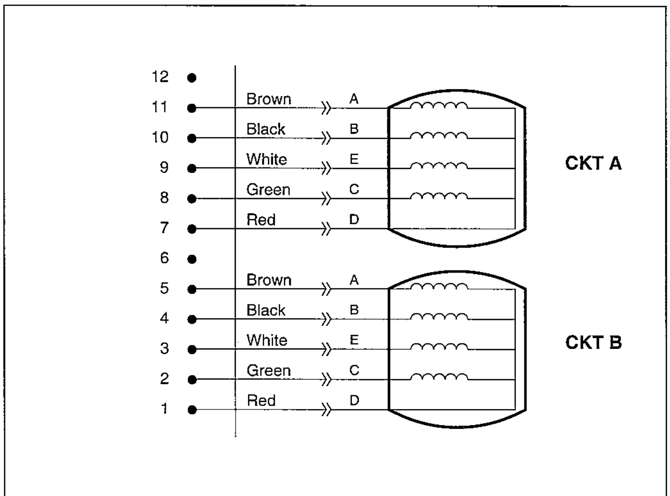


Fig. 23 EXV cable connections

• Step 4. Check pressure transducer and thermistor that control EXV

Check thermistors that control processor output voltage pulses to EXVs. Circuit A : thermistor is R3 and pressure transducer is BP3. Circuit B : thermistors is R4 and pressure transducer is BP4.

1. Use the temperature subfunction of the status function (5 STAT) to determine if thermistors are reading correctly.
2. Check thermistor calibration at known temperature by measuring actual resistance and comparing value measured with values listed in Table 2.
3. Make sure that thermistor leads are connected to proper pin terminals at 1J7 terminal strip on processor module and that thermistor probes are located in proper position in refrigerant circuit (fig. 25)

When above checks have been completed, actual operation of EXV can be checked by using procedures outlined in step 5.

• Step 5. Check operation of the EXV

Use following procedure to check actual operation of electronic expansion valves.

1. Close liquid line service valve for circuit to be checked and run through the Quick Test step (in subfunction 3 of test function) for the lead compressor in that circuit to pump down the low side of the system. Repeat test step 3 times to ensure that all refrigerant has been pumped from low side.

Note :
Be sure to allow compressors to run full 10 seconds at each step.

2. Turn OFF compressor. Make sure that electrical power is shut-off. Disconnect compressor fuses or compressor optional circuit breakers. Close compressor discharge valves.
3. Remove screws holding top cover of EXV. Carefully remove top cover, using caution to avoid damage to the O-ring seal and motor leads. If EXV plug was disconnected during this process, reconnect it after the cover is removed.
4. Enter appropriate EXV Quick Test step for EXVA or EXVB in the outputs subfunction of the test function (2 TEST). Press ENTR to initiate test. With cover lifted off the EXV valve body, observe operation of valve motor and lead screw. The motor should turn in the clockwise direction and the lead screw should move down into the motor hub until the valve is fully closed or fully open depending on whether you initiated the open or close test step for that valve. Lead screw movements should be smooth and uniform from fully open to fully closed position, or from fully closed to fully open.
   If valve is properly connected to processor and receiving correct signals, yet does not operate as described above, the valve should be replaced.

The EXV test can be repeated as required by pressing ENTR to start the test.

If operating problems persist after reassembly, they may be due to out-of calibration thermistor(s), or intermittent connections between processor board terminals and EXV plub. Recheck all wiring connections and voltage signals.
Other possible causes of improper refrigerant flow control could be restrictions in liquid line. Check for plugged filter drier(s), stuck liquid line solenoïd valve(s) or restricted metering slots in the EXV.

Formation of ice or frost on lower body of electronic expansion valve is one symptom of restricted metering slots. Clean or replace valve if necessary.

Note :
Frosting of valve is normal during compressor Quick Test steps and at initial start-up. Frost should dissipate after 5 to 10 minutes operation of a system that is operating properly. If valve is to be replaced, wrap valve with a wet cloth to prevent excessive heat from damaging internal components.

Thermistors

All thermistors are identical in their temperature vs resistance performance. Resistances at various temperatures are listed in table 4.

Location

General location of thermistor sensors are shown in fig. 21.

Cooler leaving water sensor R1, is located in the leaving water nozzle. The probe is immersed directly in the water. Connection is made through a 1/4-in. coupling (fig. 25).

Compressor Suction Gas Temperature Sensors, R3 and R4, are located in lead compressor in each circuit in a suction passage between motor and cylinders, above oil pump. The 1/4-in. coupling is used (fig. 25).

Reset Sensor, R10, is an accessory sensor and is mounted remotely from unit. It is used for outside air or space temperature reset. Carrier Part No. HH79NZO14 should be used for this purpose (see fig. 29); it is included in Service Parts package no. 30GB660002. The thermistor should be connected to the 4x4 module as shown in fig. 24.

To avoid electrical interference, **do not** run the thermistor wire near line voltage wiring, electrical machinery, large contactors or other devices. Wire lengths up to 300 m may be used with 22-gauge wire.

The accessory thermistor is equipped with 9.1 m 22-gauge twisted-pair cable. If additional length is required, use twisted-pair wire with a minimum of one twist per inch. The additional wire should be spliced onto the end of the 9.1 m wire. All connections should be soldered.

When outside air is used, the thermistor should be mounted in a location that is shielded from the sun.

When using space reset, the thermistor should be mounted in an area within the space where it will sense freely circulating air.

Sensor replacement (compressor and cooler)

Important :
Sensors are installed directly in refrigerant or water circuit. Relieve all refrigerant pressure or drain water before removing.

Proceed as follows (refer to fig. 22) :

1. Remove and discard original sensor and coupling.

Important :
Do not disassemble new coupling; install as received.

2. Apply pipe sealant to 1/4-in. NPT threads on replacement coupling and install in place of original. Do not use packing nut to tighten coupling ; this would damage ferrules (see fig. 28)

3. Insert new sensor in coupling body to its full depth. Hand tighten packing nut to position ferrules, then finish tightening 1-1/4 turns with a suitable tool. Ferrules are now attached to sensor, which can be withdrawn from coupling for unit servicing.

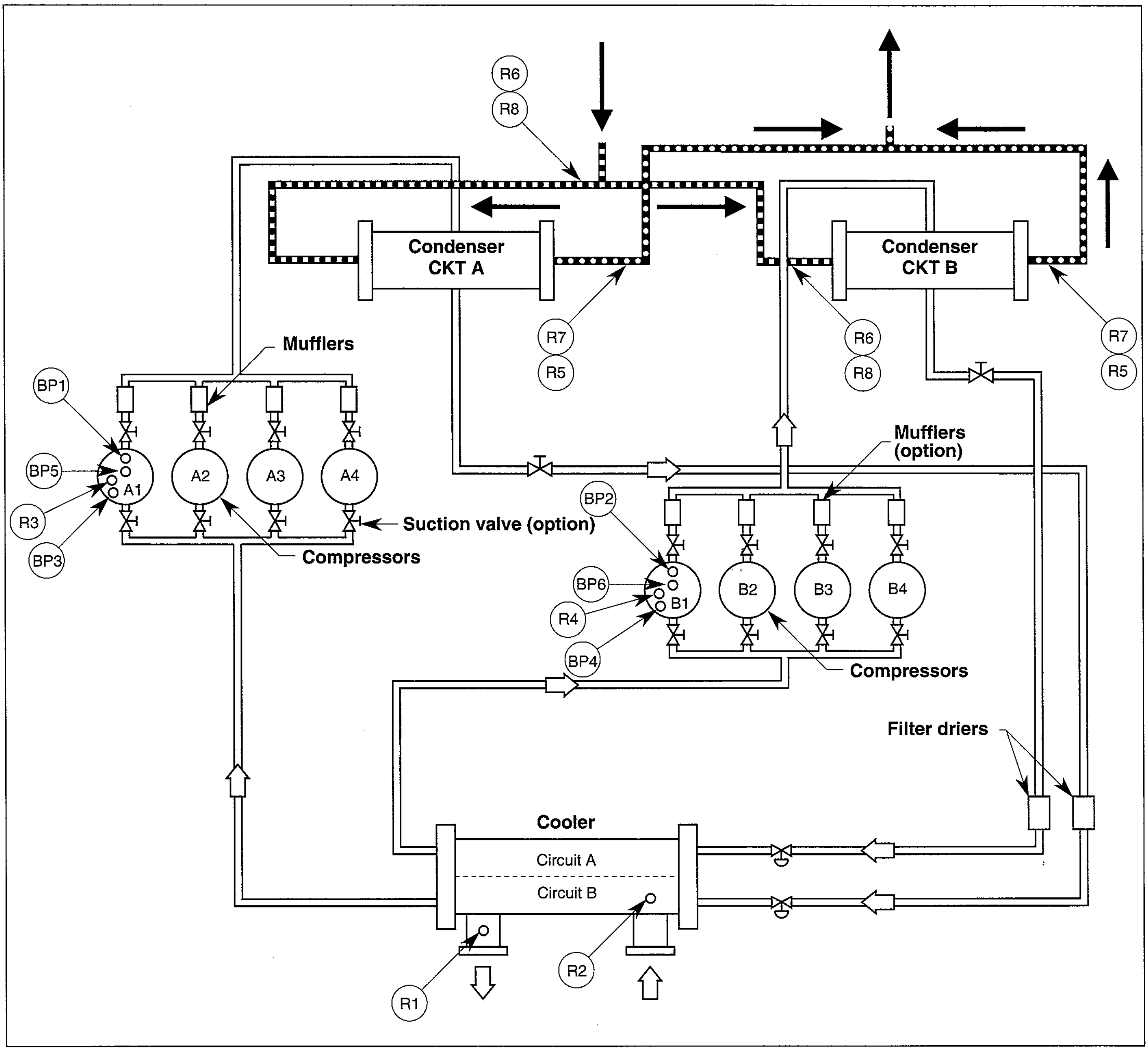


Fig. 24 Thermistors and transducers locations

Legend :

R1	*Cooler leaving chilled water temperature*
R2	*Cooler entering water (return temperature)*
R3	*Suction gas temperature - Circuit A*
R4	*Suction gas temperature - Circuit B*
R5	*Leaving hot water temperature (heat machines only) or optional leaving condenser water temperature*
R6	*Entering hot water temperature (heat machines only) or optional entering condenser water temperature.*
R7	*Optional heat reclaim condenser leaving water temp.*
R8	*Optional heat reclaim condenser entering water temperature.*
R10	*Remote temperature sensor (accessory)*
BP1	*Discharge pressure Comp 1 Circuit A*
BP2	*Discharge pressure Comp 1 Circuit B*
BP3	*Suction pressure Comp 1 Circuit A*
BP4	*Suction pressure Comp 1 Circuit B*
BP5	*Oil pressure Comp 1 Circuit A*
BP6	*Oil pressure Comp 1 Circuit B*

Temp. (°C)	Resistance (Ohms)	Voltage Drop (v)	Temp. (°C)	Resistance (Ohms)	Voltage Drop (v)	Temp. (°C)	Resistance (Ohms)	Voltage Drop (v)	Temp. (°C)	Resistance (Ohms)	Voltage Drop (v)	Temp. (°C)	Resistance (Ohms)	Voltage Drop (v)
-32.0	100049.0	4.690	-4.0	20075.9	3.756	24.0	5203.2	2.201	52.0	1694.0	1.003	80.0	602.4	0.431
-31.5	97006.4	4.680	-3.5	19560.8	3.732	24.5	5088.1	2.174	52.5	1663.5	0.988	80.5	592.4	0.425
-31.0	94060.8	4.671	-3.0	19060.6	3.707	25.0	4976.0	2.147	53.0	1633.5	0.974	81.0	582.8	0.418
-30.5	91209.3	4.661	-2.5	18574.8	3.682	25.5	4866.8	2.120	53.5	1604.1	0.959	81.5	573.4	0.412
-30.0	88449.0	4.651	-2.0	18102.9	3.656	26.0	4760.2	2.094	54.0	1575.2	0.945	82.0	564.4	0.406
-29.5	85777.0	4.641	-1.5	17644.5	3.631	26.5	4656.4	2.067	54.5	1546.9	0.931	82.5	555.7	0.400
-29.0	83190.7	4.630	-1.0	17199.1	3.605	27.0	4555.2	2.041	55.0	1519.0	0.917	83.0	547.2	0.394
-28.5	80687.1	4.620	-0.5	16766.3	3.579	27.5	4456.6	2.015	55.5	1491.6	0.903	83.5	539.1	0.388
-28.0	78263.9	4.609	0.0	16345.7	3.553	28.0	4360.4	1.989	56.0	1464.7	0.890	84.0	531.2	0.383
-27.5	75918.3	4.597	0.5	15936.9	3.526	28.5	4266.7	1.963	56.5	1438.3	0.876	84.5	523.6	0.377
-27.0	73648.0	4.586	1.0	15539.5	3.500	29.0	4175.4	1.938	57.0	1412.3	0.863	85.0	516.2	0.371
-26.5	71450.6	4.574	1.5	15153.1	3.473	29.5	4086.3	1.912	57.5	1386.8	0.850	85.5	509.2	0.366
-26.0	69323.7	4.562	2.0	14777.5	3.446	30.0	3999.6	1.887	58.0	1361.6	0.837	86.0	502.3	0.361
-25.5	67265.0	4.550	2.5	14412.2	3.419	30.5	3915.0	1.862	58.5	1336.9	0.825	86.5	495.7	0.355
-25.0	65272.4	4.537	3.0	14056.9	3.392	31.0	3832.5	1.837	59.0	1312.6	0.812	87.0	489.4	0.350
-24.5	63343.7	4.525	3.5	13711.4	3.364	31.5	3752.1	1.813	59.5	1288.7	0.800	87.5	483.2	0.345
-24.0	61476.9	4.512	4.0	13375.3	3.337	32.0	3673.7	1.789	60.0	1265.2	0.788	88.0	477.4	0.340
-23.5	59670.0	4.499	4.5	13048.3	3.309	32.5	3597.3	1.764	60.5	1242.1	0.776	88.5	471.6	0.335
-23.0	57920.9	4.485	5.0	12730.1	3.281	33.0	3522.9	1.741	61.0	1219.3	0.765	89.0	466.1	0.331
-22.5	56227.9	4.471	5.5	12420.5	3.253	33.5	3450.2	1.717	61.5	1196.9	0.753	89.5	460.8	0.326
-22.0	54589.1	4.457	6.0	12119.2	3.225	34.0	3379.4	1.693	62.0	1174.8	0.742	90.0	455.6	0.321
-21.5	53002.7	4.443	6.5	11826.0	3.197	34.5	3310.4	1.670	62.5	1153.2	0.731	90.5	450.6	0.317
-21.0	51467.0	4.428	7.0	11540.5	3.169	35.0	3243.1	1.647	63.0	1131.8	0.720	91.0	445.7	0.312
-20.5	49980.4	4.413	7.5	11262.7	3.140	35.5	3177.5	1.624	63.5	1110.9	0.709	91.5	440.9	0.308
-20.0	48541.1	4.398	8.0	10992.1	3.112	36.0	3113.4	1.602	64.0	1090.2	0.698	92.0	436.3	0.303
-19.5	47147.7	4.383	8.5	10728.8	3.083	36.5	3051.0	1.579	64.5	1069.9	0.688	92.5	431.8	0.299
-19.0	45798.6	4.367	9.0	10472.3	3.054	37.0	2990.1	1.557	65.0	1050.0	0.678	93.0	427.4	0.295
-18.5	44492.4	4.351	9.5	10222.6	3.026	37.5	2930.7	1.536	65.5	1030.3	0.667	93.5	423.0	0.291
-18.0	43227.6	4.334	10.0	9979.3	2.997	38.0	2872.8	1.514	66.0	1011.0	0.657	94.0	418.8	0.287
-17.5	42002.9	4.318	10.5	9742.5	2.968	38.5	2816.2	1.492	66.5	992.1	0.648	94.5	414.5	0.283
-17.0	40816.9	4.301	11.0	9511.7	2.939	39.0	2761.1	1.471	67.0	973.4	0.638	95.0	410.3	0.279
-16.5	39668.3	4.283	11.5	9287.0	2.911	39.5	2707.2	1.450	67.5	955.1	0.628	95.5	406.0	0.275
-16.0	38555.9	4.266	12.0	9068.0	2.882	40.0	2654.7	1.430	68.0	937.1	0.619	96.0	401.8	0.271
-15.5	37478.4	4.248	12.5	8854.7	2.853	40.5	2603.4	1.409	68.5	919.4	0.609	96.5	397.6	0.267
-15.0	36434.7	4.230	13.0	8646.9	2.824	41.0	2553.3	1.389	69.0	902.1	0.600	97.0	393.3	0.264
-14.5	35423.7	4.211	13.5	8444.5	2.795	41.5	2504.4	1.369	69.5	885.1	0.591	97.5	389.0	0.260
-14.0	34444.2	4.193	14.0	8247.2	2.766	42.0	2456.6	1.349	70.0	868.4	0.582	98.0	384.7	0.257
-13.5	33495.2	4.174	14.5	8055.0	2.737	42.5	2410.0	1.330	70.5	852.0	0.574	98.5	380.3	0.253
-13.0	32575.6	4.154	15.0	7867.7	2.708	43.0	2364.4	1.311	71.0	836.0	0.565	99.0	375.8	0.250
-12.5	31684.6	4.135	15.5	7685.1	2.680	43.5	2319.9	1.292	71.5	820.2	0.557	99.5	371.1	0.246
-12.0	30821.0	4.115	16.0	7507.2	2.651	44.0	2276.3	1.273	72.0	804.8	0.548	100.0	366.5	0.243
-11.5	29984.0	4.094	16.5	7333.9	2.622	44.5	2233.8	1.254	72.5	789.8	0.540	100.5	361.6	0.240
-11.0	29172.7	4.074	17.0	7164.9	2.593	45.0	2192.2	1.236	73.0	775.0	0.532	101.0	356.7	0.236
-10.5	28386.3	4.053	17.5	7000.3	2.565	45.5	2151.5	1.218	73.5	760.6	0.524	101.5	351.5	0.233
-10.0	27623.8	4.032	18.0	6839.8	2.536	46.0	2111.7	1.200	74.0	746.5	0.516	102.0	346.3	0.230
-9.5	26884.4	4.010	18.5	6683.4	2.508	46.5	2072.8	1.182	74.5	732.6	0.508	102.5	341.1	0.227
-9.0	26167.5	3.989	19.0	6530.9	2.479	47.0	2034.7	1.165	75.0	719.2	0.501	103.0	335.3	0.224
-8.5	25472.2	3.967	19.5	6382.3	2.451	47.5	1997.4	1.148	75.5	706.1	0.493	103.5	329.7	0.221
-8.0	24797.8	3.944	20.0	6237.5	2.423	48.0	1960.9	1.131	76.0	693.3	0.486	104.0	323.8	0.218
-7.5	24143.6	3.922	20.5	6096.3	2.395	48.5	1925.1	1.114	76.5	680.8	0.479	104.5	317.9	0.215
-7.0	23509.0	3.899	21.0	5958.7	2.367	49.0	1890.1	1.098	77.0	668.6	0.472	105.0	311.6	0.212
-6.5	22893.2	3.876	21.5	5824.6	2.339	49.5	1855.7	1.081	77.5	656.8	0.465	105.5	305.3	0.209
-6.0	22295.6	3.852	22.0	5693.9	2.311	50.0	1822.1	1.065	78.0	645.2	0.458	106.0	298.6	0.206
-5.5	21715.7	3.829	22.5	5566.4	2.283	50.5	1789.1	1.049	78.5	634.0	0.451	106.5	292.1	0.204
-5.0	21152.8	3.805	23.0	5442.2	2.256	51.0	1756.8	1.034	79.0	623.2	0.444	107.0	285.2	0.201
-4.5	20606.4	3.781	23.5	5321.2	2.228	51.5	1725.1	1.019	79.5	612.6	0.437			
-4.0	20075.9	3.756	24.0	5203.2	2.201	52.0	1694.0	1.003	80.0	602.4	0.431			

Table 4

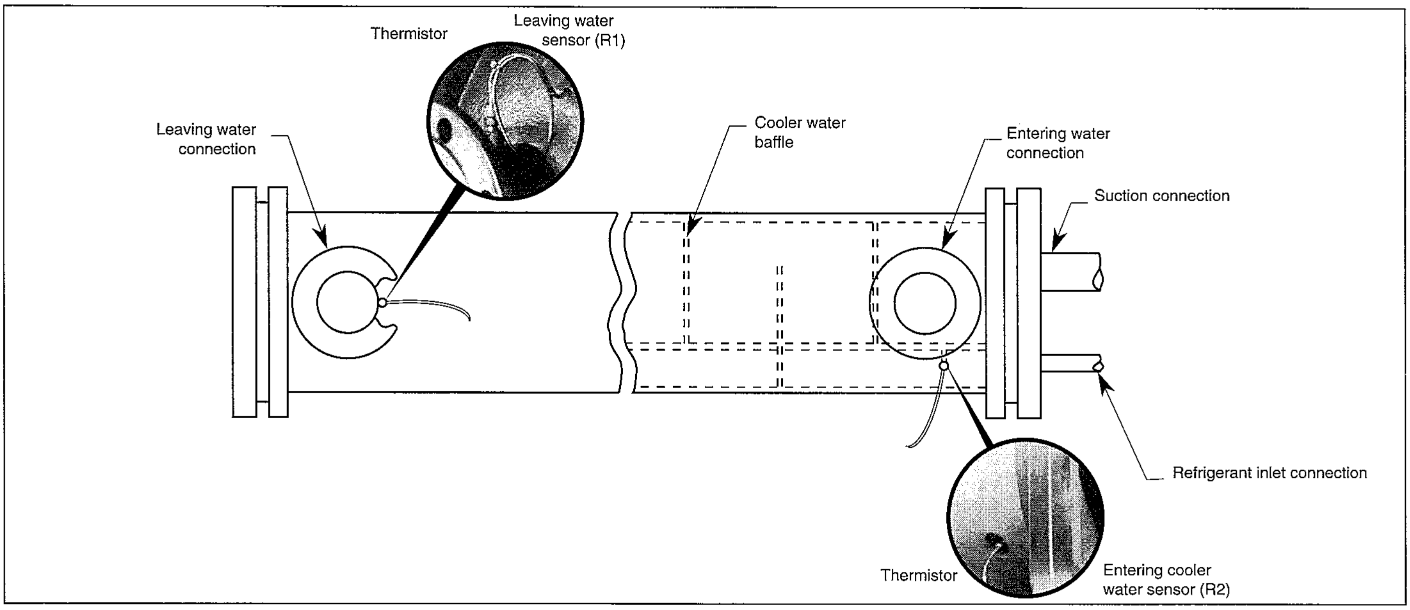


Fig. 25 Cooler sensor locations

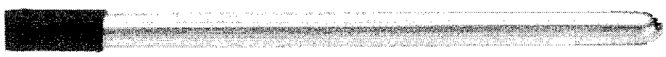


Fig. 26 Reset thermistor

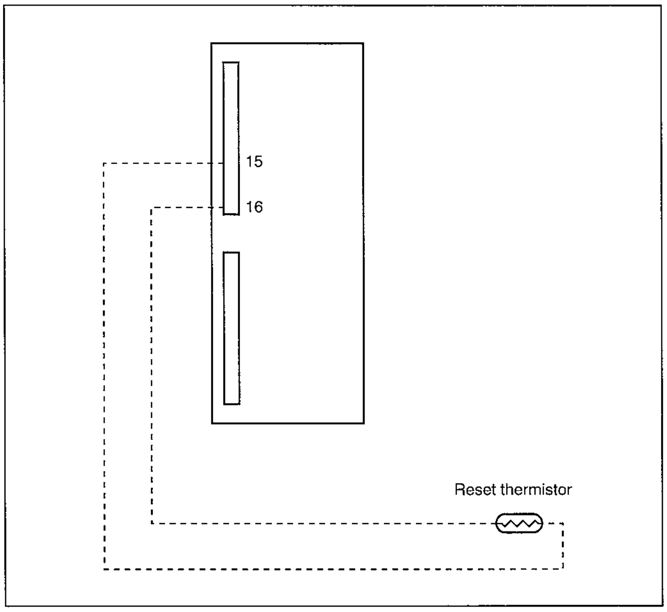


Fig. 27 Space/outside air termistor - Wiring diagram (Option board n° 138)

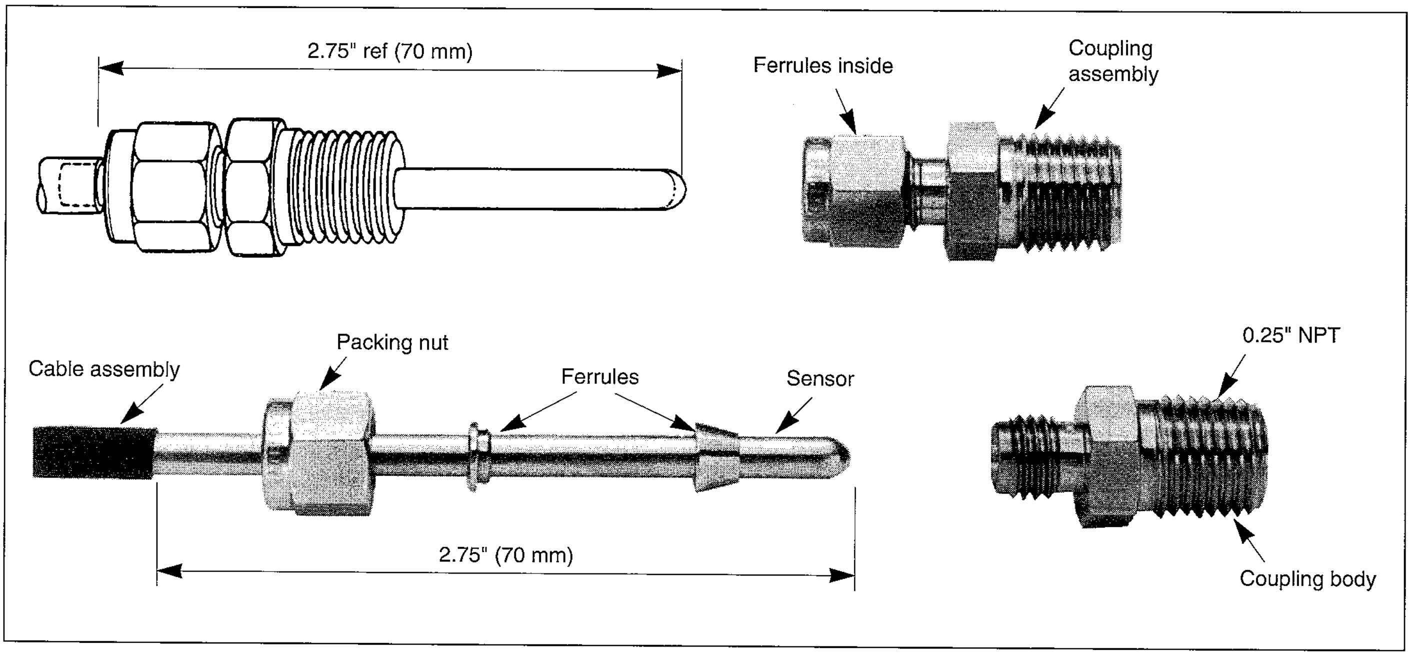


Fig. 28 Thermistor (compressor and cooler)

Transducers

Pressure transducers are used to measure the following pressures in each circuit :
- discharge pressure
- suction pressure
- oil pressure

These sensors are smart sensors with on-board electronics that linearize the signal and output a 0 to 5 DC signal to the PSIO module. These transducers give gauge reading in kPa or psig units. Two versions are used. One version is calibrated for the high pressure and one version is calibrated for the low pressure and oil pressure.
The fig. 21 and fig. 22 show these transducers curves for voltage output (V DC) versus measured pressure (psig). Faulty transducers are detected by checking if the transducers output signal is greater than 99% or less than 1%. Values outside this range should be treated as an error and faulty transducer(s) should be replaced.

Transducers testing

To test the transducers; the pressure and voltage reading must be taken. Then voltage output reading should be compared with voltage value taken from the curve at the pressure value indentical to the test pressure from fig. 21 or fig. 22 depends if high or low pressure transducer was tested.

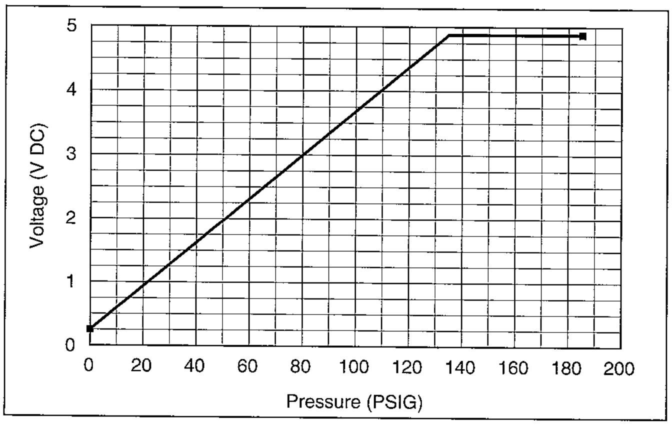


Fig. 29 Low pressure transducer, voltage vs pressure 5 VDC supply

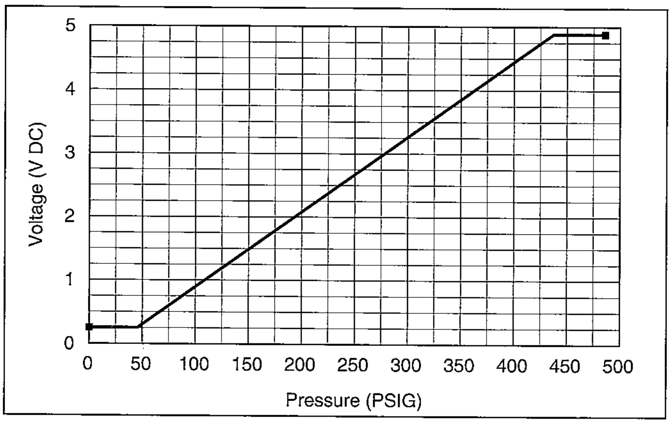


Fig. 30 High pressure transducer, voltage vs pressure 5 VDC supply

Use tee connector completed with manometer to take the pressure reading. Shut off the suction and discharge valves before installing tee and manometer in the refrigerant line. Voltage output reading could be taken from HSIO display. To read voltage function TEST must be used.

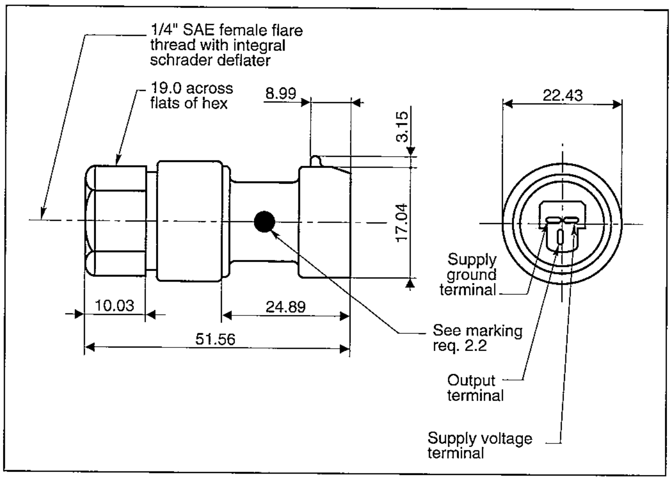


Fig. 31 Compressor transducer

Discharge pressure transducers (BP1, BP2)

These transducers are located in the high side of each circuit at each lead compressor. They replace the discharge pressure gauges and they are used to control the head pressure.

Suction pressure transducers (BP3, BP4)

These transducers are used to measure the pressure on the low side of the unit. They are connected to the lead compressor of each refrigeration circuit in the oil cranckase port. The reading of suction pressure transducers is used to control the electronic expansion valves (EXV). They replace the low pressure switch and the oil switch.

Oil pressure transducers (BP5,BP6)

These transducers are used to measure the oil pressure of the lead compressor of each refrigeration circuit. The suction pressure is substracted for this reading to determine the oil pressure differential.

Sensor replacement (compressor)

Proceed as follows (see fig. 25) :

> ***Important :***
> ***Sensors are installed directly in lead compressors of refrigerant circuits A and B. Pumpdown the cooler as described in § "Compressor replacement" and relieve all refrigerant pressure from the lead compressors A or B before removing transducers.***

1. Disconnect electrical and control wires from transducers
2. Remove and discard original transducer
3. Apply pipe sealant to 1/4-in. NPT threads on replacement transducer coupling and install in place of original.
   Do not use packing nut to tighten coupling; this would damage ferrules (see fig. 27).
4. Hand tighten transducers, then finish tightening 1-1/4 turns with a suitable tool.
5. Connect the electrical and control wires.
6. Open shut-off and discharge valves of lead compressor.
7. Start up the unit.

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