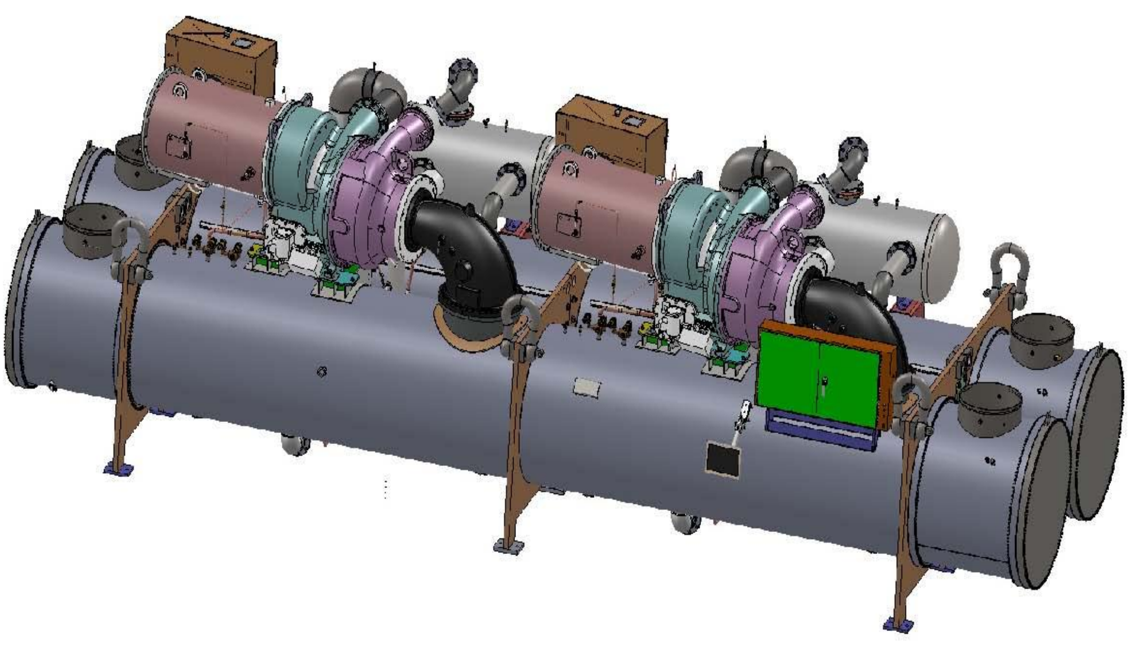
Operating & Maintenance Manual

D-EOMWC01302-16EN

WCT

Counter-Flow Centrifugal Chillers with Two-Stage Compressors
2200 to 3250 TONS (7750 to 11400 kW)
Series Counter-Flow with Two-Stage Compressors
4500 to 6400 TONS (15830 to 22500 kW)



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Manufactured in an ISO Certified Facility

Safety Instructions

The following recommendations should be carefully observed as part of installation, operation, maintenance or service.

- This equipment must be installed and operated by trained and qualified personnel who have received suitable instruction in their use.
- This manual is intended for use by owner or Daikin authorized service personnel.

Cautions and Warnings

At several points in the manual, items of special interest or significant impact are highlighted by one of the following notices in the appropriate section of the manual.

⚠ DANGER
Dangers indicate a hazardous situation which will result in death or serious injury if not avoided.

⚠ WARNING
Warnings indicate potentially hazardous situations, which can result in property damage, severe personal injury, or death if not avoided.

⚠ CAUTION
Cautions indicate potentially hazardous situations, which can result in personal injury or equipment damage if not avoided.

Introduction

⚠ CAUTION
It is important that the operator reads this manual to become familiar with the equipment before attempting to operate the chiller..

⚠ NOTE
During the initial startup of the chiller the Daikin technician will be available to answer any questions and instruct in the proper operating procedures. This Daikin centrifugal chiller represents a substantial investment and deserves the attention and care normally given to keep this equipment in good working order. If abnormal or unusual operating conditions occur, it is recommended that a Daikin service technician be consulted.

General Description

The Daikin Two-Stage Dual Centrifugal Water Chillers (WCT) are complete, self-contained, automatically controlled fluid chilling units. Each unit is completely assembled and factory tested before shipment. These chillers have a separate refrigerant circuit for each compressor. They are available in single pass arrangement only. They provide the high full load efficiency advantage of two separate chillers arranged for counterflow operation in a single, compact unit.

The Daikin Model WCT Chillers use 2-stage ~~K~~ compressors and provide cooling capacity from 2200 to 3250 TONS (7750 to 11400 kW) depending on operating conditions in each chiller, which comes up 4500 to 6400 TONS (15830 to 22500 kW) system capacity when chiller installs in series counter-flow configuration. In the WCT series, each unit has two compressors and two economizers connected to a single condenser, and an evaporator. Each condenser and evaporator has two separate refrigerant circuits. WCT chiller is suitably designed for series counter-flow, which two WCT unit is connecting in series and work as one chiller.

The driveline of the WCT is made up of two two-stage compressors, each with a gear set and a 2-pole, induction semi-hermetic motor.

The controls are pre-wired, adjusted and tested. Only normal field connections such as water and relief valve piping, electrical and interlocks, etc. are required, thereby simplifying installation and increasing reliability. Most of the necessary equipment protection and operating controls are factory installed in the control panel.

All Daikin centrifugal chillers must be commissioned at the job site by a factory trained Daikin authorized technician.

The standard limited warranty on this equipment covers parts that prove defective in material or workmanship. Specific details of this warranty can be found in the warranty statement furnished with the equipment.

Nomenclature

WCTKDCCCP2Z / KDCCCP2Z / E5426-BG-1LL / C5426-BR-1LL /134

WCT	Compressor (No.1)	Compressor (No.2)	Evaporator	Condenser	Refrigerant

WCT : Water Cooled Two-Stage Centrifugal

COMPRESSOR
K : Frame Type of Compressor
D : Shroud Pattern of 1st Stage Impeller
C : Impeller Head of 1st Stage Impeller
C : Shroud Pattern of 2nd Stage Impeller
C : Impeller Head of 2nd Stage Impeller
P2 : Motor Rating (kW)
Z : Voltage (V) and Frequency (Hz)

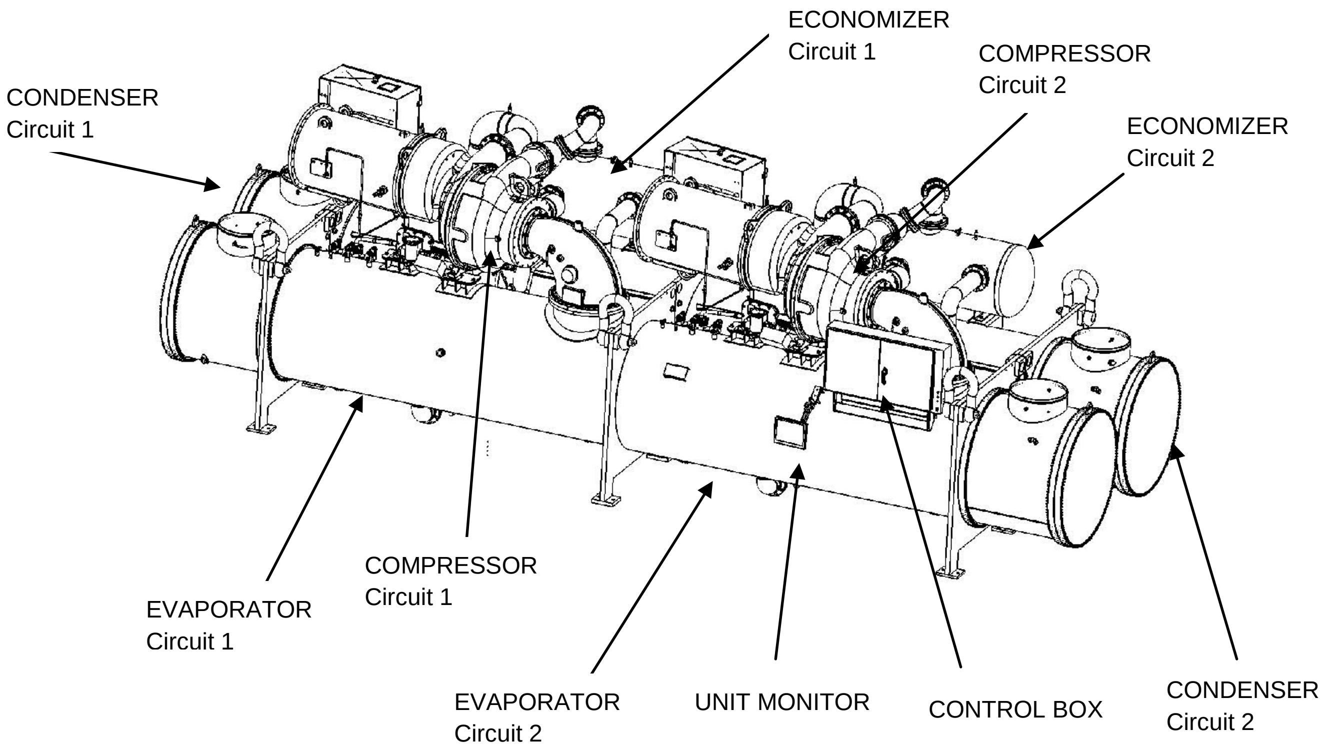
EVAPORATOR
E5426 : Evaporator Diameter (in) and Length (ft)
B : Tube Count
G : Tube Type
1 : Number of Passes
L : Water Inlet Nozzle Location (R = Right Inlet ; L= Left Inlet)
L : Nozzle Configuration

CONDENSER
C5426 : Condenser Diameter (in) and Length (ft)
B : Tube Count
R : Tube Type
1 : Number of Passes
L : Water Inlet Nozzle Location (R = Right Inlet ; L= Left Inlet)
L : Nozzle Configuration

REFRIGERANT
134 : Refrigerant Type (134 = HFC-134a); WCT is for R134a only.

Components and Operation

Figure 1*, *WCT Major Component Locations



Note: Evaporator nozzles may be side-by-side or over-and-under depending on model.

Dual Circuit, Series Counter-flow Chillers Overview

The WCT chiller has a single evaporator and a condenser. Each evaporator and condenser shell contains two separate refrigerant circuits for each of the two compressors and economizers on the chiller. Each circuit is isolated from each other by a welded tube sheet in the middle of the vessel.

They are available in single pass only. Single-pass water flows in evaporator and condenser are counterflow to each other.

Each of the two separate refrigerant circuits use the vapor compression cycle as shown in Figure 3.

. ***Figure 2, Series Counterflow Flow Diagram***

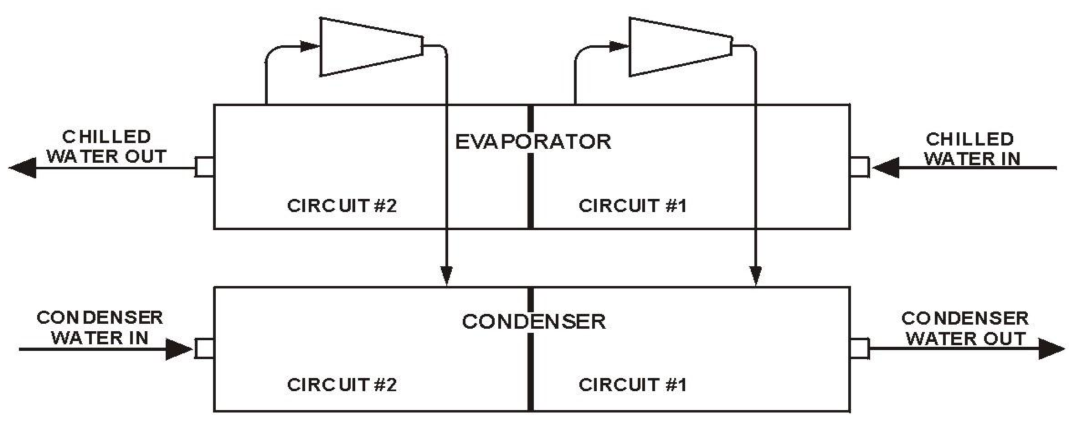


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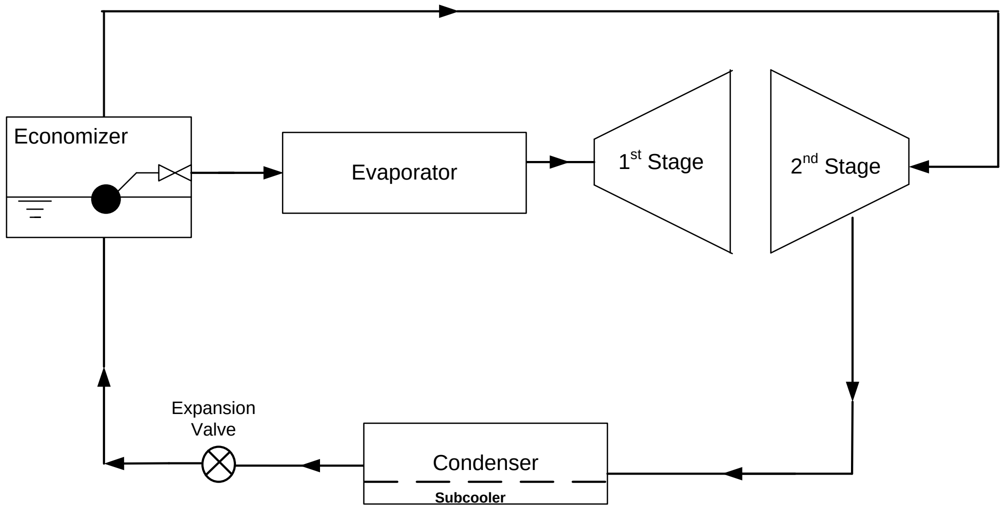
Figure 3, Two-Stage Vapor Compression Refrigerant Cycle (valid for each circuit)



Capacity Control System

The motor-driven inlet guide vanes (IGV) located at the entrance to the compressor first stage impeller control the quantity of refrigerant entering the impeller thereby controlling the compressor capacity in the first-stage. There is a motor driven variable diffuser geometry or discharge diffuser control (DDC) in the second stage. Both IGV and DDC is well-related to keep wide range of efficient operation without surge.

The operating range is from 20% to 100% of the specified nominal capacity depending on system water temperatures.

The major components of the two-stage system are evaporator, condenser, expansion valve, economizer and compressor.

There are two compression stages in a single compressor by two impellers mounted on a single common shaft within a single casing. The discharge of one stage feeds the input of the next stage.

The driveline of each of the WCT is made up of one two-stage compressor, gear train and a 2 pole, 3 phase squirrel cage induction semi-hermetic motor.

Condenser/Subcooler

The condenser is a shell-and-water tube heat exchanger with the refrigerant in the shell side, where gained heat from evaporator and compressor is rejected out of chiller system.

Starting at the inlet of the condenser, the high-pressure, high temperature refrigerant vapor is forced into the condenser and as it passes through the condenser shell, it gives up its latent heat of condensation, heat of compression and other heat absorbed to the cooling tower water flowing inside the condenser tubes i.e. *Isobaric/Isothermal (constant pressure, temp) Heat Rejection process.* The decrease in the refrigerant's latent heat content equals the increase in the water's sensible heat. This heat removal changes the phase of the refrigerant and it becomes liquid at constant pressure and temperature.

As the condensed refrigerant liquid enters the condenser's internal subcooler at the bottom of the condenser, just before it leaves the condenser, it loses its sensible heat further and becomes subcooled liquid at a lower temperature due to heat transfer to the water in the subcooler tubes. Allowing any refrigerant vapor to enter the subcooler decreases the efficiency of the subcooler because the rate of convection heat transfer in the vapor phase is much less than in the liquid phase. Further, allowing vapor to enter the subcooler may allow vapor to leave the condenser, thereby decreasing the efficiency of the system. Therefore, the liquid level must extend far enough above the subcooler entrance to prevent vapor within vortex, which is typically formed at high flow rates, from entering the subcooler.

When the chiller is operating at load, the most reliable source of liquid refrigerant is the condenser. Liquid refrigerant in the evaporator will be boiling.

Expansion Valve

The liquid refrigerant travels through the liquid line to the expansion valve where the pressure is reduced and part of the refrigerant flashes into vapor creating of a two-phase refrigerant mixture downstream of the expansion valve. The vapor absorbs the liquid's latent heat of vaporization and lowers the liquid temperature flowing to the economizer. Therefore, the net latent heat content of the refrigerant is unchanged or no heat loss to the outside due to this heat exchange between the liquid and vapor.

This is the first expansion process in the two-stage cycle. Since the decrease in the refrigerant liquid's sensible heat content equals the increase in the refrigerant vapor's latent heat of vaporization, the total enthalpies before and after expansion are the same. This part of the refrigeration cycle is called the *Isenthalpic – constant enthalpy Expansion process.*

Economizer and Two-stage Compressor

An economizer is a flash tank consisting of baffles to separate the refrigerant vapor from liquid and mechanical float-type expansion valve(s) for liquid control. Economizer separates any vapor, mainly generated at primary expansion valve, and preventing such vapor feed it into evaporator. Vapor in the economizer may no longer work for cooling water in the evaporator, but 1st compression stage of compressor must work for the vapor once it is provided into evaporator which cause loss of compression power. Thus economizer promises efficient chiller operation than without economizer system, which is one of the most advantage of 2-stage with economizer system.

The expanded liquid-vapor mixture from the expansion valve enters the economizer where vapor and liquid separate from each other.

The liquid, being denser than the vapor, accumulates at the bottom of the economizer and the vapor bubbles through liquid refrigerant to the top of the economizer. As the second stage impeller of the compressor exerts suction and draws vapor from the economizer, it reduces the pressure of the economizer. As the pressure is lowered, so is the temperature or boiling point of the refrigerant in the economizer to a temperature corresponding to the suction pressure of the second stage. This vapor is piped to the inlet of the second stage impeller, thereby maintaining the economizer at interstage pressure.

As the liquid level rises, it lifts the float valve and opens it. The liquid exiting the float valve opening expands second time and its pressure drops further and more latent heat is absorbed by the vapor from liquid – a zero heat loss from the refrigerant to the ambient, and lowers the refrigerant liquid's temperature further flowing into the evaporator.

Because of this additional refrigerant liquid temperature drop, there will not be a capacity penalty to the chiller even though the mass flow of the refrigerant is less than a single-cycle system compared with the same capacity. The shrinkage of refrigerant mass, on the other hand is, due to the refrigerant vapor separating in the economizer and leaving the economizer to the inlet of the second stage suction of the compressor where it mixes with and desuperheats the discharge vapor from the first stage impeller. The two incoming refrigerant vapor streams mix together in the interstage elbow before flowing into the second stage compression (Isentropic (constant entropy) compression process).

As the economizer vapor decreases the temperature of the first stage discharge vapor entering the second stage, it reduces the required compression energy input by utilizing energy that would otherwise be wasted which gives an efficiency advantage to the two-stage over single-stage.

The terms “intercooler” and “economizer” are interchangeably used in the industry for the liquid/vapor separator tank.

Evaporator

The evaporator is a flooded shell-and-water tube heat exchanger with refrigerant on the shell side, where chilled water getting cooler, eventually to desired target temp level at water outlet of the evaporator.

When the compressor starts, it creates suction and draws some of the refrigerant gas from the evaporator, thus decreasing the pressure of the evaporator. As the refrigerant pressure is lowered, so is the temperature or boiling point of the refrigerant in the evaporator, and it is this factor that creates a difference in temp between the refrigerant and the water which is to be cooled. Thus, a flow of heat from the warmer water to the refrigerant is set up.

The refrigerant enters the evaporator at or near the bottom of the shell with vapor quality in the range of 0 to 30 %. In order to boil the greatest possible amount of refrigerant in the evaporator, it is necessary that the entire surface of the evaporator be kept wet with refrigerant liquid. Under this condition of operation the refrigerant vapor from the vaporized liquid leaves the evaporator outlet in a saturated condition, which means it is the same temperature as the liquid in the evaporator *(Isobaric/Isothermal (constant pressure, temp) heat addition process)*. The warm water to be chilled from the cooling load circulating through the evaporator tubes causes the pool of liquid refrigerant to boil and for a horizontal tube arrangement, the refrigerant then flows upward throughout the tube bundle, changing phase and emerging from the top tube row at or near a vapor quality of 100 %. This boiling displaces the liquid level upwards until the entire bundle is just submerged in boiling refrigerant. The increased boiling takes place where the tube depth is greater in the bundle at the center. The greater the tube depth, the greater the amount of heat transferred causing boiling.

The flow is then directed out of the evaporator shell and routed to the inlet of the compressor. Any major entrained liquid in the vapor flow stream can fall back to the evaporator tube bundle by gravity and may not be carried over to the compressor suction, which keeps compressor performance/reliability staying longer.

As the load across the evaporator increases the available refrigerant will boil off more rapidly, if it is completely evaporated prior to exiting the evaporator, the vapor itself will continue to absorb heat. This heat is referred to as superheat which is the heat added to a substance above its saturation temperature itself will continue to absorb heat.

The vaporized refrigerant, that is, the “suction gas,” is compressed by the first stage of the compressor to the second stage to complete the cycle.

Lubrication System

The lubrication system provides lubrication and heat removal for compressor bearings and internal parts. Lubricant must be visible in the oil sump sight glass at all times and must be added during the operation for any oil loss.

Emkarate RL68H Polyolester Oil must be used in the two-stage centrifugal compressor. The nominal oil charge for K compressor is 22 gallons.

The internal oil sump for the compressor is completely self-contained within the compressor housing. The assembly includes a motor driven submersible 1 HP, 4 pole oil pump (220 V,3 phase, 50/60 Hz), a 1000 Watt (220 V,1 phase, 50/60 Hz) cartridge type immersion oil heater and a 10 micron oil filter.

During normal chiller operation, the unit control center operates and controls the oil pump at all times. The oil heater is only energized during compressor is off. The oil pump operates prior to compressor run (prelube) to provide oil to the bearings. It also runs after compressor shutdown to lubricate the bearings during coast down (postlube).

During idle periods, the oil in the sump tends to absorb as much refrigerant as it can hold, depending upon the oil temperature and sump pressure. Lower oil temperature will increase of amount of refrigerant absorbed that can cause violent foaming during compressor start-up, as the system pressure is lowered. Refrigerant bubbles out of the oil during that time and the subsequent foaming can affect the oil pump operation and system oil differential pressure**.**

The oil is pumped to the internal oil filter in the compressor casting and then to the external refrigerant-cooled oil cooler through a factory pre-set pressure regulator valve. It maintains above 22 psi as minimum, and around 50psi(50Hz) / 36psi(60Hz) as normal oil differential pressure (the difference between the oil sump and oil supply pressure to gear/bearings)**.**

A plate-type oil cooler maintain**s** the proper oil temperature under normal operating conditions. A TXV valve maintains less than max 140°F (60°C) oil supply temperature by regulating the flow of subcooled refrigerant liquid from the condenser to the cooler**.**

A typical flow diagram is shown in Figure 4.

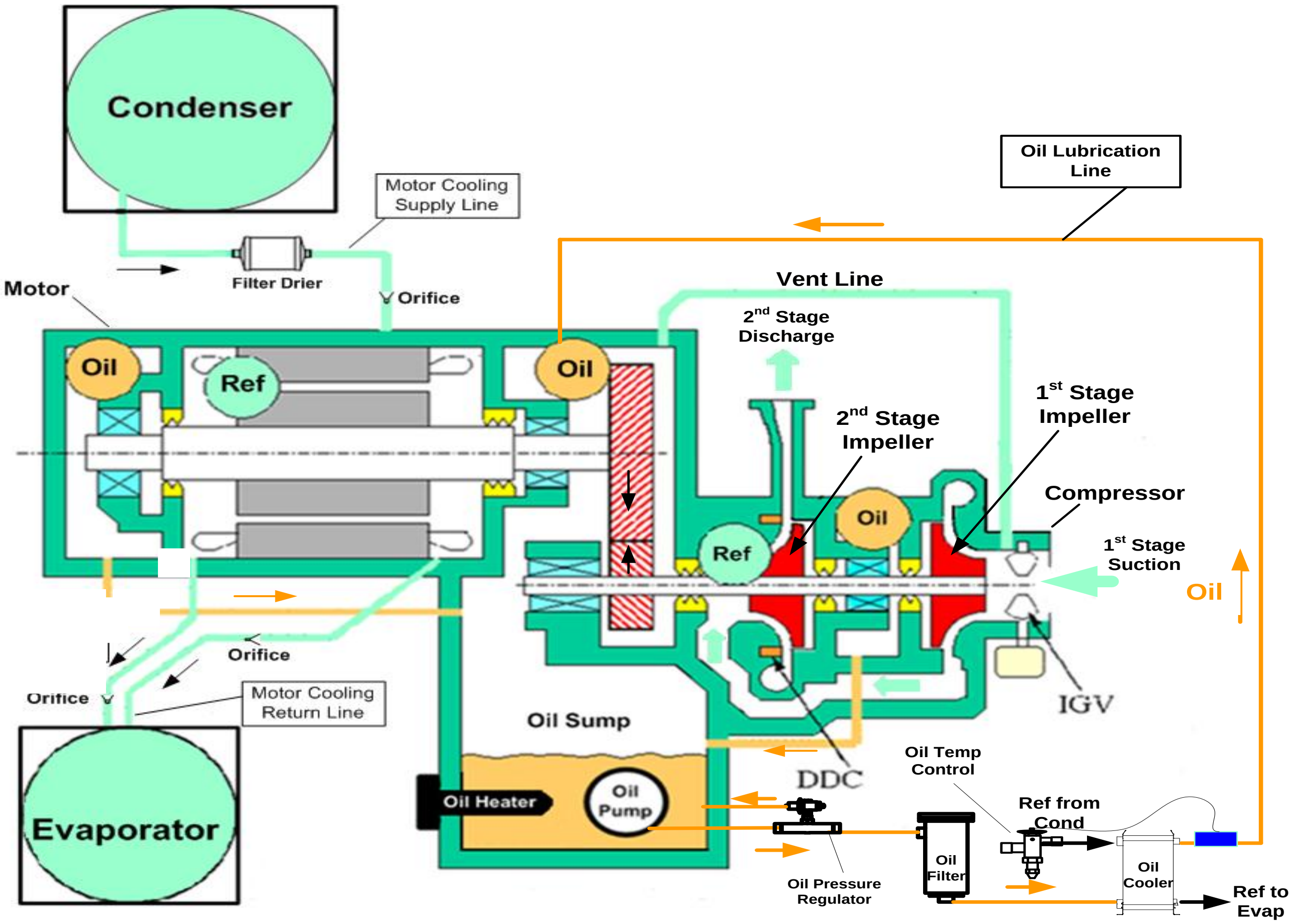
Manual isolation stop valves in the oil line and drain connections on the lubricant sump are provided for ease of servicing**.**

Motor Cooling

The high pressure subcooled liquid refrigerant flows through a filter-drier to the low pressure area in the motor housing, for motor cooling purpose. The refrigerant gas returns to the evaporator after cooling the motor.

The flow is motivated by the pressure difference between the condenser and the evaporator.

Figure 4, **Oil & Motor Cooling and Drain Lines**



Oil Return Control

Two eductor circuits are provided to properly return oil and refrigerant mixture from the refrigeration circuits to the oil sump for separation. See Figure 5.

Oil migration is often the result of operating conditions. Small portion of the oil used within the compressor will be occasionally carried out of the compressor, especially when frequent compressor start/stop is made. Most of the case oil out of the compressor happens through vent line (see Figure 4) and will primarily drain to bottom of IGV plenum, and any oil out of the compressor eventually fall or drain to the evaporator.

The excess accumulation of oil in the evaporator will cause oil-foaming which may entrain liquid refrigerant into compressor (carry over) and letting compressor performance lower. Also it will cause evaporator performance down.

For preventing performance loss mentioned in above, Eductor Circuit 1 is equipped for primary oil return, proactively works preventing oil loss to evaporator. Eductor Circuit 2 works preventing excessive oil accumulation in the evaporator which helps to maintain good chiller efficiency.

In Eductor Circuit 1, high pressure condenser refrigerant gas flows continuously through the eductor inducing any low pressure oil accumulated in the inlet guide vane plenum to the oil sump.

In Eductor Circuit 2, high pressure condenser gas flows continuously through the eductor inducing low pressure oil-contaminated refrigerant liquid from the evaporator through the filter to the oil sump.

There are no moving parts in the eductors. They create a reduced pressure area inside which draws lubricant into the compressor.

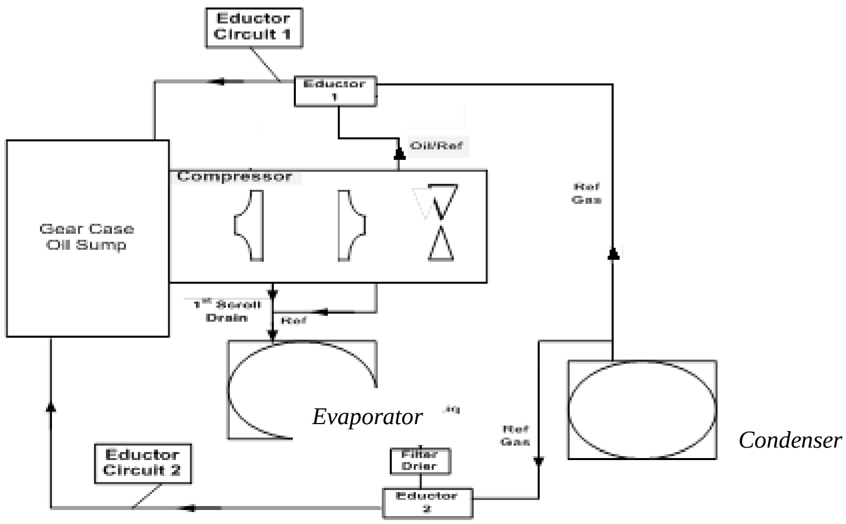
Manual isolation stop valves in the Eductor Circuit 2 are provided for filter servicing.

⚠ NOTE

Change the eductor filter-drier when excessive amount of lubricant is noticeable in the refrigerant charge as viewed in the liquid line sight glass. The filter drier PN is 735028828.

Figure 5 Eductor Circuits and Scroll Drain Lines

Note : Connections are not necessarily in correct relative location and can vary depending upon specific model.



Standby Power

It is essential that any centrifugal chiller connected to standby power come to a complete stop on grid power and then be restarted with the standby power. Attempting to switch from regular grid line power to auxiliary power while the compressor is running can result in extreme transient torque that will severely damage the compressor.

Features of the Control Panel

- Control of leaving chilled water within a ±0.5°F (±0.3°C) tolerance. Systems with a large water volume and relatively slow load changes can do better.
- Readout of the following temperature and pressure readings:
  - ✓ Entering and leaving chilled water temperature
  - ✓ Entering and leaving condenser water temperature
  - ✓ Saturated evaporator refrigerant temperature and pressure
  - ✓ Saturated condenser temperature and pressure
  - ✓ Suction line, liquid line and discharge line temperatures - calculated superheat for discharge and suction lines – calculated subcooling for liquid line
  - ✓ Oil sump temperature - oil feed temperature and pressure
- Automatic control of primary and standby evaporator and condenser pumps.
- The controller will store and display key historic operating data for recall in a graphic format on the screen. Data can also be exported for archival purposes via a USB port.
- Three levels of security protection against unauthorized changing of setpoints and other control parameters.
- Warning and fault diagnostics to inform operators of warning and fault conditions in plain language. Al1 warnings, problems and faults are time and date stamped so there is no guessing of when the fault condition occurred. In addition, the operating conditions that existed just prior to shutdown can be recalled to aid in isolating the cause of the problem.
- Twenty-five latest faults are displayed on the unit controller; eight can be displayed on the touch screen. Data can be exported for archival purposes via a USB port.
- Soft loading reduces electrical consumption and peak demand charges during loop pulldown.
- Adjustable load pull-down rate reduces under-shoot during loop pulldown.
- Remote input signals for chilled water reset, demand limiting, unit enable.
- Manual control mode allows the service technician to command the unit to different operating states. Useful for system checkout.
- BAS communication capability via LONMARK®, Modbus® or BACnet® standard protocols for BAS manufacturers.
- Service Test mode for troubleshooting controller hardware.
- Pressure transducers for direct reading of system pressures. Preemptive control of high motor amps, low evaporator pressure conditions and high discharge temperature takes corrective action prior to a fault trip.

General Description

The control panel is located on the front of the unit. There are two doors. The control panel is behind to right door.

The centrifugal MicroTech III control system consists of microprocessor-based controllers and a number of extension modules, which vary depending on the unit size and conformation. The control system provides all monitoring and control functions required for the controlled, efficient operation of the chiller.

The system consists of the following components:

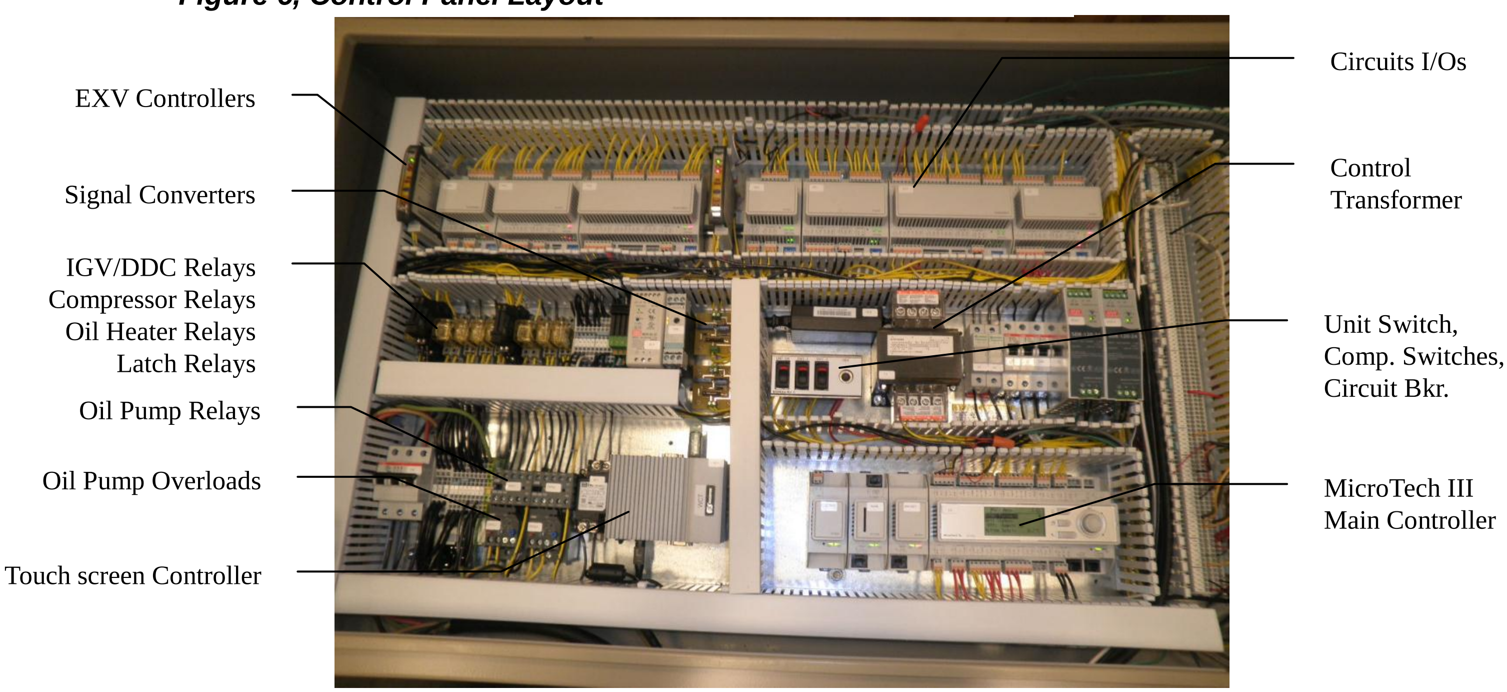
- Operator Interface Touch Screen (OITS), one per unit-provides unit information and is the primary setpoint input instrument. It has no control function.
- Unit Controller, one per chiller-controls unit and compressor functions. It is the secondary location for setpoint input if the Interface Screen is inoperative. It is located in the control box adjacent to the OITS.

The operator can monitor all critical operating conditions by using the screens on the OITS or screen located on the main controller. In addition to providing all normal operating controls, the MicroTech III control system will take corrective action if the chiller is operating outside of its normal design conditions. If a fault condition develops, the controller will shut a compressor, or the entire unit, down and activate an alarm output.

The system is password protected and only allows access by authorized personnel. Except that some basic information is viewable and alarms can be cleared without a password. No settings can be changed.

NOTE: It is important to understand that the OITS is the operator interface device under normal conditions and has no control function. If it is unavailable, the unit controller will be used to enter setpoint changes, view operating parameters and operate the chiller.

Figure 6, Control Panel Layout



Controller Description

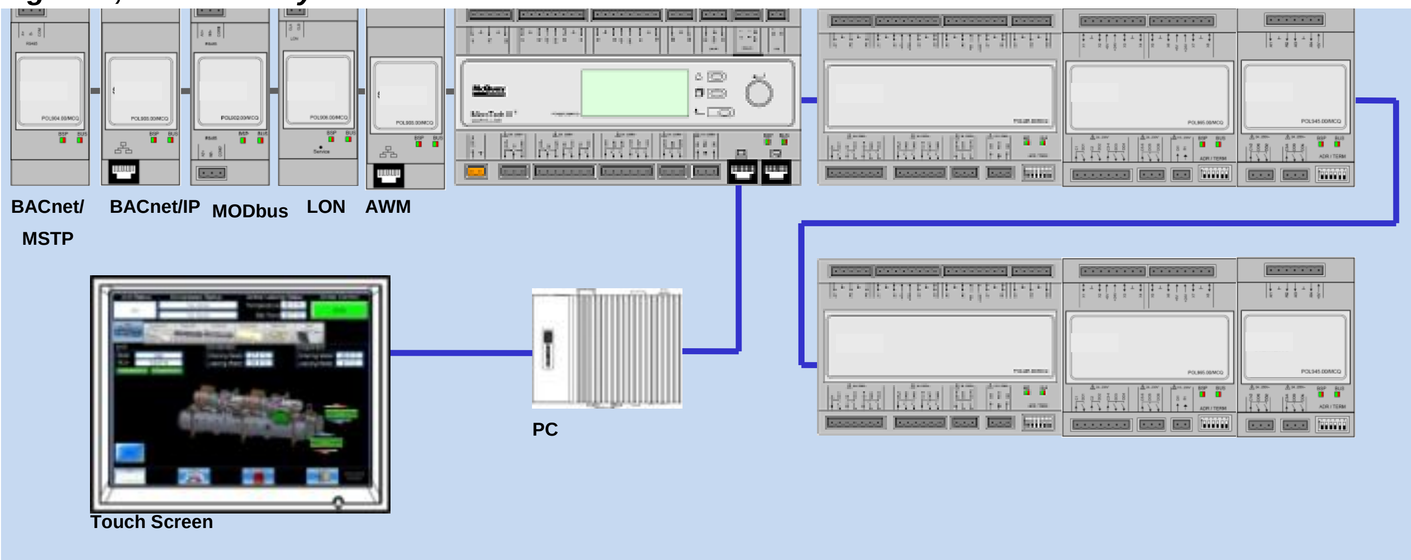
Hardware Structure

The MicroTech III control system for WCT chillers consists of a main unit controller with a number of extension input/output I/O modules, Operator touch screen, lubrication control, miscellaneous switches and field connections terminals.

One of the optional BAS communication modules may be included.

The MicroTech III controllers used on WCT chillers are not interchangeable with previous MicroTech II controllers.

Figure 7, Hardware layout

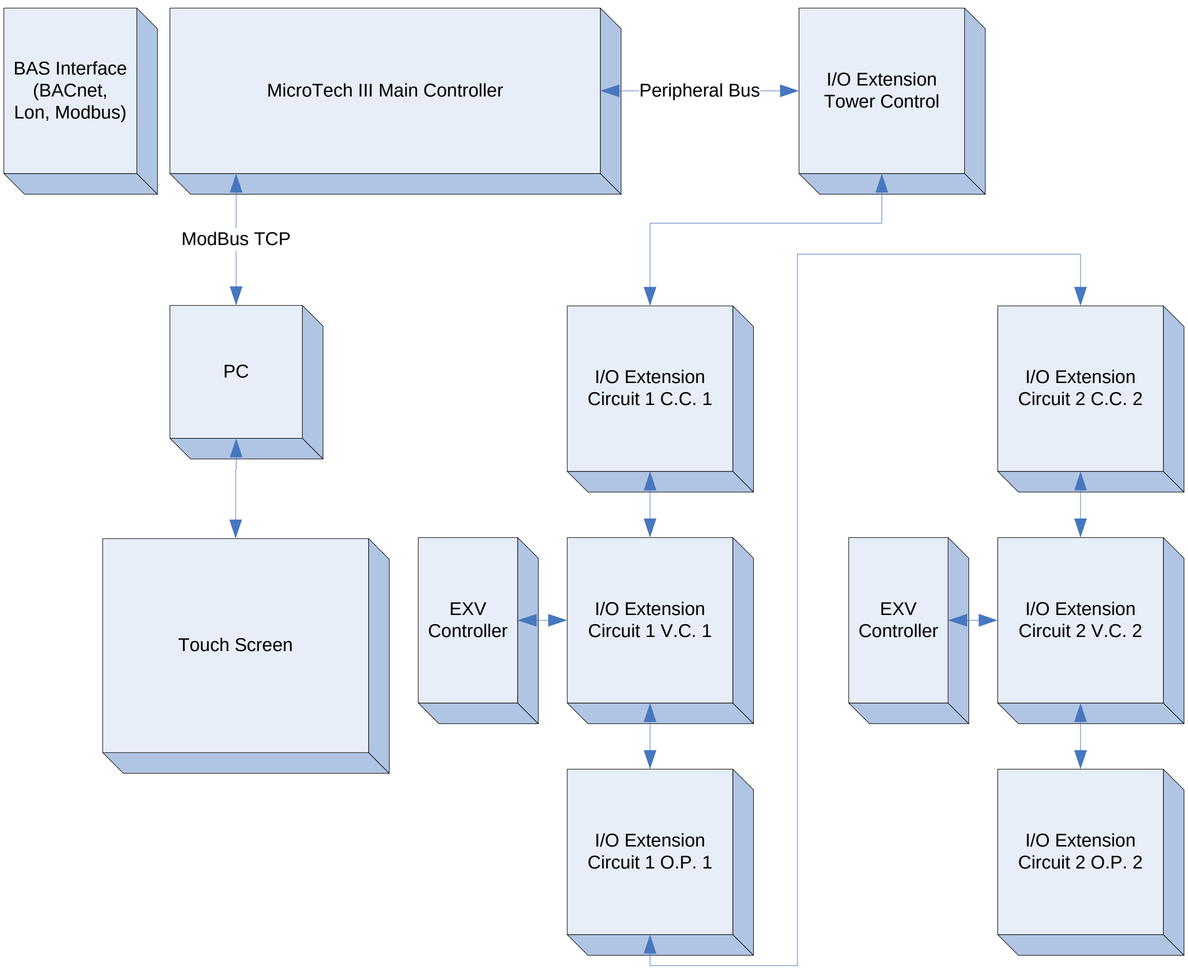


System Architecture

The overall controls architecture uses the following:

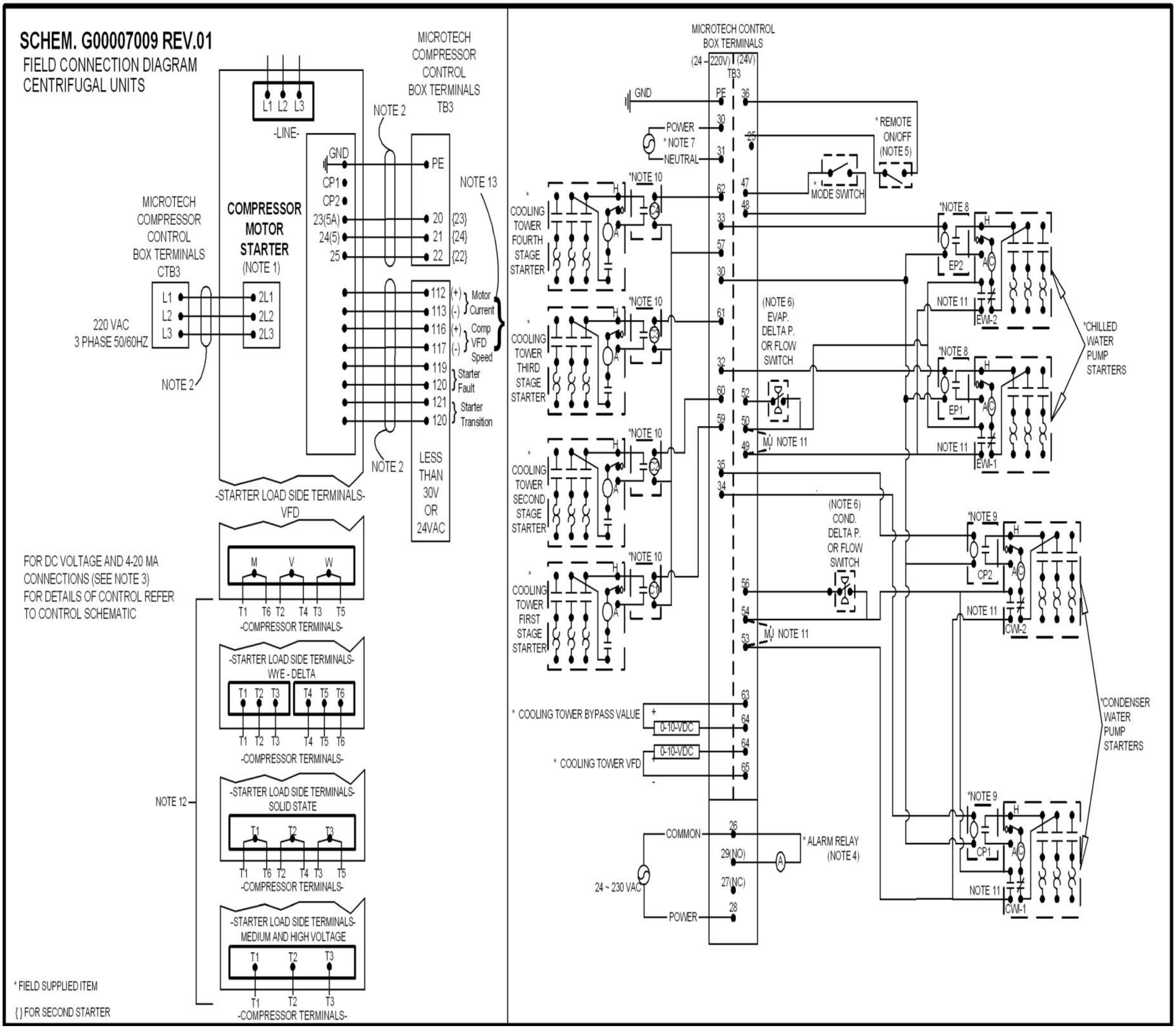
- One MicroTech III main controller
- I/O extension modules (sometimes referred to as "controllers") as needed depending on the configuration of the unit
- Optional BAS interface as selected
- In series counter-flow system, both lead WCT chiller controller and lag WCT chiller controller are available to communicate and have optimized series counter-flow system capacity control by looking at common ELWT at lag chiller, when providing "Konex" interface cable between controllers are provided and series chiller mode is chosen from MicroTech III controller.

Figure 8, System Architecture



Field Wiring Diagram

Figure 9, Field Wiring Diagram



Wiring Diagram Notes

1. Compressor motor starters are either factory mounted and wired or shipped separate for field mounting and wiring. If provided by others starters must comply with Daikin specification 359A999. All line and load side power conductors must be copper, with ampacity based on 75°C conductor rating. (Exception: for equipment rated over 2000 volts, 90°C or 105°C rated conductors shall be used.
2. Field control wiring between the starter and the control panel is required with free-standing starters. Minimum wire size for 115 VAC to 220 VAC is 12 GA. for a maximum length of 50 feet. If greater than 50 feet refer to Daikin for recommended wire size minimum. Wire size for 24 VAC is 18 GA. All wiring to be installed as NEC class 1 wiring system. All 20 VAC wiring must be run in separate conduit from 115 VAC and 220 VAC wiring. Main power wiring between starter and motor terminal is factory installed when units are supplied with unit mounted starters. Wiring of free standing starter must be wired in accordance with NEC and connection to compressor motor terminals must be made with copper wire and copper lugs only.
3. For optional sensor wiring see unit control diagram. It is recommended that DC wires be run separately from 115 VAC to 220 VAC wiring.
4. A customer furnished 24 or 230 VAC power for alarm relay coil may be connected between TB3 terminals 28 power and 26 neutral of the control panel. For normally open contacts wire between 26 and 29, for normally closed wire between 26 and 27. The alarm is operator programmable. Maximum rating of the alarm relay coil is 25 VA.
5. Remote on/off control of unit can be accomplished by installing a set of dry contacts between terminals 36 and 25.
6. Evaporator and condenser flow switches are required. Factory mounted flow switches are standard on WCT units. Field installed flow switches must be wired as shown. If field supplied pressure differential switches are used then these must be installed across the vessel and not the pump. Paddle flow switches may also be field installed if desired.
7. Customer supplied 24 to 230 VAC 20 amp power for optional evaporator and condenser water pump control power and tower fans is supplied to unit control terminals (TB3) 30 power / 31 neutral, PE equipment ground.
8. Optional customer supplied 24-220 VAC 25 VA maximum coil rated chilled water pump relay (EP 1 and 2) may be wired as shown. This optional will cycle the chilled water pump in response to chiller demand.
9. The condenser water pump must cycle with the unit. A customer supplied 24-220 VAC 25 VA maximum coil rated condenser water pump relay (CP 1 and 2) is to be wired as shown. Units with free cooling must have condenser water above 60^{o} before starting.
10. Optional customer supplied 24-220 VAC 25 VA maximum coil rated cooling tower fan relays (C1 – C2 standard, C3 – C4 optional) may be wired as shown. This option will cycle the cooling tower fans in order to maintain unit head pressure.
11. Auxiliary 24 VAC rated contacts in both the chilled water and condenser water pump starters should be wired as shown and remove MJ.
12. For VFD, Wye-Delta, and solid state starters connected to six (6) terminal motors. The conductors between the starter and motor carry phase current and selection shall be based on 58 percent of the motor rated load amperes (RLA). Wiring of free standing starter must be in accordance with the NEC and connection to the compressor motor terminals shall be made with copper wire and copper lugs only. Main power wiring between the starter and motor terminals is factory installed when chillers are supplied with unit-mounted starters.
13. Motor current has three selectable options as follows : 0-5V/0-10V/0-20mA by build in HMI.

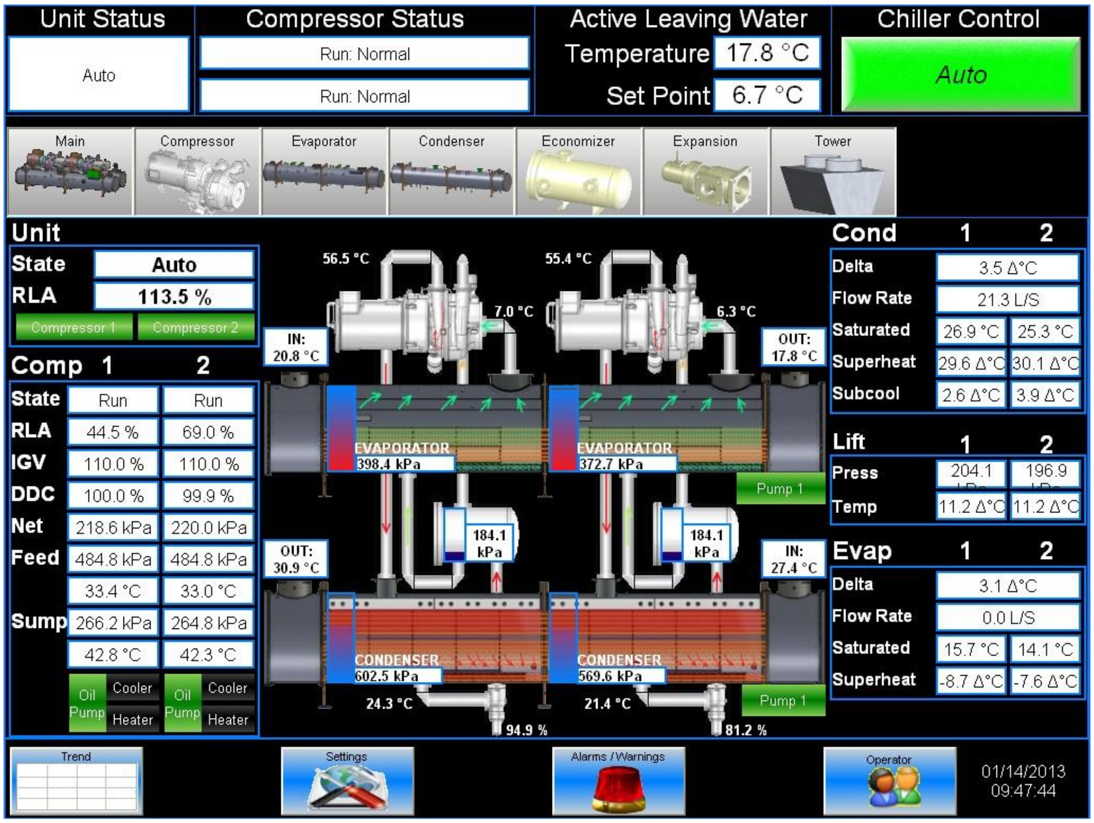
Operator Interface Touch Screen (OITS)

The operator interface touch screen (OITS) is the primary device by which commands and entries into the control system are made. It also displays all controller data and information on a series of graphic screens.

The control panel contains a USB port that can be used for loading information to and from the control system.

The OITS panel is mounted on a moveable arm to allow placement in a convenient position.

Figure 10, OTIS Screen Layout



Hardware Structure

The controller is fitted with a 32-bit microprocessor for running the control program. There are terminals for connection to the controlled devices (for example: solenoid valves, pumps). The program and settings are saved permanently in FLASH memory, preventing data loss in the event of power failure without requiring a back-up battery.

The controller connects to the OITS via a ModBus TCP communications network. It also has remote communication access capability for BAS interface.

Software

The operating software is revised occasionally. The version can be viewed at any time by going the “About Chiller” screen and looking at “App ver.”

Unit Controller

Unit and compressor on/off switches are mounted in the control panel located adjacent to the OITS panel. The compressor on/off switch should only be used when an immediate stop is required since the normal shut down sequence is bypassed.

The switch panel also has a circuit breaker that interrupts power to the cooling tower fans, valves and evaporator and condenser pumps' control relays, if any of these are tied into the MicroTech III for control of their operation. If these components operate independently from the chiller control, the breaker has no effect.

There is an emergency shutdown switch located on the left outside of the panel that causes an immediate compressor shutdown.

The unit controller's function is processing data relating to the entire chiller operation. The unit controller processes information and sends data to other devices and relays information to the OITS for graphic display. It has a 5-line by 22 character display and keys for accessing data and changing setpoints. The unit controller display has the same information as the OITS and can operate the chiller independently if the OITS is not available. Inputs and outputs are shown in the following tables.

Motor Thermal Protection

The motor is protected with embedded Klixon sensors in the motor windings. If the motor temperature rises to an unsafe level, the klixon will signal the compressor controller and the compressor will shut down.

Signal Converter Board

On medium voltage starters, the AC current signal generated by the starter is converted by the signal converter board into a 0-5 VDC signal that is directly proportional to the compressor motor amp draw. The amp draw signal is sent to the compressor controller.

Navigation

The Main screen is shown Main screen on page 25 is usually left on. Other of screens can be accessed from the Tab menu or one of the three buttons at the bottom of the screen: Trend, Setting and Alarms/Warnings.

- Trend will go to the Trend screen
- Settings will go to a series of screens used to set setpoints.
- Alarms/Warnings will go to Active Alarm with tab to select Alarm History

The figure on the following page illustrates the arrangement of the various screens available on the OITS. A few minutes practice on an actual OITS should provide a comfortable level of confidence in navigating through the screens.

Table 1, Init Controller Analog Inputs

#	Description	**Signal Source**	**Range**
AI1	Entering Evaporator Water Temperature	NTC Thermister (10k@25°C)	-58 to 212°F
AI2	Leaving Evaporator Water Temperature	NTC Thermister (10k@25°C)	-58 to 212°F
AI3	Leaving Condenser Water Temperature	NTC Thermister (10k@25°C)	-58 to 212°F
X1	Entering Condenser Water Temperature	NTC Thermister (10k@25°C)	-58 to 212°F
X2	Open		
X3	Demand Limit	4-20 mA Current	0-100 %RLA
X4	Reset of Leaving Water Temperature	4-20 mA Current	0-(10 to 80°F)
X5	Evaporator Water Flow	4 to 20 mA Current	0 to 10,000 gpm
X6	Condenser Water Flow	4 to 20 mA Current	0 to 10,000 gpm
OC-X6	Entering Heat Recovery Temp.	NTC Thermister (10k@25°C)	-58 to 212°F
OC-X5	Leaving Heat Recovery Temperature	NTC Thermister (10k@25°C)	-58 to 212°F

Table 2, Unit Controller, Digital Inputs

#	Description	Signal	Signal
DI1	Mode Switch	0 VAC (Cool)	24 VAC (Ice or Heat)
DI2	Unit OFF Switch	0 VAC (Stop)	24 VAC (Auto)
DI3	Evap Flow	0 VAC (No Flow)	24 VAC (Flow)
DI4	Cond Flow	0 VAC (No Flow)	24 VAC (Flow)
DI5	Remote Start/Stop	0 VAC (Stop)	220 VAC (Start)
DI6	External Fault	0 VAC(No Fault)	220 VAC (Fault)

Table 3, Unit Controller, Digital Outputs

#	Description	Load	Output OFF	Output ON
DO1	Alarm	Alarm Indicator	Alarm OFF	Alarm ON
DO2	Run/Stop LED	LED Indicator	Run Red	Stop Green
DO3	Primary Evaporator Water Pump	Pump Contactor	Pump OFF	Pump ON
DO4	Standby Evaporator Water Pump	Pump Contactor	Pump OFF	Pump ON
DO5	Primary Condenser Water Pump	Pump Contactor	Pump OFF	Pump ON
DO6	Standby Condenser Water Pump	Pump Contactor	Pump OFF	Pump ON
DO7	Open			
DO8	Open			
DO9	Open			
DO10	Open			
OC-DO1	Tower Fan #1	Fan Contactor	Fan OFF	Fan ON
OC-DO2	Tower Fan #2	Fan Contactor	Fan OFF	Fan ON
OC-DO3	Tower Fan #3	Fan Contactor	Fan OFF	Fan ON
OC-DO4	Tower Fan #4	Fan Contactor	Fan OFF	Fan ON

Table 4, Unit Controller, Analog Outputs

#	Description	Output Signal	Range
OC-X1	Cooling Tower Bypass Valve Position	0 to 10 VDC	0 to 100% Open
OC-X2	Cooling Tower VFD Speed	0 to 10 VDC	0 to 100%

Circuit I/O

Inputs and outputs are as follows:

Table 5, Circuit I/O, Analog Inputs

#	Description	Signal Source	Range
CC-AI1	Compressor Suction Temperature	NTC Thermister (10k@25°C)	-58 to 212°F
CC-AI2	Compressor Discharge Temperature	NTC Thermister (10k@25°C)	-58 to 212°F
CC-AI3	Liquid Line Refrigerant Temperature	NTC Thermister (10k@25°C)	-58 to 212°F
CC-X1	Evaporator Refrigerant Pressure	0.1 to 0.9 VDC	0 to 150 psi
CC-X2	Condenser Refrigerant Pressure	0.5 to 4.5 VDC	0 to 450 psi
CC-X3	Motor Current	0.5 to 4.5 VDC	0 to 125% RLA
CC-X5	Economizer Refrigerant Pressure	0.5 to 4.5 VDC	0 to 150 psi
CC-X6	Open		
OP-AI1	Oil Feed Temperature	NTC Thermister (10k@25°C)	-58 to 212°F
OP-AI2	Oil Sump Temperature	NTC Thermister (10k@25°C)	-58 to 212°F
OP-AI3	Oil Sump Pressure	0.5 to 4.5 VDC	0 to 150 psi
OP-AI4	Oil Supply Pressure to Compressor	0.5 to 4.5 VDC	0 to 450 psi
VC-X2	Hot Gas Bypass Valve	0 to 5 VDC	0 to 100%
VC-X3	Inlet Guide Vanes Position	0 to 5 VDC	0 to 120%
VC-X4	DDC (Diffuser) Position	0 to 5 VDC	0 to 100%

Table 6, Circuit I/O, Digital Inputs

#	Description	Signal	Signal
CC-DI1	Manual Off	0 VAC (Off)	24 VAC (Auto)
CC-DI2	Starter Fault	0 VAC (Fault)	24 VAC (No Fault)
CC-DI3	Starter Transition	0 VAC (No Transition)	24 VAC (Transition)
CC-DI4	Mech High Pressure	0 VAC (High Pressure)	220 VAC (OK)
CC-DI5	Motor High Temperature	0 VAC (High Temp)	220 VAC (OK)

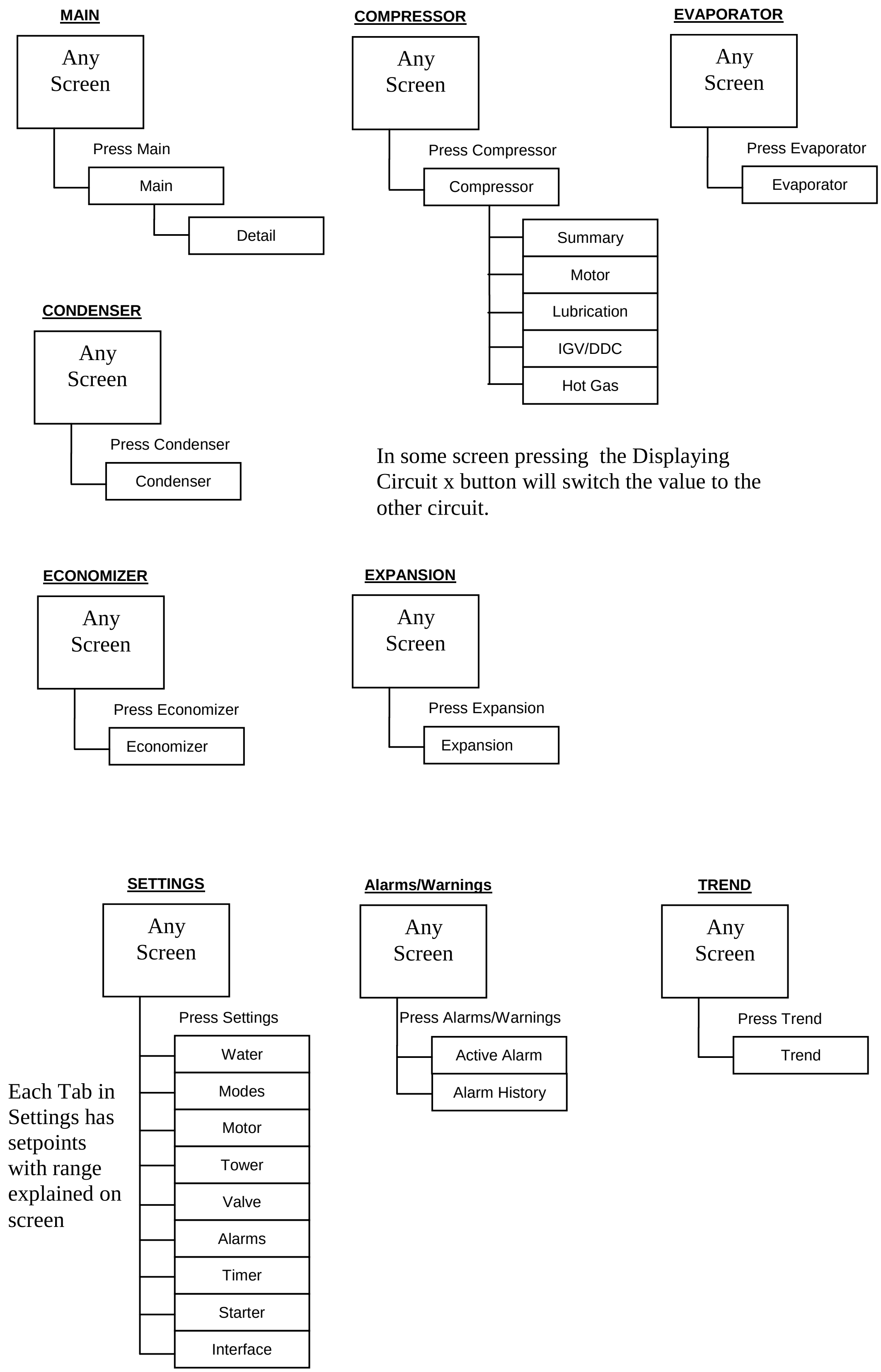
Table 7, Circuit I/O, Analog Outputs

#	Description	Output Signal	Range
CC-X4	Compressor VFD Speed	0 to 10 VDC	0 to 100%
VC-X1	Electronic Expansion Valve (EEV)	0 to 10 VDC	0 to 100% Open

Table 8, Circuit I/O, Digital Outputs

#	Description	Load	Output OFF	Output ON
CC-DO1	Latch Relay	Relay		
CC-DO2	Open			
CC-DO3	Hot Gas Bypass	Solenoid	No Bypass	Bypass
CC-DO4	Economizer Bypass	Solenoid	No Bypass	Bypass
CC-DO5	Open			
CC-DO6	Open			
CC-DO7	Open			
CC-DO8	Open			
CC-DO9	Open			
CC-DO10	Open			
CC-X7	Open			
CC-X8	Open			
VC-DO1	EXV Init	Relay		
VC-DO2	Open			
VC-DO3	Open			
VC-DO4	Open			
VC-DO5	Hot Gas Bypass Open	Relay	Null	Actuator Drive Open
VC-DO6	Hot Gas Bypass Close	Relay	Null	Actuator Drive Closed
VC-X5	IGV Open Relay	Relay	Null	Actuator Drive Open
VC-X6	IGV Close Relay	Relay	Null	Actuator Drive Closed
VC-X7	DDC Open Relay	Relay	Null	Actuator Drive Open
VC-X8	DDC Close Relay	Relay	Null	Actuator Drive Closed
OP-DO1	Motor Control Relay	Starter	Compressor OFF	Compressor ON
OP-DO2	Open			
OP-DO3	Oil Pump	Pump Contactor	Pump OFF	Pump ON
OP-DO4	Oil Sump Heater	Heater	Heater OFF	Heater ON

Figure 11, OITS Screen Layout

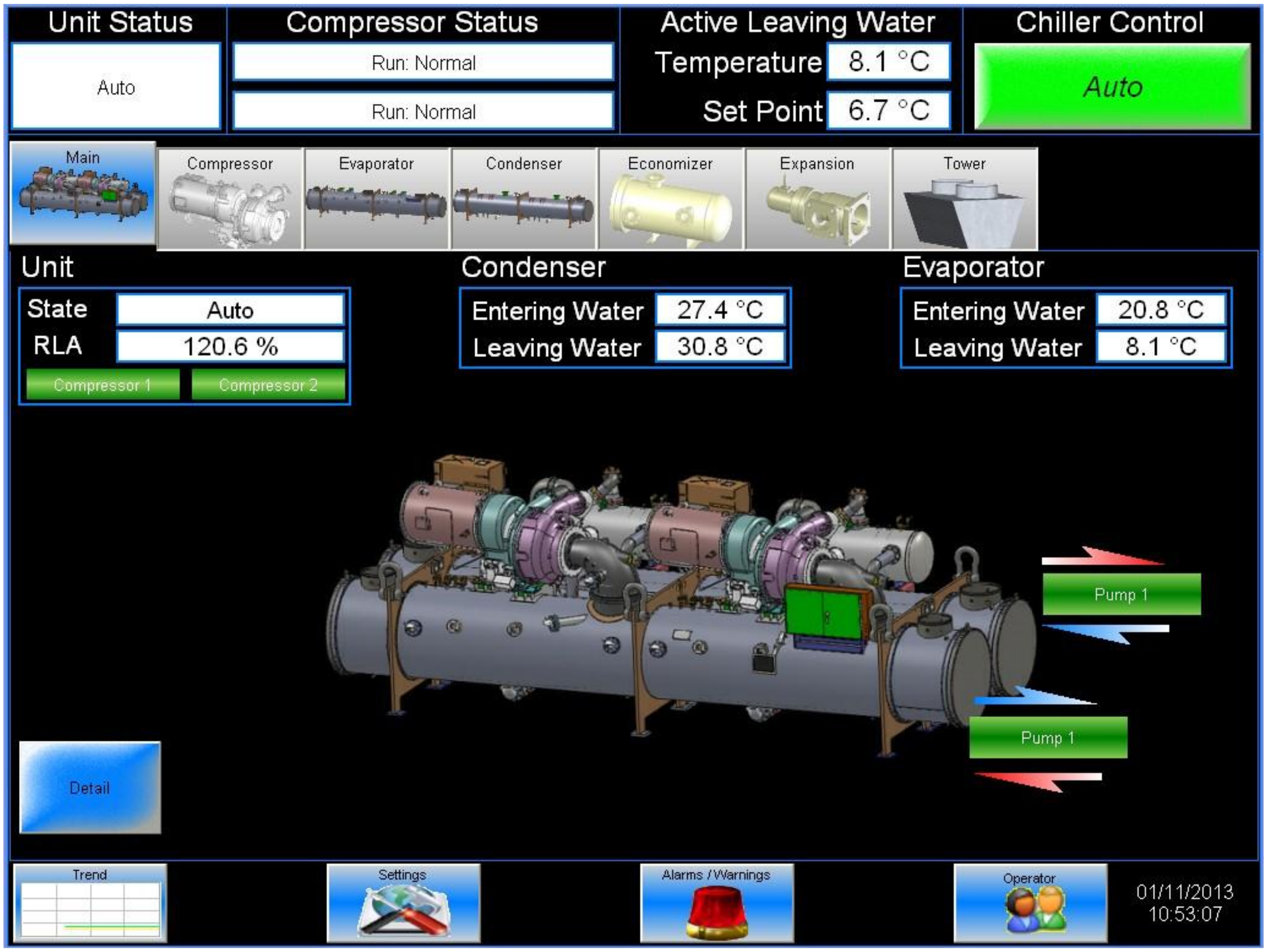


Screen Descriptions

Main Screens

Main screens are used for viewing unit status and conditions.

***Figure 12,* Home View Screen**



Main Screen

The Main Screen shows the basic condition of the chiller and is the screen that is normally left on. Superimposed on a chiller schematic is:

Information

- Active chilled water setpoint
- Entering and leaving chilled water temperatures
- Entering and leaving condenser water temperatures
- Percent motor amps
- UNIT STATUS is MODE followed by STATE followed by the SOURCE that is the device or signal that created the STATE. The possible combinations are in the following table:

Table 9, UNIT STATUS Possibilities

Status Text
Auto
Off – Ice Mode Timer
Off – All Cir Disable
Off – Unit Alarm
Off – Keypad Disable
Off – Remote Switch
Off – BAS Disable
Off – Unit Switch
Off – Test Mode
Off – Seq Num Equal
Auto – Wait For Load
Auto – Evap Recirc
Auto Pump down

Note: Shutdown is the state of shutting down; vane close, postlube, etc.

COMPRESSOR STATUS is MODE followed by STATE followed by the SOURCE that is the device or signal that created the STATE. The possible combinations are in the following table

Table 10, COMPRESSOR STATUS Possibilities

Status Text
Off – Ready
Off – Cycle Timer xxx
Off - Max Comp Starts
Off – Manual Switch
Off – Oil Temperature
Off – DDC Calibrating
Off – IGV Calibrating
Off – Alarm
Test Mode
Prelube Timer xxx
Unload Timer xxx
Postlube Timer xxx
Run – Normal
Off – Exv Calibrating
Oil Pump On
Hold – Max Amps
Unload – Max Amps
Hold – Capacity Limit
Unload – Capacity Limit
Load – Discharge Temperature
Hold – Pull Down Rate
Hold – Evaporator Pressure
Unload – Evaporator Pressure
Off - Vanes Not Closed

NOTE**:** Timer countdown values will be shown where “(xxx)” is shown below.

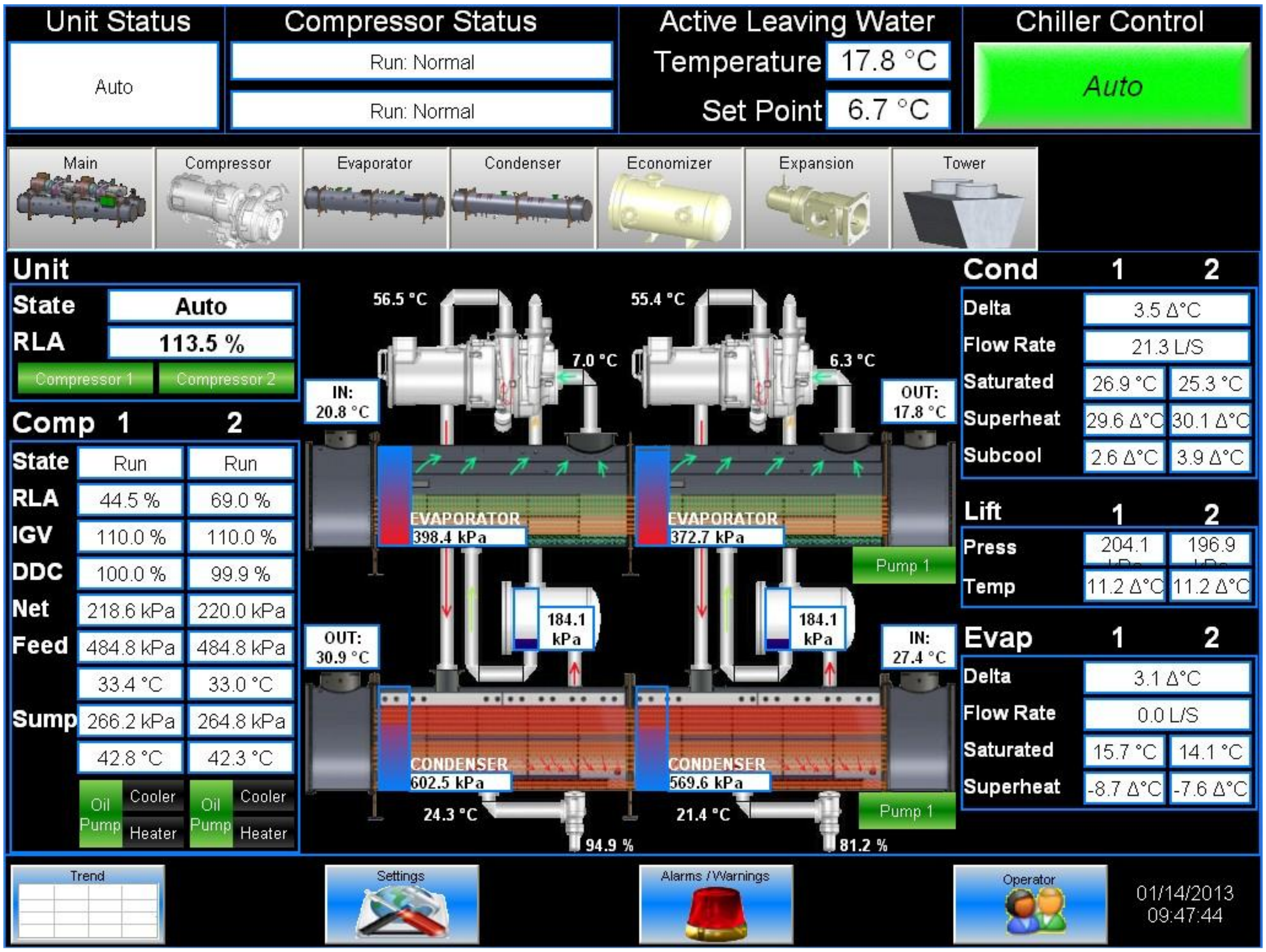
Action Buttons for:

- Figure AUTO and STOP buttons, normal start (AUTO) and STOP button activates the normal start and shutdown sequence. These buttons are only active when the control is in the "Local Control" mode. This eliminates the possibility of inadvertently shutting off the unit locally when it is under control of a remote signal such as a BAS.
- Trend takes you to the Trend history screen.
- Settings take to you to Set points screens.
- Alarms/Warnings take you to the Alarms screens.

Returning

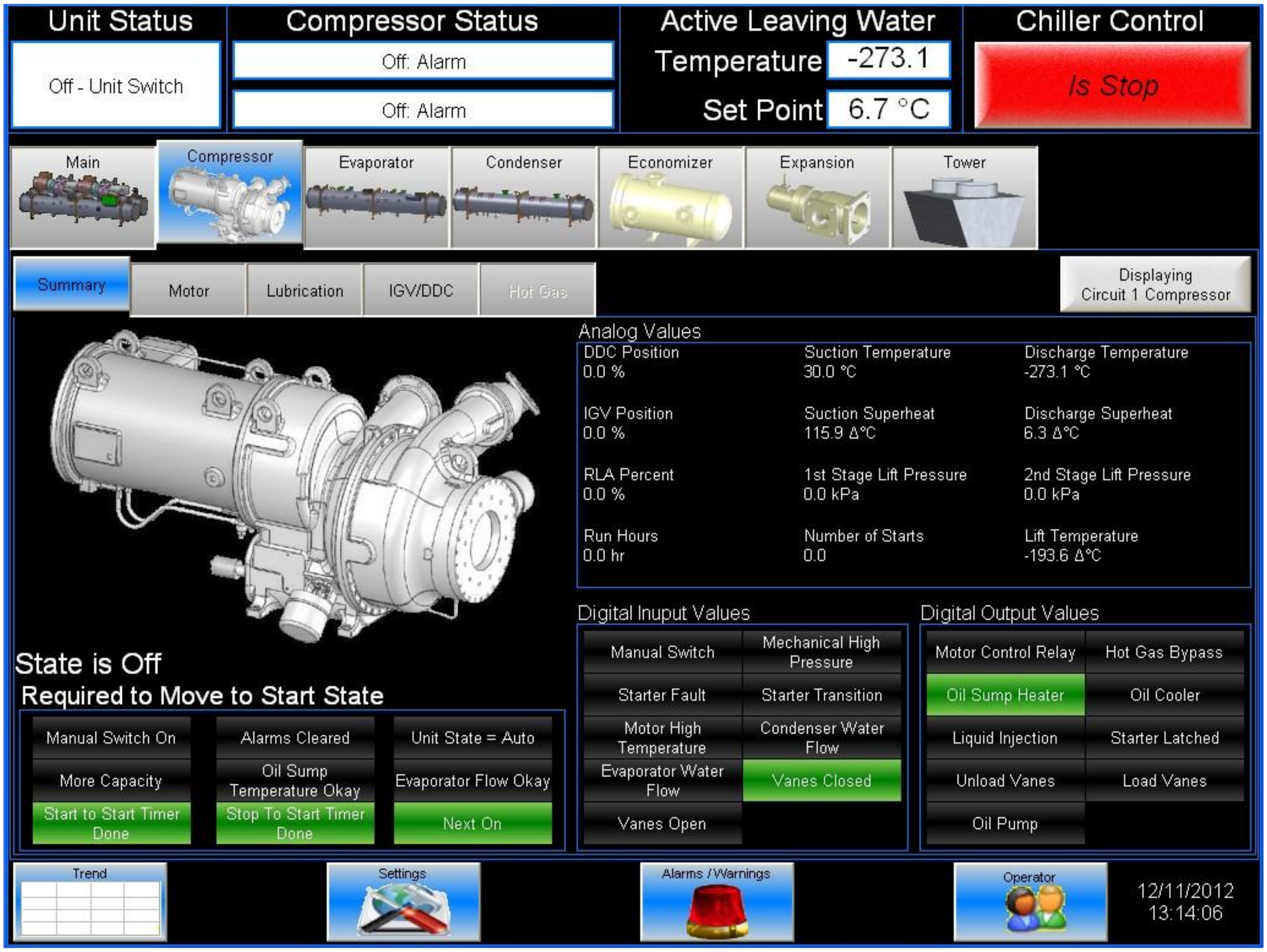
Pressing the Main button from any screen will return to the Main screen.

Figure 13, Detail View Screen



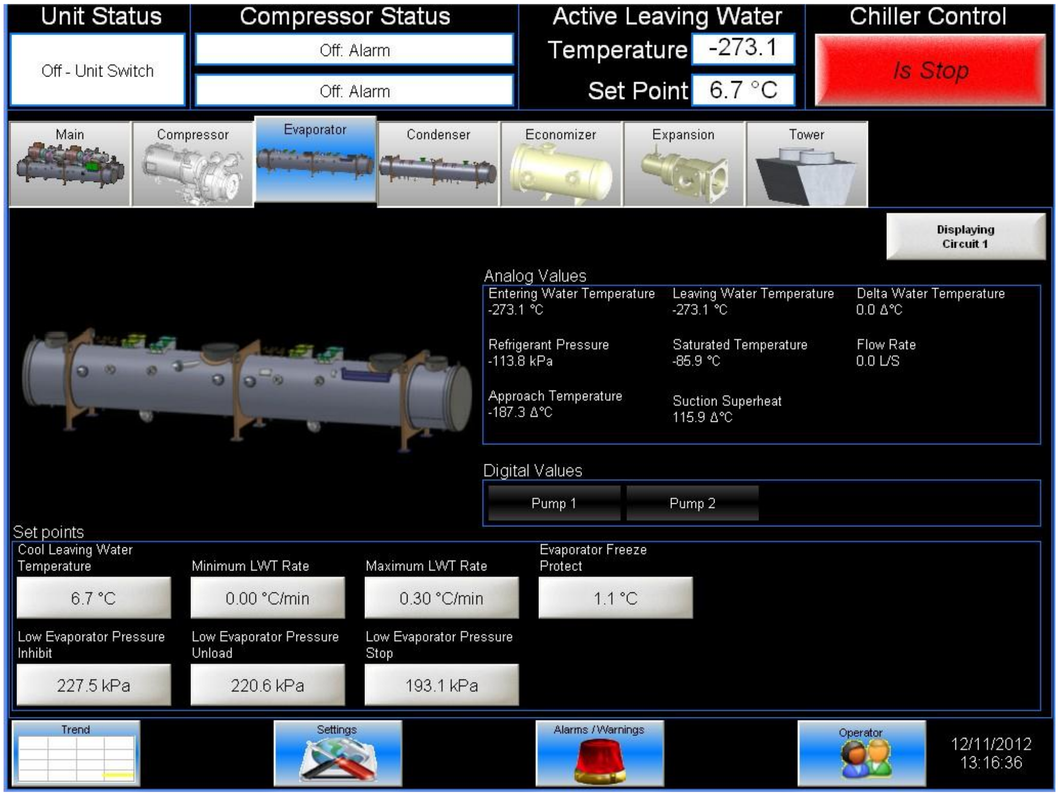
Pressing the Detail button on the bottom of the Main screen (Figure on page 25 ~~24~~) accesses the Detail screen shown above. This screen gives additional information on the refrigerant pressures and temperatures and lubricant data.

Table 14, Compressor Screen



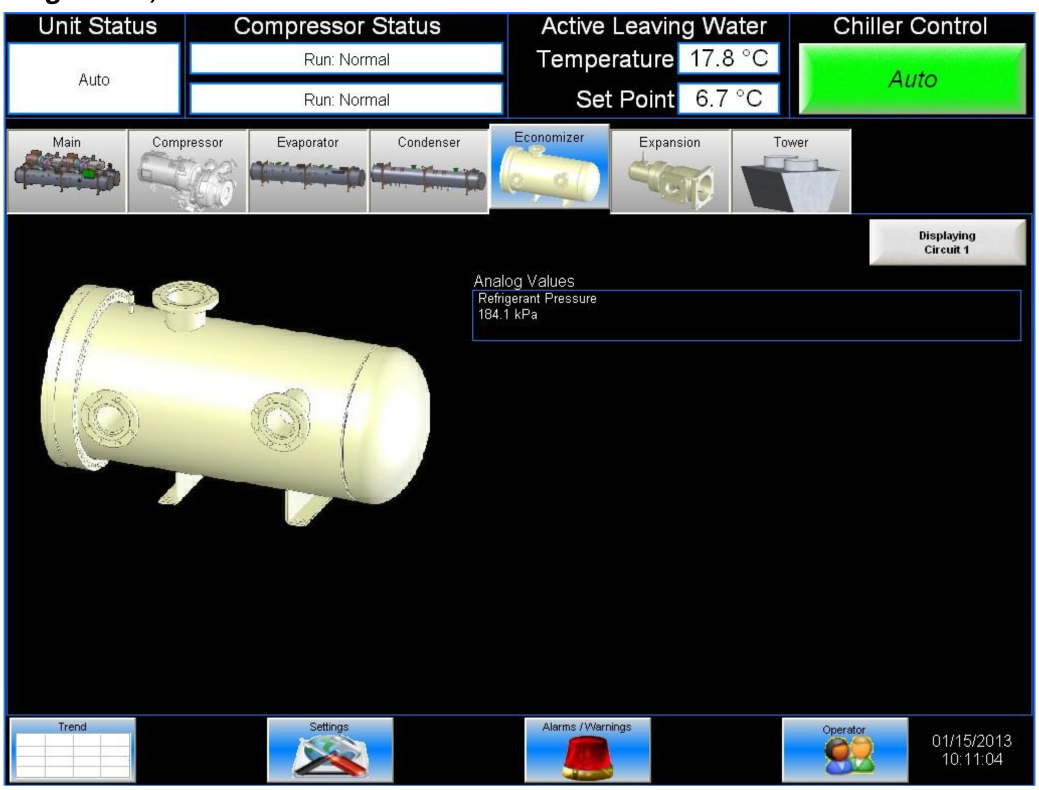
Pressing the Compressor button will give detailed information on the compressor (State, Inputs and Outputs).

Figure 15, Evaporator Screen



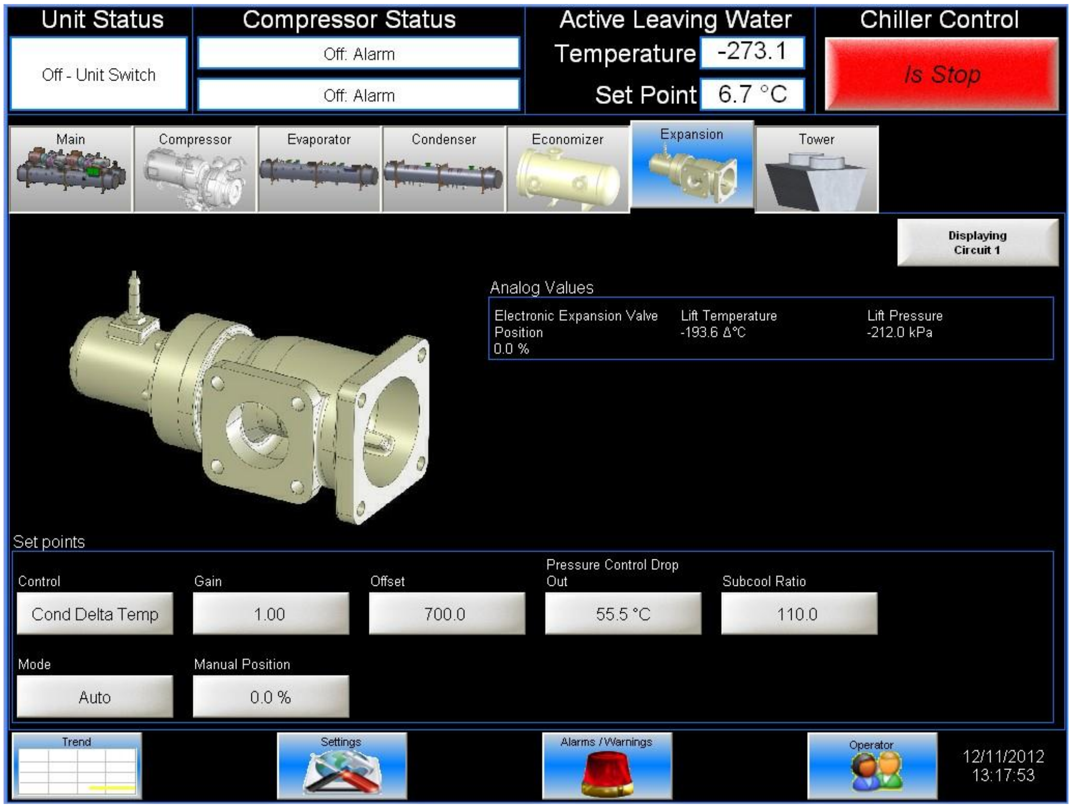
Pressing the Evaporator or Condenser button will give detailed information on the evaporator or condenser.

Figure 16, Economizer Screen



Pressing the Economizer button will give detailed information on the Economizer.

Figure 17, Expansion Screen



Pressing the Expansion button will give detailed information on the Expansion.

SET Screens

The set screens on the Interface Panel are used to input the many setpoints associated with equipment of this type. MicroTech III provides an extremely simple method for accomplishing this. (NOTE: If the Interface Panel is unavailable, the unit controller can be used to change setpoints.) Appropriate setpoints are factory set and checked by DaikinService or Factory Authorized Service Company during commissioning. However, adjustments and changes are often required to meet job conditions. Certain settings involving pumps and tower operation are field set.

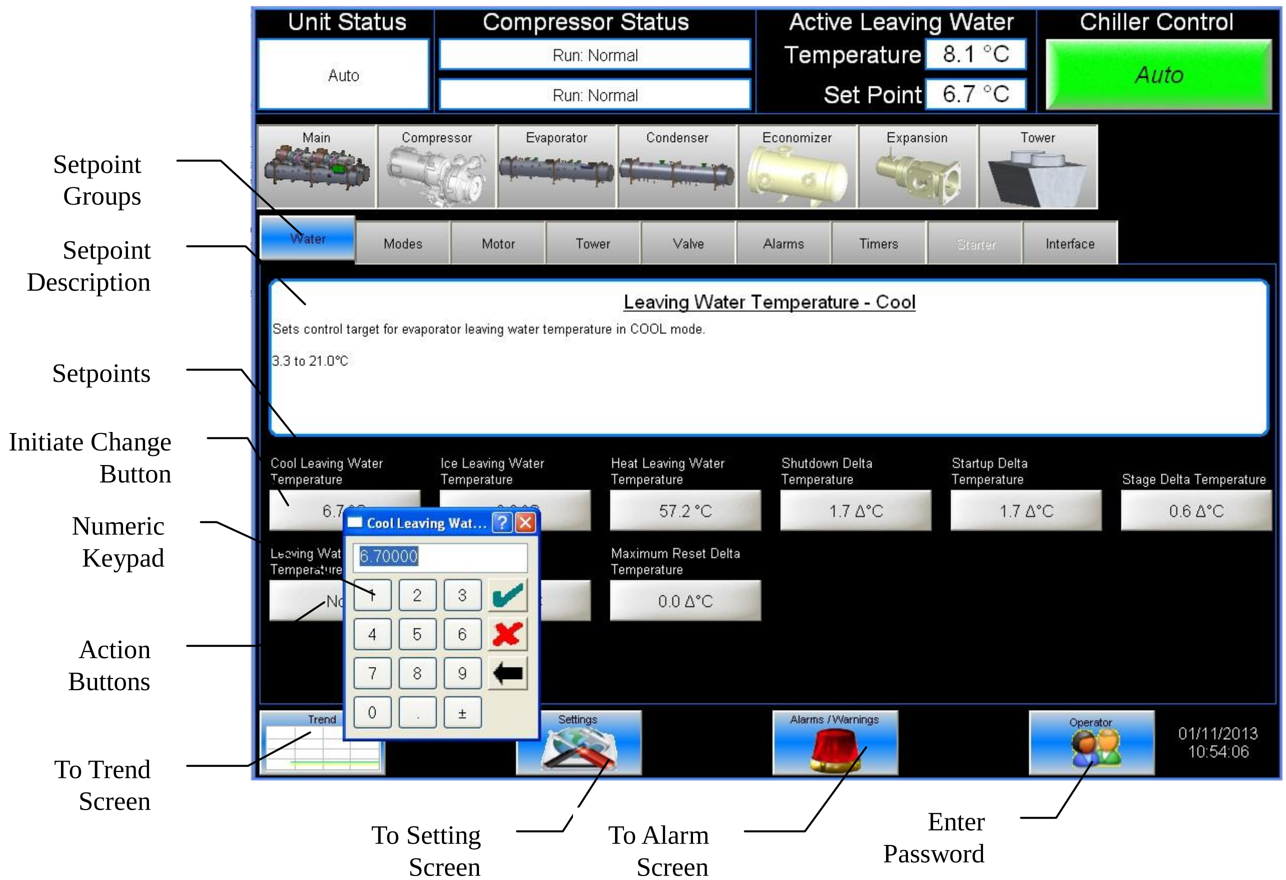
Pressing the SET button found on almost every screen accesses the last SET screen used or the SERVICE screen, whichever of the two was used last.

When in any SET screen, pressing the SET button again will toggle to the SERVICE screen shown on page 43.

The next figure shows the Settings screen with WATER setpoints selected. The various setpoint groups are in tabs on the top of the setting screen. Each button contains a number of setpoints grouped together by similar content. The WATER button (as shown) contains various setpoints relating to water temperatures.

NOTE: Some setpoints that do not apply to a particular application may still be listed on the screen. They will be inactive, grayed out, and can be ignored. For example, of setpoints Ice LWT will only be active depending on the unit mode selected in the MODE setpoints .

Figure 18, A Typical SETPOINT Screen



Procedure for Changing a Setpoint

A list of setpoints, their default value, their available setting range, and password authority are in Table 20 on page 57.

1. Press the applicable Setpoint Group Button. A complete explanation of setpoint content of each group follows this section.
2. Select the desired setpoint.
3. Press button indicating that you wish to change a setpoint value. The KEYBOARD screen will be turned on automatically for entering the password.

- O = Operator level password is 5321
- M = Manager level (password is reserved for Daikin service personnel)
- T = Technician level (password is reserved for authorized technicians)

4. Press the appropriate numbers in the numeric keyboard to enter the password. There is a small delay between pressing the keypad and recording the entry. Be sure that an asterisk appears in the window before pressing the next number. Press Green Check button to return to the Settings screen. The password will remain open for 15 minute after initiation and does not need to be re-entered during this period.
5. Press button again.
6. The numeric keypad will appear again select the desired value by pressing the numbered buttons. Press Green Check to enter the value or Red X to cancel the transaction.

7. Additional setpoints can be changed by selecting another setpoint on the screen or by selecting an entirely new group of setpoints.

Explanation of Setpoint Groups

Each of the seven setpoint group of screens are detailed in the following section. In many cases the setpoint content is obvious and no explanation is included.

1. TIMERS, for setting timers such as start-to-start, Prelube, Postlube, etc.
2. ALARMS, for setting the limit and shutdown alarms.
3. VALVE, sets the parameters for operation of an optional field installed tower bypass valve.
4. TOWER, selects the method of controlling the cooling tower and sets the parameters for fan staging/VFD.
5. MOTOR, selects motor related setpoints such as amp limits, VFD settings, etc. Also has maximum and minimum rate of change of chilled water temperature.
6. MODES, selects various modes of operation such as control source, multiple compressors staging, pump staging, BAS protocol, etc.
7. WATER, leaving water temperature setpoint, start and stop delta-T, resets, etc.

WATER Setpoints

Figure 19, WATER Setpoint Screen

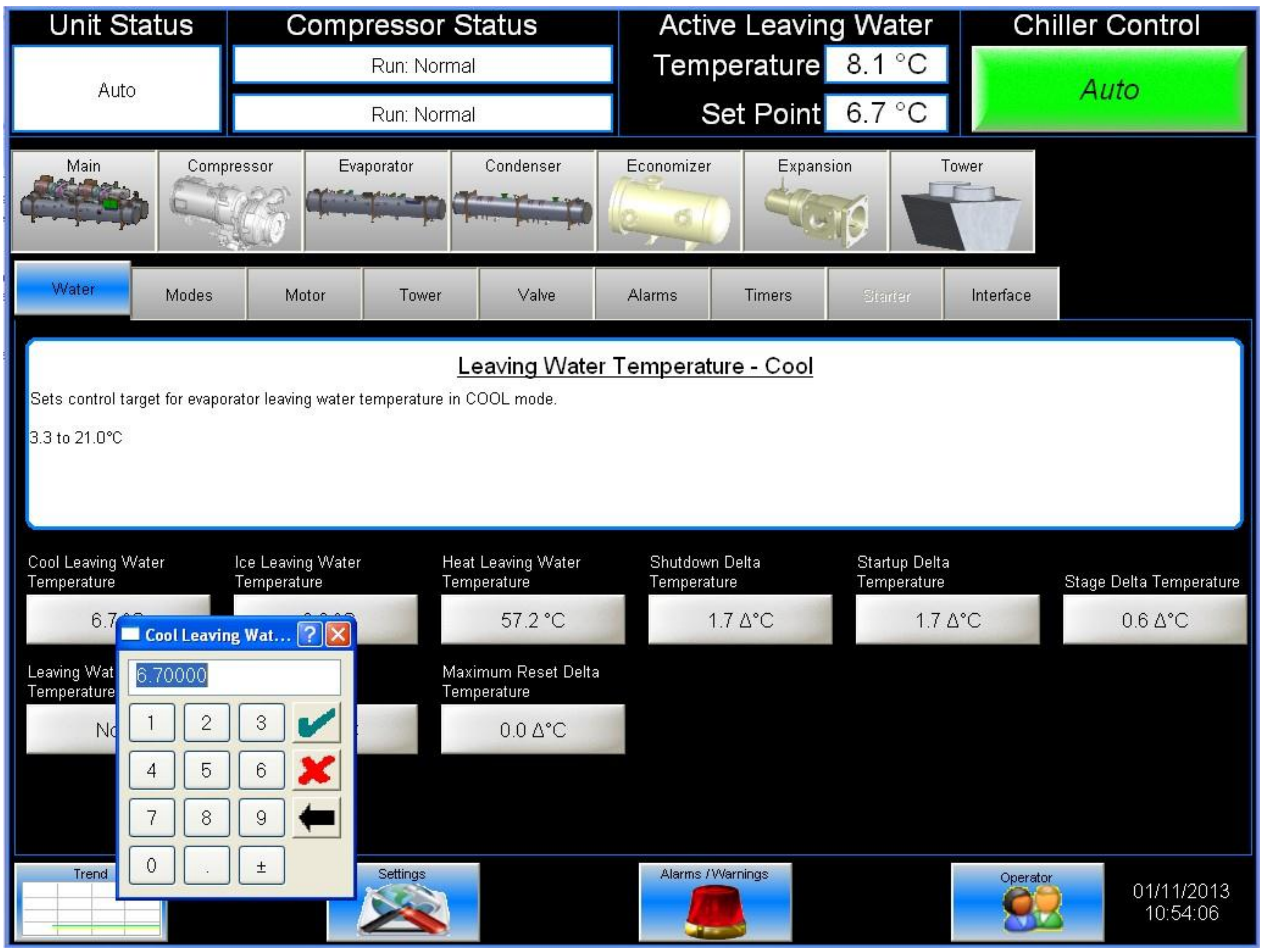


Table 11, WATER Setpoint Settings

Description	Default	Range	Pass-word	Comments
Cool LWT	44. 0°F	35.0 to 80.0 °F	M	Evaporator LWT setpoint in COOL mode
Ice LWT	25. 0°F	15.0 to 35.0 °F	M	Evaporator LWT setpoint in the ICE mode
~~Heat LWT~~	~~135. 0°F~~	~~100.0 to 150.0 °F~~	~~M~~	~~Condenser LWT setpoint in HEAT (Templifier) mode~~
Shutdown Delta T	3.0°F	0.0 to 3.0 °F	M	Degrees below setpoint for compressor to stop.
Startup Delta T	3.0°F	0.0 to 10.0 °F	M	Degrees above setpoint for compressor to start.
Stage Delta T	1ºF	0.5 to 5°F	M	Sets the temperature the leaving water must be below setpoint for next compressor to start.
LWT Reset Type	NONE	NONE, RETURN, 4-20mA	M	Select reset type, NONE for none, RETURN for reseting chilled water based on the entering water, or 4-20 mA for external analog signal
Start Reset Delta T	10. 0°F	0.0 to 20.0 °F	M	Sets the evap delta-T above which Return reset begins.
Max Reset Delta T	0.0°F	0.0 to 20.0 °F	M	Set the maximum reset that can occur, in °F if LWT reset is selected or max reset at 20 mA input if 4-20 mA is selected in SP7

MODES Setpoints

Figure 20, MODES Setpoint Screen

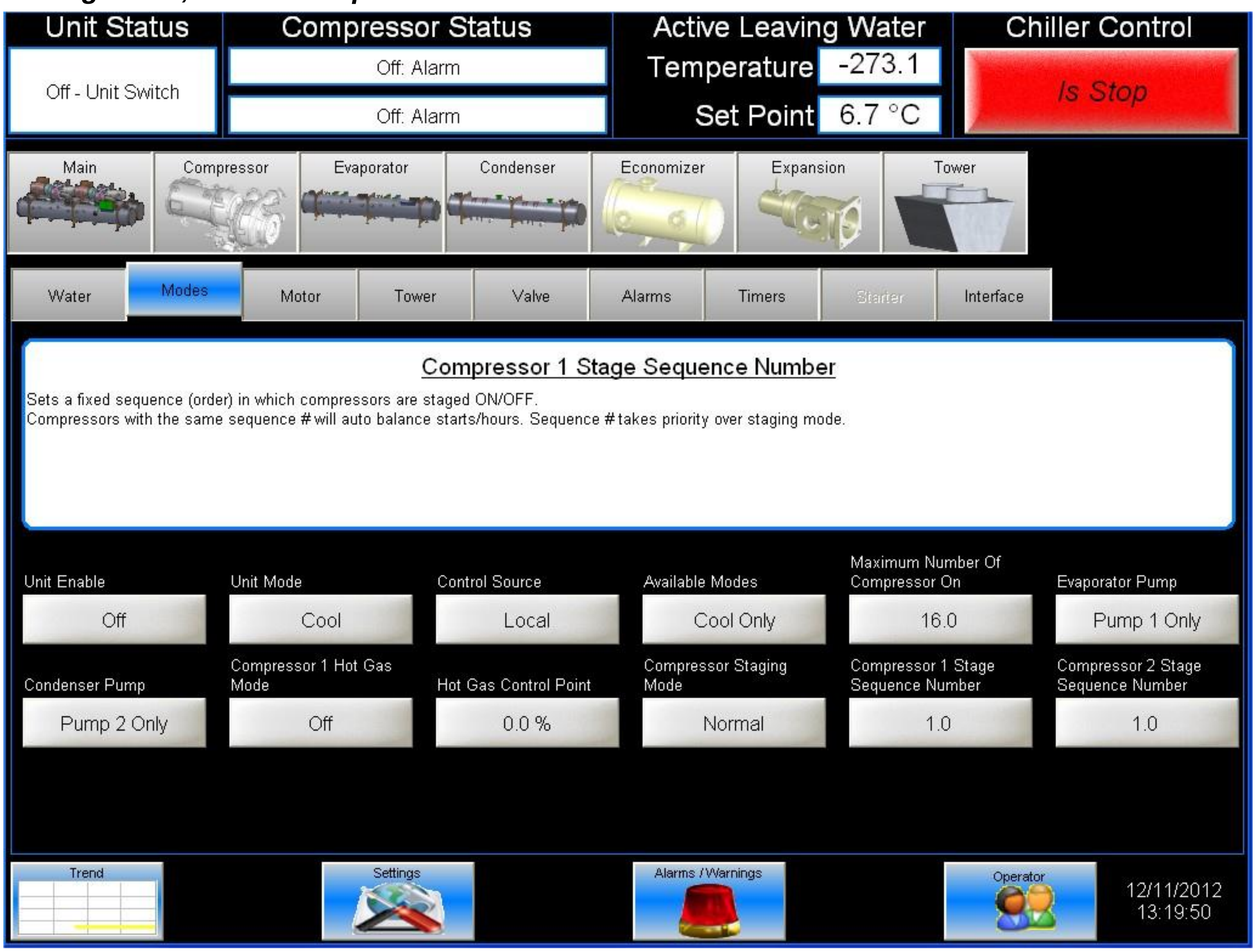


Table 12, MODE Setpoint Settings

Description	Default	Range	Pass-word	Comments
Unit Enable	OFF	OFF, ON	O	OFF, everything is off. ON, Evap pump on, comp, cond pump and tower on as required to meet LWT
Unit Mode	COOL	COOL, ICE, HEAT, TEST		Selects from MODES in SP4
Control Source	LOCAL	LOCAL, BAS, SWITCH	O	Sets control source
Available Modes	COOL	COOL, COOL/ICE, ICE, COOL/HEAT, HEAT	T	Sets modes that can be selected in SP 2
Evap Pump	Pump #1 Only	Pump #1 Only, Pump #2 Only, Auto Lead, #1 Primary, #2 Primary	M	Pump #1 Only, Pump #2 Only, use only these pumps AUTO, balance hours between #1 and #2 #1 Primary, #2 Primary, if primary fails, use other
Cond Pump	Pump #1 Only	Pump #1 Only, Pump #2 Only, Auto Lead, #1 Primary, #2 Primary	M	Pump #1 Only, Pump #2 Only, use only these pumps AUTO, balance hours between #1 and #2 #1 Primary, #2 Primary, if primary fails, use other
Hot Gas Bypass Mode	Normal	Off, Water LWT, %RLA	T	Sets mode for hot gas operaton
Hot Gas Control Point	30%	20 to 70%	T	LWT or % RLA below which HGBP solenoid is on
Max. Comp. ON	16	1 to 16		
Comp 1 Stage Sequence	1			
Comp 2 Stage Sequence	1			

MOTOR Setpoint Screen

Figure 21, MOTOR Setpoint Screen

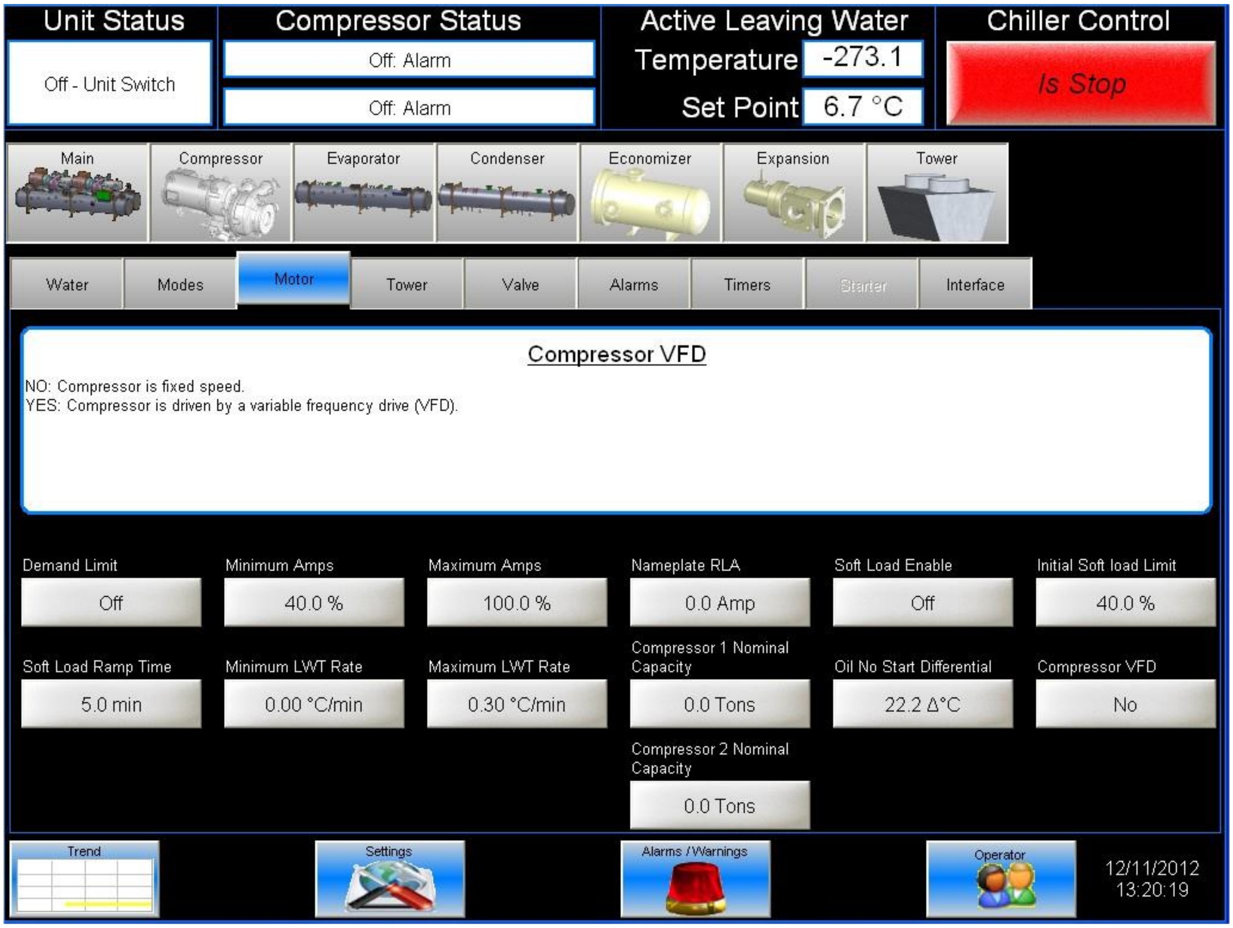


Table 13, MOTOR Setpoint Settings

Description	Default	Range	Pass-word	Comments
Demand Limit Enable	OFF	OFF, ON	O	ON sets %RLA at 0% for 4 mA external signal and at 100% RLA for 20 mA signal
Minimum Amps	40%	20 to 80%	T	% RLA below which unloading is inhibited
Maximum Amps	100%	40 to 100%	T	% RLA above which loading is inhibited (Load Limit)
Nameplate RLA				Not used on WSC/WDC models
Soft Load Enable	OFF	OFF, ON	M	Soft load on or off
Initial Soft Load Amp Limit	40%	20 to 100%	M	Initial amps as % of RLA
Soft Load Ramp	5 min	1 to 60 min	M	Time period to go from initial load point (% RLA) set in SP 5 to 100% RLA
Minimum Rate	0.1 °F/min	0.0 to 5.0 °F/min	M	Additional compressor can start if LWT change is below setpoint.
Maximum Rate	0.5 °F/min	0.1 to 5.0 °F/min	M	Inhibits loading if LWT change exceed the setpoint value.
Nominal Capacity		0 to 9999 Tons		Determines when to shut off a compressor
Oil No Start Diff (above Evap Temp)	40 °F	30 to 60 °F	T	Minimum Delta-T between oil sump temperature and saturated evaporator temperature
VFD	No	No, Yes	T	VFD on unit or not
Minimum Speed	70%	60 to 100%	T	Min VFD speed, has priority over Speed @ 0 Lift & Lift @ 100 % Speen
Speed @ 0 Lift	50%	0 to 100%	T	Lift @ min speed as a % of 100 % lift
Lift @ 100% Speed	40 °F	30 to 60 °F	T	Temp lift at 100 % speed (cond sat – evap sat temp)

Cooling TOWER Fan Settings

Figure 22, TOWER Fan Setpoint Screen (See page 3635 for complete explanation.)

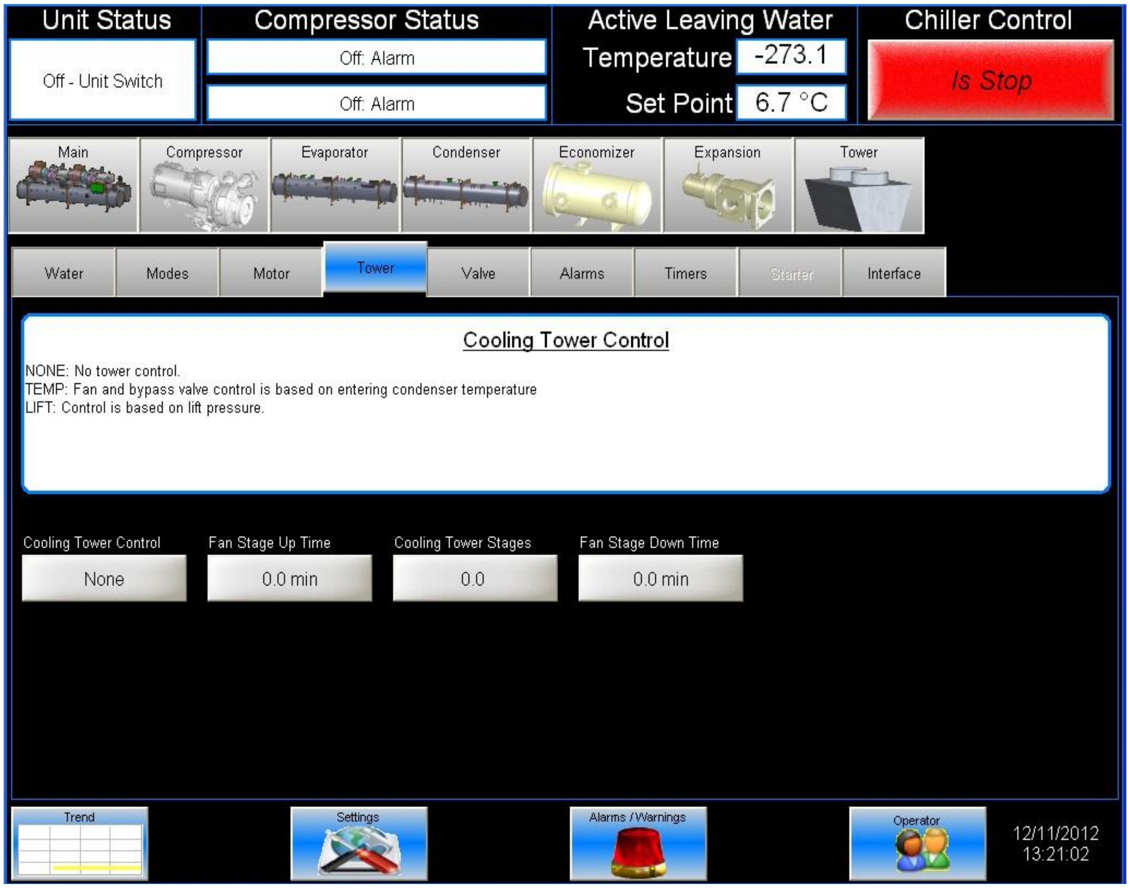


Table 14, Tower Fan Settings

Description	Default	Range	Pass-word	Comments
Tower Control	None	None, Temperature, Lift	M	None: No tower fan control Temperature: Fan and valve controlled by EWT Lift: Fan and valve controlled by lift pressure
Stage Up Time	2 min	1 to 60 min	M	Time delay between stage up/down event and next stage up
Tower Stages	2	1 to 4	M	Number of fan stages used
Stage Down Time	5 min	1 to 60 min	M	Time delay between stage up/down event and next stage down
Stage Differential (Lift)	6.0 psi	1.0 to 20.0 psi	M	Fan staging deadband with Setpoint # 1=Lift
Stage #1 On (Lift)	35 psi	10 to 130 psi	M	Lift pressure for fan stage #1 on
Stage #2 On (Lift)	45 psi	10 to 130 psi	M	Lift pressure for fan stage #2 on
Stage #3 On (Lift)	55 psi	10 to 130 psi	M	Lift pressure for fan stage #3 on
Stage #4 On (Lift)	65 psi	10 to 130 psi	M	Lift pressure for fan stage #4 on
Stage Differential (Temp)	3.0 °F	1.0 to 10.0 °F	M	Fan staging deadband with Setpoint #1=Temp
Stage #1 On (Temp)	70 °F	40 to 120 °F	M	Temperature for fan stage #1 on
Stage #2 On (Temp)	75 °F	40 to 120 °F	M	Temperature for fan stage #2 on
Stage #3 On (Temp)	80 °F	40 to 120 °F	M	Temperature for fan stage #3 on
Stage #4 On (Temp)	85 °F	40 to 120 °F	M	Temperature for fan stage #4 on

Explanation of Tower Control Settings

MicroTech III control can control cooling tower fan stages, a tower bypass valve, and/or a tower fan VFD if the chiller has a dedicated cooling tower.

The Tower Bypass Valve position will always control the Tower Fan Staging if Valve Setpoint, Stage Setpoint is selected. Fan staging is determined by Min & Max Tower Valve Position.

There are five possible tower control strategies as noted below and explained in detail later in this section. They are selected from SETPOINT TOWER SP2.

1. NONE, Tower fan staging only. In this mode the tower fan staging (up to 4 stages) is controlled by either the condenser Entering Water Temperature (EWT) or LIFT pressure (difference between the condenser and evaporator pressures). Tower bypass or fan speed are not controlled.
2. VALVE SP, Tower staging with low-limit controlled bypass valve. In this mode the tower fans are controlled as in #1 plus a tower bypass valve is controlled to provide a minimum condenser EWT. There is no interconnection between the fan control and the valve control.
3. VALVE STAGE, Tower staging with stage controlled bypass valve. In this mode the bypass valve controls between fan stages to smooth the control and reduce fan cycling
4. VFD STAGE. In this mode a VFD controls the first fan. Up to 3 more fans are staged on and off and there is no bypass valve.
5. VALVE/VFD, Tower fan control with VFD plus bypass valve control.

Tower Fan Staging Only (NONE)

The following settings are used for the Tower Fan Staging Only mode, (SP= setpoint)

1) TOWER SETPOINT Screen
    - i) Tower Control. Select TEMP if control is based on condenser EWT or LIFT if based on compressor lift expressed in psi.
    - ii) Valve/VFD Control. Select NONE for no bypass valve or fan VFD control.
    - iii) Tower Stages. Select one to four fan outputs depending on the number of fan stages to be used. More than one fan can be used per stage through the use of relays.
    - iv) Stage up Time. Select STAGE UP TIME from 1 to 60 minutes. The default value of 2 minutes is probably a good starting point. The value may need to be adjusted later depending on actual system operation.
    - v) Stage down Time. Select STAGE DOWN TIME from 1 to 60 minutes. The default value of 5 minutes is probably a good starting point. The value may need to be adjusted later depending on actual system operation.
2) If TEMP is selected in Tower Control, use
    - i) Stage Diff. Select STAGE DIFFERENTIAL in °F, start with default of 3 °F.
    - ii) Stage #1-4 On (Temp). Set the STAGE ON temperatures consistent with the temperature range over which the condenser EWT is desired to operate. The default values of 70°F, 75°F, 80°F and 85°F are a good place to start in climates with moderate wet bulb temperatures. The number of STAGE ON setpoints used must be the same as Tower Stages.
3) If LIFT is selected in Tower Control, use
    - i) Stage Diff. Select STAGE DIFFERENTIAL in PSI. Start with default of 6 PSI.
    - ii) Stage #1-4 On (Lift). Start with default setpoints. The number of STAGE ON setpoints used must be the same as Tower Stages.

Tower Fan Staging With Bypass Valve Controlling Minimum EWT (VALVE SP)

1) TOWER SETPOINT Screen
   a) Tower Control. Select TEMP if control is based on condenser EWT or LIFT if based on compressor lift expressed in psi.
   b) Valve/VFD Control. Select Valve SP for control of bypass valve based on temperature or lift.
   c) Tower Stages. Select one to four fan outputs depending on the number of fan stages to be used. More than one fan can be used per stage through the use of relays.
   d) Stage up Time. Select STAGE UP TIME from 1 to 60 minutes. The default value of 2 minutes is probably a good starting point. The value may need to be adjusted later depending on actual system operation.
   e) Stage down Time. Select STAGE DOWN TIME from 1 to 60 minutes. The default value of 5 minutes is probably a good starting point. The value may need to be adjusted later depending on actual system operation.
   f) If TEMP is selected in SP1, use
      i) Stage Diff. Select STAGE DIFFERENTIAL in °F, start with default of 3 °F.
      ii) Stage #1-4 On (Temp). Set the STAGE ON temperatures consistent with the temperature range over which the condenser EWT is desired to operate. The default values of 70°F, 75°F, 80°F and 85°F are a good place to start in climates with moderate wet bulb temperatures. The number of STAGE ON setpoints used must be the same as Tower Stages.
   g) If LIFT is selected in Tower Control, use
      i) Stage Diff. Select STAGE DIFFERENTIAL in PSI. Start with default of 6 PSI.
      ii) Stage #1 On (Lift). Start with default setpoints. The number of STAGE ON setpoints used must be the same as Tower Stages.
2) VALVE SETPOINT Screen
   a) Valve Type, Select NC or NO depending if valve is closed to tower with no control power or open to tower with no control power.
   b) If TEMP was selected for fan control above, use
      i) Valve Setpoint (Temp), Set the VALVE TARGET (setpoint), usually 5 degrees below the minimum fan stage setpoint established in TOWER Stage 4 On (Temp). This keeps full flow through the tower until the last fan is staged off.
      ii) Valve Deadband (Temp), Set VALVE DEADBAND, the default of 2 °F is a good place to start.
      iii) Minimum Start Position, Set MINIMUM VALVE POSITION when EWT is at or below Temp - Minimum Position. Default is 0%.
      iv) Temp-Minimum Position, Set the EWT at which the valve position will be at (Minimum Start Position). Default is 60°F.
      v) Minimum Start Position, Set MINIMUM VALVE POSITION when EWT is at or below Temp - Minimum Position. Default is 0%.
      vi) Temp -Minimum Position, Set the EWT at which the valve position is set to allow the fans to stage up (Minimum Start Position). Default is 60°F.
      vii) Maximum Start Position, Set the initial valve position when EWT is at or above Temp-Maximum Position. Default is 100%.

         Temp-Maximum Position, Set the EWT at which initial valve position is set to Minimum Start Position. Default is 90°F.
      viii) Valve Control Range (Min), Set the minimum position to which the valve can go. Default is 10%.
      ix) Valve Control Range (Max), Set the maximum position to which the valve can go. Default is 100%.

x) Error Gain, Set the control gain for error. Default is 25.

xi) Slope Gain, Set the control gain for slope. Default is 25.

NOTE: Setpoints Error Gain and Slope Gain are site specific dealing with system fluid mass, component size and other factors affecting the reaction of the system to control inputs. These setpoints should be set by personnel experienced with setting up this type of control.

c) If LIFT was selected for fan control, use

i) Valve Target, Set the VALVE TARGET (setpoint), usually 30 psi below the minimum fan stage setpoint established in TOWER Stage #1 On (Lift). This keeps full flow through the tower until the last fan is staged off.

ii) Valve Deadband (lift), Set VALVE DEADBAND, the default of 6 psi is a good place to start.

iii) Minimum Start Position, Set MINIMUM VALVE POSITION when EWT is at or below Temp-Maximum Position. Default is 0%.

iv) Temp-Maximum Position, Set the EWT at which the valve position will be at (Minimum Start Position). Default is 60°F.

v) Valve Control Range (Min), Set the minimum position to which the valve can go. Default is 10%.

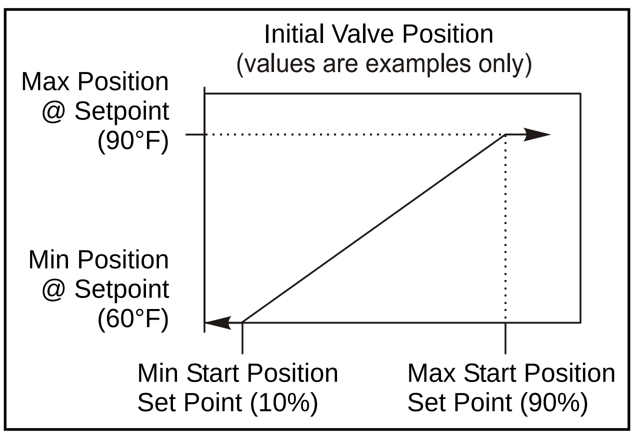
vi) Valve Control Range (Max), Set the maximum position to which the valve can go. Default is 100%.

vii) Error Gain, Set the control gain for error. Default is 25.

viii) Slope Gain, Set the control gain for slope. Default is 25.

NOTE: Setpoints Error Gain and Slope Gain are site specific dealing with system fluid mass, component size and other factors affecting the reaction of the system to control inputs. These setpoints should be set by personnel experienced with setting up this type of control.

Figure 23, Valve Positioning



See **Errore. L'origine riferimento non è stata trovata.**on page 16 for fan staging and bypass valve field wiring connection points.

Tower Staging with Bypass Valve Controlled by Fan Stage (VALVE STAGE)

This mode is similar to #2 above except that the bypass valve setpoint changes to be set at the same point of whatever fan stage is active rather than just maintaining a single minimum condenser EWT. In this mode the valve controls between fan stages and tries to maintain the fan stage setting in effect. When it is max open or max closed (staging up or down) and the temperature (or lift) moves to the next fan stage, the valve will go the opposite max setting. This mode reduces fan cycling.

This mode is programmed the same as Mode #2 above except that in SETPOINT, TOWER, Tower bypass Valve/Fan VFD, VALVE STAGE is selected instead of VALVE SP.

Fan VFD, No Bypass Valve (VFD STAGE)

The fan VFD mode assumes the tower is driven by one large fan. Set up is as above except in SETPOINT, TOWER, Tower bypass Valve/Fan VFD, VALVE/VFD is selected.

Unit Controller Supplements to Tower Control

The following is intended to clarify the Tower: Error Gain and Slope Gain set points found on under the OITS VALVE group of setpoints, and on the Unit controller mask "SET TOWER Stage #1 On (Temp).

PD Control Loop

The Tower is governed with two Proportional and Derivative (PD) control loops, and is applied with a step and wait philosophy**. One PD loop controls the tower fan VFD and the second controls the tower bypass value. The input to both PD control loops is the sum of the error signal and the tower slope. The following two set points apply to both control loops.

Error Gain

The error signal is used to correct the current tower setting based on the difference between the tower setpoint and its feedback signal*. The Error Gain setpoint is used to increase or decrease the control logic' sensitivity to this input. The default setting is 25 with an adjustment range from 10 to 99. Increasing this setting will increase the controls response to an error between the tower target and feedback signal.

Slope Gain

The slope signal is used to correct the current tower setting based on the direction and rate of change in the tower feedback signal*. The Slope Gain setpoint is used to increase or decrease the control logic' sensitivity to this input. The default setting is 25 with an adjustment range from 10 to 99. Increasing this setting will increase the controls response to the direction and rate of change in the tower feedback signal.

Tuned Operation

By independently adjusting these gain settings you can tune the tower controls response to the system installed.

* The tower feedback signal is determined by the Tower Control method selected (either condenser return water Temp, or compressor/s Lift temp of the chiller.

** The step and wait philosophy has a wait period that is adjustable in the Unit controllers series of Advanced Setpoint mask, specifically "Adv Set#9 Tower Ctrl". Reducing the Tower Update Timer (TUT) from its default value of 12 seconds, will speed up the tower reaction time. This is useful on chiller systems with very short tower water loops.

This mask also allows the adjust of the minimum Tower VFD speed.

Caution, reducing the TUT time has the same effect as increasing the gains as described above. That is, the tower is making corrections more often. If you need to shorten the TUT (for a small loop), then you should also reduce the gains to compensate.

Figure 24, Tower Bypass VALVE Setpoint Screen

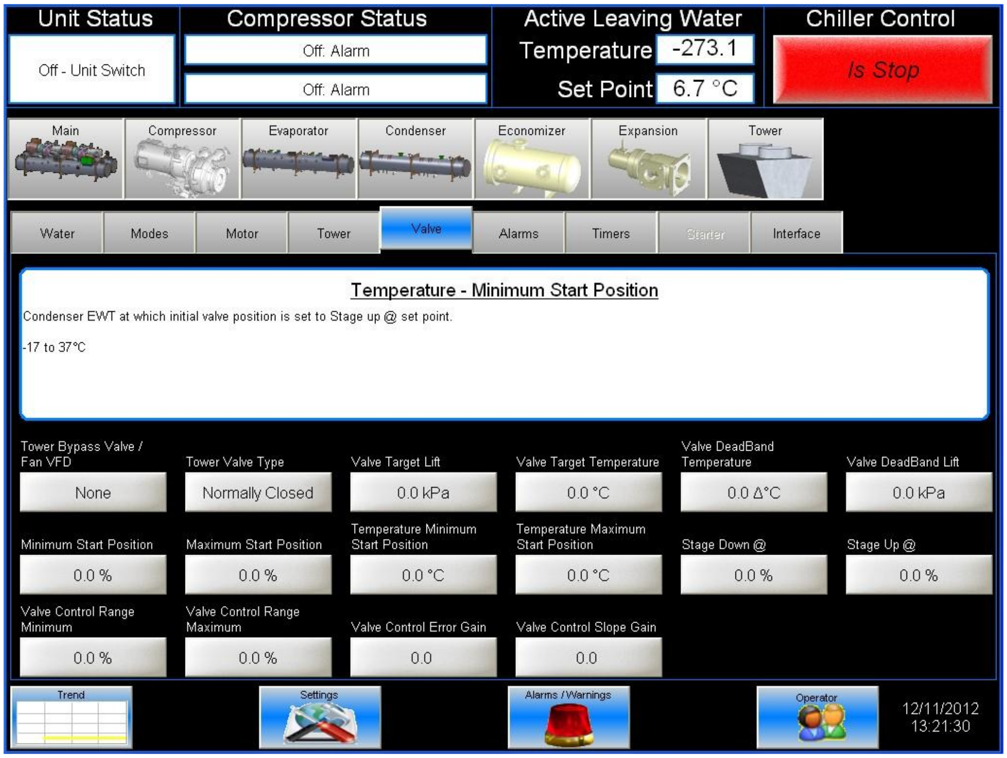


Table 15, Tower Bypass VALVE Setpoints

Description	Default	Range	Pass-word	Comments
Valve/VFD Control	None	None, Valve Setpoint, Valve Stage, VFD Stage, Valve SP/VFD Stage	M	None: No tower valve or VFD Valve Setpoint: Valve controls to VALVE SP3(4) & 5(6) Valve Stage: Valve control setpoint changes to fan stage setpoint VFD Stage: 1st fan is VFD controlled, no valve Valve Setpoint/VFD Stage: Both valve and VFD
Valve Type	NC (To Tower)	NC, NO	M	Normally closed or normal open to tower
Valve Setpoint (Temp)	65 °F	40 to 120 °F	M	Target for condenser EWT (Tower Setpoint #1= Temp), Works with Setpoint # 4
Valve Target (Lift)	30 psi	10 to 130 psi	M	Target for lift pressure (Tower Setpoint #1= Lift), Works with Setpoint # 5
Valve Deadband (Temp)	2.0 °F	1.0 to 10.0 °F	M	Control deadband, Tower Setpoint #1=Temp
Valve Deadband (Lift)	4.0 psi	1.0 to 20.0 psi	M	Control deadband, Tower Setpoint #1=Lift
Stage Up @	80%	0 to 100%	M	Valve position above which the fans can stage up (Tower Setpoint #2 = Valve Stage Down VFD speed above which the next fan speed can turn on (Tower Setpoint # 2 = valve/VFD ????
Stage Down @	20%	0 to 100%	M	Valve position below which the fans can stage down (Tower Setpoint #2 = Valve Stage Down VFD speed below which the next fan speed can turn off (Tower Setpoint # 2 = valve/VFD ????
Minimum Start Position	10%	0 to 100%	M	Initial position of valve when condenser EWT is at or below Setpoint # 7
Temp - Minimum Position	60 °F	0 to 100 °F	M	Condenser EWT at which initial valve position is set to Setpoint # 6
Maximum Start Position	100%	0 to 100%	M	Initial valve position when condenser EWT is at or above Setpoint # 9
Temp - Maximum Position	90 °F	0 to 100 °F	M	Condenser EWT at which valve should be open to tower
Valve Control Range (Min)	10%	0 to 100%	M	Minimum valve position, overrides all other settings
Valve Control Range(Max)	100%	0 to 100%	M	Maximum valve position, overrides all other settings
Error Gain	25	10 to 99	M	Control gain for temperature (or lift) error
Slope Gain	25	10 to 99	M	Control gain for temperature (or lift) slope

ALARMS Setpoint

Figure 25, ALARMS Setpoint Screen

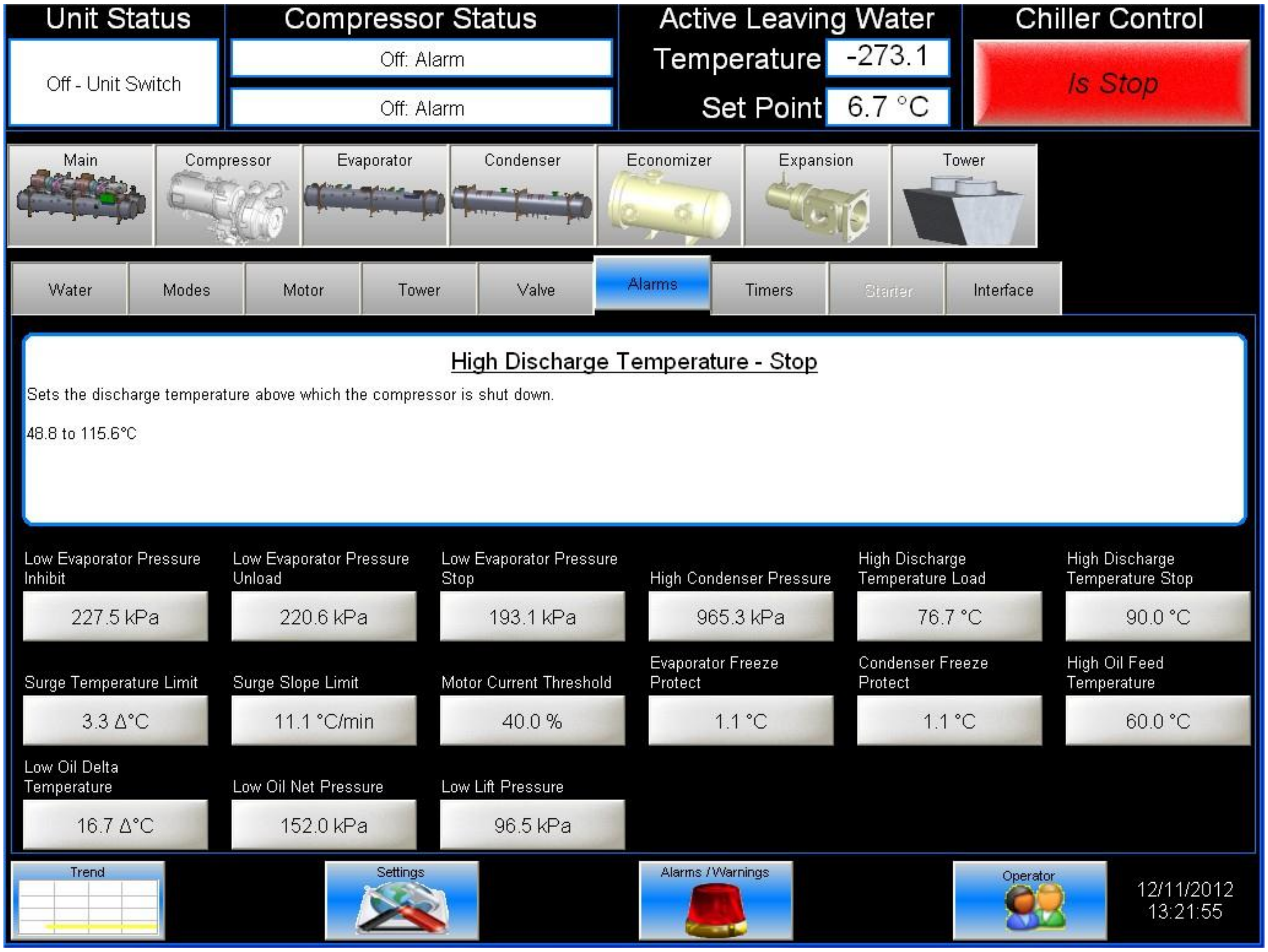


Table 15, ALARM Setpoints

Description	Default	Range	Pass-word	Comments
Low Evap Pressure-Inhibit	33 psi	20 to 45 psi	T	Min evap pressure – inhibit loading
Low Evap Pressure-Unload	31 psi	20 to 45 psi	T	Min evap pressure – unload compressor
Low Evap Pressure, Stop	29 psi	10 to 45 psi	T	Min evap pressure – stop compressor
High Condenser Pressure	140 psi	120 to 240 psi	T	Max discharge pressure, stop compressor
High Discharge Temp-Load	170 °F	120 to 240 °F	T	Max discharge gas temp – load comp
High Discharge Temp-Shutdown	190 °F	120 to 240 °F	T	Max discharge gas temp, stop compressor
Surge Temperature Limit	6	2 – 25 ° F	T	See screen above
Surge Slope Limit	20	1 – 99 ° F/min.	T	Surge slope temp that triggers alarm
Motor Current Threshold	10%	3% to 99%	T	Min %RLA to consider motor off
Evaporator Freeze	34.0 °F	-9.0 to 45.0 °F	T	Minimum evap. sat. temp. to start pump
Condenser Freeze	34.0 °F	-9.0 to 45.0 °F	T	Minimum cond. sat. temp. to start pump
High Oil Feed Temperature	140 °F	120 to 240 °F	T	Max oil temperature
Low Oil Delta Temperature	30 °F	20 to 80 °.F	T	Min Delta-T (sat evap minus oil temp)
Low Net Oil Pressure	22 psi	0 to 76 psi	T	Min net pressure (feed minus sump)
Low Lift Pressure	14 psi	0 to 73 psi	M	Min pressure (cond – evap press)

TIMERS Setpoint

Figure 26, TIMERS Setpoint Screen

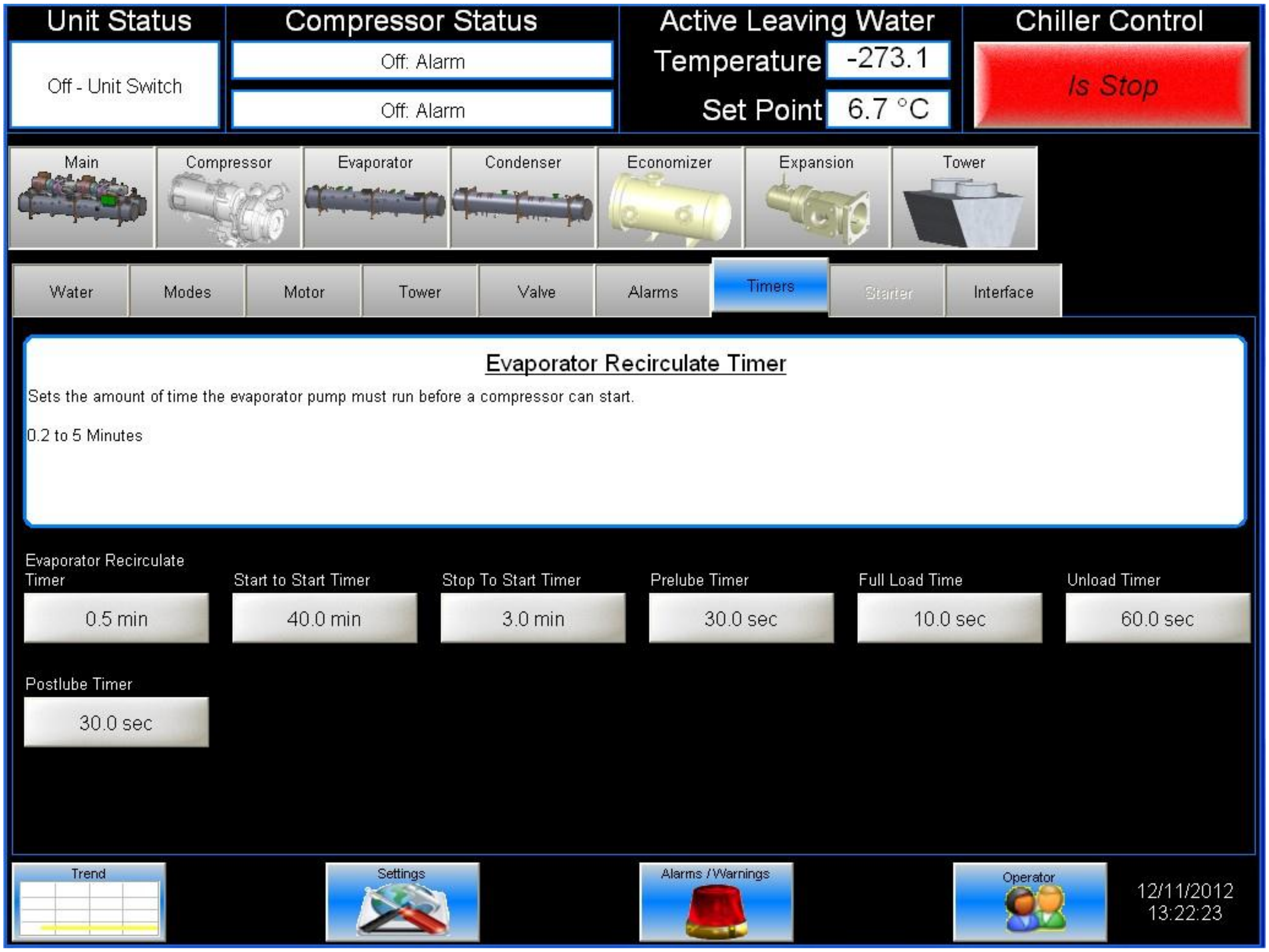
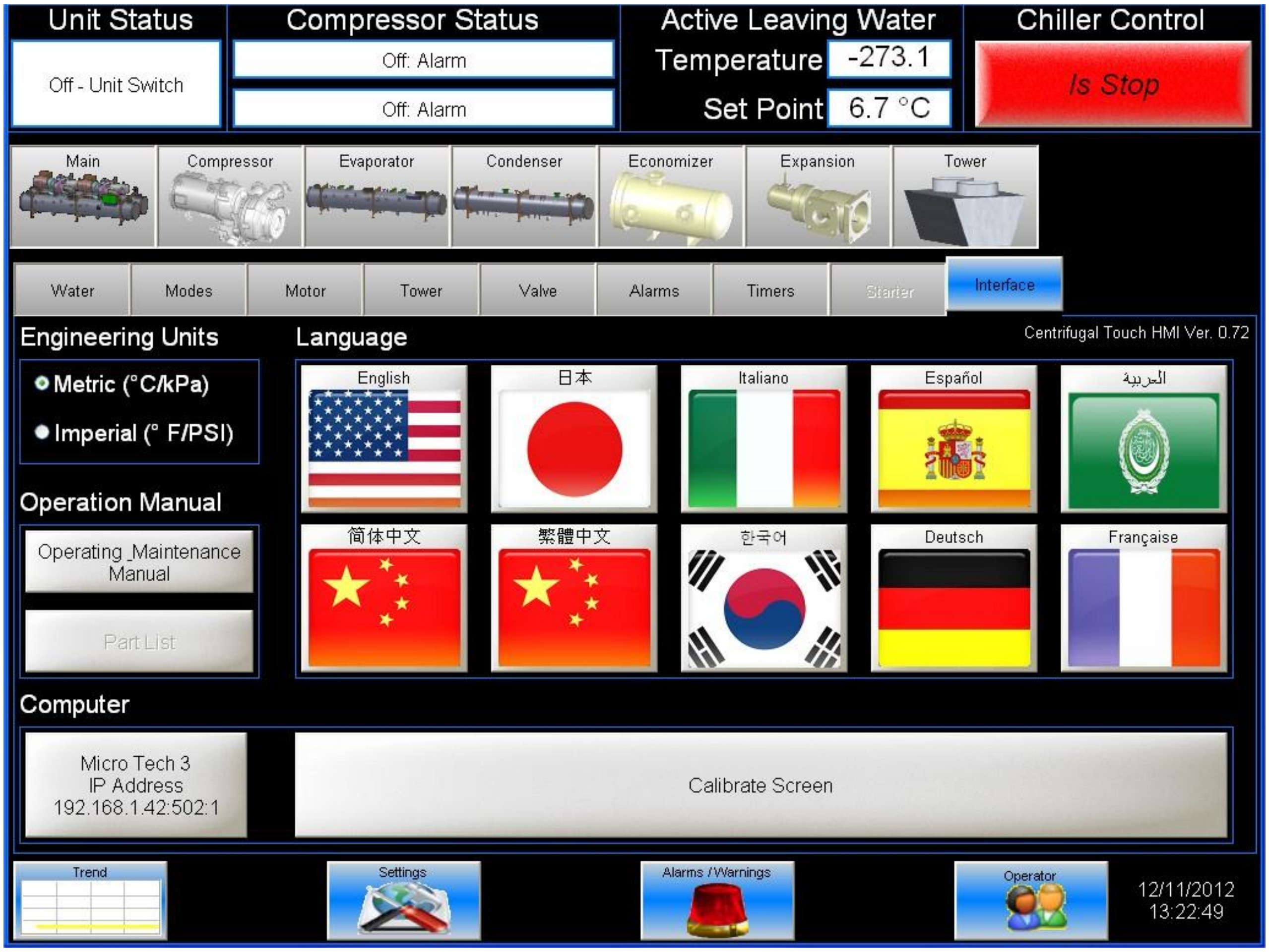


Table 16, TIMER Setpoints

Description	Default	Range	Pass-word	Comments
Evap Recirculate	0.5 min	0.2 to 5 min	M	Time that evaporator pump must run before compressor start
Start-Start	40 min	15 to 60 min	M	Time from when compressor starts to when it can start again
Stop-Start	3 min	3 to 20 min	M	Time from when compressor stops to when it can restart
Prelube Timer	30 sec	10 to 240 sec	T	Time compressor must prelube before starting
Full Load Timer	30 sec	5 to 60 sec	T	Time compressor must load for full open vanes
Unload Timer	30 sec	10 to 240 sec	T	Time compressor will unload before going to postlube
Postlube Timer	30 sec	10 to 240 sec	T	Time for postlube before compressor can stop

Interface Screen

Figure 27, Service Screen



Pressing Interface from any screen accesses the Interface screen. While containing information and activity buttons for the service technician, it also has valuable information for the operator.

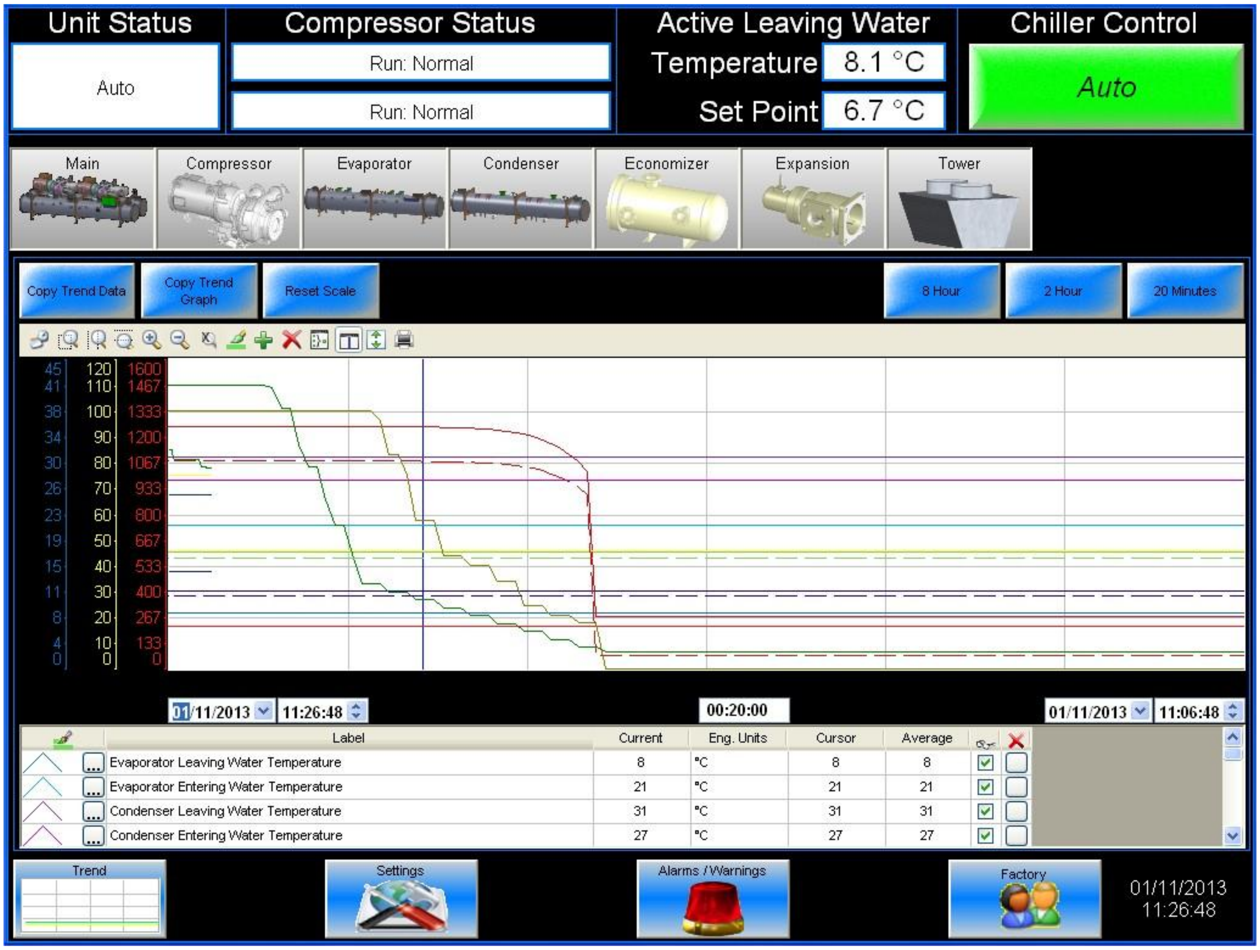
The touch screen software version number shown in the upper right corner. The Operating Manual button will access the operating and maintenance manual for the unit. Pressing these buttons will display the manual on the screen where it can be manipulated as an Adobe Acrobat file®.

Language allows toggling between the available languages.

Date/Time in the lower-right corner is automatic updated from the MicroTech III controller.

Trend Screens

Figure 28, History Trend Graph



The Trend Overview allows the user to view the various parameters listed on the lower of the screen. The temperature, % and Pressure scale are on the left. The screen can display trend history for 8 hour, 2 hour or 20-minute periods by pressing 8 hour, 2 hour, or 20 min respectively from the default 1 hour.

Display for the current time beginning on the left of the screen with history flowing to the right.

To download trend data or trend image connect a USB portable storage device to the USB port located in the unit control box adjacent to the OITS, press the copy trend data button or the copy trend graph and select the date you wish then press ok button, then select location to save the file.

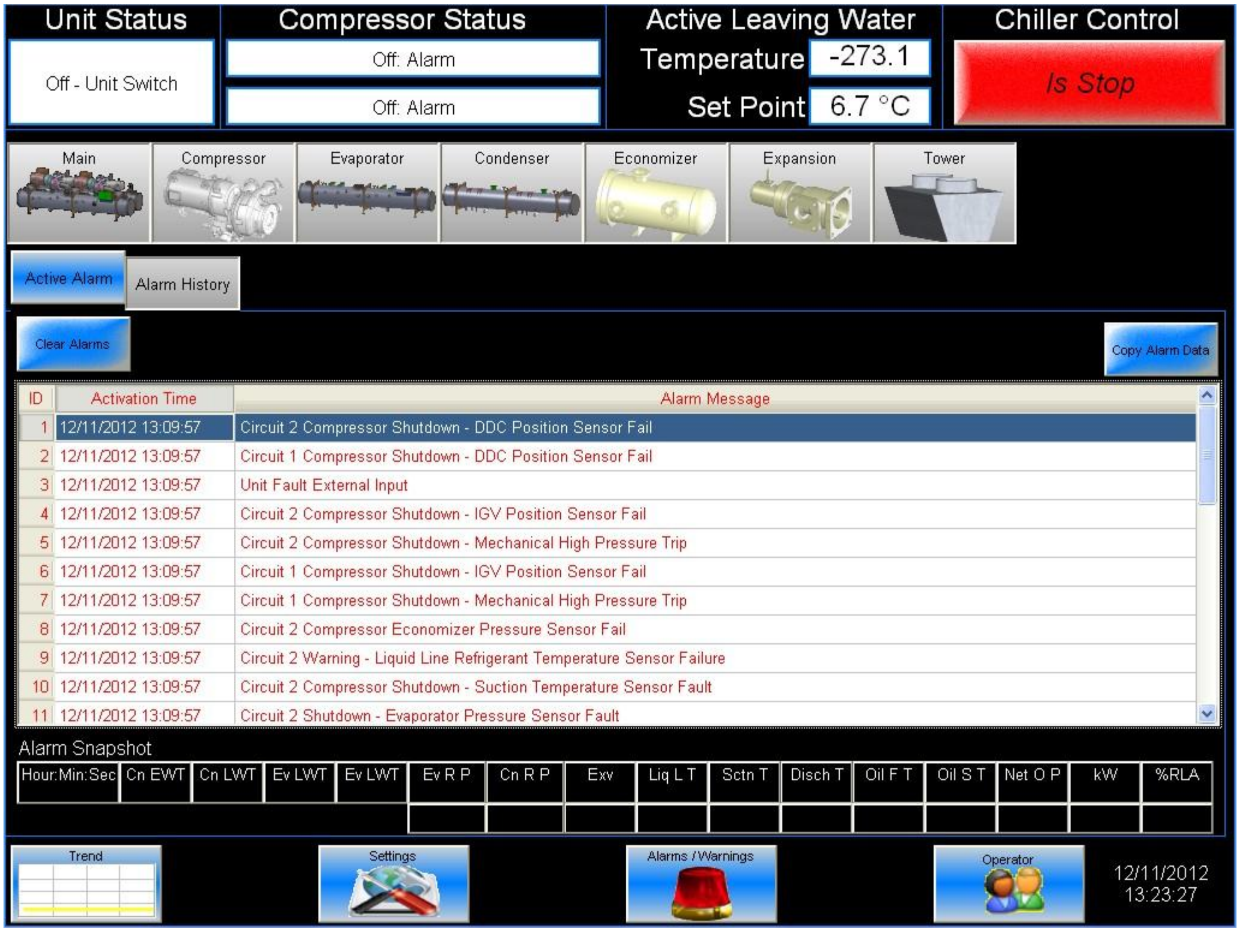
Figure 29, Alarm History

The Alarm History lists the alarms with the most current on top with date stamp, action taken and the cause of the alarm.

This screen is also used to download the Alarm History shown above. To download alarm history connect a USB portable storage device to the USB port located in the unit control box adjacent to the OITS, press the copy alarm data button, then select location to save the file.

ACTIVE ALARM Screen

Figure 30, Active Alarms



The Active Alarm screen is accessible when an active alarm exists on the unit by pressing the animated red alarm signal on any screen.

Alarms are arranged in order of occurrence, with the most recent on top. Once the abnormal condition is corrected, pressing the "Clear Alarm" button will clear the alarm.

The current active alarms (there may be more than one) are displayed.

The date/time and cause of the alarm are displayed.

This screen is also used to download the Active Alarm shown above. To download active alarm connect a USB portable storage device to the USB port located in the unit control box adjacent to the OITS, press the copy alarm data button, then select location to save the file.

Clearing Alarms

After eliminating the cause of the alarm, clear the alarm by pressing the clear alarm button. This will clear the alarm from the register and allow the unit to restart after going through the start sequence. The alarm notice will be deleted from the screen.

However, if the cause of the alarm is not remedied, the alarm is still active and the alarm message will remain on screen. The unit will not begin its starting sequence.

Always remedy the cause of an alarm before attempted to clear it.

Alarms fall into three distinct categories: Faults, Problems, and Warnings as detailed in the following section.

Fault Alarms

All fault alarms require a manual reset.

Table 17, Fault Alarm Description

Description	Occurs When:	Action Taken
Low Evaporator Pressure	Evaporator Press < Low Evap Pressure SP	Rapid Stop
High Condenser Pressure	Cond Press > High Condenser Pressure SP	Rapid Stop
Vanes Open No Start	Compressor state = PRELUBE for 30 sec after Prelube timer expires	Rapid Stop
Low Oil Delta Pressure	(Comp State=PRELUBE, RUN, UNLOAD, or POSTLUBE) & Net Oil Press < Low Net Oil Press SP	Rapid Stop
Low Oil Feed Temperature	(Comp State=RUN or UNLOAD) & Oil Feed temp < (Evap Saturated Refr Temp + Low Oil Delta Temperature SP) for > 1 min	Rapid Stop
High Oil Feed Temperature	Temp > High Oil Feed Temperature SP OR, Sump Temp > Max Sump T Sp > Sump T Delay	Rapid Stop
Low Motor Current	I < Motor Current Threshold with Comp. ON for 30 sec	Rapid Stop
High Discharge Temperature	Temp > High Discharge Temperature SP	Rapid Stop
Mechanical High Pressure	Digital Input = High Pressure	Rapid Stop
High Motor Temperature	Digital Input = High Temperature	Rapid Stop
Surge High	Surge Temp > Surge Temp SP Surge Temp Slope > Surge High Slope SP	Rapid Stop
No Starter Transition	Starter Transition Digital Input = No Transition AND Compressor ON for > 15 seconds	Rapid Stop
Starter Fault	Starter Fault Digital Input = Fault AND Compressor State = START, PRELUBE, RUN, or UNLOAD	Rapid Stop
Low Oil Pressure Start	Compressor State = START for 30 sec	Rapid Stop
No Evaporator Water Flow	Chilled Water Flow Switch Open	Rapid Stop
No Condenser Water Flow	Condenser Water Flow Switch Open	Rapid Stop
Leaving Evaporator Water Temperature Sensor Fault	Sensor shorted or open	Rapid Stop
Evaporator Pressure Sensor Fault	Sensor shorted or open	Rapid Stop
Condenser Pressure Sensor Fault	Sensor shorted or open	Rapid Stop
Suction Temperature Sensor Fault	Sensor shorted or open	Rapid Stop
Discharge Temperature Sensor Fault	Sensor shorted or open	Rapid Stop
Oil Feed Temperature Sensor Fault	Sensor shorted or open	Rapid Stop
Oil Sump Temperature Sensor Fault	Sensor shorted or open	Rapid Stop
Oil Feed Pressure Sensor Fault	Sensor shorted or open	Rapid Stop
Oil Sump Pressure Sensor Fault	Sensor shorted or open	Rapid Stop
Low Lift Pressure	Lift Pressure < SP AND Enabled, AND Delay	Rapid Stop
Economizer Pressure Sensor Fault	Sensor shorted or open	Rapid Stop
IGV Position Sensor Failure	Calibration Span < SP	Rapid Stop
DDC Position Sensor Failure	Calibration Span < SP	Rapid Stop
Low Discharge Superheat	Indication of possible flooded Economizer	Shutdown(3)

NOTES:

1. Surge Temperature is the suction temperature minus the leaving chilled water temperature.
2. Shutdown is an Unload state/routine prior to actual shutdown, it is the normal shutdown sequence.

Problem Alarms

The following alarms do not cause compressor shutdown but limit operation of the chiller in some way as described in the Action Taken column. A limit alarm will trigger the red alarm screen and the digital output for the optional remote alarm.

Table 18, Problem Alarm Description

Description	Occurs When:	Action Taken	Reset
Low Evaporator Pressure – Inhibit Loading	Pressure < Low Evap Pressure– Inhibit setpoint	Inhibit loading	Evap Press rises above (SP + 3psi)
Low Evaporator Pressure – Unload	Pressure < Low Evap Pressure– Unload setpoint	Unload	Evap Press rises above (SP + 3psi)
Evaporator Freeze Protect	Evap Sat Refr Temp < Evaporator Freeze SP	Start evaporator pump	Temp > (Evaporator Freeze SP + 2°F)
Condenser Freeze Protect	Cond Sat Refr Temp < Condenser Freeze SP	Start condenser pump	Temp > (Condenser Freeze SP + 2°F)
High Discharge Temperature	Temperature > High Discharge Temperature-Load SP AND Suction superheat < 15°F	Load	Temp < (High Dsch Temp Load SP – 3°F) OR Superheat > 18°F

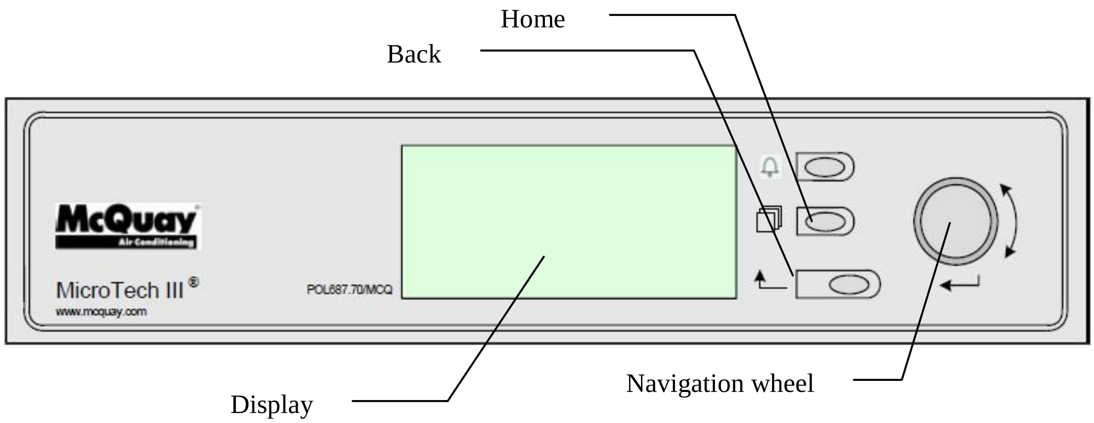
A warning is annunciated whenever an abnormal condition exists which does not affect chiller operation.

Table 19, Warning Alarm Description

WARNING	CONDITION
Liquid Line Refrigerant Temperature Sensor Fall Warning	Sensor is shorted or open
Entering Evaporator Water Temperature Sensor Fall Warning	Sensor is shorted or open
Leaving Condenser Water Temperature Sensor Fail Warning	Sensor is shorted or open
Entering Condenser Water Temperature Sensor Fail Warning	Sensor is shorted or open
Evaporator Pressure Sensor Fault	Sensor is shorted or open

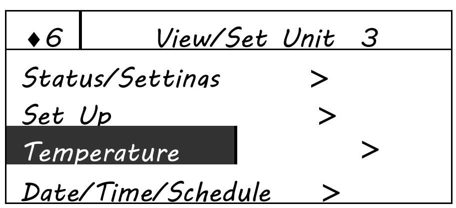
Using the Controller

Figure 31, Display and Keypad Layout



The keypad/display consists of a 5-line by 22-character display, three buttons (keys) and a "push and roll" navigation wheel. There is an Alarm Button, Menu (Home) Button, and a Back Button. The wheel is used to navigate between lines on a screen (page) and to increase and decrease changeable values when editing. Pushing the wheel acts as an Enter Button and will jump from a link to the next set of parameters.

Figure 32, Typical Screen



Generally, each line on the display contains a menu title, a parameter (such as a value or a setpoint), or a link (which will have an arrow in the right of the line) to a further menu.
The first line visible on each display includes the menu title and the line number to which the cursor is currently "pointing", in the above case 3, Temperature.

The left most position of the title line includes an "up" arrow ▲ to indicate there are lines (parameters) "above" the currently displayed line; and/or a "down" arrow ▼ to indicate there are lines (parameters) "below" the currently displayed items or an "up/down" arrow ♦ to indicate there are lines "above and below" the currently displayed line. The selected line is highlighted.
Each line on a screen can contain status-only information or include changeable data fields (setpoints).

When the cursor is on a line the highlights will look like this:

If line contains a changeable value-

If the line contains status-only information-

Or a line in a menu may be a link to further menus. This is often referred to as a jump line, meaning pushing the navigation wheel will cause a "jump" to a new menu. An arrow (>)is displayed to the far right of the line to indicate it is a "jump" line and the entire line is highlighted when the cursor is on that line.

NOTE - Only menus and items that are applicable to the specific unit configuration are displayed.

This manual includes information relative to the operator level of parameters; data and setpoints necessary for the everyday operation of the chiller. There are more extensive menus available for the use of service technicians.

Navigating

When power is applied to the control circuit, the controller screen will be active and display the Home screen, which can also be accessed by pressing the Menu Button The navigating wheel is the only navigating device necessary, although the MENU, ALARM, and BACK buttons can provide shortcuts as explained later.

Passwords

Enter passwords from the Main Menu:

- Enter Password, links to the Entry screen, which is an editable screen so pressing the wheel goes to the edit mode where the password (5321) can be entered. The first (*) will be highlighted, rotate the wheel clockwise to the first number and set it by pressing the wheel. Repeat for the remaining three numbers.

  The password will time out after 10 minutes, and is cancelled if a new password is entered or the control powers down.

- Not entering a password allows access to a limited number of parameters with asterisks.

***Figure 33,* Password Menu**

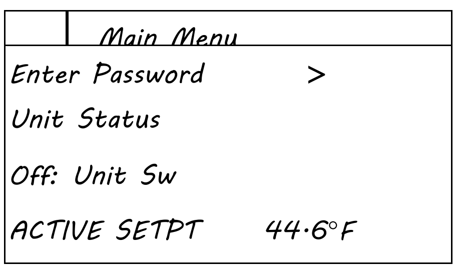
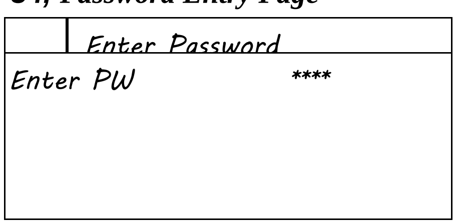


***Figure 34,* Password Entry Page**



Entering an invalid password has the same effect as not entering a password.

Once a valid password has been entered, the controller allows further changes and access without requiring the user to enter a password until either the password timer expires or a different password is entered. The default value for this password timer is 10 minutes.

Navigation Mode

When the navigation wheel is turned clockwise, the cursor moves to the next line (down) on the page. When the wheel is turned counter-clockwise the cursor moves to the previous line (up) on the page. The faster the wheel is turned the faster the cursor moves. Pushing the wheel acts as an “Enter” button.

Three types of lines exist:

- Menu title, displayed in the first line as in Figure .
- Link (also called Jump) having an arrow (>) in the right of the line and used to link to the next menu.
- Parameters with a value or adjustable setpoint.

For example, “Time Until Restart” jumps from level 1 to level 2 and stops there.

When the Back Button is pressed the display reverts back to the previously displayed page. If the Back button is repeatedly pressed the display continues to revert one page back along the current navigation path until the “main menu” is reached.

When the Menu (Home) Button is pressed the display reverts to the “main page.”

When the Alarm Button is depressed, the Alarm Lists menu is displayed.

Edit Mode

The Editing Mode is entered by pressing the navigation wheel while the cursor is pointing to a line containing an editable field. Once in the edit mode pressing the wheel again causes the editable field to be highlighted. Turning the wheel clockwise while the editable field is highlighted causes the value to be increased. Turning the wheel counter-clockwise while the editable field is highlighted causes the value to be decreased. The faster the wheel is turned the faster the value is increased or decreased. Pressing the wheel again cause the new value to be saved and the keypad/display to leave the edit mode and return to the navigation mode.

A parameter with an “R” is read only; it is giving a value or description of a condition. An “R/W indicates a read and/or write opportunity; a value can be read or changed (providing the proper password has been entered).

Example 1: **Check Status,** for example **-**is the unit being controlled locally or by an external network? We are looking for the Unit Control Source since this is a unit status parameter, start at Main Menu and select View/Set Unit and press the wheel to jump to the next set of menus. There will be an arrow at the right side of the box, indicating that a jump to the next level is required. Press the wheel to execute the jump.

You will arrive at the Status/ Settings link. There is an arrow indicating that this line is a link to a further menu. Press the wheel again to jump to the next menu, Unit Status/Settings.

Rotate the wheel to scroll down to Control Source and read the result.

Example 2; Change a Setpoint, the chilled water setpoint for example. This parameter is designated as Cool LWT setpoint and is a unit parameter. From the Main Menu select View/Set Unit. The arrow indicated that this is link to a further menu.

Press the wheel and jump to the next menu View/Set Unit and use the wheel to scroll down to Temperatures. This again has an arrow and is a link to a further menu. Press the wheel and jump to the Temperatures menu, which contains temperatures values and setpoints. The first line is Evap LWT, rotate wheel until Cool LWT is highlighted. Press the wheel to enter edit mode. Rotate wheel until new setpoint is reached, then press wheel to accept the new value and exit edit mode.

Example 3; Clear an Alarm, from the Main Menu scroll down to the Alarms line. Note the arrow indicating this line is a link. Press the wheel to jump to the next menu Alarms There are two lines here; Alarm Active and Alarm Log. Alarms are cleared from the Active Alarm link. Press the wheel to jump to the next screen. With the first line highlighted, press the wheel to enter edit mode. Rotate wheel until AlmClr is set to On, then press wheel to clear the alarms.

Screen Content

Figure 35, No Password View Screens

Menu Level 1	Menu Level 2	Menu Level 3
Enter Password		
	Enter PW	
Unit Status		
Active Setpoint Evap Leaving Water Temp		
Unit Mode		
Time Until Restart		
	Compressor 1 Cycle Time Remaining	
	Compressor 2 Cycle Time Remaining	
Alarms		
	Alarm Active	
		Active Alarm 1
		…
		Active Alarm n
		Clear Alarms
	Alarm Log	
		Alarm Entry 1
		…
		Alarm Entry 25
		Clear Log
Scheduled Maintenance		
	Next Maintenance Month/Year	
	Service Support Reference	
About This Chiller		
	Model Number	
	G. O. Number	
	Unit Serial Number	
	Starter Model Number(s)	
	Starter Serial Number(s)	
	BSP Version	
	Application Version	
	HMI GUID	
	OBH GUID	

Figure 36, Operator View Screen

Menu Level 1	Menu Level 2	Menu Level 3	Menu Level 4
Enter Password			
Quick Menu			
View/Set Unit			
	Status/Settings		
	Set-Up		
	Temperatures		
	Date/Time/Schedules		
	Power Conservation		
	Alarm Limits		
	Ctrlr IP Setup		
	Design Conditions		
	Menu Password		
View/Set Circuit			
	Circuit #1		
	Circuit #2		
		Data	
		Compressor 1	
			Data
			Motor
			Oil Sump
		Exv	
Unit Status			
Active Setpoint			
Evap Leaving Water Temp			
Unit Mode			
Time Until Restart			
Alarms			
	Alarm Active		
	Alarm Log		
	Event Log		
		Unit Power Restore	
		Circuit #1	
		Circuit #2	
Scheduled Maintenance			
About This Chiller			

Figure 37, Manager View Screen

Menu Level 1	Menu Level 2	Menu Level 3	Menu Level 4
Enter Password			
Quick Menu			
View/Set Unit			
	Status/Settings		
	Set-Up		
	Temperatures		
	VFD Setup		
	Date/Time/Schedules		
	Power Conservation		
	Alarm Limits		
	Calibrate Sensors		
	Configuration		
	Ctrlr IP Setup		
	Design Conditions		
		Evap Approach @ Design	
		Cond Approach @ Design	
	Menu Password		
View/Set Circuit			
	Circuit #1		
	Circuit #2		
		Data	
		Compressor 1	
			Data
			Motor
			Oil Sump
			IGV/DDC
			VFD Setup
		Exv	
		Calibrate Sensors	
Unit Status			
Active Setpoint			
Evap Leaving Water Temp			
Unit Mode			
Time Until Restart			
Alarms			
	Alarm Active		
	Alarm Log		
	Event Log		
		Unit Power Restore	
		Circuit #1	
		Circuit #2	
Scheduled Maintenance			
Review Operation			
	Alarm Active		

	Alarm Log
	Unit Status/Settings
	Circuit 1 Status/Settings
	Circuit 2 Status/Settings
	Scheduled Maintenance
Manual Control	
	Unit
	Circuit 1 Compressor 1
	Circuit 2 Compressor 1
Commission Unit	
	About Chiller
	Configure Unit
	Set-Up
	Date/Time/Schedules
	Power Conservation
	Alarm Limits
	Calibrate Unit Sensors
	Calibrate Circuit Sensors
	Ctrlr IP Setup
	Alarm Active
	Alarm Log
	Scheduled Maintenance
	Save Parameters
	Unit Manual Control
	C1 Manual Control
	C2 Manual Control
About This Chiller	

Setpoints

Table 20, Unit Setpoints

Description	Default	Range	Password
Unit			
Unit Enable	OFF	OFF, ON	O
Number of Cir	2	1 to 2	T
Number of Comp	2	1 to 2	
Pbus Address			
Unit Mode	COOL	COOL, ICE, HEAT, TEST	O
Available Modes	COOL	Cool, Cool w/Glycol, Cool/Ice, Ice, Cool/Heat, Heat	T
Control Source	Local	LOCAL, Network, Inputs	O
Display Units	°C/kPa	°C/kPa, °F/psi	O
Alarm Output	All Alarm	Alarms, Safety Only	
Lift Factor	0.09	0.00 to 2.00	
External Fault Input	0		
Cool LWT	44. 0°F	35.0 to 80.0 °F	O
Ice LWT	25. 0°F	15.0 to 35.0 °F	O
Heat LWT	135. 0°F	100.0 to 150.0 °F	O
Startup Delta T	3.0°F	0.0 to 10.0 °F	O
Shutdown Delta T	3.0°F	0.0 to 3.0 °F	O
LWT Reset Type	NONE	NONE, RETURN, 4-20mA	M
Max Reset Delta T	0.0°F	0.0 to 20.0 °F	M
Start Reset Delta T	10. 0°F	0.0 to 20.0 °F	M
Evap Recirculate	30 sec	0.2 to 5 min	M
Evap Pump Control	Pump #1 Only	Pump #1 Only, Pump #2 Only, Auto Lead, #1 Primary, #2 Primary	M
Cond Pump Control	Pump #1 Only	Pump #1 Only, Pump #2 Only, Auto Lead, #1 Primary, #2 Primary	M
Maximum Pull down Rate	0.5 °F/min	0.1 to 5.0 °F/min	M
Minimum Pull down Rate	0.1 °F/min	0.0 to 5.0 °F/min	M
Maximum Compressor Run	1	1 to 16	M
Stage Delta T	1	0.5-5.0	M
Language	ENGLISH	ENGLISH,	O
Unit Offset			
Evap LWT Offset	0	-5 to 5 °C	
Evap EWT Offset	0	-5 to 5 °C	
Cond LWT Offset	0	-5 to 5 °C	
Cond EWT Offset	0	-5 to 5 °C	

Continued next page.

Description	Default	Range	Password
Global Circuit			
Electronic Expansion Valve			
Exv Control	Cond Delta T	Cond Delta T, Evap Delta T	
SH Drop out	55.5 Δ°C	0 to 55.5 Δ°C	M
WCC Cap Ratio	0.6	0.45 to 0.70	
Timers			
Start-Start	40 min	15 to 60 min	M
Stop-Start	3 min	3 to 20 min	M
Prelube Timer	30 sec	10 to 240 sce	
Unload Timer	60 sec	10 to 240 sec	T
Postlube Timer	300 sec	10 to 360 sec	T
Full Load Delay	10 sec	5 to 60 sec	
Load Cycle Time	30 sec	150 to 60 sec	
Unload Cycle Time	30 sec	150 to 60 sec	
Oil Sump Delay	10 sec	0 to 60 sec	
Motor Amps			
Demand Limit Enable	OFF	OFF, ON	O
Demand Limit Minimum Amps	40%	5 to 80%	T
Demand Limit Maximum Amps	100%	10 to 100%	T
Soft Load Enable	OFF	OFF, ON	M
Begin Amp Limit	40	10 to 100%	M
Nameplate RLA	0.0 Amps	0.0 to 2000 Amps	
Soft Load Ramp Time	5 min	1 to 60 min	M
Stage Down RLA	60%	0.0 to 99.0%	
Db Adjustment	0.0	0.0 to 0.3 Δ°C	
Capacity Balance	10.0	2 to 18	
Lead Unload Rate	6.0	2 to 18	
Balance Mode	Local Unit	Local Unit, Network Unit, Alternative	
Motor RLA Input Type	0-5V	0-5V, 0-10V, 4-20mA	
Motor RLA Maximum	125%	0.0 to 500%	
Staging			
Comp Stage Mode	Normal	Normal, Efficiency, Pump, Standby	M
Absolute Capacity	100T	0 to 9999	T
Alarms			
Low Discharge Superheat	3 °C	0.0 to 6.0 °C	
Evaporator Freeze	34.0 °F	-9.0 to 45.0 °F	T
Condenser Freeze	34.0 °F	-9.0 to 45.0 °F	T
Low Pressure Alarm	28 psi	5 to 45 psi	T
Low Pressure Hold	33 psi	7 to 45 psi	T
Low Pressure Unload	31 psi	6 to 45 psi	T

Continued next page.

Description	Default	Range	Password
High Discharge Temperature Alarm	194 °F	120 to 240 °F	T
High Discharge Temperature Load	170 °F	120 to 240 °F	T
High Pressure Alarm	140 psi	120 to 240 psi	T
Minimum RLA	40%	5 to 80 %	
Oil No Start Delta Temperature	22.2 °C	16.6 to 33.4°C	T
Maximum Oil Feed Temperature	140 °F	0 to 212 °F	T
Minimum Oil Feed Delta Temperature	16.7 °C	0 to 44.5 °C	T
Low Net Oil Pressure	22 psi	0 to 76 psi	T
Maximum Surge Slope	11.1 °C/min	0.5 to 55 °C/min	T
Surge Delta Temperature	3.3 °C	1.1 to 13.9 °C	T
Low Lift Pressure	14.0 psi	0 to 73.0 psi	T
Minimum Oil Sump Temperature	104°F	0 to 120°F	T
Maximum Oil Sump Temperature	158°F	0 to 212°F	T
Vanes Calibration Time	8 hrs	0.3 to 24 hrs	
VFD			
VFD Enable	No	No, Yes	T
VFD Minimum Speed	70	70 to 100%	T
Speed @ 0 Lift	50	0 to 100%	T
Lift @ 100% Speed	22.2∆°C	16.7 to 33.3 ∆°C	T
VFD Update	4 sec	1 to 20 sec	
VFD Output Type	4-20mA	4-20mA, 0-10Vdc	
Circuit			
Exv Gain	1	0.25 to 4.0	
Exv Offset	700.0	100.0 to 2000.0	
Exv SC Ratio	110.0	80.0 to 250.0	
Exv Offset Target	0.0	-9.0 to 9.0	
Exv Superheat Enable	True	True, False	
Exv Error Gain	0.9	0.1 to 2.0	
Exv Mode	Auto	Auto, Manual	
Exv Offset Bdi	50.0	2.0 to 500.0	
Exv Offset Bdd	100.0	2 .0 to 500.0	
Exv Offset Kd	25.0	-32.0 to 32.0	
Exv AOC Range	20.0	5.0 to 100.0	
Exv Manual Position	5.0	0.0 to 100.0	
Evaporator Pressure Offset	0.0	-100.0 to 100.0	
Condenser Pressure Offset	0.0	-100.0 to 100.0	
Liquid Line Temp Offset	0.0	-5.0 to 5	
Compressor			
Comp Stage Sequence #	1	1,2, … (# of Compressors)	M
Vane Manual Mode	0		

Continued next page.

Description	Default	Range	Password
IGV Manual Position	0		
DDC Manual Position	0		
IGV Maximum Position Stop	110%	100 to 130	
IGV Start Position	0	0 to 40%	T
DDC Minimum Position	0	0 to 40%	T
IGV Minimum Position	0	0 to 40%	T
IGV Load Gain	0.5	0.01 to 100	
IGV Unload Gain	1.0	0.01 to 100	
Save Curve			
Load Save			
Load Default			
DDC_Y1	0.0		T
DDC_Y2	16.0		T
DDC_Y3	22.0		
DDC_Y4	25.0		M
DDC_Y5	39.0		M
DDC_Y6	45.0		
DDC_Y7	100.0		T
IGV_X1	5.0		T
IGV_X2	8.0		
IGV_X3	12.0		T
IGV_X4	15.0		
IGV_X5	20.0		T
IGV_X6	25.0		
IGV_X7	32.0		T
SavedDDC_Y1	0.0		T
SavedDDC_Y2	16.0		T
SavedDDC_Y3	22.0		
SavedDDC_Y4	25.0		M
SavedDDC_Y5	39.0		M
SavedDDC_Y6	45.0		
SavedDDC_Y7	100.0		T
SavedIGV_X1	5.0		T
SavedIGV_X2	8.0		
SavedIGV_X3	12.0		T
SavedIGV_X4	15.0		
SavedIGV_X5	20.0		T
SavedIGV_X6	25.0		
SavedIGV_X7	32.0		T
VFD Mode	AUTO	AUTO, MANUAL	T
VFD Manual Speed	0	Vfd Lift Limit to 100	
VFD Gain	1.0	0.1 to 1	

Continued next page.

Description	Default	Range	Password
Suction Temp Offset	0.0	-5.0 to 5.0	
Discharge Temp Offset	0.0	-5.0 to 5.0	
Oil Feed Temp Offset	0.0	-5.0 to 5.0	
Oil Sump Temp Offset	0.0	-5.0 to 5.0	
Econ Press Offset	0.0	-100.0 to 100	
Oil Feed Press Offset	0.0	-100.0 to 100	
Oil Sump Press Offset	0.0	-100.0 to 100	
Cooling Tower			
Tower Control	None	None, Temperature, Lift	M
Tower Stages	2	1 to 4	M
Tower Stage Up Time	2 min	1 to 60 min	M
Tower Stage Down Time	5 min	1 to 60 min	M
Tower Stage Differential Temp	1.7 °C	0.6 to 5.6 °C	M
Tower Stage On Temp #1	70 °F	40 to 120 °F	M
Tower Stage On Temp #2	75 °F	40 to 120 °F	M
Tower Stage On Temp #3	80 °F	40 to 120 °F	M
Tower Stage On Temp #4	85 °F	40 to 120 °F	M
Tower Valve Setpoint Temp	18.3	4.4 to 48.9 °C	
Tower Valve Db Temp	1.1	0.6 to 5.6 °C	
Tower Stage Differential Press	6.0 psi	1.0 to 20.0 psi	M
Tower Stage On Lift #1	35 psi	10 to 130 psi	M
Tower Stage On Lift #2	45 psi	10 to 130 psi	M
Tower Stage On Lift #3	55 psi	10 to 130 psi	M
Tower Stage On Lift #4	65 psi	10 to 130 psi	M
Tower Valve Setpoint Lift	207.0	69.0 to 897.0 kPa	
Tower Valve Db Lift	14.0	7.0 to 138.0 kPa	
Tower Valve/VFD Control	None	None, Valve Setpoint, Valve Stage, VFD Stage, Valve SP/VFD Stage	M
Tower Valve Setpoint Temp	65 °F	40 to 120 °F	M
Tower Valve Setpoint Lift	30 psi	10 to 130 psi	M
Tower Valve Deadband Temp	2.0 °F	1.0 to 10.0 °F	M
Tower Valve Deadband Lift	4.0 psi	1.0 to 20.0 psi	M
Tower Stage Down @	20	0 to 100%	M
Tower Stage Up @	80	0 to 100%	M
Tower Valve Minimum Range	10	0 to 100%	M
Tower Valve Maximum Range	90	0 to 100%	M
Tower Valve Type	NC	NC, NO	M
Tower Valve Minimum Start Position	0	0 to 100%	M
Tower Valve Minimum Position Temp	60 °F	0 to 100 °F	M
Tower Valve Maximum Start Position	10	0 to 100%	M
Tower Valve Maximum Position Temp	90 °F	0 to 100 °F	M
Tower Valve Error Gain	25	10 to 99	M
Tower Valve Slope Gain	25	10 to 99	M

Condenser Water

Cooling towers used with Daikin centrifugal chillers are normally selected for maximum condenser inlet water temperatures between 75°F and 90°F (24°C and 32°C). Lower entering water temperatures are desirable from the standpoint of energy reduction, but a minimum does exist.

When the ambient wet bulb temperature is lower than design, the condenser water temperature can be allowed to fall. The resultant lower condensing temperature will improve chiller performance.

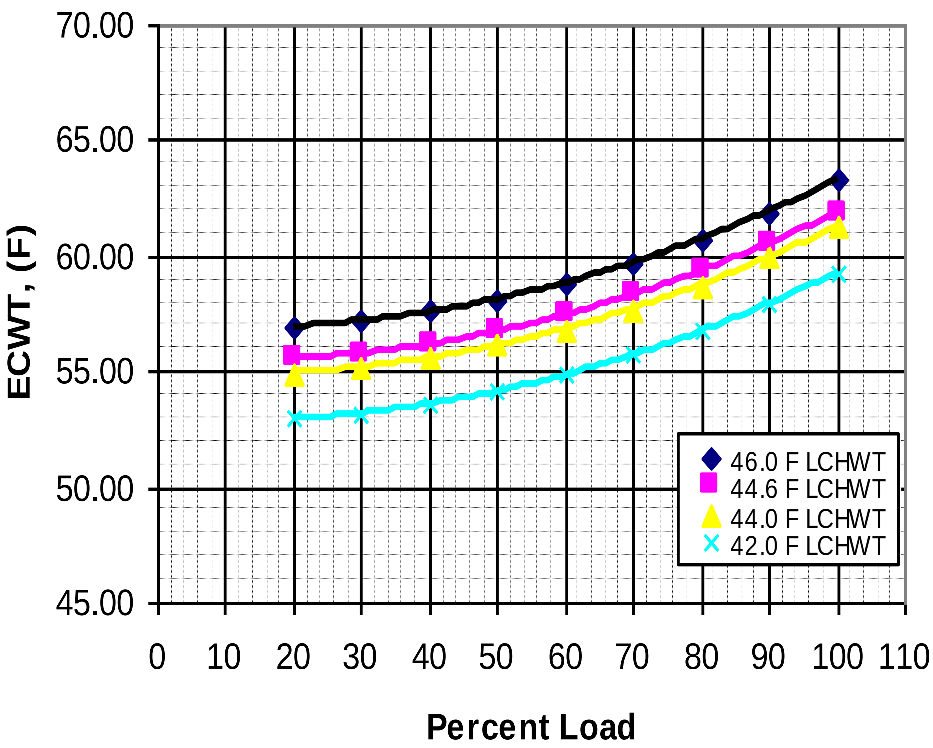
WCT chillers are equipped with electronic expansion valves (EEV) and will operate with entering condenser water temperatures as low as calculated by the following equation and shown in the chart following.

Note: Provisions or modifications need to be made in the event of inverted starts (condenser water colder than chilled water). For example, 3 way bypass valve controlled by the chiller, or tower controls.

Min. ECWT = 10.973 + LCHWT – 0.17 * $CHWDT_{FL}$(PLD/100) + 8 * (PLD/100)2

- ECWT = Entering condenser water temperature
- LCHWT = Leaving chilled water temperature
- $CHWDT_{FL}$ = Chilled Water Delta-T at full load
- PLD = The percent chiller load point to be checked

Figure 38, **Minimum Operating Entering Condenser Water Temperature (10° Range)**



Note : Some limitation in control may apply when operating chiller in the condition that ECWT is same or above but still around minimum ECWT

For example; at 44°F L**C**HWT, 10-degree F chilled water Delta-T, and 50% full load operation, the entering condenser water temperature could be as low as 56 °F.

The operating strategy for cooling tower fans requires some analysis. Regardless of power consumption considerations, the minimum allowable entering condenser water temperature must be maintained.

Depending on local climatic conditions, using the lowest possible entering condenser water temperature may be more costly in total system power consumed than the expected savings in chiller power would suggest, due to the excessive fan power required.

Even with tower fan control, some form of water flow control, such as tower bypass, is recommended and is required if fan control alone will not maintain minimum water temperatures.

Table 21, R-134a Pressure/Temperature Chart

HFC-134a Temperature Pressure Chart							
°F	PSIG	°F	PSIG	°F	PSIG	°F	PSIG
6	9.7	46	41.1	86	97.0	126	187.3
8	10.8	48	43.2	88	100.6	128	192.9
10	12.0	50	45.4	90	104.3	130	198.7
12	13.2	52	47.7	92	108.1	132	204.5
14	14.4	54	50.0	94	112.0	134	210.5
16	15.7	56	52.4	96	115.9	136	216.6
18	17.1	58	54.9	98	120.0	138	222.8
20	18.4	60	57.4	100	124.1	140	229.2
22	19.9	62	60.0	102	128.4	142	235.6
24	21.3	64	62.7	104	132.7	144	242.2
26	22.9	66	65.4	106	137.2	146	249.0
28	24.5	68	68.2	108	141.7	148	255.8
30	26.1	70	71.1	110	146.3	150	262.8
32	27.8	72	74.0	112	151.1	152	270.0
34	29.5	74	77.1	114	155.9	154	277.3
36	31.3	76	80.2	116	160.9	156	284.7
38	33.1	78	83.4	118	166.0	158	292.2
40	35.0	80	86.7	120	171.1	160	299.9
42	37.0	82	90.0	122	176.4	162	307.8
44	39.0	84	93.5	124	181.8	164	315.8

Routine Maintenance

Oil Charging

⚠ CAUTION

Improper servicing of the oil system, including the addition of excessive or incorrect oil, substitute quality oil filter, or any mishandling can damage the equipment. Only authorized and trained service personnel should attempt this service. For qualified assistance, contact your local Daikin service location. Failure to do so can cause severe compressor damage.

After the system is once placed into operation, no additional oil is required except in the event that repair work becomes necessary to the oil pump or unless a large amount of oil is lost from the system due to a leak.

During operation, the oil level must be visible in the oil sump sight glass(es). Otherwise, shut down the unit and charge oil into the sump as follows:

1. Since the system is under pressure, use a hand pump.
2. Immerse the suction of the hand pump in a clean container of Emkarate RL68H polyolester oil.
3. Connect its discharge line to the oil charging/drain valve on the condenser side of the lubricant sump.

⚠ CAUTION

The POE oil used with R-134a is hygroscopic and care must be exercised to avoid exposure to moisture (air).

4. Pump a few strokes of the oil to fill the connection line with oil to purge air just before tightening the connection at the charging valve.
5. Open the sump charging valve and bring the oil level to be visible on the sight glass.
6. Close the charging valve while the oil pump is still connected.
7. Manually start the oil pump to fill the oil lines, oil cooler and oil filter to check the "true" lubricant level since this will lower the oil level in the sump.
8. If it is necessary to make up the lost oil in the lines then shut down the oil pump and repeat steps 5 through 7.
9. After oil charging is completed and if the oil is visible on the sight glass(es) while the oil pump is operating, shut down the oil pump and disconnect the hand pump.

⚠ CAUTION

The oil heater should be immersed in oil all the time it is energized. Therefore, as a caution de-energize the oil heater during the oil charging process to minimize the possibility of damage to the oil heater.

⚠ CAUTION

When the machine is operated again, and on a regular basis during operation, the oil level must be checked to determine if oil needs to be added to maintain the proper operating level. Failure to do so can cause compressor damage.

Oil Analysis

The condition of compressor oil can be an indication of the general condition of the refrigerant circuit and compressor wear. Dark color or cloudy oil, rather than clear, is an indication of contamination and should be further investigated. An annual oil check by a qualified laboratory is essential for maintaining a high level of maintenance. It is useful to have an oil analysis at initial startup to provide a benchmark from which to compare future tests. Oil analysis has long been recognized as a useful tool for indicating the internal condition of rotating machinery and continues to be a preferred method for Daikin centrifugal chillers. The local Daikin service office can recommend suitable facilities for performing these tests.

To accurately estimate the internal condition it is essential to properly interpret the lubricant wear test results.

Most of the elements and contaminants in a system end up in the oil. Polyolester oils are excellent solvents and can readily dissolve trace elements and contaminants. Also, the polyolester oils used in R-134a chillers are more hygroscopic than mineral oils and can contain much more water in solution. For this reason, it is imperative that extra care be used when handling polyolester oils to minimize their exposure to ambient air. Extra care must also be used when sampling to ensure that sample containers are clean, moisture-free leak proof and non-permeable.

Daikin has done extensive testing in conjunction with refrigerant and oil manufacturers and has established guidelines to determine action levels and the type of action required. Table 22 on page 66 gives the upper limits for metals and moisture in the polyolester lubricants required by Daikin chillers.

Table 22, Metal and Moisture Limits in Polyolester Lubricants

ELEMENT	UPPER LIMIT (PPM)	ACTION
Aluminum	50	1
Copper	100	1
Iron	100	1
Moisture	150	2 & 3
Silica	50	1
Total Acid Number (TAN)	0.19	3

Key to Action

1) Re-sample after 500 hours of unit operation.
   a) If content increases less than 10%, change lubricant and lubricant filter and re-sample at normal interval (usually annual).
   b) If content increases between 11% and 24%, change lubricant and lubricant filter and re-sample after an additional 500 hours of operation.
   c) If content increases more than 25%, inspect compressor for cause.
2) Re-sample after 500 hours of unit operation.
   a) If content increases less than 10%, change filter-drier and re-sample at normal interval (usually annual).
   b) If content increases between 11% and 24%, change filter-drier and re-sample after an additional 500 hours of operation.
   c) If content increases more than 25%, monitor for a water leak.

   Since POE lubricants are hygroscopic, many times the high moisture level is due to inadequate handling and packaging. The TAN reading ***MUST BE USED*** in conjunction with moisture readings

3) If TAN is less than 0.10, system is safe as far as acid is concerned.
   a) For TAN between 0.10 and 0.19, re-sample after 1000 hours of operation.
   b) For TAN above 0.19, change lubricant, lubricant filter, and filter-drier and resample at normal interval

In general Daikin International does not recommend changing oil and filters on a periodic basis. The need should be based on a careful consideration of oil analysis, vibration analysis and knowledge of the operating history of the equipment. A single oil sample is not sufficient to estimate the condition of the chiller. Oil analysis is only useful if employed to establish wear trends over time. Changing oil and the filter prior to when its needed will reduce the effectiveness of oil analysis as a tool in determining machinery condition.

The following metallic elements or contaminates and their possible sources will typically be identified in an oil wear analysis.

Aluminum

Typical sources of aluminum are impellers, seals or casting material. An increase in aluminum content in the lubricant may be an indication of impeller or other wear. A corresponding increase in other wear metals may also accompany an increase in aluminum content.

Copper

The source of copper can be the evaporator or condenser tubes, copper tubing used in the lubrication system such as oil cooler lines, scroll or motor drain lines or motor cooling systems or residual copper from the manufacturing process. The presence of copper may be accompanied by a high TAN (total acid number) and high moisture content. Lubricants containing an anti-wear formulation might react with copper and result in high copper content in the oil.

Iron

Iron in the oil may originate from compressor castings, oil pump components, shells, tube sheets, tube supports, shaft material and rolling element bearings.

Zinc

The source, if any may be from additives in lubricant.

Silicon

Silicon can originate from residual particles of silicon left from the manufacturing process, filter drier material, or dirt.

Moisture

Moisture in the form of dissolved water can be present in lubricating oil to varying degrees. Some polyolester lubricants may contain up to 50 parts per million (ppm) of water from new unopened containers. Other sources of water may be the refrigerant (new refrigerant may contain up to 10 ppm water), leaking evaporator or condenser tubes, or moisture introduced by the addition of either contaminated oil or refrigerant or improperly handled oil.

Liquid R-134a has the ability to retain up to 1400 ppm of water in solution at 100° F. With 225 ppm of water dissolved in liquid R-134a, free water would not be released until the liquid temperature reached -22° F. Liquid R-134a can hold approximately 470 ppm at 15°F (an evaporator temperature which could be encountered in ice applications). Since free water is what causes acid production, moisture levels should not be of a concern until they approach the free water release point.

A better indicator of a condition which should be of concern is the TAN (Total Acid Number). A TAN below 0.09 requires no immediate action. TANs above 0.09 require certain actions. In the *absence* of a high TAN reading and a regular loss of oil (which may indicate a heat transfer surface leak), a high moisture content in an oil analysis is probably due to handling or contamination of the oil sample. It should be noted that air (and moisture) can penetrate plastic containers. Metal or glass containers with gasket in the top will slow moisture entry.

In conclusion, a single element of an oil analysis should not be used as the basis to estimate the overall internal condition of a Daikin chiller. The characteristics of the oil and refrigerant, and knowledge of the interaction of wear materials in the chiller must be considered when interpreting a wear metal analysis. Periodic oil analysis performed by a reputable laboratory and used in conjunction with compressor vibration analysis and operating log review can be helpful tools in estimating the internal condition of a Daikin chiller.

Daikin recommends that an oil analysis be performed annually. Professional judgment must be exercised under unusual circumstances, for example, it might be desirable to sample the oil shortly after a unit has been placed back into operation after it has been opened for service, as recommended from previous sample results or after a failure. The presence of residual materials from a failure should be taken into consideration in subsequent analysis. While the unit is in operation, the sample should be taken from a stream of oil, not in a low spot or quiet area.

Changing Oil Filters

The oil filter in these compressors can be changed by simply isolating the filter cavities. Close the oil discharge line service valve and the oil pressure regulator valve**.** Remove any refrigerant using EPA approved methods**,** Remove the filter cover, remove the filter and replace with new element. Reopen the valve in the pump discharge line and purge air from the lubricant filter cavity. Re-adjust the oil pressure regulator valve for the right pressure differential setting @ 50psi (50Hz) / 36psi (60Hz) after starting the oil pump manually and before restarting the chiller.

Refrigerant Cycle

Maintenance of the refrigerant cycle includes maintaining a log of the operating conditions, and checking that the unit has the proper lubricant and refrigerant charge.

At every inspection, all system pressures and temperatures should be recorded on a copy of the Log Sheet on page 92.

The first stage suction temperature at the compressor should be taken at least once a month. Subtracting the saturated temperature equivalent of the suction pressure from this will give the suction superheat. Extreme changes in subcooling and/or superheat over a period of time may indicate losses of refrigerant or possible deterioration or malfunction of the expansion valves. Proper superheat setting is 0 to 2 degree F (1.0 degree C) at full load. Such a small temperature difference can be difficult to measure accurately. Another method is to measure the compressor discharge superheat, the difference between the actual second stage discharge temperature and the saturated condenser temperature. The discharge superheat should be between 13 and 16 degrees F (7 to 9 degrees C) at full load.

The MicroTech III interface panel can display all superheat and subcooling temperatures.

Electrical System

Maintenance of the electrical system involves the general requirement of keeping contacts clean and connections tight and checking on specific items as follows:

1. The compressor current draw should be checked and compared to nameplate RLA value. Normally, the actual current will be lower, since the nameplate rating represents full load operation. Also check all pump and motor amperages, and compare with nameplate ratings.
2. Inspection must verify that the lubricant heaters are operative. The heaters are insert-cartridge type and can be checked by ammeter reading. They should be energized whenever power is available to the control circuit, when the lubricant temperature sensor calls for heat, and when the compressor is inoperative. When the compressor runs, the heaters are de-energized. The Digital Output screen and second View screen on the operator interface panel both indicate when the heaters are energized.
3. At least once a quarter, all equipment protection controls except compressor overloads should be made to operate and their operating points checked. A control can shift its operating point as it ages, and this must be detected so the controls can be adjusted or replaced. Pump interlocks and flow sensors should be checked to be sure they interrupt the control circuit when tripped.
4. The motor starter contactors should be maintained per starter manufacturer's recommendations.
5. The compressor motor resistance to ground should be checked and logged annually. This log will track insulation deterioration. A reading of 50 megohms or less indicates a possible insulation defect or moisture and must be further checked.
6. The centrifugal compressor must rotate in the direction indicated by the arrow on the back of the motor as viewed through the rotation sight glasses located in the rear motor cover.

⚠ CAUTION

Never meg a motor while in a vacuum. Severe motor damage can result. It is recommended to meg the motor after 24 hours of sitting idle at ambient temperature

⚠ CAUTION

Anytime external leads from motor are removed for servicing etc. the compressor must be jogged to check rotation after leads are reconnected at the start-up.

Equipment Cleaning and Preserving

A common cause of service calls and equipment malfunction is dirt. This can be prevented with normal maintenance. The system components most subject to dirt are:

1. Permanent or cleanable filters in the air handling equipment must be cleaned in accordance with the manufacturer's instructions; throwaway filters should be replaced. The frequency of this service will vary with each installation.
2. Remove and clean strainers in chilled water system and condenser water system at every inspection.

Seasonal Servicing

Prior to shutdown periods and before starting up again, the following service procedures must be completed.

Annual Shutdown (Including Other Nonscheduled Extended Shutdown)

Where the chiller can be subject to freezing temperatures, the chiller must be drained of all water. Water permitted to remain in the piping and vessels can rupture these parts if subjected to freezing temperature. The condenser and evaporator are not self-draining and therefore, first drain the condenser and evaporator heads. Then, remove the heads and blow dry air through the evaporator and condenser tubes to force out all water out.

1. Take measures to prevent the shutoff valve in the water supply line from being accidentally turned on.
2. If a cooling tower is used, and if the water pump will be exposed to freezing temperatures, be sure to remove the pump drain plug and leave it out so any water that can accumulate will drain .
3. Open the compressor disconnect switch, and remove the fuses**.** If the transformer is used for control voltage, the disconnect switch must remain on to provide power to the oil heater**.** Set the manual UNIT ON/OFF switch in the unit control panel to the OFF position.
4. Check for corrosion and clean and paint rusted surfaces.
5. Clean and flush the water tower. Make sure tower blowdown or bleed-off is operating. Set up and use a good maintenance program to prevent scaling of both tower and condenser. It should be recognized that atmospheric air contains many contaminants that increase the need for proper water treatment. The use of untreated water can result in corrosion, erosion, sliming, scaling or algae formation. It is recommended that the service of a reliable water treatment company be used. Daikin assumes no responsibility for the results of untreated or improperly treated water.
6. Drain water from the chiller and remove water heads at least once a year to inspect the condenser and evaporator tubes and clean if required.
7. Test all chiller joints with an R-134a compatible electronic leak detector to be sure all joints are tight. All leaks found should be repaired before a prolonged shutdown for a season.

Tube Fouling and Cleaning

Fouling is generally defined as the deposit of solid insulating material on a heat transfer surface, or accumulation of unwanted material on solid surfaces. Over a period of time, due to poor water quality caused by dirty strainers, unclean cooling tower conditions or environmental factors, drawing water from lakes, rivers, and oceans, moisture or acidic conditions for tube corrosion may exist. An accumulation of rust, debris, aquatic organisms or sludge inside the tubes may plug tubes and will decrease heat transfer. The formation of thin mineral compounds or "scaling" such as calcium carbonate, manganese compounds and silicates build up on the inner tube surfaces are other type of deposits will cause tube fouling and poor heat transfer. The fouling results in a raised tube temperature and condensing saturation temperature, with a resulting increase in the system power requirement.

Once formed, scale must be treated chemically with an acid solution treated water to remove these types of hard deposits.   Tubes can be cleaned with a nylon brush.

⚠ CAUTION
Do not clean with a steel bristle brush, which can cause tube damage. Always clean with a brush before acid cleaning of tubes. Cleaning tubes with water and brush together will improve results

⚠ CAUTION
Acid cleaning of tubes must only be performed by authorized and trained service personnel. For qualified assistance, contact your local Daikin Factory Service office.

Types of In-Tube Fouling :

1) *Biological* : The attachment of macro- and/or micro-organisms to the heat transfer surfaces. slime deposits such as bacteria, fungi and algae.

2) *Particulate* : The accumulation of finely divided solids suspended in the fluid onto the heat transfer surface. Formation of agglomerates (a jumbled mass or collection) at low velocities. Airborne particles in cooling towers, rusting in pipes. Impurities such as chemicals, salts, pollutants, dirt, rust are typically contained in the cooling water flowing inside a tube will adhere to the tube inner surface. These impurities cause fouling in the heat transfer tubes after a period of time and reduces the heat transfer across the tube wall.

Particulate fouling occur in evaporators.

3) *Precipitation (Scale)* : The precipitation of dissolved substances on the heat transfer surface. When the dissolved substances have inverse rather than normal solubility – vs. – temperature behavior, the precipitation occurs on superheated rather than subcooled surfaces and the process is often referred to as scaling. *Warmer the surface less soluble*. Deposits on cold surfaces if bulk solubilities are exceeded. In precipitation fouling, which may occur simultaneously with particulate fouling, chemicals (dissolved solids) that are contained in the cooling water will deposit on the inner surface of the tube if the concentration of the chemicals is higher than the solubility limit at the water temperature. The precipitation of the chemicals onto the warmer tube inner surface is caused by this reverse solubility of the chemicals typically found in cooling water. The presence of precipitate fouling often results in an increase in the rate of particulate fouling, because particles such as rust or dirt will more easily adhere to the inner tube surface if chemicals have already adhered to the inner tube surface.

Fouling of the precipitation type is not as large of a problem in evaporators as in condenser because the tube walls have a lower temperature than the water circulating inside. Because of the lower temperature of the tube walls, the chemicals do not undergo inverse solubility as they do in the condenser.

4) *Corrosion* : Corrosion of the heat transfer surface that produces products fouling the surface and/or roughens the surface, promoting attachment of other foulants.Causes surface roughness, adds corrosion products and promotes combinations of several fouling types.

5) *Chemical Reaction* : Deposits formed on the surface by a chemical reaction not involving the surface material.

6) *Freezing* : The solidification of a liquid or some of its higher – melting point constituents on the heat transfer surface. Freezing fouling is due to the solidification of vapor condensing from the gas stream onto a below-freezing temperature heat transfer surface.

Examples of harmful deposits (tubercles) are:

- High amount of iron or metallic deposits due to corrosion occurring inside the iron/carbon steel piping in the water circuit can be carried by the water to the tubes. These metallic deposits often adhere or fuse themselves to the tube.
- Molybdenum which is used as an iron corrosion inhibitor in water systems.
- Sulfur which is known as an aggressive element in corrosion reactions, is a result of environmental factors transferred to the water systems such as acid rain, auto exhaust etc.

The signs of tube fouling due to deposits can be observed as a decrease of evaporator capacity and an increase of evaporator and/or condenser small temperature difference. In addition, lubricant loss to the evaporator and refrigerant leak will also deteriorate the performance of evaporator. Therefore, it is usually hard to isolate tube fouling as the only main cause for bad evaporator performance.

Water velocity, turbulence, or high temperature will cause erosion and combined with metal loss created by corrosion might cause condenser tube foul.

Tube Leak Detection

Tubes can be ruptured or broken due to vibration, freezing, or corrosion etc.. Depends on the shell and tube side pressures refrigerant might leak through the tubes to the cooling tower or water might enter the shells.

Refrigerant leaks from the tubes can be detected at the heads using a refrigerant leak detector whereas water leaks in the shells can be detected visually through the sight glasses or poor chiller capacity.

Eddy current testing is recommended based on site conditions to determine any defective tubes.

Annual Startup

A dangerous condition can exist if power is applied to a faulty compressor motor starter that has been burned out. This condition can exist without the knowledge of the person starting the equipment.

This is a good time to check all the motor winding resistance to ground. Semi-annual checking and recording of this resistance will provide a record of any deterioration of the winding insulation. All new units have well over 100 megohms resistance between any motor terminal and ground.

Whenever great discrepancies in readings occur, or uniform readings of less than 50 megohms are obtained, the motor cover must be removed for inspection of the winding prior to starting the unit. Uniform readings of less than 5 megohms indicate motor failure is imminent and the motor should be replaced or repaired. Repair before failure occurs can save a great deal of time and labor spent in the cleanup of a system after a motor burnout.

1. The control circuit must be energized at all times, except during service. If the control circuit has been off and lubricant is cool, energize lubricant heaters and allow 8 hours for heater to remove refrigerant from the lubricant before starting.
2. Check and tighten all electrical connections.
3. Replace the drain plug in the cooling tower pump if it was removed at shutdown time the previous season.
4. Install fuses in main disconnect switch (if removed).
5. Reconnect water lines and turn on supply water. Flush condenser and check for leaks.
6. Refer to the startup section of this manual before energizing the compressor circuit.

Repair of System

⚠ NOTE

It is at utmost importance that all local, national, and international regulations concerning the handling and emission of refrigerants are observed.

Pumping Down

If a major repair is necessary on the chiller other than condenser, refrigerant charge can be isolated and stored in the condenser of the related circuit by pumping down. When pumping the system down, extreme care must be used to avoid damage to the evaporator of the corresponding circuit from freezing. Always make sure that full water flow is maintained through the evaporator and condenser while pumping down. To pump the system down, close the main liquid line valve and set the MicroTech III control to the manual load. The vanes must be open while pumping down to avoid a surge or other damaging condition. Pump the unit down until the MicroTech III controller cuts out at approximately 26 psig. It is possible that the unit might experience a mild surge condition prior to cutout. If this should occur, immediately shut off the compressor. Then, close the following lines only after the compressor stops:

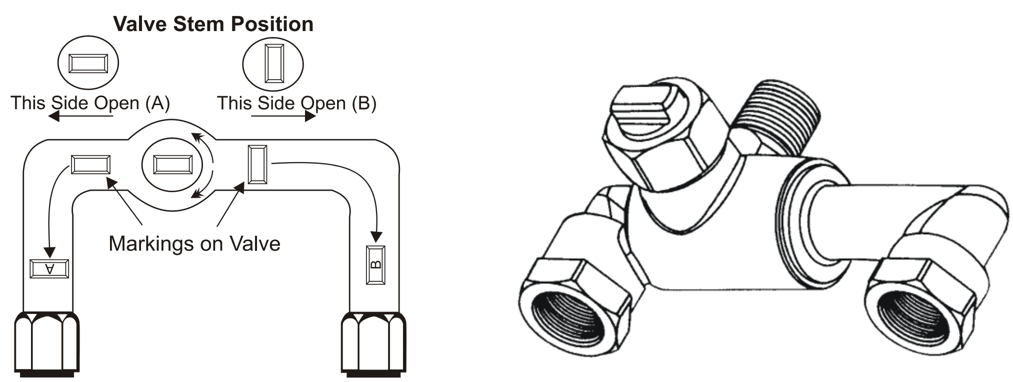
1. Oil cooling supply line
2. Motor cooling supply line
3. Eductor gas supply line
4. First stage/scroll drain line

Use a portable recovery unit to complete the pump down, condense the refrigerant, and pump it into the condenser or pumpout vessel using approved procedures.

Pressure Relief Valve Replacement

Relief valves are separated by a three-way shutoff valve on the vessel. This three-way valve allows either relief valve to be shut off, but at no time can both be shut off. This makes it possible to replace the a relief valve while the refrigerant charge is still in the condenser.

***Figure 39*, Evaporator and Condenser 3-Way Valve**



⚠ WARNING

Under no circumstances should relief valves be replaced while the unit is running. Property damage, severe personal injury, or death can result.

Leak Testing

After a service repair**,** the unit must be checked for leaks prior to recharging the complete system. This can be done by charging enough refrigerant R-134a into the system to build the pressure up to approximately 10 psig (69 kPa) and adding sufficient dry nitrogen to bring the pressure up to a maximum of 125 psig (860 kPa). Leak test with an R-134a compatible electronic leak detector to be sure all joints are tight. Halide leak detectors do not function with R-134a.

Leak testing should be focused on the areas worked on. Leaks around tubing or fitting connections can often be stopped by simply tightening them. However, for any leaks that are found in welded or brazed joints, or if it is necessary to replace a gasket, relieve the test pressure in the system before proceeding. Brazing is required for copper joints.

After it has been determined that there are no refrigerant leaks, the system must be evacuated as described in the following section starting from step 3 in the following Evacuation section.

⚠ WARNING

Do not use oxygen or a mixture of refrigerants and air to build up pressure as an explosion can occur causing serious personal injury.

Evacuation of the System

If there is a need for major service work on the chiller or on the condenser for any of the circuits and the whole charge must be evacuated then proceed as follows:

1) Connect the service valve at the bottom of the condenser to the refrigerant cylinder and start taking charge out while running the unit at full load with high condenser water inlet temperature until the unit shuts down on low evaporator pressure.

2) Continue taking liquid charge out after shutdown while circulating warm condenser water in the unit to keep the condenser pressure higher than the cylinder pressure.

3) Once the pressures between the cylinder and unit equalizes, connect a recovery unit with a capacity that will reduce the vacuum to the acceptable EPA standards.

4) An electronic or other type of micron gauge, must be connected at the farthest point from the vacuum pump. For readings below 1000 microns, an electronic or other micron gauge must be used.

5) To improve evacuation circulate warm water not to exceed 122 °F (50 °C) through the condenser and evaporator tubes to thoroughly dehydrate the shells. A portable water heater can be employed as an alternative source for hot water. A suggested method is to connect a hose between the source of hot water under pressure and the evaporator head drain connection, out the evaporator vent connection, into the condenser head drain and out the condenser vent back to the inlet of the water heater.

6) The triple evacuation method may be necessary due to severe contamination of the refrigerant.

7) The system is first evacuated to approximately 500 microns. Dry nitrogen is then added to the system to bring the pressure up to zero pounds.

8) Then the system is once again evacuated to approximately 500 microns.

9) After evacuation is completed to 500 microns, a vacuum hold test should be conducted.

10) Close the condenser service valve to the vacuum pump and hold the vacuum in the system for 4 hours. The slightest rise in pressure is an indication of either a leak to the atmosphere or the moisture in the chiller or both. If, after 4 hours the micron gauge has not risen above 1000 microns, the system may be considered tight.

11) If the vacuum hold test fails then do another leak test.

12) If the vacuum hold test fails use Table 32 to determine if the failure is due to a leak or water/moisture in the unit. If the vacuum level rises above water saturation point then do another leak test. If it stops at water saturation temperature, continue evacuation until dry or source determined.

Table 23, Pressure Chart

GAGE PRESSURE	ABSOLUTE PRESSURE				WATER TEMPERATURE AT SATURATION °F
VACUUM in. Hg	psia	in. Hg	mm Hg	Microns	
0	14.696 (Std. at Sea Level)	29.921	760	760,000	212 (Water Boiling Temperature)
10.24	9.668	19.68	500	500,000	192
22.05	3.867	7.87	200	200,000	152
25.98	1.934	3.94	100	100,000	125
27.95	0.967	1.97	50	50,000	101
28.94	0.483	0.98	25	25,000	78
29.53	0.193	0.39	10	10,000	52
29.72	0.097	0.20	5	5,000	34
29.74	0.089	0.18	4.58	4,580	32 (Water Freezing Temperature)
29.842	0.039	0.08	2	2,000	15
29.882	0.019	0.04	1	1,000	1
29.901	0.010	0.02	0.50	500	-11
29.909	0.006	0.01	0.30	300	-20
29.917	0.002	0.004	0.10	100	-38
29.919	0.001	0.002	0.05	50	-50
29.9206	0.0002	0.0004	0.01	10	-73
29.921	0	0	0.00	0	

Notes:

1. psia (pounds per square inch absolute): sum of gage and atmospheric pressures
2. psig (pounds per square inch gage): pressure over atmospheric pressure
3. vacuum: pressure below atmospheric *i.e.* negative gage pressure (always stated as positive numbers)
4. in. Hg: inches of mercury, mm Hg: millimeters of mercury

Charging the System

WCT water chillers are leak tested at the factory and the correct charge of refrigerant is indicated on the nameplate.

In the event the refrigerant charge was lost due to leak(s) or the unit exhibits a lack of performance due to insufficient amount of charge, the system should be charged or trimmed**.**

In order to ease the evacuation, charging and trimming, service connection valves are provided at the top and bottom of condenser and evaporator and at the bottom of economizer as well as sight glasses on the evaporator, economizer, and condenser.

If there are any leaks found then first repair the leaks.

If the system is evacuated due to service and is still under a vacuum then in order to put charge back into the system follow these steps which are applicable for both circuits :

1. Make up a suitable charging connection from new copper tubing or yellow jacket/flexible hose to fit between the chiller charging valve and the fitting on the refrigerant charging cylinder. This connection should be as short as possible but long enough to permit sufficient flexibility for charging cylinders.

2. Stand the refrigerant cylinder with the connection up. In order to avoid possibility of freezing the liquid within the evaporator tubes when charging an evacuated system, only refrigerant vapor from the top of the refrigerant cylinder must be admitted first.
3. Just before connecting the charging line to the service valve on top of the evaporator, open the valve on the cylinder and purge any air in the charging line.
4. After purging the charging connection and connecting the line to the evaporator, keep the evaporator service valve closed while the cylinder valve is open. The charging line should be filled with refrigerant and with very little or no air at this point.

⚠ NOTE
While charging, every precaution must be taken to prevent moisture laden air from entering the system.

5. Turn on both the cooling tower water pump and chilled water pump and allow water to circulate through the chiller. In order to lower the chiller system pressure, low water temperature is recommended to accelerate the charging. Chiller system pressure as well as refrigerant cylinder pressure should be monitored during charging process. Make sure the cylinder pressure is always higher than the chiller system pressure in order to maintain refrigerant flow by pressure differential.
6. If there is oil in the oil sump, then energize the oil heater before charging with any refrigerant. This will keep the oil hot and prevent any refrigerant concentration in the oil by boiling of the refrigerant from the oil.
7. Then open the service valve on top of the evaporator to the mid-position and break the vacuum with refrigerant gas to a saturated pressure above the point corresponding to the freezing point of the liquid to avoid the possibility of freezing liquid within the evaporator tubes. If the liquid is water, then the system pressure corresponding to the freezing point would be 28 psig (0.19 MPaG) for R-134a (at sea level). Therefore, keep charging with refrigerant vapor until the chiller pressure is well above 28 psig.
8. After the chiller pressure is above 28 psig by gas charging, the rest of the charge could be put into the system by refrigerant liquid form and without water circulation even though running water pumps until the end of charging process is strongly recommended.
9. Reconnect the refrigerant cylinder and charging line to the service valve on the bottom of the evaporator. Again purge the connecting line, stand the cylinder with the connection up, and place the service valve in the open position.
10. At some point both the chiller and cylinder pressures might equalize with each other during the charging process and in return that might slow or stop the process. However, there a few ways to prevent situations like this (see #11 – 14 below).
11. Circulate cold water through the evaporator and condenser tubes to keep the chiller system pressure lower.
12. If there is a crane in the facility, invert the charging cylinder and elevate the cylinder above the evaporator. With the cylinder in this position, valves open, water pumps operating, liquid refrigerant will flow into the evaporator by gravitational force.
13. If there is no crane capability in the facility, heat lamps are recommended to heat the cylinder to raise the pressure. A recovery unit can be used to create a pressure difference.
14. If there are no crane or heat lamps available, then start the chiller and run at part load and low condenser water temperature. Low evaporator pressure will improve and accelerate the rest of the charging rapidly.

If charge needs to be added to improve performance, repeat Step 8 above while the chiller is running at full load capacity and check the refrigerant charge level through sight glasses. The level on the condenser sight glass should be about an inch above the subcooler trough cover plate without any condenser tubes at the bottom immersed in the liquid, and about an inch above the evaporator tubes all wetted but not totally immersed. Capacity of the chiller and discharge superheat should also be monitored through the main control console in order to manage the process.

If charge needs to be taken out during trimming for optimum performance then repeat Step 8 with connection to the bottom of the condenser during running at high load/high head condition or at full load with high condenser water inlet temperature. The refrigerant charge level and capacity should be monitored as explained above in order to regulate trimming.

⚠ NOTE

Record the charge amount and level of charge in the evaporator and condenser sight glasses if refrigerant amount has been changed.

Maintenance Schedule

Maintenance Check List Item	Daily	Weekly	Monthly	Quarterly	Annually	5-Yr	As Req'd
I. Unit							
· Operational Log	O						
· Analyze Operational Log		O					
· Refrigerant Leak Test Chiller					O		
· Test Relief Valves or Replace						X	
II. Compressor							
· Vibration Test Compressor					X		
A. Motor							
· Meg. Windings (Note 2)					X		
· Ampere Balance (within 10% at RLA)		O					
· Terminal Check (Infrared temperature measurement)					X		
· Motor Cooling Filter Drier Pressure Drop					X		
B. Lubrication System							
· Lubricant Appearance (clear color, quantity)		O					
- Lubricant Filter Pressure Drop			O				
· Lubricant Analysis (Note 6)					X		
· Lubricant change if indicated by lubricant analysis							X
III. Controls							
A. Operating Controls							
· Calibrate Temperature Transducers					X		
· Calibrate Pressure Transducers					X		
· Check Vane Control Setting and Operation					X		
· Verify Motor Load Limit Control					X		
· Verify Load Balance Operation					X		
· Check Lubricant Pump Contactor					X		
B. Protective Controls							
· Test Operation of:							
Alarm Relay					X		
Pump Interlocks					X		
Guardistor and Surgeguard Operation					X		
High and Low Pressure Cutouts					X		
Lubricant Pump Pressure Differential Cutout					X		
Lubricant Pump Time Delay					X		

Continued on next page.

Maintenance Schedule, Cont.

Maintenance Check List Item	Daily	Weekly	Monthly	Quarterly	Annually	5-Yr	Or As Req'd
IV. Condenser							
A. Evaluation of Temp Approach (NOTE 3)			O				
B. Test Water Quality			O				
C. Clean Condenser Tubes (NOTE 3)					X		X
D. Eddy current Test - Tube Wall Thickness						V	
E. Seasonal Protection							X
V. Evaporator							
A. Evaluation of Temp Approach (NOTE 3)			O				
B. Test Water Quality					V		
C. Clean Evaporator Tubes (NOTE 3)							X
D. Eddy current Test - Tube Wall thickness						V	X
E. Seasonal Protection							X
VI. Starter(s) – See vendor requirements							

KEY:

O = Performed by in-house personnel.

X = Performed by Daikin authorized service personnel. (NOTE 5)

V = Normally performed by third parties.

NOTES:

1. It is recommended that the operator maintain an operating log for each individual chiller unit. In addition, a separate maintenance log should be kept of the periodic maintenance and servicing activities.
2. Some compressors use power factory correction capacitors and all have a surge capacitor (excepting units with solid state starters). The surge capacitor can be installed out of sight in the compressor motor terminal box. In all cases, capacitors must be disconnected from the circuit to obtain a useful megger reading. Failure to do so will produce a low reading. In handling electrical components, only fully qualified technicians must attempt service.
3. Approach temperature (the difference between the leaving water temperature and the saturated refrigerant temperature) of either the condenser or evaporator is a good indication of tube fouling, particularly in the condenser, where constant flow usually prevails. Daikin's high efficiency heat exchangers have very low design approach temperatures, in the order of one to one and one half degrees F.

   It is recommended that benchmark readings (including condenser pressure drop to confirm future flow rates) be taken during startup and then periodically afterward. An approach increase of two-degrees or more would indicate that excessive tube fouling could be present. Higher than normal discharge pressure and motor current are also good indicators
4. Evaporators in closed fluid circuits with treated water or anti-freeze are not normally subject to fouling; however it is prudent to check the approach periodically. Evaporators in open systems may require additional evaporator cleaning.
5. Not part of standard initial warranty service.
6. Lubricant filter change and compressor teardown and inspection should be done based on the results of the annual lubricant test performed by a company specializing in this type of test. Consult Daikin Factory Service for recommendations.

EVAPORATOR :

SYMPTOM	RESULTS	Possible Cause	Remedy
Extreme Low Suction Pressure	High Evaporator Approach Temperature with High Discharge Temperature	Low Charge	Check for leaks and add charge
		EXV problem	Remove obstruction
	High Evaporator Approach Temperature with Normal Discharge Temp	Dirty or restricted evaporator tubes	Clean Evaporator Tubes and/or Check water conditioning
	Low Evaporator water leaving Temperature with w/ Low Motor Current	Insufficient Load for sys capacity	Check IGV motor operation and set point of Evaporator water leaving temperature cutout
			Check Cutout setting and increase it if necessary so Evaporator water leaving temperature will not be so low and the unit will down NOT causing low suction pressure anymore
			IGV might not be Full Open but not give enough due to linkage slippage etc.
High Evaporator pressure	Low Evaporator water leaving Temperature	IGV failed to open	Check the IGV motor positioning circuit
		System Overload	Be sure the vanes are wide open without overloading the motor until the load decreases
Low discharge superheat	Overall reduced performance due to refrigerant accumulation in Evaporator	Economizer float valves are stuck open	Adjust EXV until system stabilizes

CONDENSER

SYMPTOM	RESULTS	Possible Cause	Remedy
Extreme High Discharge Pressure	Condenser Approach temperature is higher than normal	Air in Condenser	Take refrigerant charge out and put the unit on a vacuum pump and then recharge
	High Condenser water range with normal Evaporator temperature	Insufficient Condenser water flow rate	Increase Condenser water flow rate
	Overall performance loss	Condenser Tubes are dirty/scaled	Clean Condenser tubes and/or check water conditioning
		High Condenser water entering temperature	Reduce Condenser water entering Temperature (check cooling tower and water circulation)

SYMPTOM	RESULTS	Possible Cause	Remedy
Small Evaporator water pressure difference between water entering and leaving	Capacity Loss and high Evaporator approach temperature	Evaporator pass baffle gasket damage	Stop unit operation, drain water, remove water box and replace gasket
Fluctuating unsteady water flow	Pass baffle gasket damage	Air in water boxes	Vent any air from the chiller water boxes prior to starting the water pumps

OIL SIDE

SYMPTOM	RESULTS	Possible Cause	Remedy
No oil pressure when system start button pushed	Low oil press displayed on control center and compressor will not start	Oil pump running in wrong direction	Check rotation of oil pump - electrical connections
		Oil pump not running	Troubleshoot electrical problem with oil pump
		Oil pressure regulator valve is not adjusted	Adjust oil pressure regulator valve to maintain proper oil pressure differential before the start-up
Unusually high oil pressure develops when oil pump runs	High oil pressure is displayed on control center when the oil pump is running	Defective oil pressure transducer or oil pressure regulator valve is not adjusted	Adjust oil pressure regulator valve to maintain proper oil pressure differential and/or check oil pressure transducer
Oil pump vibrates or is noisy	Oil pump vibrates or is extremely noisy with some oil pressure	Oil not reaching pump suction inlet in sufficie quantity	Check Oil Level
		Worn or Failed Pump	Repair/Replace Oil Pump
Reduced Oil Pump Capacity	Oil pump pumping capacity	Excessive end clearance pump	Inspect and replace worn parts
		Other worn pump parts	
		Partially blocked oil supply inlet	Check oil inlet for blockage
Oil Pressure Gradually Decreases		Oil filter is dirty	Change oil filter
Oil loss during operation	Oil level is decreasing in oil sump	Filter-drier in oil return system dirty	Replace old filter-drier with a new one.
		Orifice of oil return jet clogged	Remove orifice, inspect for dirt, remove dir using solvent and replacement
No oil pressure display	No oil pressure registers on the control panel when oil pump runs	Faulty oil pressure transducer	Replace oil pressure transducer
		Faulty wiring/connectors	Inspect oil transducer wiring connections to the panel

PERATING LOG SHEET
WCT CENTRIFUGAL CHILLER

WCT Model No.__________ Chiller ID No. __________ Date __________ Operator ________________

DATA POINT	VALUE	SOURCE
EVAPORATOR		
1. WATER PRESSURE DROP ACROSS CHILLER		Gauges
2. ENTERING CHILLED WATER TEMPERATURE		VIEW #2
3. LEAVING CHILLED WATER TEMPERATURE		VIEW #2
4. DELTA TEMPERATURE (LINE 2 – 3)		Calculate
5. SUCTION PRESSURE		VIEW #2
6. EVAP. SATURATION TEMPERATURE (FROM #5)		R 134a Chart
7. SUCTION TEMPERATURE (LINE 8 + 6)		VIEW #2
8. SUPERHEAT (LINE 7 – 6)		Calculate
9. APPROACH TEMPERATURE (LINE 3 – 6)		Calculate
10. EVAPORATOR G.P.M.		Note 1
CONDENSER		
11. WATER PRESSURE DROP ACROSS CONDENSER		Gauges
12. ENTERING CONDENSER WATER TEMPERATURE		VIEW #2
13. LEAVING CONDENSER WATER TEMPERATURE		VIEW #2
14. DELTA TEMPERATURE (LINE 13 – 12)		Calculate
15. COMPRESSOR DISCHARGE PRESSURE		VIEW #2
16. COMPRESSOR DISCHARGE TEMPERATURE		VIEW #2
17. COND. SATURATION TEMPERATURE (FROM #15)		R-134a Chart
18. APPROACH TEMPERATURE (LINE 17 – 13)		Calculate
19. DISCHARGE SUPERHEAT (LINE 16 – 17)		Calculate
20. LIQUID LINE TEMPERATURE		VIEW #2
21. SUBCOOLING (LINE 17 – 20)		Calculate
22. CONDENSER G.P.M.		Note 1
23 Economizer Pressure		
COMPRESSOR		
24 COMPRESSOR MOTOR CURRENT (%RLA)		VIEW #2
25 OIL FEED PRESSURE (PSIG)		VIEW #2
26 OIL SUMP TEMPERATURE		VIEW #2
27 OIL FEED TEMPERATURE		VIEW #2
28 OUTDOOR DRY BULB AIR TEMPERATURE		Thermometer
29 UTDOOR WET BULB AIR TEMPERATURE		Thermometer
30 Oil Level		

NOTES:

1. Flow can be determined from a Flow/Pressure Drop curve from flow meters if available.
2. To convert FT H_20 to PSIG, multiply FT. X .434 OR ÷ BY 2.31
   To convert PSIG to FT H_20, multiply PSIG. X 2.31 OR ÷ .434
3. "VIEW **#2**" refers to the second VIEW screen on the operator interface panel.

Service Programs

It is important that an air conditioning system receive adequate maintenance if the full equipment life and full system benefits are to be realized.

Maintenance should be an ongoing program from the time the system is initially started. A full inspection should be made after 3 to 4 weeks of normal operation on a new installation, and on a regular basis thereafter.

Daikin offers a variety of maintenance services through the local Daikin service office, its worldwide service organization, and can tailor these services to suit the needs of the building owner. Most popular among these services is the Daikin Comprehensive Maintenance Contract.

For further information concerning the many services available, contact your local Daikin service office.

Operator Schools

Daikin conducts training for centrifugal operators at its factory Training Center in Staunton, Virginia, USA several times a year. These sessions are structured to provide basic classroom instruction and include hands-on operating and troubleshooting exercises. For further information, contact your Daikin representative.

Training courses for Centrifugal Maintenance and Operation are held through the year at the Daikin Training Center. The school duration is three and one-half days and includes instruction on basic refrigeration, MicroTech controllers, enhancing chiller efficiency and reliability, MicroTech troubleshooting, system components, and other related subjects. Further information can be found on www.Daikineurope.com or call Daikin and ask for the Training Department.

Warranty Statement

Limited Warranty

Consult your local Daikin Representative for warranty details. Refer to Form 933-43285Y. To find your local Daikin Representative, go to www. Daikineurope.com.

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