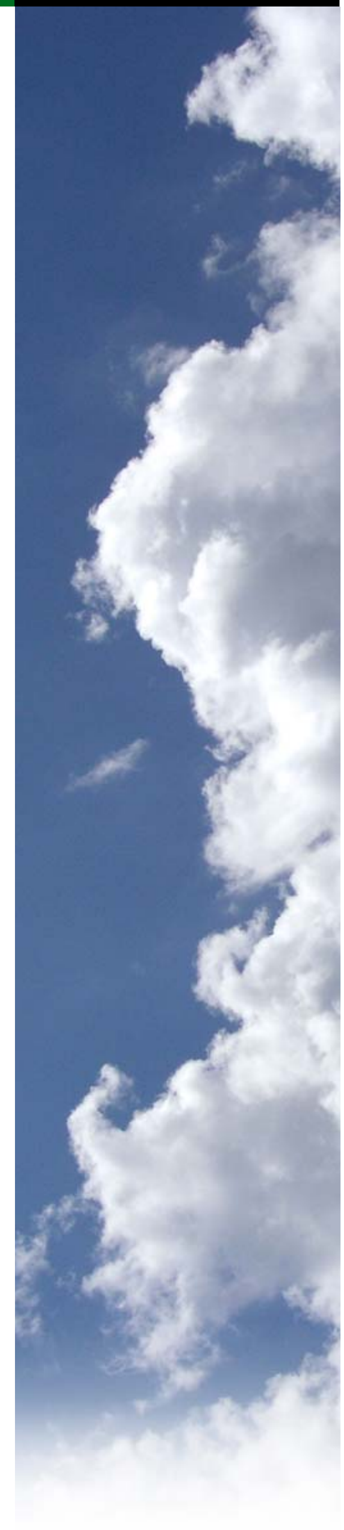
Catalog 865-4

Modular Self-Contained Air Conditioning System

Type SWT 018C-040C
15 to 45 Tons



MEA
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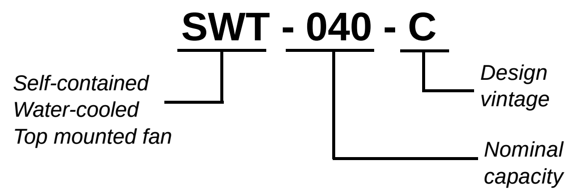
McQuay International

Continued Leadership in Floor-by-Floor, Self-Contained System Designs

McQuay SWT self-contained air conditioning systems trace their history to the late 1970s and the pioneering concepts of Blazer Industries. Working closely with the consulting engineer to solve special system and space challenges, Blazer Industries developed and provided the first self-contained, variable air volume systems with water side economizer cycle for the prestigious 499 Park Avenue office building. Following the success of this project was more than a decade of innovation and product leadership, with thousands of systems provided for prominent building projects.

In 1991, McQuay acquired Blazer Industries. The result has been a continuation of this tradition of innovation and leadership. The comprehensive, updated modular McQuay SWT system offering is now supplying quiet, efficient and flexible systems to meet today's diverse and demanding performance needs for new and retrofit, commercial, industrial and institutional buildings worldwide.

Nomenclature



Agency Listed

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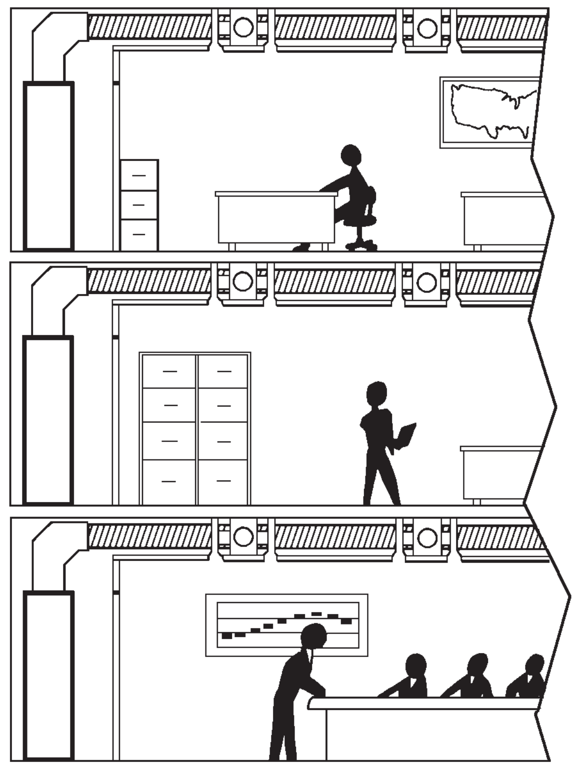
McQuay Self-contained VAV Systems

System Performance Providing Tenant Comfort and Operating Economy

Since the introduction of self-contained systems in the late 1970s, the industry has seen this concept grow into one of the most widely specified systems for new office buildings, for retrofitting existing structures, and for institutional, industrial, and other specialized applications. The reason is simple: system performance. Designed specifically to satisfy growing system retrofit needs, McQuay SWT self-contained VAV systems provide the total performance advantage of:

- Modular construction
  - Prime candidate for building renovation
  - Special 34.5" maximum section width fits through a 3' door frame
  - Refrigerant lines always remain intact
  - Requires minimum floor area when reassembled
  - Retrofit alternative where existing chiller cannot be accessed for replacement
- Tenant Comfort
  - Tenants enjoy individual control over comfort conditions and off-hour system operation
  - Tenants benefit from their individual efforts to control energy costs
  - Routine service is located where it minimizes tenant inconvenience
  - Individual or dual systems per floor provide system redundancy and standby
- First cost economics
  - VAV system flexibility uses building diversity to reduce system tonnage and first cost
  - Factory packaged concept reduces field labor, installation time and expense
  - No expensive chilled water piping or chiller room
  - Individually tested, factory designed systems reduce start-up and installation expense
  - Reduce penthouse and equipment room requirements
  - Centralize condenser water and condensate piping and streamline system layout
- Energy-saving VAV system control
  - Reduces fan kW and operating costs at part load conditions
  - Savings maximized through use of variable speed fan control
  - Individual zone control without overcooling or use of reheat
- Quiet system operation
  - Provided by structural quality and specialized design
  - Recognized for quiet operation by renowned U.S. acoustical consultants
- Energy saving economizer operation
  - Water or air economizer capability for optimized energy savings
  - Economizer reduces compressor operating hours and energy costs
  - Year-round “free cooling” capability
- Energy saving building part load operation
  - System energy efficiency comparable to central chilled water systems
  - Multiple systems and compressors versus a single, large central plant
  - Efficient system for partial occupancy and after hours operation
  - Operate only the system(s) on the floor(s) requiring after hours use

Figure 1. McQuay Self-Contained VAV Systems



- System savings of advanced MicroTech II™ DDC control system
  - Monitoring and diagnostics reduce the potential for expensive field repairs
  - Industry leading Protocol Selectability™ feature provides effective BAS selection flexibility
- Reduced system maintenance and service costs
  - No complicated central chiller plant to maintain
  - Service and maintenance are performed out of the occupied space
  - Control and product reliability functions designed by the equipment manufacturer for single source responsibility and improved reliability

Design Features

Cabinet, Casing and Frame

For vibration control and rigging strength, the SWT unit base is constructed of welded structural steel channel and 10- gauge galvanized steel panels. Heavy-duty lifting brackets are strategically placed for balanced cable or chain hook lifting.

For long equipment life, unit exterior panels are constructed of heavy gauge, pre-painted, galvanized steel. The complete cabinet, frame and access panels are insulated with 1 inch thick, 1.5 lb. dual density insulation. Double wall construction is available to enhance performance and satisfy IAQ requirements.

For maintenance and service ease, system components are strategically located for ease of inspection and maintenance. Refrigeration components are positioned out of the airstream so adjustments and readings can be made without disrupting system operation. Service friendly access is made through heavy-duty, conveniently removable panels. Access panels are set on neoprene gaskets to prevent air leakage.

Modular Design

The SWT unit is easily disassembled into three compact sections; main cooling/heating, filter/waterside economizer and fan. See "Modular Construction" under "System Flexibility" on page 11.

Figure 2. SWT Cabinet

Condensing Section

Multiple compressors are featured in all SWT systems for efficient system part load control, quiet operation and system redundancy. Compressors are quiet, reliable hermetic scroll type complete with sightglass, anti-slug protection, and motor overload protection. Suction and discharge service valves, with gauge ports, are available on each compressor. Individual branch circuit fusing protects each compressor. The unit's MicroTech II™ control system incorporates timing functions to prevent compressor short cycling. All compressors are resiliently mounted to minimize any noise transmission. The condensing section is insulated and segregated from the air handling section of the unit to avoid transmission of noise to the circulated air stream.

Figure 3. Copeland Specter™ scroll compressor

Each compressor is on an independent refrigerant circuit complete with filter-drier, liquid moisture indicator/sightglass, thermal expansion valve capable of modulation from 100-25% of its rated capacity, liquid line shutoff valve with charging port, high pressure relief device and high and low pressure cutouts. If any compressor is made inoperable, the remaining compressors are still allowed to operate.

The unit's MicroTech II controller senses entering condenser water temperature and prevents mechanical cooling when the temperature falls below an adjustable setpoint value, minimum 55°F. For systems which will see entering condenser water temperatures below 55°F, a waterside economizer or head pressure activated control valve is available.

SWT water cooled condensers feature a mechanically cleanable, all copper design using the same high performance enhanced tubing found in modern centrifugal chillers. Liquid refrigerant subcooling is provided as standard. Each condenser is part of an independent refrigerant circuit and comes complete with a spring loaded high pressure relief valve. All condensers are independently leak tested. All completed units are leak tested, evacuated and shipped with a full operating charge of R-22 and oil. R-407C is also available as an alternate selection.

The condenser assembly and all factory water piping is rated for a waterside working pressure of 400 psig and is factory leak tested before shipment. Condenser water channels are mechanically cleanable by removing brass service plugs that are sealed with reusable o-ring gaskets. Main interconnecting condenser water headers include vent and drain plugs and a large cleanout plug for removing debris dislodged during cleaning. Condensers are factory piped for a single condenser water supply and a single condenser water return connection.

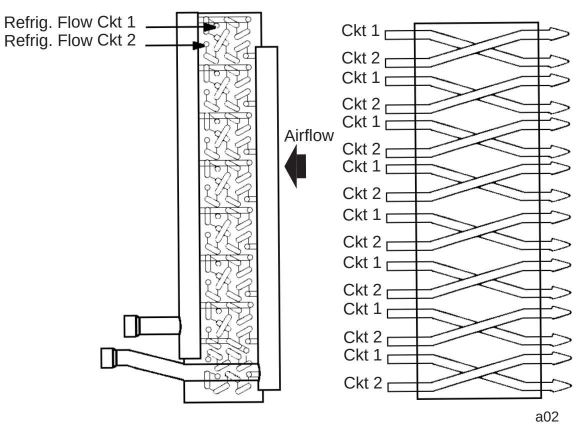
Both right-hand and left-hand piping locations are available.

Cooling Coil Section

SWT evaporator coils incorporate a high efficiency ripple corrugated fin design. SWT system design maximizes coil face area without developing uneven, performance robbing disruptions in airflow patterns. The result is high coil performance and reduced static pressure losses. Coils are 4 or 6 row configurations.

The evaporator coil is mounted in a stainless steel double sloped drain pan. The condensate drain line is trapped internal to the unit, eliminating the expense and inconsistency of field installed traps.

Figure 4. Evaporator Coil Circuiting



All evaporator coils are interlaced circuiting, keeping the full face of the coil active to eliminate air temperature stratification. For optimum part load performance, all three and four circuit evaporator coils are circuited for both interlaced and row control. Compressor staging is sequenced to take maximum advantage of available coil surface.

Each evaporator coil circuit is furnished with a wide range thermostatic expansion valve with an adjustable superheat setting and external equalizer.

Heating Section

SWT units are available as cooling only systems or with factory installed electric or hot water heat for morning warm-up, constant volume and specialty heating requirements.

Electric Heat

The factory assembled electric heating coils are constructed of low watt density nickel-chromium elements for long lasting durability. Electric heaters are protected by automatic reset high limit controls and line break protection. Heater branch circuits are individually protected by branch circuit fusing. The MicroTech II control system sequences the electric heating elements for operating economy.

Hot Water Heat

Hot water coils have 1 or 2 rows with high efficiency ripple corrugated fin design and 1/2 inch O.D. seamless copper tubes. Coils are available complete with a factory mounted, piped and wired 2-way or modulating valve controlled by the unit's MicroTech II controller. A factory mounted freezestat is provided to help protect against coil freeze-up.

Supply Fan Section

Figure 5. Supply Fan

The supply fan section uses one or two double width, double inlet medium pressure forward curved fans and housings. Each fan is statically and dynamically balanced. The fan assembly is constructed of high strength structural steel and welded for maximum strength. The entire fan assembly is mounted on spring isolators for excellent isolation effectiveness. Seismic control restrained spring isolators are available. A vibration dampening flex connection is installed at the fan discharge. The entire fan, motor and drive assembly is dynamically balanced at the factory for quiet operation.

Supply fans are configured with a gradual expansion, aerodynamic duct within the cabinet. This unique gradual expansion feature contributes to the high performance of the SWT by lowering brake horsepower and sound power levels.

All fans are mounted on solid steel shafts rotating in 200,000 hour pillow block ball bearings with grease fittings. Multiple belt, fixed pitch sheaves are matched to the specific cfm, static pressure and horsepower requirements of the system. Drives rated for a minimum of 150% of fan design are available. Drive components and fan bearings are easily accessed for periodic maintenance.

Fan motors are three phase, NEMA design B, rated at 40°C. Motor availability includes high efficiency open drip-proof and totally enclosed, EPACT compliant, NEMA T-frame selections and premium efficiency selections. Motors are 1800 RPM with grease lubricated ball bearings.

Energy saving advanced technology variable frequency drive (VFD) fan speed control is available with the convenience and cost savings of factory mounting and testing. All VFD selections are plenum rated. A manually activated bypass contactor is available to allow system operation even in the event of drive service.

MicroTech II controls provide advanced duct static pressure control. Static pressure can be controlled by either a single or two duct static pressure sensors. All VAV systems include an adjustable duct high-limit switch to protect duct work from excessive pressure.

Economizer Options

Waterside Economizer

An energy saving, waterside economizer package is available on all units. The complete economizer system is factory mounted including a 4-row mechanically cleanable coil, control valves and factory piping complete with cleanouts. The complete economizer package is rated for up to 400 psig waterside working pressure and the entire coil and piping assembly is factory leak tested.

Economizer operation is controlled by the SWT's MicroTech II controller to maximize free cooling potential. Economizer operation is enabled whenever the available cooling tower water temperature is less than the unit entering air temperature by a field adjustable value, generally 5-7°F. The economizer control valve modulates in response to the cooling load. Control valve operation can be selected to (1) maintain full flow through the unit at all times or (2) isolate the unit from the condenser water loop when there is no call for cooling to save energy with a variable pumping system. (Economizer control valves do not eliminate the need to provide unit isolation valves.) To extend free cooling savings, mechanical cooling is enabled during economizer operation. Only when the economizer valve is driven 90% open and the cooling load is not satisfied, will compressors be staged to maintain cooling setpoint. Economizer control will maintain full free cooling capability until disabled by the economizer changeover setpoint. A factory mounted freezestat is provided to help protect against coil freeze-up.

Airside Economizer

An airside economizer control package is available for controlling field installed mixing dampers capable of 100% outside airflow. Economizer operation will be controlled by the SWT's MicroTech II controller to maximize free cooling potential. Economizer operation is enabled whenever an outside air (or comparative) enthalpy sensor or outside air temperature sensor indicates that outside air is suitable for free cooling. The economizer damper control actuator shall modulate in response to the cooling load. The outside air damper will be positioned to maintain minimum ventilation requirements when economizer is disabled.

To extend free cooling savings, mechanical cooling is enabled during economizer operation. Only when the economizer damper is driven 90% open and the cooling load is not satisfied, will compressors be staged to maintain cooling setpoint. Economizer control will maintain full free cooling capability until disabled by the economizer changeover setpoint. Factory supplied mixing boxes are available for airside economizer use using the McQuay Vision™ air handling unit platform.

Condenser Head Pressure Control

For applications where a waterside economizer package is not being used and entering condenser water temperatures can be less than 55°F, condenser head pressure control is required. To satisfy these applications, a factory installed 2-way, head pressure activated control valve is available to maintain unit operation with entering condenser water temperatures as low as 40°F.

Figure 6. Mechanically Cleanable Waterside Economizer Coil

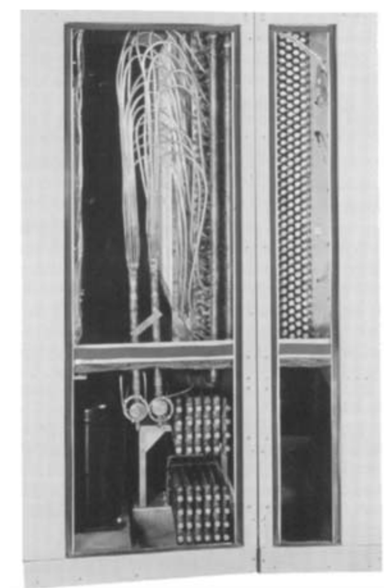


Figure 7. Economizer Piping

Filter Section

All SWT units are provided, as standard, with 4" deep extended media 30% efficient filters. For higher filtration requirements, 65% and 85% AmericanAirFilter™ Varicel® filters are available with an optional pre-filter rack. Filters are removable from the rear of the unit or through hinged and latched side access doors on the filter box.

Electrical

Each unit is completely wired and tested at the factory prior to shipment. Wiring complies with NEC requirements and conforms to all applicable UL standards for reliability and safety. All electrical components are labeled according to the electrical diagram and are UL recognized whenever applicable. Line voltage components and wiring are physically separated from the low voltage control system.

The supply fan motor, compressor motors and electric heat all have individual branch circuit fuse protection. Control circuit power is supplied through a factory installed, low voltage transformer. The supply fan motor circuit includes a three phase contactor and ambient compensated overload protection with manual reset. Each refrigerant circuit includes both a high and low pressure cutout switch and a coil frost protection thermostat.

A terminal block is provided for the single, main power connection and a terminal board is provided for low voltage control wiring. A factory mounted, non-fused main circuit interrupter is available for disconnecting the main electrical power to the unit. The switch is visible, located at the front of the unit, and is accessible without unit penetration. Dual power blocks or disconnect switches are available to accommodate requirements for standby, emergency power supplies.

Controls

MicroTech II Unit Controls

All SWT units feature advanced MicroTech II DDC controls to provide all temperature and static pressure control, product reliability control functions, system time clock and all monitoring and diagnostics. Each MicroTech II control system features a human interface with a 4-line, 20 character English language display for fast system diagnostics and adjustments. The complete control system is factory installed and commissioned prior to shipment.

Protocol Selectability™ Feature

All Microtech II control systems have McQuay's exclusive Protocol Selectability feature. MicroTech II control systems can be factory configured for standalone operation or for incorporation into an independent building automation system using either the BACnet® MS/TP, BACnet®/IP or LonTalk® protocols.

Auxiliary Control Options

Condenser Water Flow Switch. A factory installed, flow switch is available to verify water flow status at each unit. Compressor operation is disabled and an alarm signal provided if condenser water flow is lost. Unit operation is restored when water flow has again been sensed. Water flow status is displayed at the MicroTech II control's plain language screen.

Freezestat. A nonaveraging type freezestat is available factory installed on the entering face of the economizer coil. Upon sensing a potential freeze condition, the unit supply air fan is shut down, the economizer (and heating) valve drives to the full open position and an alarm signal is provided. Unit operation is restored following the manual reset of the freezestat.

Phase Failure/Undervoltage Protection. Factory installed phase failure/under voltage protection is available to protect three phase motors from damage due to single phasing, phase reversal and low voltage conditions.

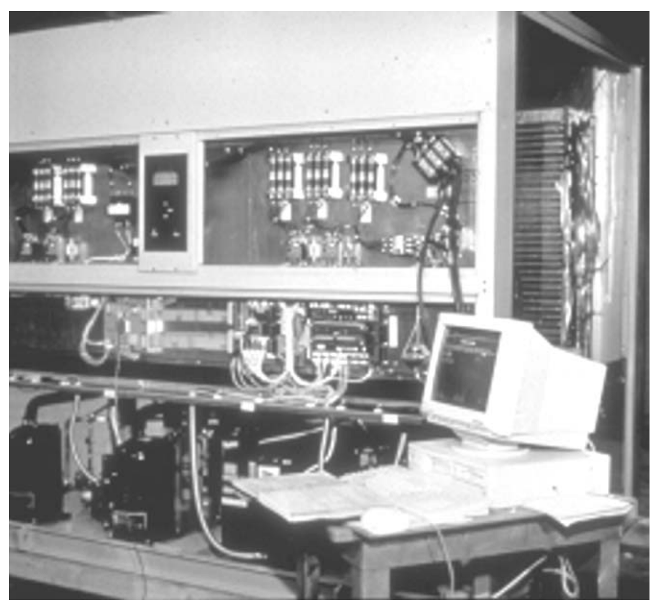
Individual Unit Factory Test

All SWT units are provided completely factory assembled, piped, wired, tested, and shipped in one piece. Each unit undergoes a factory test that includes:

- Dynamic trim balance of the completed fan assembly
- Run check of all electrical components, alarms and shutdowns, including proper control sequencing
- Pressure test, at rated pressure, of refrigerant coils, water coils and condensers prior to assembly
- Final leak check of the completed refrigerant circuits
- Final leak check of the completed water circuit
- Compressor run check

Verification of factory run test is available at time of unit shipment.

Figure 8. Test Stand



System Flexibility

Along with providing high quality and state-of-the-art innovation, SWT self-contained systems emphasize system flexibility, flexibility not even considered by the competition. McQuay SWT systems offer customized flexibility to satisfy a wide range of diverse applications.

Selection/Application Flexibility

Nominal cooling capacities range from 15 to 45 tons and all units feature a 6 row evaporator coil. In addition, all units offer multiple compressor selections to meet exacting system requirements. Many standard compressor/coil capacity selections are available. The flexibility to optimize the self-contained system to fit the application is a McQuay SWT advantage. Available system applications include:

- VAV discharge air temperature control with static pressure control
- Discharge air temperature control with constant air volume
- Constant volume, zone temperature control
- 100% outside air control
- Dehumidification control, with or without reheat control

In addition to compressor/coil flexibility, SWT systems offer double width, double inlet, forward curved fans with factory mounted variable frequency drives for maximizing VAV system fan performance. High efficiency fan capability coupled with extensive compressor flexibility can provide the right system selection for the application.

Modular Construction

The SWT unit has been designed with the flexibility to be easily disassembled into three compact sections. The three sections are the main cooling/heating, filter/waterside economizer and fan sections. Whereas most competitive products require removal of the door frame, each SWT section has a maximum width of 34.5", including fastener heads, and can fit through standard 3' steel door frames.

The system installer is able to break the unit down into its three main sections without breaking any refrigerant lines. All SWT refrigerant lines remain intact, contained in the main cooling/heating section. This SWT feature can add up to substantial savings by avoiding the field expense to braze, evacuate and charge each refrigerant circuit.

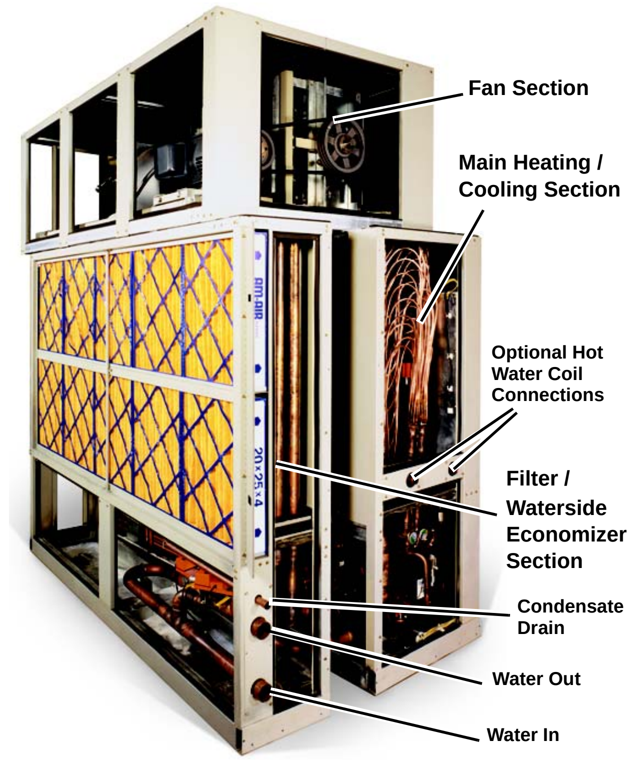
Optimal Discharge Air Temperature:

More and more system engineers are designing optimal discharge air temperature systems to improve system performance and system first cost, and the McQuay SWT provides the flexibility to do it successfully. Optimal discharge air temperature systems are designed to provide unit leaving air temperature selections of 52-53°F versus more conventional systems that supply air at temperatures closer to 58°F. This five to six °F reduction in air temperature to the room diffusers can subsequently reduce the required supply air volume to the room by 20-25%.

The benefits of optimal discharge air temperature systems become quite apparent with a look at the advantages offered with reduced airflow:

- Reduced supply air CFM reduces first cost and installation cost by allowing smaller duct sizes and a smaller air distribution system.
- Reduced supply air CFM reduces fan BHP requirements. Depending on changes in duct size and the resulting total static pressure, a 20% reduction in supply air CFM can reduce the fan BHP requirements by 25% or more.
- Reduced supply air CFM provides reduced fan sound power generation and a quieter room environment.
- Reduced supply air CFM can often reduce the equipment room size due to the use of a physically smaller unit size.

Figure 9. Modular Construction



Arrangement Flexibility

All SWT systems offer the flexibility of right-hand and left-hand piping arrangements and front and rear fan discharge orientations. Piping and fan arrangement flexibility can simplify mechanical equipment room arrangement, improve installed cost and improve total system performance.

Filtration Flexibility

SWT systems are offered with 4 inch, 30% efficient pleated filters as standard. 4 inch, 65% efficient pleated filters and 4 inch, 85% efficient filters with pre-filters are also available.

Energy Saving Economizer Flexibility

To improve system operating performance, all SWT systems offer complete factory mounted and controlled waterside economizer capability. Each waterside economizer system includes a 4 row, mechanically cleanable coil with dual, two-way control valves to allow use in either a constant or variable volume pumping system. In addition, units can be applied with air economizer cycles with integrated factory control.

Heating Flexibility

A variety of heating media is offered with each SWT system. Hot water coils with modulating valve and actuator are available along with staged electric heat to provide heating control in a variety of applications.

Controllers

MicroTech II DDC control systems provide constant volume, variable air volume, 100% outside air, and/or dehumidification control flexibility. Each MicroTech II control system comes with a control screen conveniently mounted on the front of the unit to allow easy adjustment and monitoring of control functions. And with its easy to follow and read English language menus and data displays, it simply encourages and invites the operator to take advantage of its many capabilities.

Figure 10. Keypad/Display Panel

Protocol Selectability Feature

All Microtech II control systems have McQuay's exclusive Protocol Selectability feature. MicroTech II control systems can be factory configured for standalone operation or for incorporation into an independent building automation system using either the BACnet® MS/TP, BACnet®/IP or LonTalk® protocols.

Summary of Available Options:

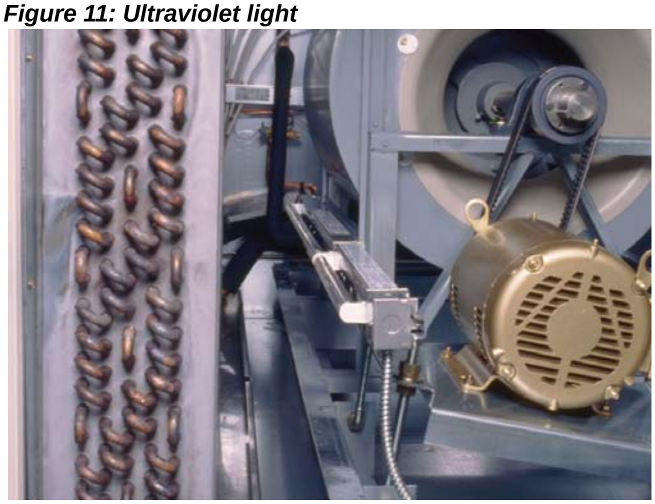
- Multiple compressor/coil capacity selections
- Multiple control options: VAV, CV, 100% OA, dehumidification
- Non-fused main power disconnect switch
- Dual non-fused main disconnect switches
- Non-averaging freezestat for hot water, or waterside economizer coil protection
- Unit phase failure/under voltage protection
- Premium efficiency fan motors
- TEFC fan motors
- Condenser water flow switch
- 4-row waterside economizer system
- Air cycle economizer system
- Modulating hot water heat
- Staged electric heat
- Factory mounted and controlled variable frequency drives
- High efficiency filtration options
- Right- and left-hand piping selections
- Front and back fan discharge arrangements
- Head pressure control valve
- Special coil coatings
- Double wall cabinet construction
- Seismic fan isolation
- R407C or R22 refrigerant
- UV lights

Ultraviolet Lights

Factory-installed ultraviolet lights are available on the downstream side of all cooling coils and above the unit drain pan.

All ultraviolet lights are pre-engineered and factory installed for ease of use and proper placement for maximum effectiveness. The ultraviolet lamps irradiate the coil and drain pan surfaces with light in the 245 nanometer wavelength of the light spectrum (UV-C). UV-C light has proven effective in killing most bacteria, molds, and viruses in both laboratory and practical application. This complete package of equipment and ultraviolet lights includes Intertek Services Inc. (ETL) safety agency certification.

Figure 11: Ultraviolet light



Features

- High-output, hot cathode lamps produce ultraviolet germicidal irradiation (UVGI) for 254 nm that constantly irradiates the coil and drain pan surfaces.
- Fixture design and stainless steel construction make the ultraviolet light device suitable for saturated air conditions.
- Automatic disconnects are standard on all doors (or panels) with line-of-sight access to the lamps to help prevent eye contact with the UV-C ultraviolet light.
- Special ultraviolet filtering glass windows block ultraviolet light, allowing the coil, drain pan, and lights to be inspected while in use from outside the unit.

Benefits

- For pennies a day, UVGI can improve IAQ by destroying mold, fungi, and bacteria on coil and drain pan surfaces.
- Clean coil surfaces maintain peak heat transfer for "near new" performance and lower energy costs.
- Reduced coil and drain pan maintenance requirements and costs.
- Satisfies GSA federal facilities standard requirements for UVGI lights to be incorporated downstream of all cooling coils and above all drain pans to control airborne and surface microbial growth and transfer.

Figure 12: Ultraviolet light

Refrigerant R-407C

McQuay SWP units with independent refrigerant circuits are available with non-ozone depleting R-407C refrigerant. R-407C refrigerant is better for the environment than R-22 (see the note below).

Note: In response to the Montreal Protocol, the United States EPA announced that R-22 production/imports will be limited starting January 1, 2010, likely ending R-22 use in all new equipment. After January 1, 2020, domestic R-22 production/imports will cease and all service work will require recycled R-22 refrigerant or a replacement such as R-407C.

Note: Given the many inherent differences in oil, operating pressure, and control settings between R-22 and the HFC alternatives, future conversion of an R-22 system to an HFC is likely to be difficult and costly.

Features

- HFC-407C refrigerant is environmentally friendly with zero ozone depleting allowance (ODP).
- ASHRAE Standard 34, Designation and Safety Classification of Refrigerants, classifies HFC-407C as an A1 (lower toxicity—no flame propagation) refrigerant.
- Units are factory engineered for proper cooling performance using R-407C.
- Units are factory charged with R-407C and synthetic oil (such as POE), and they include components and controls specifically tailored to R-407C.
- Units are factory tested prior to shipment.

Benefits

- HFC-407C allows you to provide your tenants with a comfortable building environment in an environmentally friendly way.
- With no phase out date for production of HFC-407C, a reliable supply should be available for the life of your equipment.
- Fully engineered and factory tested units with R-407C avoid the downtime, high costs, and risk associated with a field conversion of an R-22 system to an R-407C.

MicroTech II Unit Controller

Designed with the system operator in mind, McQuay SWT systems continue to provide industry leading performance, featuring the microprocessor based MicroTech II Self-contained System Unit Control system. The latest in microprocessor technology and software innovation have been used in each MicroTech II controller to give you the ultimate in control and flexibility. In addition to providing stable, efficient temperature and static pressure control, the controller is capable of providing comprehensive diagnostics, alarm monitoring and alarm specific component shutdown if critical equipment conditions occur.

A user interface featuring an 8-key keypad and a 4-line x 20 character display comes as standard with each MicroTech II control system, providing system operators with superior access to temperatures, pressures, operating states, alarm messages, set points, control parameters and schedules. All messages are displayed in plain English text. This high degree of system interface and diagnostics capability makes MicroTech II controls a recognized standard for total performance. Password protection is included to protect against unauthorized or accidental set point or parameter changes.

The MicroTech II Self-contained System Unit Control system is capable of complete, stand-alone unit control. If desired, it can also provide interoperability with building automation systems (BAS) through McQuay's innovative Protocol Selectability feature. Protocol Selectability allows the unit control system to be factory, or field, configured for BACnet® MS/TP, BACnet®IP or LonTalk® protocols. In addition, MicroTech II unit controls can be accessed via modem using a standard MicroTech II service tool.

Protocol Selectability™ Feature

MicroTech II unit control systems are factory configured for either standalone operation or for incorporation into independent building automation systems (BAS) through our Protocol Selectability feature. By using industry recognized communication protocols, BACnet® MS/TP, BACnet®/IP or LonTalk®, McQuay MicroTech II controls expand the horizon of opportunities for BAS choice without the sacrifice of system performance. The same extensive range of functionality is available to the user if they use the independent BAS supplier of their choice as if they were to use a McQuay control network.

BACnet® communications conform to the BACnet® Standard, ANSI/ASHRAE Standard 135-2001, and are supported by a protocol implementation conformance statement (PICS).

LonTalk® communications are in accordance with either the Discharge Air Controller (DAC) or Space Comfort Controller (SCC) profiles.

The building automation system can interact with one or multiple self-contained unit controllers in the following ways:

- Set the unit's operating and occupancy modes
- Monitor all controller inputs, outputs, set points, parameters, and alarms
- Set controller set points and parameters
- Clear alarms
- Reset the cooling discharge air temperature set point (DAC units)
- Reset the heating discharge air temperature set point (DAC units with modulating heat)
- Reset the duct static pressure set point (DAC units)
- Set the heat/cool changeover temperature
- Set the representative zone temperature (SCC units)
- Provide common fan control for multiple units on a common duct system

Components

Each SWT self-contained system is equipped with a complete MicroTech II unit control system that is pre-engineered, preprogrammed, and factory tested prior to shipment. Each of the MicroTech II unit control systems is composed of several components that are individually replaceable for ease of service. These components include:

- Keypad/display user interface
- Main control board
- Cooling control board(s)
- Communication protocol module (optional)
- Pressure transducers
- Unit mounted temperature sensors
- Zone temperature sensor packages

Main Control Board (MCB)

The main control board (MCB) contains a microprocessor that is preprogrammed with the software necessary to control the unit, so that schedules, set points and parameters will not be lost, even during a long-term power outage. The microprocessor board processes system input data and then determines and controls output responses. A RS-232 communication port is provided as standard to allow for direct or modem access with a PC based service tool.

Cooling Control Boards (CCB)

A cooling control board (CCB) is used to expand the input and output capability of the main control board (MCB). Each CCB communicates with the MCB via serial data communications. These microprocessor based boards provide independent operation and alarm response even if communication is lost with the MCB.

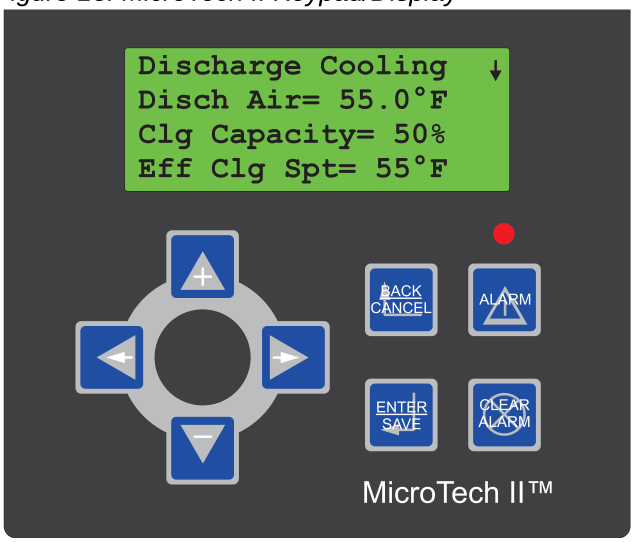
Communication Protocol Module (CPM)

The communication protocol module (CPM) provides the means to factory or field configure MicroTech II unit controls for interoperability with an independent BAS using McQuay's innovative Protocol Selectability feature. Communication protocol modules are available to support industry recognized communication protocols including BACnet® MS/TP, BACnet®/IP and LonTalk®.

Keypad/Display

All MicroTech II controllers include a keypad/display that provides user interface with the main control board (MCB). The keypad/display has eight easy-to-use, touch-sensitive membrane key switches that are used for positioning the display and entering changes. The display is a supertwist nematic type with highly visible black characters on a yellow background. The 4-line by 20-character format allows for easy to understand plain English display messages. All operating conditions, system alarms, control parameters and schedules can be monitored from the keypad/display. If the correct password has been entered, any adjustable parameter or schedule can be modified from the keypad.

Figure 13. MicroTech II Keypad/Display



Temperature and Humidity Sensors

With the exception of the return air sensor and zone sensor, all temperature sensors are factory installed and tested. Return air sensors are factory tested but require field installation in the return air duct. Zone sensor packages are available to suit any application. When required for dehumidification applications, a humidity sensor is available for field installation.

Static Pressure Transducers

All pressure transducers are factory installed and tested. Connection and routing of sampling tubes is done at time of unit installation.

Zone Temperature Sensors

Two optional zone temperature sensors are available for use with the MicroTech II controller:

(1) Zone sensor with tenant override switch.

(2) Zone sensor with tenant override switch and remote set point adjustment.

Timed tenant override is a standard MicroTech II control feature.

Zone sensors are required to utilize the controller's purge cycle, space reset of supply air set point, and night setback or setup features (see following). All zone sensors are field installed with field wiring terminated at a separate, clearly marked terminal strip.

Stand-alone controller features

MicroTech II self-contained system unit controls include all of the essential features required to make them capable of completely independent, stand-alone operation. Additional multiple unit control capabilities are available through control provided by a BAS.

Internal time clock

An internal, battery-backed time clock is included with each and every MicroTech II unit controller. Current date and time can be quickly and easily set at the user interface keypad.

Internal Schedule

Seven daily schedules and one holiday schedule can be entered at the keypad of all unit controllers. For each of these eight schedules, one start and one stop time can be entered. Up to 16 holiday periods of any duration can be designated. The unit will automatically run according to the holiday schedule on the holiday dates. To handle special occasions, an additional 'one event' schedule can also be used.

In lieu of its internal schedule, the unit can be operated according to a network schedule from the BAS.

External Time Clock or Tenant Override Input

An input is supplied that can be used to accept a field wired start/stop signal from a remote source. An external time clock, a tenant override switch, or both may be connected. Whenever the external circuit is closed, the controller overrides the internal schedule (if activated) and places the unit into the occupied mode.

If the internal schedule or a BAS network schedule is used, field wiring is not required.

Timed Tenant Override

Off-hour operation flexibility is a must in today's office environments and even standalone MicroTech II controllers handle it with ease. When unit operation is desired during unoccupied hours, timed tenant override can be initiated by pressing the tenant override button on either of the optional zone sensor packages. The unit will then start and run in the occupied mode for a keypad adjustable length of time (up to five hours). If the button is pressed again while the unit is operating, the timer will reset to the full time allowance without interrupting unit operation. Tenant override operation can also be initiated by the BAS.

Remote Set Point Adjustment

All constant air volume-zone temperature control (SCC) unit controllers include an input that can be used to remotely adjust the zone cooling and heating set points. To utilize this feature, the optional zone sensor package with set point adjustment must be wired to the controller. The remote set point adjustment feature can be enabled or disabled from the keypad at any time. When enabled, remote set point adjustment is available even if the return temperature is selected to be the Control Temperature.

Auto/Manual Operation Selection

Automatic or manual operation can be controlled either remotely or at the keypad.

All controllers include two inputs that can be used to enable or disable cooling, heating, and fan operation from remote switches. With the "heat enable" and "cool enable" terminals, the operator can enable cooling, heating, or both as desired. Using the system "off" terminals, the operator can disable the fans, and thus the entire unit, without the unit being able to be started remotely.

From the keypad, there are a variety of occupancy and auto/manual control mode selections available to the operator:

- Occupancy modes
  - Auto
  - Occupied
  - Unoccupied
  - Tenant override
- Control modes
  - Off
  - Auto
  - Heat/cool
  - Cool only
  - Heat only
  - Fan only

Compressor Lead-lag Selection

All unit controllers are capable of automatic compressor, lead-lag control. If automatic control is not desired, the operator can disable the compressor lead lag function.

Waterside Economizer Changeover

On units equipped with a waterside economizer package, the MicroTech II unit controller includes an internal changeover strategy that compares entering cooling tower water temperature to the unit's mixed air temperature. If the entering water temperature is less than the mixed air temperature by a field adjustable differential (typically 5-7ºF), the economizer control valve modulates in response to the cooling load.

Airside Economizer Changeover

On units equipped with airside economizer control (control only, economizer mixing dampers by others), there are two methods of determining whether the outdoor air is suitable for free cooling: one method senses enthalpy (dry bulb temperature and humidity) and one senses outdoor air dry bulb temperature.

The enthalpy changeover method uses an external control signal wired to a designated controller input.

All unit controllers include an internal changeover strategy that can be selected at the keypad. When this method is selected, the controller compares the outdoor air dry-bulb temperature, provided by the optional outdoor air temperature sensor, to a keypad programmable set point. The external enthalpy control input is then ignored.

Cooling and Heating Lockout Control

All unit controllers include a keypad programmable set point for locking out mechanical cooling when the entering tower water temperature is below the lockout set point. The factory default set point is 55ºF. The default is adjustable to a minimum of 50ºF when a waterside economizer package is used. For systems without waterside economizer, an optional head pressure regulating valve is required for operation below 55ºF.

When an economizer system is used, mechanical cooling is locked out whenever economizer is enabled and the economizer position is less than 90%. This energy saving feature requires that full economizer potential be used before mechanical cooling is allowed to energize.

Night Setback and Setup Control

When one of the available zone temperature sensors is connected to the unit controller, night setback heating and night setup cooling control are available. Separate, keypad programmable night heating and cooling set points are used to start the unit when necessary. After the unit starts, night setback and setup control is similar to normal occupied control except that the minimum outside air damper position is set to zero. If the outside air is suitable for free cooling, and an airside economizer is used, outside air will be used during night setup operation.

Except for 100% outside air applications, night setback control is available even if the unit is not equipped with any heating equipment. When the space temperature falls to the night setback set point, the fan simply starts and runs until the temperature rises above the differential. This feature might be useful for applications that utilize, for example, duct mounted heating coils.

Morning Warm-up Control

If the space temperature is below set point when the unit enters the occupied mode, the morning warm-up control function will keep the outside air dampers closed while heat is supplied to satisfy set point. The outside air damper will remain closed until either the space temperature rises to the heating set point or the keypad adjustable morning warm-up timer expires (default is 90 minutes). The morning warm-up timer works so that the minimum required amount of outdoor air will be supplied after a certain time regardless of the space temperature.

Morning warm-up control is automatically included on all except 100% outside air units. It is available even if the unit is not equipped with any heating equipment for applications that utilize, duct mounted heating coils, for example.

Condenser Head Pressure Control
(Units without waterside economizer only)

Mechanical cooling is allowed whenever the entering cooling tower water temperature is 55ºF or warmer, without the use of head pressure control. When the entering water temperature is below 55ºF, a factory installed and controlled 2-way modulating head pressure control valve can be utilized. The regulating valve is controlled by the MicroTech II controller to maintain refrigerant head pressure.

Outdoor Air Purge Control
(Units with airside economizer only)

Designed to take advantage of cool early morning outside air conditions, purge control will start the fans and modulate the economizer dampers to maintain occupied cooling requirements during unoccupied periods if conditions are appropriate. This provides the opportunity to flush the space with fresh outdoor air prior to occupancy. Purge operation is possible only during a keypad adjustable time window prior to occupancy (0 to 240 minutes). When the purge-cycle is active, mechanical cooling is disabled. To utilize the purge feature, one of the zone temperature sensors must be connected to the unit controller. Following is a description of purge control operation.

During the purge time window, the unit will start and run whenever these three requirements are met:

- The space temperature must be warm enough to enable occupied cooling.
- The outside air enthalpy must be low enough to enable the economizer.
- The outside air temperature must be at least 3°F less than the space temperature.

When any one of these conditions is no longer true, the unit will be shut down again. As conditions allow, purge will cycle the unit in this manner until it enters the occupied mode.

Proportional Integral Derivative (PID) Control algorithm

The Proportional-Integral-Derivative (PID) Control algorithm controls modulating actuators to maintain a measured variable (temperature or pressure) at or near its set point. For example, it controls economizer actuators to maintain the discharge cooling set point and it controls the supply fan variable frequency drives to maintain the duct static pressure set point. The integral control feature effectively eliminates "proportional droop" (load dependent offset) resulting in the tightest possible control.

For each PID loop, five keypad adjustable parameters allow the control loop to be properly tuned for any application: (1) period, (2) dead band, (3) proportional band, (4) integral time and (5) derivative time. Appropriate default values for these parameters are loaded into each controller. These default values will provide proper control for most applications; therefore, field tuning is usually not required and thus start-up time is reduced.

Change Algorithm

The PID function is also used to adjust set points instead of controlling variable speed drives or actuators directly. For example, in zone control applications, the PID loop automatically "changes" the discharge temperature set point (cooling or heating) as the Control Temperature deviates from the zone set point. Another PID loop then controls the economizer actuator or heating valve actuator using the current discharge temperature set point. Unlike a typical "master-submaster" reset strategy, this "cascade control" continuously adjusts the discharge set point, even if the Control Temperature's deviation from set point remains constant. This means that the unit's cooling or heating output is set according to the actual load, not just the current zone temperature. Tight zone temperature control results because "proportional droop" (load dependent offset) is eliminated.

Calibrate

When initiated at the keypad by an operator, the Calibrate function automatically calibrates all actuator position feedback inputs and all pressure transducer inputs. It does this by shutting the unit down and then driving all actuators to the full closed and full open positions. The controller records the input voltage values that correspond to these positions. The pressure transducer input voltages, which are assumed for 0.00" W.C., are also recorded. When Calibrate is finished, an operator command must be entered at the keypad to start the unit. The Calibrate feature can reduce start-up time and assist in periodic maintenance.

Field Output Signals

All MicroTech II controllers include four solid-state relay outputs that are available for field connection to any suitable device: remote alarm output, fan operation output, outside air damper output and pump start output. On VAV units, an additional VAV box output is also available. These five outputs are used to signal field equipment of unit status.

Remote alarm output: The remote alarm output can be used to operate a 24V relay to provide a remote alarm signal to a light, audible alarm, or other device when an alarm condition exists at the unit.

Fan operation output: The fan operation output is used to control field equipment that depends on fan operation; for instance, to open field installed isolation dampers or VAV boxes. To allow actuators enough time to stroke, the fan operation output is energized three minutes before the fans start. It then remains energized until thirty seconds after the unit airflow switch senses no airflow. The fan operation output is on whenever the unit airflow switch senses airflow.

Outside Air Damper output: The outside air damper output can be used to signal an outside air damper actuator to open whenever the unit is in an occupied cooling or heating condition.

VAV box output: The VAV box output provides a means of interfacing unit and VAV box control. When the output is energized (closed), the VAV output indicates that the unit is in the cooling mode. When de-energized (open), it indicates that the unit is either providing heat or circulating air to equalize temperature conditions just after start-up (this is the Recirculate operating state). On units with single-stage "morning warm-up" heat, the open VAV box output contact is meant to provide a signal to drive the boxes wide open. To prevent duct over pressurization, fan variable speed drives or inlet vanes are driven to a minimum position before the output's contacts are de-energized again for normal cooling operation (this is the Post Heat operating state).

Pump Start output: The pump start output is used to provide a start/stop signal to the cooling tower circulating pump. The pump start output is on whenever fan operation and cooling is required.

Standard Control Options

SWT Self-contained Systems are available for most any constant or variable air volume application. MicroTech II controls offer three basic control configurations: variable air volume with discharge temperature control (DAC), constant air volume with zone temperature control (SCC), and constant air volume with discharge temperature control (DAC), that use sophisticated state change control logic to provide stable, reliable and efficient control. When combined with MicroTech II's many available control capabilities, both factory installed and keypad programmable, these three basic configurations can be customized to meet the requirements of the most demanding applications.

VAV with Discharge Temperature Control (DAC)

All VAV units provide true discharge temperature control in addition to duct static pressure control. Cooling only, cooling with single-stage "morning warm-up" heat, and cooling with modulating heat configurations are available.

Constant Air Volume with Zone Temperature Control (SCC)

SCC units are available in either cooling only or cooling with modulating heat configurations. Either of these configurations is available for 100% recirculated, mixed, or 100% outdoor air applications.

Constant Air Volume with Discharge Temperature Control (DAC)

DAC units are available in cooling only, cooling with single-stage "morning warm-up" heat, or cooling with modulating heat configurations. This unit configuration can be used for applications that have zone controlled terminal heating coils or for constant volume, 100% outdoor air applications. The discharge temperature control strategies used with the hybrid DAC unit are identical to those used with the DAC unit.

Discharge Temperature Control

MicroTech II DAC controllers provide sophisticated and flexible discharge air temperature control that is only possible with DDC systems. Separate discharge air temperature set points are used for cooling and modulating heating control. At the keypad, the operator can either enter the desired set points or select separate reset methods and parameters for each set point (see “Supply Air Reset” on page 19).

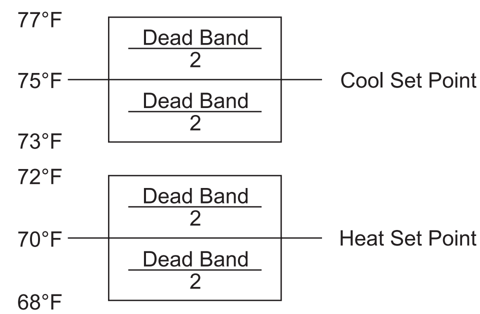
Control Temperature

The Control Temperature makes the heat/cool changeover decision. It determines whether cooling or heating is enabled; the discharge temperature then determines whether cooling or heating is actually supplied. At the keypad, the operator can choose the source of the Control Temperature from among the following selections.

- Space temperature sensor
- Return temperature sensor
- Outside air temperature sensor (modulating heat only)
- Network communication

The operator enters separate cool and heat enable set points and deadbands that the Control Temperature is compared with (Figure 14). When the Control Temperature is greater than or equal to the cooling set point, cooling is enabled. When the Control Temperature is less than or equal to the heat set point, heating is enabled. If desired, these set points and differentials can be set so that there is a dead band in which both cooling and heating are disabled. The controller's software prevents simultaneous cooling and heating.

Figure 14. Control Temperature: Discharge Temperature Control



Proportional Integral Derivative Modulation

When operating in economizer free cooling or unit heating, the previously described PID algorithm maintains discharge temperature control. The PID algorithm provides precise control of the economizer dampers, modulating gas heat, steam or hot water valves.

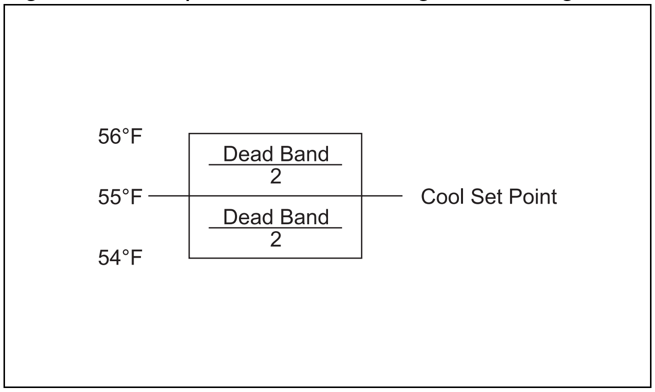
Compressor Staging

Two staging algorithms are available to control a unit's multiple steps of capacity control, "Average" and "Nearest." These control algorithms provide reliable discharge temperature control while managing compressor cycling rates. Constraints on compressor staging are essential for preventing the short cycling which can reduce compressor life by causing improper oil return and excessive heat buildup in the motor windings.

The "Average" compressor staging algorithm keeps track of the discharge temperature and stages cooling up or down to maintain an average temperature that is equal to the effective discharge cooling set point. A stage change can only occur (1) after the keypad adjustable inter-stage timer has expired (five minute default setting) and (2) if the discharge temperature is outside a keypad programmed dead band (see Figure 15). After these two conditions have been met, staging occurs as the controller attempts to equalize two running totals: degree-time above set point and degree-time below set point. The result is that the average discharge temperature is maintained at the cooling set point.

The "Nearest" compressor staging algorithm keeps track of the discharge temperature and stages cooling up or down to maintain the discharge temperature as close as possible to set point. A stage change can only occur (1) after the keypad adjustable inter-stage timer has expired (five minute default setting) and (2) if the control logic calculates that a stage change will result in a discharge temperature closer to set point than the existing condition. The controller logic continually calculates the expected effect of a stage change and uses this information before making a change. A change is made only if it will bring the discharge temperature closer to set point, resulting in a more consistent discharge temperature, reduced compressor cycling and more stable control VAV box control.

Figure 15. Compressorized discharge air cooling



Supply Air Reset

By automatically varying the discharge air temperature to suit a building's cooling or heating requirements, supply air temperature reset can increase the energy efficiency of VAV systems. MicroTech II controllers offer a variety of different reset strategies that can be selected at the keypad. Because they are keypad programmable, reset strategies can be changed or eliminated as desired. Separate strategies can be selected for both cooling and modulating heat. If reset is not desired, a fixed discharge cooling or heating set point can be entered.

The following reset methods are available:

- Space temperature
- Return temperature
- Outdoor air temperature
- Supply airflow (VAV, cooling set point only)
- External 1-5 VDC or 4-20mA signal
- Network communication

For all temperature reset methods, the minimum and maximum cooling and heating set points are keypad programmable along with the corresponding minimum and maximum space, return or outdoor air temperature parameters. For the supply airflow method, the discharge set point will be reset as the supply fan modulates between 30% and 100%. For the external method, the discharge set point will be reset as the voltage or current signal varies over its entire range. For units in a BAS network, the discharge set points are reset via the communication signal.

Zone Temperature Control

The MicroTech II SCC control system provides the sophisticated and flexible zone temperature control that is only possible with DDC systems. Zone temperature sensors are available with or without a remote set point adjustment. With the remote adjustment model, the space set point can be set at the keypad or at the zone sensor package. (Even if a zone sensor is connected, remote set point adjustment can be enabled or disabled as desired at the keypad.)

Control Temperature

The Control Temperature is the representative zone temperature. When compared with the zone set points, the Control Temperature determines whether the unit will supply heating, cooling, or neither. It also determines the amount of cooling or heating required to satisfy the load. Its source can be selected at the keypad from among the following selections:

- Zone temperature sensor
- Return temperature sensor

Because it is the representative zone temperature, the Control Temperature is the primary input to the MicroTech II zone temperature control algorithms. Figure 14 shows the control parameters that the Control Temperature is compared with to control the cooling or heating output. The functions of these parameters are described below. The controller's software will prevent cooling and heating from being inadvertently enabled at the same time.

Change and Proportional Integral Derivative Modulation

When economizer "free" cooling or unit heating is required, the two MicroTech II PID loops combine for cascade-type control, providing the tightest possible zone temperature control. By controlling the discharge temperature along with the zone temperature, these functions eliminate temperature variations near the diffusers that could otherwise occur as a result of traditional zone control's inherent lag effect.

Change: If the Control Temperature is above or below the set point by more than the dead band, the Change PID loop periodically adjusts the cooling or heating discharge air temperature set point either up or down as necessary. The amount of this set point change corresponds to the Control Temperature's position in the modulation range. The farther the Control Temperature is from the set point, the greater the discharge set point change will be. The Change-adjusted discharge cooling and heating set points are limited to ranges defined by keypad programmable maximum and minimum values.

PID: Using the Change function's current discharge set point, the PID function maintains precise discharge temperature control by modulating the economizer dampers and gas heat, steam or hot water heating valves.

Compressor Staging

Compressor staging is controlled directly by the Control Temperature. When the Control Temperature is warmer than the zone cooling set point, cooling is staged up; when the Control Temperature is cooler than the zone cooling set point, cooling is staged down. However, a stage change can only occur when the Control Temperature is outside the dead band. Staging is constrained by an inter-stage delay timer (five minute default setting) and minimum and maximum discharge air temperature limits (all keypad programmable). These constraints protect the compressors from short cycling while eliminating temperature variations near the diffusers.

Project Ahead Algorithm

Because the inherent lag effect in zone temperature control applications can cause overshoot during warm-up or cool-down periods, MicroTech II features a unique "Project Ahead" control algorithm. Project Ahead calculates the rate at which the Control Temperature is changing and reduces the unit's cooling or heating output as the zone temperature nears its set point, thus eliminating overshoot. A separate, keypad programmable Project Ahead time parameter for both heating and cooling allows for control fine tuning.

Duct Static Pressure Control

On all DAC units, duct static pressure control is maintained by the PID algorithm, which provides precise control of the supply fan variable frequency drive or inlet vanes. The keypad programmable set point can be set between 0.20" W.C. and 4.00" W.C.

On larger buildings with multiple trunk runs or large shifts in load due to solar effects (East/West building orientation), an optional second duct static sensor is offered. The MicroTech II controller will automatically select and use the lower of the two sensed pressures to control fan volume. This feature supplies adequate static pressure to the most demanding space at all times.

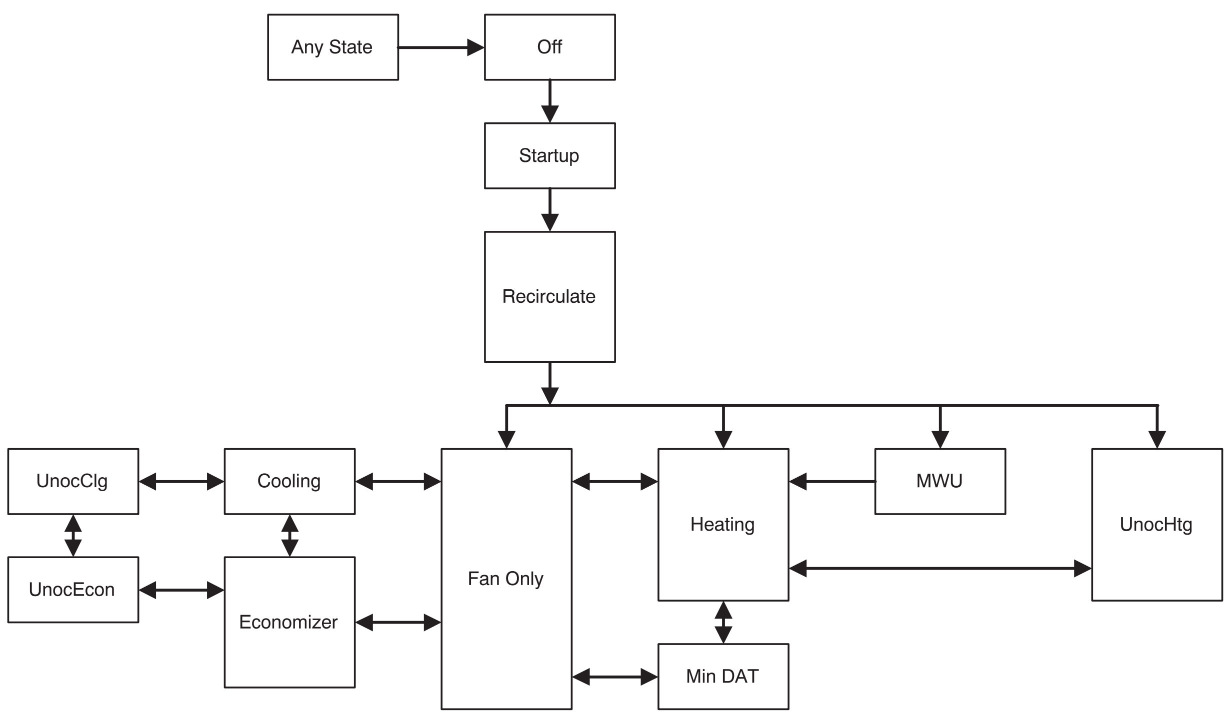
Multiple Unit Applications

For applications in which multiple units are connected in a common duct system, it is important to control all units from a common duct static pressure sensor and to control all operating units in unison. Centralized duct static pressure control can be accomplished through communication with the BAS network.

Operating States

Operating states define the current overall status of the self-contained system. At the control screen and keypad, the operator can display the current operating state and thereby quickly assess the unit's operating condition. Figure 16 shows all possible operating states and the status information they summarize. Depending on unit options, some operating states may not apply. For example, a 100% outside air unit will not have a Morning Warm-Up, Economizer or Unoccupied Economizer operating state. Following are descriptions of each operating state.

Figure 16. Operating State Sequence Chart



Alarm Management and Control

MicroTech II unit controllers are capable of sophisticated alarm management and controlled response functions. Each alarm that occurs is prioritized, indicated, and responded to with the appropriate action. The current alarm (up to four alarms, arranged by alarm priority) and previous alarm (up to eight alarms, arranged by date/time cleared), each with a time and date stamp, can be displayed at the user interface. Whenever a current alarm is cleared, it is logged as a previous alarm and all events in memory are shifted. The current alarm becomes the new previous alarm, and the oldest previous alarm is removed.

Alarm Priority

The various alarms that can occur are prioritized according to the severity of the problem. Three alarm categories are used: faults, problems, and warnings.

1. Faults are the highest priority alarms. If a fault condition occurs, the complete unit will be shut down until the alarm condition is gone and the fault has been manually cleared at the keypad. A fault example would be Fan Fail alarm.
2. Problems are the next lower priority to faults. If a problem occurs, the complete unit will not be shut down, but its operation will be modified to compensate for the alarm condition. A problem will automatically clear when the alarm condition that caused it is gone. Compressor Fail would be an example of a problem, where just the affected compressor is shut down.
3. Warnings are the lowest priority alarms. No control action is taken when a warning occurs; it is simply indicated to alert the operator that the alarm condition needs attention. To make sure that they have been read, the operator must manually clear all warnings. Dirty Filter indication would be an example of a warning.

Generally, a specific alarm condition will generate an alarm that falls into only one of these categories. Under different sets of circumstances, however, the freezestat and most of the sensor failure alarm conditions can generate alarms that fall into multiple categories.

Adjustable Alarm Limits

Four alarm indications have adjustable limits that are used to trigger the alarm. The high return temperature alarm and the high and low supply temperature alarms are adjusted at the user interface. The dirty filter alarm(s) is adjusted at the sensing device.

Table 1. MicroTech II Alarm Summary

Alarm Name	Fault	Problem	Warning
Freeze	X	X	
Smoke	X		
Temperature Sensor Fail	X	X	
Duct High Limit	X		
High Return Temp	X		
High Discharge Temp	X		
Low Discharge Temp	X		
Fan Fail	X		
Fan Retry		X	
Discharge Air Capacity Feedback	X		
Economizer Stuck	X	X	
Auxiliary Control Board Enable		X	
Auxiliary Control Board Communications		X	
Low Airflow		X	
Heat Fail		X	
Circuit 1 — 4 High Pressure		X	
Circuit 1 — 4 Low Pressure/Frost		X	
Compressor 1 — 4 Motor Protection		X	
Compressor 1 — 4 Fail		X	
Auxiliary Control Board Enable Hardware			X
Airflow Switch (False Airflow)			X
Dirty Filter			X

Personal Computer Based Service Tool

A personal computer (PC) can be equipped with Windows® -based MicroTech II service tool software to provide a high-level operator interface with the MicroTech II unit controls for expanded diagnostic and service capability. The service tool can be connected directly to the MicroTech II controller, or used remotely with the addition of an optional unit mounted phone modem.

Hardware Requirements

The following are guidelines (minimum requirements) for hardware needed to operate MicroTech II Service Tools™ software:

- 160 MHz Pentium CPU, or faster
- 64 MB RAM
- 100 MB available space on hard disk
- SVGA card and color monitor
- 800 x 600 resolution
- CD-ROM drive and floppy disk drive
- Bus mouse
- RS-232 serial communications port
- Printer (optional)

Software Requirements

- Microsoft Windows 98 Second Edition
- Microsoft Windows 2000
- Microsoft NT 4.0 Service Pack 3
- Microsoft Internet Explorer 5.0 or later
- MicroTech II Service Tools™

For more complete controller information, refer to the MicroTech II Installation & Maintenance Manuals and MicroTech II Installation and Operation Manuals.

Application Considerations

The following section contains basic application and installation guidelines which must be considered as part of the detailed analysis of any specific project.

General

Units are intended for use in normal heating, ventilating and air conditioning applications. Consult your local McQuay sales representative for applications involving operation at high entering condenser water temperatures, high altitudes, non-cataloged voltages and for applications requiring modified or special control sequences. Consult your local McQuay sales representative for job specific unit selections that fall outside of the range of the catalog tables, such as 100% outside air applications.

For proper operation, rig units in accordance with instructions stated in IM 709.

Factory check, test and start procedures must be explicitly followed to achieve satisfactory start-up and operation (see IM 709).

Many self-contained system applications take advantage of the significant energy savings provided by the use of economizer operation. When a water economizer system is used, mechanical refrigeration is typically not required below an entering condenser water temperature of 55°F. Standard McQuay self-contained systems are designed to operate with entering water temperatures down to 50°F when a water economizer is used and 55°F with no water economizer. For applications where a water economizer system cannot be used, a modulating head pressure control system is available to permit operation at entering condenser water temperatures below 55°F.

Unit Location

Make sure that the floor is structurally strong enough to support the unit with minimum deflection (See "Unit Weights" on page 48). Provide proper structural support to minimize sound and vibration transmission. A concrete floor should be considered. Extra caution is required when installing on a wooden structure. Units must be installed level from front-to-back and over their length.

Unit fresh air intakes must be located away from building flue stacks, exhaust ventilators and areas containing automotive or other exhaust to prevent the possible introduction of contaminated air to the system. Consult code requirements for minimum fresh air volumes.

Allow sufficient space around the unit for service and maintenance clearance. Refer to Figure 17 for recommended service/maintenance clearances. See also "Recommended Clearances" on page 45". Locate equipment room access doors in a manner that can assist in service access if needed (i.e., coil removal). Contact your local McQuay sales representative if reduced service/maintenance clearances are required.

Where code considerations, such as the NEC, require extended clearances, they take precedence over minimum service/maintenance clearances.

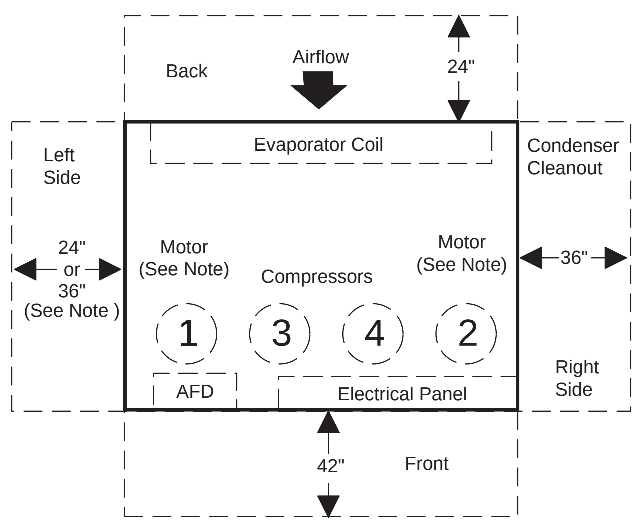
Acoustical Considerations

Good acoustical design is a critical part of any successful installation and should start at the earliest stages in the design process. Each of the four common sound paths must be addressed. These are: (1) radiated sound through the casing of the unit, (2) structure borne vibration, (3) airborne sound through the supply air duct and (4) airborne sound through the return air duct.

Some basic guidelines for good acoustic performance include:

1. Always provide proper structural support under the unit.
2. Provide adequate mass in the floor structure, especially when located over an occupied space where good acoustics are essential.
3. Seal all supply and return air duct penetrations once the duct is installed.
4. Don't overlook the return air path. Always include some duct work (acoustically lined tee) at the return inlet.
5. Minimize system static pressure losses to reduce fan sound generation.
6. Select the appropriate unit/fan for the application. Fans should be selected as close as possible to their peak static efficiency. To assist you, peak static efficiency is identified by the first system curve to the right of the shaded "Do not select" region on each fan curve.
7. Design duct systems to minimize turbulence.
8. Account for low frequency duct breakout noise in system design. Route the first 20' of rectangular duct over non-sensitive areas and avoid large duct aspect ratios. Consider round or oval duct to reduce breakout.

Figure 17. Recommended Service/Maintenance Clearances



Note: 36 inches are required if water and condensate drain connections are left-hand, or fan discharge arrangement is back.

Equipment Room

Locate the equipment room away from sound sensitive areas. Whenever possible, isolate the equipment room from these areas by locating rest rooms, utility rooms, stairwells, hallways, elevators, etc., around its perimeter. This allows not only isolation from radiated sound but provides the capability to route ductwork over less sensitive areas.

Acoustically seal the equipment room. All equipment room penetrations should be sealed with a high quality, flexible material to prevent air and noise from escaping. Even a small leak will compromise the acoustic performance of the installation. The equipment room door should seal tightly on a perimeter gasket.

Equipment room wall construction should be concrete block or offset, double stud. The decision will depend on the critical nature of the application. If offset, double stud construction is used the cavity should be lined with glass fiber insulation and a double layer of sheetrock used on each side of the wall.

Ductwork

Fan noise can be carried through the ductwork to occupied spaces and likely will be the most challenging to control. Careful duct design and routing practice is required. The ASHRAE Applications Handbook discusses sound attenuation relevant to self-contained system applications. Contact your local McQuay sales representative for sound power data for designing the appropriate sound levels for your specific application.

Return Duct

The return duct is the most often over looked. Return air can be ducted directly to the unit or ducted into the equipment room. If ducted to the equipment room, an elbow should be installed within the equipment room. Running a return air drop to near the floor of the room will provide added attenuation. A length of lined ductwork should extend from the equipment room to a length of 15 feet. The maximum recommended return air duct velocity is 1000 feet per minute.

Supply Duct

A lined section of supply air duct should extend at least 15 feet from the equipment room. The use of round duct should be reviewed as it will significantly reduce low frequency sound near the equipment room. If rectangular duct is used, the aspect ratio of the duct should be kept as small as possible. The large flat surfaces associated with large aspect ratios will transmit sound to the space and the potential for duct generated noise, such as oil canning, is increased. The maximum recommended supply air duct velocity is 2000 feet per minute.

When direct ducting to the fan outlet, a minimum of two fan diameters from the fan outlet is recommended and the elbow should turn in the direction of fan rotation. Abrupt turns, takeoffs, etc., will generate air turbulence and resulting unwanted sound and should be avoided.

Duct Protection

An adjustable duct high limit switch is standard equipment on all SWT system's with VAV controls. This is of particular importance when fast acting, normally closed boxes are used. The switch is field adjustable and must be set to meet the specific rating of the system ductwork.

Vibration Isolation

Duct connections to the unit or to the acoustic discharge plenum should be made with a flexible connection. Flexible piping and electrical connections should not be required, but attention should be paid to these areas to avoid vibration transmission from outside sources to the SWT unit.

Condenser Water Piping

Always follow good industry practice in the design of the water piping system. Attention to water treatment and proper strainer application are always necessary. All SWT systems feature mechanically cleanable condensers and optional waterside economizer coils. In addition to mechanically cleanable heat exchangers, cleanouts are provided in the interconnecting piping and in the internal condensate drain trap. Costly field traps are not required. To allow periodic cleaning of the condensers and economizer coils, isolation valves should be provided. Condensers, economizer coils and hot water coils are provided with vent and drain connections.

Always review for possible requirements for condenser piping insulation, especially if cold entering condenser water conditions (<55°F) will be experienced.

Head Pressure Control

If cold entering condenser water conditions (<55°F) will be experienced, a waterside economizer or a condenser head pressure control valve is required. A 2-way, head pressure activated control valve is available factory installed for these applications. A head pressure control valve is not required when the SWT unit is applied with factory waterside economizer package.

Variable Air Volume

Variable frequency drives offer reliable speed control over a wide range of airflow, with advantages in sound and energy performance. In addition, McQuay offers the ability to sense duct static pressure in multiple locations, enhancing control accuracy and helping minimize energy use.

Variable Frequency Drives

Variable frequency drives provide the most efficient means of variable volume control by taking advantage of the fan law relation between fan speed (rpm) and fan brake horsepower (bhp). Also, since airflow reduction is accomplished by changing fan speed, the noise penalties often associated with mechanical control devices, e.g. inlet vanes, are not introduced. The following equation illustrates how fan bhp varies as the cube of the change in fan speed:

$$hp_2 = hp_1 \left(\frac{density_2}{density_1}\right)\left(\frac{rpm_2}{rpm_1}\right)^3$$

In an ideal system, at 50% fan speed, brake horsepower would be reduced to 12.5% of that at full speed.

Variable frequency control varies the speed of the fan by adjusting the frequency and voltage to the motor. Keeping a constant volts/frequency ratio (constant magnetic flux) to the motor allows the motor to run at its peak efficiency over a wide range of speeds and resulting fan airflow volumes.

Duct Static Pressure Sensor Placement

The static pressure should be sensed near the end of the main duct trunk(s). The MicroTech II static pressure control should be adjusted so that at full airflow all of the terminals receive the minimum static pressure required plus any downstream resistance. Control is to the lowest static pressure set point that will satisfy airflow requirements. Lower static pressure setpoints will reduce fan brake horsepower requirements and fan sound generation.

The static pressure sensor tap should be located in the ductwork in an area free from turbulence effects and at least 10 duct diameters downstream and several duct diameters upstream from any major interference, including branch takeoffs. The SWT MicroTech II control system can receive a second duct static pressure sensor in installations having multiple duct trunks or significantly varying zones. The control logic will maintain static pressure at both sensors.

Zone Sensor Placement

Placement of the zone temperature sensor is extremely important to provide proper and economical operation of the heating and cooling system. It is generally recommended that the space sensor be located on an inside wall (3 to 5 feet from an outside wall) in a space having a floor area of at least 400 square feet. The sensor should not be located below the outlet of a supply air diffuser, in the direct rays of the sun, on a wall adjacent to an unheated or abnormally warm room (boiler or incinerator room), or near any heat producing equipment. Where zone sensor placement is a problem, all SWT zone control systems have, as standard, the capability to use the return air sensor for heating & cooling control.

Filtration

Filters should be routinely replaced to minimize filter loading. As filters get dirty, the filter pressure drop increases, affecting system airflow and energy requirements. Depending on fan type, forward curved or airfoil, this airflow change can be significant. The effect of filter loading is the most critical when using high efficiency filters.

When making a fan selection, a pressure drop component for filters as they get dirty should be included in the system total static pressure. A value midway between clean and dirty filter ratings is recommended. If a minimum airflow is critical, the fan selection should be made using the higher, dirty filter pressure drop value. For VAV systems, consider setting the fan control device such that part of its modulation range can be used to maintain airflow as filters become dirty. Following these recommendations should limit airflow fluctuation as the filters load.

System Operating Limits

SWT units can be applied in a wide range of system needs. High cfm/ton or high/low discharge temperature applications are available. However, for proper system operation, some application limits do apply.

Airflow

Maximum cfm limits, based on coil face velocity, are givenTable 4 on page 28.

Separate minimum design cfm limits, by unit size, are given in the physical data table for constant and variable air volume applications. Fan modulation should be limited to 40% of the minimum design cfm limit. Minimum airflow conditions are also dependent on fan selection criteria. Contact your McQuay sales representative to answer any questions on minimum airflow capability or for conditions not shown in the catalog.

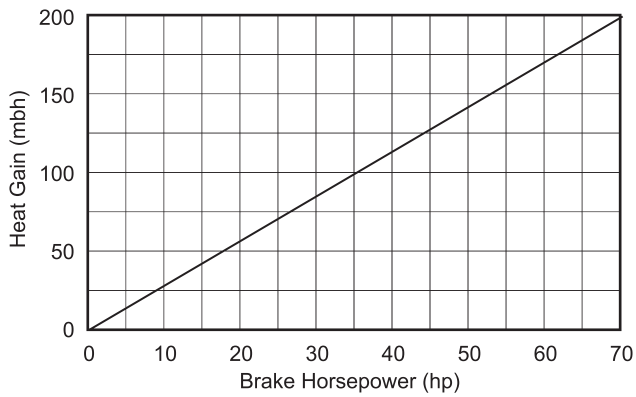
VAV box minimum airflow settings should correspond with the minimum VAV fan operating point. All units are provided with multi-groove, fixed pitch sheaves. During system air balance, alternate fixed pitch sheaves may be needed to match final system requirements. Alternate sheaves are available from McQuay.

Fan Heat

Sensible heat gain from the fan, fan motor and drives occurs in all fan systems and its effect must be considered during equipment selection. It is an added load in cooling and an added source when in heating. The majority of the heat gain occurs through the fan itself, as the air is elevated from the low-pressure side to the high-pressure side of the fan. Moving the motor out of the air stream has a negligible effect on overall fan heat gain. A unit with higher fan power requirements/higher fan heat will have less net cooling capability and may not have enough left to satisfy system loads.

As a "rule of thumb," a typical supply fan heat gain is 3°F. However, fan heat gain can be quickly calculated once the fan has been selected and the fan brake horsepower has been determined. Using Figure 18, "Fan & Motor Heat Gain", select your fan brake horsepower on the horizontal axis, move up vertically until you intersect with the heat gain curve and then move horizontally to find the fan heat gain in Mbh.

Figure 18. Fan and Motor Heat Gain



Fan Temperature rise = (Fan Heat (Mbh)) / (1.085 x Fan cfm)

A draw through unit has the fan located after the DX cooling coil. In this arrangement, fan heat is applied as reheat to the cold, conditioned air coming off of the coil. This arrangement will have a lower sensible heat ratio and higher dehumidification capability than a blow through coil arrangement. The discharge temperature available to the supply duct is always the sum of the coil leaving air temperature plus the fan temperature rise. This must be considered when selecting the supply air volume required to satisfy space requirements.

Example:
52°F leaving coil temp.
+ 3°F fan temp. rise = 55°F discharge air temp.

Condenser Water Flow

System capacity tables provide selections for a condenser flow rate of 3 gpm/ton. For a given entering condenser water temperature, 3 gpm/ton will provide maximum unit performance. Reducing condenser water flow rates to 2.5 or 2 gpm/ton can significantly reduce pumping energy costs and reduce piping costs. The reduction in pumping energy can be compared to the change in unit performance and an evaluation made. The SWT capacity tables can be used for condenser flow rates from 2 to 3 gpm/ton by using the appropriate leaving condenser water temperature column (interpolation is allowed). Minimum condenser flow rate is 2 gpm/ton.

Coil Freeze Protection

Consideration must always be made for coil freeze protection when applying units in geographic areas which see sub-freezing temperatures. Careful design of outside air/return air mixing systems is critical to minimizing freeze potential. Some applications may require the use of glycol and/or preheat coils. No control sequence can prevent coil freezing in the event of power failure.

A nonaveraging type freezestat is factory installed on all units with hot water heat or waterside economizer. If a potential freeze condition is sensed, unit water valves will be driven to the full open position, the supply fan de-energized and an alarm signal sounded.

In nonducted return applications where the equipment room is the mixing plenum, some form of heat within the equipment room should be considered.

Air Density Correction

Fan performance data is based on standard 70°F air temperature and zero feet altitude (sea level). For applications other than standard, a density ratio must be multiplied to actual static pressure values. Density correction factors are expressed as a function of temperature and altitude in Table 2.

Table 2. Temperature and altitude conversion factors

AIR TEMP	ALTITUDE (FEET)								
	0	1000	2000	3000	4000	5000	6000	7000	8000
-20°F	1.20	1.16	1.12	1.08	1.04	1.00	0.97	0.93	0.89
0°F	1.15	1.10	1.08	1.02	0.99	0.95	0.92	0.88	0.85
20°F	1.11	1.06	1.02	.098	0.95	0.92	0.88	0.85	0.82
40°F	1.06	1.02	0.98	0.94	0.91	0.88	0.84	0.81	0.78
60°F	1.02	0.98	0.94	0.91	0.88	0.85	0.81	0.79	0.76
70°F	1.00	0.96	0.93	0.89	0.86	0.83	0.80	0.77	0.74
80°F	0.98	0.94	0.91	0.88	0.84	0.81	0.78	0.75	0.72
100°F	0.94	0.91	0.88	0.84	0.81	0.78	0.75	0.72	0.70
120°F	0.92	0.88	0.85	0.81	0.78	0.76	0.72	0.70	0.67
140°F	0.89	0.85	0.82	0.79	0.76	0.73	0.70	0.78	0.65

Unit Wiring

All units require 3-phase, 60 Hz, 208, 230, 460 or 575 volt power or 3-phase, 50 Hz, 400 volt power. Units will operate satisfactorily at ±10% of rated voltage at the power connection terminals of the unit. All units include individual branch circuit fusing of all motor loads and have a single-point power connection. A factory mounted, nonfused disconnect switch is an available option.

All wiring must be installed in accordance with the NEC and local codes.

Selection Procedure

Achieving the optimal performance of any system requires both accurate system design and proper equipment selection. Factors which control unit selection include applicable codes, ventilation and filtration requirements, heating and cooling loads, acceptable temperature differentials and installation limitations. McQuay SWT units offer a wide selection of component options providing the capability to meet diverse application needs.

The McQuay SelectTools™ software selection program allows your local McQuay sales representative to provide you with fast, accurate and complete selection of McQuay SWT units. Unit selection can also be accomplished through reference to physical, performance, dimensional and unit weight data included in this catalog. Due to the variety of cooling system options available, only a sampling of cooling capacity data has been presented in this catalog

Proper equipment selection can be accomplished by following these three simple steps:

1. Select unit size and compressor combination.
2. Selecting heating system.
3. Select fan and motor.

The following example is provided to illustrate the catalog selection procedure

Selection Example:

Scheduled Design Requirements:

Supply air volume	12,000 cfm
Maximum face velocity	550 fpm
Supply fan external SP	2.00" w.g.
Altitude	sea level

Variable air volume system with fan speed control

Hot water heat

Water economizer system

30% pleated filters

460V/60Hz/3Ph

Double wall construction

Stainless steel drain pan

Premium efficiency motor

Summer Design:

DX coil mixed air dry bulb	80°F
DX coil mixed air wet bulb	67°F
Sensible load	345,000 Btu/hr
Total load	450,000 BTU/hr
Supply fan sensible heat rise	3°F
Entering condenser water	85°F
Leaving condenser water	95°F
Minimum condenser water	55°F

Winter Design:

Return air temperature	60°F
Space heating load	450 mbh
Entering hot water temperature	180°F

Step 1 - Unit Size Selection

Unit size is based on coil face area and cooling capacity requirements. Supply air capacity and maximum face velocity constraints should serve as a guide for selecting coil dimensions and cabinet size.

Based on the given data, the appropriate coil face area may be determined as follows:

Minimum face area = supply air volume/maximum face velocity
=12,000 cfm/550 fpm
= 21.8 square feet

Note: Unit data is based on standard air conditions of 70°F at sea level. See “Application Considerations” on page 22 for temperature/altitude conversion factors for non-standard conditions.

Referring to Table 4 on page 28 under the Physical Data section, the 23.3 square foot coil of the SWT040C satisfies the requirements.

Step 2 - Unit DX Cooling Selection

Since the design cfm is less than the nominal value in the DX Cooling Capacity Data table, the capacities must be adjusted. See Table 6. DX Cooling Capacity Correction Multipliers on page 29 .

CFM correction factor =
design cfm / nominal cfm = 12,000 / 14,000 = .857

Total heat correction multiplier = .973
Capacity required from table = 450mbh /.973 = 462.5 mbh

Sensible heat correction multiplier =.929
Capacity required from table = 345 mbh /.929 = 371.4 mbh

Using the "DX Cooling Capacity Data" tables provided, the unit selection is a SWT040C with (1) 6hp and (3) 10hp compressors. Unit performance from the table equals 512.8 TMBH/375.9 SMBH at 123gpm. Adjusting for the lower cfm yields:

Total capacity = 512.8 MBH x .973 = 499.0 MBH

Sensible capacity = 375.9 MBH x .929 = 349.2 MBH

Coil LAT = 80º F - 349.2 MBH / (1.085 x 12,000 cfm) = 53.2°F.

Condenser flow rate = 123 gpm x .973 = 120 gpm

Step 3 - Economizer Capacity Selection

Determine the Waterside Economizer Capacity by referring to Table 21 on page 34. Use entering air of 80/67°F and entering water of 55°F at 120 gpm. Interpolating for the required gpm, economizer performance equals 276.3 TMBH / 261.9 SMBH at the unit's nominal cfm. Using the Waterside Economizer Capacity Correction Factors (Table 7 on page 29), performance at the specified cfm can be found.

Total capacity = 276.3 MBH x 0.943 = 260.6 MBH

Sensible capacity = 261.9 MBH x 0.904 = 236.8 MBH

Step 4 - Heating Selection

Determine hot water capacity from Table 22 on page 35. After interpolating for the specified cfm, Table 22 indicates a total of 457mbh.

Step 5 - Fan/Motor Selection

Fan/motor selection is based on unit total static pressure and design airflow. Total static pressure includes the internal air pressure drops of unit components and external air pressure drops of supply and return air duct systems. See “Component Pressure Drops” on page 36 for internal pressure drops of unit components. Values in the table may be interpolated for the specified cfm.

Internal pressure drops:

DX coil (wet surface)	0.68" w.g.
Economizer coil (dry surface)	0.38" w.g.
Hot water coil	0.11" w.g.
4", 30% efficient filters	0.19" w.g.
Total internal pressure drop	1.36" w.g.

External pressure drop:

Supply + return duct	2.00" w.g.

Total static pressure = internal drops + external drops
= 1.34" + 2.00"
= 3.36" w.g.

Entering the fan curve for the SWT040C at 12,000cfm and 3.75" w.g., yields 13.0 required fan brake horsepower. A 15 horsepower motor can be selected.

Step 6 - Calculating Unit Weight

Referring to Table 32 on page 48, for a SWT040C:

Unit weight = SWT basic unit + 6 row evaporator coil
+ economizer coil + water (econ. coil)
+ hot water coil + water (HW coil) + [(1) 6 hp, (3)10 hp] compressor / condenser
+ water (condenser) SAF + SAF motor + VFD
= 1473 + 450 + 410 + 111 + 152 + 32 + 1233 + 74 + 1120 + 185 + 50
= 5,290 Lbs.

Step 7 - Supply Power Wiring

Sizing supply power wire for a unit is based on the circuit with the highest amperage draw. All electrical equipment is wired to a central control panel for either single or optional dual power connections. See “Electrical Data” on page 46 for FLA and RLA ratings. Determine Minimum Circuit Ampacity (MCA) as follows:

MCA = [1.25 x RLA or FLA of largest motor] + [1.00 x RLA or FLA of all other loads] + [2 amps (controls)]

	RLA/FLA
(1) 6 horsepower compressors	8.1 amps each
(3) 10 horsepower compressors	14.1 amps each
15 horsepower premium efficiency supply fan motor	18.9 amps

MCA = [1.25 x 18.9] + [(8.1 + 14.1 + 14.1 + 14.1)] + [2] = 76.0 amps

Note: If a unit has been selected with non-concurrent electric heat, MCA must be calculated for both the heating mode and the cooling mode and the **larger** value used.

Step 8 - R-407C vs. R-22

The cooling tables (starting on page 29) document the R-22 cooling capacity and compressor kW. The R-407C performance correction factors vary slightly with the unit size and operating conditions but can be estimated as shown in the table below. Use the McQuay SelectTools™ computer selection program to obtain the exact R-407C performance.

Table 3. R-407C correction factor

Compressor capacity	Compressor kW
0.96 to .98	1.02 to 1.04

Physical Data

Table 4. SWT 018C Through SWT 040C

Data	SWT Model Size				
	018C	023C	028C	035C	040C
Compressor					
Quantity	3, 4	3, 4	4	4	4
Size	See DX Cooling Capacity Tables				
Evaporator Coil					
Face Area ($Ft.^2$)	11.8	15.3	18.9	23.3	26.3
Rows	4, 6	4, 6	4, 6	4, 6	4, 6
Fpi	12	12	12	12	12
Performance[a]					
EER / IPLV	See Table 5 on page 29				
Waterside Economizer Coil					
Face Area ($Ft.^2$)	11.8	15.3	18.9	23.3	26.3
Rows	4	4	4	4	4
FPI	12	12	12	12	12
Maximum Working Pressure (psig)	400	400	400	400	400
Hot Water Heating Coil					
Face Area ($Ft.^2$)	9.3	12.8	16.3	20.2	23.8
Rows	1, 2	1, 2	1, 2	1, 2	1, 2
Fpi	12	12	12	12	12
Electric Heat					
Kw	34	34	34	34	34
Filters					
(Qty) size (in) 4" depth	(3) 20 x 20 (2) 25 x 20 (4) 16 x 25	(3) 20 x 20 (2) 25 x 20 (4) 16 x 25	(3) 20 x 20 (2) 25 x 20 (4) 16 x 25	(5) 20 x 20 (5) 25 x 20	(5) 20 x 20 (5) 25 x 20
Evaporator Fan [b]					
Quantity	1	1	1	2	2
Size	15	18	18	15	15
Minimum Horsepower	5	7.5	10	10	15
Maximum Horsepower	10	15	20	20	25
Minimum Design cfm, CV	2950	3825	4725	5825	6575
Minimum Design cfm, VAV	4720	6120	7560	9320	10520
Maximum Design cfm	7080	9180	11340	13980	15780
Condensers					
Waterside Working Pressure (psig)	400	400	400	400	400
Minimum Entering Temperature (°F) Mechanical Cooling	55	55	55	55	55
Minimum GPM	25	41	53	66	69
Maximum GPM	88	108	125	159	166

a. Based on ARI 340/360-93 standard rating conditions, 80/67°F to the coil, 85-95° condenser water.
b. Standard fan TSP limit is 5.5 inches of water. Consult your local McQuay sales representative for applications beyond this range.

Unit Efficiency Ratings

Table 5. Unit EER

Model	Compressors	Gross MBH	EER
18	3 x 6	238.7	14.47
18	4 x 6	297.5	13.33
23	4 x 6	313.3	13.95
23	6-6-6-10	363.1	13.30
28	4 x 6	309.3	14.70
28	6-6-10-10	406.1	12.95
35	6-6-10-10	419.3	14.06
35	6-10-10-10	482.4	13.47
40	6-10-10-10	491.9	13.82
40	4 x 10	523.6	13.27

Note: R22, 6 row DX coil, ARI 340/360-93 standard rating conditions.

Correction Multipliers

DX Cooling Capacity Correction Multipliers

Table 6. DX Cooling Capacity Correction Multipliers

Description	Percent Standard Cfm								
	-20%	**-15%**	**-10%**	**-5%**	**Std.**	**+5%**	**+10%**	**+15%**	**+20%**
Total Heat	0.968	0.971	0.985	0.991	1.000	1.006	1.012	1.019	1.025
Sensible Heat	0.900	0.925	0.952	0.974	1.000	1.024	1.048	1.070	1.093
Compressor Motor Kw	0.980	0.985	0.989	0.995	1.000	1.004	1.006	1.011	1.017

Waterside Economizer Capacity Correction Factors

Table 7. Waterside Economizer Capacity Correction Factors

	Cfm Compared To Rated Quantity	Total Cooling Capacity Multiplier	Sensible Cooling Capacity Multiplier
Waterside Economizer	-20%	0.920	0.870
	-10%	0.960	0.930
	STD.	1.000	1.000
	+10%	1.04	1.06
	+20%	1.08	1.12

50 Hertz

For 50 Hz applications, the total capacity must be derated by 0.89 and the sensible capacity must be derated by 0.94. The 50 Hz supply fan motor horsepower selections must be based on fan brake horsepower (from Figure 23through Figure 32) divided by 0.8.

DX Cooling Capacity Data

SWT018C - 6000 CFM

Table 8. SWT018C - 6000 CFM (3 Compressors)

Compressors	EDB(°F)	EWB(°F)	EWT(°F)	TMBH	SMBH	LDB	LWB	GPM
(3)6HP	**75**	**62**	75	227.3	174.3	48.4	48.2	54
			85	219.8	170.3	48.9	48.7	53
			95	212.1	167.3	49.4	49.3	53
	80	**67**	75	246.2	171.8	53.7	53.6	58
			85	238.2	168.6	54.2	54.1	57
			95	229.8	165.2	54.7	54.6	57
	85	**72**	75	266.7	168.9	59.2	59.1	62
			85	258.2	165.9	59.6	59.5	61
			95	249.2	162.7	60.1	60.0	61

SWT023C - 8000 CFM

Table 9. SWT023C - 8000 CFM (3 Compressors)

Compressors	EDB(°F)	EWB(°F)	EWT(°F)	TMBH	SMBH	LDB	LWB	GPM
(3)6HP	**75**	**62**	75	241.7	204.9	51.5	51.3	57
			85	233.9	201.5	51.9	51.7	56
			95	225.7	197.9	52.3	52.1	56
	80	**67**	75	260.7	202.1	56.8	56.7	61
			85	252.2	198.9	57.2	57.0	60
			95	243.2	195.4	57.6	57.4	59
	85	**72**	75	281.4	199.0	62.2	62.0	65
			85	272.3	195.8	62.5	62.4	64
			95	262.9	192.6	62.9	62.8	63

Table 10. SWT023C - 8000 CFM (4 Compressors)

Compressors	EDB(°F)	EWB(°F)	EWT(°F)	TMBH	SMBH	LDB	LWB	GPM
(4)6HP	**75**	**62**	75	298.6	230.4	48.6	48.4	71
			85	289.3	226.1	49.1	48.9	70
			95	279.3	221.7	49.6	49.4	70
	80	**67**	75	323.3	227.1	54.0	53.8	76
			85	313.0	223.0	54.4	54.3	75
			95	302.3	218.7	54.9	54.8	75
	85	**72**	75	349.9	223.3	59.4	59.2	82
			85	339.0	219.4	59.9	59.7	81
			95	327.5	215.3	60.3	60.2	80

Note: See Table 6 DX Cooling Capacity Correction Factors on page 29 for determining unit capacity at other than nominal cfm. For a computer generated job specific selection, contact your local McQuay sales representative. For 50 Hz applications, the total capacity must be derated by 0.89 and the sensible capacity must be derated by 0.94. All capacities are gross and do not account for fan motor heat.
Altitude and/or Glycol selections also available.

SWT028C - 10,000 CFM

Table 11. SWT028C - 10,000 CFM (4 Compressors)

Compressors	EDB(°F)	EWB(°F)	EWT(°F)	TMBH	SMBH	LDB	LWB	GPM
(4) 6HP	75	62	75	314.6	261.7	51.0	50.8	74
			85	304.2	257.1	51.4	51.2	73
			95	293.7	252.5	51.8	51.6	73
	80	67	75	339.2	258.0	56.3	56.2	79
			85	328.3	253.8	56.7	56.6	79
			95	317.0	249.4	57.1	57.0	78
	85	72	75	366.3	253.9	61.7	61.6	85
			85	354.4	249.8	62.1	61.9	84
			95	342.4	245.6	62.5	62.3	83

Table 12. SWT028C - 10,000 CFM (3/1 Compressors)

Compressors	EDB(°F)	EWB(°F)	EWT(°F)	TMBH	SMBH	LDB	LWB	GPM
(3) 6HP, (1) 10HP	75	62	75	364.2	283.6	49.0	48.8	87
			85	352.7	278.4	49.5	49.3	86
			95	340.5	272.9	50.0	49.8	85
	80	67	75	394.7	280.0	54.3	54.2	93
			85	382.1	274.9	54.8	54.7	92
			95	368.9	269.5	55.3	55.1	91
	85	72	75	427.8	275.5	59.7	59.6	100
			85	414.1	270.6	60.2	60.1	99
			95	399.8	265.5	60.6	60.5	97

SWT035C - 12,000 CFM

Table 13. SWT035C - 12,000 CFM (2/2 Compressors)

Compressors	EDB(°F)	EWB(°F)	EWT(°F)	TMBH	SMBH	LDB	LWB	GPM
(2) 6HP, (2) 10HP	75	62	75	422.1	333.7	49.5	49.3	100
			85	408.7	327.6	50.0	49.8	100
			95	394.7	321.4	50.4	50.3	99
	80	67	75	457.8	329.6	54.8	54.7	108
			85	443.3	323.8	55.3	55.1	107
			95	428.0	317.7	55.7	55.6	105
	85	72	75	496.5	324.6	60.2	60.1	116
			85	481.0	319.1	60.6	60.5	114
			95	464.3	313.2	61.1	60.9	113

Table 14. SWT035C - 12,000 (1/3 Compressors)

Compressors	EDB(°F)	EWB(°F)	EWT(°F)	TMBH	SMBH	LDB	LWB	GPM
(1) 6HP, (3) 10HP	75	62	75	468.6	354.8	47.9	47.8	112
			85	454.0	348.0	48.4	48.3	111
			95	438.6	341.0	48.9	48.8	110
	80	67	75	509.4	350.7	53.2	53.1	120
			85	493.5	344.1	53.7	53.6	119
			95	476.6	337.2	54.2	54.1	118
	85	72	75	553.9	345.6	58.6	58.5	130
			85	536.7	339.2	59.1	59.0	128
			95	518.3	332.5	59.6	59.5	127

Note: See Table 6 DX Cooling Capacity Correction Factors on page 29 for determining unit capacity at other than nominal cfm.
For a computer generated job specific selection, contact your local McQuay sales representative.
For 50 Hz applications, the total capacity must be derated by 0.89 and the sensible capacity must be derated by 0.94.
All capacities are gross and do not account for fan motor heat.
Altitude and/or Glycol selections also available.

SWT040C - 14,000 CFM

Table 15. SWT040C - 14,000 CFM 2/2 Compressors)

Compressors	EDB(°F)	EWB(°F)	EWT(°F)	TMBH	SMBH	LDB	LWB	GPM
(2)6HP, (2)10HP	**75**	**62**	75	436.1	364.0	51.2	50.9	103
			85	422.2	357.8	51.6	51.3	102
			95	407.6	351.3	52.0	51.7	101
	80	**67**	75	471.8	359.6	56.4	56.3	110
			85	456.9	353.8	56.8	56.6	109
			95	440.8	347.5	57.2	57.0	108
	85	**72**	75	511.4	354.6	61.8	61.6	119
			85	495.0	348.9	62.1	62.0	117
			95	477.2	342.8	62.5	62.4	116

Table 16. SWT040C - 14,000 CFM 1/3 Compressors)

Compressors	EDB	EWB	EWT	TMBH	SMBH	LDB	LWB	GPM
(1)6HP, (3)10HP	**75**	**62**	75	487.9	387.0	49.6	49.5	116
			85	472.2	379.9	50.1	50.0	114
			95	456.0	372.5	50.6	50.4	113
	80	**67**	75	530.1	382.9	54.9	54.8	124
			85	512.8	375.9	55.4	55.3	123
			95	494.6	368.6	55.8	55.7	121
	85	**72**	75	576.9	377.8	60.2	60.2	134
			85	557.8	371.0	60.7	60.6	132
			95	537.7	363.9	61.2	61.1	130

Waterside Economizer Capacity

SWT018D - 6000 CFM

Table 17. SWT018D - 6000 CFM

EWT	GPM	EDB	EWB	TMBH	SMBH	LDB	LWB	LWT
45	33	75	62	120.1	118.4	57.0	55.1	52.3
	43			136.0	128.6	55.4	54.2	51.4
	72			163.5	142.7	53.3	52.5	49.5
	39	80	67	164.7	135.9	59.3	58.4	53.4
	51			187.4	145.3	57.8	57.1	52.4
	85			225.2	160.8	55.5	54.9	50.3
55	20	75	62	61.1	61.1	65.7	58.6	61.2
	26			74.2	74.2	63.7	57.8	60.7
	46			92.7	92.7	60.9	56.8	59.0
	26	80	67	93.2	93.2	65.8	62.3	62.1
	34			106.0	105.9	63.9	61.6	61.2
	59			126.2	120.0	61.7	60.5	59.3

Note: See Table 7. Waterside Economizer Capacity Correction Factors on page 29 for determining capacity at other than nominal cfm.

SWT023D - 8000 CFM

Table 18. SWT023D - 8000 CFM

EWT	GPM	EDB	EWB	TMBH	SMBH	LDB	LWB	LWT
45	44	75	62	160.2	157.8	57.0	55.1	52.3
	57			180.9	171.1	55.4	54.2	51.4
	96			216.9	189.6	53.3	52.5	49.5
	52	80	67	219.3	180.9	59.3	58.4	53.4
	68			249.1	193.3	57.9	57.2	52.4
	113			298.6	213.5	55.6	55.0	50.3
55	26	75	62	81.9	81.9	65.6	58.6	61.3
	35			99.1	99.1	63.7	57.8	60.7
	61			123.2	123.2	60.9	56.8	59.0
	35	80	67	124.3	124.3	65.8	62.3	62.1
	46			141.0	141.0	63.9	61.6	61.2
	79			167.5	159.5	61.8	60.6	59.3

Note: See Table 7. Waterside Economizer Capacity Correction Factors on page 29 for determining capacity at other than nominal cfm.

SWT028D - 10,000 CFM

Table 19. SWT028D - 10,000 CFM

EWT	GPM	EDB	EWB	TMBH	SMBH	LDB	LWB	LWT
45	55	75	62	199.9	196.6	57.0	55.2	52.3
	71			224.4	212.3	55.6	54.3	51.3
	120			266.5	234.2	53.6	52.7	49.4
	65	80	67	272.7	224.9	59.4	58.5	53.3
	85			307.9	239.6	58.1	57.3	52.3
	142			366.1	263.5	55.9	55.2	50.2
55	33	75	62	103.5	103.5	65.5	58.5	61.3
	44			123.9	123.9	63.7	57.8	60.7
	76			152.3	152.3	61.1	56.8	59.0
	44	80	67	155.4	155.4	65.8	62.3	62.1
	57			175.1	175.1	64.0	61.7	61.1
	98			206.1	197.1	62.0	60.7	59.2

Note: See Table 7. Waterside Economizer Capacity Correction Factors on page 29 for determining capacity at other than nominal cfm.

SWT035D - 12,000 CFM

Table 20. SWT035D - 12,000 CFM

EWT	GPM	EDB	EWB	TMBH	SMBH	LDB	LWB	LWT
45	65	75	62	259.8	249.5	56.0	54.6	52.9
	85			289.9	266.5	54.7	53.6	51.8
	144			338.3	290.5	52.9	52.1	49.7
	79	80	67	357.0	283.0	58.4	57.7	54.1
	101			399.8	300.7	57.1	56.4	52.9
	170			466.0	327.9	55.0	54.4	50.5
55	39	75	62	137.0	137.0	64.6	58.2	62.0
	52			160.6	160.6	62.8	57.5	61.1
	92			192.2	192.2	60.4	56.6	59.2
	52	80	67	201.8	201.9	64.6	61.9	62.7
	69			223.9	221.9	63.1	61.3	61.5
	118			261.2	244.9	61.4	60.3	59.4

Note: See Table 7. Waterside Economizer Capacity Correction Factors on page 29 for determining capacity at other than nominal cfm.

SWT040D - 14,000 CFM

Table 21. SWT040D - 14,000 CFM

EWT	GPM	EDB	EWB	TMBH	SMBH	LDB	LWB	LWT
45	76	75	62	303.4	291.4	56.0	54.6	53.0
	99			339.0	311.5	54.7	53.6	51.8
	168			396.3	339.9	52.8	52.1	49.7
	92	80	67	417.3	330.7	58.4	57.6	54.1
	118			467.6	351.4	57.0	56.4	52.9
	198			545.9	383.6	54.9	54.4	50.5
55	46	75	62	159.6	159.6	64.6	58.2	62.0
	61			187.4	187.4	62.8	57.5	61.1
	107			224.9	224.9	60.3	56.6	59.2
	61	80	67	235.6	235.6	64.6	61.9	62.7
	80			261.7	259.3	63.1	61.3	61.5
	137			305.9	285.7	61.3	60.3	59.5

Note: See Table 7. Waterside Economizer Capacity Correction Factors on page 29 for determining capacity at other than nominal cfm.

Heating Capacity Data

Hot Water Coil Capacity (1 Row)

Table 22. Entering Water 180°F and Entering Air 60°F

UNIT	CFM	TMBH	LWT	LDB	GPM
018C	4000	191.6	158.1	103.8	18
	7000	241.7	152.4	91.6	18
023C	6000	277.9	158.8	102.4	25
	9000	329.7	154.9	93.5	25
028C	8000	353.3	159.8	100.4	35
	10500	397.1	157.5	94.6	35
035C	9000	430.2	158.1	103.7	40
	13500	512.3	154.0	94.7	40
040C	11000	524.5	158.2	103.6	50
	16000	621.0	155.2	95.5	50

Note: For complete one-row capacity and extended two-row capacity, please contact your McQuay sales representative.
Selections based on water, for glycol/water solutions, please contact your McQuay sales representative.

Electric Heat

Table 23. SWT018D - 040D

SWT	208V/60HZ/3PH			230V/60HZ/3PH			400V/50HZ/3PH			460V/60HZ/3PH			575V/60HZ/3PH		
Unit Size	**kW**	**MBH**	**FLA**	**kW**	**MBH**	**FLA**	**kW**	**MBH**	**FLA**	**kW**	**MBH**	**FLA**	**kW**	**MBH**	**FLA**
018D - 040D	27.8	94	77.2	34	116	85.6	25.7	88	37.2	34	116	42.8	34	116	34.2

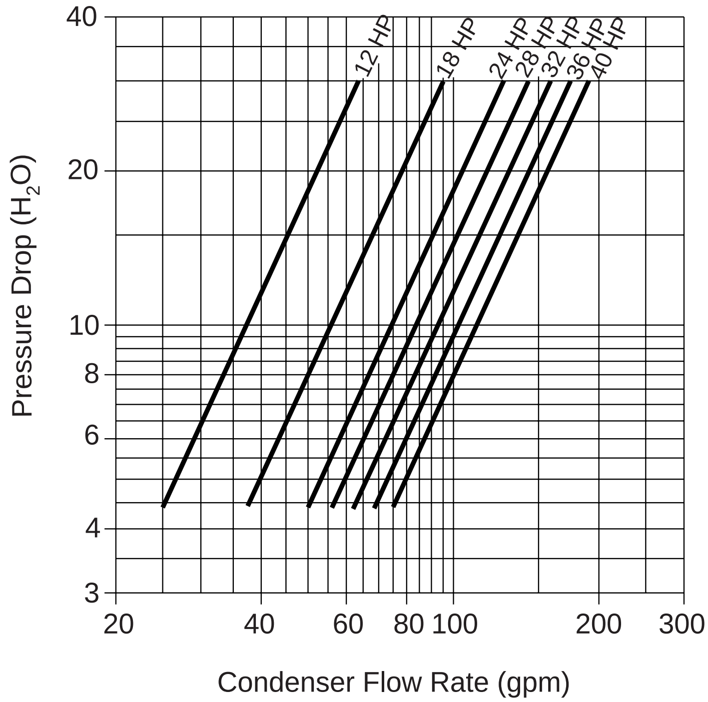
Component Pressure Drops

Table 24. Unit Air Pressure Drops (inches w.g.)

Unit	CFM	4", 30% Filter	4", 65% Filter	4-Row Econo.	6-Row DX	1-Row HW
SWT018C	4500	0.14	0.27	0.28	0.52	0.11
	5000	0.17	0.31	0.34	0.61	0.13
	6000	0.23	0.41	0.46	0.81	0.17
	7000	0.29	0.52	0.60	1.04	0.22
SWT023C	6000	0.15	0.28	0.29	0.54	0.10
	7000	0.19	0.35	0.38	0.69	0.13
	8000	0.23	0.43	0.48	0.85	0.16
	9000	0.28	0.51	0.59	1.03	0.20
SWT028C	8000	0.17	0.31	0.34	0.61	0.11
	9000	0.20	0.37	0.41	0.74	0.13
	10000	0.24	0.44	0.49	0.86	0.16
	11000	0.28	0.50	0.58	1.00	0.19
SWT035C	8000	0.12	0.23	0.23	0.44	0.08
	10000	0.17	0.32	0.34	0.62	0.11
	12000	0.23	0.42	0.47	0.83	0.15
	14000	0.29	0.52	0.61	1.04	0.19
SWT040C	10000	0.14	0.27	0.28	0.52	0.08
	12000	0.19	0.35	0.38	0.68	0.11
	14000	0.24	0.44	0.50	0.86	0.15
	16000	0.30	0.55	0.63	1.05	0.19

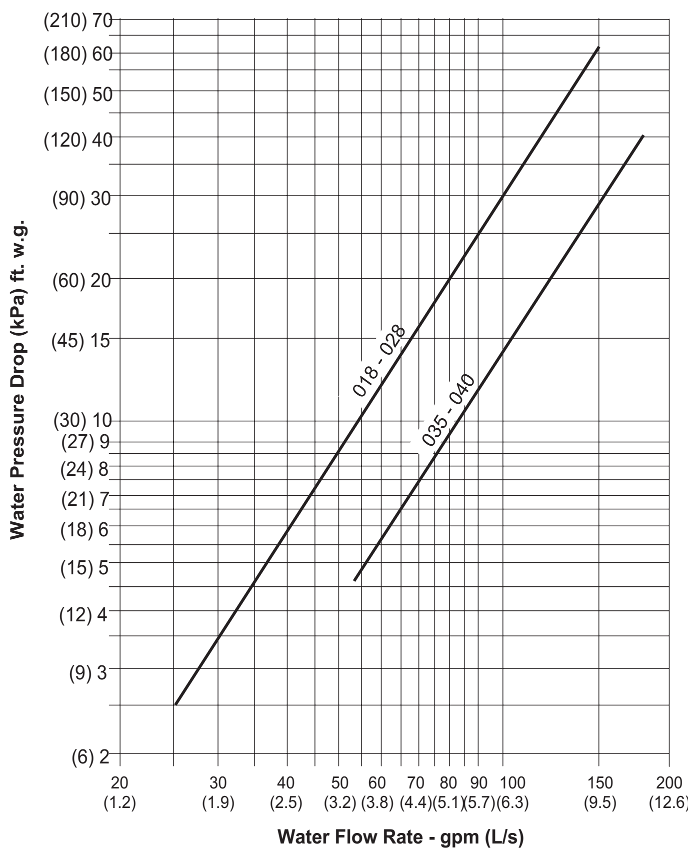
Note: DX pressure drops are wet coil and economizer are dry coil.
All units must have a DX coil pressure drop.

Figure 19. Condenser Water Pressure Drop, SWT 018C through SWT 040C



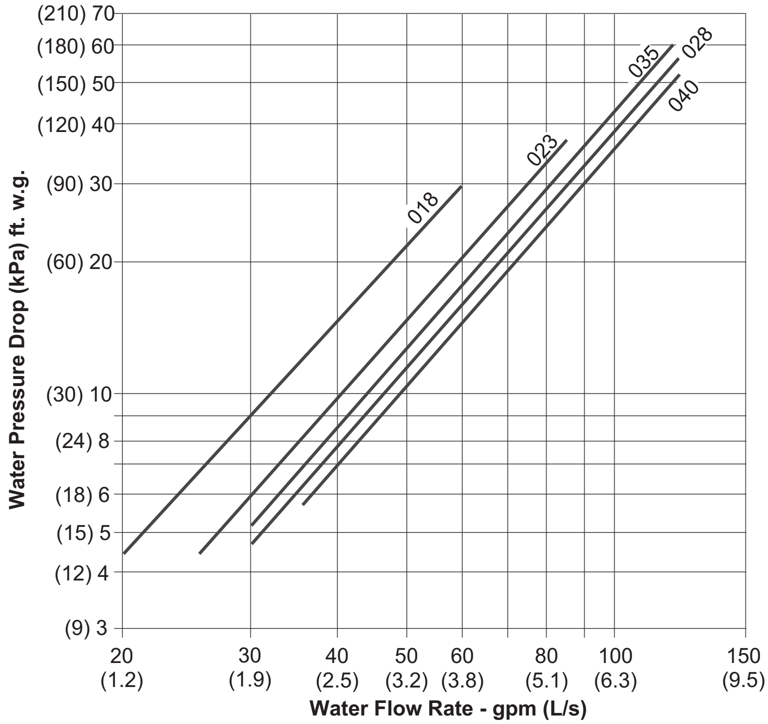
Note: HP = Total unit compressor horsepower.

Figure 20. Economizer System Water Pressure Drop, SWT 018C through 040C



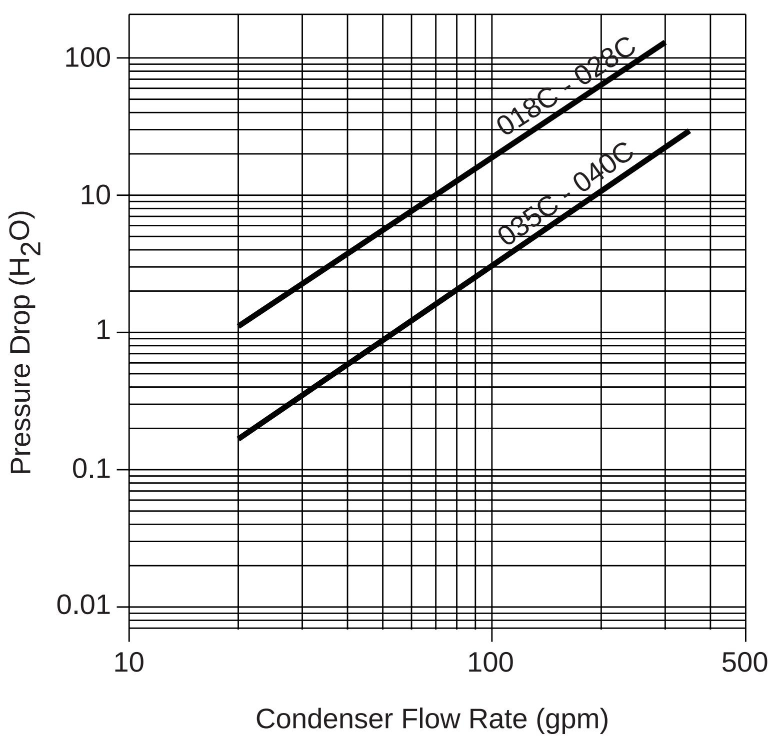
Note: Includes coil, Control valves, and interconnecting piping.
Note: Add this ∆P to condenser ∆P to obtain unit ∆P for pump selection.

Figure 21. Hot Water Coil Water Pressure Drop (1-row), SWT018C through SWT040C



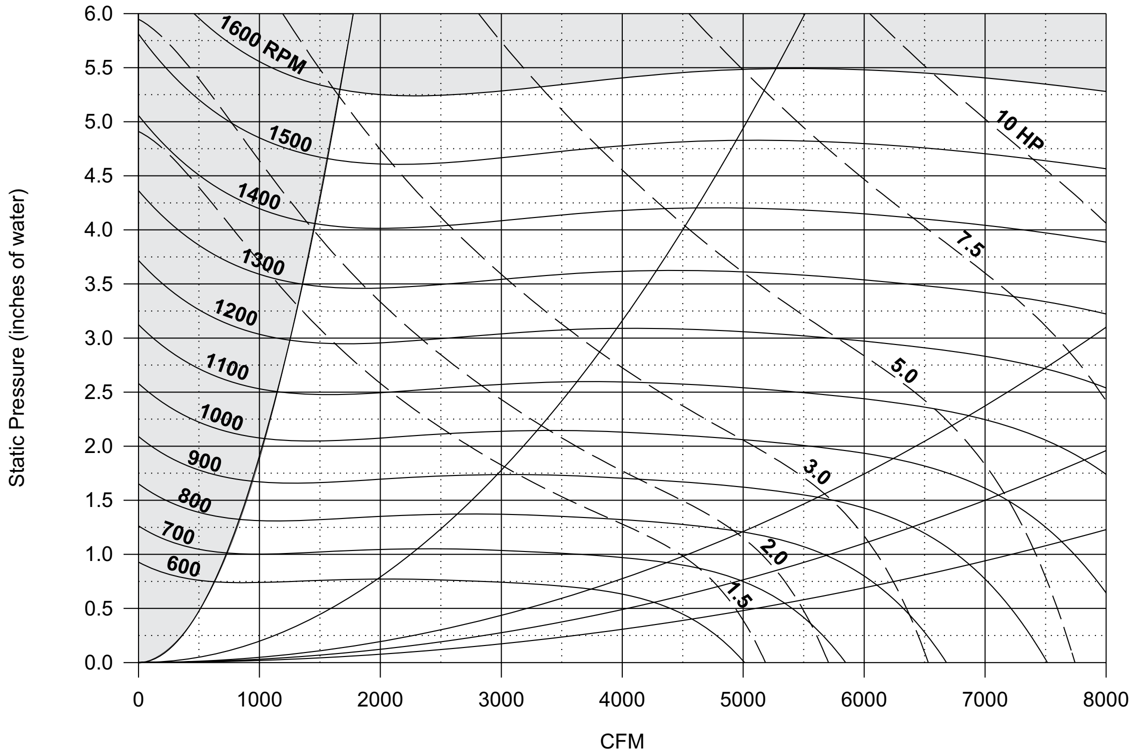
Note: Includes coil, control valve and interconnecting piping.

Figure 22. Water Regulating Valve Pressure Drop



Fan Curves

Figure 23. SWT018C, 15"x15" Fan Without Variable Inlet Vanes



Note: Fan TSP limit is 5.5" of water. Consult your local McQuay sales representative for applications beyond this range.

Figure 24. SWT018C, 15"x15" Fan, with Variable Inlet Vanes

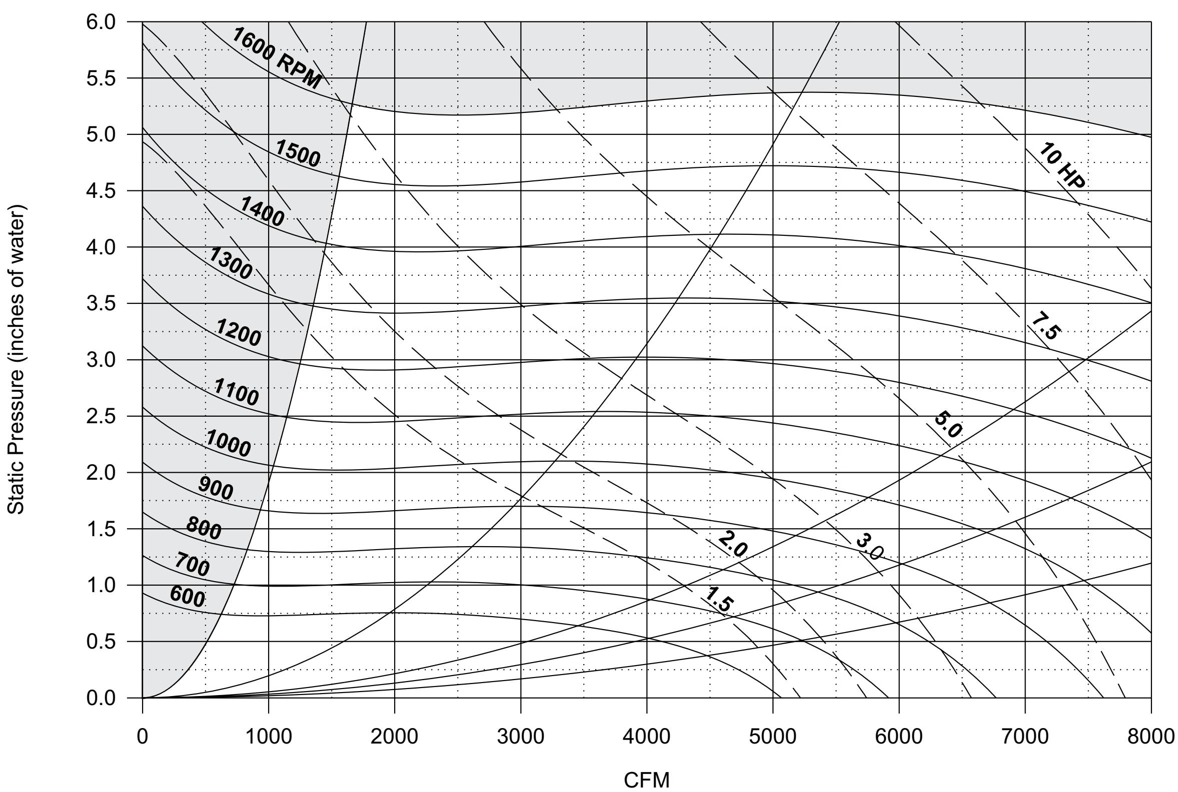
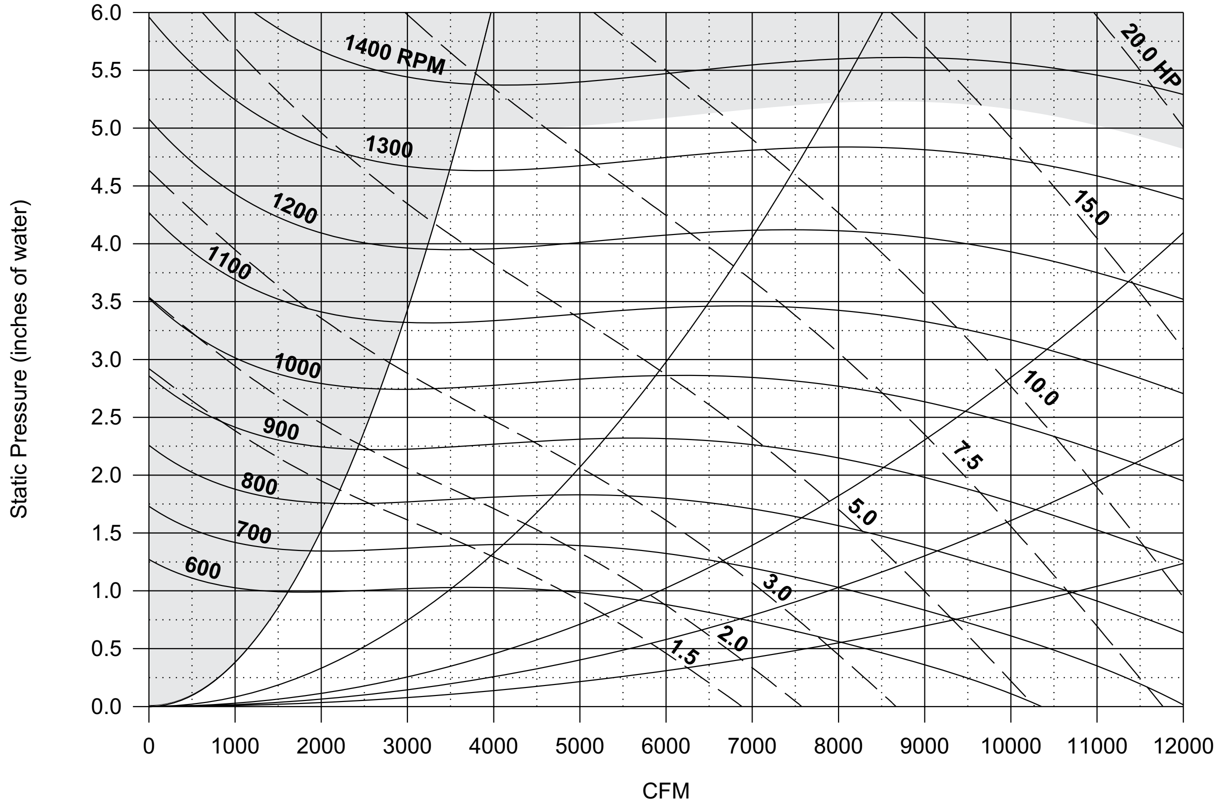


Figure 25. SWT023C/028C, 18"x18" Fan, without Variable Inlet Vanes



Note: Fan TSP limit is 5.5" of water. Consult your local McQuay sales representative for applications beyond this range.

Figure 26. SWT023C/028C. 18"x18" Fan with Variable Inlet Vanes

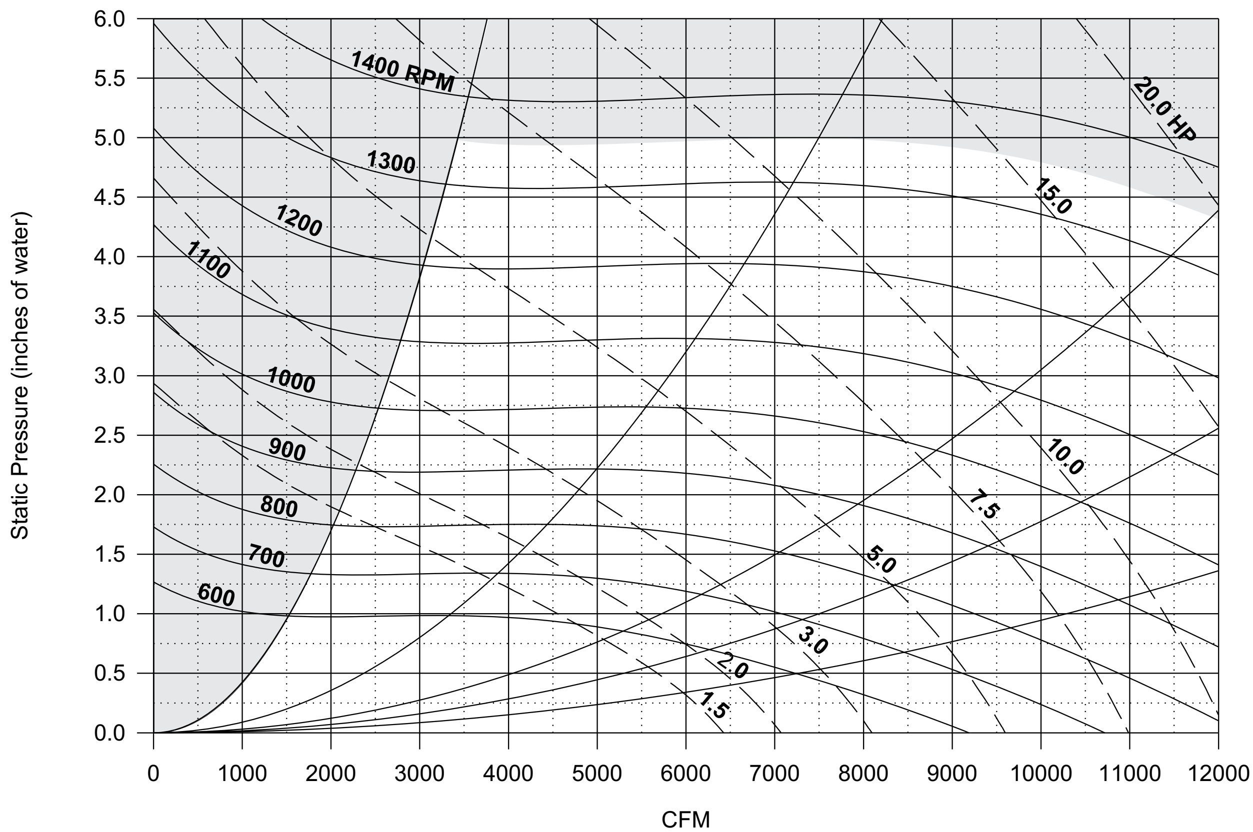
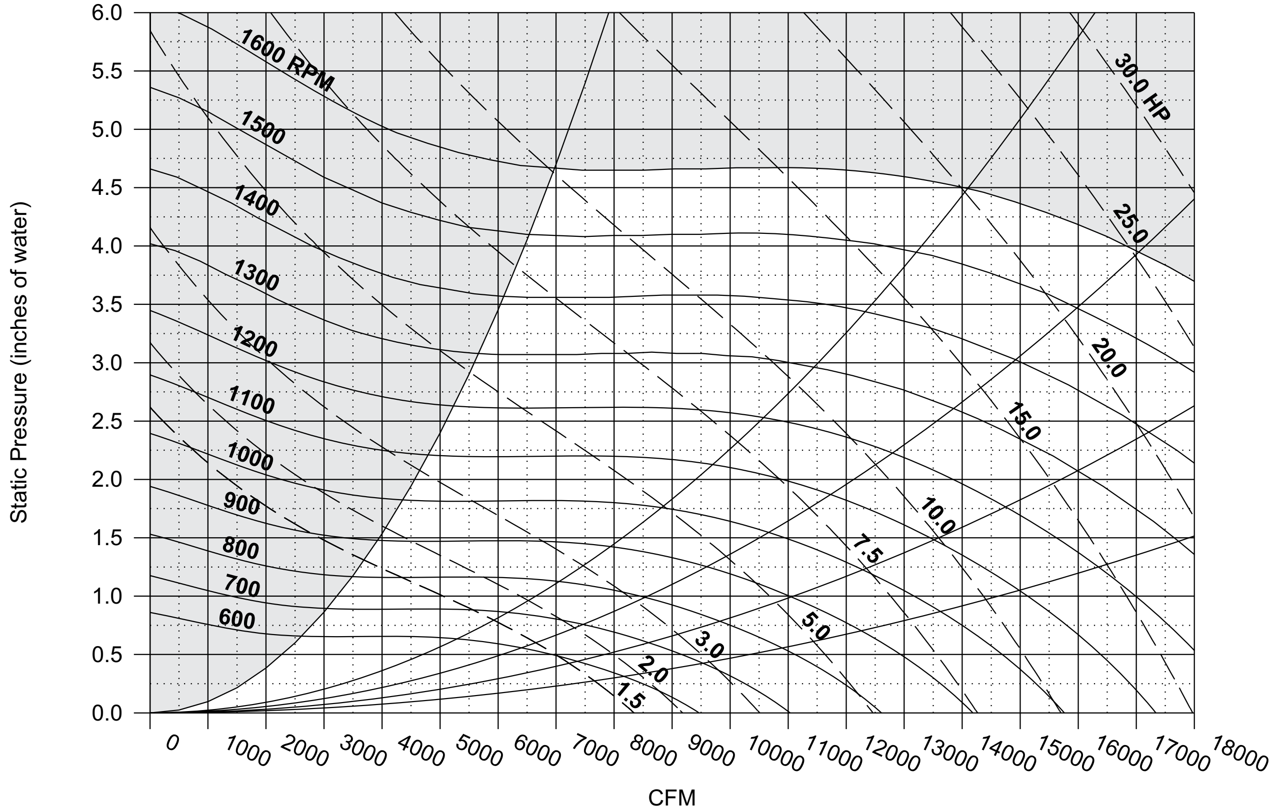


Figure 27. SWT 035C/040C. Dual 15"x15" Fan, Without Variable Inlet Vanes



Note: Fan TSP limit is 5.5" of water. Consult your local McQuay sales representative for applications beyond this range.

Dimensional Data

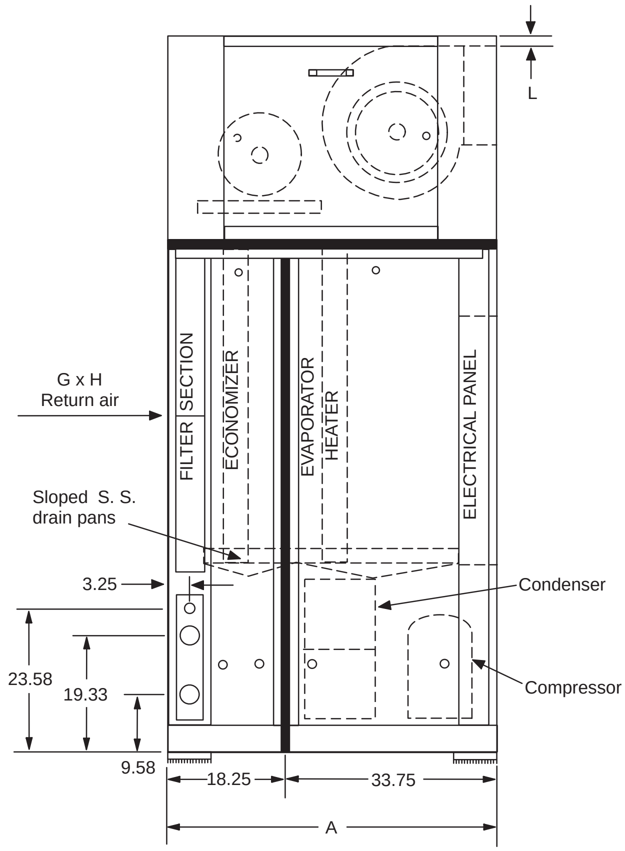


Figure 28. Left Side, Front (CW) Discharge

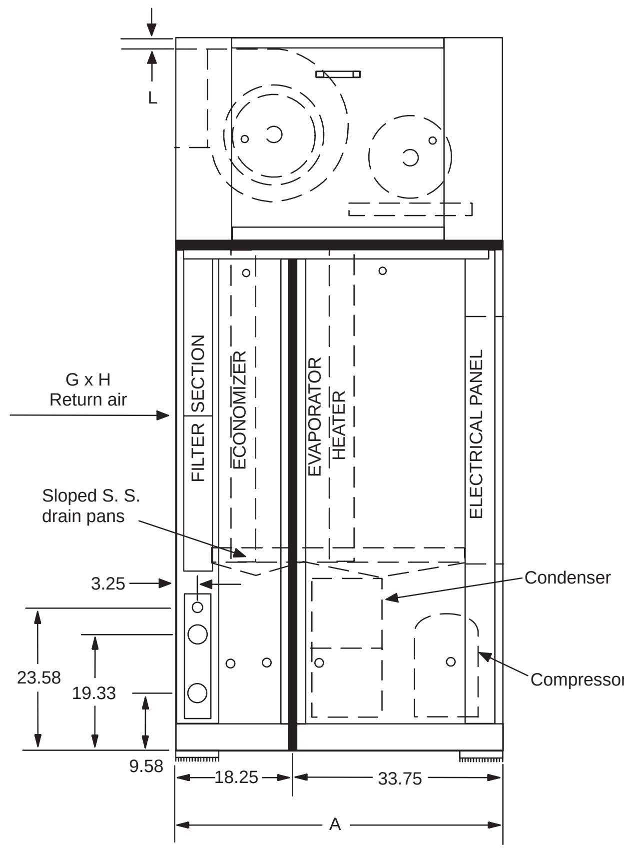


Figure 29. Left Side, Back (CCW) Discharge

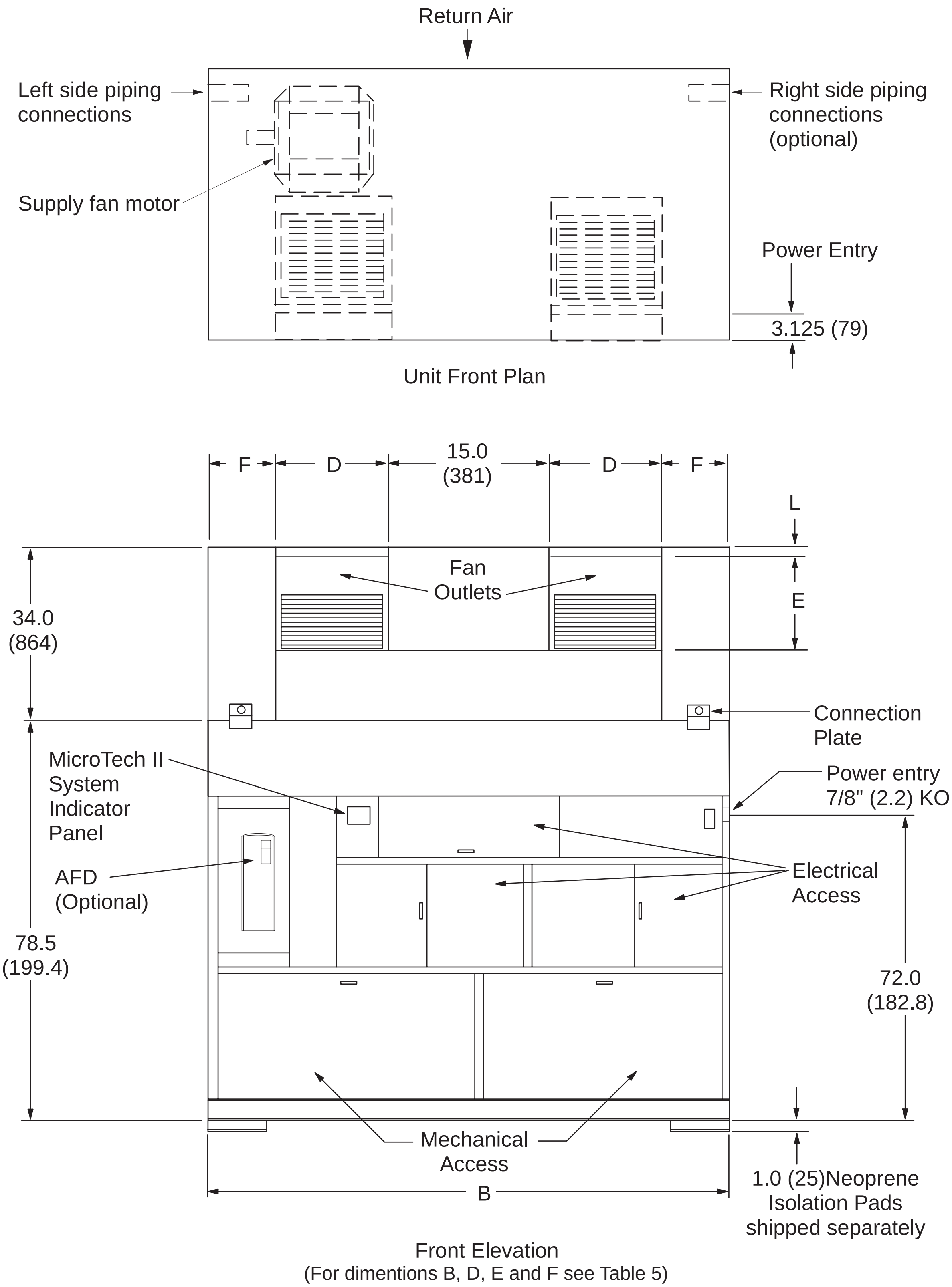
Note: Select unit arrangement on the unit selection.

Table 25. SWT018C - 040C Dimensions

BASIC UNIT		018C	023C	028C	035C	040C
A	**Depth[a b]**	52.00	52.00	52.00	52.00	52.00
B	**Length[a b]**	84.00	84.00	84.00	100.00	100.00
C	**Height[a b]**	112.75	112.75	112.75	112.75	112.75
D	**Fan Discharge**	18.62	21.88	21.88	18.62	18.62
E	**Fan Discharge**	15.88	18.88	18.88	15.88	15.88
F	**Unit Side to Fan**	32.69	31.06	31.06	23.88	23.88
G	**Return Duct Height**	45.94	45.94	45.94	45.94	45.94
H	**Return Duct Length**	80.00	80.00	80.00	96.00	96.00
J	**Water Out/In (ODS)**	2-1/8	2-1/8	2-1/8	2-5/8	2-5/8
K	**Hot Water Out/In (ODS)**	1-5/8	1-5/8	1-5/8	1-5/8	1-5/8
L	**To Fan Discharge**	2.0	2.0	2.0	6.46	6.46

a. Dimensions do not include lifting lugs, handle, latch, or fastener extensions.
b. For shipping dimensions add 4" (102mm) to depth, 8" (204mm) to length, and 4" (102mm) to height.

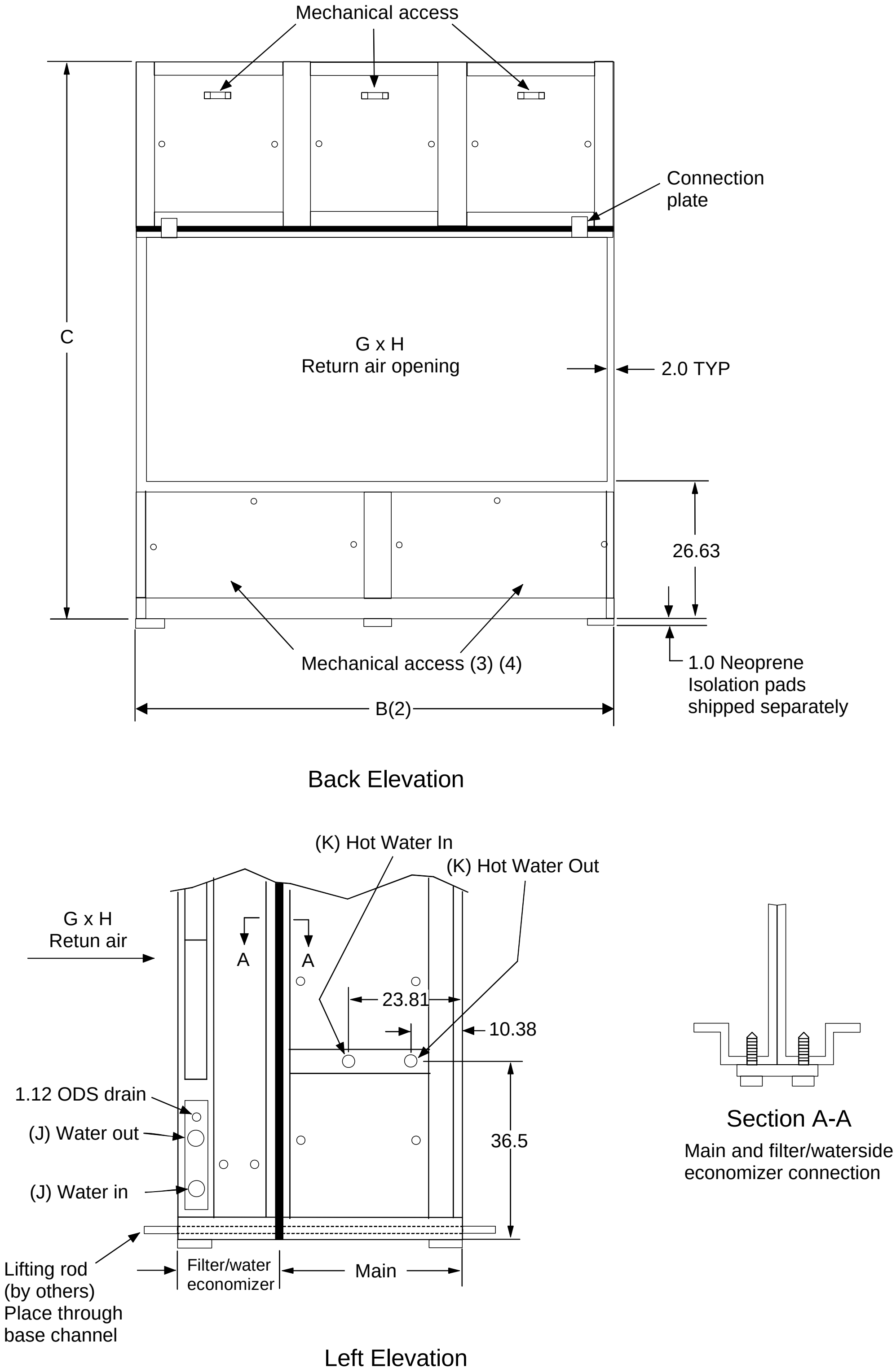
Figure 30. Unit Front Plan and Front Elevation



Front Elevation
(For dimentions B, D, E and F see Table 5)

Note:
1. See Table 25 for dimensions B, D, E, F and L.
2. Service connections determined when facing the front of the unit. Left-hand standard, right-hand optional. Please indicate on the unit submittal.
3. Unit sizes 018C, 023C, and 028C have single fan.
4. Unit sizes 018C, 023C, and 028C have single mechanical access panel in bottom front and bottom back.

Figure 31. Back Elevation and Left Side (typical SWT018C - 040C)



Note:
1. Filters are removable from the rear of the unit or through a side filter access door, located on piping connection side.
2. Length will be increased by approximately 3-1/2", for piping connections when water economizer option is ordered
3. Mechanical access panels(s) in the back of the unit start 2" below return duct opening. Do not obstruct the access panel(s).
4. There are two access doors on 018C, 023C, and 028C instead of three as shown.
5. All dimensions are given in inches.
6. All dimensions are ±0.25".

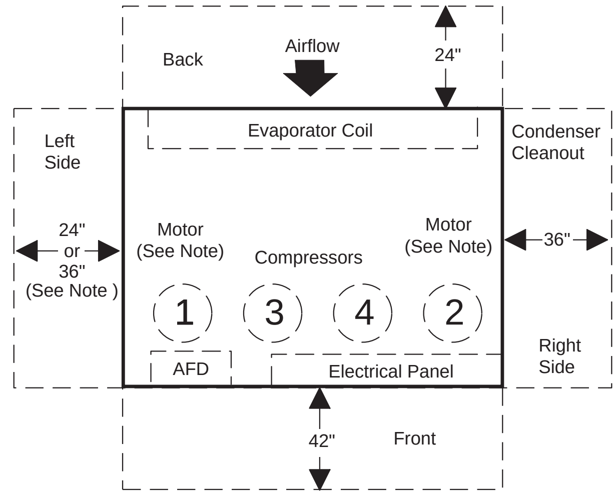
Recommended Clearances

For good installation, service and maintenance access, follow recommended clearances. Minimum clearances required by local, state or federal codes, such as the NEC, take precedence over those listed below. Clearance is required to allow room for side filter access, mechanical cleaning of condenser tubes and economizer coil access to expansion valves and other control components and to allow for possible fan shaft or compressor removal.

Unit Front	42 inch
Unit Rear	24 inch
Motor Location Side	36 inch
Piping Location Side	36 inch
Side Without Motor or Piping	24 inch
Clearance at Face of VFD	42 inch

Note: For clearance requirements less than those indicated, consult your local McQuay sales representative.

Figure 32. Recommended Service and Maintenance Clearances



Note: (1) 36 inches is required if piping connections are left hand or fan discharge is back.

Electrical Data

Table 26. SAF Motor Nameplate Amp Table

Horsepower	TYPE	208/60/3	230/60/3	400/50/3[a]	460/60/3	575/60/3
		FLA	FLA	FLA	FLA	FLA
3	High Efficiency	9.9	9.0	4.5	4.5	3.4
	Premium Efficiency	9.3	8.2	4.1	4.1	3.1
5	High Efficiency	16.1	14.0	7.0	7.0	5.3
	Premium Efficiency	15.7	13.6	6.8	6.8	5.2
7.5	High Efficiency	25.0	21.6	10.8	10.8	8.2
	Premium Efficiency	22.3	20.0	10.0	10.0	7.4
10	High Efficiency	33.0	28.0	14.0	14.0	11.0
	Premium Efficiency	29.0	25.8	12.9	12.9	10.3
15	High Efficiency	44.8	40.6	20.3	20.3	16.2
	Premium Efficiency	43.4	37.8	18.9	18.9	14.1
20	High Efficiency	61.0	50.0	25.0	25.0	20.0
	Premium Efficiency	57.0	49.0	24.5	24.5	18.9
25	High Efficiency	74.0	62.0	31.0	31.0	24.3
	Premium Efficiency	70.0	61.0	30.5	30.5	24.2

a. 460/60/3 motors are used. Derate nameplate horsepower to 0.83 to obtain actual horsepower.

Table 27. R-22 and R-407C Compressor Amperages

Compressor HP	Refrigerant	208/60/3		230/60/3		460/60/3		575/60/3	
		RLA	LRA	RLA	LRA	RLA	LRA	RLA	LRA
6	R-22	14.9	156.0	14.9	156.0	7.4	75.0	6.0	54.0
	R-407C	14.7	156.0	14.7	156.0	7.3	75.0	5.8	54.0
10	R-22	28.4	278.0	28.4	278.0	14.2	127.0	11.4	100.0
	R-407C	27.5	278.0	27.5	278.0	13.8	127.0	11.0	100.0

Table 28. Electric Heat

SWT UNIT SIZE	208V/60HZ/3PH			230V/60HZ/3PH			400V/50HZ/3PH			460V/60HZ/3PH			575V/60HZ/3PH		
	kW	MBH	FLA	kW	MBH	FLA	kW	MBH	FLA	kW	MBH	FLA	kW	MBH	FLA
018C - 040C	27.8	94	77.2	34	116	85.6	25.7	88	37.2	34	116	42.8	34	116	34.2

Supply Power Wiring

1. Units require three-phase power supply.
2. Allowable voltage tolerances:
   a. 60 Hertz
      i. Nameplate 208V: Min. 187V, Max. 229V
      ii. Nameplate 230V: Min. 207V, Max. 253V
      iii. Nameplate 460V: Min. 414V, Max. 506V
      iv. Nameplate 575V: Min. 518V, Max. 632
   b. 50 Hertz
      i. Nameplate 400V: Min. 342V, Max. 418V
3. Power lead wire sizing:
   a. For units with cooling capability (all concurrent loads) with or without hot water heating and circuits with motor loads only:
      MCA = 1.25 (largest motor RLA or FLA) + other loads + 2 amps
   b. For units with cooling capability and non concurrent electric heat capability:
      In the cooling mode, the loads will be composed of supply fan motor and compressors. In heating mode, the loads will be compose of supply fan motor and electric heater. The MCA is calculated for unit running in either mode; the highest value obtained is used for the MCA.
      i. For unit in cooling mode:
         MCA = 1.25 (largest RLA or FLA) + other loads + 2 amps
      ii. For unit in heating mode:
         MCA = 1.25 (electric heat FLA + supply fan motor FLA) + 2 amps

Note: Use copper wire only.

4. Size wires in accordance with Table 310-16 or 310-19 of the National Electrical Code.
5. Wires should be sized for a maximum of 3% voltage drop. See Table 30 and Table 31 for Single Disconnect or Power Block lug sizes.

Table 29. Single Disconnect

UNIT	VOLTAGE	SIZE (AMPS)
018-028	208/230	225
018-028	400/460	100
018-028	575	100
035-040	208/230	225
035-040	400/460	150
035	575	100
040	575	150

Table 30. Lug Sizes For Single Disconnect

DISCONNECT SIZE	LUG SIZE
100	#6-2/0
150	#2-3/0
225	#3-300 MCM
250	#4-350 MCM

Table 31. Lug Sizes For Power Block

UNIT	VOLTAGE	LUG SIZE
018-040	ALL	#6-400 MCM

Unit Weights

Table 32. Unit and Component Weight in lbs.

Unit Weights		Unit Size				
		018C	023C	028C	035C	040C
Basic Configuration						
SWT basic unit		1314	1314	1314	1473	1473
Filters						
4" - 30% efficiency		(Included in basic unit weight)				
4" - 65% efficiency		(Included in basic unit weight)				
Evaporator Coil						
6 Row, 12 fpi		250	294	347	417	450
4 Row, 12 fpi		206	238	278	333	354
Water Economizer Coil (1)						
4 Row, 12 fpi		266	298	340	393	410
Water weight		51	65	75	94	111
Hot Water Coil (2)						
1 Row, 12 fpi		71	97	119	130	152
Water weight		16	20	23	28	32
Electric Heat						
34 KW		20	20	20	20	20
Compressor / Condenser Assembly						
	Water					
(3) 6	35	705	705	—	—	—
(4) 6	43	856	856	856	856	—
(3) 6 (1)10	57	—	987	987	987	987
(2) 6 (2)10	66	—	—	1105	1105	1105
(1) 6 (3)10	74	—	—	—	1233	1233
(4)10	95	—	—	—	1368	1368
Supply Fan (3)						
15"x15" FC		900	—	—	—	—
18"x18" FC		—	930	930	—	—
(2) 15"x15" FC		—	—	—	1120	1120
Supply Fan Motors						
3 HP ODP		71	—	—	—	—
5 HP ODP		82	—	—	—	—
7.5 HP ODP		124	124	—	—	—
10 HP ODP		144	144	144	144	—
15 HP ODP		—	185	185	185	185
20 HP ODP		—	—	214	214	214
25 HP ODP		—	—	—	—	266
3 HP TEFC		72	—	—	—	—
5 HP TEFC		85	—	—	—	—
7.5 HP TEFC		140	140	—	—	—
10 HP TEFC		170	170	170	170	—
15 HP TEFC		—	235	235	235	235
20 HP TEFC		—	—	300	300	300
25 HP TEFC		—	—	—	—	330
Variable Frequency Drive 208/230V						
3 HP		25	—	—	—	—
5 HP		25	—	—	—	—
7.5 HP		40	40	—	—	—
10 HP		50	50	50	50	—
15 HP		—	50	50	50	50
20 HP		—	—	75	75	75
25 HP		—	—	—	—	75
Variable Frequency Drive 380/460V						
3 HP		20	—	—	—	—
5 HP		20	—	—	—	—
7.5 HP		25	25	—	—	—
10 HP		25	25	25	25	—
15 HP		—	40	40	40	40
20 HP		—	—	50	50	50
25 HP		—	—	—	50	50

Notes: 1. Water economizer coil weight includes valves and piping.
2. Hot water coil weight includes valves and piping.
3. Supply fan weight does not include motor or VFD.

Engineering Guide Specifications

General

Furnish and install, as shown on plans, McQuay model SWT self-contained packaged air conditioning system(s). Unit performance, electrical characteristics and unit arrangement shall be per the job schedule.

[Each unit shall be completely factory assembled and shipped in one piece.] [Each unit shall be shipped in two pieces, a base unit section and the unit fan section.] All units shall be shipped with a full charge of Refrigerant 22 or 407C and oil. Unit ratings shall be in accordance with the latest update of ARI Standard 360.

All units shall have decals and tags to indicate caution areas and to aid in unit service. A unit nameplate shall be fixed to a permanent panel next to the main control panel access. Electrical wiring diagrams shall be supplied with each unit. Installation, operating and maintenance bulletins and start-up forms shall be supplied with each unit.

Factory Run Test

Each unit shall undergo a rigorous factory run test prior to shipment and factory test sheets shall be available upon request. The factory test shall include dynamic trim balancing of the completed fan assembly, a compressor run check, a complete run test of all electrical components and safeties, including proper control sequencing, a leak check of all refrigerant circuits, a leak check of all water circuits and a final unit inspection.

Safety Agency Listed

The complete unit(s) shall be ETL-US and ETL-Canada listed by Intertek Testing Services, Inc. Units shall conform to bi-national standard ANSI/UL Standard 1995/CSA Standard C22.2 No. 236. Unit(s) shall be accepted for use in the City of New York by the Department of Building, MEA #368-93-E Vol. II.

Cabinet, Casing and Frame

Each unit shall have a welded 3/16" structural steel base integrated with formed members of 10, 12 and 14 gauge continuous galvanized steel. Exterior frame and panels shall be constructed of pre-painted galvanized steel for aesthetics and long term durability. Paint finish to include a base primer with a high quality, polyester resin topcoat of a neutral beige color. Finished surface to withstand a minimum 750-hour salt spray test in accordance with ASTM B117 standard for salt spray resistance. Lifting brackets capable of handling the unit shipping weight shall be welded to the unit base with holes to accept cable or chain hooks.

Each unit shall be compartmentalized for ease of service and shall be designed to permit adjustment of system electrical and refrigeration components while the unit is in operation. The unit shall incorporate removable access panels tightly set on neoprene gaskets. Access panels shall be a minimum of 18-gauge galvanized steel and shall be located on all sides of the unit for complete accessibility. The airside cabinet shall be insulated with 1", 1.5 pound density coated glass fiber insulation. [Solid galvanized steel liners shall be provided, allowing no exposed insulation within the air stream.]

The unit shall be comprised of three distinct sections: 1) Main cooling/heating, 2) Filter/waterside economizer and 3) Fan section. Each unit shall be designed for disassembly into the three distinct sections for access to the mechanical equipment room. Disassembly of the unit shall not require the breaking of any refrigeration lines. Separation of water piping shall be through the use of factory installed grooved couplings. The maximum allowable section width, including fastener heads, shall not exceed 34.5 inches.

Filter/Economizer Section:

Filters

Each unit shall be provided with an integral filter section complete with 4" panel filters. The filters shall be removable from the rear of the unit and shall have side access capability through [access panels] [hinged and latched access doors] on each end of the unit. The use of 2" filters is not acceptable.

[4" thick, 30% efficient, UL Std. 900, Class II, AmericanAirFilter filters shall be provided. Filters shall be frame mounted and shall slide into galvanized steel tracks contained within the unit.]

[4" thick, 60-65% efficient, UL Std. 900, Class II, AmericanAirFilter Varicel filters shall be provided. Filters shall be frame mounted and shall slide into galvanized steel tracks contained within the unit.] [An auxiliary pre-filter rack, with 2" thick 30% efficient filters, shall be provided to upstream of the high efficiency filters.]

[4" thick, 80-85% efficient, UL Std. 900, Class II, AmericanAirFilter Varicel filters shall be provided. Filters shall be frame mounted and shall slide into galvanized steel tracks contained within the unit.] [An auxiliary pre-filter rack, with 2" thick 30% efficient filters, shall be provided to upstream of the high efficiency filters.]

Waterside Economizer

A complete waterside economizer package shall be provided including a mechanically cleanable [chemically cleanable] coil, control valves and factory piping complete with cleanouts. Coils shall be fabricated of seamless 1/2" diameter copper tubing that is mechanically expanded into high efficiency aluminum plate fins. Coils shall be a minimum 4-row, staggered tube design with 12 fins per inch. The complete economizer package shall be rated for 400psig waterside working pressure.

The economizer section shall be complete with an insulated stainless steel drain pan. The drain pan shall be sloped in two directions to provide positive drainage. Access panels on both sides of the unit shall provide convenient access to the coil, valves and drain pan for inspection and cleaning. A factory installed drain line, with trap and cleanout, shall be provided for convenient connection at the unit exterior.

Economizer operation shall be controlled to maximize free cooling. Economizer operation shall be enabled whenever the entering water temperature is less than the entering air temperature by a field adjustable value. The economizer control valve shall modulate in response to the cooling load. Control valve operation shall [maintain full flow through the unit at all times.] [isolate the unit from the condenser water loop when there is no call for cooling, allowing for the use of an energy saving, variable pumping system.]

Mechanical cooling shall be enabled during economizer operation. If the economizer control valve is driven 90% open and the cooling load is not satisfied, compressors will stage on to maintain set point. To maximize energy savings, economizer control will maintain full water flow until the differential between entering water and entering air temperatures falls below set point.

A factory installed, non-averaging type freezestat shall provide some protection against coil freeze-up.

The completed economizer assembly shall be factory leak tested.

Airside Economizer Control (External Mixing Box)

Integrated airside economizer control capability of a separate unit or remote mounted mixing box shall be provided. Economizer operation shall be controlled to maximize free cooling operation. Economizer shall be enabled whenever the remote [outside air enthalpy sensor] [comparative enthalpy sensors] [outside air temperature sensor] indicates that outside air is suitable for free cooling. The remote economizer damper actuator shall modulate in response to the cooling load.

Mechanical cooling shall be enabled during economizer operation. If the outside air damper is driven to 90% open and the cooling load is not satisfied, compressors will stage on to maintain set point. To maximize energy savings, the economizer control will maintain 100% outdoor airflow until disabled by the enthalpy or temperature cutout. Outside air will reset to minimum position at that time.

Fan Section

Fan Assembly

All fan assemblies shall be statically and dynamically balanced at the factory, including a final trim balance, prior to shipment. All fan assemblies shall employ solid steel fan shafts. Heavy-duty pillow block type, self-aligning, grease lubricated ball bearings shall be used. Bearings shall be sized to provide an L-50 life at 200,000 hours and shall be no smaller than the main shaft diameter. The entire fan, drive and motor assembly shall be mounted on a welded, heavy-gauge tubular steel frame and shall be mounted on [spring isolators] [spring isolators with seismic restraints]. The fan assembly shall further be isolated from the unit with a flexible connection at the fan discharge. Fixed pitch V-belt drives with matching belts shall be provided. V-belt drives shall be selected at [the manufacturer's standard service factor] [1.5 times fan brake horsepower].

The fan assembly shall feature a gradual expansion, aerodynamic duct outlet to reduce system sound generation.

Fan (SWT018C-028C)

The supply air fan shall be a double width, double inlet (DWDI) forward curved centrifugal fan, with hub and shaft secured with mating keyways. The fan wheel and housing shall be constructed from painted steel and shall be Class II construction to satisfy the specified application.

Fan (SWT035C & 040C)

The supply air fan system shall be dual, double width, double inlet (DWDI) forward curved centrifugal fans, with hubs and shaft secured with mating keyways. The fan wheels and housings shall be constructed from painted steel and shall be Class II construction to satisfy the specified application.

Fan Motor

Fan motors shall be heavy-duty 1800 rpm [open drip-proof (ODP)] [totally enclosed fan cooled (TEFC)] type with grease lubricated ball bearings. [Motors shall be high efficiency and meet applicable EPACT requirements.] [Motors shall be premium efficiency.] Motors shall be NEMA, T-frame, Class B. Motors shall be mounted on an adjustable base that provides for proper alignment and belt tension adjustment.

Variable Frequency Drives (SWT18C-040C)

An electronic variable frequency drive shall be provided for the supply air fan. Variable frequency drives shall be latest generation pulse width modulation type utilizing IGBT technology. The drive shall be factory installed in a designated location that provides ready access to the drive and does not void unit accessibility. Drives shall meet UL Standard 95-5V and the variable frequency drive manufacturer shall have specifically approved them for plenum duty application. The completed unit assembly shall be listed by a recognized safety agency, such as ETL.

The unit manufacturer shall install all power and control wiring. A manually activated bypass contactor arrangement shall be provided. The bypass arrangement will allow fan operation at full design CFM, even if the drive has been removed for service.

The supply air fan drive output shall be controlled by the factory installed main unit control system and drive status and operating speed shall be monitored and displayed at the main unit control panel. A factory mounted, field adjustable duct high-limit control shall be provided to protect ductwork from excessive duct pressure. The installer shall provide and install sensor tubing from [a single unit mounted pressure sensor] [two unit mounted pressure sensors] to the duct location(s).

All drives shall be factory run tested prior to unit shipment.

Coils

Drain Pan

The main coil section shall be complete with an insulated stainless steel drain pan. The drain pan shall be sloped in two directions to provide positive drainage. Access panels on both sides of the unit shall provide convenient access to the coil and drain pan for inspection and cleaning. A factory installed drain line, with trap and cleanout, shall be provided for convenient connection at the unit exterior.

Cooling Coil

Direct expansion (DX) cooling coils shall be fabricated of seamless 1/2" diameter high efficiency copper tubing that is mechanically expanded into high efficiency aluminum plate fins. Coils shall be a 6-row, staggered tube design with 12 fins per inch. All units shall have an independent refrigerant circuit per compressor and shall use a combination row/interlaced circuiting for efficient part load operation and to prevent air temperature stratification at partial load conditions. Each circuit shall be fed by an adjustable thermal expansion valve, with external equalizer, sized to provide efficient operation at full and at part load operating points. Plastic sleeves shall protect all distributor tubes.

All coils shall be factory leak tested with high pressure air under water.

Hot Water Coil

A 1 row hot water heating coil shall be factory installed. Coils shall be fabricated of seamless 1/2" diameter copper tubing that is mechanically expanded into high efficiency aluminum plate fins. All coil vents and drains shall be factory installed. Access panels shall provide convenient access to the coil and valve for inspection and cleaning.

A factory installed two-way [modulating] [on/off] control valve and actuator shall provide control of the hot water coil. The valve actuator shall be controlled by the factory installed main unit control system.

[Propylene glycol shall be added to the hot water circuit to protect against coil freeze-up.]

[A factory installed, non-averaging type freezestat shall provide some protection against coil freeze-up.]

Coils shall be factory leak tested with high pressure air under water.

Electric Heat

Staged electric heating coils shall be factory installed in the unit heat section. Heating coils shall be visible and easily accessed for inspection and service. Heating coils shall be constructed of low watt density, nickel-chromium elements. Equipment protection controls shall include automatic reset high limit control for each heater element with manual reset backup line break protection in each heater element branch circuit. Heating element branch circuits shall be individually fused to a maximum of 48 Amps per NEC requirements.

Multiple full magnetic line break contactors shall be controlled by the factory installed main unit control system to provide multiple stages of control.

Condensers

Condensers shall be a counter flow, tube and tube design with all nonferrous water channels. Each condenser shall be on an independent refrigerant circuit and shall provide liquid sub-cooling for optimum system performance. Condensers shall be rated for 400psig refrigerant working pressure. Each condenser shall be suitable for 400psig waterside working pressure and shall be mechanically cleanable. All factory piping shall be capable of a waterside working pressure of 400 psig. Condensers shall be factory piped to provide for single field condenser water supply and return connections.

Units provided with condensers that are not mechanically cleanable will not be acceptable.

Condensers shall be factory leak tested with high pressure air under water. The completed condenser and interconnecting piping assembly shall be factory leak tested.

Condenser head pressure control

(Not available with Water Economizer)

Mechanical cooling shall be available whenever entering condenser water temperatures are 55ºF or warmer, without the use of head pressure control. For entering condenser water temperatures below 55ºF, a factory installed and controlled 2-way modulating head pressure control valve shall be provided. The valve actuator shall be controlled through the factory installed main unit control system to maintain refrigerant head pressure at entering condenser water temperatures as low as 40°F.

Compressors

Each unit shall have multiple, heavy-duty scroll compressors. Each compressor shall be on an independent refrigerant circuit and include [suction and discharge service valves with gauge ports], sight-glass, anti-slug protection, motor overload protection and a time delay to prevent short cycling and simultaneous starting of compressors following a power failure. Compressors shall be isolated on resilient rubber isolators to decrease noise transmission. The number of compressors shall be as shown on the unit schedule.

Refrigeration Controls

Each unit shall have multiple independent refrigeration circuits. Each circuit shall include a filter-drier, liquid moisture indicator/sight-glass, thermal expansion valve, liquid line shutoff valve with charging port and high pressure relief device. The thermal expansion valve shall be capable of modulation from 100% to 25% of its rated capacity. [Shutoff valves shall isolate each filter-drier and sight-glass. (Units with compressor service valves only.)] Sight-glasses shall be accessible for viewing without disrupting unit operation. Each circuit shall be dehydrated and factory charged with Refrigerant 22 or 407C and oil.

Each refrigerant circuit shall have a high and low-pressure cutout switch and a coil frost protection thermostat. The high pressure cutout shall be a manual reset control. Each low pressure control (loss of charge) and frost protection thermostat shall require a manual reset if the alarm condition occurs three times within any 24 hour period.

Refrigeration Capacity Control

Refrigeration capacity control shall be accomplished by staging of the unit's multiple compressors. To maintain desired temperature control, the unit shall have a minimum of [two] [three] [four] steps of capacity control.

All compressor capacity control staging shall be controlled by the factory installed main unit control system.

Electrical

Unit wiring shall comply with NEC requirements and with all applicable UL standards. All electrical components shall be UL recognized, where applicable. To provide for easy identification, all wiring and electrical components shall be numbered, color-coded and labeled according to the electrical diagrams provided with each unit. The main unit control panel shall be completely factory wired and contained in an accessible enclosure. The main control panel shall be provided with dead front covers over all line voltage components. A terminal board shall be provided for low voltage control wiring. Branch circuit fusing, 115V control circuit transformer with fuse, system switches and high temperature sensor shall also be provided.

Pilot knockouts shall be provided at the main control panel for field wiring entrance. The unit shall have a [single] [dual] [terminal block] [non-fused disconnect] for main unit power connection.

Each compressor shall be controlled by its own dedicated contactor, shall be individually fused and shall have thermal overload protection. The supply fan motor circuit shall include a dedicated contactor, external line break overload protection and dedicated fuse protection. Group fusing of components in lieu of individual fuse protection for each component is not acceptable.

The unit control system shall permit starting and stopping of the unit locally or remotely. The keypad/display and monitoring panel shall include a three position "on", "off", "auto" switch, an Alarm indication light and a Power indication light. The Alarm light shall provide a visual indication whenever a malfunction occurs and it shall remain until the malfunction is corrected. The control system shall be capable of providing a remote alarm indication. The unit control system shall provide for pump start, outside air damper actuation, smoke shutdown, emergency shutdown, remote heat enable/disable, remote cool enable/disable, heat indication, cool indication, fan interlock and fan operation.

Non-fused Disconnect Switch

[A single non-fused disconnect switch shall be provided for disconnecting electrical power at the unit. The switch handle shall be visible, located at the front of the unit, and shall be accessible without unit entrance.]

[Dual non-fused disconnect switches shall be provided for disconnecting electrical power at the unit. One switch will service the supply fan plus the unit control system. The second switch will service the condensing unit section. Disconnect switch handles shall be visible, located at the front of the unit, and shall be accessible without unit entrance.]

Phase Failure/Under Voltage Protection

A phase failure/under voltage protection device shall be provided to protect three-phase motors from damage due to single phasing, phase reversal and low voltage conditions.

Water Flow Switch

A water flow switch shall be provided, factory installed, to verify water flow status at the unit. Compressor operation shall be disabled and an alarm signal provided if condenser water flow is lost. Unit operation will be restored when water flow has again been sensed. Water flow status shall be displayed at the unit's main controller.

Freezestat
(Units with Waterside Economizer)

A non-averaging type freezestat shall be factory installed on the entering face of the economizer coil. Upon sensing a freeze condition, the unit supply air fan will be shut down, the [economizer] [heating] [economizer and heating] valve will be driven to the full open position and an alarm signal will be provided. Unit operation will be restored following the manual reset of the freezestat.

Freezestat
(Units without Waterside Economizer)

A non-averaging type freezestat shall be factory installed on the leaving face of the hot water heating coil. Upon sensing a freeze condition, the unit supply air fan will be shut down, the heating valve will be driven to the full open position and an alarm signal will be provided. Unit operation will be restored following the manual reset of the freezestat.

Battery Pack

The unit shall be provided with a factory mounted and wired rechargeable battery pack. The battery pack shall be available to provide control power to unit actuators in the event of a power failure.

UV Lights

Unit to have factory-mounted UV lights located on the leaving air side of the cooling coil. Unit to have view port to allow for visual indication of operation through UV resistant glass. Unit to have door interlocks on each removable panel accessing UV light. Interlock to kill power to UV light when panel is removed.

Lamp and fixture to consist of a housing, power source, lamp sockets, and lamp. All components are to be constructed to withstand typical HVAC environments and are UL/C-UL listed. Housings are to be constructed of type 304 stainless steel and are to be equipped with both male and female power plugs with one type at each end to facilitate simple fixture-to-fixture plug-in for AC power.

Power source shall be an electric, rapid-type with overload protections and is to be designed to maximize radiance and reliability at UL/C-UL listed temperatures of 55°F–135°F. Power source will include RF and EMI suppression.

Sockets shall be medium bi-pin, single click safety, twist lock type and are to constructed of a UVC-resistant polycarbonate.

Lamp shall be a high output, hot cathode, T8 diameter, medium bi-pin that produces UVGI of 254 nm. Each tube produces the specified output at 500 fpm and air temperatures of 55°F–135°F.

MicroTech II™ Unit Controller

Each unit shall be equipped with a complete MicroTech II microprocessor based control system. The unit control system shall include all required temperature and pressure sensors, compressor control boards, heating control board, main microprocessor control board and opera-tor interface. The unit control system shall perform all unit control functions including scheduling, [constant air volume, zone temperature control (SCC)] [constant air volume, discharge temperature control (DAC)] [variable air volume, cooling only discharge temperature control [with single-stage morning warm-up heat] (DAC)] [variable air volume, cooling/modulating heating discharge temperature control (DAC)] [duct static pressure control], [building static pressure control], unit diagnostics and safe-ties. All boards shall be individually replaceable for ease of service. All microprocessors, boards, and sensors shall be factory mounted, wired and tested.

The microprocessor shall be a stand-alone DDC controller not dependent on communications with any on-site or remote PC or master control panel. The microprocessor shall maintain existing set points and operate stand alone if the unit loses either direct connect or network communications. The micro-processor memory shall be protected from voltage fluctuations as well as any extended power failures. All factory and user set schedules and control points shall be maintained in nonvolatile memory. No settings shall be lost, even during extended power shutdowns.

The main microprocessor shall support an RS-232 direct connection to a product service tool or a modem. A [BACnet®/IP] [BACnet® MS/TP] [LonTalk®] communications port shall be provided for direct connection into the BAS network.

All digital inputs and outputs shall be protected against damage from transients or wrong voltages. Each digital input and digital output on the main microprocessor shall be equipped with an LED for ease of service. An alarm LED on the user interface shall provide quick visual identification that an alarm condition exists. All field wiring shall be terminated at a separate, clearly marked terminal strip.

The microprocessor shall have a built-in time schedule. The schedule shall be programmable from the unit keypad interface. The schedule shall be maintained in nonvolatile memory to insure that it is not lost during a power failure. There shall be one start/stop per day and a separate holiday schedule. The controller shall accept up to sixteen holidays each with up to a 5-day duration. Each unit shall also have the ability to accept a time schedule via BAS network communications.

If the unit is to be programmed with a night setback or setup function, an optional space sensor shall be provided. Space sensors shall be available to support field selectable features. Sensor options shall include:

1. Zone sensor with tenant override switch.
2. #1 plus a heating and cooling set point adjustment. (CAV-ZTC only)

The unit keypad/display character format shall be 20 characters x 4 lines. The character font shall be 5 x 8 dot matrix. The display shall be a supertwist nematic (STN) LCD display with black characters on yellow background for high visibility. For ease of service, the display format shall be English language readout. Coded formats with look-up tables shall not be acceptable.

The keypad interface shall be equipped with eight individual touch-sensitive membrane key switches that allow convenient navigation and access to all control functions. All control settings shall be password protected against unauthorized changes.

The user interaction with the display shall provide the following information:

1. Return air temperature
2. Supply air temperature
3. Outdoor air temperature (opt.)
4. Space air temperature (opt.)
5. Discharge air temperature
6. Entering condenser water temperature
7. Leaving condenser water temperature
8. Mixed air temperature
9. Outdoor enthalpy high/low (opt.)
10. Dirty filter indication
11. Airflow verification
12. Supply fan status
13. Supply vane position/VFD speed indication
14. Outside air damper position(opt.)
15. Duct static pressure
16. Duct static pressure #2 (opt.)
17. Building static pressure (opt.)
18. Cooling status
19. Cooling control method
    a. Nearest
    b. Average
20. Heating status
21. Dehumidification status
22. Control Temperature (changeover)
23. External exhaust fan status (opt.)
24. VAV output status
25. Fan operation status
26. Unit status
27. Time schedules
28. Up to four active alarms with time and date
29. Previous 8 alarms with time and date
30. Optimal start
31. Purge cycle
32. System operating hours
    a. Fan
    b. Cooling
    c. Individual compressor
    d. Heating
    e. Economizer
    f. Tenant override
    g. Dehumidification

The user interaction with the keypad shall provide the following set points as a minimum:

1. Control modes
   a. Off manual
   b. Auto
   c. Heat/cool
   d. Cool only
   e. Heat only
   f. Fan only
2. Occupancy mode
   a. Auto
   b. Occupied
   c. Unoccupied
   d. Tenant override
3. Control temperature (changeover)
   a. Return air temperature
   b. Space temperature
   c. Network signal
   d. Outdoor air temp. (VAV w/ mod. heat)
4. Cooling with deadband
5. Heating with deadband
6. Cooling and heating supply
7. Cooling & heating supply reset options
   a. Return air temperature
   b. Outdoor air temperature
   c. Space temperature
   d. Airflow (VAV)
   e. No reset
   f. Network signal
   g. External (1-5 VDC)
8. Temperature alarm limits
   a. High supply air temperature
   b. Low supply air temperature
   c. High return air temperature
9. Lockout control
   a. Compressor lockout
   b. Heat lockout
10. Lead-lag on compressors
    a. Auto
    b. Disabled
11. Compressor Inter-stage timers
12. Night setback and setup space temp.
13. Duct static pressure reset options
    a. No reset
    b. Network
14. Building static pressure (opt.)
15. Minimum outdoor airflow reset
    a. Percent of CFM capacity
    b. External reset (1-5 VDC)
    c. Fixed outdoor damper position
16. Economizer changeover
    a. Enthalpy
    b. Dry bulb
17. Current time and date
18. Tenant override time
19. Occupied/unoccupied time schedules
20. One event schedule
21. Holiday dates and duration
22. Service mode
    a. Timers normal (all time delays normal)
    b. Timers fast (all time delays 20 sec.)
    c. Mode normal (unit on)

Open Communications Protocol

The unit control system shall have the ability to communicate to an independent Building Automation System (BAS) through a direct [BACnet®/IP] [BACnet® MS/TP] [LonTalk®] communications connection.

[BACnet® Communications shall conform to the BACnet® protocol (ANSI/ASHRAE135-2001). A protocol implementation conformance statement (PICS) shall be provided. Multiple units may be connected in a common communications network.]

[Communications shall conform to LonMark® Interoperability Guidelines and shall be certified. Controls shall conform to the [Discharge Air Controller (DAC)] [Space Comfort Controller (SCC)] profile.]

Through communications, the BAS System Integration (SI) contractor shall be capable of interacting with the individual self-contained unit controllers in the following ways:

1. Access to [quantity and description from specification] “read only” variables and [quantity and description from specification] “read & and write” variables.
2. Set the unit's operating mode.
3. Monitor controller inputs, outputs, setpoints, parameters and alarms.
4. Change controller setpoints and configuration parameters.
5. Clear alarms.
6. Reset the cooling discharge air temperature setpoint (DAC units).
7. Reset the heating discharge air temperature setpoint (DAC units with modulating heat).
8. Reset the duct static pressure setpoint (DAC units).
9. Set the heat/cool changeover temperature (DAC units).
10. Set the representative zone temperature (DAC units).

It will be the responsibility of the SI Contractor to integrate the self-contained unit data into the BAS to affect the integrated building control logic and centralized system workstation interface.

NOTES:

McQuay Training and Development

Now that you have made an investment in modern, efficient McQuay equipment, its care should be a high priority. For training information on all McQuay HVAC products, please visit us at www.mcquay.com and click on training, or call 540-248-9646 and ask for the Training Department.

Warranty

All McQuay equipment is sold pursuant to its standard terms and conditions of sale, including Limited Product Warranty. Consult your local McQuay Representative for warranty details. Refer to Form 933-43285Y. To find your local McQuay Representative, go to www.mcquay.com.

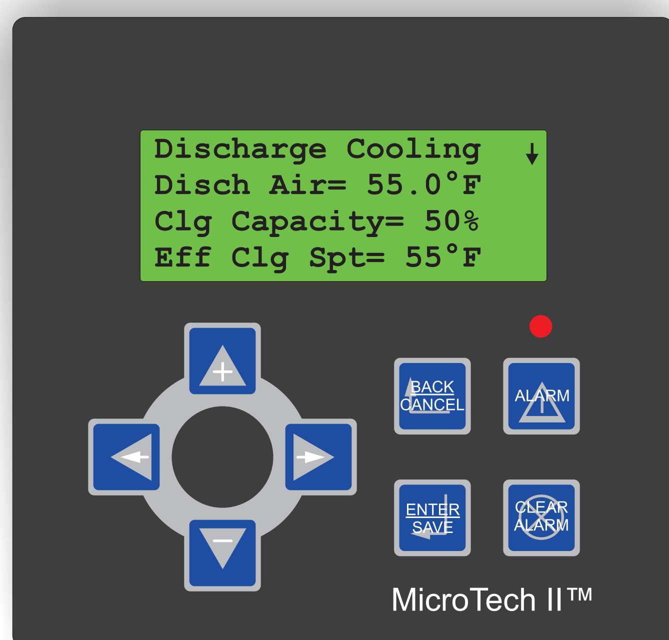
This document contains the most current product information as of this printing. For the most up-to-date product information, please go to www.mcquay.com.

McQuay® Air Conditioning

Installation and Maintenance	IM 710-2
	Group: **Applied Systems**
	Part Number: **IM 710-2**
	Date: **August 2005**

MicroTech II®
Vertical Self-Contained Systems Unit Controller

- **Used with McQuay models: SWP, SWT**



McQuay® Air Conditioning

Contents

Introduction

This manual contains information regarding the MicroTech II® control system used in the McQuay® Vertical Self-Contained product line. It describes the MicroTech II components, input/output configurations, field wiring options and requirements, and service procedures.

For a description of operation and information on using the keypad to view data and set control parameters, refer to the appropriate program-specific operation manual in Table 1 below. For installation and commissioning instructions and general information on a particular unit model, refer to the model-specific installation manual in Table 2.

Table 1: Program-specific unit operation literature

Unit control configuration	Operation manual bulletin number
Discharge air control (VAV or CAV)	OM 711
Space comfort control (CAV-Zone Temperature control)	OM 712

Table 2: Model-specific unit installation literature

Unit model	Installation and maintenance data bulletin number
SWP (018 to 105)	IM 708
SWT (018 to 040)	IM 709

NOTICE

This equipment generates, uses, and can radiate radio frequency energy. If not installed and used in accordance with this instruction manual, can cause interference to radio communications. It has been tested and found to comply with the limits for a Class A digital device, part 15 of the FCC rules. The limits are designed to provide reasonable protection against detrimental interference when the equipment is operated in a commercial environment. Operating this equipment in a residential area is likely to cause detrimental interference. Users will be required to correct the interference at their own expense. **McQuay International disclaims any liability resulting from any interference or for the correction thereof.**

⚠ WARNING

Electric shock hazard. Can cause personal injury or equipment damage.
This equipment must be properly grounded. Connections and service to the MicroTech II control panel must be performed only by personnel knowledgeable in the operation of the equipment being controlled.

⚠ CAUTION

Extreme temperatures can damage system components.
The MicroTech II controller is designed to operate in ambient temperatures from –20°F to 125°F. It can be stored in ambient temperatures from –40°F to 140°F. The controller is designed to operate in a 10% to 90% RH (non-condensing) and to be stored in a 5% to 95% RH (non-condensing) environment.

⚠ CAUTION

Static sensitive components.
A static discharge while handling electronic circuit boards can damage the components.
Before performing any service work, discharge any static electrical charge by touching the bare metal inside the main control panel. Never unplug any cables, circuit board terminal blocks, relay modules, or power plugs while power is applied to the panel.

General Description

The MicroTech II Unit Controller is a microprocessor-based controller designed to provide sophisticated control of McQuay Vertical Self-Contained units. In addition to providing normal temperature, static pressure, and ventilation control, the controller can provide alarm monitoring and alarm-specific component shutdown if critical system conditions occur.

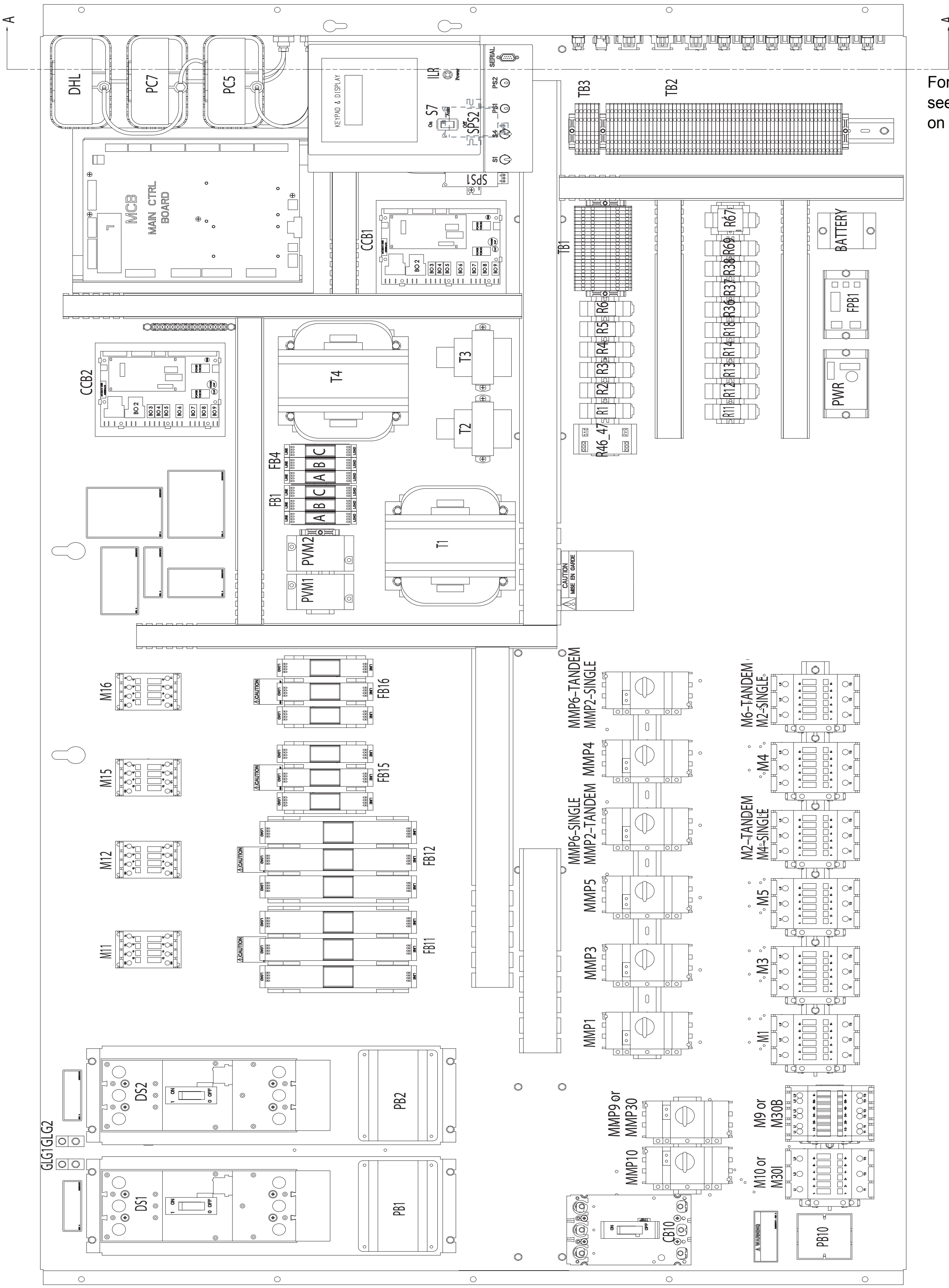
The operator can access temperatures, pressures, operating states, alarm messages, control parameters, and schedules with an 8-key keypad and a 4-line by 20-character display. The controller includes password protection against unauthorized or accidental control parameter changes.

This MicroTech II controller is capable of complete, stand-alone unit control or it can be incorporated into a building-wide network using an optional plug-in communication module. Available communication modules include BACnet Ethernet, BACnet MSTP, LONMARK Space Comfort Controller (SCC) and LONMARK Discharge Air Controller (DAC).

Component Data

The main components of the MicroTech II control system include the main control board (MCB), either one or two optional auxiliary cooling control boards (CCB1 and CCB2), and a keypad/display. The MCB, CCB1 and CCB2 are always located in the main control panel as shown in Figure 1 on page 3. These components are interconnected by shielded multi-conductor communication cables, or in the case of the keypad/ display, by a six conductor cable with an RJ-11 style modular connector. Transformers T1, T2, and T3 supply power to the system. Descriptions of these components and their input and output devices follow.

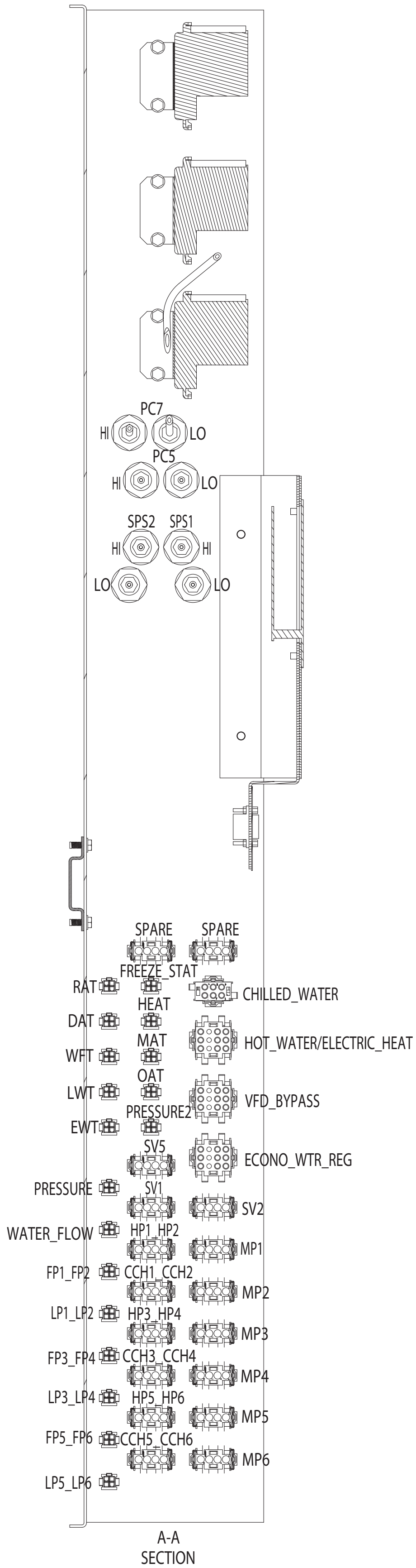
Figure 1: Typical MicroTech II main control panel layout



For A-A detail, see Figure 2 on page 4.

Unit controller is LonMark® certified with the LonWorks® communication module.

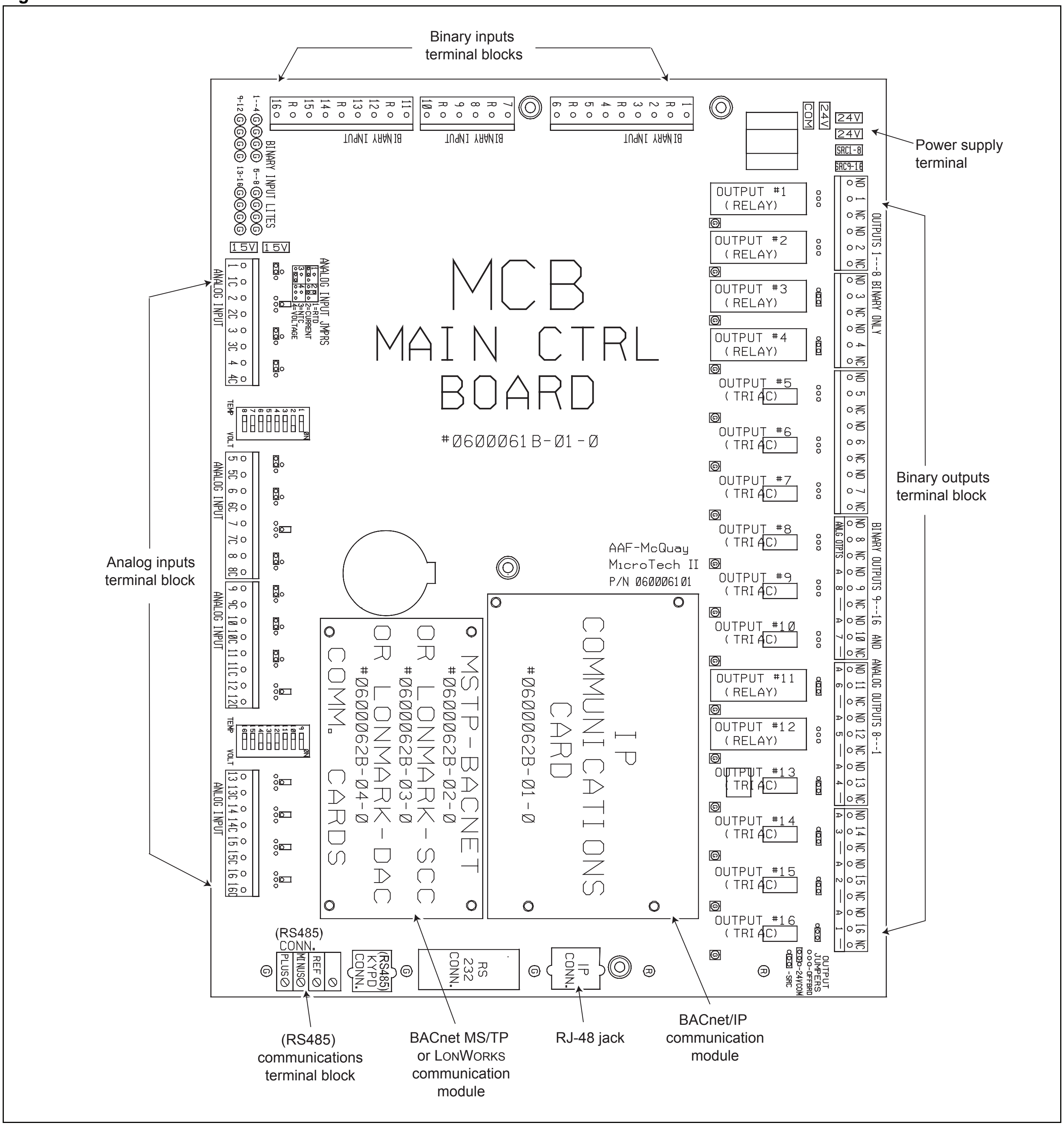
Figure 2: A-A detail, typical MicroTech II main control panel layout



Main Control Board (MCB)

Figure 3 shows the main control board (MCB). It contains a microprocessor that is programmed with the main application code to control the unit. The MCB receives up to 16 analog and 16 binary inputs directly and up to 6 analog and 12 binary inputs from each optional auxiliary control board (CCB1, CCB2). Auxiliary control boards communicate this data with the MCB via an RS-485 communication bus interface. The MCB controls its own 16 binary outputs and up to 9 binary outputs on each auxiliary board based on the inputs.

Figure 3: Main control board



Analog inputs terminal blocks

The MCB receives up to 16 analog input signals. From top to bottom, analog inputs AI1 through AI6 are terminated on the TB2 terminal block. Each analog input has two terminals. The terminals for AI1 are 1 and 1C, the terminals for AI2 are AI-2 and AI-2C, and so forth. Refer to "Analog Inputs—Main Control Board (MCB)" on page 19 for details regarding analog inputs.

Binary Inputs Terminal Blocks

The MCB receives up to 16 binary input signals. From right to left, binary inputs BI1 through BI6 terminate on the TB2 terminal block. Refer to "Binary Inputs—Main Control Board (MCB)" on page 20 for details regarding binary inputs.

Binary Outputs Terminal Blocks

The MCB controls up to 16 binary outputs when controlling the unit. The binary outputs either energize on-board electromechanical relays (BO1–BO4, BO11 and BO12) or triacs (BO5–BO10 and BO13–BO16).

The unit control devices are wired to these relays or triacs through TB2 terminal block on the right side of the MCB, or they are wired directly to the factory-installed sensor plugs.

Each binary output has three terminals. The terminals for BO1 are NO, 1, and NC; the terminals for BO2 are NO, 2, and NC; and so forth. Each binary output lights an LED when the output is active. Refer to "Binary Inputs—Main Control Board (MCB)" on page 20 for details regarding binary outputs.

RS-485 Communications Terminal Block

The MCB exchanges information with up to four optional auxiliary control boards via the RS-485 communication bus terminal block in the lower left corner of the MCB. This terminal block has four terminals, three of which are labeled REF, Minus, and Plus. These terminals connect the auxiliary boards to the RS-485 communication bus to interface them with the MCB.

Power Supply Terminals

Transformer T2 supplies 24 VAC power to the MCB on the 24 V and COM terminals located at the upper right corner of the MCB.

Some of the binary outputs on the MCB drive 24 VAC pilot relays in the unit control circuit.The 24 VAC to power these pilot relays is provided from transformer T3 through the SRC 1–8 and SRC 9–16 terminals located at the upper right corner of the MCB and through the particular binary output contacts.

Note – Place the output jumper associated with these outputs in the SRC position. For detailed information regarding binary output jumpers, refer to "Binary Inputs—Main Control Board (MCB)" on page 20.

Keypad/LCD Display Connection

The keypad is connected to the main control board via a six-conductor cable connected to an RJ-11 style modular jack located at the bottom of the MCB. This connects the keypad to the RS-485 communication bus interface with the MCB.

Communication Modules

In systems that require networking, install one of the following communications modules.

Plug-in BACnet/IP Communications Module

A BACnet/IP Communication Module can be plugged into the MCB in the port location shown in Figure 3 on page 5.

The BACnet/IP Communication Module is designed to be an add-on module to the MCB for networking to Building Automation and Control Network (BACnet) systems. It is a plug-in module that can be attached to the MCB via a 36-pin header. It includes four locking stand-offs to securely attach it to the board. The MicroTech II Vertical Self-Contained Unit Controller meets the requirements of ANSI/ASHRAE 135-2001 standard for BACnet/IP per Annex J of the standard with a conformance level of 3.

For a detailed description and troubleshooting information regarding this communications module, refer to installation and maintenance bulletin *IM 703, MicroTech II BACnet/IP Communications Module*. For details regarding BACnet protocol data, refer to engineering data document, *ED 15061, MicroTech II Protocol Information Data for Vertical Self-Contained Units*.

A unit equipped with an optional BACnet/IP Communication Module is connected to a BACnet/IP network through an eight-position RJ-45 style modular jack located on the bottom edge of the MCB. This connection is shown schematically in Figure on page 8.

Plug-in BACnet MS/TP Communications Module

A BACnet/MSTP Communication Module can be plugged into the MCB in the port location (see Figure 3 on page 5).

The BACnet MS/TP Communication Module is designed to be an add-on module to the MCB for networking to Building Automation and Control Network (BACnet) systems. It is a plug-in module that can be attached to the MCB via a 12-pin header and includes four locking stand-offs to securely attach it to the board. It allows the MCB to interoperate with systems that use the BACnet Master Slave Token Passing (MS/TP) protocol with a conformance level of 3. The MicroTech II Vertical Self-Contained Unit Controller meets the requirements of ANSI/AHSRAE 135-2001 standard for BACnet systems.

For a detailed description and troubleshooting information regarding this communications card, refer to installation and maintenance bulletin *IM 704, MicroTech II BACnet MS/TP Communications Module*. For details regarding BACnet protocol data, refer to engineering data document, *ED 15061, MicroTech II Protocol Information Data for Vertical Self-Contained Units*.

A unit equipped with an optional BACnet MS/TP Communication Module is connected to a BACnet MS/TP network through terminals 128 (+), 129 (–) and 130 (REF) on terminal block TB2 in the main control panel. These terminals are factory wired to the BACnet MS/TP module when the module is factory installed. When the module is field installed, the add-on communication card kit includes a wiring harness to install between terminals 128, 129 and 130 and the BACnet MS/TP module. This connection is shown schematically in Figure 3 on page 5.

LONWORKS® Communication Modules

A LONWORKS Communication Module can be plugged into the MCB in the port location shown in Figure 3 on page 5. This card provides LONWORKS network communication capability to the MCB. It is a plug-in module that can be attached to the MCB via a 12-pin header, and includes four locking stand-offs to securely attach it to the board.

For a detailed description and troubleshooting information regarding this communications module, refer to installation and maintenance bulletin *IM 702, MicroTech II LONWORKS Communications Module*. For details regarding LONWORKS protocol data, refer to engineering data document, *ED 15061, MicroTech II Protocol Information Data for Vertical Self-Contained Units*.

There are two versions of this module available. They are:

Space Comfort Control (SCC) Module. The Space Comfort Controller (SCC) Communication Module supports the LONMARK Space Comfort Controller (SCC) profile number 8500.

Discharge Air Control (DAC) Module. The Discharge Air Controller (DAC) Communication Module supports the LONMARK Discharge Air Controller (DAC) profile number 8610.

A unit equipped with an optional LONWORKS Space Comfort Controller (SCC) Communication Module or LONWORKS Discharge Air Controller (DAC) Communication Module can be connected to a LONWORKS network through terminals 128 (A) and 129 (B) on terminal block TB2 in the main control panel. These terminals are factory wired to the module when the module is factory installed. When the module is field installed, the add-on communication module kit includes a wiring harness to install between terminals 128 and 129 and the module. This connection is shown schematically in Figure 3 on page 5.

RS-232 Connection Port

A PC loaded with MicroTech II Service Tool software can be connected directly or via a telephone modem to the RS-232 communications port located on the bottom edge of the MCB. This connection is shown schematically in Figure 3 on page 5.

15 VDC Supply Connection

> ⚠ **CAUTION**
>
> This is an unregulated power supply. Do not use to feed three-wire potentiometer inputs. Equipment damage can result.

The two 15 V terminals located above the analog input terminals provide 15 VDC power. This power is not used in the Vertical Self-Contained Controller application. It is limited to sourcing 30 mA.

Figure 4: MCB communication interface

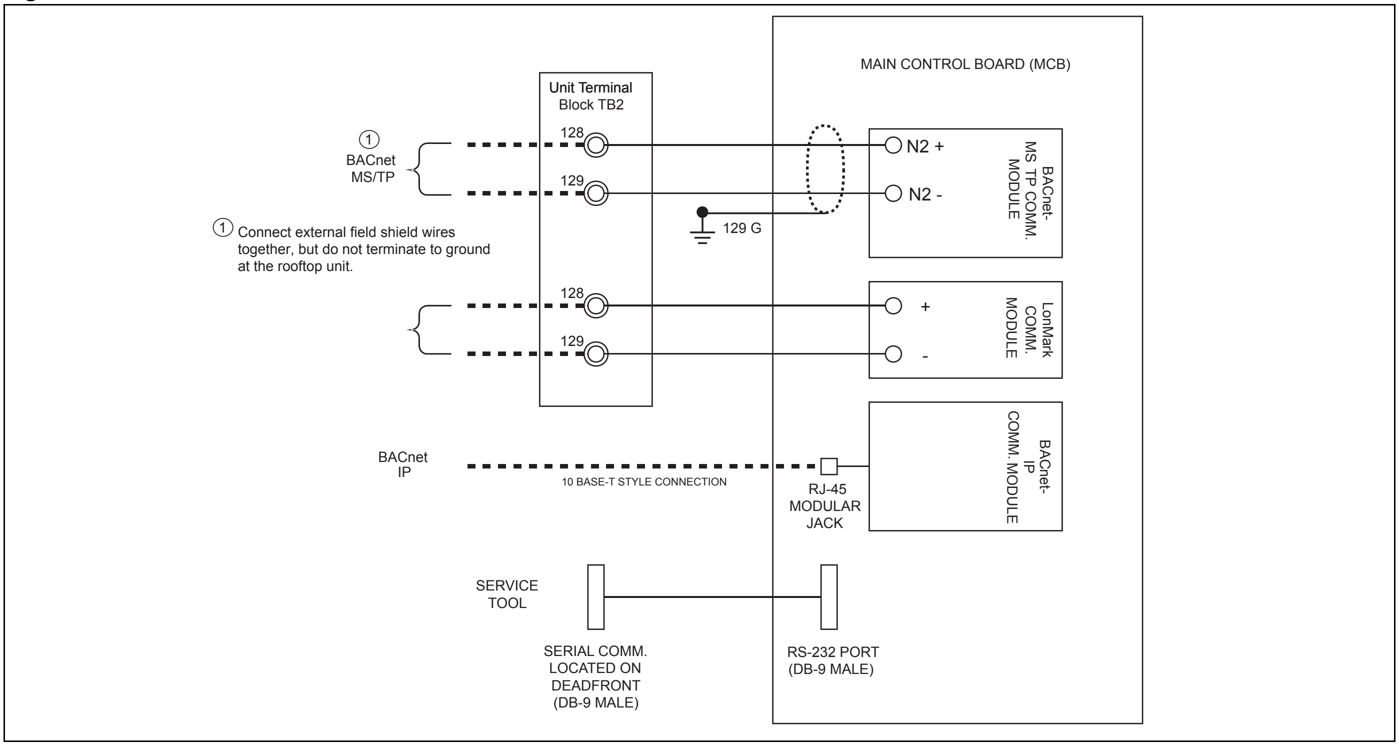


Table 3: Main control board miscellaneous LEDs

<table>
<tr><th colspan="2">LED function</th><th>Location on MCB</th><th>LED color</th></tr>
<tr><td colspan="2">RS-485 bus activity Indication (LED is ON when activity present on the RS-485 bus)</td><td>Left of RS-485 port connector</td><td>Green</td></tr>
<tr><td colspan="2">RS-232 port activity Indication (LED is ON when activity present at the RS-232 port)</td><td>Left of RS-232 port connector</td><td>Green</td></tr>
<tr><td colspan="2">BACnet/IP port activity indication (LED is ON when activity present at the BACnet/IP Port)</td><td>Left of BACnet/IP port connector</td><td>Green</td></tr>
<tr><td colspan="2">MCB error indication*</td><td rowspan="3">Right of BACnet/IP port connector</td><td rowspan="3">Red</td></tr>
<tr><td>OFF</td><td>Blinking</td></tr>
<tr><td>Normal</td><td>Battery low or defective</td></tr>
</table>

*Refer to “Troubleshooting Main Control Board (MCB)” on page 42.

Main Control Board LEDs

There are a number of LEDs in various locations on the MCB. These LEDs consist of three groupings. There are 16 Binary Input (BI) LEDs located in the upper left corner of the MCB. These LEDs illuminate when the corresponding Binary Input is turned on. For information regarding the functions of the Binary Inputs refer to “Binary Inputs—Main Control Board (MCB)” on page 20. There are 16 Binary Output (BO) LEDs, one located next to each Binary Output on the right side of the MCB. These LEDs illuminate when the corresponding Binary Output is turned on. For information regarding the functions of the Binary Outputs refer to “Binary Outputs—Main Control Board (MCB)” on page 22. There are four miscellaneous LEDs. These LEDs provide error code information and indicate activity on the various communication channels. Table 3 lists these LEDs with their functions.

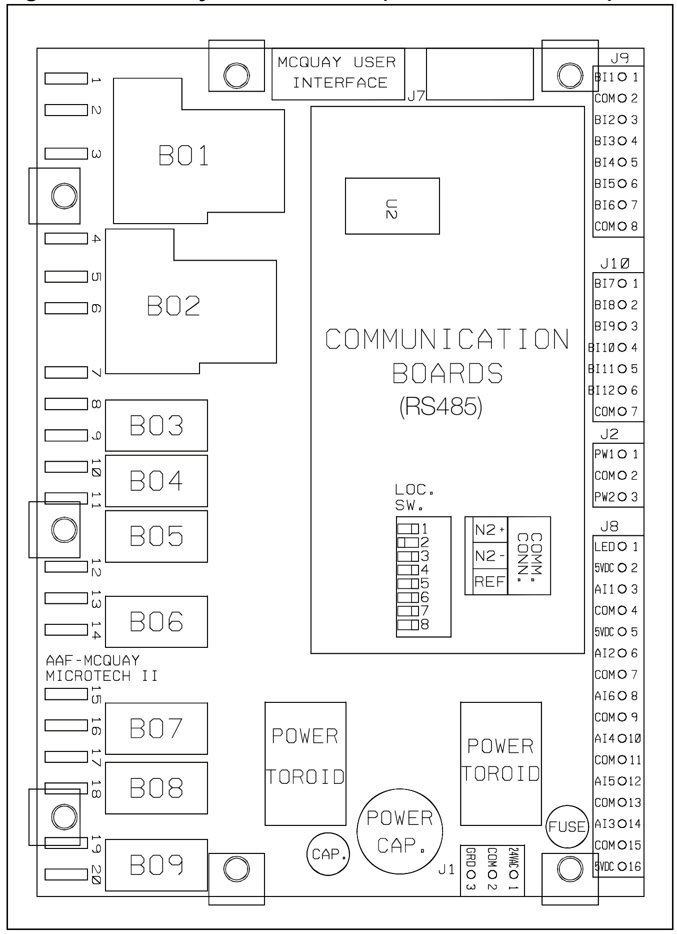
Auxiliary Control Boards (CCB1and CCB2)

There are up to two optional auxiliary cooling control boards (CCB1 and CCB2). Although the input and output functions on the two boards are defined differently in software, the boards are physically identical.

The CCB1 and CCB2 are used whenever a unit is equipped with factory DX cooling (models SWP and SWT). The CCB1 and CCB2 are not used on units equipped with chilled water or no cooling.

A typical auxiliary control board is shown in Figure 5. This board receives up to 6 analog and 12 binary inputs and exchanges information with the MCB via an RS-485 communication bus.

Figure 5: Auxiliary control board (CCB1 board shown)



Analog Inputs Terminal Block (J8)

The auxiliary control board receives up to six analog input signals via the AI (J8) terminal block on the right side of the board.

Note – Only analog input AI5 is used with factory DX cooling applications. The other five AIs are not used for Self-Contained units and are not supported in the application software. Refer to “Analog inputs—Auxiliary Control Boards (CCB1 and CCB2)” on page 20 for details regarding analog inputs.

Binary Inputs Terminal Blocks (J9 and J10)

The auxiliary control board receives up to 12 binary input signals via the BI terminal blocks (J9 and J10) on the right side of the board. BI1 through BI6 are located on terminal block J9 and BI7 through BI12 are located on terminal block J10. Refer to "Binary Inputs—Auxiliary Control Boards (CCB1 and CCB2)" on page 20 for details regarding binary inputs.

Binary Outputs Terminal Block

The auxiliary control board includes nine binary output relays (BO1 through BO9) that are energized based on commands received from the MCB. These relays provide the appropriate switching actions for the control devices that are wired to them through the BO terminals on the left side of the board. Refer to "Binary Outputs—Auxiliary Control Boards (CCB1 and CCB2)" on page 23 for details regarding binary outputs.

RS-485 Communications Module

Each auxiliary control board is equipped with a plug in R-485 Communication Module. This module includes a 3-position terminal block with terminals labeled N2+, N2–, and REF. These terminals are wired to the Plus, Minus, and REF terminals on the RS-485 communication terminal block on the MCB. The auxiliary control board exchanges information with the MCB via this interface.

Each auxiliary board RS-485 Communication Module includes an 8-position dip switch assembly (SW1) for addressing the board. See Figure 5 on page 9. Always set CCB1 to address 2 and CCB2 to address 3 by setting the switches on each of the auxiliary control boards as indicated in Table 4. If the switches are not set as indicated, the MCB will not communicate correctly with the board, and the auxiliary control board will not function properly.

Table 4: Auxiliary control board address switches

Auxiliary control board (address)	Dip switch #							
	1	2	3	4	5	6	7	8
CCB1 (2)	Up	Down	Up	Up	Up	Up	Up	Up
CCB2 (3)	Down	Down	Up	Up	Up	Up	Up	Up

Power Supply Terminals (J1)

Transformer T3 supplies 24 VAC power to terminal block J1, terminals 1 (24 VAC) and 2 (COM) on the auxiliary control board (CCB1 and CCB2).

J7 Terminal Block

The J7 terminal block located at the top of the auxiliary control board is not used in this product application.

J2 Terminal Block

The J2 terminal block located between the J10 and J8 terminal block on the right side of the auxiliary control board is not used in this product application.

Main Control Board (MCB) Output Relays and Triacs

Binary outputs BO1 through BO4, BO11, and BO12 control pilot duty Form C electromechanical relays mounted on the MCB. The output terminals of these relays are connected to a set of binary output terminal blocks located on the right side of the MCB. These relays are designed for Class 2 operation and to switch loads with either of the following characteristics:

- 5 VDC @ 10 mA minimum, 1 A maximum
- 30 VAC @ 2 A nominal, 10 A inrush

Binary outputs BO5 through BO10 and BO13 through BO16 control triacs mounted on the MCB. The output terminals of these triacs are connected to a binary output terminal block located on the right side of MCB. These triacs are designed to switch loads with 20 mA minimum, 24 VAC @ 1 A maximum (with a total load current from all triacs not to exceed 2.8 A, TBV).

Auxiliary Control Boards (CCB1 and CCB2) Output Relays

Binary outputs BO1 and BO2 control high power Form A electromechanical relays mounted on the auxiliary control board. The output terminals of these relays are connected to the binary output terminals located on the left side of the auxiliary control board. These relays are designed to switch loads with either of the following characteristics:

- 1 hp 120 VAC
- 25 A resistive @ 120 VAC

Note – For this product application, place both of the two jumpers on the board just below the upper right corner of the RS-485 Communication Module on the right-most pins. If these are not positioned correctly, the devices controlled by binary outputs BO1 and BO2 do not function properly.

Binary outputs BO3 through BO5 and BO7 through BO9 control low power Form A electromechanical relays mounted on the auxiliary control board. The output terminals of these relays are connected to the binary output terminals located on the left side of the auxiliary control board. These relays are designed to switch loads with either of the following characteristics:

- 1/10 hp 120 VAC
- 5 A resistive @ 120 VAC

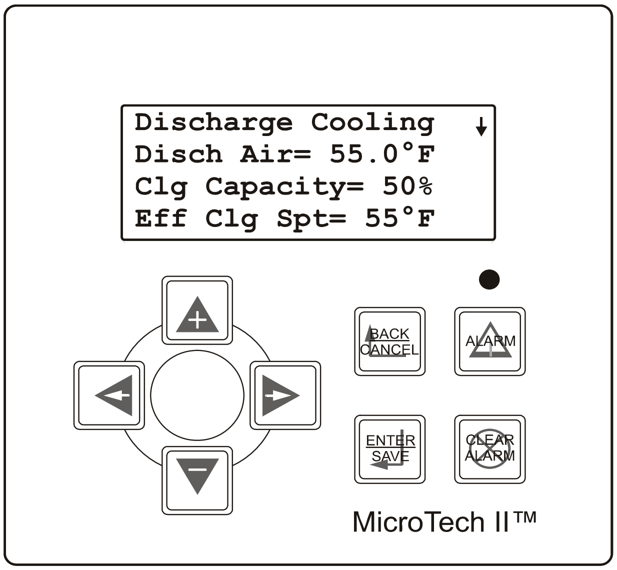
Binary output BO6 controls one low power Form C electromechanical relay mounted on the auxiliary control board. The output terminals of this relay are connected to the binary output terminals located on the left side of the auxiliary control board. This relay is designed to switch loads with either of the following characteristics:

- 1/10 hp 120 VAC
- 5 A resistive @ 120 VAC

Keypad/Display

The keypad/display, shown in Figure 6, has eight keys and a 4-line × 20-character LCD display. The keypad/display is the operator interface to the MCB. All operating conditions, system alarms, control parameters, and schedules can be monitored from the keypad/display. If the correct password is entered, adjustable parameters or schedules can be modified. For information on using the keypad/display, refer to the "Getting Started" section of the applicable operation manual (see Table 1 on page 1).

Figure 6: Keypad/display



Temperature Sensors

The MicroTech II controller uses passive positive temperature coefficient (PTC) sensors. These sensors vary their input resistance to the MCB as the temperature changes. Resistance versus temperature information is included in "Troubleshooting Temperature Sensors" on page 47.

Pressure Transducers

The MicroTech II controller uses 0 to 5" wc, 1 to 6 VDC static pressure transducers for measuring duct static pressure. Voltage-to-pressure conversion data is included in "Troubleshooting Static Pressure Transducers" on page 48.

Humidity Sensors

The MicroTech II controller uses 0 to100% rh, 0 to 5 VDC humidity sensors. Refer to "Humidity Sensors" on page 11 for details regarding these sensors.

Actuators

The MicroTech II controller uses floating point (tri-state) control actuators for valve, damper, and variable inlet vane modulation.

Non-spring return actuators are used for the condenser, waterside economizer and heating valves, and inlet vanes. Use a non-spring return actuator with the field-supplied airside economizer. All valves normally are closed.

The controller senses position feedback from 0 to 1000 ohm potentiometers on the waterside economizer, heating, and inlet vane actuators. The field-supplied actuator for the airside economizer must have this same feedback. The MCB uses these feedback signals to determine and display economizer position and fan capacity and to display heating capacity.

Adjustable Frequency Drives (AFDs)

When controlling the adjustable discharge frequency drives (AFDs), the MicroTech II controller uses floating-point (tri-state) output signals to modulate the drive speed.

Speed feedback is supplied to the controller via a 0 to 10 VDC signal from the AFD. The MCB uses the feedback signal to determine and display discharge fan capacity.

Field Wiring

Below are descriptions of the various options and features that may require field wiring to the MicroTech II controller. Refer to the job plans and specifications and the as-built wiring schematics. For a typical set of wiring schematics, see Figures 17 through 22. For complete, exact component designations and locations, refer to the legend supplied with the unit.

For more information on electrical installation, refer to the applicable unit installation manual (see Table 2 on page 1).

Field Output Signals

Depending on unit type, the following output signals are available for field connections to any suitable device:

- Outside Air Damper Output (MCB-BO2)
- Fan Operation Output (MCB-BO3)
- Remote Alarm Output (MCB-BO4)
- VAV Box Output (MCB-BO12)
- Pump Start Output (CCB1-BO3 or CCB2-BO3)

The Remote Alarm Output and Fan Operation Output are available on all units. The VAV Box Output is available only on VAV units.

Outside Air Damper

The Remote Damper Output (MCB-BO2) supplies 24 VAC to terminal 119 on the field terminal block (TB2) when the output is on. To use this signal, wire the coil of a field-supplied and field-installed 24 VAC pilot relay across terminals 119 and 117 on TB2. When this output is on, 24 VAC is supplied from the T2 control transformer through output relay MCB-BO2 to energize the field relay. See the as-built wiring diagrams or the schematic on page 34.

For control of units with return air, the Remote Damper Output is in the Close (OFF) position and the airside economizer minimum position is set to zero, if any of the following is true:

- Unit is in the OFF state.
- Unit is in the Start Initial state
- Unit is in the Recirc state
- Unit is in the Morning Warmup state
- Unit is operating during the Unoccupied period due to Night Setback or Night Setup

For control of units with 100% outside air, the Remote Damper Output is in the Open (ON) position during the Start Initial period, and it remains in the Open (ON) position during all operating stages. This output remains in the Open (ON) position after the fan is turned off until 30 seconds after the Airflow Switch digital input indicates loss of airflow. This keeps the outside air dampers open in case there is a failure or external override that keeps the fan running after it is turned off by MicroTech II. If the fan is running with the MicroTech II controls bypassed, the Damper output is NOT on. The economizer is driven closed when the unit is off.

Fan Operation Output

The Fan Operation Output (MCB-B03) supplies 24 VAC to terminal 116 on the field terminal block (TB2) when the output is on. To use this signal, wire the coil of a field-supplied and field-installed 24 VAC pilot relay across terminals 116 and 117 on TB2. When the output is energized, 24 VAC is supplied from the T2 control transformer through output relay MCB-B03 to energize the field relay. Refer to the as-built wiring diagrams or to the schematic on page 34.

⚠ CAUTION

Improper current can cause improper operation and equipment damage.
The total VA of all field-mounted relays must not exceed 15 VA and they must have a 24 VAC Class 2 coil.

Use the Fan Operation Output (MCB-BO3) to control field equipment that depends on fan operation (field-installed isolation dampers, VAV boxes, etc.) This output is turned on at the beginning of the Startup operating state and remains on during fan operation. The fans remain off during the Startup operating state, allowing time for equipment such as isolation dampers to open prior to the starting of the fan. The duration of the Startup operating state is adjustable by setting the *Start Init=* parameter in the Timer Settings menu on the keypad. When the unit is shut off this output remains on for 30 seconds after the airflow switch stops sensing airflow. This output is on whenever the airflow switch senses airflow.

Remote Alarm Output

The Remote Alarm Output (MCB-B04) supplies 24 VAC to terminal 115 on the field terminal block (TB2) when the output is on. To use this signal, wire the coil of a field-supplied and installed 24 VAC pilot relay across terminals 115 and 117 on TB2. When this output is on, 24 VAC is supplied from the T2 control transformer through output relay MCB-B04 to energize the field relay. Refer to the as-built wiring diagrams or to "Output schematic: actuator control" on page 34.

⚠ CAUTION

Improper current can cause improper operation and equipment damage.
The total VA of all field-mounted relays must not exceed 15 VA, and they must have a 24 VAC Class 2 coil.

The action of this output depends on the setup of each of the possible alarms. The output is on continuously (field relay energized) when there are no active alarms within the unit controller. Each alarm then is configured to cause the output to turn off, blink on and off rapidly, blink on and off slowly, or remain on (no alarm indication). For details on how to use the keypad to configure these alarms, see the “Alarm Monitoring” section of the applicable operation manual (see Table 1 on page 1).

VAV Box Output

The VAV Box Output (MCB-B012) supplies 24 VAC to terminal 118 on the field terminal block (TB2) when the output is on. To use this signal, wire the coil of a field-supplied and field-installed 24 VAC pilot relay across terminals 118 and 117 on TB2. When the output is energized, 24 VAC is supplied from the T2 control transformer through output relay MCB-B012 to energize the field relay. Refer to the as-built wiring diagrams or to the schematics on pages 34–37.

> ⚠ **CAUTION**
>
> **Improper current can cause improper operation and equipment damage.**
> The total VA of all field-mounted relays must not exceed 15 VA and they must have a 24 VAC Class 2 coil.

The VAV Box Output (MCB-BO12) is designed to coordinate unit operation with VAV box control. Field use of this output is optional; however, it is highly recommended, especially for VAV systems that have heating capability (unit or duct mounted).

Below are application guidelines for four basic heating configurations. For all of these configurations, the VAV Box Output (MCB-BO12) is off for an adjustable time period after unit startup (default is 3 minutes). During this period (the Recirc operating state), heating and cooling is disabled, and the outside air damper is held closed. The fans circulate building air and equalize space, duct, and unit temperatures.

Cooling-Only Units

For cooling-only VAV systems, the VAV Box Output can override zone thermostat control and drive the VAV boxes fully open to facilitate air circulation during the Recirc operating state. During this time, the VAV Box Output is in the OFF (or heat) position (field-installed pilot relay de-energized).

VAV units have a “post heat” control feature that forces the discharge air volume to a minimum before turning on the VAV Box Output when the Recirc operating state is complete. Post heat operation prevents excessive duct static pressure that otherwise could occur when the zone thermostats regain VAV box control.

Note – Setting a “post heat” timer determines the duration of post heat operation. This timer is set to zero at the factory. To enable the “post heat” function, set it to a nonzero value. For more information on post heat operation, refer to “Post Heat Operation” in the “Discharge Fan Airflow Control” sections of the applicable VAV operation manual (see Table 1 on page 1).

When the unit is not in the Startup or Recirc operating state and “post heat” is not active, the VAV Box Output is in the ON (or cool) position (field relay energized), so the zone thermostats control the VAV boxes.

Wire the field-supplied fan operation and VAV box relay contacts in series so the boxes open when the unit is not operational.

Cooling-Only Units with Field-supplied Heat

For VAV systems with cooling-only units and duct mounted reheat coils, the VAV Box Output can override zone thermostat control and drive the VAV boxes fully open when heating is required. If necessary, the MicroTech II controller energizes the fans for night setback and morning warm-up heating operation. When this occurs, the unit enters and remains in the UnocFanO or MWU operating state until heat no longer is required. The temperature control sequences are the same as those for units with factory-supplied heating equipment. While the unit is in these states, the VAV Box Output is in the OFF (or heat) position (field-supplied pilot relay de-energized).

VAV units have a “post heat” control feature that forces the discharge air volume to a minimum before closing the VAV box output when the heating period is complete. “Post heat” operation prevents excessive duct static pressure that could occur when the zone thermostats regain VAV box control.

Note – Setting a “post heat” timer determines the duration of post heat operation. This timer is set to zero at the factory. To enable the “post heat” function, set it to a nonzero value. For more information on post heat operation, refer to “Post Heat Operation” in the “Discharge Fan Airflow Control” section of the applicable VAV operation manual (see Table 1 on page 1).

When the unit is not in the Startup, Recirc, or any heating operating state and “post heat” is not active, the VAV Box Output is in the ON (or cool) position (field-supplied pilot relay energized) so that the zone thermostats control the boxes.

Wire the field-supplied fan operation and VAV box relay contacts in series so the boxes open when the unit is not operational.

Units With Staged Heat

Use the VAV Box Output to override zone thermostat control and drive the VAV boxes fully open when heating is required. While the unit is in Startup, Recirc, or any heating operating state (UnocHtg, MWU, or Heating), the VAV Box Output is in the OFF (or heat) position (field-installed pilot relay de-energized).

VAV units have a “post heat” control feature, which forces the discharge air volume to a minimum before closing the VAV Box Output when the unit leaves the Recirc or any other heating operating state. “Post heat” operation prevents excessive duct static pressure conditions that otherwise could occur when the zone thermostats regain VAV box control.

Note – Setting a “post heat” timer determines the duration of post heat operation. This timer is set to zero at the factory. To enable the “post heat” function, set it to a nonzero value. For more information on post heat operation, refer to “Post Heat Operation” in the “Discharge Fan Airflow Control” section of the applicable VAV operation manual (see Table 1 on page 1).

When the unit is not in Startup, Recirc, or any other heating state and post heat operation is not active, the VAV Box Output is in the ON (or cool) position (field-supplied pilot relay energized) so the zone thermostats control the boxes.

Wire the field-supplied fan operation and VAV box relay contacts in series so the boxes open when the unit is not operational.

Units With Modulating Heat

Use the VAV Box Output to switch the VAV boxes between heating and cooling control. While the unit is in Startup, Recirc, or any heating operating state (UnocHtg, MWU, or Heating), the VAV Box Output is in the OFF (or heat) position (field-installed pilot relay de-energized) switching the VAV boxes into heating operation.

VAV units have a “post heat” control feature that forces the discharge air volume to a minimum before closing the VAV Box Output when the unit leaves Recirc or any other heating operating state. “Post heat” operation prevents excessive duct static pressure that otherwise could occur when the zone thermostats regain VAV box control.

Note – Setting a “post heat” timer determines the duration of post heat operation. This timer is set to zero at the factory. To enable the “post heat” function, set it to a nonzero value. For more information on post heat operation, refer to “Post Heat Operation” in the “Discharge Fan Airflow Control” section of the applicable VAV operation manual (see Table 1 on page 1).

When the unit is not in Startup, Recirc, or any other heating operating state, the VAV Box Output is in the ON (or cool) position (field-supplied pilot relay energized) switching the boxes to cooling control.

Pump Start Output

The Pump Start Output (CCB1-BO3) supplies 24 VAC to terminal 113 on field terminal block (TB2) when the output is on. To use this signal, wire the coil of the field-supplied and field-installed 24 VAC pilot relay across terminals 113 and 117 on TB2. When this output is on, 24 VAC is supplied from the T3 control transformer through output relay CCB1-BO3 to energize the field relay. See the as-built wiring diagram or Figure 20 on page 37. The Pump Start Output is on when water flow is required. It is off at all other states.

Field Analog Input Signals

Zone Temperature Sensor Packages

Table 5 lists the two zone (space) temperature sensor packages that are available for use with Vertical Self-Contained units equipped with a MicroTech II controller. A zone temperature sensor (ZNT1) is optional for all Vertical Self-Contained units except for the 100% outdoor air CAV-ZTC (SCC) unit, in which case, one is required. On all programs, however, a zone temperature sensor is required to take advantage of any of the following standard controller features:

- Unoccupied heating and cooling
- Discharge air reset based on space temperature (DAC only)
- Timed tenant override
- Remote set point adjustment (CAV-ZTC only)
- Pre-occupancy purge (Airside Economizer only)

Table 5: MicroTech II zone temperature sensors

McQuay part#.	Tenant override switch	Remote set point adjustment	For use with	
			DAC	CAV-ZTC (SCC)
111048101	Yes	No	X	X
111048102	Yes	Yes		X

Zone Sensor Without Remote Set Point Adjustment

The standard MicroTech II room temperature sensor package that does not include set point adjustment can be used with any vertical self-contained MicroTech II control configuration. It includes a tenant override button.

Field install and field wire the zone sensor to the unit using a twisted pair, shielded cable (Belden 8761 or equivalent). Figure 7 on page 15 shows the required wiring termination points.

Zone Sensor With Remote Set Point Adjustment

The standard MicroTech II room temperature sensor package equipped with a set point adjustment potentiometer is available to use with CAV-ZTC (SCC) units. This sensor package also includes a tenant override button. If wall mounted, set point adjustment is not required; the sensor package without remote set point adjustment can be used on a CAV-ZTC (SCC). The set point adjustment potentiometer is wired across analog input MCB-AI2. The set point varies from 52°F to 83.9°F as the resistance changes from 0 to 1660 ohm.

Field install and field wire the zone sensor package to the unit using twisted, shielded cable. Four conductors with a shield wire are required. Cable with 22 AWG conductors (Belden 8761 or equivalent) is sufficient. Figure 7 on page 15 shows the required wiring termination points.

⚠ CAUTION

Do not install the zone sensor cable in the same conduit as power wiring. Improper control function will result.

Figure 7: Zone sensor with tenant override

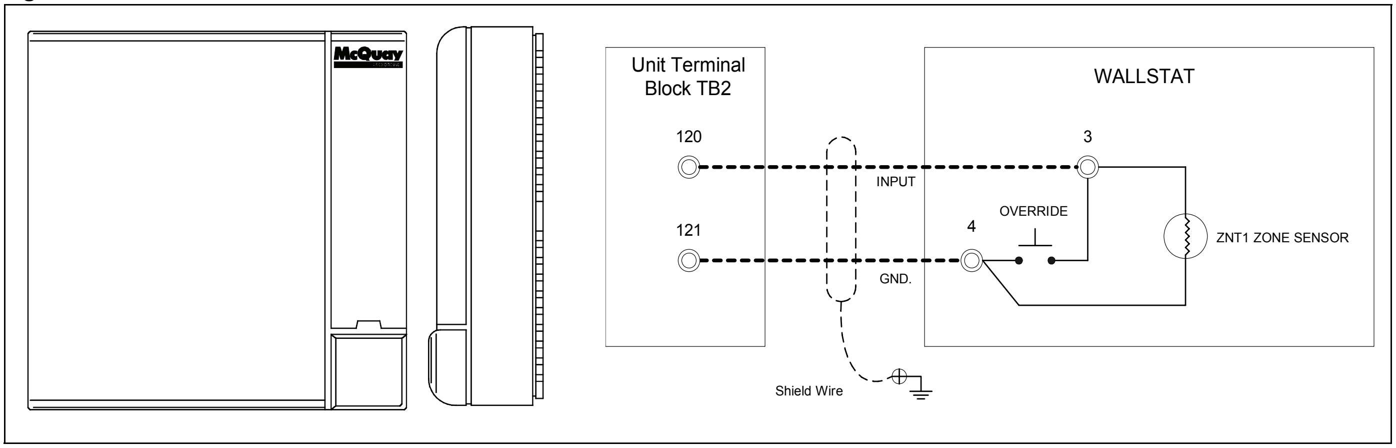
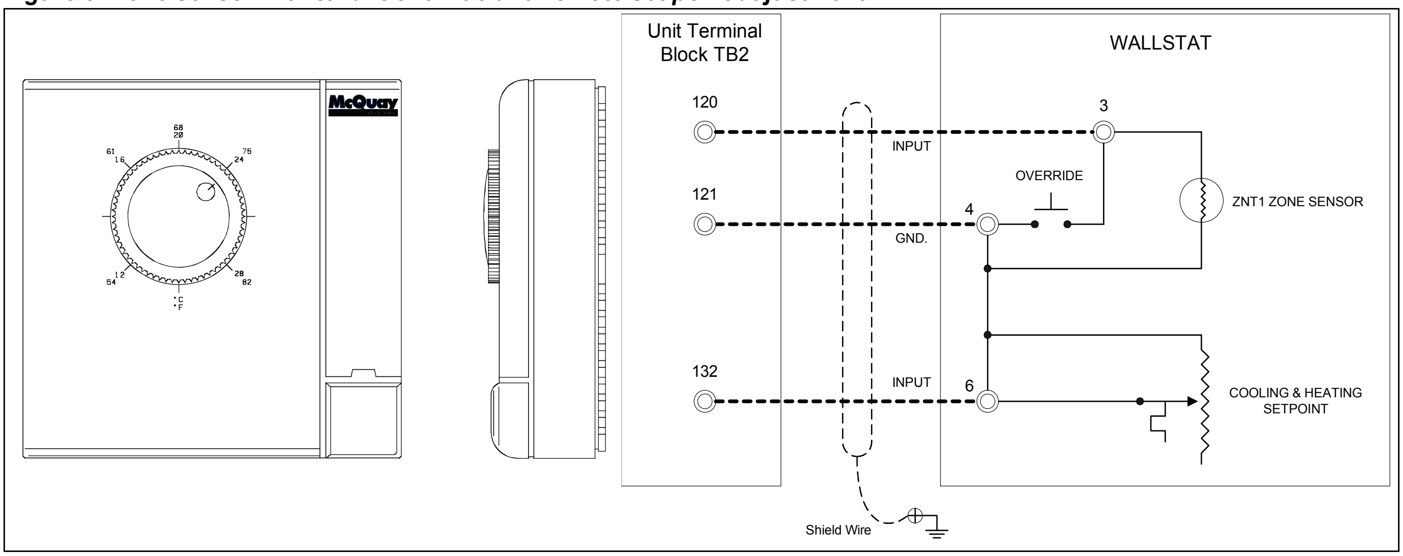


Figure 8: Zone sensor with tenant override and remote set point adjustment



Tenant Override (Timed)

The tenant override button provided with the two optional zone temperature sensor packages can be used to override unoccupied operation for a programmed time period. This time period is adjustable between 0 and 5 hours by the *Tenant Ovrd* = parameter in the Timer Settings menu of the keypad/display (default is 2 hours).Tenant override operation is identical to occupied operation except it is temporary.

Pressing and releasing the push button switch on the sensor momentarily shorts zone temperature sensor ZNT1, resetting and starting the override timer. The unit then starts up and runs until the override timer times out.

Note – Hold the button in for 1 second, but not more than 30 seconds.

For detailed information on setting the override timer, refer to the “Auto/Manual Operation” section of the applicable operation manual (see Table 1 on page 1).

Note – If this tenant override feature is used on a VAV unit, it may be necessary to signal the VAV boxes that the unit is operating. Use the VAV Box Output for this purpose.

External Discharge Air Reset Signal

The discharge air temperature set point on DAC units can be reset by an external voltage or current signal applied to analog input MCB-AI2. Select the external reset method at the controller keypad. External reset requires a field-supplied reset signal in the range of 0–10 VDC or 0–20 mA wired to terminals 132 and 133 on the field terminal block (TB2). Refer to the unit wiring diagrams or Figure 17 on page 30 for wiring termination details.

⚠ CAUTION

Ground loop current hazard. Can cause equipment damage. Isolate external reset signal from all grounds other than MicroTech II controller chassis ground.

Isolate the external reset signal from all grounds other than the MicroTech II controller chassis ground. If it is not isolated, ground loop currents can damage or cause erratic operation of the MicroTech II controller. If the device or system providing the external reset signal is connected to a ground other than the MicroTech II controller chassis, it must provide an isolated output. If not, condition the signal with a signal isolator.

If the external reset option is selected, the controller linearly resets the cooling and heating discharge air temperature set points between user-programmed minimum and maximum values since the field-supplied reset signal varies from a minimum to maximum (or maximum to minimum) value.

Field-wire the external reset signal to the unit using a twisted pair, shielded cable (Belden 8761 or equivalent). Cable with 22 AWG conductors is sufficient.

⚠ CAUTION

Do not install this cable in the same conduit as power wiring. Improper control will result.

Note – If the field signal is in the 0 to 10 VDC range, configure the analog input jumper associated with analog input MCB-AI2 in the no-jumper (NJ-VDC) position. The analog input dip switch for this input then must be in the ON (V) position. If the field signal is in the 0 to 20 mA range, configure the jumper in the current (2 mA) position. The analog input dip switch for this input then must be in the OFF (or T) position.

Detailed information regarding discharge air temperature reset can be found in the “Discharge Set Point Reset” section of the applicable operation manual (see Table 1 on page 1).

Field Actuator Feedback

When the MicroTech II controller is interfaced with a field-supplied steam/hot water, airside economizer, or chilled water valve actuator, a position feedback signal can be field wired from the actuator and input to the MCB. This signal is not required for the steam/hot water and chilled water control purposes but is required for 0 to 100% capacity indication on the keypad or via a network interface. If the signal is not supplied, the valve is controlled properly, but associated capacity parameter will always indicate 0%. The signal is required for the airside economizer control.

Field wire the external feedback signal to the unit using a twisted pair, shielded cable (Belden 8761 or equivalent). Cable with 22 AWG conductors is sufficient.

⚠ CAUTION

Do not install this cable in the same conduit as power wiring. Improper control will result.

Field airside economizer damper actuator. When interfaced with a field-supplied damper actuator, a damper feedback signal—in the form of a resistance that varies from 0 to 1000 ohms as the actuator strokes from 0 to 100% open—can be wired to terminals 65 and 66 on the terminal block (TB2). These terminals are factory wired to analog input MCB-AI9. Refer to the unit wiring diagrams.

Note – The analog input jumper associated with MCB-AI9 must be set to the resistance (1-RTD) position. The analog input dip switch associated with this input must be set to the OFF (or T) position.

Field steam valve actuator. When interfaced with a field-supplied steam valve actuator, a valve feedback signal—in the form of a resistance that varies from 0 to 1000 ohms as the actuator strokes from 0 to 100% open—can be wired to terminals 91 and 92 on the terminal block (TB2). These terminals are factory wired to analog input MCB-AI10. Refer to the unit wiring diagrams.

Note – The analog input jumper associated with MCB-AI10 must be set to the resistance (1-RTD) position. The analog input dip switch associated with this input must be set to the OFF (or T) position.

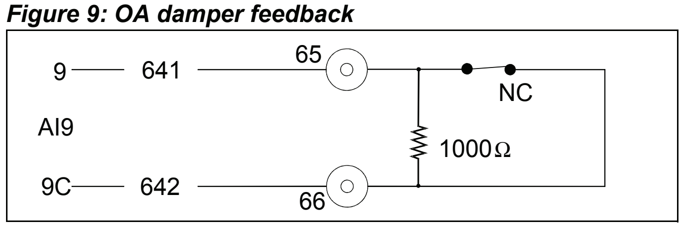
Field 100% OA Damper Actuator

When interfaced with a field-supplied damper actuator, wire a damper feedback signal—in the form of resistance varying from 0 to 1000 ohms as the actuator strokes from 0 to 100% open—to terminals 65 and 66 per Figure 9. On terminal block (TB2), these terminals are factory wired to analog input MCB-AI9.

A normally closed contact along with a 1000 ohm resistor between the economizer (MCB-AI9) position terminals can be used instead of the 0–1000 ohm potentiometer to indicate the outside damper is at least 50% open. When the normally closed contact opens, the fan starts.

Note – The analog input jumper associated with MCB-AI9 must be set to resistance (1-RTD) position. The analog input DIP switch associated with this input must be set to the OFF (or T) position.

Figure 9: OA damper feedback



Humidity Sensors

When the MicroTech II controller is configured for constant volume zone temperature control (SCC), a dehumidification sequence is available and can be activated through the keypad. To use this function, an optional factory-supplied, field-mounted humidity sensor is required.

Either a wall-mounted or duct-mounted sensor is available. The sensor must be wired to terminals *126, 127 and 131* on the unit field terminal block (TB2). Terminal *126* is wired to OUT (0–5 VDC), terminal *127* to GND, and terminal *131* to PWR on the humidity sensor. These terminals are factory wired to the MCB analog input MCB-AI16. The input must be 0–5 VDC as the relative humidity varies from 0–100%.

Note – The output select jumper (J1) on the sensor must be in the 0–5 VDC position. The TEMP terminals on the sensor are not used (see Figure 10 or Figure 11 on page 17).

Field wire the humidity sensor wiring to terminals *126 and 127* to the unit using a twisted pair, shielded cable (Belden 8761 or equivalent). Cable with 22 AWG conductors is sufficient.

⚠ CAUTION

Do not install this cable in the same conduit as power wiring. Improper control will result.

Note – The analog input jumper associated with MCB-AI16 must be set to the no jumper (NJ-VDC) position. The analog input dip switch associated with this input must be set to the ON (V) position.

Humidity sensor—discharge air control (DAC) unit

A humidity sensor can be wired to terminals *126, 127 and 131* on TB2 on a discharge air control (DAC) unit. However, this input is not used for control purposes, and the current relative humidity value from the sensor cannot be read via the keypad/display. The current value from the sensor can be read only via a network interface.

Figure 10: Humidity sensor (duct mounted)

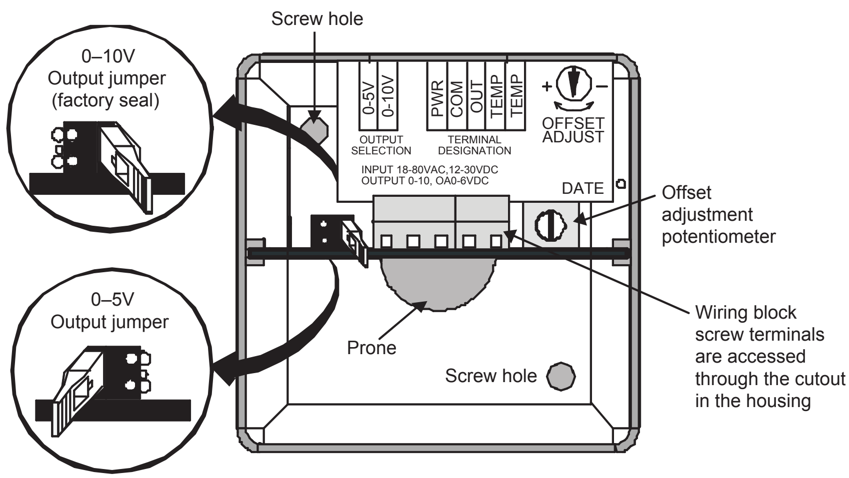
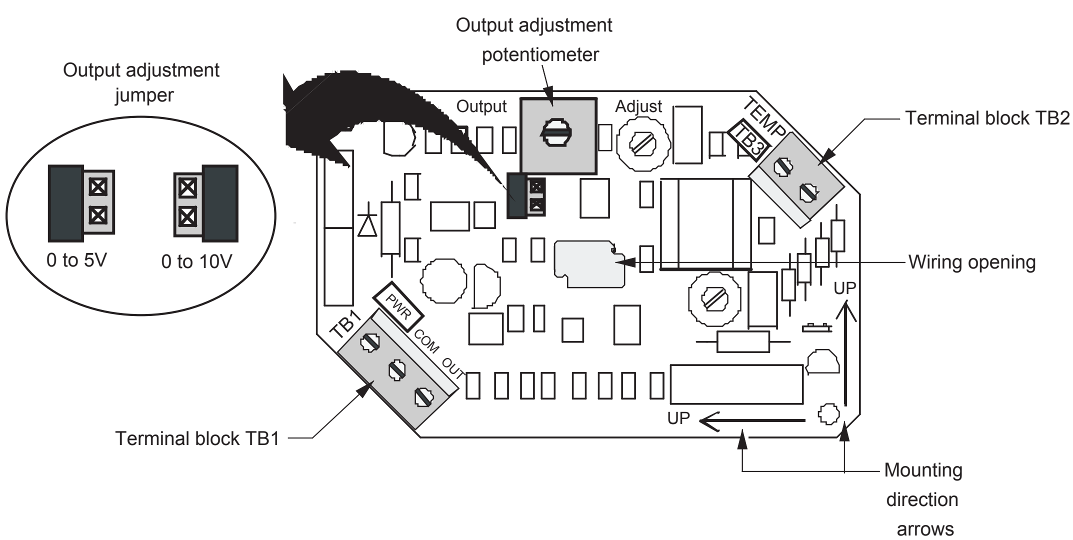


Figure 11: Humidity sensors (wall mounted)



Field Binary Input Signals

The following sections describe options that, if used, require field wiring to binary input terminals. Twisted pair, shielded cable is not required for binary input wiring.

Manual Cooling and Heating Enable

Cooling Enable

Apply 24 VAC to binary input MCB-BI3 to enable cooling operation. If not applied, the unit *Clg Status=* parameter in the System menu of the keypad/display indicates "Off Sw" and cooling operation is unavailable. Apply 24 VAC to MCB-BI3 when terminals 101 and 105 on the unit terminal block (TB2) are made, either with a factory-installed jumper wire or a field-supplied switch. Refer to the unit wiring diagrams or Figure 17 on page 30 (DAC units) or Figure 18 on page 33 (SCC units) for wiring termination details.

Heating Enable

Apply 24 VAC to binary input MCB-BI4 to enable heating operation. If not applied, the *Htg Status=* parameter in the System menu of the keypad/display indicates "Off Sw" and heating operation is unavailable. Apply 24 VAC to MCB-BI4 when terminals 101 and 106 on the terminal block (TB2) are made, either with a factory-installed jumper wire or field-supplied switch. Refer to the unit wiring diagrams or Figure 17 on page 30 (DAC units) or Figure 18 on page 33 (SCC units) for wiring termination details.

Manual Unit Enable

When 24 VAC is applied to binary input MCB-BI2, unit operation is manually disabled. The *UnitStatus=* parameter in the System menu of the keypad/display indicates "Off Sw" and the unit will not operate. This occurs when a field-supplied and field-installed switch across terminals 101 and 104 on the terminal block (TB2) is in the ON or Closed position. Refer to the unit wiring diagrams or Figure 17 on page 30 (DAC units) or Figure 18 on page 33 (SCC units) for wiring termination details.

If not disabled by this method, the unit is enabled to run when placed in the occupied mode. For details regarding occupied/ unoccupied operation, refer to the "Auto/Manual Operation" section of the appropriate program-specific operation manual (see Table 1 on page 1).

External Time Clock or Tenant Override

Switching the Vertical Self-Contained unit between occupied and unoccupied operation can be done using the controller internal schedule, a network schedule, an external time clock, or a tenant override switch.

If the internal schedule or a network schedule is used, field wiring is not required.

An external time clock or a tenant override switch can be used by installing a set of dry contacts across terminals 101 and 102 on the terminal block (TB2). When these contacts close, 24 VAC is applied to binary input MCB-BI1, overriding any internal or network schedule and placing the unit into occupied operation (provided the unit is not manually disabled). When the contacts open (24 VAC is removed from MCB-BI1), the unit acts according to the controller internal time schedule or a network schedule. Refer to the unit wiring diagrams or Figure 17 on page 30 (DAC units) or Figure 18 on page 33 (SCC units) for wiring termination details.

For information on setting internal and network controller schedules, refer to the "Scheduling" section in the applicable operation manual (see Table 1 on page 1).

Miscellaneous Output Signals

The five optional output signals listed below can be provided by installing field-supplied 24 VAC relays wired between terminal 107 on the terminal block (TB2) and the terminals listed in Table 6. Refer to the unit wiring diagrams or Figure 17 on page 30 (DAC units) or Figure 18 on page 33 (SCC units) for wiring termination details.

- Airflow status
- Dirty filter
- Heat fail alarm
- Freeze alarm (steam or water coils, optional)
- Smoke alarm (optional)

⚠ CAUTION

The total VA of all field-mounted relays must not exceed 15 VA; they must have a 24 VAC Class 2 coil.

Table 6: Miscellaneous field signal termination points

Terminal block TB2	Description	Energized field relay indication
107	Ground	NA
108	Fan operation (airflow indication)	Airflow present
109	Dirty filter indication	Filters dirty
111	Heat alarm detected	Alarm
112	Freezestat (freeze condition detected)	Normal
53	Smoke (smoke detected)	Normal

Controller Inputs

Analog Inputs—Main Control Board (MCB)

The 16 analog inputs to the MCB are configurable for four different input types by positioning a jumper associated with each input position (see Figure 12). The four jumper positions are as follows:

1-RTD (temperature sensor or potentiometer). Used for all the temperature sensor inputs and the 0 to 1000 ohm actuator potentiometer position feedback inputs.

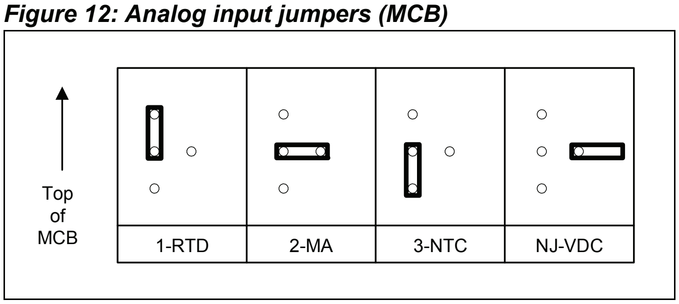
2-MA (current). Used when AI-2 on the MCB for DAT reset with a to 0 to 20 mA reset signal.

3-NTC (10 K ohm thermistor). Not used in this product application for any of the standard input devices.

No jumper NJ-VDC (voltage). Used for the remainder of the standard input devices which are configured for either 0 to 5 VDC or 0 to 10 VDC.

Refer to Table 7 (DAC units) and Table 8 on page 20 (SCC units) for a description of all the analog inputs including the correct jumper positions.

Figure 12: Analog input jumpers (MCB)



In addition to the analog input jumpers, there are two sets of dip switches (SW1 and SW4) associated with the MCB analog inputs. Each set contains eight switches numbered 1 through 8. See Figure 13. The switches on SW1 correspond to inputs MCB-AI1 through MCB-AI8; the switches on SW4 correspond to inputs MCB-AI9 through MCB-AI16. One switch corresponds to each analog input. If the input is a temperature sensor or potentiometer input (input jumper in the 1-RTD position), then the corresponding switch must be in the T (OFF) position. If the input is a voltage input (no input jumper NJ-VDC position), then the corresponding switch must be in the V (ON) position. Table 7 (DAC units) and Table 8 on page 20 (SCC units) include the correct switch settings for all the analog inputs.

Note – If a special application requires a current input with the input jumper set to the 2 mA position, then the corresponding input switch must be set to the T (OFF) position.

Figure 13: Analog input switches (MCB)

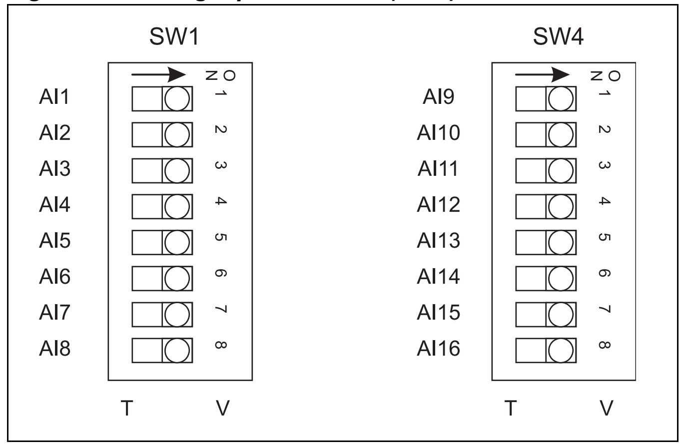


Table 7: Analog inputs for main control board (MCB)—Discharge Air Controller (DAC)

Analog input	Input description	Input jumper	Input switch
MCB-AI1	Zone (space) air temperature (optional)	1-RTD	T (OFF)
MCB-AI2	External discharge air temperature reset	NJ-VDC (no jumper)	V (ON)
MCB-AI3	Discharge air temperature	1-RTD	T (OFF)
MCB-AI4	Return air temperature	1-RTD	T (OFF)
MCB-AI5	Outdoor air temperature	1-RTD	T (OFF)
MCB-AI6	Mixed air temperature	1-RTD	T (OFF)
MCB-AI7	Entering water temperature	1-RTD	T (OFF)
MCB-AI8	Leaving water temperature	1-RTD	T (OFF)
MCB-AI9	Economizer/OA damper position	1-RTD	T (OFF)
MCB-AI10	Heating valve position	1-RTD	T (OFF)
MCB-AI11	Refrigerant pressure #1	1-RTD	T (OFF)
	Cooling valve position	NJ-VDC (no jumper)	V (ON)
MCB-AI12	Refrigerant pressure #2	NJ-VDC (no jumper)	V (ON)
MCB-AI13	Duct static pressure #1[a]	NJ-VDC (no jumper)	V (ON)
MCB-AI14	Duct static pressure #2[b]	NJ-VDC (no jumper)	V (ON)
MCB-AI15[a]	Discharge fan AFD speed	NJ-VDC (no jumper)	V (ON)
MCB-AI16	Spare	1-RTD	T (OFF)

a. This input is applicable to VAV units only (discharge fan AFD or inlet vanes).
b. This input is defined as a second duct static pressure input on VAV units.

Table 8: Analog inputs for main control board (MCB)—CAV-ZTC (SCC)

Analog input	Input description	AI jumper	AI switch
MCB-AI1	Zone (space) air temperature[a]	1-RTD	T (OFF)
MCB-AI2	Remote space temperature set point (optional)	1-RTD	T (OFF)
MCB-AI3	Discharge air temperature	1-RTD	T (OFF)
MCB-AI4	Return air temperature	1-RTD	T (OFF)
MCB-AI5	Outdoor air temperature	1-RTD	T (OFF)
MCB-AI6	Mixed air temperature	1-RTD	T (OFF)
MCB-AI7	Entering water temperature	1-RTD	T (OFF)
MCB-AI8	Leaving water temperature	1-RTD	T (OFF)
MCB-AI9	Economizer/OA damper position	1-RTD	T (OFF)
MCB-AI10	Heating valve position	1-RTD	T (OFF)
MCB-AI11	Refrigerant pressure #1	NJ-VDC (no jumper)	V (ON)
	Cooling Valve position	1-RTD	T (OFF)
MCB-AI12	Refrigerant pressure #2	NJ-VDC (no jumper)	V (ON)
MCB-AI13	Not used	NA	NA
MCB-AI14	Not used	NA	NA
MCB-AI15	Not used	NA	NA
MCB-AI16	Relative humidity or Dew Point	NJ-VDC (no jumper)	V (ON)

a. Sensor is required if unit is 100% OA. Otherwise it is optional.

Analog inputs—Auxiliary Control Boards (CCB1 and CCB2)

The optional auxiliary control boards (CCB1 and CCB2) have up to six analog inputs.

Note – Only CCB*-AI5 is used; the other five AIs are not used and not supported in the application software.

Refer to Table 9 for a description of each analog input on the CCB1 or CCB2 board.

Table 9: Analog inputs for compressor control boards (CCB1 and CCB2)

Analog input	Input description
AI1	Not used
AI2	Not used
AI3	Not used
AI4	Not used
AI5	Cool enable/ pump enable
AI6	Not used

Binary Inputs—Main Control Board (MCB)

The 16 binary inputs to the MCB are in the form of 0 VAC (off) or 24 VAC (on) applied to the binary input terminals. Transformer T2 is the source of the 24 VAC for these inputs.

Each binary input has an LED associated with it that lights when 24 VAC is present at the corresponding input terminal. These binary input LEDs are grouped together and are located in the upper left corner of the board. Table 10 summarizes the binary input functions and LED indications for the binary inputs to the MCB.

Binary Inputs—Auxiliary Control Boards (CCB1 and CCB2)

The optional auxiliary control boards include 12 binary inputs. Inputs BI1 through BI6 are designed for a set of dry contacts between the COM terminal and the individual binary input terminals on J9. BI7 through BI12 are designed for 24 VAC inputs (input is ON when 24 VAC is present at the corresponding input terminal on J10 and OFF when 0 VAC is not present). The following sections describe how these inputs are defined for each of the auxiliary control boards.

Note – The set of jumpers in the upper right corner of the board (under the RS-485 Communications Module) must both be in the “down” position (jumper on the bottom two pins). Placing the jumper on the left most pins interlocks binary inputs BO1 with BI1 and BO2 with BI2 respectively. This interlock is not used on this product application.

Table 10: Binary inputs for main control board (MCB)

Binary input	Input description	Lit LED indication
MCB-BI1	External time clock or tenant override	Occupied
MCB-BI2	Manual system disable	Disabled
MCB-BI3	Remote cool enable	Enabled
MCB-BI4	Remote heat enable	Enabled
MCB-BI5	Heat failure alarm	Alarm
MCB-BI6	Airflow status	Airflow detected
MCB-BI7	Freeze alarm for steam, hot water coils, or waterside economizer	Normal
MCB-BI8	Smoke alarm	Normal
MCB-BI9	Filter switch	Normal
MCB-BI10	Not used	—
MCB-BI11	Outdoor enthalpy status[a]	Low OA enthalpy
MCB-BI12	Not used	—
MCB-BI13	Not used	—
MCB-BI14	Duct Hi limit[b]	Normal
MCB-BI15	Not used	—
MCB-BI16	Water flow switch	Normal

a. Not used on 100% outdoor air or waterside economizer units.
b. Applicable on VAV units only.

CCB1 and CCB2

Cooling circuit #1 through circuit #4 are controlled by the CCB1 and circuits #5 and #6 are controlled by the CCB2.

Table 11 and Table 12 on page 21 summarize the binary inputs for the CCB1 and CCB2, respectively.

Table 11: Binary inputs for auxiliary cooling control board (CCB1)

Binary input	Input description	24 VAC present indication	Continuity present
CCB1-BI1	High pressure switch, circuit #1 (HP1)	NA	Normal
CCB1-BI2	High pressure switch, circuit #2 (HP2)	NA	Normal
CCB1-BI3	High pressure switch, circuit #3 (HP1)—independent circuit units only	NA	Normal
	Frost protect switch, circuit #1 (FP1)—dual circuit units only	NA	Normal
CCB1-BI4	High pressure switch, circuit #4 (HP1)—independent circuit units only	NA	Normal
	Frost protect switch, circuit #2 (FP2)—dual circuit units only	NA	Normal
CCB1-BI5	Low pressure switch & frost protect switch, circuit #1 (LP1 & FP1)—independent circuit units only	NA	Both switches closed
	Low pressure switch, circuit #1 (LP1)—dual circuit units only	NA	Switch closed
CCB1-BI6	Low pressure switch & frost protect switch, circuit #2 (LP2 & FP2)—independent circuit units only	NA	Both switches closed
	Low pressure switch, circuit #2 (LP2)—dual circuit units only	NA	Switch closed
CCB1-BI7	Low pressure switch & frost protect switch, circuit #3 (LP3 & FP3)—independent circuit units only	Both switches closed	NA
	Not used –dual circuit units only	—	—
CCB1-BI8	Low pressure switch & frost protect switch, circuit #4 (LP4 & FP4)—independent circuit units only	Both switches closed	NA
	Not used—dual circuit units only	—	—
CCB1-BI9	Compressor #1 contactor auxiliary switch status	M1 contactor energized	NA
CCB1-BI10	Compressor #2 contactor auxiliary switch status	M2 contactor energized	NA
CCB1-BI11	Compressor #3 contactor auxiliary switch status	M3 contactor energized	NA
CCB1-BI12	Compressor #4 contactor auxiliary switch status	M4 contactor energized	NA

Table 12: Binary inputs for circuit #5 and #6 auxiliary cooling control board (CCB2)—independent circuit units only

Binary input	Input description	24 VAC present indication	Continuity present
CCB2-BI1	High pressure switch, circuit #5 (HP5)	N/A	Normal
CCB2-BI2	High pressure switch, circuit #6 (HP6)	N/A	Normal
CCB2-BI3	Not used	—	—
CCB2-BI4	Not used	—	—
CCB2-BI5	Low pressure switch, (LP5) & frost protection switch (FP5)	N/A	Both switches closed
CCB2-BI6	Low pressure switch, (LP6) & frost protection switch (FP6)	N/A	Both switches closed
CCB2-BI7	Not used	—	—
CCB2-BI8	Not used	—	—
CCB2-BI9	Compressor #5 contactor auxiliary switch status	M5 contactor energized	N/A
CCB2-BI10	Compressor #6 contactor auxiliary switch status	M6 contactor energized	N/A
CCB2-BI11	Spare	—	—
CCB2-BI12	Spare	—	—

Controller Outputs

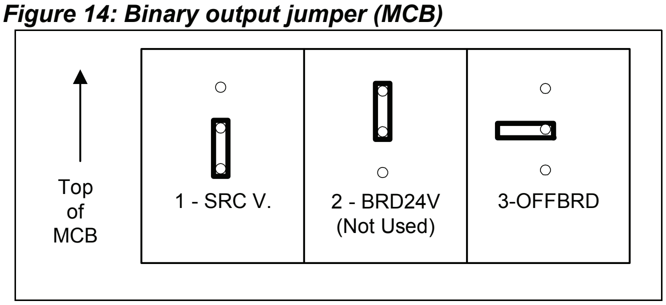
Binary Outputs—Main Control Board (MCB)

The main control board has 16 binary outputs that provide unit control in responses to input conditions. Binary outputs energize on-board electromechanical relays (BO1 through BO4, BO11 and BO12), or triacs (BO5 through BO10 and BO13 through BO16). Unit control devices are wired to the relays and triacs through six output terminal blocks located on the right side of the MCB.

There are three terminals associated with each binary output. The terminals associated with BO1 are labeled NO, 1, and NC; the terminals associated with BO2 are labeled NO, 2, and NC; and so forth. Each binary output has an LED associated with it that illuminates when the corresponding output relay or the triac is turned on.

Each binary output has an output jumper associated with it. The three jumper positions are: 1-SRC V (jumper on the bottom two pins), 2-BRD24V (jumper on the top two pins), or 3-OFFBRD (no jumper). See Figure 14.

Figure 14: Binary output jumper (MCB)



When the jumper is in position 1-SRC V, 24 VAC from the SRC 1-8 terminal (BO1 through BO8) or the SRC 9-16 terminal (BO9 through BO16) is applied to the numbered terminal of the associated outputs. In the case of BO1 through BO4, BO11, and BO12, this signal then is delivered to either the NC terminal when the corresponding output is off (output relay de-energized) or the NO terminal when the corresponding output is on (output relay energized). In the case of BO5 through BO10 and BO13 through BO16, this signal then is delivered to the NO terminal when the corresponding output is on (triac energized). Transformer T2 from the MCB furnishes 24 VAC to the SRC 1-8 terminal and the SRC 9-16 terminal. This jumper configuration is used when a specific binary output is used to energize a 24 VAC pilot relay in the unit. See Table 13 for the correct jumper position for all the standard binary outputs.

The 3-OFFBRD (no jumper installed) configuration is not used in this product application.

The 2-BRD24V jumper configuration is not used in this product application.

Table 13: Binary outputs for main control board (MCB)

Binary output	Output description	Lit LED Indication	Jumper Position
BO1	Discharge air fan, on/off	Fan On	1-SRC V
BO2	Outdoor damper, open/ closed	Open	1-SRC V
BO3	Fan operation output signal	Fan Op	1-SRC V
BO4	Alarm output signal	Normal	1-SRC V
BO5	Close economizer	Closing	1-SRC V
BO6	Open economizer	Opening	1-SRC V
BO7	Close bypass valve/close water regulating valve	Closing	1-SRC V
BO8	Open bypass valve/open water regulating valve	Opening	1-SRC V
BO9[a]	Close heating valve	Closing	1-SRC V
	Electric heat stage #1	Heat On	1-SRC V
BO10[b]	Open Heating Valve	Opening	1-SRC V
	Electric heat stage #2	Heat On	1-SRC V
BO11	Cool enable	Enabled	1-SRC V
BO12	VAV box output signal	Cooling Mode	1-SRC V
BO13	Decrease discharge fan AFD speed	Decreasing	1-SRC V
BO14	Increase discharge fan AFD speed	Increasing	1-SRC V
BO15	Spare	—	—
BO16	Spare	—	—

a. If the unit is equipped with modulating heat, output BO9 closes the heating valve. If the unit is equipped with electric heat, output BO9 stages on Heating Stage #1.

b. If the unit is equipped with modulating heat, output BO10 opens the heating valve. If the unit is equipped with electric heat, output BO10 stages on Heating Stage #2.

Binary Outputs—Auxiliary Control Boards (CCB1 and CCB2)

The optional auxiliary control boards include nine binary outputs that control 9 on-board electromechanical relays. Unit control devices are wired to these outputs through output terminals on the left side of the board. The functions of these outputs vary for the different auxiliary board applications. The following sections describe the output functions for the auxiliary control board applications.

CCB1 and CCB2

Circuit #1 through circuit #4 are controlled by the CCB1 and circuit #5 and #6 are controlled by the CCB2. There are nine binary output relays on each cooling control board. These relays are energized based on commands received from the MCB to provide the appropriate switching actions in the DX cooling control circuits.

A number of different compressor/stage configurations are available on these units. The following sections describe the DX staging sequencing for each configuration.

Table 14: Binary outputs for cooling control boards (CCB1 and CCB2)

Cooling circuit #	Output #	Description	Action with output ON
1 (CCB1)	BO1	Compressor #1 ON/OFF	ON
	BO2	Compressor #2 ON/OFF	ON
	BO3	Pump start	ON
	BO4	Solenoid valve #1 (SV1)*	Open
	BO5	Solenoid valve #2 (SV2)*	Open
	BO6	Compressor #3 ON/OFF	ON
	BO7	Hot gas bypass valve #1 (HGBP#1)	Open
	BO8	Hot gas bypass valve #2 (HGBP#1)*	Open
	BO9	Compressor #4 ON/OFF	ON
2 (CCB2)	BO1	Compressor #5 ON/OFF	ON
	BO2	Compressor #6 ON/OFF	ON
	BO3	Pump start	ON
	BO4	Not used	—
	BO5	Not used	—
	BO6	Not used	—
	BO7	Not used	—
	BO8	Not used	—
	BO9	Not used	—

* Applicable when controlling a remote air cooled condensing unit only

Two compressors—two stages, dual circuits

There are two equally sized compressors and two independent cooling circuits. The unit capacity is increased or decreased by turning compressors on and off. One of the compressors is designated the "Lead" and the other "Lag." Based on operating hours, the compressor with the fewest run hours is staged on first and turned off last. When a capacity increase is required and the cooling capacity is 0%, the "Lead" compressor is staged on. When further capacity is required, the "Lag" compressor is staged on. Disabled compressors are not turned on.

For detailed information regarding compressor lead/lag operation, refer to the "Compressor Staging" section of the applicable operation manual (refer to Table 1 on page 1).

Table 15 summarizes the staging sequencing for the two compressor—two-Stage cooling configuration.

Table 15: Two compressors—two stages

Stages	Compressors
1	1 or 2
2	1, 2

Three compressors—three stages, independent circuits

There are three equally sized compressors and three independent cooling circuits. The unit capacity is increased or decreased by turning on and off compressors. One of the compressors is designated the "Lead" and the other two "Lag." Based on operating hours, the compressor with the fewest run hours is staged on first and turned off last. When a capacity increase is required and the cooling capacity is 0%, the "Lead" compressor is staged on. When further capacity is required, a "Lag" compressor with the least operating hours of the remaining two is staged on. When further capacity increase is required, the remaining "Lag" compressor is staged on. When a capacity decrease is required, the "Lag" compressor with the most hours is turned off. When a further capacity decrease is required, the remaining "Lag" compressor is turned off. When a further capacity decrease is required, the "Lead" compressor is staged off.

For detailed information regarding circuit lead/lag operation, refer to the "Compressor Staging" section of the applicable operation manual (refer to Table 1 on page 1).

Table 16 summarizes the staging sequencing for the three-compressor/three-stage cooling configuration.

Table 16: Three compressors—three stages

Stages	Compressors
1	1 or 2
2	1,2 or 1,3 or 2,3
3	1,2,3

Four compressors—four stages, independent circuits

There are four compressors and four independent cooling circuits. The unit capacity is increased or decreased by turning compressors on and off. Compressors #1 and #2 provide the first two stages of cooling. The compressor with the fewest run hours is staged on first and turned off last. Compressors #3 and #4 provide the last two stages of cooling. The compressor with the fewest run hours is staged on first and turned off last. For detailed information regarding circuit lead/lag operation, refer to the "Compressor Staging" section of the applicable operation manual (refer to Table 1 on page 1). Disabled compressors are not turned on.

Table 17 summarizes the staging sequencing for the four-compressor/four-stage cooling configuration.

Table 17: Four compressors—four stages

Stages	Compressors
1	1 or 2
2	1,2
3	1,2, (3 or 4)
4	1,2,3,4

Three small compressors and one large compressor—five stages, independent circuits

There are three equally sized small compressors and one large compressor. Each compressor is on an independent cooling circuit. The unit capacity is increased or decreased by staging compressors on and off. Compressors #1 or #2 provides the first stage of cooling. The compressor with the fewest run hours is staged on first and staged off last. Compressors #1 and #2 provide the second stage of cooling. When further capacity is required, an operating small compressor is turned off and the large compressor is staged on to provide the third stage of cooling. When further capacity is required, compressors #1 or #2 will provide the fourth stage of cooling. Compressor #3 provides the last stage of cooling.

Note – Stages 3 and 4 are skipped when the large compressor is disabled. The next enabled small compressor in the sequence is staged on when one or more of the small compressors is disabled and a stage up is required.

Table 18 summarizes the staging sequencing for the three small compressors and one large compressor—five-stage cooling configuration.

Table 18: Three small compressors and one large compressor—five stages

Stages	Compressors
1	1 or 2
2	1,2
3	1 or 2,4
4	1,2,4
5	1,2,3,4

Two small compressors and two large compressors—six stages, independent circuits

There are two equally sized small compressors and two equally sized large compressors. Each compressor is on an independent cooling circuit. The unit capacity is increased or decreased by staging compressors on and off. The small compressors #1 or #2 provide the first stage of cooling. The compressor with the fewest run hours is staged on first and staged off last. The second stage of cooling turns on the remaining small compressor (#1 or #2). The third stage of cooling turns off either #1 or #2 and stages on either #3 or #4. The third stage has one small and one large compressor operating. The fourth stage of cooling stages on the remaining small compressor. The fifth stage of cooling turns off one of the small compressors and stages on the remaining large compressor. If further cooling is required, the remaining small compressor is staged on to provide the sixth stage of cooling. Disabled compressors are ignored. The next enabled compressor in the sequence is turned on when one or more compressors are disabled and a stage up is required.

Table 19 summarizes the staging sequencing for the two small compressors and two large compressor—six-stage cooling configuration.

Table 19: Two small compressors and two large compressors—six stages

Stages	Compressors
1	1 or 2
2	1,2
3	(1 or 2),(3 or 4)
4	1,2,(3 or 4)
5	(1or 2),3,4
6	1,2,3,4

Six compressors—six stages, independent circuits

There can be either six equally sized compressors or three smaller and three larger sized compressors. Each compressor is on an independent cooling circuit. The unit capacity is increased or decreased by turning on and off compressors. Compressors #1, #2, or #3 provide the first three stages of cooling. The compressor with the fewest run hours is staged on first and staged off last. Compressors #4, #5, or #6 provide the last three stages of cooling. The compressor with the fewest run hours is staged on first and staged off last. For detailed information regarding circuit lead/lag operation, refer to the "Compressor Staging" section of the applicable operation manual (refer to Table 1 on page 1). Disabled compressors are not turned on.

Table 20 summarizes the staging sequencing for the six compressor—six-stage cooling configuration.

Table 20: Six compressor—six stage

Stages	Compressors
1	1 or 2
2	1,2 or 1,3 or 2,3
3	1,2,3
4	1,2,3, (4 or 5 or 6)
5	1,2,3, (4,5 or 4,6 or 5,6)
6	1,2,3,4,5,6

Dual refrigerant circuits—two or four compressors

Compressor sequencing varies depending on the type of lead lag and loading sequence that is selected. The lead circuit and the loading sequence are user-selectable variables. These two variables are changeable via the Compressor Setup menu of the keypad.

Lead circuit:

The user can designate circuit #1 or #2 to be the lead circuit or allow the compressor with the fewest run hours to designate the lead circuit automatically by adjusting the *Lead Circuit=* parameter in the Compressor Setup menu.

- When this variable is set to *#1*, circuit #1 is designated as the Lead Circuit.
- When this variable is set to *#2*, circuit #2 is designated as the Lead Circuit.
- When this variable is set to *Auto*, the Lead Circuit is determined based on run time hours.

In all three cases, the other circuit is designated as the Lag Circuit.

Loading sequence:

The user can choose between two loading sequence methods by setting the *CompCrtl=* parameter in the Compressor Control menu to either "Cross Circ" or "Lead Load."

Cross circuit loading (Cross/Circ). When *CompCrtl=* is set to Cross/Circ, a compressor on the Lead Circuit turns on first and then a compressor on the Lag Circuit turns on. The loading sequence is as follows (reverse for unloading):

1. The compressor with the fewest hours on the lead circuit sequences on first.
2. The compressor with the fewest hours on the lag circuit sequences on second.
3. The compressor with the next fewest hours on the lead circuit sequences on third.
4. The compressor with the next fewest hours on the lag circuit sequences on fourth.

Lead circuit loading (Lead Load). When *CompCrtl=* is set to Lead Load, all available compressors on the Lead Circuit turn on before any compressors on the Lag Circuit turn on. All compressors on the Lag Circuit turn off before any compressors on the Lead Circuit turn off. The loading sequence is as follows (reverse for unloading):

1. The compressor with the fewest hours on the lead circuit sequences on first.
2. The compressor with the next fewest hours on the lead circuit sequences on second.
3. The compressor with the fewest hours on the lag circuit sequences on third.
4. The compressor with the next fewest hours on the lag circuit sequences on fourth.

Hot Gas Bypass Operation:

Hot gas bypass solenoid valves for circuit #1 and #2 are controlled by Compressor Board binary outputs #7 and #8, respectively. Whenever a compressor on circuit #1 is operating, CCB1 binary output #7 is closed. This output remains closed as long as any compressor on circuit #1 is operating and opens when the last compressor on circuit #1 shuts off. Whenever a compressor on circuit #2 is operating, CCB1 binary output #8 is closed. This output remains closed as long as any compressor on circuit #2 is operating and opens when the last compressor on circuit #2 shuts off.

Be sure the controller configuration calls for circuit #1 to be the lead circuit (cooling, lead circuit = 1) so hot gas bypass operates correctly.

Software Identification and Configuration

Software Identification

The MicroTech II control system code is comprised of up to three different software components. All unit applications include a main control board application code component that resides in the main control board (MCB). Then, depending on the unit configuration, there may be one or two cooling auxiliary control boards loaded with an application code component.

The application code in the main control board and any auxiliary control boards each are assigned a 10-digit base number. This includes a seven-digit base number, followed by a three-digit version number.

The software identification numbers with which the unit was loaded at the factory appear on the software identification label. The label is located near the main control board (MCB) in the main control box.

Figure 15 shows a typical software identification label. The box labeled UNIT SOFTWARE NUMBER contains the software identification number for the code in the main control board (MCB). The box labeled COMPRESSOR SOFTWARE contains the software identification number for the code in the auxiliary cooling control board(s) (CCB1, CCB2), when applicable.

Identifying Application Code Using Unit Keypad/Display

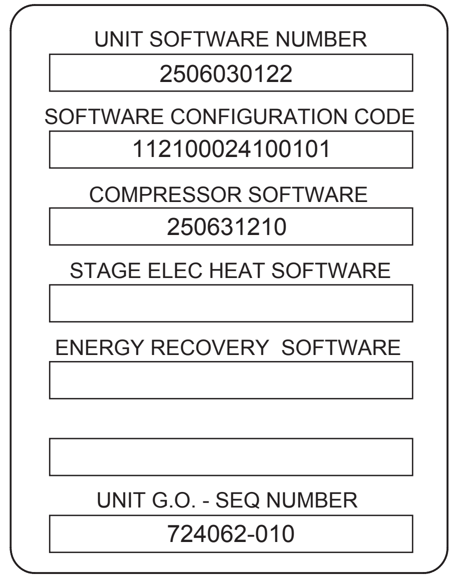
To identify the software identification number for the application currently loaded into the main control board (MCB), go to the *AHU ID=* parameter in the Unit Configuration menu on the unit keypad/display. The entire 10-digit unit software number displays.

To determine the software identification number for the application currently loaded into the CCB1 and CCB2 auxiliary cooling control boards, go to the *CCB1 ID=* and *CCB2 ID=* parameters in the Unit Configuration menu on the unit keypad/display.

Note – Only the sixth through the ninth positions of the compressor software identification number display.

For example, if a CCB1 board is loaded with version 2506031220 compressor board software, then the *CCB1 ID=* parameter displays 3122. If a unit is not equipped with CCB1 and CCB2 boards, the *CCB1 ID=* and *CCB2 ID=* parameters display three question marks (???).

Figure 15: Software identification label



Main Control Board (MCB) Configuration

After the main control board software component is loaded into the MCB, it is configured for the specific control application, which consists of setting the value of 15 configuration variables within the MCB. These variables define things such as the type of cooling, number of compressors and cooling stages, and the type of heat. If all of these items are not set appropriately for the specific unit, the unit does not function properly. Collectively, these 15 parameters make up a 15-digit string called the Software Configuration Code. The Software Configuration Code appears on the software identification label located near the main control board (MCB) in the main control box. See Figure 15.

The Software Configuration Code currently loaded into a unit controller also can be determined via the unit keypad/display by viewing the following four menu items under the Configuration Code menu: *Pos # 1–4=*, *Pos # 5–8=, Pos # 9–12=,* and *Pos # 13–15=*. To determine the Software Configuration Code in the unit, combine the values of these four parameters. For example, if the four parameters read as follows: *Pos # 1–4 = 1.121*, *Pos # 5–8 = 0.002, Pos # 9–12 = 4.100,* and *Pos # 13–15 = 1.01,* then the Software Configuration Code in the unit is 112100024100101. Note that the decimal points in the values are ignored when constructing the code.

Table 21 lists the configuration string variables including the position within the string, description of the parameter, the variable object name, the attribute name, and the applicable settings for each. The factory default values are shown in bold font.

Main Control Board (MCB) Data Archiving

All MCB control parameters and the real time clock settings are backed up by the MCB battery when power is removed from the MCB. In the event of a battery failure, the MCB includes a data archiving function. Once a day, just after midnight, all the MCB control parameter settings are archived to a file stored in the MCB flash memory. If the MCB is powered up with a low or defective battery (or with the battery removed), the most recently archived data is restored to the controller.

Note – When the archived data restoration process occurs, it increases the controller start-up and initialization time period by approximately 75 seconds.

Table 21: Software configuration string

Configuration string position	Description	Values (default in bold)
1	Unit type	0, RA zone control **1, RA DAT control** 2, 100% OA zone control 3, 100% OA DAT control
2	Cooling type	0, None **1, Compressorized Clg** 2, Chilled Water
3	Number of compressors/number of cooling stages	0, 2 Comp/2 stage 1, 3 Comp/3 stage **2, 4 Comp/4 stage** 3, 6 Comp/6 stage 4, 3S & 1L comp/5 stage 5, 2S & 2L comp/6 stage
4	Economizer	0,Airside **1, Waterside** 2, None
5	Head pressure control	**0, No** 1, Yes
6	Heat type	**0, None** 1, Single staged local 2, Two staged local 4, Steam or hot water
7		0
8	Discharge fan type	0, Constant volume **2, AFD**
9		**4**
10	VIV/AFD control type SAF	0, None **1, Duct static control** 2, Building static control 3, Position
11		0
12	Second static pressure sensor	**0, None** 1, Duct static pressure 2, Building static pressure
13	Communication option	**0, None** 1, BAC net IP 2, BAC net MS/TP 3, LONMARK SCC 4, LONMARK DAC
14	Cooling circuit type	0, Individual circuits 1, Dual circuits water cond. 2, Dual circuits air cond.
15	Bypass valve control	**1, Bypass**

Typical Wiring Diagrams

The Vertical Self-Contained unit wiring diagrams on the following pages are typical. They are included here to show common factory-wiring and field-wiring schemes. For wiring information pertaining to a particular unit, refer to the wiring diagrams supplied with the unit.

Figure 16 on page 29 identifies symbols specific to these diagrams.

Note – Some of the component designations depend on unit sizes. The abridged legend shown in Table 22 applies to Figures 17 through 22. For complete, exact component designations and locations, refer to the legend supplied with the unit.

Table 22: Wiring diagram legend

ID	Description	Standard location
ACT3, 4	Actuator motor, economizer	Comp/cond section
AFD10	Adjustable frequency drive, supply fan	Front assembly
CB10	Circuit breaker, supply fan	Main control box
CCB1, 2	Compressor control boards, refrig. circuits	Main control box
DAT	Discharge air temperature sensor	Discharge section
DHL	Duct hi-limit	Main control box
DS1	Disconnect, total unit or cond/ heat	Main control box
DS2	Disconnect, saf/raf/controls	Main control box
F1A, B	Fuse, control circuit transformer (t1), primary	Main control box
F1C	Fuse, control circuit transformer (t1), secondary	Main control box
FB11, 12	Fuseblock, electric heat (top bank)	Main control box
FB13, 14	Fuseblock, electric heat (boat. bank)	Main control box
FP1, 2, 3, 4, 5, 6	Frost protection, refrig. circuits	Coil section, cool
HL11A, HL11B	Hi-limits, pwr, elec heaters (top bank)	Heat section, electric
HL12A, HL12B	Hi-limits, pwr, elec heaters (boat. bank)	Heat section, electric
HP1–6	Hi-pressure controls, refrig	On compressors

Table 22: Wiring diagram legend (continued)

ID	Description	Standard location
LP1–6	Low-pressure controls, refrigeration	On compressors
M1–6, M21–26	Contactor, compressor	Main control box
M9 M10	Contactor, supply fan	Main control box
M30	Contactor, reversing, invertor bypass, supply fan	Inverter bypass box
MCB	Microprocessor circuit board	Main control box
MJ	Mechanical jumper	All control boxes
MMP1–6, MMP21–26	Manual motor protector, compressors	Main control box
MMP9–10	Manual motor protector, supply fan	Main control box
MP1–6	Motor protector, compr.#1–6	On compressors
OAT	Outside air temperature sensor	Economizer section
PB1, 2	Power block, power distribution	Main control box
PB10	Power block, supply fan	Main control box
PC5	Pressure control, clogged filter	Main control box
PC7	Pressure control, proof airflow	Main control box
PB10	Power block, supply fan	Main control box
PM1	Phone modem	Main control box
PVM1, 2	Phase voltage monitor	Main control box
R1–6	Relay, compressor high pressure	Main control box
R11, 12, 13, 14	Relay, electric heat	Main control box
R18	Relay, cool enable	Main control box
R36, R37, R38	remote fan start stop	Main control box
R11, 12, 13, 14	Relay, electric heat	Main control box
R46, 47	Relay, supply fan inverter, incr/ decr	Main control box
R62, 63, 65	Relay, use on specials	Main control box
R67	Relay, supply fan, enable	Main control box
R69	relay, inv. bypass VAV box interlock	Main control box
R70–79	Relay, use on specials	Main control box
RAT	Return air temperature sensor	Main control box

Table 22: Wiring diagram legend (continued)

ID	Description	Standard location
S1	Switch, system on/off	Main control box
S4	Switch, inverter bypass, on/ off	Main control box
S7	Switch, local on/auto/off to controller	Main control box
SPS1, 2	Static pressure sensors, duct/ building	Main control box
PSR1, 2	Pressure transducer, head pressure control	Condenser section
SV5, 6	Solenoid valves, hot gas	Condenser section
T1	Transformer, main control (line/ 115 VAC)	Main control box
T2	Transformer, control input (115/ 24 VAC)	Main control box
T3	Transformer, control output (115/ 24 VAC)	Main control box
T4	Transformer, exh. damper actuator (115/12 VDC)	Main control box
TB1	Terminal block, internal	Main control box
TB2	Terminal block, field, Class 2	Main control box
TB3	Terminal blocks, factory	Main control box
TB4	Terminal block, field, 115 VAC	Main control box
UV	Ultra-violet light(s)	Coil/discharge section
VM1	Valve motor #1, heating	Heat section
ZNT1	Zone temp. sensor, setback	Field installed

Figure 16: Wiring diagram legend

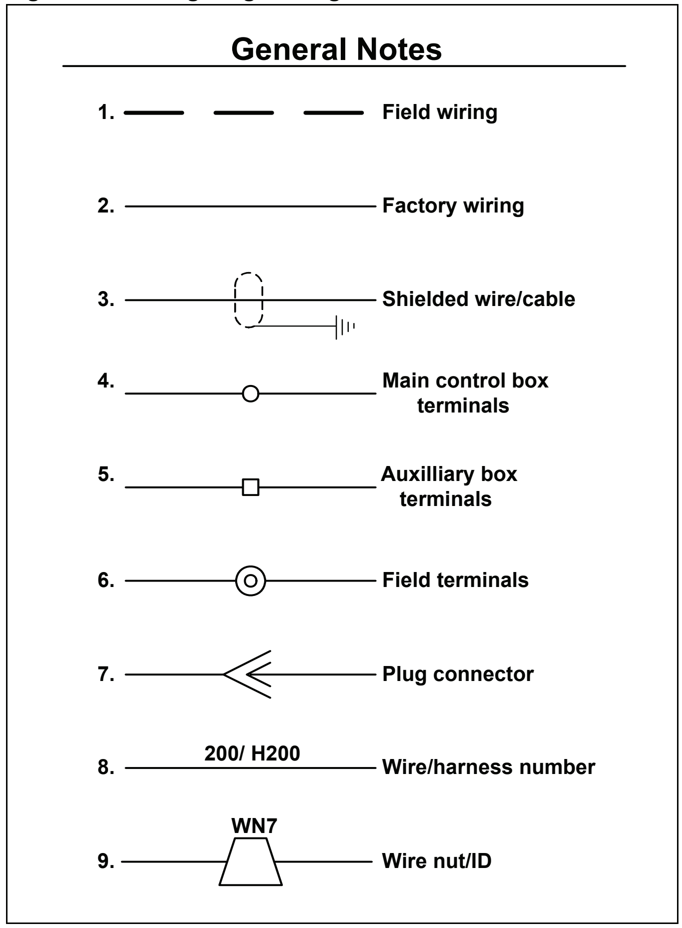


Figure 17: Typical input schematic: Discharge Air Control (DAC)

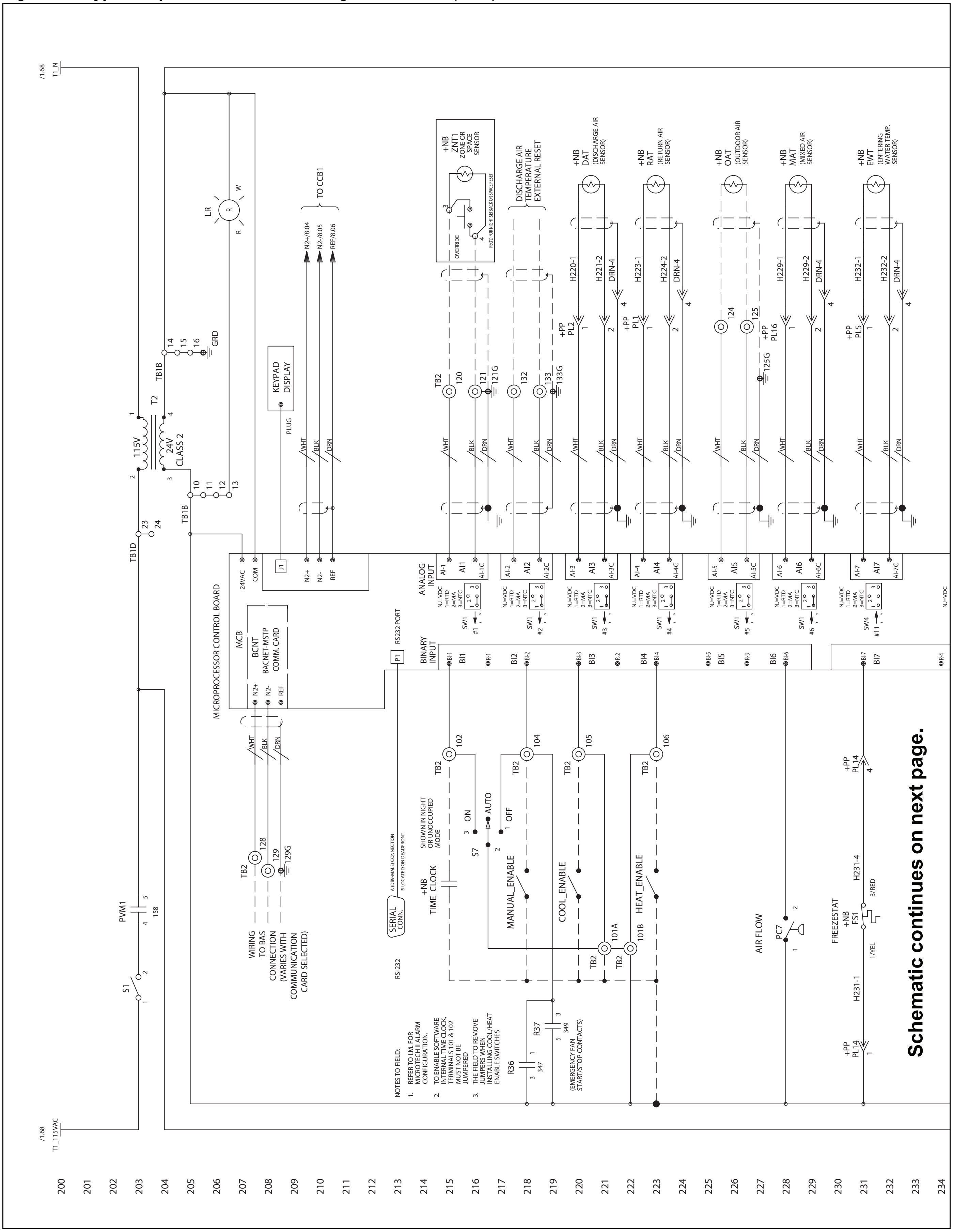


Figure 17: Typical input schematic: Discharge Air Control (DAC), continued

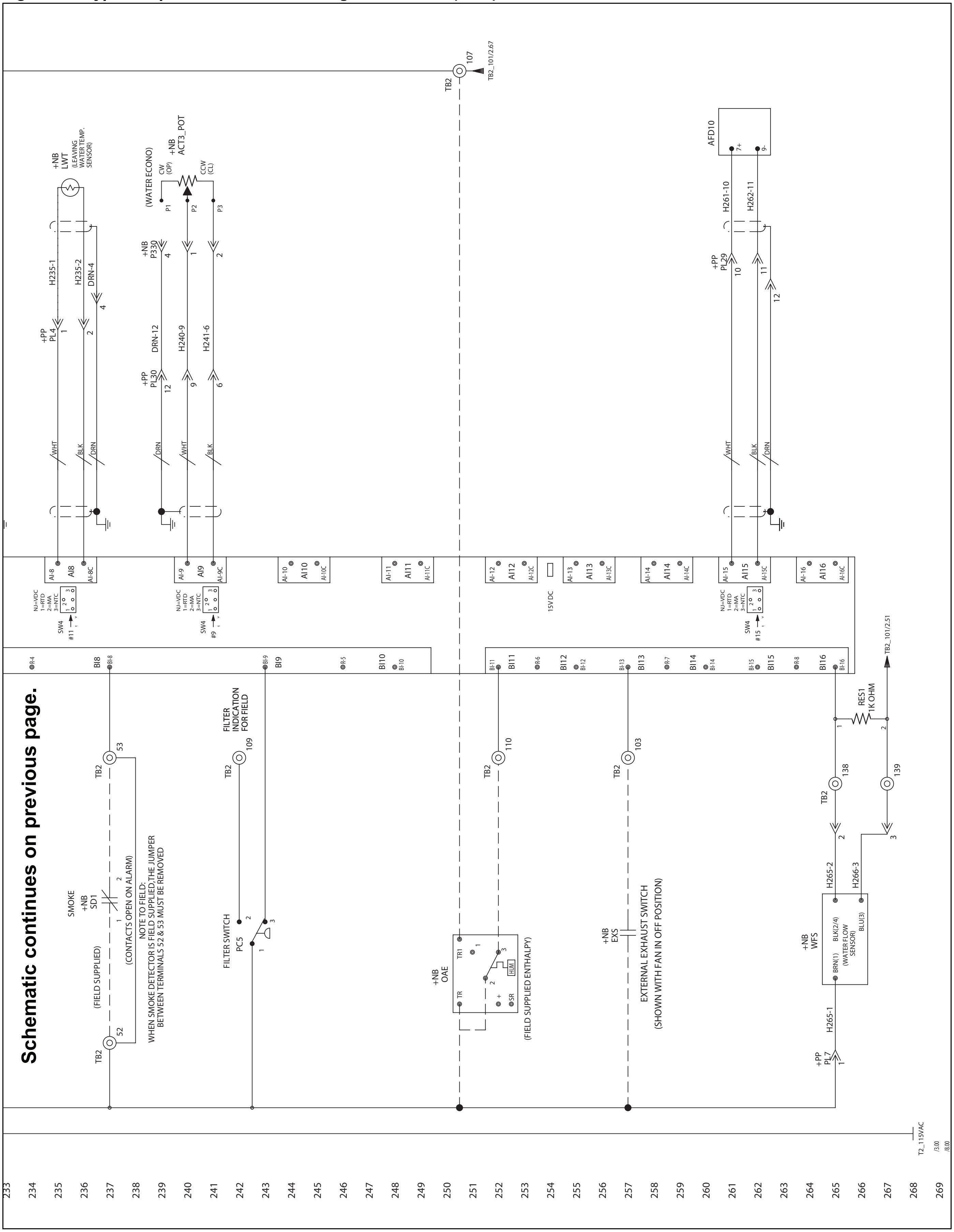


Figure 18: Typical input schematic: zone or Space Comfort Control (SCC)

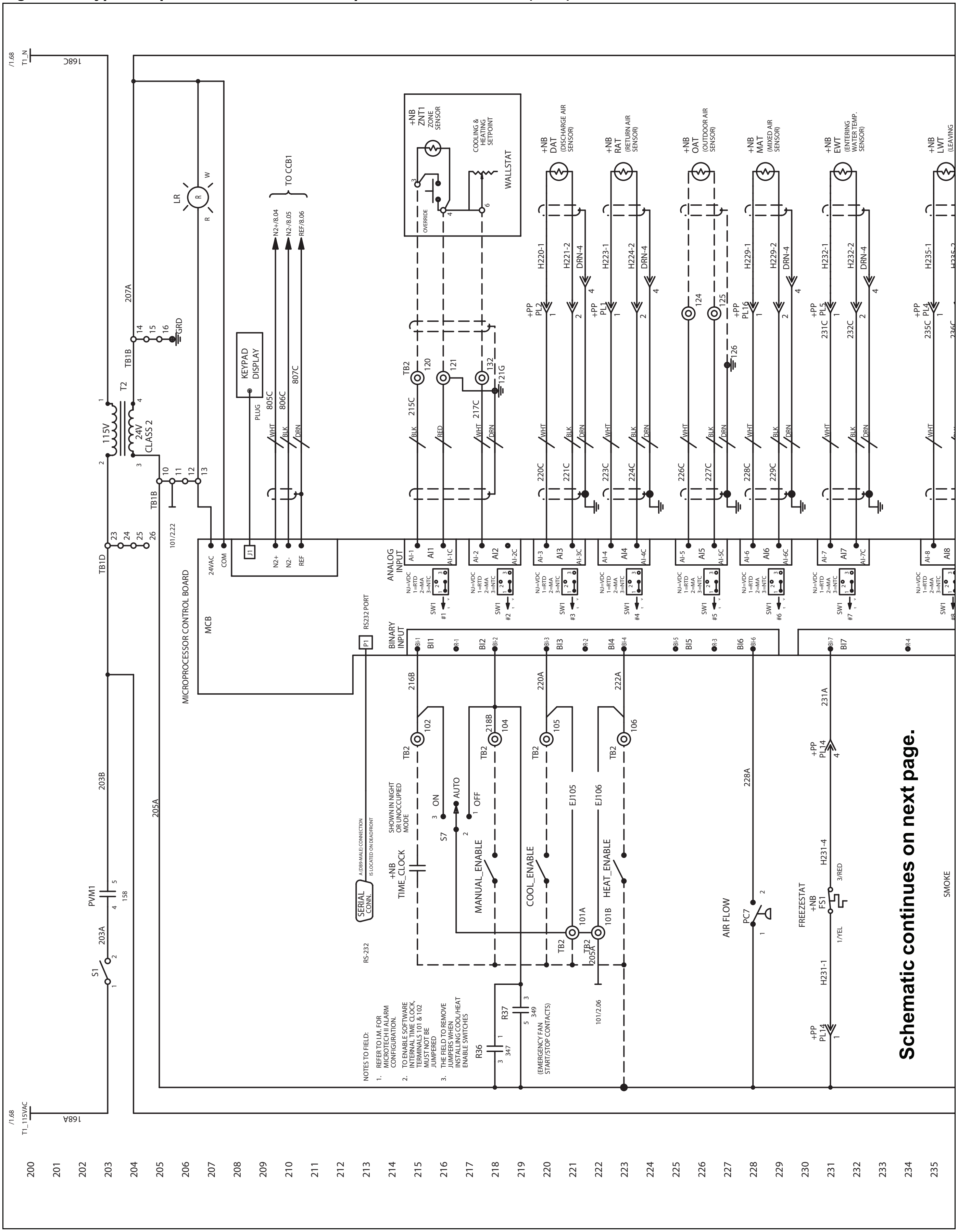


Figure 18: Typical input schematic: zone or Space Comfort Control (SCC), continued

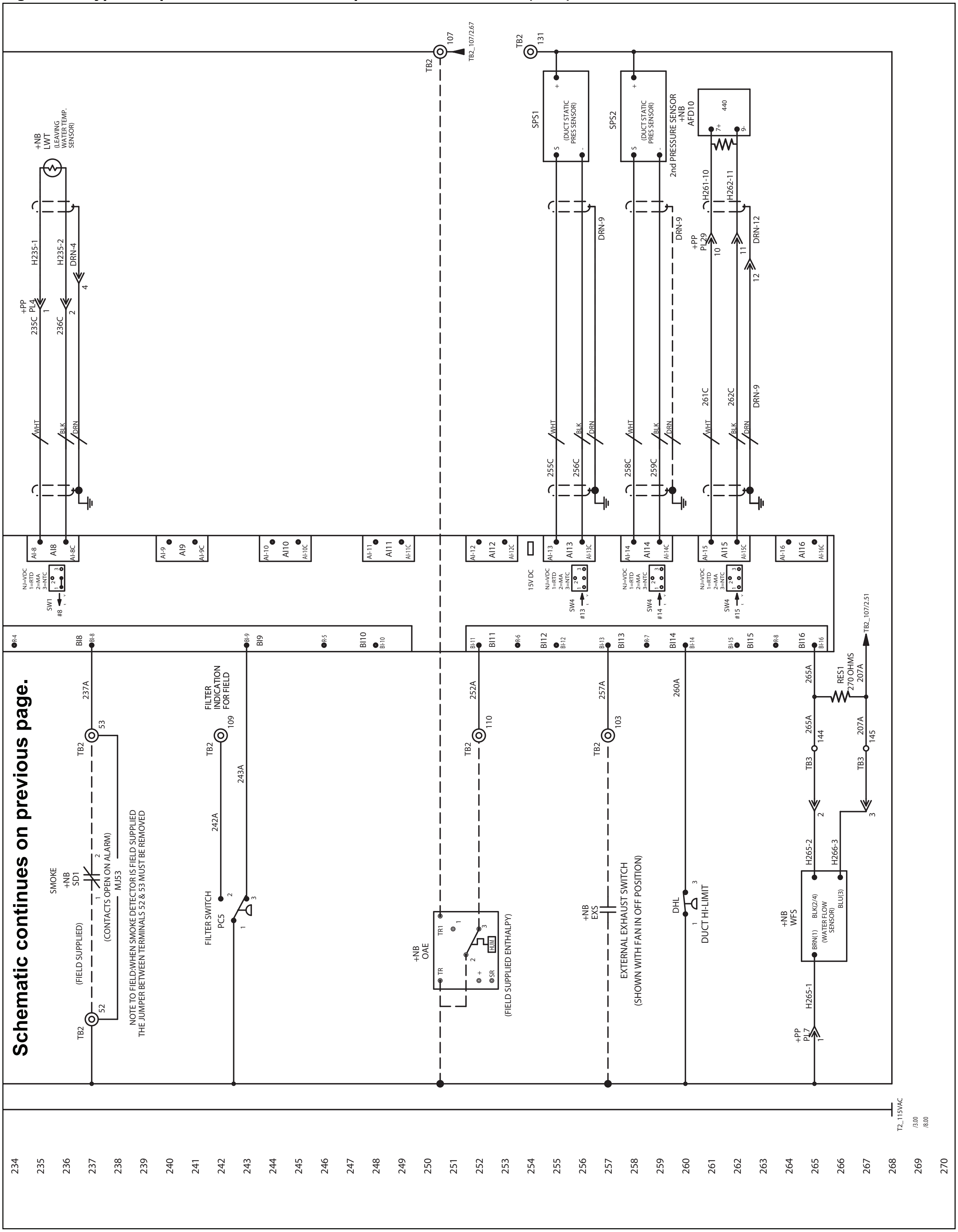


Figure 19: Typical output schematic: actuator control

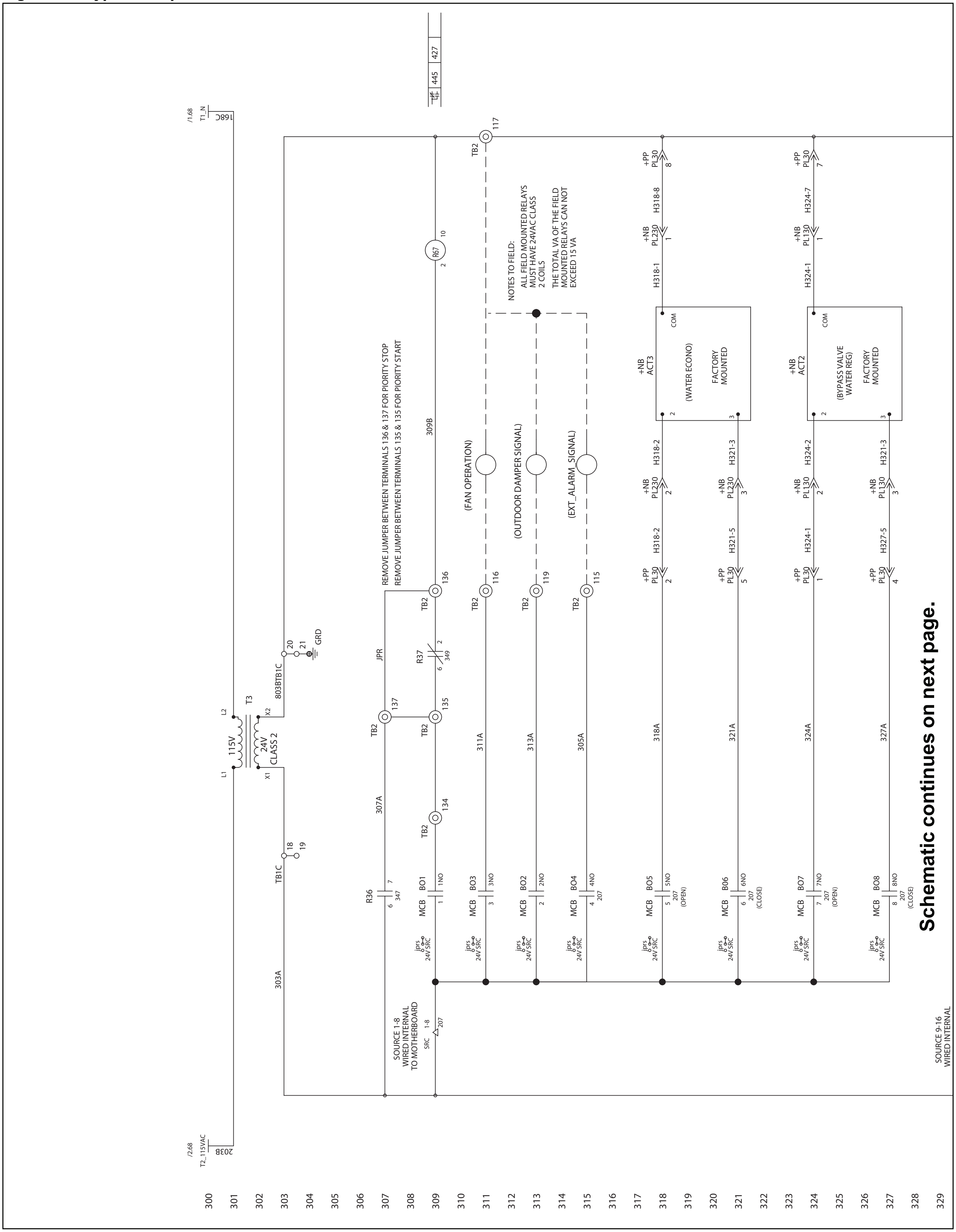


Figure 19: Typical output schematic: actuator control, continued

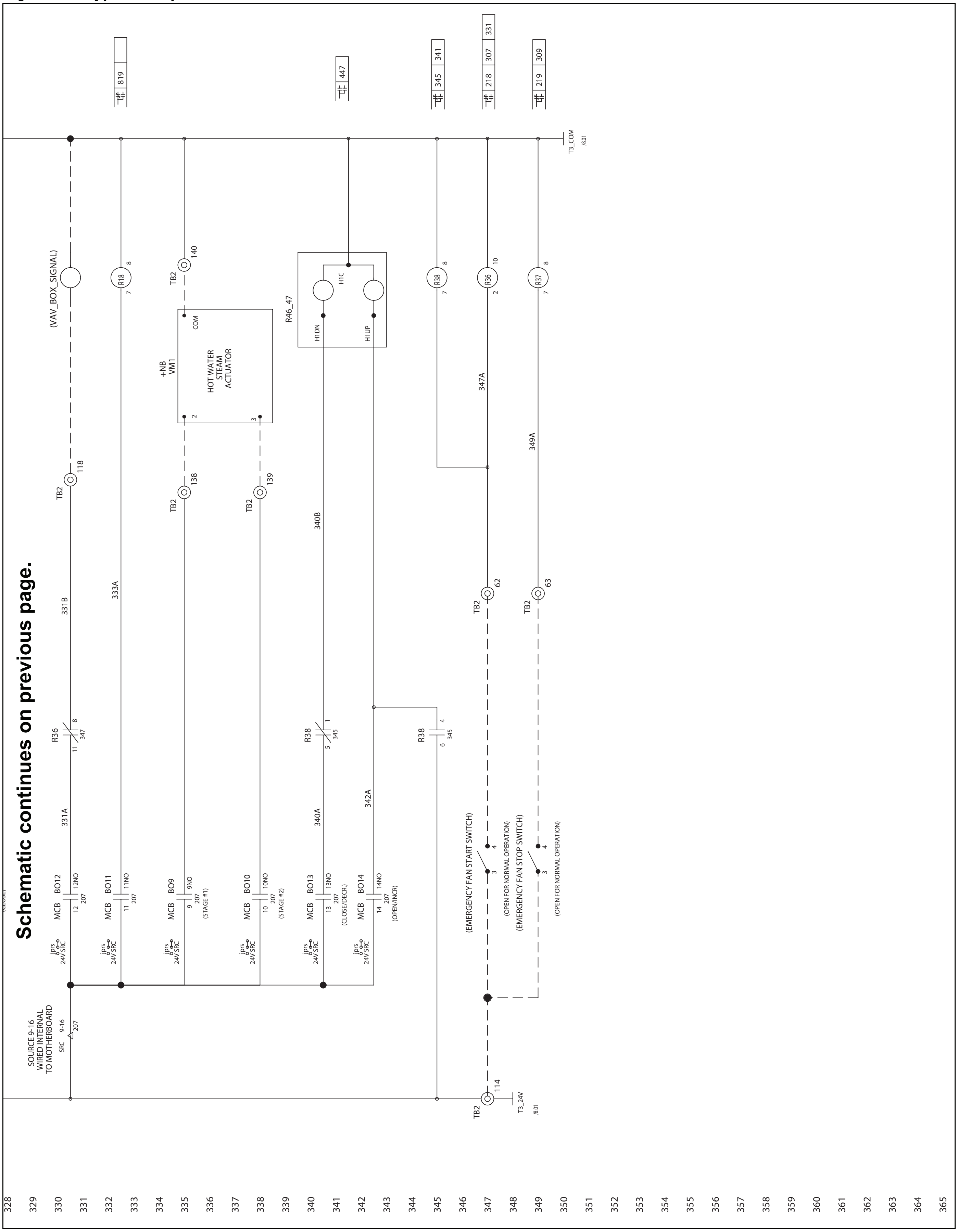
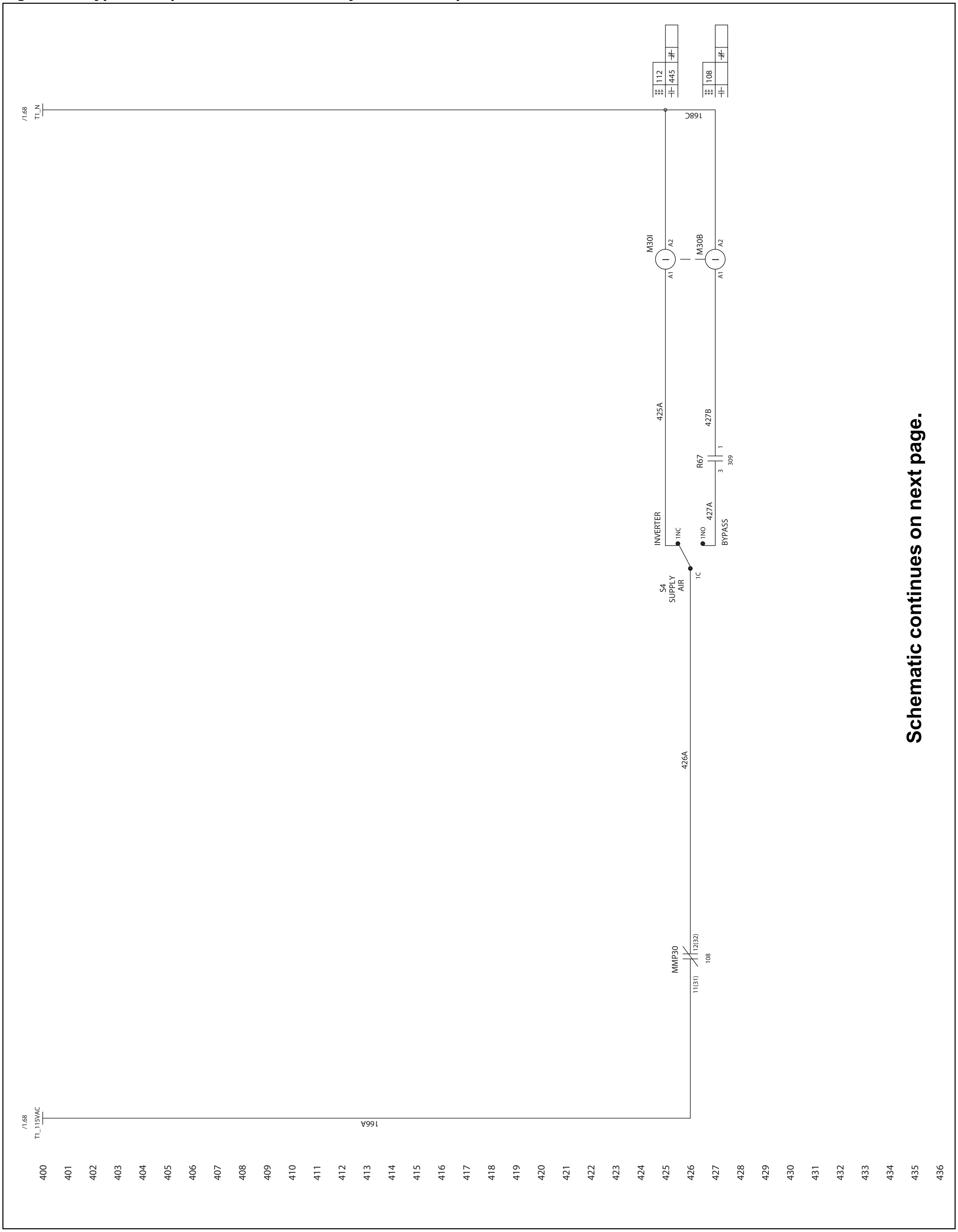
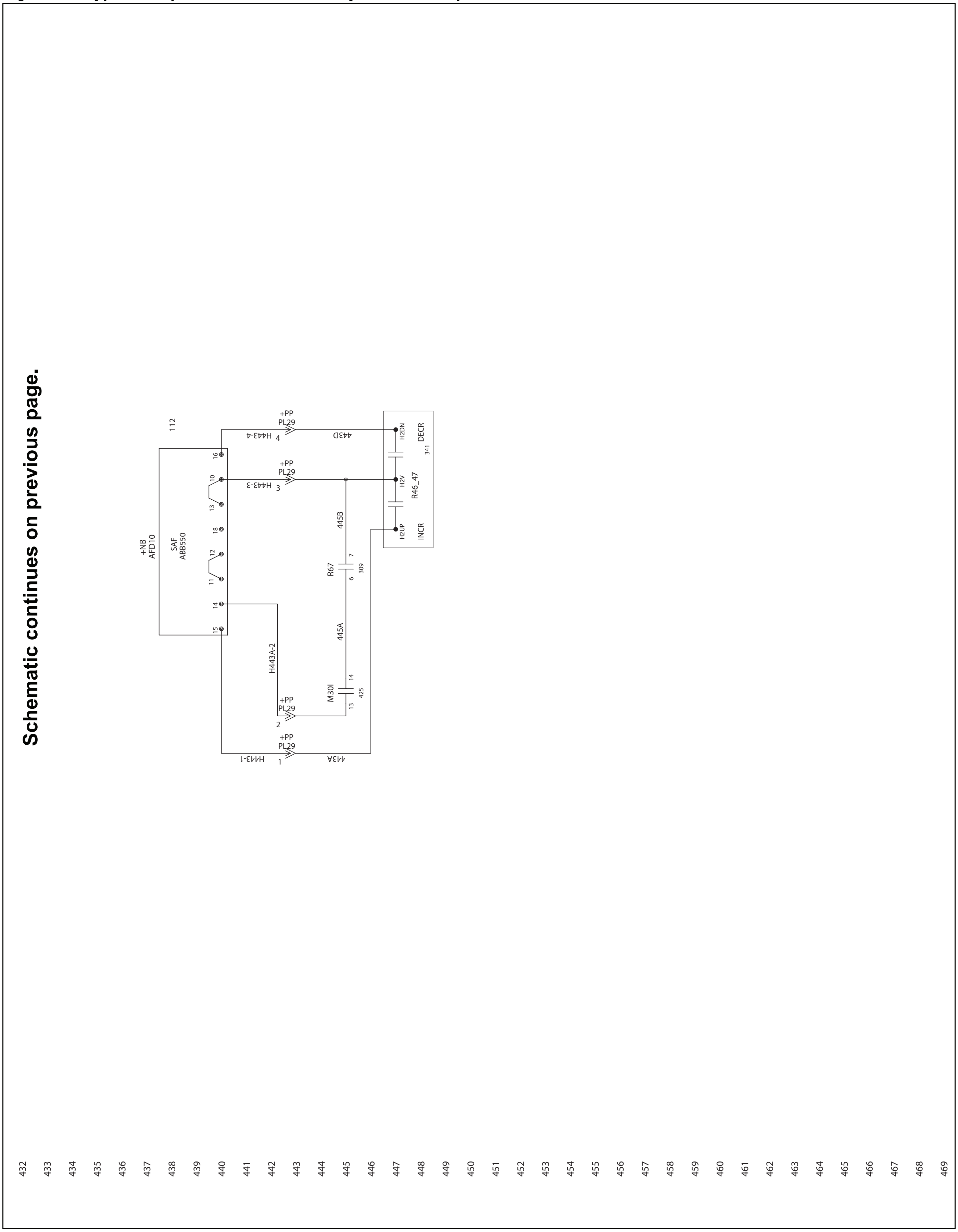


Figure 20: Typical output schematic: auxiliary fan start/stop control



Schematic continues on next page.

Figure 20: Typical output schematic: auxiliary fan start/stop control, continued



Schematic continues on previous page.

Figure 21: Typical output schematic: compressor control (four compressors—dual circuit)

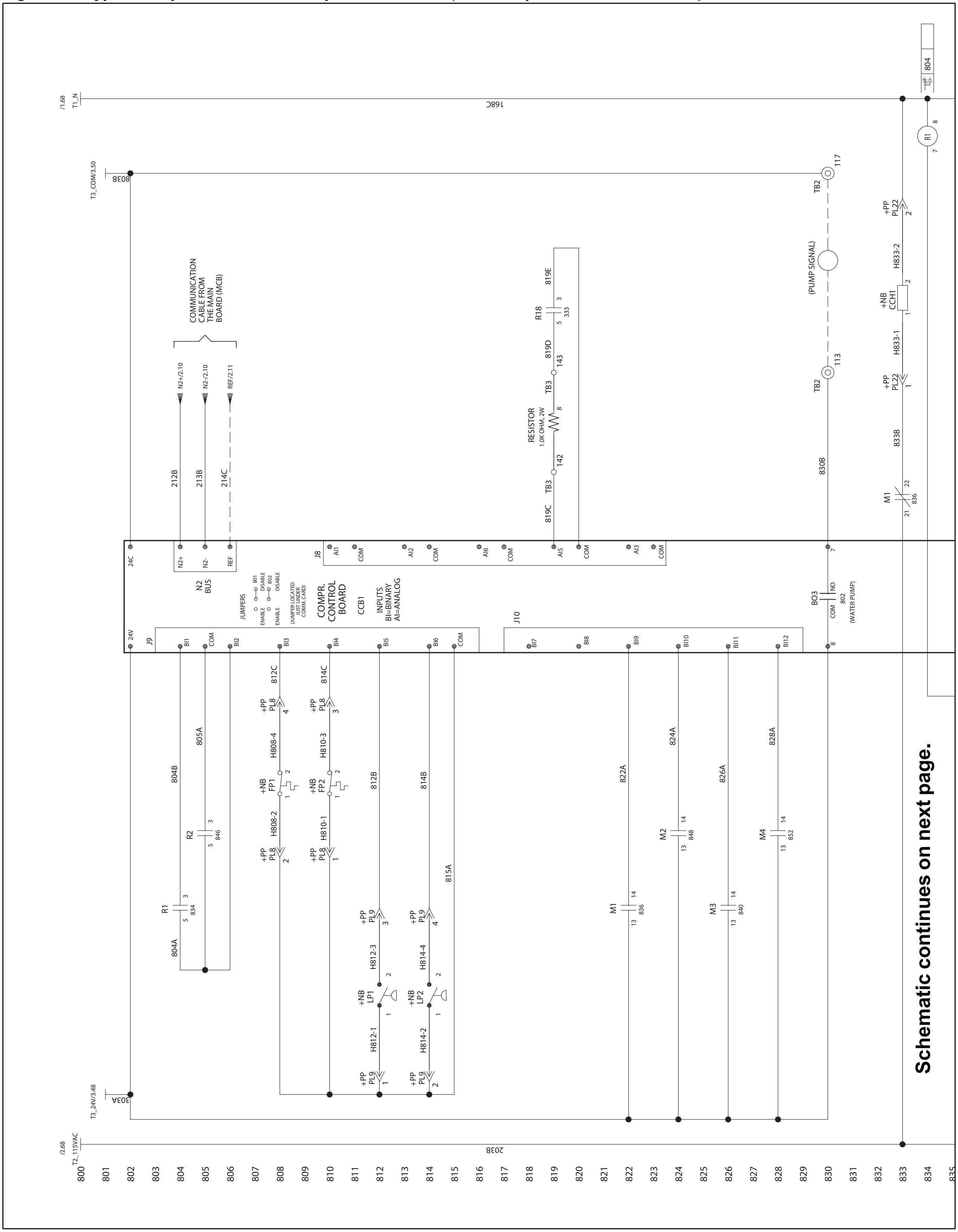


Figure 21: Typical output schematic: compressor control (four compressors—dual circuit), continued

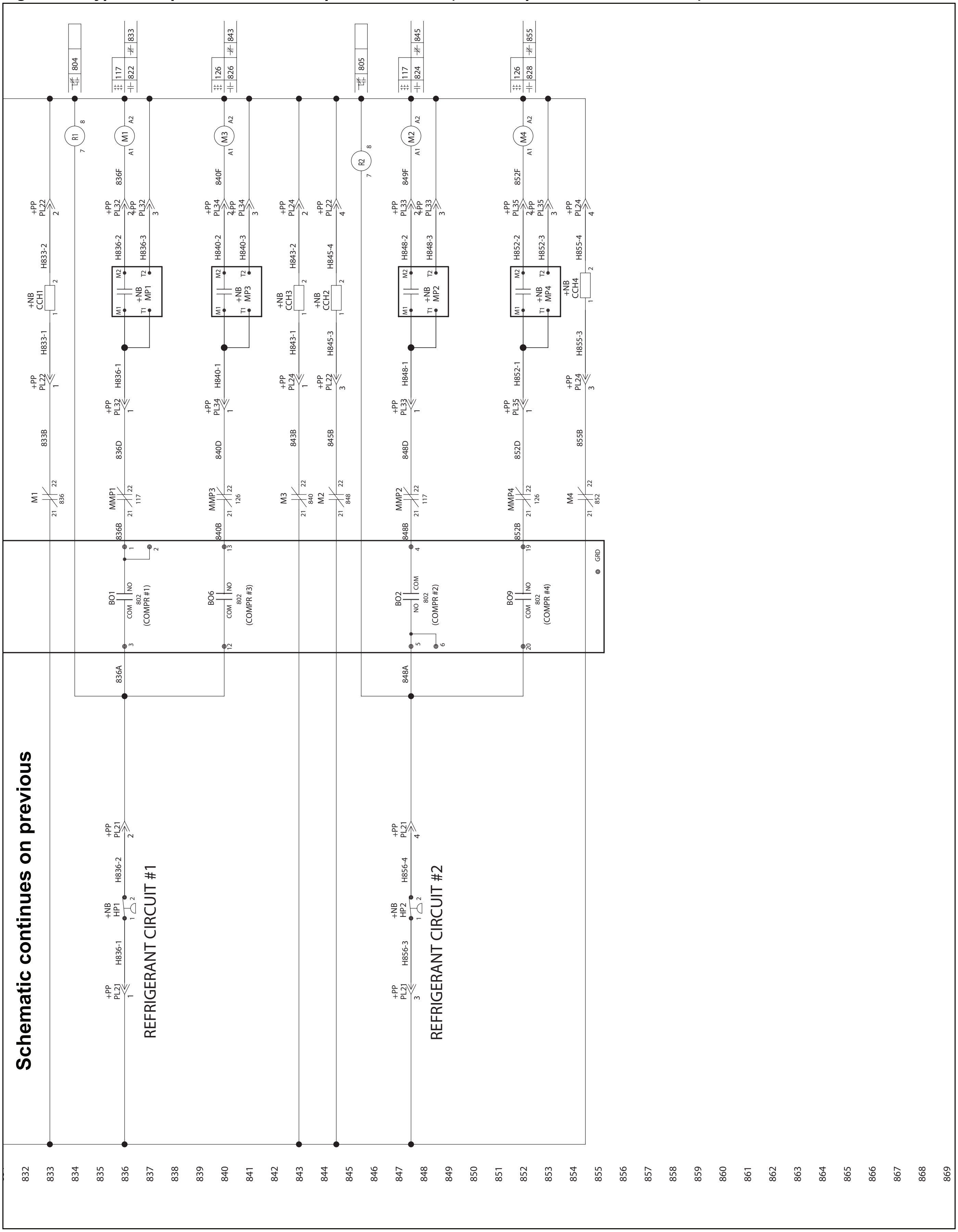


Figure 22: Typical output schematic: compressor control (6 compressors—independent circuits)

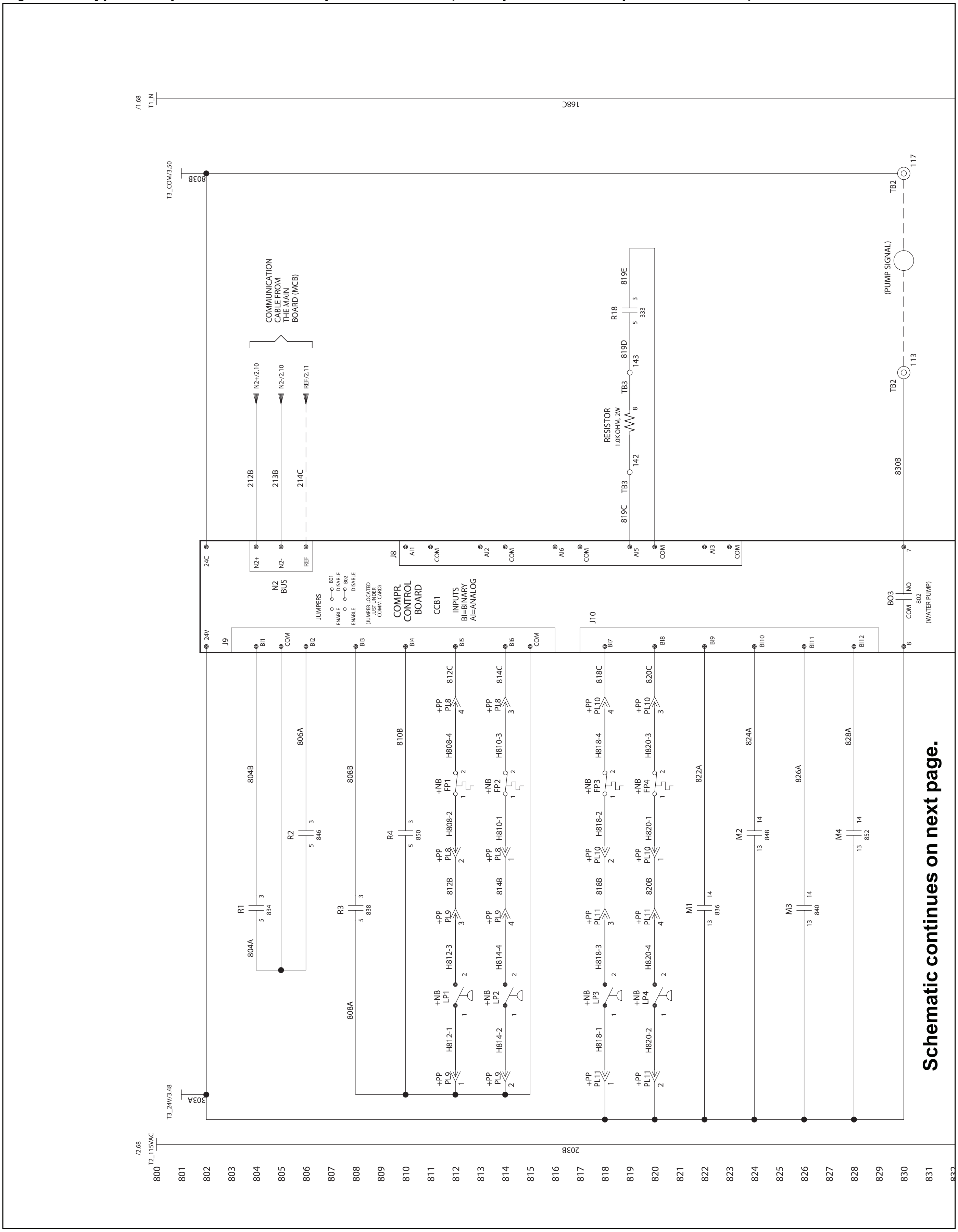


Figure 22: Typical output schematic: compressor control (6 compressors—independent circuits), continued

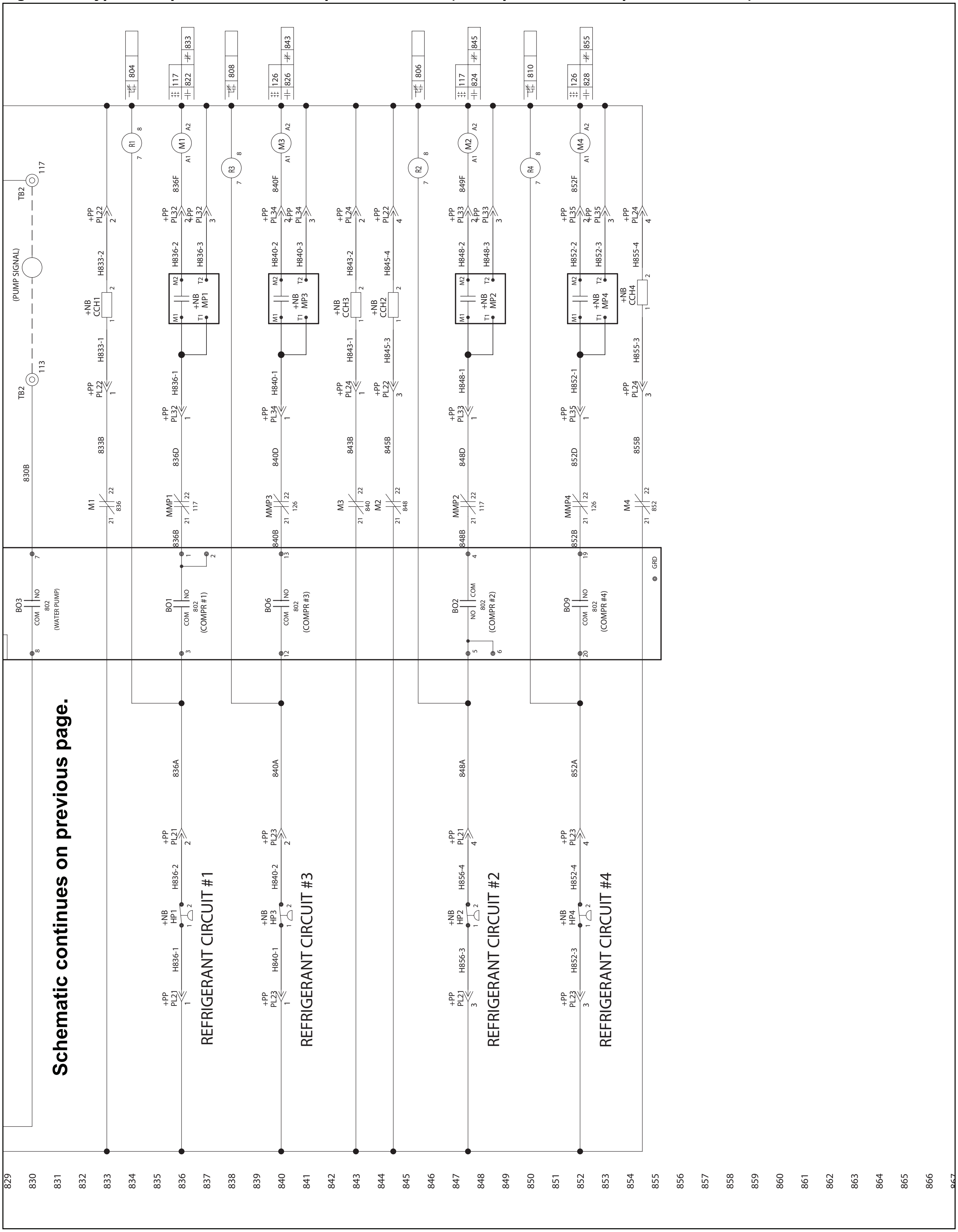


Table 26 on page 50 in the "Parts List" section at the end of this manual includes a listing of MicroTech II related part numbers.

Troubleshooting Main Control Board (MCB)

MCB Battery

Standby power is provided by a 3-VDC lithium battery, which will maintain the MCB Static Random Access Memory (SRAM) and the Real Time Clock (RTC) while power is removed from the MCB.

The battery will degrade with time depending on load, temperature, and the percentage of time the MCB does not have power. With an operating temperature under 25ºC, normal battery life expectancy is as follows:

Table 23: Normal battery life

Battery usage	Typical life	Std. minimum life
1%	10 years	5 years
10%	10 years	5 years
100%	1 year	0.3 years

A battery test is performed each time the MCB power-up diagnostics are executed. The minimum voltage needed to sustain the SRAM and RTC is 2.0 VDC. A warning occurs when the battery voltage drops below approximately 2.5 VDC, which is indicated by the red MCB Error LED blinking after the Main Control Board Power-Up Sequence described below is completed. This warning signals that the battery is reaching the end of its useful life and should be replaced. Once a battery warning alarm occurs, replace the battery within 14 days to avoid complete battery failure and memory loss. Regardless of the battery status, the MCB board will continue execution of the on-board program.

Note – After battery replacement, the Error LED does not revert to the normal off condition until one of the following occurs:

- Power cycles to the MCB.
- The battery is tested at two minutes after midnight each day. If battery is normal, the Error LED reverts to normal.
- A battery test command is issued with a PC using the MicroTech II Service Tool.

MCB Data Archiving

All the MCB control parameters and the real time clock settings are backed up by the MCB using the SRAM. The SRAM is maintained by the MCB battery when power is removed from the MCB. Because battery failure can occur and to avoid losing the information stored on the board, the MCB performs a data archiving function once a day, just after midnight. At the same time, all the MCB control parameter settings are archived to a file stored in the MCB flash memory.

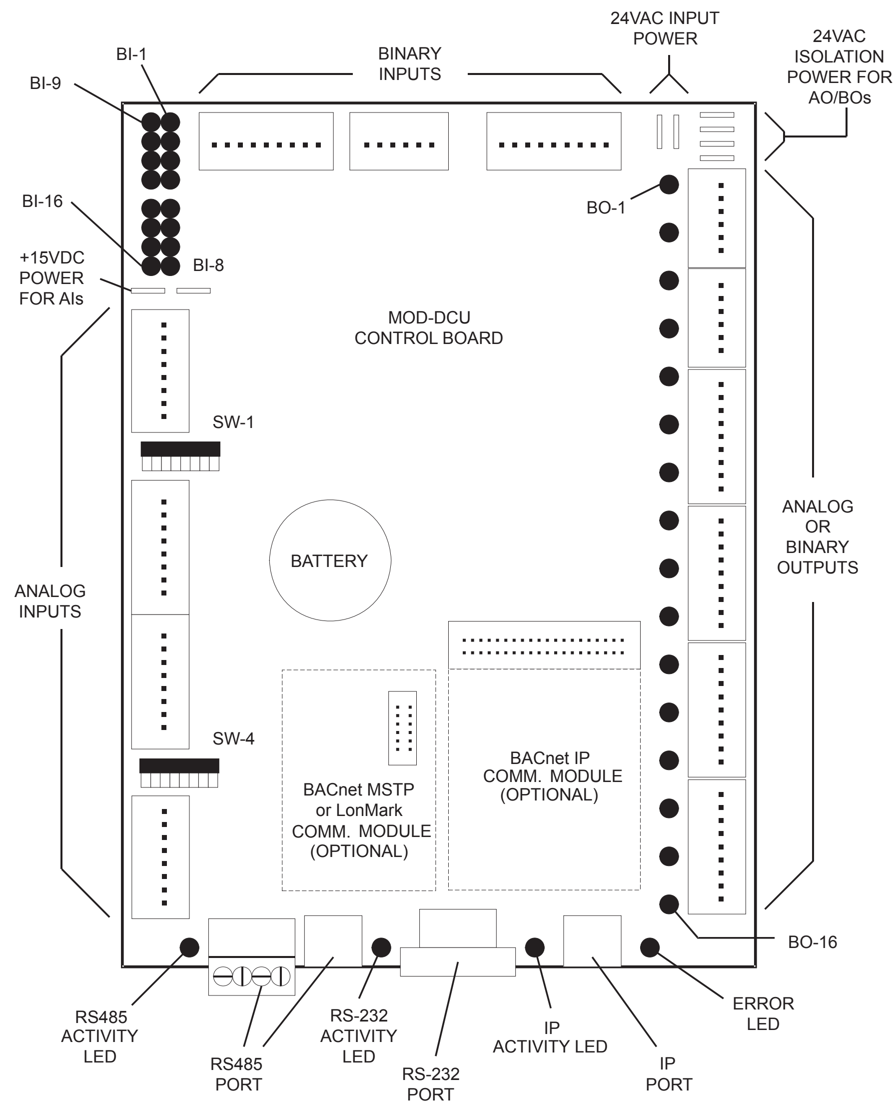
If the MCB is powered up with a low or defective battery (or no battery), the most recently archived data is restored to the controller.

Note – When this archived data restoration process occurs, it increases the controller start-up and initialization period by approximately 75 seconds.

MCB LED Power-Up Sequence

The various LEDs on the MCB are shown in Figure 23 on page 43. When power is applied to the MCB, the LEDs on the board should execute a specific startup sequence. This startup sequence consists of three main components: LED Operational Check period, the MCB Error Code Display period, and the MCB Initialization period, which are described in the following sections.

Figure 23: Main control board



LED Operational Check Period. When power is applied to the MCB or when the MCB is reset, an operational test of the 16 Binary Input LEDs (in the upper left corner) and the four miscellaneous status LEDs (at the bottom of the MCB) is performed, which provides a visual check of the operational status of the LEDs. The following LED sequence should occur:

1. All 16 of the Binary Input LEDs and all the miscellaneous LEDs (3 green and 1 red) across the bottom of the MCB, turn on for approximately 1–3 seconds and then turn off.
2. The miscellaneous LEDs across the bottom of the MCB sequence on for one-half second and then off from left to right (N2 Bus Port Activity, RS-232 Port Activity, Ethernet Port Activity, and MCB Error).
3. Binary Input LEDs BI-1 through BI-8 all turn on for one half second and then turn off.
4. Binary Input LEDs BI-9 through BI-16 all turn on for one half second and then turn off.

If any of these LEDs fail to light as described, replace the MCB to correct problem.

Note – Binary Outputs are not tested and remain off during the LED Operational Check period.

MCB Error Code Display Period. After the LED Operational Check period is complete, if any MCB startup errors are detected, an error code displays. The error code display consists of the red MCB Error LED on the bottom right side of MCB turning on or blinking along with one other LED on MCB turning on. If multiple error conditions exist, each error code appears in succession lasting approximately 3 seconds each, and then these LEDs turn off. If no startup errors are detected, all MCB LEDs remain off and the MCB Initialization period occurs as described below. See "MCB LED Startup Error Codes" below for details regarding the various LED error codes.

MCB Initialization Period. When the MCB Error Code Display period is complete, the MCB Initialization begins. This period consists of the following LED sequence:

1. All the LEDs on the board remain off for approximately 1 to 20 seconds (with a normal battery).

Note – If the battery is low or defective, this period lasts approximately 90 seconds during which previously archived control parameter data is restored to the controller. Refer to "Main Control Board (MCB) Data Archiving" on page 27.

2. The RS-485 Bus Port Activity Indication LED in the lower left corner of MCB begins blinking indicating activity on the RS-485 bus port
3. After an approximate 1–2 second delay, the Binary Input LEDs turn ON according to the Binary Input switch conditions.
4. After a 15–20 second pause, the Binary Output LEDs on the right side of the board turn ON according to the control program logic, and the start-up sequence is complete.

Note – The elapsed time for the entire start-up sequence, including the LED Operational Check, the MCB Error Code Display, and the MCB Initialization period is approximately 45–120 seconds depending on the network configuration and on the MCB battery condition.

MCB LED Startup Error Codes

The 16 green Binary Input LEDs in the upper left corner and miscellaneous LEDs on the bottom (3 green and 1 red) of the MCB (see Figure 26 on page 49) provide a tool for diagnosing problems with the MCB.

During the MCB Error Code Display period of the Main Control Board LED Power-up Sequence described above, MCB failures are indicated by the red MCB Error LED along with another LED, according to Table 24 below. Nondisabling errors are indicated during the MCB Error Code Display period with the red MCB Error LED on continuously. All nondisabling errors are logged in RAM to be retrieved by the MCB operating system. Unit disabling errors are indicated during the MCB Error Code Display period with the red MCB Error LED flashing at a rate of approximately 5.9 Hz. When the MCB Error Code Display period is complete, the start-up sequence continues.

The following diagnostic tests are run during the startup sequence:

- Battery Test
- Flash CRC (Cyclic Redundancy Check) Test
- SRAM (Static RAM) Test
- Communication Port Tests
- IP Register Test

The following sections provide a brief description of each of these startup tests and recommended steps to correct the problem.

Table 24: Main control board LED startup error codes

LED	Startup errors										
	Battery	Flash CRC startup	Flash CRC main/boot	Flash CRC config.	RAM low byte	RAM high byte	N2 bus port	RS 232 port	BACnet-MSTP/ LonMark port (optional)	I/O expansion port	IP port
RS-485 bus port							ON				
RS-232 port								ON			
IP port											ON
MCB error	ON	Blinking	Blinking	Blinking	Blinking	Blinking	ON	ON	ON	ON	ON
B1-1	ON										
B1-2									ON		
B1-3										ON	
B1-4		ON									
B1-5			ON								
B1-6				ON							
B1-7					ON						
B1-8						ON					

Battery Test

The battery test determines the status of the MCB battery. When the battery fails the test, the error is indicated by the red MCB Error LED and the Binary Input BI-1 LED turning ON during the MCB Error Code Display period of the Main Control Board LED Power-Up Sequence described above. This warning signals that the battery is nearing the end of its useful life and should be replaced. Regardless of the battery status, the MCB board continues execution of the on-board program. Once the Main Control Board LED Power-Up Sequence is complete, the red Error LED blinks on and off at a rate of one second on and one second off if the battery is bad and remains off if the battery is good.

Note – After battery replacement, the Error LED does not revert to the normal off condition until one of the following occurs:

- Power is cycled to the MCB.
- The battery is tested at two minutes after midnight each day. If the battery is normal, the Error LED reverts to normal.

Flash CRC Test

The startup flash memory test consists of a sector-by-sector CRC check of the three Flash code bases; Startup, Boot, and Main and two Flash data bases: Dictionary and Configuration. The results of all five tests are saved in SRAM for use by the operating system. A Dictionary failure does not result in a start-up error display. The following scenarios describe the possible failure modes of the flash CRC test.

Bad CRC in startup Code Base. After displaying the Startup Flash CRC error during the MCB Error Code Display period of the Main Control Board LED Power-Up Sequence, the startup process continues, if possible. Since the startup code validity is questionable, correct operation from this point is unpredictable. Download the start-up code again. If this is not possible or ineffective, replace the MCB.

Bad CRC in Main Code Base and Boot Code Base. After displaying the Main/Boot Flash CRC error during the MCB Error Code Display period of the Main Control Board LED Power-Up Sequence, the startup process continues. After the start-up sequence is completed, execution is passed to the Boot code. Since the Boot code validity is questionable, correct operation after entering Boot code is unpredictable. A CRC failure in only the Boot or only the Main code base does not result in an error display. Download the Main and Boot code again.

Bad CRC in Configuration Data Base. This error requires replacing the MCB. The configuration database contains user-defined and factory-defined configuration parameters including the device name, communication parameters, and I/O setup and calibration data. After displaying the Configuration Flash CRC error during the MCB Error Code Display period of the Main Control Board LED Power-Up Sequence, the startup process continues. If main code is run, the MCB reboots, resulting in endlessly repeating the error code and reboot cycle. If boot code is run, MCB runs with factory default values.

SRAM Test

The SRAM test checks each memory location by writing values to them, reading the values back and comparing the read-back values to the expected values. If an SRAM error is detected in the low byte, the RAM Low Byte failure displays during the MCB Error Code Display period of the Main Control Board LED Power-Up Sequence. The MCB then is reset by an external “watchdog” circuit and the Main Control Board LED Power-Up Sequence begins again. If a SRAM failure is detected in the high byte, the RAM High Byte failure displays and the Serial Bus Port LED turns on during the MCB Error Code Display period of the Main Control Board LED Power-Up Sequence. The MCB then is reset by an external “watchdog” circuit and the Main Control Board LED Power-Up Sequence begins again. If either the RAM Low Byte or the RAM High Byte error occurs, replace the MCB.

Communication Port Tests

The various communication ports on the MCB are tested during the Main Control Board LED Power-Up Sequence. This feature allows the processor to verify the internal transmit and receive data paths of MCB data communication channels. Once in the test mode, proper operation of the various communication channels is verified by writing data to the corresponding transmit buffer of the channel under test and then reading the data back from the receive register. If read data does not match write data, the MCB displays the appropriate communication port error during the MCB Error Code Display period of the Main Control Board LED Power-Up Sequence and then continues start-up and initialization. If any of the possible communication port errors occur, replace the MCB.

IP Register Test

After determining the existence of an optional IP communication card, the MCB performs a series of read/write tests on critical registers of the IP processor. If any of the register tests fail, an IP port failure displays during the MCB Error Code Display period of the Main Control Board LED Power-Up Sequence, and then the MCB continues running startup and initialization. If the IP port error occurs, replace the IP communication module to correct the problem. If the problem persists, replace the IP communication module. If the problem persists after replacing the IP communication module, MCB is likely defective. Refer also to literature shipped with the IP communication module.

Troubleshooting Auxiliary Control Boards (CCB1and CCB2)

This section outlines a typical process for troubleshooting any of the auxiliary control boards that might be connected to the MCB via the RS-485 communication bus interface.

Hardware Check

1. Verify that the auxiliary control board is wired and terminated properly. Refer to the as-built unit wiring schematics or refer to Figure 17 on page 31 (DAC units) or Figure 18 on page 33 (SCC units).
2. Verify that the RS-485 Communications Module on the auxiliary control board is installed properly. Verify that the RS-485 Address Switch on the RS-485 Communication Module is set to the correct address. See Table 4 on page 10.
3. Verify that 24 VAC power is available and properly terminated on the J1 terminal block on the auxiliary control board.

RS-485 Communication Module Status LEDs

A set of two status LEDs is located in the lower right area of the RS-485 Communication Module mounted on the auxiliary control boards (see Figure 5 on page 9). These LEDs provide useful trouble shooting information. The upper LED verifies that the MCB is transmitting data to the auxiliary control board. The lower LED verifies that the auxiliary control board is transmitting data to the MCB.

1. The upper LED should always blink at the same rate as the RS-485 Activity LED on the MCB (see Figure 3 on page 5). If it is not blinking and the RS-485 Activity LED on the MCB is blinking, verify that the wiring between the MCB and auxiliary board is free of defects. If the RS-485 Activity LED on the MCB is not blinking, it is likely that the problem is with the MCB.
2. The lower LED should always be blinking. If not, perform the hardware checks listed above. If these check out correctly and the problem persists, cycle power to the entire controls system using the system S1 switch. If the problem persists, either the MCB was not downloaded and configured correctly or it is likely that the auxiliary control board or the RS-485 communication module is defective. Use the following procedure to isolate the problem components:
   - **a** Verify that the MCB download and configuration was performed correctly and then cycle power to the entire controls system using the S1 system switch. If this was done and the problem persists, see item (b) below.
   - **b** Remove power from the control system and replace the RS-485 communication module on the suspect auxiliary control board with a module that is known to function properly. This can be accomplished by exchanging the RS-485 communication module with one of the other auxiliary control boards on the unit. If this is done, make sure to change the addresses switches on the RS-485 communication modules according to Table 4 on page 10. Apply power to the control system and check operation. If the problem follows the suspect communication module, the module is defective. If the problem remains with the suspect auxiliary control board, it is likely that the auxiliary control board is defective.

Troubleshooting Keypad/Display

Keypad/Display Power Up Initialization

When the keypad/display is connected to the MCB and power is applied, the firmware in the keypad/display runs a diagnostic test of its static RAM (SRAM) and also checks the micro controller ROM for proper checksum. After these tests are completed, the keypad/display responds to a poll of its address by the MCB with an acknowledge message to the MCB. This causes the controller to start downloading display information to the keypad/display. The keypad is locked out until the tests and the download are complete.

Note – The keypad/display address is defined by a four-position dip switch block on the right side of the device. For this application, all four of these switches should be in the UP position, which defines address 32.

When the keypad/display is connected to the MCB and power is applied, the display has the backlight and the red Alarm LED turned on. The backlight remains on until it times out (15 minutes after a key press or after power up). During the next 5 seconds, the LCD counts down from 9 to 0 in all 80 character locations. After the countdown is complete, the Alarm LED turns off and the display appears as follows:

Version	xxx
Address	yy
Status	zz zzzz
Startup	aaaa bbbb ccc

Where:

xxx = The version of firmware in the keypad/display

yy = The keypad/display address 32

zzzz = OK normally or NO COMM if the MCB is not communicating with the keypad/display

aaaa = OK normally or IRAM of internal RAM test failed

bbbb = OK normally or XRAM if external RAM test failed

ccc = OK normally or ROM if ROM checksum does not match stored checksum

When the MCB finishes downloading to the keypad/display, it sends a “download complete” message to the keypad/display. When this message is received by the keypad/display, the LCD displays the “main” self-contained application menu screen.

Note – A NO COMM indication on the Status line during the initialization period does not necessarily indicate a problem. A communication problem is indicated if the LCD indefinitely shows the initialization display screen as above with the Status line indicating NO COMM. In other words, the LCD will not proceed to display the “main” application menu screen.

If aaaa= IRAM, bbbb= XRAM and/or ccc= ROM, replace the keypad/display.

Note – The keypad/display may be connected to the MCB while power is on. The normal elapsed time for the “main” self-contained menu screen to appear in the LCD upon initializing is approximately 60 seconds.

Troubleshooting Temperature Sensors

The MicroTech II temperature sensor consists of a positive temperature coefficient (PTC) silicon sensing element whose resistance increases with increasing temperature. The element has a reference resistance of 1035 ohms at 77°F (25°C). Each element is calibrated according to the graphs shown in Figure 24 (°F) and Figure 25 (°C). Tabulated resistance vs. temperature data is shown in Table 25.

Use the following procedure to troubleshoot a suspect sensor:

1. Disconnect the sensor from the MCB.
2. Take a temperature reading at the sensor location. Be sure to allow the thermometer to stabilize before taking the reading.
3. Use the temperature reading from Step 2 to determine the expected sensor resistance from Table 25.
4. Using an ohmmeter, measure the actual resistance across the two sensor leads.
5. Compare the expected resistance to the actual resistance.
6. If the actual resistance value deviates substantially (more than 10%) from the expected resistance listed in Table 25, replace the sensor.

Figure 24: MicroTech II temperature sensor—temperature (°F) vs. resistance graph

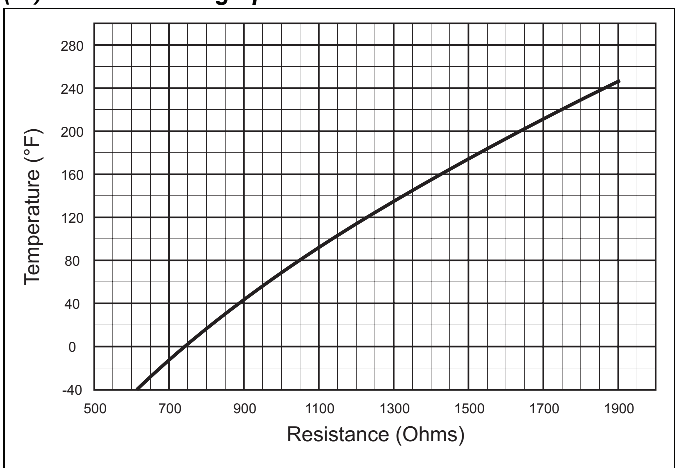


Figure 25: MicroTech II temperature sensor—temperature (°C) vs. resistance graph

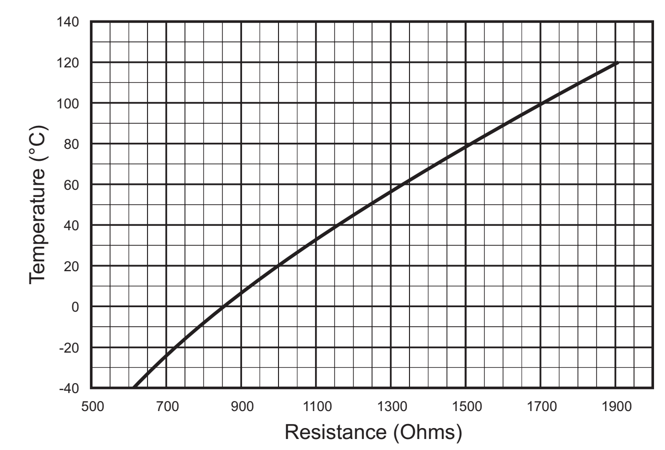


Table 25: MicroTech II temperature sensor—temperature vs. resistance chart

Temperature °F (°C)	Resistance in ohms
–40 (–40)	613
–31 (–35)	640
–22 (–30)	668
–13 (–25)	697
–4 (–20)	727
5 (–15)	758
14 (–10)	789
23 (–5)	822
32 (0)	855
41 (5)	889
50 (10)	924
59 (15)	960
68 (20)	997
77 (25)	1035
86 (30)	1074
95 (35)	1113
104 (40)	1153
113 (45)	1195
122 (50)	1237
131(55)	1279
140 (60)	1323
149 (65)	1368
158 (70)	1413
167 (75)	1459
176 (80)	1506
185 (85)	1554
194 (90)	1602
203 (95)	1652
212 (100)	1702
221(105)	1753
230(110)	1804
239 (115)	1856
248 (120)	1908

Troubleshooting Communications Cards

BACnet/IP Module

For a detailed description and troubleshooting information regarding the BACnet/IP communications module, refer to installation and maintenance bulletin *IM 703, MicroTech II BACnet/IP Communications Module*. For details regarding BACnet protocol data, refer to engineering data document, *ED 15061, MicroTech II Protocol Information Data for Vertical Self-Contained Units*.

BACnet MS/TP Module

For a detailed description and troubleshooting information regarding the BACnet MS/TP communications module, refer to installation and maintenance bulletin *IM 704, MicroTech II BACnet MS/TP Communications Module*. For details regarding BACnet protocol data, refer to engineering data document, *ED 15061, MicroTech II Protocol Information Data for Vertical Self-Contained Units*.

LONMARK Module

For a detailed description and troubleshooting information regarding the LONMARK communications module, refer to installation and maintenance bulletin *IM 702, MicroTech II LONWORKS Communications Module.* For details regarding LONMARK protocol date, refer to engineering data document, *ED 15061 MicroTech II Protocol Information Data for Vertical Self-Contained Units.*

Troubleshooting Static Pressure Transducers

To troubleshoot a suspect sensor, use the procedure below:

1. If the duct static pressure always reads 0" wc on the unit keypad/display and the discharge inlet vane position of AFD speed is continuously ramping to 100%, check the following:
   a. If the unit has two duct static pressure sensors (SPS1 and SPS2), verify that they both function properly following steps 2 through 5 below. Also check for faulty wiring connections at analog inputs MCB-AI13 and MCB-AI14. The controller displays and controls to the lower of the two readings. If one is defective and inputs 0 volts to the controller, the static pressure reading on the keypad/display reads 0 and the controller attempts to increase the 0 value to set point by ramping up the discharge inlet vanes or AFD.
   b. If a second sensor (SPS2) is not installed or the pressure tubing to it is not connected, make sure the *2nd P Sensor=* parameter in the Unit Configuration menu of the keypad/display is set to “None” so the controller ignores the second static pressure analog input MCB-AI14.
   c. If a second sensor (SPS2) is installed, but is a building space rather than a duct static pressure sensor, make sure the *2nd P Sensor=* parameter in the Unit Configuration menu of the keypad/display is set to “Bldg.”

4 Verify the 24 VAC power supply to the sensor:

- **a** If the sensor is SPS1 or SPS2 (duct static), verify that there is 24 VAC between the suspect transducer "+" and "–" terminals.
- **b** If the sensor is SPS2 (building static) verify that there is 24 VAC between the "IN" and "CM2" terminals on the SPS2 terminal block.
- **c** If 24 VAC supply reads low and/or the MCB is malfunctioning, the sensor may be drawing too much current (24 VAC terminals can supply only 30 mA). Disconnect the sensor and recheck voltage and the MCB operation.

4 Using an accurate manometer or gauge, measure the same pressure that the suspect transducer is sensing. To do this, tap into the transducer high and low pressure tubing or locate the measurement device taps next to the transducer taps.

⚠ CAUTION

Pressure transducer fittings are fragile. Do not remove tap tube from fitting; instead, splice a tee fitting into each tap tube. Use an airtight cap to cover the test port after the pressure measurement.

5 Measure the DC voltage output from the transducer.

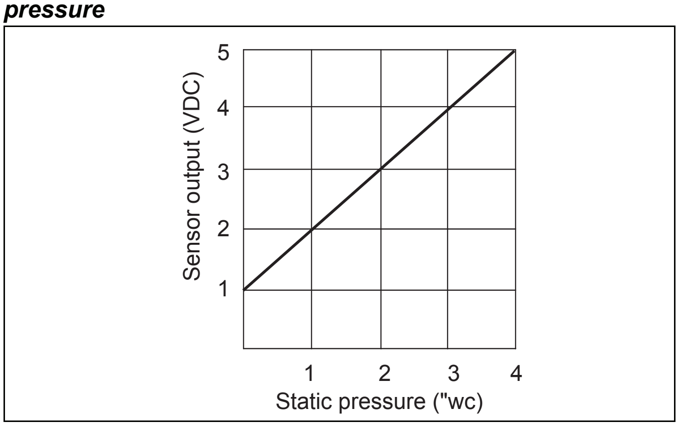
- **a** If the sensor is SPS1 or SPS2 (duct static), measure the voltage across the sensor "S" and "–" terminals.
- **b** If the sensor is SPS2 (building static), measure the voltage across the "OT2" and "CM2" terminals on the SPS2 terminal block.

If the measured voltage and pressure do not match, there may be a wiring problem or the transducer may be defective. Check the transducer input circuit wiring and connections for defects.

If the measured voltage and pressure match, it is likely the MCB is misconfigured or defective.

3 Remove power from the controller by opening system switch S1. If available, swap a similar working transducer with the suspect transducer or try installing a new transducer. Restore power by closing S1, and verify whether the suspect transducer is defective.

Figure 26: Duct static pressure transducer voltage vs. pressure



Troubleshooting Refrigerant Pressure Transducers

Use the following procedure to troubleshoot a suspect sensor:

1 Verify the 5 VDC power supply to the sensors at terminal block TB2 terminals 54 and 55.

- **b** If the suspect sensor is PSR1, verify that there is 5 VDC between wire 179 (RED) and wire 178 (BLK).
- **c** If the suspect sensor is PSR2, verify that there is 5 VDC between wire 279 (RED) and wire 278 (BLK).

4 Measure the DC voltage output from the sensor.

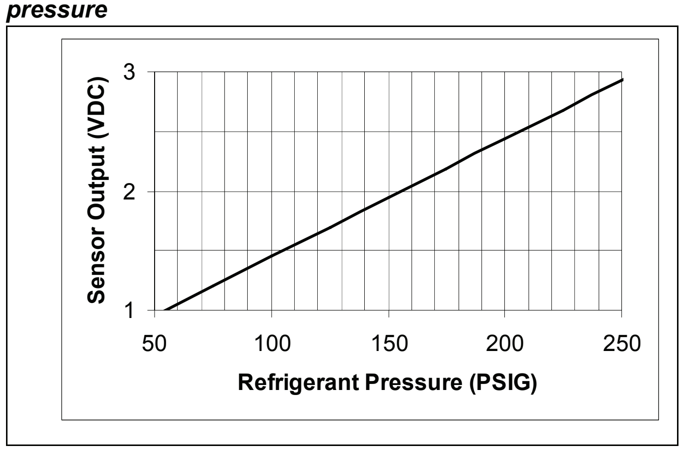
- **a** If the suspect sensor is PSR1 (MCB-AI11), measure between wire 177 (WHT) and wire 178 (BLK). MCB-AI11 should not have a jumper and the dip switch SW4:3 should be in the ON position.
- **b** If the suspect sensor is PSR2 (MCB-AI12), measure between wire 277 (WHT) and wire 278 (BLK). MCB-AI12 should not have a jumper and the dip switch SW4:4 should be in the ON position

If the measured voltage and pressure do not match, there may be a wiring problem or the transducer may be defective. Check the transducer wiring harness for defects.

If the measured voltage and pressure match, the MCB may be defective.

3 Remove power from the controller. If available, swap a similar working transducer with the suspect transducer or try installing a new transducer. Restore power and verify whether the suspect transducer is defective.

Figure 27: Refrigerant pressure transducer voltage vs. pressure



Parts List

The following is a partial list of applied self-contained unit replacement parts. For additional information, contact a local sales representative.

Table 26: Parts list

Component designation	Description	McQuay part number
MCB	Main Control Board	060006101
CCB1	Auxiliary Cooling Control Board	112026101
CCB2	Auxiliary Cooling Control Board	112026101
—	RS-485 Communication Module (for Auxiliary Control Boards—PN 112026101)	060006202
—	Standoffs for mounting RS-485 Communication Module (PN 060006202) onto Auxiliary Control Boards (PN 112026101)	048166707
—	Auxiliary Cooling Board with RS-485 Communication Module	300040211
—	Keypad/Display	060006301
—	Keypad-Main Control Board Cable	111044601
ZNT1	Zone Temperature Sensor with Tenant Override	111048101
	Zone Temperature Sensor with Tenant Override & Remote set point Adjustment (SCC units only)	111048102
DAT	Discharge Air Temperature Sensor (20 feet cable length)	170047222
RAT	Return Air Temperature Sensor (30 feet cable length)	170047402
OAT	Outside Air Temperature Sensor (30 feet cable length)	060004703
MAT	Mixed Air Temperature Sensor (20 feet cable length)	060004702
EWT	Entering Water Temperature Sensor (20 feet cable length)	170042402
LWT	Leaving Water Temperature Sensor (20 feet cable length)	170042602
SPS1	Static Pressure Sensor #1	049545007
SPS2	Static Pressure Sensor #2	049545007
PC5	Dirty Filter Switch	060015801
PC7	Airflow Proving Switch	065493801
DHL	Duct High Limit	065493801
—	BACnet MS/TP Communication Module (RS-485)	060006202
—	BACnet /IP Communication Module (IP Cable 10 Baset)	060006201
—	LONMARK Space Comfort Controller (SCC) Communication Module	060006203
—	LONMARK Discharge Air Controller (DAC) Communication Module	060006204
—	5 VDC Power Supply	111049610
—	Serial Port Ribbon Cable	111047201
—	MCB Battery	BR2325
T2	Transformer 115/24 VAC 75VA	060004601
T3	Transformer 115/24 VAC 50VA	060630801
PSR1	Refrigerant Pressure Transducer CRT#1	065816802
PSR2	Refrigerant Pressure Transducer CRT#2	065816802
WFS	Water Flow Sensor	098867101
—	MicroTech II Repair Kit that contains hardware to terminate inputs and outputs	300036605

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