

USERGUIDE

Central Chilling Systems



WARNING - Reliance on this Manual Could Result in Severe Bodily Injury or Death!

This manual is out-of-date and is provided only for its technical information, data and capacities. Portions of this manual detailing procedures or precautions in the operation, inspection, maintenance and repair of the product forming the subject matter of this manual may be inadequate, inaccurate, and/or incomplete and cannot be used, followed, or relied upon. Contact Conair at info@conairgroup.com or 1-800-654-6661 for more current information, warnings, and materials about more recent product manuals containing warnings, information, precautions, and procedures that may be more adequate than those contained in this out-of-date manual.

INSTALLATION, OPERATION, & MAINTENANCE INSTRUCTIONS

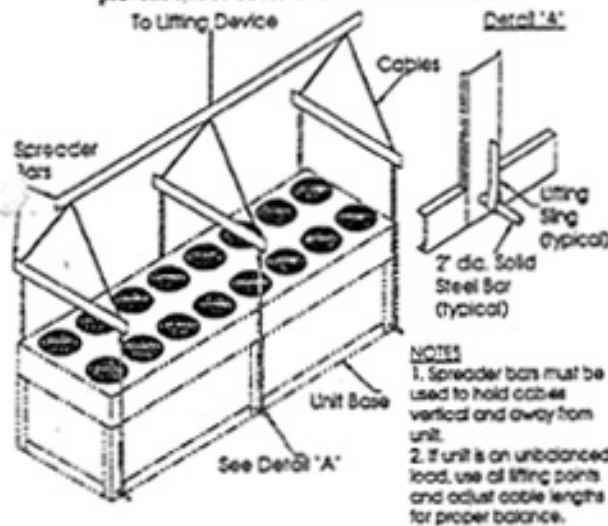
TECHNICAL SYSTEMS AIR COOLED CONDENSERS, CONDENSING UNITS & PACKAGED CHILLERS

A. RECEIVING AND INSPECTION

1. Immediately upon receiving shipment, equipment should be inspected for evidence of any damage received in transit. If shipping damage has occurred, a claim should be made with the transportation company, and the local Technical Systems representative should be advised of the nature of the damage.
2. Equipment should be inspected for compliance with original order acknowledgment (equipment model numbers, voltages, etc.).

B. RIGGING

1. Equipment is equipped with lifting eyes or sling points. These should be used to prevent structural damage.
2. Equipment should be lifted in a near level condition to prevent undue stress on structural members.



C. MOUNTING

1. Equipment should be mounted on a smooth, hard, level surface.
2. Mounting surface should be rigid, and provision should be made to prevent noise transmission (structural) to surrounding areas.
3. Air cooled equipment should not be installed under low structural overhangs which can cause condenser air recirculation or restriction.
4. Adequate Area (approx. 1 unit width) must be provided around equipment for unrestricted air flow and service. Two units side by side should have a minimum of 1 1/2 unit width between them.
5. Care should be taken to prevent air from other sources from entering condenser if this air is at an elevated temperature.

6. Indoor design equipment must be installed in a protected enclosure.
7. Roof mounted equipment should be isolated to prevent noise/vibration transmission to the structure.

D. PIPING

1. All piping must be in accordance with applicable local and state codes.
2. Refrigerant piping (split systems) should be designed and installed in accordance with recommended practices as outlined in ARI or ASHRAE piping guide.
3. Water piping (Chillers) should be designed and installed to meet application requirements. Provisions must be made to prevent freezing if design ambient temperatures decrease.
4. All mechanical connections should be checked for tightness before pressure testing and evacuation of system.
5. Compressor shipping hold down bolts (spring mounted compressors) should be loosened until compressor swings free on its isolators before piping is made-up. Line isolators or loops must be used with spring-mounted compressors.
6. When piping is completed, a thorough leak test should be performed before evacuation start-up. Do not exceed 150 psig test pressure on low side of system.

E. WIRING

1. All local and state codes must be strictly adhered to and good electrical practices should be followed to achieve the best installation possible.
2. Power wiring to equipment must be adequately sized for minimum ampacity as shown on unit nameplate. A disconnect should be located adjacent to unit for both safety and servicing purposes.
3. Equipment wiring diagram should be examined and thoroughly understood before field wiring connections are made.
4. Power supply should be checked to be certain that supply voltage agrees with equipment nameplate. Serious damage to compressors and motors can occur if improper voltage is applied.
5. All unit wiring terminals should be checked for tightness before power is applied to the equipment.
6. When wiring is completed, fan motors should be checked for proper rotation. All fan motors of multiple fan equipment have been factory wired to operate with same rotation. If rotation is found to be incorrect, reverse two of three leads on main motor.

F. SYSTEM EVACUATION

1. With refrigerant piping completed and leak tested, equipment is ready to evacuate. Do not use compressor to evacuate system. A quality vacuum pump capable of 350 micron vacuum is necessary for adequate and dependable system vacuum. Moisture in a refrigeration system can cause corrosion, expansion valve freeze-up and oil sludge.
2. Attach vacuum pump to both high and low side of system through compressor service valves and evacuate to 350 microns (all service valves*, hand valves, and solenoids must be open during evacuation). It is suggested that vacuum pump be run for a period of time after vacuum has been reached.

*Service valves are back seating valves and must be in mid-position to open to both sides of the system.

G. SYSTEM CHARGING (Less Flooded Head Pressure Control)

With system wired, piped, and evacuated, unit is ready for refrigerant charging. All charging lines and manifolds must be purged with refrigerant vapor prior to admitting refrigerant into system to prevent contaminating system with noncondensibles.

1. Connect charging line to receiver outlet valve and admit "liquid" refrigerant into high side of system until flow stops due to pressure equalization between high side and drum pressure. Backseat outlet valve and disconnect charging line.
2. Connect charging line to compressor suction service valve and admit "vapor" into low side of system.
3. Energize equipment and continue to admit vapor into low side of system until liquid line sight glass clears, indicating a fully charged system (it may be necessary to defeat low pressure control on initial start to prevent nuisance trip until low side pressure is above cut out point of control.

H. SYSTEM CHARGING (With Flooded Head Pressure Control)

1. Initial charging is the same as outlined in Item G.
2. Do not adjust flood control valves. These are either factory preset or nonadjustable, depending on size.
3. Calculate required charge in pounds for the minimum ambient at which equipment is to operate.
4. Set unloaders (if supplied) to load compressors to 100% while charging. Add additional charge to bring total charge up to required charge as calculated in item No. 3. Additional charge to be added through low side (vapor) as outlined in Section G, Item 3.

I. START-UP

This is a continuation of "system charging" and must be performed before equipment can be left operating and unattended. This will involve checking and adjusting of all safety and operating controls (pressure and temperature controls have been set at the factory; however, it is still desirable to confirm that settings are correct and controls function properly). Do not attempt to function safety controls without some means of stopping compressor in event of extreme high or low pressure conditions that could damage the equipment. If controls fail to function at set points, determine cause and correct. Jumpering any safety control other than for testing purposes is dangerous to personnel and equipment, and nullifies equipment warranty.

Energize crankcase heaters and allow a minimum of 24 hours operation before a compressor start.

1. HIGH PRESSURE CONTROL - Connect a gauge to the compressor discharge service valve. Stop condenser air flow by stopping fans on air cooled equipment. Control should open immediately when discharge pressure reaches control set point.
2. LOW PRESSURE (PUMP-DOWN) CONTROL - Connect a gauge to the compressor suction service valve. Throttle receiver outlet valve to lower suction pressure at compressor. Compressor should pump-down and be de-energized when suction pressure reaches "cut-out" setting of control. Open receiver outlet valve and observe rise in pressure at compressor suction connection. Compressor should be energized when pressure reached "cut-in" setting of control.
3. OIL PRESSURE CONTROL
 - a) Copeland Compressor - jumper between terminals T1 and T2. Compressor should run approximately 120 seconds and cycle off. Remove jumper and reset control. Check operating oil pressure. This is the differential between oil pump discharge pressure and suction pressure and should be a minimum of 10 psig. Also, after several hours running time, check oil level in compressor. Proper level is approximately 1/4 level on oil sight glass.
 - b) Carlyle Compressor - jumper between terminals T1 and T2. Compressor should run approximately 45/60 seconds and cycle off. Remove jumper and reset control. Check operating oil pressure. This is the differential between oil pump discharge pressure and suction pressure and should be a minimum of 7 psig. Also, after several hours running time, check oil level in compressor. Proper level is approximately 1/3 to 1/2 level on oil sight glass.

4. TEMPERATURE CONTROL (Air Cooled Water Chillers)

- This control is the main unit operating thermostat. The control cycles both the compressor and the unloader(s) in response to return water temperature. The sensing bulb is located in a well on the return water nozzle. This control has been factory set to maintain 45°F leaving water temperature (based on a 10°F TD Design). The temperature control can be field adjusted. To calculate the proper set point, add the specified leaving water temperature and the design temperature difference of return to supply (TD). Temperature control adjustment should be made as follows:

EXAMPLE: Design conditions - 10°F TD, 55°F entering (return) water, 45°F leaving (supply) water and 5 psi water side pressure drop at rated flow.

Step 1: Check proper flow through cooler. Pressure gauges at the entering and leaving nozzles should be used. Adjust flow by balancing valves or throttling valves on discharge side of the cooler to corresponding pressure drop.

Step 2: The system water temperature should be at 60°F or above to simulate a pull down for proper start-up and check out.

Step 3: Adjust temperature control dial to 55°F. This will produce 45°F leaving water temperature at designed flow rate.

Step 4: Observe the suction pressure as the return water temperature continues to fall and the compressor(s) and/or unloader(s) are staged by the temperature control. The suction pressure at the compressor should not fall below approximately 58 psi during all stages of compressor/compressors operation.

The compressor(s) will eventually be staged off by the temperature control. When this occurs, the return water temperature must rise to the cut in set point of the temperature control (the dial setting) before the compressor(s) is staged on again.

Always consult equipment submittals for proper design conditions before adjusting the temperature control.

Possible causes of control failures and recommended corrective action:

| Cause | Correction |
|--|---|
| A. Temperature Control Setting too Low | Readjust to proper setting. Check catalog or submittal data. |
| B. Cooler flow incorrect | Balance flow to catalog or submittal requirements |
| C. Low refrigerant charge | Recharge to correct operating level - clear sight glass. |
| D. Restricted liquid line | Check valves and dryer |
| E. Thermal expansion | Adjust superheat to approximately 8 - 12°F at the compressor |

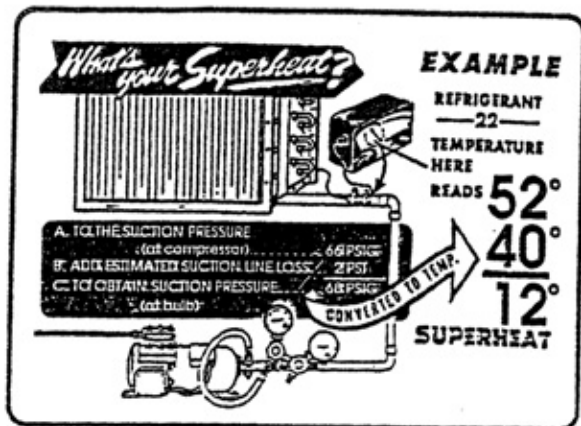
5. FREEZE PROTECTION CONTROL- Control is a pressure sensing, manual reset safety control. It responds to suction pressure and prevents circuit operation should suction pressure fall below control set point for a period in excess of 120 seconds. Control is factory set and sealed at a pressure selected for the fluid being cooled or application requirements. For water systems, the control is set at 54 psig. The fixed time delay (120 seconds) allows circuit to stabilize on start-up and normal pump-down operation. Control is sealed at the factory. This seal must be intact to maintain warranty of compressor and/or cooler failures. Should readjustment be necessary, contact the factory for authorization.

6. THERMAL EXPANSION VALVE - Adjust superheat setting to job requirements.

How to determine superheat correctly:

- Measure the temperature of the suction line at the point the bulb is clamped.
- Obtain the suction pressure that exists in the suction line at the bulb location by either of the following methods.
 - If the valve is externally equalized, a gauge in the external equalizer line will indicate the desired pressure directly and accurately. OR
 - Read the gauge pressure at the suction valve of the compressor. To the pressure add the estimated pressure drop through the suction line between bulb location and compressor suction valve.
The sum of the gauge reading and the estimated pressure drop will equal the approximate suction line pressure at the bulb.
- Convert the pressure obtained in 6b(1) or 6b(2) to saturated evaporator temperature by using a temperature pressure chart.
- Subtract the two temperatures obtained in 6a and 6c, the difference is superheat.

Figure A



Courtesy of Sporlan Valve Company

Figure A illustrates a typical example of superheat measurement on a refrigeration system using refrigerant 22. The temperature of the suction line at the bulb location is read at 52°F. The suction pressure at the compressor is 66 psig and the estimated suction line pressure drop is 2 psig... 66 psig + 2 psig = 68 psig at the bulb, which is equivalent to a 40°F saturation temperature. 40°F subtracted from 52°F = 12°F superheat.

7. **HOT GAS BYPASS** (if supplied) - Connect gauge to compressor suction service valve. Throttle receiver outlet valve to lower suction pressure at compressor. Hot gas regulator should begin to open as suction pressure approaches design suction pressure. This should be done before unit has pulled down to design conditions.

J. SHUT DOWN

Equipment which will not be required to operate for a period of time should be secured by storing refrigerant charge in the receiver or condenser.

1. Front seat the receiver outlet valve. Set thermostatic at a setting below system temperature to insure that liquid line solenoid is energized. Defeat the low pressure control and allow unit to pump down to a suction pressure of approximately 5 psig. It may be necessary to repeat pump-down as some refrigerant will remain in oil and will slowly boil off. When suction pressure holds at 5 psig, front seat suction service valve. Lock disconnect in off position.
2. On units with water cooled condensers, special precautions must be taken to completely drain the vessels to prevent freezing if ambient should be below 32°F
3. Inspect system for possible worn or faulty components and repair if required.

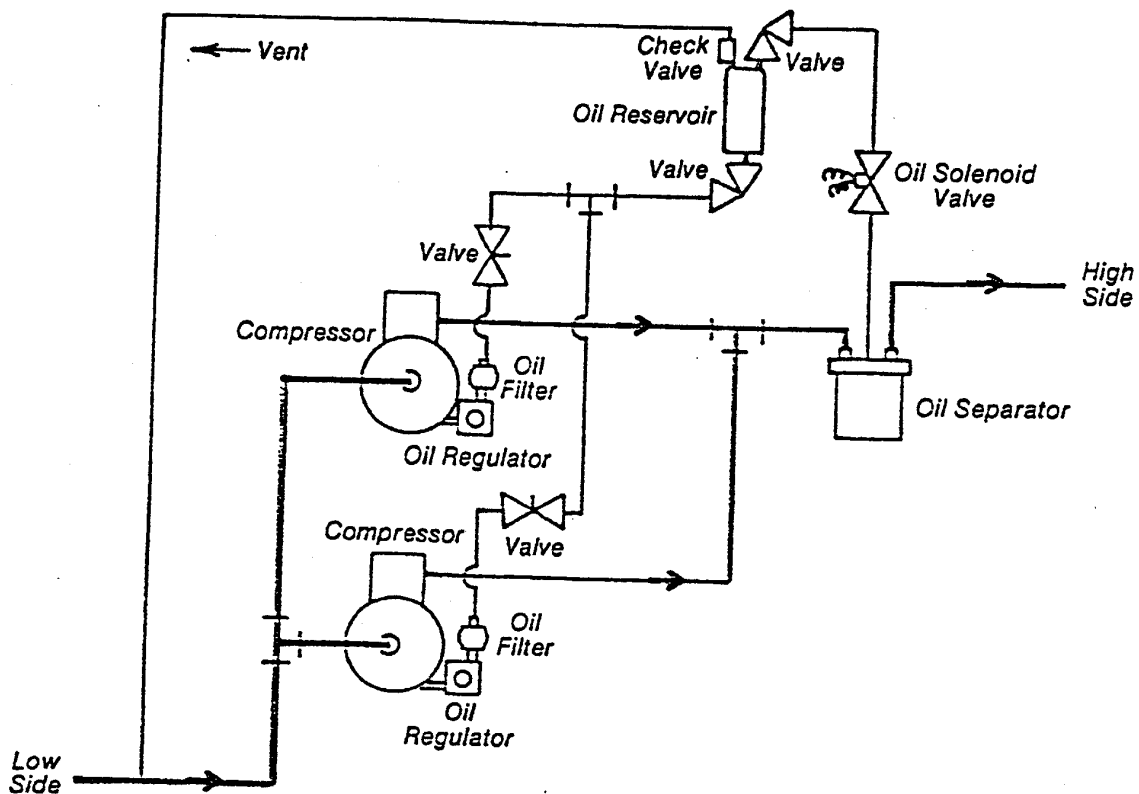
K. SYSTEM RESTART AFTER SHUT DOWN

1. Thorough leak test should be performed.
2. Coil(s) should be checked for dirt accumulation obstruction and cleaned if necessary.
3. Energize crankcase heaters and allow a minimum of 1 hour operation before a compressor restart.
4. Install gauges, start system and check for correct refrigerant charge, and proper system operation and balance.

L. MAINTENANCE

1. The system should be checked periodically. Use only the services of a qualified refrigeration mechanic for inspection and maintenance checks or service operations.
2. **Water Treatment** (Water Cooled Condensing Units) - The water should be tested by a local testing agency and their recommendations adhered to.
3. **Air Cooled Condenser** - The inlet side of the condenser coil must be kept clean through a regular preventive maintenance program.
4. **Compressor Oil Level** - The compressor oil level should be checked periodically. If oil is needed, allow equipment to pump down to approximately 5 psig crankcase pressure. Place disconnect in off position and close suction and discharge service valves. Slowly remove oil fill plug from compressor crankcase. (Slight pressure is still in crankcase and care must be taken to prevent "blow out" of plug.) Add clean, dry oil until the oil level shows in approximately one quarter of sight glass. Replace oil fill plug and open discharge and suction service valves. Restart compressor and check oil level after two hours of operation. (Loss of oil would suggest that a leak may be in system. Carefully inspect entire system for evidence of oil and repair as necessary.)
5. Periodically check all electrical connections for possible loose or corroded terminals. Repair as necessary.

OIL CONTROL SYSTEM



OIL CONTROL SYSTEM - CM SERIES UNITS

The CM Series condensing units and chillers are designed having two compressors on a common circuit. When using this method, it is necessary that oil equalization between each compressor be maintained to prevent loss of oil from either compressor.

The method of crankcase equalization used by Technical Systems consists of an oil separator mounted in the common discharge line, an oil reservoir, and an oil regulating valve mounted on each compressor crankcase. In addition, a check valve having a 20 pound differential is installed in the vent line from the reservoir to the suction line.

With either or both compressors running, the oil separator will collect the oil vapor leaving the compressor(s) and return this oil to the reservoir. The reservoir will be at a pressure approximately 20 pounds above the compressor crankcase pressure. Oil from the reservoir is piped to the oil regulators which are mounted on the compressor crankcase. As crankcase oil level drops, the regulator

will admit oil to the crankcase to maintain a proper operating level. This method is approved by Copeland Corporation in accordance with Copeland Application Engineering Bulletin No. AE-1235.

HOW IT WORKS

A reserve of oil is necessary for the operation of the OIL CONTROL SYSTEM. The OIL RESERVOIR is the holding vessel for this stand-by oil. It has two sight glass ports on the shell to observe the oil level inside the vessel. Oil is fed into the OIL RESERVOIR by the OIL SEPARATOR.

It can be realized that high pressure from the high side returns with the oil from the OIL SEPARATOR to the RESERVOIR. In a period of time, enough pressure could build up to adversely affect the float and needle assembly in the OIL LEVEL REGULATOR. For protection, a vent line is installed from the top of the OIL RESERVOIR (a fitting is provided) back to the low pressure suction line. This line permits the pressure in the OIL RESERVOIR to be approximately the same as the pressure in the suction line and the crankcases of the compressors. Oil in the OIL RESERVOIR

feeds down through $\frac{3}{8}$ " and $\frac{1}{4}$ " OD tubing and keeps the OIL LEVEL REGULATORS supplied with oil.

A REGULATING VALVE is mounted on the suction line vent connection on top of the OIL RESERVOIR and will maintain 20 lbs. pressure differential over the crankcase. This positive pressure will keep the oil line to the OIL LEVEL REGULATORS filled and ready.

The valve on the top of the OIL RESERVOIR automatically receives oil from the OIL SEPARATOR (open position). To add oil to the OIL RESERVOIR manually close the valve and fill the OIL RESERVOIR through the $\frac{1}{4}$ " flare connection on the side of the valve. Open valve after filling.

The valve on the bottom of the OIL RESERVOIR is the distribution valve to the OIL LEVEL REGULATORS (open position). To remove oil from the OIL RESERVOIR, close the valve and use the $\frac{1}{4}$ " flare connection on the side of the valve to drain the oil out. Open valve after draining.

NEW SYSTEM START-UP

On system start-up of a new parallel system, oil should be added to the OIL RESERVOIR to the upper sight glass port, NOT ABOVE IT. It is commonly accepted that in a new refrigeration systems, some oil will be absorbed by the refrigerant as the system becomes balanced out. After two hours of operation, the OIL RESERVOIR, if necessary, should again be filled to the upper sight glass and also after two days, by which time the entire refrigeration system should be balanced out. Then the OIL RESERVOIR must be observed on each service call. No oil should be added again until the oil level falls below the lower sight glass port.

EXISTING SYSTEM START-UP

When installing this OIL CONTROL SYSTEM, on a parallel system that has been in operation for some time, the amount of oil should be added cautiously. With the efficiency of the new OIL SEPARATOR, the oil return could likely be sufficient to fill the OIL RESERVOIR. So fill the OIL RESERVOIR to the lower sight glass port only. Observe for one day. After the second day, if the oil level has not risen to the upper sight glass, add oil. If the oil level has risen above the upper sight glass port, remove the excess oil from the OIL RESERVOIR.

HEAD PRESSURE CONTROL

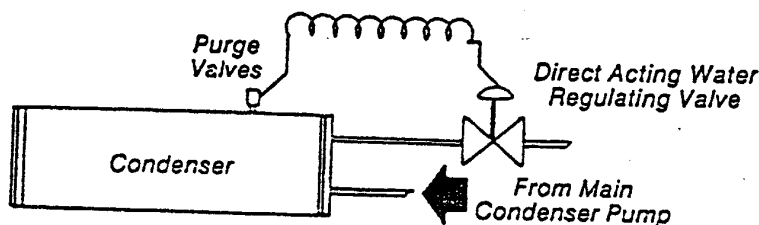


Fig. 1

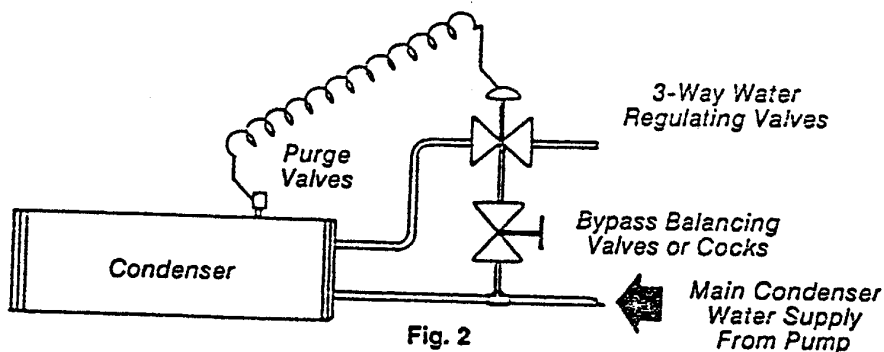


Fig. 2

In order to achieve proper system operation, it is necessary that adequate discharge pressures be maintained to insure that the expansion valve will feed correctly to prevent low suction conditions. The expansion valve is sized to meet capacity requirements at a pressure differential between discharge pressure and design suction pressure. If discharge pressure is allowed to drop below a point which will not maintain this design differential, the suction will also drop due to "starving" of the evaporator. When this happens, nuisance tripping of low pressure control, or low evaporator temperature, will occur.

Normal system design will allow satisfactory operation with discharge pressure down to approximately 180# (95°F). On air cooled equipment, a number of methods can be used to maintain this minimum discharge pressure. The most common, and suitable

for applications where ambient temperatures are not extreme, is fan cycling. When closer control, or extreme ambient differentials are encountered, condenser flooding would be preferred. Other methods are suitable; however, not offered due to design or component limitations.

On water cooled equipment, discharge pressures are much easier to control, and the most common would be by the use of condenser water regulating valves directly sensing discharge pressure. (See Piping Illustration, Figure 1 and 2).

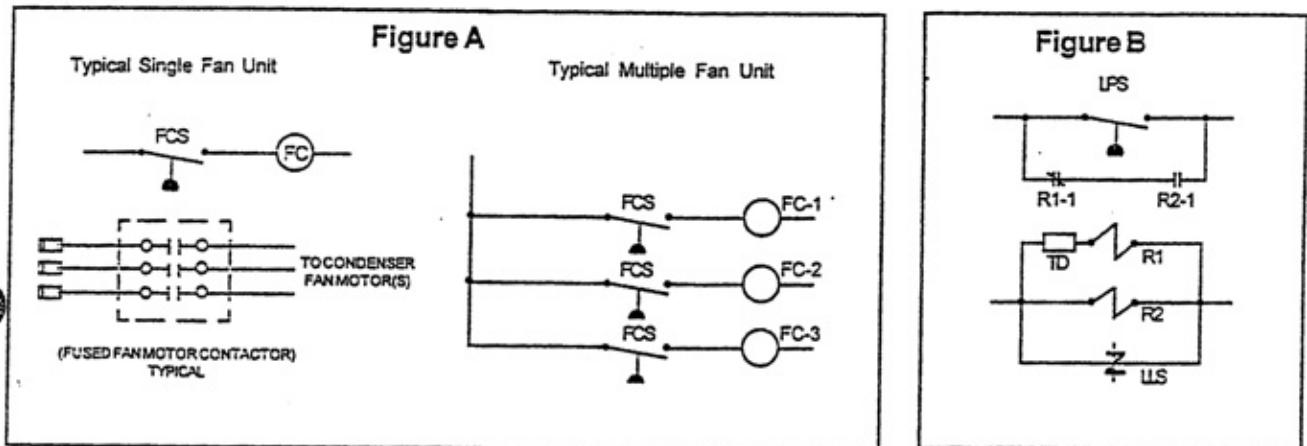
Since systems are normally subjected to varying load requirements, and fluctuating ambient temperatures, it is not possible to design units to operate satisfactorily and with optimum efficiencies without some means of control of discharge pressures.

AIR COOLED CONDENSING UNITS LOW AMBIENT OPERATION

Air conditioning systems utilizing air cooled condensing units operating at ambient temperatures below design, will require some means to stabilize high side pressure. In order to maintain sufficient high side pressure, the condenser capacity must be reduced in response to decreasing high side pressure. This may be accomplished by either reducing the air flow across the condenser, or reducing effective condenser surface by "flooding" the condenser with liquid refrigerant. Technical Systems offers both means of control, factory installed and preset.

FAN CYCLE 20°F controls head pressure by cycling condenser fan(s) in response to a decrease in high side pressure. This system is normally satisfactory down to 20°F ambient. Each step of control is accomplished by a pilot duty pressure control(s), fused fan motor contactor(s), completely installed, wired and factory calibrated. See figure A for typical fan cycle wiring.

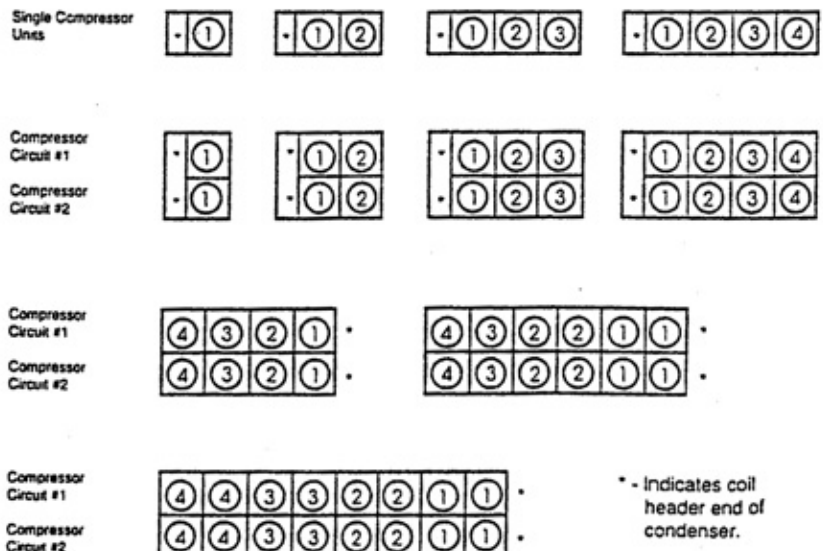
FAN CYCLE 0°F includes, in addition to fan cycling controls, a "positive start" control circuit to insure that the compressor will start at low ambients. All Technical Systems condensing units operate on a pumpdown cycle. During low ambients sufficient low side pressure may not develop to start the compressor upon a call from the temperature control. The "positive start" time relay momentarily bypasses the low pressure operating control to insure compressor operation for 90 seconds. At the end of this timed period, the system pressure will be up to normal operating levels. The timer contacts open returning compressor control to the low pressure operating control. See Figure B for typical wiring of the positive start circuit.



Pressure Settings (PSIG)

| CONTROL | Refrigerant 22 | |
|-----------------------|----------------|-----------|
| | cut-in | cut-out |
| High Pressure | 320 | 360 |
| Low Pressure | 50 | 20 |
| Unloader "A" | 60 | 75 |
| Unloader "B" | 55 | 70 |
| Fan Cycle | step 1 | 220 / 200 |
| | step 2 | 230 / 210 |
| | step 3 | 240 / 220 |
| | step 4 | 250 / 230 |
| Fan Cycle | step 1 | 220 / 200 |
| | step 2 | 230 / 210 |
| | step 3 | 250 / 220 |
| Fan Cycle | step 1 | 220 / 200 |
| | step 2 | 250 / 210 |
| Freeze Control | 54 | 54 |
| Fan Cycle (Penn adj.) | 250 | 200 |

Fan Staging



Fan stage(s) are per compressor circuit.

B20 FLOOD CONTROL utilizes a valve(s) mounted, piped and adjusted to regulate condensing pressure by flooding the condenser with liquid refrigerant. This option does require additional refrigerant in the system.

As shown in Figure 1, during the normal cycle the valve will prevent flow from the discharge line into the receiver, and allow free flow of liquid from the condenser. As the receiver pressure drops, the valve will modulate allowing discharge gas to enter the receiver, and restrict liquid flow from the condenser. The valve continues to modulate in this manner, maintaining a constant receiver pressure.

In addition to flooding valve(s), a "positive start" control circuit is added to insure that the compressor will start at low ambients. All Technical Systems condensing units operate on a pumpdown cycle. During low ambients, sufficient low side pressure may not develop to start the compressor upon a call from the temperature control. The "positive start" time relay momentarily bypasses the low pressure operating control to insure compressor operation for 90 seconds. At the end of this timed period, the system will be up to normal operating levels. The timer contacts open returning compressor control to the low pressure operating control. See Figure 2 for typical wiring.

Figure 1

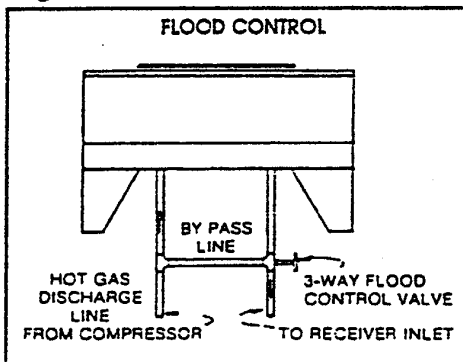
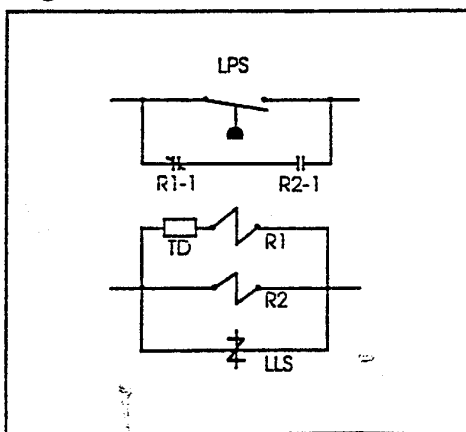


Figure 2



**TABLE 2
CRANKCASE HEATERS
COPELAWELD COMPRESSORS**

J MODELS

| Watts | Volts | Copeland Part No. | | Tutco Part No. |
|-------|-------|-------------------|---------------|----------------|
| | | Heater Kit * | Heater Only | |
| 35 | 120 | 518-0020-00 | 018-0039-00 | CH135-2 |
| 35 | 240 | Not Available | Not Available | CH135 |

* Kit includes Reference Drawing

R, S MODELS

| Watts | Volts | Copeland Part No. | | Springfield Wire Part No. | Tutco Part No. |
|-------|-------------------|---|---|---------------------------|-----------------------------|
| | | Heater Kit * | Heater Only | | |
| 42 | 120 240 | | 018-0015-01 018-0015-00 | GAGN-1 GAGN-1 | |
| 45 | 120 208 240 | 518-0022-00 Not Available 518-0022-02 | 018-0038-00 Not Available 018-0038-02 | | CH103-2 CH103-1 CH103 |

* Kit includes Reference Drawing

B MODELS

| Watts | Volts | Copeland Part No. | | Tutco Part No. |
|-------------------|--------------------------|--|--|---|
| | | Heater Kit * | Heater Only | |
| 70 wrap around | 120 240 460 575 | 518-0019-01 518-0019-00 518-0019-02 518-0019-03 | 018-0036-01 018-0036-00 018-0036-02 018-0036-03 | CH202-02 CH202 CH202-03 CH203-06 |

* Kit includes Reference Drawing and Insulator

C MODELS

| Watts | Volts | Copeland Part No. | | Tutco Part No. |
|-------------------------|--------------------------|--|--|--|
| | | Heater Kit * | Heater Only | |
| Wrap Around (CR*4 only) | | | | |
| 54 | 120 208 240 480 | 518-0021-00 518-0021-01 518-0021-02 518-0021-03 | 018-0037-00 018-0037-01 018-0037-02 018-0037-03 | CH101-2 CH101-1 CH101 CH101-3 |
| Round | | | | |
| 40 | 240/480/600 | | 018-0031-02 | S.W. SO-111 T.I. 9HT5-13 |

* Kit includes Reference Drawing

**TABLE 3
CRANKCASE HEATERS
COPELAMETIC COMPRESSORS**

H, K MODELS

| Watts | Volts | Copeland Part No. | Indeeco Part No. | Hot Watt Part No. |
|---------------|-------|---|--|---|
| | | Heater Kit | | |
| 50 clip on | 12 | 998-0118-07 998-0118-05 998-0118-06 (Kit includes clips.) | | 13R0115-1-AL1 13R0115-2-AL1 13R0115-3-AL1 |
| | 120 | | | |
| | 240 | | | |
| 50 bolt on | 420 | 998-0118-02 998-0118-03 (Kit includes bolts & reference drawing) | 66-12976-7-30C24-C 66-12976-4-30C24-C | |
| | 480 | | | |

2D, E, 3R, L, M, N, 9, 3D, 4, 6 MODELS

| Watts | Volts | Copeland Part No. | | Acra Part No. | Hot Watt Part No. | |
|-------|-------|-------------------|-------------|---------------|-------------------|------------------|
| | | Heater Kit * | Heater Only | | | |
| 55 | 120 | 518-0009-00 | 018-0034-00 | ARB6215 | 13J0600-1-ERC1-1 | |
| | 240 | 518-0009-01 | 018-0034-01 | ARB6215 | 13J0600-2-ERC1-1 | |
| | 480 | 518-0009-02 | 018-0034-02 | ARB6215 | | |
| | 600 | 518-0009-03 | 018-0034-03 | ARB6215 | | |
| | 12 | | 518-0009-04 | 018-0034-04 | ARB6215 | 13J0600-5-ERC1-1 |
| | | | | | | |

* Kit Includes Bolts and Reference Drawing

**2D, M MODELS, Internal Immersion Type For Deep Oil Sump
9, 3D MODELS, Internal Immersion Type For Fiat Bottom Plate or Deep Oil Sump**

| Watts | Volts | Copeland Part No. | Hot Watt Part No. | Acra Part No. |
|-------|-------|-------------------|-------------------|---------------|
| 65 | 120 | 518-0001-03 | 13A0054-4-EB1J-1 | IBW-375 |
| | 240 | 518-0001-02 | 13A0054-3-EB1J-1 | IBW-375 |
| | 480 | 518-0001-01 | | IBW-375 |
| | 600 | 518-0001-00 | | IBW-375 |

4, 6 MODELS, Internal Immersion Type For Flat Bottom Plate

| Watts | Volts | Copeland Part No. | Hot Watt Part No. | Acra Part No. |
|-------|-------|-------------------|-------------------|---------------|
| 100 | 120 | 518-0002-03 | 13A9996-4-EB1J-3 | IBW-625 |
| | 240 | 518-0002-02 | 13A9996-3-EB1J-3 | IBW-625 |
| | 480 | 518-0002-01 | | IBW-625 |
| | 600 | 518-0002-00 | | IBW-625 |
| | 420 | 518-0002-04 | | IBW-625 |

4, 6, 8 MODELS, Internal Immersion Type For Deep Oil Sump

| Watts | Volts | Copeland Part No. | Acra Part No. |
|-------|-------|-------------------|---------------|
| 200 | 120 | 998-0518-00 | ARCW901-500 |
| | 240 | 998-0518-01 | ARCW901-500 |



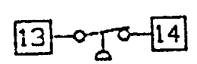
Wiring Diagram Symbols



DIFFERENTIAL PRESSURE SWITCH



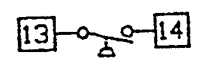
LIQUID LINE SOLENOID



HIGH PRESSURE SAFETY



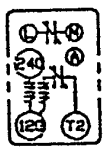
COOLING STAGE THERMOSTAT



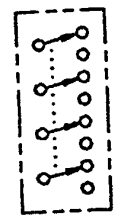
LOW PRESSURE CONTROL



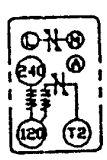
COOLING STAGE THERMOSTAT



OIL FAILURE SAFETY



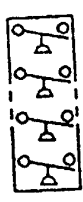
MANUAL LEAD LAG SWITCH



FREEZE SAFETY



FLOW SWITCH



FAN CYCLE CONTROL



TIME DELAY RELAY

TROUBLE SHOOTING CHART

| PROBLEM | POSSIBLE CAUSES | POSSIBLE CORRECTIVE STEPS |
|-------------------------------|--|---|
| Compressor will not run | <ul style="list-style-type: none"> a) Main switch open <li style="padding-left: 20px;">Circuit breakers open b) Fuse blown c) Thermal overloads tripped or fuses blown d) Defective contactor or coil e) System shut down by safety devices f) No cooling required g) Liquid line solenoid will not open h) Motor electrical trouble i) Loose wiring | <ul style="list-style-type: none"> a) Close switch b) Check electrical circuits and motor winding for shorts or grounds. Investigate for possible overloading. Replace fuse or reset breakers after fault is corrected c) Overloads are auto reset. Check unit closely when unit comes back on line d) Repair or replace. e) Determine type and cause of shut-down and correct it before resetting safety switch f) None. Wait until unit calls for cooling. g) Repair or replace coil h) Check motor for opens, short circuit, or burnout. i) Check all wire junctions. Tighten all terminal screws |
| Compressor noisy or vibrating | <ul style="list-style-type: none"> a) Flooding of refrigerant into crankcase *b) Improper piping support on discharge or liquid line c) Worn compressor | <ul style="list-style-type: none"> a) Check setting of expansion valve b) Relocate, add, or remove hangers c) Replace |
| High Discharge Pressure | <ul style="list-style-type: none"> a) Condenser water insufficient or temperature too high b) Fouled condenser tubes (water-cooled condenser) Clogged spray nozzles (evaporative condenser) Dirty tube and fin surface (air cooled condenser) c) Non-condensibles in system *d) System overcharged with refrigerant e) Discharge shut off valve partially closed *f) Condenser undersized *g) High ambient conditions | <ul style="list-style-type: none"> a) Readjust water regulating valve. Investigate ways to increase water supply b) Clean c) Purge the non-condensibles d) Remove excess e) Open valve f) Check condenser rating tables against the operation g) Check condenser rating tables against the operation |
| Low Discharge Pressure | <ul style="list-style-type: none"> a) Faulty condenser temperature regulation b) Suction shut-off valve partially closed c) Insufficient refrigerant in system d) Low suction pressure e) Compressor operating unloaded *f) Condenser too large *g) Low ambient conditions | <ul style="list-style-type: none"> a) Check condenser control operation b) Open valve c) Check for leaks. Repair and add charge d) See Corrective Steps for low suction pressure below e) See Corrective Steps for failure of compressor to load up below f) Check condenser rating tables against the operation g) Check condenser rating tables against the operation |
| High Suction Pressure | <ul style="list-style-type: none"> a) Excessive load b) Expansion valve overfeeding c) Compressor unloaders open | <ul style="list-style-type: none"> a) Reduce load or add additional equipment b) Check remote bulb. Regulate superheat c) See Corrective Steps below or failure of compressor to load up |
| Low Suction Pressure | <ul style="list-style-type: none"> a) Lack of refrigerant b) Evaporator dirty c) Clogged liquid line filter-drier d) Clogged suction line or compressor suction gas strainers e) Expansion valve malfunctioning | <ul style="list-style-type: none"> a) Check for leaks. Repair and add charge b) Clean chemically c) Replace cartridge(s) d) Clean strainers e) Check and reset for proper superheat. Replace if necessary |

* Remote condenser models

Wiring Diagram Symbols



DIFFERENTIAL PRESSURE SWITCH



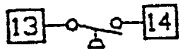
LIQUID LINE SOLENOID



HIGH PRESSURE SAFETY



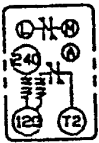
COOLING STAGE THERMOSTAT



LOW PRESSURE CONTROL



COOLING STAGE THERMOSTAT



OIL FAILURE SAFETY



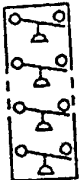
MANUAL LEAD LAG SWITCH



FREEZE SAFETY



FLOW SWITCH



FAN CYCLE CONTROL



TIME DELAY RELAY

TROUBLE SHOOTING CHART

| PROBLEM | POSSIBLE CAUSES | POSSIBLE CORRECTIVE STEPS |
|-------------------------------|--|--|
| Compressor will not run | <ul style="list-style-type: none"> a) Main switch open Circuit breakers open b) Fuse blown c) Thermal overloads tripped or fuses blown d) Defective contactor or coil e) System shut down by safety devices f) No cooling required g) Liquid line solenoid will not open h) Motor electrical trouble i) Loose wiring | <ul style="list-style-type: none"> a) Close switch b) Check electrical circuits and motor winding for shorts or grounds. Investigate for possible overloading. Replace fuse or reset breakers after fault is corrected c) Overloads are auto reset. Check unit closely when unit comes back on line d) Repair or replace. e) Determine type and cause of shut-down and correct it before resetting safety switch f) None. Wait until unit calls for cooling. g) Repair or replace coil h) Check motor for opens, short circuit, or burnout. i) Check all wire junctions. Tighten all terminal screws. |
| Compressor noisy or vibrating | <ul style="list-style-type: none"> a) Flooding of refrigerant into crankcase *b) Improper piping support on discharge or liquid line c) Worn compressor | <ul style="list-style-type: none"> a) Check setting of expansion valve b) Relocate, add, or remove hangers c) Replace |
| High Discharge Pressure | <ul style="list-style-type: none"> a) Condenser water insufficient or temperature too high b) Fouled condenser tubes (water-cooled condenser); Clogged spray nozzles (evaporative condenser); Dirty tube and fin surface (air cooled condenser) c) Non-condensibles in system *d) System overcharged with refrigerant e) Discharge shut off valve partially closed *f) Condenser undersized *g) High ambient conditions | <ul style="list-style-type: none"> a) Readjust water regulating valve. Investigate ways to increase water supply b) Clean c) Purge the non-condensibles d) Remove excess e) Open valve f) Check condenser rating tables against the operation g) Check condenser rating tables against the operation |
| Low Discharge Pressure | <ul style="list-style-type: none"> a) Faulty condenser temperature regulation b) Suction shut-off valve partially closed c) Insufficient refrigerant in system d) Low suction pressure e) Compressor operating unloaded *f) Condenser too large *g) Low ambient conditions | <ul style="list-style-type: none"> a) Check condenser control operation b) Open valve c) Check for leaks. Repair and add charge d) See Corrective Steps for low suction pressure below e) See Corrective Steps for failure of compressor to load up below f) Check condenser rating tables against the operation g) Check condenser rating tables against the operation |
| High Suction Pressure | <ul style="list-style-type: none"> a) Excessive load b) Expansion valve overfeeding c) Compressor unloaders open | <ul style="list-style-type: none"> a) Reduce load or add additional equipment b) Check remote bulb. Regulate superheat c) See Corrective Steps below or failure of compressor to load up |
| Low Suction Pressure | <ul style="list-style-type: none"> a) Lack of refrigerant b) Evaporator dirty c) Clogged liquid line filter-drier d) Clogged suction line or compressor suction gas strainers e) Expansion valve malfunctioning | <ul style="list-style-type: none"> a) Check for leaks. Repair and add charge b) Clean chemically c) Replace cartridge(s) d) Clean strainers e) Check and reset for proper superheat. Replace if necessary |

*Remote condenser models

TROUBLE SHOOTING CHART

| PROBLEM | POSSIBLE CAUSES | POSSIBLE CORRECTIVE STEPS |
|--|---|--|
| Low Suction Pressure (Continued) | <ul style="list-style-type: none"> f) Condensing temperature too low g) Compressor will not unload h) Insufficient water flow | <ul style="list-style-type: none"> f) Check means for regulating condensing temperature g) See Corrective Steps for failure of compressor to unload h) Adjust gpm |
| Compressor will not unload or load up | <ul style="list-style-type: none"> a) Defective capacity control b) Unloader mechanism defective c) Faulty thermostat stage or broken capillary tube d) Stages not set for application | <ul style="list-style-type: none"> a) Replace b) Replace c) Replace d) Reset thermostat setting to fit application |
| Compressor Loading-Unloading intervals too short | <ul style="list-style-type: none"> a) Erratic water thermostat b) Insufficient water flow | <ul style="list-style-type: none"> a) Replace b) Adjust gpm |
| Little or no oil pressure | <ul style="list-style-type: none"> a) Clogged suction oil strainer b) Excessive liquid in crankcase c) Oil pressure gauge defective d) Low-oil pressure safety switch defective e) Worn oil pump f) Oil pump reversing gear stuck in wrong position g) Worn bearings h) Low oil level i) Loose fitting on oil lines j) Pump housing gasket leaks k) Flooding of refrigerant into crankcase | <ul style="list-style-type: none"> a) Clean b) Check crankcase heater. Reset expansion valve for higher superheat. Check liquid line solenoid valve operation. c) Repair or replace. Keep valve closed except when taking reading. d) Replace e) Replace f) Reverse direction of compressor rotation g) Replace compressor h) Add oil i) Check and tighten system j) Replace gasket k) Adjust thermal expansion valve |
| Compressor loses oil | <ul style="list-style-type: none"> a) Lack of refrigerant *b) Velocity in risers too low *c) Oil trapped in line d) Excessive compression ring blow-by | <ul style="list-style-type: none"> a) Check for leaks and repair. Add refrigerant b) Check riser sizes c) Check pitch of lines and refrigerant velocities d) Replace compressor |
| Motor overload relays or circuit breakers open | <ul style="list-style-type: none"> a) Low voltage during high load conditions b) Defective or grounded wiring in motor or power circuits c) Loose power wiring d) High condensing temperature e) Power line fault causing unbalanced voltage f) High ambient temperature around the overload relay g) Failure of second starter to pull in on part-winding start system | <ul style="list-style-type: none"> a) Check supply voltage for excessive line drop b) Replace compressor-motor c) Check all connections and tighten d) See Corrective Steps for high discharge pressure e) Check supply voltage. Notify power company. Do not start until fault is corrected f) Provide ventilation to reduce heat g) Repair or replace starter or time delay mechanism |
| Compressor thermal protector switch open | <ul style="list-style-type: none"> a) Operating beyond design conditions b) Discharge valve partially shut c) Blown valve plate gasket | <ul style="list-style-type: none"> a) Add facilities so that conditions are within allowable limits b) Open valve c) Replace gasket |
| Freeze protection opens | <ul style="list-style-type: none"> a) Thermostat set too low b) Low water flow c) Low suction pressure | <ul style="list-style-type: none"> a) Reset to 40 F or above b) Adjust gpm c) See "Low Suction Pressure" |

*Remote condenser models

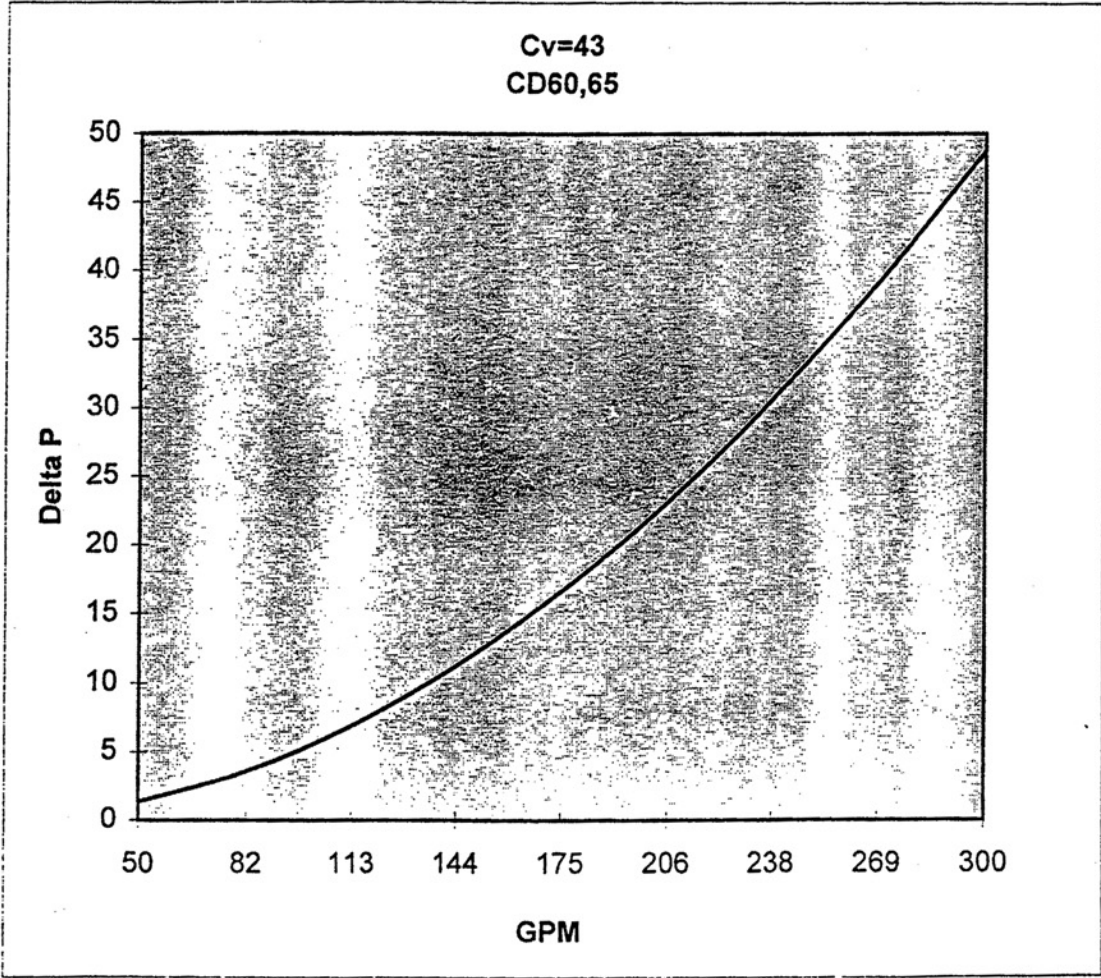
TEMPERATURE PRESSURE CHART

| Temp. Deg. F. | REFRIGERANT | | | Temp. Deg. F. | REFRIGERANT | | | Temp. Deg. F. | REFRIGERANT | | |
|------------------|-------------|-------------|-------------|------------------|-------------|-------------|-------------|------------------|--------------|--------------|--------------|
| | 22 | 134a | 502 | | 22 | 134a | 502 | | 22 | 134a | 502 |
| -60 | <i>11.9</i> | <i>21.6</i> | <i>7.2</i> | <i>14</i> | <i>36.8</i> | <i>14.4</i> | <i>45.4</i> | <i>64</i> | <i>109.3</i> | <i>62.7</i> | <i>124.6</i> |
| -55 | 9.2 | 20.2 | 3.9 | 15 | 37.8 | 15.1 | 46.5 | 66 | 113.3 | 65.4 | 128.9 |
| -50 | <i>6.7</i> | <i>16.6</i> | <i>0.2</i> | <i>16</i> | <i>38.8</i> | <i>15.7</i> | <i>47.7</i> | <i>68</i> | <i>117.3</i> | <i>68.2</i> | <i>133.2</i> |
| -45 | 2.7 | 16.7 | 1.9 | 17 | 39.9 | 16.4 | 48.9 | 70 | 121.5 | 71.1 | 137.6 |
| -40 | <i>0.6</i> | <i>14.7</i> | <i>4.1</i> | <i>18</i> | <i>40.9</i> | <i>17.1</i> | <i>50.0</i> | <i>72</i> | <i>125.7</i> | <i>74.1</i> | <i>142.2</i> |
| -38 | 1.4 | 13.8 | 5.1 | 19 | 42.0 | 17.7 | 51.2 | 74 | 130.0 | 77.1 | 146.8 |
| -36 | 2.2 | 12.8 | 6.0 | 20 | 43.1 | 18.4 | 52.5 | 76 | 134.5 | 80.2 | 151.5 |
| -34 | 3.1 | 11.8 | 7.0 | 21 | 44.2 | 19.2 | 53.7 | 78 | 139.0 | 83.4 | 156.3 |
| -32 | 4.0 | 10.8 | 8.1 | 22 | 45.3 | 19.9 | 54.9 | 80 | 143.7 | 86.7 | 161.2 |
| -30 | 4.9 | 9.7 | 9.2 | 23 | 46.5 | 20.6 | 56.2 | 82 | 148.4 | 90.0 | 166.2 |
| -28 | <i>5.9</i> | <i>8.6</i> | <i>10.3</i> | <i>24</i> | <i>47.6</i> | <i>21.4</i> | <i>57.5</i> | <i>84</i> | <i>153.3</i> | <i>93.5</i> | <i>171.4</i> |
| -25 | 6.9 | 7.4 | 11.5 | 25 | 48.8 | 22.1 | 58.8 | 86 | 158.2 | 97.0 | 176.6 |
| -24 | <i>8.0</i> | <i>6.2</i> | <i>12.7</i> | <i>26</i> | <i>50.0</i> | <i>22.9</i> | <i>60.1</i> | <i>88</i> | <i>163.3</i> | <i>100.6</i> | <i>181.9</i> |
| -22 | 9.1 | 4.9 | 14.0 | 27 | 51.2 | 23.7 | 61.5 | 90 | 168.4 | 104.3 | 187.4 |
| -20 | <i>10.2</i> | <i>3.6</i> | <i>15.3</i> | <i>28</i> | <i>52.4</i> | <i>24.5</i> | <i>62.8</i> | <i>92</i> | <i>173.7</i> | <i>108.1</i> | <i>192.9</i> |
| -18 | 11.4 | 2.2 | 16.7 | 29 | 53.7 | 25.3 | 64.2 | 94 | 179.1 | 112.0 | 198.6 |
| -16 | <i>12.6</i> | <i>0.7</i> | <i>18.1</i> | <i>30</i> | <i>54.9</i> | <i>26.1</i> | <i>65.6</i> | <i>96</i> | <i>184.6</i> | <i>115.9</i> | <i>204.3</i> |
| -14 | 13.9 | 0.4 | 19.5 | 31 | 56.2 | 26.9 | 67.0 | 98 | 190.2 | 120.0 | 210.2 |
| -12 | <i>15.2</i> | <i>1.2</i> | <i>21.0</i> | <i>32</i> | <i>57.5</i> | <i>27.8</i> | <i>68.4</i> | <i>100</i> | <i>196.0</i> | <i>124.1</i> | <i>216.2</i> |
| -10 | 16.5 | 2.0 | 22.6 | 33 | 58.8 | 28.6 | 69.9 | 102 | 201.8 | 128.4 | 222.3 |
| -8 | <i>17.9</i> | <i>2.8</i> | <i>24.2</i> | <i>34</i> | <i>60.2</i> | <i>29.5</i> | <i>71.3</i> | <i>104</i> | <i>207.8</i> | <i>132.7</i> | <i>228.5</i> |
| -6 | 19.4 | 3.7 | 25.8 | 35 | 61.5 | 30.4 | 72.8 | 106 | 213.9 | 137.2 | 234.9 |
| -4 | 20.9 | 4.6 | 27.5 | 36 | 62.9 | 31.3 | 74.3 | 108 | 220.1 | 141.7 | 241.3 |
| -2 | 22.4 | 5.5 | 29.3 | 37 | 64.3 | 32.2 | 75.9 | 110 | 226.4 | 146.4 | 247.9 |
| 0 | 24.0 | 6.5 | 31.1 | 38 | 65.7 | 33.1 | 77.4 | 112 | 232.9 | 151.1 | 254.6 |
| 1 | 24.8 | 7.0 | 32.0 | 39 | 67.1 | 34.1 | 79.0 | 114 | 239.5 | 155.9 | 261.5 |
| 2 | 25.7 | 7.5 | 32.9 | 40 | 68.6 | 35.0 | 80.5 | 116 | 246.2 | 160.9 | 268.4 |
| 3 | 26.5 | 8.0 | 33.9 | 42 | 71.5 | 37.0 | 83.8 | 118 | 253.1 | 166.0 | 275.5 |
| 4 | 27.4 | 8.6 | 34.9 | 44 | 74.5 | 39.0 | 87.0 | 120 | 260.0 | 171.1 | 282.7 |
| 5 | 28.3 | 9.1 | 35.9 | 46 | 77.6 | 41.1 | 90.4 | 125 | 278.1 | 184.5 | 301.4 |
| 6 | 29.1 | 9.7 | 36.9 | 48 | 80.8 | 43.2 | 93.9 | 130 | 297.0 | 198.7 | 320.8 |
| 7 | 30.0 | 10.2 | 37.9 | 50 | 84.1 | 45.4 | 97.4 | 135 | 316.8 | 213.5 | 341.2 |
| 8 | 31.0 | 10.8 | 38.9 | 52 | 87.4 | 47.7 | 101.1 | 140 | 337.5 | 229.2 | 362.6 |
| 9 | 31.9 | 11.4 | 39.9 | 54 | 90.8 | 50.0 | 104.8 | 145 | 359.1 | 245.6 | 385.0 |
| 10 | 32.8 | 12.0 | 41.0 | 56 | 94.4 | 52.4 | 108.6 | 150 | 381.7 | 262.8 | 408.4 |
| 11 | 33.8 | 12.6 | 42.1 | 58 | 98.0 | 54.9 | 112.4 | 155 | 405.4 | 281.0 | 432.9 |
| 12 | 34.8 | 13.2 | 43.2 | 60 | 101.6 | 57.4 | 116.4 | 160 | 430.1 | 299.9 | 458.7 |
| 13 | 35.8 | 13.8 | 44.3 | 62 | 105.4 | 60.0 | 120.5 | 165 | 455.8 | 319.9 | 485.8 |

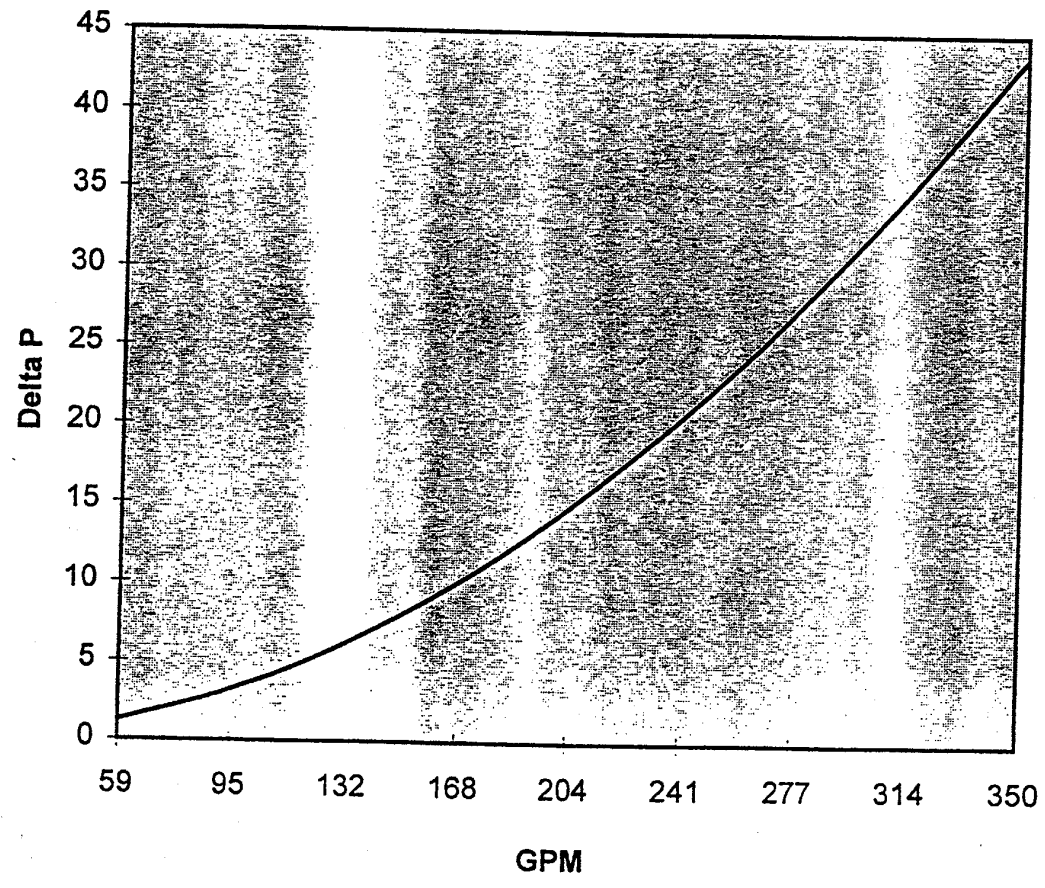
VACUUM - Inches of Mercury - *Italic Figures*

PRESSURE - Pounds Per Square Inch Gauge - **Bold Figures**

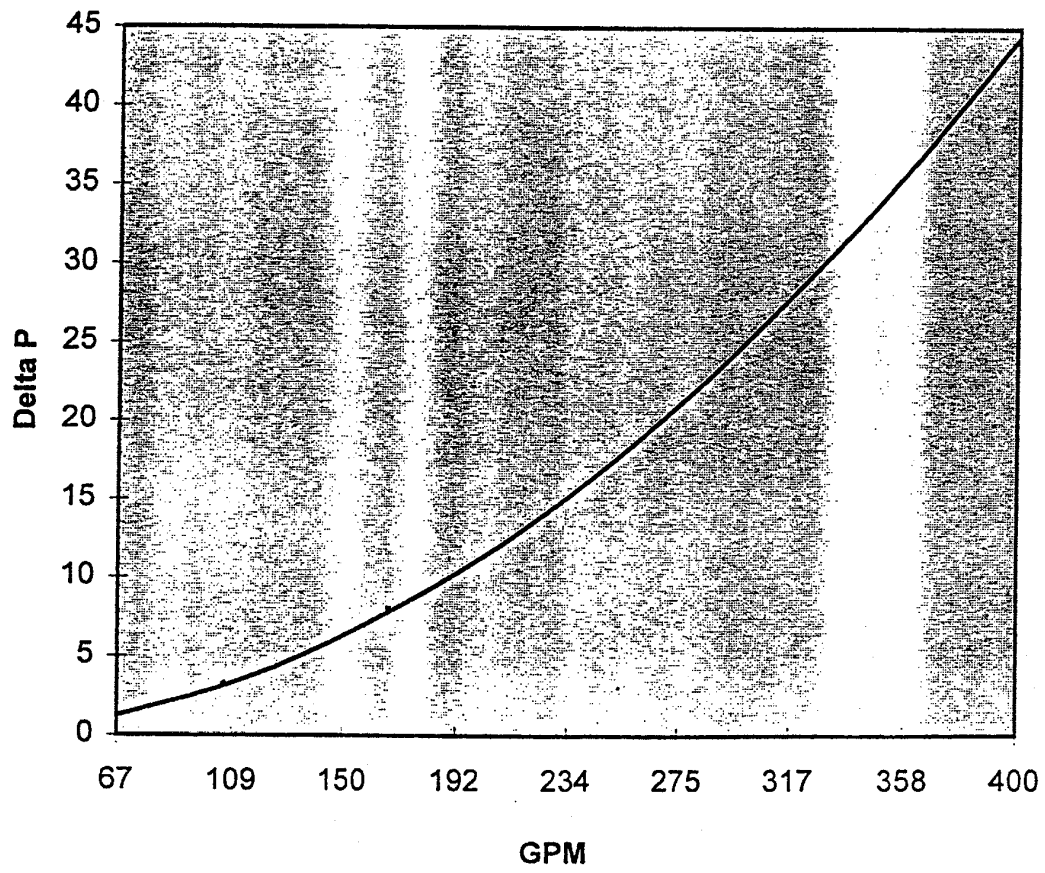
Cv=43
CD60,65



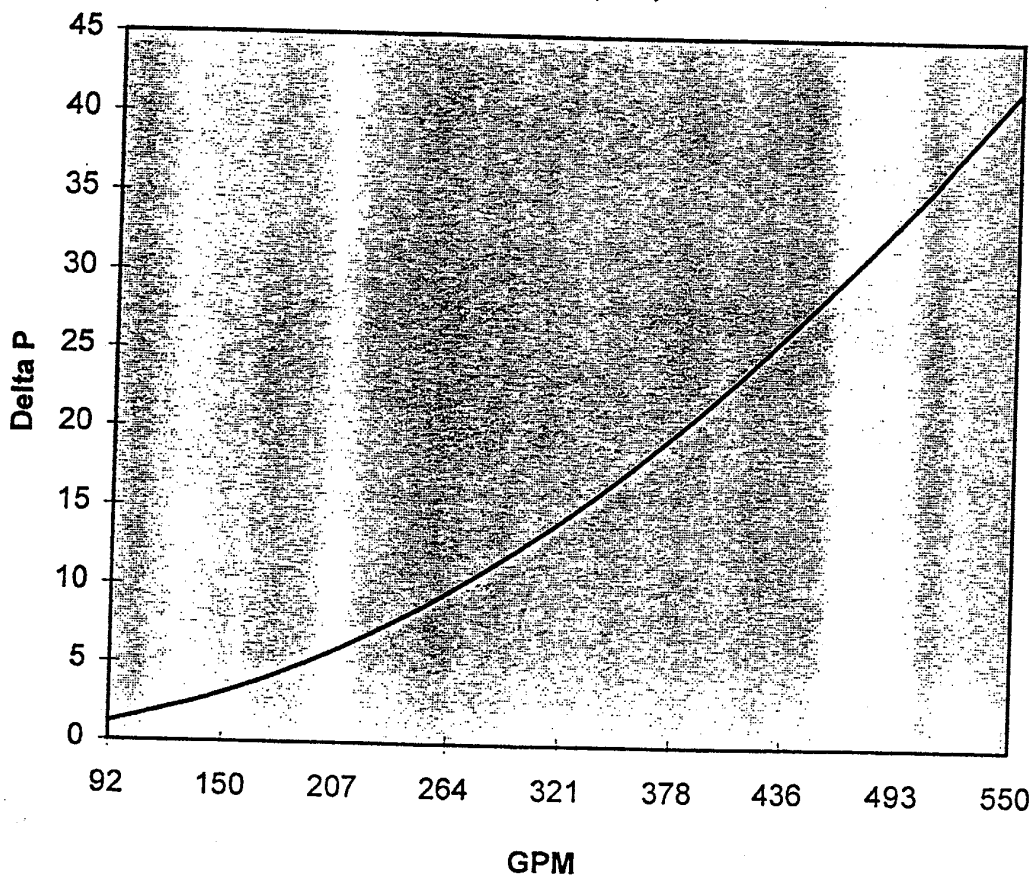
Cv=53
CD70,75



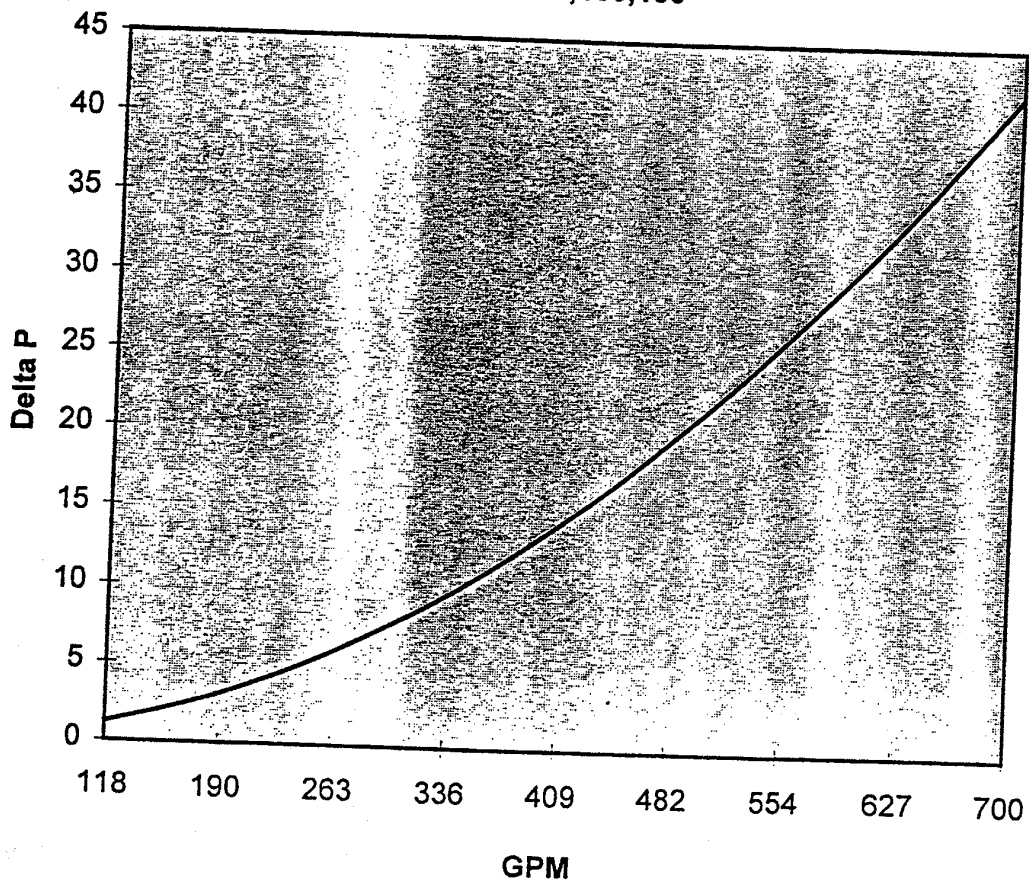
Cv=80
CD80,CM90,CM100



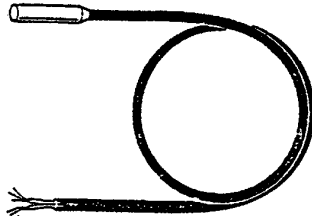
Cv=110
CM110,120,122,130



$C_v=120$
CM140,150,160



SET189A Temperature Sensor



SET189A

Description:

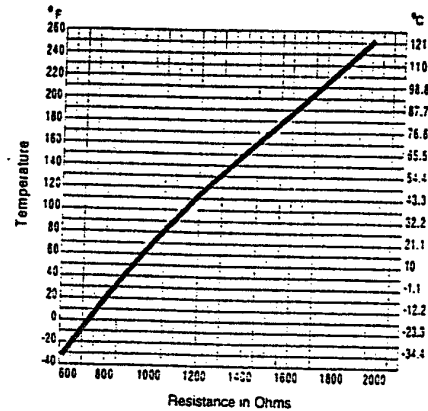
The SET189A-600R is a PTC (Positive Temperature Coefficient) silicon sensor with a range of -30 to 250°F. The sensor has a reference resistance of 1035 ohms at 77°F and a change of approximately 0.42%/°F. The sensor itself measures 0.25 in. x 1.75 in. (6 mm x 44 mm) and can be combined with various mounting hardware to cover a wide application spectrum. The SET189A-600R is used in conjunction with the A350, A350P, and A350R temperature controls.

Features:

- -30 to 250°F range with linear response
- compact size (less than 2 in. long)
- various mounting configurations with optional hardware

Applications:

- used in conjunction with A350, A350P, and A350R controls to sense space temperature and transmit corresponding resistance signal



Temperature vs. Resistance Chart for SET189A-600R Sensor

Specifications:

- reference resistance of 1035 ohms at 77°F and .42%/°F change

To Order:

Specify sensor catalog number and optional hardware from the tables below.

Selection Chart SET189A Temperature Sensors

| Catalog Number | Description |
|----------------|---|
| SET189A-600R | Sensor with 9 in. leads, bulb diameter 0.25 in., length 1.75 in. (6 mm x 44 mm) |
| SET189A-605R | Sensor with 10 ft leads, bulb diameter 0.25 in., length 1.75 in. (6 mm x 44 mm) |
| SET189A-606R | Sensor with 15 ft leads, bulb diameter 0.25 in., length 1.75 in. (6 mm x 44 mm) |
| SET189A-607R | Sensor with 6 ft leads, bulb diameter 0.25 in., length 1.75 in. (6 mm x 44 mm) |
| SET189A-608R | Outdoor sensor kit, includes SET189A-600R sensor mounted in a PVC plastic enclosure and two wire nuts |
| SET189A-612R | Sensor with 50 ft leads, bulb diameter 0.25 in., length 1.75 in. (6 mm x 44 mm) |

Optional Hardware for SET189A-600R

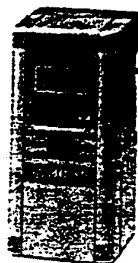
| Application | Catalog Number | Description |
|-----------------|----------------|--|
| Room Sensor | TE-6001-4 | Wall mount plate with sensor mounting clip |
| | T-4000-26-4 | Cover for wall mount plate |
| Outdoor Air | TE-6001-2 | Housing for outside application |
| Conduit Adapter | ADP11A-600R | 1/2 in. snap-fit connector enables metal conduit to be linked to a variety of PVC enclosures |
| Enclosure | BOX10A-600R | Outdoor PVC enclosure without sensor |
| Sunshield | SHL10A-603R | For use with outside sensors mounted in direct sunlight |
| Immersion | WEL11A-601R | For use with SET189A-600 series sensors; incorporates a copper tube and brass connector |
| Duct | TE-6001-11 | Sensor holder |
| | TE-6001-1 | Sensor holder with handi box |

Recommended Maximum Sensor Cable Lengths

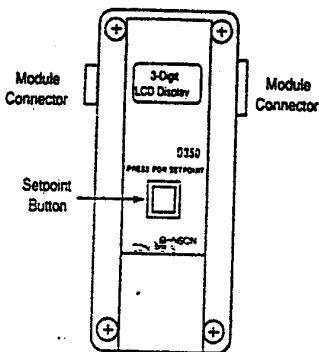
| Gauge | Shielded Cable Length | |
|--------|-----------------------|--------|
| | Feet | Meters |
| 14 AWG | 800 | 244 |
| 16 AWG | 500 | 152 |
| 18 AWG | 310 | 94 |
| 20 AWG | 200 | 60 |
| 22 AWG | 124 | 38 |

Note: Shielded cable is not generally required for sensor wiring runs of less than 50 ft.

D350 Temperature Display Module



D350



Features:

- display of actual space temperature and setpoint
- remote display mounting with WHA29A cable (up to 50 ft)
- snap-on, 5-pin connector for easy installation

Applications:

- temperature indication (local or remote) in conjunction with A350, A350P, and A350R Controls

Accessories:

For remote mounting of the D350 display module, specify the catalog number (cable length) from the table below.

| Catalog Number | Cable Length |
|----------------|--------------|
| WHA29A-600R | 3 ft |
| WHA29A-601R | 25 ft |
| WHA29A-602R | 50 ft |

Description:

The D350 is a digital display module used in conjunction with the A350, A350P, and A350R Series temperature controls. A 3-digit LCD display provides continuous read-out of the actual space temperature.

By pressing the setpoint button for three seconds, the actual setpoint can also be displayed. When used with the A350R, pressing the setpoint button will cause the supply sensor temperature to be displayed.

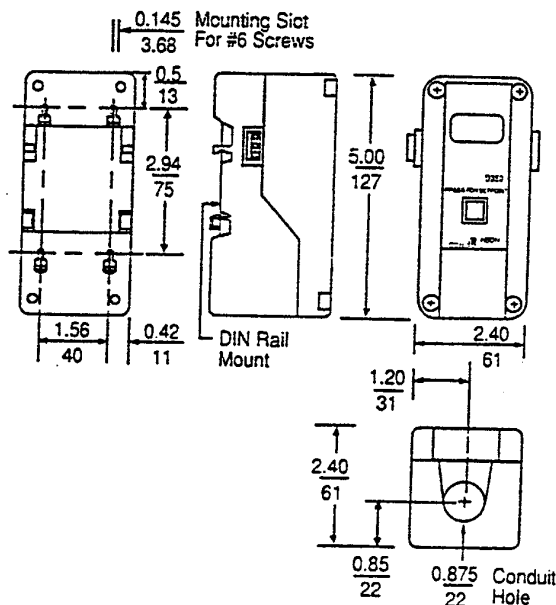
To Order:

Specify the catalog number in the selection chart below.

Selection Chart D350 Digital Display

| Catalog Number | Display Range (F/C) | Display Character |
|----------------|---------------------|-------------------|
| D350AA-1C | -30 to 250°F | 0.35 in. LCD |
| D350BA-1C | -34 to 121°C | |

| Specifications | | |
|-------------------------|---|--|
| Product | D350AA | Temperature module with Fahrenheit scale |
| | D350BA | Temperature module with Celsius scale |
| Case and Cover Material | High impact plastic | |
| Read-out | 3-digit LCD (Liquid Crystal) continuous display | |
| Input Voltage | 5 VDC provided by the A350 Temperature Control | |
| Ambient Temperature | Operating | -30 to 140°F (-34 to 60°C) |
| | Shipping | -40 to 167°F (-40 to 75°C) |
| Humidity | 0 to 95% RH non-condensing | |
| Mounting | Surface or DIN rail | |



D350 Dimensions

Specifications

| | |
|----------------------------|---|
| Product | S350AA: Temperature Module with Fahrenheit Scale S350AB: Temperature Module with Celsius Scale S351AA: Humidity Module with Percent RH Scale S352AA: Pressure Module with PSIG Scale |
| Material | Case, Cover: NEMA 1 High Impact Noryl® Plastic |
| Input Voltage | S350: 5 VDC Reference Provided by the A350; 24 V Power Supply S351: 12 VDC Reference Provided by the W351; 24 V Power Supply. S352: 14 VDC Reference Provided by the P352; 24 V Power Supply. |
| Ambient Temperature | Operating : -30 to 150°F (-34 to 66°C) Shipping: -40 to 185°F (-40 to 85°C) |
| Humidity | 0 to 95% RH Non-condensing |
| Relays | SPDT Enclosed Relays. Contacts Rated at 10 amp Non-inductive, 1/2 hp, 120/240 VAC |
| Differential Range | S350AA: 1 to 30 F° S350AB: 0.6 to 16.7 C° S351AA: 2 to 10% RH S352AA: 10 to 100 PSI |
| Offset Range | S350AA: 1 to 30 F° S350AB: 0.6 to 16.7 C° S351AA: 2 to 30% RH S352AA: 10 to 60 PSI |
| Mounting | Wall or DIN Rail |
| Agency Listing | UL Guide No. XAPX File E6688 CSA Class No. 4813 02 File LR948 |

Noryl® is a registered trademark of the General Electric Company.

The performance specifications are nominal and conform to acceptable industry standards. For application at conditions beyond these specifications, consult the local Johnson Controls office. Johnson Controls, Inc. shall not be liable for damages resulting from misapplication or misuse of its products.

**JOHNSON
CONTROLS**

Controls Group
E. Michigan Street
Box 423
Milwaukee, WI 53201

FAN 930
System 350 Product Guide
Printed in U.S.A.

System 350™ A350 Electronic Temperature Control

The A350 Series is an on/off electronic temperature control with single-pole, double-throw relay output and LED indication. The A350 Series is designed with heating or cooling modes of operation, adjustable differential, and an interchangeable temperature sensor. The A350 will accept up to nine S350 Temperature Stage Modules to control a total of ten stages of heating, cooling, or combinations thereof.

Like all System 350 Products, the A350 is housed in a NEMA 1 high-impact plastic enclosure. The modular design provides easy, snap-together connections for quick installation and future expandability.

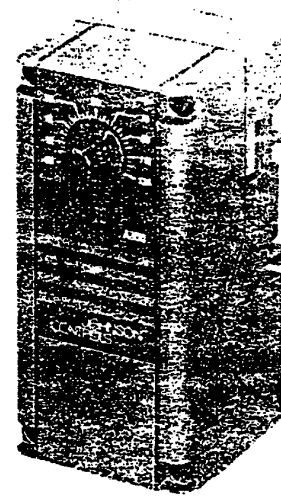


Figure 1: A350 Electronic Temperature Control

| Features and Benefits | |
|--|--|
| <input type="checkbox"/> Modular Design | Provides the flexibility to add up to nine S350 Stage Modules, a D350 Temperature Display Module, and a Y350R Power Module |
| <input type="checkbox"/> Plug-in Connectors and 35 mm DIN rail Mounting | Eliminates wiring between modules, reducing installation costs |
| <input type="checkbox"/> Two Models Cover Temperature Ranges from -30 to 250°F (-35 to 120°C) | Reduces inventory by encompassing temperature ranges required to support the majority of HVAC/R applications |
| <input type="checkbox"/> Wide Adjustable Differential of 1 to 30°F (0.5 to 17°C) | Enables the user to match equipment cycle rate and/or sequencing for a given application |
| <input type="checkbox"/> Field-selectable Mode Jumpers | Works in any combination of heating or cooling equipment |
| <input type="checkbox"/> Available with Either Visible or Concealed Setpoint | Provides a range of user accessibility |
| <input type="checkbox"/> Interchangeable Temperature Sensors | Increases versatility and serviceability |

Application Overview

The A350 Temperature Control can be used as a standalone device or in conjunction with other System 350 Plug-in Accessory Modules to control a wide variety of single or multiple stage HVAC or refrigeration equipment. Typical applications include:

- frozen/refrigerated food cases
- cooling tower control
- beverage/milk coolers
- chiller staging
- space temperature control

A typical System 350 Temperature Control scheme includes the following:

- A350 Temperature Control
- S350 Stage Modules
- D350 Digital Temperature Sensor/Setpoint Display Module
- Y350R Power Module (or 24 VAC transformer)
- SET189A Series Temperature Sensor

Operation

IMPORTANT: All System 350 Controls are designed for use only as operating controls. Where an operating control failure would result in personal injury and/or loss of property, it is the responsibility of the installer to add devices (safety, limit controls) that protect against, or systems (alarm, supervisory systems) that warn of control failure.

The A350 Temperature Control operates on 24 VAC and supplies a SPDT relay output. A front panel "ON" LED lights to indicate when the relay is energized. Adjustable features include:

- setpoint
- differential
- heating/cooling mode

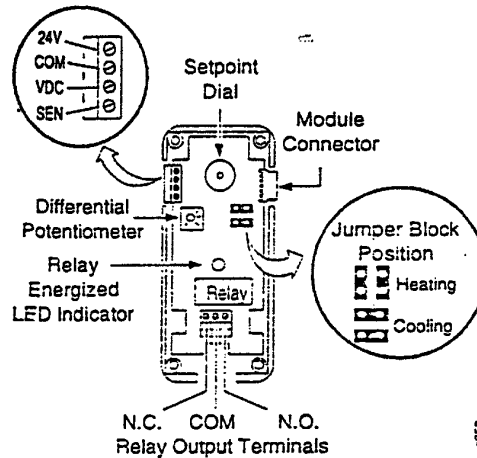


Figure 2: The A350 Electronic Temperature Control Board Layout and Terminal Locations

Setpoint Adjustment

Setpoint is defined as the temperature at which the A350's relay will de-energize. With the mode jumper in either the heating or cooling position, the relay will de-energize when the sensor temperature reaches setpoint.

Differential Adjustment

Differential is defined as the change in sensor temperature between energization and de-energization of the relay. The differential can be adjusted between 1 and 30 F° (0.5 to 17 C°). Adjustment is made using the potentiometer marked "DIFF"; see Figure 2 for potentiometer location.

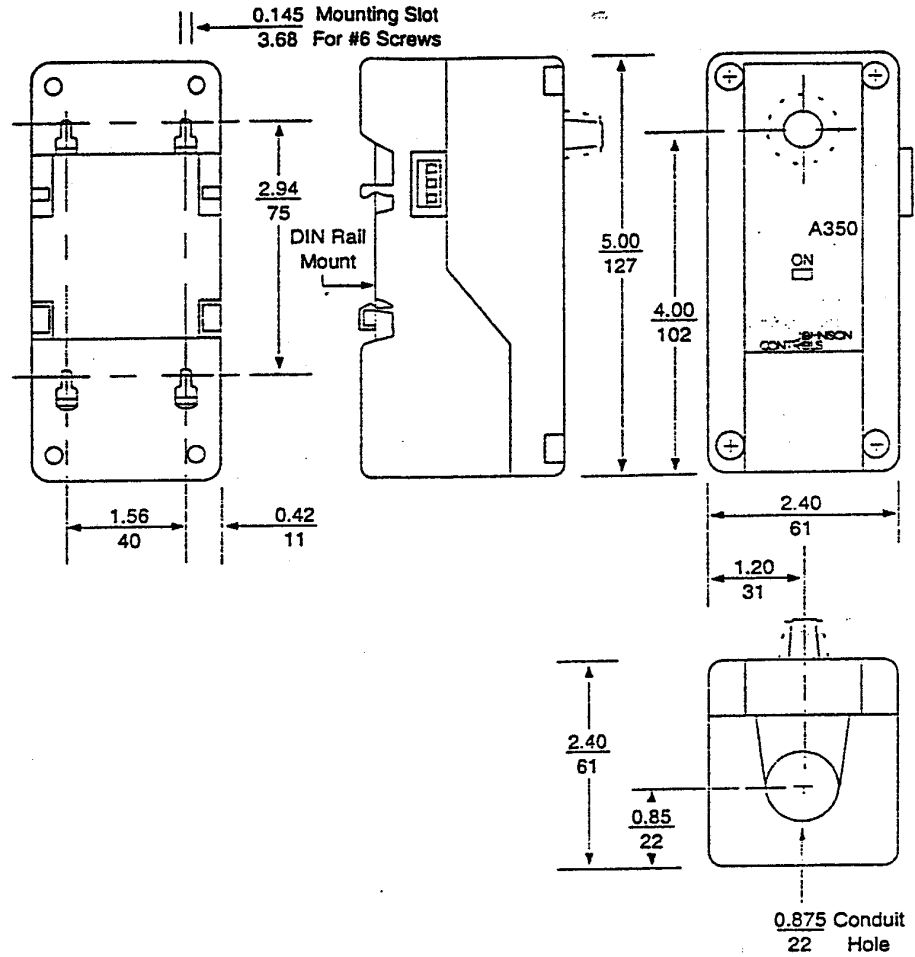
Heating/Cooling Mode Adjustment

With the heating mode selected, the differential is below the setpoint. The relay and LED indicator will de-energize as the temperature rises to the setpoint. As the temperature drops to the setpoint *minus* the differential setting, the relay will energize and the LED will illuminate.

With the cooling mode selected, the differential is above the setpoint. The relay and LED indicator will de-energize as the temperature drops to the setpoint. As the temperature rises to the setpoint *plus* differential setting, the relay will energize and the LED will illuminate.

As shipped from the factory, the heating/cooling jumper blocks are installed in the horizontal cooling position. (See Figure 2.)

Dimensions



a350

Figure 3: A350 Control Dimensions in./mm

Installation and Wiring

The A350 Series Control is housed in a compact NEMA 1 plastic enclosure designed for standard 35-mm DIN rail mounting. Four key-slot mounting holes on the back of the control case are provided should surface mounting be required.

The A350 is not position sensitive but should be mounted for convenient wiring and adjustment.

Note: When mounting the A350 (or any System 350 module) to rigid conduit, attach the hub to the conduit before securing the hub to the control enclosure.



WARNING: Disconnect power supply before wiring connections are made to avoid electrical shock or damage to equipment.

All wiring must be installed to conform to the National Electrical Code and local regulations. For maximum electrical rating of control, see label inside the control cover. Use copper conductors only.

Consult the typical wiring diagrams (Figures 4 and 5) for proper wiring and terminal designations.

Sensor Connection

Shielded cable is not generally required for sensor wiring on runs of less than fifty feet, but is recommended for lengths greater than fifty feet. When using shielded cable, isolate and tape the shield at the sensor. Connect the shield to the "COM" sensor terminal on the A350 (see Figure 2 for terminal location).

Note: At the maximum cable lengths listed in Table 1, no more than 1 F° (0.5 C°) error in the sensed temperature will result due to wire resistance.

Table 1: Recommended Sensor Cable Lengths

| Wire Gauge | Shielded Cable Length* | |
|------------|------------------------|--------|
| | Feet | Meters |
| 14 AWG | 800 | 244 |
| 16 AWG | 500 | 152 |
| 18 AWG | 310 | 94 |
| 20 AWG | 200 | 60 |
| 22 AWG | 124 | 38 |

*Values provided are for two-wire stranded cable.

- A variety of SET189A Series Temperature Sensors and mounting hardware are available for use with A350 Series Controls. The sensor must be connected to the (-) "COM" and (+) "SENSOR" terminals on the three conductor terminal strip located at the top center of the printed circuit board (Figure 2). The sensors are not polarity sensitive.
- The sensor must be mounted so that it can accurately sense the temperature of the controlled medium.
- For more information regarding sensor installation, refer to the *SET189A Series Product/Technical Bulletin*.

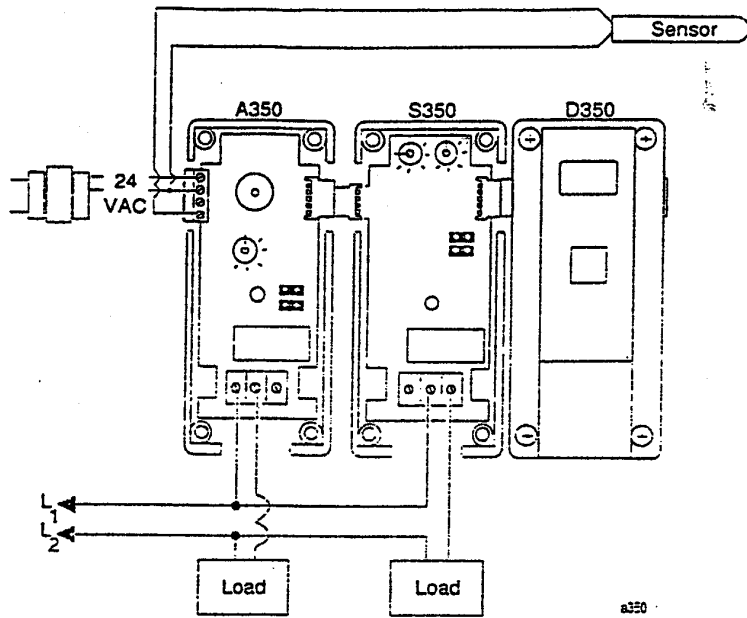


Figure 4: Typical Wiring Diagram for an A350 Powered by an External Class 2 Transformer (Sensor is Mounted Less than 50 feet from the A350)

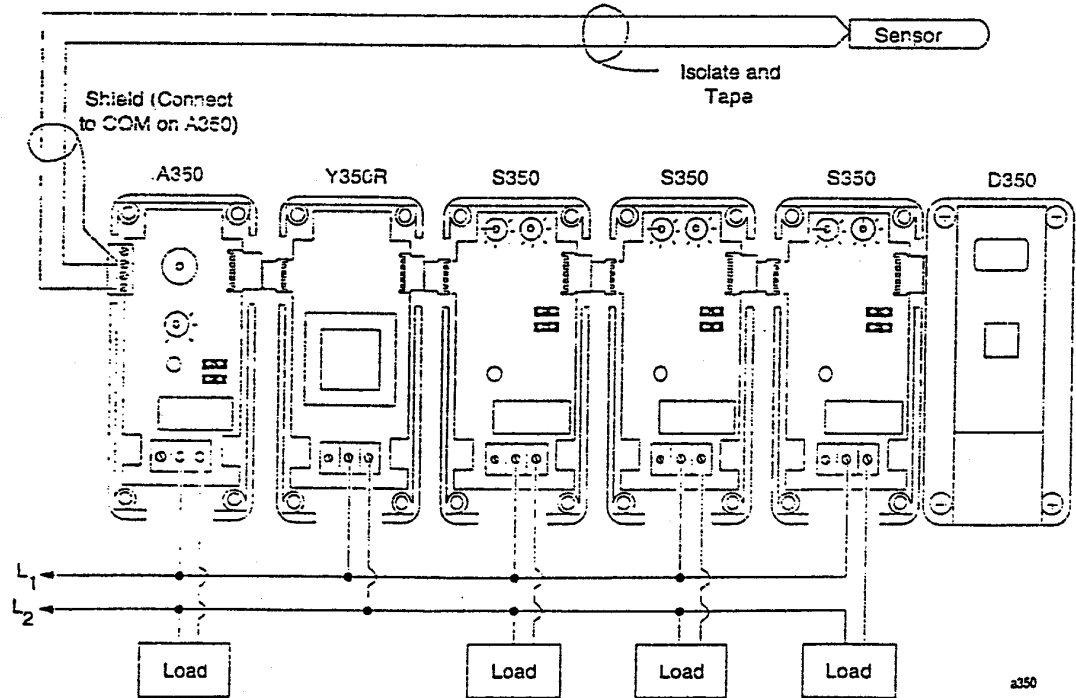


Figure 5: System 350 Powered by Y350R Power Module with the Sensor Between 50 and 800 feet from the A350

Add-On Modules

The S350 Stage Modules, D350 Digital Temperature Display Module, and Y350R Power Module snap together and plug into the A350 via connectors on both sides of each add-on module.

S350 Temperature Stage Modules

The S350 Stage Modules receive their power, setpoint, and sensor input from the A350 Control. As many as nine additional S350s can be plugged into the A350.

D350 Temperature Sensor/Setpoint Display Module

The D350 receives its power, sensor, and setpoint information from the A350. A three digit, Liquid Crystal Display (LCD), gives continuous read-out of the sensed temperature. Pushing the "PRESS FOR SETPOINT" button on the front of the D350 will cause the setpoint of the adjoining A350 to be displayed.


Y350R Power Module

The Y350R provides a convenient method of powering System 350 Modules from a 120 or 240 VAC power source. The Y350R supplies a rectified 24 VAC to the modules. See Figure 5 for a typical wiring diagram where a Y350R is used to power the A350.

Adjustments

A350

1. Remove the A350 cover by loosening the four captive cover screws.
2. Set the heating/cooling jumper blocks to the desired mode of operation. Position the jumper blocks vertically for heating or horizontally for cooling. (See Figure 2.)

 **CAUTION:** Verify that the heating/cooling jumper blocks are in the proper position before powering the System 350 modules. If the jumper blocks on the control or staging modules are left in the wrong position, the device will activate the relay in response to the opposite signal. The heating or cooling equipment will remain energized until the error is corrected.

3. Adjust the differential potentiometer "DIFF" as desired (the number of degrees between relay energized and de-energized). Clockwise rotation increases the differential. Refer to Figure 7 for a sample multistage application if needed.
4. Replace the cover, fasten in place with the four screws, and move the setpoint dial to the desired setpoint.

Note: The A350 is factory calibrated at midscale to a tolerance of $\pm 1F^{\circ}$ ($0.5C^{\circ}$). The setpoint tolerance at the extreme ends of the setpoint potentiometer rotation in relation to the printed scale plate can be $\pm 3F^{\circ}$ ($1.7C^{\circ}$). The D350 Display Module is unaffected by this tolerance shift. Use the D350 for the most accurate setpoint selection scale.

S350

When the A350 is used in conjunction with multiple S350 Stage Modules, the following adjustments must be made to each S350 (additional stage module adjustment information is available in the *S350 Product/Technical Bulletin*):

1. Remove the S350 cover by loosening the four captive cover screws.

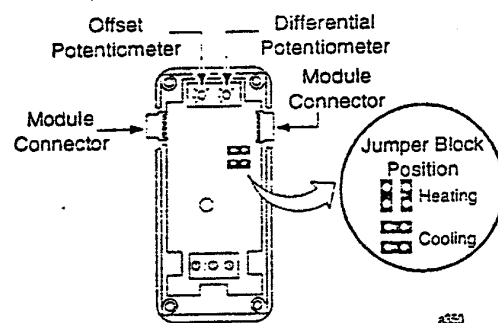


Figure 6: The S350 Stage Module

2. Set the heating/cooling jumper blocks to the desired mode of operation.
3. Adjust the S350's differential potentiometer "DIFF" to the desired setting. See Figure 7 for a sample multistage application if needed.
4. Adjust the S350's offset potentiometer "OFFSET" to the number of degrees from the A350 setpoint (above setpoint with cooling mode selected or below setpoint with heating mode selected) that the stage relay will de-energize.
5. Replace the cover and fasten in place with the four screws.

Checkout Procedure

Before applying power, make sure installation and wiring connections are according to job specifications. After necessary adjustments and electrical connections have been made, put the system in operation and observe at least three complete operating cycles before leaving the installation.

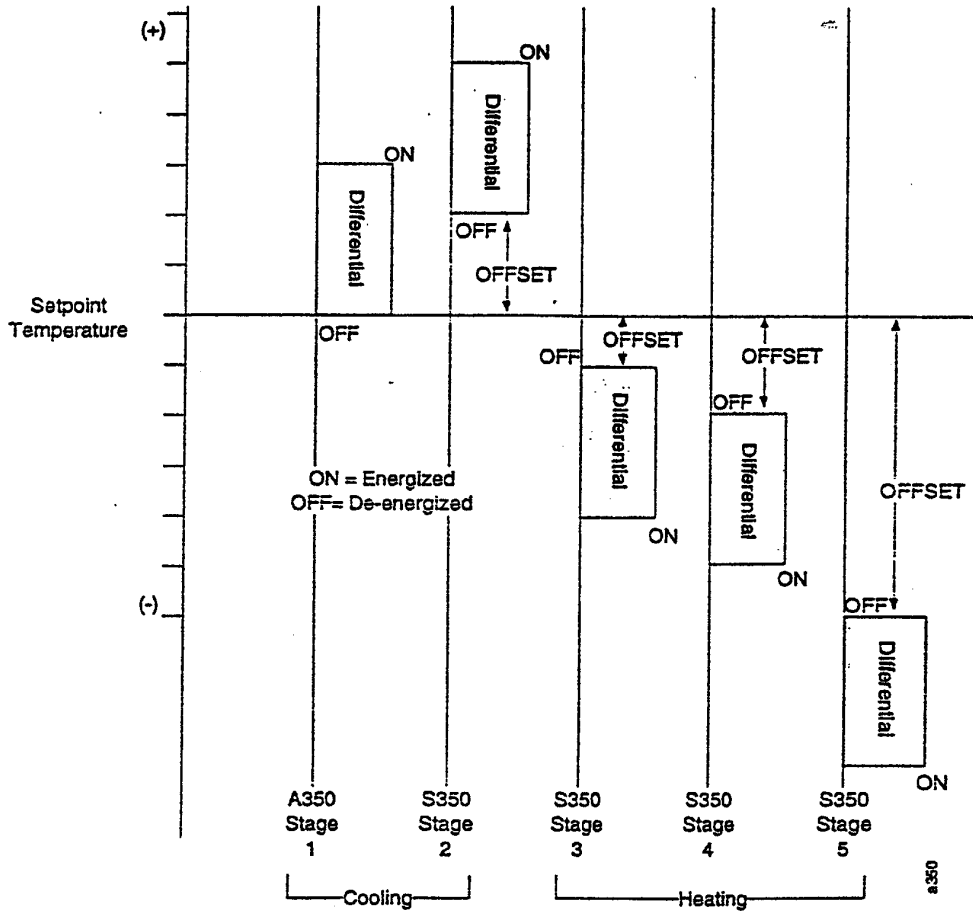


Figure 7: Typical Multistage Heating/Cooling Application

Troubleshooting

If the control system does not function properly, verify that the proper mode is selected on each module (e.g. heat/cool, RA/DA) and then use the following procedures to determine the cause of the problem:

1. Check for proper voltage applied to the A350 Control.

- a) Connect a digital voltmeter (DVM) between the "24V" (+) and "COM" (-) terminals located on the control's left side terminal block (Figure 2).

—If an external transformer is used, select AC volts on the DVM and verify that the voltage is between 20 and 30 VAC.

—If a Y350R Power Module is used, select DC volts on the DVM and verify that the voltage is between 16 and 38 VDC.

- b) If the DVM reading is within the indicated voltage range, proceed to Step 2.
- c) If the DVM reading is NOT within the indicated voltage range, check wiring, then replace the Y350R or the external transformer.

2. Check temperature sensor for proper resistance.

- a) Take an independent temperature reading at the sensor location (T_s). Be sure to let the thermometer stabilize before taking a reading.
- b) Disconnect the sensor from the control. Using an ohmmeter, measure the resistance across the two sensor leads. Consult the Temperature vs. Resistance Chart (Figure 8) to verify sensor conformance.
- c) If the sensor's actual performance deviates substantially from that represented on the chart, the sensor must be replaced.

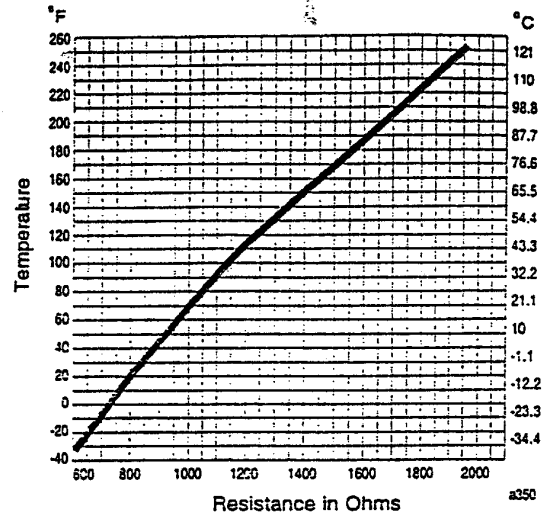


Figure 8: Temperature vs. Resistance Chart for the SET189 Series Sensor

Note: The sensor reading indicated by the D350 may differ somewhat from thermometer readings due to sensor tolerances, time constraints, thermometer accuracies, and other factors.

3. Check the A350 for proper operation.

Note: Steps 1 and 2 must be performed first.

- a) Adjust the setpoint dial to at least 40° below the sensor temperature (T_s) determined in Step 2.
- b) Increase the setpoint by slowly adjusting the dial until the control relay and LED turn ON and OFF as shown in Table 2.
- c) If the relay performs as expected, continue to Step 4.
- d) If the relay does NOT perform as indicated in Table 2, replace the A350.

Ordering Information

Table 4: Ordering Information

| Item | Product Code Number | Description |
|---|---------------------|--|
| A350 Temperature Control (Includes SET189A-600R Temperature Sensor) | A350AA-1C | Range: -30 to 130°F; Adjustable Differential: 1 to 30F° |
| | A350AA-2C | Range: 90 to 250°F; Adjustable Differential: 1 to 30F° |
| | A350AA-3C | Range: -30 to 130°F; Adjustable Differential: 1 to 30F°; Concealed Setpoint |
| | A350SA-1C | Range: -34 to 55°C; Adjustable Differential: 1 to 17C° |
| | A350BA-2C | Range: 32 to 120°C; Adjustable Differential: 1 to 17C° |
| Digital Temperature Sensor/ Setpoint Display Modules | D350AA-1C | Fahrenheit Scale |
| | D350BA-1C | Celsius Scale |
| Temperature Stage Modules | S350AA-1C | Fahrenheit Scale |
| | S350AB-1C | Celsius Scale |
| Power Module | Y350R-1C | Rectified 24 VAC from 120/240 VAC Source |
| Temperature Sensors | SET189A-600R | Sensor with 9-in. leads |
| | SET189A-606R | SET189A-600R with PVC Enclosure, Wire Nuts |
| | SET189A-607R | SET189A-600R Sensor with 6 ft Leads |
| | SET189A-605R | SET189A-600R Sensor with 10 ft Leads |
| | SET189A-606R | SET189A-600R Sensor with 15 ft Leads |
| Conduit Adapter | ADP11A-600R | 1/2 in. Snap-fit EMT Conduit Adapter (box of 10) |
| Immersion Well | WEL11A-601R | For Liquid Sensing Applications |
| Sun Shield | SHL10A-603R | For Use with Outside Sensors in Sunny Locations |
| DIN Rail Sections | BKT267-1R | 35 x 7.5 mm, 0.305 m (12 in.) long |
| | BKT267-2R | 35 x 7.5 mm, 0.914 m (36 in.) long |
| DIN Rail End Clamps | PLT344-1R | Consists of Two End Clamps |
| Cable for Remote Mounting of D350 Display Module | WHA29A-600R | 3 ft (0.9 m)* |
| | WHA29A-603R | 25 ft (7.6 m) |
| | WHA29A-604R | 50 ft (15.2 m) |

*WHA29A-600R can also be used toaisy chain S350 Stage Modules together.

Table 2: A350 Relay Troubleshooting

| Action | LED | N.O. Relay Status | Setpoint Dial Setting |
|---------|-----|-------------------|-------------------------------|
| Heating | ON | Closed | $(T_s) + \text{differential}$ |
| Heating | OFF | Open | (T_s) |
| Cooling | ON | Closed | $(T_s) - \text{differential}$ |
| Cooling | OFF | Open | (T_s) |

4. Check the S350 Stage Module for proper operation.

If this is a single-stage system, skip to Step 5.

Note: Steps 1, 2 and 3 must be performed first.

- a) Turn the setpoint dial on the control to minimum.
- b) Increase the setpoint by slowly adjusting the dial until the stage relays and LEDs turn ON and OFF as shown in Table 3.
- c) If the relays do NOT perform as indicated in Table 3, adjust the differential and offset potentiometers to minimum and try again.
- d) If the relays still do NOT turn on and off, replace the defective S350(s)*.

*Note: There is the unlikely possibility that a defect in one S350 could cause defective symptoms in all modules. Plug each stage into the A350 individually and check its performance as outline in Steps 3a and 3b.

5. Check the D350 Display Module for proper operation.

If there is no D350 in the system, skip this step.

Note: Steps 1 through 4 must be performed first.

- a) Check temperature at the sensor (T_s) determined in Step 2a. The display should read the same temperature.
- b) If the D350 does NOT read the correct sensor temperature (T_s), replace the D350.
- c) Pressing the button on the D350 should cause the display to read the selected setpoint.
- d) If pressing the SETPOINT button results in an out-of-range reading (greater than 200°C or 500°F) replace the D350.
- e) If pressing the SETPOINT button results in a reading other than the expected setpoint value, check the setpoint dial setting and correct if necessary. If the display continues to read an incorrect value, replace the D350.

Note: If the A350 and add-on modules all appear to be operating properly, but the field device still does not turn on and off as expected, check the wiring from the A350 or S350 to the field device.

Table 3: S350 Relay Troubleshooting

| Action | LED | N.O. Relay Status | Setpoint Dial Setting |
|---------|-----|-------------------|---|
| Heating | ON | Closed | $(T_s) + \text{offset} + \text{differential}$ |
| Heating | OFF | Open | $(T_s) + \text{offset}$ |
| Cooling | ON | Closed | $(T_s) - \text{offset} - \text{differential}$ |
| Cooling | OFF | Open | $(T_s) - \text{offset}$ |

Repairs and Replacement

Field repairs or calibration must not be made. SET189A Series Sensors and replacement controls are available through local Johnson Controls distributors. See Table 4.

Specifications

| | | | |
|----------------------|--|----------------------------|--------------------|
| Product | A350 Electronic Temperature Control | | |
| Temperature Range | See Table 4 | | |
| Differential Range | 1 to 30F° (1 to 17C°) | | |
| Input Voltage* | Transformer: 20 to 30 VAC Class 2, 50/60 Hz Y350R Power Module: 120/240 VAC, 50/60 Hz | | |
| Relays | SPDT Enclosed Relays; Contacts Rated at 10 amp; Non-inductive (resistive), 1/2 hp 120/240 VAC | | |
| Current Draw | 1.4 VA | | |
| Electrical Ratings | Full Load Amp: | 9.8 (120 VAC) | 4.9 (208/240 VAC) |
| | Locked Rotor Amp: | 58.8 (120 VAC) | 29.4 (208/240 VAC) |
| | Non-Inductive Amp | 10 at 24/240 VAC | |
| | Pilot Duty: | 125 VA at 24/240 VAC | |
| Ambient Temperatures | Operating: | -30 to 150°F (-34 to 66°C) | |
| | Shipping: | -40 to 185°F (-40 to 85°C) | |
| Humidity | 0 to 95% RH Non-condensing; Maximum Dew Point: 85°F (29°C) | | |
| Sensor | Replaceable Positive Temperature Coefficient Sensor Reference Resistance 1035 Ohms at 77°F (25°C) | | |
| Material | Case, Cover: NEMA 1 High Impact Noryl® Plastic | | |
| Agency Listings | UL Guide No. XAPX File E6688; CSA Class No. 4813 02 File LR948 | | |

Only one input voltage source may be used.
Noryl® is a registered trademark of the General Electric Company.

Add-on Modules:

| | | |
|-------|-----------------|--|
| S350 | Input Power: | 20 to 30 VAC, 50/60 Hz, 1 VA Maximum |
| | Relay Contacts: | SPDT, 10 Amp Resistive, 1/2 hp 120/240 VAC |
| | DIFF & OFFSET: | 1 to 30F° (0.6 to 16.7C°) |
| Y350R | Input Voltage: | 120/240 VAC, 50/60 Hz |
| | Output Power: | 24 VAC Rectified, 10 VA Maximum |
| D350 | Display Range: | -30 to 250°F (-34 to 120°C) |

The performance specifications are nominal and conform to acceptable industry standards. For application at conditions beyond these specifications, consult the local Johnson Controls office. Johnson Controls, Inc. shall not be liable for damages resulting from misapplication or misuse of its products.

**JOHNSON
CONTROLS**

rois Group
E. Michigan Street
Box 423
Milwaukee, WI 53201

FAN 930
System 350 Product Guide
Printed in U.S.A.

System 350™ Y350R Power Module

The Y350R is a rectified Class 2, 24 VAC power supply module designed specifically for use with System 350 Modular Control Systems. The Y350R's rectified output gives improved performance over the Y350D Transformer Module, which it replaces.

Like all System 350™ products, the Y350R is housed in a compact NEMA 1 high-impact plastic enclosure. The modular design provides easy, snap-together connections for quick installation and future expandability.

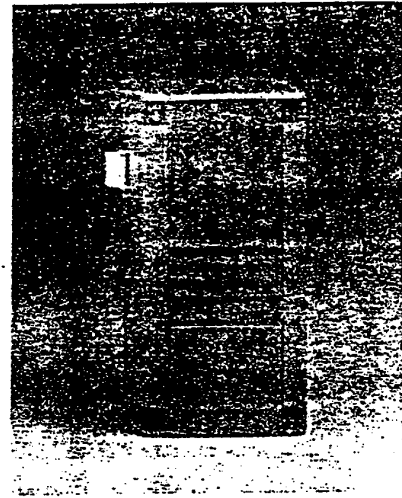


Figure 1: Y350R Power Module

| Features and Benefits | |
|--|--|
| <input type="checkbox"/> Modular Design | Enables stage, display, and transformer modules to be purchased and installed as necessary |
| <input type="checkbox"/> Plug-in Connectors and 35 mm DIN-Rail Mounting | Eliminates wiring between modules and reduces installation costs |
| <input type="checkbox"/> Accepts Input Voltages of 120 or 240 VAC, 50/60 Hz | Reduces inventory by encompassing the primary voltage requirements |
| <input type="checkbox"/> Provides 24 VAC Rectified Power | Maximizes the number of add-on stages which can be used with System 350 Temperature, Pressure, and Humidity Controls |

Application

The Y350R Power Module provides the power necessary to operate all System 350 controls and add-on modules. For system capabilities, see Table 1.

All System 350 add-on modules snap on to a DIN rail and plug into the control and to each other via five-pin connectors. Add-on modules can be arranged in any order and there is no wiring required to interconnect the System 350 components.

Operation

The Y350R operates from a 240 VAC or 120 VAC power source. A step down transformer brings the voltage to a level which the System 350 modules will accept. There are no adjustments for the power module.

IMPORTANT: All Series Y350R Power Modules are designed for use only in conjunction with operating controls. Where an operating control failure would result in personal injury and/or loss of property, it is the responsibility of the installer to add devices (safety, limit controls) that protect against, or systems (alarm, supervisory systems) that warn of, control failure.

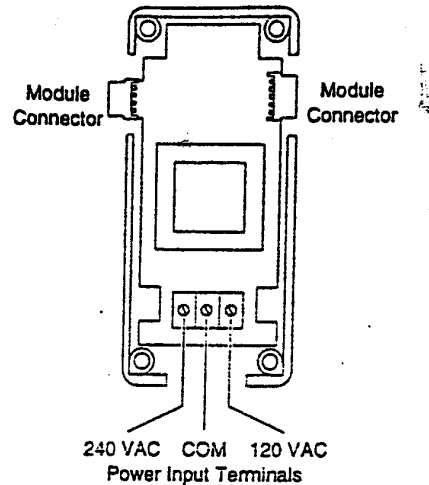


Figure 2: Interior of the Y350R Power Module

Dimensions

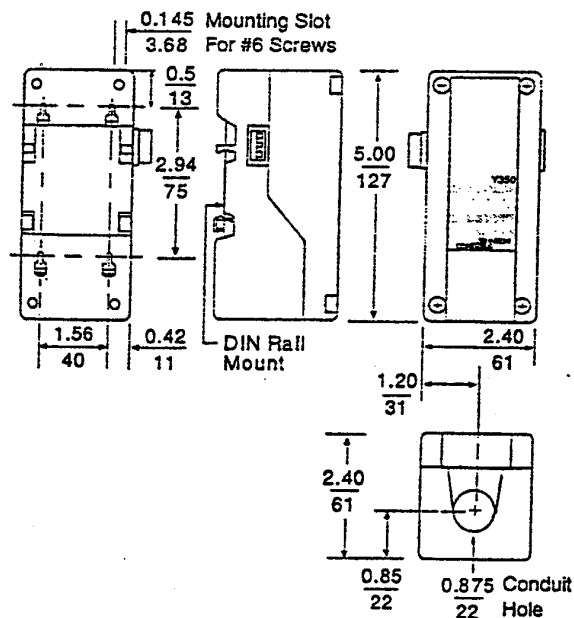


Figure 3: Y350R Dimensions in./mm

Table 1: Total System 350 Modules That Can Be Powered by One Y350R Module

| Control Module | Plus | Stage Modules | | Plus | Display Module | |
|----------------|------|---------------|------|------|----------------|------|
| | | Quantity | Type | | Quantity | Type |
| A350 | Plus | 9 | S350 | Plus | 1 | D350 |
| A350P | Plus | 4 | S350 | Plus | 1 | D350 |
| A350R | Plus | 9 | S350 | Plus | 1 | D350 |
| W351 | Plus | 5 | S351 | Plus | 1 | D351 |
| P352 | Plus | 5 | S352 | Plus | 1 | D352 |
| R353 | Plus | 5 | S353 | — | — | — |


Installation and Wiring

The Y350R case has provisions for mounting to a standard 35 mm DIN rail, or can be mounted using the four key slot mounting holes located in the rear of the case.

Mount System 350 modules in any convenient location using either the DIN rail mounts or the mounting holes located on the back of the control case. The components are not position sensitive, but should be mounted so they can be easily wired and adjusted.

Note: All wiring must be installed to conform to the National Electrical Code and local regulations.

1. Secure the module to the DIN rail, wall, or panel.



WARNING: Disconnect power supply before modules are interconnected and wiring connections are made to avoid possible electrical shock or damage to equipment.

2. Connect input wiring to the Y350R power module. Strip approximately 3/8 of an inch from the wire insulation and insert the wire under each terminal screw and tighten.

Note: If conduit is used when installing System 350 components, be sure to connect the hub to the conduit before the hub is secured to the enclosure.

Checkout Procedure

Before applying power, make sure installation and wiring connections are according to job specifications. After necessary adjustments and electrical connections have been made, put the system in operation and observe at least three complete operating cycles before leaving the installation.

Troubleshooting

If the control system does not function properly and the Y350R is suspect, proceed as follows:

1. Connect a digital voltmeter (DVM) between the "24V" (+) and "COM" (-) terminals located on the control module's left-side connector. (Terminal designations are marked on the control module.)
2. Select DC volts on the DVM and verify that the voltage is between 16 and 38 VDC. If the DVM reading is within range, the Y350R is functioning properly.

Note: Consult the *Troubleshooting* section of the control bulletin for a complete system troubleshooting procedure.

3. If the DVM reading is not within the indicated voltage range, check wiring and correct if necessary. If the wiring is correct and the reading remains out of range, replace the Y350R.

Repairs and Replacement

Field repairs or calibration must not be made. Replacement modules are available through local Johnson Controls branch and wholesale distributors.

Ordering Information

| Item | Product Code | Description |
|--------------|--------------|---|
| Power Module | Y350R-1C | Rectified, Class 2, 24 VAC Power Supply |

Specifications

| | |
|----------------------------|---|
| Product | Y350R Power Module |
| Input Voltage | 120/240 VAC, 50/60 Hz |
| Output Voltage | 24 VAC Rectified at 10 VA, Class 2 |
| Material | Case, Cover: NEMA 1 High Impact Lexan® Plastic |
| Ambient Temperature | Operating: -30 to 150°F (-34 to 66°C) Shipping: -40 to 185°F (-40 to 85°C) |
| Ambient Humidity | 0 to 95% RH Non-condensing |
| Mounting | Wall or DIN Rail |
| Agency Listing | UL Guide No. XAPX, File E6688 CSA Class No. 4813 02, File LR948 |

* Lexan is a registered trademark of the General Electric Company

The performance specifications are nominal and conform to acceptable industry standards. For application at conditions beyond these specifications, consult the local Johnson Controls office. Johnson Controls, Inc. shall not be liable for damages resulting from misapplication or misuse of its products.

**JOHNSON
CONTROLS**

Controls Group
507 E. Michigan Street
P.O. Box 423
Milwaukee, WI 53201

Printed in U.S.A.



System 350™
**S350 Temperature, S351 Humidity
and S352 Pressure Stage Modules**

The S350, S351 and S352 Stage Modules can be used with System 350™ controls. Each stage module plugs into the respective control module to add multiple stage capability. All stage modules have single-pole, double-throw relay output with LED indication.

Like all System 350 products, the stage modules are housed in NEMA 1 high-impact plastic enclosures. The modular design provides easy, snap-together connections for quick installation and future expandability.

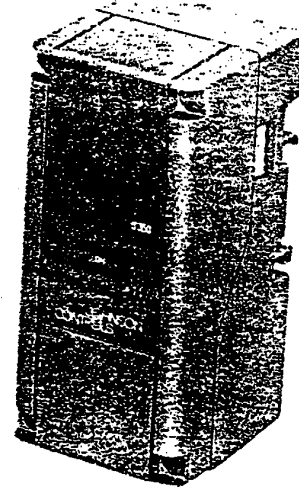


Figure 1: System 350 Stage Modules

| Features and Benefits | |
|---|--|
| <input type="checkbox"/> Modular Design | Enables stage, display, and transformer modules to be purchased and installed as necessary |
| <input type="checkbox"/> Plug-in Connectors and 35 mm DIN-rail Mountability | Eliminates wiring between modules and reduces installation costs |
| <input type="checkbox"/> Adjustable Offsets of 1 to 30°F (S350), 2 to 30% RH (S351) and 10 to 60 PSIG (S352) | Allows flexibility in sequencing multiple stages |
| <input type="checkbox"/> Selectable Heating/Cooling (S350), Humidification/Dehumidification (S351) and Reverse/Direct Acting Mode Jumpers | Provides the ability to energize each relay independently, either above or below setpoint |

Application Overview

The S350, S351 and S352 Stage Modules receive their power, setpoint and sensor input from their respective System 350 Control Modules. When connected, the individual modules act as a multistage control system.

The maximum number of stages that can be used in a system varies with the control module type (temperature, pressure or humidity) and stage module design. The latest design in stage modules incorporates mode jumper blocks (rather than the mode switches in the previous generation of stage modules). The jumper block design allows a greater maximum number of stages to be connected in multistage applications.

Use the following table to determine the maximum number of stages that may be used with each control module. When mixing stage module designs, always use the lower number.

Table 1: Maximum Stages with Each Control Module

| Control Module | Stage Module | Jumper Design | Switch Design |
|----------------|--------------|---------------|---------------|
| A350 | S350 | 9 | 5 |
| A350P | S350 | 4 | 4 |
| W351 | S351 | 5 | 3 |
| P352 | S352 | 6 | 5 |

Operation

IMPORTANT: All System 350 Controls are designed for use only as operating controls. Where an operating control failure would result in personal injury and/or loss of property, it is the responsibility of the installer to add devices (safety, limit controls) or systems (alarm, supervisory) that protect against or warn of control failure.

All System 350 Stage Modules operate on 24 VAC and provide SPDT relay output. A front-panel LED lights to indicate the relay is energized. Adjustable features include:

- offset
- differential
- reverse/direct action mode

Offset

The offset adjustment determines the amount of offset from the control module setpoint that the stage module's relay will de-energize. This adjustment is made using the potentiometer marked OFFSET located at the upper left of the circuit board.

Differential

The control differential is the difference in degrees, %RH or PSI between relay energize and de-energize. This adjustment is made using the potentiometer marked DIFF located on the printed circuit board to the right of the offset potentiometer.

Reverse/Direct Action Mode

With the reverse action (RA) mode selected, the differential is below the setpoint plus offset. The relay and LED indicator will de-energize as the setpoint plus offset value is approached.

With the direct action (DA) mode selected, the differential is above the setpoint plus offset. The relay and LED indicator will de-energize as the setpoint plus offset value is approached.

The direct/reverse action mode is selected via jumper blocks marked "RA/DA" located on the right side of the circuit board above the relay (see Figure 3). Mounting the blocks on the pins in the vertical position selects heating/humidification/reverse action operation. Mounting the blocks on the pins in the horizontal position selects cooling/dehumidification/direct action operation. As shipped from the factory, the blocks are installed in the horizontal position.

Dimensions

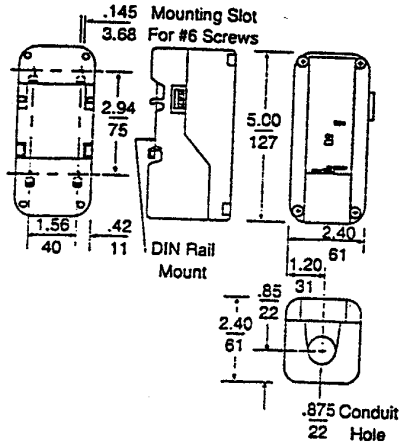


Figure 2: Dimensions in./mm

Installation and Wiring

Each System 350 Stage Module is housed in a compact NEMA 1 plastic enclosure designed for standard 35 mm DIN-rail mounting. Four key-slot mounting holes on the back of the control case are provided should surface mounting be required. The modules are not position sensitive but should be mounted for convenient access to wiring and adjustments.

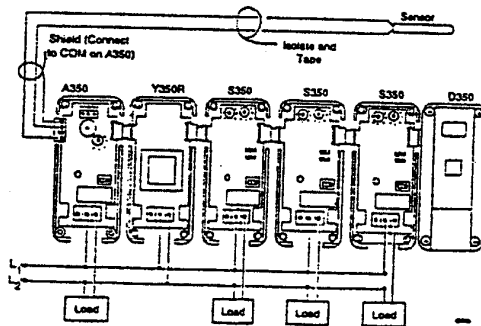



Figure 3: Typical Multistage Temperature Control System

The stage modules plug into the control and other add-on modules via five-pin connectors located on either side of each module. Wiring to a controlled device is made at the NO/NC relay terminal strip (see Figure 3).

System 350 modules can be arranged in any order; no external wiring is required to interconnect components. The system will become operational as soon as power is applied.

Note: When mounting a stage module (or any System 350 module) to rigid conduit, attach the hub to the conduit before securing the hub to the control enclosure.



WARNING: Disconnect power supply before modules are interconnected and wiring connections are made to avoid possible electrical shock or damage to equipment.

- All wiring must be installed to conform to the National Electrical Code and local regulations. For maximum electrical rating of control see label inside control cover. Use copper conductors only.
- Consult the typical wiring diagrams (Figures 4, 5 & 6) for proper system wiring.

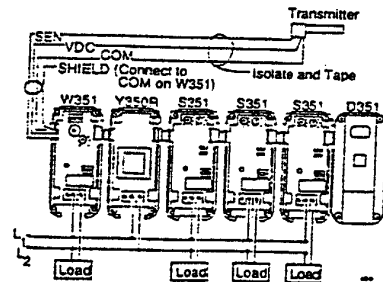


Figure 4: Typical Multistage Humidity Control System

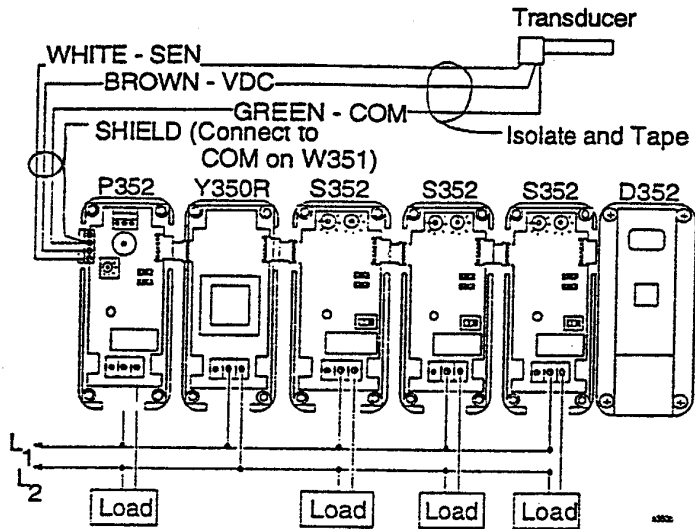


Figure 5: Typical Multistage Pressure Control System

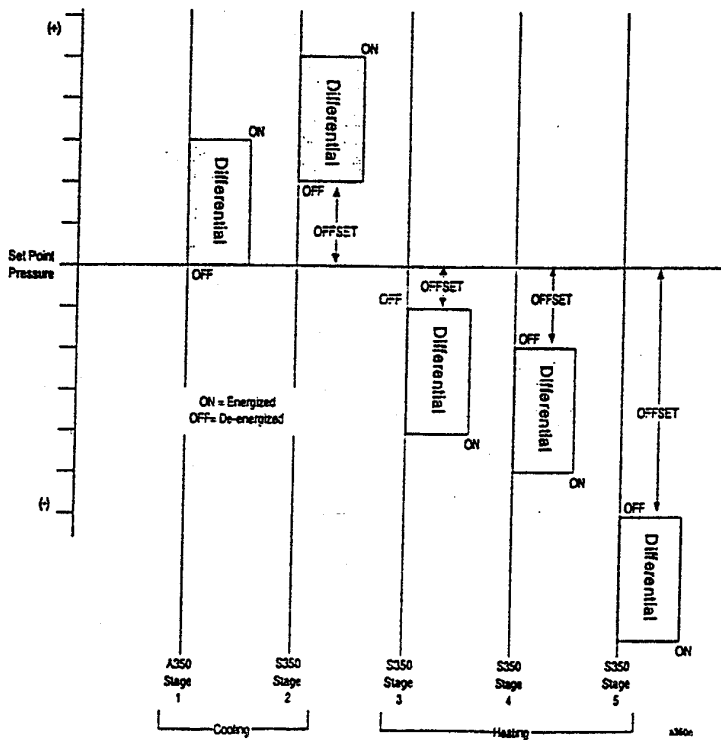


Figure 6: Example of a Heating/Cooling Application Using One A350 and Four S350s

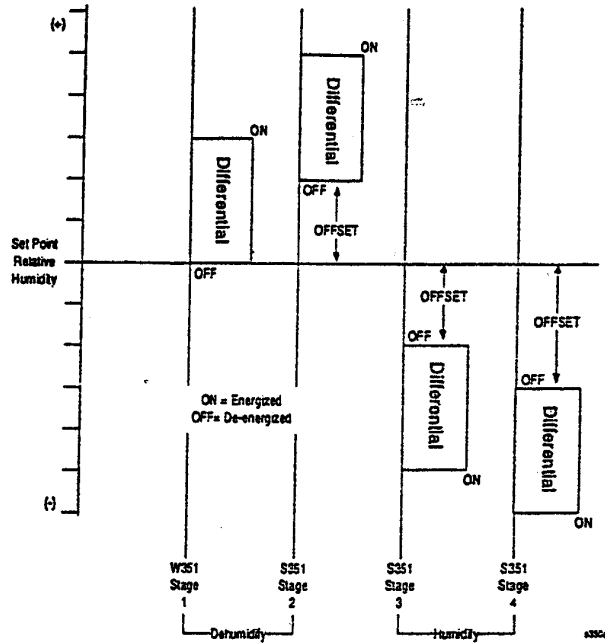


Figure 7: Example of a Humidification/Dehumidification Application Using One W351 and Three S351s

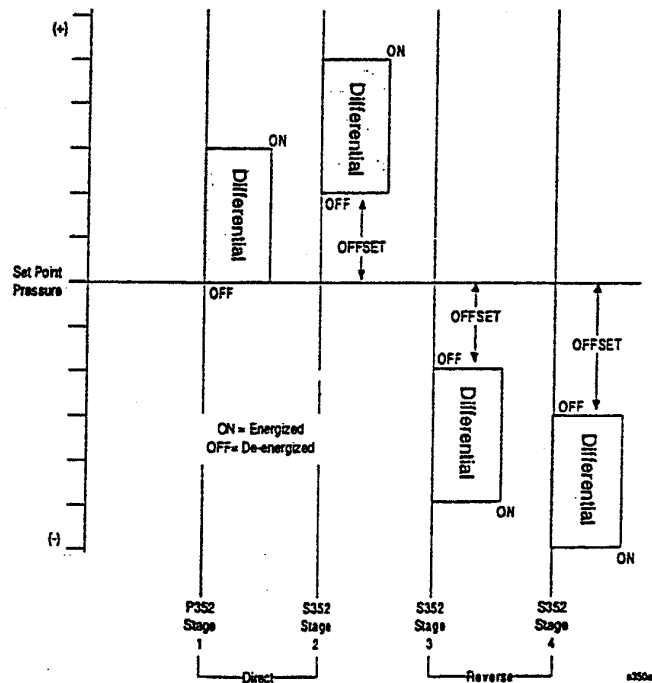


Figure 8: Example Reverse Action/Direct Action Application Using One P352 and Three S352s

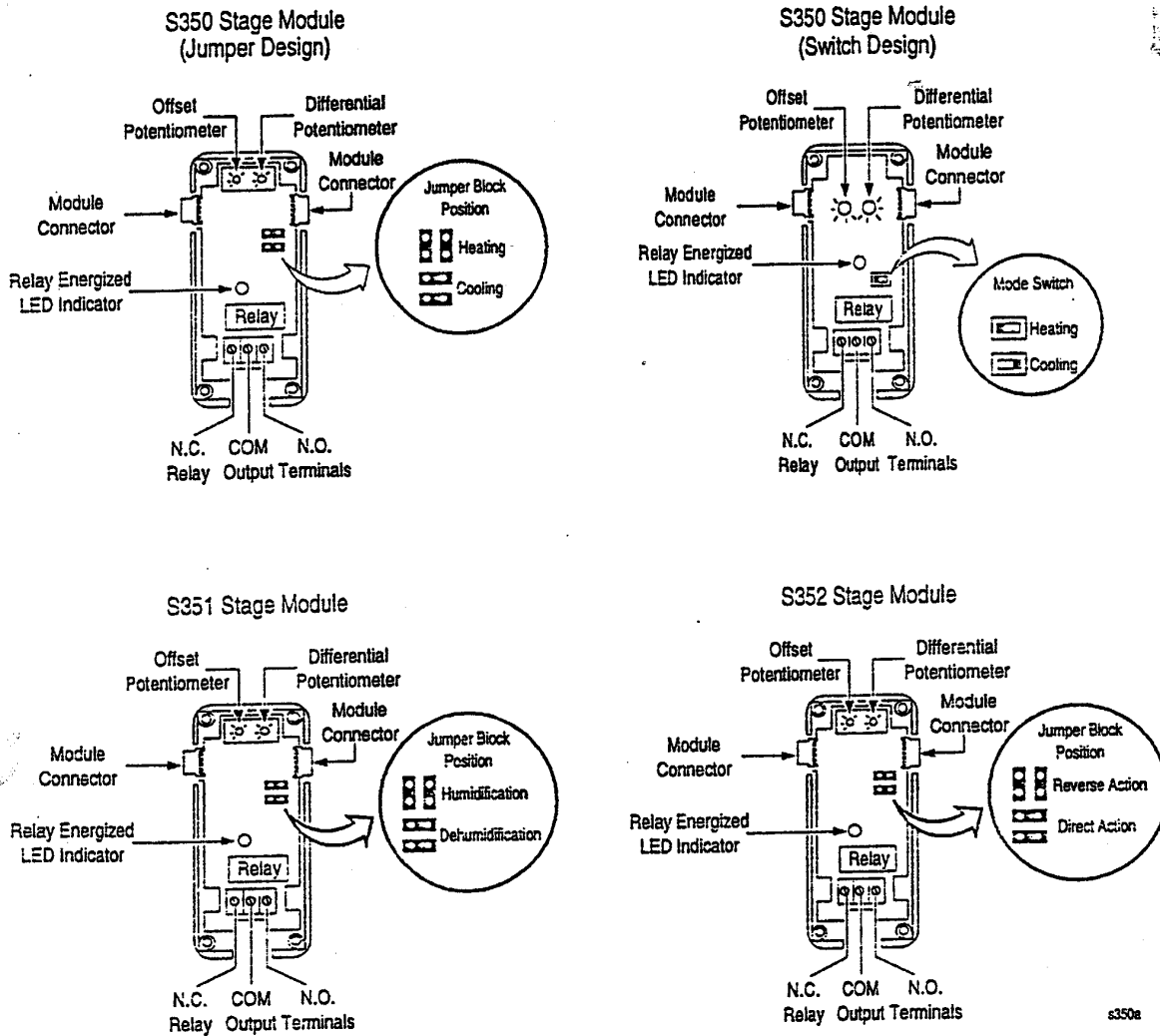


Figure 9: Interior Views of S350, S351, and S352 Stage Modules

Adjustments

1. Remove the stage module cover by loosening the screws located at the four corners of the cover.
2. Position the mode jumpers to the desired mode of operation. (See Figure 3 for jumper block positioning.)

Adjust the differential potentiometer to the desired setting. (The number of degrees, %RH or PSI between relay energized and de-energized.) Clockwise rotation increases the differential.

4. Adjust the offset potentiometer to the number of degrees, %RH or PSI from the System 350 control's setpoint (above setpoint with cooling, dehumidification or DA mode selected or below setpoint with heating, humidification or RA mode selected) that the stage relay will de-energize. Clockwise rotation increases offset.
5. Replace the cover and fasten in place with screws.

Troubleshooting

If the control system does not function properly, verify that the proper mode is selected on each module (e.g. heat/cool, humidification/dehumidification, RA/DA) and then use the following procedures to determine the cause of the problem:

- 1 Turn the setpoint dial on the control to minimum.
- 2 Increase the setpoint by slowly adjusting the dial until the stage relays and LEDs turn ON and OFF as shown in Table 2.
- 3 If the relays do NOT perform as indicated in Table 2, adjust the differential and offset potentiometers to minimum and try again.
- 4 If the relays still do NOT turn on and off, replace the defective stage modules*.

*Note: There is the unlikely possibility that a defect in one stage module could cause defective symptoms in all modules. Plug each stage into the control individually and check its performance as outlined in Steps 1 and 2.

Table 2: Stage Relay Troubleshooting

| Action | LED | N.O. Relay Status | Set Point Dial Setting |
|------------|-----|-------------------|---|
| Heating | ON | Closed | $(T_S) + \text{offset} + \text{differential}$ |
| Heating | OFF | Open | $(T_S) + \text{offset}$ |
| Cooling | ON | Closed | $(T_S) - \text{offset} - \text{differential}$ |
| Cooling | OFF | Open | $(T_S) - \text{offset}$ |
| Reverse | ON | Closed | $(PSIG_+) + \text{differential}$ |
| Reverse | OFF | Open | $(PSIG_+)$ |
| Direct | ON | Closed | $(PSIG_-) - \text{differential}$ |
| Direct | OFF | Open | $(PSIG_-)$ |
| Humidify | ON | Closed | $(RH_+) + \text{differential}$ |
| Humidify | OFF | Open | (RH_+) |
| Dehumidify | ON | Closed | $(RH_-) - \text{differential}$ |
| Dehumidify | OFF | Open | (RH_-) |

Checkout Procedure

Before applying power, make sure installation and wiring connections are according to job specifications. After necessary adjustments and electrical connections have been made, put the system in operation and observe at least three complete operating cycles before leaving the installation.

Repairs and Replacement

Field repairs or calibration must not be made. Sensors and replacement controls are available through local Johnson Controls branch or distributor offices.

Conair has made the largest investment in customer support in the plastics industry. Our service experts are available to help with any problem you might have installing and operating your equipment. Your Conair sales representative also can help analyze the nature of your problem, assuring that it did not result from misapplication or improper use.

WE'RE HERE TO HELP

To contact Customer Service personnel, call:



HOW TO CONTACT CUSTOMER SERVICE

From outside the United States, call: 814-437-6861

You can commission Conair service personnel to provide on-site service by contacting the Customer Service Department. Standard rates include an on-site hourly rate, with a one-day minimum plus expenses.

If you do have a problem, please complete the following checklist before calling Conair:

- Make sure you have all model, serial and parts list numbers for your particular equipment. Service personnel will need this information to assist you.
- Make sure power is supplied to the equipment.
- Make sure that all connectors and wires within and between loading control and related components have been installed correctly.
- Check the troubleshooting guide of this manual for a solution.
- Thoroughly examine the instruction manual(s) for associated equipment, especially controls. Each manual may have its own troubleshooting guide to help you.
- Check that the equipment has been operated as described in this manual.
- Check accompanying schematic drawings for information on special considerations.

BEFORE YOU CALL ...

Additional manuals and prints for your Conair equipment may be ordered through the Customer Service or Parts Departments for a nominal fee.

EQUIPMENT GUARANTEE

Conair guarantees the machinery and equipment on this order, for a period as defined in the quotation from date of shipment, against defects in material and workmanship under the normal use and service for which it was recommended (except for parts that are typically replaced after normal usage, such as filters, liner plates, etc.). Conair's guarantee is limited to replacing, at our option, the part or parts determined by us to be defective after examination. The customer assumes the cost of transportation of the part or parts to and from the factory.

PERFORMANCE WARRANTY

Conair warrants that this equipment will perform at or above the ratings stated in specific quotations covering the equipment or as detailed in engineering specifications, provided the equipment is applied, installed, operated and maintained in the recommended manner as outlined in our quotation or specifications.

Should performance not meet warranted levels, Conair at its discretion will exercise one of the following options:

- Inspect the equipment and perform alterations or adjustments to satisfy performance claims. (Charges for such inspections and corrections will be waived unless failure to meet warranty is due to misapplication, improper installation, poor maintenance practices or improper operation.)
- Replace the original equipment with other Conair equipment that will meet original performance claims at no extra cost to the customer.
- Refund the invoiced cost to the customer. Credit is subject to prior notice by the customer at which time a Return Goods Authorization Number (RGA) will be issued by Conair's Service Department. Returned equipment must be well crated and in proper operating condition, including all parts. Returns must be prepaid.

Purchaser must notify Conair in writing of any claim and provide a customer receipt and other evidence that a claim is being made.

WARRANTY LIMITATIONS

Except for the Equipment Guarantee and Performance Warranty stated above, Conair disclaims all other warranties with respect to the equipment, express or implied, arising by operation of law, course of dealing, usage of trade or otherwise, including but not limited to the implied warranties of merchantability and fitness for a particular purpose.