TRANE™

Operator's Guide

CVMA-OG-1B

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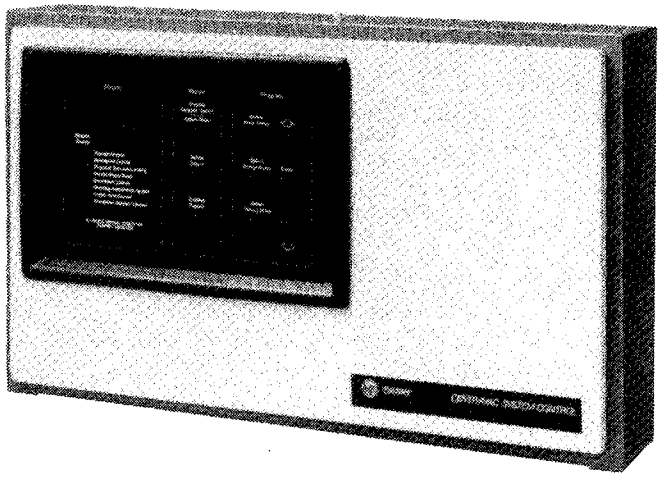
SCP699 System Control Panel



Art No.
RF/CTV-1900

Model CVMA 003

SCP699 System Control Panel for Use with Model CVHE and CVHB CenTraVacs Equipped with UCP695 Control Panels

Since The Trane Company has a policy of continuous product improvement, it reserves the right to change specifications and design without notice. The installation and servicing of the equipment referred to in this booklet should be done by qualified, experienced technicians.

Part No. X39640309-03

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Literature Change History

CVMA-OG-1 (October 1986)
Original issue of manual; provides start-up, operation, programming, maintenance and troubleshooting information for "A"-design CVMA System Control Panels (SCP699).

CVMA-OG-1A (January 1987)
Revised original manual to remove unnecessary cautions relating to shorted battery terminals from "Maintenance and Trouble Analysis" section; also corrected several typos.

CVMA-OG-1B (October 1987)
Revised CVMA-OG-1A to update SCP wiring requirements per UL. Also corrected the default setting for the free cooling chilled water setpoint (i.e., FC CWS default is 1 F, not 0 F).

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The Trane Company
La Crosse, Wisconsin 54601-7599
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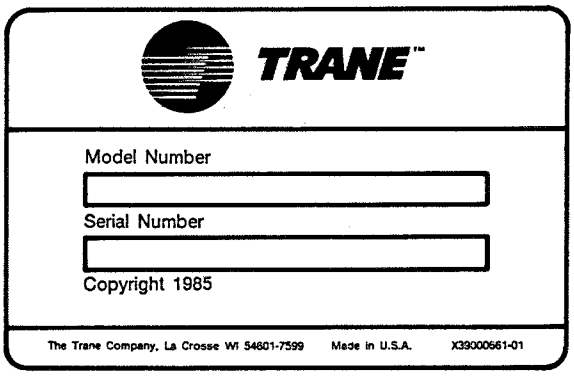
Model Number Description

All standard Trane products are identified by a multiple-character model number that precisely identifies a particular type of unit. An explanation of the alphanumeric identification code used with CenTraVac SCP699 System Control Panels is provided below. Its use will enable the owner/operator to define the components, operation and options for a particular unit.

Be sure to refer to the model number stamped on the unit nameplate (shown below, and mounted on the bottom of the panel) when ordering replacement parts or requesting service.

CVMA Nameplate (for SCP699 System Control Panels)



Drwg. X39000661

Model No. CV M A - 003 N - A A - A

Digit No.	1,2	3	4	5,6,7	8	9	10	11

Digits 1, 2
CenTraVac

Digit 3
Multiple

Digit 4
Development Sequence

Digits 5, 6, 7
Capacity (No. of Units Controlled)
003 = 1, 2 or 3 Units

Digit 8
Electrical Characteristics
N = 98-132 VAC, 50-60 Hz

Digit 9
Microprocessor Control

Digit 10
Design Sequence

Digit 11
Sideboard Option
0 = No Sideboard Installed
A = Sideboard Installed (w/Generic BAS and/or Condenser Limit Control)

General Information

Literature Change History

CVMA-OG-1 (October 1986)
Original issue of manual; provides start-up, operation, programming, maintenance and troubleshooting information for "A"-design Model CVMA System Control Panels (i.e., SCP699).

CVMA-OG-1A (January 1987)
Revised original manual to remove unnecessary cautions relating to shorted battery terminals from "Maintenance and Trouble Analysis" section; also corrected several typos.

About this Manual

This booklet describes the proper start-up, operation and programming procedures for Model CVMA CenTraVac System Con trol Panels (i.e., SCP699). By carefully reviewing this information and following the instructions given, the owner/ operator can successfully use the SCP699 panel to govern up to 3 CVHE or CVHB chillers equipped with UCP695 control panels.

A "Maintenance and Trouble Analysis" section at the end of this manual describes the minimal maintenance requirements associated with the SCP, and provides troubleshooting information for system-level diagnostic conditions. (Refer to the chiller operation/ maintenance manual when troubleshooting unit-level diagnostic conditions.)

If equipment problems do occur, however, contact a qualified service organization to ensure proper diagnosis and repair.

Notice that an "SCP Operator Reference Guide"--summarizing SCP report and programming menus--is provided at the back of this booklet, and is designed to aid the experienced SCP operator.

Note: To ensure that this operator's guide remains with the SCP once it is installed, store it behind the panel. Rails are mounted on the back of the panel enclosure (i.e., at the top and bottom) for this purpose.

Commonly Used Acronyms

For convenience, the Model CVMA SCP699 System Control Panel is referred to simply as the "SCP" or "SCP699 panel" throughout the rest of this manual.

Other acronyms that appear in this operator's guide are listed (alphabetically) and defined below.

BAS = Building Automation System
BCL = Bidirectional Communication Link

CLS = Current Limit Setpoint
CWR = Chilled Water Reset
CWS = Chilled Water Setpoint

FC = Free Cooling

I/O = Input and Output Wiring

NEC = National Electric Code

RLA = Rated Load Amps
RSCWS = Reset System Chilled Water Setpoint

SCLS = System Current Limit Setpoint
SCWS = System Chilled Water Setpoint

Tracer = Type of Trane building automation system (BAS) frequently used to govern chiller system operation via an SCP.

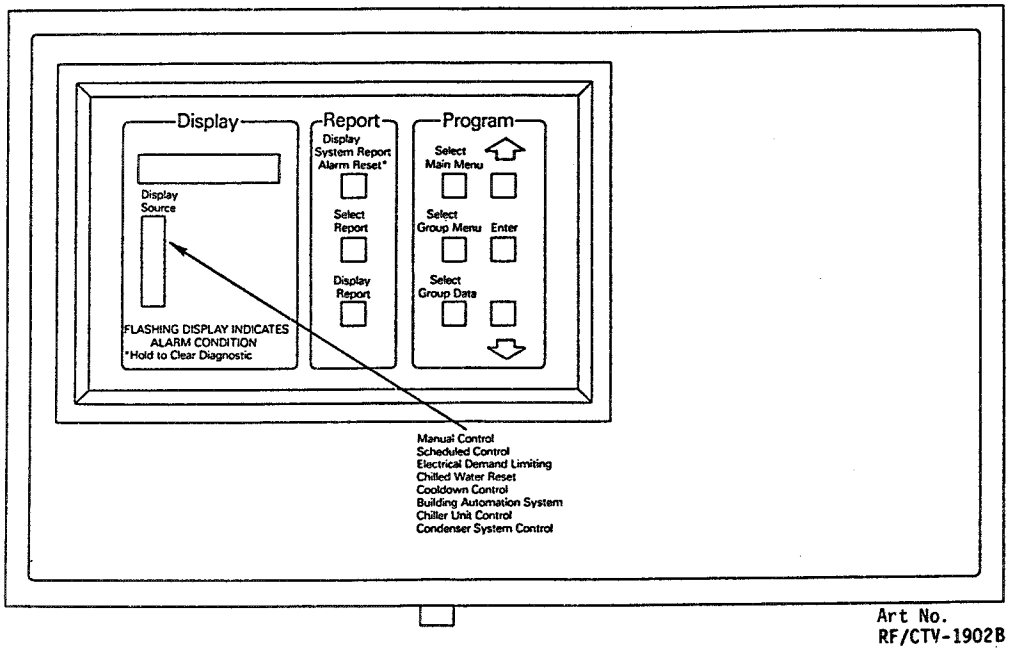
UCLS = Unit Current Limit Setpoint
UCP695 = Microcomputer-based Chiller Control Panel
UCWS = Unit Chilled Water Setpoint

Warnings and Cautions

Notice that **warnings** and **cautions** appear at appropriate intervals throughout this manual. **Warnings** are provided to alert operating and service personnel to potential hazards that could result in personal injury or death, while **cautions** are designed to alert personnel to conditions that could result in equipment damage.

Your personal safety and the proper operation of this system depend upon the strict observance of these precautions.

Figure 1
SCP699 Panel Operator Interface



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SCP699 System Control Panel Overview

The Trane CenTraVac SCP699 System Control Panel (Figure 1) is a computerized, operator-programmable control system intended to operate 1, 2 or 3 centrifugal water chillers as a single system. It is specifically designed for use with Model CVHE or CVHB units equipped with microcomputer-based UCP695 control panels.

Among the standard capabilities of the SCP699 System Control Panel are these:

[ ] a "user interface" that gives the operator access to data available within the chiller system;

[ ] coordinated control--including lead/lag sequencing--of up to 3 CenTraVac chillers with UCP695 control panels (i.e., 3 chillers piped in parallel; 2 chillers piped either in series or parallel);

[ ] maintains system chilled water temperature by regulating chiller loading to meet building cooling requirements;

[ ] scheduled system operation on a 7-day, 24-hour basis, plus holiday scheduling;

[ ] "soft loading"/cooldown control (i.e., to minimize electrical demand peaks);

[ ] system chilled water reset;

[ ] electrical demand limit control;

[ ] a proprietary, bidirectional communications link (i.e., to connect the SCP699 panel with a Tracer® building automation system);

[ ] manual chiller control from a central location; and,

[ ] control of these auxiliary chiller system components:

a. up to 4 chilled water pumps (i.e., 3 for individual chillers plus 1 system pump), and,

b. condenser water pumps (i.e., via the chiller UCP695 control panels).

Several SCP699 control options are also available; these include:

[ ] cooling tower 2-stage limit control;

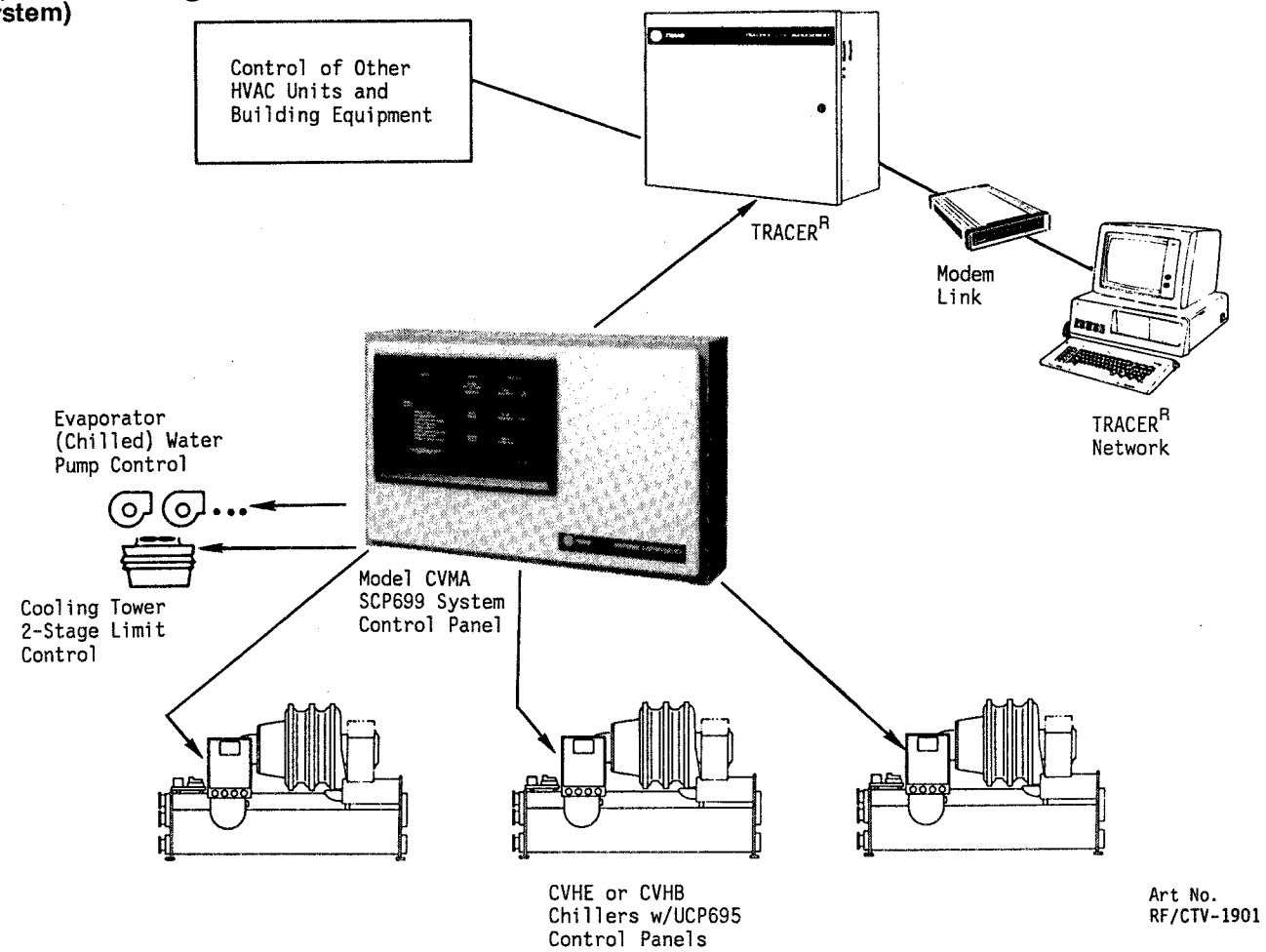
[ ] thermostatically-controlled, automatic free cooling control; and,

[ ] an analog interface that allows an external analog controller or generic BAS to govern chiller operation.

Refer to the "Operation" section of this manual for explanations of each of the standard and optional SCP699 capabilities outlined above.

For an illustration of a typical SCP699 System Control Panel application, see Figure 2.

Figure 2
Typical SCP699 Application (w/Trane Building Automation System)



After the SCP699 panel is properly installed, several switches--both in the SCP699 and at each of the chiller UCP695 control panels--must be set up before the system is started. Follow the step-by-step instructions provided below.

SCP699 DIP Switch Setup

WARNING: To prevent injury or death due to electrical shock, lock power supply disconnect open before removing SCP panel enclosure. It may be necessary to open several disconnects to remove all connected power from SCP.

1. Remove the 5 screws that secure the control panel enclosure to the panel back plate; then remove the enclosure from the SCP699.

2. Find the SCP699 configuration switches; see Figure 3. (These switches--numbered 1 through 10--are located to the right of the "Program" block, directly above terminal strip TB2.)

Note: Notice that 2 additional configuration switches are located on the SCP's sideboard. (The optional sideboard is provided whenever the generic BAS or condenser control options are specified.)

3. Refer to Table 1; notice that 11 of the 12 "configuration" DIP switches must be properly set at either ON or OFF. Each of these switch settings is discussed briefly below (i.e., and summarized in Table 1).

a. Pump Relay Command. To ensure proper operation of the system and unit chilled water pumps, DIP Switch No. 1 must be set in the OFF (i.e., "normal") position.

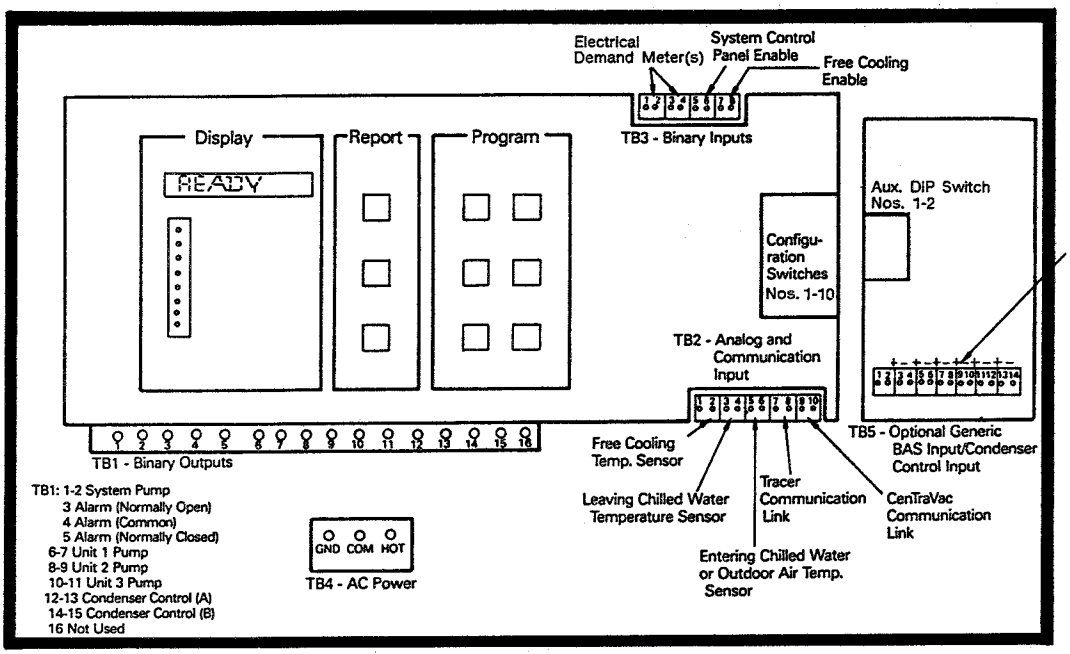
b. Alarm Relay. With DIP Switch No. 2 set at the OFF (i.e., "normal") position, the alarm relay is normally de-energized, and will energize when an alarm condition occurs.

Conversely, the alarm relay is normally energized when DIP Switch No. 2 is in the "reverse" (i.e., ON) position, and will de-energize when an alarm condition is detected.

c. Degrees F/C Display. The position of DIP Switch No. 3 determines what units the SCP will use to display temperatures. Degrees Fahrenheit (F) are displayed when DIP Switch No. 3 is in the OFF position. With this switch set at ON, temperatures are displayed in degrees Centigrade (C).

d. Chilled Water Reset (CWR). DIP Switch No. 4's position determines how the SCP will calculate a new system leaving chilled water temperature using its chilled water reset control function.

Figure 3
SCP699 Terminal Strip Connections



Note: Run the wires for all TB2, TB3 and TB5 connections through the low voltage conduit.

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Whenever the CWR setpoint (i.e., "SET = ") is ≤ 25 F, the SCP uses the following load-based equation to determine the reset system chilled water setpoint whether DIP Switch No. 4 is set at OFF or ON.

RSCWS =
SCWS + RATE [CWR SET + STMP - AUXTMP]

where:
RSCWS = Reset System Chilled Water Setpoint
SCWS = Sched./BAS System Chilled Water Setpoint
RATE = Operator-Set CWR Rate
CWR SET = Operator-Set CWR Setpoint Temp.
STMP = Actual Lvg. Chilled Water Temp.
AUXTMP = Actual Ent. Chilled Water Temp.

If the CWR setpoint temperature is > 25 F, then chilled water reset is solely a function of outdoor ambient temperature. When DIP Switch No. 4 is set at OFF (i.e., "normal"), the SCP uses this equation to calculate a new chilled water setpoint:

RSCWS = SCWS + RATE [CWR SET - AUXTMP]

Setting DIP Switch No. 4 at ON (i.e., "reverse") when the CWR setpoint is > 25 F causes the SCP to determine a new chilled water setpoint with this equation:

RSCWS = SCWS + RATE [AUXTMP - CWR SET]

Note: Control logic prevents the SCP from establishing a reset chilled water setpoint that is lower than the original value.

See "Chilled Water Reset" in the SCP699 Operation section of this manual for a further explanation of the CWR control function.

e. BCL Address. DIP Switch Nos. 5, 6, 7, 8 and 9 are used to "tag" the SCP699 panel with an identification number, and are not used unless the SCP is connected to a Trane BAS (i.e., building automation system [Tracer®]).

For your reference, the DIP switch positions corresponding to SCP address numbers of 0 through 31 are provided in Table 2.

Note: "BCL" is used throughout this manual to represent the "bidirectional communication links" that enable the SCP to exchange data with the UCP695 chiller control panels and a Trane BAS.

f. DIP Switch No. 10 is not used, so either switch position (i.e., ON or OFF) is permissible.

g. Condenser Limit Enable. To enable the SCP's optional condenser limit control function, sideboard DIP Switch No. 1 must be positioned at ON. (Field-installation of up to 3 condenser refrigerant temperature sensors is also required; see "Condenser Limit Option" on page 68.)

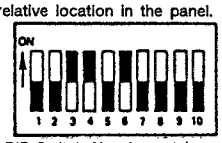
h. Generic BAS Enable. Positioning sideboard DIP Switch No. 2 at ON allows a generic BAS to interface with the SCP.

Note: Enabling the generic BAS option disables a number of standard SCP control functions; see "Generic BAS Option" on page 63 of this manual.

Table 1
SCP699 "Configuration" Switch Settings (1,4)

DIP Switch No.	DIP Switch Function	Switch Position ON	OFF
1	Pump Relay Command (2)	Service	Normal
2	Alarm Relay	Reverse (NC)	Normal (NO)
3	Degrees F/C Display	Degrees C	Degrees F
4	Chilled Water Reset Mode (3)	Reverse	Normal
5, 6, 7, 8, 9	Address for Bidirectional Communication Link (BCL) with Trane BAS	See Table 2 for DIP switch settings.	
10	Not Used	Either switch position is acceptable.	
1 (Aux.)	Opt. Condenser Limit Control (4)	Enabled	Disabled
2 (Aux.)	Opt. Generic BAS Interface (4)	Enabled	Disabled

Notes:
1. This illustration represents the SCP699 panel's 10 standard "configuration" DIP switches; refer to Figure 3 for their relative location in the panel.



2. Standard "configuration" DIP Switch No. 1 must be positioned at OFF (i.e., normal) to ensure proper chilled water pump operation.
3. The SCP assumes load-based chilled water reset operation when the CWR setpoint is ≤ 25 F, and ambient-based CWR when the CWR setpoint is > 25 F. Control logic for either type of CWR always results in a system chilled water setpoint that is ≥ the scheduled (or Tracer-issued) setpoint.
4. Auxiliary DIP Switch Nos. 1 and 2 are located on the SCP's optional sideboard; Figure 3 indicates their relative location.

Setup for SCP Condenser Relay Rotary Switches (Optional)

When equipped with the condenser option, a "condenser water control/generic BAS analog interface" sideboard is factory-installed inside the SCP's panel enclosure. Four rotary-type switches on this sideboard allow the system operator to set up "open" and "close" values for the contacts of Condenser Relays A (CRA) and B (CRB).

For an explanation of the condenser limit control function--along with an illustration of the sideboard, and available rotary switch settings--see "Condenser Limit Option" (page 68).

UCP695 DIP Switch Setup (Unit Address)

WARNING: To prevent injury or death due to electrical shock, always open unit disconnect switch before opening control panel door.

Each UCP695 chiller control panel connected to the SCP699 must be "tagged" with its own unique address (i.e., either "1", "2" or "3"). This address number is assigned by setting DIP Switch Nos. 1 through 5 on switch block S11.

To access DIP switch block S11, open the unit control panel door and remove the access cover strip located at the top of the micro module. See Figure 4. Notice that S11 is located in the upper left-hand corner of micro module 1U3.

Caution: To ensure proper chiller operation, never tamper with any UCP695 controls located behind panel door without first consulting a qualified service technician.

Refer to Table 3 for S11 DIP switch settings. Since no more than 3 chillers can be connected to any one SCP699 panel, only 3 addresses/switch combinations are listed.

Remember that all chillers communicating with an SCP must have separate, unique addresses. If 2 or more units connected to an SCP share the same address--or if a unit is tagged with an address other than "1", "2" or "3"--communications are automatically terminated.

Note: When only 1 chiller is connected to the SCP--and the SCP's system leaving chilled water temperature sensor is not installed, that unit must be given a chiller address of "1". The SCP will not govern system operation if the S11 DIP switches are "configured" to any other address number!

Table 2
BCL Address/DIP Switch Settings for SCP699 Panel (See Note 1)

SCP699 "Configuration" DIP Switch Nos.					Corresponding
No. 5	No. 6	No. 7	No. 8	No. 9	SCP Address
ON	ON	ON	ON	ON	0
ON	ON	ON	ON	OFF	1
ON	ON	ON	OFF	ON	2
ON	ON	ON	OFF	OFF	3
ON	ON	OFF	ON	ON	4
ON	ON	OFF	ON	OFF	5
ON	ON	OFF	OFF	ON	6
ON	ON	OFF	OFF	OFF	7
ON	OFF	ON	ON	ON	8
ON	OFF	ON	ON	OFF	9
ON	OFF	ON	OFF	ON	10
ON	OFF	ON	OFF	OFF	11
ON	OFF	OFF	ON	ON	12
ON	OFF	OFF	ON	OFF	13
ON	OFF	OFF	OFF	ON	14
ON	OFF	OFF	OFF	OFF	15
OFF	ON	ON	ON	ON	16
OFF	ON	ON	ON	OFF	17
OFF	ON	ON	OFF	ON	18
OFF	ON	ON	OFF	OFF	19
OFF	ON	OFF	ON	ON	20
OFF	ON	OFF	ON	OFF	21
OFF	ON	OFF	OFF	ON	22
OFF	ON	OFF	OFF	OFF	23
OFF	OFF	ON	ON	ON	24
OFF	OFF	ON	ON	OFF	25
OFF	OFF	ON	OFF	ON	26
OFF	OFF	ON	OFF	OFF	27
OFF	OFF	OFF	ON	ON	28
OFF	OFF	OFF	ON	OFF	29
OFF	OFF	OFF	OFF	ON	30
OFF	OFF	OFF	OFF	OFF	31 (2)

Notes:
1. "Configuration" DIP switch nos. 5 thru 9 are only used to establish a bidirectional-communication-link (BCL) address when the SCP699 panel is connected to a Trane building automation system.
2. When connected to a Tracer 100 system, the SCP's address must be "31".

SCP/UCP Communication Check

Once DIP switch setup at the SCP and chillers is complete, verify that the SCP is communicating with each of the chillers.

1. Adjust the chiller switch on each UCP695 chiller control panel to the "Standby/Reset" position.

2. Apply power to each of the UCP695 panels; then power up the SCP. (It will be necessary to close several disconnect switches.)

Operating codes A 88 and A 0, respectively, should appear on the UCPs, and the "READY" message should be displayed at the SCP.

3. Display the SCP's preformatted "Chiller" report.

To do this:

a. press the "Select Report" key (Figure 1) until "CHILLER" appears on the display; then,

b. press the "Display Report" push button. The SCP should now display the operating status of each connected chiller (i.e., UNIT 1, UNIT 2, UNIT 3).

Communication has not been established with a chiller if it is omitted from this report. If this occurs, refer to "Troubleshooting Charts" on pages 71 and 72 of this manual.

* * * * *

Note: Once you have successfully verified communication between the SCP and chillers, adjust the chiller switch on each UCP695 panel to the "Auto/Remote" position before programming the SCP.

Figure 4
UCP695 Chiller Control Panel Layout

Legend

1C1	= Oil Pump Capacitor
1DL2	= Sump Vent-Line Interval Timer (CVHEs Only)
1F1	= Oil Pump Fuse
1J*	= Post Header Power Supply Jacks
1K8	= Oil Pump Starter Relay
1K9	= Oil Tank Heater Relay
1K15	= Hot Gas Bypass Relay (Opt.)
1K16	= Chilled Water Pump Relay
1K17	= Condenser Water Pump Relay
1P*	= Post Header Power Supply Plugs
1R1	= Condenser Pressure Transducer
1S1	= Condenser High Pressure Switch
1S2	= Differential Pressure Switch
1T1	= Power Supply Transformer
1TB*	= Terminal Blocks
1U1	= Relay Output Module
1U2	= Power Supply Output Module
1U3	= Micro Module
	DIP Switch Blocks:
S1	= RLA Setpoint
S3	= Max. Acceleration Time, Frequency, Phase Imbalance/Surge Protection
S9	= Unit I.D., Temperature Range, Units-of-Measure
S11	= Unit Address

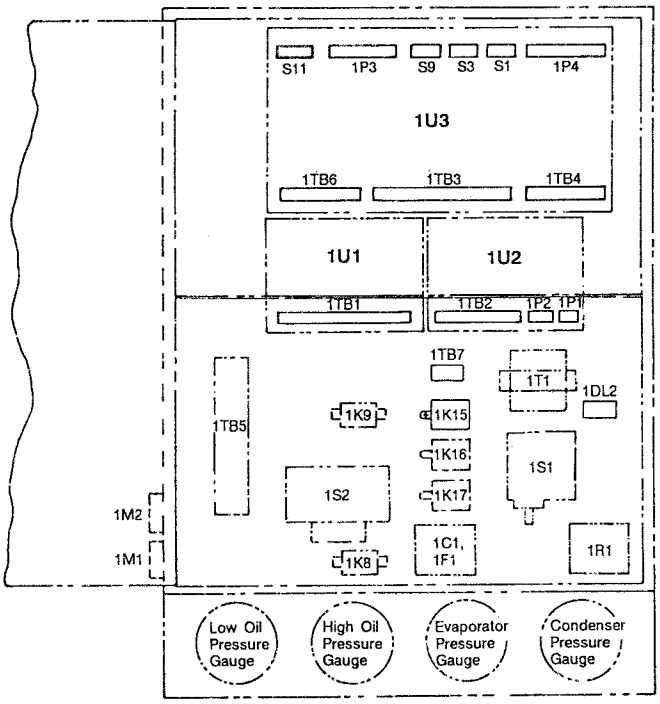


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Table 3
S11 Chiller Address Setup for UCP695 Control Panel (See Notes)

UCP695 S11 DIP Switch Nos. (See Figure 4)					Corresponding Chiller Address
No. 1	No. 2	No. 3	No. 4	No. 5	
ON	ON	ON	ON	OFF	1 (3)
ON	ON	ON	OFF	ON	2
ON	ON	ON	OFF	OFF	3

Notes:

1. No more than 3 chillers can be connected to any one SCP699 panel.
2. All chillers communicating with an SCP must have separate, unique addresses. If 2 or more units connected to an SCP share the same address, communications are automatically terminated.
3. In single-chiller system applications, that unit must be assigned an address of "1" if the SCP's system leaving chilled water temperature sensor is not installed. If any other unit address is assigned, the SCP will not govern system operation.

SCP699 Operator Interface

Overview

The operator interface portion of the SCP699 panel is comprised of an 8-character, alphanumeric display, 8 status indicator lights, and 9 pushbutton switches. All of these devices are accessible without removing the panel front cover. See Figure 1.

Notice that the SCP interface is divided –by function–into 3 groups of related elements:

[ ] the **Display** group, which consists of the 8-character, alphanumeric display and 8 system status indicator lights;

[ ] the **Report** group, which consists of 3 pushbuttons (i.e., "Display System Report/Alarm Reset*", "Select Report" and "Display Report"); and,

[ ] the **Program** group, which consists of these 6 pushbutton switches–"Select Main Menu", "Select Group Menu", "Select Group Data", " ↑ " (increase), "Enter" and " ↓ " (decrease).

Each of these categories is described in detail in the following paragraphs.

"Display" Interface (Figure 5)

Alphanumeric Display

An 8-character, alphanumeric, vacuum-fluorescent display is provided in the horizontal window of the SCP's "Display" block. It allows the operator to:

[ ] check the current system operating status;

[ ] program or display system and individual chiller operating parameters; and,

[ ] view a number of preformatted system and chiller status reports.

Four 1-line messages automatically appear on the display to indentify the present system operating status:

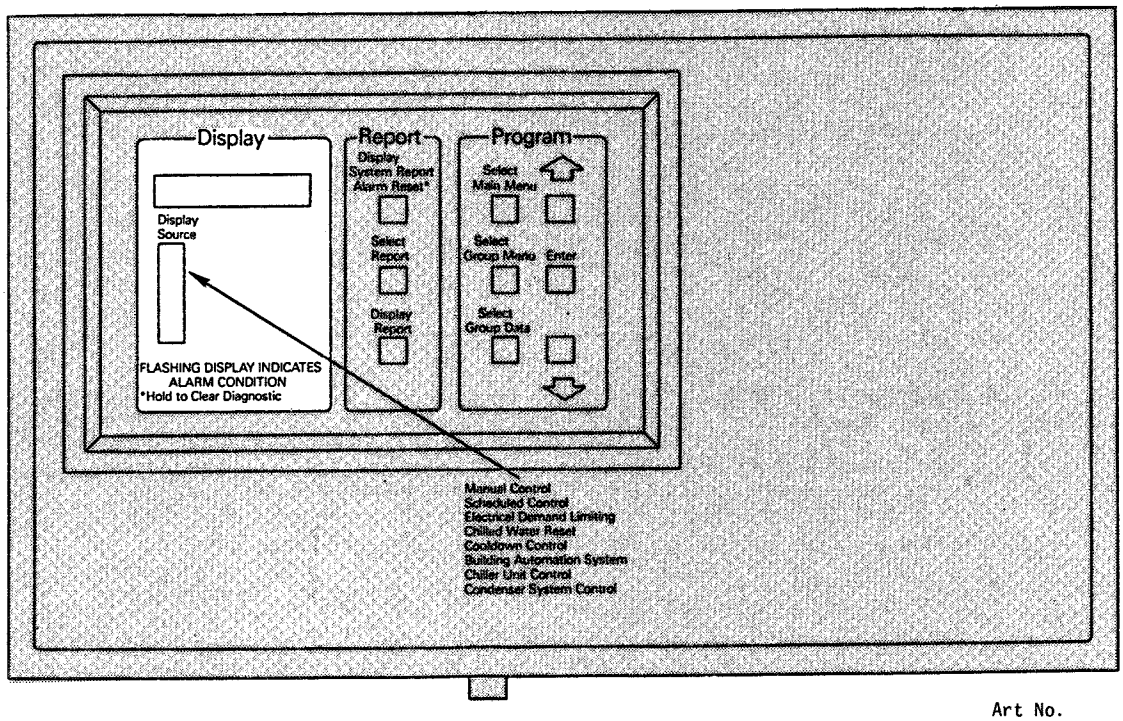
1. **READY** (i.e., no cooling operations are scheduled; or, the SCP is unable to issue chiller control information).

2. **STARTING** (i.e., the SCP is attempting to start a chiller).

3. **INHIBIT** (i.e., the SCP is attempting to bring a chiller on-line, but can't because the unit's restart inhibit period has not yet expired).

4. **COOLING** (i.e., displayed when none of the conditions described in Items 1 through 3 exist).

Figure 5
SCP "Display" Interface



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Note: If the SCP detects an error at the system level, it flashes the system status message appearing on the alphanumeric display and energizes the alarm relay until the "Display System Report/Alarm Reset*" button is pressed. (See Table 4 in "Report Interface" for a list of system-level diagnostic codes and corresponding errors.)

In addition to the 4 system status messages, a number of reports and programming entries can be read in the alphanumeric display window. Since the display is limited to 8 characters, a number of these entries consist of 2 or 3 lines that appear one at a time. For instance, the chilled water reset setpoint is a 2-line display that appears as "RESET", then "TEMP = 48"; the "Chilled Water Reset" status indicator light also illuminates while these entries are displayed.

Note: An "ERROR" message momentarily appears on the alphanumeric display if any of these keys are pressed while the system status message is shown--

[ ] the "Display Report" key;
[ ] the "Select Group Menu" key;
[ ] the " ↑ " (increase) key;
[ ] the "Enter" key; and,
[ ] the " ↓ " (decrease) key.

The present system status message then returns to the display.

If the "Select Group Data" key is pressed while the system status message is displayed, the SCP will test all segments and characters of its alphanumeric display by illuminating "********" for 1 second, followed by "0,0,0,0,0,0,0,0," for 1 second. (Notice that all status indicator lights also illuminate during this 2-second test.) The current system status message returns to the display once the 2-second display check is complete.

For more specific information about the alphanumeric displays used in the SCP's reports, see "Report Interface". The "Program Interface" section of this manual describes the alphanumeric displays that will appear while programming the SCP699 panel.

Status Indicator Lights

A series of 8 status indicator lights are also located in the SCP's "Display" block, directly below the horizontal alphanumeric display window. These blue lights--along with the information presented on the 8-character display--allow the operator to monitor system operation. The purpose of each status indicator light is described below.

Note: No more than 1 status indicator light is ever illuminated at any given time (i.e., unless the SCP malfunctions). If the value of a displayed operating parameter is derived from more than 1 control function, the illuminated status light indicates which control function influenced that value last.

[ ] Manual Control. Illumination of this light indicates that the operating parameter appearing on the alphanumeric display was manually set at the SCP and is not a "scheduled" system setpoint.

[ ] Scheduled Control. This light only illuminates when the operating parameter appearing on the alphanumeric display was established with the SCP's schedule function (i.e., consisting of a 7-day operating list of system chilled water setpoints and "setback" times).

[ ] Electrical Demand Limiting. Illumination of this status light indicates that the displayed operating parameter was established with the SCP's electrical demand limit function.

[ ] Chilled Water Reset. When this light glows, the displayed operating parameter was established with the SCP's chilled water reset function.

[ ] Cooldown Control. The operating parameter that appears on the alphanumeric display while this status light is on was established with the SCP's cooldown control function.

[ ] Building Automation System. Illumination of this light indicates that the displayed operating parameter was set at the building automation system (BAS) level.

[ ] Chiller Unit Control. This status indicator light illuminates whenever the operating parameter shown on the alphanumeric display is governed by the UCP695 control panel of that particular chiller (i.e., Unit 1, Unit 2 or Unit 3).

[ ] Condenser System (Limit) Control. When this status indicator light is on, the displayed operating parameter (i.e., refrigerant temperature differential between the evaporator and condenser [HEAD]; or, the common entering condenser water--or outdoor ambient--temperature [TEMP]) is being monitored by the SCP as a part of the optional condenser limit control function.

"Report" Interface (Figure 6)

Use of the 3 push buttons in the SCP's "Report" block enables the operator to view as many as 7 preformatted status reports (i.e., 4 system reports, and up to 3 chiller reports).

Each of these reports are described briefly in the following paragraphs; for a summary of SCP report access and contents, refer to the flow chart in Figure 7.

System (Status) Report

Pressing the "Display System Report/ Alarm Reset*" push button allows the operator to sequentially view the system operating parameters--itemized below--on the alphanumeric display.

Notice that the SCP automatically advances from one system status report entry to the next; after the last entry appears, the present system status (e.g., READY, COOLING, INHIBIT, etc.) returns to the display.

When applicable, a status indicator light also illuminates, enabling the operator to determine the source of the displayed characteristic.

Note: Each system status report entry below appears as it does on the SCP699 alphanumeric display.

1. System Chilled Water Temperature and Setpoint. This 4-line report entry indicates:

a. the temperature registered by the SCP sensor field-installed in the common system leaving chilled water line; and,

b. the "active" system chilled water temperature setpoint. Illumination of the appropriate status indicator light identifies the source of this setpoint (e.g., manual control, scheduled control, chiller unit control, etc.).

Note: If the SCP controls only a single chiller--and a system temperature sensor is not installed, "UNIT 1" is substituted for "SYSTEM" throughout the report. Also, the "FREECOOL" message appears on the display in lieu of a setpoint value if the system is presently operating in the automatic free cooling mode.

Following is the format used to display this information:

SYSTEM (or UNIT 1)
CHLD. WTR.
TEMP = (0 to 99 F)

SET = (OFF, or 1 to 99 F)

or

FREECOOL

Figure 6
SCP "Report" Interface

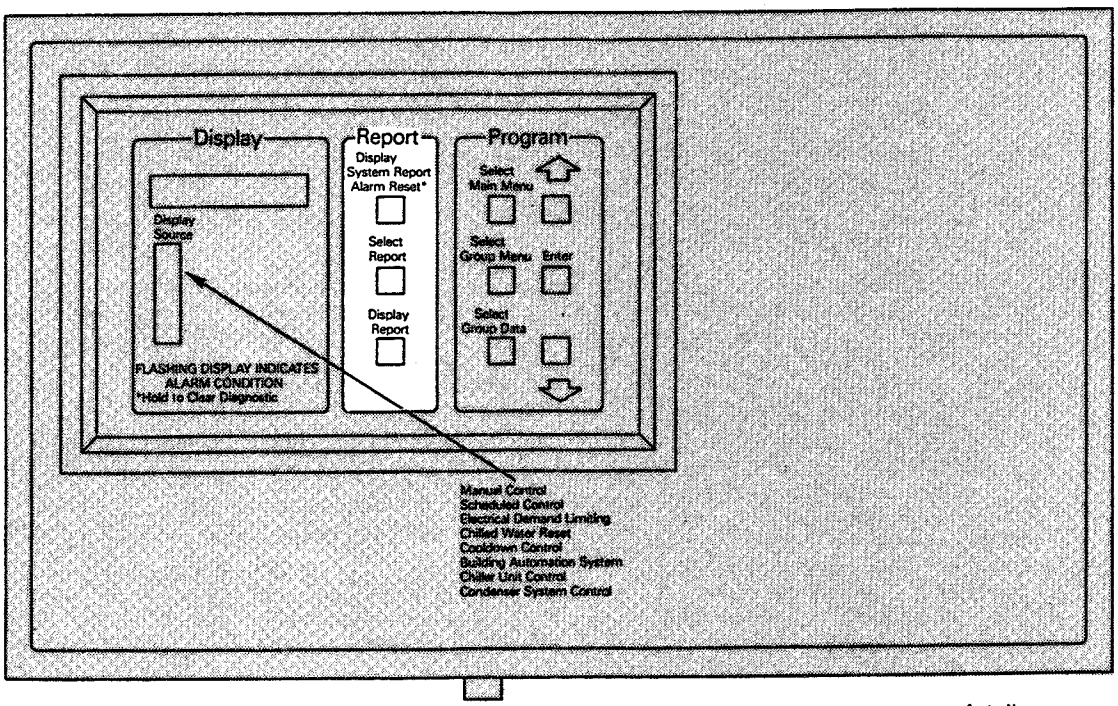

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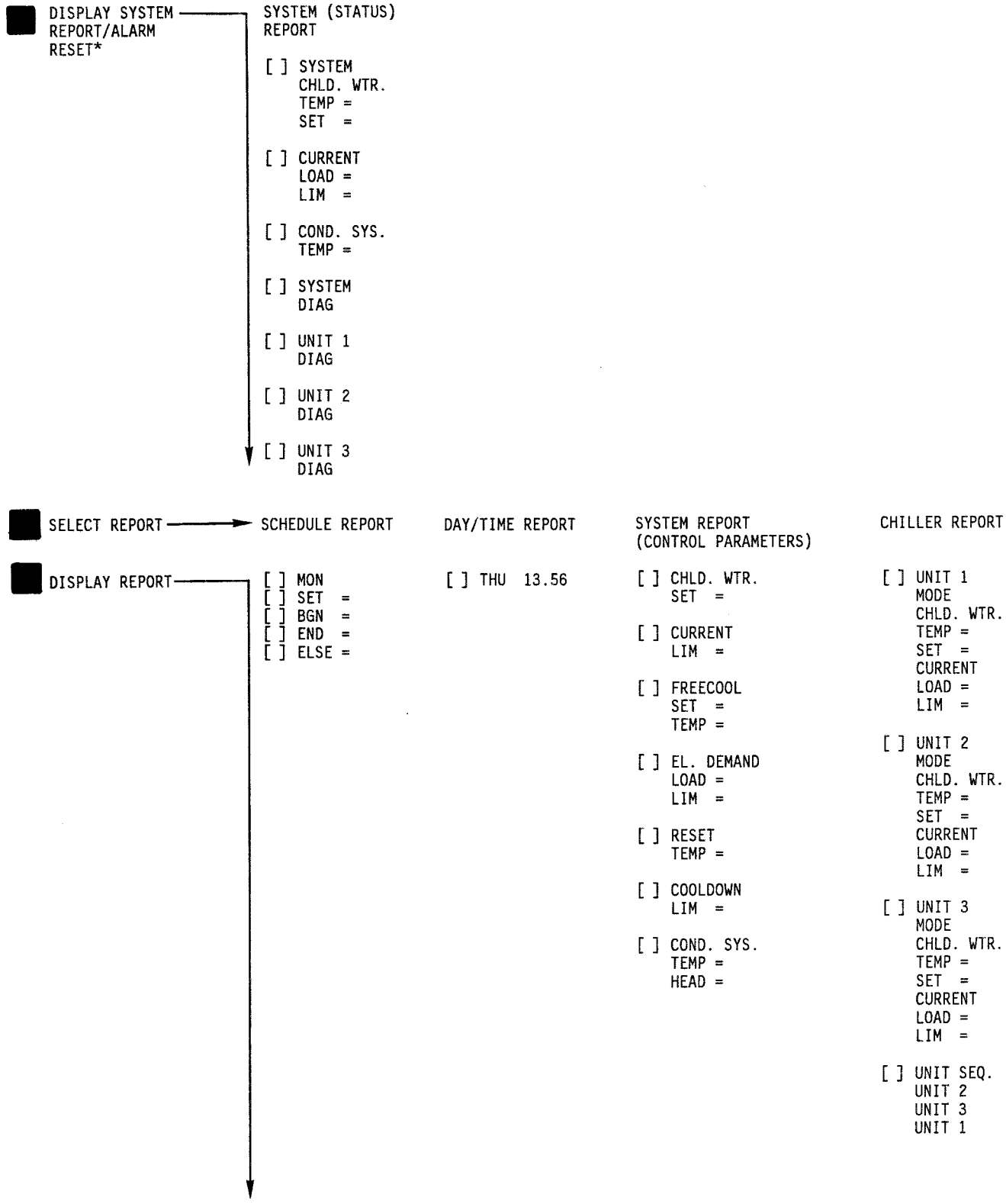
Figure 7
Preformatted SCP Reports



2. System Current Load and Limit. This 3-line report entry displays the following information:

a. the present electrical load (i.e., percent of total chiller rated load amps [RLA]).

b. the "active" system current limit setpoint. Illumination of the appropriate status indicator light indicates the source of this setpoint (e.g., manual control, scheduled control, chiller unit control, etc.).

This data appears in the following format:

CURRENT
LOAD = (0 to 100%)
LIM = (0 to 100% system RLA)

3. Condenser System Temperature. This 2-line report entry indicates the temperature registered by the optional sensor installed in either the common, system entering-condenser water line, or the outdoor ambient. Notice that the "Condenser System Control" status indicator light is illuminated while this report entry is displayed.

This format is used to display the system condenser return water temperature:

COND. SYS.
TEMP = (0 to 140 F; default is 0 F)

"COND. SYS. TEMP = 0" only occurs if the optional condenser water temperature sensor is "open" or not installed.

4. System (or Unit) Diagnostic. This 2-line entry reports the last abnormal condition that was detected at a system or unit level, and was recorded as an error in the SCP's memory.

Following are the formats used to display the last recorded system or unit diagnostic:

SYSTEM
DIAG (see Table 4)
and/or
UNIT 1
DIAG (see Table 5)
and/or
UNIT 2
DIAG (see Table 5)
and/or
UNIT 3
DIAG (see Table 5)

If no diagnostic code was recorded, the system status message returns to the display immediately after the condenser system temperature (see Item 3) is indicated.

Note: To remove the last recorded diagnostic code from the SCP's memory, simply press the "Display System Report/ Alarm Reset*" key and hold it down while the system status report is displayed. After the "SYSTEM (and each UNIT) DIAG " entry appears, the SCP generates a "CLEARED" message. The current system operating status then returns to the display.

Each error condition is represented by a 2-character code. See Table 4 for system-level diagnostic codes; unit-level diagnostic codes are listed in Table 5.

Notice that detection of a system-level diagnostic (other than D9)--or a latching chiller-level diagnostic--causes the SCP to flash the alphanumeric display and energize a customer-supplied and -installed alarm device connected to the SCP's alarm relay. This display will flash (and the alarm relay remain energized) until the "Display System Report/Alarm Reset*" button is pressed.

Table 4
SCP699 System Diagnostic Codes (See Note)

2-Digit Code	Description of Diagnostic Condition
AA	System Leaving Water Temperature Sensor (1,3)
DF	Communications Failure (1,3)
D9	Power Loss (Program Retained) (2,3)
EF	Power Loss (Program Lost) (1,3)
FF	System Control Module (1,3)

Notes:
1. Detection of 1 of these 4 system-level diagnostic conditions causes the alphanumeric display to flash and energizes the alarm relay. To reset the alarm relay--and stop the display from flashing, press the "Display System Report/Alarm Reset*" button.
2. Detection of the "D9" system-level diagnostic causes the SCP to flash its alphanumeric display; however, the alarm relay is not energized.
3. To remove the last recorded diagnostic code from the SCP's memory, press the "Display System Report/Alarm Reset*" button and hold it down while the system status report is displayed. After "SYSTEM DIAG = " appears, the SCP generates a "CLEARED" message.

Table 5
Chiller-Level Diagnostic Codes (See Notes 1, 2)

Diagnostic Codes (3)			
UCP695 Display	SCP Display	Description of Diagnostic Condition	System Reset
b A3	DIAG. A3	Evaporator Refrigerant Temperature Range	Manual
b A4	DIAG. A4	Motor Temperature Sensor #1 (4B1R2)	Manual
b A5	DIAG. A5	Maximum Acceleration Time Range	Manual
b A7	DIAG. A7	Motor Temperature Sensor #2 (4B1R3)	Manual
b A8	DIAG. A8	Motor Temperature Sensor #3 (4B1R4)	Manual
b A9	DIAG. A9	Oil Temperature Sensor (4RT7)	Manual
b Ab	DIAG. Ab	Leaving Water Temperature Sensor (4RT1)	Manual
b AC	DIAG. AC	Opt. Condenser Refrig. Pressure Sensor (1R1)	Manual
b Ad	DIAG. Ad	Evaporator Temperature Sensor (4RT5)	Manual
b AE	DIAG. AE	Opt. Ambient Temperature Sensor (4RT6)	Manual
b AF	DIAG. AF	Opt. Bearing Temperature Sensor #1 (4RT8)	Manual
b b0	DIAG. b0	Opt. Bearing Temperature Sensor #2 (4RT9)	Manual
*b d9	DIAG. d9	Extended Power Loss	Automatic
b dA	DIAG. dA	Surge	Manual
b dC	DIAG. dC	Condenser Water Flow Overdue	Manual
*b E2	DIAG. E2	Momentary Power Loss	Automatic
b E3	DIAG. E3	Phase Imbalance	Manual
b E4	DIAG. E4	Phase Loss	Manual
b E5	DIAG. E5	Phase Reversal	Manual
b E7	DIAG. E7	High Motor Temperature	Manual
b E8	DIAG. E8	Differential Oil Pressure Switch	Manual
b E9	DIAG. E9	Stop Relay	Manual
b EA	DIAG. EA	High Bearing Temperature (Sensor #1)	Manual
b Eb	DIAG. Eb	High Bearing Temperature (Sensor #2)	Manual
b EC	DIAG. EC	Running Overload	Manual
*b Ed	DIAG. Ed	Chilled Water Flow	Automatic
b EE	DIAG. EE	Exceeded Maximum Acceleration Time	Manual
b F0	DIAG. F0	Transition	Manual
b F1	DIAG. F1	Opt. Running External Interlock	Manual
b F2	DIAG. F2	Low Oil Pressure	Manual
b F4	DIAG. F4	High Oil Temperature	Manual
b F5	DIAG. F5	High Condenser Refrigerant Pressure	Manual
*b F7	DIAG. F7	Condenser Water Flow	Automatic
b F8	DIAG. F8	Improper Unit Identification	Manual
b F9	DIAG. F9	Free-Cooling Valves	Manual
b FA	DIAG. FA	Actuator	Manual
b Fb	DIAG. Fb	Low Evaporator Refrigerant Temperature	Manual
b Fd	DIAG. Fd	Opt. External Interlock	Manual
b FF	DIAG. FF	Unit Control Module	Manual

*The SCP does not record and alarm "nonlatching" (i.e., automatic reset) chiller diagnostic conditions.

Notes:
1. It is not possible to clear "latching" diagnostic condition (i.e., one requiring manual reset) from a higher level device such as an SCP699, Tracer or generic BAS. To manually reset the UCP695 panel--after diagnosing and correcting the problem, toggle the 3-position chiller switch to "Standby/Reset", then back to "Auto/Remote" or "Auto/Local".
2. To determine if manual reset is required, check the "Manual Reset Required" status indicator light on the front of the UCP695 control panel.
3. The "b" prefix on the UCP695 diagnostic codes does not appear on the SCP699 display.

Note: When a system diagnostic condition is detected and recorded, the SCP will not:

a. record a subsequent system error until the "Display System Report/Alarm Reset*" button is pressed; nor

b. alarm a diagnostic condition with the same error code previously recorded.

For instance, if the last diagnostic code recorded in the SCP's memory is "DF" [i.e., communications failure]--and the SCP detects another communications failure, it will not flash the display and energize the alarm relay. However, the original "DF" error code will remain in the system status report either until another, different diagnostic [e.g., "AA", system leaving chilled water temperature sensor] is detected and recorded, or until the SCP's diagnostic register is cleared. (See the first note under Item 4 for diagnostic clearance instructions.)

Schedule Report

To view a report of the present day's operating schedule, press the "Select Report" push button until "SCHEDULE" appears on the alphanumeric display. (Notice that the "Scheduled Control" status indicator light comes on and remains lit throughout this report.) Then, press the "Display Report" key.

The SCP automatically displays the current day of the week, the "occupied" system chilled water setpoint, the "on" and "off" times (i.e., based on the 24-hour clock) for this setpoint, and an alternative "unoccupied" chilled water setpoint (i.e., for setback operation).

These report entries are displayed in the following manner:

MON. (TUE. thru SUN.; default is MON.)
SET = (OFF, or 1 to 99 F; default is OFF)
BGN = (00.00 to 23.45; default is 00.00)
END = (00.00 to 23.45; default is 00.00)
ELSE = (OFF, or 1 to 99 F; default is OFF)

After the "ELSE = " entry appears, "SCHEDULE" returns to the display.

Note: If no additional push buttons are pressed within 2 minutes, the present system operating status (e.g., "READY", "COOLING", etc.) reappears on the alphanumeric display.

Day/Time Report

By pressing first the "Select Report" key until "DAY/TIME" appears--then the "Display Report" key--the operator can check the status of the SCP's system clock. The current day of the week, along with the present time of day, appear in a 1-line report entry that follows this format:

THU. 13.56
(MON thru SUN; 00.00 to 23.59; default is MON. 00.00)

The "DAY/TIME" report title then reappears on the display and remains there until either: (a) another SCP key is pressed, or (b) 2 minutes elapses. At the end of the 2-minute interval, the present system operating status recurs on the display.

System Report

Note: This report displays system control parameters, and is not the same as the "System (Status) Report" that is issued when the "Display System Report/ Alarm Reset*" button is pressed.

For a rundown of each of the operating parameters associated with the SCP's various control functions, press the "Select Report" key until "SYSTEM" appears on the alphanumeric display. Next, press the "Display Report" push button.

The SCP automatically advances from one system control parameter to the next; as each report entry is displayed, a status indicator light also illuminates. This allows the operator to determine what control function (or mode) was used to establish that particular operating parameter (e.g., manual control, chilled water reset, building automation system, etc.).

Following is a sequential listing of the standard (5) and optional (2) control function entries included in the system report:

1. System Chilled Water Setpoint. Remember to check the status indicator lights during this 2-line report entry to review where this setpoint was established:

CHLD. WTR.
SET = (OFF, or 1 to 99 F; default is OFF)

2. System Current Limit Setpoint. The value in this 2-line entry is expressed as a percentage of the total chiller RLA; check the status indicator lights to determine where this limit was set:

CURRENT
LIM = (0 to 100%; default is 0%)

3. System Free Cooling Setpoint and Temperature (Optional). If any of the units connected to the SCP is equipped with the free cooling option, the SCP displays a 3-line report entry that indicates:

a. the operator-set, entering-condenser (outdoor) sensor temperature limit for automatic free cooling; and,

b. the temperature registered by the optional SCP sensor field-installed either in the common, system entering-condenser water line, or in the outdoor ambient.

FREECOOL
SET = (OFF, or 1 to 140 F; default is OFF)
TEMP = (0 to 140 F; default is 0 F)

4. Electrical Demand Load and Limit. This 3-line report entry indicates:

a. the actual percentage of metered electrical demand at which the system is currently operating; and,

b. the operator-set electrical demand limit point. (The SCP initiates the electrical demand limit mode if the actual percentage of metered electrical demand exceeds this limit point.)

Notice that the "Electrical Demand Limiting" status indicator light is lit while this report entry is displayed.

Below is a typical electrical demand limit entry for the system report:

EL. DEMAND
LOAD = (0 to 100%; default is 0%)
LIM. = (0 to 100%; default is 0%)

Note: This control function is disabled if the electrical demand limit is set at 0% (zero).

5. Chilled Water Reset Temperature. A 2-line system report entry indicates the actual temperature registered at an SCP sensor field-installed in the common, system entering-evaporator water line (i.e., or in the outdoor ambient).

RESET
TEMP = (0 to 140 F; default is 0 F)

The "Chilled Water Reset" status indicator light also illuminates while this entry is displayed.

6. Cooldown Control Limit. A 2-line entry reports the operator-set current limit point (i.e., as a percentage of total chiller RLA) that is effective while the system is operating in the cooldown mode.

Note: The SCP compares the cooldown limit point with the system current limit point and uses the lowest value.

COOLDOWN
LIM = (0 to 100%; default is 0%)

Notice that the "Cooldown Control" status indicator light is on while this entry is on the display.

Note: If the cooldown limit point is set at 0%, the cooldown control function is disabled.

7. Condenser System Limit Control Temperature and "Head" (Optional). SCPs equipped with this control option generate a 3-line system report entry that illuminates the "Condenser System Control" status indicator light, and yields the following information:

a. the temperature registered by the optional SCP sensor installed in either the common, system entering-condenser water line, or outdoor ambient; and,

b. the difference between the evaporator and condenser refrigerant temperatures for the chiller with the lowest differential. (The SCP looks only at those units that are presently operating, compares their "head" values, and displays the lowest refrigerant temperature differential.)

COND. SYS.
TEMP = (0 to 140 F; default is 0 F)
HEAD = (0 to 140 F; default is 0 F)

Note: This control function is active whenever any chiller in the system is operating; it is not operative when the system is in the automatic free cooling mode.

Once the last system report entry is displayed, the "SYSTEM" report title reappears and remains on the alphanumeric display until either: (a) another SCP key is pressed, or (b) 2 minutes elapses. (The SCP indicates the present system operating status [e.g., "COOLING", "INHIBIT", etc.] at the end of the 2-minute interval.)

Chiller Report(s)

In addition to the preformatted system (operating status), schedule, day/time and system (control parameters) reports already described, the SCP also enables the operator to review chiller operation on a unit-by-unit basis.

Press the "Select Report" key until "CHILLER" appears on the display; then press the "Display Report" push button. The SCP automatically displays each of the chiller report entries--itemized below--in the sequence shown.

When applicable, a status indicator light also illuminates; this allows the operator to determine what control function is presently governing the operation of that unit.

Note: The chiller report begins with a display of the 3 (or 4) operating status report entries associated with "UNIT 1"; corresponding status reports for "UNIT 2" and "UNIT 3" follow, where applicable. (Remember that unit numbers correspond to the addresses set up with DIP switch block S11 in the chiller control panels; so, actual chiller status reports for a particular system may include only "UNIT 2", or "UNIT 1" and "UNIT 3", etc.)

A "unit sequence" entry is included after the last unit status report for systems with multiple chillers.

Refer to the chiller report entry descriptions that follow.

1. Chiller Operating Mode. A 1- or 2-digit code indicates the unit's present mode of operation; notice that this same code (i.e., along with an "A" prefix) is also displayed on the unit's UCP695 control panel. (See Table 6 for a summary of chiller operating codes.)

Below is a typical, 1-line report entry for the chiller's operating mode:

MODE 74 (see Table 6)

2. Unit Chilled Water Temperature and Setpoint. This 3-line chiller report entry provides:

a. the temperature registered by that unit's leaving chilled water temperature sensor (4RT1); and,

b. the "active" unit chilled water temperature setpoint. Check the status indicator lights to determine where this setpoint was established (e.g., SCP manual control, SCP scheduled control, building automation system, etc.).

Note: The "FREECOOL" message is displayed in lieu of a setpoint value if the unit is presently operating in the free cooling mode (i.e., operating code "09").

Following is the format used to display the unit's chilled water temperature and setpoint:

CHLD. WTR.
TEMP = (0 to 99 F; default is 0 F)

SET = (AUTO, OFF, or 1 to 99 F; default is AUTO)

or

FREECOOL

3. Chiller Current Load and Limit. A 3-line report entry displays the following data:

a. chiller load (i.e., represented as a percentage of that unit's compressor RLA); and,

b. the "active" unit current limit setpoint. Again, check the status indicator lights to identify the source of this setpoint (e.g., chiller unit control, SCP scheduled control, etc.).

This data appears in the following report entry format:

CURRENT
LOAD = (0 to 100%; default is 0%)
LIM = (0 to 100%; default is 0%)

The SCP then proceeds to the chiller operating status report for "UNIT 2" (if applicable).

In single-chiller system applications, the "CHILLER" report title reappears on the display, and remains there until either: (a) another SCP key is pressed, or (b) 2 minutes elapses. (A status message--representing the system's present operating status--returns to the display once the 2-minute period expires.)

When the SCP is connected to 2 or 3 chillers, chiller report items 1 through 4 are repeated for "UNIT 2" and--if applicable--"UNIT 3".

Note: Chiller status reports are only displayed for units that have communicated with the SCP during the last 2 minutes.

Table 6
Chiller Operating Codes

Operating Codes (1)		
UCP695 Display	SCP Display	Description of Operating Mode
Blank	Blank	Power Off
A 0	MODE 00	Standby/Reset (or chiller off on diagnostic)
A 1	MODE 01	Auto (Local or Remote)
A 9	MODE 09	Free Cooling
A 70	MODE 70	Restart Inhibit
A 71	MODE 71	Establish Condenser Water Flow
A 72	MODE 72	Start
A 74	MODE 74	Run: Normal
A 75	MODE 75	Run: Current Limit (2)
A 76	MODE 76	Run: Condenser Limit (3)
A 77	MODE 77	Run: Evaporator Limit (4)
A 78	MODE 78	Run: Surge Condition (5)
A 79	MODE 79	Post-Lube
A 88	MODE 88	Reset

Notes:
1. The "A" prefix on the UCP695 chiller operating codes does not appear on the SCP699 display.
2. As the current limit setpoint is approached, the UCP695 restricts further opening of the inlet guide vanes.
3. As the condenser limit setpoint is reached, the UCP695 restricts additional compressor loading to avoid shutdown on high condenser pressure (i.e., diagnostic b F5), and initiates a "head relief request" (i.e., optional UCP695 relay package).
4. The UCP695 restricts further opening of the inlet guide vanes to avoid a shutdown on low evaporator refrigerant temperature (i.e., diagnostic b Fb).
5. The UCP695 limits compressor loading and initiates a "head relief request" (i.e., optional relay) when the unit enters a surge condition. An automatic unit shutdown occurs if the unit remains in surge for 15 minutes (i.e., diagnostic b dA).

4. Unit Sequence. Following the last chiller status report item, the SCP generates a 3- or 4-line report entry that identifies which unit (i.e., "UNIT 1", "UNIT 2" or "UNIT 3") is presently the first chiller in the operating sequence, which is second, and--if applicable--which chiller is third in the operating sequence.

Note: The "UNIT SEQ." report entry is not displayed if the SCP is only connected to--or communicating with--1 chiller.

This chiller report entry format indicates the chillers' operating sequence:

UNIT SEQ.
UNIT 2 (1st chiller in operating sequence)
UNIT 3 (2nd chiller in operating sequence)
If applicable,
UNIT 1 (3rd chiller in operating sequence)

After the "UNIT SEQ." report entry is complete (if displayed), the "CHILLER" report title reappears on the display. It remains there either until: (a) another SCP key is pressed, or (b) 2 minutes elapses. (A status message--representing the system's present operating status--returns to the display once the 2-minute period expires.)

"Program" Interface (Figure 8)

Since the SCP's control strategies are an integral part of the panel's software, very little programming is required. The operator simply inputs scheduled setpoints, and enters values for the control parameters associated with the SCP's standard and optional control functions (e.g., electrical demand limiting, chilled water reset, free cooling, condenser system control, unit sequencing, and cooldown control).

See Figure 8. Notice that the 6 push-button keys--along with the display portion of the panel--allow the operator to set up system operation.

Like the report displays described in the previous section, "programmable" SCP entries are grouped into 4 categories or "main menus": "Schedule", "Day/Time", "System", and "Chiller". The control parameters associated with each of these main menus are described in the following paragraphs, and summarized in Figure 9.

For discussions of how the SCP's major control strategies (i.e., electrical demand limiting, chilled water reset, etc.) work, refer to the SCP699 Operation section of this manual.

Note: An "SCP Programming Aid" worksheet is provided at the back of this manual. It summarizes all operator -programmable control entries, and can be used to record the specific values entered for each.

Figure 8
SCP "Program" Interface

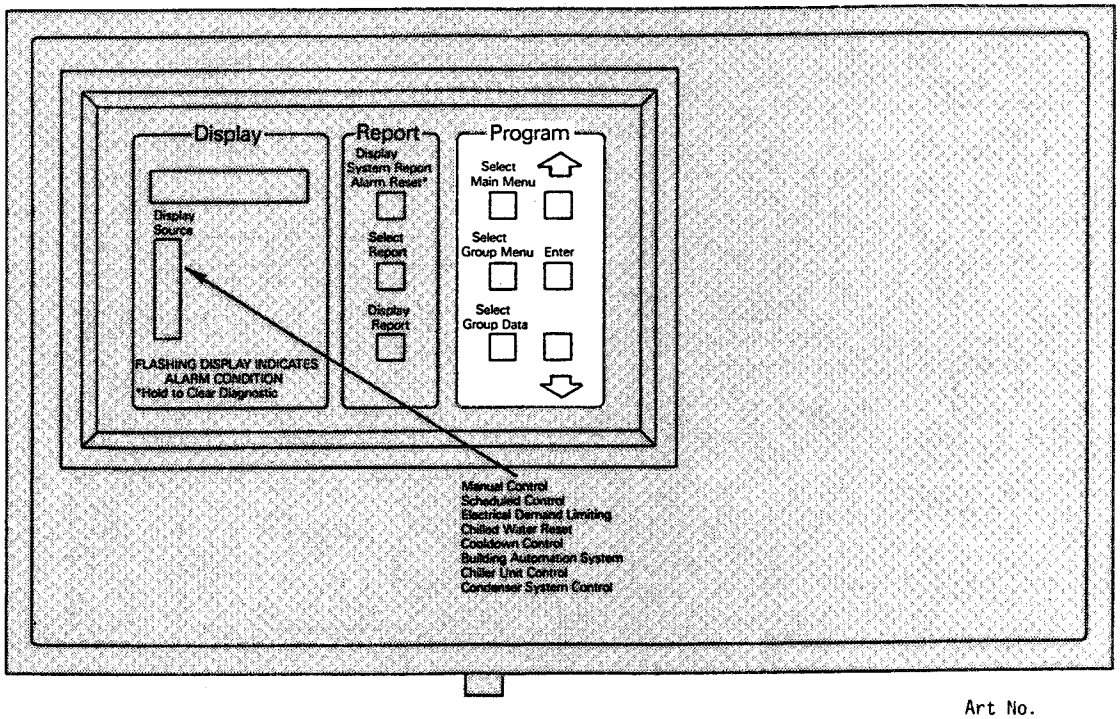


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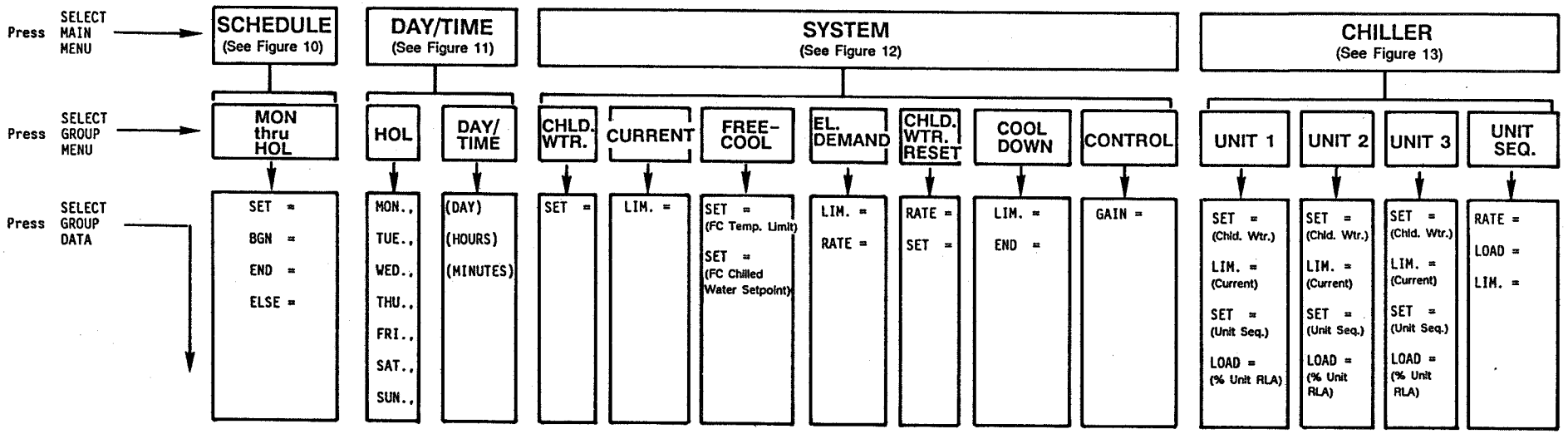
Figure 9
SCP Program Selection



Note: For a more detailed look at each of the 4 main SCP programming menus (i.e., SCHEDULE, DAY/TIME, SYSTEM and CHILLER), see Figures 10 through 13. The schematics in these illustrations include the range of settings for each programmable SCP control setting.

"Schedule" Program

The SCP's schedule control function is comprised of a 7-day operating list of system chilled water setpoints, daily "begin" and "end" times for these setpoints, and alternative chilled water setpoints for "setback" (i.e., unoccupied or "after-hours") operation.

Notice that 4 distinct types of system schedules are possible; the operator can:

1. schedule the system off all day, with none of the pumps running;

2. schedule the system on all day, with a single system (i.e., common leaving-chiller) chilled water setpoint;

3. schedule the system on for part of the day with one chilled water setpoint, and off for the remainder of the day; and,

4. schedule the system on for part of the day with one chilled water setpoint, and use an alternative setpoint for the remainder of the day.

Once established, the 7-day, Monday-through-Sunday system operating scheme is repeated each week until the schedule is manually changed by the operator, or until the SCP encounters a "holiday" schedule.

Note: In addition to the entries for Monday through Sunday, the "schedule" menu day list includes a "holiday" entry that allows the operator to set up a unique, 24-hour system schedule. When any (or all!) of the weekdays--including Saturday and Sunday--are designated as "holidays" under the Day/Time menu, the temporary, 24-hour holiday schedule is executed. (See "'Day/Time' Program" for a further explanation of holiday programming.)

Schedule Setup

Follow the step-by-step instructions outlined below to set up a system operating plan using the SCP's schedule function. (Refer to Figure 10 for a flow chart that summarizes these steps.)

1. Access the SCP's "Schedule" menu.

Press the "Select Main Menu" key (i.e., located in the SCP's "Program" block; Figure 8) until "SCHEDULE" appears on the alphanumeric display.

Notice that the "Scheduled Control" status indicator light illuminates at this time; it will remain on as long as the operator continues to review entries within the "schedule" menu.

2. Specify the day (i.e., Monday through Sunday, or Hoilday) you wish to schedule.

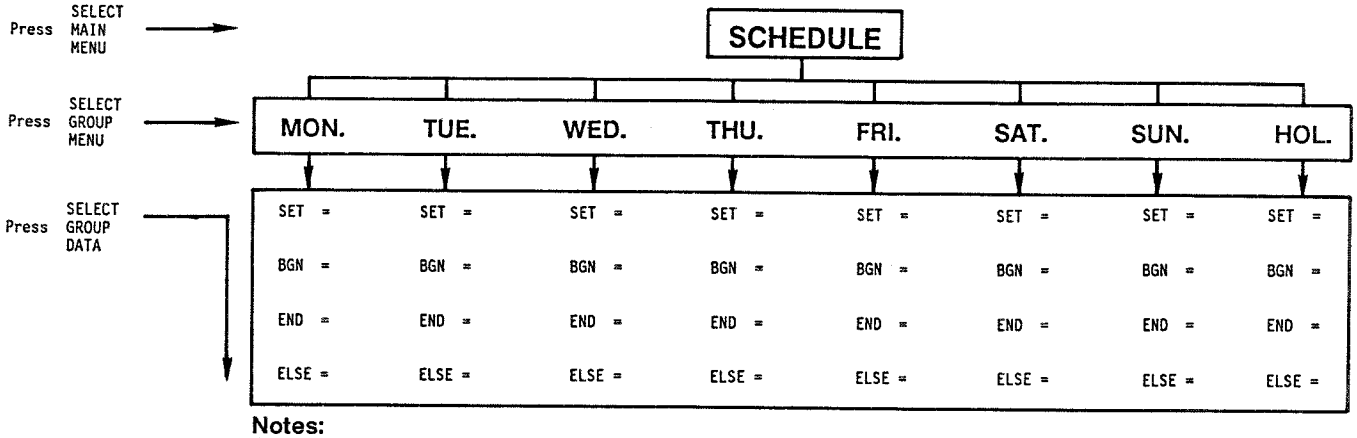
To establish a day-to-day system operating schedule, press the "Select Group Menu" key; "MON." will appear on the display.

Note: Monday is always the first group heading within the "schedule" menu, followed by Tuesday, Wednesday, and so on. To advance from one day of the week to the next, press the "Select Group Menu" key until the desired day is displayed. (The last "schedule" group heading--following Sunday--is Holiday. If "Select Group Menu" is pressed while "HOL." is displayed, "SCHEDULE" reappears on the display.)

3. Enter the desired system leaving chilled water setpoint for that day's scheduled operation.

With the desired day displayed, press the "Select Group Data" key; "SET = " should now appear on the display. This program entry represents the control setpoint for system leaving chilled water temperature; the SCP regulates system operation as necessary --during scheduled hours--to maintain this setpoint.

Figure 10
"Schedule" Setup



Notes:
1. The "Scheduled Control" status indicator light illuminates when "SCHEDULE" appears on the alphanumeric display, and remains lit while the operator completes the schedule program entries.
2. Possible entries for "SET = " are: OFF (i.e., default setting), MON. thru HOL., and 1 F thru 99 F in increments of 1 F.
3. Possible entries for "BGN = " and "END = " are 00.00 (i.e., default setting) thru 23.45 in 15-minute increments.
4. Possible entries for "ELSE = " are OFF (i.e., default setting), or 1 F thru 99 F in increments of 1 F.

Possible values for this control setting include OFF (i.e., SCP's default value), and 1 F through 99 F, along with MON. through SUN. and HOL. To change the "SET = " value displayed, simply press the " ↑ " (increase) or " ↓ " (decrease) keys until the desired setpoint is obtained; then press "Enter" to store this value in the SCP's memory.

Note: To duplicate the operating schedule of a prior day already programmed, enter the abbreviation of the day to be duplicated for the "SET = " parameter. For instance, if you want Monday's operating schedule (i.e., chilled water setpoint, "begin" and "end" times, and "else" setpoint) to be repeated on Wednesday:

a. Use the "Select Group Menu" key to scroll through the "schedule" menu.

b. When "WED." is displayed, press the "Select Group Data" key; "SET = " should now appear on the display.

c. Press the " ↑ " (increase) and " ↓ " (decrease) keys as needed until "SET = MON." is displayed; then press "Enter". (Notice that the SCP displays the numeric value for Monday's system chilled water setpoint after "Enter" is pressed.)

Important! Although Wednesday's schedule was originally established by entering "SET = MON." (Steps "a" thru "c", above), the SCP will not automatically revise Wednesday's operating schedule if any of Monday's "Schedule" entries are changed!

Note: Entering "SET = HOL." for a given day establishes a permanent holiday! (For example, if "HOL." is entered for Wednesday's "SET = " schedule, the SCP will execute the holiday schedule every Wednesday.) To designate a temporary, one-time-only holiday, be sure to use the "Day/Time" programming menu.

4. Enter the time of day scheduled operation is to begin.

After entering a value for the system leaving chilled water setpoint (Step 3), press the "Select Group Data" key to display "BGN = __.__". This control parameter "tells" the SCP what time of day the scheduled setpoint goes into effect, and is based on the 24-hour clock.

Values ranging from 00.00 (i.e., default setting) to 23.45--in 15-minute increments--are possible. Use the " ↑ " (increase) and " ↓ " (decrease) keys to obtain the desired "begin" time; then press "Enter" to store this value in the SCP's memory.

5. Enter the time of day that scheduled operation should cease.

Once the "begin" time entry is complete (Step 4), press the "Select Group Data" key to display "END = __.__". This parameter "tells" the SCP when to stop maintaining the scheduled system chilled water setpoint established in Step 3.

Again, possible "end" time values are based on the 24-hour clock, and range from 00.00 (i.e., default setting) to 23.45 in increments of 15 minutes. To obtain the desired "end" time, press the " ↑ " and " ↓ " keys until the proper time is displayed; then press "Enter".

Note: If the "begin" and "end" times are identical, the SCP will attempt to maintain the scheduled system leaving chilled water setpoint (i.e., set in Step 3) for 24 continuous hours.

It is possible to enter an "end" time that is earlier than the corresponding "begin" time. For example, if the begin time is 22.15 and the end time is 07.30, the SCP will: begin enforcing the "SET = " value at midnight; stop at 7:30 a.m.; resume enforcement of "SET = " at 10:15 p.m.; and, stop at midnight.

6. Enter the desired alternative ("else") system leaving chilled water setpoint to be used during the remainder of the day (i.e., outside the scheduled "begin" and "end" times).

After completing the "end" time entry (Step 5), press the "Select Group Data" key to display "ELSE = ". This value tells the SCP what system leaving chilled water temperature to maintain during the unscheduled portion of the day (i.e., after the day's scheduled "end" time). Generally, an alternative chilled water setpoint is established for nighttime and weekend (or holiday) operation.

The "ELSE = " control point can be set either at OFF (i.e., default setting), or at any temperature value ranging from 1 F through 99 F in increments of 1 F. Use the " ↑ " and " ↓ " keys to obtain the desired alternative chilled water temperature; then press "Enter" to store this value in the SCP's memory.

Note: If "OFF" is entered for the "ELSE = " chilled water setpoint, the SCP will shut down system operation once the scheduled "end" time is reached.

7. Press the "Select Group Menu" key to advance to the next day to be scheduled.

Note: To schedule a system shutdown through the weekend--or during a holiday--enter "OFF" for Saturday's (or Holiday's) "SET = " program entry. Be sure that the BGN and END times are the same, too. Then enter either "SET = OFF" or "SET = SAT." for Sunday's scheduled system chilled water setpoint.

Repeat the programming procedure described in Steps 3 through 7 until all of the programmable "schedule" menu control settings (i.e., indicated in Figure 10) are complete.

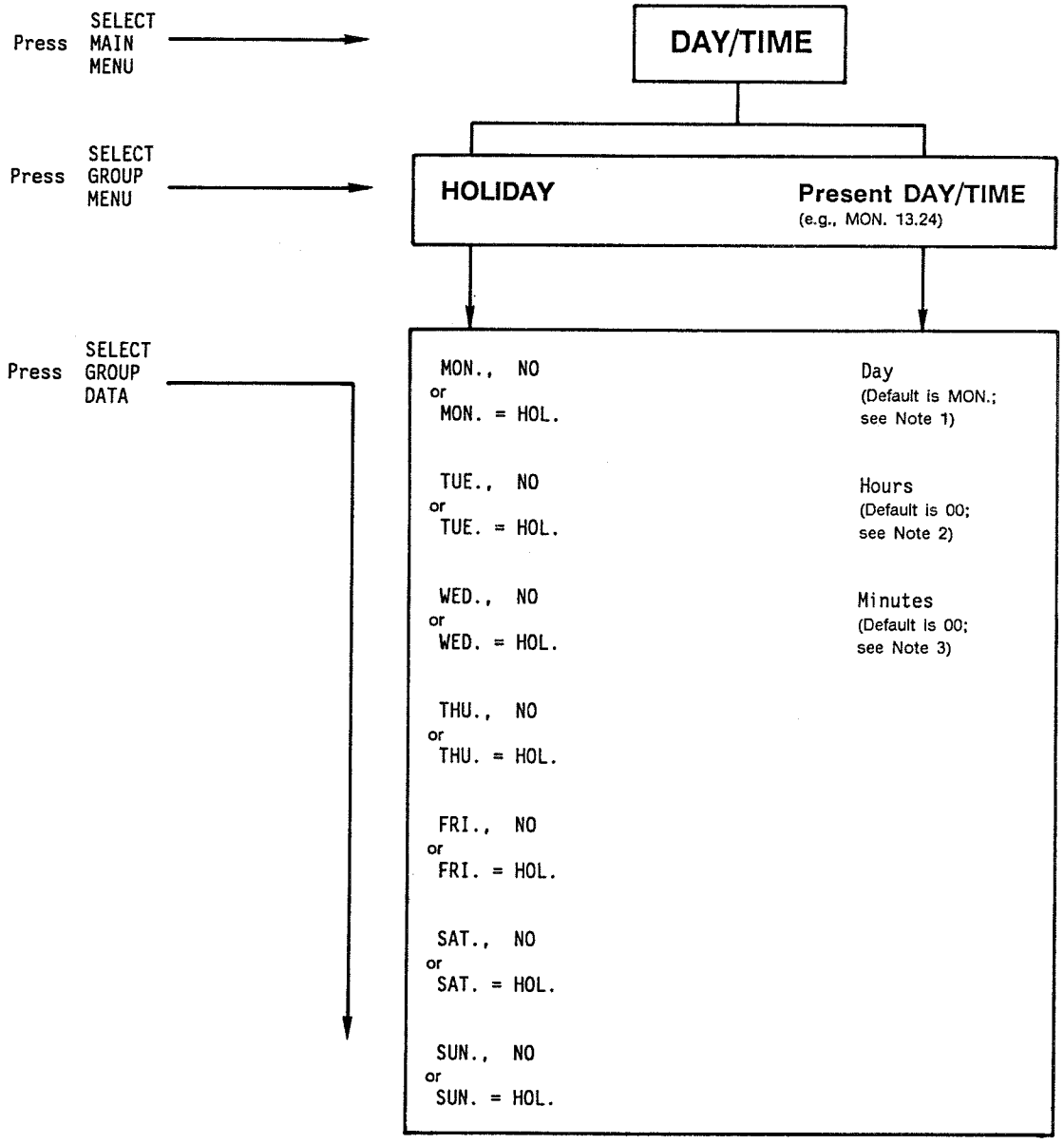
"Day/Time" Program

The SCP's day/time function consists of a 24-hour, 7-day clock/calendar that distinguishes one day of the week from the next (i.e., Monday through Sunday), with each day beginning at 00.00 and ending at 23.59.

See Figure 11. Notice that the "day/time" program menu enables the operator to specify a maximum of 7 days as holidays, and that each holiday can be assigned up to 6 days in advance.

When the operator specifies a particular day of the week as a holiday (e.g., Friday)--and the present day and time match this designated day (e.g., FRI 00.00)--the SCP executes the temporary schedule. At the beginning of the next calendar day (e.g., Saturday), at 00.00, the previous day's holiday "tag" is erased from the SCP's memory. The next time that day occurs (e.g., Friday), its normal operating schedule is used.

Figure 11
"Day/Time" Setup



Notes:

1. Use this entry to establish the present day of the week (i.e., MON., TUE., WED., THU., FRI., SAT. or SUN.).

2. This entry allows the operator to set the SCP's "clock" with the present hour of the day in terms of the 24-hour clock (i.e., 00 thru 23). For example, if it is presently 2:00 p.m., set the "hours" at "14".

3. Use this entry to "tell" the SCP how many minutes past the hour it is (i.e., 00 thru 59).

Day/Time Setup

Follow the instructions outlined below to set up the SCP's clock/calendar.

1. Access the SCP's "Day/Time" menu.

Press the SCP's "Select Main Menu" key until "DAY/TIME" appears on the alphanumeric display.

2. Identify which days of the present 7-day cycle are to be "holidays".

To designate upcoming holidays (i.e., no more than 6 days in advance):

a. Press "Select Group Menu" until "HOLIDAY" appears on the display.

b. Press "Select Group Data"; "MON., NO" (i.e., SCP's default setting) or "MON. = HOL." will appear on the display.

To identify Monday as a holiday, press the " ↑ " or " ↓ " keys until "MON. = HOL." is displayed; then press "Enter".

If Monday is not a holiday, use the " ↑ " and " ↓ " keys to obtain the "MON., NO" display; then press "Enter".

c. Advance to the next day of the week by pressing the "Select Group Data" key. Check the entry displayed to verify that the day is properly tagged as a holiday or non-holiday. Use the " ↑ " and " ↓ " keys as described in Step 2b to change the designation, if necessary.

d. Repeat Steps 2b and 2c for each holiday list entry (i.e., through "SUN"; see Figure 11).

Note: Remember that the holiday designation is temporary; a day tagged as a holiday one week will return to its normal system operating schedule the following week (i.e., unless the SCP is programmed otherwise).

3. Enter the present day and time into the SCP's memory.

a. Press the "Select Group Menu" key until "real time"–according to the SCP's internal clock/calendar–is displayed. (The clock/calendar default setting is "MON. 00.00".)

b. Press "Select Group Data" to display only the day portion of the day/time message. Use the " ↑ " and " ↓ " keys to display the current day of the week; then press "Enter".

c. Once the present day of the week is established, press the "Select Group Data" key again; this time, only the hours portion of the real time entry is displayed. Press the " ↑ " and " ↓ " keys, as appropriate, until the present hour of the day is obtained; then press "Enter".

Note: Remember that the SCP's clock function is based on military time (i.e., 24-hour clock). So, if it is presently 2:00 p.m., change the hours display to read "14".

d. To change the minutes portion of the "real time" display, press "Select Group Data" so that only the minutes portion of the entry is displayed. Then, press the " ↑ " and " ↓ " keys, as required, until the display reflects the actual number of minutes past the hour. Depress "Enter" to store this value in the SCP's memory.

Note: Changing the time of day registered by the SCP's clock/calendar does not reset the SCP's internal seconds counter.

If you wish to doublecheck the status of the SCP's internal clock/calendar, press the "Select Group Menu" key until the present day and time are displayed.

"System" Program

Use of the SCP's system programming menu enables the operator to govern system operation by setting up certain "manual" control setpoints.

Following are the system-level operating parameters that can be regulated by operator-entered "manual" control setpoints:

[ ] leaving chilled water temperature;
[ ] current limit;
[ ] free cooling "enable" and chilled water temperature;
[ ] electrical demand limit and rate settings;
[ ] chilled water reset rate and setpoint; and,
[ ] cooldown limit and duration.

SCP responsiveness to cooling requirement changes can also be regulated via the "system" programming menu.

For an illustration of "system" menu organization, see Figure 12; a summary of control settings for each operating parameter is also included there.

System Setup: Chilled Water

To establish the setpoint for system leaving chilled water temperature:

1. Press the "Select Main Menu" push button until "SYSTEM" is displayed.

2. Depress the "Select Group Menu" key once; "CHLD. WTR." should now appear on the alphanumeric display. (Notice that the "Manual Control" status indicator light also illuminates at this time; it will remain on as long as the chilled water setpoint entry is displayed.)

3. With "CHLD. WTR." displayed, push the "Select Group Data" key; "SET = " (or "AUTO") should now appear. This program entry represents the control setpoint for system leaving chilled water temperature; the SCP will regulate system operation as necessary to maintain this setpoint.

Possible values for the system chilled water control setting include AUTO (i.e., default setting), OFF, and 1 F through 99 F in 1-degree increments.

To alter the displayed "SET = " value, press the " ↑ " and " ↓ " keys as necessary until the desired setting appears on the display. Press "Enter" to store this value in the SCP's memory.

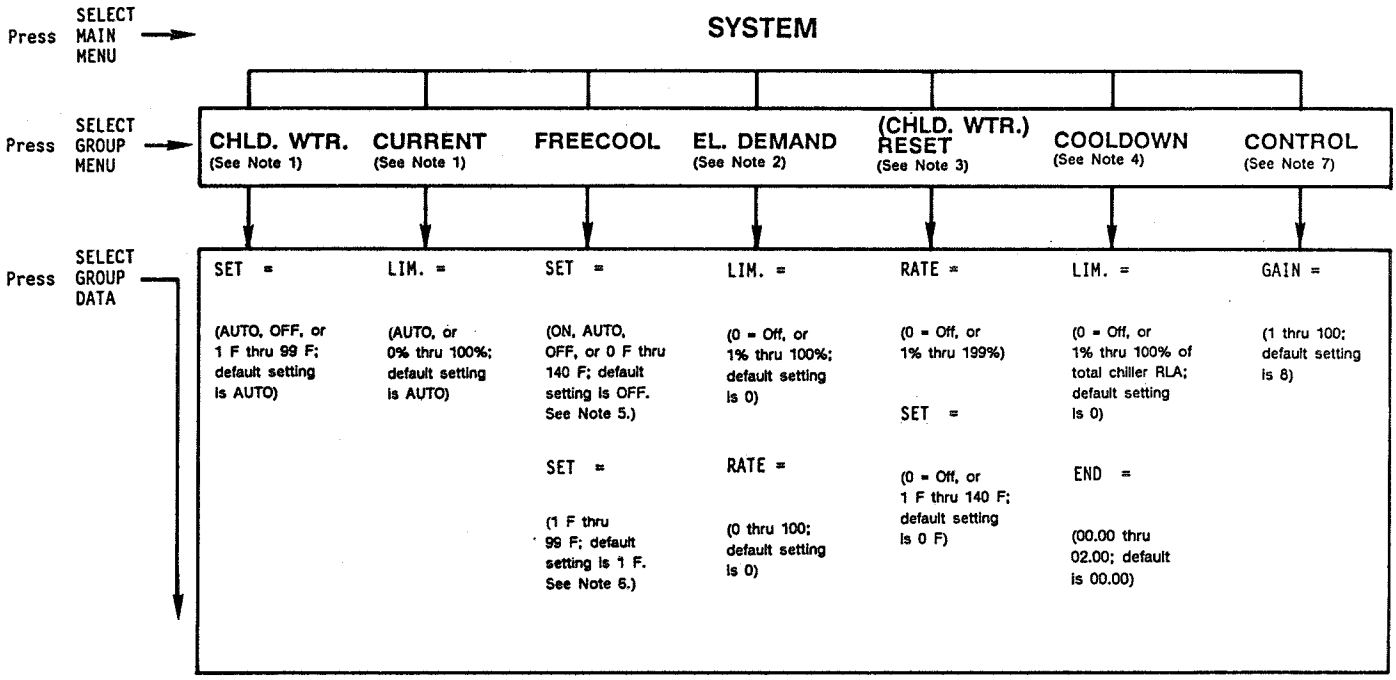
Note: When deciding what value to enter for the system chilled water "SET = " control setting, remember that:

a. The SCP will shut down system operation if "SET = OFF" is entered for the system chilled water setpoint.

b. If a numeric value is entered here (e.g., "SET = 40"), the SCP will attempt to maintain that leaving chilled water temperature (e.g., 40 F). Any alternative chilled water setpoint values–determined at the BAS, SCP schedule, or optional chilled water reset control levels–are ignored!

c. Selecting AUTO for the "SET = " value tells the SCP to look elsewhere (e.g., BAS, SCP schedule, optional chilled water reset, etc.) for the effective system leaving chilled water setpoint.

Figure 12
"System" Setup



Notes:

1. Manual system leaving chilled water and current limit setpoints; "Manual Control" status indicator light is illuminated while these program entries are displayed.
2. Electrical demand limit value entered for "LIM. = " is compared with the actual system demand to determine whether chillers should be unloaded; "RATE = " is an SCP program constant used to translate meter pulse input data into a desired peak kw percentage (i.e., computed and entered once). "Electrical Demand Limiting" status indicator light is illuminated while these program entries are displayed.
3. "RATE = " value is multiplied by the CWR temperature differential to calculate the amount of setpoint reset; "SET = " values $\leq$ 25 indicate load-based CWR, while ambient-based CWR is used for values > 25. "Chilled Water Reset" status indicator light remains lit while the CWR program entries are displayed.
4. Effective current limit setpoint during SCP operation in the cooldown mode; "END = " value determines length of cooldown period (i.e., in increments of 15 minutes), as well as minimum duration for thermostatically-controlled free cooling. "Cooldown Control" status indicator light is on while these entries are displayed.
5. Manual sensor setpoint temperature used to determine system free cooling status.
6. Chilled water setpoint used when the SCP is operating in the thermostatically-controlled free cooling mode. (Also, see Note 4.)
7. "GAIN = " value governs the SCP's responsiveness to changes in cooling requirements; the lower the control gain setting, the slower the response time.

System Setup: Current

Note: If you haven't already accessed the "system" programming menu, press "Select Main Menu" until "SYSTEM" appears on the display. Then follow the instructions outlined below.

To set up a manual system current limit setpoint:

1. Press the "Select Group Menu" key until "CURRENT" appears on the display. (Notice that the "Manual Control" status indicator light illuminates at this time; it will remain on as long as the current limit entry is displayed.)

2. Depress the "Select Group Data" key; "LIM. = " (or "AUTO") is now displayed. This entry allows the operator to enter a current limit setpoint for the system as a percentage of total chiller RLA. (If this value is exceeded, the SCP will begin to unload the chillers until the electrical demand is reduced sufficiently.)

Possible values for the system current limit setpoint are AUTO (i.e., default setting), and 0% through 100% of total chiller RLA in increments of 1%.

3. To alter the displayed "LIM. = " value, press the " ↓ " and " ↑ " keys as necessary until the desired setting appears on the display. Press "Enter" to store this value in the SCP's memory.

Note: When selecting a control setting for the system current limit setpoint, remember that:

a. A numeric value (i.e., from 0 through 100) entered for "LIM. = " becomes the effective system current limit setpoint. Any alternative value--either the SCP's default setting, or a BAS-generated current limit setpoint--is ignored!

b. Entering "AUTO" for the "LIM. = " value tells the SCP to look elsewhere for the effective system current limit setpoint. (Other sources for this setpoint include the BAS, SCP default setting, cooldown control, or electrical demand limit control.)

System Setup: Freecool

Note: If you haven't already accessed the "system" programming menu, press "Select Main Menu" until "SYSTEM" appears on the display. Then follow the instructions outlined below.

To set up the thermostatically-controlled, system automatic free cooling option:

1. Press the "Select Group Menu" key until "FREECOOL" appears on the display.

2. Now, push the "Select Group Data" key to display the free cool system setpoint; "SET = " (or "AUTO") should now appear. The SCP uses this particular program entry to control the operating status of the automatic free cooling option. (For an explanation of the various free cooling control strategies, refer to "Automatic Free Cooling" in the Operation section of this manual.)

3. To alter the displayed "SET = " value, press the " ↓ " and " ↑ " keys as necessary until the desired setting appears on the display.

Possible values for the free cool system setpoint include ON, AUTO, OFF (i.e., default setting), and 0 F through 140 F in 1-degree increments.

Note: When deciding what control setting to enter for the free cooling (FC) system setpoint, remember that:

a. The SCP will disable system-level free cooling operation if "SET = OFF" is entered for the FC system setpoint.

b. Entering "SET = ON" tells the SCP to operate all chillers equipped with the free cooling option in the free cooling mode. Free cooling operation will continue until the FC system setpoint is changed to a numeric value, AUTO or OFF.

c. When the FC system setpoint is AUTO, the SCP looks elsewhere (e.g., BAS) for the effective control setting or "enabling" contact closure(s).

d. Thermostatically-controlled, system -level free cooling is available when a numeric value is entered for the "SET = " FC system setpoint. (See note in Step 6.)

4. Press "Enter" to store the selected free cool system setpoint value in the SCP's memory.

5. Display the system free cool (FC) chilled water setpoint by pressing the "Select Group Data" push button; again, a "SET = " message appears on the display. The value shown there represents the system leaving chilled water setpoint used by the SCP when it is operating in the thermostatically-controlled free cooling mode.

6. Use the " ↓ " and " ↑ " keys to change the displayed FC chilled water setpoint until the desired setting is obtained; then press "Enter". Setpoint values range from 1 F through 99 F (i.e., in 1-degree increments); the SCP default value for the FC chilled water setpoint is 1.

Note: The SCP allows the system to remain in the free cooling mode as long as the system leaving chilled water temperature is less than or equal to the FC chilled water setpoint. When this value is exceeded, the SCP returns the system to the powered cooling mode. Once the thermostatically-controlled FC mode is initiated, however, the system will operate in that mode--regardless of chilled water temperature--for a minimum of either 15 minutes or the duration of the cooldown period, whichever is greater.

System Setup: Electrical Demand Limit

Note: If you haven't already accessed the "system" programming menu, press "Select Main Menu" until "SYSTEM" appears on the display. Then follow the instructions outlined below.

To set up the SCP's electrical demand limit control function:

1. Press the "Select Group Menu" key until "EL. DEMAND" appears on the display.

Notice that the "Electrical Demand Limiting" status indicator light illuminates; it will remain on as long as electrical demand limit program entries are displayed.

2. Depress the "Select Group Data" push button once to display the electrical demand limit setting (i.e., "LIM. = "). The SCP compares the value shown here against actual system electrical demand to determine whether or not chiller unloading is required.

3. To alter the displayed "LIM. = " setting, use the " ↓ " and " ↑ " keys to obtain the desired limit value; then press "Enter" to store this control setting in the SCP's memory.

Possible electrical demand limit settings range from 1% through 100% (i.e., in 1% increments) of total system demand; a default setting of 0% disables the electrical demand limit option.

4. Press "Select Group Data" to display the control setting for the electrical demand meter rate (i.e., "RATE = "). The value entered here is a program constant used to translate meter pulse input data into a percent of electrical load; it is calculated and programmed into the SCP's memory only once. (See "Electrical Demand Limit Option" in the SCP699 Operation section of this manual.)

5. Use the " ↑ " and " ↓ " keys to obtain the desired meter rate setting; meter rate values range from 0 through 100 (i.e., in increments of 1).

Press the "Enter" key when the designated rate setting is displayed.

Note: Remember that the electrical demand limit function is inoperative unless "AUTO" is entered for the system current limit.

System Setup: Chilled Water Reset

Note: If you haven't already accessed the "system" programming menu, press "Select Main Menu" until "SYSTEM" appears on the display. Then follow the instructions outlined below.

To set up the SCP's chilled water reset (CWR) control function:

1. Press the "Select Group Menu" key until "RESET" appears on the display.

Notice that the "Chilled Water Reset" status indicator light comes on at this time; it will remain lit as long as CWR program entries are displayed.

2. Depress the "Select Group Data" key once; the "RATE = " entry displayed represents the chilled water reset rate. This value is used to calculate the amount of reset (i.e., in degrees F) that will be applied to either a scheduled or BAS-generated system leaving chilled water setpoint. (Refer to "Chilled Water Reset Option" in the SCP699 Operation section of this manual.)

3. Press the " ↑ " and " ↓ " keys, as appropriate, until the desired CWR rate is displayed; control settings range from 1% through 199% in increments of 1%. (The SCP default value for CWR rate is 0, which disables the CWR control function.)

To store this value in the SCP's memory, press "Enter".

4. Display the CWR setpoint temperature (i.e., "SET = ") by pressing the "Select Group Data" key. This program entry tells the SCP when to enable the system CWR control function.

5. To change the "SET = " value from the SCP default setting of 0 (i.e., off), press the " ↑ " and " ↓ " keys, as appropriate, until the desired setpoint is displayed. CWR setpoint values range from 1 F through 140 F in increments of 1 F.

Note: Whenever the CWR setpoint is less than or equal to 25 F, it is defined as the system design delta-T (i.e., differential between system entering and leaving chilled water temperatures). If the "SET = " value is greater than 25 F, the SCP identifies this control setting as an outdoor ambient temperature. Check the position of configuration DIP Switch No. 4 (i.e., see "SCP699 DIP Switch Setup):

a. In the "normal" mode, CWR is enabled whenever the actual outdoor ambient temperature is less than or equal to the CWR "SET = " value.

b. When the outdoor ambient "reverse" mode is selected, CWR is enabled when the outdoor temperature is greater than the CWR "SET = " value.

6. Store the selected CWR setpoint temperature in the SCP's memory by pressing the "Enter" key.

System Setup: Cooldown Control

Note: If you haven't already accessed the "system" programming menu, press the "Select Main Menu" key until "SYSTEM" appears on the display. Then follow the instructions outlined below.

To set up the SCP's cooldown control function:

1. Press the "Select Group Menu" key until "COOLDOWN" appears on the display.

Check the SCP's status indicator lights; notice that the "Cooldown Control" light is on. It will remain lit as long as programming entries associated with the cooldown control function are displayed.

2. Depress the "Select Group Data" key once; "LIM. = " should appear on the display. This program entry gives the SCP the effective system current limit setpoint for cooldown operation.

Note: Remember that the current limit aspect of the cooldown control function is inoperative unless "AUTO" is entered for the system current limit setpoint.

3. Enter the desired cooldown current limit setpoint by pressing the " ↑ " and " ↓ " keys until the proper "LIM. = " value is displayed; then press "Enter".

Values for this setpoint range from 1% through 100% of the total chiller RLA. Entering the SCP default setting--"LIM. = 0"--disables the cooldown control function.

4. Press the "Select Group Data" key to display the cooldown period setting (i.e., "END = "). The value entered here not only determines the length of the cooldown period, but also establishes the minimum "on" time for thermostatically-controlled free cooling.

Control setting values for "END = " range from zero (00.00) through 2 hours (02.00) in 15-minute increments. "END = 00.00" serves as the SCP's default setting. For example, if the "END = " setting is 01.15, the cooldown period will last 75 minutes.

5. Enter the desired value for the cooldown period control setting by pressing the " ↑ " and " ↓ " until the proper "END = " setting is displayed; then press "Enter".

System Setup: Control Gain

Note: If you haven't already accessed the "system" programming menu, press the "Select Main Menu" until "SYSTEM" appears on the display. Then follow the instructions outlined below.

To set up the standard SCP control gain function:

1. Press the "Select Group Menu" key until "CONTROL" appears on the display.

2. Depress the "Select Group Data" key once; "GAIN = " should appear on the display. This program entry directly affects the SCP's responsiveness to changes in cooling requirements; the lower the control gain setting, the longer the SCP's reaction time.

SCP control gain is measured in arbitrary units ranging from 1 through 100, with "GAIN = 8" serving as the default setting.

3. Enter the desired control gain setting. To do this, use the " ↑ " and " ↓ " keys to display the proper "GAIN = " value; then press "Enter".

A control gain setting of "15" is appropriate for most system applications.

Note: Entering an increased gain setting at the SCP will not necessarily yield a faster system response time since the SCP must wait for the units to respond to--and stabilize at--their own individual chilled water setpoints. Instead, the higher "GAIN = " value causes the SCP to more rapidly communicate setpoint changes to the units--but only after:

a. all connected units "tell" the SCP that they are in control (and have been for the last 75 consecutive seconds); and,

b. a discrepancy exists between the actual chilled water temperature and the system chilled water setpoint.

"Chiller" Program

Use of the SCP's chiller programming menu allows the operator to manually establish the following control settings for each chiller in the system:

1. leaving chilled (evaporator) water temperature setpoint;

2. electrical current limit setpoint;

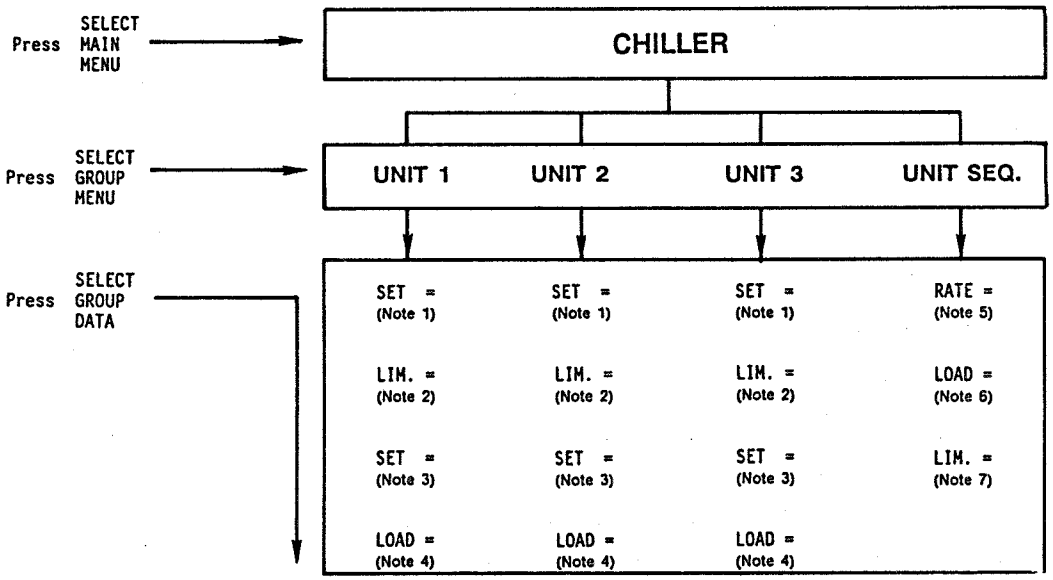
3. order in the chiller start sequence rotation; and,

4. percentage of total chiller capacity.

Values entered for these chiller settings become the effective operating setpoints for the unit designated, provided that the chiller switch (i.e., located on the UCP695 unit control panel) is set at "Auto/Remote".

For an illustration of "chiller" menu organization, see Figure 13. A summary of available control settings for each operating parameter is also included there.

Figure 13
"Chiller" Setup



Notes:

1. Leaving chilled water setpoint for that particular unit; possible control settings include: AUTO (i.e., default setting), OFF, and 1 F thru 99 F in increments of 1 F. "Manual Control" status indicator light is on.

2. Current limit setpoint--in terms of % compressor RLA--for that particular unit. Values for this control setting are AUTO (i.e., default setting), and 0% thru 100% of the compressor RLA. "Manual Control" status indicator light is on.

3. The "UNIT SEQ. SET = " entry determines whether this particular chiller is to be started first, second or last. Control settings are 1, 2 or 3; the default setting is 1.

4. Use the "LOAD = " entry to indicate the relative current draw of this particular unit when compared to the total chiller RLA. Possible values for this setting range from 1% (i.e., default) thru 100% of the total chiller RLA. The sum of the "LOAD = " entries for Units 1, 2 and 3 should equal 100%.

5. Rotation period--in days--for the chiller start sequence (i.e., see Note 3). Values ranging from 0 thru 99 may be entered; the default setting is 0 (i.e., no rotation).

6. This program entry tells the SCP when to start an additional chiller. Possible values range from 20% (i.e., default) thru 100% of the compressor RLA; however, the load setting entered must exceed the unit sequence "LIM. = " entry (Note 7) by at least 20.

7. Unit sequence limit setpoint; tells the SCP when to shut down an operating chiller running under SCP control. Possible settings range from 0% (i.e., default) through 80% of the compressor RLA.

Remember this equation when entering setpoints for the unit sequence load and limit:

UNIT SEQ. LOAD > UNIT SEQ. LIMIT + 20

Chiller Setup

Follow the instructions outlined below to set up individual chiller operating setpoints from the SCP:

1. Access the SCP's "Chiller" menu. To do this, press the "Select Main Menu" key until "CHILLER" appears on the alphanumeric display.

2. Select the chiller you wish to set up (i.e., "UNIT 1", "UNIT 2" or "UNIT 3") by pressing the "Select Group Menu" key.

Note: Remember that the unit's identity--or "address"--is assigned at switch block S11 in the UCP695 control panel of each chiller. (See "UCP695 DIP Switch Setup" in the Start-Up section of this manual.)

3. Enter the desired leaving chilled water temperature for that unit.

a. Push the "Select Group Data" key once to display the unit's chilled water setpoint. "SET = " (or "AUTO") should appear, and the "Manual Control" status indicator light will illuminate.

b. Press the " ↑ " and " ↓ " keys until the desired "SET = " value is displayed. Possible entries for this control setting are: AUTO (i.e., default setting), OFF, and 1 F through 99 F in increments of 1 F.

Note: The SCP cannot automatically control unit operation unless AUTO is entered for "SET = " .

c. Press "Enter" to store the selected unit chilled water setpoint in the SCP's memory.

4. Enter the desired unit electrical current limit setpoint.

a. After completing the chilled water setpoint entry (Step 3), press "Select Group Data" once. "LIM. = " (or "AUTO") will appear on the display, and the "Manual Control" status indicator light will come on.

b. Use the " ↑ " and " ↓ " keys to obtain the desired "LIM. = " setpoint. Values for the unit current limit setting include AUTO (i.e., default setting), and 0% through 100% of the compressor RLA.

Note: To enable the SCP's electrical demand limit, cooldown, and unloading-before-a-start control functions, enter "LIM. = AUTO".

c. Press "Enter" when the selected "LIM. = " value is displayed.

5. Determine where you wish to place this unit in the chiller start rotation (i.e., first, second or third).

a. After entering a "LIM. = " value (Step 4), press the "Select Group Data" key once to display the chiller start rotation order (i.e., "UNIT SEQ. SET = ") setting for this unit.

b. Use the " ↑ " and " ↓ " keys to obtain the desired sequence order. Control settings of 1, 2 and 3 tell the SCP whether to start this chiller first, second or last, respectively. (The default setting is "UNIT SEQ. SET = 1".)

Note: The SCP changes this value automatically at the end of each rotation period (i.e., "RATE = ").

c. Press "Enter" when the selected order in the start rotation is displayed.

6. Enter the relative current draw of this unit (i.e., percentage of total chiller current draw for the system).

a. Once the unit sequence setting is entered (Step 5), press "Select Group Data" once; "LOAD = " will appear on the display. (The SCP uses this program entry to calculate system current draw.)

b. Determine the relative current draw of this particular unit when compared to the chiller RLA of the system:

$$\text{LOAD \#1} = \frac{\text{UNIT 1 RLA}}{\text{SYSTEM RLA}},$$

where the "LOAD #x" value is rounded to the nearest integer.

For instance, if a system includes 3 chillers of equal size, the "LOAD = " value for each chiller would be 33, 33 and 34.

Note: The sum of the "LOAD = " settings for all chillers connected to the SCP (i.e., Unit 1, Unit 2 and Unit 3, if applicable) must equal 100%.

c. Press the " ↑ " and " ↓ " keys until the correct numeric value for "LOAD = " is displayed; then press "Enter". (Control settings range from 1% through 100% of total chiller current draw.)

7. Repeat Steps 2 through 6 for each remaining chiller in the system.

Note: When fewer than 3 chillers are connected to the SCP, you may wish to change these control settings for the unused chiller designations (i.e., "UNIT 3", or "UNIT 2" and "UNIT 3"):

a. enter "OFF" for the unit "SET = " chilled water temperature setpoint; and,

b. enter "0" for the unit "LIM. = " electrical current limit setpoint.

8. Access the SCP's chiller start sequence function by pressing the "Select Group Menu" key until "UNIT SEQ." is displayed. (See Figure 13.)

9. Set up the frequency of rotations for the chiller start sequence.

a. Press the "Select Group Data" key once to display the unit sequence rate program entry (i.e., "RATE = "). The range of settings extends from 0 days through 99 days; if "RATE = 0" (i.e., default setting), automatic rotation of the chiller start sequence will not occur.

b. Use the " ↑ " and " ↓ " keys as needed to obtain the desired rotation period.

c. Press "Enter" when the selected "RATE = " value is displayed.

10. Enter a value for the unit sequence load setpoint. This numeric value is a percentage of the compressor RLA for each chiller, and is used to tell the SCP when to start another chiller. (The SCP looks at the "UNIT SEQ. SET = " values [entered in Step 5] to determine which chiller to bring "on-line".)

a. Press the "Select Group Data" key once; "LOAD = " will appear on the display.

b. Use " ↑ " and " ↓ " to obtain the desired control setting; values range from 20% (i.e., default setting) through 100% of the compressor RLA for each chiller.

"LOAD = " values of 90% to 95% are recommended for most system applications.

Note: The load setting entered must exceed the unit sequence "LIM. = " entry (Step 11) by at least 20.

c. Press "Enter" when the selected "LOAD = " value is displayed.

11. Enter the desired setting for the unit sequence limit setpoint. The SCP uses this setpoint to decide when to shut down a chiller operating under its control. (The "UNIT SEQ. RATE = " settings entered in Step 5 also determine the order for shutting down the chillers.)

a. Press the "Select Group Data" key once; "LIM. = " will appear on the display.

b. Use the " ↓ " and " ↑ " keys to obtain the desired control setting; values range from 0% (i.e., default setting) through 80% of the compressor RLA for each chiller.

"LIM. = " values of approximately 55% are recommended for most system applications.

c. Press "Enter" when the selected "LIM. = " value is displayed.

Note: When determining the unit sequence limit setpoint, remember this equation:

UNIT SEQ. LOAD > UNIT SEQ. LIM. + 20,

where:

[ ] the unit sequence load setting corresponds to approximately 90% to 95% of a chiller's capacity (i.e., under normal operation, this value must be exceeded by all operating chillers before an additional chiller is started);

[ ] the unit sequence limit setting represents approximately 40% to 45% of a chiller's cooling capacity (i.e., all operating chillers must be operating below this value before a chiller is shut down); and,

[ ] the units affected are only those with chiller switches positioned at AUTO/REMOTE.

Note: Unit sequence load and limit settings are based on chiller RLA. When selecting appropriate values for these setpoints, it is important to remember that there is not a direct relationship between a chiller's RLA and its relative cooling capacity.

* * * * *

For your convenience, an "SCP Operator Reference Guide"--summarizing the SCP's report and programming menus--is provided at the back of this manual.

SCP Setup Recommendations for Typical Systems

Remotely-Controlled SCP

While the SCP controls the operation of connected chiller system equipment, its own operation can--in turn--be governed remotely from a higher-level control device.

There are 3 alternatives for remotely controlling the SCP; the extent or degree of control possible varies with the remote control method selected:

[ ] **Bidirectional Communications Link (BCL).** This method of remote control allows the operator the most flexibility when deciding whether various chiller system control functions are executed by the SCP or a Trane BAS (e.g., Tracer®).

Using the direct serial link established with the BCL, a Tracer can receive all SCP data and control information, as well as communicate all programmable control settings to the SCP.

Notice that chiller and system data can be displayed at either the SCP or the Tracer. Manual overrides for system and individual chiller setpoints are available at the SCP.

[ ] **"Scheduled System Enable/ Disable" Binary Input.** Like a remote "on/off" switch, the SCP's "Scheduled System Enable/Disable" binary input allows a supervisory controller (e.g., time clock or BAS) to turn on the chiller system by closing a set of contacts. Similarly, opening these same contacts will shut down system operation.

To use this method of remote control, the SCP must be: (1) wired to control the chillers and auxiliary equipment; and, (2) programmed to provide either 24-hour, stand-alone operation, 7 days a week, or scheduled system operation.

Again, manual overrides for system and individual chiller setpoints are available at the SCP, but chiller and system data can only be displayed at the SCP.

[ ] **Generic BAS Option.** Once the generic BAS option is installed and enabled, the SCP loses all but two of its system control capabilities (i.e., automatic on/off free cooling and condenser limit control functions are retained). Therefore, the generic BAS must be responsible for controlling the chilled water pumps and chillers--as well as issuing any temperature or current setpoint analog inputs.

Notice, too, that manual overrides available at the SCP are restricted to individual unit setpoints.

Note: When programming the SCP to meet the requirements of your chiller system, be sure to account for the impact of any supervisory controller on SCP operation!

Sample SCP Programs

Following are SCP program examples that correspond to 3 typical types of chiller systems:

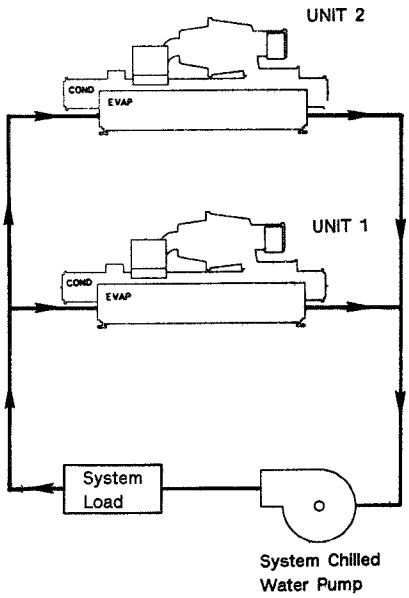
1. 2 parallel-piped chillers with a common system chilled water pump;

2. 2 series-piped chillers with a common system chilled water pump; and,

3. 3 parallel-piped chillers in a decoupled system with a chilled water pump for each chiller and a common system pump.

These examples--along with the explanations that accompany them--are intended to help you establish an SCP program that meets the requirements and constraints of your chiller system application.

Example 1
2 Parallel-Piped Chillers



System Characteristics

[ ] Common system chilled water pump.
[ ] SCP controls system operating schedule.
[ ] System design delta-T is 10 F.

SCP Program Entries

SCHEDULE Menu	MON.	TUE.	WED.	THU.	FRI.	SAT.	SUN.	HOL.
System Setpoint	45	45	45	45	45	45	OFF	OFF
Begin Time	5.00	5.00	5.00	5.00	5.00	5.00	0.00	0.00
End Time	18.00	18.00	18.00	18.00	18.00	12.00	0.00	0.00
Else	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF

DAY/TIME Menu							
Holiday (1)	NO	NO	NO	NO	YES	NO	NO
Day/Time	Enter current day of week and time of day (e.g., MON. 7.45)						

SYSTEM Menu			
Chilled Water	SET = AUTO		
Current	SET = AUTO		
Freecool	FC SET = 50	FC SCWS = 55	(2)
El. Demand	LIM. = 55	RATE = 34	
Reset	RATE = 100	CWR SET = 10	(3)
Cooldown	LIM. = 100	END = 1.00	(2, 4)
Control	GAIN = 15		

CHILLER Menu	UNIT 1	UNIT 2	UNIT 3
Chilled Water	SET = AUTO	SET = AUTO	SET = OFF (5)
Current Limit	LIM. = AUTO	LIM. = AUTO	LIM. = 0 (6)
Sequence No.	SET = 1	SET = 2	
Load (% Total)	LOAD = 50	LOAD = 50	
Sequence	RATE = 7	LOAD = 90	LIM. = 55

UCP695 Chiller Control Panel Settings

[ ] chilled water setpoint = 45
[ ] current limit setpoint = 100
[ ] control gain setpoint = 25
[ ] differential-to-start setpoint = 6 (7)
[ ] condenser limit setpoint = 95
[ ] evaporator refrig. trip setpoint = 30

Notes:

1. Notice that Friday has been assigned a holiday operating schedule. In this example, the chiller system will be turned off all day Friday; the normal system operating schedule will be executed the following Friday.

2. **The free cooling parameters set up in this sample program allow the SCP to automatically initiate free cooling operation at system start-up if the temperature (i.e., outdoor ambient) registered by the freecool sensor is less than or equal to 50 F.**

Notice that the system will remain in the free cooling mode for a minimum of 1 hour (i.e., cooldown period). If there is sufficient free cooling capacity to maintain a system chilled water temperature of 55 F or less, the SCP will remain in this mode.

3. Notice that the chilled water reset parameters are programmed to maintain a constant return water temperature (i.e., RATE = 100) that is 10 F (i.e., CWR SET = 10) above the scheduled system chilled water setpoint of 45 F.

Maintenance of a constant return water temperature during chilled water reset can be critical in parallel-piped chiller systems where there may be water flow through a nonoperating chiller(s). In this situation, chilled water from an operating chiller mixes with return water through the nonoperating chiller to supply a warmer "mixed" chilled water temperature to the building.

Because its leaving chilled water temperature sensor is registering this "mixed" temperature, the SCP may step the operating chiller's setpoint significantly below the actual system setpoint in order to satisfy the cooling load. Operating the chiller system at a constant return water temperature will prevent this from occurring.

4. Values entered for the SCP's cooldown control settings in this program will ramp the system chilled water setpoint from the start-up water temperature to 45 F over a 1-hour period. Since the cooldown current limit setting is 100, no current limiting will occur during this time.

System free cooling operation may occur during the cooldown period if the outdoor ambient is low enough (i.e., free cool sensor registers a temperature less than or equal to 50 F).

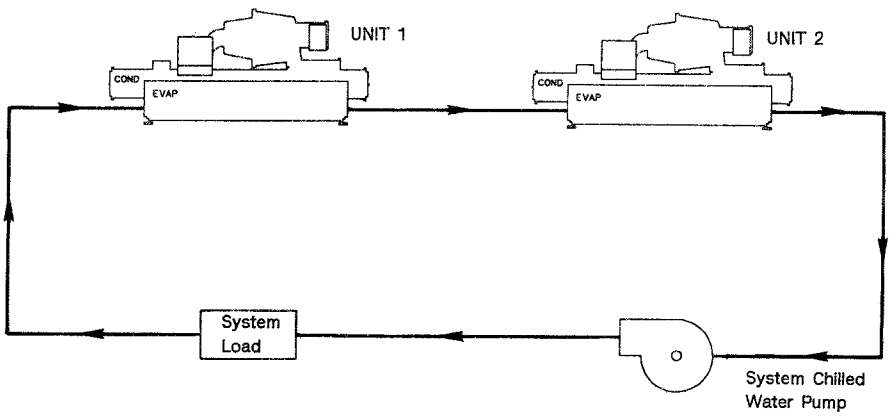
5. To enable SCP control of the unit chilled water setpoints, each setpoint entry in the SCP's CHILLER menu must be AUTO.

6. AUTO must be entered for each of the unit current limit entries in the CHILLER menu to allow the SCP's electrical demand limit function to operate.

These AUTO current limit entries also cause the SCP to unload the running chiller just before the second chiller is brought on-line; this allows the system to establish a load-balance between the chillers.

7. Notice that the differential-to-start setting at each UCP695 chiller control panel is 6. Setting the unit differential-to-start setpoint at a value slightly higher than 1/2 the unit's design delta-T also helps the SCP achieve a load-balance between the chillers.

Example 2
2 Series-Piped Chillers



System Characteristics

[ ] Common system chilled water pump.
[ ] SCP is enabled remotely from an external control system.
[ ] Chiller design delta-T is 10 F.
[ ] UNIT 1 is the "upstream" chiller.

UCP695 Chiller Control Panel Settings

[ ] chilled water setpoint = 45
[ ] current limit setpoint = 100
[ ] control gain setpoint = 25
[ ] differential-to-start setpoint = 5 (5)
[ ] condenser limit setpoint = 95
[ ] evaporator refrig. trip setpoint = 30

SCP Program Entries

SCHEDULE Menu (1)

	MON.	TUE.	WED.	THU.	FRI.	SAT.	SUN.	HOL.
System Setpoint	45	45	45	45	45	45	45	45
Begin Time	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
End Time	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Else	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF

DAY/TIME Menu

Holiday (1)	NO	NO	NO	NO	NO	NO	NO

Day/Time: Enter current day of week and time of day (e.g., MON. 7.45)

SYSTEM Menu

Chilled Water	SET = AUTO (2)	
Current	SET = AUTO	
Freecool	FC SET = OFF	FC SCWS = 1
El. Demand	LIM. = 0	RATE = 0
Reset	RATE = 0	CWR SET = 0
Cooldown	LIM. = 0	END = 0.00
Control	GAIN = 15	

CHILLER Menu

	UNIT 1	UNIT 2	UNIT 3
Chilled Water	SET = AUTO	SET = AUTO	SET = OFF
Current Limit	LIM. = 100	LIM. = 100	LIM. = 0 (3)
Sequence No.	SET = 2	SET = 1	(4)
Load (% Total)	LOAD = 50	LOAD = 50	
Sequence	RATE = 0 (4)	LOAD = 90	LIM. = 55

Notes:

1. Notice that the operator entries in the SCP's SCHEDULE menu set up continuous system operation (i.e., 24 hours each day, 7 days a week). Actual chiller system operation is then enabled and disabled by an external contact closure at the SCP's "Scheduled System Enable/Disable" binary input (i.e., TB3-5 and -6).

2. To "force" the SCP to obtain its system chilled water setpoint from the SCHEDULE menu, AUTO is entered for the chilled water setpoint entry in the SCP's SYSTEM menu.

3. In this program, a value of 100 was entered for the current limit settings in the SCP's CHILLER menu. While this restrains the SCP from unloading the operating chiller when the second unit is started (i.e., as it would if "LIM. = AUTO"), it may also hinder the SCP's ability to load-balance the 2 chillers.

See Note 6 in Example 1.

4. The sequence number assignments in the SCP's CHILLER menu ensure that the downstream chiller--UNIT 2--is always the first chiller to start (i.e., CHILLER Sequence "RATE = 0"). This arrangement minimizes any disturbance of the system leaving chilled water temperature caused by start-up of the upstream chiller (UNIT 1).

If the downstream chiller in this system (UNIT 2) was turned off first, UNIT 1's chilled water setpoint would be rapidly adjusted to bring the system leaving chilled water temperature to setpoint.

5. In series-piped chiller systems, the SCP will attempt to load-balance both chillers as soon as the second chiller is started; load-balancing is accomplished by adjusting each unit's chilled water setpoint.

Notice that increasing or decreasing the differential-to-start setting at the second unit's UCP695 chiller control panel (i.e., UNIT 1 in this example) can influence the load-balance attained by the SCP.

Lowering the value of the upstream unit's differential-to-start setpoint can cause the downstream chiller to initially assume most of the cooling load. However, further increases in system delta-T will be absorbed by the upstream chiller until it reaches its maximum capacity; additional loading of the downstream chiller will not occur until this point is reached.

Example 3

3 Parallel-Piped Chillers (Decoupled System)

SCP Program Entries

SCHEDULE Menu

	MON.	TUE.	WED.	THU.	FRI.	SAT.	SUN.	HOL.
System Setpoint	45	45	45	45	45	45	OFF	OFF
Begin Time	5.00	5.00	5.00	5.00	5.00	5.00	0.00	0.00
End Time	18.00	18.00	18.00	18.00	18.00	12.00	0.00	0.00
Else	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF

DAY/TIME Menu

Holiday (1)	NO	NO	NO	NO	NO	NO	NO

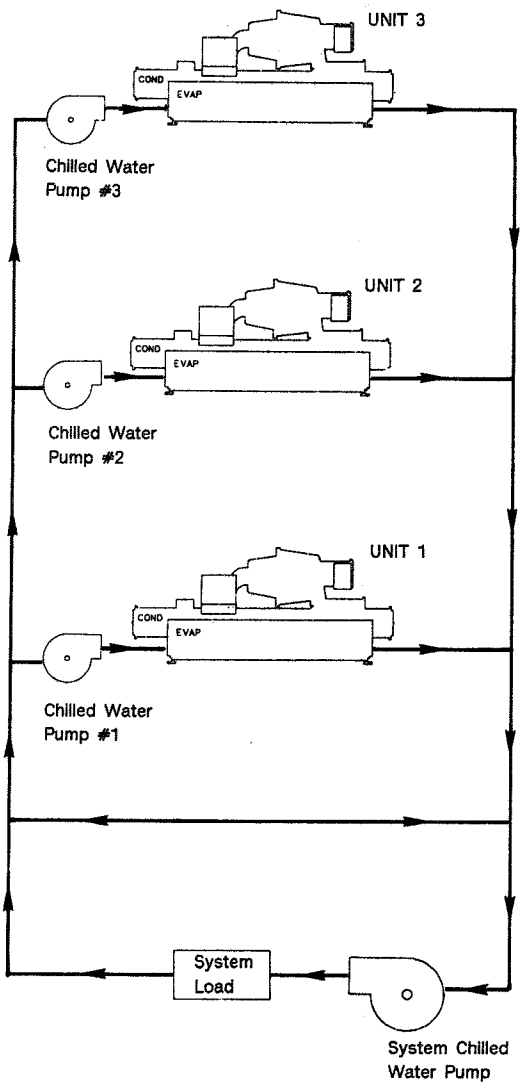
Day/Time: Enter current day of week and time of day (e.g., MON. 7.45)

SYSTEM Menu

Chilled Water Current	SET = AUTO	
Freecool	FC SET = OFF	FC SCWS = 1
El. Demand	LIM. = 0	RATE = 0
Reset	RATE = 0	CWR SET = 0
Cooldown	LIM. = 0	END = 0.00
Control	GAIN = 15	

CHILLER Menu

	UNIT 1	UNIT 2	UNIT 3
Chilled Water	SET = AUTO	SET = AUTO	SET = AUTO
Current Limit	LIM. = AUTO	LIM. = AUTO	LIM. = AUTO
Sequence No.	SET = 1	SET = 1	SET = 1 (1)
Load (% Total)	LOAD = 20	LOAD = 40	LOAD = 40
Sequence	RATE = 0	LOAD = 90	LIM. = 55



System Characteristics

[ ] Decoupled chiller system.

[ ] individual chilled water pumps for each chiller, and a common system chilled water pump.

UCP695 Chiller Control Panel Settings

[ ] chilled water setpoint = 45

[ ] current limit setpoint = 100

[ ] control gain setpoint = 10 (2)

[ ] differential-to-start setpoint = 5

[ ] condenser limit setpoint = 95

[ ] evaporator refrig. trip setpoint = 30

Notes:

1. Notice that the chiller sequencing shown in this program example is slightly different than that used in the previous examples.

Since all of the chillers are assigned the same sequence number (i.e., SET = 1), the SCP compares the unit addresses to determine the chiller start order. In this example, UNIT 1 would be started first, followed by UNIT 2 and UNIT 3, respectively.

Notice, too, that when the SCP decides to shut down a chiller, UNIT 1 will be turned off first, followed by UNIT 2 and UNIT 3, respectively. In this example, because the unit sequence numbers are the same--and the smallest unit has the lowest unit address, the smallest chiller is always turned off (and turned on) first. Look at the "Load (% Total)" entries in the SCP's CHILLER menu; the values entered there indicate that UNIT 1 is 1/2 the size of UNIT 2 and UNIT 3.

Since the rotation interval is set at 0 (i.e., "RATE = 0" in the CHILLER menu), the chiller start-up and shutdown orders just described will be maintained permanently.

2. In a decoupled chiller system, leaving (supply) chilled water may flow into the entering (return) water circuit whenever there is an imbalance between the amount of water circulating in the chiller loop and that circulating in the load loop. This can significantly reduce the circulation time of the chiller water loop!

When this type of loop imbalance exists, the unit leaving chilled water temperature sensor (4RT1) of each chiller must respond quickly. To ensure the fastest possible response time:

a. verify that each 4RT1 sensor is inserted properly into its bulbwell, and that enough thermoconductive paste has been used to provide good thermal contact.

b. reduce the control response setting at each UCP695 chiller control panel to approximately 1/2 of the calculated value. (Contact a qualified service technician for assistance.)

The chiller control response setting selected for each unit should be high enough that the unit starts properly and remains on-line when it approaches its setpoint, yet low enough to prevent the system temperature from cycling at low loads.

A unit control response setting of 8 to 12 may be appropriate for a chiller used at the rated water flow, and with a design delta-T of 10 F.

SCP699 Operation

Overview

SCP699 System Control Panels are primarily intended to coordinate operation of connected chiller system equipment (Figure 14) to satisfy and maintain an operator-selected system leaving (supply) chilled water temperature.

To determine–automatically–what system- and chiller-level operating states are needed to meet this cooling requirement, the SCP checks the control settings entered by the system operator, and evaluates:

1. the status of its binary input circuits (i.e., "Scheduled System Enable/Disable" [TB3-5, -6], and "Free Cooling Enable/Disable" [TB3-7, -8]);

2. digital data communicated over its bidirectional communication links (BCLs) with the chillers and Trane BAS, if applicable; and,

3. temperature inputs received from field-installed sensors. The following sensors may be connected to the SCP, depending on system application:

a. system leaving chilled water temperature sensor (i.e., part no. 4533-1710-44B);
b. system entering (return) water temperature sensor (i.e., part no. 4533-1710-44B);
c. tree cooling temperature sensor (i.e., part no. 4533-1710-41B);
d. condenser control temperature sensor (i.e., part no. 4533-1710-41C).

Collectively, this information influences the SCP's control status. That is, (1) does a system cooling requirement exist?, and–if so, (2) should free cooling or powered cooling operation be used to satisfy the cooling load?

These major SCP control states (i.e., "off", "cooling" and "free cooling"–along with the system inputs that initiate them–are summarized in Table 7.

Besides providing overall system temperature control, the SCP also includes control functions that enable the operator to dictate the system operating state, limit chiller cooling capacity, and modify the established system chilled water setpoint. These "user-oriented" SCP control functions include scheduling, cooldown, system current and electrical demand limiting, free cooling, and chilled water reset.

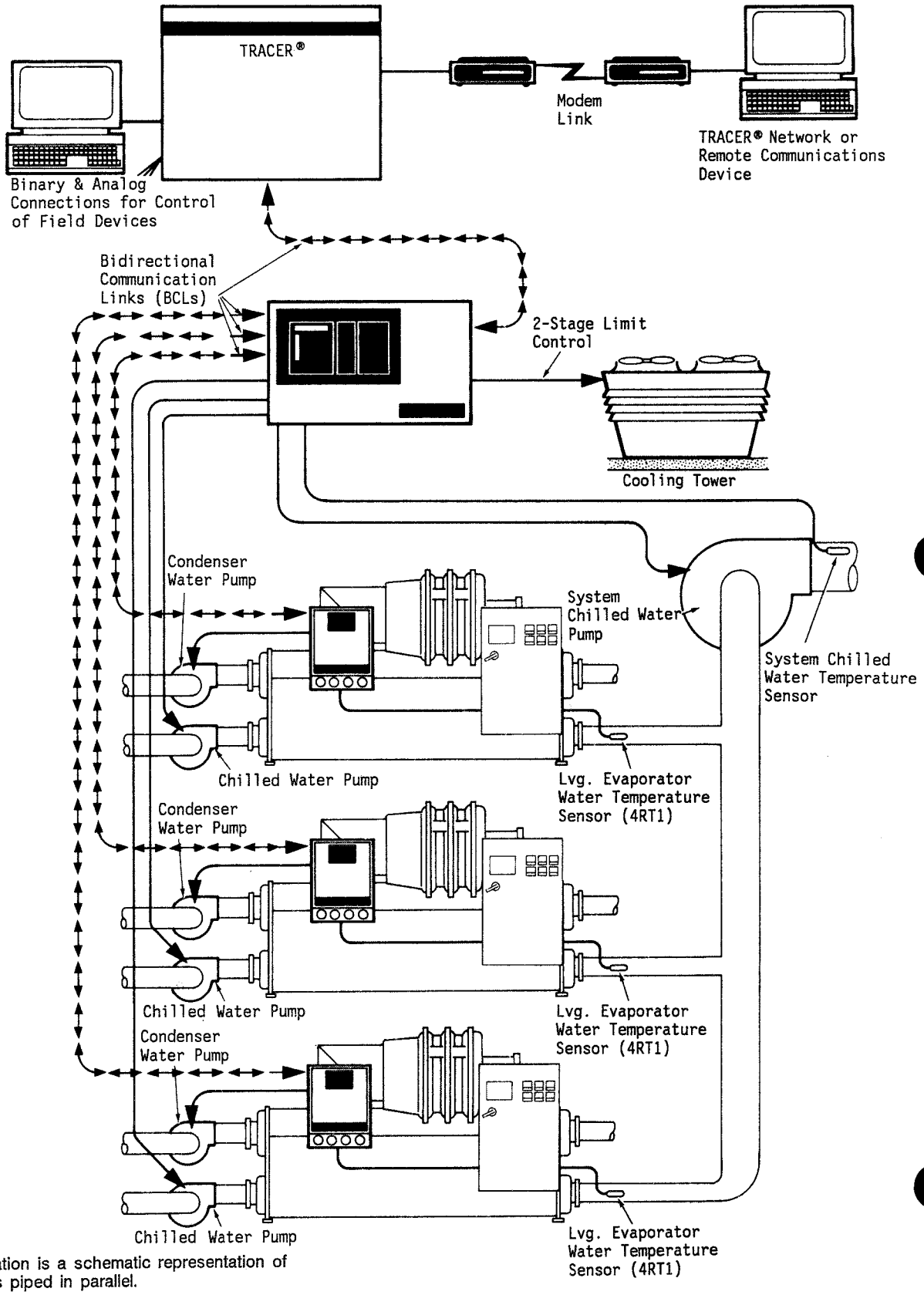
Table 7
Major SCP Control States

Manual System CWS (1)	Trane BAS System CWS (2)	Scheduled System CWS (3)	SCP Enable (Binary Input; See Note 4)	SCP Status (5)
Off On	On or Off " "	On or Off " "	Open or Closed " "	Off Cooling
Auto "	Off On	On or Off " "	Open or Closed " "	Off Cooling
Auto "	Auto "	Off On	Open or Closed Closed	Off Cooling
Auto	Auto	On	Open	Off

Notes:
1. Manual system chilled water setpoint is entered with the SCP's "SYSTEM: CHLD. WTR." programming menu; see Figure 9. It is "on" whenever the manual CWS is a valid setpoint and not OFF.
2. Trane BAS system chilled water setpoint is communicated over the BCL (i.e., SCP Terminals TB2-7, -8). It is "on" whenever the BAS system CWS is a valid setpoint and not OFF.
3. Scheduled system chilled water setpoint is entered using the SCP's "SCHEDULE" programming menu; see Figure 9. It is "on" whenever the scheduled CWS value is a valid setpoint and not OFF.
4. Represents the status of the SCP's "Scheduled System Enable/Disable" binary input circuit at Terminals TB3-5 and -6.
5. Major SCP control states are defined as follows:
   a. "Off" = a "ready" status;
   b. "Cooling" = powered cooling or free cooling operation is enabled.

Table 12 indicates the control hierarchy in effect when the SCP's system-level free cooling function is used.

Figure 14
Typical SCP/Chiller System Application



Note: This illustration is a schematic representation of 3 CenTraVac chillers piped in parallel.

The availability of these (and other) SCP control functions in a particular system application is determined by the field-installed input and output wiring connections. Refer to Figure 15; notice that SCP functions can be categorized into 3 "capability" levels, with each level defined by the types of inputs and outputs (i.e., I/O's) required.

[ ] **"Level 1"** input/output wiring connections must be field-installed to make the SCP operational. Once these connections (i.e., 120 VAC power supply, system chilled water temperature sensor, and CenTraVac BCL) are complete, the SCP is capable of the following standard control functions:

a. coordinated control of as many as 3 CenTraVac chillers;
b. 7-day, 24-hour scheduling;
c. chiller sequencing and automatic rotation;
d. system chilled water temperature control;
e. system and individual chiller reporting;
f. manual system control override;
g. manual chiller control overrides and,
h. cooldown.

[ ] **"Level 2"** input/output connections "tailor" SCP control functions to the requirements of a specific chiller system application. All of the control schemes associated with "Level 2" I/O's are standard, and are available in addition to the basic control functions found at "Level 1".

"Level 2" SCP control capabilities include:

a. chilled water reset;
b. remote system enable/disable;
c. remote free cooling enable/disable;
d. electrical demand limit control;
e. bidirectional communication with a Trane BAS or monitoring system;
f. system chilled water pump control;
g. individual chiller evaporator water pump control; and,
h. external alarm function.

Note: Selection of any--or all--"Level 2" control functions will not disable any other SCP function.

[ ] **"Level 3"** input/output connections are associated with SCP control features that are purchased as options. Two of the 3 functions found at this level will deactivate some of the SCP's standard control functions.

A brief description of all 3 optional control features--including any limitations--is provided below.

a. Thermostatically-Controlled, Automatic Free Cooling. Field installation of the optional free cooling temperature sensor enables the SCP to decide when it is appropriate to initiate system-level free cooling. Use of this optional control function overrides the SCP's remote free cooling binary input.

b. Condenser Limit Control. Use of this option--which consists of an electronic sideboard and 4 temperature sensors--will not disable any other SCP control function. Once installed, the sensors detect unit refrigerant temperature differences between the condensers and evaporators, triggering activation of 2 SCP output relays. Enable/disable setpoint values for these relays are operator-programmable.

c. Generic BAS. Comprised of an electronic sideboard and 6 resistors, this option requires field installation of up to 6 analog input lines (i.e., 2 per chiller) between the generic BAS and the SCP. A DIP switch located on the sideboard serves as an "on/off" switch for the generic BAS/SCP interface.

It is important to realize that nearly half of the SCP's inputs, outputs and associated control functions become inoperative when the generic BAS option is installed and enabled. Refer to the asterisked items in Figure 15.

* * * * *

The remainder of this section discusses the basic operation of a number of major SCP control functions; these include:

[ ] system chilled water temperature and current limit control;
[ ] chiller sequencing and automatic rotation;
[ ] cooldown;
[ ] chilled water reset;
[ ] manual and automatic free cooling;
[ ] bidirectional communication with a Trane BAS;
[ ] electrical demand limiting;
[ ] system chilled water and unit evaporator pump control;
[ ] optional generic BAS interface; and,
[ ] optional condenser limit control.

Note: When reviewing the operation of these control functions, remember that the SCP can--in turn--be controlled by a higher-level device. Three "avenues" for SCP interaction with a supervisory controller are available:

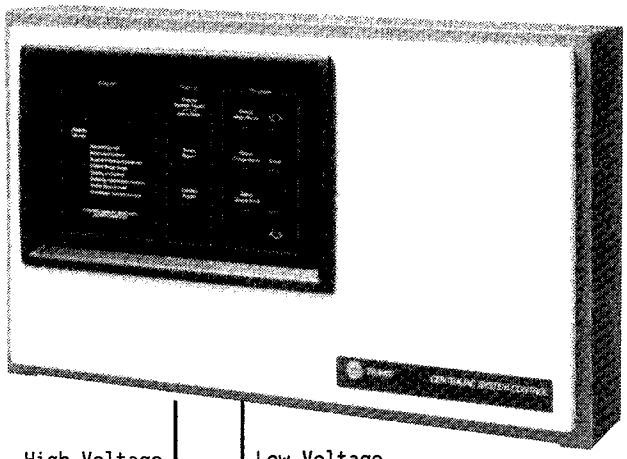
1. a bidirectional communication link (i.e., Trane BAS only);

2. an optional analog interface (i.e., generic BAS); and,

3. a "scheduled system enable/disable" binary input.

For explanations of the SCP's scheduling and reporting functions, refer to SCP699 Operator Interface. Manual system- and chiller-level overrides are described where appropriate throughout this manual.

Figure 15
SCP Control Functions and Input/Output Requirements



High Voltage (115 VAC)

Low Voltage (< 30 Volts)

Art No. RF/CTV-1900

"Level 1" Inputs/Outputs (Note 1)
[ ] 115 VAC Power Supply

"Level 2" Inputs/Outputs (Note 2)
[*] System Chilled Water Pump Relay, energized when system requires cooling
[ ] System "External" Alarm Relay (NO/NC)
[*] Chiller Evaporator Pump Relays, 1 relay per chiller; energized before corresponding chiller is started

"Level 3" Inputs/Outputs (Note 3)
[ ] Condenser Water Control Relays (2)

"Level 1" Inputs/Outputs (Note 1)
[*] System Leaving Chilled Water Temperature Sensor (i.e., optional for single-chiller systems, but req'd. for system-level CWR)
[ ] BCL to Chiller Control Panel(s)

"Level 2" Inputs/Outputs (Note 2)
[*] System Entering Chilled Water Temperature Sensor (Req'd. for Chilled Water Reset)
[ ] Scheduled System Enable/Disable (Req'd. for Remote On/Off)
[ ] Free Cooling Enable/Disable (Req'd. for Remote FC On/Off)
[*] Electrical Demand Meter Pulse Input (Req'd. for Elec. Demand Limit)
[ ] BCL to Trane BAS or Monitor (Req'd. for Trane BAS Control)

"Level 3" Inputs/Outputs (Note 3)
[*] Free Cooling Temperature Sensor (Req'd. for Thermostatically-Controlled FC)
[ ] Condenser Water Temperature Sensor, incl. 3 additional sensors for connection at chiller(s) (Req'd. for Condenser Limit Control)
[ ] Generic BAS, 2 analog inputs per chiller

Notes:

1. "Level 1" I/O field wiring connections are required to enable SCP to function at its minimum capability, which includes these standard control functions:
- – multiple-unit control for up to 3 CenTraVacs
- * – 7-day, 24-hour scheduling
- * – chiller sequencing and automatic rotation
- * – system chilled water temperature control
- – system and individual chiller reporting
- * – manual system override
- – manual chiller override(s)
- * – cooldown ("soft start")

2. "Level 2"I/O field wiring connections can be made selectively if associated function is desired for a particular system application. All "Level 2" functions are standard, and will not disable any "Level 1" functions; they include:
- * – chilled water reset
- – remote system enable/disable
- – remote free cooling enable/disable
- * – electrical demand limit control
- – bidirectional communication with Trane BAS or monitor
- * – system chilled water pump control
- * – individual chiller evaporator pump control
- – field-supplied/-installed alarm device

3. "Level 3" I/O field wiring connections are associated with 3 optionally purchased SCP control functions. These optional functions are listed below; notice that 2 of them deactivate a number of standard SCP control functions.

- – thermostatically-controlled automatic free cooling (i.e., overrides remote free cooling enable/disable binary input)
- – condenser limit control (i.e., does not disable any other SCP function)
- – generic BAS (i.e., disables all asterisked I/O's and functions; see asterisked note at right)

***Generic BAS disables all asterisked I/O's and functions when installed and enabled, though system leaving and entering water temperature sensors may still be installed for readout display if desired.**

System Chilled Water Temperature Control

Note: System-level chilled water temperature control is not available when the SCP is used in a generic BAS application.

Designed to perform overall temperature control for CenTraVac water chiller systems, the SCP699 panel determines what coordinated unit chilled water (and current limit) setpoint(s) are needed to maintain a stable system leaving chilled water temperature. To do this, the SCP compares the effective system chilled water setpoint with the actual system leaving chilled water temperature.

Notice that the operator can enter a system chilled water setpoint (SCWS) in several ways; he can (1) schedule a setpoint using the SCP's "SCHEDULE" program, (2) enter a manual setpoint with the SCP's "SYSTEM" program, (3) enable a Trane BAS to communicate a setpoint value to the SCP over the Tracer BCL, or (4) allow a generic BAS to send unit setpoint reset values to the SCP via an optional analog interface.

Since several system chilled water setpoint values may exist at one time, the SCP must decide which value to use (i.e., which takes precedence, or is the effective SCWS). This temperature control decision is based on the setpoint priority shown in Table 8 and described below:

1. Use the **manual SCWS** value (i.e., see "'System' Program" in the section entitled SCP699 Operator Interface).

If this "SET =" entry is "AUTO", then . . .

2. Use the **Trane BAS-issued SCWS** value.

If there have been no BAS communications for the last 15 minutes, or if the BAS setpoint is AUTO, then . . .

3. Check the **status of the "SCP enable" contacts** (i.e., "Scheduled System Enable/Disable" binary input circuit; SCP Terminals TB3-5, -6).

When this circuit is open, shut off the system; if the circuit is closed, then . . .

4. Use the **scheduled SCWS** value.

Note: Keep in mind that an SCWS value issued by a Trane BAS--or scheduled at the SCP--can be modified by the chilled water reset function (if applicable). In turn, the resulting SCWS value can then be altered again by the cooldown control function (if applicable). (Both of these control functions are described later in this section.)

Once the effective SCWS is established, the SCP compares it with the actual system leaving water temperature to determine if a cooling requirement exists.

In multiple-chiller systems, this temperature input is provided by a sensor that ships with the SCP and is field-installed in the common leaving (supply) chilled water line; here, it measures a mixed leaving water temperature.

Where the SCP is connected to a single chiller, a system sensor is not required (i.e., unless chilled water reset is also desired). Instead, the SCP can use the temperature "seen" by the chiller's leaving evaporator water temperature sensor (4RT1).

Note: When only 1 chiller is connected to the SCP--and the SCP's leaving chilled water temperature sensor is not installed, that unit must be assigned a chiller address of "1". (See "UCP695 DIP Switch Setup" on page 8.)

If system cooling is required, the SCP sends appropriate unit chilled water setpoints to each of the communicating chillers (i.e., with chiller switches set at AUTO/REMOTE). When only 1 chiller is controlled by the SCP (and a system chilled water temperature sensor is not installed), it gives that unit a chilled water setpoint equal to the SCWS.

Table 8
System Chilled Water Setpoint Priority (1)

Manual SCP Setpoint	Trane BAS Setpoint	Scheduled SCP Setpoint	SCP Enable/Disable Contact Closure (3)	Effective System Chilled Water Setpoint
1-99 F	------	------	------	1-99 F
Off	------	------	------	Off
Auto	1-99 F (2)	------	------	1-99 F
Auto	Off	------	------	Off
Auto	Auto	------	Open	Off
Auto	Auto	1-99 F (2)	Closed	1-99 F
Auto	Auto	Off	------	Off

"------" = A setpoint value entered at this control level will not determine the actual system chilled water setpoint (SCWS).

Notes:
1. This setpoint hierarchy is only applicable when the generic BAS option is not installed/enabled.
2. Trane BAS and scheduled SCP system chilled water setpoints can be modified by the SCP's chilled water reset and cooldown control functions.
3. This contact closure input is "read" at SCP Terminals TB3-5 and TB3-6; these terminals must be jumpered if not used.

Note: Like the effective SCWS, the actual unit chilled water setpoint value used by the chiller control panel is also subject to a setpoint priority; this hierarchy is summarized in Table 9 and described in Items "a" through "d" below. Notice, too, that although chilled water setpoint values at the SCP range from 1 F to 99 F, the chiller control panel will not accept a setpoint value lower than 37 F (i.e., "standard"-range units).

a. Use the **UCP695 CWS potentiometer setting** if the chiller switch is set at AUTO/LOCAL.

If the chiller switch is set at AUTO/REMOTE, then . . .

b. Use the **manual SCP unit CWS** value entered in the "CHILLER" programming menu.

If this "SET = " entry is "AUTO", then . . .

c. Use the **manual Trane BAS unit CWS** value communicated over the BCL.

If the unit CWS value sent by the Trane BAS is "AUTO", then . . .

d. Use the **calculated unit CWS** that is derived from the SCWS by the SCP's control algorithm.

Two priorities are "built into" the SCP's temperature control logic. As it calculates individual unit chilled water setpoints, it first attempts to equalize chiller loading as much as possible by evaluating each chiller's electrical current load level. Then, it tries to equalize the unit chilled water setpoints as much as possible.

Once a chilled water setpoint is communicated to a particular chiller, it is that unit's responsibility to control its own evaporator leaving water temperature. In other words, the UCP695 chiller control panel is entrusted to modulate its own inlet guide vanes and restrict their movement when limiting is appropriate.

It is important to realize that this "step-and-wait" method of control can result in slow responses to load changes. That is, after sending a new chilled water setpoint to a given unit, the SCP must wait until that unit's leaving chilled water temperature is within 1 F of setpoint for 75 seconds before it can evaluate the effect of the setpoint change.

Table 9
Unit Leaving Chilled Water Setpoint Priority (1)

Chiller Status (2)	UCP695 CWS Pot. Setting (3)	SCP Manual Unit CWS (4)	Trane BAS Unit CWS (5)	SCP Calculated Unit CWS (6)	Effective Unit CWS
Standby	-------	-------	-------	-------	OFF
Alarm (7)	-------	-------	-------	-------	OFF
Auto/Local	37-60 F	-------	-------	-------	37-60 F
Auto/Remote	-------	1-99 F	-------	-------	37-60 F (8)
Auto/Remote	-------	Off	-------	-------	Off
Auto/Remote	-------	Auto	1-99 F	-------	37-60 F (8)
Auto/Remote	-------	Auto	Off	-------	Off
Auto/Remote	-------	Auto	Auto	1-99 F	37-60 F (8)
Auto/Remote	-------	Auto	Auto	Off	Off

"------" = A setpoint value entered at this control level will not determine the actual unit chilled water setpoint (UCWS).

Notes:
1. This setpoint hierarchy is only applicable when the generic BAS option is not installed/enabled.
2. Unit status is determined by the position of the chiller switch on the front of the UCP695 chiller control panel.
3. UCP695 chilled water setpoint adjustments extend from 37 F thru 60 F for standard-range chillers, and 20 F thru 70 F for extended-range chillers.
4. Manual SCP chiller setpoints are entered using the "CHILLER" program menu; see the SCP699 Operator Interface section of this manual.
5. Specific Trane BAS-issued chiller setpoints are communicated to the appropriate chillers via the BCLs that join the BAS, SCP and chillers.
6. "Calculated" unit CWS' are derived from the effective SCWS by the SCP's control algorithm.
7. "Alarm" status indicates the existence of a latching chiller diagnostic condition; manual reset at the UCP695 panel is required to resume chiller operation. Reset the SCP to de-energize the alarm relay.
8. Though Trane BAS-issued unit CWS values--as well as manual or "calculated" SCP CWS values--may be any value between 1 F and 99 F, the UCP695 chiller control panel will only accept what it considers to be a valid entry (i.e., see Note 3). If the Trane BAS- or SCP-issued CWS value is less than 37 F, the effective unit setpoint is 37 F; likewise, if the Trane BAS- or SCP-issued CWS value is greater than 60 F, the effective unit setpoint is 60 F.

Chiller Start-Up and Shutdown

When the system cooling requirement is small enough to be satisfied by only 1 chiller, the SCP allows the first chiller in the start rotation to determine when it will start and stop based on the start differential setpoint selected at the chiller's UCP695 control panel.

Additional chillers are started when the cooling requirement is high enough so that any units presently running are either operating: (1) above the "unit sequence load setpoint", or (2) in a unit limit mode (e.g., evaporator limit). Regardless of how much cooling is required, however, the SCP will limit chiller start-ups to 1 every 6 minutes.

The SCP evaluates unit electrical loads and guide vane positions to decide when to turn off chillers. If the actual current load of each operating chiller is less than the "unit sequence limit setpoint"--or if the chillers' vanes are closed, the SCP will shut down a chiller.

By monitoring the current loads and vane positions of those chillers still running, the SCP uses the same criteria to determine whether another chiller should be turned off.

As long as the SCP is providing normal temperature control, it limits chiller shutdowns to 1 every 6 minutes. However, if the chiller system is scheduled "off", the SCP will shut down any operating units at 1-minute intervals.

Note: Unit sequence load and limit setpoints, as well as the chiller start rotation, are entered with the SCP's "CHILLER" program. Setup instructions for this program are provided in the SCP699 Operator Interface section of this manual.

Temperature Control Near Setpoint

Whenever the actual system leaving chilled water temperature is within 10 F of the system chilled water setpoint, the SCP "fine-tunes" the unit chilled water setpoints until the system chilled water temperature falls within the SCWS deadband range (i.e., ± 1 F).

SCP control logic ensures that unit chilled water setpoint (CWS) changes are limited to 1 F per minute, and that only 1 chiller is given a CWS change per minute.

Further, the SCP will only issue unit CWS changes if all operating chillers have been in control for the last 75 seconds. (If an operating chiller is not in control, the SCP will still issue unit CWS changes if that unit is running in the evaporator- or condenser-limit mode.)

Note: While the SCP will not send a lower CWS to a chiller operating in an evaporator- or condenser-limit mode, that unit will be the first to receive a higher CWS.

Internal (Fast) Cooldown

Designed to bypass the normal "step-and-wait" method of control, internal (or "fast") cooldown allows the SCP to bring the actual system leaving water temperature within proximity of the SCWS in an acceptable period of time.

To do this, the SCP gives the first chiller started a unit chilled water setpoint equal to the system setpoint; it then monitors the system leaving water temperature. If this temperature drops at a sufficient rate, no other chillers will be started. However, if the SCP determines that the temperature is not falling quickly enough, it will bring additional chillers on line (i.e., but no faster than 1 chiller every 5 minutes).

Once the system leaving water temperature is within 5 F of the system chilled water setpoint, the SCP issues new unit chilled water setpoints that are slightly higher than the leaving water temperature. This allows the chillers to unload slowly when the system chilled water temperature is rapidly approaching setpoint.

System Current Limit Control

Besides providing overall temperature control for the chiller system, the SCP also monitors and regulates the current draw of all connected--and controlled--chillers. To do this, the SCP checks the individual chiller current loads reported over the CenTraVac BCL, and compares the sum of these loads to an operator-programmable system current limit setpoint (SCLS).

Note: Setpoint values for the system current limit setting range from 0% through 100% of the total chiller RLA (i.e., in increments of 1%), and AUTO. See "System Setup: Current" in the SCP699 Operator Interface section of this manual.

If the percentage of total chiller RLA "in use" exceeds the system current limit value, the SCP will begin to unload chillers by sending the unit control panels current limit setpoints below their reported electrical load levels. Once the total chiller current load falls below the SCLS, new, increased unit current limit settings will be issued.

Keep in mind that the SCP will current-limit system operation whenever the SCLS is violated regardless of the existing cooling requirement!

Like the system chilled water setpoint, the operator can also enter a system current limit setpoint (SCLS) in 1 of 2 ways. He can either (1) select the desired manual SCLS using the SCP's "SYSTEM" program, or (2) enable a Trane BAS to communicate an SCLS over the Tracer BCL.

If an operator-entered current limit setpoint is not established at either of these levels, the SCP will use a default setting of 100%.

Since as many as 3 system current limit setpoint values may exist at one time, the SCP must decide which value takes precedence--or is the effective SCLS. It selects a controlling SCLS value on the basis of the setpoint priority shown in Table 10 and described below:

1. Use the **manual SCLS** value; but if "LIM. = " is "AUTO", then . . .

2. Use the **Trane BAS-issued SCLS** value.

If there have been no BAS communications for the last 15 minutes, or if the BAS setpoint is AUTO, then . . .

3. Use the **SCP default setting** (i.e., "LIM. = 100%").

Note: Remember that either the Trane BAS-issued SCLS value--or the SCP's default SCLS--can be modified by the cooldown function (if applicable). In turn, the resulting SCLS value can then be altered again by the electrical demand limit function (if applicable). (Both of these control functions are described later in this section.)

Determination of an effective current limit setpoint at the unit level is subject to another control hierarchy (see Table 11) that hinges on:

1. the position of the chiller switch located on each UCP695 chiller control panel; and,

2. what UCP695 chiller panel control logic will accept as a valid unit current limit setpoint.

Table 10
System Current Limit Setpoint Priority (1)

Manual SCP Setpoint	Trane BAS Setpoint	SCP Default Setpoint	Effective System Current Limit Setpoint
0-100% RLA	-------	-------	0-100% RLA
Auto	0-100% RLA (2)	-------	0-100% RLA
Auto	Auto	100% RLA (2)	100% RLA

"------" = A setpoint value entered at this control level will not determine the actual system current limit setpoint (SCLS).

Notes:
1. This setpoint hierarchy is only applicable when the generic BAS option is not installed/enabled.
2. Trane BAS and SCP default system current limit setpoints can be modified by the SCP's cooldown and electrical demand limit control functions.

Table 11
Unit Current Limit Setpoint Priority (1)

Chiller Status (2)	UCP695 CLS Pot. Setting (3)	SCP Manual Unit CLS (4)	Trane BAS Unit CLS (5)	SCP Calculated Unit CLS (6)	Effective Unit CLS
Auto/Local	40-100% RLA	-------	-------	-------	40-100% RLA
Auto/Remote	-------	0-100% RLA	-------	-------	40-100% RLA (7)
Auto/Remote	-------	Auto	0-100% RLA	-------	40-100% RLA (7)
Auto/Remote	-------	Auto	Auto	0-100% RLA	40-100% RLA (7)

"------" = A setpoint value entered at this control level will not determine the actual unit current limit setpoint (UCLS).

Notes:
1. This setpoint hierarchy is only applicable when the generic BAS option is not installed/enabled.
2. Unit status is determined by the position of the chiller switch on the front of the UCP695 chiller control panel.
3. UCP695 current limit setpoint adjustments range from 40% thru 100% of the compressor RLA.
4. Manual SCP chiller current limit setpoints are entered using the "CHILLER" program menu; see the SCP699 Operator Interface section of this manual.
5. Specific Trane BAS-issued chiller setpoints are communicated to the appropriate chillers via the BCLs that join the BAS, SCP and chillers.
6. "Calculated" unit CLS' are derived from the effective SCLS by the SCP's control algorithm.
7. Though Trane BAS-issued unit CLS values--as well as manual or "calculated" SCP CLS values--may be any value between 0% and 100%, the UCP695 chiller control panel will only accept what it considers to be a valid entry (i.e., see Note 3). Therefore, a UCLS value less than 40% issued by the SCP--or a Trane BAS--results in a 40% CLS at the UCP695 control panel.

Chiller Sequencing and Rotation

Several SCP "CHILLER" program entries allow the operator to establish a start-up order for all connected chillers. (See Figure 13 in SCP699 Operator Interface.) That is, the operator can tell the SCP which chiller (i.e., Unit 1, Unit 2 or Unit 3) to start first and which to start next or last.

Note: Remember that each unit's identity or "address" is assigned with DIP switch block S11 in the UCP695 chiller control panel. (See "UCP695 DIP Switch Setup" in the Start-Up section of this manual.) Do not confuse unit address numbers with the unit sequence numbers assigned in the SCP's "CHILLER" program!

When the SCP decides that another chiller must be brought on-line, it checks the unit sequence setpoint and operating status of each chiller. The chiller started is the unit with the lowest sequence number that isn't already running.

If the same sequence number is shared by more than 1 chiller, the SCP will then compare the unit addresses of these chillers and start the unit with the lowest address number. For example, if the unit sequence setpoint value for both Unit 2 and Unit 3 is "SET = 2", then Unit 2 will be the next chiller started when the SCP brings another unit on-line.

Unit sequence numbers also tell the SCP which chiller to stop first when the cooling requirement is low enough to warrant a unit shutdown, or when the system is scheduled off. In either case, the SCP checks the sequence setpoints of the operating chillers and stops the unit with the highest sequence number.

Again, if more than 1 chiller has the same sequence setting, the unit with the lowest address number is stopped first.

Note: For chiller sequencing alternatives, refer to SCP Setup Recommendations for Typical Systems.

The SCP's "CHILLER" program also includes a "unit sequence rate" setting that provides an opportunity for equalizing chiller duty. By entering a whole number between 1 and 99 (days) for the "RATE = " entry, the operator can set up periodic rotations of the chiller start-up order.

Every time this interval elapses, the SCP automatically increases the unit sequence setting of each chiller by one. Notice that the unit sequence number rotation typically occurs at midnight. However, in applications where the chillers operate continuously, the SCP will not shut down units in order to enforce the unit sequence number rotation. Instead, the assigned sequence numbers are changed only when the SCP starts and stops the chillers as a part of its normal control routine.

Once the sequence setting equals "3", the SCP will assign a sequence value of "1" to that unit at the end of the next rotation period. (In systems where "2" is the highest sequence number programmed, the unit sequence setpoint returns to "1" after it reaches "2".)

If "RATE = 0", the default setting, the SCP will not rotate the chiller start-up order.

Note: A power failure will not prevent the SCP from maintaining the established interval between chiller start-up sequence rotations.

Cooldown Control

The SCP's standard cooldown (or "soft loading") control function allows the operator to control the rate of chiller loading when a significant difference exists between the actual leaving chilled water temperature and the system chilled water setpoint.

By "soft loading" the chiller system in situations like this (e.g., system start-up), the operator not only improves temperature control at unstable loads, but also minimizes the associated electrical demands and unit cycling.

Cooldown operation is governed by two operator-entered control settings at the SCP's "SYSTEM" programming level. First, the operator selects a cooldown current limit setpoint that is to be in effect during the cooldown mode. Expressed as a percentage of total chiller RLA, values for the cooldown current limit setpoint entry range from 0% through 100%. If a numeric value of "0" is entered here, the cooldown control function is turned off.

If a BAS-issued system current limit setpoint exists and is lower than the cooldown "LIM. = " setting, then the SCP will use the BAS value as the effective current limit setpoint during the cooldown period.

Note: While the cooldown current limit setpoint may be set as low as 0%, the UCP695 control panels at the chillers will not accept a setpoint lower than 40%.

The operator must also determine the length of the cooldown period, and can tailor its duration to the constraints of that particular chiller system application. Represented by an "END = " program entry, cooldown periods may last up to 2 hours (i.e., "END = 02.00"), and are incremented in 15-minute intervals.

Remember that the SCP will default to "END = 00.00" unless some other value is entered here, and that this program entry also establishes the minimum "on" time for thermostatically-controlled, automatic free cooling.

Several conditions must be met before cooldown can occur:

1. "AUTO" must be entered for the system- and unit-level chilled water temperature setpoint entries in the SCP's "SYSTEM" and "CHILLER" programming menus.

Note: Cooldown can only modify: (a) a BAS-issued, scheduled, or CWR-based system chilled water setpoint; and (b) a BAS-issued or SCP default system current limit setpoint.

2. A value other than zero must be entered for the cooldown current limit setpoint program entry. (The SCP's default setting–"LIM. = 0"–disables the cooldown control function.)

3. The actual system leaving chilled water temperature must be at least 10 F above the present, effective system chilled water setpoint. (This condition usually exists at system start-up.)

Once cooldown is initiated, the SCP creates a "stepped" sequence of decreasing system chilled water setpoints that approach the desired chilled water temperature within the cooldown time period (i.e., "END = "). However, SCP control logic limits cooldown-initiated setpoint changes to a maximum of 1 F per minute unless "END = 00.00".

Note: If cooldown is enabled when "END = 00.00", the SCP will bring the system to its maximum operating capacity at once–within the constraints of the system current limit function–in order to satisfy the cooling requirement.

Recall that one of the operator-entered, cooldown program entries was a system current limit setpoint. If total chiller electrical demand exceeds the effective current limit value during cooldown operation, the SCP will unload the system--regardless of the present chilled water temperature--until electrical demand is sufficiently reduced.

When system electrical demand is again at an acceptable level, "stepped" reduction of the leaving chilled water temperature will continue until: (1) the desired temperature is attained, (2) the next current limit violation occurs, or (3) the cooldown period expires.

Chilled Water Reset (CWR)

Note: The CWR control function can only modify a system chilled water setpoint that is communicated by a Trane BAS or scheduled at the SCP. See Table 8. Chilled water reset will not affect:

a. a manual, system-level setpoint entry;

b. chillers operating under AUTO/LOCAL control; or,

c. chillers given a manual chilled water setpoint--either at the SCP via the "CHILLER" programming menu, or communicated from a Trane BAS over the BCLs between the BAS, SCP and UCP695 chiller control panels.

Chilled water reset is ideal for water-cooled chiller systems that seldom operate at full load, and do not require the design chilled water temperature at part load. In these applications, the system leaving chilled water temperature can be reset upward using the CWR control function.

Two sensor inputs are required for the CWR control function to operate, so a matched pair of thermistor-type sensors (i.e., part no. 4533-1710-44B) is provided with each SCP. Refer to Figure 16. Notice that one sensor must be field-installed in the common system leaving (supply) chilled water line. Never substitute a chiller leaving-evaporator water temperature sensor (4RT1) for this input!

Placement of the remaining sensor depends on whether "load-" or "ambient-based" chilled water setpoint reset is desired:

[ ] When load-based CWR is selected, the remaining sensor is field-installed in the common system entering (return) chilled water line. The difference between the leaving and entering chilled water temperatures--reflecting system cooling requirements--is then used to calculate a new system chilled water setpoint.

[ ] With the selection of ambient-based CWR, the SCP adjusts the system chilled water setpoint in response to a measured temperature, usually the outdoor ambient. In order to monitor this temperature, the remaining sensor is typically field-installed just inside the building's fresh air intake duct, or on the north exterior wall of the building. (In either case, shelter the sensor from direct sunlight and the elements.)

Selection of the type of chilled water reset desired for a given system application is not only determined by the location of the CWR sensors, but is also a function of 2 operator-programmable control settings:

1. Chilled Water Reset Rate (RATE =). The SCP uses this CWR variable to calculate the amount of reset--in degrees F--that will be applied to either a scheduled or Trane BAS-generated system leaving chilled water setpoint. Values for CWR rate extend from 1% through 199%; entering "0" disables the CWR control function.

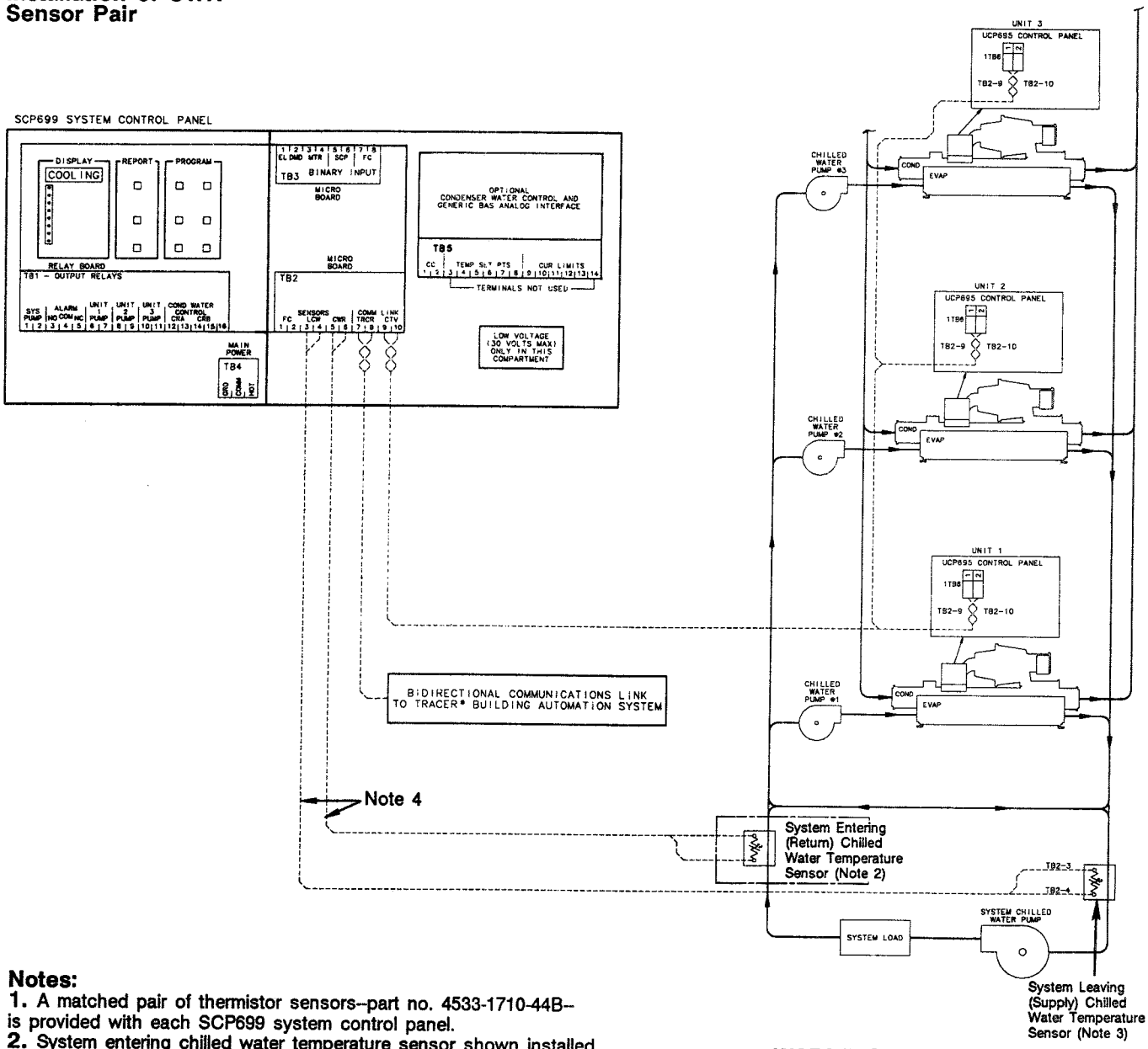
2. Chilled Water Reset Setpoint Temperature (SET =). This operator-entered temperature tells the SCP when to enable system chilled water reset, and can be set at any integer value from 1 F through 140 F. Again, entering a "0" for the CWR setpoint will turn off this control function.

Note: Whenever the CWR setpoint temperature is less than or equal to 25 F, load-based CWR is indicated. If the "SET = " value is greater than 25 F, the SCP identifies this control setting as an outdoor ambient temperature.

"Load-based" system CWR is enabled whenever the actual system delta-T is ≤ the CWR "SET = " value. Enablement of "ambient-based" CWR can occur when the actual outdoor temperature is either ≤ ("normal") or > ("reverse") the CWR "SET = " setting. (See "Ambient-Based CWR".)

Instructions for programming the CWR control function are provided under "System Setup: Chilled Water Reset Option" in the SCP699 Operator Interface section of this manual. For your convenience, the CWR program menu is shown in Figure 17.

Figure 16
Installation of CWR Sensor Pair



Notes:

1. A matched pair of thermistor sensors--part no. 4533-1710-44B-- is provided with each SCP699 system control panel.
2. System entering chilled water temperature sensor shown installed in entering (return) water line for load-based CWR. Alternatively, this sensor may be installed in the outdoor air for ambient-based CWR.
3. For single-chiller applications where CWR at the SCP is desired, the SCP's system leaving chilled water temperature sensor must be installed.
4. Sensor wiring is 30V or less, 14-18 AWG 600V wire; it must be shielded or run in conduit w/conductors carrying 30V or less. Following are maximum conductor lengths:
   - 5,000 ft. for 14 AWG
   - 2,000 ft. for 16 AWG
   - 1,000 ft. for 18 AWG
5. Illustrated arrangement of chilled and condenser water piping is not a piping schematic; use it only to identify temperature sensor locations.
6. Dashed lines (----) represent field-installed wiring; phantom lines (—— - ——) indicate available sales options.
7. All field wiring must be in accordance with the National Electric Code (NEC), and state and local requirements.

WARNING
Disconnect electrical power supply to prevent injury or death due to electrical shock.

Caution
Use copper conductors only to prevent equipment damage.

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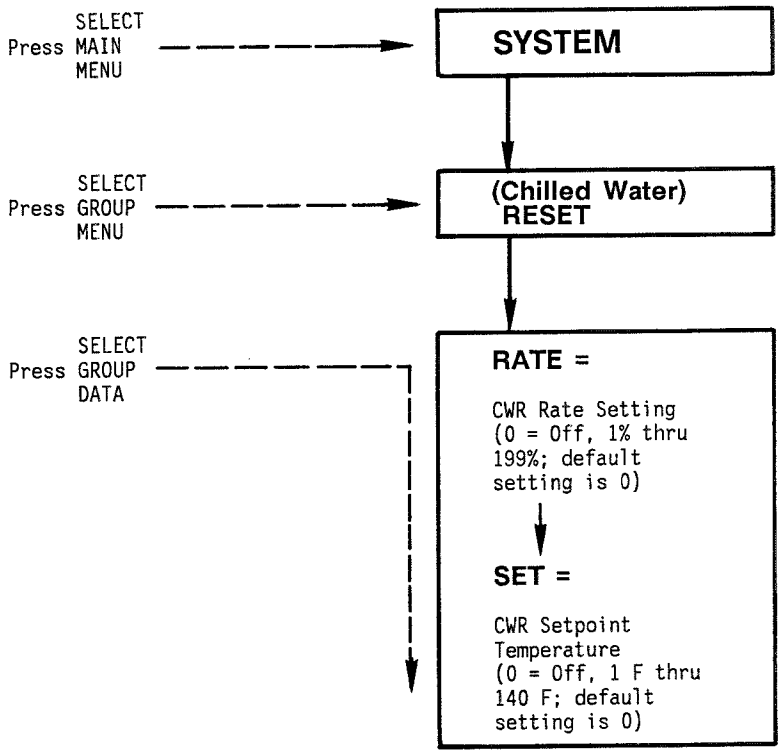
Figure 17
Operator-Programmable Entries for System Chilled Water Reset



Note: A CWR "SET = " value ≤ 25 F indicates load-based chilled water reset; ambient-based chilled water reset is indicated by a CWR "SET = " value > 25 F. In order to enable the CWR control function, a setting other than "0" must be entered for both "RATE = " and "SET = ".

Load-Based CWR

The SCP looks at several sensor and operator-entered inputs to arrive at a reset system chilled water setpoint (RSCWS) that reflects the system's reduced cooling requirements. These variables include the:

[ ] actual system leaving (supply) chilled water temperature (STMP);

[ ] actual system entering (return) chilled water temperature (AUXTMP);

[ ] operator-entered CWR rate between 1% and 199% (RATE);

[ ] operator-entered CWR setpoint temperature between 1 F and 25 F (SET); and,

[ ] scheduled or BAS-generated system chilled water setpoint (SCWS).

Based on this information, the SCP then calculates the RSCWS using this equation:

$$RSCWS = SCWS + RATE\ [CWR\ SET + STMP - AUXTMP]$$

To use this equation correctly, remember that:

1. Decimal values must be used for the RATE variable in this equation. (Divide the operator-entered "RATE = " value by 100.)

2. The SCP's CWR control function will not use a RSCWS value that is lower than the SCWS, so the effective RSCWS is always ≥ the SCWS.

3. Increasing the CWR "RATE = " and/or "SET = " values results in more reset.

4. If you know (1) when you want to enable the CWR function (CWR SET), and (2) how many degrees of reset are desired (RSCWS), this equation can be rearranged to solve for the appropriate CWR rate setting:

$$RATE = \frac{RSCWS - SCWS}{[CWR\ SET + STMP - AUXTMP]}$$

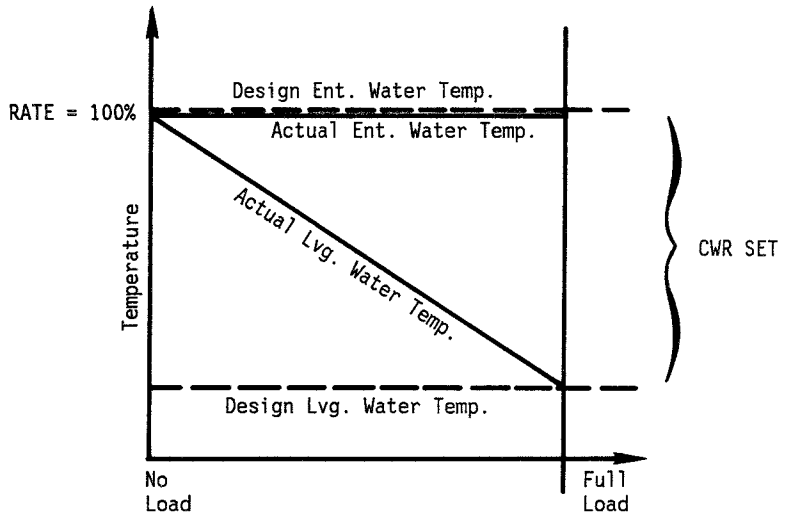
5. The effective RSCWS value is always ≤ 99 F.

Review the examples that follow to ensure that you understand both how to calculate a load-based reset system chilled water setpoint, and how this reset value changes with the operator-entered CWR rate and setpoint temperature control settings.

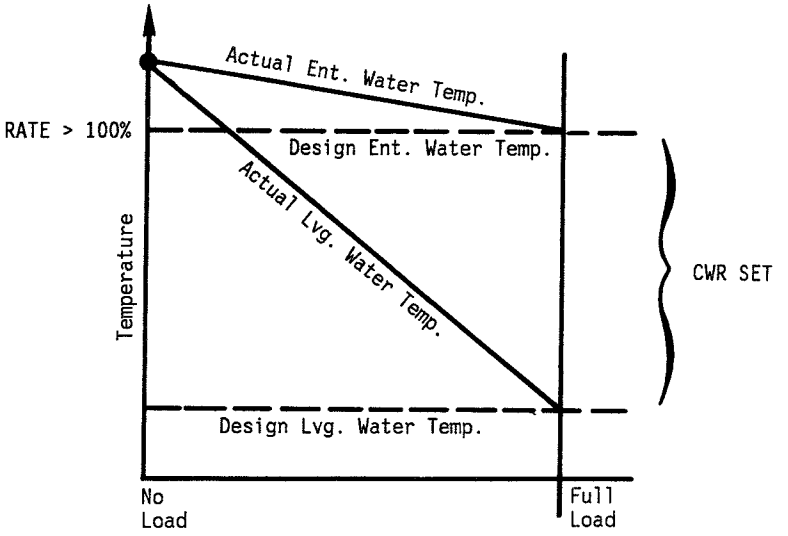
* * * * *

First, let's look only at how the value entered for the CWR rate can affect the scheduled (or BAS-generated) system chilled water setpoint. Review Examples 1 through 3 below; Figure 18 provides graphs that illustrate these situations.

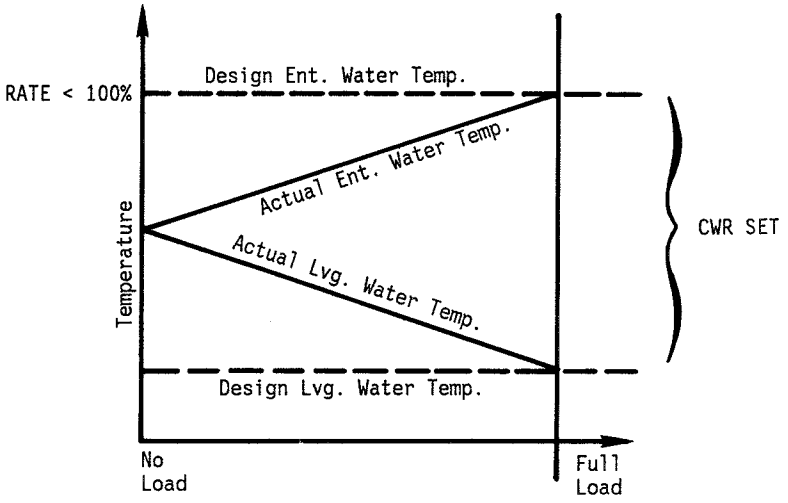
Figure 18
Load-Based CWR---
Variable RATE Settings



Example 1
RATE = 100%
CWR SET = System Design Delta-T



Example 2
RATE > 100%
CWR SET = System Design Delta-T



Example 3
RATE < 100%
CWR SET = System Design Delta-T

Notice that the same value--"SET = 10"--is entered for the CWR setpoint temperature in each of these examples (i.e., although any value ≤ 25 F could be selected).

Example 1. At full load, "System A" is designed to operate with a leaving (supply) chilled water temperature--SCWS--of 45 F, and a common entering-evaporator (return) temperature of 55 F; design delta-T is 10 F.

Presently, System A is only partially loaded, and:
SCWS = 45 F,
STMP = 45 F,
AUXTMP = 50 F,
CWR SET = 10 F, and,
RATE = 100% (i.e., 1.0).

To determine the reset system chilled water setpoint (RSCWS) for this set of operating conditions:

RSCWS = 45 F + 1.0 [10 F + 45 F - 50 F]
RSCWS = 45 F + 5.0 F
RSCWS = 50 F

Refer to the graph labelled "Example 1" in Figure 18. Notice that a constant return water temperature can be attained by selecting a 100% CWR rate when the CWR setpoint is equal to (or greater than) the system design delta-T.

Selection of CWR rate and setpoint temperature values that result in a constant return water temperature may be particularly desirable in parallel-piped systems with 2 chillers and 1 system pump or 2 individual unit pumps. When the system is running at part load (i.e., 1 chiller on and the other off), the operative unit's chilled water setpoint is never stepped below design as long as the system return water temperature remains constant at a level equal to--or greater than the design return water temperature at full load. (See SCP Setup Recommendations for Typical Systems.)

Example 2. Given the same operating conditions listed in Example 1, but with an increased CWR rate--150% or 1.5, notice that the calculated reset chilled water setpoint also increases:

RSCWS = 45 F + 1.5 [10 F + 45 F - 50 F]
RSCWS = 45 F + 7.5 F
RSCWS = 52.5 F or 53 F

(Calculated RSCWS values are always rounded to the nearest integer.)

Example 3. Finally, suppose that a value less than 100% (e.g., 80% or 0.8) is entered for the CWR rate:

RSCWS = 45 F + 0.8 [10 F + 45 F - 50 F]
RSCWS = 45 F + 4 F
RSCWS = 49 F

Compare the RSCWS values obtained in Examples 1, 2 and 3; notice that the degree of reset increases proportionately with the CWR rate setting.

* * * * *

Now let's look at how various CWR setpoint values can affect the degree of reset applied to System A's chilled water setpoint. Review Example 1 again, along with Examples 4 and 5; in each instance, a value of 100% was selected for the CWR "RATE = " program entry. (See Figure 19 for graphs illustrating these examples.)

Example 4. As in Example 1, entering a 100% CWR rate and a CWR setpoint greater than the system design delta-T also yields a constant return temperature. (Compare the corresponding graphs in Figure 19.)

RSCWS = 45 F + 1.0 [12 F + 45 F - 50 F]
RSCWS = 45 F + 7.0 F
RSCWS = 52 F

Example 5. Suppose that the CWR setpoint is changed to a value less than the system design delta-T. Since System A's design delta-T is 10 F, let's use CWR "SET = 8":

RSCWS = 45 F + 1.0 [8 F + 45 F - 50 F]
RSCWS = 45 F + 3.0 F
RSCWS = 48 F

If the CWR setpoint value is low enough, the calculated RSCWS value will be less than the scheduled system chilled water setpoint. However, SCP control logic ensures that the effective RSCWS temperature is always equal to--or greater than--the value of SCWS. This is demonstrated below, and illustrated in the graph labelled "Example 5" in Figure 19.

RSCWS = 45 F + 1.0 [4 F + 45 F - 50 F]
RSCWS = 45 F + -1.0 F
RSCWS = 44 F, but 44 F is not ≥ 45 F,
so
RSCWS = 45 F

Ambient-Based CWR

The SCP relies on essentially the same sensor and operator-entered inputs to perform ambient-based chilled water reset that it uses for load-based CWR:

[ ] an operator-entered CWR rate between 1% and 199% (RATE);

[ ] an operator-entered CWR setpoint temperature between 26 F and 140 F (SET);

[ ] a scheduled--or Trane BAS-issued--system chilled water setpoint; and,

[ ] the actual outdoor ambient temperature (AUXTMP).

But in addition to these variables, the SCP also checks the position of its No. 4 configuration DIP switch to determine whether the operator has selected the "normal" or "reverse" mode of ambient chilled water reset.

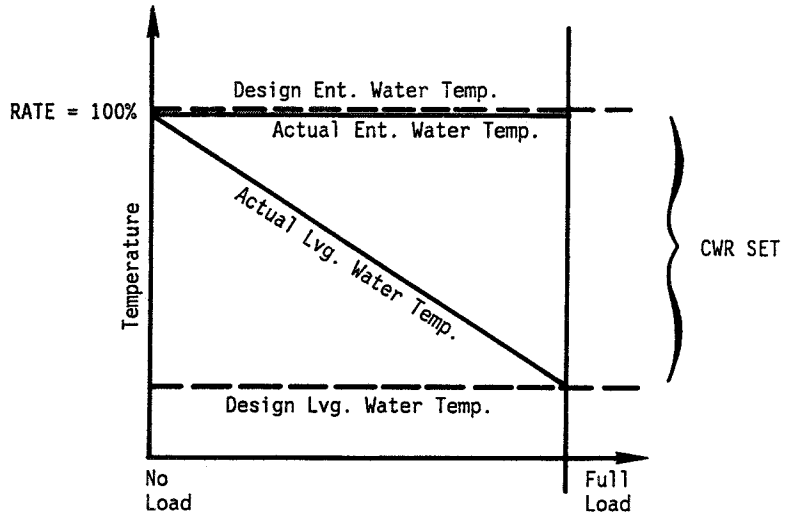
Note: DIP Switch No. 4's position only affects the ambient-based chilled water reset control function (i.e., CWR setpoint temperature is > 25 F). Its position has no effect on load-based CWR.

* * * * *

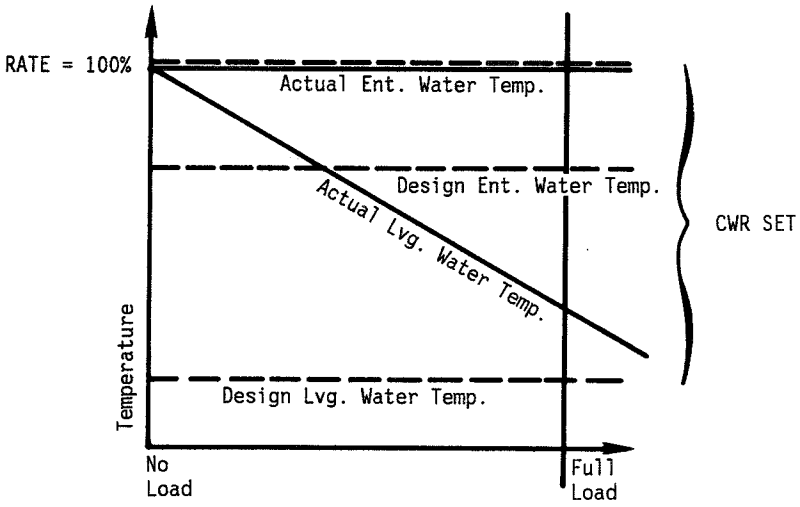
"Normal" CWR. This mode of ambient-based chilled water reset is selected by positioning configuration DIP Switch No. 4 in the OFF position. In effect, this tells the SCP to calculate a reset system chilled water setpoint (RSCWS) using this equation:

RSCWS = SCWS + RATE [CWR SET - AUXTMP]

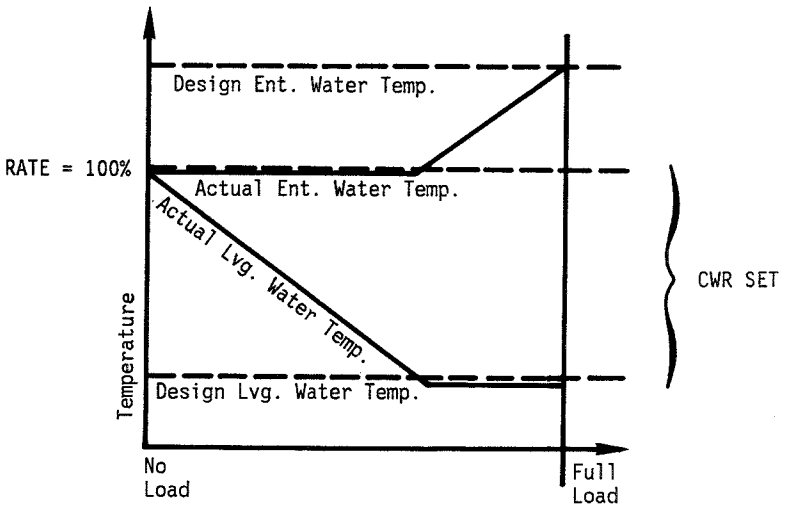
Figure 19
Load-Based CWR---
Variable CWR SET Temperatures



Example 1
RATE = 100%
CWR SET = System Design Delta-T



Example 4
RATE = 100%
CWR SET > System Design Delta-T



Example 5
RATE = 100%
CWR SET < System Design Delta-T

To correctly interpret this equation, remember that:

1. Decimal values must be used for the RATE variable, so divide the operator-entered "RATE = " setting by 100.

2. As the actual outdoor ambient falls, the SCP resets the system chilled water setpoint upward.

3. Increasing the CWR rate setting results in a greater amount of reset.

Figure 20 illustrates the overall relationship between the actual outdoor ambient temperature, CWR setpoint and rate values, and the resulting RSCWS on a graph. In particular, notice that RSCWS is always ≥ SCWS; control logic prevents the SCP from resetting the chilled water setpoint below the originally scheduled (or BAS-issued) value.

Review the examples that follow to ensure that you understand the correlation between CWR rate and reset system chilled water setpoint in "normal" ambient-based chilled water reset. (In each instance, the same value--"SET = 90"--is entered for the CWR setpoint temperature, although any value > 25 F could be selected).

Example 1. "System B" is designed to operate at full load when the outdoor ambient temperature is 90 F, and to produce 45 F chilled water. At the present time, the outdoor air sensor indicates a temperature of 80 F.

Here is a summary of the CWR input values for System B:
- SCWS = 45 F,
- STMP = 45 F,
- AUXTMP = 80 F,
- CWR SET = 90 F,
- RATE = 100% (i.e., 1.0), and,
- DIP Switch No. 4 = OFF/"normal".

To determine how many degrees of reset will be added to the system chilled water setpoint when a CWR rate of 100% is selected:

RSCWS = 45 F + 1.0 [90 F - 80 F]
RSCWS = 45 F + 10.0 F
RSCWS = 55 F

If the outdoor air temperature falls to 70 F--given the same set of operating conditions, then:

RSCWS = 45 F + 1.0 [90 F - 70 F]
RSCWS = 45 F + 20.0 F
RSCWS = 65 F

Notice that 10 F is added to the system chilled water setpoint for every 10 F drop in outdoor air temperature when the CWR rate is 100%.

Example 2. Let's look at the amount of reset produced when 150% (i.e., 1.5) is entered for System B's CWR rate.

RSCWS = 45 F + 1.5 [90 F - 70 F]
RSCWS = 45 F + 30.0 F
RSCWS = 75 F

Example 3. Finally, suppose that a value less than 100% (e.g., 80% or 0.8) is entered for the CWR rate:

RSCWS = 45 F + 0.8 [90 F - 70 F]
RSCWS = 45 F + 16.0 F
RSCWS = 61 F

Compare the RSCWS values obtained in Examples 1, 2 and 3; notice that the degree of reset is directly proportional to the difference between the actual and --in this case--design ambient temperatures.

* * * * *

"Reverse" CWR. When the No. 4 configuration DIP switch is positioned at ON, the SCP uses the following equation to calculate a reset system chilled water setpoint:

RSCWS = SCWS + RATE [AUXTMP - CWR SET]

Notice the difference between this equation and the one used for "normal" ambient CWR. Using this "reverse" equation, the SCP will reset the system chilled water setpoint upward as the outdoor ambient temperature rises (i.e., rather than falls, as in the "normal" mode).

See Examples 3 and 4 below--along with Figure 21--for an interpretation of the SCP's "reverse", ambient-based CWR control function.

Example 3. At full load, "System C" is designed to produce 45 F chilled water when the outdoor ambient temperature is 90 F. The SCP's outdoor air sensor presently indicates an actual ambient temperature of 100 F.

Here is a summary of System C's CWR input values:
- SCWS = 45 F,
- STMP = 45 F,
- AUXTMP = 100 F,
- CWR SET = 90 F,
- RATE = 100% (i.e., 1.0), and,
- DIP Switch No. 4 = ON/"reverse".

To determine how many degrees of reset will be added to the system chilled water setpoint when a CWR rate of 100% is selected:

RSCWS = 45 F - 1.0 [90 F - 100 F]
RSCWS = 45 F - 1.0 [-10 F]
RSCWS = 55 F

If the CWR rate is changed to 150% (i.e., 1.5), given the same operating conditions, then:

RSCWS = 45 F - 1.5 [90 F - 100 F]
RSCWS = 45 F - 1.5 [-10 F]
RSCWS = 60 F

Or, if a value of 50% is entered for the CWR rate, then:

RSCWS = 45 F - 0.5 [90 F - 100 F]
RSCWS = 45 F - 0.5 [-10 F]
RSCWS = 50 F

A comparison of these RSCWS values and corresponding CWR rate settings reveals that the amount of reset added to the system chilled water setpoint is directly proportional to the difference between the actual ambient temperature and the CWR setpoint.

Figure 20
"Normal" Ambient-Based Chilled Water Reset

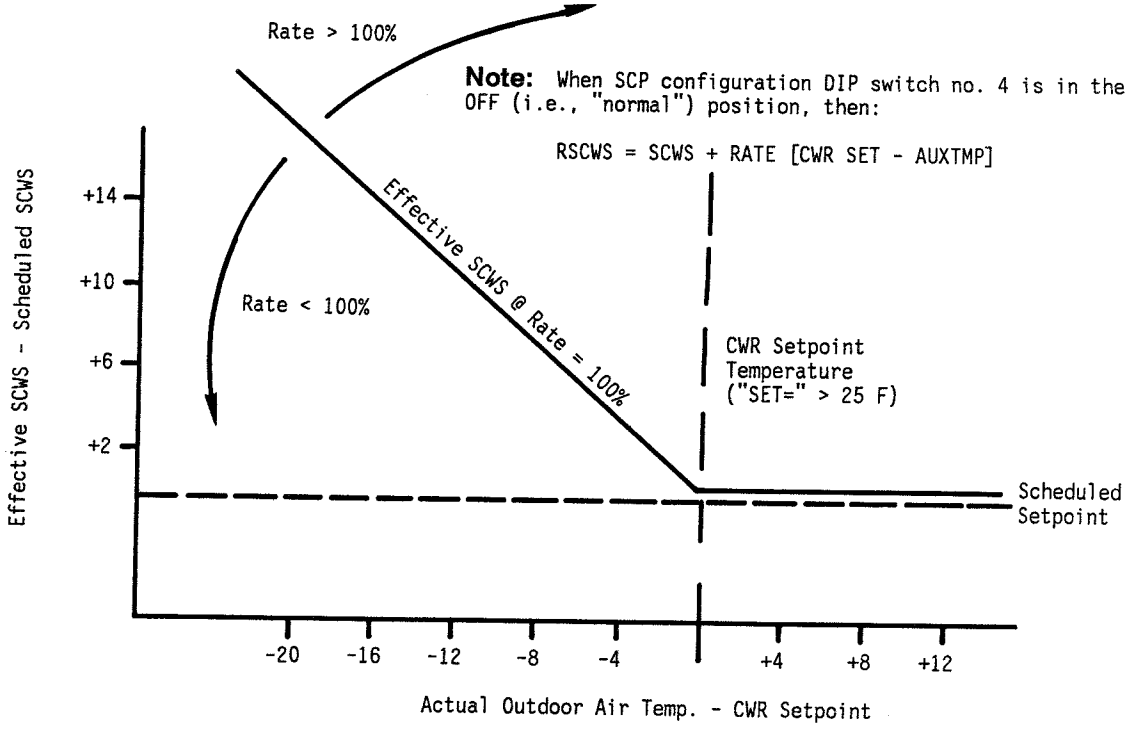
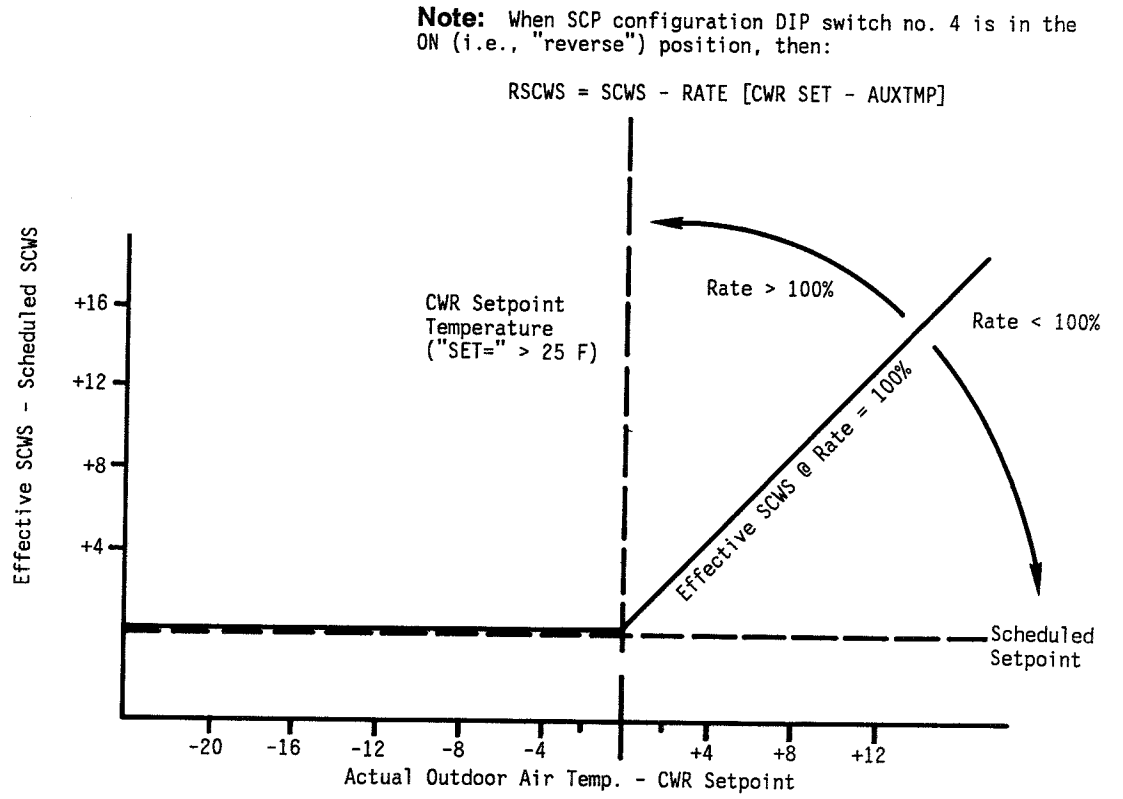


Figure 21
"Reverse" Ambient-Based Chilled Water Reset



Example 4. Let's look at what happens if the actual outdoor ambient temperature falls below the CWR setpoint when "reverse" ambient CWR is in effect.

RSCWS = 45 F - 1.0 [90 F - 80 F]
RSCWS = 45 F - 1.0 [+10 F]
RSCWS = 35 F, but 35 F is not ≥ 45 F,
so,
RSCWS = 45 F

Notice that the calculated reset system chilled water setpoint will be lower than the scheduled system chilled water setpoint whenever the actual outdoor ambient temperature falls below the CWR setpoint. However, SCP control logic prevents it from using any value less than the SCWS as the effective chilled water setpoint.

Free Cooling

Based on the principle that refrigerant migrates to the coldest area(s) in the system, free cooling adapts chillers equipped with that option to function as simple heat exchangers. (An explanation of free cooling at the chiller level is included in the operation/maintenance manual that shipped with the unit.)

The SCP's free cooling (FC) control function enables the operator to select either manual or automatic (i.e., thermostatically-controlled, or on/off input) free cooling on a system-wide basis if at least 1 chiller connected to the SCP is an FC unit. (It is not possible to govern the free cooling operation of individual chillers from the SCP.)

Note: Automatic, thermostatically-controlled free cooling is an SCP control option that requires field installation of a sensor (i.e., part no. 4533-1710-41B) in either the common entering-condenser water line, or the outdoor ambient. See Figure 22.

Bidirectional communications between the SCP and connected chillers enables the SCP to identify which units (i.e., Unit 1, Unit 2 and/or Unit 3) are equipped with the FC option and can be operated in that mode.

Notice that it is possible to govern system free cooling from any of 3 control levels; these levels--in order of priority--are:

1. the SCP's front panel push buttons;

2. a Trane BAS communicating with the SCP over a bidirectional communication link; and,

3. a contact closure input--in the SCP--produced by a generic BAS or external analog controller.

Note: To automatically initiate free cooling from a generic BAS, an external analog controller, or other similar supervisory control device:

a. "SET = AUTO" must be entered for the FC system setpoint (Figure 24); and,

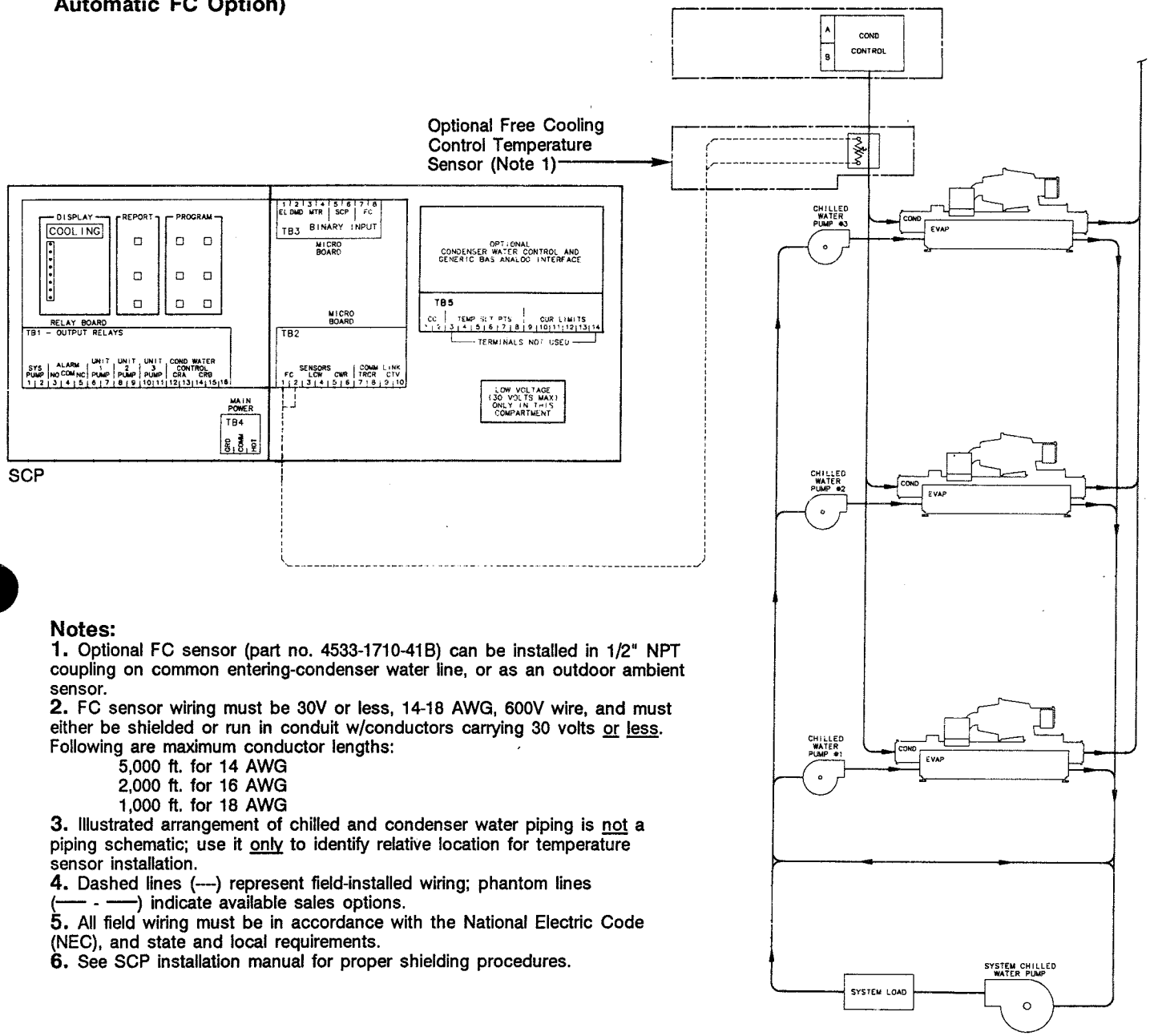
b. the SCP must "see" closure of both the "Scheduled System Enable/Disable" and "FC Enable/Disable" contacts. See Figure 23.

Thermostatically-controlled free cooling is not available via the "FC Enable/Disable" contacts!

Caution: Use generic BAS to turn off all non-FC chillers when system is running in free cooling mode. Running powered cooling units while very low condenser water temperatures exist is detrimental to operating efficiency and equipment life.

To better understand this control hierarchy, refer to Table 12.

Figure 22
Field Installation of Free Cooling Sensor (Thermostatically-Controlled Automatic FC Option)



Notes:

1. Optional FC sensor (part no. 4533-1710-41B) can be installed in 1/2" NPT coupling on common entering-condenser water line, or as an outdoor ambient sensor.
2. FC sensor wiring must be 30V or less, 14-18 AWG, 600V wire, and must either be shielded or run in conduit w/conductors carrying 30 volts or less. Following are maximum conductor lengths:
   - 5,000 ft. for 14 AWG
   - 2,000 ft. for 16 AWG
   - 1,000 ft. for 18 AWG
3. Illustrated arrangement of chilled and condenser water piping is not a piping schematic; use it only to identify relative location for temperature sensor installation.
4. Dashed lines (---) represent field-installed wiring; phantom lines (—— - ——) indicate available sales options.
5. All field wiring must be in accordance with the National Electric Code (NEC), and state and local requirements.
6. See SCP installation manual for proper shielding procedures.

WARNING
Disconnect electrical power supply to prevent injury or death due to electrical shock.

Caution
Use copper conductors only to prevent equipment damage.

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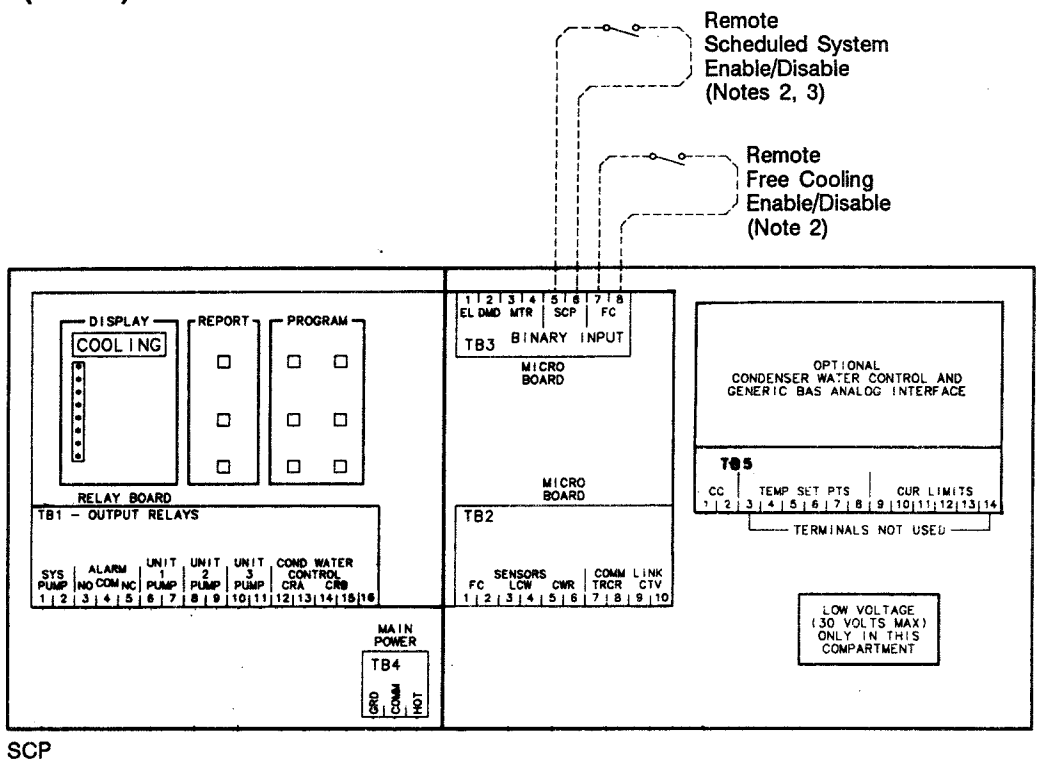
Figure 23
Remote Free Cooling Enable/Disable Contact Closure Inputs (Note 1)



WARNING
Disconnect electrical power supply to prevent injury or death due to electrical shock.

Caution
Use copper conductors only to prevent equipment damage (unless otherwise specified).

Notes:
1. Use the "Remote Scheduled System Enable/Disable" and "Remote Free Cooling Enable/Disable" contacts if the SCP is connected to a generic BAS, external analog controller, or similar supervisory control device.
2. These control circuits are "enabled" when the contacts are closed, and disabled when the control circuits are open. Wiring is 30 volts or less; use 14-18 AWG, 600V wire. Do not route these wires in conduit with circuits exceeding 30 volts. Silver contacts (or better) are required; do not use series contacts!
3. Jumper Terminals TB3-5 and TB3-6 if the "Scheduled System Enable/Disable" contacts are not used for system control.
4. Dashed lines (----) represent field-installed wiring.

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Table 12
SCP Control Hierarchy for Free Cooling Function (6)---including Auto & Manual On/Off FC, & Thermostatically-Controlled FC

SCP Status (See Table 7)	Freecool System Setpoint (1) SCP Program	Freecool System Setpoint (1) Trane BAS	Freecool System Lvg. CWS (1) SCP Program	Freecool System Lvg. CWS (1) Trane BAS	"Remote FC Enable" Binary Input	System Operating Mode	Effective FC Setpoints System Setpoint	Effective FC Setpoints Lvg. SCWS
Off	n/a	n/a	n/a	n/a	n/a	Off	n/a	n/a
Cooling	Off	n/a	n/a	n/a	n/a	Powered Cooling	n/a	n/a
	On	n/a	n/a	n/a	n/a (2)	Free Cooling	n/a	n/a
	Auto	Off	n/a	n/a	n/a	Powered Cooling	n/a	n/a
		On	n/a	n/a	n/a	Free Cooling	n/a	n/a
	Auto	Auto (5)	n/a	n/a	Open	Powered Cooling	n/a	n/a
			n/a	n/a	Closed (3)	Free Cooling	n/a	n/a
	0-140 F	n/a	1-99 F	n/a	n/a	Free Cooling	0-140 F	1-99 F
	Auto	0-140 F	n/a	1-99 F	n/a (4)	Free Cooling	0-140 F	1-99 F
		0-140 F	1-99 F	Auto	n/a	Free Cooling	0-140 F	1-99 F

n/a = A setpoint entered here will not influence SCP status or system operating mode.

Notes:
1. The freecool system setpoint and freecool system leaving chilled water setpoint (CWS) can be entered using the SCP's "SYSTEM: FREECOOL" program, or communicated by a Trane BAS.
2. Manual ON/OFF free cooling operation.
3. Automatic ON/OFF free cooling operation via the SCP's binary input (i.e., closure of the SCP's "Remote FC Enable" circuit).
4. Thermostatically-controlled, automatic free cooling operation. (This type of free cooling is only possible when the optional free cooling sensor is installed.) When in this mode, the SCP automatically "converts" system operation to the powered cooling mode when the temperature registered by the FC sensor equals or exceeds the operator-entered FC system setpoint.
5. The SCP uses "AUTO" for the Trane BAS-issued FC system setpoint if: (1) the chiller system does not include a Trane BAS; (2) the Trane BAS is not communicating any setpoints to the SCP; or, (3) the Trane BAS is sending a setpoint value of "AUTO".
6. Shaded portions of this table (i.e., excluding the column headings) represent conditions where a Trane BAS is determining SCP status and system operating mode.

Manual Free Cooling

Continuous, system-wide free cooling operation can be initiated manually via the SCP's "SYSTEM" programming menu by entering "ON" for the free cool system setpoint. (See Figure 24, and "System Setup: Freecool" in the SCP699 Operator Interface section of this manual.)

This "SET = ON" entry tells the SCP to shut down all powered CenTraVac cooling --unless a manual chiller operating command exists--and operate all FC-equipped chillers in the free cooling mode.

Free cooling operation will continue--regardless of the system leaving chilled water temperature--until the operator changes the free cool system setpoint to AUTO, OFF, or some numeric value between 0 F and 140 F. Further, as long as the system is running in the free cooling mode, none of the chillers communicating with the SCP (i.e., chiller switch(es) set at AUTO/REMOTE) can resume powered cooling operation unless a manual chiller-level operating command is issued.

Note: Manual, chiller-level operating commands that will override the SCP's freecool "ON" setting include these:

a. UCP695 control panel chiller switch is set at either AUTO/LOCAL or STANDBY/RESET;

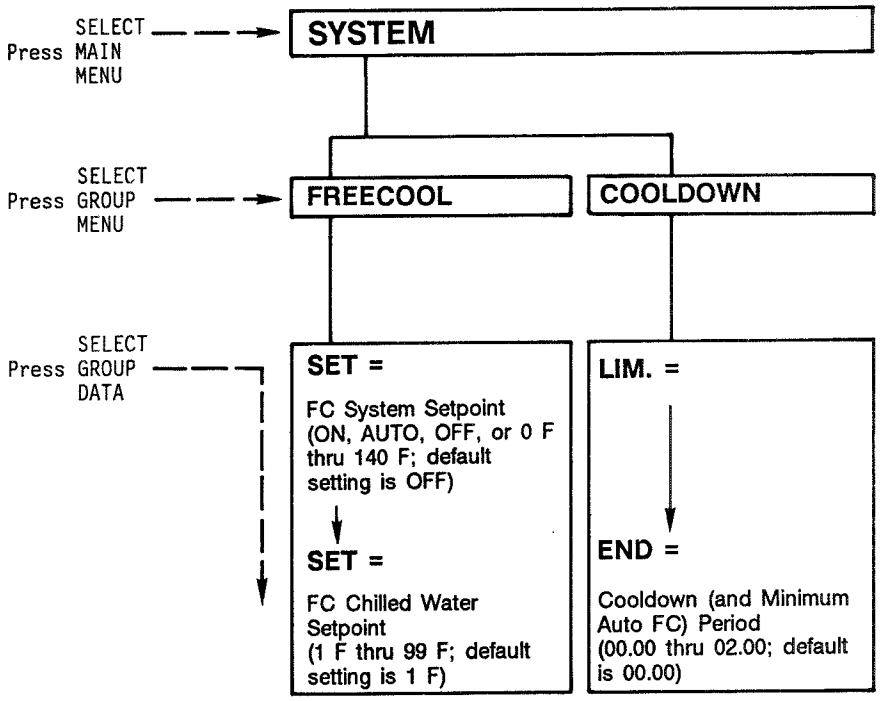
b. a manual leaving chilled water setpoint (i.e., OFF, or 1 F through 99 F) was entered for a given unit via the SCP's "CHILLER" programming menu; or,

c. a Trane BAS has communicated a manual chilled water setpoint (i.e., OFF, or 1 F through 99 F) to a specific chiller over the bidirectional communications links between the Trane BAS, SCP and UCP695 chiller control panel.

If continuous free cooling operation is desired on an individual chiller basis, position that unit's chiller switch at AUTO/LOCAL, and set its free cooling switch at ON. Remember that the unit free cooling switch is only operational when the chiller switch is in the AUTO/LOCAL position.

Note: Entering "SET = OFF" for the SCP's free cool system setpoint prevents all system-level free cooling operation --whether manual or automatic.

Figure 24
Operator-Programmable Entries for Automatic Free Cooling Option



Note: "SET = AUTO" must be entered for the FC system setpoint to enable a generic BAS, external analog controller, or similar supervisory control device to provide automatic on/off control of the SCP's system free cooling function.

Automatic Free Cooling

Note: The SCP does not provide control relays to maintain condenser water pump operation during the changeover from powered cooling to free cooling. Use the relays available at the individual chiller control panels for this purpose.

Thermostatically-Controlled FC

Field installation of the optional free cooling sensor enables the SCP to thermostatically initiate system free cooling operation based on either the temperature of the common entering-condenser water or outdoor ambient.

Operating parameters for automatic, thermostatically-controlled free cooling are determined by several operator-set SCP "SYSTEM" program entries (Figure 24). The operator must specify:

[ ] a free cooling (FC) "enable" temperature setpoint; and,

[ ] a system chilled water setpoint to be maintained during the FC mode.

A minimum "on"-time for free cooling operation can also be entered when an interval longer than 15 minutes is desired.

Below is a more detailed explanation of these control settings:

[ ] Freecool System Setpoint (SET =). This control setting determines the status of the SCP's free cooling control mode; several control states are possible:

a. SET = OFF. System-level free cooling operation--whether manual or automatic--is disabled.

b. SET = ON. All units equipped with the FC option are running in the manual free cooling mode, while all other units are turned off unless a manual chiller-level operating command exists. ("Manual" FC override commands are described in a note under "Manual Free Cooling".)

c. SET = 0 thru 140 F. Entering a whole number between 0 and 140 F enables the thermostatically-controlled free cooling control function. The SCP automatically initiates this type of free cooling operation if: (1) the temperature registered by the free cooling sensor is less than the "SET = " value; (2) none of the chillers are running in the powered cooling mode (unless manually controlled); and, (3) the system is scheduled "on", or is given a manual--or BAS--command to operate in the cooling mode.

Note: Since its initiation requires that all powered cooling is "off"--and since the SCP will not automatically interrupt powered cooling operation to attempt free cooling, thermostatically-controlled free cooling typically occurs at daily start-up.

d. SET = AUTO. This prompts the SCP to look to a higher level control device (e.g., BAS) for the effective freecool system setpoint or "enabling" contact closure inputs. (See "Automatic Free Cooling: On/Off FC".)

[ ] Freecool Chilled Water Setpoint (SET =). A value entered here tells the SCP what chilled water temperature to maintain while the system is operating in the automatic, thermostatically-controlled free cooling mode. Setpoint values range from 1 F through 99 F in increments of 1 degree.

The SCP will allow the system to remain in free cooling as long as the system chilled water temperature is less than or equal to this "SET = " value. If the actual chilled water temperature exceeds the freecool chilled water setpoint, the SCP will reinstate powered cooling operation.

Note: Once thermostatically -controlled free cooling is initiated, the system will continue to operate in that mode--regardless of the actual chilled water temperature--for a minimum of either 15 minutes or the time period established for the cooldown mode, whichever is greater. Beyond that, free cooling will remain on until the actual chilled water temperature exceeds the FC chilled water setpoint.

[ ] Cooldown Period (END =). While this operating parameter is an integral part of the SCP's cooldown control function, the value entered there also determines the minimum duration of the thermostatically-controlled free cooling mode. Accessed via the SCP's "SYSTEM" programming menu (Figure 24), "END = " values range from zero (00.00) to 2 hours (02.00) in 15-minute increments.

Note: If "END = 00.00" (i.e., SCP's default setting), the minimum automatic free cooling "on"-time is 15 minutes.

Collectively, these control setting entries tell the SCP when to begin automatic, thermostatically-controlled FC operation, and how much time to allow for the FC chillers to reduce the chilled water temperature to the FC chilled water setpoint. If the system's free cooling capacity is insufficient to reach or maintain this temperature, then the SCP converts system operation to the powered cooling mode.

When system operation is no longer required (i.e., either as a result of the system operating schedule, a BAS command, or a manual setpoint), the SCP shuts down all chillers presently running under its control. (This occurs regardless of whether these units are operating in the free cooling or powered cooling mode.)

On/Off FC

Two contact closure inputs at the SCP allow a generic BAS, external analog controller, or other supervisory control device to "automatically" initiate system-level free cooling. See Figure 23.

Notice that several conditions must be met before free cooling can occur:

1. The SCP's "FC Enable/Disable" control circuit--Terminals TB3-7 and TB3-8--must be closed.

Closure of this circuit could be prompted by a field-supplied and -installed, temperature-sensitive device. Actual "FC Enable/Disable" circuit configuration will vary with system application.

2. The SCP's "Scheduled System Enable/Disable" control circuit---Terminals TB3-5 and TB3-6---must be closed.

Closure of this circuit may be the result of a command from a connected, supervisory control device. A jumper is field-installed across these terminals to close this circuit when the "Scheduled System Enable/Disable" contact closure input is not used.

3. "SET = AUTO" must be entered for the freecool system setpoint in the SCP's "SYSTEM: FREECOOL" programming menu.

When all 3 of these requirements are satisfied, the SCP initiates free cooling operation in those units that are equipped with the FC option--and are presently under its control (i.e., chiller switch set at AUTO/REMOTE). The operating status of non-FC chillers controlled by the SCP (as well as units under manual control) will not change. In other words, simultaneous powered cooling and free cooling operation can occur within the system if both FC and non-FC chillers are present.

Caution: Turn off all non-FC chillers when system is running in free cooling. Operating chillers in powered cooling mode while very low condenser water temperatures exist is detrimental to operating efficiency and equipment life.

Once free cooling has begun, system operation will remain in that mode--regardless of chilled water temperature --until either of the contact closure inputs is open, or the FC system setpoint entry is changed to some value other than AUTO.

Remember that the "FC Enable/Disable" contact closure input only provides on/off control of the system-level free cooling function. Thermostatically-controlled free cooling is not possible without reprogramming the SCP and installing the optional free cooling sensor.

Trane BAS Interface

Field installation of a twisted-pair conductor (BCL) between the SCP (i.e., at Terminals TB2-7 and TB2-8) and a Trane building automation system enables the Trane BAS to send system--or chiller --setpoint and scheduling information to the SCP. In turn, the SCP uses this data to regulate the operation of all connected chiller system equipment (e.g., chillers, pumps, etc.).

Note: SCP control logic is bypassed as long as the Trane BAS is regularly transmitting system and chiller setpoints. However, if more than 15 minutes elapses between Trane BAS communication updates, the SCP will default to its own internal control values.

Notice that the Trane BAS can issue setpoints for all of the SCP's programmable control settings; Figure 9 in SCP699 Operator Interface summarizes these entries. In addition, the BCL allows the Trane BAS to "read" all operating data monitored by the SCP--at both system and chiller levels.

(Remember that the relay settings associated with the optional condenser limit control function must still be adjusted manually on the SCP's sideboard. See "Condenser Limit Option" on page 68 of this manual.)

Electrical Demand Limiting

Note: Remember that the electrical demand limit function is inoperative unless "AUTO" is entered for the system current limit setpoint. See Figure 25 (and Figure 12 in SCP699 Operator Interface).

The SCP's electrical demand limiting function enables it to monitor the building's incoming power level and reduce chiller system current draw accordingly (i.e., at a minimum rate of 2% per minute) when an operator-selected peak demand point is exceeded.

To do this, the SCP compares a sensor input value with an operator-entered, system electrical demand limit setpoint (Figure 25). Whenever the incoming power level registered by the sensor violates the demand limit, the SCP lowers the effective system current limit setpoint (SCLS). Then, using the new SCLS value, it begins to unload chillers by sending the unit control panels current limit setpoints below their individual, reported electrical load levels.

Note: For the SCP's electrical demand limit function to operate properly, the chiller system must constitute a significant percentage of the metered building electrical load. If the chiller system draws a relatively small portion of that load, the SCP may unload all of the chillers in order to reduce electrical demand!

Once system electrical demand falls below the electrical demand limit setpoint, the SCP raises the effective SCLS value and issues new, higher unit current limit settings.

Like the SCP's normal system current limit control function, its electrical demand limit function takes precedence over system temperature control. In other words, the SCP will demand-limit system operation whenever the electrical demand limit setpoint is exceeded--even if the lower unit current limit values force the chillers out of temperature control range!

Note: The SCLS value determined with the SCP's electrical demand limit function is ignored if it is higher than an existing cooldown or Trane BAS-issued SCLS value.

Two programmable entries in the "SYSTEM" menu allow the operator to establish an electrical demand limit setting and an electrical demand meter rate. See Figure 25. The limit setting is compared against the actual system electrical demand to determine whether or not chiller unloading is required. Limit settings range from 1% through 100% of the metered building electrical load (i.e., in increments of 1%); the demand limit function is disabled when "LIM. = 0".

The meter rate entry is a program constant that ranges from 0 through 100 (i.e., in increments of 1), and is used to translate meter pulse input data into a percent of electrical load. It is calculated and entered only once, and numerically converts the frequency of the demand meter contact closure input to a percentage of full-scale output.

See Figure 26. Notice that 4 input connections--SCP Terminals TB3-1 through TB3-4--are associated with the electrical demand limit function. These terminals are field-connected to a 2- or 3-wire contact closure output from some metering device--usually the pulse output of a watt-hour meter.

The SCP is capable of counting pulse rates ranging from 1 pulse/100 seconds to 10 pulses/1 second. However, each contact closure and opening must be maintained for approximately 20 milliseconds for the pulse to be detected.

Watt-Hour Meter/ Pulse Initiator Selection

The electrical utility will select and install a suitable watt-hour meter for your chiller system application. If the utility does not "size" the pulse-output device (or "initiator") as well, it will be necessary to calculate a "revolutions -per-pulse" (R/P) value that can then be used to select an appropriate pulse initiator.

A numeric value for the R/P ratio is derived from this equation:

$$\frac{R}{P} = \frac{1000 \times Ke}{PKh},$$

where,
Ke = kilowatt-hours per pulse; and,
PKh = watt-hours per revolution.

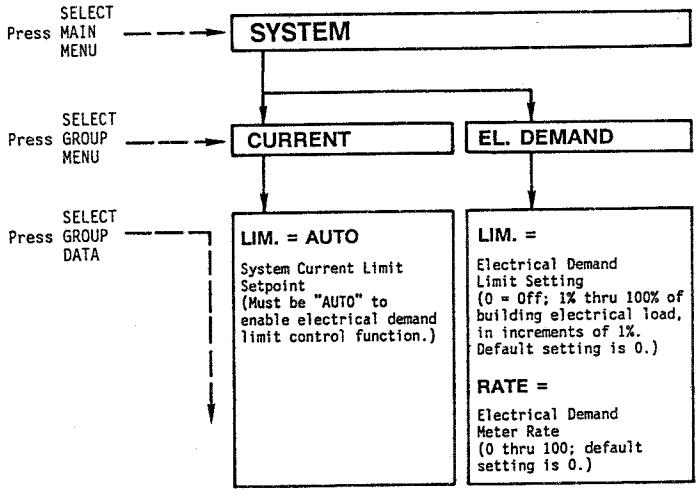
In order to solve for "R/P", several preliminary calculations are required:

1. Solve the following equation to arrive at a numeric value for "PKh":

$$PKh = Kh \times CTR \times VTR,$$

where,
Kh = meter constant displayed on the demand meter;
CTR = current transformer ratio; and,
VTR = voltage transformer ratio.

Figure 25
Operator-Programmable Entries for Electrical Demand Limiting



2. Using a pulse rate of 3 pulses per second at maximum power input, calculate a "kilowatt-hours per pulse" (Ke) value with this equation:

$$Ke = \frac{\text{Max. System Kw}}{\text{Pulses per Hour}},$$

where "pulses per hour" is 10,800 (i.e., 3 pulses/sec. x 60 sec./min. x 60 min./hr.).

Note: Using a frequency (or pulse rate) of "3" not only minimizes the effect of rounding off when calculating the SCP's meter rate setting, but also allows more flexibility when selecting meter/pulse gearing. (An "acceptable" frequency input for a 2-wire output at full power draw can be as much as 10 contact closures per second.)

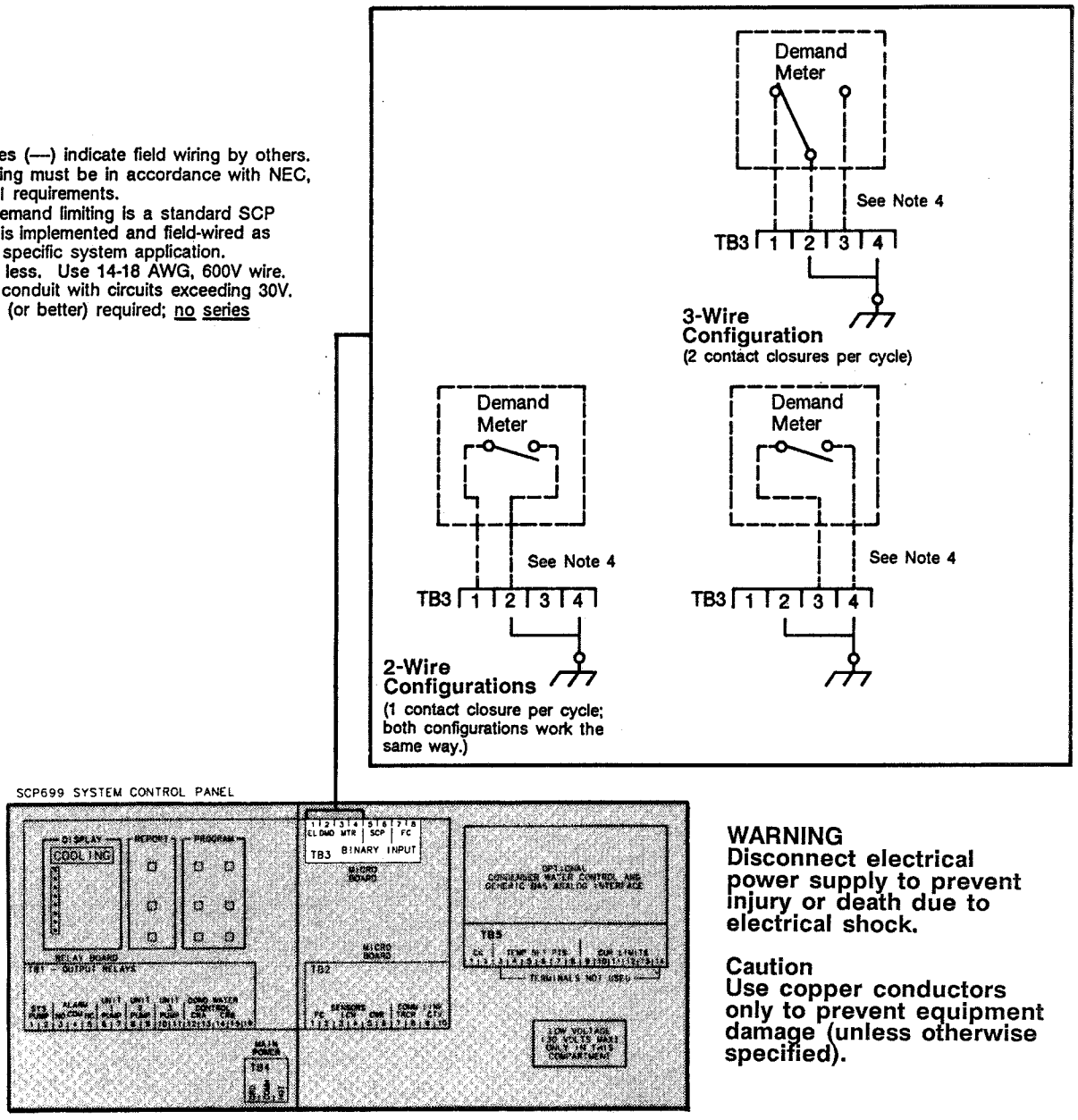
3. Substitute the numeric values calculated for PKh (Step 1) and Ke (Step 2) into the following equation to arrive at an "R/P" ratio for your system.

$$\frac{R}{P} = \frac{1000 \times Ke}{PKh},$$

4. Select a pulse-output device with an "R/P" ratio that most closely matches the R/P ratio calculated in Step 3.

Figure 26
Field Connections for Electrical Demand Meter Wiring

Notes:
1. Dashed lines (---) indicate field wiring by others.
2. All field wiring must be in accordance with NEC, state and local requirements.
3. Electrical demand limiting is a standard SCP feature, but it is implemented and field-wired as required for a specific system application.
4. 30 volts or less. Use 14-18 AWG, 600V wire. Do not run in conduit with circuits exceeding 30V. Silver contacts (or better) required; no series contacts!



WARNING
Disconnect electrical power supply to prevent injury or death due to electrical shock.

Caution
Use copper conductors only to prevent equipment damage (unless otherwise specified).

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Determining Electrical Demand Limit Settings

Once the watt-hour meter and pulse initiator are selected, several additional computations must be made to arrive at appropriate electrical demand limit setpoint and meter rate values for your system application. These calculations are described below.

1. Calculate the kilowatt-hours per pulse (Ke) based on the actual watt-hours/revolution (PKh) and revolutions/pulse (R/P) values of the watt-hour meter installed. Use this equation:

$$Ke = \frac{R}{P} \times \frac{PKh}{1000}$$

(Remember that PKh = Kh x CTR x VTR; see Step 1 of "Watt-Hour Meter/Pulse Initiator Selection".)

2. Determine what kilowatt value will correspond to a 100% electrical demand load.

Note: Select a Kw value that is (1) close to--but greater than--the demand limits that will be set, and (2) a multiple of 10 (e.g., 1000, 5000, etc.) so that any operator-entered demand limit setpoint can be easily converted to a Kw value.

(For example, if a system's electrical demand meter peak is 850 Kw, you may wish to set the 100% load value equal to 1000 Kw. In this instance, the equivalent kilowatt value for a demand limit setpoint of 54% would then be 540 Kw.)

3. Use the following equation to calculate the appropriate value for the SCP's electrical demand limit meter rate setting. Be sure to round off the calculated "RATE = " value to the nearest integer between 0 and 100.

$$RATE = \frac{0.0025 \times Kw(@100\%)}{Ke},$$

where,
Kw (@100%) = kilowatt value equivalent to a 100% electrical demand load (see Step 2); and,
Ke = kilowatt-hours/pulse (see Step 1).

4. Calculate the actual kilowatt value that corresponds to a 100% electrical demand load using the "rounded-off" rate value determined in Step 3. (Because the meter rate was rounded to the nearest integer, the kilowatt value calculated here will not match the value found in Step 2.)

$$Kw(@100\%) = \frac{RATE \times Ke}{0.0025},$$

where,
RATE = integer RATE value calculated in Step 3; and,
Ke = kilowatt-hours/pulse (see Step 1).

5. Using the kilowatt value found in Step 4, determine the peak building load (in kilowatts), and calculate the appropriate electrical demand limit setpoint with this equation:

$$El.\ Demand\ Limit = \frac{Peak\ Kw \times 100}{Kw(@100\%)},$$

where,
Peak Kw = desired limit--in kilowatts--for the maximum building load; and,
Kw (@100%) = 100% demand load in kilowatts (see Step 4).

Again, be sure to round off the calculated limit value to the nearest integer.

For example, if the kilowatt value corresponding to a 100% demand load is 1012 kw--and the desired electrical demand limit is 550 kw, then:

$$El.\ Demand\ Limit\ Setpoint = \frac{550\ Kw \times 100}{1012\ Kw}$$

$$El.\ Demand\ Limit\ Setpoint = 54.35 \text{ or } 54$$

Note: Repeat Step 5 to determine the electrical demand limit setpoint for other peak load conditions, but do not change the value used for RATE.

Once calculated, enter the electrical demand limit setpoint and meter rate values in the SCP's "SYSTEM" program menu. (See "System Setup: Electrical Demand Limit" in the SCP699 Operator Interface section of this manual.)

* * * * *

Review the example below to ensure that you understand the calculations used first to size a pulse initiator, and then to determine appropriate SCP electrical demand limit settings.

"Suppose a building operator installs a 2-wire electrical demand meter on the 480-volt, 3-phase incoming power lines of a building. The metered circuit includes a 1000:5 current transformer, and a voltage (potential) transformer with a ratio equal to 1. The desired peak building load is 750 Kw.

"Both the meter and transformers are designed for a maximum input of 1,000 Kw, and the meter constant is 2.4."

Calculate the values needed to establish appropriate electrical demand limit setpoint and meter rate values.

a. Determine the value of PKh (i.e., watt-hours per revolution).

$$PKh = 2.4 \times \frac{1000}{5} \times 1 = 480$$

b. Calculate a value for Ke (i.e., kilowatt-hours per pulse); remember to base this calculation on a frequency of 3 pulses per second.

$$Ke = \frac{1{,}000}{10{,}800} = 0.093 \text{ or } 0.09$$

c. Determine the proper R/P value for this application.

$$\frac{R}{P} = \frac{1000 \times 0.09}{480} = \frac{90}{480} \text{ or } \frac{1}{5.3}$$

d. Since the "R/P" ratio found in Step c is 1/5.3, select a pulse initiator that will produce 1 revolution per 6 pulses (i.e., R/P = 1/6).

e. Using the PKh and R/P values determined in Steps a and d, compute an "actual" value for Ke.

$$Ke = \frac{1}{6} \times \frac{480}{1000} = 0.08$$

f. Remember that the desired peak building load is 750 Kw; therefore, let's use a value of 1000 Kw as the "100% electrical demand load".

g. Solve for RATE; be sure to round off the calculated RATE value to the nearest integer.

$$RATE = \frac{0.0025 \times 1000}{0.08} = 31.25 \text{ or } 31$$

h. Use the integer value for RATE (calculated in Step g) to determine the actual Kw value that corresponds to a 100% electrical demand load.

$$Kw(@100\%) = \frac{31 \times 0.08}{0.0025} = 992$$

i. Calculate the appropriate electrical demand limit setpoint; in this example, use the desired peak building load of 750 Kw.

$$\text{El. Demand Limit} = \frac{750 \times 100}{992} = 75.6 \text{ or } 76$$

j. Access the SCP's "SYSTEM" programming menu, and enter "LIM. = 76" and "RATE = 31".

Evaporator Water Pump Control

Note: SCP control of evaporator water pump(s) is not possible in generic BAS applications.

Besides operating the connected centrifugal water chillers, the SCP also provides coordinated control of as many as 3 individual chiller evaporator pumps and 1 system pump.

Four normally-open relays on the SCP's output relay board are designated for evaporator pump control, and can be wired into the pump starter interlock control circuits. Specific pump relay terminal connections at the SCP are listed below (and illustrated in Figure 27):

[ ] system pump starter connected to SCP Terminals TB1-1 and -2;

[ ] Unit 1's pump starter connected to SCP Terminals TB1-6 and -7;

[ ] Unit 2's pump starter connected to SCP Terminals TB1-8 and -9; and,

[ ] Unit 3's pump starter connected to SCP Terminals TB1-10 and -11.

Note: Remember that each of the "Unit 1", "Unit 2" and "Unit 3" designators corresponds to the address set up with DIP Switch Block S11 in each chiller control panel. (See "UCP695 DIP Switch Setup" in the Start-Up section of this manual.)

Together, (1) SCP operating status, (2) unit chilled water setpoint(s), and (3) the position of SCP configuration DIP Switch No. 1 determine whether any--or all--of the chilled water pumps are running at a given time. (Recall that DIP Switch No. 1 must be in the OFF--or "normal"--position to assure proper SCP control of pump operation.)

Table 13 summarizes the relationship between these factors and the status (i.e., open or closed) of the SCP's chilled water pump control relays.

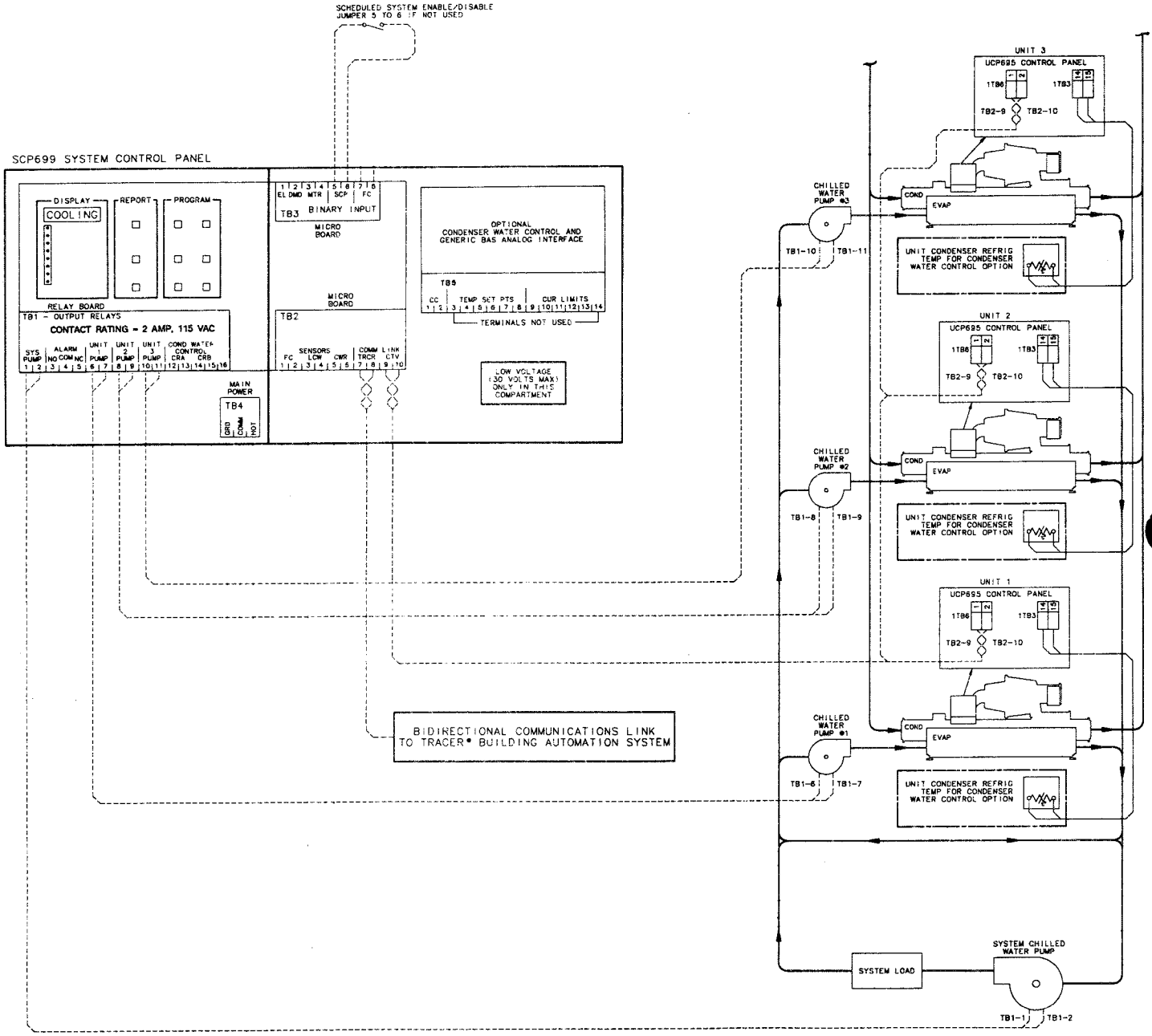
Notice that as long as any unit connected to the SCP is running, the SCP will not de-energize the system or chiller pump until the unit is shut down. This is true regardless of whether the unit is actually "scheduled" off (but running under a manual command), or operating in the "Auto/Local" mode--provided that the BCL between the SCP and chiller remains intact.

Table 13
Operation of SCP Evaporator Control Output Relays (1)

SCP Operating Status	Unit(s) Chilled Water Setpoint Status	Pump Relay Status: System Pump	Pump Relay Status: Chiller Pump(s)
Off	Manual On	On	On
Off	Manual Off	Off	Off
Off	Auto	Off	Off
On	Off	On	Off
On	Free Cooling	On	On
On	On	On	On

Notes:
1. All SCP evaporator pump output relays are subject to minimum "on" (i.e., 5 ± 1 minutes) and "off" (i.e., 0 minutes) times unless configuration DIP Switch No. 1 is in the ON--or "service" position.
2. Whether DIP Switch No. 1 is set at OFF or ON, the system pump relay will energize whenever:
   a. a chiller evaporator pump relay energizes; or,
   b. the system is turned ON.
3. Whenever the SCP's operating status is "ON", it starts the chiller evaporator pump associated with the first chiller in rotation.

Figure 27
SCP/Evaporator Water Pump Field Wiring Connections



Notes:

1. Dashed lines (---) represent field-installed wiring; phantom lines (—— - ——) indicate available sales options.
2. All field wiring must be in accordance with the National Electric Code (NEC), and state and local requirements.
3. Control circuit wiring between the SCP relay board and evaporator pump starters is 14 AWG, 600V wire rated for 105 C. A separate 120 VAC power supply is required.
4. While SCP evaporator pump **control** is a standard feature, its actual implementation is optional. Field **wiring** is dictated by the specific system application.
5. Illustrated arrangement of chilled and condenser water piping is <u>not</u> a piping schematic; use it <u>only</u> to identify temperature sensor locations.

WARNING
Disconnect all electrical power supplies to prevent injury or death due to electrical shock.

Caution
Use copper conductors only to prevent equipment damage.

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System Pump

The normally-open contacts of the **system pump** control relay close whenever the SCP is enabled and the system is scheduled--or manually commanded--to maintain a chilled water setpoint. Once closed, an internal timer function ensures that the contacts do not reopen for at least 5 minutes; during this period, the SCP can verify the existence of a cooling requirement.

Note: Remember that the SCP is "enabled" whenever its "Scheduled System Enable/Disable" circuit (i.e., TB3-5 to TB3-6) is closed.

System pump operation will continue until the system is scheduled off, or the SCP is disabled.

In the event of a power loss or an SCP malfunction, the system pump output relay is de-energized, shutting down system pump operation.

Chiller Pumps

Like the system pump, each chiller evaporator pump is governed by its own normally-open set of SCP output relay contacts. Any valid numerical setpoint for a particular unit--whether issued by the SCP, communicated from a Trane BAS, or manually entered at the SCP by the operator--will cause the associated chiller pump (along with the system pump) relay to energize.

Notice that SCP control logic anticipates chiller operation by energizing the chiller pump relay associated with the first unit in the start rotation whenever the system is scheduled "on". (See Table 13.) This assures that the unit pump is running before that chiller is expected to operate in either the powered cooling or free cooling mode. Further, once the pump relay contacts "make", they will remain closed for a minimum of 5 minutes.

When a unit is issued an "off" value for its chilled water setpoint, its evaporator pump control relay is de-energized once post-lube is complete--but only if the SCP does not anticipate restarting that chiller in the immediate future.

All chiller evaporator pump operation is shut down if a power loss or SCP malfunction occurs.

Condenser Water Pump Control

SCP699 system control panels do not include control output relays for each chiller's condenser water pump. Instead, condenser pump control is handled at the chiller level by the UCP695 control panel. Integration of condenser pump control with unit operation is explained in the installation and operation/maintenance manuals that ship with each CenTraVac chiller.

Generic BAS Option

Note: It is important to remember that when the SCP is used in a generic BAS application, its role is reduced to one of relaying setpoint changes from the generic BAS to the chillers. All system control functions--such as scheduling and chilled water pump control--must be performed by the generic BAS.

As a result, operator setup at the SCP is limited to ensuring that DIP Switch No. 2 (i.e., located on the sideboard; see Figures 28 and 29) is set at the ON position to enable SCP interface with the generic BAS.

Required SCP program entries are limited to the following:

[ ] In the "FREECOOL" portion of the "SYSTEM" program, enter "AUTO" for the free cooling system setpoint.

[ ] In the Unit 1, Unit 2 and Unit 3 portions of the SCP's "CHILLER" program, enter:

a. "AUTO" for each unit's leaving chilled water setpoint;

b. "AUTO" for each unit's current limit setpoint; and,

c. the percentage of total chiller current draw--"LOAD = "--of each unit. (This entry is an important part of the SCP's reports.)

In addition to these entries, you may also wish to set up the SCP's clock/calendar. (See "Program Interface" in the SCP699 Operator Interface section of this manual for instructions.)

Note: In generic BAS system applications, the SCP will only record and alarm system-level diagnostic conditions; it will not alarm diagnostic conditions that occur at the chillers.

Factory-installation of a sideboard within the SCP panel enclosure provides the means for a non-Trane BAS to directly control chiller operation by varying unit chilled water and current limit setpoints.

Analog control signals issued by the generic BAS for each unit's chilled water setpoint and current limit setting are sent to the SCP over twisted-pair conductors field-connected to Terminals TB5-3 through TB5-14 on the sideboard. Specific terminal connections are listed below and shown in Figure 28:

[ ] Chilled Water Temperature Setpoints:
Unit 1 = Terminals TB5- 3, - 4
Unit 2 = Terminals TB5- 5, - 6
Unit 3 = Terminals TB5- 7, - 8

[ ] Current Limit Settings:
Unit 1 = Terminals TB5- 9, -10
Unit 2 = Terminals TB5-11, -12
Unit 3 = Terminals TB5-13, -14

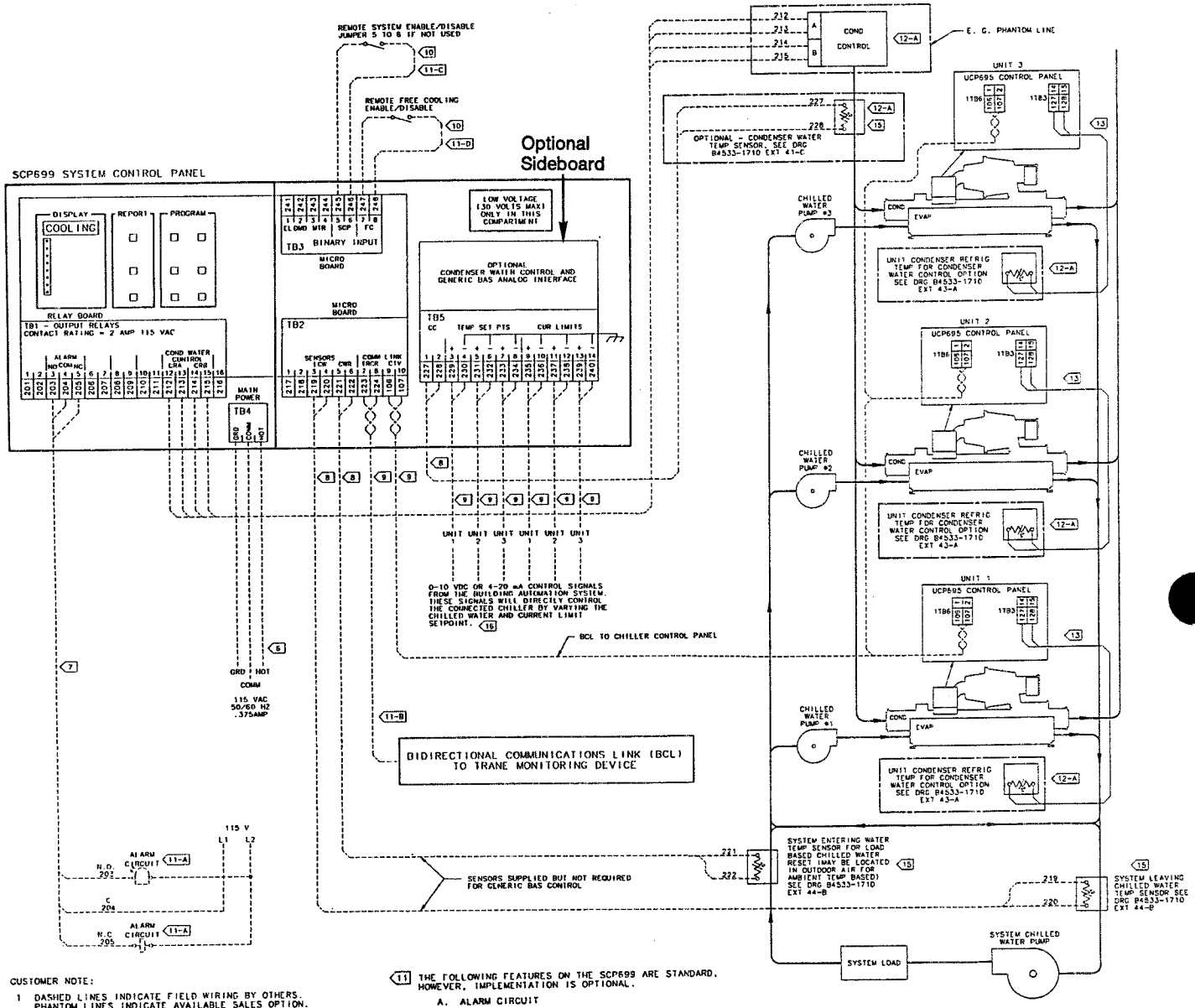
The SCP's generic BAS input terminals are designed to receive control signals of 0 to +10 VDC; SCP load is 96.4 kilo-ohms. Alternatively, 4 to 20 maDC signals may be substituted if the six 499-ohm resistors (i.e., R23 thru R28; supplied with the SCP) are field-installed on the sideboard for each pair of analog input terminals. In this instance, each 4 to 20 maDC current signal is driven into the appropriate 499-ohm load. See Figure 29.

To automatically control chiller operation, the "System Enable/Disable" circuit between SCP Terminals TB3-5 and TB3-6 must be closed. Closure of this input circuit allows the SCP to enable powered cooling operation of all connected chillers (i.e., with chiller switches set at AUTO/REMOTE).

For system applications that require individual on/off chiller control, field-wire a contact closure into the chilled water flow interlock circuit of each unit. (Typically, this set of contacts would be positioned in series with the starter auxiliary and chilled water flow switch.) If individual pumps are allocated for each chiller, the generic BAS can enable operation of a specific chiller simply by starting the appropriate chilled water pump.

Note: If the chiller switch of a particular unit is moved to AUTO/LOCAL, setpoints established at the UCP695 chiller control panel override any setpoints communicated by the SCP.

Figure 28
SCP Field Wiring Connections for Generic BAS Applications



CUSTOMER NOTE:

1. DASHED LINES INDICATE FIELD WIRING BY OTHERS. PHANTOM LINES INDICATE AVAILABLE SALES OPTION.
2. ALL FIELD WIRING MUST BE IN ACCORDANCE WITH THE NATIONAL ELECTRIC CODE (NEC), STATE AND LOCAL REQUIREMENTS. OTHER COUNTRIES APPLICABLE NATIONAL AND OR LOCAL REQUIREMENTS SHALL APPLY.
3. ALL CHILLED WATER PUMPS ARE CONTROLLED BY THE BAS. CONDENSER WATER PUMPS CAN BE ENABLED BY THE CONTROL CONTACT PROVIDED IN THE CENTRAVAC CHILLER UNIT CONTROL PANEL (UCP695).
4. PROVISION SHOULD BE MADE TO TURN THE CONTROLLED CHILLERS ON AND OFF VIA THE CHILLED WATER FLOW INTERLOCK ON THE UCP695.
5. CHILLED WATER AND CONDENSER PIPING ARRANGEMENT IS NOT INTENDED AS A PIPING SCHEMATIC. IT IS USED TO ILLUSTRATE TEMPERATURE SENSOR LOCATIONS.

(6) #14-16 AWG, 105°C, 600 VOLT WIRE.

(7) #14 AWG, 105°C, 600V WIRE. SEPARATE 120 VAC POWER SUPPLY IS REQUIRED.

(8) 30V OR LESS, #14-18 AWG 600V WIRE. MUST BE SHIELDED OR RUN IN CONDUIT. DO NOT RUN IN CONDUIT W/CIRCUITS GREATER THEN 30V. SEE TABLE 1 FOR MAX LENGTH.

(9) SHIELDED TWISTED PAIR. #14-18 AWG 600V WIRE. MAX LENGTH 5000 FT. DO NOT RUN IN CONDUIT W/CIRCUITS GREATER THAN 30V.

(10) #14-18 AWG 600V WIRE. DO NOT RUN IN CONDUIT W/CIRCUITS GREATER THAN 30V. SILVER CONTACTS OR BETTER REQUIRED (NO SERIES CONTACTS).

(11) THE FOLLOWING FEATURES ON THE SCP699 ARE STANDARD, HOWEVER, IMPLEMENTATION IS OPTIONAL.
- A. ALARM CIRCUIT
- B. COMMUNICATION TO TRANE MONITORING DEVICE
- C. REMOTE SYSTEM ENABLE/DISABLE
- D. REMOTE FREE COOLING ENABLE/DISABLE

(12) THE FOLLOWING CAPABILITIES ARE OPTIONAL - THEY ARE IMPLEMENTED AND WIRED AS REQUIRED FOR A SPECIFIC SYSTEM APPLICATION.
- A. CONDENSER LIMIT CONTROL

(13) WIRING INCLUDED WITH SENSOR. FIELD CONNECTION REQUIRED.

14. SEE SCP699 INSTALLATION MANUAL (CVMA-IN-1) FOR PROPER SHIELDING CONNECTIONS.

(15) 1/2 NPT COUPLINGS REQUIRED FOR WATER TEMPERATURE SENSOR WELLS.

(16) NEGATIVE SIGNAL INPUTS ARE GROUNDED TO SCP ENCLOSURE FOR CORRECT OPERATION. EXTERNAL EQUIPMENT SIGNALS SHALL BE ISOLATED OR FLOATING WITH RESPECT TO SCP ELECTRICAL SERVICE GROUND AND ISOLATED FROM EACH OTHER. SPECIAL CONSIDERATION MUST BE GIVEN TO 4-20 mA SIGNALS. IF THE CURRENT SOURCE REGULATES CURRENT FLOW ON THE NEGATIVE LEAD, USE A SEPERATE POWER SUPPLY FOR EACH CHANNEL. IN SOME APPLICATIONS, IT MAY BE NECESSARY TO INSTALL A LOOP ISOLATOR IN EACH CHANNEL TO PREVENT LOOP INTERFERENCE.

TABLE 1

WIRE SIZE	MAX LENGTH FOR SENSOR LEADS
14 AWG	5000 FT
16 AWG	2000 FT
18 AWG	1000 FT

WARNING
Disconnect electrical power supply to prevent injury or death due to electrical shock.

Caution
Use copper conductors only to prevent equipment damage (unless otherwise specified).

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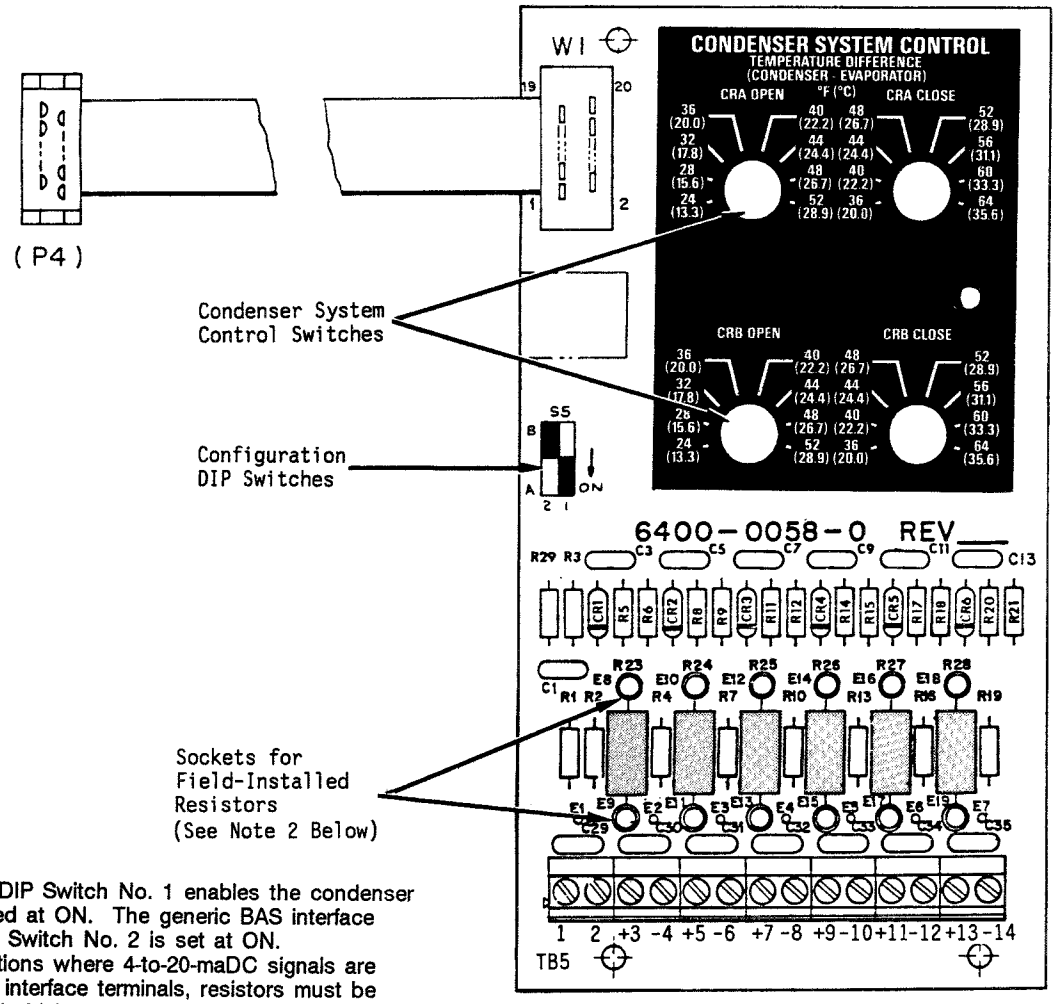
Figure 29
Optional SCP Sideboard for Condenser Water Control and Generic BAS Interface



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Notes:

1. Sideboard configuration DIP Switch No. 1 enables the condenser limit function when positioned at ON. The generic BAS interface option is enabled when DIP Switch No. 2 is set at ON.

2. For generic BAS applications where 4-to-20-maDC signals are issued to the SCP's analog interface terminals, resistors must be field-installed on the optional sideboard--just above terminal strip TB5.

Six resistors are factory-included with the optional sideboard--2 resistors for each chiller in the system. To install the resistors, bend the resistor leads at a 90-degree angle; then insert each resistor into the appropriate set of sockets.

Resistor designations are stamped on the sideboard, and are as follows:

R23 = Unit 1 chilled water setpoint
R24 = Unit 2 chilled water setpoint
R25 = Unit 3 chilled water setpoint

R26 = Unit 1 current limit setpoint
R27 = Unit 2 current limit setpoint
R28 = Unit 3 current limit septoint

Remember that chiller designations (i.e., Unit 1, Unit 2 and Unit 3) are determined by DIP switch settings (S11) in each UCP695 chiller control panel.

3. SCP input impedance values for generic BAS applications are as follows:

a. 96.4 kilo-ohms for 0 to +10 VDC control signals (optional sideboard without field-installed resistors); and,

b. 499 ohms for 4 to 20 maDC control signals (optional sideboard with field-installed resistors).

Analog input signals sent to the SCP from the generic BAS are "converted" into unit chilled water and current limit setpoints that are then communicated to the appropriate chiller over the SCP/CenTraVac BCL (i.e., bidirectional communications link).

Note: Remember that each UCP695 chiller control panel connected to the SCP is "tagged" with its own, unique address ("Unit 1", "Unit 2" or "Unit 3") by the setup of DIP Switch Block S11. See "UCP695 DIP Switch Setup" in the Start-Up section of this manual.

When the generic BAS schedules the SCP "off" by opening the "System Enable/ Disable" circuit, the SCP shuts down all chiller operation (i.e., except for those units running under AUTO/LOCAL control).

Unit Chilled Water Setpoints.

The value of the analog signal is used to determine how many degrees (F)--if any--are added to the temperature setpoint established at the designated chiller's UCP695 control panel. See Figure 30. If the change upward in the analog signal value is great enough, the chiller may be shut down (i.e., the SCP does not "slew-rate limit" unit setpoint changes issued by a generic BAS).

The SCP uses the following criteria to arrive at a chilled water setpoint that corresponds to the analog control signal issued by the generic BAS:

[ ] When the analog input voltage for a given unit is greater than 0 VDC but less than 1.5 VDC, the SCP will not transmit a chilled water setpoint (CWS) to that unit. (Therefore, the "Remote Chilled Water Setpoint" status indicator light on the chiller panel will not be lit.)

[ ] If the analog input for a given unit is greater than 1.5 VDC but less than 2.0 VDC, the SCP will send a CWS that is equal to that chiller's front panel setpoint (and the "Remote Chilled Water Setpoint" status indicator light on the chiller panel will illuminate).

[ ] The SCP uses this equation to calculate a new CWS for a particular unit when the analog input signal is greater than 2.0 VDC but less than 10.0 VDC:

$$\text{"New" CWS} = \text{Front Panel CWS} + 15\ \text{F}\ \frac{(\text{Analog Input} - 2)}{8}$$

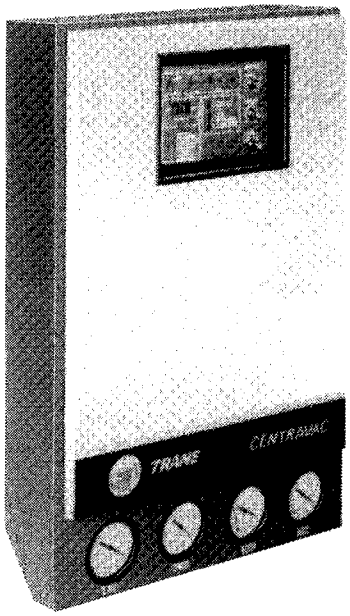
Table 14 indicates the amount of chilled water setpoint reset associated with various analog input voltage values ranging from 2.1 VDC to 9.9 VDC.

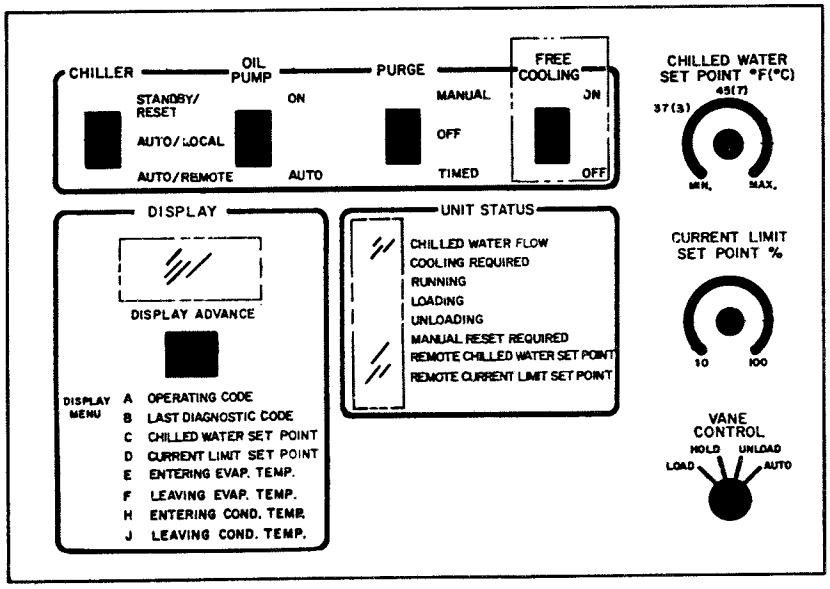
[ ] Whenever the analog input voltage is greater than 10.0 VDC but less than 12.0 VDC, the SCP transmits a new CWS that is equal to that chiller's front panel setpoint plus 15 F.

Note: The SCP will not apply more than 15 F reset to a unit's front panel chilled water setpoint.

Caution: To avoid damaging the SCP, never apply an analog input signal greater than 12.0 VDC to Terminals TB5-3 thru -8.

Figure 30
UCP695 Chiller Control Panel





Note: These controls are accessible without opening the control panel door.

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(Sheet 6 of 7)

Table 14
Unit Chilled Water and Current Limit Setpoints from Generic BAS Analog Inputs

Analog Input Voltage Signal (Vin) (1, 2)	Temperature Reset Added to Front Panel Chilled Water Setpoint	New Chiller Current Limit Setpoint (3)
0.0 < Vin < 1.5 VDC (or 0 - 3 mA)	No new CWS sent to unit.	No new CLS sent to unit.
1.5 < Vin < 2.0 VDC (or 3 - 4 mA)	New CWS = unit front panel CWS	New CLS = 100%
Vin = 2.1 VDC	Unit CWS + 0.188 F	99.25%
Vin = 2.5 VDC	Unit CWS + 0.938 F	96.25%
= 3.0 VDC	Unit CWS + 1.875 F	92.50%
= 3.5 VDC	Unit CWS + 2.813 F	88.75%
Vin = 4.0 VDC (or 8 mA)	Unit CWS + 3.750 F	85.00%
= 4.5 VDC	Unit CWS + 4.688 F	81.25%
= 5.0 VDC	Unit CWS + 5.625 F	77.50%
Vin = 5.5 VDC	Unit CWS + 6.563 F	73.75%
= 6.0 VDC (or 12 mA)	Unit CWS + 7.500 F	70.00%
= 6.5 VDC	Unit CWS + 8.438 F	66.25%
Vin = 7.0 VDC	Unit CWS + 9.375 F	62.50%
= 7.5 VDC	Unit CWS + 10.313 F	58.75%
= 8.0 VDC (or 16 mA)	Unit CWS + 11.250 F	55.00%
Vin = 8.5 VDC	Unit CWS + 12.188 F	51.25%
= 9.0 VDC	Unit CWS + 13.125 F	47.50%
= 9.5 VDC	Unit CWS + 14.063 F	43.75%
Vin = 9.9 VDC	Unit CWS + 14.813 F	40.75%
10.0 < Vin < 12.0 VDC (or > 20 mA)	New CWS = unit front panel CWS + 15 F	New CLS = 40%

Notes:

1. Analog input voltage values represented in this table include + 3%.
2. Whenever the analog input voltage is "2.0 < Vin < 10.0 VDC", the SCP sends the designated chiller a new chilled water (CWS) or current limit setpoint (CLS) based on these equations:

   a. New CWS = Unit Front Panel CWS + 15 F x ([Vin - 2] / 8)
   b. New CLS = 100% - 60 x ([Vin - 2] / 8)

3. The "new CLS" values in this column replace the designated chiller's front panel current limit setpoint if that unit is operating under AUTO/REMOTE control.

Unit Current Limit Setpoints. Another set of criteria (outlined below) is used to determine chiller current limit setpoints from the generic BAS analog input signals received at SCP Terminals TB5-9 through TB5-14. These new current limit setpoints are then sent to the appropriate chillers over the SCP/CenTraVac BCL.

Remember that chiller shutdown(s) may result if the values of the rate of change in the analog signal values issued by the generic BAS are great enough!

[ ] When the analog input voltage for a given unit is greater than 0 VDC but less than 1.5 VDC, the SCP will not transmit a current limit setpoint (CLS) to that unit.

[ ] If the analog input for a given unit is greater than 1.5 VDC but less than 2.0 VDC, the SCP will send that chiller a CLS that is equal to 100%.

[ ] The SCP uses this equation to calculate a new CLS for a particular unit when the analog input signal is greater than 2.0 VDC but less than 10.0 VDC:

$$\text{"New" CLS} = 100\% - 60\ \frac{(\text{Analog Input} - 2)}{8}$$

Current limit setpoints corresponding to various analog input voltages that range from 2.1 VDC to 9.9 VDC are included in Table 14.

[ ] Whenever the analog input voltage is greater than 10.0 VDC but less than 12.0 VDC, the SCP transmits a new CLS that is equal to 40% for the designated unit.

Caution: To avoid damaging the SCP, never apply analog input signals exceeding 12.0 VDC to Terminals TB5-9 thru -14.

Note: Besides modifying unit chilled water and current limit setpoints, a generic BAS can also initiate system-level free cooling via the SCP. See "Automatic Free Cooling: On/Off FC" in the SCP699 Operation section of this manual.

Condenser Limit Option

Note: This SCP option is intended to signal the cooling tower controller; it is not designed to control cooling tower operation!

The SCP's condenser control option is typically used to regulate cooling tower capacity by providing a 2-stage condenser limiting function. Specifically designed to maintain a minimum refrigerant pressure differential between each unit's evaporator and condenser, this control function also enables the chillers to operate over a broader range of operating conditions.

SCPs equipped with the condenser option include a "condenser water control/generic BAS analog interface" sideboard that is factory- (or field-) installed inside the SCP panel enclosure. See Figure 31. Notice that several sensor input and relay output electrical connections must be field-installed to make the sideboard operational:

1. Depending on the number of chillers connected to the SCP, up to 3 condenser refrigerant temperature sensors must be field-installed and -wired.

Refer to Figure 31. To ensure an accurate reading, each sensor (i.e., part no. 4533-1710-43A) must be epoxied to the condenser refrigerant line located between the unit's economizer and condenser. Do not install the sensor in the refrigerant line well! Remember that: (1) the tip of the thermistor must contact the bare metal of the refrigerant line; and, (2) the sensor and line must be wrapped with Armaflex insulation or equivalent.

The sensor leads are then routed into the low-voltage (upper) section of the UCP695 control panel, where they are connected to Terminals 1TB3-14 and -15. (These terminals are ordinarily designated for use with optional unit ambient temperature sensor 4RT6.)

Note: The SCP obtains evaporator refrigerant temperatures from each chiller control panel. Chiller sensor 4RT5 provides this data; it is factory-installed on all CVHE/B chillers with UCP695 control panels.

2. Two SCP condenser water control output relays--Relay A (CRA) and Relay B (CRB)--must be wired into the cooling tower control circuit. Connections at the SCP are made at Terminals TB1-12 and -13, and Terminals TB1-14 and -15, respectively. See Figure 31.

3. If desired, a condenser water temperature sensor (i.e., part no. 4533-1710-41C) may be installed in the common entering-condenser water pipe.

Note: The temperature input provided by this sensor is checked twice each second, and is used for display purposes only; it is not a part of the condenser limit control function. (See "'Report' Interface" in the SCP699 Operator Interface section of this manual.)

A "COND. SYS. TEMP = 0" entry appears in the SCP's system reports if the condenser system temperature sensor is not installed.

To enable the condenser limit function once these electrical connections are complete, DIP switch No. 1 on the sideboard (Figure 29) must be set at ON. In addition, 2 rotary switches--also located on the sideboard--must be adjusted to establish the desired "open" and "close" values for the condenser output relays.

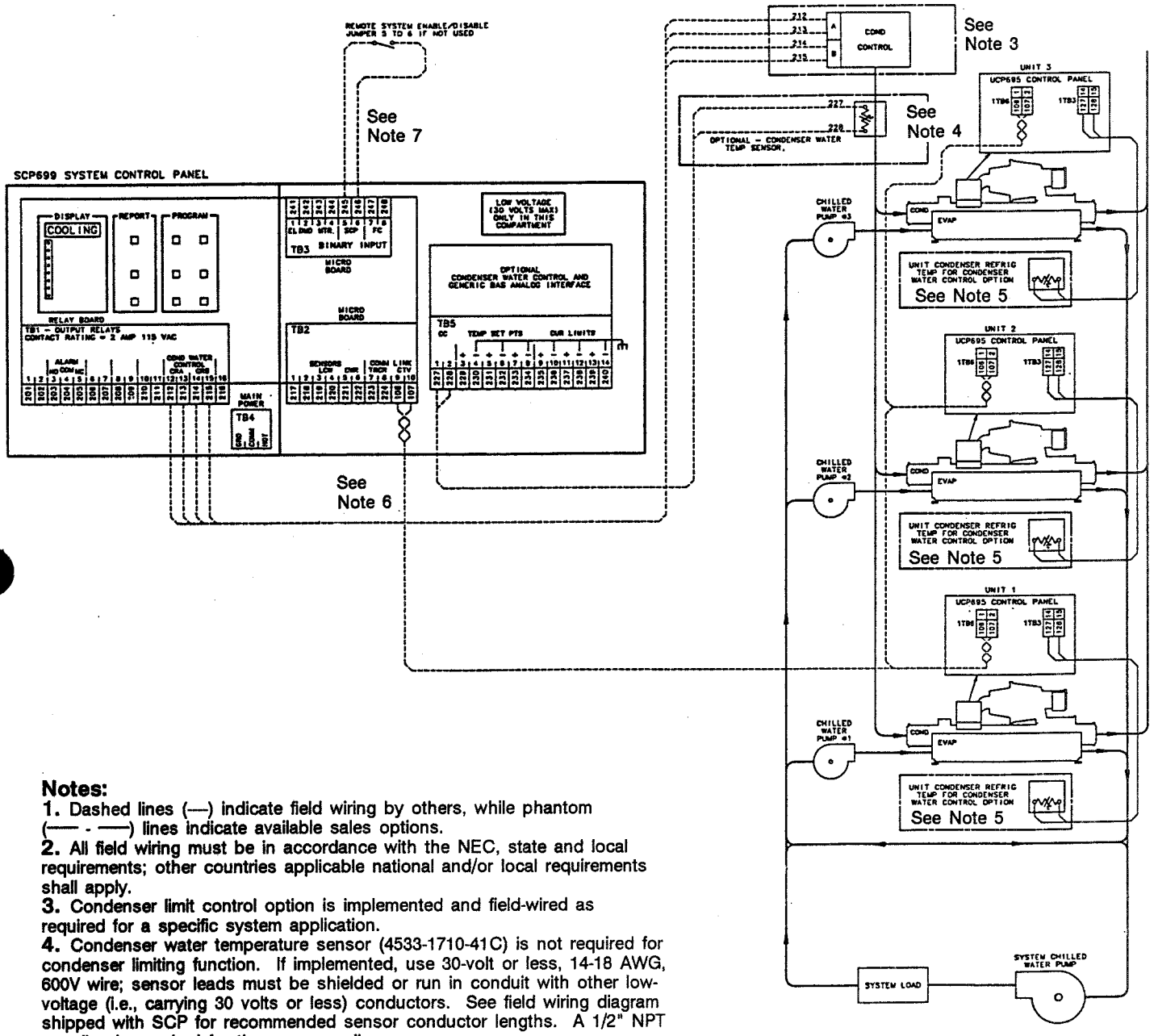
Condenser Relays A and B are electrically-isolated, normally-open relay outputs that are "on" when the relay contacts are open. These contacts are designed to close--on a staggered basis--when the measured difference in refrigerant temperature between the evaporator and condenser rises to a specified level; "close" setpoint values for both relays range from 36 F to 64 F in increments of 4 F.

The relay contacts will reopen--again, at staggered levels--when the temperature differential drops sufficiently. Adjustment values for the relay "open" setpoints range from 24 F to 52 F in 4-degree increments. (Minimum condenser relay open time is 2 minutes.)

The SCP monitors the refrigerant temperature differential of each operating chiller, and uses the unit with the lowest differential to determine whether additional cooling tower capacity is required. Keep in mind that, once enabled, the condenser limit function is active whenever any of the system's chillers are running in the powered cooling mode.

Note: Condenser limiting is disabled during free cooling operation, and when all of the chillers are off.

Figure 31
SCP Field Wiring Connections for Condenser Limit Control Option



Notes:

1. Dashed lines (—) indicate field wiring by others, while phantom (—— - ——) lines indicate available sales options.
2. All field wiring must be in accordance with the NEC, state and local requirements; other countries applicable national and/or local requirements shall apply.
3. Condenser limit control option is implemented and field-wired as required for a specific system application.
4. Condenser water temperature sensor (4533-1710-41C) is not required for condenser limiting function. If implemented, use 30-volt or less, 14-18 AWG, 600V wire; sensor leads must be shielded or run in conduit with other low-voltage (i.e., carrying 30 volts or less) conductors. See field wiring diagram shipped with SCP for recommended sensor conductor lengths. A 1/2" NPT coupling is required for the sensor well.
5. Wiring included with sensor(s) (4533-1710-43A); field connection required.
6. Shielded, twisted-pair; use 30-volt or less, 14-18 AWG, 600V wire. Maximum conductor length is 5,000 feet. Do not run in conduit with circuits greater than 30V!
7. Use 30-volt or less, 14-18 AWG, 600V wire, and do not run in conduit with circuits exceeding 30V. Silver contacts (or better) are required; do not use series contacts!

WARNING
Disconnect electrical power supply to prevent injury or death due to electrical shock.

Caution
Use copper conductors only to prevent equipment damage (unless otherwise specified).

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Maintenance and Trouble Analysis

Periodic Maintenance

Weekly Checks

[ ] Review the SCP's "SCHEDULE" and "DAY/TIME" program entries; in particular, check the holiday list and update it as necessary for the upcoming week. (For program setup instructions, see "Program Interface: 'Day/Time' Program" in the SCP699 Operator Interface section of this manual.)

Note: Remember that "DAY/TIME" holiday designations are temporary. A day tagged as a holiday one week will return to its normal operating schedule the following week unless the SCP is programmed otherwise.

[ ] Check the SCP's present clock/calendar readout; correct it, if necessary.

Monthly Checks

[ ] Complete the weekly program entry checks.

[ ] Visually inspect the panel for loose or damaged parts or wiring; also check for any accumulation of dirt or moisture.

[ ] Review the SCP's preformatted System (Status), Schedule, System (Control Parameters), and Chiller reports.

Power Failures

In the event of a power failure an electrical backup system (i.e., capacitor) prevents loss of operator-programmed entries for up to 7 days.

A 9-volt, alkaline, transistor-type battery (field-supplied), mounted within the SCP panel enclosure, backs up the control panel clock function for a maximum of 8 hours. Be sure to replace it after extended power outages, or once annually, to ensure that the internal clock function continues to reflect the present time.

If a power failure occurs and the battery is either dead or not installed, scheduled system operation will not occur at the desired intervals since the SCP's internal clock no longer reflects the actual time of day. (That is, when power is restored, the SCP's clock function--i.e., day and time--will resume operation from the point of power interruption.

Trouble Analysis

Error Detection

As explained under "Report Interface", the SCP is designed to detect and record each of the system-level diagnostic conditions listed below:

- AA System Leaving Water Temperature Sensor
- DF Communications Failure
- D9 Power Loss w/Program Retained
- EF Power Loss w/Program Lost
- FF System Control Module (i.e., SCP self-check indicates a malfunction.)

Its CenTraVac bidirectional communication link (BCL) also allows the SCP to detect abnormal chiller operations and record "latching" diagnostic information from the UCP695 chiller control panels. (See Table 5 in SCP699 Operator Interface.)

Detection of a system-level (other than "D9") or "latching" chiller-level diagnostic condition causes the SCP to flash its alphanumeric display and energize its alarm relay (i.e., unless generic BAS is enabled). The display will continue to blink--and the alarm relay remain energized--until the "Display System Report/Alarm Reset*" button is pressed.

Note: "Latching" chiller diagnostics are defined as abnormal unit operating conditions that prompt the chiller to shut down and require manual reset at the UCP695 control panel before the chiller can be restarted.

Chiller-level diagnostic conditions are determined and reported by the SCP based on the following criteria:

1. If any chiller fails to respond to 2 consecutive communication attempts, the SCP considers that chiller to be nonexistent. When this occurs, the SCP alarms this loss of chiller communication with a DF diagnostic.

2. Operating parameters from any chiller that fails to communicate are not included in any of the SCP's preformatted status report displays.

3. All "latching" unit diagnostic conditions are reported at the SCP.

Note: While "latching" unit diagnostics are reported at the SCP when the generic BAS option is enabled, they are not alarmed.

If the chiller reports that the error or diagnostic condition no longer exists, the SCP considers it to be ready to operate.

The last entry of the System (Status) Report advises the most recent diagnostic condition detected and recorded by the SCP at the system or chiller level.

Once a system diagnostic is alarmed, it is important to remember that the SCP will not record a subsequent system error until the "Display System Report/Alarm Reset*" button is pressed.

Further, the SCP will not alarm a diagnostic condition with an error code that is the same as the last error code recorded. For example, if the last diagnostic code recorded in the SCP's memory is "DF" (i.e., communications failure)--and the SCP detects another communications failure, it will neither flash its display nor energize its alarm relay.

However, notice that the original "DF" error code will remain in the system status report either until: (1) another, different diagnostic (e.g., D9/power loss w/program retained) is detected and recorded; or, (2) the diagnostic register is cleared.

To remove the last recorded diagnostic code from the SCP's memory, simply press the "Display System Report/Alarm Reset*" key and hold it down while the system status report is displayed. After the "SYSTEM (and each UNIT) DIAG = " entry appears, the SCP generates a "CLEARED" message. (The current system operating status then returns to the display.)

Note: For your reference, a label listing the condition codes for system and unit diagnostics is affixed to the side of the SCP panel enclosure.

Keep in mind that the SCP will not be able to start a chiller if:

1. that particular unit is presently in a "latching" diagnostic mode. (In this situation, the SCP will attempt to start the next chiller in the start-up rotation order.)

2. that unit remains in a "nonlatching" diagnostic mode (i.e., b d9, b E2, b Ed or b F7; see Table 5) for 10 minutes. (At the end of this period, the SCP will attempt to start the next chiller in the start-up rotation order.)

3. that unit is in the restart inhibit mode (A 70). (The SCP will wait for the restart inhibit period to elapse rather than attempt to start the next chiller.)

Troubleshooting Charts

Note: Troubleshooting charts are provided solely as a guide for determining the cause of a mechanical failure or equipment malfunction. When operational problems do occur, be sure to contact a qualified service organization to ensure proper diagnosis and equipment repair.

Organization of the following troubleshooting chart is based on the possible 2-character system diagnostic condition codes that may be alarmed and displayed in the SCP's System (Status) Report at one time or another. Notice that these codes are arranged alphabetically, and that each is followed by a brief description of the diagnostic condition represented, along with the suggested action(s) for correcting the problem.

Note: When the SCP is "powered up", the "READY" system status message should appear on the alphanumeric display for at least 40 seconds unless a key is pressed. If any other message appears (e.g., "BAD RAM", "BAD ROM", "BAD MICRO", etc.), contact a qualified service technician.

Troubleshooting charts for chiller-level diagnostic conditions are included in the operation/maintenance manual that shipped with each CenTraVac unit. However, in the event that a chiller does not seem to function properly, always:

1. Ensure that the chiller switch (on the UCP695 control panel) is set at "Auto/Remote".

2. Check the SCP's chiller report for that unit. (This will verify that the unit is in communication with the SCP.)

3. Program manual unit chilled water and current limit setpoints at the SCP. (Use the SCP's "CHILLER" program menu.)

To verify that these commands were received at the UCP695 panel, check the UCP's status indicator lights when each setpoint is displayed at the UCP. If the setpoints were received, the "Remote Chilled Water Setpoint" and "Remote Current Limit Setpoint" lights should illuminate. (The pump relay(s) should then energize, and the unit should start.)

4. Single-Chiller System Applications Only. If the SCP's system leaving chilled water temperature sensor is not installed, verify that the chiller's address is "1". (See "UCP695 DIP Switch Setup" in the Start-Up section of this manual.)

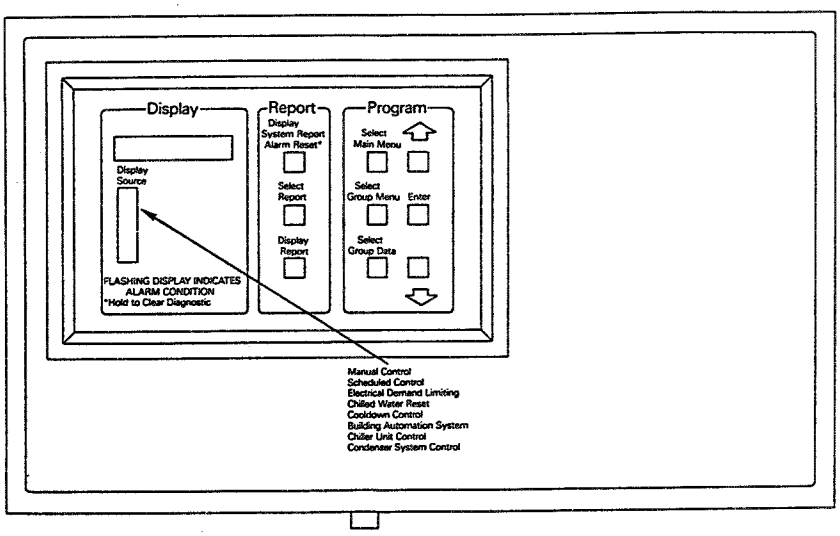
WARNING: To prevent injury or death due to electrical shock, lock power supply disconnect open before removing SCP panel enclosure. It may be necessary to open several disconnects to remove all connected power from the SCP.

Troubleshooting Chart

Code	System Diagnostic Description	Recommended Action
AA	System Leaving Chilled Water Temperature Sensor	Contact a qualified service oganization; or, Check sensor connections at: (1) SCP Terminals TB2-3 and TB2-4; (2) sensor; and (3) intermediate points for open, shorted or loose connections. Repair wiring connections or replace sensor, as necessary. Note: This diagnostic only occurs if more than 1 chiller is connected to the SCP.
DF	Communications Failure	**WARNING: To prevent injury or death due to electrical shock, lock power supply disconnect open before removing SCP panel enclosure. It may be necessary to open several disconnects to remove all connected power from the SCP.** Secure all chillers, chilled water pumps, and connected equipment. Remove power from the UCP695 chiller control panels; then disconnect power from the SCP. Wait 1 minute; then restore power to the SCP and UCP695 control panels. If the "DF" diagnostic persists, contact a qualified service organization.
D9	Power Loss w/Program Retained	Clear the diagnostic. If the cumulative length of power outages exceeds 6 hours, replace the battery backup. Note: The battery's charge is depleted with each successive power loss; it is not recharged when power is restored to the SCP.
EF	Power Loss w/Program Lost	Clear the diagnostic and reprogram the SCP.
FF	System Control Module	**WARNING: To prevent injury or death due to electrical shock, lock power supply disconnect open before removing SCP panel enclosure. It may be necessary to open several disconnects to remove all connected power from the SCP.** Secure all chillers, chilled water pumps, and connected equipment. Remove power from the UCP695 chiller control panels; then disconnect power from the SCP. Wait 1 minute; then restore power to the SCP and UCP695 control panels. If the "FF" diagnostic persists, contact a qualified service organization.

Note: This troubleshooting chart is provided solely as a guide for determining the cause of a mechanical failure or equipment malfunction. When operational problems do occur, contact a qualified service organization to ensure proper diagnosis and equipment repair.

SCP Operator Reference Guide



RF/CTV-1902B

Preformatted SCP Reports

DISPLAY SYSTEM REPORT/ALARM RESET*

SYSTEM (STATUS) REPORT
(Ref. pp. 12-16)

[ ] SYSTEM
CHLD. WTR.
TEMP =
SET =

[ ] CURRENT
LOAD =
LIM =

[ ] COND. SYS.
TEMP =

[ ] SYSTEM
DIAG =

[ ] UNIT 1
DIAG =

[ ] UNIT 2
DIAG =

[ ] UNIT 3
DIAG =

SELECT REPORT

SCHEDULE REPORT
(Ref. p. 16)

DAY/TIME REPORT
(Ref. p. 16)

SYSTEM REPORT
(CONTROL PARAMETERS)
(Ref. pp. 16, 17)

CHILLER REPORT
(Ref. 17-19)

DISPLAY REPORT

[ ] MON
[ ] SET =
[ ] BGN =
[ ] END =
[ ] ELSE =

[ ] THU 13.56

[ ] CHLD. WTR.
SET =

[ ] CURRENT
LIM =

[ ] FREECOOL
SET =
TEMP =

[ ] EL. DEMAND
LOAD =
LIM =

[ ] RESET
TEMP =

[ ] COOLDOWN
LIM =

[ ] COND. SYS.
TEMP =
HEAD =

[ ] UNIT 1
MODE =
CHLD. WTR.
TEMP =
SET =
CURRENT
LOAD =
LIM =
(HT. RCVRY)

[ ] UNIT 2
MODE =
CHLD. WTR.
TEMP =
SET =
CURRENT
LOAD =
LIM =
(HT. RCVRY)

[ ] UNIT 3
MODE =
CHLD. WTR.
TEMP =
SET =
CURRENT
LOAD =
LIM =
(HT. RCVRY)

[ ] UNIT SEQ.
UNIT 2
UNIT 3
UNIT 1

Note: System and unit diagnostic code conditions are listed on a label affixed to the right-hand side of the SCP699 System Control Panel.

SCP Programming Aid

Use right-hand column to record SCP program entries for your chiller system application.

Press "Select Main Menu"	Press "Select Group Menu"	Press "Select Group Data"	Range of Available Control Settings	Operator Entry
SCHEDULE (Ref. pp. 21,22)	MON., TUE., WED., THU., FRI., SAT., SUN., HOL.	SET = (Chilled Water Setpoint)	OFF*, MON.-HOL., 1-99 F	MON. ____ FRI. ____ TUE. ____ SAT. ____ WED. ____ SUN. ____ THU. ____ HOL. ____
		BGN = (Scheduled Begin Time)	00:00*-23:45	MON. ____ FRI. ____ TUE. ____ SAT. ____ WED. ____ SUN. ____ THU. ____ HOL. ____
		END = (Scheduled End Time)	00:00*-23:45	MON. ____ FRI. ____ TUE. ____ SAT. ____ WED. ____ SUN. ____ THU. ____ HOL. ____
		ELSE = (Alternative Chilled Water Setpoint)	OFF*, 1-99 F	MON. ____ FRI. ____ TUE. ____ SAT. ____ WED. ____ SUN. ____ THU. ____ HOL. ____
DAY/TIME (Ref. pp. 22-24)	HOLIDAY	MON. (Monday)	= HOL.; ,NO*	
		TUE. (Tuesday)	= HOL.; ,NO*	
		WED. (Wednesday)	= HOL.; ,NO*	
		THU. (Thursday)	= HOL.; ,NO*	
		FRI. (Friday)	= HOL.; ,NO*	
		SAT. (Saturday)	= HOL.; ,NO*	
		SUN. (Sunday)	= HOL.; ,NO*	
	Present Day/Time	Day	MON.*-SUN.	
		Hours	00*-23	
		Minutes	00*-59	
SYSTEM (Ref. pp. 24-28)	CHLD. WTR.	SET = (Lvg. Chilled Water Temp.)	AUTO*, OFF, 1-99 F	
	CURRENT	LIM. = (System Current Limit)	AUTO*, 0-100%	
	FREECOOL (T'stat-controlled, automatic FC option)	SET = (Auto FC Sensor Temp.)	ON, AUTO, OFF*, 0-140 F	
		SET = (FC Chilled Water Setpoint)	1*-99 F	
	EL. DEMAND	LIM. = (System Current Limit)	0*, 1-100%	
		RATE = (Meter Pulse Program Constant)	0*-99	
	RESET (Chilled Water)	RATE = (CWR Reset Rate)	0*, 1-199%	
		SET = (CWR Setpoint Temp.)	0 F*, 1-140 F	
	COOLDOWN	LIM. = (System Current Limit)	0*, 1-100%	
		END = (Duration of Cooldown and Automatic Free Cooling)	00.00*-02.00	
	CONTROL	GAIN = (SCP Responsiveness to Cooling Requirement Changes)	1*-100	
CHILLER (Ref. pp. 28-30)	UNIT 1, UNIT 2, UNIT 3	SET = (Lvg. Chilled Water Temp.)	AUTO*, OFF, 1-99 F	Unit 1 ____ Unit 2 ____ Unit 3 ____
		LIM. = (% of Compressor RLA)	AUTO*, 0-100%	Unit 1 ____ Unit 2 ____ Unit 3 ____
		SET = (Order in Unit Start Rotation)	1*, 2, 3	Unit 1 ____ Unit 2 ____ Unit 3 ____
		LOAD = (Unit capacity--% of total)	1*-100%	Unit 1 ____ Unit 2 ____ Unit 3 ____
	UNIT SEQ.	RATE = (Rotation Period for Chiller Start Order)	0*-100 days	
		LOAD = (% of Compressor RLA)	20*-100%	
		LIM. = (% of Compressor RLA; Unit Seq. Load > Unit Seq. Limit + 20)	0*-80%	

Note: Asterisked control setting values indicate the SCP's default settings.

SCP "Configuration" Switch Settings

Check the appropriate box to record DIP switch settings. (Table 1, on page 7, defines DIP switch positions.)

Pump Relay Command
[ ] On [ ] Off DIP Switch No. 1

Alarm Relay
[ ] On [ ] Off DIP Switch No. 2

Degrees F/C Display
[ ] On [ ] Off DIP Switch No. 3

Chilled Water Reset
[ ] On [ ] Off DIP Switch No. 4

SCP Address
[ ] On [ ] Off DIP Switch No. 5
[ ] On [ ] Off DIP Switch No. 6
[ ] On [ ] Off DIP Switch No. 7
[ ] On [ ] Off DIP Switch No. 8
[ ] On [ ] Off DIP Switch No. 9

Not Used
[ ] On [ ] Off DIP Switch No. 10

Auxiliary DIP Switch Settings (Optional Sideboard)

Opt. Condenser Limit Control
[ ] On [ ] Off DIP Switch No. 1

Opt. Generic BAS Interface
[ ] On [ ] Off DIP Switch No. 2

For further information on this product or other Trane products, refer to the "Trane Service Literature Catalog", ordering number IDX-IOM-1. This catalog contains listings and prices for all service literature sold by Trane. The catalog may be ordered by sending a $20.00 check to: The Trane Company, Service Literature Sales, 3600 Pammel Creek Road, La Crosse, WI 54601.

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