CHAPTER 4

APPLICATION OF ENERGY CONSERVING TECHNIQUES

4-1. General

The programs described in chapter 3 can be applied to existing or new systems. Most of these programs may be applied to several types of systems, but others may only be applicable to special types of systems. For example, the boiler selection program is only applicable to facilities with multiple boiler plants. Due to the interactive nature of the programs, the inputs and/or output of one implemented program may provide inputs to other programs to be implemented.

4-2. Instruments and inputs

Certain instruments and inputs can be common to the entire EMCS system. OA dry bulb, OA relative humidity, electrical consumption, and demand instrumentation do not need to be duplicated except in special cases, such as when an EMCS serves an extremely large geographical area, or when a FID is located several miles away. The minimum requirement is one OA temperature and one RH instrument for the entire EMCS. However, the designer may need to increase the minimum requirements to satisfy site specific requirements. For example, separate OA instruments will be specified at each FID where stand-alone applications programs such as economizers are required. Outside air instruments will also be furnished where intake temperatures of the OA measured on a roof mounted unit may vary significantly from the MCR location, causing erroneous economizer calculations.

4-3. Diagrams

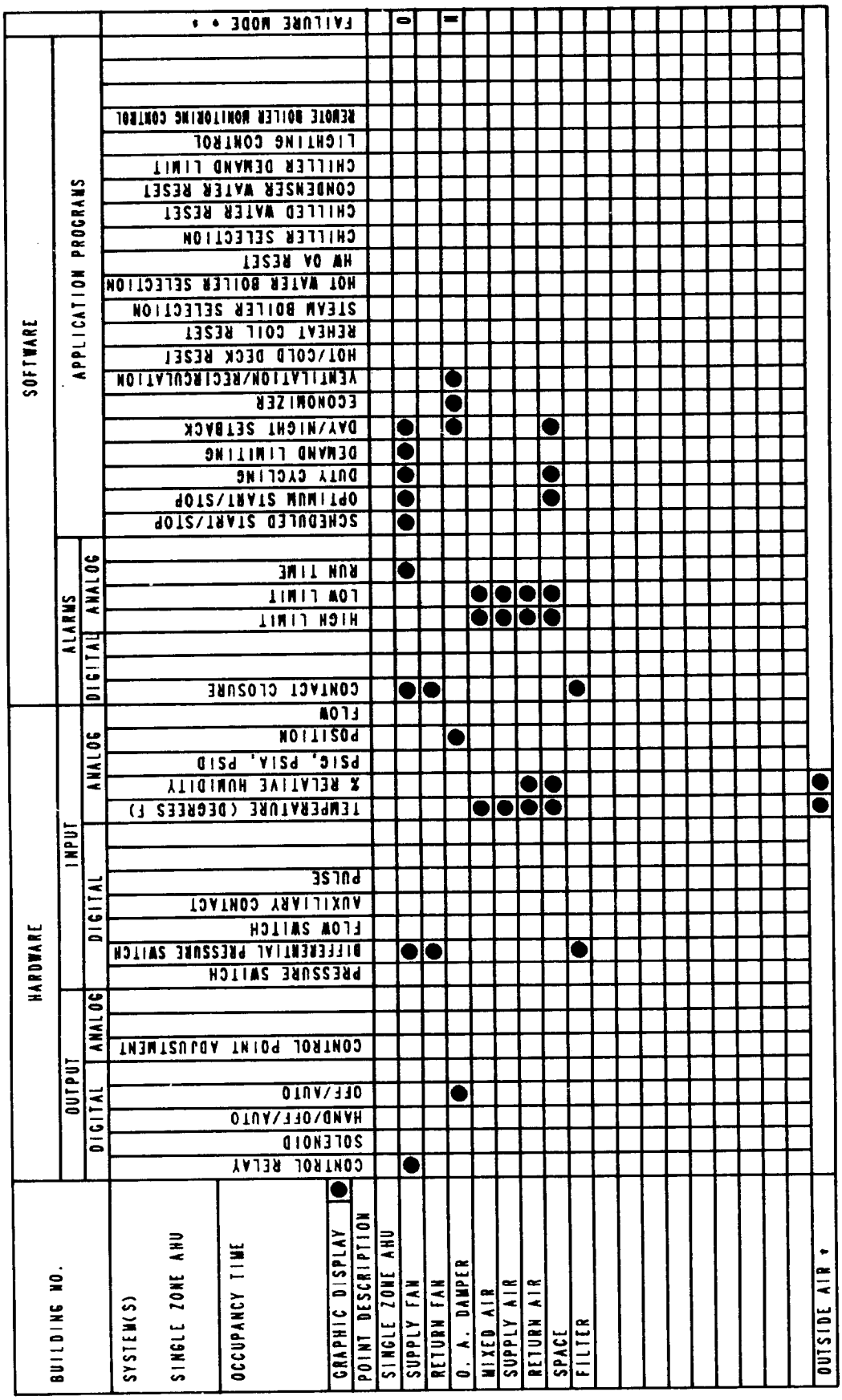
Graphic diagrams of typical systems showing EMCS devices and locations are in figures 4-1 through 4-29.

4-4. Tables

I/O summary tables listing EMCS hardware and software applied to typical systems are in tables 4-1 through 4-29. The designer will generate a separate I/O summary table for each system to be controlled or monitored by the EMCS. Two or more identical systems within the same building, having the same occupancy schedule, may be listed on the same I/O summary table. The table's contents will be tailored to the system being controlled for each specific application. Failure modes will be defined by the designer for each system's controlled devices in the event of a FID/MUX malfunction. Failure modes will be based on climate, type of system, and user requirements. The failure modes shown are random selections for example purposes only.

4-5. Symbols and abbreviations

A listing of symbols and abbreviations used in the system schematics is in table 4-30.



* ONE MEASUREMENT FOR ENTIRE SYSTEM
* * C - LAST COMMAND O - ON (OPEN)
H - HIGH VALUE F - OFF (CLOSED)
L - LOW VALUE N - LOCAL LOOP

Table 4-1. I/O summary table for single zone AHU.

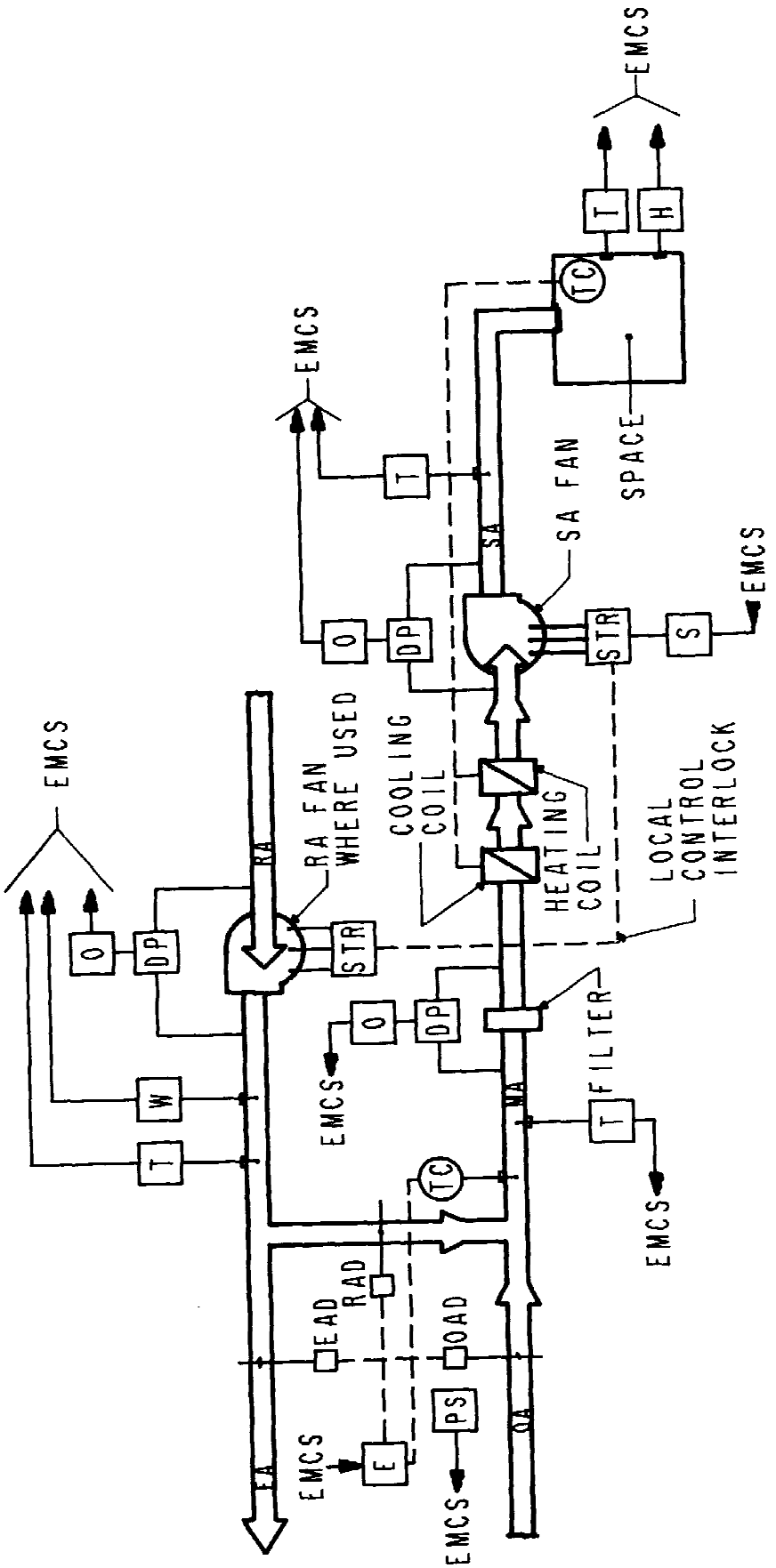
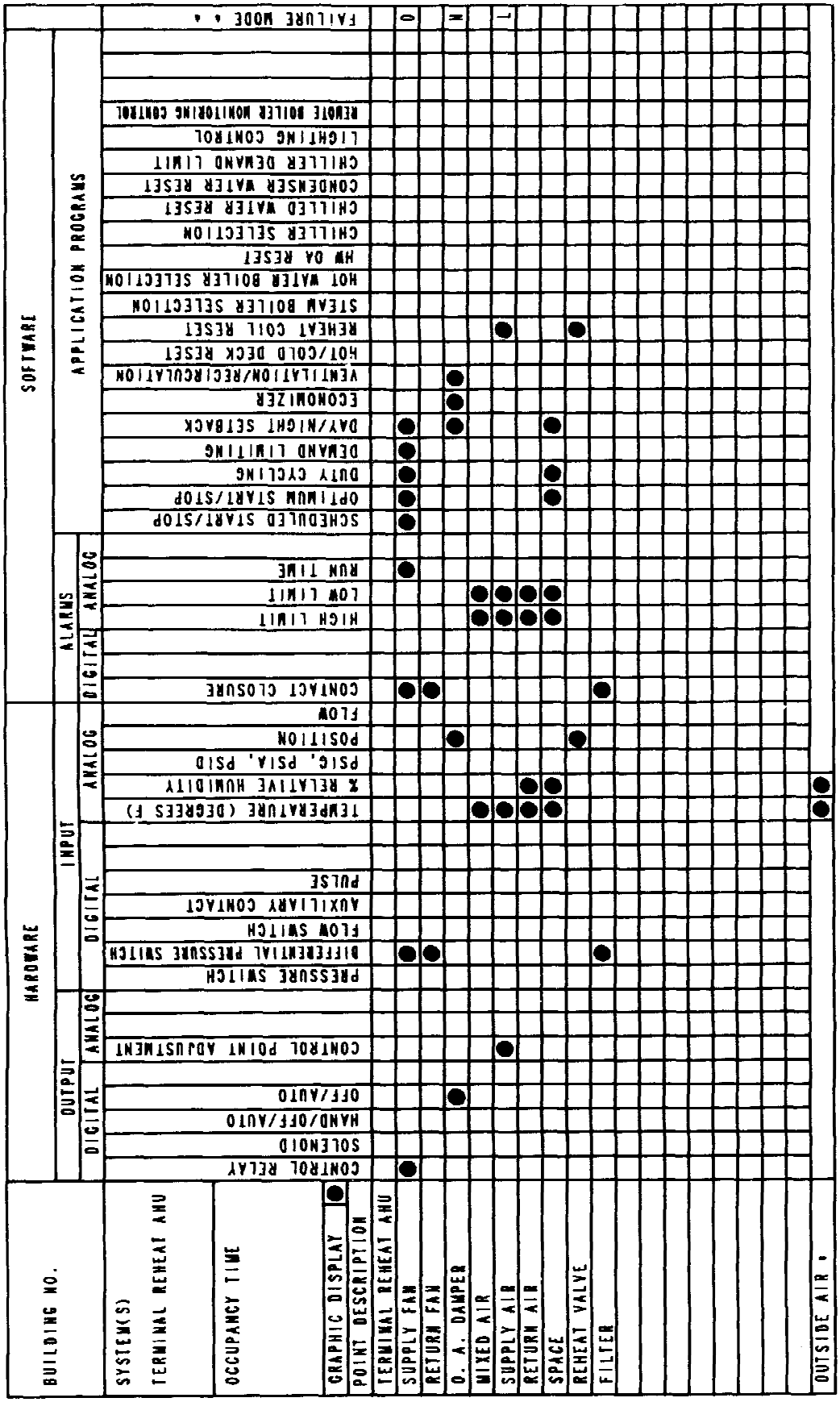


Figure 4-1. Single zone AHU schematic.



* ONE MEASUREMENT FOR ENTIRE SYSTEM
* * C - LAST COMMAND O - ON (OPEN)
H - HIGH VALUE F - OFF (CLOSED)
L - LOW VALUE N - LOCAL LOOP

Table 4-2. I/O summary table for terminal reheat AHU.

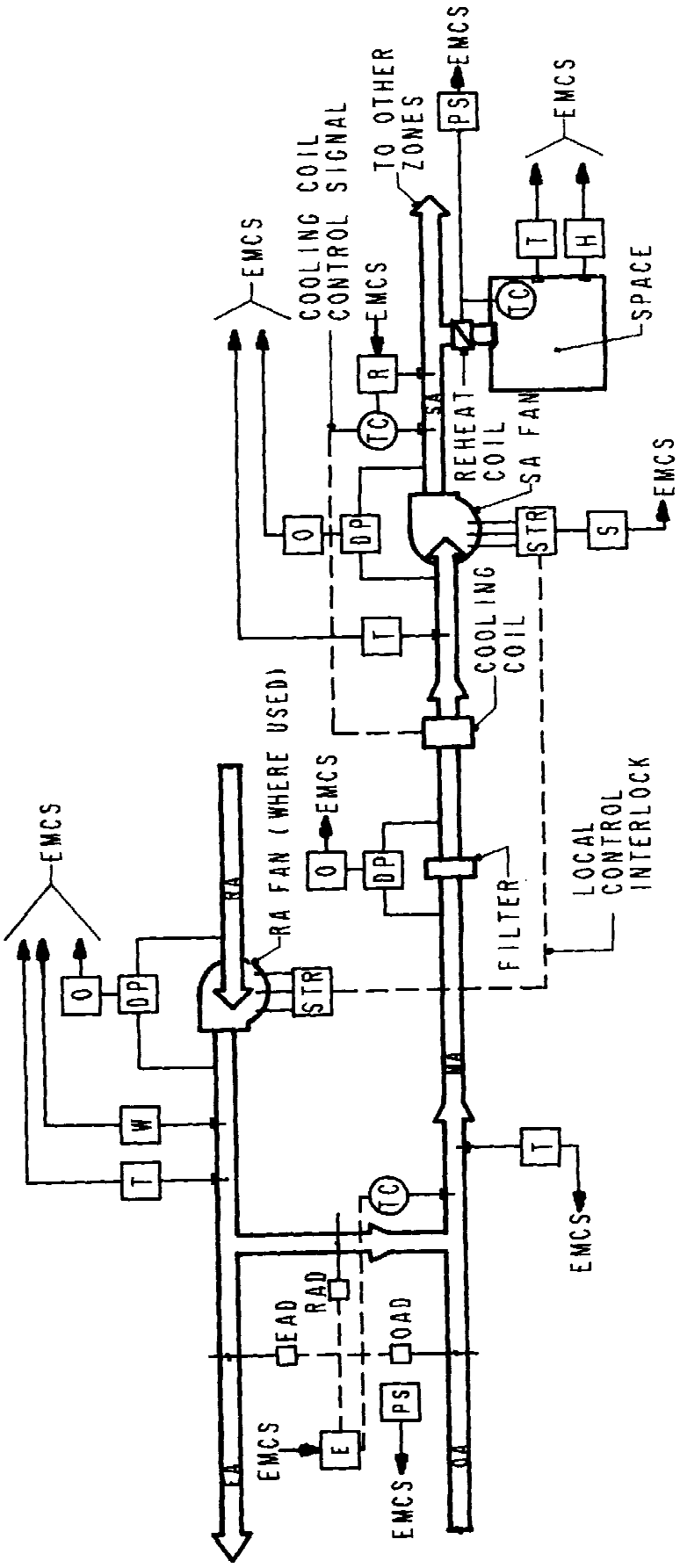
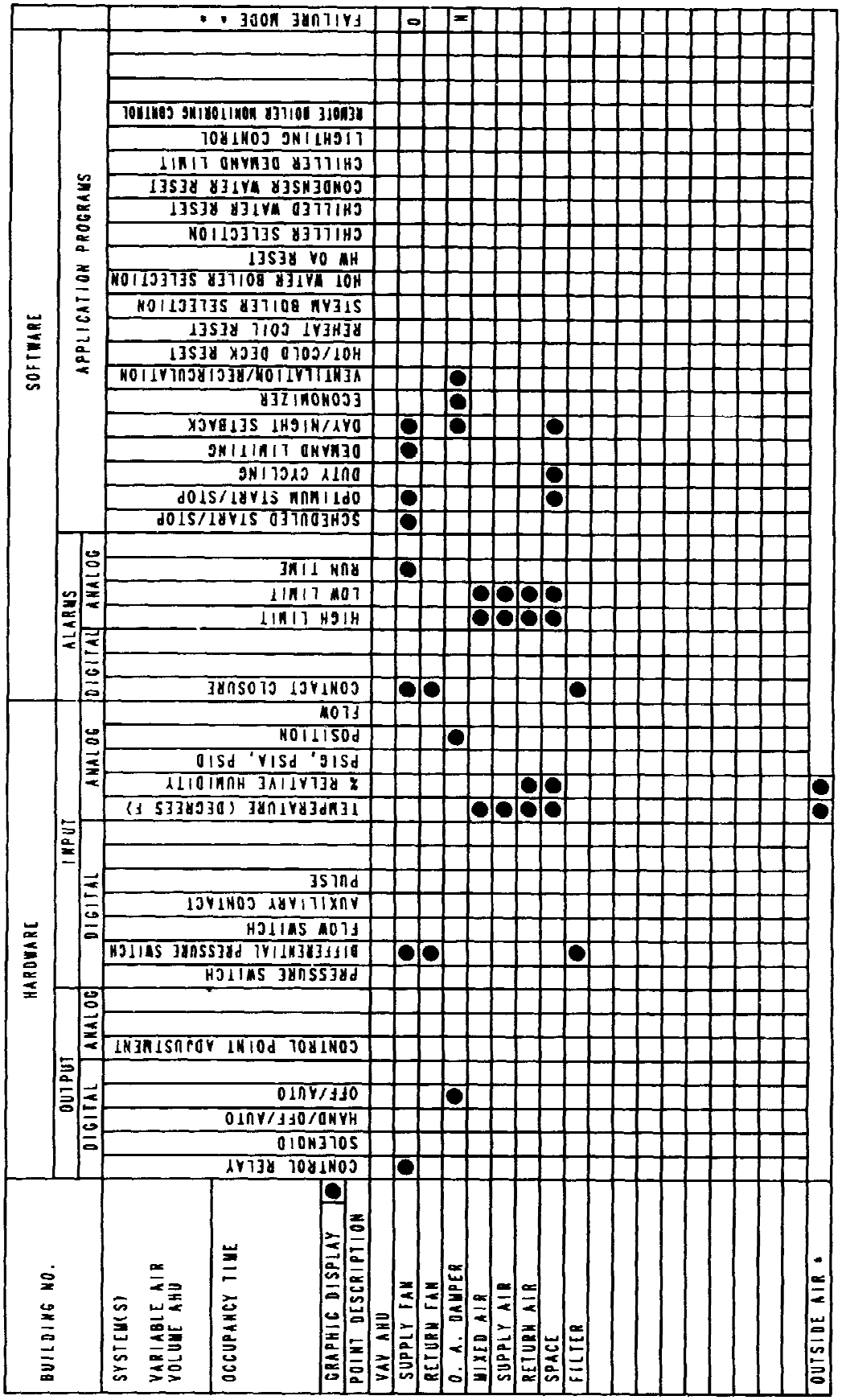


Figure 4-2. Terminal reheat AHU schematic.



* ONE MEASUREMENT FOR ENTIRE SYSTEM
* * C – LAST COMMAND O – ON (OPEN)
H – HIGH VALUE F – OFF (CLOSED)
L – LOW VALUE M – LOCAL LOOP

Table 4-3. I/O summary table for variable air volume AHU.

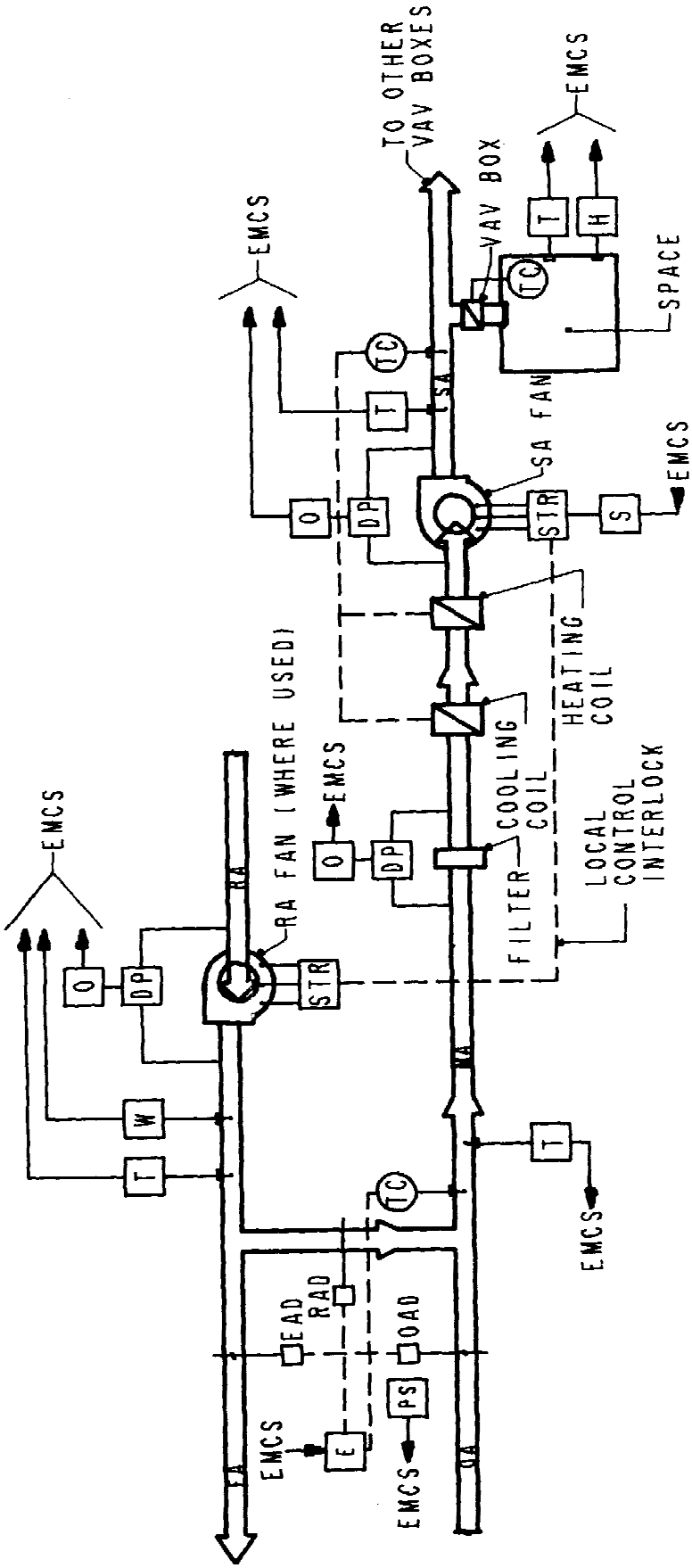
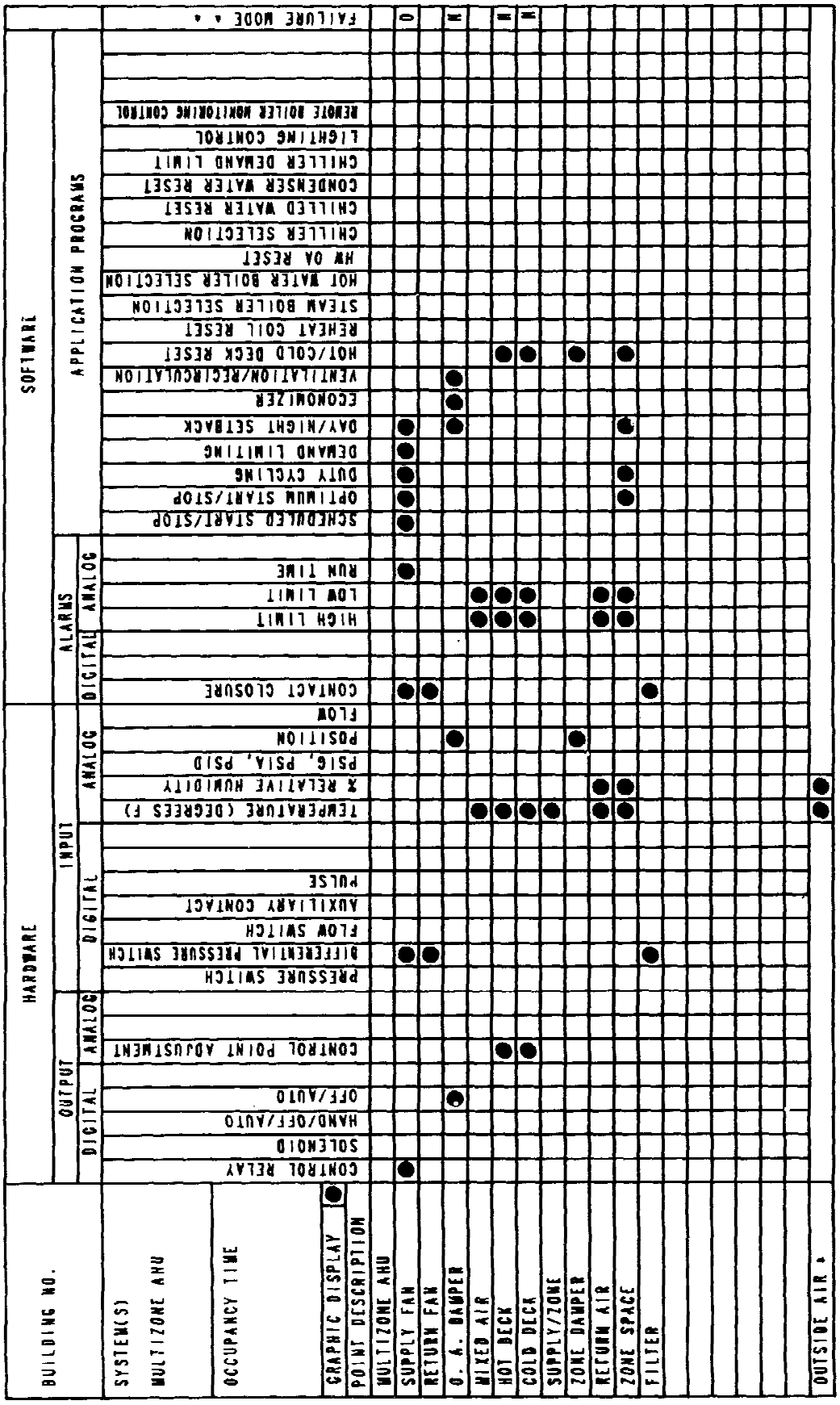


Figure 4-3. Variable air volume AHU schematic.



* ONE MEASUREMENT FOR ENTIRE SYSTEM
* * C - LAST COMMAND O - ON (OPEN)
H - HIGH VALUE F - OFF (CLOSED)
L - LOW VALUE M - LOCAL LOOP

Table 4-4. I/O summary table for multizone AHU.

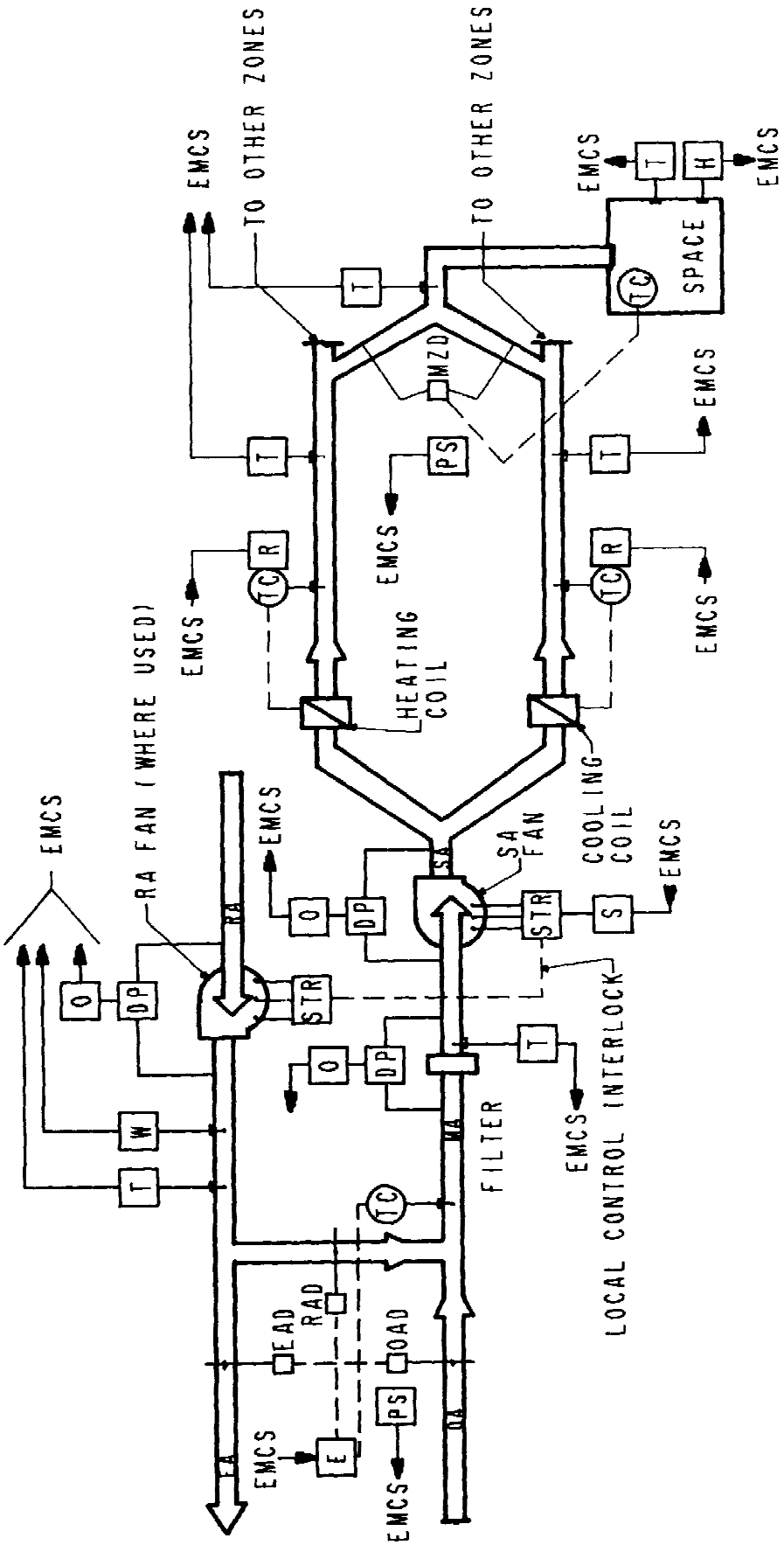


Figure 4-4. Multizone AHU schematic.

BUILDING NO.	HARDWARE																				SOFTWARE																												
SYSTEM(S) SINGLE ZONE DX AHU	OUTPUT								INPUT												ALARMS							APPLICATION PROGRAMS																					
OCCUPANCY TIME	DIGITAL					ANALOG			DIGITAL							ANALOG					DIGITAL			ANALOG																							
GRAPHIC DISPLAY ● / POINT DESCRIPTION	CONTROL RELAY	SOLENOID	HAND/OFF/AUTO	OFF/AUTO		CONTROL POINT ADJUSTMENT			PRESSURE SWITCH	DIFFERENTIAL PRESSURE SWITCH	FLOW SWITCH	AUXILIARY CONTACT	PULSE			TEMPERATURE (DEGREES F)	% RELATIVE HUMIDITY	PSIG, PSIA, PSID	POSITION	FLOW	CONTACT CLOSURE			HIGH LIMIT	LOW LIMIT	RUN TIME		SCHEDULED START/STOP	OPTIMUM START/STOP	DUTY CYCLING	DEMAND LIMITING	DAY/NIGHT SETBACK	ECONOMIZER	VENTILATION/RECIRCULATION	HOT/COLD DECK RESET	REHEAT COIL RESET	STEAM BOILER SELECTION	HOT WATER BOILER SELECTION	HW OA RESET	CHILLER SELECTION	CHILLED WATER RESET	CONDENSER WATER RESET	CHILLER DEMAND LIMIT	LIGHTING CONTROL	REMOTE BOILER MONITORING CONTROL				FAILURE MODE * *
SINGLE ZONE DX AHU																																																	
SUPPLY FAN	●									●											●					●		●	●	●	●	●																		0
RETURN FAN										●											●																													
O. A. DAMPER				●															●													●	●	●																N
MIXED AIR																●								●	●																									
SUPPLY AIR																●								●	●																									
RETURN AIR																●	●							●	●																									
SPACE																●	●							●	●				●	●		●																		
FILTER										●											●																													
OUTSIDE AIR *																●	●																																

* ONE MEASUREMENT FOR ENTIRE SYSTEM
* * C - LAST COMMAND O - ON (OPEN)
H - HIGH VALUE F - OFF (CLOSED)
L - LOW VALUE N - LOCAL LOOP

Table 4-5. I/O summary table for single zone DX-AC unit.

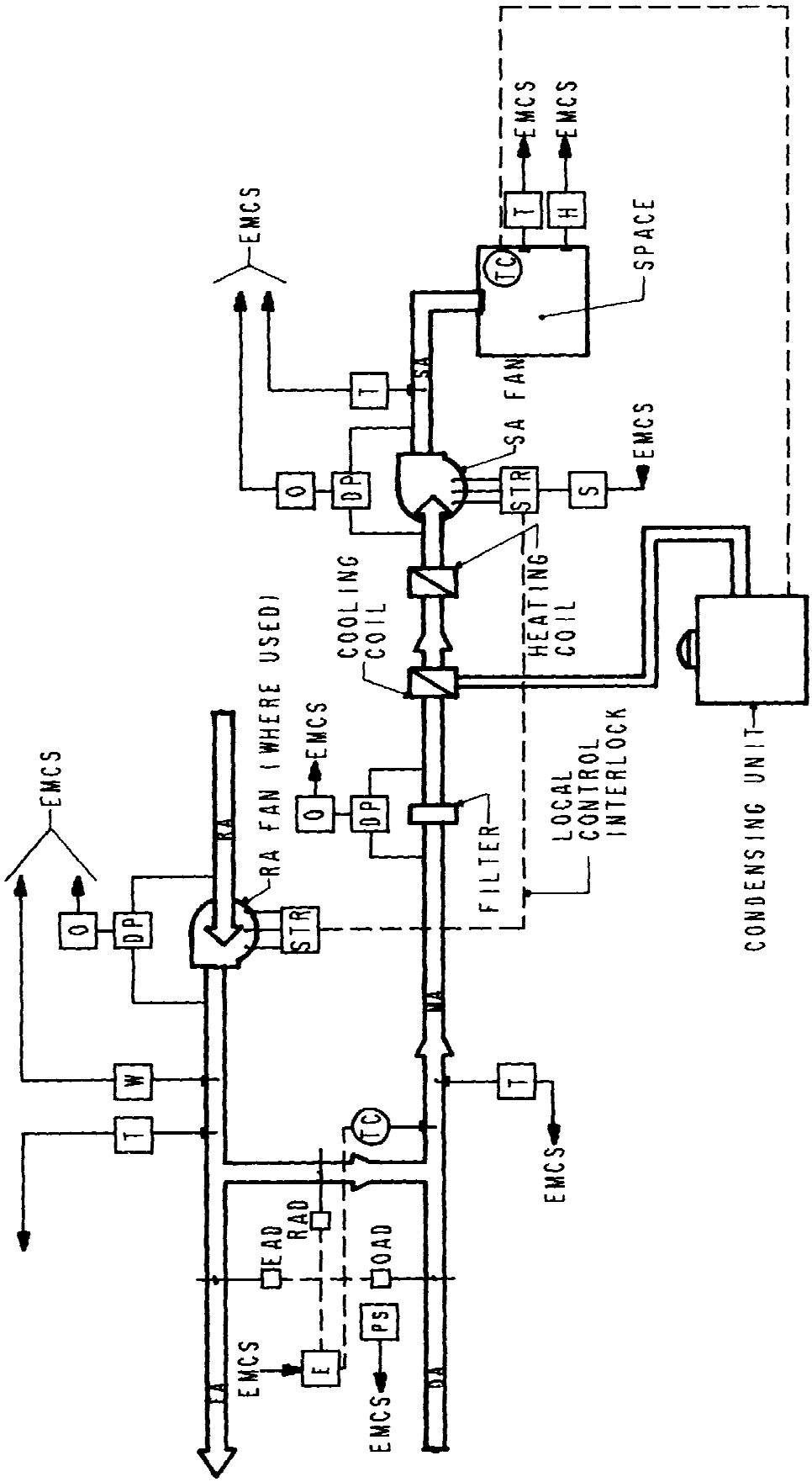


Figure 4-5. Single zone DX-AC unit schematic.

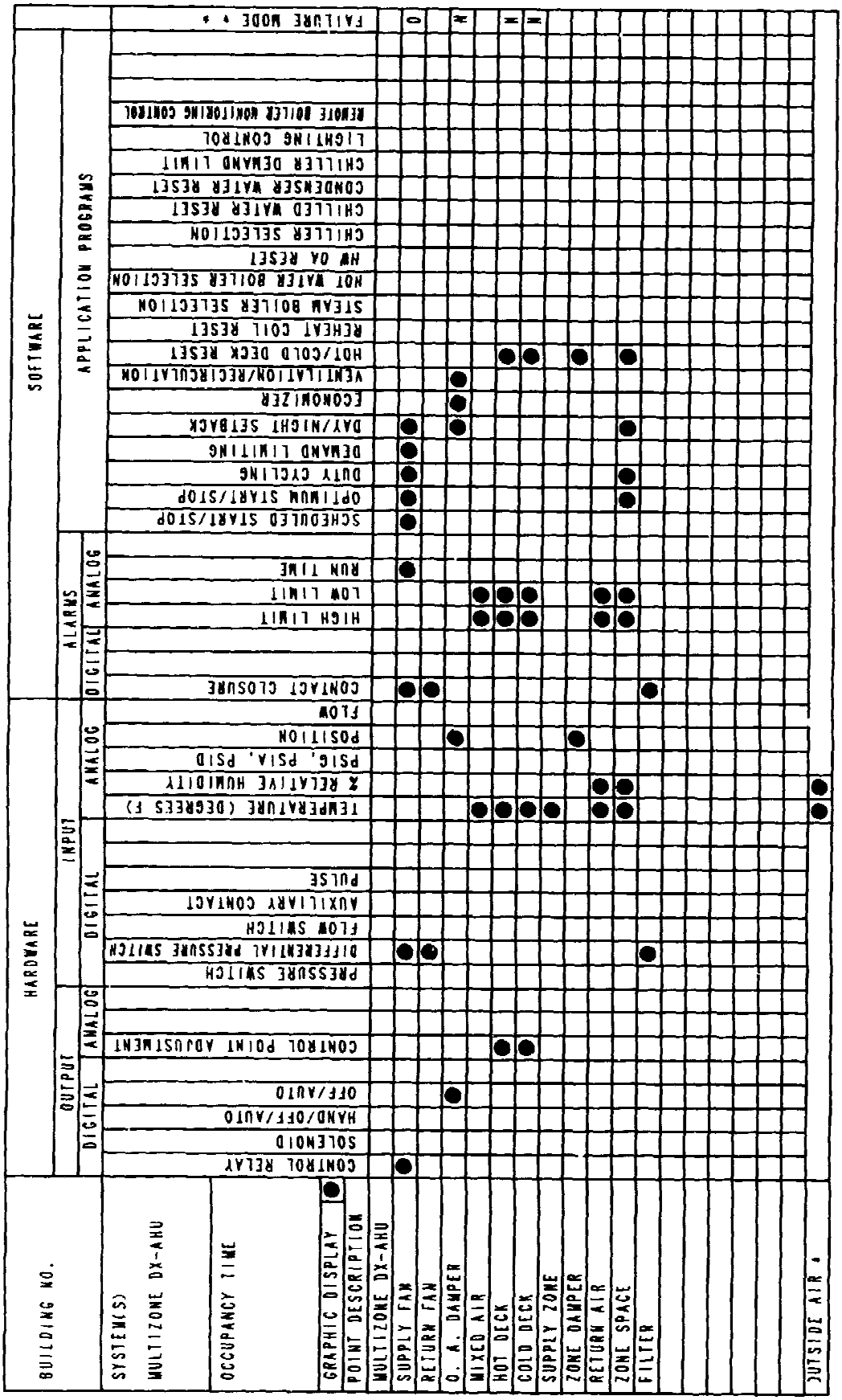


Table 4-6. I/O summary table for multizone DX-AC unit.

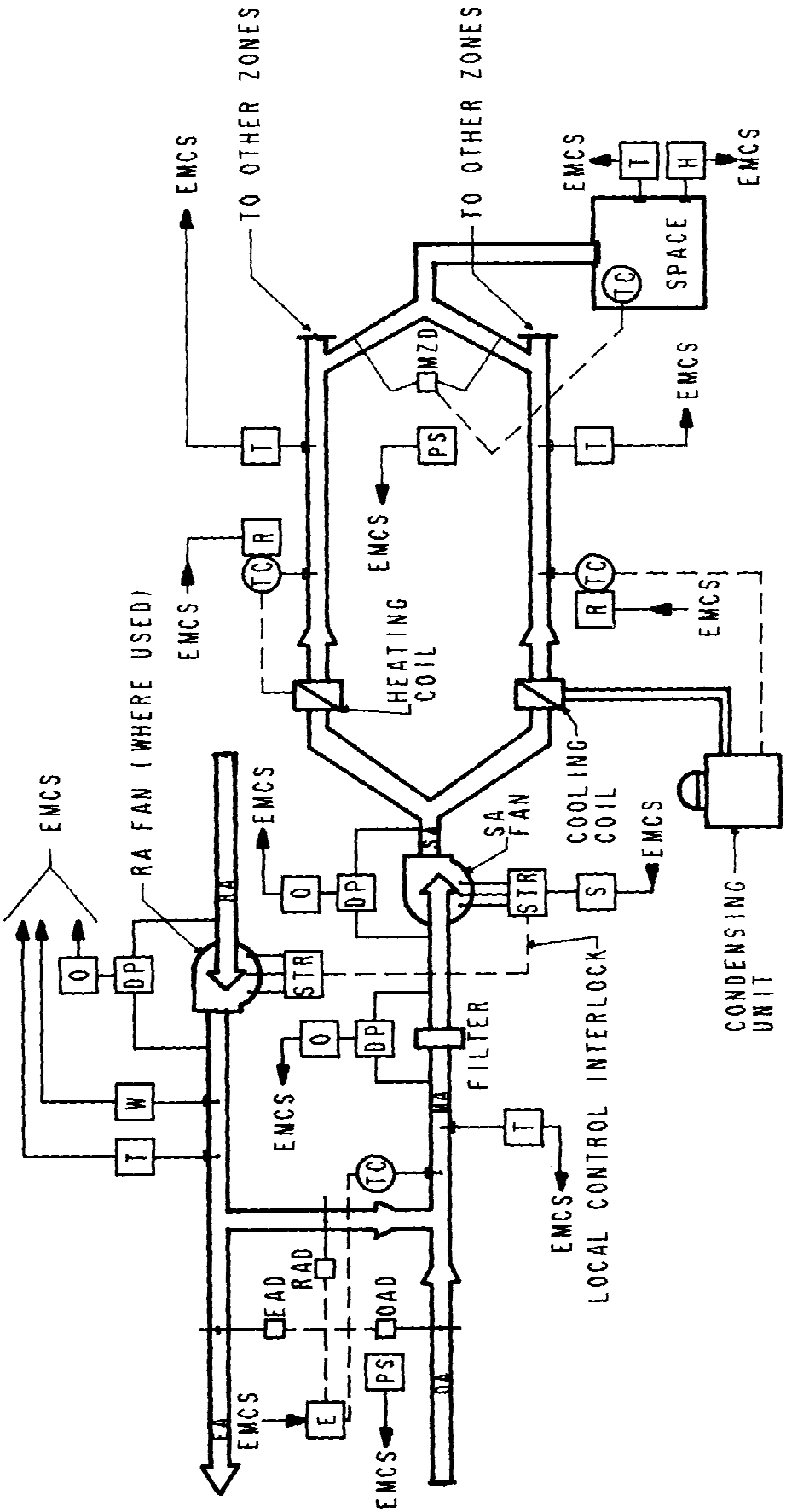
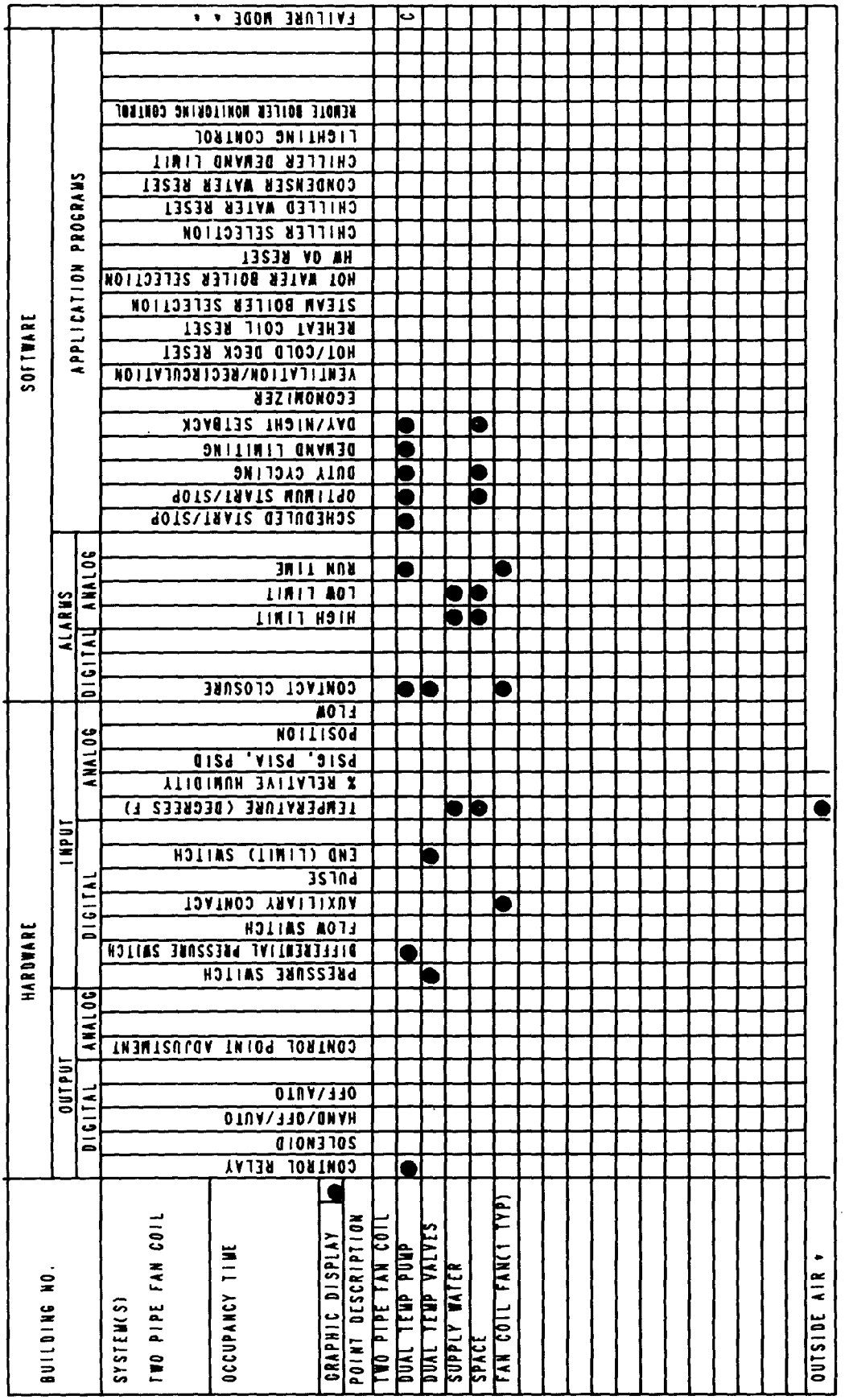


Figure 4–6. Multizone DX–AC unit schematic.



* ONE MEASUREMENT FOR ENTIRE SYSTEM
* * C - LAST COMMAND O - ON (OPEN)
H - HIGH VALUE F - OFF (CLOSED)
L - LOW VALUE M - LOCAL LOOP

Table 4-7. I/O summary table for two pipe fan coil system.

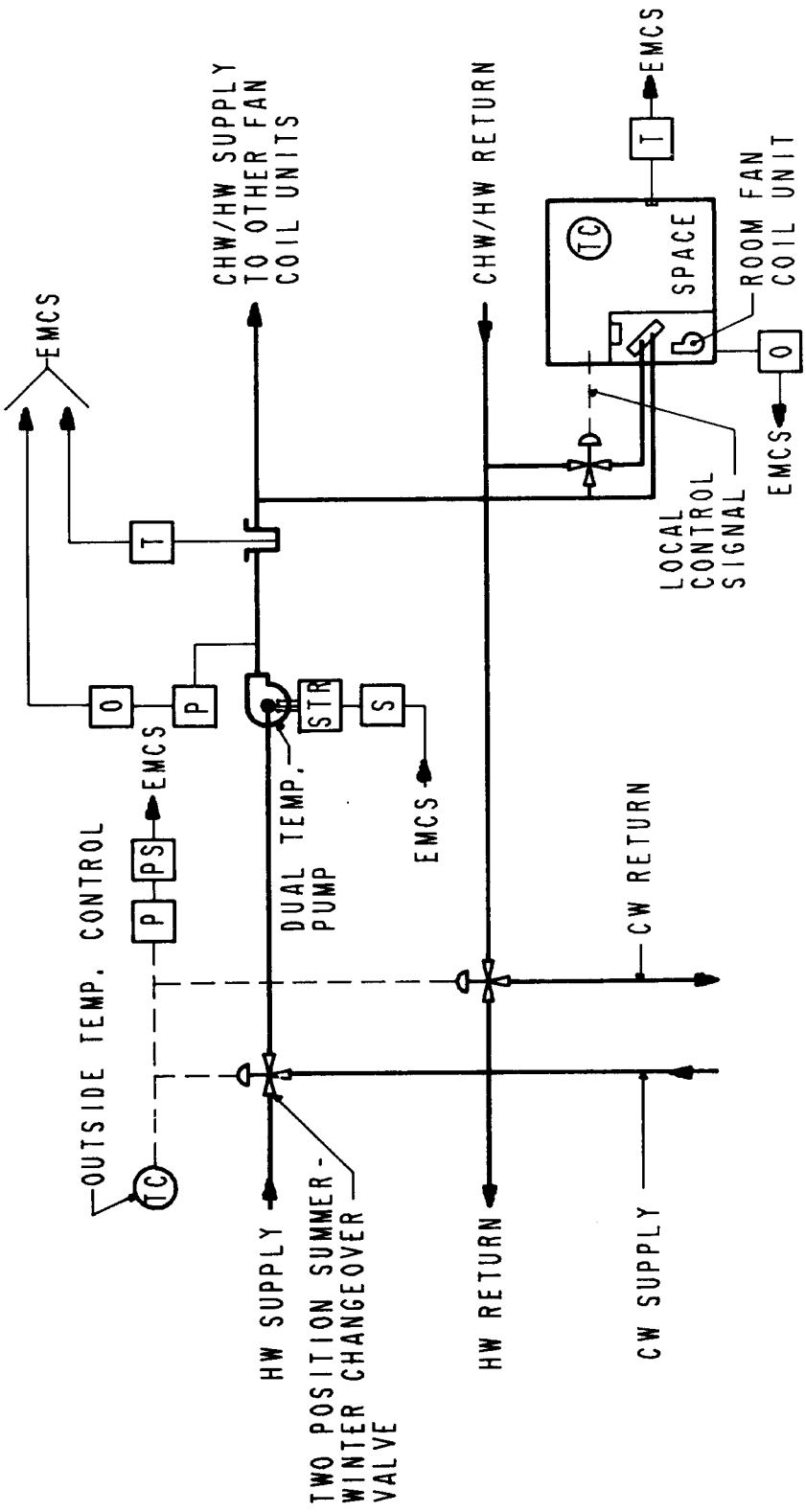
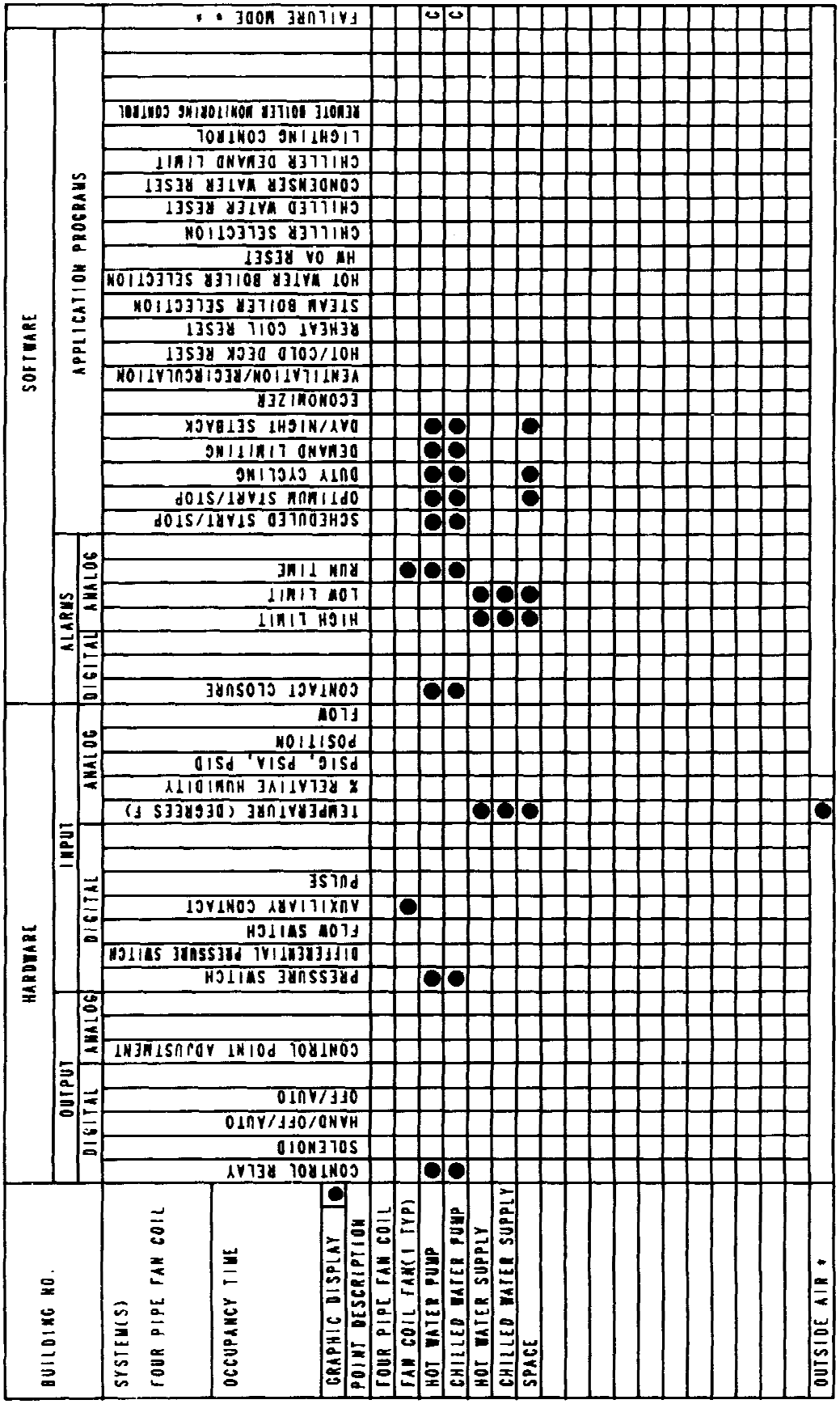


Figure 4–7. Two pipe fan coil schematic.



* ONE MEASUREMENT FOR ENTIRE SYSTEM
* * C - LAST COMMAND O - ON (OPEN)
H - HIGH VALUE F - OFF (CLOSED)
L - LOW VALUE M - LOCAL LOOP

Table 4-8. I/O summary table for four pipe fan coil system.

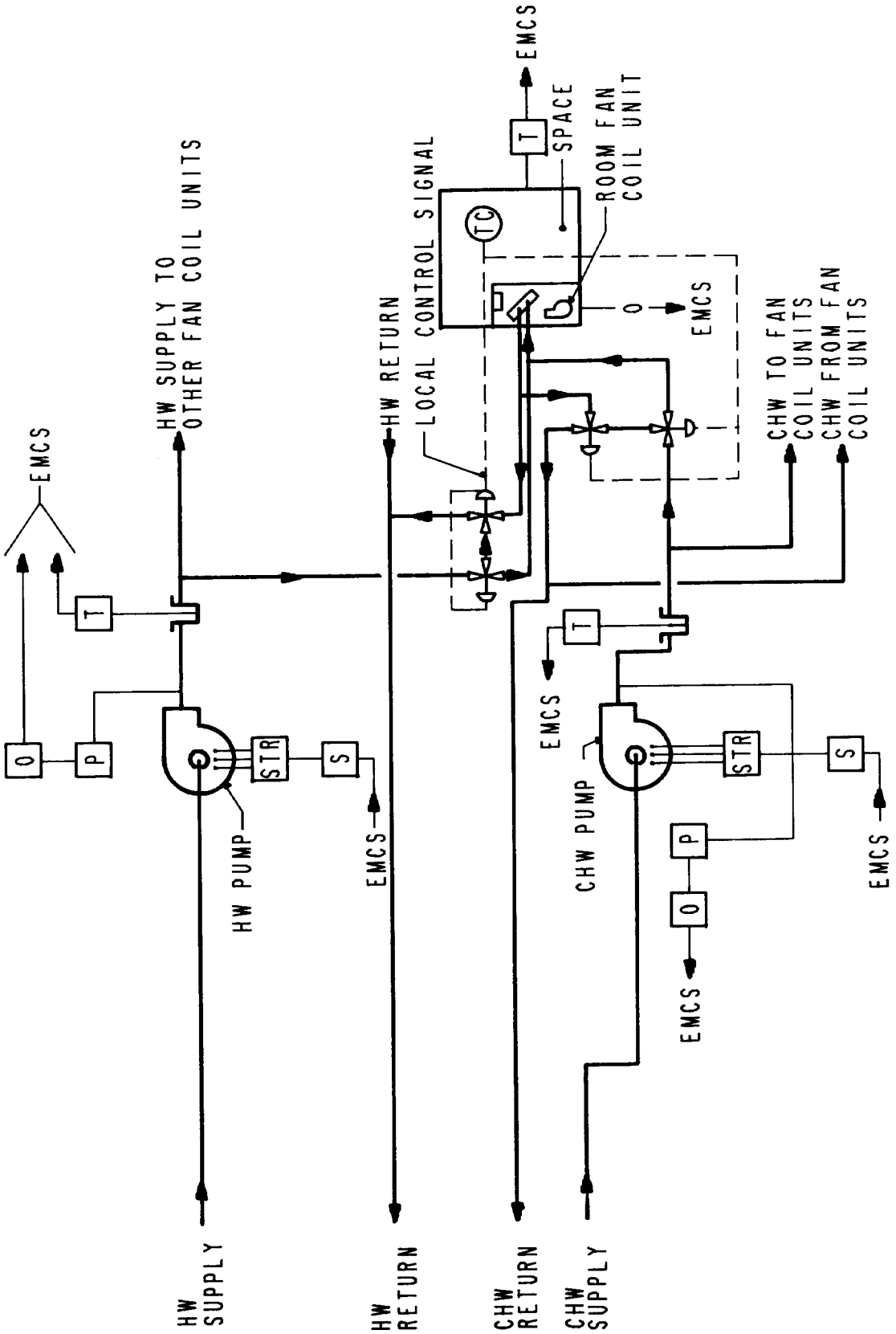


Figure 4-8. Four pipe fan coil schematic.

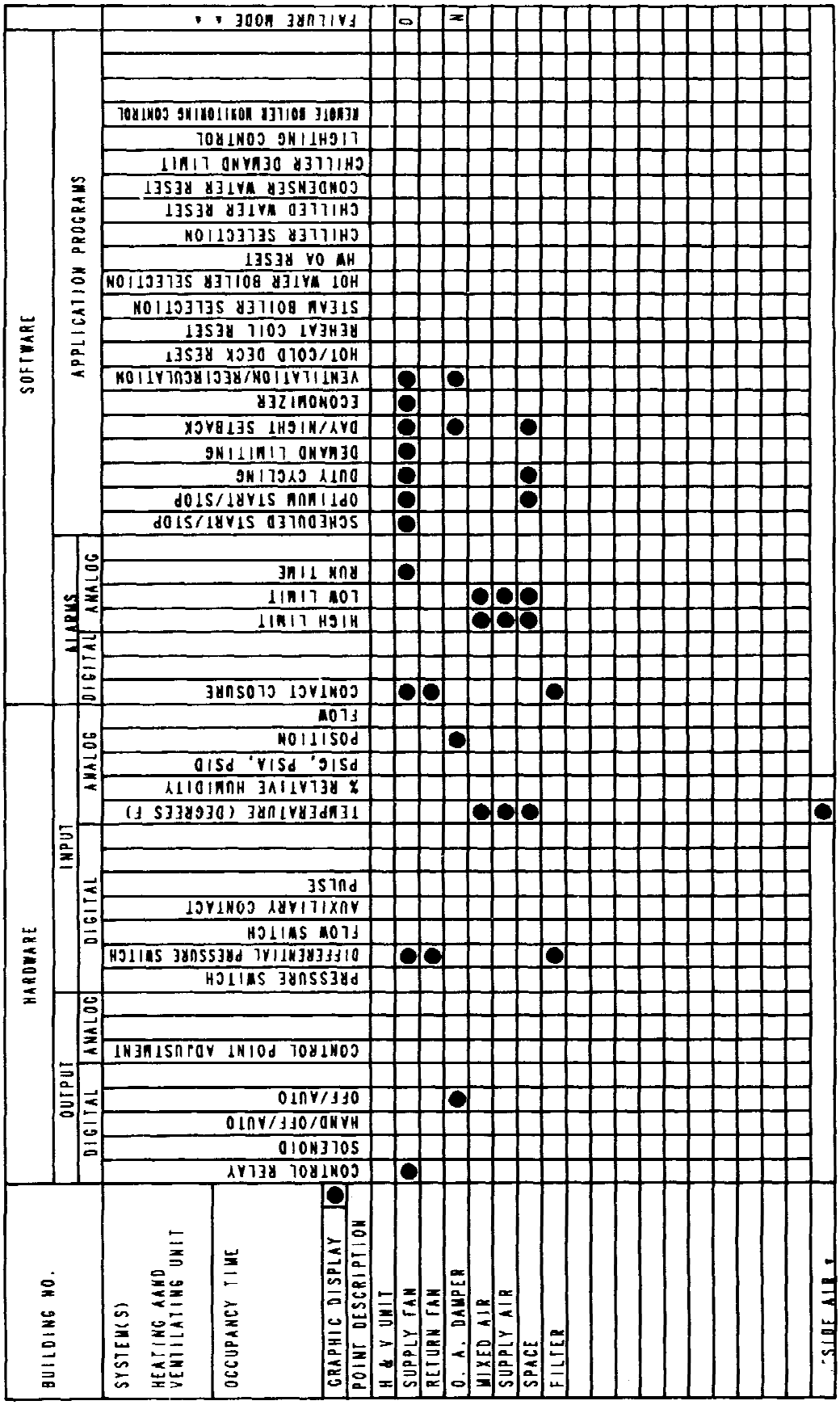


Table 4-9. I/O summary table for heating and ventilating unit.

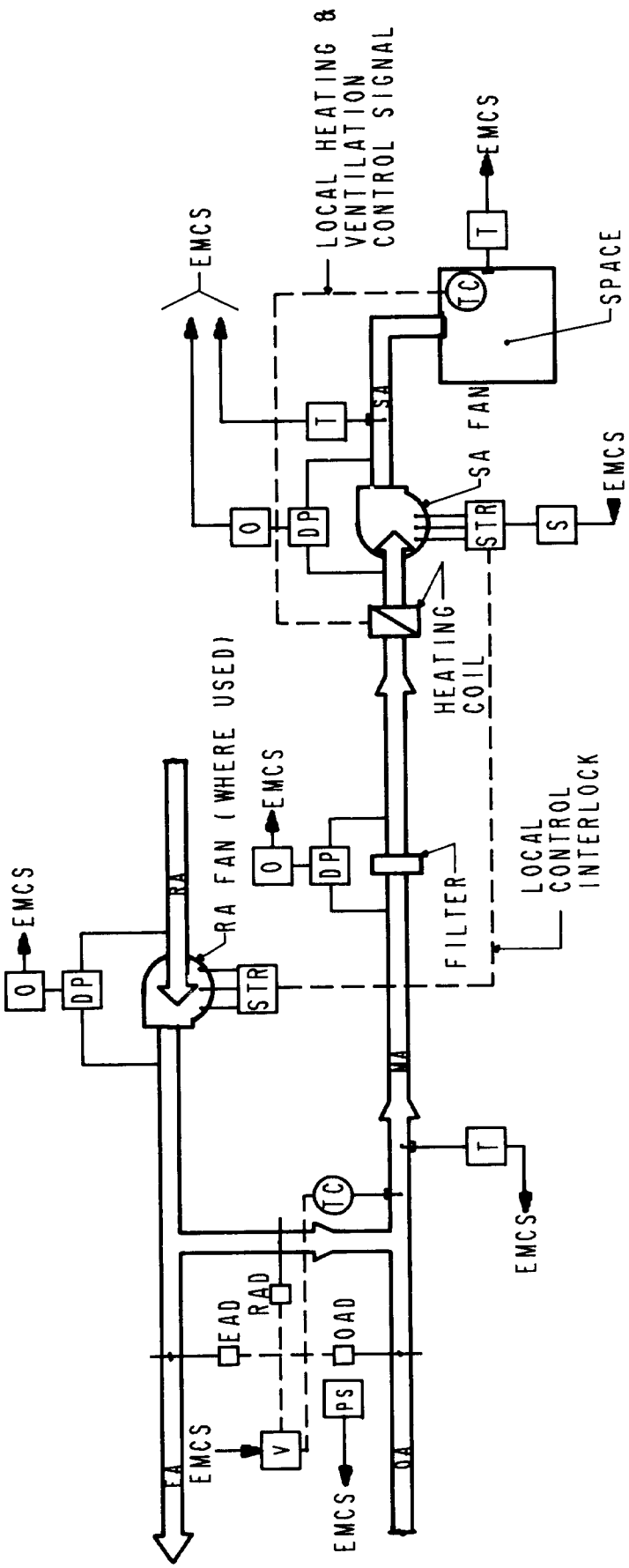
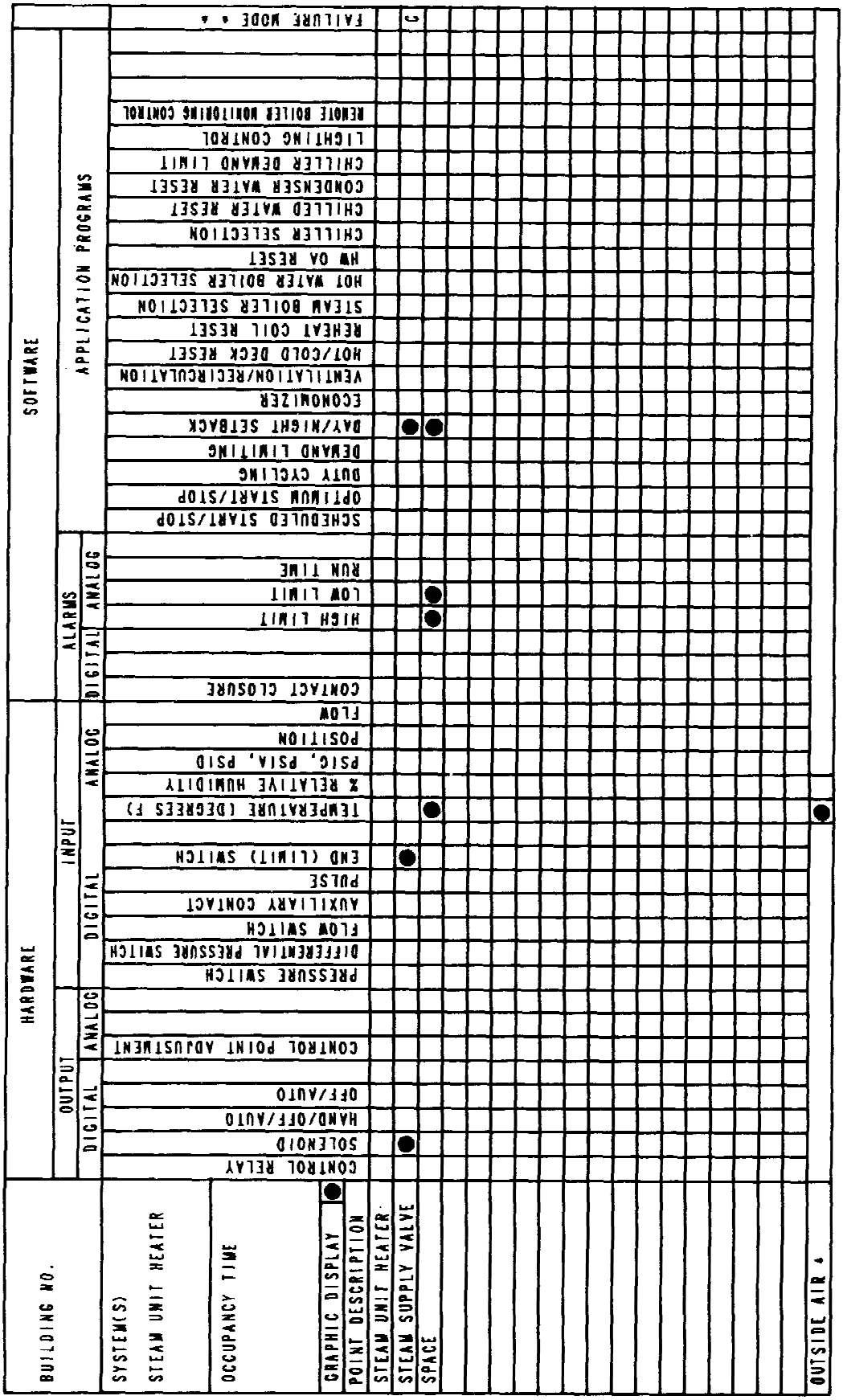


Figure 4–9. Heating and ventilating unit schematic.



* ONE MEASUREMENT FOR ENTIRE SYSTEM
* * C - LAST COMMAND O - ON (OPEN)
H - HIGH VALUE F - OFF (CLOSED)
L - LOW VALUE M - LOCAL LOOP

Table 4-10. I/O summary table for steam unit heater.

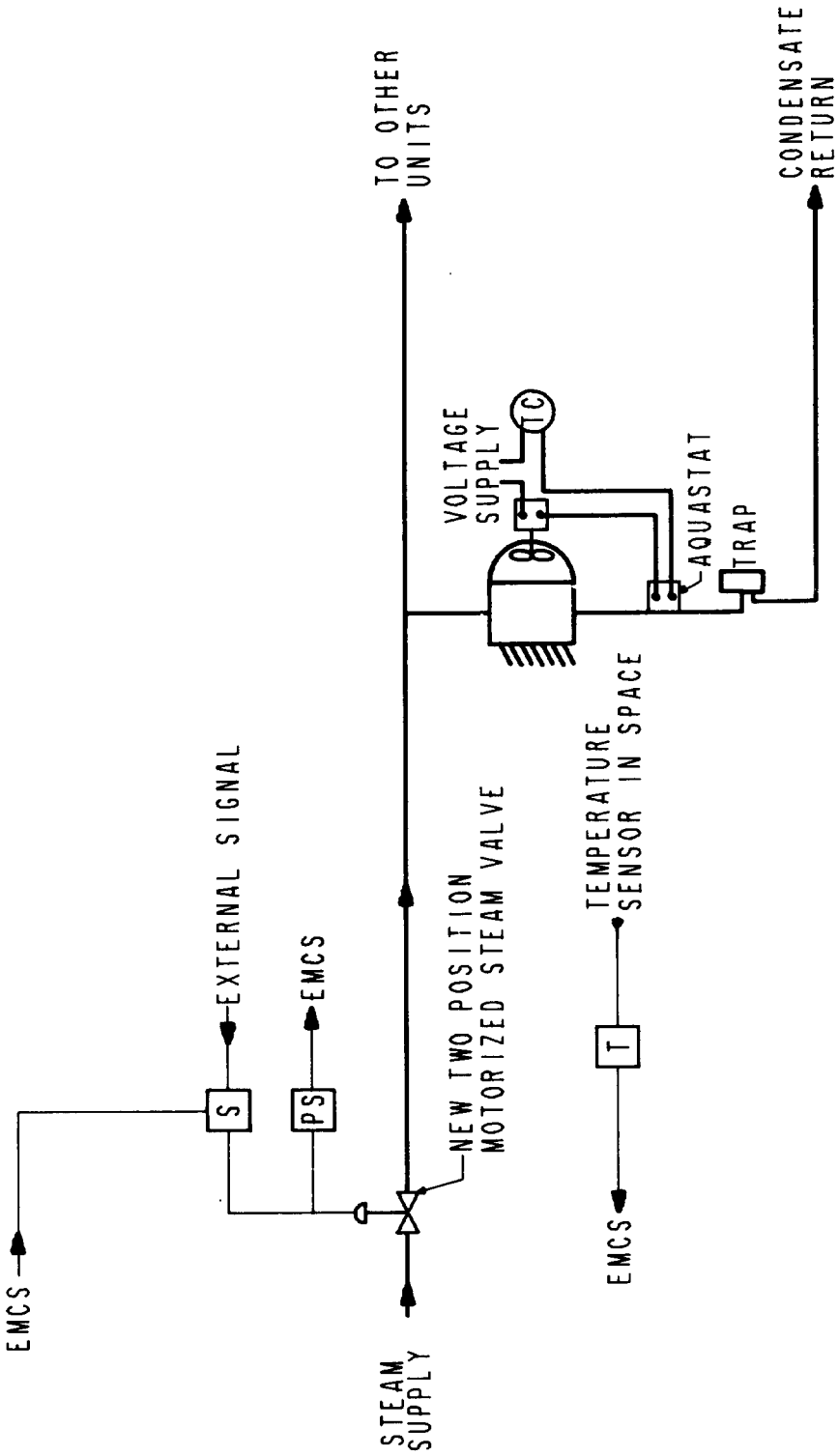


Figure 4-10. Steam unit heater schematic.

BUILDING NO.

SYSTEM(S)
ELECTRIC UNIT HEATER

OCCUPANCY TIME

GRAPHIC DISPLAY ●

	HARDWARE																				SOFTWARE																												
	OUTPUT								INPUT												ALARMS							APPLICATION PROGRAMS																					
	DIGITAL					ANALOG			DIGITAL							ANALOG					DIGITAL			ANALOG																									
POINT DESCRIPTION	CONTROL RELAY	SOLENOID	HAND/OFF/AUTO	OFF/AUTO		CONTROL POINT ADJUSTMENT			PRESSURE SWITCH	DIFFERENTIAL PRESSURE SWITCH	FLOW SWITCH	AUXILIARY CONTACT	PULSE			TEMPERATURE (DEGREES F)	% RELATIVE HUMIDITY	PSIG, PSIA, PSID	POSITION	FLOW	CONTACT CLOSURE			HIGH LIMIT	LOW LIMIT	RUN TIME		SCHEDULED START/STOP	OPTIMUM START/STOP	DUTY CYCLING	DEMAND LIMITING	DAY/NIGHT SETBACK	ECONOMIZER	VENTILATION/RECIRCULATION	HOT/COLD DECK RESET	REHEAT COIL RESET	STEAM BOILER SELECTION	HOT WATER BOILER SELECTION	HW OA RESET	CHILLER SELECTION	CHILLED WATER RESET	CONDENSER WATER RESET	CHILLER DEMAND LIMIT	LIGHTING CONTROL	REMOTE BOILER MONITORING CONTROL				FAILURE MODE **
ELECTRIC UNIT HEATER																																																	
CONTACTOR	●											●																●	●	●	●	●																	O
SPACE																●								●	●				●	●		●																	
OUTSIDE AIR *																●																																	

* ONE MEASUREMENT FOR ENTIRE SYSTEM
** C - LAST COMMAND O - ON (OPEN)
H - HIGH VALUE F - OFF (CLOSED)
L - LOW VALUE N - LOCAL LOOP

Table 4-11. I/O summary table for electric unit heater.

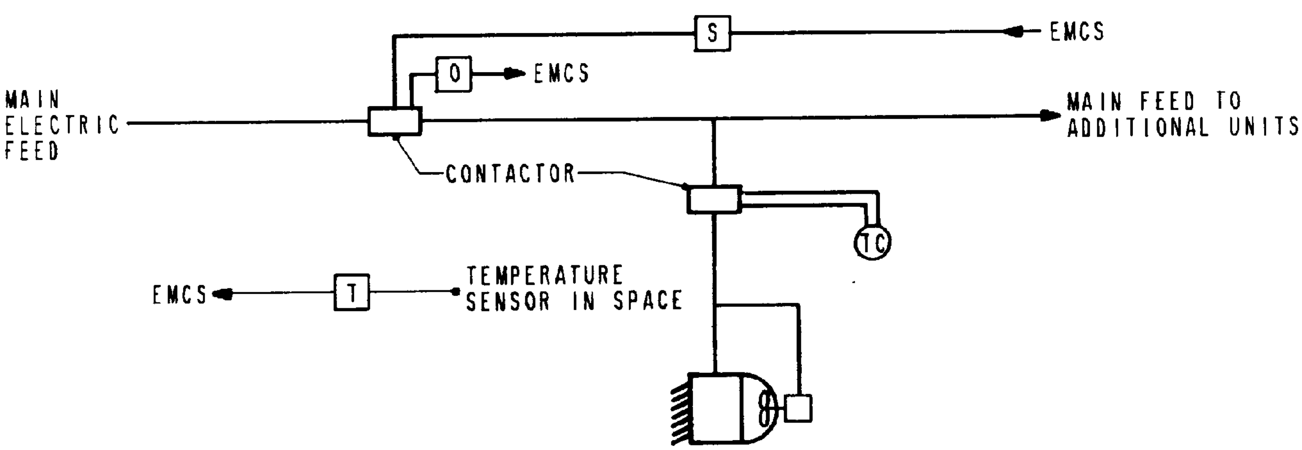
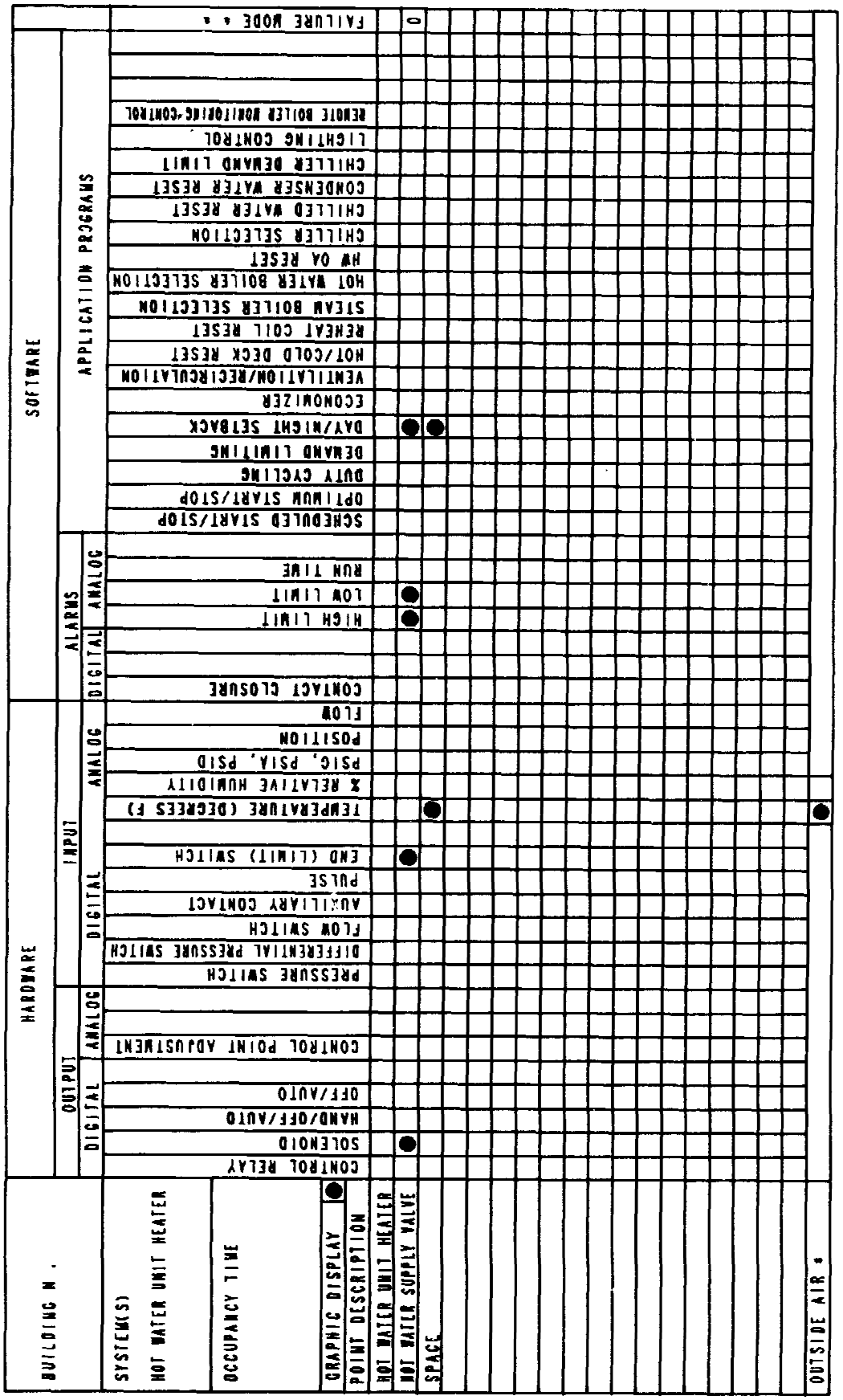


Figure 4-11. Electric unit heater schematic.



* ONE MEASUREMENT FOR ENTIRE SYSTEM
* * C - LAST COMMAND O - ON (OPEN)
H - HIGH VALUE F - OFF (CLOSED)
L - LOW VALUE M - LOCAL LOOP

Table 4-12. I/O summary table for hot water unit heater.

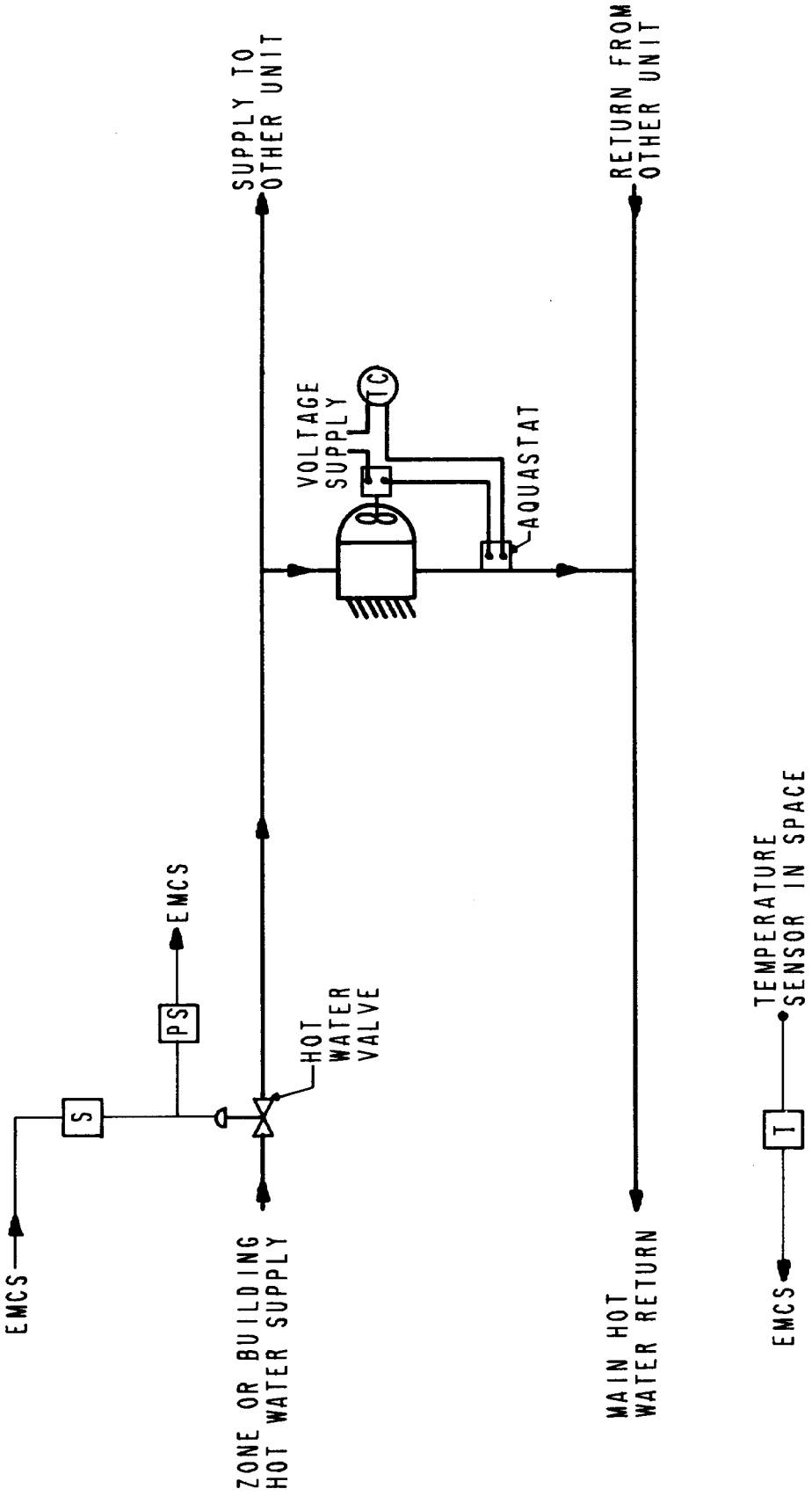


Figure 4-12. Hot water unit heater schematic.

BUILDING NO.

SYSTEM(S) STEAM RADIATION

OCCUPANCY TIME

GRAPHIC DISPLAY ●

POINT DESCRIPTION

HARDWARE

POINT DESCRIPTION	Output Digital: CONTROL RELAY	Output Digital: SOLENOID	Output Digital: HAND/OFF/AUTO	Output Digital: OFF/AUTO	Output Analog: CONTROL POINT ADJUSTMENT	Input Digital: PRESSURE SWITCH	Input Digital: DIFFERENTIAL PRESSURE SWITCH	Input Digital: FLOW SWITCH	Input Digital: AUXILIARY CONTACT	Input Digital: PULSE	Input Digital: END (LIMIT) SWITCH	Input Analog: TEMPERATURE (DEGREES F)	Input Analog: % RELATIVE HUMIDITY	Input Analog: PSIG, PSIA, PSID	Input Analog: POSITION	Input Analog: FLOW
STEAM RADIATION																
STEAM SUPPLY VALVE		●									●					
SPACE												●				
OUTSIDE AIR *												●				

SOFTWARE

POINT DESCRIPTION	Alarms Digital: CONTACT CLOSURE	Alarms Analog: HIGH LIMIT	Alarms Analog: LOW LIMIT	Alarms Analog: RUN TIME	SCHEDULED START/STOP	OPTIMUM START/STOP	DUTY CYCLING	DEMAND LIMITING	DAY/NIGHT SETBACK	ECONOMIZER	VENTILATION/RECIRCULATION	HOT/COLD DECK RESET	REHEAT COIL RESET	STEAM BOILER SELECTION	HOT WATER BOILER SELECTION	HW OA RESET	CHILLER SELECTION	CHILLED WATER RESET	CONDENSER WATER RESET	CHILLER DEMAND LIMIT	LIGHTING CONTROL	REMOTE BOILER MONITORING CONTROL	FAILURE MODE * *
STEAM RADIATION																							
STEAM SUPPLY VALVE									●														C
SPACE		●	●						●														
OUTSIDE AIR *																							

* ONE MEASUREMENT FOR ENTIRE SYSTEM
* * C - LAST COMMAND O - ON (OPEN)
H - HIGH VALUE F - OFF (CLOSED)
L - LOW VALUE N - LOCAL LOOP

Table 4-13. I/O summary table for steam radiation.

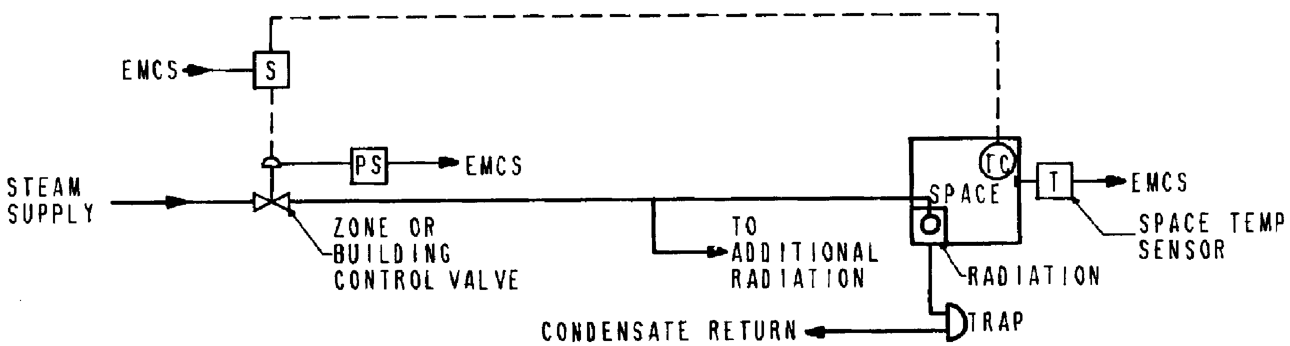


Figure 4-13. Steam radiation schematic.

Building No.	Hardware: Output, Digital				Hardware: Output, Analog	Hardware: Input, Digital					Hardware: Input, Analog					Software: Alarms, Digital	Software: Alarms, Analog			Software: Application Programs																		
	Control Relay	Solenoid	Hand/Off/Auto	Off/Auto	Control Point Adjustment	Pressure Switch	Differential Pressure Switch	Flow Switch	Auxiliary Contact	Pulse	Temperature (Degrees F)	% Relative Humidity	PSIG, PSIA, PSID	Position	Flow	Contact Closure	High Limit	Low Limit	Run Time	Scheduled Start/Stop	Optimum Start/Stop	Duty Cycling	Demand Limiting	Day/Night Setback	Economizer	Ventilation/Recirculation	Hot/Cold Deck Reset	Reheat Coil Reset	Steam Boiler Selection	Hot Water Boiler Selection	HW OA Reset	Chiller Selection	Chilled Water Reset	Condenser Water Reset	Chiller Demand Limit	Lighting Control	Remote Boiler Monitoring Control	Failure Mode **
System(s): Electric Radiation																																						
Occupancy Time																																						
Graphic Display ●																																						
Point Description																																						
Electric Radiation																																						
Contactor	●																			●	●	●	●	●														C
Space Sensor											●						●	●			●	●		●														
Outside Air *											●																											

* One measurement for entire system
** C - Last command O - On (open)
H - High value F - Off (closed)
L - Low value N - Local loop

Table 4-14. I/O summary table for electric radiation.

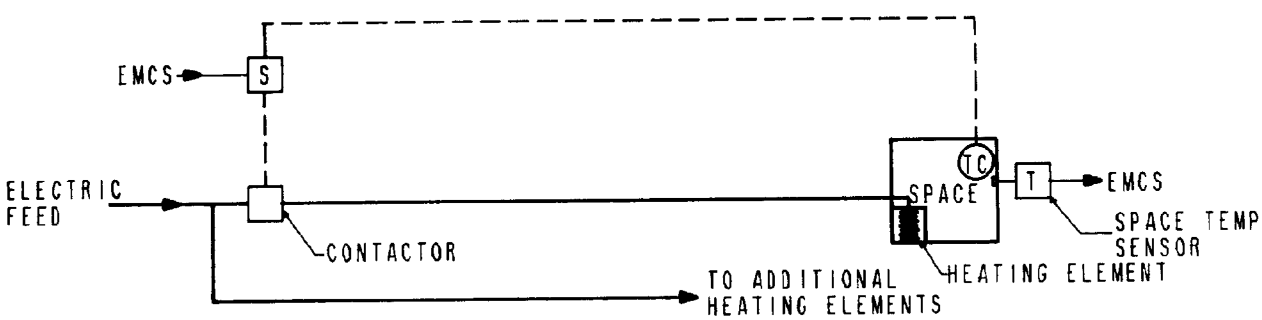
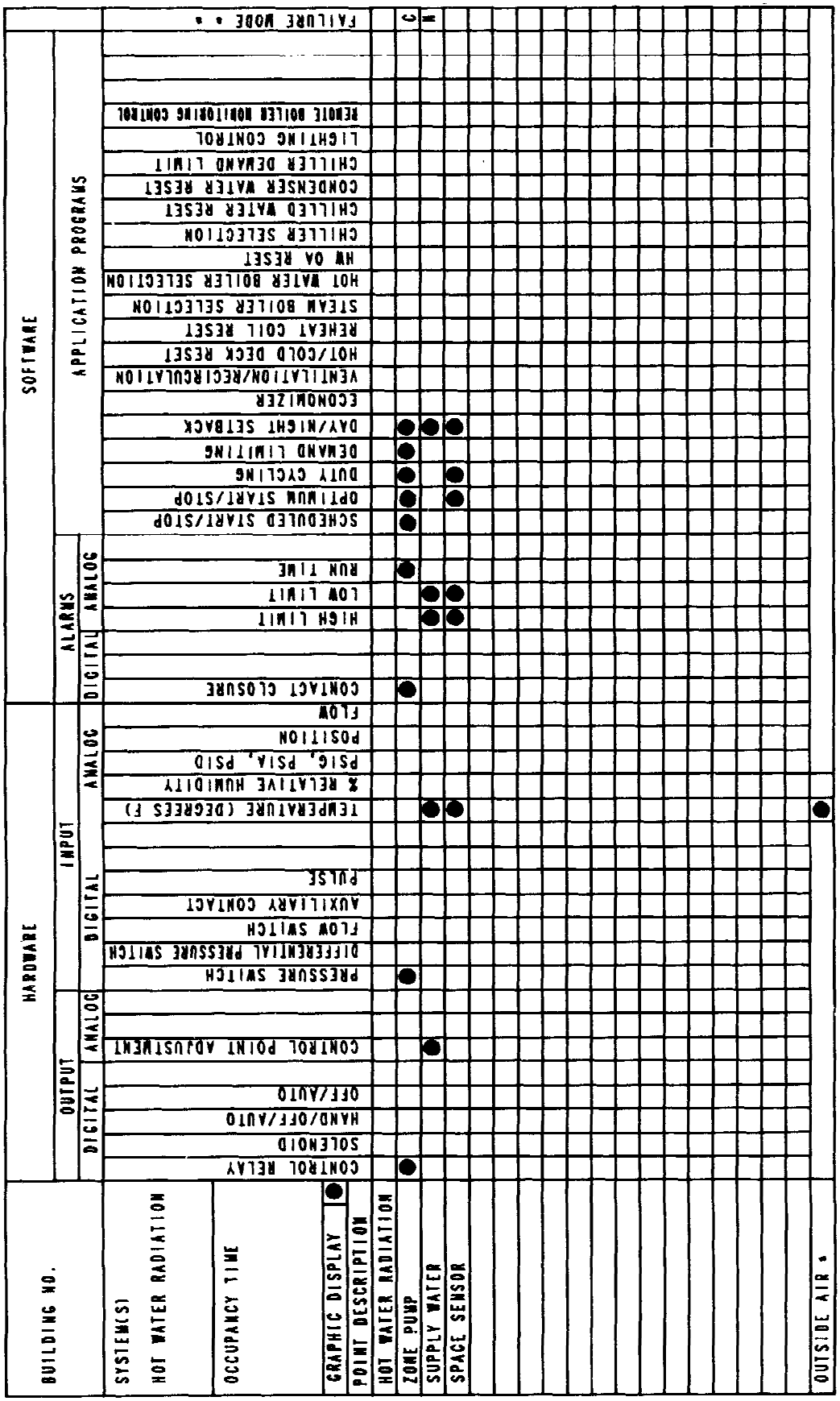


Figure 4-14. Electric radiation schematic.



* ONE MEASUREMENT FOR ENTIRE SYSTEM
* * C - LAST COMMAND O - ON (OPEN)
H - HIGH VALUE F - OFF (CLOSED)
L - LOW VALUE M - LOCAL LOOP

Table 4–15. I/O summary table for hot water radiation.

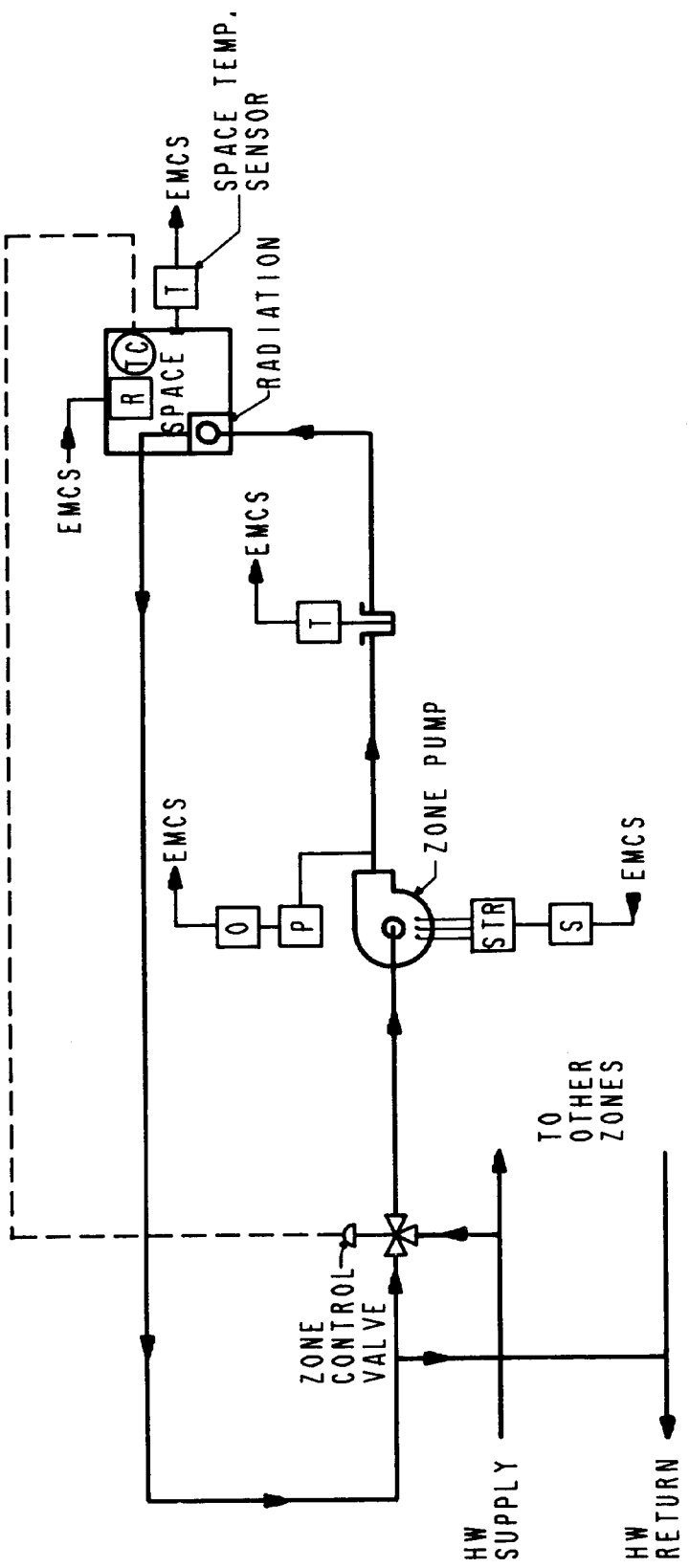
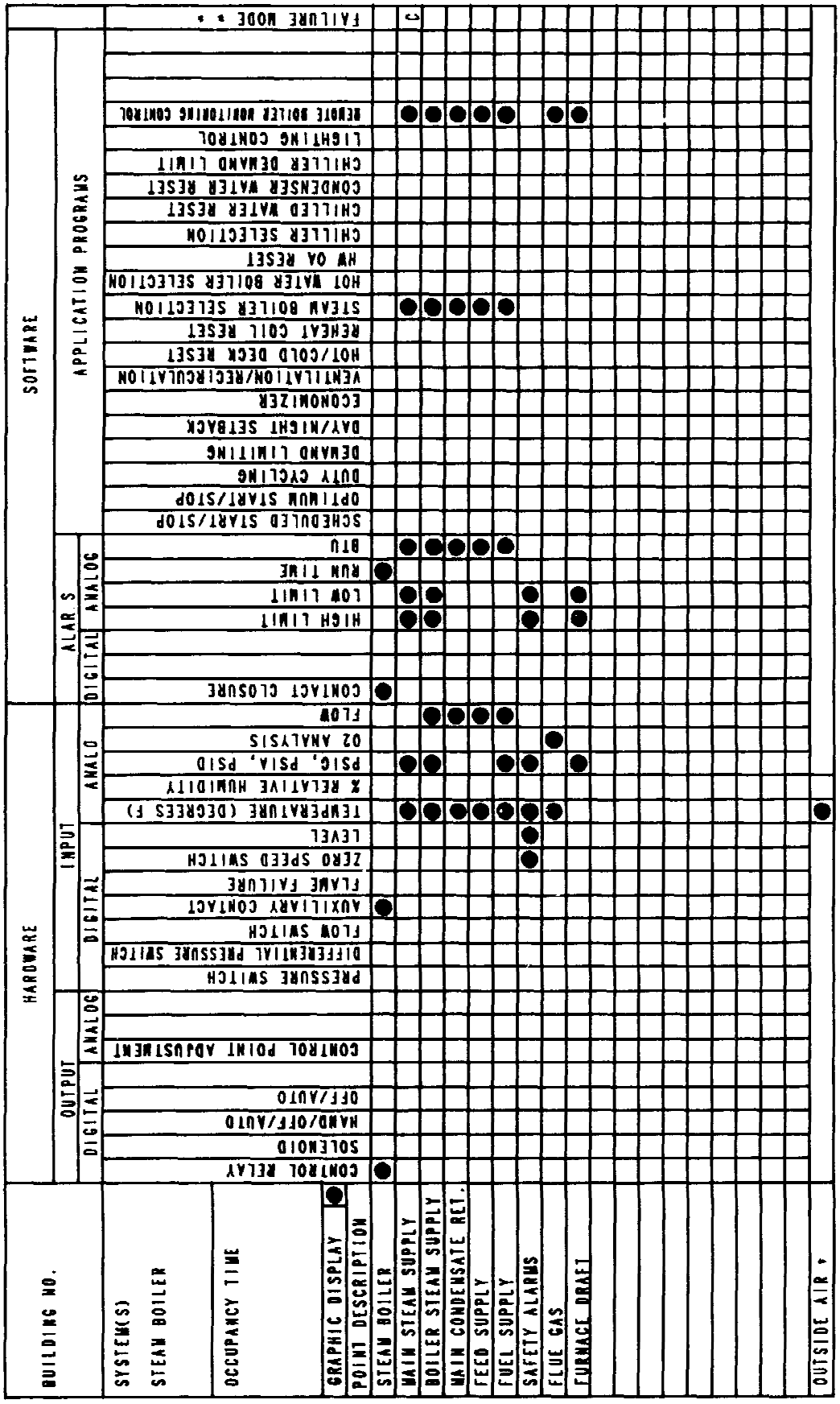


Figure 4-15. Hot water radiation schematic.



* ONE MEASUREMENT FOR ENTIRE SYSTEM
* * C - LAST COMMAND O - ON (OPEN)
H - HIGH VALUE F - OFF (CLOSED)
L - LOW VALUE M - LOCAL LOOP

Table 4-16. I/O summay table for steam boiler.