

Chapter 6

Reading Schematic Diagrams





Objectives

- Upon completion of this course, you will be able to:
 - Read and interpret the schematic of a dehumidifier
 - Read and interpret the schematic of a window air conditioner
 - Read and interpret the schematic of a walk-in cooler



Objectives (cont'd.)

- Read and interpret the schematic of a commercial freezer
- Read and interpret the schematic of a gas furnace with a standing pilot
- Read and interpret the schematic of a small packaged residential air conditioner
- Read and interpret the schematics of light commercial air-conditioning systems with control relays





Objectives (cont'd.)

- Read and interpret the schematics of light commercial air-conditioning systems with lockout relays
- Read and interpret the schematics of twostage heating and two-stage cooling systems
- Read and interpret the schematics of heat pumps with defrost boards and with defrost timers



Objectives (cont'd.)

- Read and interpret the schematic of a commercial refrigeration system with pump down
- Read and interpret most diagrams found in the refrigeration, heating, and airconditioning industry







Key Terms

- Balance point
- Combustion chamber
 Line-voltage
- Control relay
- Heat pump
- Light commercial airconditioning system

- Limit switch
 - Line-voltage control system
- Lockout relay
- Low-voltage control system
- Defrost cycle





Key Terms (cont'd.)

- Dehumidifier
- Gas furnace
- Multistage thermostat
- Pump-down control system

- Reversing valve
- Set point
- Short cycle





Introduction

- Wiring diagrams
 - Many types used in the industry
 - Used for multiple purposes
 - Installing equipment
 - Locating electrical components in a control panel
 - Troubleshooting

- Most emphasize the part they are used for



Introduction (cont'd.)

- Schematic wiring diagram (i.e., ladder diagram)
 - Important tool for installing and troubleshooting
 - Provides information regarding:
 - Equipment operation
 - Operation during specific modes
 - Installation connections
 - Troubleshooting and repairs



Introduction (cont'd.)

- Schematic diagrams
 - Show and identify electrical components
 - Illustrate how the unit works and electrical connections
 - Tell how, when, and why a system works as it does







Legend

C: Contactor COMP: Compressor CFM: Condenser fan motor IFM: Indoor fan motor IFR: Indoor fan relay HP: High-pressure switch LP: Low-pressure switch RC: Run capacitor

Figure 6.2 Schematic diagram. (Delmar/Cengage Learning)







Schematic Diagram Design

- Schematic diagrams resemble a ladder
 - Two vertical lines represent incoming electrical sources
 - Electrical source: electrical energy supplied
 - Use symbols to represent electrical components
 - Made up of series and parallel circuits
 - Circuit-by-circuit arrangement





Figure 6.6 Parallel circuits in a schematic. (Delmar/Cengage Learning)

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DELMAR CENGAGE Learning Figure 6.7 Switches connected in series with loads. (Delmar/Cengage Learning)



Reading Basic Schematic Diagrams

- Basic schematics
 - Dehumidifier
 - Simple window air conditioner
 - Walk-in cooler
 - Commercial freezer
 - Gas furnace with standing pilot
 - Packaged air-conditioning unit







Figure 6.11 Schematic diagram of a dehumidifier. (Delmar/Cengage Learning) Figure 6.14 Schematic diagram of a simple window air conditioner. (*Delmar/Cengage Learning*)







Figure 6.18 Schematic diagram of a walk-in cooler. (Delmar/Cengage Learning)

Figure 6.20 Schematic diagram of a commercial freezer. (Delmar/Cengage Learning)



L2

Legend

Contactor COMP: Compressor

Condenser fan motor

High-pressure switch

Low-pressure switch

Indoor fan motor

Indoor fan relay

Run capacitor

C:

CFM:

IFM:

IFR:

HP:

LP:

RC:





Figure 6.25 Schematic diagram of a gas furnace with a standing pilot. (Delmar/Cengage Learning)

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Figure 6.28 Schematic diagram of a packaged air-conditioning unit. (Delmar/Cengage Learning)





Reading Advanced Schematic Diagrams

- Advanced schematic diagrams
 - Light commercial air-conditioning control system with a control relay
 - Light commercial air-conditioning control system with a lockout relay
 - Two-stage heating, two-stage cooling control system



Reading Advanced Schematic Diagrams (cont'd.)

- Heat pump with defrost timer
 - Refer to Figure 6.40
- Heat pump with defrost board
- Commercial refrigeration system using a pump-down control system

Edition



Figure 6.32 Schematic diagram of light commercial packaged air conditioner with control relay. (Delmar/Cengage Learning)



Thermostat

Legend

- COMP: Compressor C: Contactor IFR: Indoor fan relay IFM: Indoor fan motor CR: Control relay HPS: High-pressure switch LPS: Low-pressure switch CR: Control relay Crankcase heater CH: **TRANS:** Transformer CIT: Compressor internal thermostat
- CT: Cool thermostat







- Contactor
- COMP: Compressor
- CIT: Compressor internal thermostat
 - : Heating relay
 - R: Indoor fan relay
 - I: Indoor fan motor
- LR: Lockout relay T: Thermostat

Figure 6.34 Air-conditioning system with lockout relay. (Delmar/Cengage Learning)

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L1 L2 240/1Ø/60 cycles C1 CC1 CC1 CFM1 C2 CC2 CC2 CFM2 ዿ H1 TL1 HC1 HC1 \sim ኇ H2 HC2 TL2 HC2 IFM IFR han mm 24 Volts W1 HC1 HC2 W2 Y1 CC HPS1 CIT1 R CC2 Y2 T ፍ HPS2 CIT2

IFR

G

- CC1: Cooling contactor 1 CC2: Cooling contactor 2 C1: Compressor 1 C2: Compressor 2
- CFM1: Condenser fan motor 1
- CFM2: Condenser fan motor 2
- HC1: Heat contactor 1
- HC2: Heat contactor 2 H1: Heater 1
- Heater 1 H2: Heater 2
- IFM: Indoor fan motor
- HPS1: High-pressure switch 1
- HPS2: High-pressure switch 2
- CIT1: Compressor internal thermostat 1
- CIT2: Compressor internal thermostat 2
- TL1: Temperature limit 1
- TL2: Temperature limit 2

Figure 6.37 Schematic diagram of two-stage cooling, twostage heating control system.

(Delmar/Cengage Learning)





L1 L2 (Outdoor unit) COMP С С OFN DT ę DB1 С (Y) ТТ 0 RVS DВ Thermostat DB2 С E R W1 -**G** R SHR1 SHR2 DB3 ODT BR Legend C: Contactor uuu COMP: Compressor OFM: Outdoor fan motor DB: Defrost board BR DT: Defrost thermostat ВМ Reversing valve solenoid RVS: SHR1: Strip heat relay #1 SHR2: Strip heat relay #2 दु BR: Blower relay SHR1 SHT1 SH1 SHT1: Strip heat thermostat 1 SHT2: Strip heat thermostat 2 SH1: Strip heater 1 ड SH2: Strip heater 2 SHR2 SHT2 SH2 ODT: Outdoor thermostat (Indoor unit) BM: Blower motor L1 L2

Figure 6.52 Schematic diagram of heat pump with solidstate defrost control. (Delmar/Cengage Learning)





L1 L2 240/1/60 С CC CC CFM 5 CFMT LLS Ş т DTC 4 2 5 DH DT СС 5 ት HPS LPS CMT EFM DTM

Legend

C:	Compressor
CC:	Compressor contactor
CFMT:	Condenser fan motor
	thermostat
CFM:	Condenser fan motor
DTM:	Defrost timer motor
DTC:	Defrost timer contacts
T:	Thermostat
LLS:	Liquid line solenoid
DH:	Defrost heater
HPS:	High-pressure switch
LPS:	Low-pressure switch
CMT:	Compressor motor
	thermostat
EFM:	Evaporator fan motor

Figure 6.57 Schematic diagram of commercial freezer with pumpdown control. (Delmar/Cengage Learning)

