installation instructions

941A

Energy MinderT Control
P/N 941AHX000000MDAA

Cancels: IIK 690A-14-9 IIK 690A-14-16
4/1/91

NOTE: Read the entire instruction before starting the installation.

INTRODUCTION

This instruction covers the installation of a Model 941A Energy Minder Control. The control is designed to increase heating system energy efficiency.

SAFETY CONSIDERATIONS

Installation and servicing of air conditioning equipment can be hazardous due to system pressures and electrical components. Only trained and qualified service personnel should install, repair or service air conditioning equipment.

Untrained personnel can perform basic maintenance functions such as cleaning coils or cleaning and replacing filters. All other operations should be performed by trained service personnel. When working on air conditioning equipment, observe precautions in the literature and on tags and labels attached to the unit.

Follow all safety codes. Wear safety glasses and work gloves. Use a quenching cloth for brazing operations. Have a fire extinguisher available.

⚠	**WARNING:** Before beginning any installation or modification, be sure the main electrical disconnect switch is in the OFF position. TAG THE DISCONNECT SWITCH WITH A SUITABLE WARNING LABEL. Electrical shock can cause personal injury or death.

DESCRIPTION AND USAGE

The Energy Minder Control is for use with any BDP split-system heat pump added to standard oil, gas, or electric furnaces. The control reduces heating costs by switching to the system's most economical heating unit—either heat pump or furnace, depending on actual conditions in the home. To accomplish this, the Energy Minder Control uses two balance points; the *economic balance point* and the *thermal balance point:*

Economic balance point—the lowest outdoor temperature where the heat pump, based on current fuel and electric rates, heats at a lower cost than the furnace.

Thermal balance point—the outdoor temperature at which the heating load exactly matches the heating capability of the heat pump. See the appropriate heat pump Balance Point Worksheet available from your distributor or branch.

When the economic balance point temperature is above the thermal balance point temperature, the heat pump will operate at all outdoor temperatures above the economic balance point temperature. In this situation, the furnace will operate at all temperatures below the economic balance point temperature.

If the economic balance point temperature is below the thermal balance point temperature, two submodes of operations occur. In either, the heat pump operates exclusively at outdoor temperatures above the thermal balance point.

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Figure 1—Energy Minder Control

The first submode occurs when the outdoor temperature is between the economic balance point and the thermal balance point temperatures. In this temperature region, the heat pump is energized by the first stage of the wall thermostat. Since the outdoor temperature is below the thermal balance point and the heat pump capacity is unable to carry the full load, after a period of time, the second stage (approximately 2-3 degree differential) of the wall thermostat will call for additional heat. At this point, the heat pump is turned off and the furnace is energized. It will remain energized until both the second **and** the first stages of the wall thermostat are satisfied. Thereafter, the cycle repeats itself for all temperatures between the economic balance point temperature and the thermal balance point temperature.

The second submode occurs when the outdoor temperature is below the economic balance point temperature. In this lower temperature range, the heating function is turned over exclusively to the furnace. Below the economic balance point temperature, the furnace is energized by the first stage of the wall thermostat.

IMPORTANT: This installation must conform with all applicable local codes and national codes including National Electrical Code (NEC) ANSI/NFPA 70 or Canadian Electrical Code, Part I; C273.5.

The Energy Minder consists of two packages (purchased separately): the control assembly, part number 941AHX000000MDAA; and an outdoor thermostat, part number 313074-751. An indoor wall thermostat for two-stage heating is also required.

The Energy Minder Control works with its outdoor thermostat to switch the heating system into either of two operating modes, heat pump or furnace. A call for heating from the indoor thermostat plus the relationship of the field-set economic balance point to the thermal balance point determines system response. The outdoor thermostat governs the mode in which the system operates.

INSTALLATION

I. DETERMINE INDOOR AIRFLOW CAPACITY REQUIREMENTS

Indoor heating airflow capacity of furnace fan and duct system, as is or with modification, must be approximately 400 to 500 cfm per 12,000 Btuh (ton) of heat pump cooling capacity (equivalent to 33 to

42 cfm per 1000 Btuh). Determine existing system cfm capability (without indoor coil installed) by standard temperature rise or pressure drop methods. Calculate permissible cooling capacity.

Example: System cfm capability = 1176 cfm

Maximum heat pump cooling capacity permissible at 1176 cfm with minimum requirements of 400 cfm/12,000 Btuh:

$$\frac{1176}{400} \text{ X } 12{,}000 \text{ Btuh} = \frac{35{,}280 \text{ Btuh}}{\text{cooling capacity}}$$

With indoor coil installed, a larger furnace motor or blower assembly may be required. After installing coil, recheck cfm and modify blower assembly or duct system as required. *If the minimum heating airflow requirement cannot be obtained, do not install a heat pump system.*

II. INSTALL HEAT PUMP SYSTEM AND INDOOR THERMOSTAT

Refer to heat pump and indoor coil installation instructions packaged with units.

> ⚠ **CAUTION:** The indoor coil must be installed on the supply side of fossil fuel furnaces to prevent corrosion of conventional furnace heat exchangers. Refer to the installation instructions packaged with the outdoor unit and indoor coil for installation information.

Locate indoor coil on supply air side of gas and oil furnaces in blow-through positions. When installing an add-on heat pump system to an existing electric furnace, an Energy Minder Control must be used if the indoor coil is located after the heaters in the supply air side.

A furnace fan relay must be installed when one is not provided in the indoor unit. Use SPDT relay part number HN61KJ310 and install it inside the indoor unit.

NOTE: Isolation of the two class 2 transformer circuits must be maintained.

> ⚠ **CAUTION:** The outdoor thermostat must always be set at or above 0 F to prevent cycling of the heat pump compressor below 0 F. When the Energy Minder Control is used with an electric furnace, the outdoor thermostat should be set at 0 F.

III. INSTALL ENERGY MINDER CONTROL

Install control assembly vertically or horizontally, with four screws provided, in a convenient indoor location near or adjacent to the furnace. See Figure 2 for dimensions.

IV. INSTALL OUTDOOR THERMOSTAT KIT

Locate outdoor thermostat in outdoor unit. Refer to the instructions packaged in the thermostat kit for installation of outdoor thermostat.

Refer to Figure 4 for system wiring schematic, Heat Pump and Optimizer II; and Figure 5 for Control Circuit Connections.

V. DETERMINE ECONOMIC BALANCE POINT AND SET OUTDOOR THERMOSTAT

A. Gas and Oil Furnaces

To obtain full economic benefit from the Energy Minder Control, the outdoor thermostat temperature must be set properly. Obtain local cost of gas (cents/therm) by contacting local fuel supplier and utility company, or by referring to recent fuel and electric bill. Determine economic balance point *coefficient of performance (COP),* using Table I for oil furnaces, Table II for natural gas furnaces, or Table III for propane furnaces by finding the point where local fuel cost and local electric cost intersect (for exact COP refer to heat pump Product Data Digest). Then, using Figure 3, find *economic balance point temperature* at point where COP intersects curve.

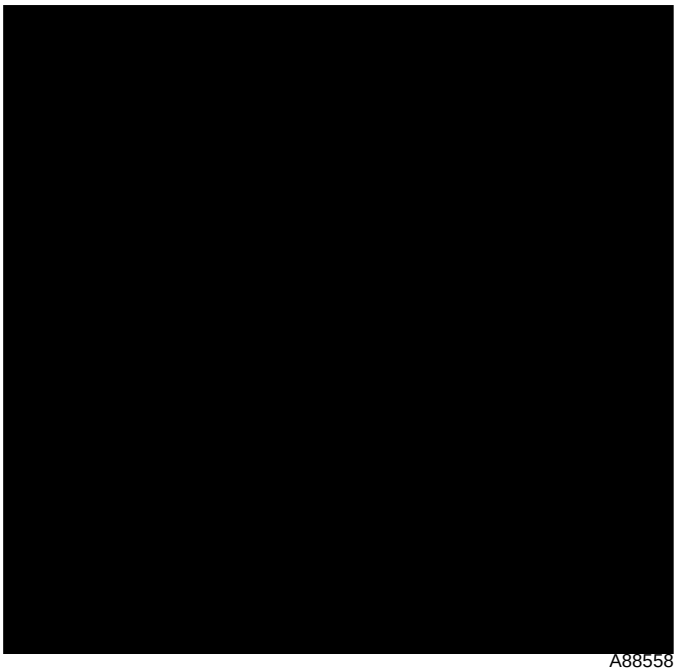

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Figure 2—Control Assembly Dimensions (Inches)

Example: Gas Furnace and Heat Pump with Energy Minder Control (shaded area on Table II).

To find economic balance point temperature:

Local cost of gas = $.45/therm

Local cost of electricity = $.06/kwhr

Economic balance point COP = 2.5

Economic balance point temperature = 32 F

Set the outdoor thermostat temperature dial at the economic balance point temperature.

B. Electric Furnaces

Since an electric furnace operates at a COP of 1.0, always set temperature dial at the thermal balance point.

For fossil furnaces that have a different efficiency, divide furnace efficiency by 0.65 then multiply by COP from Table I or II. Example:

New furnace efficiency: 75%

0.75/0.65 = 1.154

1.154 * 2.5 = 2.88 New Economic Balance point

COP (GAS) = 2.88

SEQUENCE OF OPERATION

(Refer to Figures 4 and 5)

A. Cooling Operation

Indoor thermostat calls for cooling:

A circuit is completed to the outdoor unit reversing valve solenoid (RVS), the compressor (COMP), and the outdoor fan motor (OFM). Simultaneously a circuit is completed to the indoor blower motor.

B. Heating Operation

(Above set point of outdoor thermostat)

Indoor thermostat calls for first stage heating:

A circuit is completed to the outdoor unit compressor (COMP) and the outdoor fan motor (OFM). Simultaneously a circuit is completed to the indoor blower motor.

Indoor thermostat calls for second stage heating:

With unit operation in first stage heating mode, the circuit to the outdoor unit compressor (COMP) and the outdoor fan motor (OFM) is de-energized and indoor blower motor operation stops. A circuit is completed to the indoor furnace. The furnace will control the indoor blower motor operation. The furnace will remain in operation until first stage call for heat has been satisfied. Upon next call for heat, normal heat pump operation will occur.

Table I–Economic Balance Point COP* (Oil)

LOCAL COST OF ELECTRIC CENTS/KWHR	LOCAL COST OF OIL CENTS/GALLON														
	80	85	90	95	100	105	110	115	120	125	130	135	140	145	150
3.0	1.0	0.9	0.9	0.8	0.8	0.7	0.7	0.7	0.6	0.6	0.6	0.6	0.6	0.6	0.5
3.5	1.1	1.1	1.0	0.9	0.9	0.9	0.8	0.8	0.7	0.7	0.7	0.7	0.7	0.6	0.6
4.0	1.3	1.2	1.1	1.1	1.0	1.0	0.9	0.9	0.9	0.8	0.8	0.8	0.8	0.7	0.7
4.5	1.4	1.4	1.3	1.2	1.1	1.1	1.0	1.0	1.0	0.9	0.9	0.9	0.9	0.8	0.8
5.0	1.6	1.5	1.4	1.3	1.3	1.2	1.2	1.1	1.1	1.0	1.0	1.0	1.0	0.9	0.9
5.5	1.8	1.7	1.6	1.5	1.4	1.3	1.3	1.2	1.2	1.1	1.1	1.1	1.0	1.0	1.0
6.0	1.9	1.8	1.7	1.6	1.5	1.5	1.4	1.3	1.3	1.2	1.2	1.2	1.1	1.1	1.1
6.5	2.1	2.0	1.8	1.7	1.7	1.6	1.5	1.4	1.4	1.3	1.3	1.3	1.2	1.2	1.2
7.0	2.2	2.1	2.0	1.9	1.8	1.7	1.6	1.6	1.5	1.4	1.4	1.4	1.3	1.3	1.2
7.5	2.4	2.3	2.1	2.0	1.9	1.8	1.7	1.7	1.6	1.5	1.5	1.5	1.4	1.4	1.3
8.0	2.6	2.4	2.3	2.1	2.0	1.9	1.9	1.8	1.7	1.6	1.6	1.6	1.5	1.5	1.4
8.5	2.7	2.6	2.4	2.3	2.2	2.1	2.0	1.9	1.8	1.7	1.7	1.7	1.6	1.6	1.5
9.0	2.9	2.7	2.6	2.4	2.3	2.2	2.1	2.0	1.9	1.8	1.8	1.8	1.7	1.7	1.6
9.5	3.0	2.9	2.7	2.6	2.4	2.3	2.2	2.1	2.0	1.9	1.9	1.9	1.8	1.8	1.7
10.0	3.2	3.0	2.8	2.7	2.6	2.4	2.3	2.2	2.1	2.0	2.0	2.0	1.9	1.8	1.8
10.5	3.3	3.2	3.0	2.8	2.7	2.6	2.4	2.3	2.2	2.1	2.1	2.1	2.0	1.9	1.9
11.0	3.5	3.3	3.1	3.0	2.8	2.7	2.6	2.4	2.3	2.2	2.2	2.2	2.1	2.0	2.0
11.5	3.7	3.5	3.3	3.1	2.9	2.8	2.7	2.6	2.4	2.3	2.3	2.3	2.2	2.1	2.0
12.0	3.8	3.6	3.4	3.2	3.1	2.9	2.8	2.7	2.6	2.4	2.4	2.4	2.3	2.2	2.1
12.5	4.0	3.8	3.5	3.4	3.2	3.0	2.9	2.8	2.7	2.6	2.5	2.5	2.4	2.3	2.2
13.0	4.1	3.9	3.7	3.5	3.3	3.2	3.0	2.9	2.8	2.7	2.6	2.6	2.5	2.4	2.3

*Based on 65% efficiency for oil furnaces. For other efficiencies, see Section 5.

Table II—Economic Balance Point COP* (Natural Gas)

LOCAL COST OF ELECTRIC CENTS/ KHWR	LOCAL COST OF NATURAL GAS CENTS/THERM										
	35	40	45	50	55	60	65	70	75	80	85
3.0	1.6	1.4	1.3	1.1	1.0	1.0	0.9	0.8	0.8	0.7	0.7
3.5	1.9	1.7	1.5	1.3	1.2	1.1	1.0	1.0	0.9	0.8	0.8
4.0	2.2	1.9	1.7	1.5	1.4	1.3	1.2	1.1	1.0	1.0	0.9
4.5	2.4	2.1	1.9	1.7	1.6	1.4	1.3	1.2	1.1	1.1	1.0
5.0	2.7	2.4	2.1	1.9	1.7	1.6	1.5	1.4	1.3	1.2	1.1
5.5	3.0	2.6	2.3	2.1	1.9	1.7	1.6	1.5	1.4	1.3	1.2
6.0	3.3	2.9	2.5	2.3	2.1	1.9	1.8	1.6	1.5	1.4	1.3
6.5	3.5	3.1	2.8	2.5	2.3	2.1	1.9	1.8	1.7	1.5	1.5
7.0	3.8	3.3	3.0	2.7	2.4	2.2	2.1	1.9	1.8	1.7	1.6
7.5	4.1	3.6	3.2	2.9	2.6	2.4	2.2	2.0	1.9	1.8	1.7
8.0	4.4	3.8	3.4	3.0	2.8	2.5	2.3	2.2	2.0	1.9	1.8
8.5	4.6	4.0	3.6	3.2	2.9	2.7	2.5	2.3	2.2	2.0	1.9
9.0	4.9	4.3	3.8	3.4	3.1	2.9	2.6	2.4	2.3	2.1	2.0
9.5	5.2	4.5	4.0	3.6	3.3	3.0	2.8	2.6	2.4	2.3	2.1
10.0	5.4	4.8	4.2	3.8	3.5	3.2	2.9	2.7	2.5	2.4	2.2
10.5	5.7	5.0	4.4	4.0	3.6	3.3	3.1	2.9	2.7	2.5	2.4
11.0	6.0	5.2	4.7	4.2	3.8	3.5	3.2	3.0	2.8	2.6	2.5
11.5	6.3	5.5	4.9	4.4	4.0	3.7	3.4	3.1	2.9	2.7	2.6
12.0	6.5	5.7	5.1	4.6	4.2	3.8	3.5	3.3	3.0	2.9	2.7
12.5	6.8	6.0	5.3	4.8	4.3	4.0	3.7	3.4	3.2	3.0	2.8
13.0	7.1	6.2	5.5	5.0	4.5	4.1	3.8	3.5	3.3	3.1	2.9

*Based on 65% efficiency for gas furnaces. For other efficiencies, see Section 5.

C. Heating Operation

(Outdoor ambient temperature falls below outdoor thermostat set point while in operation)

Indoor thermostat is in first stage heating:

The circuit to the outdoor unit compressor (COMP) and the outdoor fan motor (OFM) is de-energized and indoor blower motor operation stops. A circuit is completed to the indoor furnace. The furnace will control the indoor blower motor operation. The furnace will remain in operation until first stage call for heat has been satisfied. Upon next call for heat furnace operation will occur. Heat pump operation will remain off until outdoor ambient temperature goes above outdoor thermostat set point.

D. Heating Operation

(Below set point of outdoor thermostat)

Indoor thermostat calls for first stage heating:

A circuit is completed to the indoor furnace. The furnace will control the indoor blower motor operation. The furnace will remain in operation until first stage call for heat has been satisfied. Upon next call for heat furnace operation will occur. Heat pump operation will remain locked out until outdoor ambient temperature goes above outdoor thermostat set point.

E. Defrost Operation

(Outdoor ambient temperature must be above outdoor thermostat set point to operate)

Indoor thermostat calls for first stage heating:

A circuit is completed to the outdoor unit compressor (COMP) and the outdoor fan motor (OFM). Simultaneously a circuit is completed to the indoor blower motor. (The defrost board times out and checks the outdoor unit defrost thermostat finding it closed.) The defrost board completes a circuit to the outdoor unit reversing valve solenoid (RVS). With compressor (COMP) in outdoor unit still in operation, the reversing valve changes unit into cooling operation and opens circuit to outdoor fan motor (OFM). Simultaneously a circuit is completed to the indoor furnace. The furnace will control the indoor blower motor operation.

At completion of defrost, the outdoor unit will shut off and the furnace will continue to operate until indoor thermostat is satisfied. Upon next call for heat normal heat pump operation will occur.

If the indoor thermostat is satisfied before defrost cycle is completed, unit operation will be terminated. Upon the next call for heat the unit will go back into defrost operation, completing defrost cycle. After defrost cycle is completed the furnace will continue to operate until the indoor thermostat is satisfied. Upon next call for heat, normal heat pump operation will occur.

Table III–Economic Balance Point COP* (Propane)

LOCAL COST OF ELECTRIC CENTS/ KWHR	LOCAL COST OF PROPANE CENTS/GALLON												
	50	60	70	80	90	100	110	120	130	140	150	160	170
3.0	1.0	0.9	0.7	0.7	0.6	0.5	0.5	0.4	0.4	0.4	0.3	0.3	0.3
3.5	1.2	1.0	0.9	0.8	0.7	0.6	0.6	0.5	0.5	0.4	0.4	0.4	0.4
4.0	1.4	1.2	1.0	0.9	0.8	0.7	0.6	0.6	0.5	0.5	0.5	0.4	0.4
4.5	1.6	1.3	1.1	1.0	0.9	0.8	0.7	0.7	0.6	0.6	0.5	0.5	0.5
5.0	1.7	1.4	1.2	1.1	1.0	0.9	0.8	0.7	0.7	0.6	0.6	0.5	0.5
5.5	1.9	1.6	1.4	1.2	1.1	1.0	0.9	0.8	0.7	0.7	0.6	0.6	0.6
6.0	2.1	1.7	1.5	1.3	1.2	1.0	0.9	0.9	0.8	0.7	0.7	0.7	0.6
6.5	2.3	1.9	1.6	1.4	1.3	1.1	1.0	0.9	0.9	0.8	0.8	0.7	0.7
7.0	2.4	2.0	1.7	1.5	1.3	1.2	1.1	1.0	0.9	0.9	0.8	0.8	0.7
7.5	2.6	2.2	1.9	1.6	1.4	1.3	1.2	1.1	1.0	0.9	0.9	0.8	0.8
8.0	2.8	2.3	2.0	1.7	1.5	1.4	1.3	1.2	1.1	1.0	0.9	0.9	0.8
8.5	2.9	2.5	2.1	1.8	1.6	1.5	1.3	1.2	1.1	1.1	1.0	0.9	0.9
9.0	3.1	2.6	2.2	2.0	1.7	1.6	1.4	1.3	1.2	1.1	1.0	1.0	0.9
9.5	3.3	2.7	2.4	2.1	1.8	1.6	1.5	1.4	1.3	1.2	1.1	1.0	1.0
10.0	3.5	2.9	2.5	2.2	1.9	1.7	1.6	1.4	1.3	1.2	1.2	1.1	1.0
10.5	3.6	3.0	2.6	2.3	2.0	1.8	1.7	1.5	1.4	1.3	1.2	1.1	1.1
11.0	3.8	3.2	2.7	2.4	2.1	1.9	1.7	1.6	1.5	1.4	1.3	1.2	1.1
11.5	4.0	3.3	2.8	2.5	2.2	2.0	1.8	1.7	1.5	1.4	1.3	1.2	1.2
12.0	4.2	3.5	3.0	2.6	2.3	2.1	1.9	1.7	1.6	1.5	1.4	1.3	1.2
12.5	4.3	3.6	3.1	2.7	2.4	2.2	2.0	1.8	1.7	1.5	1.4	1.4	1.3
13.0	4.5	3.8	3.2	2.8	2.5	2.3	2.0	1.9	1.7	1.6	1.5	1.4	1.3

*Based on 56% efficiency for gas furnaces. For other efficiencies, see Section 5.

F. Emergency Heat

(Thermostat switch to EM position and light will illuminate)

Indoor thermostat calls for heating:

A circuit is completed to the indoor furnace. The furnace will control the indoor blower motor operation. The outdoor heat pump unit is locked out of the circuit.

G. Continuous Fan

(Thermostat fan switch to ON position)

A circuit is completed to indoor blower motor. Motor runs continuously regardless of heating or cooling demand.

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Figure 3—Economic Balance Point Temperature

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Figure 4—System Wiring Schematic; Heat Pump and Optimizer

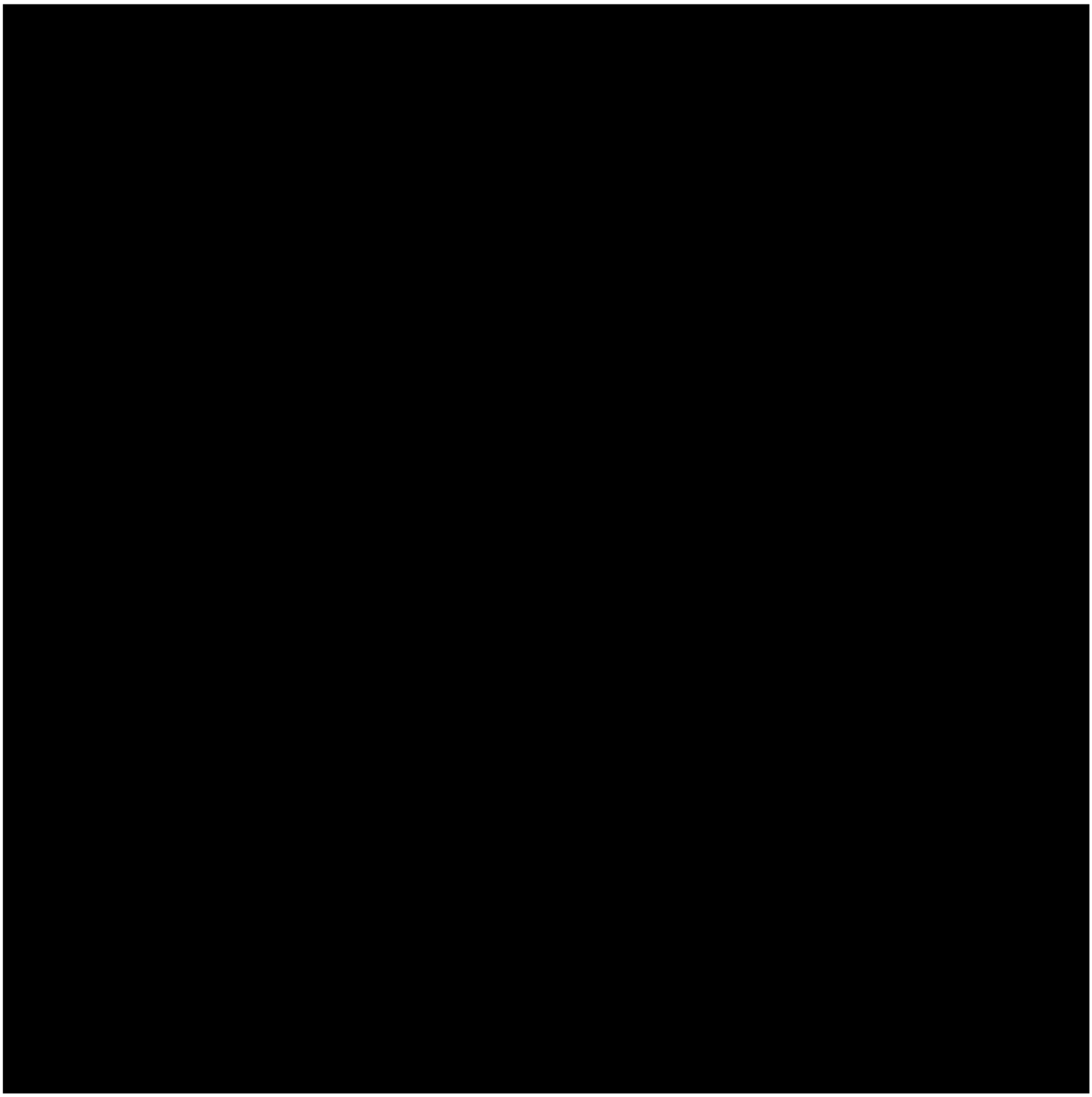

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Figure 5—Control Circuit Connections