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SECTION 1. INTRODUCTION

The Model EC200 is a completely solid state control, containing all of the logic, timing and annunciation required for the automatic control and protection of an engine. The unit consists of a single circuit card mounted in an iridited aluminum chassis with a stainless steel front panel, suitable for flush mount. Unit dimensions are 12" x 12" x 1.5" HWD. The internal power supply will operate from 8 - 30 VDC, allowing the EC200 to be used with 12 VDC or 24 VDC systems.

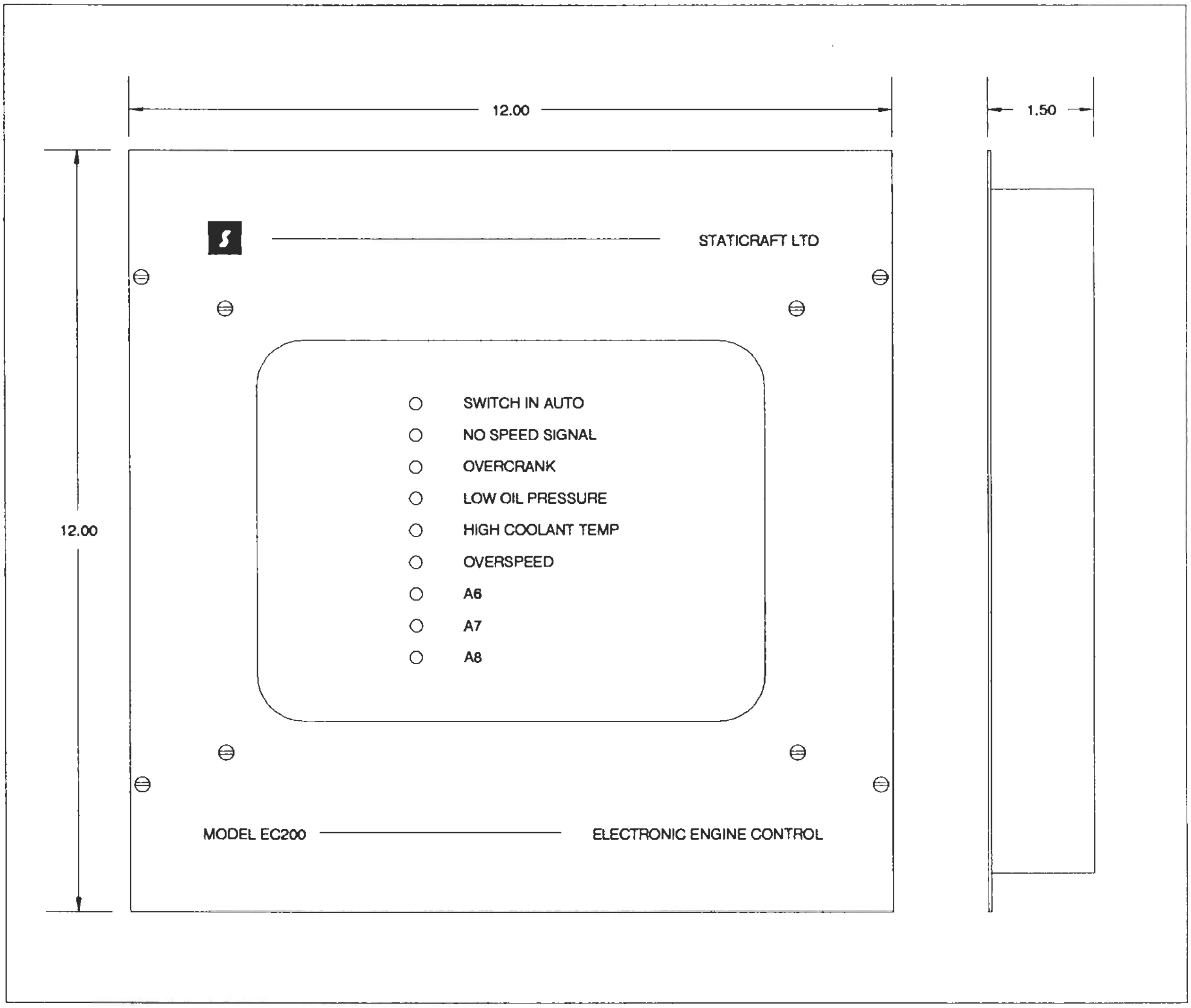

FIGURE 1-1 EC200 PHYSICAL LAYOUT

The EC200 has an internal electronic speedswitch to disconnect the starter motor and provide overspeed protection. In addition, a signal derived from the speedswitch circuitry is conditioned to provide a 0 - 1 mADC output suitable for driving a 0 - 1 mADC meter calibrated in RPM. The control also provides five user-adjustable delays, and an option selector switch to permit modification of the control logic.

The speedswitch and time delay adjustments, and tachometer calibration are performed with multi-turn potentiometers located in the top left corner of the circuit card when viewing the unit from the back. The potentiometers are accessed through a slot on the left side of the back cover, again viewing the unit from the back. The option selector switch is also located on the back of the circuit card along with a 24-pole terminal block to allow external wiring to be connected. Refer to figure 1-2.

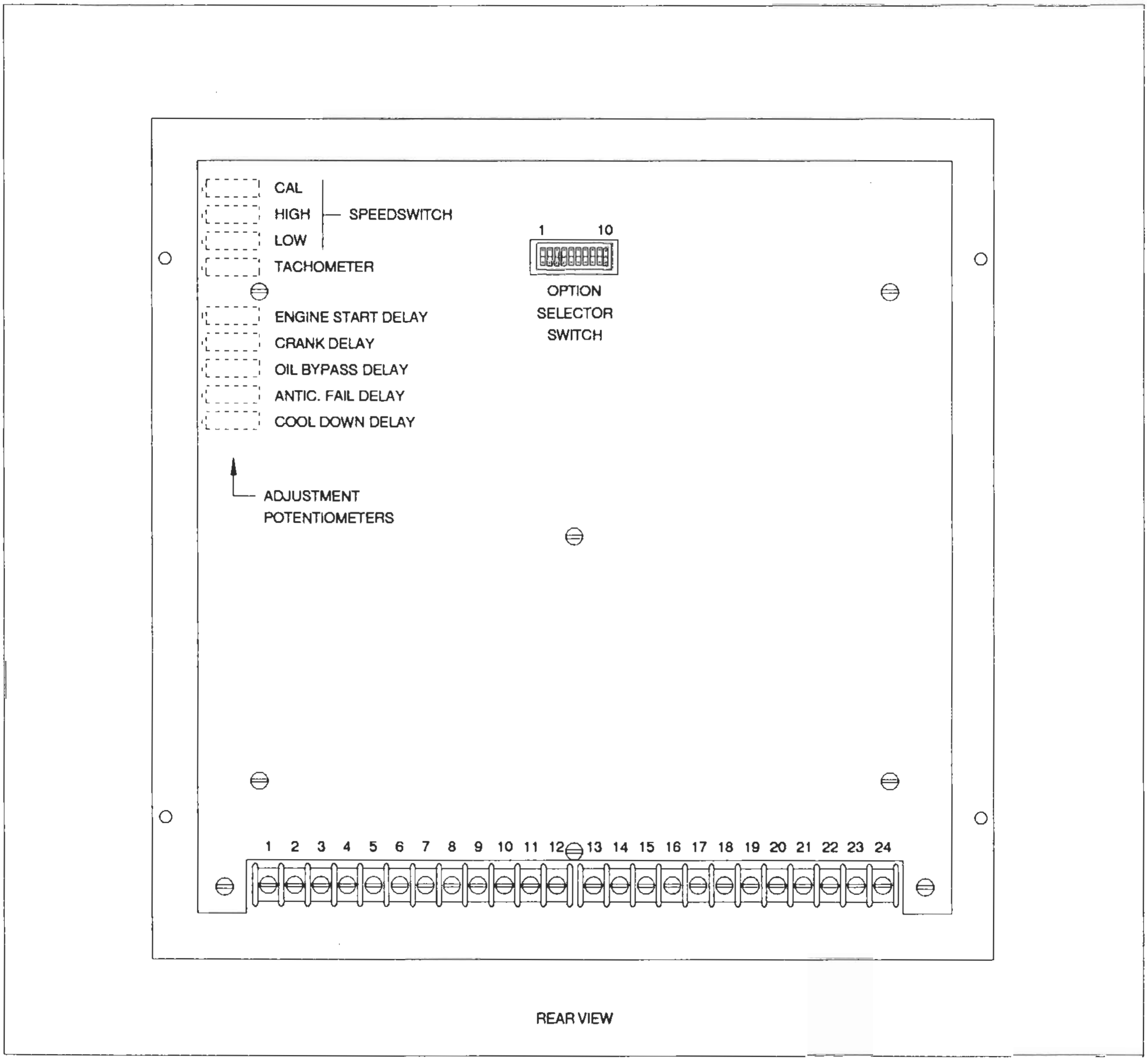

FIGURE 1-2 EC200 ADJUSTMENTS AND OPTION SWITCH

The EC200 has two modes of operation; manual and automatic. The mode is selected by grounding either terminal 1 (manual operation), or terminal 2 (automatic operation). If automatic operation is selected the "engine start contact" input (terminal 3) determines whether the control is to start or stop the engine. This is described in detail in section 3.1.

Protection is provided for the following alarm conditions;

- **No Speed Signal**
- **Overcrank**
- **Low Oil Pressure**
- **High Coolant Temperature**
- **Overspeed**

In addition, three spare alarms (A6, A7 and A8) are supplied, which may be configured to operate immediately, or following a time delay. Individual panel lamps are provided to indicate the cause of the alarm, and separate relay driver outputs are supplied for applications requiring remote alarms. These alarms can be custom-screened to user specifications.

NOTES:

SECTION 2. CIRCUITRY

In order to properly interface the Model EC200 with external wiring or devices, a clear understanding of the operation of specific sections of EC200 circuitry is required.

2.1 POWER SUPPLY

The EC200 power supply will operate from an 8 - 30 VDC source. Battery positive is applied to terminal 13, and battery negative to terminal 14. The power supply input is protected against reverse polarity, so accidentally reversing the polarity of the two terminals will not damage internal circuitry. The DC power is applied to a series pass voltage regulator to produce the +5 VDC used by internal components.

Noise protection and over-voltage protection are built in to the DC input. However, subjecting the input to extremely high DC or AC voltage can cause damage. Refer to section 6 for a more detailed coverage of this topic.

2.2 LOGIC INPUTS

This control is equipped with nine high impedance logic inputs (terminals 1 - 9). The inputs are normally held high (+5 VDC) when open circuit. In order to activate the input, ground the input terminal to battery negative. This will pull the input to ground potential, and cause the downstream logic to switch state (refer to figure 2-1). Notice that an external relay contact (supplied by others) is used to ground the logic input.

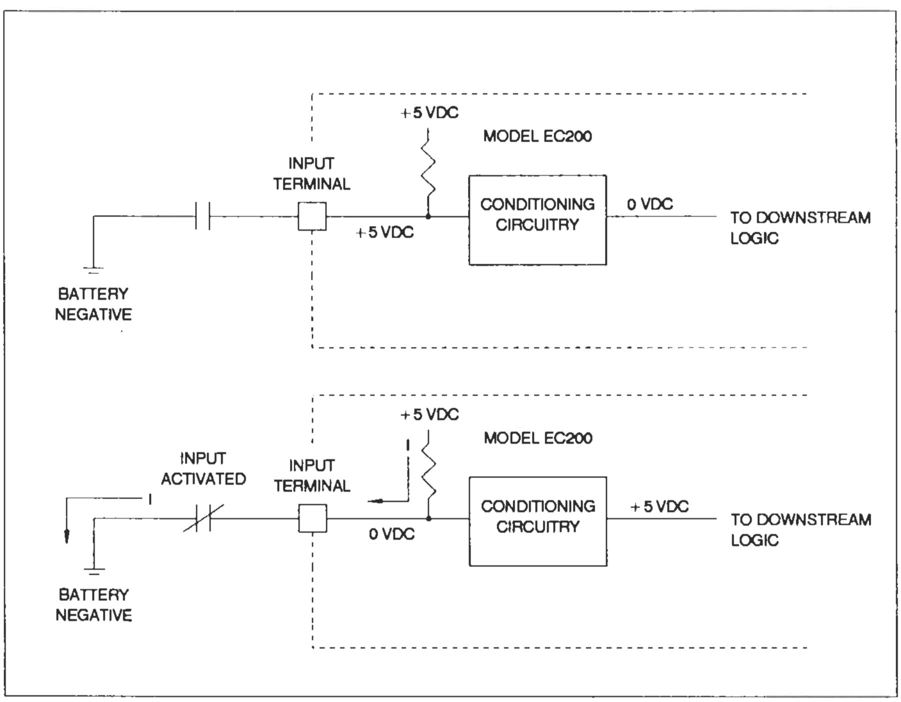

FIGURE 2-1 LOGIC INPUT

2.2.1 Manual

Terminal 1 is the connection point for the manual position of the control switch. This is described in detail in section 3.1.

2.2.2 Automatic

Terminal 2 is the connection point for the automatic position of the control switch. This is described in detail in section 3.1.

2.2.3 Start Contact

Terminal 3 is the connection point for the engine start contact. This is described in detail in section 3.1.

2.2.4 Lamp Test

An external pushbutton (supplied by others) is connected from terminal 4 to battery negative. The pushbutton contacts should be normally open. Pressing the pushbutton will cause all of the EC200 panel lamps to flash.

2.2.5 Oil Pressure

A contact from an engine mounted lube oil pressure switch (supplied by others) is connected from terminal 5 to battery negative. Switch operation should be contact closure on falling oil pressure.

2.2.6 Coolant Temperature

A contact from an engine mounted coolant temperature switch (supplied by others) is connected from terminal 6 to battery negative. Switch operation should be contact closure on rising coolant temperature.

2.2.7 Annunciator 6 (Spare)

This is a spare input. An external contact is connected from terminal 7 to battery negative. The contact should close on fault.

2.2.8 Annunciator 7 (Spare)

This is a spare input. An external contact is connected from terminal 8 to battery negative. The contact should close on fault.

2.2.9 Annunciator 8 (Spare)

This is a spare input. An external contact is connected from terminal 9 to battery negative. The contact should close on fault.

2.3 RELAY DRIVER OUTPUTS

The EC200 is equipped with 10 relay driver outputs (terminals 15 to 24). The outputs are high current silicon transistors providing a current sink to battery negative. To use the outputs, connect a relay coil (supplied by others) from the output terminal to battery positive as illustrated in figure 2-2.

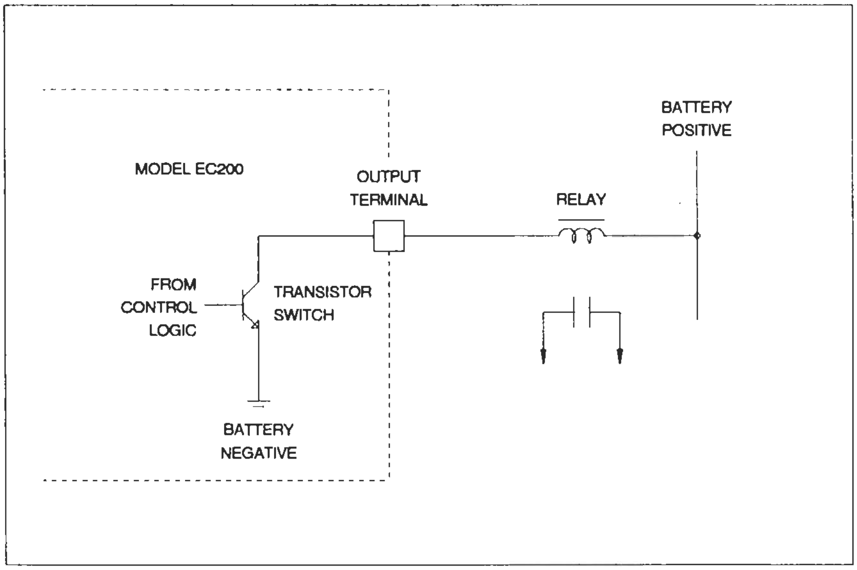

FIGURE 2-2 RELAY DRIVER OUTPUT

The transistor is controlled by internal logic. When the transistor is off, it behaves like an open switch, and no current flows through the relay coil (figure 2-3). When the transistor is turned on, it acts as a closed switch, and current flows through the relay coil and transistor to battery negative, completing the circuit and energizing the relay coil (figure 2-4).

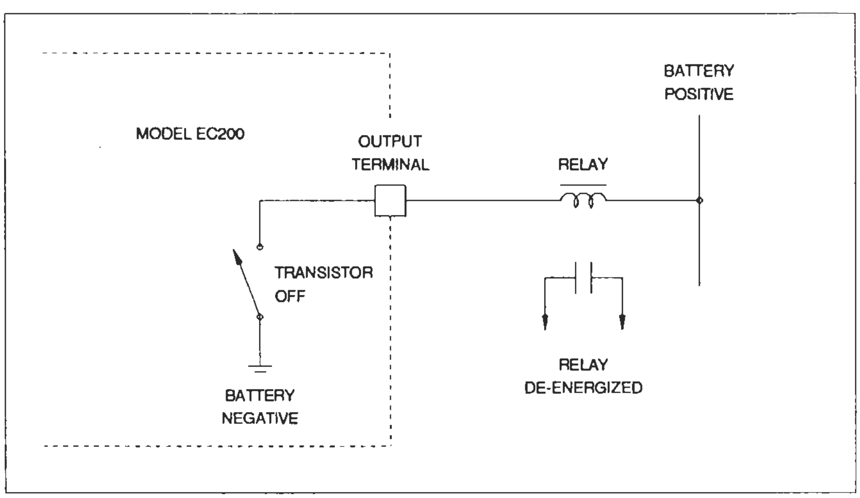

FIGURE 2-3 OUTPUT DE-ENERGIZED

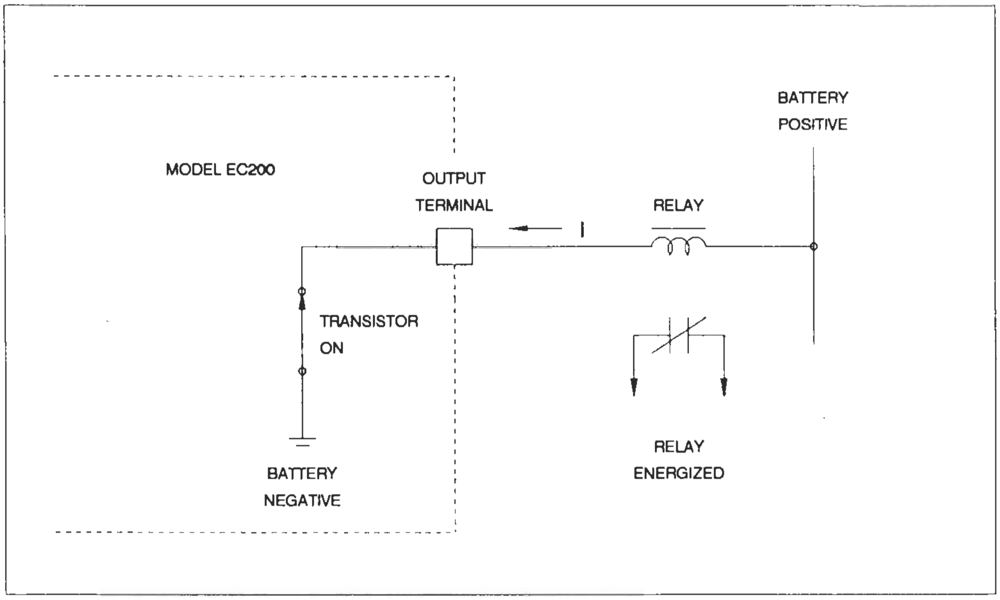

FIGURE 2-4 OUTPUT ENERGIZED

Note: the output transistors are rated at **1 ADC MAXIMUM @ 30 VDC**. Therefore, if relays or solenoids drawing more than 1 ADC (such as fuel or starter solenoids) are to be activated by the transistor output, slave relays **MUST** be used. Figure 2-5 illustrates a typical slave relay application.

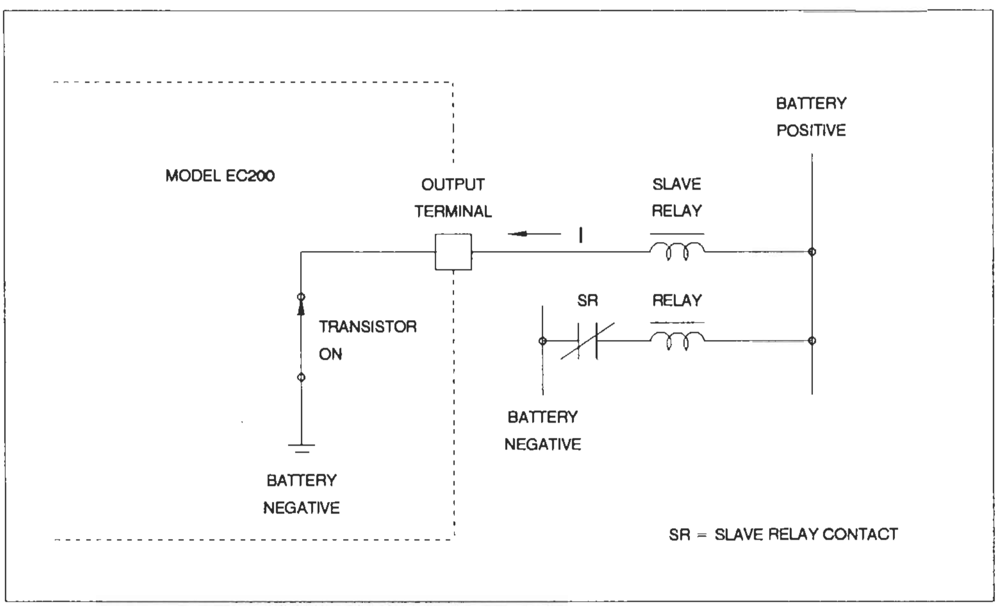

FIGURE 2-5 SLAVE RELAY CONNECTION

2.3.1 Fuel

The operation of the fuel output (terminal 15) is determined by the type of fuel control selected (section 3.7). If ETR operation is chosen, the output is energized whenever the engine is to run. The output will remain energized until the engine is signalled to stop, or a shutdown occurs.

If ETS operation is chosen, the output is energized whenever the unit is signalled to stop or a shutdown occurs, and will remain energized for approximately 30 seconds.

2.3.2 Crank

The crank output (terminal 16) is energized whenever the engine is to crank. The output is de-energized when engine speed exceeds the speedswitch low setpoint.

2.3.3 No Speed Signal

This output (terminal 17) is energized whenever the engine is shut down on a No Speed Signal fault.

2.3.4 Overcrank

This output (terminal 18) is energized whenever the engine is shut down on an Overcrank fault.

2.3.5 Low Oil Pressure

This output (terminal 19) is energized whenever the engine is shut down on a Low Oil Pressure fault.

2.3.6 High Coolant Temperature

This output (terminal 20) is energized whenever the engine is shut down on a High Coolant Temperature fault.

2.3.7 Overspeed

This output (terminal 21) is energized whenever the engine is shut down on an Overspeed fault.

2.3.8 Annunciator 6 (Spare)

This output (terminal 22) is energized whenever the engine is shut down due to contact closure on terminal 7.

2.3.9 Annunciator 7 (Spare)

This output (terminal 23) is energized whenever the engine is shut down due to contact closure on terminal 8.

2.3.10 Annunciator 8 (Spare)

This output (terminal 24) is energized whenever the engine is shut down due to contact closure on terminal 9.

NOTES:

SECTION 3. OPERATION

3.1 OPERATING MODE

The EC200 has two operating modes, MANUAL and AUTOMATIC. The mode is selected by connecting battery negative to either terminal 1 (manual operation) or terminal 2 (automatic operation). Typically, this is done using a three-position function switch (supplied by others). The third position (OFF), will reset any alarms generated by the control following a shutdown. Figure 3-1 illustrates the recommended switch arrangement.

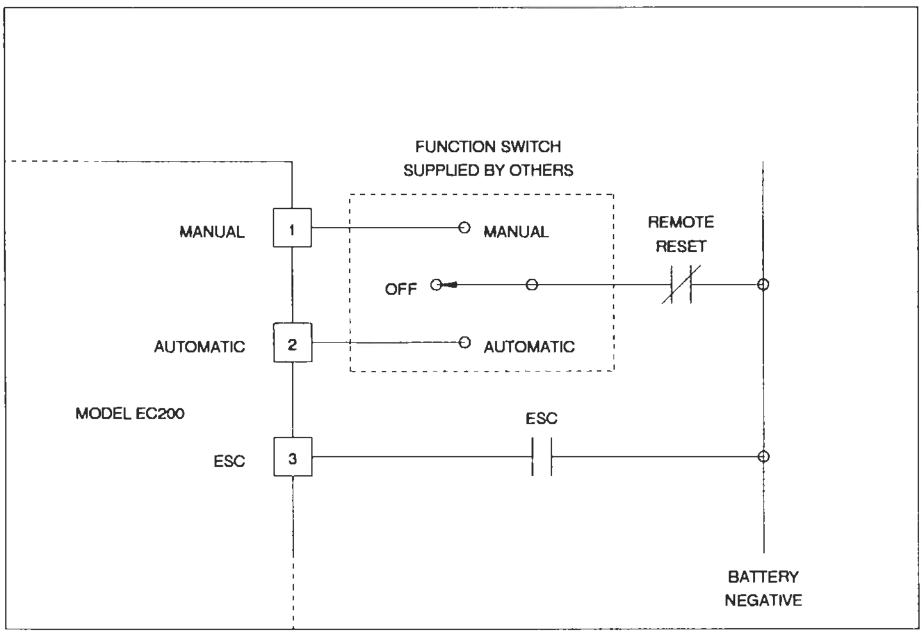

FIGURE 3-1 FUNCTION SWITCH AND ENGINE START CONTACT

3.1.1 Manual Operation

Shorting terminal 1 to battery negative will signal the engine to start and run. To stop the engine, remove battery negative from terminal 1.

3.1.2 Automatic Operation

Shorting terminal 2 to battery negative will select Automatic operation, but will not signal the engine to start. A "Switch In Auto" lamp located on the front panel is energized when the control is in this mode.

When Automatic operation is selected, the start signal is issued when the "engine start contact" (ESC) input (terminal 3) is grounded. To stop the engine, remove battery negative from terminal 3.

NOTE: The ESC input is not active unless the control is in the Automatic mode of operation.

3.1.3 Remote Reset

The EC200 can be reset from a remote location by placing a normally closed switch contact between battery negative and the function switch. Opening the contact will remove battery negative from terminals 1 and 2, resetting the control.

3.2 ELECTRONIC SPEEDSWITCH

An electronic speedswitch is built in to the EC200. The speedswitch disconnects the starter motor when the engine fires, and provides overspeed protection. Two switchpoints—speedswitch low and speedswitch high—are provided to perform these functions. The speedswitch will operate from a speed signal as low as 0.02 VAC or from a signal considerably greater than 24 VAC without damage.

Engine speed can be derived from one of two sources; the frequency of the generator output voltage, or from a magnetic pickup. The source is selected using pole 7 of the option selector switch.

If 60 Hz. sensing is selected, a transformer (supplied by others) must be used to transform the generator output voltage to a nominal 24 VAC level before it is applied to terminals 11 and 12 of the control. It is extremely important to isolate the transformer wiring from other cabling. This is described in detail in section 5.1.

If magnetic pickup sensing is selected, a magnetic pickup (supplied by others), is mounted on the engine flywheel housing. Twisted-pair cabling should be used to connect the pickup output to terminals 11 and 12.

3.2.1 Speedswitch Low

Speedswitch low is used to disconnect the starter. When the engine fires and comes up to speed, speedswitch low opens and the starter output is de-energized. The switchpoint is then latched open to ensure that the starter does not re-engage if the speed signal is lost. Speedswitch low is adjustable from 30% to 60% of nominal engine speed. The setpoint is adjusted with a multi-turn potentiometer labeled SPEEDSWITCH LOW, located on the back of the control. To increase the setpoint, turn the potentiometer clockwise. Speedswitch low is factory preset to 33% of nominal engine speed.

3.2.2 Speedswitch High

Speedswitch high is used for overspeed protection. If engine speed exceeds the switchpoint, the generator is immediately shut down and locked out on an overspeed fault. Speedswitch low is adjustable from 90% to 120% of nominal engine speed. The setpoint is adjusted with a multi-turn potentiometer labeled SPEEDSWITCH HIGH, located on the back of the control. To increase the overspeed setpoint, turn the potentiometer clockwise. Speedswitch high is factory preset to operate when engine speed reaches 110% of nominal (66 Hz. or 4500 Hz. for magnetic pickup sensing).

3.2.3 Speedswitch Calibration

Both speedswitch setpoints have a range of adjustment. A third potentiometer, labeled SPEEDSWITCH CAL is used to set the "window" for the range of adjustment. This concept is most easily understood using a diagram. Figure 3-2 illustrates the range of adjustment for both switchpoints when the speedswitch is properly calibrated. Note that the 100% point is 60 Hz. if speed sensing is derived from generator frequency, and approximately 4100 Hz. if speed sensing is taken from a magnetic pickup.

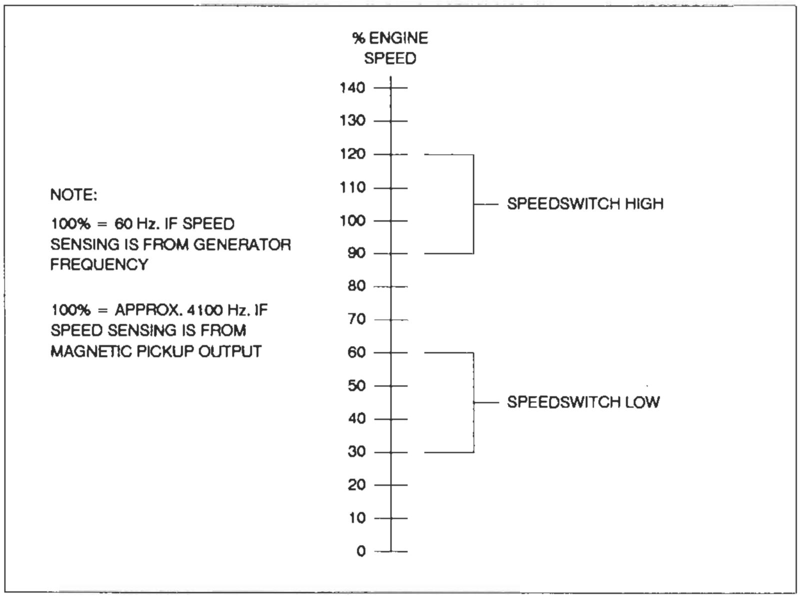

FIGURE 3-2 CORRECT SPEEDSWITCH CALIBRATION

Figure 3-3 illustrates the range of adjustment for both switchpoints when the calibration potentiometer is set to minimum (fully counter-clockwise), and maximum (fully clockwise).

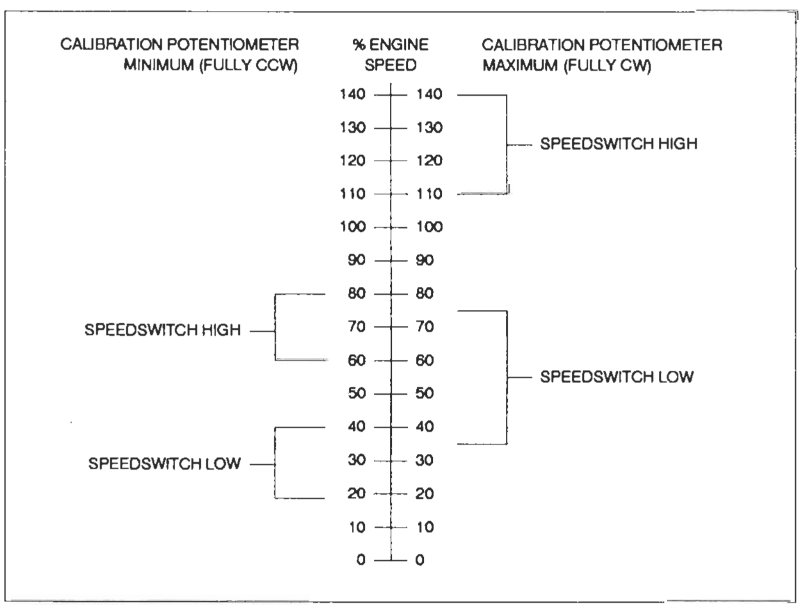

FIGURE 3-3 SPEEDSWITCH CALIBRATION MIN AND MAX POINTS

The speedswitch is calibrated before the control is shipped, and a white sealing compound is applied to the SPEEDSWITCH CAL potentiometer. However, if magnetic pickup sensing is selected, it may be necessary to adjust the "window" up or down, depending upon the nominal speed of the engine, and the number of teeth on the flywheel.

3.2.4 Loss Of Speed Signal

The continuity of the speed signal is constantly checked by the speedswitch while the engine is cranking or running. If the speed signal is lost, "time delay loss of signal" (TDLS) is initiated. If the signal is not received before TDLS times out (approximately 5 seconds), the engine is shut down and locked out on a loss of signal fault.

3.3 TACHOMETER DRIVE

A signal derived from the speedswitch is conditioned to provide a 0 - 1 mADC current sink proportional to engine speed. The output is available from terminal 10, and is suitable for driving a 0 - 1 mADC meter calibrated in RPM. Figure 3-3 illustrates the proper method of connecting the tachometer. Note: this output will not operate with an AC meter movement.

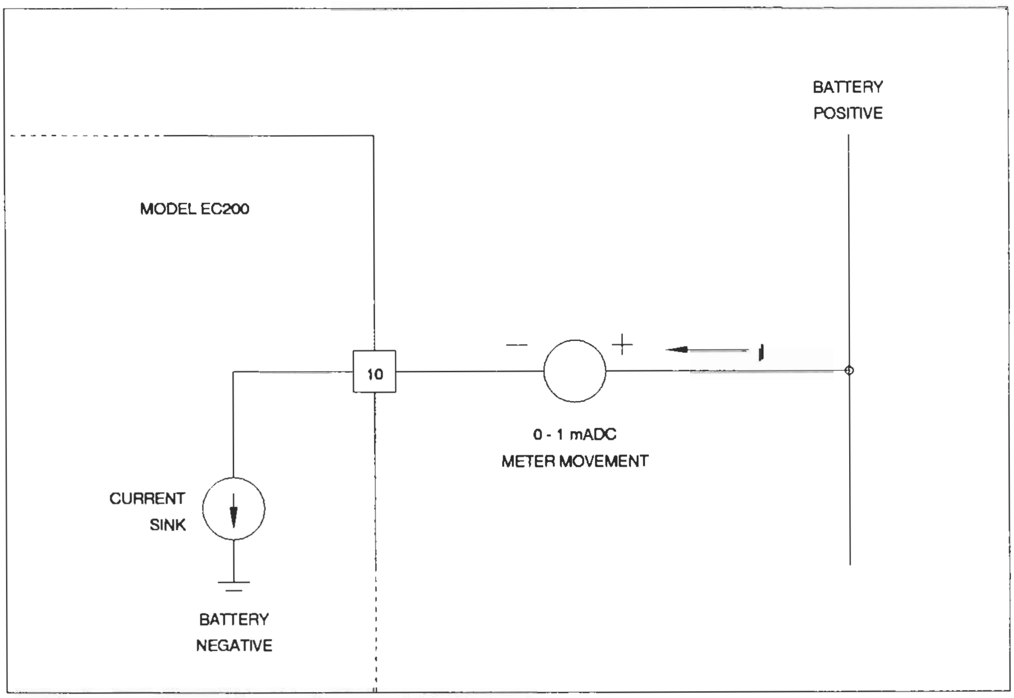

FIGURE 3-4 TACHOMETER CONNECTION

3.3.1 Tachometer Calibration

A single multi-turn potentiometer located on the back of the controller is provided to calibrate the tachometer. The potentiometer permits the current sink to be adjusted from 0.7 mADC to 1.2 mADC at 100% speed (clockwise to increase). This adjustment is done at the factory before the controller is shipped. However, if field adjustment is necessary, simply run the engine at nominal speed, and slowly turn the TACHOMETER potentiometer until the tachometer displays actual engine speed.

3.4 ALARMS

The EC200 provides eight alarms. If an alarm is received while the engine is running, the engine is shut down and locked out. A lamp on the front panel of the control will indicate which alarm occurred, and the appropriate relay driver output will be energized. In order to reset the alarm, place the function switch in the OFF position (no connection to terminals 1 or 2).

3.4.1 No Speed Signal

This fault occurs when the speed signal is lost for a period of five seconds while the engine is cranking or running. The No Speed Signal lamp and relay driver output will be energized following this fault.

3.4.2 Overcrank

This fault occurs if engine speed does not exceed the speedswitch low setpoint before the crank delay times out. The Overcrank lamp and relay driver output will be energized following this fault.

3.4.3 Low Oil Pressure

This fault occurs when terminal 5 is grounded to battery negative. The fault is inhibited on startup while time delay bypass (TDBP) times to allow oil pressure to reach prescribed limits. If the fault remains when TDBP times out, the engine is shut down, and the Low Oil Pressure lamp and relay driver output will be energized.

3.4.4 High Coolant Temperature

This fault occurs when terminal 6 is grounded to battery negative. The alarm is also inhibited on startup. Operation is identical to low oil pressure described above.

3.4.5 Overspeed

This fault occurs if engine speed exceeds the speedswitch high setpoint. The Overspeed lamp and relay driver output will be energized following this fault.

3.4.6 Annunciator 6

This fault occurs when terminal 7 is grounded to battery negative. The alarm is inhibited on startup. If the fault remains when TDBP times out, the engine is shut down and the A6 lamp and relay driver output are energized.

A "time delay anticipated failure" (TDAF) can also be incorporated into this circuit using the option selector switch. If TDAF is selected, the fault is inhibited until the delay has timed out. Refer to section 3.6.4 for additional information.

3.4.7 Annunciator 7

This fault occurs when terminal 8 is grounded to battery negative. Alarm operation is identical to annunciator 6 described above.

3.4.8 Annunciator 8

This fault occurs when terminal 9 is grounded to battery negative. Alarm operation is identical to annunciator 6 described on the previous page.

3.5 FLASHING PANEL LAMPS

Several of the EC200 panel lamps may flash during engine operation to indicate specific conditions. A flashing LOW OIL PRESSURE lamp indicates that the oil pressure contact was not closed on engine startup (the start procedure is inhibited until the contact is closed). The spare annunciator lamps (A6, A7, A8) flash if a fault exists, and TDAF is timing. This will only occur if TDAF is selected for the alarms. Refer to section 3.6.4 for details.

3.6 TIME DELAYS

The EC200 is equipped with five adjustable and two fixed time delays. The adjustable delays are set using multi-turn potentiometers located on the back of the control. To increase a delay, turn the relevant potentiometer clockwise. A table summarizing the range of adjustment for each delay, factory preset value, and adjustment potentiometer is located at the end of this subsection.

3.6.1 Time Delay Engine Start (TDES)

TDES inserts a delay between the closing of the engine start contact and the initiation of the engine start procedure. If the start contact opens before TDES times out, the delay is reset, and engine operation does not occur. This delay is only active when the function switch is in Auto, and TDES is selected. This is done by closing pole 5 of the option selector switch.

3.6.2 Time Delay Crank (TDCR)

TDCR determines the length of time the engine will crank and rest during each crank cycle before an overcrank fault occurs, assuming the engine does not start.

3.6.3 Time Delay Bypass (TDBP)

TDBP determines the length of time that low oil pressure, high coolant temperature and spare alarm faults are inhibited on startup. TDBP is initiated when the engine begins to run, as determined by the opening of speedswitch low.

3.6.4 Time Delay Anticipated Fail (TDAF)

TDAF inserts a delay between a spare alarm fault being received, and engine shutdown occurring. This delay can be switched in or out of the spare alarm (A6, A7, A8) circuitry using poles 8, 9 and 10 of the option selector switch. If the delay is selected for a spare alarm and a fault occurs, the panel lamp assigned to the alarm will flash while TDAF times out. If the fault is removed before TDAF times out, the delay is reset, and no shutdown occurs.

3.6.5 Time Delay Cool Down (TDCD)

TDCD inserts a delay between the opening of the engine start contact and termination of engine operation. This delay is only active when the selector switch is in Auto, and TDCD is selected. This is done by closing pole 6 of the option selector switch.

3.6.6 Time Delay Loss Of Signal (TDLS)

TDLS determines the length of time that the engine is permitted to crank or run when no speed signal is received. If the signal is restored while TDLS is timing, the delay is reset. If the delay times out, the engine is shut down and locked out.

3.6.7 Time Delay Fuel (TDF)

TDF determines the length of time the fuel output is energized after the engine start contact is opened. The fuel output is energized when the delay is initiated, and is terminated when the delay times out.This delay is only active if "energized to stop" fuel control is selected.

TIME DELAY	POTENTIOMETER	RANGE OF ADJUSTMENT	FACTORY SETTING
TDES	ENGINE START DELAY	1.5 - 15 SECONDS	5 SECONDS
TDCR	CRANK DELAY	6 - 60 SECONDS	20 SECONDS
TDBP	OIL BYPASS DELAY	6 - 60 SECONDS	10 SECONDS
TDAF	ANTIC. FAIL DELAY	1.5 - 15 SECONDS	10 SECONDS
TDCD	COOL DOWN DELAY	30 SEC. - 5 MIN.	60 SECONDS
TDLS	NONE	NOT ADJUSTABLE	5 SECONDS
TDF	NONE	NOT ADJUSTABLE	30 SECONDS

TABLE 3-1 TIME DELAY SUMMARY

3.7 OPTION SELECTOR SWITCH

The EC200 is equipped with a 10-pole option selector switch located on the back of the control. This switch permits the insertion or deletion of various options which customize the control logic of the EC200. All poles are placed in the CLOSED position before the unit is shipped. Pole functions are listed in table 3-2 on the following page.

Pole Number	Function
1 2 3	Poles 1, 2 and 3 determine the number of crank cycles that will occur before an overcrank fault is issued, assuming the engine fails to start. If more than one crank cycle is selected, a rest delay proportional to the crank delay is inserted between each crank attempt. Closing all three poles will select 1 crank. Opening pole 1 will select 2 crank cycles. Opening poles 1 and 2 will select 3 crank cycles. Opening all three poles will select 4 crank cycles.
4	Pole 4 selects the type of fuel control to be used. If "energized to run" (ETR) operation is selected, the fuel output is energized on engine start, and will remain energized until the engine is stopped or is shut down. If "energized to stop" (ETS) operation is selected, the fuel output is energized when the engine is stopped or shut down, and for 30 seconds thereafter. Closing pole 4 selects ETR. Opening pole 4 selects ETS.
5	Pole 5 inserts or deletes time delay engine start (TDES). TDES provides a delay between the closing of the engine start contact, and engine startup. This only applies when the function switch is in Automatic. Closing pole 5 inserts TDES. Opening pole 5 deletes TDES.
6	Pole 6 inserts or deletes time delay cool down (TDCD). TDCD provides a delay between the opening of the engine start contact and the termination of engine operation. This only applies when the function switch is in Auto. Closing pole 6 inserts TDCD. Opening pole 6 deletes TDCD.
7	Pole 7 selects the speed signal source for the speedswitch. Closing pole 7 selects 60 Hz. sensing from the generator output voltage. Opening pole 7 selects magnetic pickup sensing.
8	Pole 8 inserts or deletes time delay anticipated fail (TDAF) for annunciator A6. TDAF provides a delay between contact closure on terminal 7, and engine shutdown. Closing pole 8 inserts TDAF. Opening pole 8 deletes TDAF.
9	Pole 9 inserts or deletes TDAF for annunciator A7. Closing pole 9 inserts TDAF. Opening pole 9 deletes TDAF.
10	Pole 10 inserts or deletes TDAF for annunciator A8. Closing pole 10 inserts TDAF. Opening pole 10 deletes TDAF.

TABLE 3-2 OPTION SELECTOR SWITCH SUMMARY

3.8 SEQUENCE OF OPERATION

The following sequence of operation assumes that the option selector switch is left at default settings; that is, all poles closed. Several of the options that may be selected using this switch will alter the control sequence of the EC200. These options are described in section 3.7.

When the EC200 receives a start signal (in either Manual or Automatic), the LOP input is checked. If a low oil pressure condition is not sensed, startup is inhibited, and the low oil pressure lamp flashes to indicate the problem. Subsequent closure of the low oil pressure switch will re-initiate the startup procedure. The EC200 starts the engine by energizing the fuel and crank outputs and monitoring the presence of the speed signal. As the engine fires and comes up to speed the starter is disconnected and TDBP is initiated. At the end of TDBP the oil pressure, coolant temperature and spare alarm circuits are armed. A subsequent closure of any contact will cause a shutdown and the appropriate lamp will be lit on the front panel. The EC200 shuts down the engine by de-energizing the fuel output. All shutdowns are reset by placing the function switch in OFF.

If the speed of the engine exceeds the speedswitch high setpoint, the engine is immediately shut down and locked out. If the engine has not started when the crank delay expires the engine is shut down on an Overcrank fault. If the speed signal is lost (or does not exceed 20 mV while cranking) for a period of 5 seconds, the unit is shut down on a No Speed Signal fault.

At the end of the required run period, removing the start signal will cause the fuel circuit to de-energize, stopping the engine.

NOTES:

SECTION 4. SPECIFICATIONS

Parameter	Specification
Logic Inputs	Terminals 1 to 9 Source Impedance: 680 Kohms Open Circuit Voltage: 5 VDC Short terminal to battery negative (terminal 14) to activate input
Tachometer Drive	Terminal 10 0 - 1 mADC proportional to engine speed Suitable for driving 0 - 1 mADC meter calibrated in RPM Adjustable from 0.7 to 1.2 mADC at 100% speed
Speed Signal	Terminals 11 and 12 Input: 24 VAC (nominal) 1 VA or greater (typical) Can be derived from generator voltage or magnetic pickup
Battery Voltage	Terminal 13 (positive) and 14 (negative) Input Range: 8 - 30 VDC @ 0.25 ADC
Relay Driver Outputs	Terminals 15 to 24 Rating: 1 ADC @ 30 VDC (maximum)
Chassis	Brushed stainless steel front panel Iridited aluminum rear chassis
Terminal Block	24 pole screw type
Dimensions	12" x 12" x 1.5" HWD
Weight	4 pounds
Operating Temperature	- 20 to +55 °C

NOTES:

SECTION 5. INSTALLATION

Connecting the EC200 to external circuitry or devices is a relatively simple procedure. The recommended connection diagram is presented in figure 5-4. Subsections 5-1 through 5-3 describe areas requiring particular attention.

5.1 SPEED SIGNAL WIRING

The speedswitch input has a high sensitivity, operating from a signal as small as 0.02 VAC. As a result, problems may arise if precautions are not taken when wiring the speed sensor input (terminals 11 and 12). For example, suppose the EC200 was mounted on a generator with a block heater powered by a commercial 60 Hz. line. If some of the speed sensor wiring was common with the block heater wiring, the IR drop along the common wiring may be interpreted by the EC200 as a speed signal. As a result, the starter would not engage, and the unit would fail to start. To eliminate this problem, it is recommended that the speed sensing wiring be completely isolated from any other wiring on the generator set.

Problems may also arise if the EC200 is used in conjunction with a poorly filtered battery charger. The 120 Hz. ripple voltage at the output of the battery charger may be interpreted as an overspeed condition, resulting in an engine shutdown. Again, this problem is solved by ensuring that the speed signal wiring is isolated from all other wiring on the generator set.

Lastly, the speedswitch input wiring should not be switched or interrupted in any manner.

5.2 LOGIC INPUTS

The logic inputs (terminals 1 to 9) are high impedance, and noise protection is fitted to each channel. However, if lead lengths exceed 50 feet, it is recommended that slave relays be used at the EC200 location, as illustrated in figure 5-1.

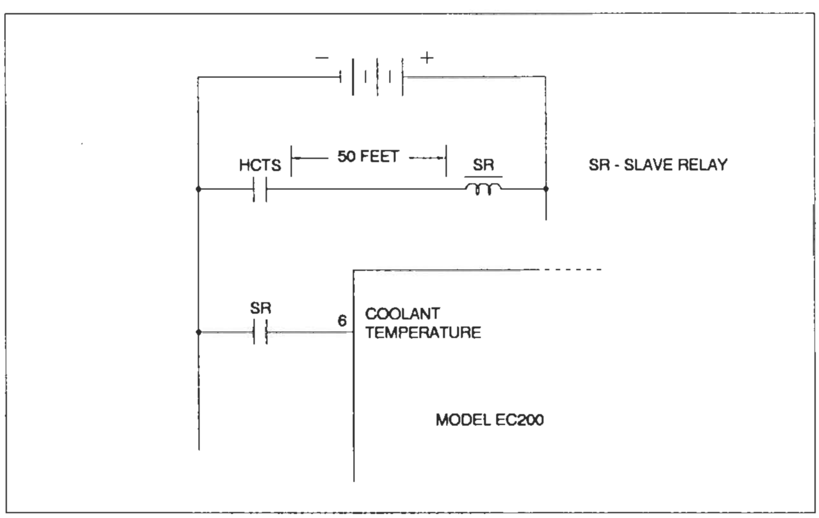

FIGURE 5-1 LOGIC INPUT WITH SLAVE RELAY

An alternate solution is to connect a 1 to 2 Kohm, 1 W resistor from the input terminal to battery positive. This provides a low impedance path shunting noise away from the input. This is illustrated in diagram 5-2.

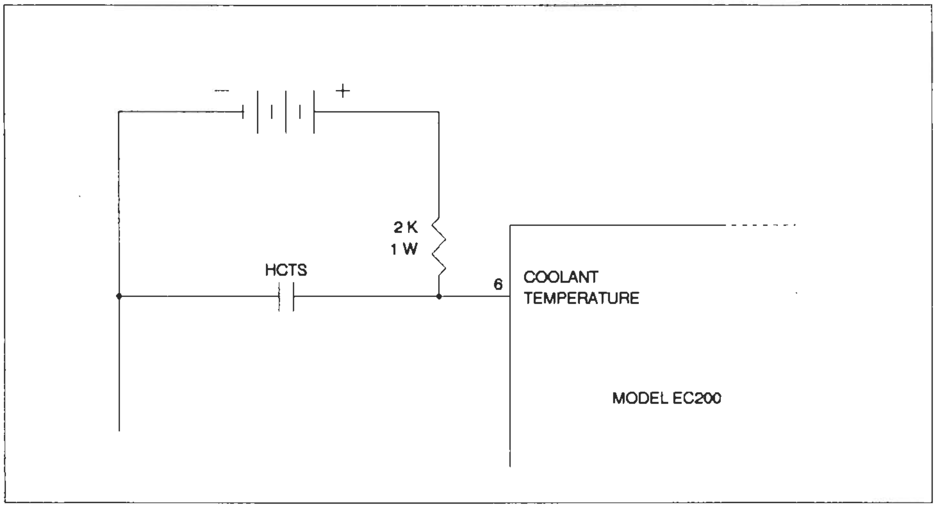

FIGURE 5-2 LOGIC INPUT WITH PULLUP RESISTOR

5.3 EXTERNAL RELAYS

It is a good practice to connect a diode across any relay or solenoid connected to the same DC source as the EC200 in order to eliminate the effects of counter-electromotive force (CEMF). The polarity of the diode is indicated in the following diagram.

The diode current rating should meet or exceed that of the coil, and the voltage rating must be adequate for the system. Typical diodes for this purpose are 1N4002, 1N4003 and 1N4004.

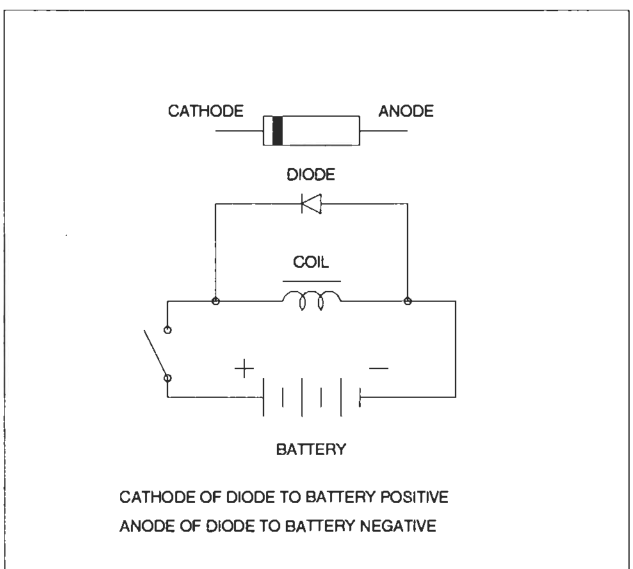

FIGURE 5-3 CEMF SUPPRESSION DIODE

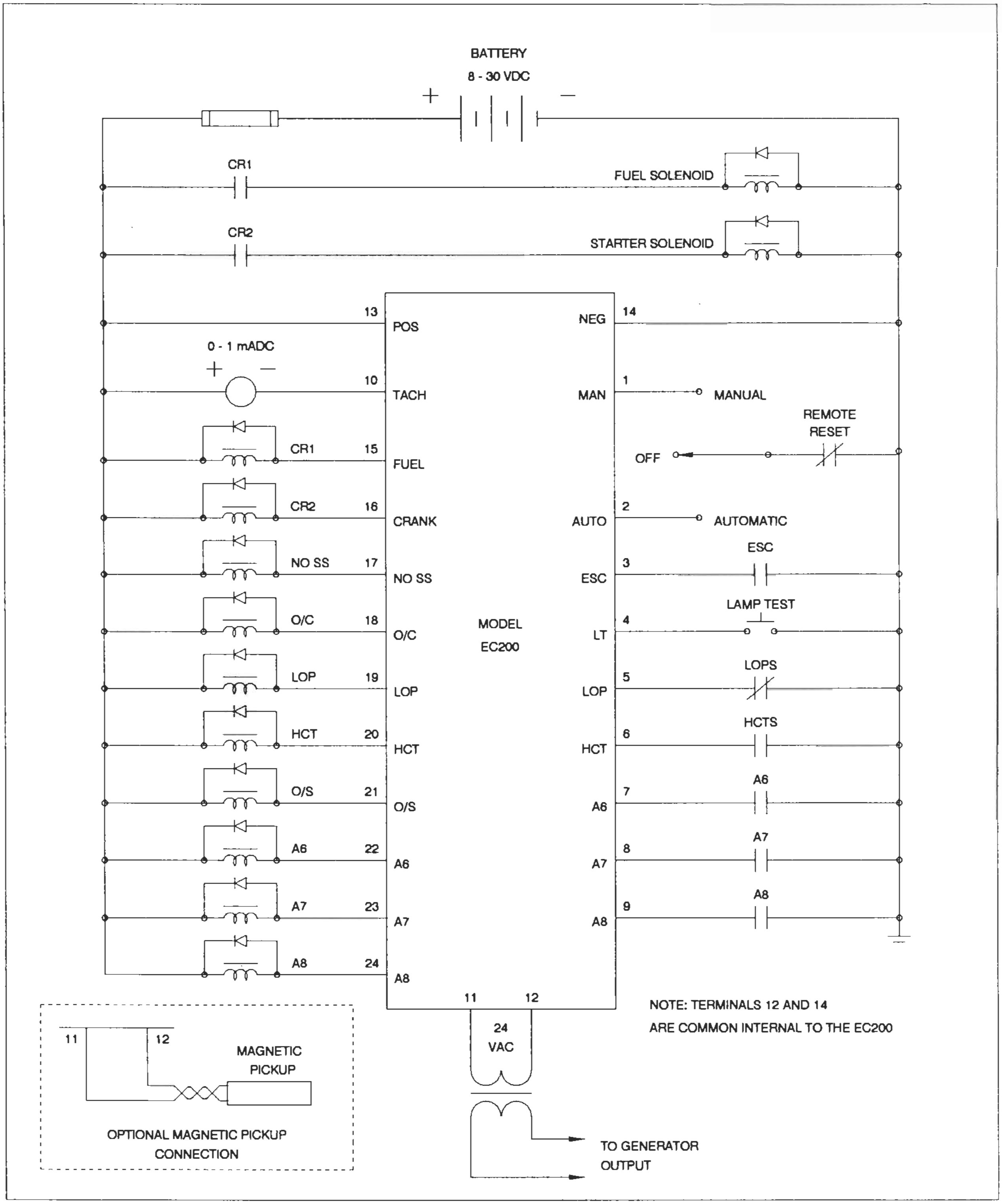

FIGURE 5-4 EC200 CONNECTION DIAGRAM

5.4 MOUNTING

The EC200 is intended to be flush mounted in the relay panel door. Four 10-32 machine screws are required for this purpose. Hole spacing and cutout dimensions are detailed in the following diagram.

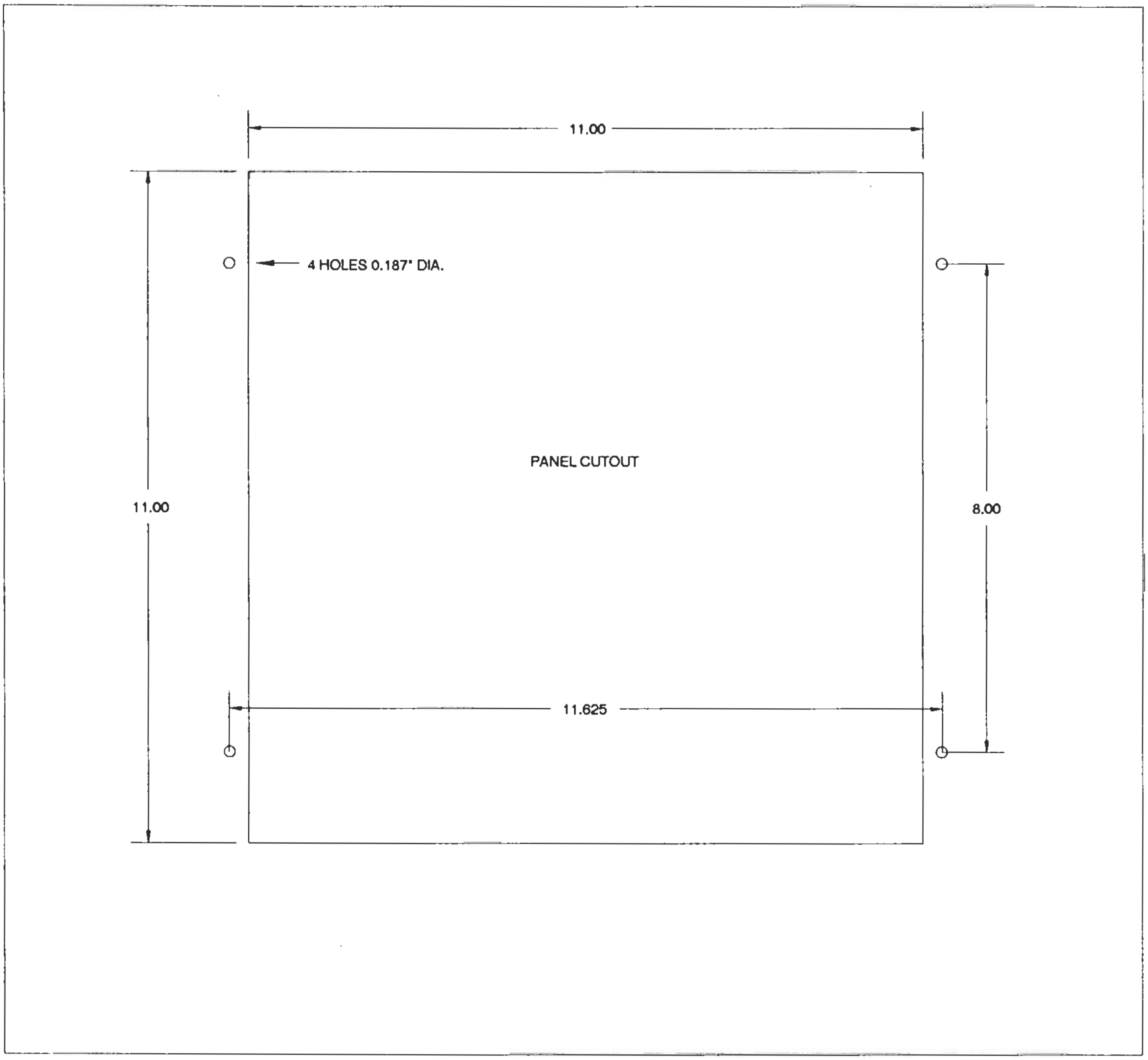

FIGURE 5-5 MODEL EC200 MOUNTING DIMENSIONS

SECTION 6. MAINTENANCE

The EC200 is a completely solid state device. The only recommended maintenance is periodic inspection for dust or heat buildup. If this occurs, disassemble the unit and remove the dust with a soft bristle brush.

6.1 BATTERY CHARGERS

A poorly filtered battery charger may produce a dangerous voltage surge at the DC input of the EC200 greater than the nominal 30 VDC maximum permitted. This occurs when the highly capacitive battery is removed from the DC bus for maintenance purposes. Therefore, it is strongly recommended the **BATTERY CHARGER ALWAYS BE TURNED OFF BEFORE REMOVING THE BATTERY FROM THE BUS.**

NOTE: random alarms may be generated by the EC200 when DC power is reapplied to the control following maintenance. To reset the alarms, place the function switch in OFF.