Technical Information

TI
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SPEC 200 NEST ALARMS

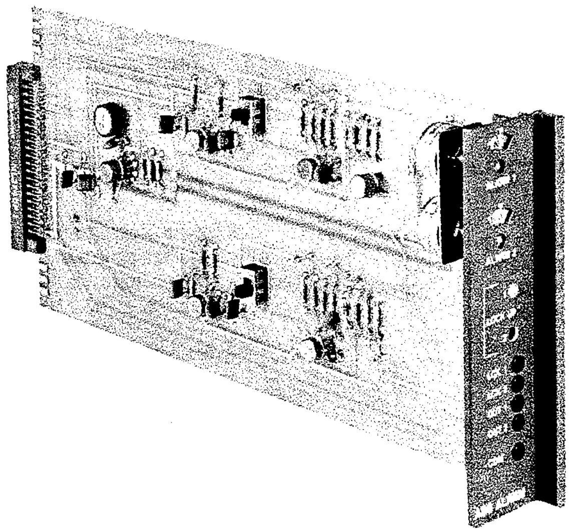

Figure 1. SPEC 200 Nest Alarms

GENERAL

SPEC 200* Nest Alarms are available in three varieties: dual absolute or duplex deviation or duplex difference. The nest alarm is a signal monitor which changes output state when a variable passes through a predetermined alarm set point. Two types of alarm conditions can occur, high and low. A high alarm condition exists when the variable is HIGHER than the alarm set point. A low alarm condition exists when the variable is BELOW the alarm set point.

Three basic alarm cards are offered, one for each of the three types of nest alarms. Essentially, the dual absolute alarm card, shown in Figure 1, consists of two single absolute alarms with a common power supply. Each alarm has one input (0 to 10 volts dc) and one adjustable alarm set point with one output (either solid state or relay). The input is compared with the adjustable alarm set point; an output is provided when the input passes the related alarm set-point value. The alarm set point is adjustable from 0.5 to 99 percent of the input span.

The duplex deviation alarm is similar in appearance to the dual absolute alarm card. However, the duplex deviation alarm monitors the positive or negative deviation between two input signals and provides output changes when the deviation passes predetermined alarm set points. The duplex deviation alarm has two inputs (each 0 to 10 volts dc), two adjustable alarm set points and two outputs (either solid state or relay). The two inputs are opposed at the input terminals to produce a difference signal which is buffered to make the deviation signal. The deviation signal can be positive or negative and is compared with each alarm set point. An output change is provided when the deviation value is positive and passes the related high alarm set-point value or when it is negative and passes the related low alarm set-point value. Each alarm set point can be selected for high or low alarm operation by the position of a jumper located on the board assembly. Both are individually adjustable, 0.5 to 99 percent of span from null (both inputs equal). The duplex deviation alarm is most commonly used to monitor measurement/set-point deviations in a controller.

The duplex difference alarm card is also similar in appearance to the dual absolute alarm card. However, the duplex difference alarm monitors the difference between two input signals (A and B) when Input A is the higher. The duplex difference alarm has two inputs (each 0 to 10 volts dc), two adjustable alarm set points and two outputs (either solid state or relay). The two inputs are opposed at the input terminals to produce a difference signal. Unlike the deviation alarm card, however, this alarm is actuated only by a positive difference signal which results when Input A is higher than Input B. Any negative difference signals are treated as low alarm conditions. The difference signal is compared with each alarm set point. Each alarm set point can be selected for high or low operation by the position of a jumper located on the board assembly. A high alarm condition exists when the difference signal is positive and GREATER than the alarm set point; a low alarm action exists when the difference signal is positive but LOWER than the alarm set point. Therefore, various alarm actions such as high-high, low-low, or high-low can be selected on the difference alarm card.

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FOXBORO

SPECIFICATIONS

Model Number:
2AP+ALM (with module)
2AX+ALM (without module)
-AR Dual absolute alarm, relay output
-AS Dual absolute alarm, solid-state output
-BR Duplex deviation alarm, relay output
-BS Duplex deviation alarm, solid-state output
-CR Duplex difference alarm, relay output
-CS Duplex difference alarm, solid-state output

Mounting: Occupies one space in SPEC 200 nest

Electrical Classification:
FM and CSA certified for Ordinary Locations

Power Requirements:
+15 V dc ±5% at 80 mA maximum (relay version) or 50 mA maximum (solid-state version)
-15 V dc ±5% at 60 mA maximum (relay version) or 25 mA maximum (solid-state version)

Input Signals: 0 to 10 V dc

Input Resistance:
Absolute alarm: 20 kilohms minimum
Deviation, difference: 150 kilohms minimum

Output Signals:
Relay version: contacts closed, will switch 100 mA at 28 V dc maximum, resistive load
Solid-state version: logic or transistor switch determined by jumpers on board assembly
Logic: (HI) high logic level at 15 V dc at 5 kilohms source, (LO) low logic level at 0.5 V dc maximum (will sink 50 mA from load)
Switch: (HI) open transistor switch, 35 V dc maximum (LO) closed transistor switch (will sink 50 mA from load)

Adjustments:
Set point: 0.5 to 99% of input span
Lockup: 0.5 to 10% of input span (uncalibrated)

Accuracy (Alarm Set Point):
Dial: ±2% of input span (styles A and B)
Test Jack: ±1% of input span (style B)

Repeatability:
Set point: less than 0.5% of input span
Lockup: less than 0.1% of input span
Alarm point: less than 0.1% of input span

Response Time:
15 ±5 milliseconds, based on input originally at 25%, step-changed to 75% with alarm set point at 50% of input span

Supply Voltage Effect:
Alarm point shift less than 0.25% of input span for a 5% change in supply voltage within normal operating limits

Ambient Temperature Limits: 5 and 50°C (40 and 120°F)

Ambient Temperature Effect:
Alarm point shift less than 0.5% on input span for any 25°C (50°F) change within normal operating limits

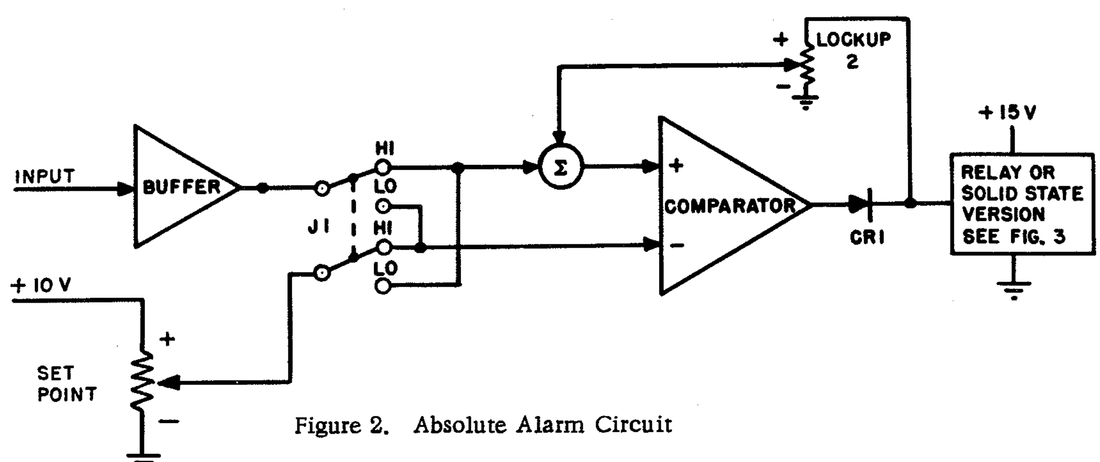

Figure 2. Absolute Alarm Circuit

PRINCIPLE OF OPERATION

Absolute Alarms

Figure 2 is a simplified schematic of an absolute alarm circuit. There are two such circuits on each absolute card.

The alarm card receives a 0 to 10 volt dc input signal which is fed to a unity gain buffer amplifier. The buffer amplifier provides common mode and noise rejection. The output of the buffer amplifier feeds the input of the comparator through Jumpers J1. The adjustable alarm set-point signal also feeds the input of the comparator through Jumpers J1. The position of the jumpers determines the HI or LO alarm action. For a high alarm action, the input signal must be greater than the alarm set-point voltage to cause the output to change state. For a low alarm action, the input signal must be less than the alarm set-point voltage to cause the output to change state.

With Jumpers J1 in the HI alarm position, the input signal is connected to the noninverting (+) input of the comparator, and the alarm set point is connected to the inverting (-) input of the comparator. When the input signal is LESS than the alarm set point, the output of the comparator is at the negative supply voltage. Diode CR1 will prevent the output current from conducting to Transistor Q1 and to the lockup resistor. In this condition, Transistor Q1 (see Figure 3) will not conduct and the voltage across the lockup resistor will be zero. When the input signal is GREATER than the alarm set point, the output of the comparator is at the positive supply voltage, Diode CR1 will pass the output current to Transistor Q1 and to the lockup resistor. In this condition, Transistor Q1 will conduct, and the output circuit is completed. The lockup voltage is fed back to the noninverting (+) input of the comparator. This feedback signal is added to the input signal to increase the difference between the two inputs of the comparator. For the output of the comparator to change in polarity, the input signal must decrease below the alarm set point by the amount of lockup voltage. The lockup prevents the output of the comparator from switching continuously when the input signal remains very close to the alarm set point.

For low alarm action, with Jumpers J1 in the LO alarm position, the above statements will apply except that the input signal alarm set-point relationship is reversed. Thus, the input signal must be LESS than the alarm set point before the output will change state.

There are two versions of outputs available for the nest alarm card: relay or solid state. The schematics of both versions are shown in Figure 3.

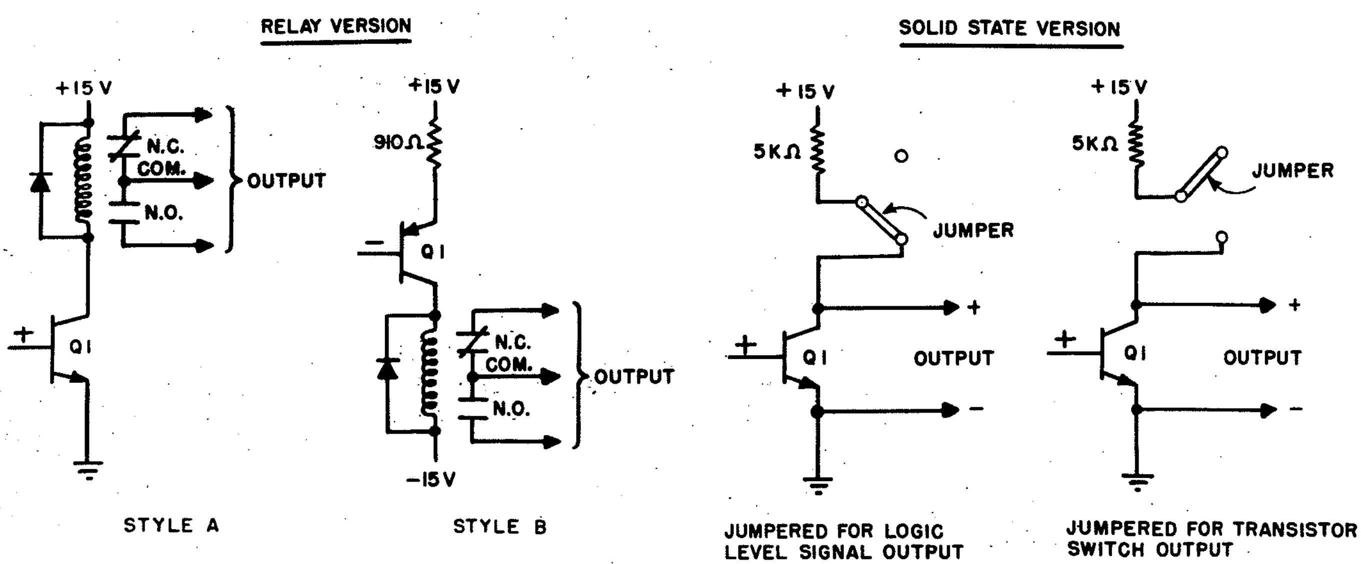

Figure 3. Nest Alarm Outputs

Nest Alarm Outputs

Nest alarm cards are available with either relay type outputs or solid-state outputs. In the relay version, the conduction of the output transistor energizes the relay coil. For Style A of the relay version the output transistor is an NPN (ON with POSITIVE bias), and the relay coil is energized during an alarm condition. For Style B of the relay version the output transistor is a PNP (ON with NEGATIVE bias), and the relay coil is energized during the no-alarm condition for fail-safe operation.

Each relay is a hermetically-sealed reed type (with Form C contacts) which can be connected to an external load and supply voltage. In the solid-state version, a jumper on the board assembly allows selection of one of the two outputs, logic level or transistor switch. Both output circuit versions are diagrammed in Figure 3.

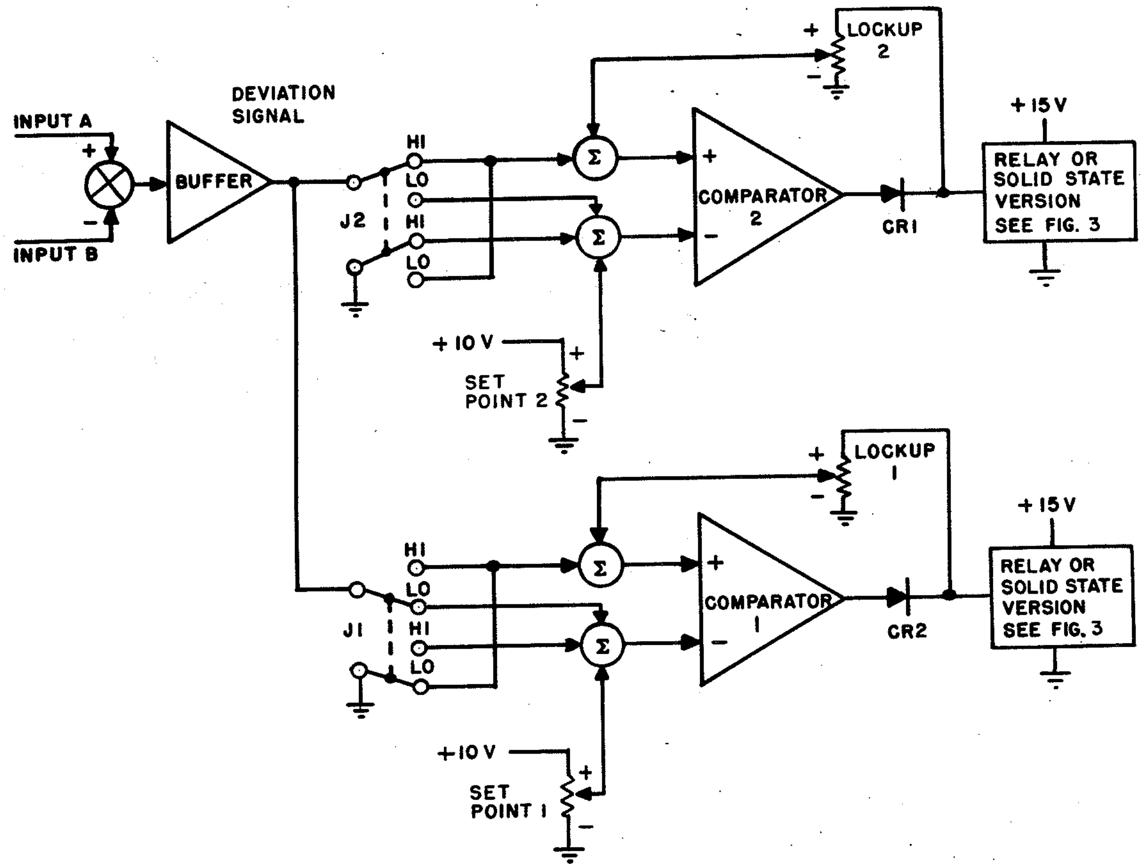

Figure 4. Deviation Alarm Circuit

Deviation Alarms

Figure 4 is a simplified schematic of a deviation alarm circuit. There is only one such circuit on a deviation alarm card.

The alarm card receives two 0 to 10 volts dc input signals. The two inputs are opposed at the input terminals to produce a difference signal. This signal is fed to a unity gain buffer amplifier. The buffer amplifier provides common mode and noise rejection. The output of the buffer is a -10 to +10 volts dc signal, proportional to the difference between the two input signals (Input A - Input B), and is called the deviation signal.

The deviation signal feeds two identical circuits through Jumpers J1 and J2. Either set can be in the HI alarm or LO alarm positions to provide combinations of high and high-high alarm, low and low-low alarm or high and low alarm. For a high alarm action, the deviation signal must be POSITIVE and greater than the alarm set-point voltage (high or high-high respectively). For a low alarm action, the deviation signal must be NEGATIVE with an absolute or numerical value greater than the alarm set-point voltage (low or low-low, respectively). For explanation purposes, Figure 4 shows Jumpers J2 in the HI alarm position and Jumpers J1 in the LO alarm position.

The deviation signal feeds two identical circuits through Jumpers J1 and J2. For explanation purposes, assume that Jumpers J2 are in the HI alarm position and Jumpers J1 are in the LO alarm position.

In the HI alarm position, the Jumpers J2 connect the deviation signal to the noninverting (+) input of Comparator 2; Alarm Set Point 2 is always connected to the inverting (-) input of Comparator 2. When the deviation signal is less than Alarm Set Point 2, the output of Comparator 2 is at the negative supply voltage. Diode CR1 will prevent the output current from conducting to Transistor Q1 (shown in Figure 3, page 3) and Lockup 2. In this condition Transistor Q1 will not conduct, and the voltage across the lockup resistor will be zero. When the deviation signal is positive and greater than Alarm Set Point 2, the output of Comparator 2 is at the positive supply voltage. Diode CR1 will pass the output current to Transistor Q1 and Lockup 2. Transistor Q1 will conduct, to complete the output circuit. Lockup 2 is fed back to the noninverting (+) input of Comparator 2. This feedback signal is added to the deviation signal to increase the difference between the two inputs of the comparator. For the output of Comparator 2 to change in polarity, the deviation signal must decrease below Alarm Set Point 2 by the amount of the lockup voltage. The lockup prevents the output of the comparator from switching when the deviation signal is very close to the alarm set point.

In the LO alarm position, Jumpers J1 connect the noninverting (+) input of Comparator 1 to system common and connect the deviation signal to the inverting (-) input of this comparator. Alarm Set Point 1 is always connected to this same inverting input. Thus the signal going to the inverting input is the algebraic sum of the deviation signal and the alarm set point voltage. When this algebraic sum is positive, the output of Comparator 1 is at the negative supply voltage.

Example:

Difference Input = Deviation + Alarm Set Point
= (-1 volt dc) + (+2 volts dc)
= +1 volt dc

Diode CR2 will prevent the output current from conducting to Transistor Q1 (see Figure 3, page 3) and Lockup 1. Transistor Q1 will not conduct, and the voltage across the lockup resistor will be zero. When the algebraic sum of the deviation signal and Alarm Set Point is negative, the output of Comparator 1 is at the positive supply voltage.

Example:

Difference Input = Deviation + Alarm Set Point
= (-3 volts dc) + (+2 volts dc)
= -1 volt dc

Diode CR2 will pass the output current to Transistor Q1 and Lockup 1. Transistor Q1 will conduct, to complete the output circuit. Lockup 1 is fed back to the noninverting (+) input of Comparator 1. This feedback signal is positive; therefore, it will increase the difference between the two inputs of the comparator. For the output of Comparator 1 to change in polarity, the deviation signal must decrease below Alarm Set Point 1 by the amount of lockup voltage. The inverting (-) input must be positive by the amount of the lockup before the output changes in polarity.

There are two versions of output available for the nest alarm card: relay or solid state. The schematics of both versions are shown in Figure 3, page 3.

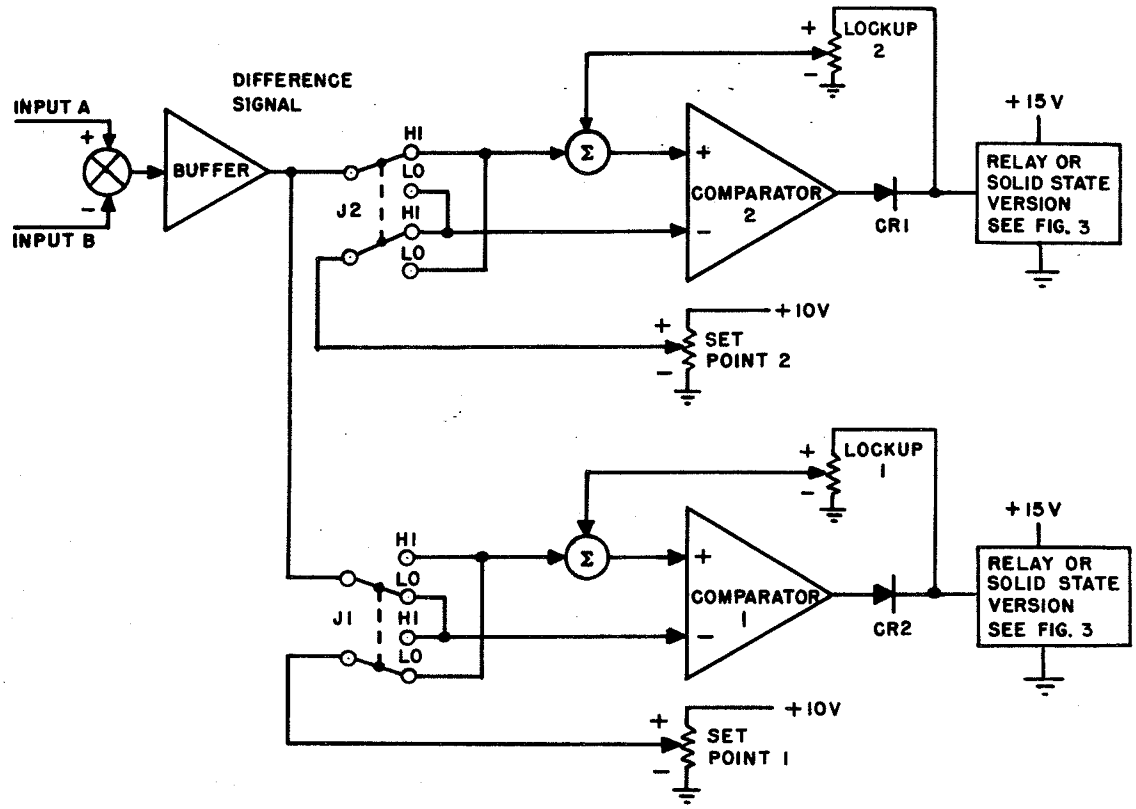

Figure 5. Difference Alarm Circuit

Duplex Difference Alarms

Figure 5 is a simplified schematic of a difference alarm circuit. There is only one such circuit on a difference alarm card.

The alarm card receives two 0 to 10 volts dc input signals. The two inputs are opposed at the input terminals to produce a difference signal. The difference signal is fed to a unity gain buffer amplifier. The buffer amplifier provides common mode and noise rejection. The output of the buffer is a -10 to 0 to +10 volts dc signal, proportional to the difference between the two input signals (Input A - Input B), and is called the difference signal. However, only a positive difference signal (which corresponds to Input A greater than Input B) can actuate the alarm.

The difference signal is connected to Jumpers J1 and J2. The position of the jumpers determines the high and low alarm action. For a high alarm action, the positive difference signal must be GREATER than the alarm set-point voltage to cause the output to change state. For a low alarm action, the difference signal must be LESS than the alarm set-point voltage to cause the output to change state. This condition includes any negative difference signal.

The difference signal feeds two identical circuits through Jumpers J1 and J2. For explanation purposes, assume that Jumpers J2 are in the HI alarm position and Jumpers J1 are in the LO alarm position.

In the HI alarm position, Jumpers J2 connect the difference signal to the noninverting (+) input of Comparator 2; also, Alarm Set Point 2 is connected to the inverting (-) input of Comparator 2. When the difference signal is negative or positive but LESS than Alarm Set Point 2, the output of Comparator 2 is at the negative supply voltage. Diode CR1 will prevent the output current from conducting to Transistor Q1 and Lockup 2. In this condition, Transistor Q1 will not conduct, and the voltage across the lockup resistor will be zero. When the difference signal is positive and GREATER than Alarm Set Point 2, the output of Comparator 2 is at the positive supply voltage. Diode CR1 will pass the output current to Transistor Q1 and Lockup 2. Transistor Q1 will conduct, to complete the output circuit. Lockup 2 is fed back to the noninverting (+) input of Comparator 2. This feedback is added to the difference signal to increase the difference between the two inputs of the comparator. For the output of Comparator 2 to change in polarity, the difference signal must decrease below Alarm Set Point 2 by the amount of lockup voltage. The lockup prevents the output of the comparator from switching when the difference signal is very close to the alarm set point.

For low alarm action, with Jumpers J1 in the LO alarm position, the preceding statements will apply except that the difference signal alarm set-point relationship is reversed. Thus the difference signal, if positive, must be less than the alarm set point before the output will change state; any negative difference signal will cause the output to change state.

There are two versions of outputs available for the nest alarm card: relay or solid state. The schematics of both versions are shown in Figure 3, page 3.