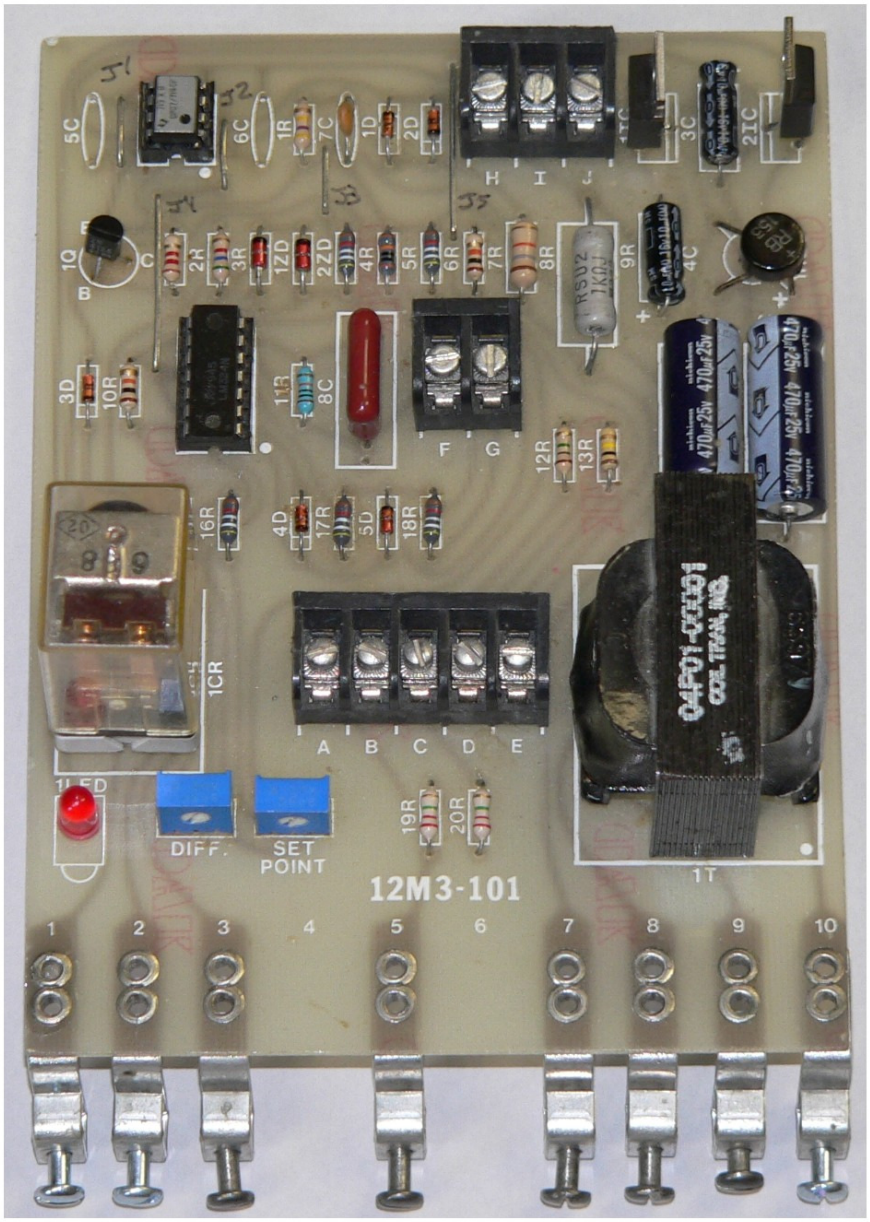
# Trouble-shooting Manual
# MODEL 202 VOLTAGE SENSITIVE RELAY
## PART NUMBER 12M03-00101-01

### BENCH TEST

1. With power off, jumpers removed, and terminal 5 disconnected, measure the following resistances on 1TB ± 5%: A to B – 4.4M, B to C – 1.0M, C to D – 0.1M, D to E – 10K.
2. Jumper F to G, I to J and A to B. Turn both pots (1P and 2P) full CCW.
3. Connect jumpers from terminal 9 to 8 and from terminal 10 to 5.
4. Apply 115V AC to terminals 9 and 10.
5. The L.E.D. on the board should light. Read continuity (with an ohmmeter or continuity tester) between terminals 1 and 2.
6. Adjust "Set Point" CW. At approximately ½ turn the L.E.D. on the board should go out. Read continuity between terminals 1 and 3. Terminals 1 and 2 should now show open.
7. Turn "Set Point" CCW until the L.E.D. goes back on. Notice that a very small amount of rotation should be required.
8. Adjust "Diff" pot fully CW and adjust "Set Point" back and forth to make the L.E.D. go on and off. Approximately one third turn should now be required.
9. Measure the voltage from terminal 8 to "H." It should be between 5.5 and 6.5V dc negative.




### VOLTAGE CHECKS

1. The primary voltage of 1T, leads 1 and 2 (terminals 10 and 9), should be 120V AC.
2. The secondary voltage of 1T, leads 3 to 4 and leads 5 to 6 should be 10V AC. These can be measured between circuit common, terminal 8 (leads 4 and 5), and each AC input to the bridge rectifier 1REC (leads 3 and 6). Voltage at the AC input to the bridge rectifier 1REC (leads 3 to 6) should be 20V AC.
3. +15V DC nominal between the positive end of capacitor 2C and terminal 8.
4. –15V DC nominal between the negative end of capacitor 1C and terminal 8.
5. +6V DC nominal (5.5 to 6.5 volts) between terminal J and terminal 8.
6. –6V DC nominal (5.5 to 6.5volts) between terminal H and terminal 8.

# GEMINI MODEL 202 VOLTAGE SENSITIVE RELAY

**PART NUMBER 12M03-00101**
**SCHEMATIC DIAGRAM 12M03-00101-01**

## I. SPECIFICATIONS

SUPPLY
- 120 Volts AC ± 10%
- 50/60 Hz, single phase

AMBIENT TEMPERATURE
- 0° to 40°C (32° to 104°F)
- 50°C in cabinet

SENSITIVITY
- 1 millivolt (on 0.1 volt scale)

INPUTS
- Scaled, 0.1 to 500 volts AC or DC, jumper selectable (A to E – 0.1 volts; A to D – 1.0 volts; A to C – 10.0 volts; A to B – 100 volts; A to A – 500 volts). Maximum safe input on 0.1 volt position, 30 volts.

OUTPUT
- Relay contact, single pole, form C , rated 2A at 115V AC, 3A at 26V AC. Programmable for pick-up or drop-out.

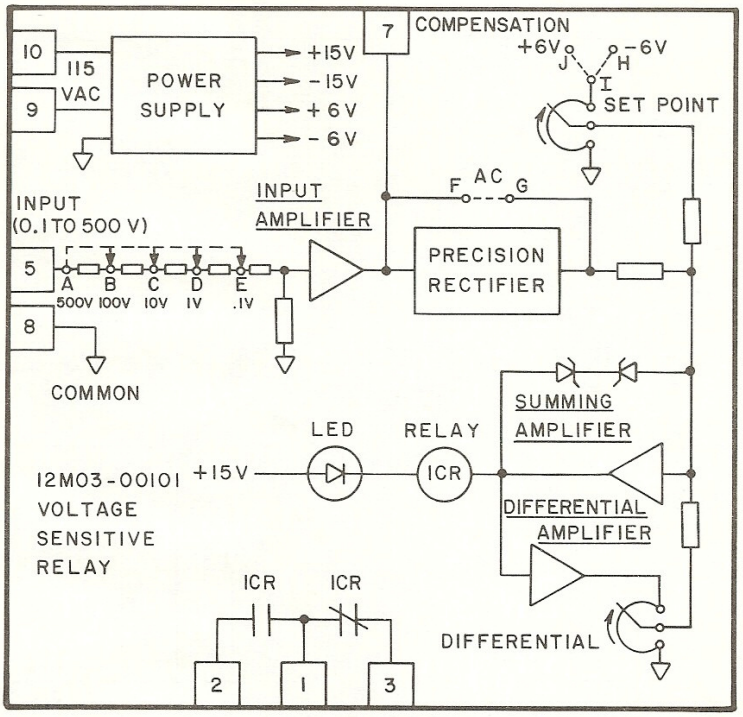



**FIGURE 1 SIMPLIFIED SCHEMATIC**

## II. THEORY OF OPERATION

The Model 202 Voltage Sensitive Relay is a versatile assembly for use wherever a relay contact operation is required in response to AC or DC analog signal levels.

It consists of the following elements as shown in the Simplified Schematic Diagram (Figure 1).

1. Power Supply
2. Input Amplifier
3. Precision Rectifier
4. Summing Amplifier
5. Differential Amplifier

1. **Power Supply** – The power supply uses a center-tapped transformer with 10 volts on each side of center together with a bridge rectifier and two 470 MF filter capacitors to provide a nominal positive and negative unregulated 15 volts DC with respect to the transformer center-tap which is connected to circuit common.

   Additionally, a regulated plus and minus 6 volts is obtained from the positive and negative 15 volt supplies using regulators 2 IC and 1 IC each with a 10 MF filter capacitor.

2. **Input Amplifier** – The input signal is scaled by selecting the proper jumper on the resistor dividing network (Points A through E on 1 TB) for the maximum signal involved. The signal is conditioned by op-amp 3 IC, a precision amplifier with a nominal gain of 26 to 1.

3. **Precision Rectifier** – When used with an AC (or positive and negative DC) input signal, a jumper between points F and G inserts an absolute value amplifier consisting of op-amps 4 IC(A) and 4 IC(B) and associated passive components between the output of the Input Amplifier and input of the Summing Amplifier so that a negative DC signal is always applied to the Summing Amplifier.

   If the jumper is not inserted between points F and G, op-amp 4 IC(B) acts as a conventional inverting amplifier with a nominal gain of 2 to 1.

4. **Summing Amplifier** – Op-amp 4 IC(C) acts as comparator, comparing the conditioned input signal at pin 7 of 4 IC(B) with the output of the Set Point potentiometer. The Set Point can be selected so the input signal can energize or deenergize the relay.

   With an AC or negative DC input signal on terminal 5, the Set Point potentiometer is connected to the regulated positive 6 volt supply through a jumper between points I and J on 2 TB. As the Set Point potentiometer is turned clockwise the relay will be deenergized.

   When the conditioned input signal at pin 7 of 4 IC(B) exceeds the signal from the Set Point potentiometer, the output of 4 IC(C) swings positive. Transistor 1Q conducts energizing the relay 1 CR as indicated by a light emitting diode 1 LED.

   With a positive DC input signal on terminal 5, the Set Point potentiometer is connected to the regulated negative 6 volt supply through a jumper between points I and H on 2 TB. As the Set Point potentiometer is turned clockwise the relay will be energized.

   When the conditioned input signal at pin 7 of 4 IC(B) exceeds the signal from the Set Point potentiometer, the output of 4 IC(C) swings negative, transistor 1Q stops conducting deenergizing the relay 1 CR as indicated by a light emitting diode 1 LED.

5. **Differential Amplifier** – Op-amp 4 IC(D) provides positive feedback from output to input of the Summing Amplifier. As the Differential Potentiometer is turned clockwise there will be a difference or "hysteresis" between pickup and drop-out. This minimizes the tendency of the relay to "chatter" when the signal is near the set point.

## COMPONENT LIST — ASSEMBLY #12M03-00101

| Symbol | Part # | Description (Acceptable Substitute) * |
|---|---|---|
| 1T | 04P01-00001 | Transformer - 120V AC PRI, two 10V AC SEC @220mA (Signal-PC20-220) |
| 1REC | 05P01-00003 | Rectifier Bridge - 50V, 1A (EDI-PF50) |
| 1D-5D | 05P02-00001 | Diode - Signal, 50mA, 200 PIV (1N4148) |
| 1ZD, 2ZD | 05P03-00005 | Zener Diode - 6.8V, 500mW, 10% |
| 1LED | 07P04-00003 | Diode - Light emitting (Litronix-RL-4403) |
| 1Q | 05P04-00002 | Transistor - NPN, Small Signal (2N3392) |
| 1IC | 05P08-00007 | -6 Volt Regulator (7906) |
| 2IC | 05P08-00006 | +6 Volt Regulator (7806) |
| 3IC | 05P08-00009 | Precision O-Amp (ICL 7650 CTV) ** |
| 4IC | 05P08-00001 | Quad Op-Amp (National-LM324) |
| 1CR | 06P01-00002 | Relay, 12V DPDT (Potter Brumfield R10E1Y2S) |
| 1P, 2P | 02P04-10301-00 | Potentiometer - 10K, ½W (Beckman 72XR10K) |
| 1C, 2C | 03P01-47102-01 | Capacitor 470MF, 25V, Electrolytic |
| 3C, 4C | 03P01-10001-00 | Capacitor - 10MF, 16V, Electrolytic |
| 5C, 6C | 03P07-10401-00 | Capacitor - 0.1MF, 100V, Film |
| 7C | 03P06-10305-00 | Capacitor - 0.01MF, 50V, Ceramic |
| 8C | 03P07-47410-00 | Capacitor - 0.47MF, 100V, Film |
| 1R | 01P01-47400-02 | Resistor - 470K, ¼W, 5% |
| 2R | 01P01-12200-02 | Resistor - 1.2K, ¼W, 5% |
| 3R | 01P01-56200-02 | Resistor - 5.6K, ¼W, 5% |
| 4, 6, 16, 17, 18R | 01P02-49921-01 | Resistor - 49.9K, ½W, 1% |
| 5R | 01P02-10031-01 | Resistor - 100K, ½W, 1% |
| 7, 10, 15R | 01P01-10300-02 | Resistor - 10K, ¼W, 5% |
| 8R | 01P01-18301-03 | Resistor - 18K, ½W, 10% |
| 9R | 01P01-10203-02 | Resistor - 1.0K, 2W, 5% |
| 11R | 01P02-20031-01 | Resistor, 200K, ½W, 1% |
| 12R | 01P01-10500-02 | Resistor - 1.0M, ¼W, 5% |
| 13R | 01P01-10400-02 | Resistor - 100K, ¼W, 5% |
| 14R | 01P01-22400-02 | Resistor - 220K, ¼W, 5% |
| 19, 20R | 01P01-22500-02 | Resistor, 2.2M, ¼W, 5% |

** Fairchild 714 may be substituted for 3IC if capacitors 5 and 6C are removed.

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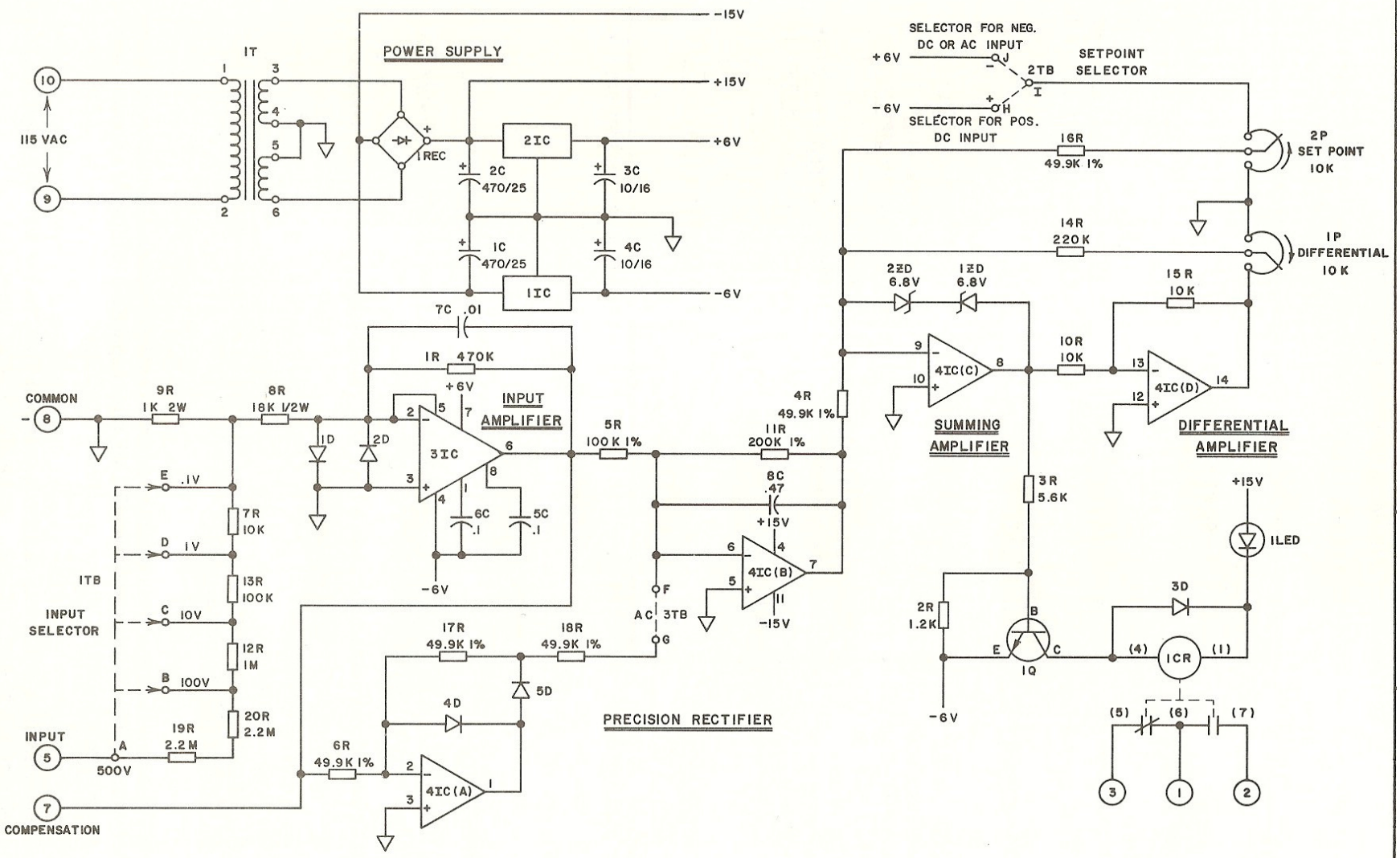


PCB NO. 13501-00101
LAYOUT NO. 12M03-00101



| REV. | DESCRIPTION | DATE | INT. | REV. | DESCRIPTION | DATE | INT. |
|---|---|---|---|---|---|---|---|
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REVISIONS

| DR. | CK'D. | APP'D. |
|---|---|---|
| JDB | | g.a. |

DATE 8-8-11 SCALE SHEET 1 OF 1

Gemini Controls LLC
Cedarburg, WI

PRODUCT VOLTAGE SENSITIVE RELAY REF (FILE No.) EX-202

CUSTOMER JOB No.

TITLE SCHEMATIC DIAGRAM DWG. No. 12M03-00101-01