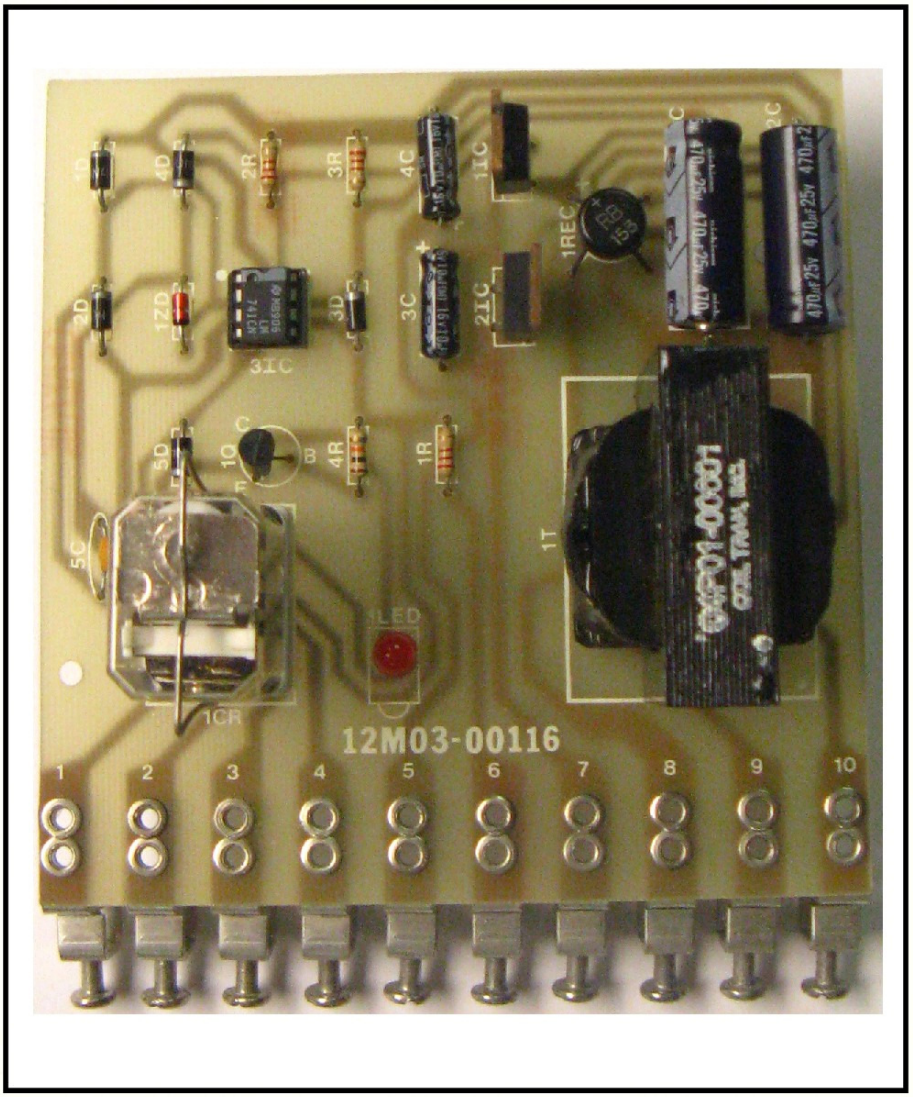
# Trouble-shooting Manual
# MODEL 236 CURRENT SENSITIVE RELAY
## PART NUMBER 12M03-00116-01

GEMINI

### BENCH TEST

TEST MATERIAL REQUIRED
- 1 - 120V AC line cord
- 1 - 470K, ¼ watt, resistor
- 1 - 100K, ¼ watt, resistor
- 1 - 5K, 2 watt, potentiometer
- 7 - Clip leads
- 1 - Continuity checker (or ohmmeter)

1. Apply a 470K resistor from terminal 5 to 4.
2. Apply a 5K potentiometer with the CCW terminal to terminal 8 and the CW terminal to terminal 7 of the assembly.
3. Using a 100K resistor, connect the wiper of the 5K potentiometer to terminal 4 of the assembly.
4. Using a continuity checking device measure "0" ohms (shorted) from terminal 1 to terminal 3 and infinite resistance (open) from terminal 1 to terminal 2.
5. Apply 120V AC power to terminals 9 and 10.
6. With the 5K potentiometer fully CW, the L.E.D. on the assembly should light and the continuity checks of step 4 should reverse (terminal 1 to 2 now shorted and terminals 1 to 3 now open).
7. Shorting terminal 6 to terminal 4 with a jumper should cause the L.E.D. to extinguish.
8. Remove the jumper from terminals 6 and 4 and rotate the 5K potentiometer "CW." At about 25% rotation the L.E.D. should again extinguish.




### VOLTAGE CHECK

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 1C and terminal 8.
4. –15V DC nominal between the negative end of capacitor 2C and terminal 8.
5. +6V DC nominal (5.5 to 6.5 volts) between terminal 5 and terminal 8.
6. –6V DC nominal (5.5 to 6.5 volts) between terminal 7 and terminal 8.

# MODEL 236 CURRENT SENSITIVE RELAY

PART NUMBER 12M03-00116-01
SCHEMATIC DIAGRAM NUMBER 12M03-00116-01

## 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

INPUT:
- Op-amp with the following characteristics:
  Input Offset Voltage: ±2mV Typical, ± 7mV maximum
  Input Bias Current: 45nA Typical, 250nA maximum
  Slewing Rate: 0.5V/u sec.
  Gain: 100,000
- Net Positive Signal to energize relay
- Operating current less than 1 uA including input bias
- Net input current should not exceed 10 mA

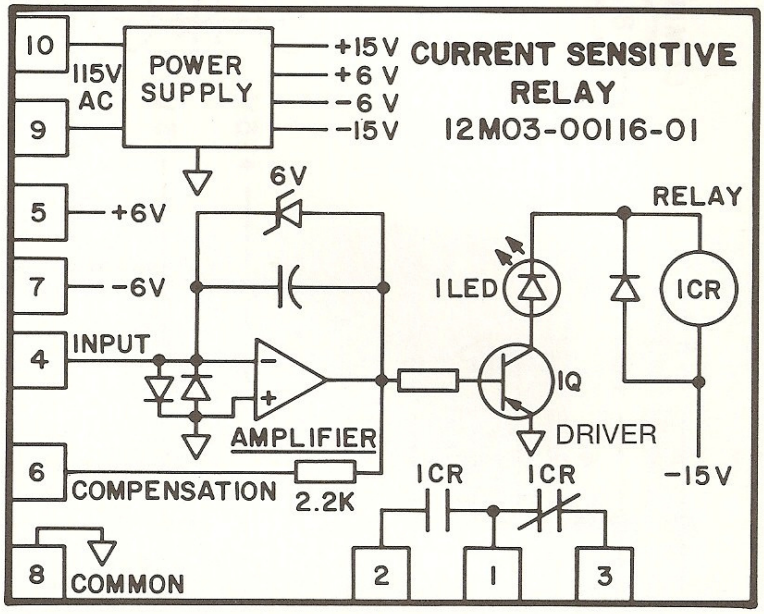



FIGURE 1 SIMPLIFIED SCHEMATIC

OUTPUT:
- Relay contact closure form C, rated 2A at 115V AC and 3A at 26V AC. Red LED indicating relay energized.

## II. THEORY OF OPERATION

The REFLEX Model 236 Current Sensitive Relay is a versatile assembly for use whenever a Relay Contact Operation is required in response to a DC Analog Signal.

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

1. Power Supply
2. Amplifier
3. Relay and Driver

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 positive and negative 6 volt regulated voltage is obtained from the positive and negative 15 volt supplies, using regulators 1IC and 2IC each with a 10 MF filter capacitor. These regulated voltages are brought out to terminals 5 and 7 for biasing the Amplifier if desired.

2. **Amplifier** – Op-amp 3IC provides a high gain to operate the relay in response to a net positive DC Signal of less than 1uA. A zener diode feedback around the amplifier prevents the input offset voltage that would occur if the amplifier were allowed to saturate.

3. **Relay and Driver** – The output of the Amplifier provides a signal to Relay Driver Transistor 1Q which activates the Relay 1CR.

## III. APPLICATION NOTES

1. The Current Sensitive Relay is normally used to detect a specific signal level. The relay is biased to one state (either on or off) by a fixed or adjustable bias current which may be obtained from one of the regulated internal 6 volt supplies (positive—terminal 5, negative—terminal 7).

   A second current proportional to the measured variable and opposite in polarity is also applied to the relay input. When its value exceeds the bias, the relay changes state. Bias and signal levels of at least several hundred micro-amperes insure accurate switching points.

2. General Op-amp theory and application applies to the amplifier within the limits of accuracy and gain. For further information refer to any Op-amp "Cookbook."

   For a complete treatment of the subject refer to the Burr Brown Electronic Series, published by McGraw Hill:

   — Operational Amplifiers—Design and Applications
   — Application of Op-amps
   — Designing with Op-amps
   — Function Circuits—Design and Applications

3. The amplifier will algebraically add multiple current inputs at terminal 4 and respond to the net sum.

4. A capacitor connected between terminals 4 and 6 (integrator) will cause a time delay before the relay is picked up or dropped out. The amount of time will depend on the value of the capacitor and magnitude of the net input signal.

   The time delay for net input currents of less than 25uA can be approximated as follows:

   Approximate time for pick up:

   $$t = \frac{0.7 \times C}{i}$$

   Approximate time for dropout:

   $$t = \frac{7.0 \times C}{i}$$

   Where: t is in seconds
   C is in microfarads
   i is net input current in microamperes

5. Bridge Unbalance Detector. The CSR can act as a sensitive galvanometer to detect the direction of unbalance in a DC bridge circuit. When used in this manner sufficient resistance must either be inherent in the bridge or added to the relay input to limit signal current to a few milliamperes with full bridge unbalance.

### COMPONENT LIST - ASSEMBLY #12MO3-00116-01

| Symbol | Part # | Description (Acceptable Substitute)* |
|---|---|---|
| 1T | 04P01-00001 | Transformer-120V AC PRI, two 10V SEC @ 220mA (Signal-PC20-220) |
| 1REC | 05P01-00003 | Rectifier Bridge–50V, 1A (EDI-PF50) |
| 1-5D | 05P01-00001 | Diode–Medium Power, 1A, 400 PIV (1N4004) |
| 1ZD | 05P03-00005 | Zener Diode-6.8V, 500mW, 10% (1N5235B) |
| 1LED | 07P04-00003 | Diode-Light emitting (Litronix-RL-4403) |
| 1CR | 06P01-00002 | Relay, 12V, DPDT (Potter Brumfield R10E1Y2S) |
| 1Q | 05P04-00001 | Transistor, PNP, Small Signal (2N3638A) |
| 1IC | 05P08-00006 | +6 Volt Regulator (7806) |
| 2IC | 05P08-00007 | –6 Volt Regulator (7906) |
| 3IC | 05P08-00011 | Op-Amp – Single (LM741) |
| 1, 2C | 03P01-47102-01 | Capacitor-470MF, 25V, Electrolytic |
| 3, 4C | 03P01-10001-00 | Capacitor-10MF, 16V, Electrolytic |
| 5C | 03P06-10305-00 | Capacitor-0.01MF, 50V, Ceramic |
| 1, 2, 3R | 01P01-22200-02 | Resistor-2.2K, ¼W, 5% |
| 4R | 01P01-10300-02 | Resistor-10K, ¼W, 5% |

*OR EQUAL

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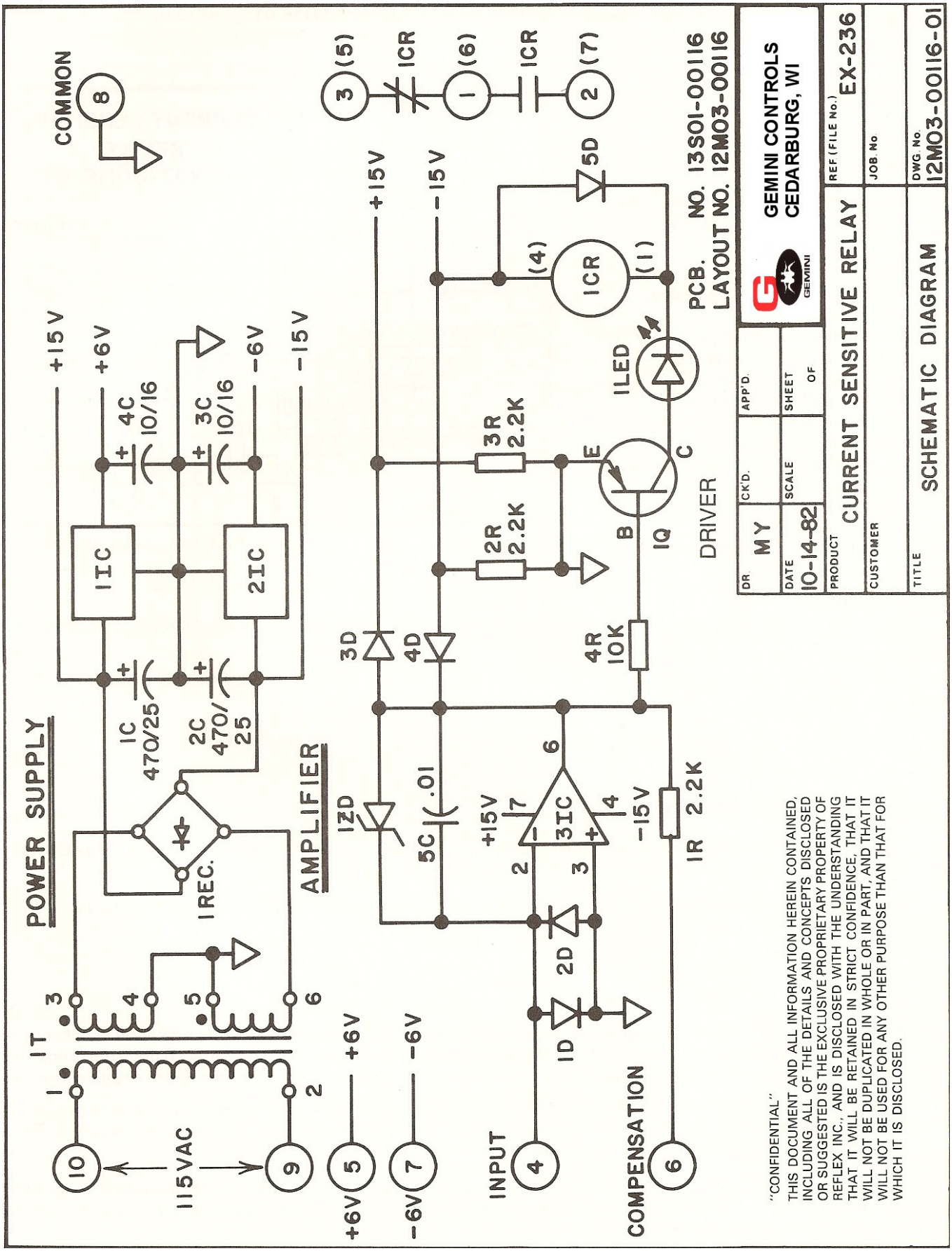


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