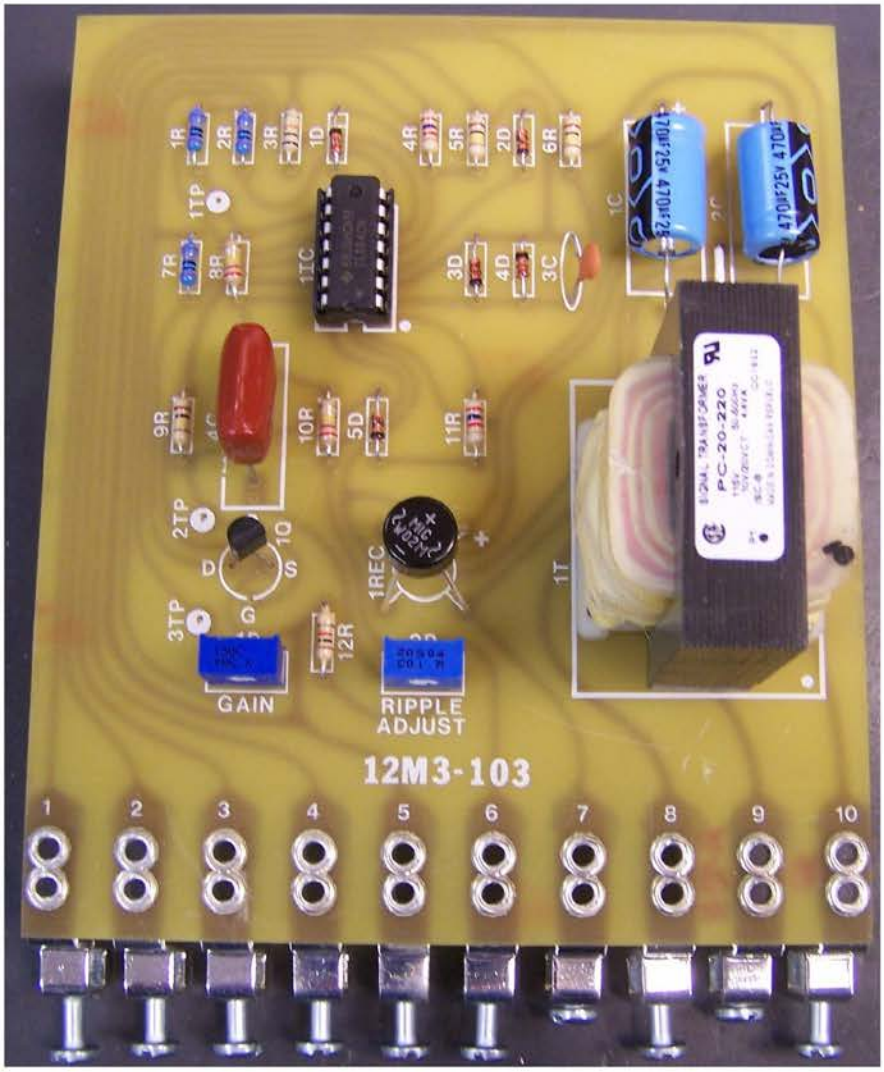
# Trouble-shooting Manual
# Model 205 Demodulator
## PART NUMBER 12M03-00103-01

### BENCH TEST

1. Jumper terminal 1 to terminal 2. Set both potentiometers to the CCW position. Connect a 5K potentiometer as follows:
   CCW end: terminal 1
   Wiper: terminal 3
   CW end: terminal 7
2. Connect a DC voltmeter and oscilloscope to terminals 6 and 8 with terminal 8 common.
3. Apply 120V AC to terminals 9 and 10.
4. As the 5K potentiometer is rotated through its range, the output at terminal 6 should swing at least +8 volts DC. Set it for 6 volts positive. Advance the "Ripple Adjust" to the full clockwise position. The ripple should steadily decrease to almost zero.
5. Jumper terminal 4 to terminal 5. The output should drop to approximately 0.15 volts DC.
6. Advance the "Gain" potentiometer to full CW position. The output should rise to approximately 7 to 8 volts DC.
7. Repeat steps 4, 5, and 6 with the opposite polarity, using the 5K potentiometer to reverse the output polarity.




### VOLTAGE CHECKS

1. The primary voltage of 1T, leads 1 and 2 (terminals 10 and 9) should be 120V AC.
2. 10V AC nominal between terminal 7 and terminal 8, and between terminal 1 and terminal 8.
3. 20V AC nominal between terminals 1 and 7.
4. +15V DC nominal between the positive end of capacitor 1C and terminal 8 (common).
5. −15V DC nominal between the negative end of capacitor 2C and terminal 8 (common).

# MODEL 205 DEMODULATOR

**PART NUMBER 12M03-00103**

**SCHEMATIC DIAGRAM 12M03-00103-01**

## 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
- 0.2 to 120 volts AC for 10 volts output
- 50 to 1000 Hz

REFERENCE INPUT
- 0.2 to 250 volts AC

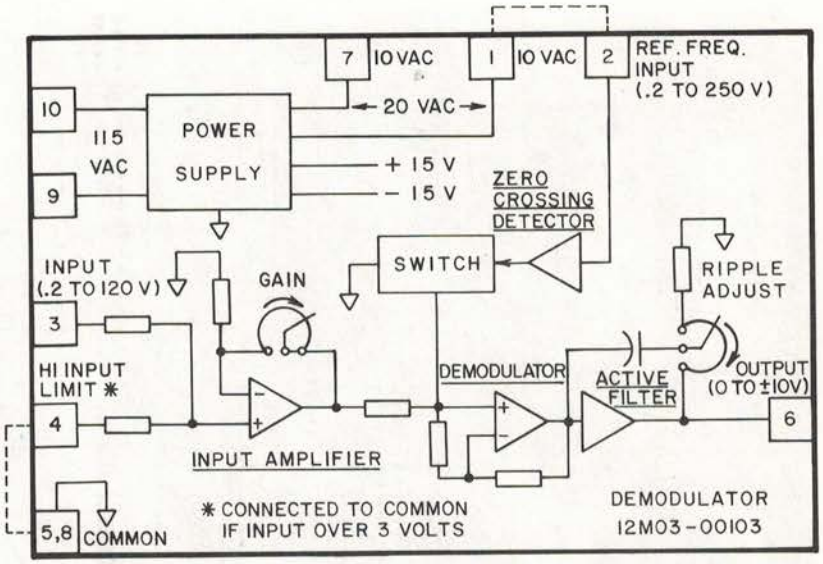



**FIGURE 1 SIMPLIFIED SCHEMATIC**

OUTPUT
- Unfiltered DC, ± 13.5 volts peak @ 5 mA
- Filtered, DC, ± 10 volts nominal @ 5 mA
- An AC voltage of 20 volts at 50 mA between terminals 1 and 7 (or 10 volts between terminal 1 or 7 and circuit common, terminal 8) is available to excite a Short Stroke Reactor.

## II. THEORY OF OPERATION

The Model 205 Demodulator is used to convert AC signals from various transducers to a DC output whose magnitude is proportional to the magnitude of the AC signal, and whose polarity is dependent on whether the AC signal is in phase or 180° out of phase with a reference AC voltage wave.

Common transducers are LVDT's, synchros, short stroke reactors, or induction regulators.

The Demodulator consists of the following elements as shown in the Simplified Schematic Diagram (Fig. 1).

1. Power Supply
2. Input Amplifier
3. Zero Crossing Detector
4. Demodulator
5. Active Filter

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, the outer legs of the transformer secondary are brought out to terminals to supply an optional 10 volt AC, 60 Hz reference for the Zero Crossing Detector, and to supply 20 volts AC excitation for transducers. 10 volts excitation is also available between common and either terminal 1 or 7.

2. **Input Amplifier** – Op-amp 1IC(B) is an AC amplifier with a gain adjustable from 1 to 50. Use of the non-inverting input provides a high input impedance for low power devices.

When used for input voltages in excess of 3 volts, a jumper between terminals 4 and 5 creates an input voltage divider of approximately 37 to 1. Clamping diodes 1D and 2D provide overvoltage protection to the input.

Its output is connected to the input of the Demodulator, 1IC(C).

3. **Zero Crossing Detector** – A frequency reference voltage of 0.2V to 250V having the same frequency as that used to supply the transducer is applied to terminal 2. In the case of 60 Hz devices this reference is obtained by a jumper to terminal 1, which supplies a nominal 10 volts AC from one half of the power transformer secondary.

   The AC reference voltage is applied to the input of 1IC(A), acting as a comparator to determine the zero crossing of the AC reference. The output of 1IC(A) is a square wave, 180° out of phase with the AC reference, and drives the gate of 1Q. FET switching transistor, 1Q, acts as open circuit between its Drain and Source when its Gate is highly negative with respect to its Source, and as a low impedance when its Gate to Source is zero.

   As the AC Reference Frequency Input on terminal 2 swings positive, the output of 1IC(A) swings negative and 1Q acts as an open circuit. As the AC Reference swings negative the output of 1IC(A) swings positive and 1Q conducts, clamping the non-inverting input, pin 10, of Demodulator 1IC(C) to circuit common.

4. **Demodulator** – Op-amp 1IC(C) acts as an inverting amplifier when its input pin 10, is clamped to circuit common by the action of 1Q, and as a non-inverting amplifier when 1Q is open. It, therefore, switches alternately between non-inverting and inverting, in-phase with the AC Reference (non-inverting when reference is in the positive half cycle).

   If the output of 1IC(B) is in phase with the AC reference, its positive half cycle passes through 1IC(C) unchanged since 1IC(C) is non-inverting at this time. During the negative half of the cycle (at the output of 1IC(B), amplifier 1IC(C) has now been changed to inverting by the action of the AC reference, and the negative signal for 1IC(B) is now inverted, and appears at the output of 1IC(C) as a positive output. Thus, the output of 1IC(C) is positive for both half cycles, and the signal from 1IC(B) has been "demodulated."

   If the output of 1IC(B) is 180° out of phase with the reference AC voltage, similar action results in both half cycles being negative.

   The output of 1IC(C) appears as a full-wave, rectified, unfiltered sine wave with a polarity depending on the phase relationship of the transducer input compared to the reference frequency and an amplitude proportional to the magnitude of the input signal. The output is fed to the Active Filter.

5. **Active Filter** – Op-amp 1IC(D) has a gain of 1 and acts as an adjustable low pass filter. As "Ripple Adjust" potentiometer 2P is turned clockwise, the output appears as increasingly pure DC. However, the response of the assembly becomes increasingly sluggish. For this reason, the ripple adjustment should be set as low as possible to allow fast system response without introducing excessive ripple.

## COMPONENT LIST - ASSEMBLY #12MO3-00103

| Symbol | Part # | Description (Acceptable Substitute)* |
|---|---|---|
| 1T | 04P01-00001 | Transformer – 120VAC PRI, two 10V AC SEC. @ 220 mA (Signal PC 20-220) |
| 1REC | 05P01-00003 | Rectifier Bridge – 50V, 1A (EDI-PF50) |
| 1D-5D | 05P02-00001 | Diode Signal–50 mA, 200PIV (1N4148) |
| 1Q | 05P05-00001 | Transistor – N Channel JFET (2N4093) |
| 1IC | 05P08-00002 | Quad Op-Amp (TI-TL084CN) |
| 1P | 02P04-50401-00 | Potentiometer – 500K, ½W (Beckman 72XR500K) |
| 2P | 02P04-10301-00 | Potentiometer – 10K, ½W (Beckman 72XR10K) |
| 1C, 2C | 03P01-47102-01 | Capacitor – 470MF, 25V, Electrolytic |
| 3C | 03P06-10205-00 | Capacitor – .001MF, 50V, Ceramic |
| 4C | 03P07-10510-00 | Capacitor – 1.0MF, 100V, Film |

| Symbol | Part # | Description (Acceptable Substitute)* |
|---|---|---|
| 1, 2, 7R | 01P02-10031-01 | Resistor – 100K, ½W, 1% |
| 3R | 01P01-10300-02 | Resistor – 10K, ¼W, 5% |
| 4R, 11R | 01P01-27200-02 | Resistor – 2.7K, ¼W, 5% |
| 5, 6, 9R | 01P01-10400-02 | Resistor – 100K, ¼W, 5% |
| 8R, 10R | 01P01-22400-02 | Resistor – 220K, ¼W, 5% |
| 12R | 01P01-10200-02 | Resistor – 1.0K, ¼W, 5% |

*OR EQUAL

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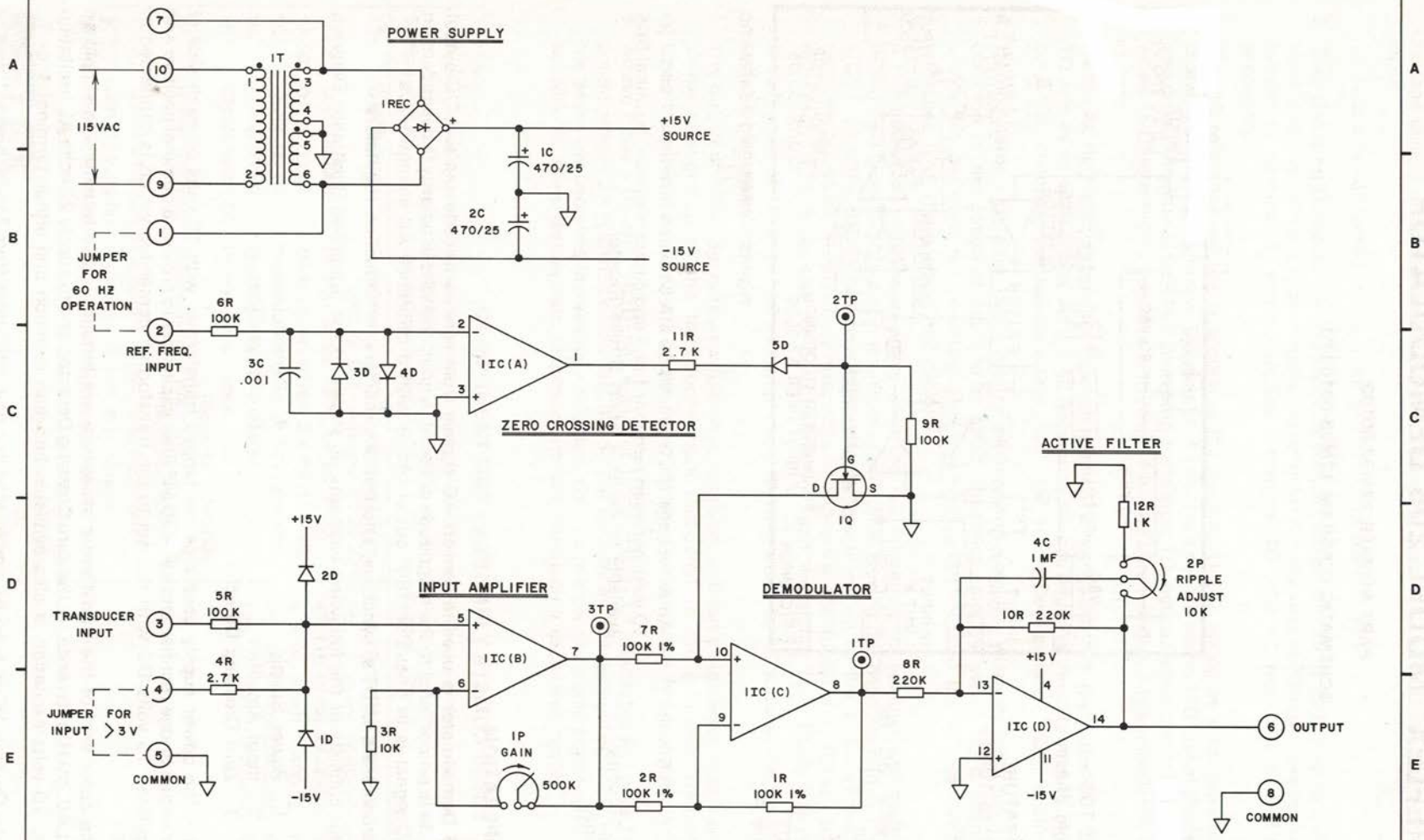


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PCB NO. 13S01-00103
LAYOUT NO. 12M03-00103

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|---|---|---|---|
| DR. M Y | CK'D. | APP'D. | Gemini Controls LLC Cedarburg, WI |
| DATE 12-28-81 | SCALE | SHEET 1 OF 1 | |
| PRODUCT DEMODULATOR | | | REF (FILE No.) EX-205 |
| CUSTOMER | | | JOB. No. |
| TITLE SCHEMATIC DIAGRAM | | | DWG. No. 12M03-00103-01 |

REVISIONS