REFLEX®

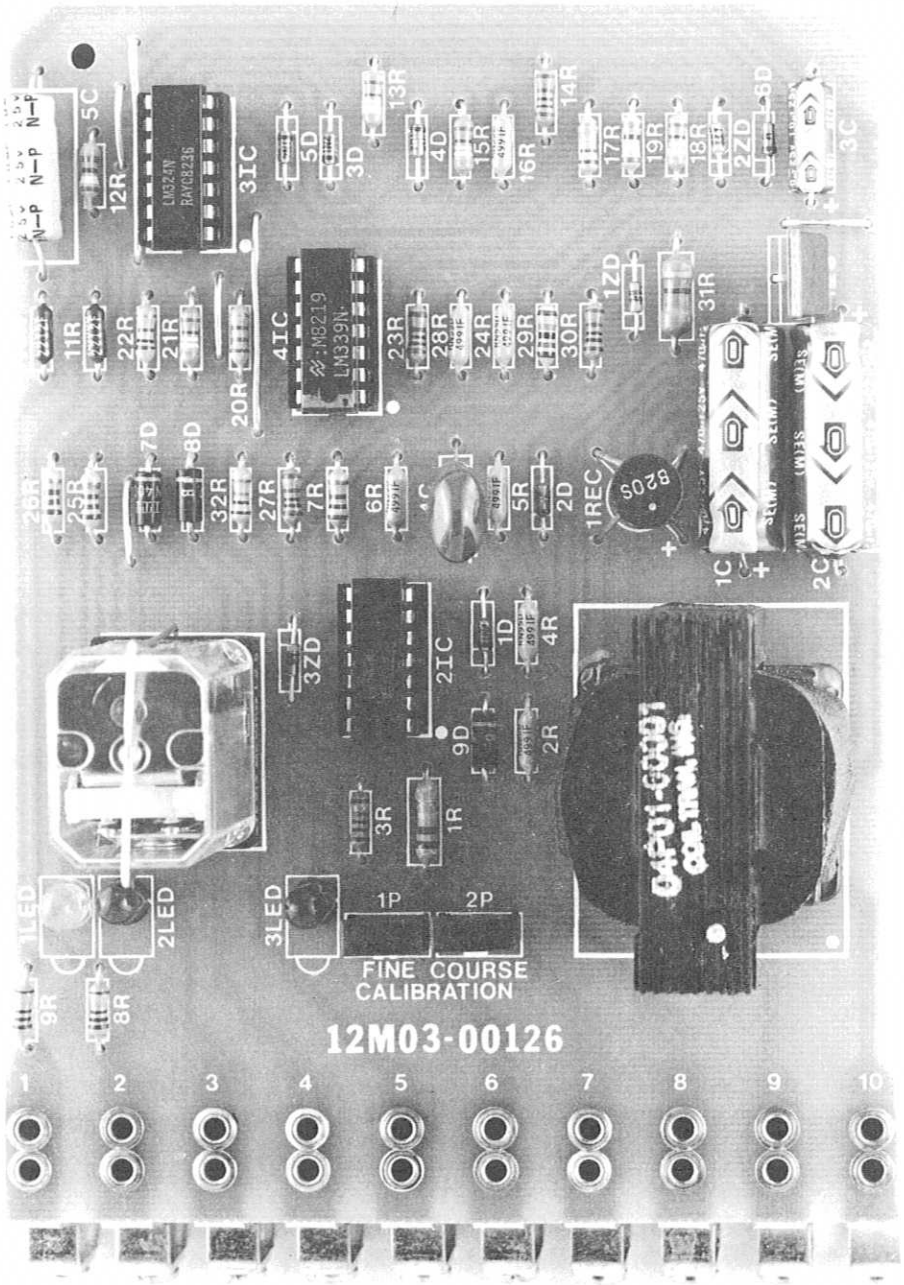
Trouble-shooting Manual
MODEL 237 TACH LOSS & OVERSPEED DETECTOR
PART NUMBER 12M03-00126-01

BENCH TEST

TEST MATERIAL REQUIRED:

1 – 120V AC line cord
1 – DC supply (variable 0-120V DC)
1 – 1 Voltmeter *
1 – Ohmmeter (or continuity tester)*
5 – Clip leads

*(Digital Voltmeter — Beckman HD-110 or equal)



1. Apply 120V AC to terminals 9 and 10. Red 3LED on the board should illuminate.
2. Connect a variable DC supply (capable of producing 0 to 120V DC) to terminals 1 and 2. Begin increasing the voltage from 0 until a point just after 3LED extinguishes.
3. Measure the voltage at terminals 1 and 2. It should be between 32 and 40V DC.
4. Reversing the polarity of the input voltage at terminals 1 and 2 or shorting (with input disconnected) each input terminal one at a time to terminal 8, should not cause the turn off point of 3 LED to fall outside the 32 to 40V DC range.
5. Set "CALIBRATION COARSE" and "CALIBRATION FINE" on the board to their 50% positions.
6. Jumper terminals 1 to 7 and 2 to 8 and increase the input voltage to 100V DC.
7. Readjust the "CALIBRATION COARSE AND FINE" potentiometers to the point where both 1 and 2 LED are of the same intensity or both extinguish. (They will both extinguish only if the filtering on your input power supply is very good.)
8. Adjusting the voltage at terminals 1 and 2 to 92V DC should cause 1LED to be fully illuminated and 2LED to be completely off.
9. Increasing the input voltage at terminal 1 and 2 to 108V DC should reverse the status of 1 and 2 LED from step 8.
10. Momentarily shorting terminal 6 to terminal 8 should cause 3LED to extinguish.
11. Using the jumper from terminal 6 to 8 and an ohmmeter or continuity checker, measure 0 ohms from terminals 3 to 5 and infinite ohms from terminals 3 to 4 when 3LED is extinguished and infinite ohms from 3 to 5 and 0 ohms from 3 to 4 when 3LED is illuminated.
12. Remove the jumper and increase the voltage input at terminals 1 and 2 to 115V DC, again 3LED should extinguish.

REFLEX® MODEL 237 TACH LOSS & OVERSPEED DETECTOR

PART NUMBER 12M03-00126-01
SCHEMATIC DIAGRAM 12M03-00126-01

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

INPUTS
- Tachometer Generator, 25 to 250 volts AC or DC at rated speed with internal scaling adjustments. (Higher voltage with external scaling.)
- DC motor armature voltage 0 to 250 volts DC (500 volts with external divider).

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

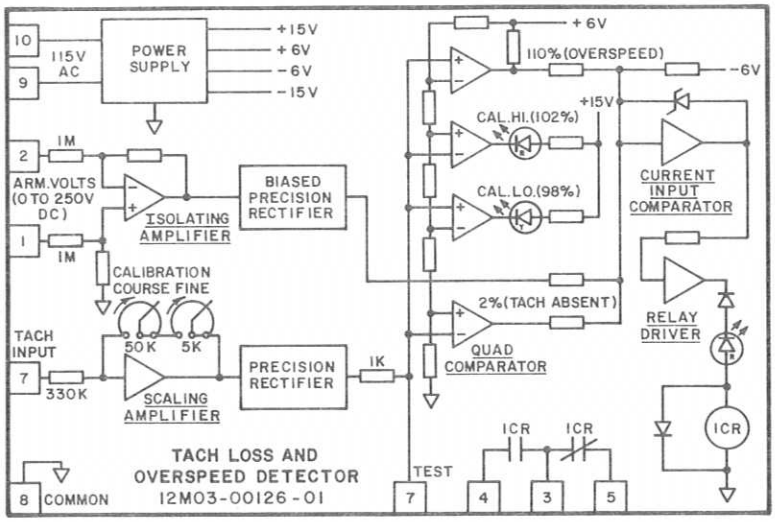


FIGURE 1 SIMPLIFIED SCHEMATIC

II. THEORY OF OPERATION

A tachometer loss detector must recognize that a drive may be required to operate at zero speed. The REFLEX Model 237 Tach Loss and Overspeed Detector is designed to operate with a DC Motor Drive and to distinguish between normal and abnormal lack of tach voltage. If the tach signal is missing and armature voltage is 15% or greater, a malfunction is indicated, and relay will drop out. The assembly will also protect against an overspeed greater than 110% of rated speed.

It consists of the following elements as shown on the detailed schematic diagram:

1. Power Supply
2. Relay Driver
3. Current Comparator #2
4. Quad Comparator
5. Current Comparator #1
6. Isolating Amplifier
7. Precision Rectifier #2
8. Tach Input Circuit

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 6 volt regulated voltage is obtained from the positive 15 volt supply, using regulator 1IC with a 10 MF filter capacitor. A negative 6 volt regulated voltage is obtained from the negative 15 volt supply using zener diode 1ZD.

2. **Relay Driver** – When pin 2 of op-amp 3IC(A) is slightly positive it provides a nominal 15 volts negative to energize relay 1CR as indicated by red light-emitting diode 3LED.

3. **Current Comparator #2** – Op-amp 2IC(D) is biased in a direction to energize relay 1CR through the Relay Driver. A negative six volts supplies a nominal 0.6 mA bias current to pin 13 of 2IC(D) through the 10K resistor 30R.

   The output at pin 14 is clamped to 0.7 volts positive by the action of zener diode 3ZD. The relay remains energized until the bias on pin 13 of 2IC(D) is exceeded by one or more of the outputs of the Quad Comparator and Current Comparator #1 which supply logic signals for indication or circuit operation.

4. **Quad Comparator** – The four sections of comparator 4IC have the following functions:

   Section A – Overspeed Protection. This section detects the presence of a tach signal greater than 10% above normal maximum voltage. Its output resistor, 24R, is chosen to provide approximately 0.85 mA to oppose the 0.6 mA bias through resistor 30R.

   This current is capable of causing the relay to drop out without requiring any additional signal since it exceeds the turn-on bias.

   Section B&D – Calibration Indicators. Each of these comparators measures tach voltage. Section B causes a red LED (2LED) to light when the tach voltage is more than 102% of rated maximum.

   Section D similarly lights the yellow LED (1LED) when the tach voltage is less than 98% of rated maximum.

   The calibration of rated tach voltage can be readily accomplished without the use of external metering by operating the drive at 100% speed and adjusting the "FINE" and "COARSE" calibration potentiometers so that both 1LED and 2LED are extinguished.

   Section C – Tach Voltage Detector. This section produces an output whenever the tach voltage is less than 2% of rated output. This output is lost completely whenever the drive is running at more than 2% speed.

Resistor 27R is chosen so that approximately 0.4 mA opposes the 0.6 mA bias current on 2IC(D). Since this output current is smaller than the bias current it cannot alone cause the relay to drop out. This allows operation at zero speed without indicating a tach loss.

5. **Current Comparator #1** – This comparator determines the presence of armature voltage greater than approximately 15% of rated armature voltage.

   If armature voltage is greater than 15%, it is assumed that the drive motor will be rotating. If simultaneously the absence of tach voltage has been detected, then tach loss is indicated.

   This is accomplished by adding the 0.4 mA output of Current Comparator #1 to the output of Section C of the Quad Comparator which is also approximately 0.4 mA. The sum of both signals is 0.8 mA which exceeds the 0.6 mA bias on 2IC(D) and drops out relay 1CR.

6. **Isolating Amplifier** – Differential amplifier 3IC(D) is impedance isolated from the motor armature power loop by the 1 megohm input resistors, 8R and 9R. Its nominal 5 volt output is filtered and applied to the input of Precision Rectifier #1.

   To maintain clearance requirements dictated by National Codes, the input voltage on terminals 1 and 2 must be limited to 250 volts.

7. **Precision Rectifier #2** – An Absolute Value Amplifier consisting of 3IC(C) provides a positive signal proportional to armature voltage to the summing junction at pin 6 of Current Comparator #1 (3IC(B)) regardless of the polarity of the armature voltage.

   The output of Precision Rectifier #2 is compared to a bias current through 17R which prevents Current Comparator #1 from producing an output. At approximately 15% armature voltage this bias current is exceeded by the output of Precision Rectifier #2 (3IC(C)) and Current Comparator #1 produces an output of approximately 0.4 mA through resistor 29R.

8. **Tach Input** – An AC or DC tachmeter generator is connected between terminal 7 and 8 (common). The voltage from the tach generator at rated speed should be between 25 and 250 volts.

   The "COARSE" and "FINE" calibration potentiometers 2P and 1P adjust the gain of op-amp 2IC(A) to produce a nominal 6 volts at rated speed.

   Precision Rectifier #1 converts an AC voltage or DC voltage of either polarity to a nominal positive 3 volts at the output of 2IC(C). This voltage becomes the input to all four sections of the Quad Comparator. Each section responds as described previously.

   The effectiveness of the circuit can be tested by momentarily connecting terminal 6 to terminal 8 (common) when armature voltage is greater than 15% of rated.

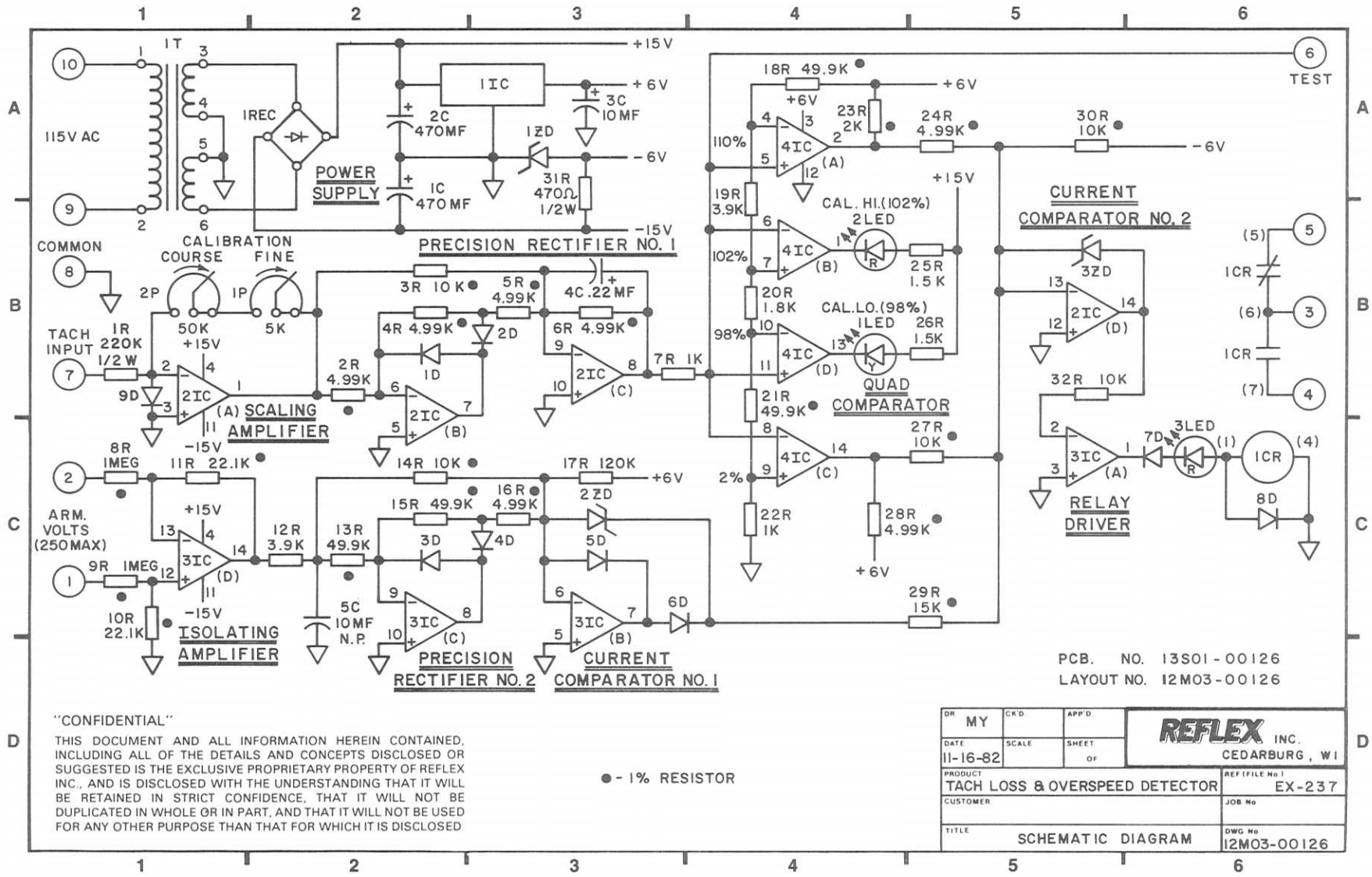
COMPONENT LIST - ASSEMBLY #12MO3-00126-01

Symbol	Part #	Description (Acceptable Substitute)*
1T	04P01-00001	Transformer-120V AC PRI, two 10V SEC @ 220mA (Signal PC20-220)
1 REC	05P01-00003	Rectifier Bridge–50V, 1A (EDI-PF50)
1-6D	05P02-00001	Diode–Signal, 50 mA, 200PIV (1N4148)
7-9D	05P01-00001	Diode-Medium power, 1A, 400PIV (1N4004)
1-3ZD	05P03-00005	Zener diode–6.8V, 500 mW, 10%
1 LED	07P04-00004	Diode, light emitting, amber (Panasonic-LN41YP.HL)
2,3 LED	07P04-00003	Diode, light emitting, red (Panasonic-LN21RP.HL)
1IC	05P08-00006	+6V Regulator (7806)
2,3IC	05P08-00001	Quad Op-amp (National-LM324)
4IC	05P08-00004	Quad Comparator (National-LM339)
1P	02P04-50201-00	Potentiometer, 5K, ½W (Beckman-72XR5K)
2P	02P04-50301-00	Potentiometer, 50K, ½W (Beckman-72XR50K)
1CR	06P01-00002	Relay, 12V DPDT (Potter Brumfield R10E1Y2S)
1,2C	03P01-47102-01	Capacitor-470MF, 25V, electrolytic
3C	03P01-10001-00	Capacitor–10MF, 15V, electrolytic
4C	03P07-22410-00	Capacitor–.22MF, 100V, film
5C	03P02-10002-00	Capacitor–10MF, 25V, N.P., electrolytic
1R	01P01-22401-02	Resistor, 220K, ½W, 5%
2,4-6,16, 24,28R	01P02-49911-01	Resistor, 4.99K, ½W, 1%
3,14, 27,30R	01P02-10021-01	Resistor, 10.0K, ½W, 1%
7,22R	01P01-10200-02	Resistor, 1K, ¼W, 5%
8,9R	01P02-10041-01	Resistor, 1M, ½W, 1%
10,11R	01P02-22121-01	Resistor, 22.1K, ½W, 1%
12,19R	01P01-39200-02	Resistor, 3.9K, ¼W, 5%
13,15, 18,21R	01P02-49921-01	Resistor, 49.9K, ½W, 1%
17R	01P01-12400-02	Resistor, 120K, ¼W, 5%
20R	01P01-18200-02	Resistor, 1.8K, ¼W, 5%
23R	01P02-20011-01	Resistor, 2.0K, ½W, 1%
25,26R	01P01-15200-02	Resistor, 1.5K, ¼W, 5%
29R	01P02-15021-01	Resistor, 15.0K, ½W, 1%
31R	01P01-47101-02	Resistor, 470, ½W, 5%
32R	01P01-10300-02	Resistor, 10K, ¼W, 5%

*OR EQUAL

REFLEX INC.
303 ALLENS AVENUE, BOX 1515, PROVIDENCE, RI 02901
401/941-4444 TLX 880060

BULLETIN TM237-0287



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 1 REC (leads 3 and 6). Voltage at the AC input to the bridge rectifier 1 REC (leads 3 to 6) should be 20V AC.
3. +15V DC nominal between the positive end of capacitor 2C and terminal 8 (common).
4. -15V DC nominal between the negative end of capacitor 1C and terminal 8 (common).
5. +6V DC nominal (5.5 to 6.5 volts) between the positive end of capacitor 3C and terminal 8 (common).
6. -6V DC nominal (6.4 to 7.2 volts) between the anode of 1ZD and terminal 8 (common).