

## Notes on the IBM / Lexmark Wheelwriter 1000 Print-Mechanism Electromagnetic Actuators.

Revision	Date	Description
1.0	5/16/2019	Initial release.

This document describes a few technical characteristics of the electromagnetic solenoid actuator and stepper motors that activate the print mechanism of the IBM / Lexmark Wheelwriter 1000 typewriter and their related driver circuitry. This information may be useful in understanding the Wheelwriter's operation and in diagnosing and repairing defective print-mechanisms.

The character-wheel position, print ribbon-advance / ribbon-shift, horizontal carriage motion and paper roller motion are each driven by individual two-phase bipolar stepper motors controlled by a PBL3717A integrated circuit (IC). The print hammer is driven by a rotary solenoid controlled by a L294 IC. The Logic Board incorporates integrated circuits that energize the various stepper motor windings and print hammer solenoid to cause mechanical motion.

The stepper motor driver IC, ST Microelectronics PBL 3717A, is currently an obsolete component according to the manufacturer. A datasheet for this IC is attached with these notes. The datasheet includes a representative application circuit showing how two PBL3717A driver ICs may be used to control a 2-phase, bipolar stepper motor. We believe that the Wheelwriter's Logic Board implements a similar driver circuit. The print hammer solenoid driver IC, ST Microelectronics L294, is also currently obsolete. A datasheet for the L294, including an application circuit for driving a solenoid, is attached with these notes. We also believe that the Logic Board's solenoid driver implementation is similar to the application circuit.

Tables 1 and 2 below summarize the stepper motor and solenoid characteristics and their connections to their related driver ICs.

Actuator Function	Actuator Type	Connections on Actuator & DC Winding Resistances (typ).	Logic Board Driver IC Type & Connections. See Figure 1.
Character wheel position.  Figure 2.	2-phase, bipolar, stepper motor.	See Table #2. Winding A: 11.9 ohms Winding B: 11.9 ohms.	ST Microelectronics PBL3717A. Winding A: U141, pins 1 & 15. Winding B: U140, pins 15 & 1. Current sense resistance: 2.2 ohms.
Ribbon-advance, Ribbon-shift.  Figure 3.	2-phase, bipolar, stepper motor.	See Table #2. Winding A: 13.6 ohms Winding B: 13.6 ohms.	ST Microelectronics PBL3717A. Winding A: U161, pins 1 & 15. Winding B: U160, pins 15 & 1. Current sense resistance: 1 ohm.
Horizontal carriage motion.  Figure 4.	2-phase, bipolar, stepper motor.	See Table #2. Winding A: 5.7 ohms Winding B: 5.7 ohms.	ST Microelectronics PBL3717A. Winding A: U131, pins 1 & 15. Winding B: U130, pins 15 & 1. Current sense resistance: 1 ohm.
Paper roller motion.  Figure 5.	2-phase, bipolar, stepper motor.	See Table #2. Winding A: 14.1 ohms Winding B: 13.7 ohms.	ST Microelectronics PBL3717A. Winding A: U151, pins 1 & 15. Winding B: U150, pins 15 & 1. Current sense resistance: 1 ohm.

Print hammer.	Rotary solenoid.	Single winding: 3 ohms.	ST Microelectronics L294. U180, pins 2 & 11. Current sense resistance: 150 mohm.
Figure 6.			

Table #1 - Wheelwriter 1000 Print Mechanism Electromagnetic Actuators.

Connector on Stepper Motor (Pin number marked on motor connector)	Pin Function
1	Winding A.
2	Winding B.
3	Winding A center tap. Not used / not connected.
4	Winding B center tap. Not used / not connected.
5	Winding A.
6	Winding B.

Table #2 - Stepper Motor Connector Pin Assignments.

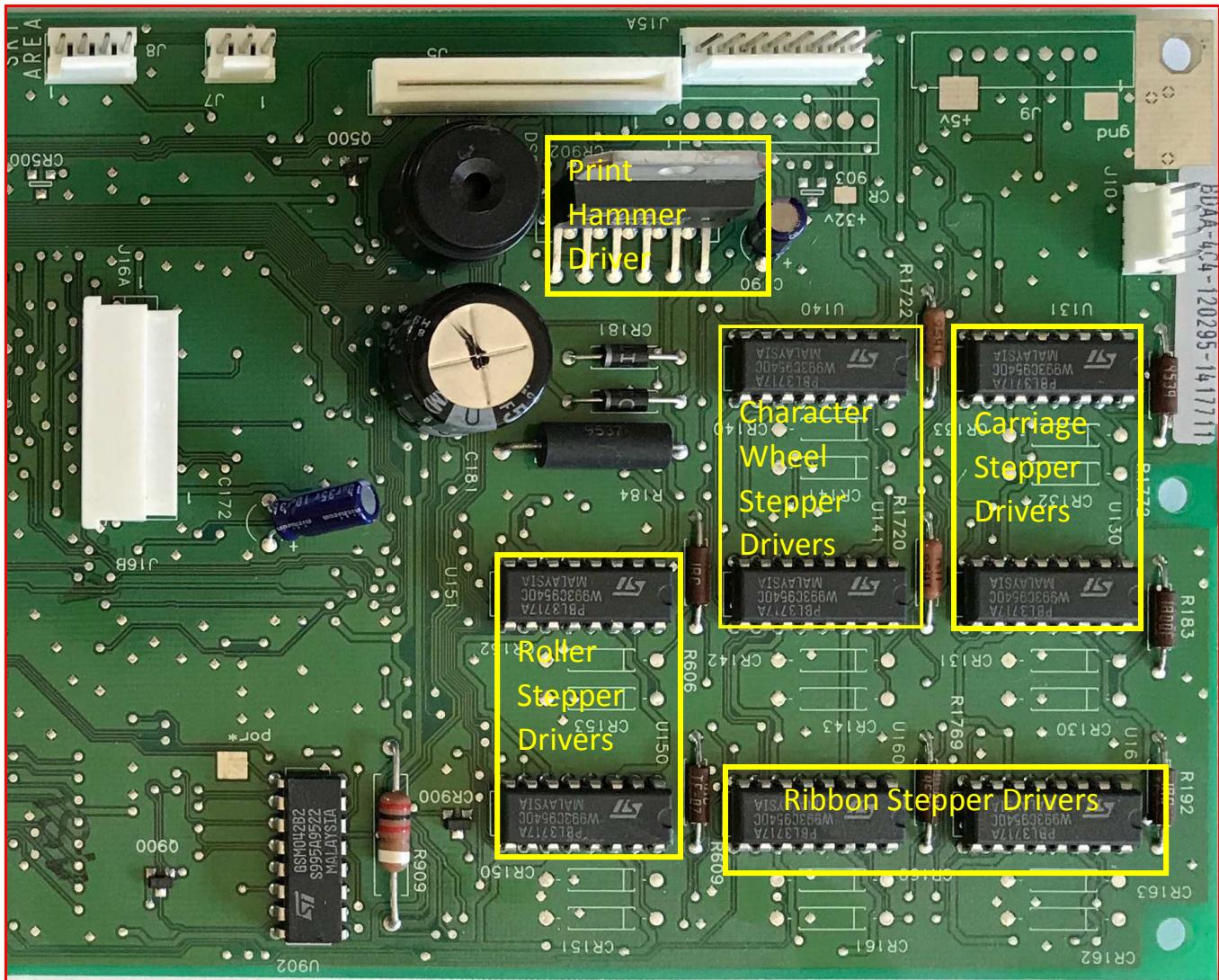


Figure 1. IBM / Lexmark Logic Board Stepper Motor and Solenoid Driver IC Locations.

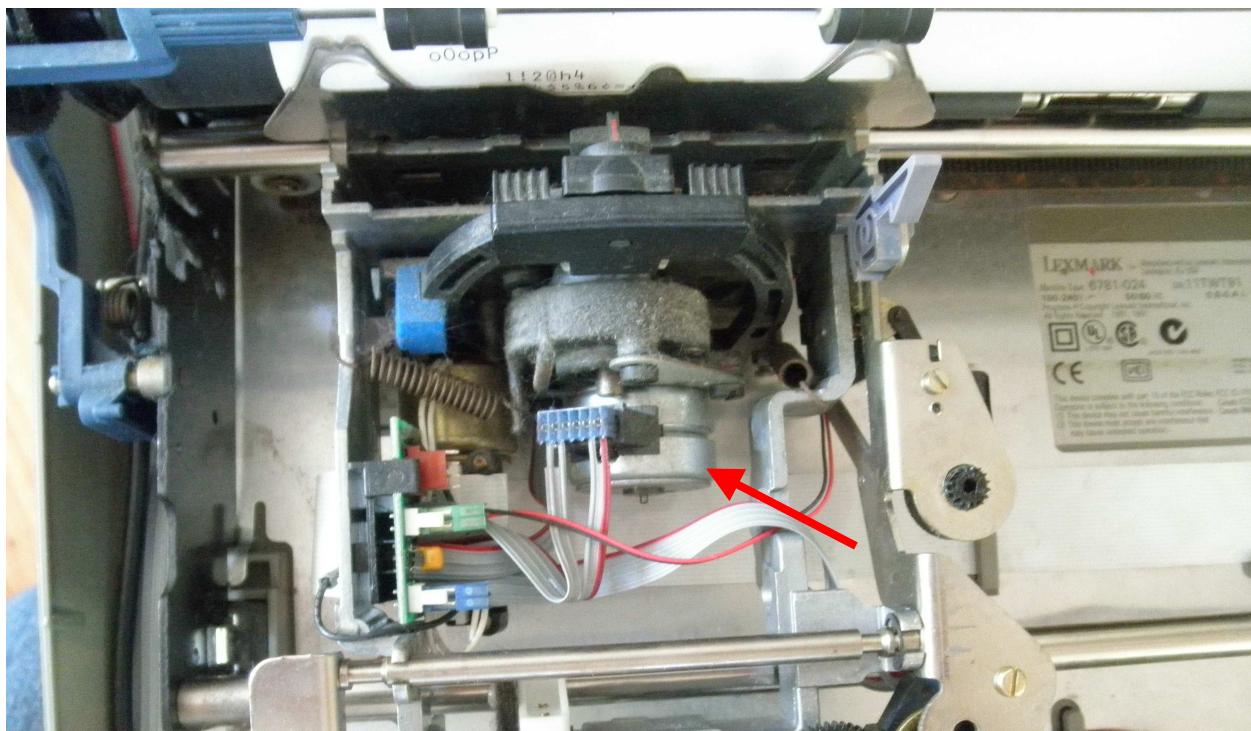


Figure 2. Character Wheel Positioning Stepper Motor Location.

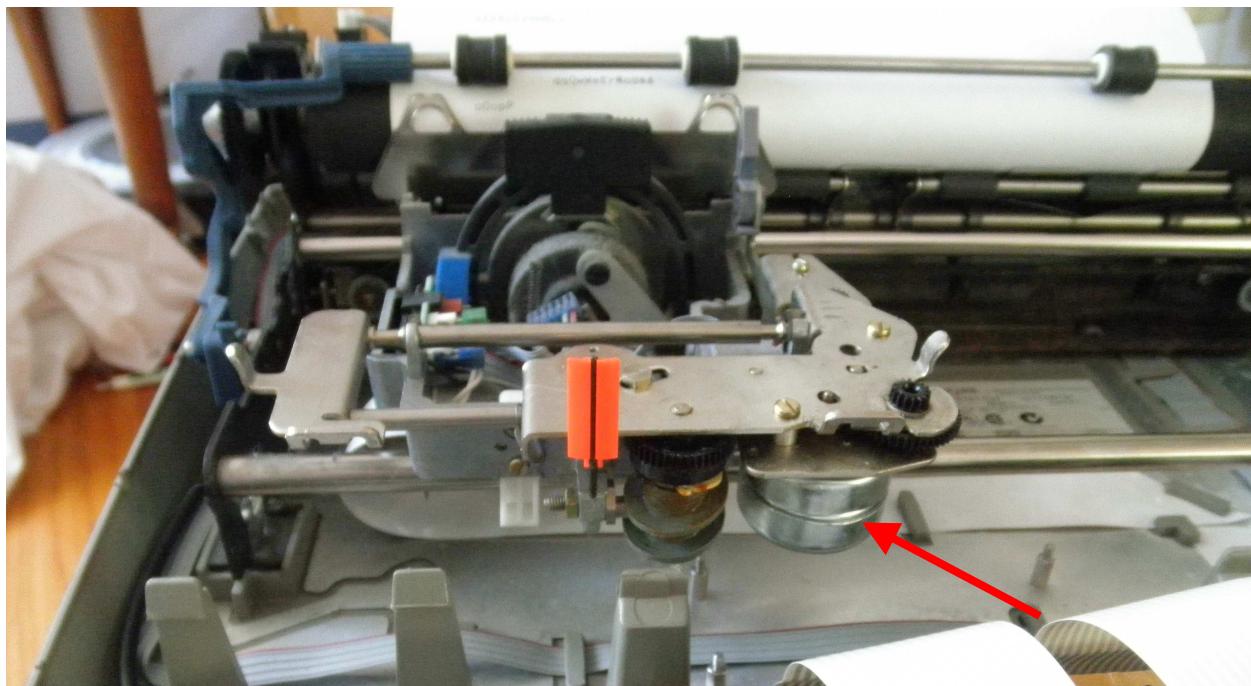


Figure 3. Ribbon-advance / Ribbon-shift Stepper Motor Location.

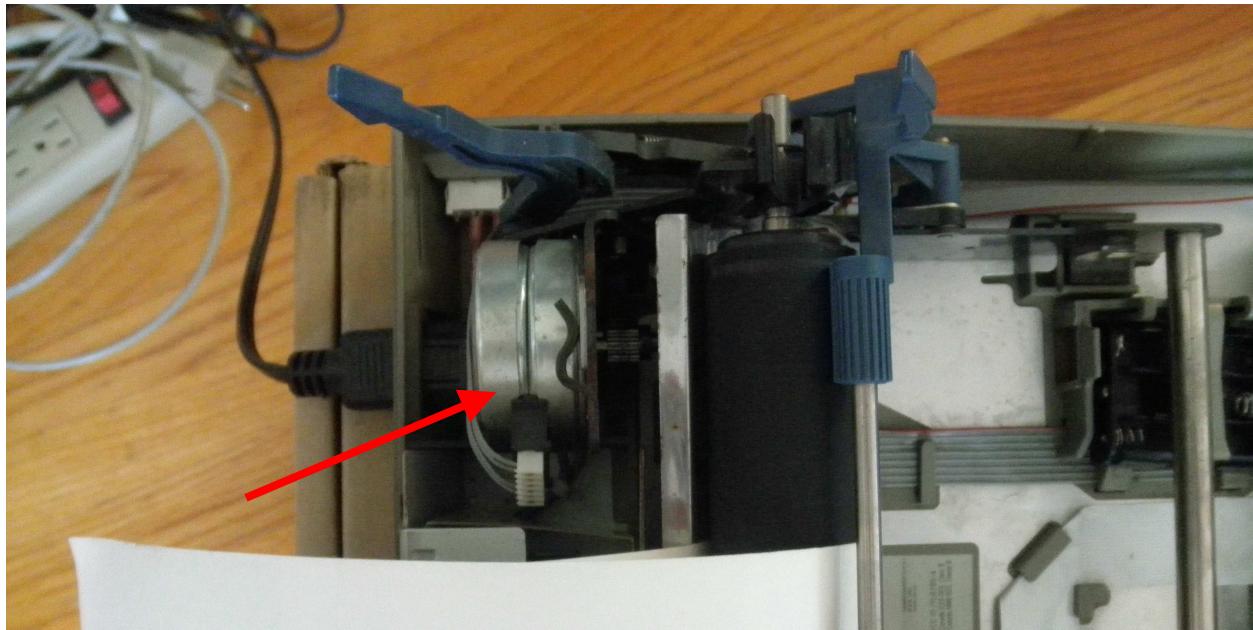


Figure 4. Horizontal Carriage Motion Stepper Motor Location.

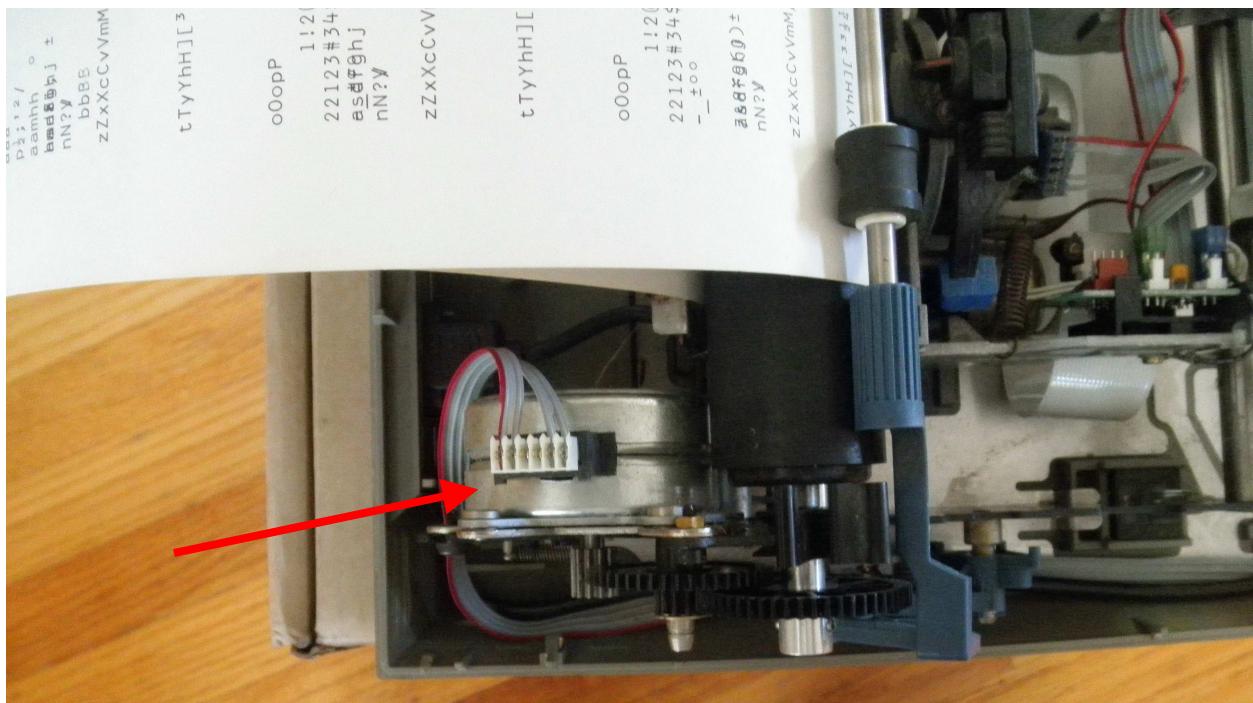


Figure 5. Paper Roller Motion Stepper Motor Location.

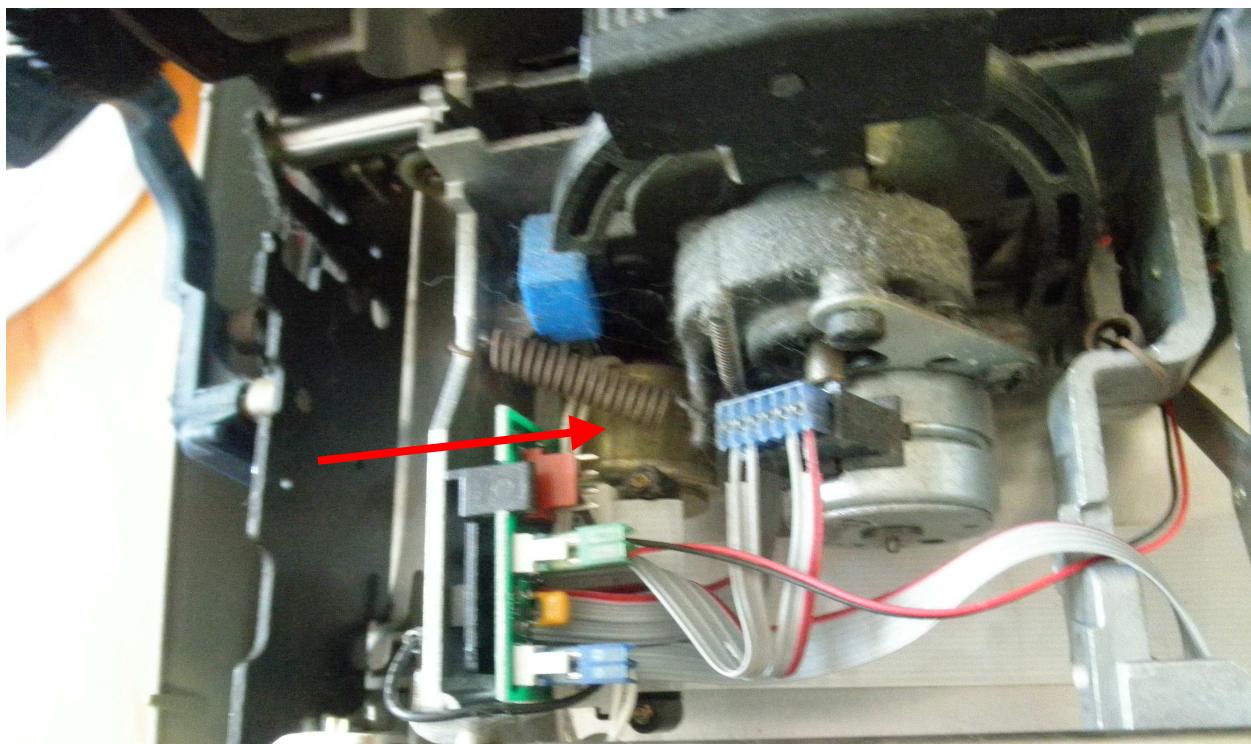


Figure 6. Print Hammer Solenoid Location.