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MITSUBISHI MINI FLEXIBLE-DISK DRIVE M4851 / M4853 Specifications

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5.25-INCH FLEXIBLE DISK DRIVES

M4851/M4853

TECHNICAL MANUAL

CONTENTS

CHAPTER 1 GENERAL

The structures of the mechanisms and control electronic circuits of the M4851/M4853 Flexible Disk Drives are as follows:

The M4851 and M4853 have same structure except the step motor and magnetic heads. The M4851 is a two-sided drive with a track density of 48 TPI, and uses a step motor with a step angle of 3.6 degrees for the head-positioning mechanism. Its maximum operating step pulse rate is 6 ms.

The M4853 has a track density of 96 TPI, which is twice the track density of the M4851, and employs a step motor with a step angle of 1.6 degrees for the head-positioning mechanism. Therefore, the capstan mounted on the step motor shaft has the same diameter as the capstan for the M4851.

The maximum operating step pulse rate of the M4853 is 3 ms.

The magnetic heads used for the M4851 and M4853 are head sliders for 48 TPI and 96 TPI respectively; the two models differ in the widths of the read/write core and erase core. The carriage assembly that mounts the magnetic head sliders has the same in construction in both models.

1.1 Composition of Mechanism by Function

The mechanism can be divided by function as follows:

(1) Door latch and diskette ejector mechanism

(2) Disk rotation and clamp mechanism

(3) Magnetic head positioning mechanism

(4) Magnetic head/carriage mechanism

(5) Head load/unload mechanism

(6) Sensors (index, write protect, track 00)

1.2 Composition of Electronic Circuitry by Function

The electronic circuits are installed on two printed-circuit boards, and can be classified by function as follows: The spindle motor drive circuit constitutes an independent printed-circuit board which is built integrally with the motor.

(1) Signal interface circuit and drive select circuit

(2) Power-on reset circuit

(3) Panel indicator drive circuit

(4) Index pulse generator circuit and ready circuit

(5) Head load solenoid drive circuit

(6) Step motor drive circuit

(7) Track 00 detection circuit

(8) Side select circuit

(9) Write/erase circuit

(10) Write-protect circuit

(11) Read circuit

(12) Spindle motor drive circuit

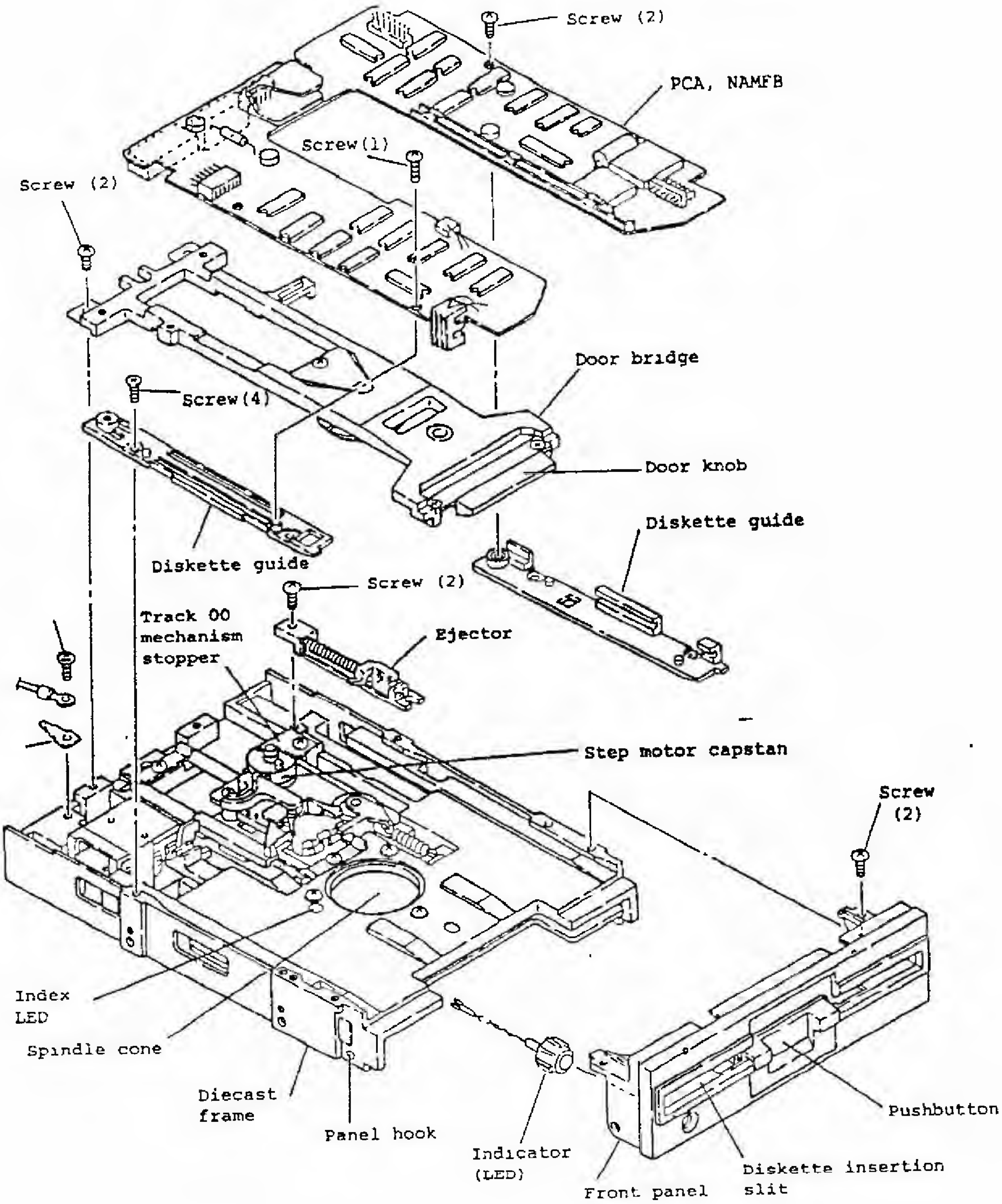


Figure 2-1 Exploded View of Mechanism

2.1 Door Latch and Diskette Ejector Mechanism

This mechanism is a pushbutton-type diskette ejector. If the door is closed when a diskette is to be inserted, press the pushbutton to open the door.

Insert the diskette in the slit, and push it in. The reaction for latching of the ejector can be felt. Keep pushing the diskette together with the pushbutton so that the ejector slider is latched and the diskette hits the stopper. When the slider is latched, the diskette will not come back out even if it is released.

In closing the door, push the door knob so it hits the pushbutton latch and tilt the pushbutton inward. Keep pushing so the pushbutton returns to the original position and the door is latched.

In the stroke up to this door latching, the trigger pin that projects from the door pushes the ejector slider to unlatch it, and the trigger pin that has two levels of height contacts the pin stopper to prevent the slider from pushing the diskette out any farther.

When the door is opened by pressing the pushbutton, the ejector slider disengages from the trigger pin to eject the diskette.

Figure 2-2 shows the ejector assembly and its relationship to the door trigger pin.

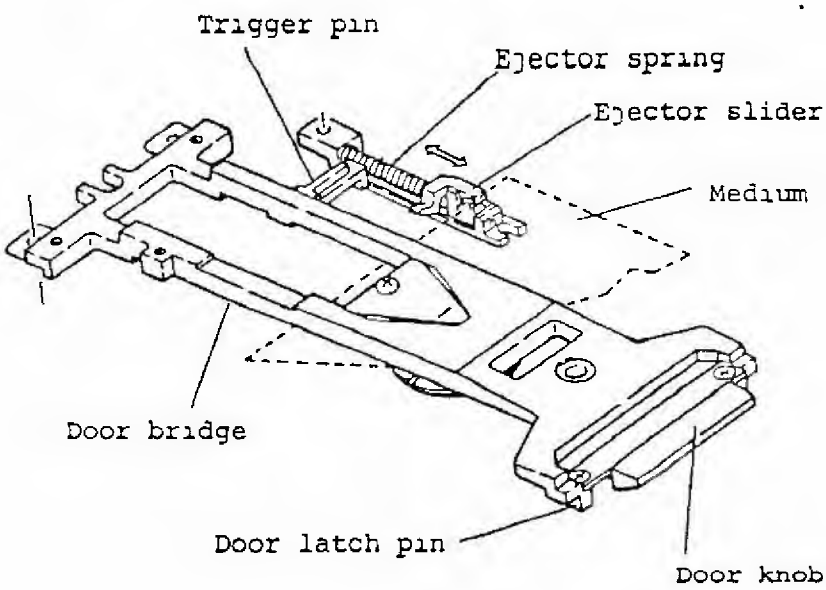


Figure 2-2 Diskette Ejector Mechanism

2.2 Disk Rotation Drive and Clamp Mechanism

The disk rotation drive motor is a flat DC servo motor. This motor has as long a life as an ordinary AC motor because it is a brushless type that uses a Hall element for coil phase-switching detection.

The motor does not use a belt, unlike conventional counterparts, but is a direct-drive type with the rotor and spindle directly connected to each other. This is another feature for prolonging motor life and assuring that the rotation mechanism is completely free of maintenance. The spindle motor runs at 300 rpm, which is controlled by the frequency-generator coil for the servo on the printed-circuit board that is built integrally with the motor. The frequency-generator coil detects the spindle motor speed and forms a servo circuit to control it.

The disk is clamped by the spindle cone on the motor side and by the collet on the door. The collet guides the disk to a position on the inner surface of the spindle cone. This assures compatibility between diskettes and the disk drives.

The collet is tapered to a specific angle to correct non-alignment of an inserted disk with the spindle cone.

Figure 2-3 shows the spindle motor and collet.

The printed-circuit board for the spindle motor servo circuit has an index sensor LED (light-emitting diode) for disk rotation detection, and a photo transistor for receiving its light is installed on another printed-circuit board (NAMFB).

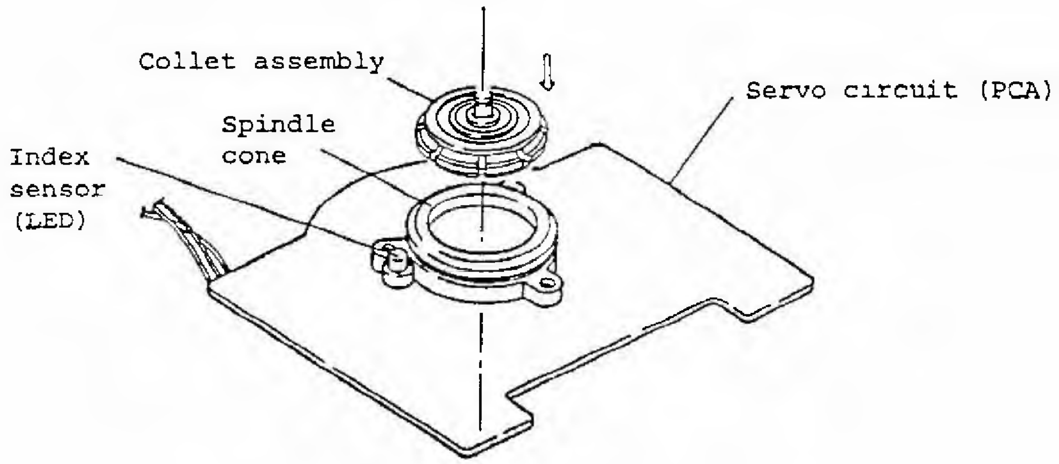


Figure 2-3 Spindle Motor and Collet

2.3 Magnetic Head-Positioning Drive Mechanism

The flat step motor drives the magnetic head to each track (cylinder) in succession. The capstan mounted on the step motor shaft has a thin-loop steel band, which is pulled by the spring attached to the idler pulley located opposite the steel band to maintain a specific tension. The head/carriage assembly, supported by two guide rods, is fastened to the steel band so that a turn of the step motor by one step angle moves the head by a single track distance.

Figure 2-4 shows the positioning drive mechanism.

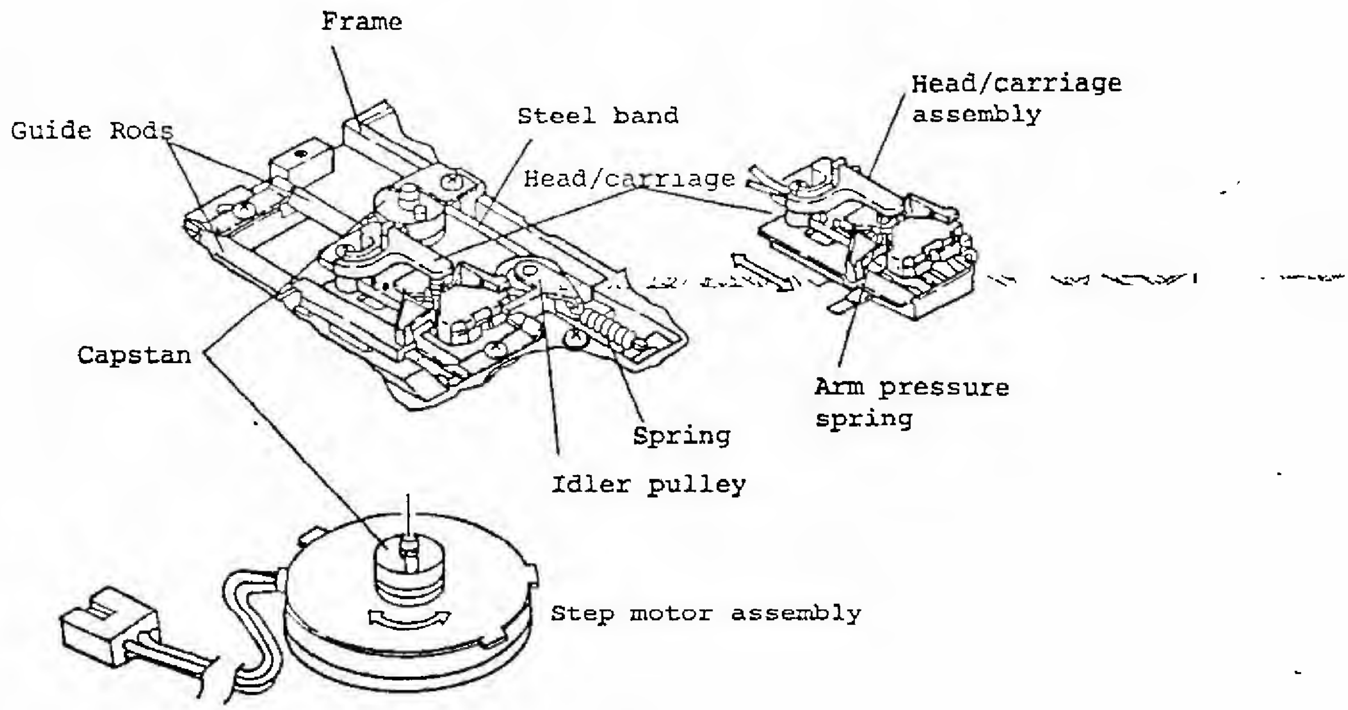


Figure 2-4 Magnetic-Head Positioning Mechanism

2.4 Magnetic Head/Carriage Mechanism

The magnetic head/carriage assembly consists of two magnetic head sliders that are supported by a circular gimbal spring and a plastic-molded carriage. The side 0 head is mounted in the carriage main frame, and the side 1 head is mounted on the movable arm for head loading and unloading. The movable arm is pushed by a coil spring to apply constant pressure during head loading. An external view of the carriage assembly is shown in figure 2-4, and the gimbal spring/head assembly is shown in figure 2-5.

The magnetic head is composed of three ferrite core chips and a ceramic support slider. The center core is for reading and writing, and the two cores on both sides of it are erase head cores.

Figure 2-6 shows an external view of the head slider.

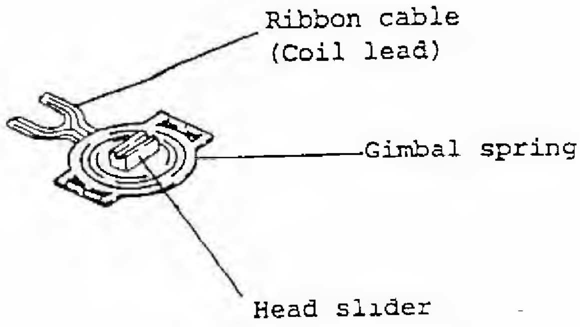


Figure 2-5 Gimbal Spring/Head Assembly

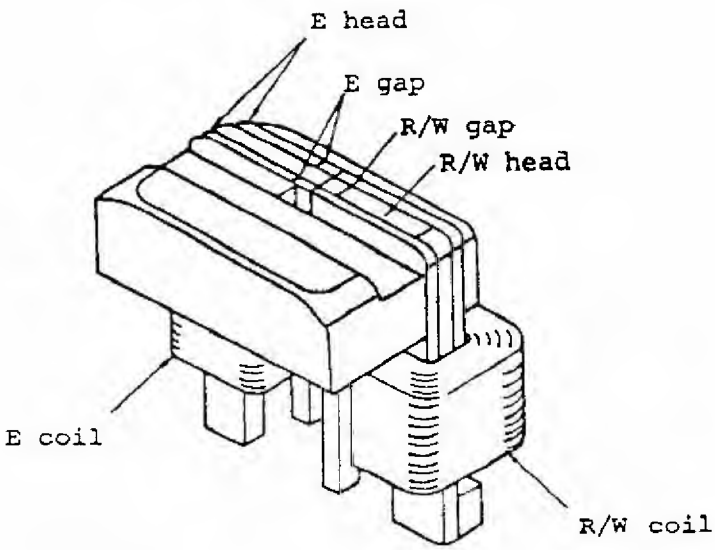


Figure 2-6 External View of Head Slider

Head Load/Unload Mechanism

The heads are loaded and unloaded by transmitting the vertical motion of the lift bar attached to the movable piece of the head load solenoid to the movable arm on the side 1 head of the head/carriage assembly.

When the head load solenoid is not energized, the lift bar and head arm are raised by the return spring, and the head is lifted clear of the disk (in the unload condition).

When the solenoid is turned on, the lift bar is attracted and lowers so that the head contacts the disk under pressure, and the lift bar and head arm are separated from each other.

A waiting time of up to 50 ms is necessary from the turning on of the head load solenoid until contact of the head with the disk. Neither read nor write is permitted during this time.

Figure 2-7 shows the head load solenoid and head/carriage assembly.

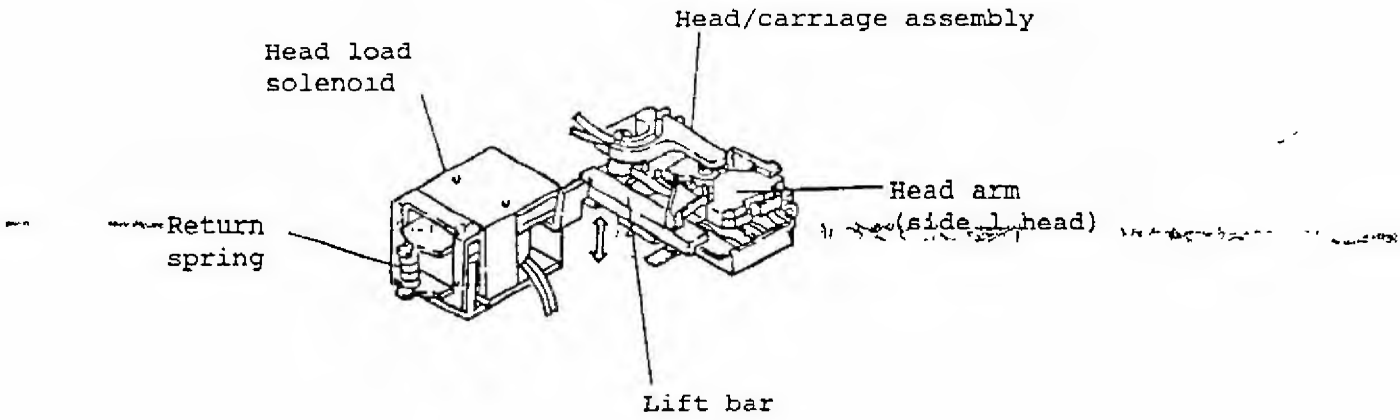


Figure 2-7 External View of Head Load Solenoid

2.6 Sensors (Index, Write Protect, Track 00)

(1) Index sensor

The index sensor detects disk rotation. This sensor consists of an LED on the light-emitting side and a photo transistor on the light-receiving side. The LED is mounted on the servo circuit PCA for the spindle motor (figure 2-3), and the photo transistor is mounted on the main control circuit PCA (NAMFB).

Index sensor timing (position) can be adjusted by loosening the screws on the NAMFB frame and shifting the index sensor.

Figure 2-8 shows where the photo-transistor for the index sensor is mounted.

(2) Write-protect sensor

The write-protect sensor detects the diskette's write-protect notch and inhibits write operation.

This sensor protects information stored on read-only disks from destruction by operation errors.

Disks with the jacket notch covered with tape or a seal that does not transmit light are protected by this sensor. Remember that vinyl or cellophane tape that has a high percentage of light transmission will not protect the disk. The write-protect sensor is mounted on NAMFB as shown in figure 2-8.

(3) Track 00 sensor

The track 00 sensor detects that the head is on track 00 and also prevents the head/carriage from moving farther backward even if excessive step pulses are supplied, thereby protecting the head/carriage from collision.

The track 00 sensor detects the position of the light-shielding plate that projects from the head/carriage assembly. The sensor is screwed to the diecast frame, and can be adjusted in position by loosening the screw.

The track 00 sensor and head/carriage assembly are shown in figure 2-9.

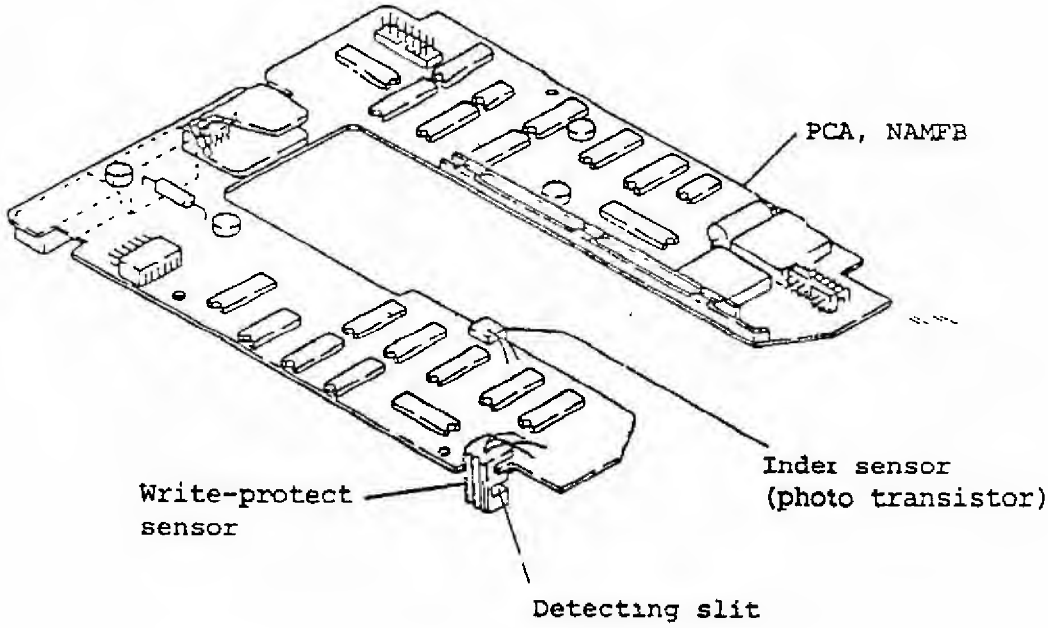


Figure 2-8 Index Sensor and Write-Protect Sensor

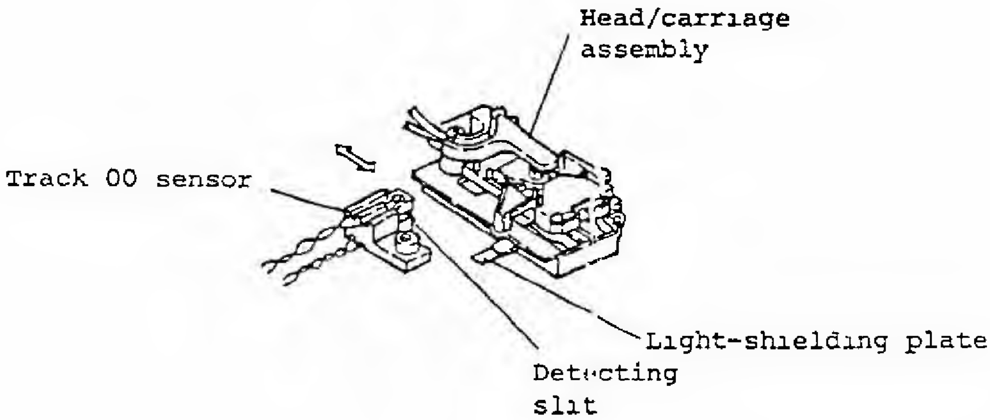


Figure 2-9 Track 00 Sensor and Head/Carriage Assembly

CHAPTER 3 DESCRIPTION OF ELECTRONIC CIRCUIT OPERATION

Figure 3-1 shows the electronic circuits of the M4851/M4853 and signal connections among these circuits.

The spindle motor drive circuit within the dotted lines constitutes the separate printed-circuit board that is built integrally with the motor.

The parts within the chain lines belong to the mechanisms described in the previous pages.

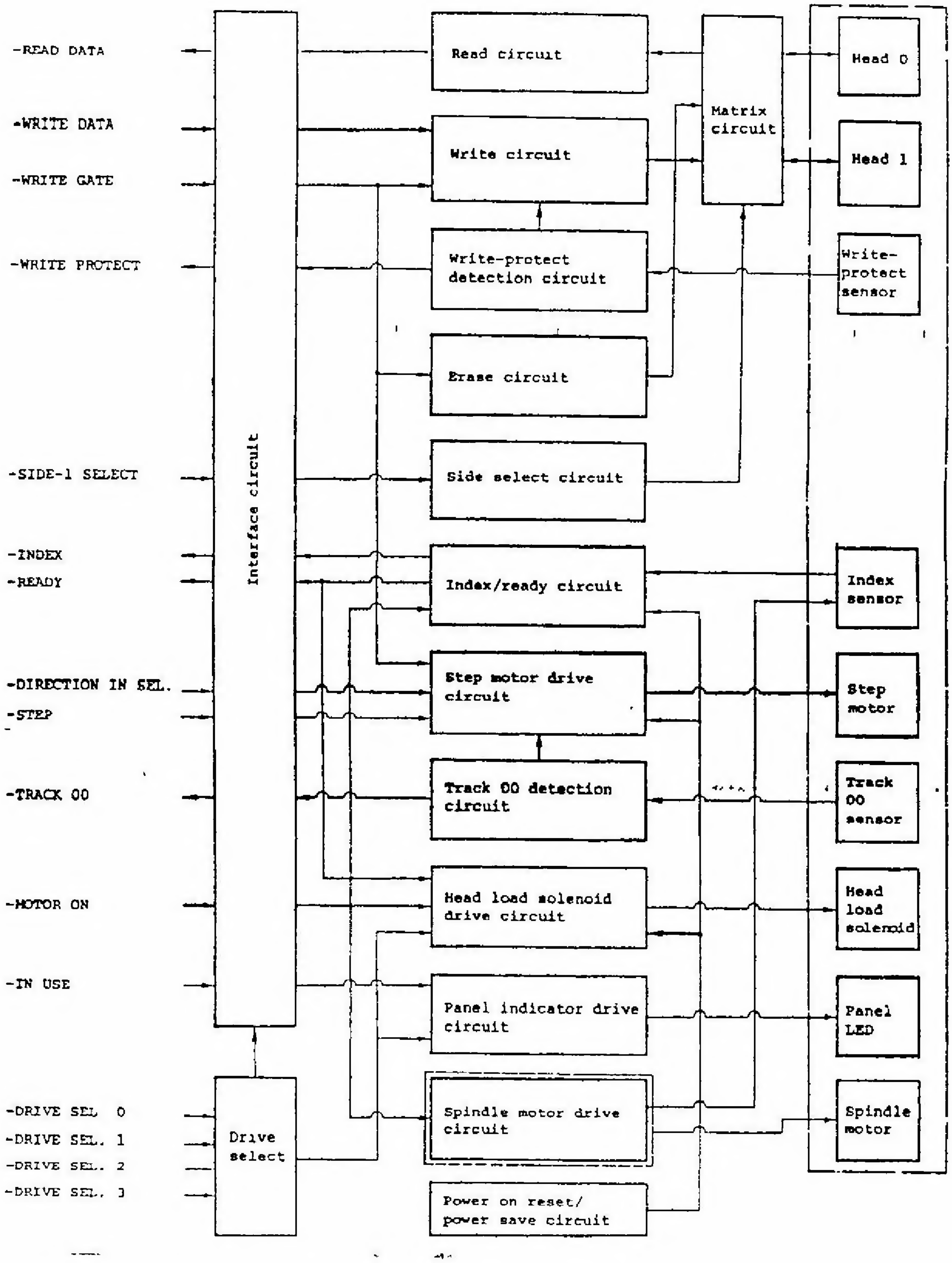


Figure 3.1 M4851/M4853 Electronic Circuits

1 Interface and Drive Select Circuits

(1) Receive circuit

All the input terminals of the receiver that receives signals from the host controller are terminated at 150 ohms, pulling them up to +5 V. The host controller, therefore, must use driver elements with a drive capacity of 40 mA or more. Normally, an SN7438N or an equivalent open-collector drive is recommended.

In connecting two or more disk drives (up to four) by a daisy-chain pattern, it is necessary to keep the cable end terminating resister and remove the terminating resistors of the other disk drives. The terminating resistors can be removed by disconnecting the jumper plugs from the printed-circuit board.

(2) Transmit circuit

The disk drive line driver is an SN7438N or equivalent open-collector gate. It is necessary for the host controller to use a terminating resistor of 150 ohms or more.

All input signals to the line driver are gated by drive select signals. Thus, if two or more disk drives are connected in the daisy-chain pattern, the signals of only one selected disk drive are transmitted to the host controller.

(3) Drive select circuit

The drive select circuit selects one of the disk drives (four maximum) connected with the same cable through four interface lines (DS0 through DS3).

The four select lines correspond to the jumper plugs on the printed-circuit boards, one of which should be inserted to select the desired line. Never insert plugs into the same-numbered jacks on two or more disk drives that are connected with the same cable; interference between the output signals from such disk drives will cause errors.

Figure 3-2 shows the drive select circuit. These select signals can be used not only for gating other signals but as head load solenoid drive signals.

The drive select signals also light the panel indicator LED.

In the case of a system requiring no drive selection, insert the jumper plug for the drive select line into the MX to maintain a selected condition.

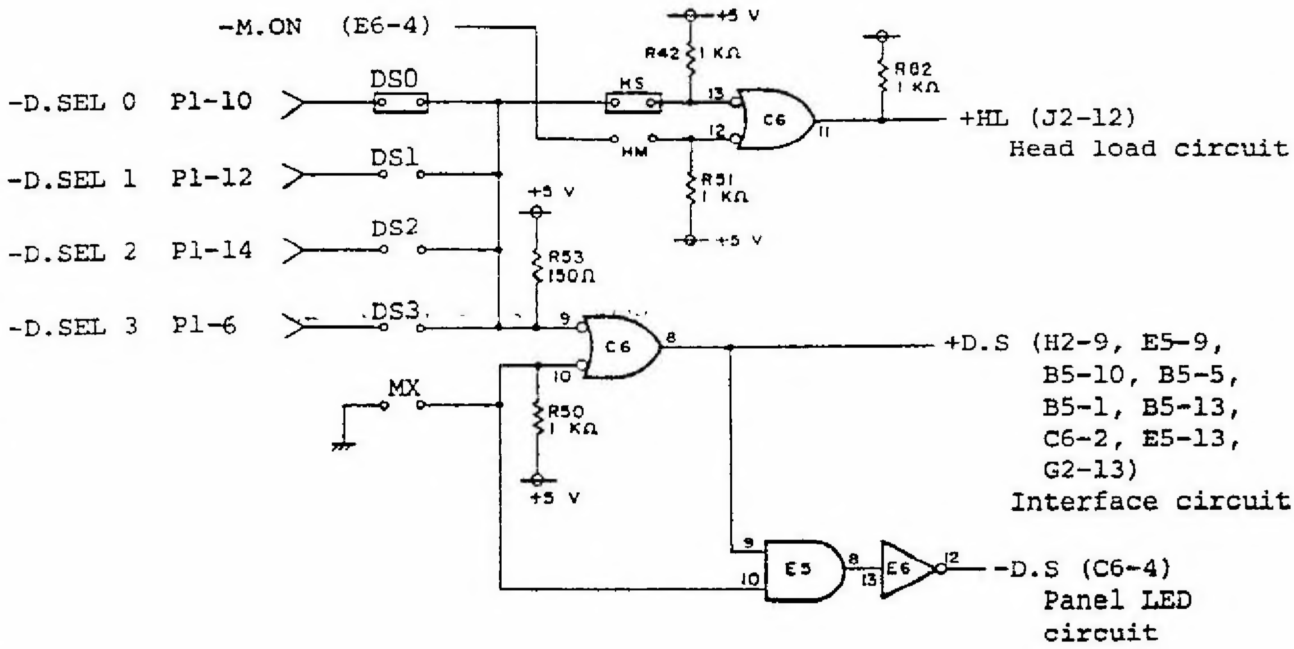


Figure 3-2 Drive Select Circuit

2 Power-On Reset and Power Save Circuits

(1) Power-on reset circuit

The power-on reset circuit, a level-detection type reset circuit, initializes the phase counter for the step motor drive circuit and reset the index pulse interval detecting mono-stable-multivibrator for the ready circuit.

The power level detection circuit for preventing operation errors of the write circuit in switching power on is provided separately on the write circuit side. This circuit output is not used.

The power-on reset circuit is shown in figure 3-3.

(2) Power save circuit

The power save circuit controls current flowing to the step motor and head load solenoid according to their operating condition to reduce heat generation by unnecessary power consumption and thus to reduce temperature rise of the disk drive.

The step motor and head load solenoid share the same timer (mono-stable-multivibrator), which has a range of 30 ms.

The power save circuit is shown in figure 3-4 and its timing chart, in figure 3-5.

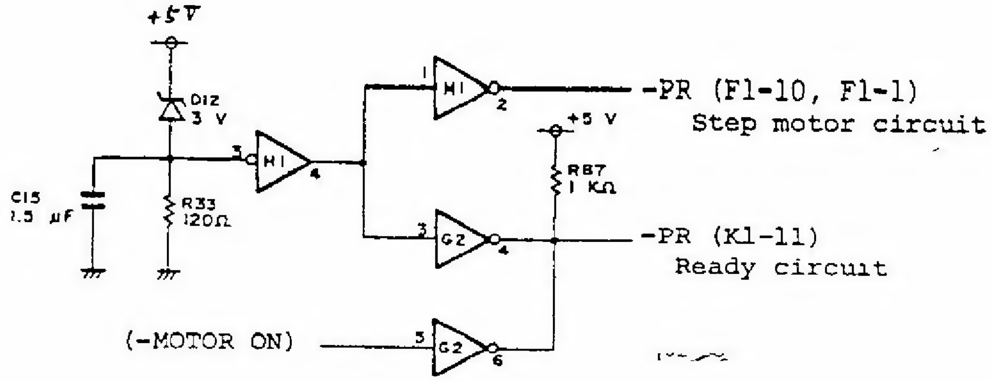


Figure 3-3 Power-On Reset Circuit

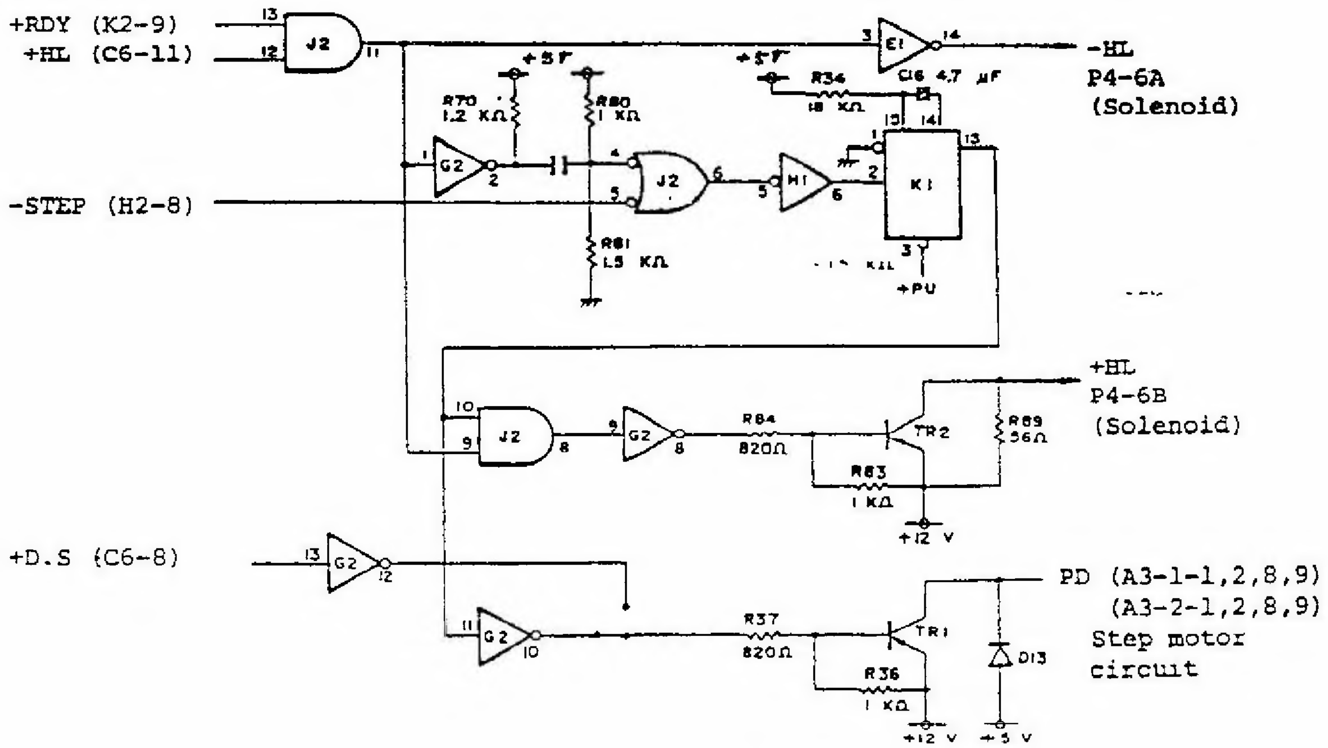


Figure 3-4 Power Save Circuit

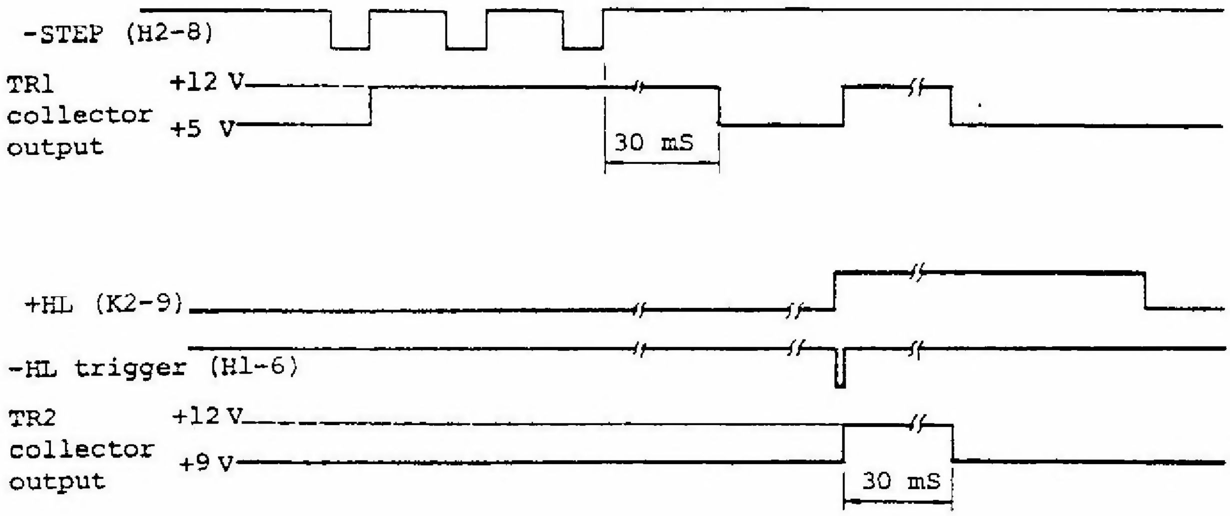


Figure 3-5 Power Save Circuit Timing Chart

3.3 Panel Indicator Circuit

The panel indicator is turned on by a drive select signal or by a drive select signal and in-use signal. Figure 3-6 shows a circuit diagram of the panel indicator.

When no in-use signal is applied to the interface, the panel indicator is turned on by a drive select signal only. If the jumper plug for the drive select circuit is inserted into the MX, the panel indicator is turned on by an in-use signal only.

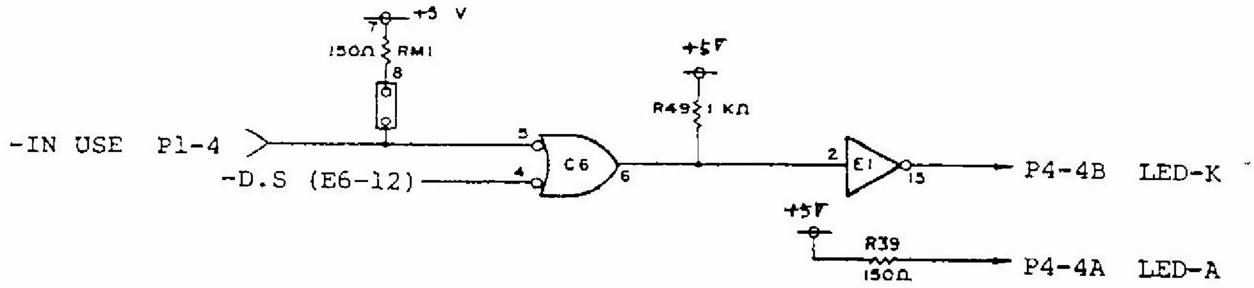


Figure 3-6 Panel LED Drive Circuit

3.4 Index Sensor and Ready Circuits

The index sensor circuit detects the index holes in the disk with a sensor, and converts its signals into logic signals.

The ready circuit checks the index pulse intervals with a timer, and becomes ready when the intervals are less than 300 ms and the next index pulse is generated.

When the door opens and the disk stops rotating, the ready signal is reset 300 ms after the last index pulse. If the motor-on signal turns off and the disk stops rotating, the ready signal is reset immediately at motor turn off.

Figure 3-7 shows a circuit diagram and figure 3-8, a timing chart.

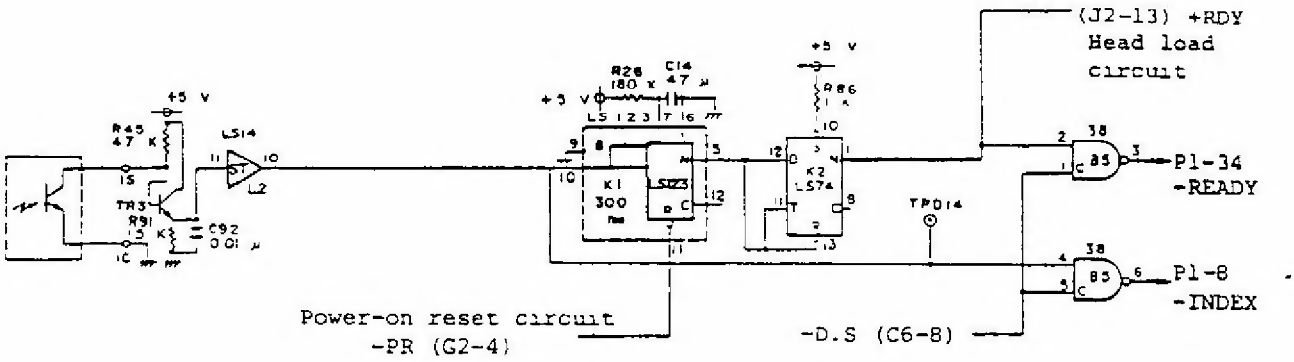


Figure 3-7 Index Sensor and Ready Circuits

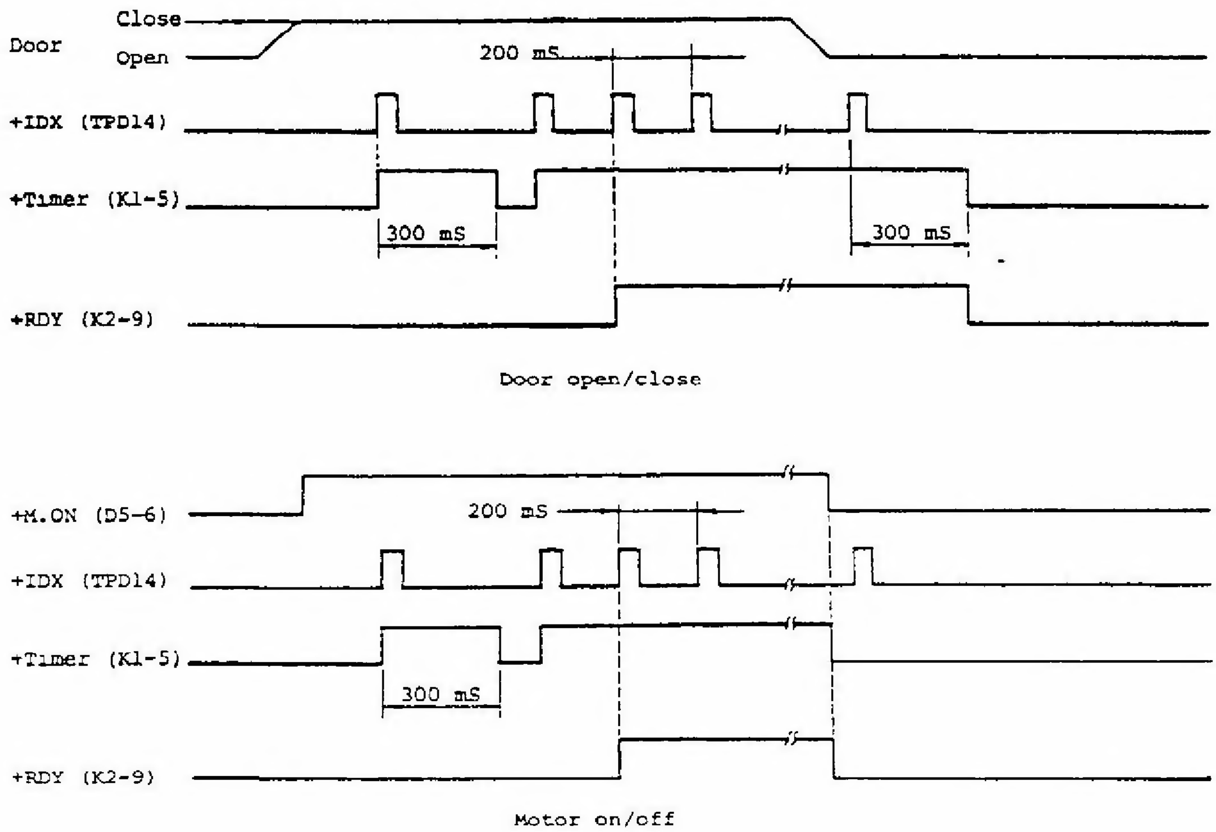


Figure 3-8 Index Sensor and Ready Circuit Timing Chart

3.5 Head Load Solenoid Drive Circuit

The head load solenoid is driven by a drive select signal or motor-on signal. If it is not ready, head load operation is inhibited.

To reduce current consumtion in the operation of the head load solenoid, a pickup current is fed for 30 ms after an input signal is applied, and the solenoid is held by a hold current (down about 25%). Refer to figures 3-4 and 3-5 for a circuit diagram and timing chart for these operations.

3.6 Step Motor Drive Circuit

The step motor is a two-phase bipolar type and is driven to a step angle of 3.6° (for M4851, 1.8° for M4853) by feeding four mode currents, using two source/sink type drivers.

These four modes are generated by an up-down ~~four count~~ counter that uses two flip-flops.

The step motor drive circuit switches the voltage supplied to the motor drive circuit to reduce power consumption during times other than seeking, when the motor is still.

In a seek operation, +12 V is supplied to the drive circuit, but if the next step pulse is not applied to the interface for 30 ms or more, +5 V is supplied.

Figure 3-9 shows a circuit diagram and figure 3-10, a timing chart.

The step motor drive circuit blocks the step pulses with a write gate (except for the erase delay time) to prevent seeking during write operation. When the track 00 sensor output turns on, the circuit also blocks the step pulses to prevent further outward seek.

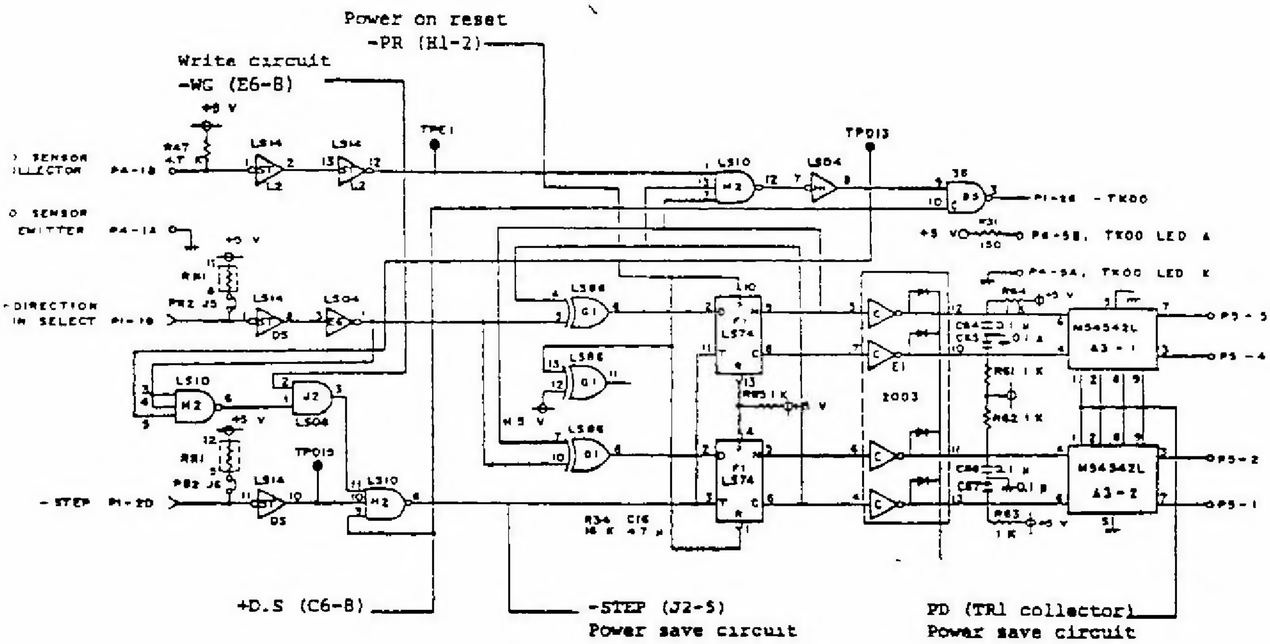


Figure 3-9 Step Motor Drive Circuit

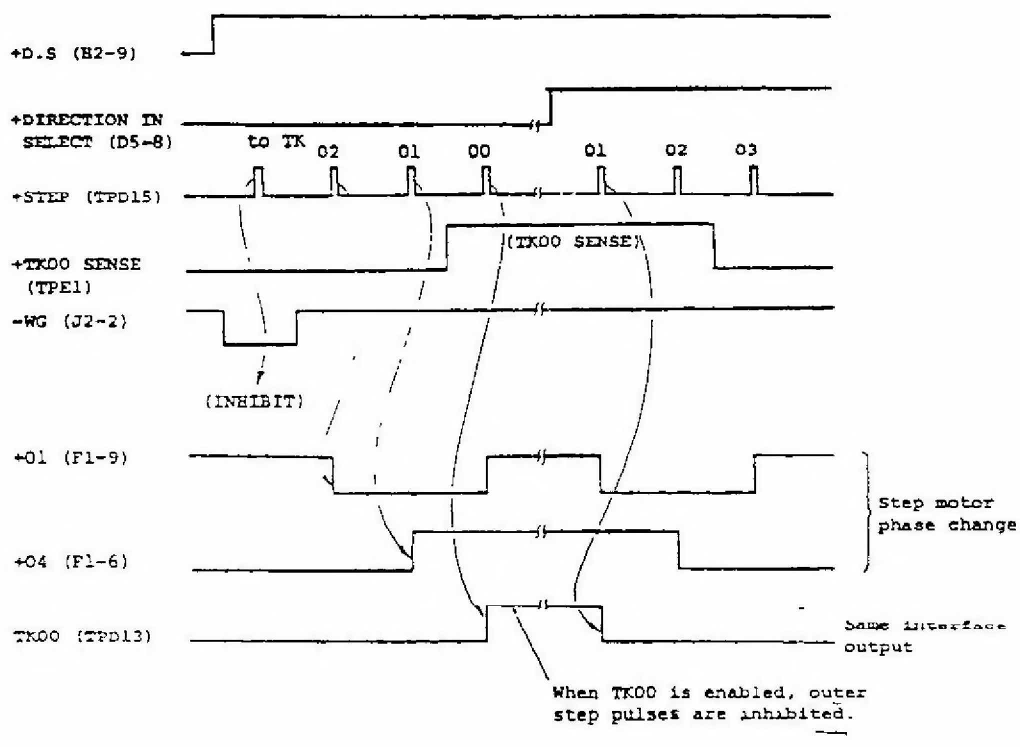


Figure 3-10 Step Motor Drive Circuit Timing Chart

3.7 Track 00 Detection Circuit

The track 00 detection circuit detects the position of the light-shielding plate that projects from the head/carriage assembly, using a sensor. This output is ANDed with the step motor drive phase (TK00) to generate a track 00 signal. The circuit will not output a signal, therefore, unless the drive phase is at track 00 even if the sensor output is on.

For a circuit diagram and timing chart, refer to figures 3-9 and 3-10.

Side Select Circuit

Side selection is made by switching the head center tap from about 11 V at off to about 1 V at on.

This operation alternately feeds a write current from R/W 1 (R/W 11) or R/W 2 (R/W 12) to the center tap CT 0 (CT 1) and an erase current from ER 0 to CT 0 during write operation. In read operation, a bias current is fed from R/W 1 (R/W 11) and R/W 2 (R/W 12) to CT 0 (CT 1) to induce a voltage between R/W 1 (R/W 11) and R/W 2 (R/W 12).

The host system selects side 1 through the interface line if - SIDE ONE SELECT is low, or side 0 through the same interface line if it is high.

Figure 3-11 shows a block diagram of the side select circuit.

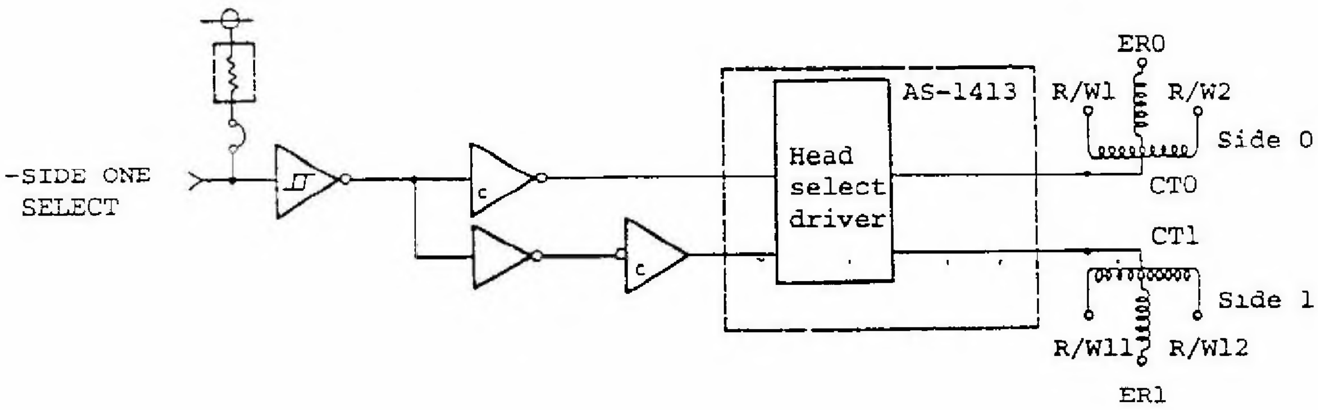


Figure 3-11 Side Select Circuit Block Diagram

3.9 Write/Erase Circuits

The write circuit is used for recording data on the disk. It starts writing when the write gate is opened for the selected head. If diskette write-protect status is detected, no write operation is performed.

The erase circuit erases the previous data written on both sides of the data by DC erasure. This function prevents old data from remaining on either side of newly written data due to a slight deviation of head position, and thus prevents old data crosstalk in reading the new data.

The write circuit consists of the following blocks:

- o Write toggle flip-flop
- o Write pre-driver
- o Write driver
- o R/W matrix
- o Write current source
- o Power driver

When a write gate is input, the write toggle flip-flop and write pre-driver are enabled to start a write operation. Write data is counted down to one half by the write toggle flip-flop, and a differential signal that changes synchronously with the write data is generated.

This differential signal is input to the write pre-driver to switch the write driver. The write driver is a switching circuit that feeds a current to the R/W head. This current is generated by the write current source and is sent to the write driver.

The R/W matrix feeds a current to the head selected by SIDE ONE SELECT as the write circuit gate is opened by a write gate.

Figure 3-12 shows the erase function and figure 3-13, a write circuit block diagram.

Current is alternately fed to the R/W head through two current routes, R/W 1 to CT 0 and R/W 2 to CT 0, as shown in the figure, according to the differential signal to invert its magnetization.

Erase operation starts with point E before write start point C and ends at point F after write end point D. The position deviation of the R/W core from the erase core is about 0.9 mm, and the erase core reaches a point that the R/W core gap has passed about 600 µs later (near TK 32).

Therefore, the delay operation shown in figure 3-15 is required for the time from the opening of the write gate to the turning on of the erase driver and from the closing of the write gate to the turning off of the erase driver. It is for this purpose that the erase delay timer is provided to control the erase driver. Thus, for about 1000 µs after the closing of the write gate, the head must remain on the track and be kept selected.

The erase function erases data from the disk by always magnetizing it in one direction.

Figure 3-14 shows a conceptual diagram of write operation and figure 3-15, an erase delay operation timing chart.

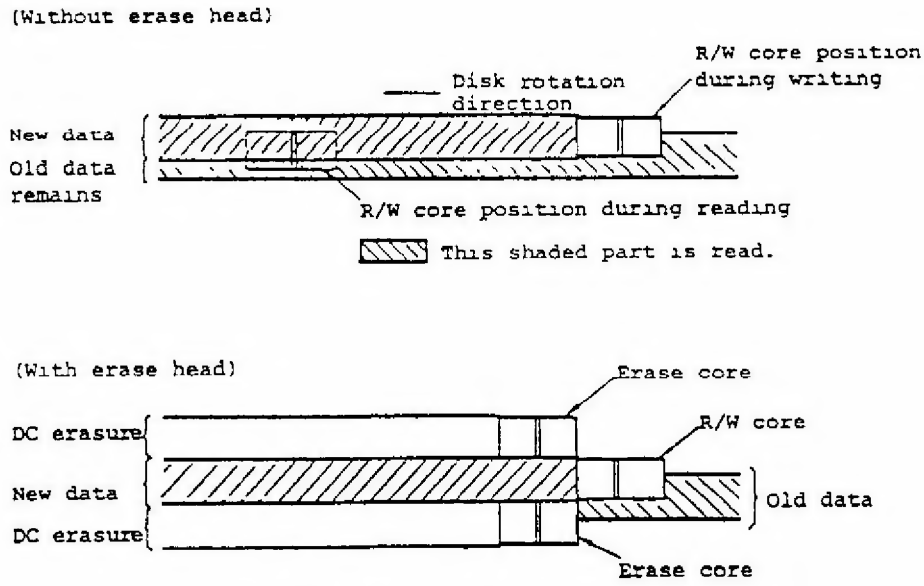


Figure 3-12 Erase Function

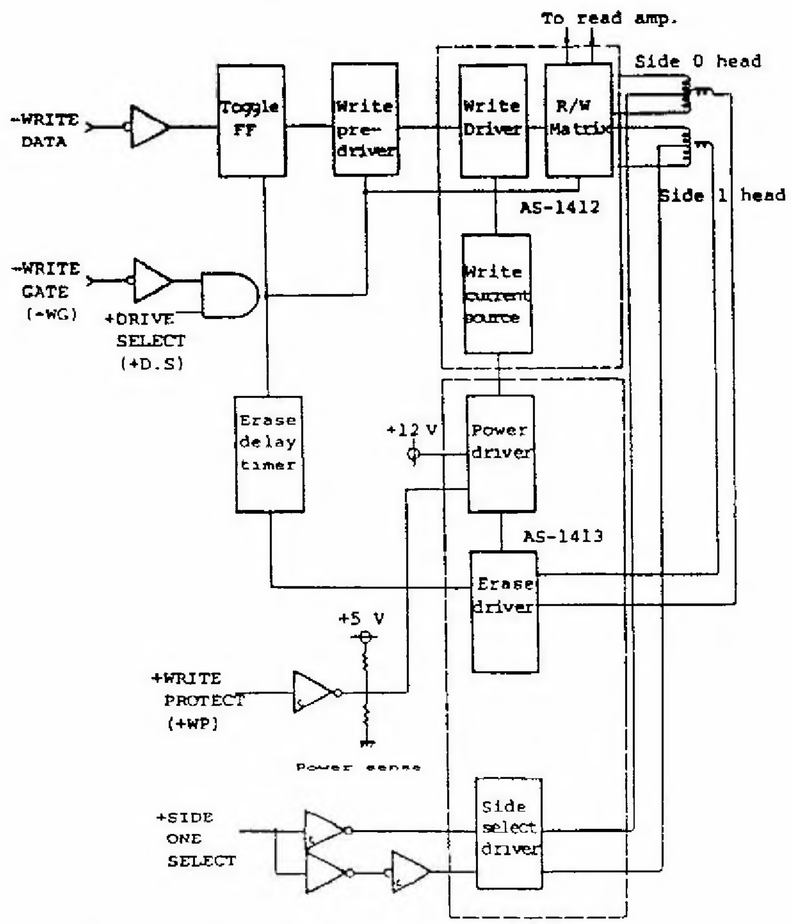


Figure 3-13 Write Circuit Block Diagram

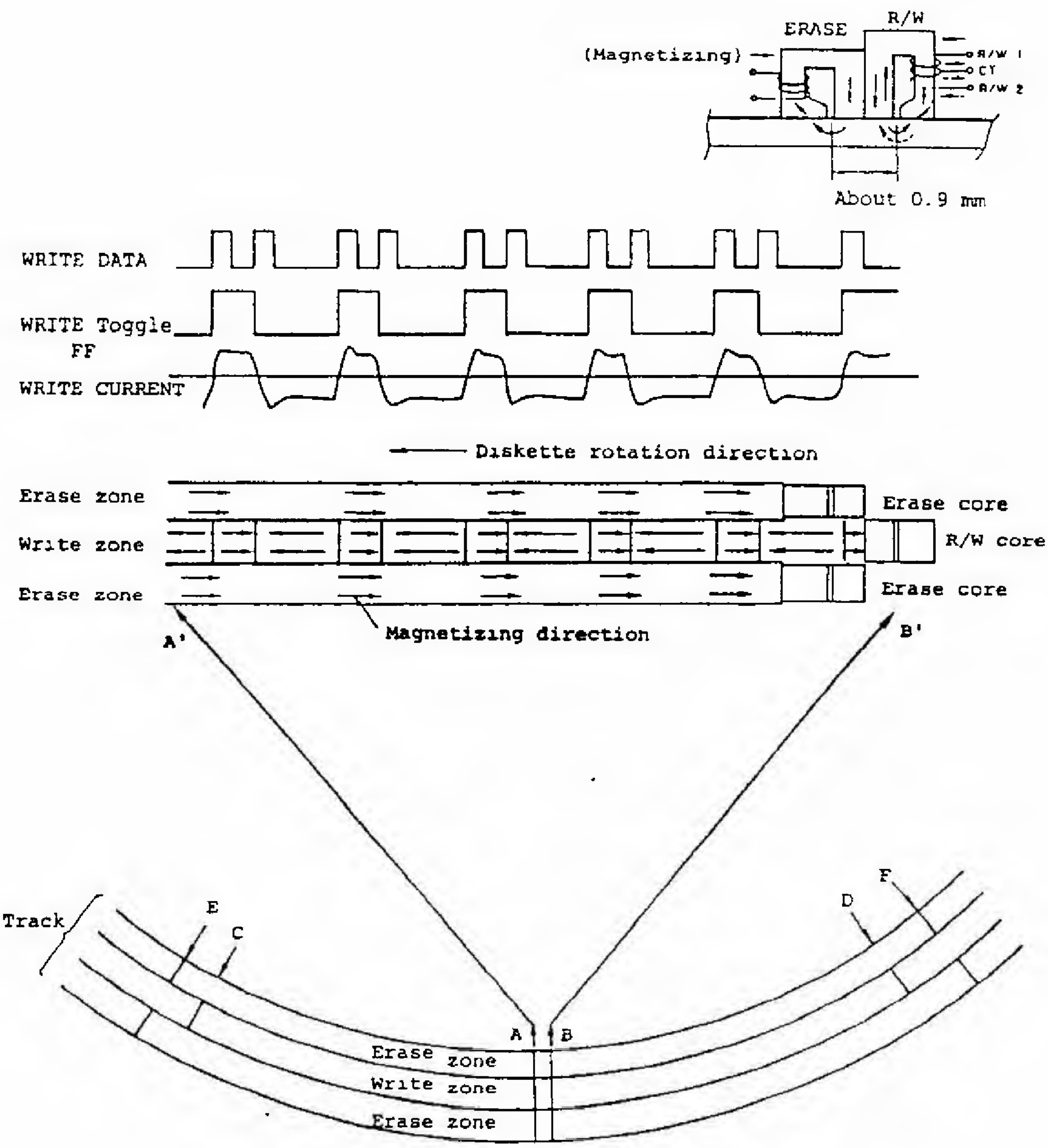


Figure 3-14 Write Operation Concept

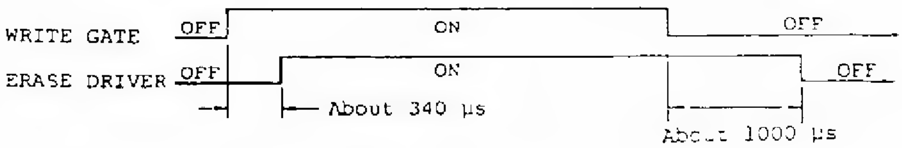


Figure 3-15 Erase Delay Operation Timing Chart

3.10 Write-Protect Circuit

The write-protect circuit detects the notch (cutout in the jacket) of the diskette with a sensor to inhibit write operation even if a write gate signal is received from the interface, and outputs a write-protect signal to the interface. Figure 3-16 shows a circuit diagram of the write-protect circuit.

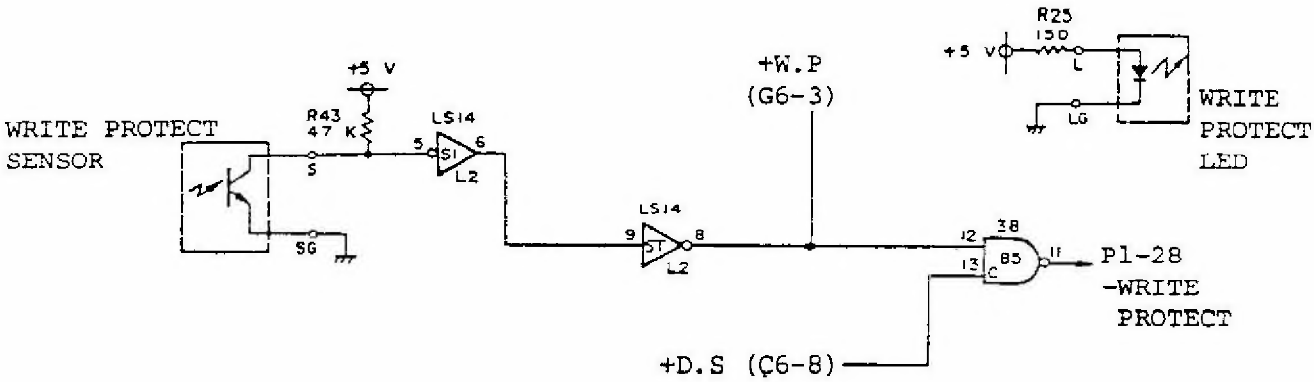


Figure 3-16 Write-Protect Circuit

1 Read Circuit

The diskette is read when the write gate and erase driver are closed.

The R/W core is on a track. If a head has been selected, the core reads the inversions of magnetization of the previously written data to induce a voltage between the two ends of the R/W coil (between R/W 1 and R/W 2). This voltage is input to the read preamplifier via the R/W matrix.

The read preamplifier provides a gain about 100 times the level of a few millivolts induced in the head, and amplifies the input into a differential signal high enough for signal processing.

The read signal from the read preamplifier is fed through a low-pass filter that cuts out excess high frequencies. Because the position of inverting magnetization is expressed by a read signal peak, the read signal is fed to a peak-detection circuit to generate a read data pulse.

The peak-detection circuit consists of three blocks.

- o Differentiator
- o Comparator
- o Time domain filter

The differentiator is a differentiating circuit to detect the peak point, and the detected peak point is converted to a zero-crossing point. The differentiated signal is routed to the comparator, where it is converted from an analog signal to a digital signal. The point of change of this digital signal actually becomes a data pulse.

FM or MFM means frequency modulation. The magnetization inversion intervals used are 8 μs and 4 μs for FM, and 8 μs, 6 μs, and 4 μs for MFM, corresponding to a maximum frequency of 125 kHz and a minimum frequency of 62.5 kHz.

Adjacent magnetization inversion waveforms interfere with the magnetization inversion waveform converted from magnetism to an electronic signal, so their combined waveform is read. If magnetization inversion intervals lengthen, however, the mutual interference decreases, resulting in generating a shoulder. When a shoulder is generated, the differentiated waveform zero-crosses so that the wrong data pulse is detected. A time domain filter is provided for removing the wrong data pulse.

If the comparator output maintains the previous level for a specific time after the mono-stable-multivibrator has operated (1) from the zero-crossing inversion point output by the comparator, the time domain filter outputs it as real read data (2).

The read data thus generated is sent to the host system. Figure 3-17 shows a read circuit block diagram and figure 3-18, a read timing chart.

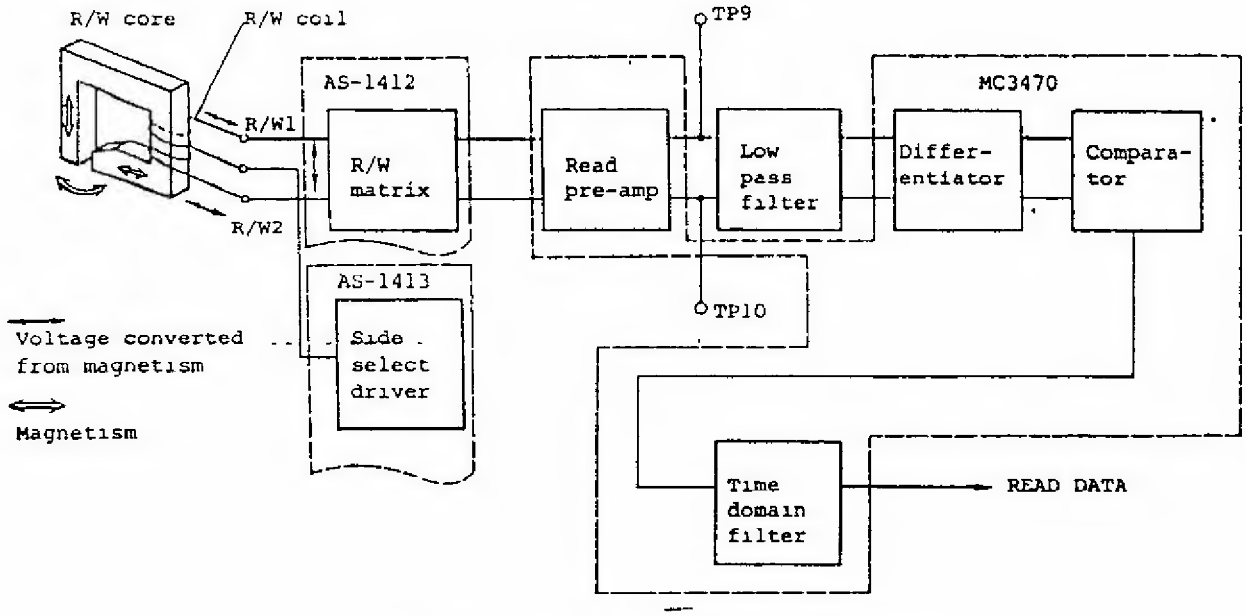


Figure 3-17 Read Circuit Block Diagram

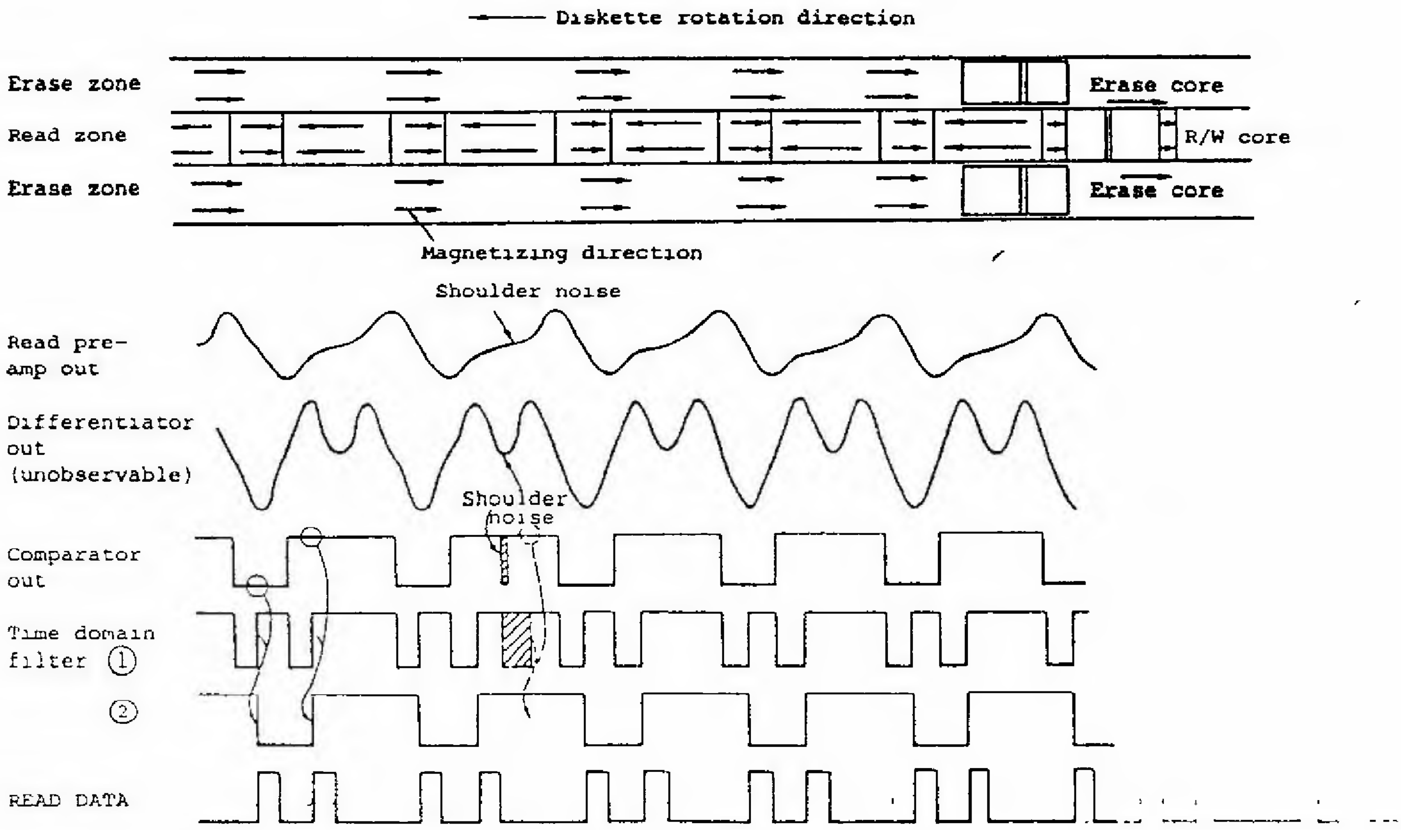


Figure 3-18 Read Timing Chart

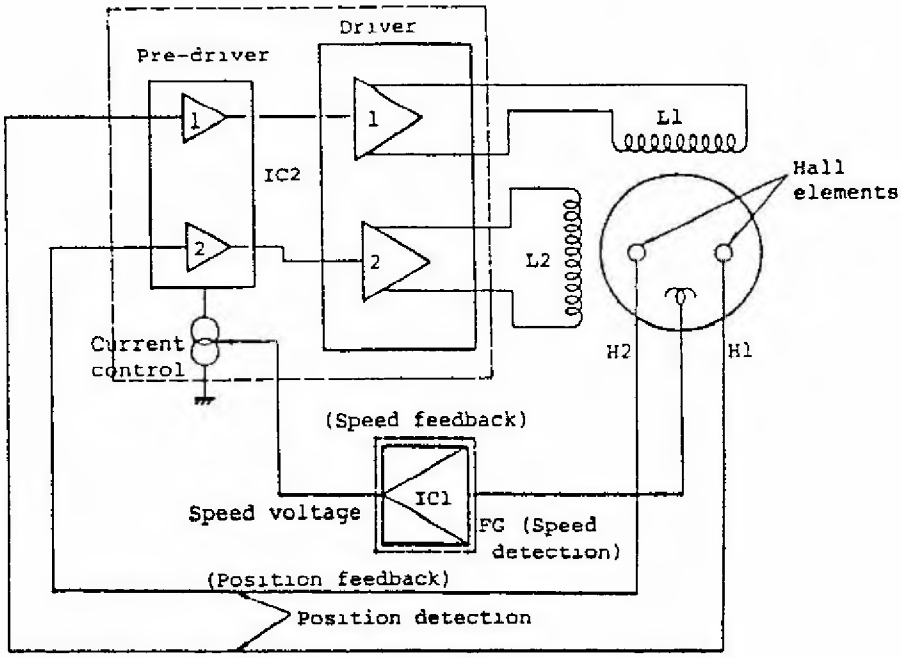


Figure 3-19 Spindle Motor Drive Circuit Block Diagram

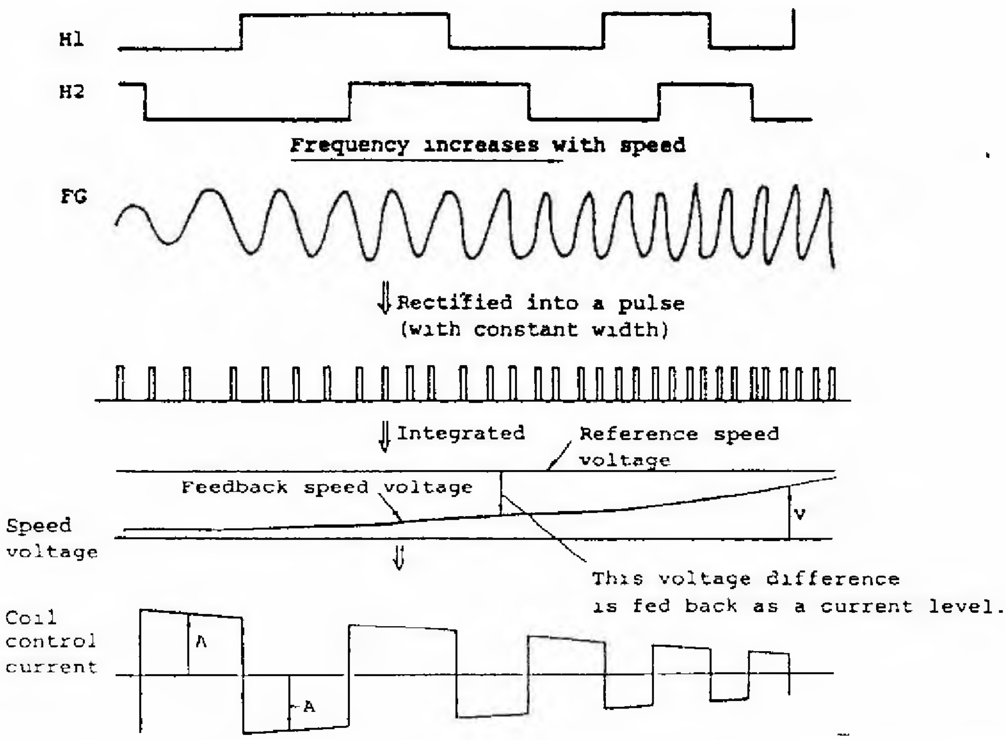


Figure 3-20 Conceptual Diagram of Spindle Motor Drive Circuit Waveforms

M4853 DISK DRIVE SCHEMATICS AND LOGIC MANUAL

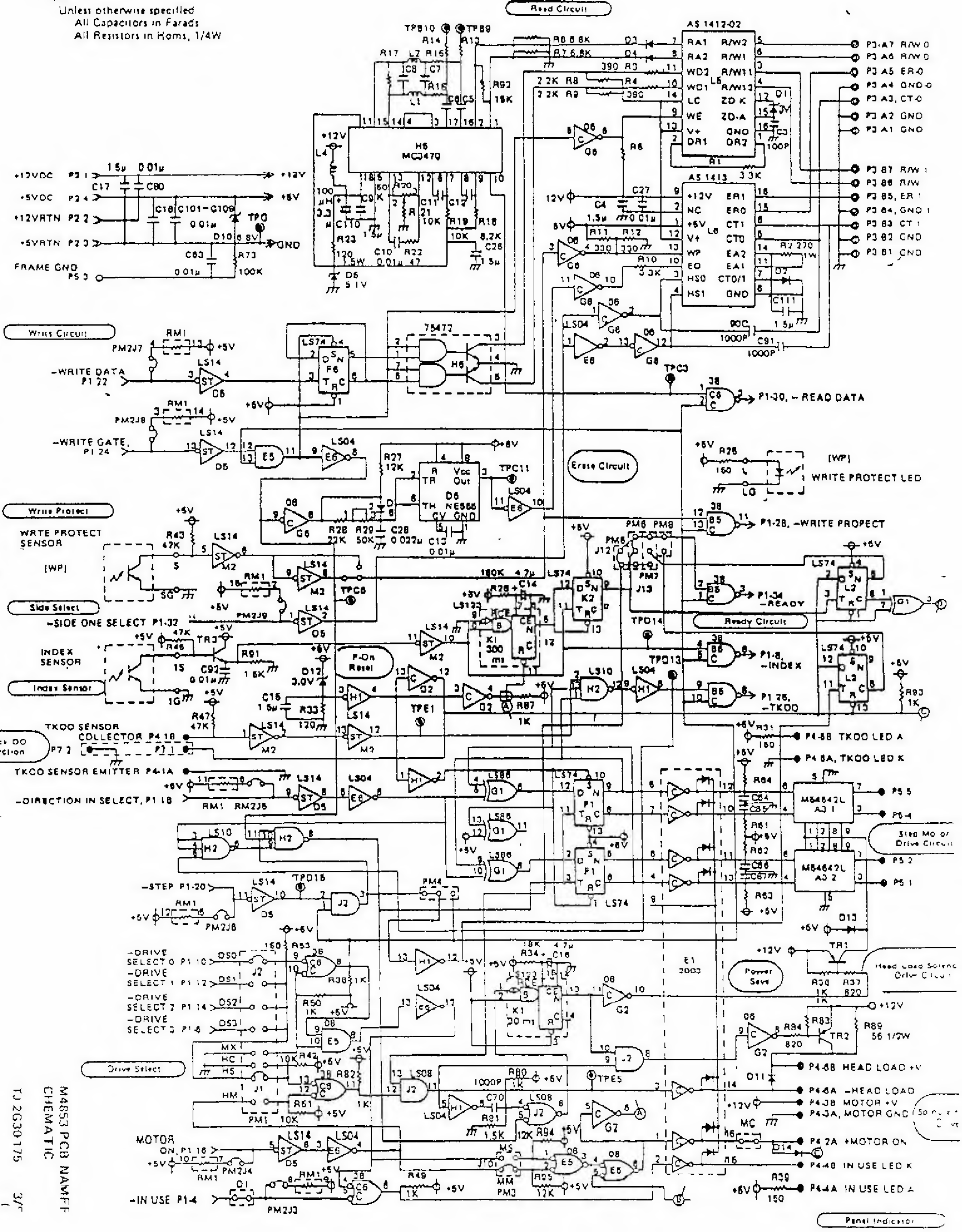
Usable for M4851

SYDEC b.v.
Postbus 6
3769 ZG SOESTERBERG
03463 - 3988
TLX 47792 HCS

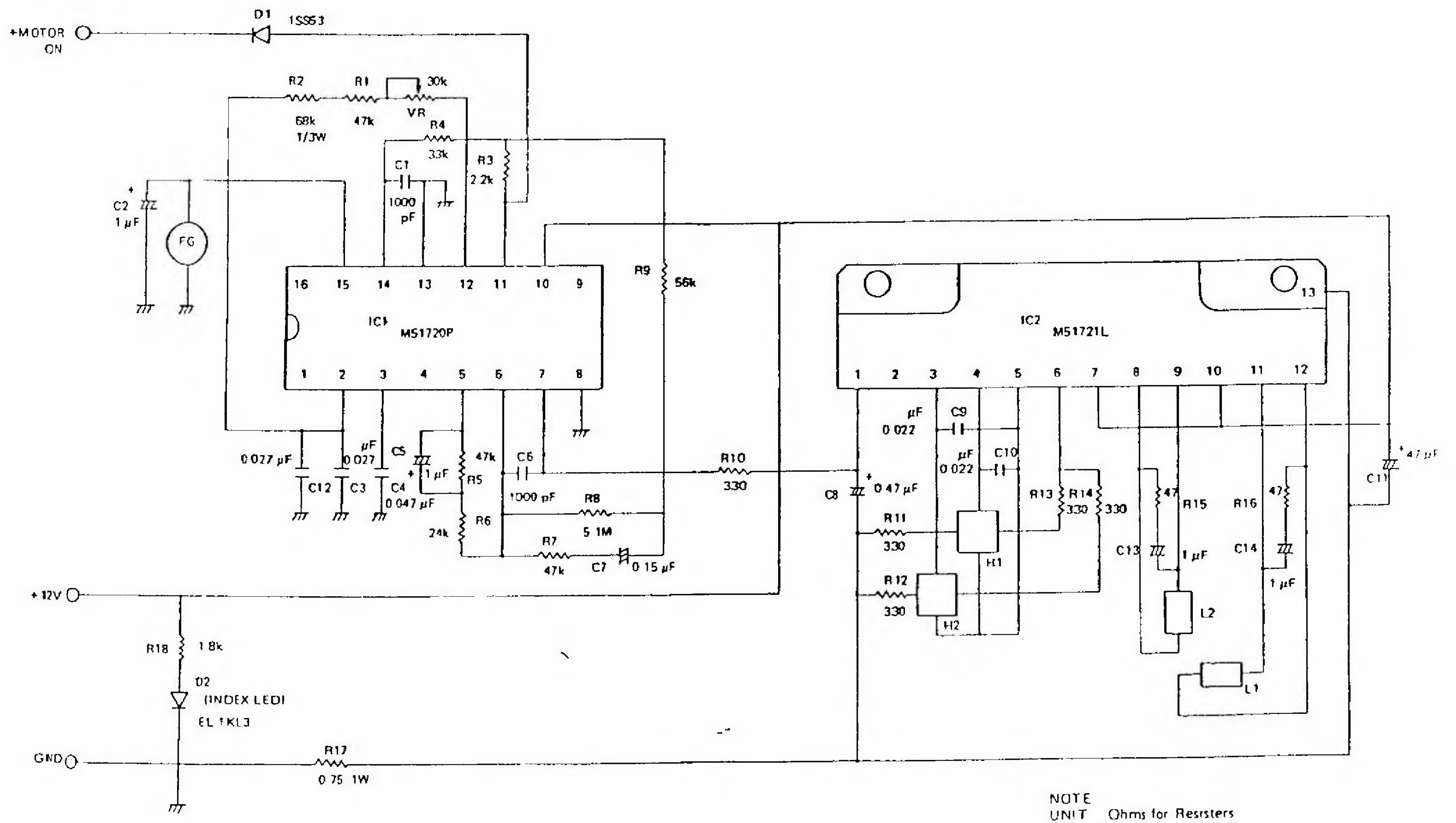
TJ2-G30175

C5 C6	0.022μ	C11	330P	R61 ~ R64 K
R13 R14	1K	C12	150P	C64 ~ C67 0.1μ
R16 R16	470			
C7 C8	1000P			
R17	1.5K			

Note
Unless otherwise specified
All Capacitors in Farads
All Resistors in Homs, 1/4W

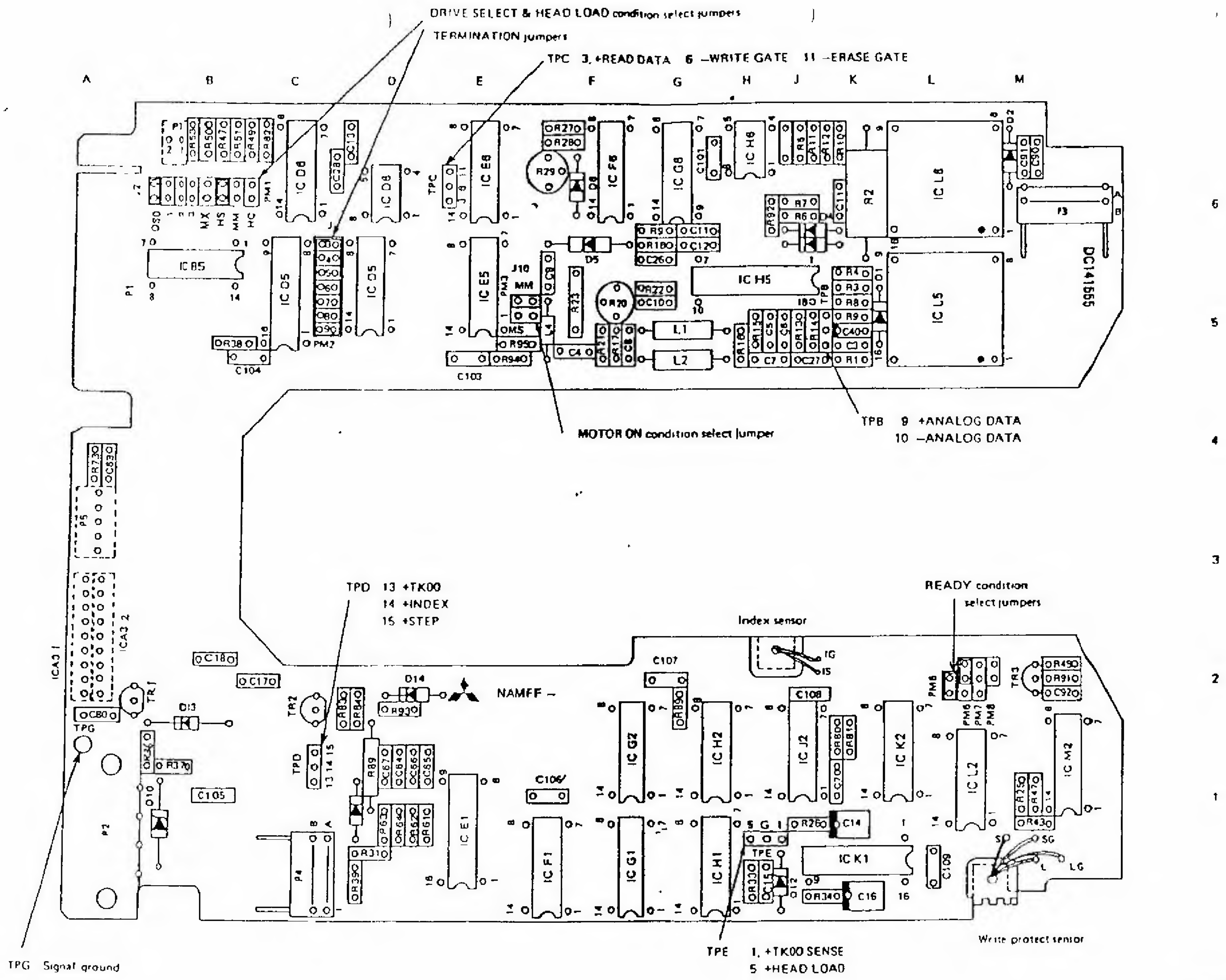


M4853 PCB NAMFF
SCHEMATIC
TJ 2G30175 3/5

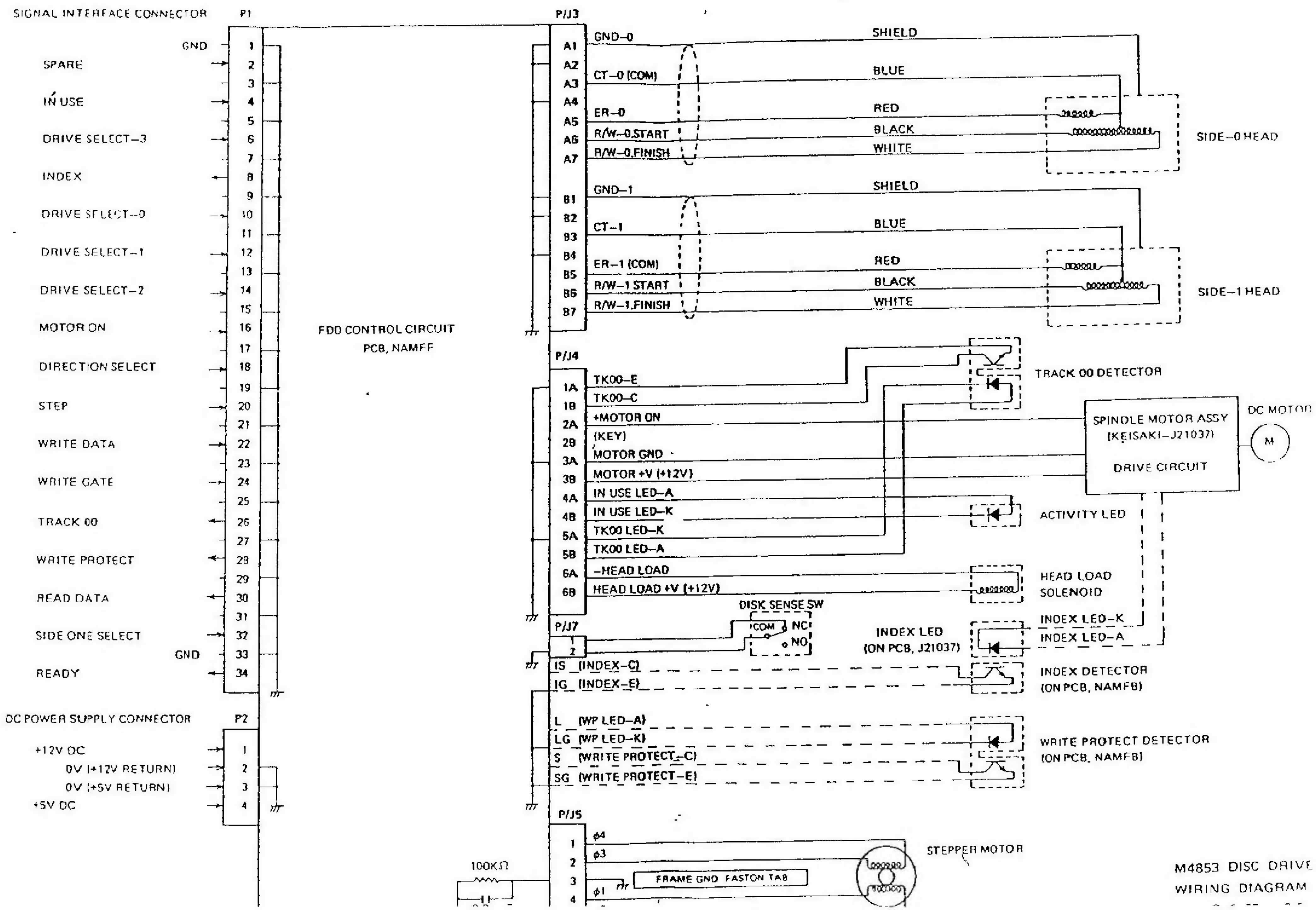


NOTE
UNIT Ohms for Resisters
Rotation speed 300RPM

M4853 SPINDLE MOTOR ASSY SCHEMATIC



M4853 PCB NAMFF
PARTS LOCATION DIA



M4853 DISC DRIVE
WIRING DIAGRAM