LEBES REFERENCE GUIDE

by

N. K. L. Raja

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ELECTRONICS RESEARCH LABORATORY

College of Engineering
University of California, Berkeley
94720

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N. K. L. Raja
(Central Electronics Engineering Research Institute, Pilani, India)
Professor in charge:
T.Van Duzer

This write up covers the general description and maintenance hints of the LEBES machine. This is done in three parts which deal with:

a. The Electron optical column

b. The Electronics console

c. The computer software

(Wherever detailed information is available elsewhere, references are given and the description is omitted.)

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1.0 Introduction

The Lebes consists of the following three major parts:

1. The electron optical column,

2. The electronics console and

3. The computer system

The controls for the electron optical column are housed in the main console. Most of these controls are common to the ETEC AUTOSCAN SEM. But the modules which perform the measurement and writing processes are unique to LEBES. There is another console which controls the stepper motors and generates the deflection power to the coils. The electron beam writing and re-registration are controlled by the computer (Perkin-Elmer 1625 system). The user interaction is provided by the CRT terminal.

2.0 The Electron Optical Column

2.1. Electron gun

It is a precentered, tungsten filament, thermionic triode gun. The gun-crossover diameter remains fixed for given set of the values of the accelerating voltage and filament temperature.

2.1a. Operational maintenance

Poor vacuum in the gun region (pressure $> 10^{-3}$ torr) can cause corona discharge in the gun region and this is indicated by the emission current meter reading out of range. If this occurs shut off the High voltage and filament and re-evacuate.

2.1.b. Changing filaments

The filament life meter on the main console reads indicates the approximate available life of the filament. (This is valid only when the filament is saturated. See the operation manual about filament saturation). It is suggested that the filament be changed when filament life indicated is < 10%. The filament replacement is discussed in the AUTOSCAN manual. It is suggested that every time the filament is changed, the anode cap and the whenelt assembly be cleaned with a metal polish using a lint-free cloth and rinsed in tetrachloro- ethane at 60oC for 20 minutes and blown dry before mounting.

2.2. The Blanking Plates

These form the next stage after the electron gun assembly. This is essentially a parallel plate capacitor which can switch upto 2 MHz. There is an aperture at the bottom of this assembly which needs cleaning after every 50 Hours of operation. Take care to disconnect the two wires connecting the Blanking plate assembly to the electron optical column.

2.3. Lenses and Deflection coils

These are inaccessible for routine maintenance. There is an aligner pipe which passes through this assembly and has two apertures that need cleaning after about 50 hours of operation. The method of retrieval of the aligner pipe is described in the Autoscan manual.

2.4. Specimen stage

The user interacts mostly with this part of the column. Always wear gloves while loading and unloading the sample to avoid unnecessary contamination of the specimen holder.

The motor drives are coupled to the specimen stage through two movable shafts which push the specimen stage in stepped increments. The stage is always under tension from two mutually orthogonal stripe springs. It is suggested that the loading/unloading operation be done gently to avoid damage to these springs and also to be sure of the stage position setting.

There are four stage traverse limit switches which allow the stage movement of up to 0 - 50 mm in orthogonal directions. But for values of stage coordinates greater than 47,47 mm

the stage touches the secondary electron detector assembly. It is recommended that these coordinates be not exceeded while selecting the stage positions.

2.5. Vacuum system

It has a diffusion pump backed by a mechanical pump, various solenoid valves and interlocking electronics for safety. The details of the system are available on the Autoscan manual and the vacuum troubleshooting is described in the Autoscan diagnostics manual.

3.0 Main Console

The modules on this console control the following functions:

a. Preliminary self-diagnosis.

b. Control the electron optical parameters.

c. Measurements and calibration.

d. Electron beam Writing and re-registration.

3.1 Self diagnosis

There is a diagnostics module on the main console which should be used to monitor the condition of the machine any time. There are various test points (mostly power suplies and some important waveforms) on the machine which are connected to this module and can be selectively read or displayed on an oscilloscope. The details of actual voltages and waveforms are mentioned on the module and in the AUTOSCAN manual. It is suggested to refer to the section 10.0 of the Autoscan maintenance manual.

3.2 Electron Optics Controls

3.21 High Voltage Power Supply

There is module named as the emission control module. This generates the necessary high voltage and the filament heating current for the gun assembly. The high voltage has been calibrated and hence DO NOT alter the calibration controls. There are basically two symptoms of problem in this module. Either No High voltage or no emission current (or neither of them) is read in the meter. This would be evident if there are some of the power supplies in the rear panel are not functioning. Refer to the section 3 of the AUTOSCAN diagnostic manual for tracing and replacing the components in these power supplies. WARNING: DO NOT DISTURB ANY OF THE HIGH VOLTAGE INTERLOCKS. IF THE FEEDER POWER SUPPLIES TO THE HIGH VOLTAGE MODULE ARE WORKING AND STILL NO HIGH VOLTAGE BEING SHOWN, CALL THE SERVICE ENGINEER. IN ANY CASE IF THE HIGH VOLTAGE MODULE IS TO BE OPENED MAKE SURE THAT ALL POWER TO IT ARE CUT OFF

AND ALL THE HIGH VOLTAGE CAPACITORS ARE DISCHARGED.

3.22 Low Voltage Power supplies

The low voltage power supplies (ranging from +-6 Volts to 300 Volts) are spaced in different rear modules. Their functions are to feed the necessary powers to various modules including the Lens current module which generates highly stable (+-50ppm) currents to excite the electromagnetic lenses. Their actual locations are described in the autoscan manual. Refer to the section 5.0 of the AUTOSCAN diagnostics manual for troubleshooting. The actual status of most of these power supplies are shown by the diagnostic module.

3.3 Measurements and calibration

There are certain modules which used only during the beam current and diameter measurements. There is an isolated cup on the specimen holder in the specimen stage. This cup has a grid over it which is used to focus the electron beam and to measure its diameter.

3.31 Beam current measurement

As described in the Lebes Operation guide the electron beam is focused on one of the grid elements and then the scan length is reduced (field size on the field control module) such that the whole raster falls in the cup. The spot mode is selected and the electron current collected by the cup is amplified and displayed at the specimen current meter. TAKE CARE that the tine toggle switch on the specimen chamber (which connects the cup to the meter) is always switched OFF when no beam is falling in to the cup. It is recommended that the range selector switch on the specimen current module be always be left at the lowest sensitivity range when the meter is not in use. There is an alarm buzzer that gets activated whenever the input current exceeds the range or when the cup is grounded. It is also observed that the input amplifier in this module is very sensitive to temperature. It is suggested that the main console switch and the auxiliary power switch (at the rear bottom of the stage control module) be switched OFF whenever the airconditioning in the room fails. In case of problems with this module test first the +- 15 volts supply to this module and then replace the input amplifier if needed.

3.32 Beam diameter measurement

The Dual scan generator produces two linescans whose length and position can be changed. The scan lengths are changed using the gain controls on this module. The scan lengths have to be calibrated if the settings of the gain potentiometer is changed. This is done by using standard samples (like LATEX spheres) as a specimen and imaging in the SEM mode and setting the field size necessary which corresponds to approximately 1.0 um across the screen. The amplitude of the line scan waveform (which is generated by the field control module) is measured. The amplitude of the necessary for 0.1 um scan is calculated and the dual scan amplitude are set to this value using the gain controls.

3.4 **EBL modules**

These modules are useful during e-beam writing and re-registration.

3.41 Field control and EBL scan generator modules

In case the patterns drawn show non orthogonality or non compatibility with desired lengths drawn the following steps must be undertaken.

3.411Non orthogonality

Probe the two test points on the large printed circuit boards which produce the deflection power drive, at the bottom of the stage control module. The CRT waveform should show the horizontal and vertical scans having intermodulation. Using the trim potentiometers on these boards (marked X in Y and Y in X) reduce the intermodulation to minimum. CAUTION: A GOOD BACKGROUND OF THE SCAN GENERATION AND PROCESSING TECHNIQUES USED IS NECESSARY BEFORE TRYING OUT THIS CORRECTION.

3.412Non compatibility

Select the EBL mode and write a pattern very slowly using a pattern file on the computer. If the waveforms monitored at the test points are saturating look for problems in the amplifier chain on the drive boards. If there are jumps in the digital addresses then the problem may lie in the DAC's on the EBL scan module. IP 3.42 Blanking signals

The following steps to be followed if there are retrace exposures on the wafer. Probe the output marked BEAM on the scan generator module using an oscilloscope. The state of the logic should change if the mode of operation is switched between EBL and SEM on the field control module. If this does not happen check the last driver amplifier on this module. It is also suggested that the dynamic blanking performance be checked by writing a pattern slowly while monitoring the blanking signals. If the logic boards are fine then check the waveform at the blanking plates. CAUTION : NOT A TTL VOLTAGE !

IP 4.0 Computer maintenance

This section describes only the steps to be taken when there is a system crash. For other details refer to the computer hardware and software manuals.

4.1 Back-up loading

When the operating system or other files are not accessible from the discs and the terminal responds with various error messages for usual commands then use the following commands to reload the software on to the discs using the back up tape. IMPORTANT: THERE IS NO BACK-UP FACILITY AVAILABLE FOR USER GENERATED PATTERN DATA ON THE DSC1 (PACK).

1. Enter:

   MA DSC1:,OFF <Return>

   MA DSC2:,OFF <Return>

   D D <Return>

   The status of all the devices are displayed.

2. Press the RUN/LOAD switch on the hard disk panel

   Wait for the LOAD light to come ON.

3. Pull out the hard disc unit after releasing the

   latch on the lower right corner.

4. Take the top disc (DSC1 or PACK) out after pushing

   the tab in and pulling the handle up.

5 Place the master disc (master PACK) in close the

   disc cover and push the disc unit in.

6. Press RUN switch and wait for the READY lamp to

   be ON.

7. Turn on the printer and load a blank tape on to

   the tape drive

8. Press INIT switch on the computer console.

9. When the system prompts for disc OD

   enter:

   DSC1.003 <Return>

10. enter:

    SE PA 1/E800 <Return>

11. enter:

    T .BG <Return>

12. enter:

    D D <Return>

    This is to check the status of the DSC1 which is the system disc now.

13. enter:

    MA DSC1:,ON,OS,PROTECT <Return>

14. enter:

    D D <Return>

    and check if DSC1 is protected.

15. To load the back-up type:

    V BACK <Return>

    T .BG <Return>

    LD MTIG:BACKUP

    OP ET

    LD BACKUP

    MA DSC2:,OFF

    INIT DSC2:,FIXD,RE

    MA DSC2:,ON

    ST ,IN = MAG1:, OUT = DSC2:, LIST = PR, VERIFY

16. To run the disk integrity check (DISCHECK)

enter:

LD DISCHECK

MARK DSC2:,OFF

OP ET

START , DSC2:,CON:

17. To re-initialise enter:

MA DSC2,ON,NEW

MA DSC2:,OFF

MA DSC2:.OFF.OS

18. Press LOAD switch on the disc console and remove top disc.

19. Remove PACK and press RUN.

20. Follow the computer start-up routine as mentioned in the OPERATION GUIDE.

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