FAIRCHILD SEMICONDUCTOR CORPORATION

PATENT NOTEBOOKS

Content

Your patent notebook should contain a complete description and record of:

1. Any activity in connection with the conception and building and testing of any idea which may be patentable.
2. The dates on which such idea was conceived and built and tested.
3. Subsequent activity relating to construction, testing ar demonstrating the idea, or of any improvements, changes or new uses.
4. References to persons who assisted or who are familiar with the idea or any phases of its subsequent development.
5. Cross-references to any other test data, technical reports, data files or other written material relating to the idea or its subsequent development and testing.

Entry Procedure

Your patent notebook should serve to provide a continuous chronological record of your activities of the nature described above. It must also be in such form that it can be used as evidence in a legal proceeding. To these ends, the following procedure should be carefully followed:

1. Form of Entry:
   a. Make all entries legibly, neatly and in ink. (Do not use pencil and do not use your notebook as a "scratch pad.")
   b. Date all entries at the beginning. (Write dates out completely.)
   c. Sign name in full and again date entry at its conclusion.
   d. Do not leave extensive blank spaces. Begin all entries on the line following the last line of the preceding entry. If there are unusually long gaps in time between successive entries (e.g. due to illness or vacation), a record of the facts should be made.
   e. Graphs, photographs, sketches, etc. on separate sheets can be securely cemented or stapled over a blank section of a page in the notebook. Each such inserted sheet should also be separately signed, dated and witnessed.
   f. Do not erase or modify entries once made. If modifications are required, make a new entry.

2. Witnessing:
   a. Each entry should be witnessed by two competent persons who have read the entry and are technically qualified to understand it. Each witness must sign his name in full. (Note: A joint inventor cannot serve as a witness for a co-inventor.)
   b. If the entry is one recording actual tests or demonstrations, the witness must also witness such and check all connections, structure, etc. of the equipment. He should then state over his signature that he actually witnessed such tests and checked such connections, etc.

General

1. Do not include statements implying lack of interest, abandonment or unimportance of the idea.
2. Keep notebooks in safe place. This notebook is charged to you and you are responsible for its safekeeping. When the notebook is filled or if you leave the division which issued it, it must be returned to your division patent representative. It must not be taken with you or destroyed.

hb
10/5/60

168 W. Wheeler

FC1-19-94(2-62)

Wheeler

YOUR NOTEBOOK

1) This notebook is a record of your thought and activity as an engineer and employee of Fairchild. Its contents must be safeguarded as "Company Private Material", and shall not be disclosed to anyone outside of the Fairchild Organization without proper authorization. All notebooks are the property of Fairchild and shall be turned in to the Notebook Registrar upon termination of employment.
2) Material selected for invention disclosure must be submitted to the Parent Company Patent Department in accordance with SPI-19-405.3. If you do not have a copy of this instruction see your supervisor.
3) The procedure below specifies how notebooks must be maintained to make them acceptable in patent proceedings as legal proof of what was done and when it was done. The early date of record may be the deciding factor in obtaining an important patent for Fairchild in your name.
4) Proper maintenance of your notebook is a meaningful contribution to your individual progress at Fairchild.

NOTEBOOK ENTRY PROCEDURE

1) Make regular entries in this notebook of all notes, calculations, sketches, circuit diagrams, formulas, equations, graphs, developmental and test observations, and all test results and conclusions regardless of whether successful or not. (DO NOT USE SCRAP OR OTHER LOOSE PAPER FOR THIS WORK.)
2) All entries shall be kept chronologically using a separate page for each idea and all entries on any one page shall be made only as of a single date indicated on the page. Draw lines through unused portions of a page so there are no empty spaces between entries. (DO NOT SKIP PAGES AND NEVER TEAR OUT PAGES.)
3) Do not make entries in the notebook of another and do not permit anyone to make entries in your notebook.
4) When blueprints, photostats, or other material will clarify or explain entries, affix such material securely to the appropriate pages.
5) New ideas which may be original regardless of whether they are conceived under company sponsored program or a commercial or government contract should be entered in sufficient detail to enable any engineer or any person skilled in the art to fully understand the idea involved. Such entries should be dated and attested by two individuals who have read and fully understood the entry. (DO THIS PROMPTLY.) Subsequent additions or changes should be made on other pages likewise dated and attested and reference previous pages and earlier notebooks.
6) If the new idea has been operated in a piece of apparatus your notes should include a description of the conditions under which the apparatus operated, the operations performed, the persons present, the data taken and any other facts which will substantiate the steps taken by you. Two engineers, one preferably your supervisor, should witness such apparatus operation, check the detail sufficiently that they know the idea embodied therein and sign the notebook pages as having witnessed the operation. At this point check with your supervisor if the apparatus is to be tagged and stored as a patent exhibit.
7) Take your notebook to conferences or technical discussions and enter any ideas or suggestions you make, refer to the discussion, those present and its date. Shortly thereafter, amplify the notes so they will be understandable at a future date. Obtain signatures of two witnesses who were present when the disclosure was made.
8) By following the above instructions you should always be able to testify that any one of your notebook pages is in its original condition and that no changes were made thereto after the original entry and signatures.
9) When inventive work is performed under a Government Prime or Subcontract which is classified for security purposes, a separate notebook shall be kept for each such contract and the notebook shall be safeguarded in accordance with requirements applicable to the security classification of the contract.

NOTEBOOK CONTROL PROCEDURE

1) Each notebook issued shall have a copy of this instruction affixed to the front inside cover.
2) Each notebook page shall be numbered and the book itself shall be numbered and recorded by employee name in a register maintained by each Engineering Department.
3) Each notebook shall be periodically reviewed by the employees supervisor.
4) Each filled notebook that has served its reference use shall be returned to the notebook registrar for filing.

PAGES 1-5 shall be used as a GENERAL INDEX FOR DATES AND MATERIAL COVERED IN FOLLOWING PAGES WCW

DATE	PAGE	ITEM
9-9-61	6	DISCUSSION OF PHOTO DIODE ARRAYS - PROCESSES TRIED
9-15-61	7	DISCUSSION OF PHOTO DIODE ARRAYS AND PHOTO TRANSISTORS
9-29-61	8	" " Zener diode, Hole Diode, Diode arrays

DATE 9-9-61

NAME Warren C. Wheeler

PHOTO DIODE ARRAYS MIGHT BE DEFINED AS ANY CONFIGURATION OF ~~A~~ TWO OR MORE DIODES WHICH ARE EXCITED BY ELECTRO-MAGNETIC RADIATION.

THE ARRAYS WITHI WHICH I HAVE BEEN INVOLVED SINCE NOVEMBER 1, 1960 ARE HIGH DENSITY (4 MIL by 30 MIL) CENTER TO CENTER SPACING. THEY ARE A P-N JUNCTION WITH AN AL EVAPORATED CONTACT.

PROCESSES OF MANUFACTURE TRIED PREVIOS TO 8-1-61 PROVED INCONCLUSIVE. THE OBJECTIVE SOUGHT IS A 600 VOLT OR HIGHER BREAKDOWN DIODE WITH SMALL LEAKAGE CURRENT. $<$ 1.00 X 10^{-7} AMPERES WITH NO EXCITING RADIATION APPLIED.

ALL PROCESSES AND RESULTS ARE ON FILE IN THE FORM OF COMPANY RUN SHEETS AND NOTE BOOKS #1 AND #2. (SECTION # 30-70, PROJECT # 170-#179)

ON 8-1-61 A COMBINATION OF HIGH RESISTIVITY SUB-STRATE (100 Ω/cm) AND REPEATED LOW TEMPERATURE OXIDATION (920°C) WAS STARTED. THESE RUNS (THREE) WERE RECIEVED AFTER METALIZATION AND EVALUATED. ONE RUN HAD THREE OXIDATIONS PRIOR TO DIFFUSION. ONE HAD THREE OXIDATIONS AFTER DIFFUSION AND THE THIRD RUN HAD NO REPEATED OXIDATION. RESULTS SHOW THE RUN WITH OXIDATION AFTER DIFFUSION TO BE SUPERIOR. BREAKDOWN VOLTAGES RANGED FROM 250 VOLTS MINIMUM TO A MAXIMUM OF 600 VOLTS. A MEAN OF 400 VOLTS WAS OBSERVED

READ & UNDERSTOOD: George [illegible] some tests observed

DATE - 9-9-61

NAME - Warren C. Wheeler

9-11-61

Warren C. Wheeler

A RUN OF DIODE ARRAYS WERE PREPARED BY NORMAL MEANS UP TO DIFFUSION. THE RUN WAS THEN SPLIT IN HALF AND DIFFUSION TIME WAS VARIED ON THE TWO HALVES. A JUNCTION DEPTH OF 4 μ WAS OBTAINED ON ONE HALF AND A DEPTH OF 7 μ ON THE OTHER HALF. THESE UNITS WERE TESTED FOR V_{BD} AND LIGHT SENSITIVITY. RESULTS WERE SIMILAR FOR BOTH HALVES. $V_{BD} \cong 110$ VOLTS. LIGHT SENSITIVITY = 0.42 AMPS/LUMEN

AREA OF DIODE = 4×10^{-6} INCHES^2 = 2.78×10^{-8} ft^2

THIS SHOWS V_{BD} TO BE A SURFACE CONTROLLED PHENOMENA

READ & UNDERSTOOD: George [illegible]

9-11-61

Warren C. Wheeler

9-13-61

Warren C. Wheeler

PREPARATIONS ARE BEING MADE IN CONJUNCTION WITH THE PHOTO-TRANSISTOR DEVELOPMENT PROGRAM TO DETERMINE IF F.S.C. PHOTO-DEVICES ARE X-RAY SENSITIVE.

9-15-61
Warren C. Wheeler

DISCUSSED WITH JACK KABELL ADVANTAGES OF OPTICAL POLISHING OF WAFERS PRIOR TO NORMAL PROCESSING.

ATTEMPTED SOLDER-DOWN OF SOME 4200 DEVICES. THE DEVICES WERE NICKLE PLATED ON THE BACK AND SOFT SOLDER WAS USED AS A DIE-DOWN MEDIA. UM RESULTS SHOW THIS TO BE A REASONABLE METHOD FOR DIE-DOWN OF LOW TEMPERATURE DEVICES

READ & UNDERSTOOD:

9-15-61
Warren C. Wheeler

9-19-61
Warren C. Wheeler

Transfer of the 2PD-1 (FSP-100) PHOTO-DIODES has been completed. The units are now in production.

The special (710-ab) FSP-5 has been recieved and is under evaluation. These units show 30% to 40% more light sensitivity than normal FSP-5 units.

READ & UNDERSTOOD:

9-19-61
Warren C. Wheeler

9-22-61
Warren C. Wheeler

attempts are being made to drill a hole in silicon. a device will be fabricated on the walls of the conical hole. a special photo-resist process will be required ie: scarbing the area from which oxide is to be removed with a dark spot. The preliminary ideas are to set up a parallel light source and mask it such that an annular ring is exposed. 9205 electrical characteristics will be sought.

READ & UNDERSTOOD:

9-22-61
Warren C. Wheeler

9-26-61
Warren C. Wheeler

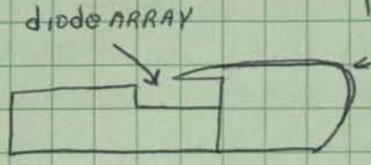
Discussed with Dave Hilliber the Mechanics of fabricating a Zener Diode from a basic 1340. The idea is to short the base and collector areas together with a second emmitter diffusion at the teardrop. Units are now in process.

READ & UNDERSTOOD:

9-26-61
Warren C. Wheeler

9-29-61

Discussed with Peter Ullman the possibility of mounting the diode arrays (4/30) xOA-2's by placing the array under a prepared overhang. The overhang will be a feather edge of some type material that will lend itself to printed circuit board techniques.



Read and Understood
Peter J. Ullman
Oct. 6, 1961

9-29-61
Warren C. Wheeler

10-2-61
Warren C. Wheeler

A number of ~60 Ω Cm. N type wafers were mechanically polished to a good optical finish in an attempt to determine how critical surface condition of substrate material is to Breakdown voltage on xOA-2 diode arrays. The wafers will be split into three runs and a similar program to that discussed on page 6 will be followed. Repeated oxidation will be used.

9-2-61
Warren C. Wheeler

10-3-61

Discussed with Dave Kilbiber the feasability of discontinuing the metal removal photo resist step. The wafers will be thoroughly cleaned before Metal evaporation. They will then be aluminized and alloyed at 580°C for 4 minutes. They will then be diced and plated in preparation for electrical sort. Dave feels that the excess aluminum covering the surface will not effect the Zener diode characteristics of this modified 1340 device.

Witnessed and Understood.
pages 8 to 8
Oct 5, '61 — Date — Signature
5 Oct '61 — Date — Signature

10-3-61
Warren C. Wheeler

10-6-61 Warren C. Wheeler

am undertaking a small ~~cell~~ scale investigation to discover whether it would be feasable to alloy immediately after metalization and then remove excess Al with NaOH. This would do away with a masked and photo resist type metal removal.

Discussed with P. Ullman the possibility of grinding a half cone in a piece of silicon for fabrication of the diode for facsimile scanning as mentioned on 9-22-61. If this process is possible it will make fabrication of this difficult device somewhat easier.

Read and Understood - Peter J. Ullman - Oct. 6, 1961

10-13-61

Photo-resist processes on photo diode arrays needs some further investigation. a study of etch times, temperature, exposure times etc. will be undertaken shortly. The main problem is the rough and jagged edges around the perfery of the devices.

10-16-61

Anne Yin is polishing some high resistivity silicon bars upon which an attempt will be made to fabricate a high density diode array. This method will alevate the ~~prop~~ problem of connecting together two seperate pieces of silicon. It seems that this method will give a more stable structure to the array and make for easier mounting.

Warren C. Wheeler
October 16, 1961

11-6-61

Responsibility for the XP3 family of photo devices has been assumed by me. An attempt will be made to have the device to the manufacturing stage by mid. March. This will require an accelerated development program and a run of good luck

Warren C. Wheeler
November 6, 1961

11-16-61

A tentative schedule for development type runs on XP3 has been devised. It consists of a complete series of this family being completed by mid December. The variations of devices are large (16 mil) emitters, with and with out grids, small emitters (4 mil) with and with out grids, three terminal variations of the above and diodes. Packaging of the device will be carried by Peter Ulmer. Drawings of these devices may be found on pages thru in my photograph binder. Copies of all run sheets with an explanation of each will be kept in a run sheet log book ~~titled~~ titled XP3.

Warren C. Wheeler
November 16, 1961

10 12-29-61
Warren C. Wheeler

Purpose: The purpose of this experiment is to obtain data as to the efficiency of the FSP-103 or (FLP-1)

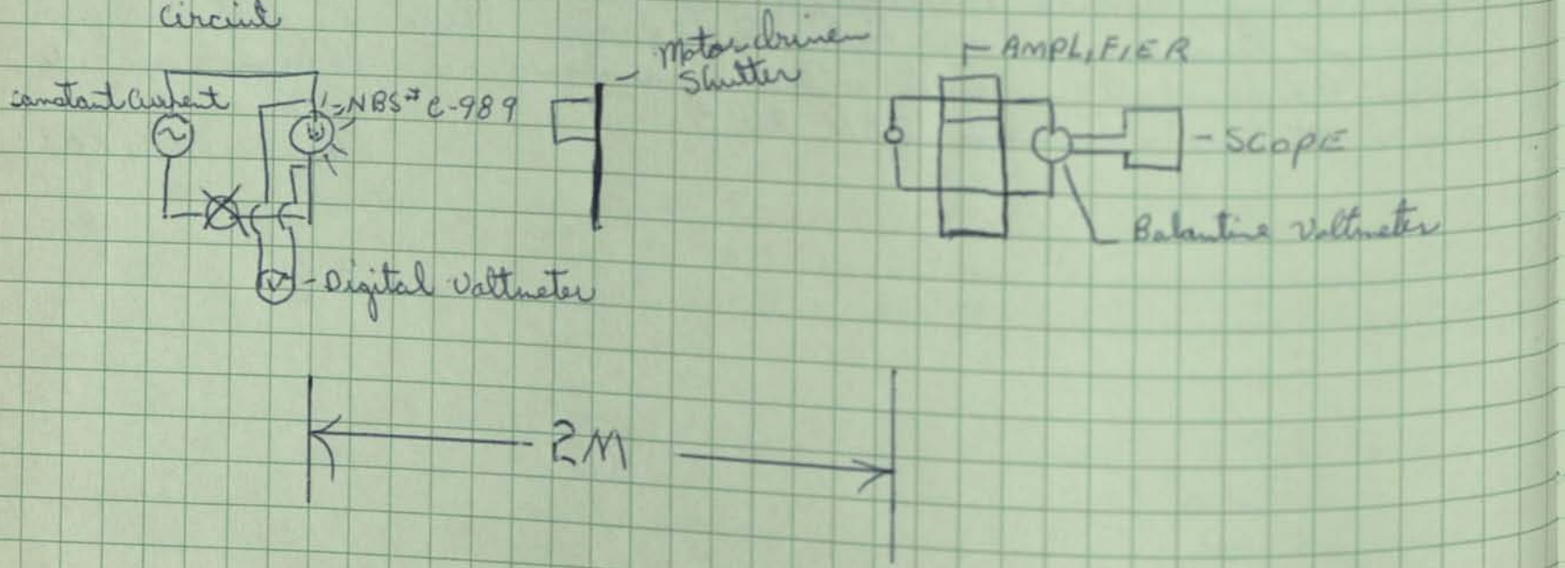
PRocedure: The FSP-103 - here after known as light pulsers will be monitored with the RCA photo-multiplier tube. A known current will be passed thru the light pulser and the output monitored.
A radiation thermocouple and amplifier system will be calibrated using NBS Bulb # C-989. The Bulb output is pulsed with a semi-circular disk rotated at 9 C.P.S. The output is viewed with Perkin Elmer radiation ~~thr~~ thermocouple the output of which is amplified and monitored with a Ballantine true RMS Volt meter.
This calibration gives a constant K which when multiplied by the meter reading give the Energy Density at that point.
This calibration now complete allows us to calibrate a light source which can in Turn be used for calibration of the photo multiplier Tube. with the photo-multiplier calibrated she can then get Meaningful data from the light pulsers.

Equipment used:

Name	Number
Standard Bulb	NBS # C-989
Perkin Elmer Thermocouple	
amplifier	
Ballantine Voltmeter	
RCA Photo multiplier	
oscilloscope	
light source (Projector)	
Digital Voltmeter	

Data (calibration of thermocouple system)

circuit



Data (calibration of thermocouple system)

	Bulb voltage	Thermocouple output voltage
1	74.57 volts	6.65×10^{-3} volts
2	85.98 volts	8.60×10^{-3} volts
3	97.44 volts	12.3×10^{-3} volts

(Light source calibration)

$D = KV$

$K = 7.06$

$\therefore D =$ ~~7.20 w~~/cm²

$D = 7.20 \times 10^{-3}$ WATTS/cm

Thermocouple output
1.02 volts

☆ at this point some of the data taken was believed suspect due to fluctuations in line voltage on the photomultiplier power supply. another series of tests will be begun as soon as the calibration system is reproducible.

January 5 1962
Warren Wheeler

Purpose: The purpose of this experiment is to gather information necessary in characterizing the FSP-103 (light pulsers). Effecency data will be gathered along with liftime data.

Procedure: The calibration procedure will be the same as that stated on page 10 this book. The exception will be that a curve tracer characteristic of the reverse breakdown will be photographed prior to the start of tests. After the traces are photographed the units will be checked for effeciency and then place in a 100 hour life test. The life test will be conducted in the following manner. Four units will pe be pulsed with a tektronix Model 105 square wave generator and four units will be placed on each of two Dumont 404-B pulse generators. All units will be pulsed at 1 KC but the Dumonts will have only a 10% duty cycle. After 65 hours the units will all be checked and their curves photographed and then they will be returned to the life test. After 115 (One Hundred and fifteen) hours they will be rechecked and photographed again. Their effecency will again be checked.