APPTRONICS review

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From the HoD's desk

Dear Reader,

This is performance appraisal time for us. Having worked in two other organisations before entering teaching field, I thought of sharing my exposure to some good practices and appraisal schemes which existed in all these organisations. Dictionary meaning of appraisal is 'formal evaluation of the performance of an employee over a period of time'. When one does a self evaluation, it becomes self appraisal. Usually self appraisal is followed by an appraisal interview. A typical appraisal interview will be around three main principles: standards, objectives and self appraisal.

Performance discussion should always be on the goals already set based on the expected standard of work. All objectives that are mutually agreed upon by the employer and the employee should be reviewed in detail. Goals could be directly related to work output or even behaviour. If objectives are met, discussions can go in the direction of further improving the objectives, and if objectives are not met, discussions can go in the direction of corrective steps. The interviewee should give one's appraisal of performance before the discussion starts. Appraisee should track the goals continuously. The objectives if set at the beginning of the review period gives a clear direction to the appraisee. These objectives should be necessarily realistic, and should be mutually agreed upon. The objective should be such that there will be no ambiguity in assessing if the result is achieved or not. It should also be time bound.

Since most people accept criticism if they are already made aware of their strength, appraisal interviews can start with discussion on strengths and then remedial action can be worked out for objectives that are not met. Any personal issues that could interfere with work can also be discussed and proper solution arrived at. Most reviews are for short period of time. These short reviews and objectives can be properly planned and aligned to achieve an identified long term career goal.

Here are some steps for improving the performance. 1) Work to improve oneself by learning. Learning can be by reading, by attending classes or by working in teams. 2) Take up new challenges that seem interesting and that will add up to your self esteem. Build on strengths and work on overcoming weakness. 3) Spend time with optimistic people. 4) Take some time off, relax and enjoy! And finally

Enjoy your work.

Introducing journals:

SADHANA - Academy Proceedings in Engineering Sciences

SADHANA is a bi-monthly research journal in English published by the ***Indian Academy of Sciences***. The journal covers all branches of engineering science including mechanics (fluid, solid, thermal), computer science, electronics, energy, aerospace technology, material science, nuclear engineering, systems analysis and alternative technologies.

The journal encourages papers

(i) likely to be of interest to more than one professional group, based on whether the work is fundamental or it reflects the best in current technology;

(ii) summarising, at a sufficiently technical level, work done on special projects of interest to engineering scientists;

(iii) offering extensive critical reviews, especially on subjects of interest in the country.

The criteria for acceptance of papers in the journal are therefore breadth of interest, irrespective of whether the paper reports research or development, theory or experiment, original work or review, and quality of work reported and its presentation (text, diagrams, etc.). Papers on developments in Indian technology must pay special attention to the problems peculiar to the country in such projects.

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Online version of the journal is available at http://www.ias.ac.in/sadhana/index.html

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Observations/Comments

[A column by PRM]

It was a year back. A colleague of mine told me: "You have taken this subject once, so you can use all those notes; you need not prepare all again."

I asked him: "What about you?"

He said: "For one subject, I don't have any problem; I have the notes from my son who was lucky enough to get all notes dictated by the lecturer."

I don't want to narrate the full story here. How do you appreciate this view? Let me wish that many of you will not agree with my friend. But what he said remains a fact. It is a general tendency among teachers to keep using the old notes for teaching. They often go to the extent of dictating the same!

What about those who do not have ready notes? Many of them are fond of Fermat's principle of least action. They search for the simplest guide-like books. Most often they get hold of some books which their teachers might have used, and which never had any revised edition. The result is that many a time they deliver mistakes to the students. I will take one specific example and try to illustrate.

Let us take an example from the subject 'Basic Electronics' prescribed for the first year, so that it becomes applicable to all the branches. We will consider comparison of the doping concentrations of the emitter, base and collector regions of a bipolar junction transistor. There is no confusion with regard to the emitter region. The emitter has to inject majority carriers into the base region when biased forward with respect to the base.

Injection depends on the difference in charge carrier concentrations of the emitter and base regions. So, for good injection rate, the difference in concentrations has to be large. Therefore, the emitter is usually highly (not heavily) doped, in comparison with the base.

What about the base? Doping here has to be essentially very much less than that of the emitter as we have already said. There is yet another reason for making the base region less doped. Larger the concentration of majority carriers in the base region, larger is the chance for recombination of the injected charge carriers, which will mean greater base current. That is not a good situation. So in order to minimise base current also base region has to be less doped. In fact it is not the only measure to minimise base current. It is most important to minimise the transportation time of the injected charge carriers across the base region. This can be achieved by ensuring sufficient accelerating potential at the collector with respect to the base (reverse bias), and by minimising the base width.

Does the requirement of minimising the base current in any way demand that doping of the base region has to be less than that of the collector region?

No.

Then, why should it be taught that the doping in the base region is the least?

There is only one reason that some old books give it so without really giving the reason. I have gone through the books available in our library to see if descriptions given there are sufficient.

Streetman and Banerjee [1] gives a beautiful account. This book gives the comparison of minority carrier density as(see page 350) : highest in collector region and least in emitter region, which means that majority carrier density is highest in the emitter region and least in the collector region.

Kanaan Kano [2] describes it (see page 220)with no room for confusion. It is given as: "The doping of the emitter is much greater than the doping of the base, which in turn may be greater than the doping of the collector. These differences in doping are dictated by the requirements of the amplification properties of the transistor, which takes place when the device is operating in the active mode."

S.M.Sze [3] gives (see page 136)the doping profile correctly.

V.Suresh Babu[4] has made an attempt to give an explanation for the actual doping profile in terms of the punch through effect(see pages 267-268). It may not be required to go to this extent for the first year students. But it is better that we, teachers, are aware of it. Let me give a brief explanation here on the reason for keeping the doping of the collector region lower than that of the base region.

As mentioned already we have to consider the active mode of operation of the transistor. This will need collector base junction to be reverse biased. We can see two effects of reverse bias, namely the growth of the depletion region and the zener break down. Let us consider these one by one.

The extension of depletion region into the base region depends on the doping of the collector region. More the doping of the collector, more the width of the depletion region in the base. Also we must remember that the thickness

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Are You Familiar With SI System?

All of us are familiar with SI units that were introduced to us in our school days. In spite of using these units extensivelyon a daily basis, we end up making mistakes while writing SI units. In this article, let us learn about SI units, prefixes and symbols.

The name *Systeme International d'Unites*, with the international abbreviation SI was adapted in the 11th CGPM (1960, Resolution 12; CR, 87). Seven well-defined units which by convention are regarded as dimensionally independent constitute the *base SI units*. They are the metre, the kilogram, the second, the ampere, the Kelvin, the mole, and the candela. The second class of SI units is that of *derived units*. These are units that are formed as products of powers of the base units according to the algebraic relations linking the quantities. The SI units of these two classes form a *coherent set of units*, where coherent is used in the specialist sense of a system whose units are mutually related by the rules of multiplication and division with no numerical factor other than 1.

It is important to emphasize that each physical quantity has only one SI unit, even if this unit can be expressed in different forms.

The SI prefixes

The CGPM adopted a series of prefixes for use in forming the decimal multiples and submultiples of SI units these are designated by the name *SI prefixes*. The multiples and submultiples of the SI units formed by using the SI units combined with SI prefixes are designated by their complete name, decimal multiples and submultiples of SI units. Basic SI units are listed below. Corresponding symbol is given in brackets.

1.Unit of length -metre (m)

The metre is the length of the path traveled by light in vacuum during a time interval of 1/299 792 458 of a second.

2.Unit of mass -kilogram (kg)

The kilogram is the unit of mass; it is equal to the mass of the international prototype of the kilogram.

3.Unit of time-second (s)

The second is the duration of 9 192 631 770 periods of the radiation corresponding to the transition between the two hyperfine levels of the ground state of the caesium 133 atom.

4.Unit of electric current -ampere (A)

The ampere is that constant current which, if mentioned in two straight parallel conductors of infinite length, of negligible circular cross-section, and placed 1 metre apart in vacuum, would produce between these conductors a force equal to 2*10-7 newton per metre of length.

5.Unit of thermodynamic temperature - Kelvin (K)

The Kelvin, unit of thermodynamic temperature, is the fraction 1/273.16 of the thermodynamic temperature of the triple point of water.

6.Unit of amount of substance - mole

1.The mole is the amount of substance of a system which contains as many elementary entities as there are atoms in 0.012 kilogram of carbon 12; its symbol is 'mol'

2.When the mole is used, the elementary entities must be specified in may be atoms, molecules, ions, electrons, other particles, or specified groups of such particles.

7. Unit of luminous intensity - candela

The candela is the luminous intensity, in the given direction, of a source that emits monochromatic radiation of frequency $540 * 10^{12}$ hertz and that has a radiant intensity in that direction of 1/683 watt per steradian.

General principles for the writing of unit symbols and numbers were first proposed by the 9th CGPM (1948, Resolution 7). These were subsequently adopted and elaborated by ISO/ TC 12

SI unit symbols (and also many non-SI unit symbols) are written as follows:

1.Roman type (upright) is used for the unit symbols. In general, unit symbols are written in lower case, but, if the name of the unit is derived from the proper name of a person, the first letter of the symbol is capital. When the name of a unit is spelt out, it is always written in lower case, except when the name is the first word of a sentence or is the name "degree Celsius".

2.Unit symbols are unaltered in the plural. (Do not add *s* to the symbol)

3.Unit symbols are not followed by a full stop(period), except as normal punctuation at the end of a sentence.

Algebra of SI unit symbols

1.Half-high dots or spaces are used to express a derived unit formed from two or more other units by multiplication. Example: N.m or N m

2.A soldius(/),a horizontal line, or a negative exponent is used to express a derived unit formed from two other units by division. Example: m/s or $m.s^{-1}$

3.The solidus is not followed by a multiplication sign or by a division sign on the same line unless ambiguity is avoided by parentheses. In complicated cases, negative exponents or parentheses are used to avoid ambiguity. Example 1) m/s^2 or $m \,.\, s^{-2}$ but not m/s/s

2) $m \,.\, kg/(s^3 \,.\, A)$ or $m \,.\, kg \,.\, s^{-3} \,.\, A^{-1}$

Rules for using SI prefixes

1.Prefix symbols are printed in roman (upright) type with no space between the prefix symbol and the unit symbol.

2.Compound prefixes, i.e., prefixes formed by placing two or more SI prefixes close together, are not used. (Do not write mns, write ps)

3.A prefix is never used in isolation.

-Jasna

....continued from page 2

increases as reverse bias increases. We cannot permit the depletion region to eat off the whole base region. At the same time because of the output voltage swing requirement, we cannot keep the reverse bias of the collector base very small. This demands that the doping of the collector be as small as possible.

There is another impact of output voltage swing. As the output voltage swing increases in one direction the reverse bias increases and in the other direction it decreases. The reverse bias must be more than half the output voltage swing required. For the direction where the bias increases, we must ensure that, even for the highest bias, Zener breakdown does not occur. This condition also gets satisfied by going for lower doping of the collector.

Putting all these together, we can represent the doping profile (majority carrier concentration) as in figure A.

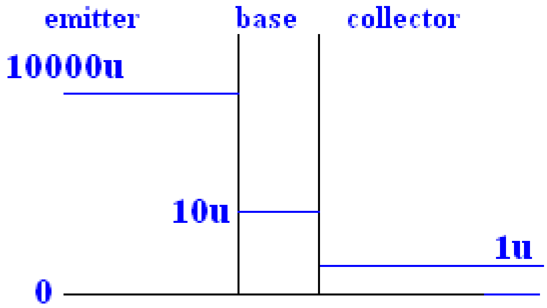


Figure A

Values shown are just arbitrary; u represents an arbitrary unit, like, say, 1017m-3.

In practice, to reduce the heating effect on the collector region, bulk resistance of the collector must be minimised. So, away from the collector base junction, doping density is increased. Collector doping can be graded also, as shown in figure B.

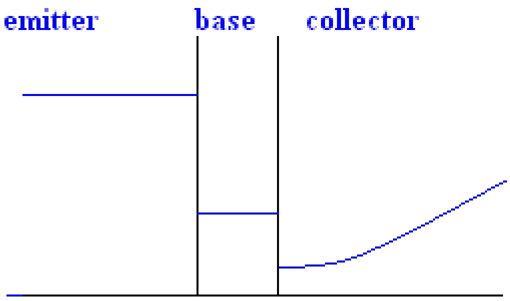


Figure B

For low collector current rated transistors this is not required.

[1] – Streetman and Banerjee, Solid State Electronic Devices, sixth edition, PHI, 2006.

[2] – Kanaan Kano, Semiconductor Devices, PHI, 2006.

[3] – S.M.Sze, Physics of Semiconductor Devices, second edition, JW, 2003.

[4] – V. Suresh Babu, Solid State Devices and Technology, second edition, Sanguine Technical Publishers, 2005.

Workshop on Silicon Microsystem Technology

We are sure, by this time every one in our campus is aware of this workshop.

It will be inaugurated on June 16th, by Dr. V.K. Aatre, Visiting Professor of IISc, former Scientific Adviser to the Defence Minister of our country. Sessions are lead by eminent professors and scientists of the country, who are leading research groups on MEMs and related technology.

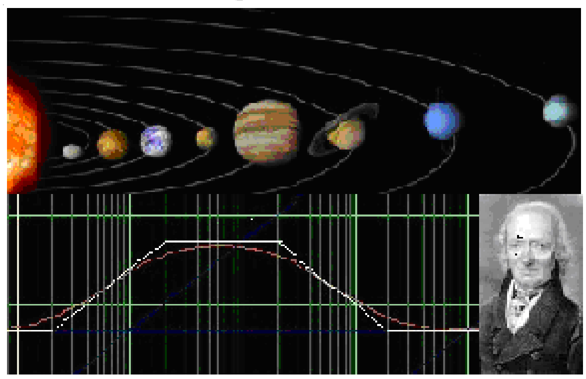
The workshop is expected to kindle interest in the subject among teachers and students of engineering colleges, and engineers of R&D organisations alike. Please visit RASET website for detailed programme.

The three day workshop and follow up activities call for intense effort. Organising committee requests one and all for sincere participation.

Do not follow where the path may lead. Go instead where there is no path and leave a trail.

-Ralph Waldo Emerson.

Curiosity Corner



Do you find any relation?

First correct answer will win a prize.

Answers can be mailed to meenav@rajagiritech.ac.in

Answer to the question in the previous issue

This picture shows a rock on a sea of Birmania, it is only possible to see this once a year with a special angle of the sun and special light conditions.

Bend your head to the left and see how spectacular it is.

Winner: Salini Varma, S8AEI.