Unit I Preliminary

exercises

1 . Прочитайте следующие слова и запомните их значение
literally — буквально
advent, n — зд, появление
to transfer -передавать
to utilize — использовать
to consume — потреблять, расходовать
to occur — происходить, случаться ,
to forego — предшествовать
portable, adj. — переносной
evident — очевидный, явный

2. Прочитайте и переведите следующие слова в словосочетания;
advent of vacuum tubes, wide-spread use of, solid state devices, miniature portable transistors, reduced size, high-speed computers

3. Определите по суффиксам,к каким частям речи относятся следующие слова и переведите их.
reliable, reliability, consume, consumer, consumption, possible, possibility, function, functional, individual, individuality, significant, significance, available, availability

4. Прочитайте текст А и ответьте Via вопрос:
What are the "revolutionary" developments that changed the course of history in the field of electronics?

Text A

1 . In the field of electronics, there have been a number of "revolutionary" developments that have in some cases literally changed the course of history. The age of electronics started insus/piciously enough with the gdvent of vacuum tubes, "revolution" came in the fifties with the advent and widespread use of the first solid-state device — the transistor, In fact, the word transistor (compressing the words — tranfer resistor) took on anothermeaning when people started calling their new miniature portable radios transistors.

x

2. The second "revolution" was the integrated circuit (1C), first produced and utilized in the early sixties. Just as transis-ors offered reduced size, lower power consumption and higher reliability than their predecessors the vacuum tubes, so the ICs offered reduced size and improved reliability. Just as transistors became common in everyday lif-f, making high-speed computers possible, the 1C has taken transistors one step funher, the higher circuit complexity possible in ICs brought as to the 21-st century in the seventies.

3. However the third major "revolution" cannot be pinpointed to a precise moment in history. This "revolution" has occurred over a long period, pf time, and will probably continue^r many years. It is pernaps the most important one in terms of its significance for the average person, as well as for those in the field of electronics. This revolution is one of cosU, For unless transistors and integrated circuits can be manufactured cheaply enough, their significance is пи to aJJ except the curious rich. In fact, not only has the manufacturing cost of transistors and especially ICs been reduced. But also the quality of the products has improved as well.

,4, Thjs is truly significant, since a low enough cost for the 1C means that the finished product, be it a digital wrietwatch, a pocket computer or a lifesaving'fjacemaker, can be made inexpensively enough to be within the reach of almost all consumers.

1560

5. Найдите в тексте эквиваленты следующих словосочетаний: уменьшенный размер; более высокая надежность; определенный момент в истории', быть доступным всем; ряд изменений; широкое использование.

6. Прочитайте текст В и ответьте на вопрос:
What are the advantages of 1C?

Text B

Advantages of

ICs

1 . An integrated circuit is a single functional block which contains many individual devices (transistors, resistors, capacitors, etc.), The first and perhaps most obvious advantage of ICs is theirsize. Thf working part of a transistor is quite small but since people are to use it, it is packaged with leads attached; thus the size is of necessity relatively large. In an 1C, many interconnecctions between transistors and other components have been
made internally, with only those terminals that are necessary being rnade available externally.

2. Another obvious advantage, closelyjelated to size, is the drastically lower weight ol ICs when compared to discrete versions. This is especially evident in large systems (like computers and airborne electronics), where decreased buffe and weight are extremely important.

Integrated circuits also offer higher reliability, simply because any given function can be implemented with fewer components.

3. Probably one of the most important advantages of ICs is the high leveLof circuit complexity made available in a small package. Because of this feature, the user of ICs can contemplate and relatively easily implement complex systems.

4. The high complexity offered on a single chip has *other* advantages — it opens up to the user a much wider range of projects and products that can be made operational with a much smaller investment of money and
manpower. In addition, the power of ICs may be reflected in the improved ope/atjon of a given system.

For example, in many applications a regulated power supply is not essential, but woj^ld irnprpye system performance. Therefore, if we had to design a ypltage regulator using discrete devices the eiecrsion would be to forego the regulator in the given system. However since available 1C voltage regulators are low cost and easy to use, we would probably Decide Jo, include the regulator and thus .etlrvance the system's performance. Another example of this kind of impact'by ICs is fn Ty_r receivers. With essentially no increase in cost, TV manufacturers haye> incorporated additional (r^nessential) features like automatic fine tuning, automatic hue (color), etc., through trie use of ICs.

1430

7. Прочитайте и переведите данные термины:
a slab of silicon
p-type substrate terminal characteristics
terminal characteristics multile collector
transistor multiple emitter transistor lateral
PNP transistor

8. Прочитайте и переведите текст С.

Text C

Basics of Device fabrication

1 . In general, the 1C begins as a slab of silicon only a few mils thick and 2 to 3 inches in diameter. The processing is done under controlled conditions to prevent contamination,

2. During the process of forrning one 1C on the wafer the mask pattern is repeated so that literally hundreds of ICs are being processed simultaneously. The wafer containing many ICs is tljen scrabed and the individual ICs
are then separated, tested, connected to headers and encapsulated in the appropriate package.

3. Many^ 1Сд are made on a P-type substrate. A key feature that needs to be recognised is this: if the mask contains identical windows for the fabrication of two or more transistors, because they ,,are rpade at the same time, on the same substrate and under identical conditions these transistors will pSsse^s almost identical terminal characteristics. Thus, matched 'traYisWors can be readily fabricated iri anJC. Furthermore unbalancing the masks for two transistors by making the emitter area of one larger by a ceftafn factor will have the effect of making the p of that transistor larger by the same factor. Thus, although it is not practical (nor easily done) to try and provide a specific, accurately controlled value of p, the ratio of p for transistors on an 1C can be readily controlled.

2) сократите предложения за счет маловажных подробностей, объедините несколько предложений в одно. Используйте следующие выражения:
to introduce the idea, to explain, to consider, to contain information, to stress, to be reported.

13. Докажите правильность или ошибочность суждений. Где можно, дайте расширенный ответ.

1 . The higher circuit cimplexity possible in ICs brought us to the 21-st century in the seventies.
2. The most significant difference between discrete components and integrated circuits is the factor governing cost. 5. In discrete circuit design the fewer the components used, the more expensive the circuit. 4. One of the disadvantages of the ICs is the drastically higher weight as compared to discrete version.

14. Составьте план текста, используя выражения;

The article examines...
It considers the problems.
Details are given of...
In conclusion the article stresses...

15. В групповой дискуссии обсудите значение появления ИС, их преимущества и основы их производства. 16. Переведите письменно текст Д без словаря,

Perhaps the most significant single difference between discrete components and integrated circuits is the factor governing costs. As a general rule, in discrete circuit design the fewer the components used, the cheaper the circuit. This is usually not the case in integrated circuits, as cost is mainly dictated by the chip area required, and does not increase proportionally with the number of devices. This is because the devices in an 1C are formed simultaneously, that is, all transistors (say NPN) are formed in the same step, all the collectors are made together all the bases, etc.

Therefore if an improvement in an IC's performance can be achieved through the use of an additional transistor, it can be incorporated with little or no increase in cost. (Since the area required for the additional device is extremely gmafl, the increase in cost is essentially due to any change in yield, i.e. the percentage of fabricated ICs that are usable, the yield is obviously governed by the complexity of the circuit). However in a discrete version, the same transistor might not be incorporated unless improvement in performance was significant enough
to offset the accompanying increase in cost.

Unite

1 . Прочитайте и запомните следующие термины:

board — доска, пульт, табло, щит, картон
wiring — электропроводка, электрическая монтажная схема
wire — п, проволока, провод v — монтировать провода
socket — штепсельная розетка, гнездо, патрон, цоколь
trace, п. — след v. — оставлять след, прослеживать, чертить, копировать

2. Прочитайте слова и переведите их, учитывая их интернациональную основу:
prototype, compromise, project, discrete components, function, system, section

3. Определите по суффиксам, к каким частям речи относятся данные слова и переведите их: apply, application, applicable, probable, probability, flexible, flexibility, available, availability, require, requirement

4. Прочитайте текст А и ответьте на вопросы.

1 . What are the 3 requirements for the use of 1C?
2. What are the requirements for the proper circuit design?

There are only three basic requirements for the proper use of ICs in any project. These are: proper circuit design, proper contraction and test procedures, and proper power supply choice. As with any rules, these three are more easily stated than followed.

PROPER CIRCUIT DESIGN.

This perhaps the hardest of the three, since it requires the most from us:

1 . Know and understand the properties and limitations of as large a variety of ICs as possible. Be on the lookout for new ICs, for they may meet the desired needs more readily than any other.

2. Use the proper 1C for the purpose at hand. Don't try to make do with another circuit — in most cases it doesn't pay.

5. Double and triple check the design to ascertain that it does exactly what is desired — no less and no more. This especially applies to digital circuits since they usually involve complex timing and it is not uncommon to overlook a given set of (signal) conditions which gives an erroneous output.

5. Прочитайте текст В со словарем.

Proper construction and testing procedures.

1 . Probably the largest percentage of problems encountered by the unitiated involved either improper construction or inappropriate testing. First, let us consider the prototype or breadboard — the stage at which the basic circuit design is tested and evaluated. There are five methods available for constructing the prototype: the custom pc (printed circuit) board; the vectorboard with sockets and point-to-point wiring; special sockets, wirewrap sockets, and lastly, standart pc boards, with a foil pattern to accommodate only one ICs (or their sockets where interconnections are wired in to suit a particular situation. Each of these methods offers certain advantages, while also presenting limitations and its own unique problems.

No single method is best for all cases.

2. The wirewrap technique is applicable where few discrete components are used and where the exact circuit configuration has not been finalized in the design stage. The wirewrap technique is not advised where signals of I MHz or higher are used. This technique although offering flexibility, makes the prototype somewhat hard to troubleshoot in terms of finding a wiring mistake or in tracing signals. This techique is especially well suited for digital circuits of great complexity.

3. Standard pc boards offer a good compromise between the custom pc board and point-to-point wired vectorboard. They are available in two types: one to accommodate DIPs (dual in-line package ICs), one to accommodate the round TO-5 type packages. The advantage of this scheme over the wirewrap is that it does not require special tools, and like the wirewrap technique, this scheme is probably better suited to digital applications.

4. Special sockets which can accommodate up to about 100 1C pins (not ICs) are a good choice for simple digital as well as analog prototypes. They provide interconnection points for wires or discrete components next to the 10 pins. This scheme offers the easiest and most convenient means for changing the circuit since no soldering is involved. However due to the high capacitance between sockets, this method is not advised for signal frequencies much above 500 kHz.

5. The vectorboard approach offers the widest latitude in parts location, since this is entirely determined at the user's discretion. It is probably the most tedious and slowest method — each socket and external component must be individually mounted and interconnected.

PROPER POWER SUPPLY

6. This is the last consideration because, it is recommended to use a good commercial regulated power supply for the initial prototype evaluation. In this way the power supply is eliminated from the possible list of problems that may originally arise. In addition, there is no need to guess or estimate the power supply characteristics necessary for the finalized project.

Words to be remembered:

to evaluate — оценивать, давать оценку, определять качество

to estimate — оценивать, давать оценку, выносить суждение

to involve — включать в себя, заключать, влечь за собой, вызывать

to suit — удовлетворять требованиям, быть удобным, устраивать

convenient, adj. — удобный
latitude — широта
tedious — скучный, утомительный
tc determine — определять
to mount — I) взбираться, восходить
2)устанавливать, монтировать

6. Переведите следующие слова и словосочетания:

proper circuit design; limitations of ICs; offers certain advantageous; exact circuit configuration; tracing signals; the scheme is better suited to; convenient means, widest latitude.

7. Ответьте на вопросы к тексту:

1 . What are the methods available for constructing the prototype?
2. When is wirewrap technique applicable?
3. What is the advantage of standard ps board over wire wrap sockets?
4. What is the nost tedious and slowest method?
5. What is the advantage of special socket technology?

8. Переведите предложения, обращая внимание на подчеркнутые слова:

1 . Large valued reristors are either avoided through circuit design, or pinched resistors are used.
2. Neither this method nor previous one could be used in the 1C design.
3. Either vacuum evaporation or cathode sputtering of the desized material can be used in the fabrication of thin film hybrid circuit elements.
4. Neither size nor weight can be reduced by applying thus method.
5. None of these objectives can be appreciably compromized in the achievement of a practical operating microsystem.
6. NO single method is best for all cases.
7. No simple way has been found to eliminate this limitation.
8. It should be pointed out that the figure by no means includes all possible 1C configurations.
9. In ICs of a high scale of integration it is possible to design a connection layout so as to exclude crossovers unless a multilayer is used.
10. Conversion of the surface layer of a solid to a solution is thing else than elimination of this layer.

9. Напишите аннотацию к тексту.

10. Докажите правильность или ошибочность суждений. Дайте расширенный ответ.

1 . There are 5 methods available for constructing the prototype.
2. Bach of these 5 methods can be used in all cases.
3. Either wirewrap or standard p.c. boards are suited to digital application.
4. The wirewrap technique is advised where signals of 1 MHz or higher are used.

1 1 . Прочитайте текст С.

Contributions of material Technology to Semiconductor Devices

1 . There are two basic disciplines underlying the design and development of solid state electronic devices. One is the design and analysis of the device from the electron physics standpoint. This involves an understanding of the transport properties of electrons and holes in the presence of p-n junctions and other energy band structures, independent of the technique used to fabricate the device. The second — material technology, undertakes to make suitable structures in solids by various techniques to fulfill the conditions specified in the device design.

2. The history of semiconductor technology can mark its beginning with the crystal rectifier which was used as the detector in the early radio receivers. Typically, a detector was made by soldering a piece of the crystal in a

receptacle and flexible wire "cat whicker" held in light contact with the crystal made the rectifying contact. Until ; the 1940s the crystal rectifier served as a laboratory device to detect and monitor UNT power, since the thermionic tubes had replaced its utility in radio receivers. For this work the combination of a silicon crystal and tungsten or molybdenum whisker was used because of the sensitive characteristic provided.

3. The theory of semiconduction predicted that the conductivity and hence the rectifying properties of silicon and germanium would be affected by small amounts of impurities. So a programme to develop a method to produce high purity silicon and gernanium was initiated. The research during late 40th resulted in considerable : prrogress in the purification of germanium and silicon and in the controlled addition of impurities to them.

4. In the latter part of 1948 scientists began experiments to grŏw germanium single crystal, they succeeded in growing large single crystals of gemanium of high structural perfection. They also showed the possibility of obtaining both rectifying and transistor action using p-n junctions in bulk material. This important theoretical step stimulated research toward preparing p-n junctions. Rapid developments soon followed in material tecnology.

' W.G. Plann discovered a simple method for repeating the action of normal multing and freesing, which avoided ; handling the material between each operation. This resulted in material of extremely high purity which was then grown into single crystal by polling technique. Plann also developed the zone leveling technique which distributee impurities uniformly through a rod. He grew single crystals in his zone leveling apparatus, using seeding techniques. The combination of zone leveling and horisontal growth of single crystals has become the standard technique used in today's transistor manufacturing operations.

12. Используя материал, изложенный в тексте С и известные Вам факты и информацию, обсудите историю полупроводниковой технологии.

Unit 7
Hybrid Integrated Circuits

Text A. Principles of Manufacture
B. Thin film ICs.
C. Substrates.
D. Conductors and Contact Pads.

Grammar Revision: Gerund.

Terminology:

1 . deposition — осаждение
film deposition — осаждение пленки
deposit (n) — осаженный слой (v) — осаждать(ся)
2. chip *- кристалл, интегральная схема, микросхема
multichip (n) — многокристальная ИС (a) — многокристальный
3. pattern (n) — образец, шаблон, форма, структура (на фотошаблоне) (v) — формировать рисунок, копировать
4. pack (n) — корпус, сборка (v) — корпусировать, укладывать
package (n) — Корпус, монтаж в корпусе
packing (n) — корпус, набивка, уплотнение
5. case (n) — корпус (v) — монтировать в корпусе
6. encapsulation — герметизация
7. pin — штырьковый вывод
lead-out pins — металлические выводы
lead wire — проволочный вывод
8. trimming — подгонка, подстройка
9. contact pad = contact land — контактная площадка
10. adhesion — адгезия, сцепление
1 1 . soldering — пайка
solderability — способность к пайке

I. Проверьте, знаете ли Вы следующие слова:

manufacture (n), monolithic (a), screen (n), discrete (a), formation (n), stripe (n), evaporation (n), thickness (n), value (n), layer (n), oxide (n), size (n), adeqaately (adj.), dimension (n), thermocompression (n), welding (n), individual chip, comparatively (adj.), version (n), dielectric type, application (n), interconnection (n), testing (n)

I1. Прочитайте текст А и расскажите:

1) о принципах производства ИС;

2) о преимуществах гибридно-пленочной технологии.

Principles of Manufacture

1 . A hybrid microcircuit consists of film passive elements deposited on a glass or ceramic substrate and active elements such as discrete semiconductor devices mounted on the same substrate. Hybrid 1C technology thus takes advantage of both film and monolithic 1C technology.

2. A multichip hybrid circuit contains Ni-Cr alloy resistors, gold wires, and discrete transistors and diodes. For such a circuit to be made it is first necesrary to use special screens, or masks, with windows to form the desired film connection pattern on the substrate.

3. The formation of a film passive circuitry on the substrate, involves a few steps. First, stripes of silver, aluminum, or gold are grown by evaporation, or deposited by any other method through the windows in a mask. Next, another mask is used to deposit resistors in the form of film stripes of tantalum, chrominum or epecal alloys. Changing both the material for film deposition and the thickness of the film gives various values of the resistors. A capacitor is made by depositing a metal layer through a special mask, then an oxide layer through another mask, and finally, a second metal layer on the top of the oxide.

4. After the passive circuitry is complete, active devices such as transistors and diodes are mounted and bonded to the substrate. Discrete components mast be comparable in size to thin-film elements, therefore hybrid circuits use either active devices of adequately decreased dimentions or unpackaged (uncased) devices. Contact between active parts and passive elements can be made by one of the known methods such as thermocompression, ultrasonic and laser welding; the aim is to bond the lead wires of the active elements to contact lands on the substrate. Hybrid circuits come in a variety of design versions, the planar type being most popular. Assembled circuits are protected against external influences by encapsulating them into metallic or ceramic cases with lead-out pins.

5. A multi-chip hybrid circuit includes a few unpackaged semiconductor ICs as active components, each arranged on an individual chip.

6. What distinguishes film hybrid technology is its high fiexibility; namely, it affords a wide choice of materials and techniques for the fabrication of film elements and makes available comparatively easy approaches both to design and produce most circcuits in the hybrid version. Both thin-film hybrid technologies enjoy use today for the
fabrication of passive elements. Thick films . range from tens to hundreds of micrometers in thickness; thin films are usually a few micrometers thick. As regards the ability to conduct and the field of application, films can be broken down into conducting, resistive, and dielectric types. Film microcircuits proper find very rare uses and serve only as resistance or resistance-capacitance ICs. They usually perform the function of passive elements in hybrid ICs.

7. The process of manufacturing hybrid ICs includes several basic stages: preparation of substrates and photomasks, deposition of film passive elements and interconnections, trimming of resistors, attachment of uncased active elements on the substrate, encapsulation, and testing.

Words to be learnt:

1 . to take advantage of— воспользоваться

2.to bond to — связывать, оцеплять

3.to distinguish — различать, проводить различие

4.approach — подход

5.to range — классифицировать

6.to break down into — зд. подразделять на...

7.to serve — годиться, удовлетворить

III. Переведите следующие словосочетания на английский язык:

дискретные полупроводниковые приборы; стеклянная или керамическая подложка; резисторы с нихромовым сплавом, золотые проводники, образовывать необходимые пленочные шаблоны на подложке; уменьшенные размеры; компоненты, используемые без корпуса; соединять проволочные вывод с контактной площадкой на подложке; различные варианты конструктивного использования; металлические и керамические корпуса с металлическими выводами; бескорпусные полупроводниковые ИС; высокая гибкость; проводящие резистовые и диэлектрические виды пленок.

IV. Закончите предложения, ориентируясь на текст, и переведите их:

1 . A hybrid microcircuit consists of...
2. A multichip hybrid circuit contains...
3.....gives various values of the resistors.
4. Discrete components must be compared in size to.... therefore... .
5. Assembled circuits are protected against... by... .
6. A multichip hybrid circuit includes....
7. Thick film ranges from..., thin films are... .

V. Переводите предложения, обращая внимание на употребление герундия в предложениях:

1 . In addition to creating insulating areas oxidation offers a practical method for growing silicon oxides at low
temperatures.
2. Changing both the material for film depositions and the thickness of the films gives various values of the resistors.
3. After completing the passive circuitry active elements such as transistors and diodes are mounted and bonded to the substrate.
4. She computer achieves a higher productivity merely by having more circuits working at a time.
5. A capacitor is made by depositing a metal layer through a special mask.
6. Assembled circuits are protected against external influences by encapsulating them into metallic or ceramic cases with lead-out pins.
7. Both thin-film and thick-film hybrid technologies are used today for fabricating passive elements.
8. Distributing materials and techniques for the fabrication of film elements makes available comparatively easy approaches to design and produce most circuits in the hybrid version.

VI. Ответьте на следующие вопросы:

1 . What does a hybrid microcircuit consist of?
2. What are the formation steps-for manufacturing a film passive circuitry?
3. What active elements are used for manufacturing hybrid microcircuits?
4. What are the advantages of film hybrid technology?
5. What types of films do you know?
6. What does the process of manufacturing ICs include?

VII. Переведите микротекст.

Самостоятельно пленочные микросхемы применяются очень редко в качестве резисторных или резисторноемких ИС. Обычно они используются как основа гибридных ИС.

Процесс изготовления гибридных ИС состоит из следующих основных этапов: изготовление подложки, фотошаблонов и пленочной пассивной части ИС, подгонки регистров, монтаж бескорпусных элементов и герметизация, контроль.

VIII. Составьте план текста на английском языке.

Кратко изложите в соответствии с планом содержания текста. Используйте следующие выражения:

1 . This text is about...
2. This is....
3. The first paragraph introduces... the second advances the idea of....
4. In conclusion ... is given.

IX. Прочитайте текст В за 10 минут и ответьте на следующие вопросы:

1) Из каких элементов состоят тонкопленочные ИС?

2) Чем отличаются тонкопленочные резисторы от полупроводниковых?

3) Перечислите основные процессы производства тонкопленочных схем.

Thin-film Hybrid ICs A thin-film 1C includea each passive elements deposited on an insulating substrate as resistors, capacitors, metallic conductors, and bonding pads. It should be noted that thin-film resistors and capacitors are made to much closer tolerances than semiconductor counterparts and excell the latter in a number of parameters, the temperature coefficient including. Thin-film passive elements are superior to semiconductor elements in frequency properties, so the use of the former in high-frequency and microwave devices offers substantial advantages. Thin-film ICs are cheaper than monolithic microcircuits, but are larger. A typical process for the manufacture of a thin-film circuit comprising resistors and capacitors with appropriate interconnections consists of the following stages: — deposition on the substrate of a tantalum layer and its thermal oxidation to transform it into an oxide that protects the substrate against etchants used in subsequent operations;

- deposition of the second tantalum layer and its subsequent etching to form tower capacitor plates;
- oxidation of tantalum to form a dielectric for capacitors; — deposition of one more tantalum layer to produce upper capacitor plates and resistors;
- growth of an alumonum layer on top of the tantalum layer; — etching of aluminum to obtain the desired connection pattern with contact pads;
- etching of the resistive layer of tantalum oxide to form resistors.

Text C.

X. Прочитайте текст С и передайте содержание текста по-английски.

Substrates

The Materials employed tor insulating substrates of thin-film circuits are commonly glasses, ceramics and glass ceramics. Glazed alumina is most popular. Substrates are usually rectangular or square in shape. The thickness of substrates is 0.6, 1.0 and 1.6 mm.

The substrate of an 10 must have a high mechanical strength, low electrical conductivity, and good thermal conductivity. The substrate surface must be mirror-like. The degree of surface finish determines the thickness of deposited films. The process of fabrication of substrates includes several stages: blank cutting, lapping, polishing, cleaning, washing, etching, drying, and last, ion bombardment using a glow descharge. She treatment gives the desired surface finish and thus ensures a good adhesion of films to the substrate. Minute crystal defects cause appreciable changes in the properties of thin-film elements.

XI. Прочитайте текст Д и задайте 10 вопросов по содержанию текста.

Conductors and Contact Pads

Conducting films serve as interconnections, inductors, and capacitor plates.
The conductivity of a metal film depends on the film thickness. A film conducts well at a thickness of 0.1 The materials for metallized current-carrying stripes interconnecting circuit elements and contact pads must fill the following requirements.

1 . High adhesion to a substrate. Contact pads are subject to thermal shocks during soldering or welding and
support the leads of active elements.

2. High conductance. The circuit designer usually specifies a lower level of connection pattern conducance that ensures the adequate performance of the circuit.

3. Chemical stability. The factors affecting the quality of films are corrosion, structural changes leading to disturbances in film layers are in contact with resistive elements, capacitor plates, and dielectrics. It is, thus, essential to avoid chemical interaction of all circuit components both during the manufacture of a film microcircuit and in the operating conditions.

4. Good solderability to enable adequate circuit assembly. Contact pads serve to connect the circuit to input, output, and power supply lines and also to interconnect active elements through film stripes and jumpers.

5. The parameters of contact pads are a contact resistance, current-voltage characteristic, and noise voltage induced by contacts.

6. The materials for thin-film conductors are commonly gold and aluminum vaporized in a vacuum.

Unit 13.

Text A. Semiconductor 1C Assembly
Text B. Typical Circuit Packages.
Text C. Assembly of Hybrid Integrated Circuits.
Grammar Revision. Infinitive.

Terminology

1 . package — конструкция корпуса, корпус
2. diamond scribe — алмазный резец scribing — скрайбирование
3. dicing — резка
4. a header- кристаллодержатель, основание корпуса package header -основание корпуса
5. metal envelope -металлический корпус
hermetically sealed metal envelope — герметически спаенный корпус
6. epoxy resin coats — покрытия эпоксидной смолой
7. a metal can — металлический корпус
8. to mold — прессовать, формовать
9. lead — вывод, расположение выводов
lead pitch — размер шага расположения выводов
10. duel-inline package — корпус с выводами по длинным сторонам основания корпуса с одинаковой геометрией отгибки
1 1 . quad-inline package — корпус с выводами по длинным сторонам основания о отгибкой в шахматном порядке
12. joint — спай
13. brazing — пайка среднеплавким припоем (с теыпературой плавления выше 500°С)
14. molten glass bonding — пайка припойным стеклом

I. Проверьте, знаете ли Вы следующие слова:
wafer (n), contain (v), separate (v), mount (v), encapsulate(v), protect (v), protection (n), influence (n), commonly (adj), welding (n), soldering (n), design (n,v), dimension (n), shape (n), however, heavy (a), light (a), ratio (n)

II. Переведите следующие словосочетания на русский язык:
after sorting out the chips; it is first necessary to mount; to connect the circuit to; plastic enclosure; ceramic and metal-ceramic package; to bond together by thermocompression; a uniform distribution of stresses; reliable sealing of the chip; planar leads; to depend on the design.

Semiconductor 1C Assembly

A set icon wafer can contain several hundred integrated circuits. Before proceeding with assembling, the wafer need be cut vertically and horizontally with a diamond scribe to separate it into individual chips. This operation is known as dicing, or scribing. After sorting out the chips, the assembly proper follows, For this, it is first necessary to mount the chip on a header, then bond or solder it to connect the circuit to the header terminals, and finally, encapsulate or package the mounted chip to protect it against mechanical and environmental influences.

Typical encapsulations for integrated circuits are hermetically-sealed metal envelopes, epoxy resin coats and other plastic enclosure, and ceramic and metal-ceramic packages. Ceramic and metal-ceramic packages are commonly meant for 1C designed to operate in adverse mechanical and environmental conditions. A metal-ceramic enclosure consists of a ceramic header (envelope bottom) and a metal can or cover bonded to the header by welding or soldering in a ceramic enclosure both the header and the can are made from a cermic material and bonded together, a plastic package has its can and bottom molded of a plastic material and bonded together by themocompression. Plastic packages are suitable for ICs intended for work in all but too arduous conditions.

The design of a package is chosen proceeding from service conditions and requirements for equipment dimensions, type of assembly and tests of the encapsulated ICs.

Packages can be cylindrical and flat in shape, with leads running parallel or normal to the header plane. 1C packages can be classified by the overall and mounting dimensions, the number of leads, and the lead pitch (spacing between leads). The lead pitches of circuit packages are given in Table I.

Table I Type 1 Package shape Lead

Lead pitch

1	Rectangular	Vertical	2.5 mm
2	Rectangular	Vertical	2.5 mm
3	Bound	Vertical	3Q| 36 45o
4	Rectangular	Planar	1 25 mm

All these types, except the first, are suitable for semiconductor ICs. The second type has three modifications.

1 . The dual-in line package.

2. The quad-in line package.

3. The package is arranged along the perimeter and each bent in the same fashion.

The 3d type is cylindrical in shape. The round shape of the package ensures a uniform distribution of stresses in the joint, reliable sealing of the chip, and good protection of the 1C against mechanical influences. This type of package, however, suffer from some disadvantages: it can hold a chip not over 2,5 by 2.5 mm in area, has a limited number of leads, and is comparatively large in size and heavy.

The 4th type with the leads parallel to the package plane is also built in three design variants. The cans mounted on ceramic heads can be both metallic and ceramic.

Plat packs with planar leads are generally 2 or 3 mm high. The maximum power of ICs enclosed in these packs ranges from 200 mW to 1000 mW. The leads are strips 0.1 mm thick soldered to the pack walls. Depending on the design of flat packs, the assembling can be done by welding, brazing, or molten glass bonding. The main advantages of flat packs are that they are light and small, in size and exhibit a comparatively large chip area-to-pack area ratio.

Words to be learnt:

1 . bo proceed — продолжить, приступить к

2. adverse conditions — неблагоприятные условия 5. arduous conditions — трудные условия

4. enclosure — оболочка, корпус

5. to intend for— предназначать для

6. to ensure — обеспечивать

7. to exhibit — показывать, проявлять

III. Переведите следующие словосочетания на английский язык:

Резать алмазным резцом по вертикали и горизонтали, резка, защитить от механических и климатических воздействий, герметический корпус, покрывать эпоксидуой смолой, керамические, металлокерамические и пластмассовые корпуса, действовать в неблагоприятных механических и климатических условиях, соединять с металлической крышкой сваркой или пайкой, условия эксплуатации, требования к габаритам аппаратуры, круглые и плоские корпуса, расположение выводов, размер шага расположения выводов, обеспечивать равномерное распределение механических напряжений в спае, выполнить сборку с помощью... , сравнительно высокое отношение площади кристалла к размером корпуса.

IV. Переведите предложения, обращая внимание на употребление инфинитива:

1) Aluminum is the most problematic material to be used tor metallization in maintaining contact stability.

2) To manufacture a hybrid microcircuit active devices such as transistors and diods are mounted and bonded to substrate.

3) To be more economically competitive, more and more systems will incorporate micros.

4) Loaf semiconductor devices are known to be made by introducing controlled numbers of impurity atoms into a crystal.

5) Before discussing the patterns themselves it is necessary to exmine factors which are likely to intefere with the results.

6) The basic demand appears to be conductivity because it can substantially improve the resistance.

7) To form a film passive circuitry stripes of silver, aluminum or gold are grown by evaporation.

8) The structure of an integrated circuit is sure to be complex both in the topology of its surface and in its internal composition.

9) A thin film happens even to be employed to select the areas on a wafer that are to be oxidized. -

V. Ответьте на следующие вопросы:

1 . What operations should be done before assembling?

2. What packages are used for intergrated circuits?

5. What are the types of packages?

4. What packages are designed to operate in adverse mechanical and environmental conditions?

5. What modifications does the second type have? 6. Describe the third type and its disadvantages. 7. Can the cane mounted on ceramic heads be only ceramic? 8. What are the advantages of flat packs?

VI. Переведите микротекст.

В зависимости от конструкции плоских корпусов при сборке могут применяться сварка, высокотемпературная пайка твердым припоем и пайка припойным стеклом. Основными достоинствами планарных корпусов являются малые размеры и масса, а также сравнительно высокое отношение площади кристалла к размерам корпуса.

VII. Составьте план текста на английском языке.

Кратко изложите в соответствии с планом содержание текста.

Используйте следующие выражения.

This text is about.... It introduces.... It advances the idea of... In conclusion... is given

VIII. Прочитайте текст со словарем, озаглавьте его и задайте 10 вопросов по содержанию текста.

In mounting a chip on the header, the chip is held with its gold-plated face down and then pressed onto the gold-plated header mounted on a header anvil, A eutectic such as a gold-silicon or gold-germanium alloy that forms under heat provides a good bond on cooling. All electrical connections are then made between the contact pads on the chip and lead-out pins of the header using thin gold wire attached by thermocompression bonding. This done, a gold-plated cover can is mounted on the header and hot-welded to form a sealed envelope.

There are other methods of bonding the chip to a header. In wide use is the flip chip method for attachment of active elements provided with ball leads, solder bumps, and beam leads. The method combines the operations of mechanical bonding and electrical connection of the chip to the header. This is essentially a thermocompression bonding method by which the chip is mounted, face down, onto the heated header and then pressed against it, so that the spider bumps (preliminarily built up on the chip) make contact with the conductor pattern and form soldered joints. Another method of bounding uses a lead frame to attact the chip to its spiderlike lead pattern. The method is rather simple end inexpensive.

High-power ICs require massive headers with external or built-in heat sinks to remove excess heat. The plastic package with a T-shaped heat sink allows the power dissipation of an 1C amplifier to be brought up to 6 W without overheating (for a common package, it reacts 1 W).

Each package bears on its surface, the designation of the 1C the date of manufacture, and the manufacturer's trade mark. To determine the lead number on the envelope the first lead is made to differ in shape from the others.