aselsan

Hacettepe University Internship Report

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Depatment: Electrical and Electronics Engineering

Grade: 4th

Company's name: ASELSAN

My internship department: Test systems and processes design directorate

Starting & ending dates: 07/08/2017 – 11/09/2017

Contents

Introduction of Company

Company Profile

ASELSAN was founded in 1975 to meet the communication needs of the Turkish Armed Forces. It has developed itself has become an international company. It produce new products using developed new technology to provide security and peace. In 1978, the first buildings were completed at Macunkoy Facility and has begun production activities. In 1980, the first manpack and tank wireless radios were produced for Turkish Armed Forces. In 1981, designing of the first handheld radio and bank alarm systems was made. In 1983, the first export was occurred. Between the years 1982-1985, new products such as Field Telephones, Computer Controlled Central Systems and Laser Distance Measurement Appliances were produced. In 1986, ASELSAN improved the power of the Turkish Armed Forces with the developed Electronic Warfare and Data Terminal appliances. In 1987, ASELSAN was included in a common project participated by 4 NATO countries for the producing of Stringer Missile. In 1988, ASELSAN produced the first avionic device for F-16 program. In 1989, wireless radio production was begun with ASELSAN licence in Pakistan's NRTC facilities. In 1991, ASELSAN founded Radar Technology Center with the SSIK 91-3 decision. In 1992, ASELSAN founded Electro-Optical Technology Center with the SSIK 92-4 decision. In 1995, ASELSAN realized the project activities in the main topics such as Microelectronic, Inertial Navigational System, Infrared Guiding, Laser Guiding, Thermal Imaging Sensors, Passive Imaging Concentrators, Laser generators and Sensors. In 1996, the TASMUS contract was signed. In 1997, ASELSAN 1919 Mobile Phone was released to the market. In 1998, thermal cameras, thermal weapon sight and thermal vision devices with target coordination addressing devices were presented to the Turkish Armed Forces. In 1999, Air Defence Early Warning and Command Control System, MILSIS Electronic Warfare and X-Band Satellite Communication System contracts were signed. In 2001, the project of serial production of KMS systems were signed. In 2002, project of MWS-TU Missile Warning System and Leopard Volkan Fire Control System was signed in order to be used Turkish Armed Forces Air Platforms. In 2003, projects of SPEWS-II F-16 Electronic Warfare Auto Defense System, Military Police Integrated Communication and Information System were signed. In 2004, project of HEWS-CMDS CHAFF/FLARE shooter system was signed. In 2005, HEWS, Helicopter Laser Warning Receiver System (LIAS) Project and Turkish Land Forces Avionic System Modernization Project was signed. In 2006, project of ASELPOD was signed.In 2007, MILGEM war system supply project was signed.In 2008, ATAK contract, project of Multi Band Digital Commmon Wireless Radio were signed and the first originally developed Air Defense Radar was delivered by ASELSAN. In 2008, the project of Coast Guard Command search and rescue, the project of AKSAZ and FOCA Naval base under and surface surveillance and acquisition system, the project of New Type Police

Station Boat and JEMUS Kastamonu, the projects of Konya Wireless Radio system were signed. In 2009, four AR-GE Center was founded, Leopard-1 Tank modernization was completed, project of MILGEM Warfare System 2nd Vessel, project of Ammunition Transfer system for Self-Propelled Howitzer Ammunition vehicle, project of SAR/Reconnaissance System Supply Integration, STAMP and SOP system project for UAE, the project for Land Located, remote ED/ET capability gaining project were signed.In 2010, Tasmus-G 2nd Army Project deliveries were occurred. ATMACA Electronic Systems development project, Pakistan Ministry of Defense Software Based Wireless Radio project, project of Naval Platform 3B Research Radar were signed.In 2011, the first originally developed Shipborne LPI Radar system ALPER was completed by ASELSAN.In 2012, Pedestal Mounted Stinger System that is Turkey's fist national Air Defense System has been produced by ASELSAN.In 2013, 4G Communication Technology Development Project (ULAK) contract was signed wit Ministry of Transport,Maritime Affairs and Communications by ASELSAN. In 2014, Transportation,Security,Energy and Automation Systems(UGES) Sector Presidency was founded.In 2015, ASELSAN Golbası Campus is opened where the radar and electronic warfare development production, test and engineering units of ASELSAN are located.

ASELSAN is the largest defence company in Turkey. ASELSAN's main aim is to be a company that protects sustainable growth with values created in global markets; preferred because of its compatitiveness, trusted as a strategic partner and is sensitive to the environment and people. ASELSAN produces products that meet the needs of domestic and abroad need authorities, especially Turkish Armed Forces. The technology of these products: communication and information technologies, radar and electronic warfare, electro-optical, avionics, unmanned systems, land,naval and weapons systems, air defence and missile systems, command and control systems, transportation, security, traffic, automation and medical systems.

ASELSAN operates under five business sectors;

- Communication & Information Technologies Business Sector
- Microelectronics, Guidance & Electro-Optics Business Sector
- Radar & Electronic Warfare Systems Business Sector
- Defense Systems Technologies Business Sector
- Transportation, Security, Energy & Automation Systems Business Sector

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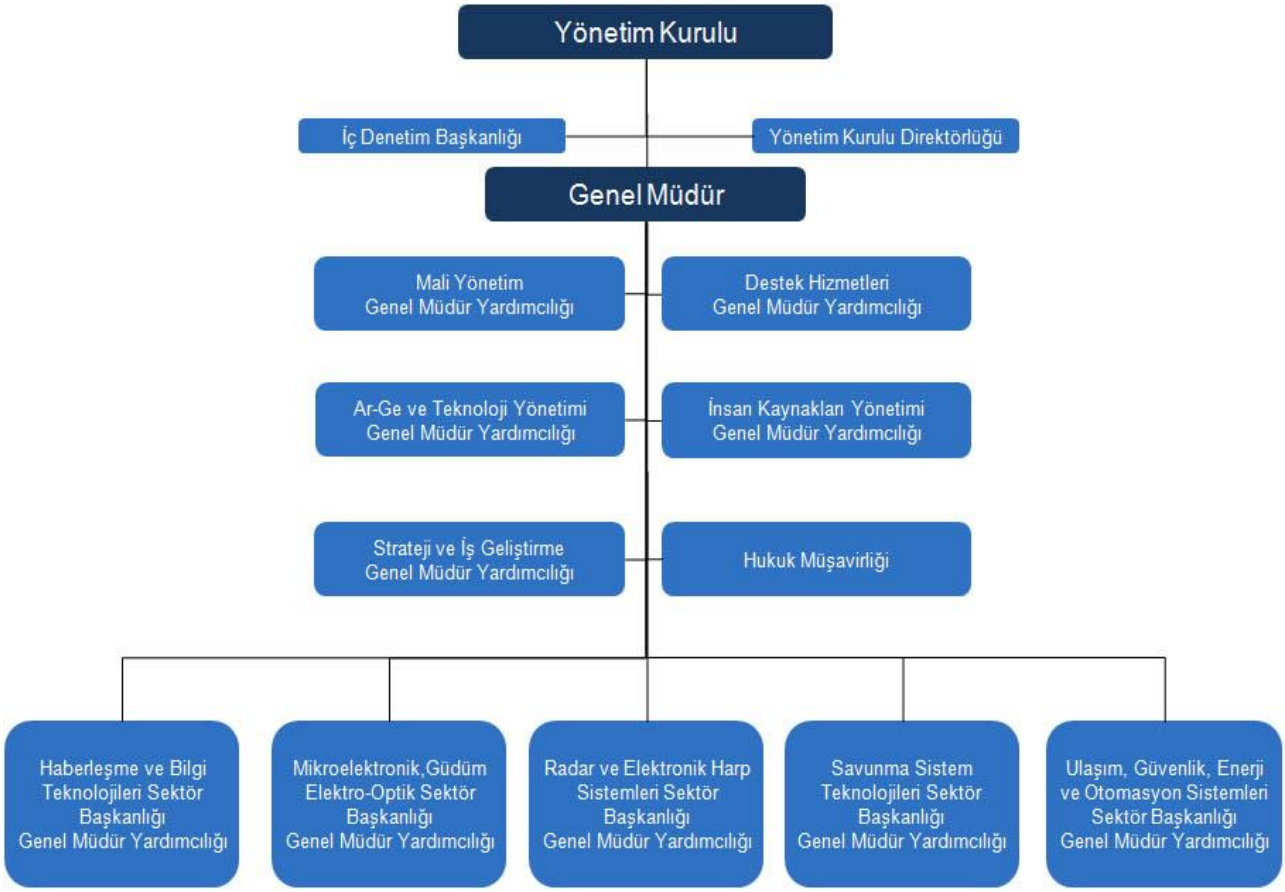
Organizational structure of ASELSAN



Orientation and 1st Week

Orientation and Presentations

My summer internship started on August 7th in Macunkoy Facility. At the first day, ASELSAN collected documentations such as contracts and insurance certificate from each interns. Entry cards were distributed by ASELSAN. ASELSAN has 4 facilities: Macunkoy Facilities, Akyurt Facilities, Golbası Facilities and METU Teknokent. Someone who works in Academy Operations Directorate department were given general information and rules about ASELSAN. ASELSAN working hours that are between 7.30 to 16.35 were specified. They informed about the facilities provided to interns such as lunch, service etc. Company services were determined for each interns. We signed privacy contract because ASELSAN has secret informations. Communication expert told us how we can communicate well with people. Two people working in the human resources department gave information what we need to do in order to work in ASELSAN. They informed about Co-Op Applications. Co-Op students work part-time to be 1,5 days in week in ASELSAN. Co-Op students' cumulative GPA must be at least 3 out of 4.

08/08/2017 - Occupational Health Safety Training

Occupational health safety training experts gave information about basics of occupatinal health safety training. In the morning, they presented about informations on working legislation, legal rights and responsibilities of employees, workplace cleaning and tidying and legal consequences of work accidents and occupational disases. Sides of occupational health safety training are state, employer and employee. They gave information obout the labor law numbered 4857 and 6331. Arrangement(classification), layout(systematization), cleanliness(sweep), perseverance(standardize) and discipline support each other. In the afternoon, doctor who works in ASELSAN presented about the reasons of occupational diseases, prevention of diseases and application of protection techniques, biological and psychosocial risk factors and first aid. Group A diseases are diseases with chemical substances. Group B diseases are diseases with skin. Group C diseases are diseases with respiratory. Group D diseases are infectious disease. Group E diseases are diseases with physical factors. Our ears are damaged after 85 dB so we need to have a headphone after 85 dB. Technical planning is done to prevent risk factors. The solution is produced respectively 1)on the source, 2)in the environment, 3)in person. Thermal comfort terms are known as air temperature, air humidity, air flow rate, and air radiant heat. It was said that the technical issues will be presented tomorrow.

09/08/2017 - Occupational Health Safety Training

Presentation of occupational health safety training continued. In the morning, they presented about information of technical topics such as chemical, physical and ergonomic risk factors, glare, explosion, fire and fire protection, working with screened tools, safety and health signs, use of personal protective equipment, evacuation and rescue. Fires can be various types such as fires of solid, liquid, gas, metal and electric. Fire signs progress in the order of smell, smoke and flame respectively. Safety and healh signs can be various colours and specific meaning. Red signs are forbidden, yellow signs are warning, blue signs are obligatory, green signs are safe situation.

Starting internship in REHIS

In the afternoon, interns were distributed to facilities by ASELSAN. My facilitity was Golbası Facilities. Me and other interns came to ASELSAN Golbası Facility by services. Someone who works in security department presented about safety principles. Interns were distributed to deparments by ASELSAN. My department was test systems and processes design directorate. In the department, i met other interns and staff in charge of department. First two days, i worked with the intern who came to the department before me. He worked on C# and he created BOM(Bill of Materials) interface on C#. Within this period, i learned basics of C# and reviewed project of other intern. As i defined below, C# is also used to create interface.

Definition of C#

C# is an elegant and type-safe object-oriented language that enables developers to build a variety of secure and robust applications that run on the .NET Framework. You can use C# to create Windows client applications, XML Web services, distributed components, client-server applications, database applications, and much, much more. Visual C# provides an advanced code editor, convenient user interface designers, integrated debugger, and many other tools to make it easier to develop applications based on the C# language and the .NET Framework.

C# syntax is highly expressive, yet it is also simple and easy to learn. The curly-brace syntax of C# will be instantly recognizable to anyone familiar with C, C++ or Java. Developers who know any of these languages are typically able to begin to work productively in C# within a very short time. C# syntax simplifies many of the complexities of C++ and provides powerful features such as nullable value types, enumerations, delegates, lambda expressions and direct memory access, which are not found in Java. C# supports generic methods and types, which provide increased type safety and performance, and iterators, which enable implementers of collection classes to define custom iteration behaviors that are simple to use by client code. Language-Integrated Query (LINQ) expressions make the strongly-typed query a first-class language construct.

As an object-oriented language, C# supports the concepts of encapsulation, inheritance, and polymorphism. All variables and methods, including the Main method, the application's entry point, are encapsulated within class definitions. A class may inherit directly from one parent class, but it may implement any number of interfaces. Methods that override virtual methods in a parent class require the override keyword as a way to avoid accidental redefinition. In C#, a struct is like a lightweight class; it is a stack-allocated type that can implement interfaces but does not support inheritance.

In addition to these basic object-oriented principles, C# makes it easy to develop software components through several innovative language constructs, including the following:

- Encapsulated method signatures called delegates, which enable type-safe event notifications.
- Properties, which serve as accessors for private member variables.
- Attributes, which provide declarative metadata about types at run time.
- Inline XML documentation comments.
- Language-Integrated Query (LINQ) which provides built-in query capabilities across a variety of data sources.

If you have to interact with other Windows software such as COM objects or native Win32 DLLs, you can do this in C# through a process called "Interop." Interop enables C# programs to do almost anything that a native C++ application can do. C# even supports pointers and the concept of "unsafe" code for those cases in which direct memory access is absolutely critical.

The C# build process is simple compared to C and C++ and more flexible than in Java. There are no separate header files, and no requirement that methods and types be declared in a particular order. A C# source file may define any number of classes, structs, interfaces, and events.

Bill of Materials(BOM)

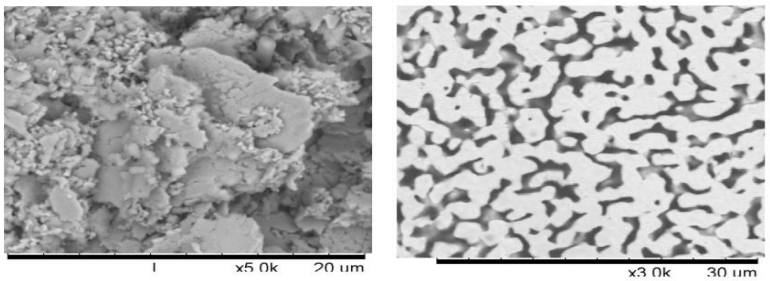
A bill of materials is a comprehensive list of parts, items, assemblies and other materials required to create a product, as well as instructions required for gathering and using the required materials. The bill of materials can be understood as the recipe and shopping list for creating a final product. The bill of materials explains what, how, and where to buy required materials, and includes instructions for how to assemble the product from the various parts ordered. All manufacturers building products, regardless of their industry, get started by creating a bill of materials (BOM).

2nd Week

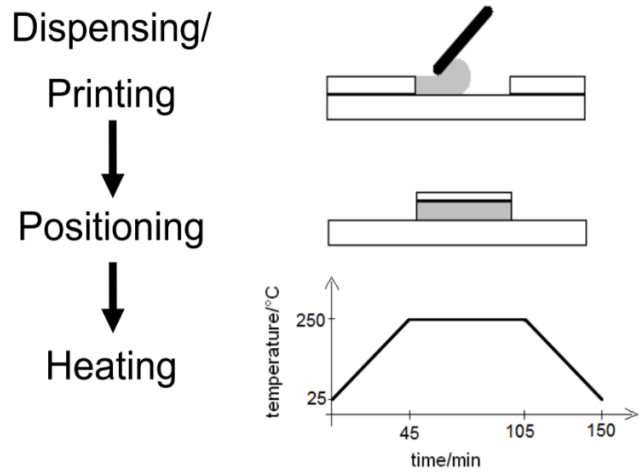
On the first day of the week, my supervisor is changed so my workspace is also changed. I started to work on evaluation of pressureless silver sintered high power semiconductor devices by measurement of thermal impedance and comparison of pressureless silver sintering materials with conventional electronic die attach practices topics and i read documents about this topics. Additionaly, i continued to learn working structure of the department in this week.

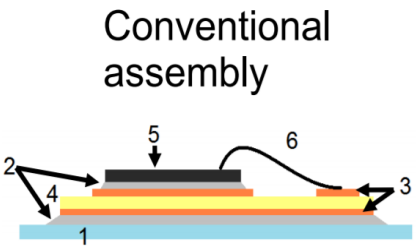
What is silver sintering?

Silver sintering is the process of compacting a paste of silver particles and organics by the use of thermal energy.



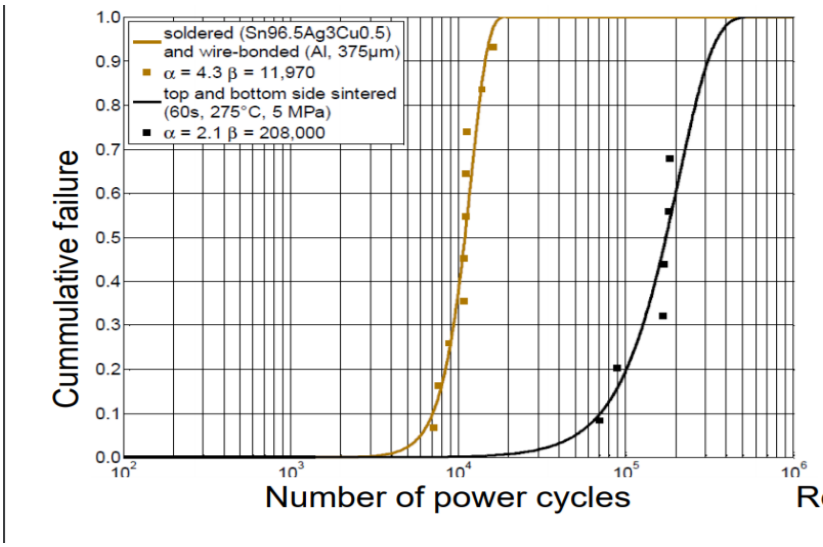
Pressureless sintering process





1 Heat sink, 2 Solder,
3 Copper, 4 Ceramic,
5 Die, 6 Bond wire

Typical power cycling test of soldered and sintered diodes



Typical power cycling test between +45 and +175 °C

Ref. [2]

THEORETICAL BACKGROUND

A. SHEAR STRENGTH

One important characteristic for a die attach material to possess for high temperature applications is a high shear strength. This thesis uses United States measurements of shear strength which correlate to units in kg/in^2 rather than N/m2 (1 kg/in^2 is equal to 15.2 kN/m2). Notice that both standard units measure the force applied over the area of the attach. The procedure for gathering die attach strength data is by shearing the electronic device from the substrate. Special equipment is needed for this test, which applies increasing pressure to the side of the device and records the pressure data at the point at which the device breaks free from the substrate. A United States military standard has been defined for electronic die attaches to ensure the integrity of the attach material under stressful conditions. This military standard plateaus at 2.5 kg once the area of the attach reaches 0.0065 in2 or about 4.2 mm2 . Furthermore, this thesis includes data on only 3 mm x 3 mm devices and so only considers the plateau region defined in MIL-STD-883G.

B. THERMAL CONDUCTIVITY

Thermal conductivity is also an extremely important factor in power-dense, high temperature applications. Understanding heat spreading through materials and interfaces is necessary in the design of multichip power modules (MCPMs). In power modules, interfaces between materials contribute to the rate of heat dissipation through the module and away from the power die. Interfaces with high thermal conductivity coefficients increase the rate of heat dissipation and are preferred in high temperature applications. The equations (1) and (2) below relate the thermal conductivity of two materials, showing the effect they have on the dissipation of heat through the materials. This relation can be translated to interfaces between materials as well.

$$\alpha_a = \tan^{-1}\left(\frac{k_a}{k_b}\right) \qquad (1)$$

$$L_2 = 2 \cdot t_a \cdot \tan(\alpha_a) + L_1 \qquad (2)$$

Where α_a is the angle of thermal spreading through material a (° angle), ka and kb are the thermal conductivities of the materials in (W/m.°C), and L1 and L2 are the lengths of thermal effect at interface one and two respectively (m).

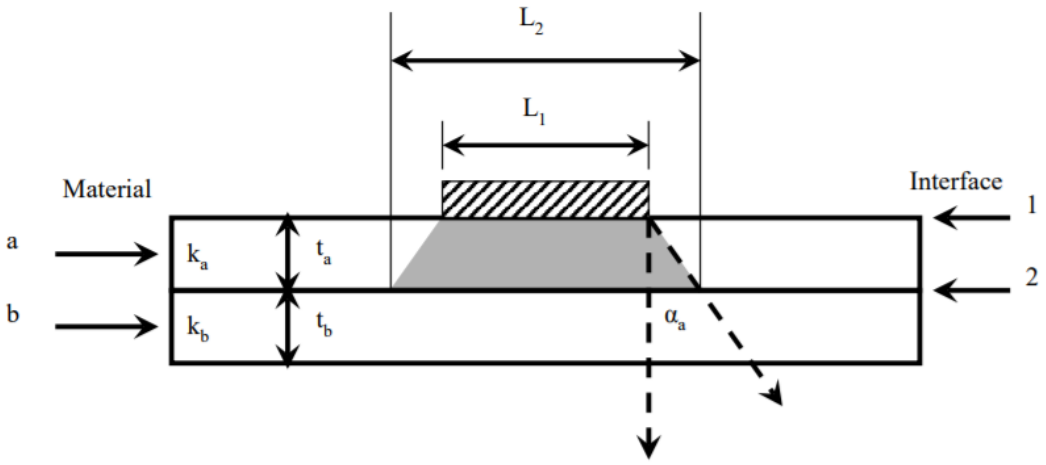


Figure 1. Representation of heat spreading [7]

After performing analysis by hand of the potential improvements in heat dissipation over traditional solder interfaces, SolidWorks® was used to verify the calculations and give more accurate data. A three-dimensional model with similar layers to the schematic shown in Figure 1 was constructed in SolidWorks®. Conduction coefficients, matching the materials used, were assigned to each layer. Variables in the simulation were the die size (2x2mm or 3x3mm), die attach thickness, baseplate thickness, and conductivity coefficient of the die attach layer. Results demonstrated, by sweeping all variables, that a higher thermal conductivity of the die attach layer significantly. promises great potential at increasing heat dissipation, thus lowering the device temperature Figures 2 and 3 show the representation model and thermal analysis used in SolidWorks® for investigating the effect of sweeping the thermal conductivity.

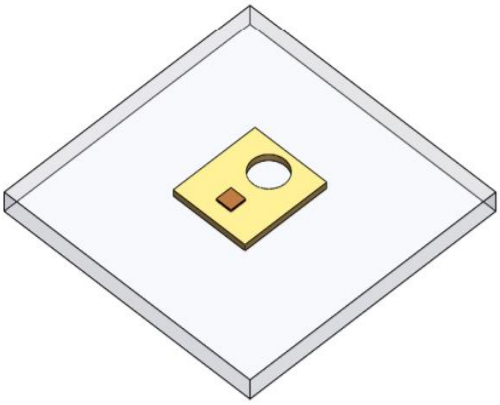


Figure 2. Isometric view of SolidWorks® model.

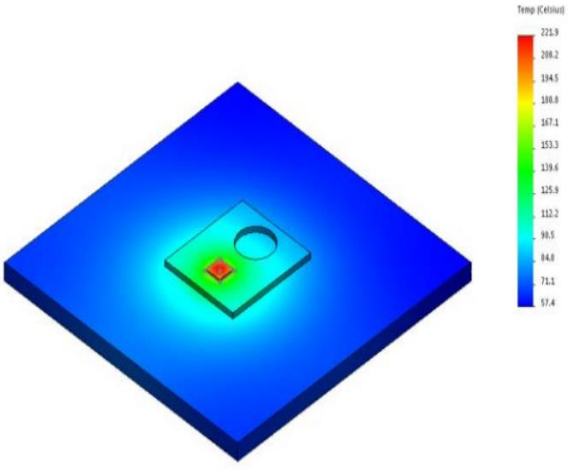


Figure 3 Thermal simulation of SolidWorks® model.

From the data in Figure 4, much lower junction to case resistances occur with higher die attach thermal conductivities, all other variables being the same. By sweeping the thermal th conductivity of the die attach material and running simulations at each interval, a curve relating e junction to case thermal resistance may be recorded to provide the data given in Figure 4. This lower resistance allows heat to spread efficiently through the surface for transfer to a heat sink, thus drawing the heat away from the device quicker than a lower thermal conductivity, which would translate to a higher resistance. The thickness of the die attach layer was also varied between 1 mil and 2 mils, represented by “tda”, to further show the range of variables which affect the thermal conductivitiy. As the thermal conductivity increases, the effect that the thickness has on the thermal resistance is greatly reduced.

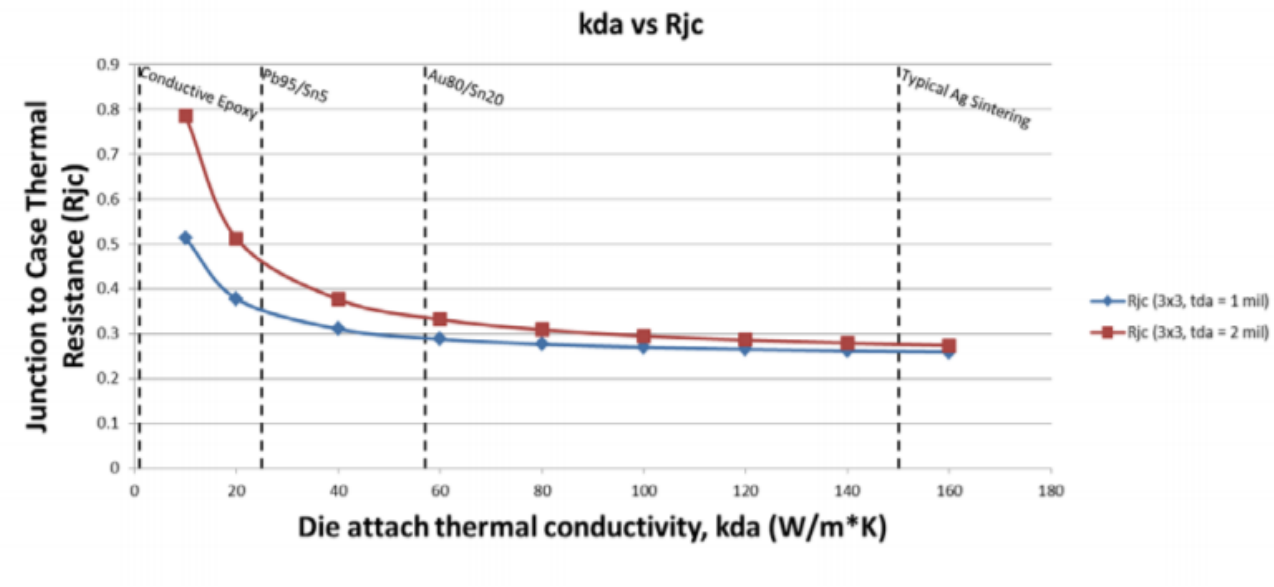


Figure 4. The junction to case thermal resistance as a function of die attach thermal conductivity.The junction to case thermal resistance is significantly reduced when the die attach thermal conductivity is > 100 W/m K. In addition, the thickness of the attach layer has a much lower effect on the junction to case thermal resistance at higher thermal conductivities.

SHEAR TESTING

After x-rays for void testing, each die was shear tested at temperatures ranging from 25 °C to 325 °C. This is to ensure a stable mechanical attach at extreme temperatures. All shear strength values are normalized to a 3mm x 3mm area. Figure 7 displays the data of shear strength in grams versus temperature. Note that the clusters around 25 °C, for example, were actually performed at exactly 25 °C but are spread out for better data visibility. Also, the high and low for each material is marked with the main point being the average. Three samples of the same material per temperature were tested. At 325 °C the solder materials returned to their liquidus state.

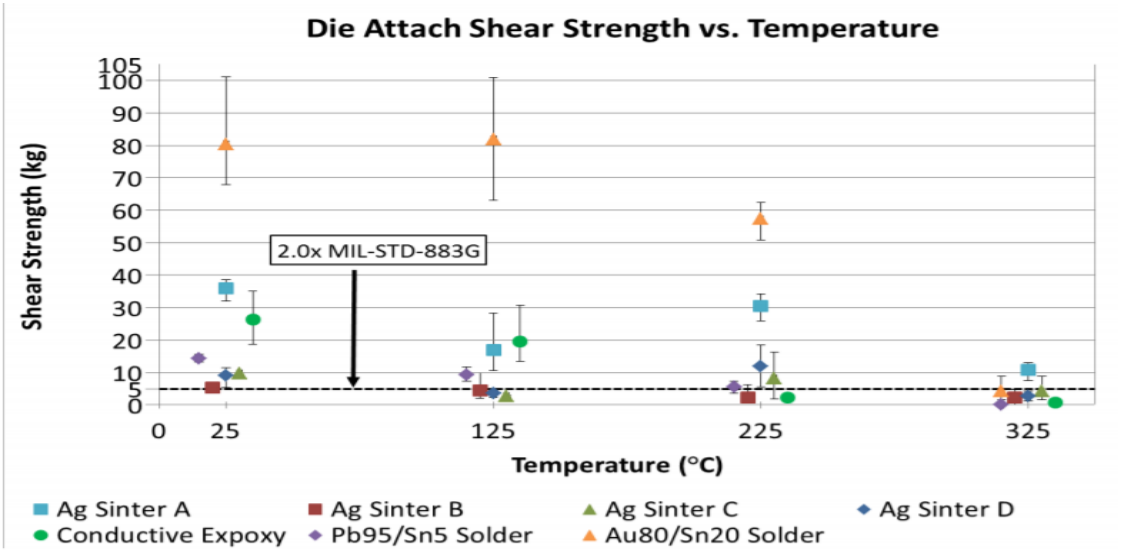


Figure 7. Shear strength vs. temperature of different die attach materials for a 3 mm × 3 mm SiC die (Au backside).

This result that Ag Sinter A material remained above this specification at all temperatures tested is significant for pushing the temperature limits of devices with a strong attach at extreme temperatures which is not only important for power devices but also high temperature die that are used to control the power die.

THERMAL TESTING

To accurately measure heat transfer in an experiment, an infrared camera must be used with the device under test (DUT) coated with a paint having a known emissivity. This setup used a matte black paint with emissivity of 0.96 to measure the maximum temperature of the die, the temperature of the top of the baseplate, along with the temperature of the top of the heat sink. Measurements at these points allow for data to be easily compared, determining the best performance.

Defining the power dissipated in the device is also important for thermal measurements. For this experiment, the voltage across the device and the current through the device were calculated. measured at each recorded temperature, leaving the power from conduction losses to be Once several temperature and power measurements have been taken for each device, die temperature as a function of power loss curves can be generated from the data. Figure 8 shows an example of the thermal images taken for measurements. The maximum temperature on the te the scale is the max temperature of the device, while the temperatures listed on the left measure mperature of the two areas; area one represents the copper baseplate and area two represents the heat sink. Since the device dissipates the most heat, the high value of the scale on the right represents the device temperature.

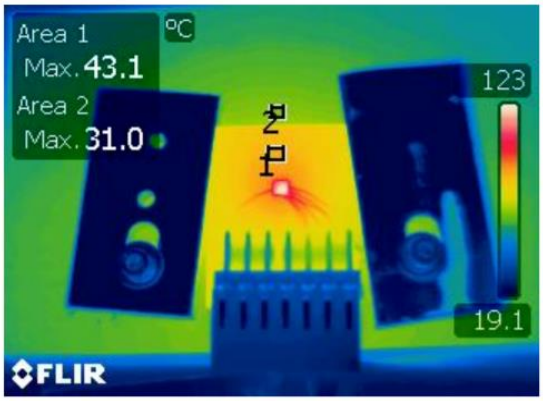


Figure 8. An infrared picture of a sample being tested.

3rd Week

In this week, my supervisor gave me two study topics. First one is high heat dissipation in electronic cards and second one is alternating die bonding techniques for electronic cards . I searched this topics from the internet computer, i read documents and gathered theoretical informations about this topics. This week i had the opporunity to review some of devices used in the department and This week is also the week before feast of the sacrifice holiday thus many engineers in the department were allowed.

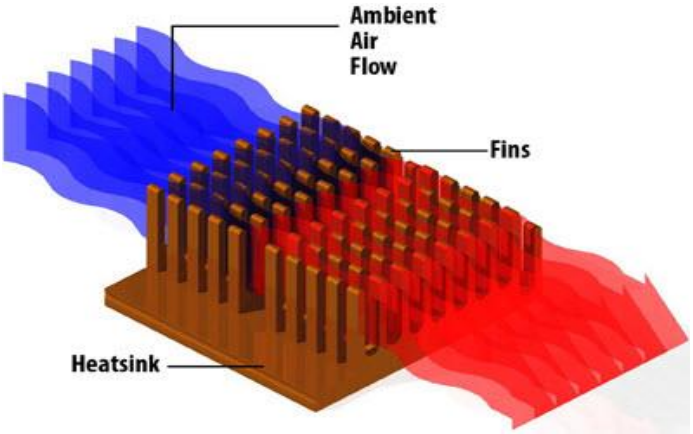
High heat dissipation in electronic cards

Every electrical and electronic component in a circuit generates some amount of heat while the circuit is executed by providing power supply. Typically high-power semiconducting devices like power transistors and the opto electronics such as light emitting diodes,lasers generate heat in considerable amounts and these components are inadequate to dissipate heat, as their dissipation capability is significantly low.

Due to this,heating up of the components leads to premature failure and may cause failure of the entire circuit or system's performance. So,to conquer these negative aspects, heat sinks must be provided for cooling purpose.

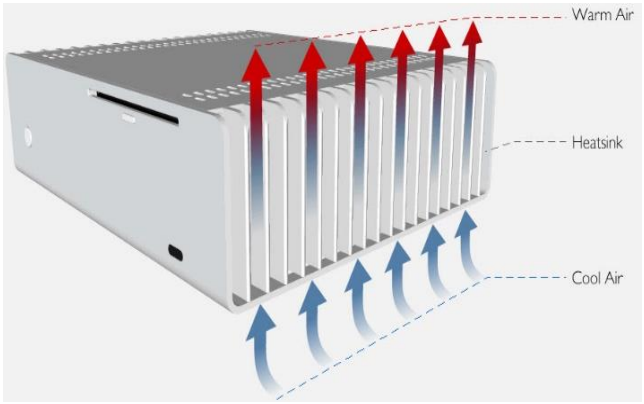
What is a heat sink?

Heat sink is an electronic component or a device of an electronic circuit which disperses heat from other components (mainly from the power transistors) of a circuit into the surrounding medium and cools them for improving their performance, reliability and also avoids the premature failure of the components. For the cooling purpose,it incorporates a fan or cooling device.



Heat sink principle

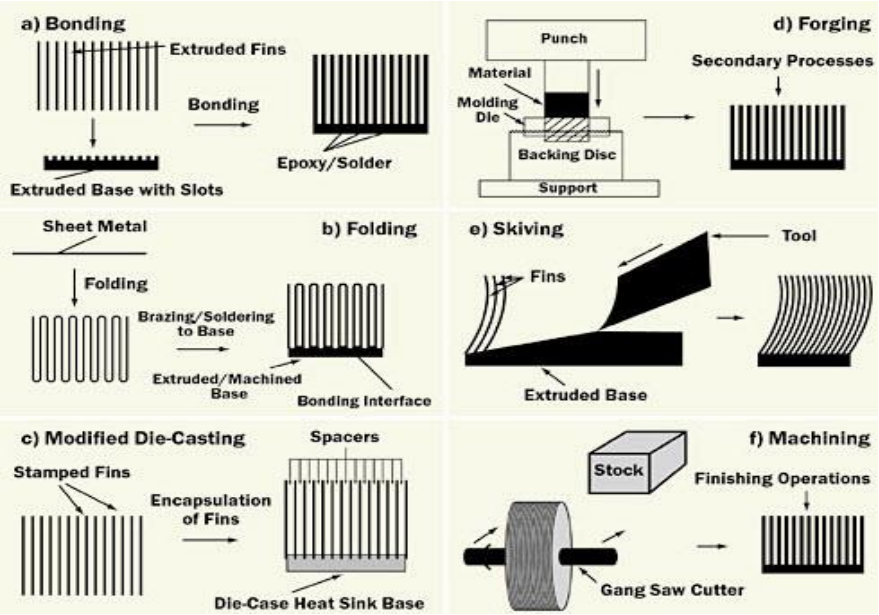
Fourier's law of heat conduction states that if temperature gradient is present in a body, then the heat will transfer from a high-temperature region to allow-temperature region.And, this can be achieved in three different ways,such as convention, radiation and conduction.



Whenever two objects with different temperature come in contact with each other,conduction occurs causing the fast-moving molecules of the high-heat object to collide with the slow-moving molecules of the cooler objects, and thus, transfers thermal energy to the cooler object, and this is termed as thermal conductivity.

Similarly, heat sink transfers the heat or thermal energy from a high-temperature component to a low-temperature medium like air, water, oil, etc.Usually air is used as a low-temperature medium; and, if water is used as medium, then it is termed as cold plate.

Heat Sink Types

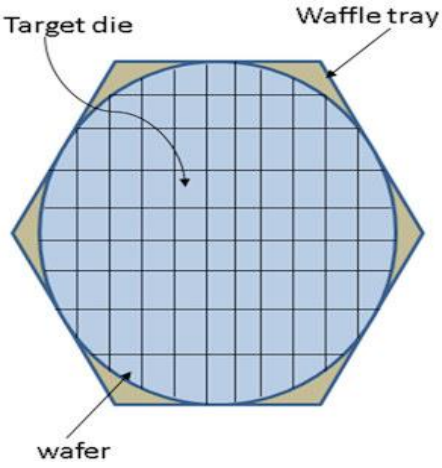


Importance of Heat Sinks in Electronic Circuits

- A heat sink is a passive heat exchanger, and it is designed to have large surface area in contact with the surrounding (cooling) medium like air. The components or electronic parts or devices which are insufficient to moderate their temperature, require heat sinks for cooling. Heat generated by every element or component of electronic circuit must be dissipated for improving its reliability and preventing the premature failure of the component.
- It maintains thermal stability in limits for every electrical and electronic component of any circuit or electronics parts of any system. The performance of the heat sink depends on the factors like the choice of a material, protrusion design, surface treatment and air velocity.
- The central processing units and graphic processors of a computer are also cooled by using the heat sinks. Heat sinks are also called as Heat spreaders, which are frequently used as covers on a computer's memory to dissipate its heat.
- The central processing units and graphic processors of a computer are also cooled by using the heat sinks. Heat sinks are also called as Heat spreaders, which are frequently used as covers on a computer's memory to dissipate its heat.
- If heat sinks are not provided for electronic circuits,then there will be a chance of failure of components such as transistors, voltage regulators, ICs, LEDs and power transistors. Even while soldering an electronic circuit, it is recommended to use heat sink to avoid over heating of the elements.
- Heat sinks not only provide heat dissipation, but also used for thermal energy management done by dissipating heat when heat is more. In case of low temperatures, heat sinks are intended to provide heat by releasing thermal energy for proper operation of the circuit.

Alternating die bonding techniques for electronic cards

Die Bonding is the process of attaching the semiconductor die either to its package or to some substrate. The process starts with picking the target die from wafer or waffle tray as shown in figure 1. The most common method is to push the target die from the tape with a pin. The tape can also be drawn away from the die by vacuum. The released die is generally picked by a vacuum tool and aligned to a target pad on the carrier or substrate, and then permanently attached, using one of several die bonding techniques.



The die bonding can be generally accomplished by distinct types of attachments.

The following die bonding techniques:

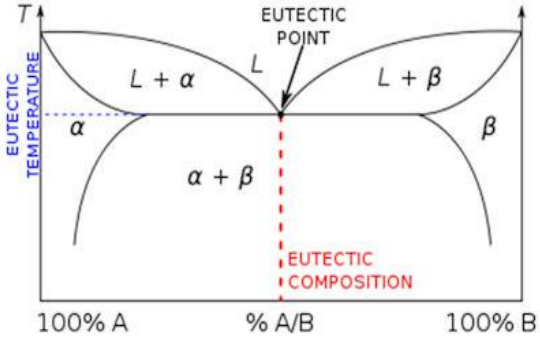
Eutectic bonding

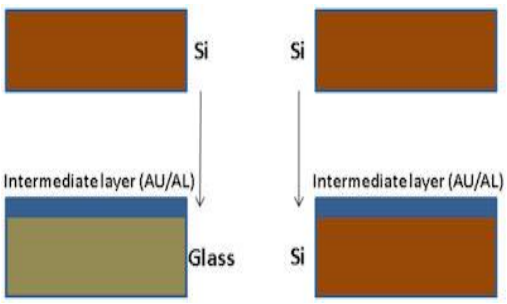
Eutectic bonding describes a die bonding technique with an intermediate metal layer (Au/Al) that can produce a eutectic system. A eutectic system is a mixture of chemical compounds or elements that has a single chemical composition that solidifies at a lower temperature than any other composition made up of the same ingredients. The fact that the eutectic temperature can be much lower than the melting temperature of the two or more pure elements can be important in eutectic bonding.

The most important parameters for eutectic bonding are:

- bonding temperature
- bonding duration
- tool pressure

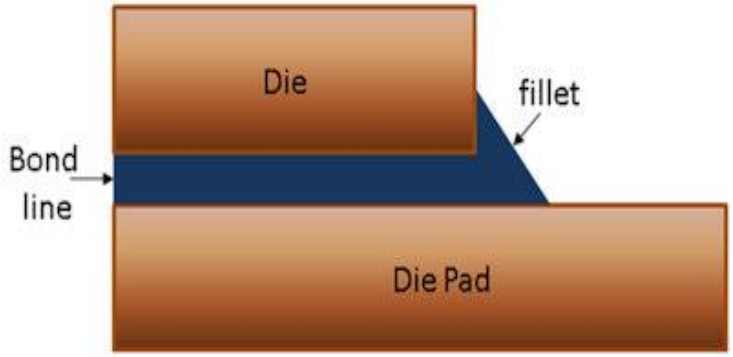
A eutectic bond is formed by melting a preform consisting of a mixture or alloy of two or more dissimilar metals in the joint between the die and substrate. The preform has a melting point which is lower than the melting point of its base materials as shown in figure2 . Consider a typical example of preform composed of gold and silicon. The melting point of gold is 1640°C, and silicon is 1414°C. However, when the preform is made up from the materials which are the combination of these two, the melting point becomes much lower than the actual melting point of the materials i.e. approximately 360° C. In this method a layer of gold metal is pre-deposited on the backside of the die. By heating the package above the eutectic temperature and placing die on it, a bond is formed between the die and package as depicted in figure 3.





Epoxy bonding

An epoxy bond is formed by attaching the die to the substrate with the use of epoxy glue. A drop of epoxy is dispensed on the package and the die placed on top of it. The package needs to be heated at an elevated temperature to cure the epoxy properly. This process uses adhesives such as polyimide, epoxy and silver-filled glass as die attach material to mount the die on the die pad. The mass of epoxy climbing the edges of the die is known as the die attach fillet. Excess of die attach fillet results in the die attach contamination of the die surface and little amount used may result in die lifting or die cracking. Epoxy adhesives are electrical insulators and have poor thermal conductivity. To improve the electrical conductivity, epoxy or polyimides are filled with the gold and silver material. In order to achieve a lower value of thermal resistance ceramic particles like SiC (Silicon carbide, compound of silicon and carbon) and BeO (Beryllium oxide, an inorganic compound) are added. Epoxy bonding is mainly preferred due to its major pros like low curing temperature, can be used for wide range of die sizes and can be reworked easily.



Solder Attach

Solder attach is the most preferably type of die bonding because of the better thermal conductivity of the solder material .As there is extreme variation of temperature on die during its operation, solder attach is used as the important concept to dissipate heat generated from the power device efficiently. By solder attach generally it is referred as soft-solder attach. Soft soldering are low melting binaries and ternaries metallic compositions.

The following steps were involved for solder attach technique:

1. Some initial solder alloy to be pre-plated over the die metallization and the substrate metallization.
2. The components are fluxed, placed together and reflowed.
3. Flux must be cleaned by cleaning mechanism before the device is encapsulated
4. In a fluxless solder wire process, a wire is fed into in-line system where it contacts the pre-heated lead frame which melts the solder and then the solder is formed in desired shape.

Solder attach provides good mechanical strength, high thermal conductivity and good electrical conductivity.

4th Week

Due to feast of the sacrifice holiday, we started work on tuesday. This week was also the last week of my internship so i spent this week doing in-company visits. Firstly, i visited card production workshop, all the processes from the production to the testing of the electronic cards at the workshop were explained by responsible engineer. I viewed the electronic card's x-ray soldering control in the pcba analyzer device and I viewed electronic cards when soldering in ovens. PCB component mounting methods and electronic device classes were explained by the responsible engineer.

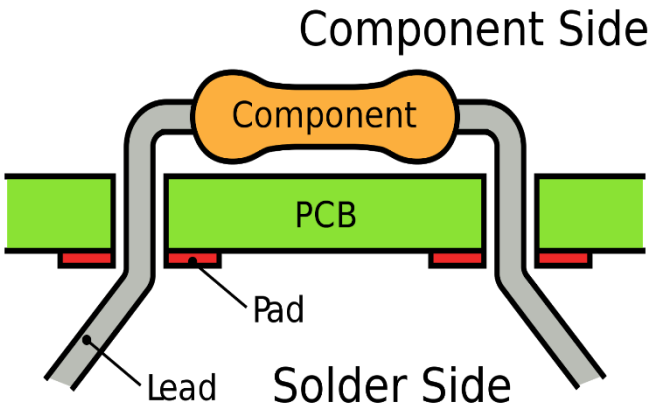
After visiting the card production workshop, We visited the area where the products produced in REHIS were introduced and we got information about the products.

PCB mounting methods

As the structure of semi conductors became more complex over time, the packaging technology required significant changes in order to offer added utilities and functionalities. To complement the complexity some new forms of packaging for semiconductor integrated circuits were developed, that were classified based on their mounting style.

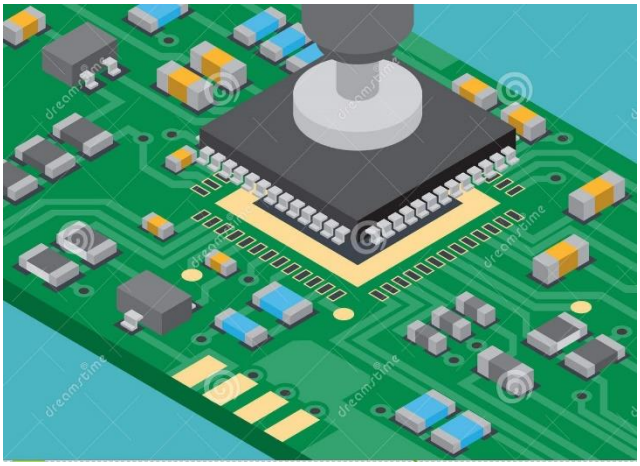
Major Types of Mounting in Semiconductors;

Through-Hole Technology



For years, through-hole technology was utilized in the construction of nearly all printed circuit boards (PCBs). This particular mounting scheme involves the use of leads on electrical components, which are then inserted into holes that were drilled on the PCB and soldered to pads situated on the opposite side. Through-hole mounting is extremely reliable, as it provides strong mechanical bonds, however, the additional drilling makes the production of boards significantly more expensive. Additionally, the presence of holes in the PCB create limitations in terms of the available routing area for signal traces on the layers which are immediately beneath the top layer on multi-layer boards. These issues are just two of the many reasons that surface mounted technology became so popular in the 1980s.

Surface Mounted Technology



In lieu of drilling holes, SMT enables electrical components to be mounted, or directly placed, onto the surface of a PCB. Generally speaking, SMT components are smaller than their through-hole counterparts. This is due to the fact that SMT components either have smaller leads, or no leads at all. Because the PCB of a surface-mount devices (SMDs) does not require as many drilled holes, and the components are more compact, higher circuit densities are possible on smaller boards. This is especially important, as today's electronics are growing more complex and more compact. Additionally, surface mounted technology is typically less expensive than through-hole mounting.

Major Differences

- SMT resolves the space problems that are common to through-hole mounting.
- In SMT, components do not have leeds and are directly mounted to the PCB, whereas through-hole components require lead wires that pass through drilled holes.
- The pin count is higher in SMT than in through-hole technology.
- SMT components are typically less expensive than their through-hole counterparts.
- SMT lends itself to assembly automation, making it far more suitable for high volume production at lower costs than through-hole production.
- Although SMT is typically cheaper on the production side, the capital required for investing in machinery is higher than for through-hole technology.
- SMT makes it easier to acquire higher circuit speeds because of its reduced size.
- The design, production, skill, and technology that SMT demands is quite advanced as compared to through-hole technology.

Electronic device classes

Class 1: Class 1 boards are in the “Limited Life” category or electronics that are of lower reliability expectance. They are considered general electronic products. A flashlight would be an example of this.

Class 2: In Class 2 Printed Circuit Boards, reliability is expected but not critical. Better thought of as dedicated service electronic end products. For example, the motherboard of a laptop.

Class 3: Class 3 boards require absolute reliability because their applications, which usually include military or medical. Examples would be a pacemaker, an airplane component or radar equipment for instance

ASELSAN Products produced in REHIS

Mobile search RADAR

ASELSAN Mobile Search Radar is a short range 3D search and track radar for mobile air defense weapon systems and point air defense of critical assets. The radar can track multiple targets accurately, adding classification and identification information to each target track. The system has been designed specifically for tracked vehicle integration and may be used as the main vehicle-mount search radar for low altitude air defense command control and missile systems.

KİRPİ - Software Defined Manpack RCIED Jammer System

ASELSAN's Software Defined Manpack RCIED (Remote Controlled Improvised Explosive Devices) Jammer KiRPiTM is designed to provide the patrols with a protection umbrella against the risk of running into Radio Frequency Controlled Improvised Explosive Devices (RCIED) both on the battlefield and in urban warfare.

With the utilization of modular multi-band RF transmitter and digital frequency synthesis techniques, the software defined jammer creates effective radio frequency interference to prevent triggering of RCIEDs.

SERHAT Counter Mortar Radar

SERHAT Counter Mortar Radar is a mortar detection system offering 360° azimuth coverage for the detection and tracking of mortar fire. The radar estimates the locations of fire source and of impact, generating valuable input for critical units under asymmetrical attack. The modular approach implemented in its design allow for use on a tripod, on a tower or building, or on a vehicle-mounted mast; resulting in increased operational flexibility.

Fire Control Radar

The Fire Control Radar is a short range 3-D tracking radar for land and naval air defense weapon system applications. The radar allows for integrated guns to be directed and locked on to targets, and thus, is suitable for use as the tracking radar in mobile air defense weapon systems. Its naval version accurately addresses naval Close-In Weapon Systems (CIWS).

SAPAN - Programmable Reactive RCIED Jammer System

SAPANTM Reactive RCIED Jammer System is designed and developed to protect convoys and VIP vehicles in motion, against RF Controlled Improvised Explosive Devices (RCIEDs), by jamming the communication between these devices and threats.

SAPANTM Programmable Active / Reactive RCIED Jammer has the ability to quickly survey the frequency spectrum and react immediately on the active signals.Hardware and the software algorithms are developed in such a way that any inevitable delay and all processing periods are minimized / optimized within the system. Ultrafast wideband tuners and DDS-based, FPGA-controlled exciters are utilized.

Land-Based Transportable Radar ESM/ELINT System

Land-Based Transportable Radar ESM/ELINT System is developed to search, intercept, analyse, classify and find direction of conventional and complex type of radar signals.

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