



VTI1J2 – Bengkel Elektronika

Pertemuan#5

Pengenalan Rangkaian Elektronika

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Doa sebelum belajar

الصَّالِحِينَ مِنْ وَاجْعَلْنِي فَهْمًا وَارْزُقْنِي عِلْمًا، رَبِّ زِدْنِي رَبِّ
الْعَالَمِينَ رَبِّ يَا آمِينَ

ROBBII ZIDNII 'ILMAA WARZUQNII FAHMAA WAJ'ALNII MINASH-
SHOOLI_HIIN AMIIN YA ROBBAL 'AALAMIIN

Terjemahan artinya :

Ya Allah Tambahkanlah aku ilmu, serta berilah aku karunia untuk dapat memahaminya Dan jadikanlah aku termasuk golongan orang-orang shaleh Ya Allah kabulkanlah do'aku ini.

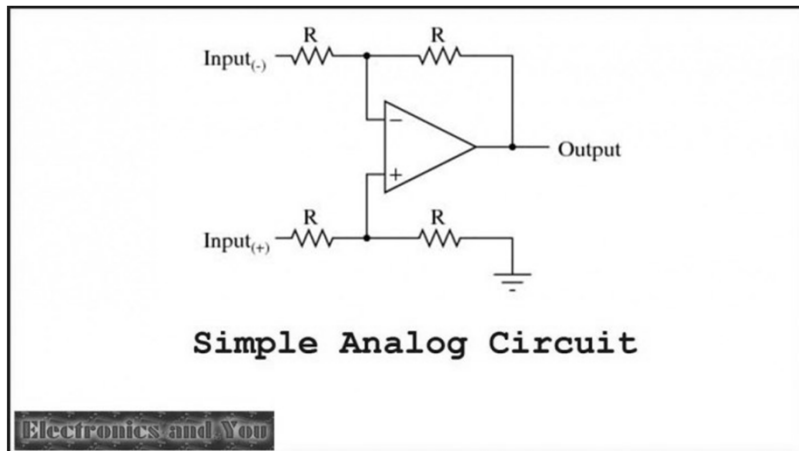
Rangkaian Elektronika

- Rangkaian Elektronika adalah sekumpulan bahan konduktor, isolator dan semikonduktor yang dihubungkan/dirangkai membentuk aliran listrik arus lemah untuk fungsi tertentu
- **Rangkaian Elektronika** adalah sebuah struktur untuk mengarahkan dan mengendalikan arus listrik agar dapat melakukan beberapa fungsi yang berguna.
- Rangkaian elektronik terdiri dari komponen elektronik berdiri sendiri, seperti resistor, transistor, kapasitor, induktor dan dioda, yang dihubungkan oleh kabel konduktif atau jalur sehingga arus listrik dapat mengalir melaluinya.
- Komponen-komponen ini dapat berupa through-hole atau SMD.
- Sebutan "rangkain" menyiratkan bahwa strukturnya tertutup, seperti loop.
- Kombinasi komponen dan kabel memungkinkan berbagai operasi sederhana dan kompleks untuk dilakukan seperti: sinyal dapat diperkuat, komputasi dapat dilakukan, dan data dapat dipindahkan dari satu tempat ke tempat lain.
- Agar disebut sebagai elektronik, bukan listrik, umumnya setidaknya satu komponen aktif harus ada.

Jenis Rangkaian Elektronika

- An electronic circuit can usually be categorized as an analog circuit, a digital circuit, or a mixed-signal circuit (a combination of analog circuits and digital circuits).
- The most widely used semiconductor device in electronic circuits is the MOSFET (metal-oxide-semiconductor field-effect transistor).^[3]

Rangkaian Elektronika Analog

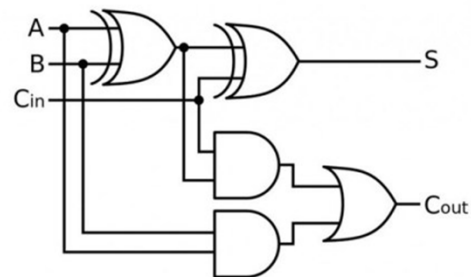


- Analog electronic circuits are those in which current or voltage may vary continuously with time to correspond to the information being represented.
- **Example:** Electronic Equipment like voltage amplifiers, power amplifiers, tuning circuits, radios, and televisions are mainly analog.
- Analog circuitry is constructed from two fundamental building blocks: series and parallel circuits.
- In a series circuit, the same current passes through a series of components. A string of Christmas lights is a good example of a series circuit: if one goes out, they all do.
- In a parallel circuit, all the components are connected to the same voltage, and the current divides between the various components according to their resistance.

Rangkaian Elektronika Analog

- The basic components of analog circuits are wires, resistors, capacitors, inductors, diodes, and transistors.
- (In 2012 it was demonstrated that memristors can be added to the list of available components.)
- Analog circuits are very commonly represented in schematic diagrams, in which wires are shown as lines, and each component has a unique symbol.
- Analog circuit analysis employs Kirchhoff's circuit laws: all the currents at a node (a place where wires meet), and the voltage around a closed loop of wires is 0.
- Wires are usually treated as ideal zero-voltage interconnections; any resistance or reactance is captured by explicitly adding a parasitic element, such as a discrete resistor or inductor.
- Active components such as transistors are often treated as controlled current or voltage sources: for example, a field-effect transistor can be modeled as a current source from the source to the drain, with the current controlled by the gate-source voltage.

Rangkaian Elektronika Digital



Simple Digital Circuit

Electronics and You

- In digital electronic circuits, electric signals take on discrete values, to represent logical and numeric values.^[4]
- These values represent the information that is being processed. In the vast majority of cases, binary encoding is used: one voltage (typically the more positive value) represents a binary '1' and another voltage (usually a value near the ground potential, 0 V) represents a binary '0'.
- Digital circuits make extensive use of transistors, interconnected to create logic gates that provide the functions of Boolean logic: AND, NAND, OR, NOR, XOR and combinations thereof. Transistors interconnected so as to provide positive feedback are used as latches and flip flops, circuits that have two or more metastable states, and remain in one of these states until changed by an external input.
- Digital circuits therefore can provide logic and memory, enabling them to perform arbitrary computational functions. (Memory based on flip-flops is known as static random-access memory (SRAM). Memory based on the storage of charge in a capacitor, dynamic random-access memory (DRAM) is also widely used.)

Rangkaian Elektronika Digital

- The design process for digital circuits is fundamentally different from the process for analog circuits.
- Each logic gate regenerates the binary signal, so the designer need not account for distortion, gain control, offset voltages, and other concerns faced in an analog design. As a consequence, extremely complex digital circuits, with billions of logic elements integrated on a single silicon chip, can be fabricated at low cost.
- Such digital integrated circuits are ubiquitous in modern electronic devices, such as calculators, mobile phone handsets, and computers. As digital circuits become more complex, issues of time delay, logic races, power dissipation, non-ideal switching, on-chip and inter-chip loading, and leakage currents, become limitations to circuit density, speed and performance.

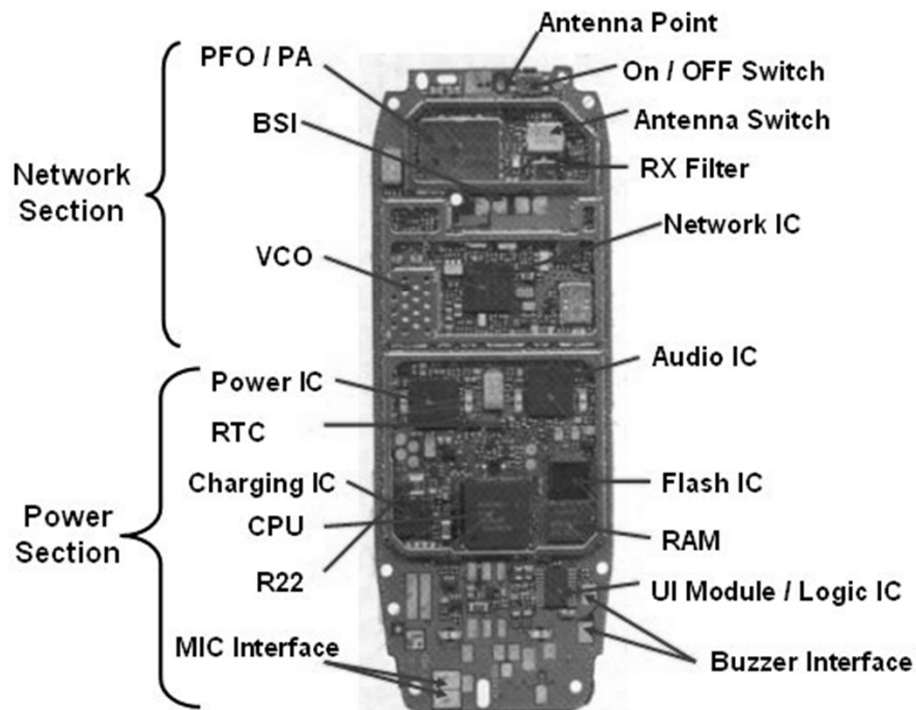
Rangkaian Elektronika Digital

- Digital circuitry is used to create general purpose computing chips, such as microprocessors, and custom-designed logic circuits, known as application-specific integrated circuit (ASICs). Field-programmable gate arrays (FPGAs), chips with logic circuitry whose configuration can be modified after fabrication, are also widely used in prototyping and development.

Rangkaian Elektronika *Mixed-Signal*

Mobile Phone PCB Diagram

www.mobilecellphonerepairing.com



NOTES:

1. **UEM** =
Logic IC
+ Charging IC
+ Audio IC
+ Power IC
2. **PFO** =
Antenna
Switch
+ PFO
3. **Flash IC** =
RAM + Flash
IC

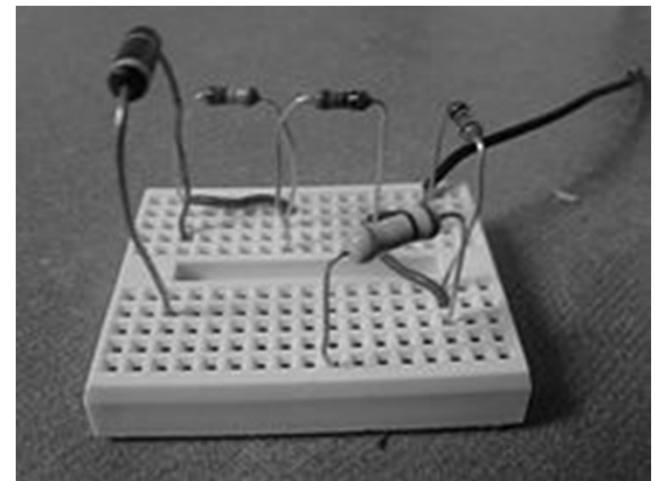
- Mixed-Signal Circuit, are also called hybrid circuits, contain elements and properties of both Analog Circuit and Digital Circuit.
- A mixed-signal IC or Chip is an IC with both Analog Circuits and Digital Circuits on the same semiconductor die.
- Mixed-signal or hybrid circuits contain elements of both analog and digital circuits. Examples include comparators, timers, phase-locked loops, analog-to-digital converters, and digital-to-analog converters.
- Most modern radio and communications circuitry uses mixed signal circuits. For example, in a receiver, analog circuitry is used to amplify and frequency-convert signals so that they reach a suitable state to be converted into digital values, after which further signal processing can be performed in the digital domain.
- These Mixed-signal ICs does processing of analog and digital signals together.
- Example: Modern 3G, 4G and 5G Smartphones, Wireless Communication, Data converters, Analog-to-digital converter, Digital-to-analog converter, Digital Radio, LAN, WAN.

Implementasi Rangkaian Elektronika

- Circuits can be constructed of discrete components connected by individual pieces of wire, but today it is much more common to create interconnections by photolithographic techniques on a laminated substrate (a printed circuit board or PCB) and solder the components to these interconnections to create a finished circuit.
- These components or devices are connected to each other via conductive traces (*generally of copper*) or conductive wires through which electric current can flow. In simple words, these electronic components are soldered onto a PCB to perform a predefined work.
- In an integrated circuit or IC, the components and interconnections are formed on the same substrate, typically a semiconductor such as silicon or (less commonly) gallium arsenide.^[2]
- Breadboards, perfboards, and stripboards are common for testing new designs. They allow the designer to make quick changes to the circuit during development.

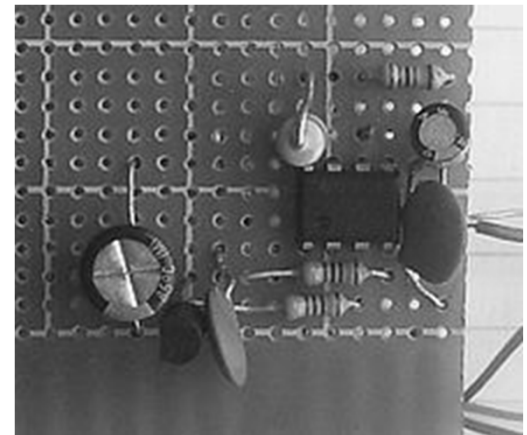
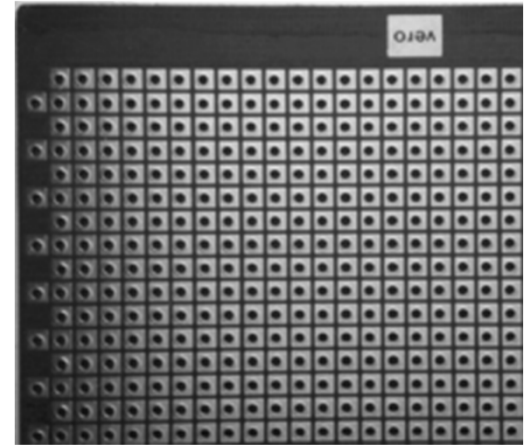
Breadboard

- A breadboard is a construction base for prototyping of electronics. Originally the word referred to a literal bread board, a polished piece of wood used for slicing bread.[1] In the 1970s the solderless breadboard (a.k.a. plugboard, a terminal array board) became available and nowadays the term "breadboard" is commonly used to refer to these.



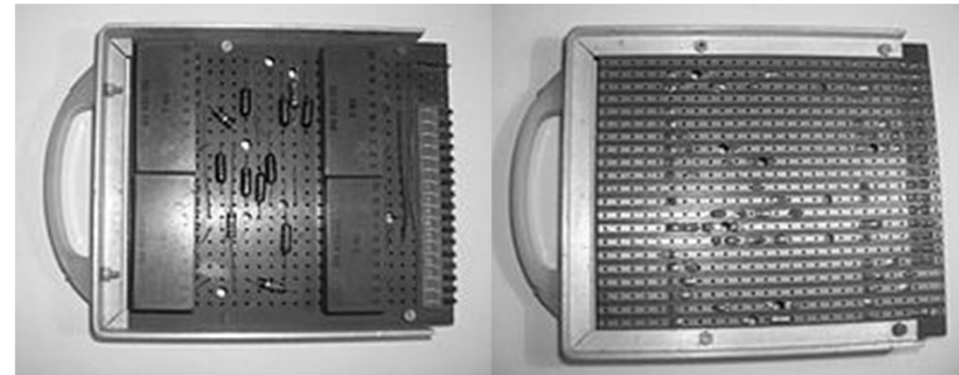
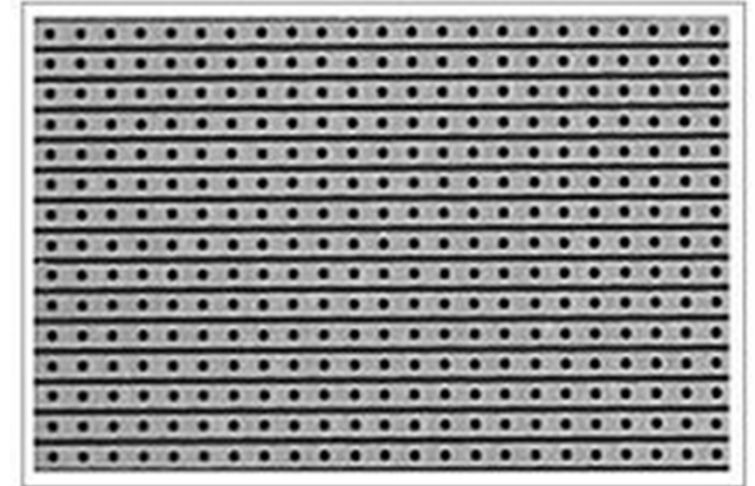
Perfboard

- **Perfboard** is a material for prototyping electronic circuits (also called DOT PCB). It is a thin, rigid sheet with holes pre-drilled at standard intervals across a grid, usually a square grid of 0.1 inches (2.54 mm) spacing. These holes are ringed by round or square copper pads, though bare boards are also available. Inexpensive perfboard may have pads on only one side of the board, while better quality perfboard can have pads on both sides (plate-through holes). Since each pad is electrically isolated, the builder makes all connections with either wire wrap or miniature point to point wiring techniques. Discrete components are soldered to the prototype board such as resistors, capacitors, and integrated circuits. The substrate is typically made of paper laminated with phenolic resin (such as FR-2) or a fiberglass-reinforced epoxy laminate (FR-4).



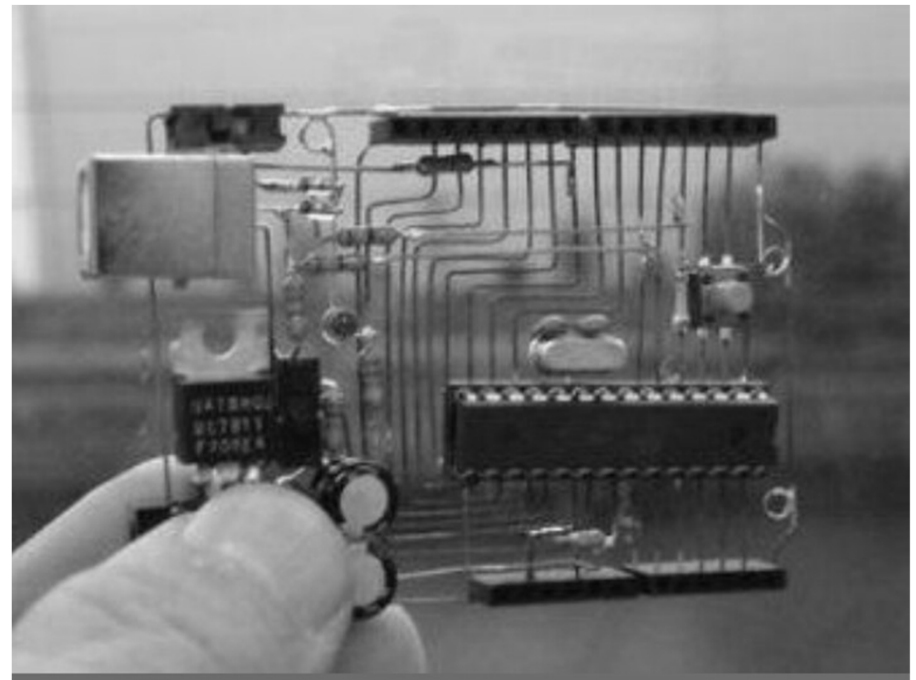
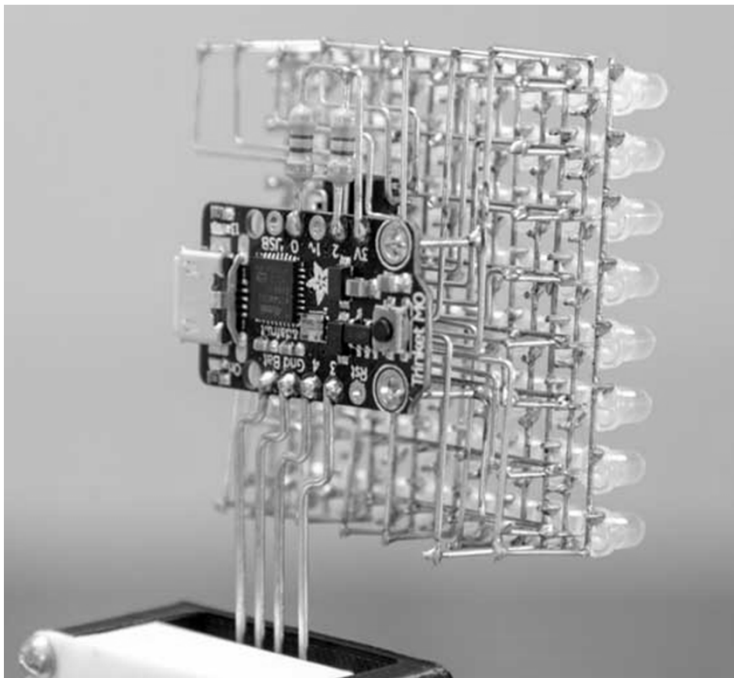
Stripboard

- **Stripboard** is the generic name for a widely used type of electronics prototyping board characterized by a 0.1 inches (2.54 mm) regular (rectangular) grid of holes, with wide parallel strips of copper cladding running in one direction all the way across one side of the board. It is commonly also known by the name of the original product Veroboard, which is a trademark, in the UK, of British company Vero Technologies Ltd and Canadian company Pixel Print Ltd. In using the board, breaks are made in the tracks, usually around holes, to divide the strips into multiple electrical nodes. With care, it is possible to break between holes to allow for components that have two pin rows only one position apart such as twin row headers for IDCs.
- Stripboard is not designed for surface-mount components, though it is possible to mount many such components on the track side, particularly if tracks are cut/shaped with a knife or small cutting disc in a rotary tool.



Freeform Circuit Sculpture

It is the art of creating a sculpture from electrical components using brass rods or wire to build the circuit into form. This is an aesthetically pleasing and highly compelling practice that typically doesn't include circuit boards or enclosures, although they are sometimes still used.



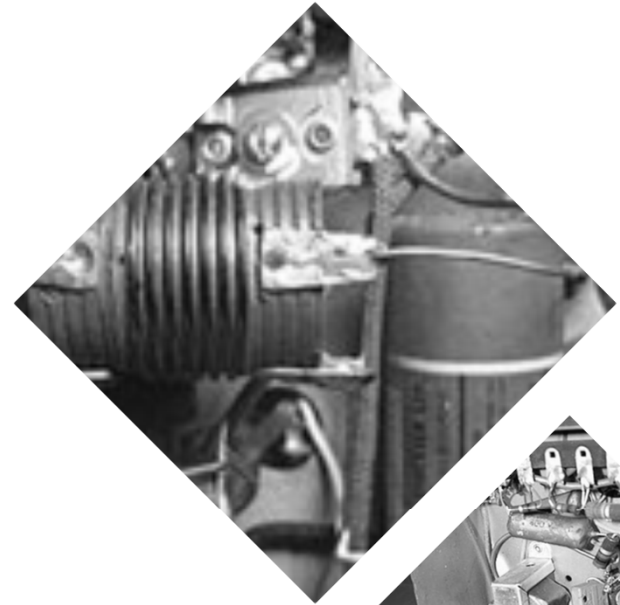
Wire Wrap

- **Wire wrap** was invented to wire telephone crossbar switches, and later adapted to construct electronic circuit boards. Electronic components mounted on an insulating board are interconnected by lengths of insulated wire run between their terminals, with the connections made by wrapping several turns of uninsulated sections of the wire around a component lead or a socket pin.
- Wires can be wrapped by hand or by machine, and can be hand-modified afterwards. It was popular for large-scale manufacturing in the 1960s and early 1970s, and continues today to be used for short runs and prototypes. The method eliminates the design and fabrication of a printed circuit board. Wire wrapping is unusual among other prototyping technologies since it allows for complex assemblies to be produced by automated equipment, but then easily repaired or modified by hand.



Point-to-point construction

- **Point-to-point construction** is a non-automated method of construction of electronics circuits widely used before the use of printed circuit boards (PCBs) and automated assembly gradually became widespread following their introduction in the 1950s. Circuits using thermionic valves (vacuum tubes) were relatively large, relatively simple (the number of large, hot, expensive devices which needed replacing was minimised), and used large sockets, all of which made the PCB less obviously advantageous than with later complex semiconductor circuits. Point-to-point construction is still widespread in power electronics where components are bulky and serviceability is a consideration, and to construct prototype equipment with few or heavy electronic components. A common practice, especially in older point-to-point construction is to use the leads of components such as resistors and capacitors to bridge as much of the distance between connections as possible, often removing the need to add additional wire between the components.



Printed Circuit Board

- A **printed circuit board (PCB)** mechanically supports and electrically connects electrical or electronic components using conductive tracks, pads and other features etched from one or more sheet layers of copper laminated onto and/or between sheet layers of a non-conductive substrate.
- Components are generally soldered onto the PCB to both electrically connect and mechanically fasten them to it.

Jenis PCB

Single Sided PCB

Double Sided PCB

Multilayer PCB

Rigid PCB

Flex PCB or Flexible PCB

Rigid Flex PCB

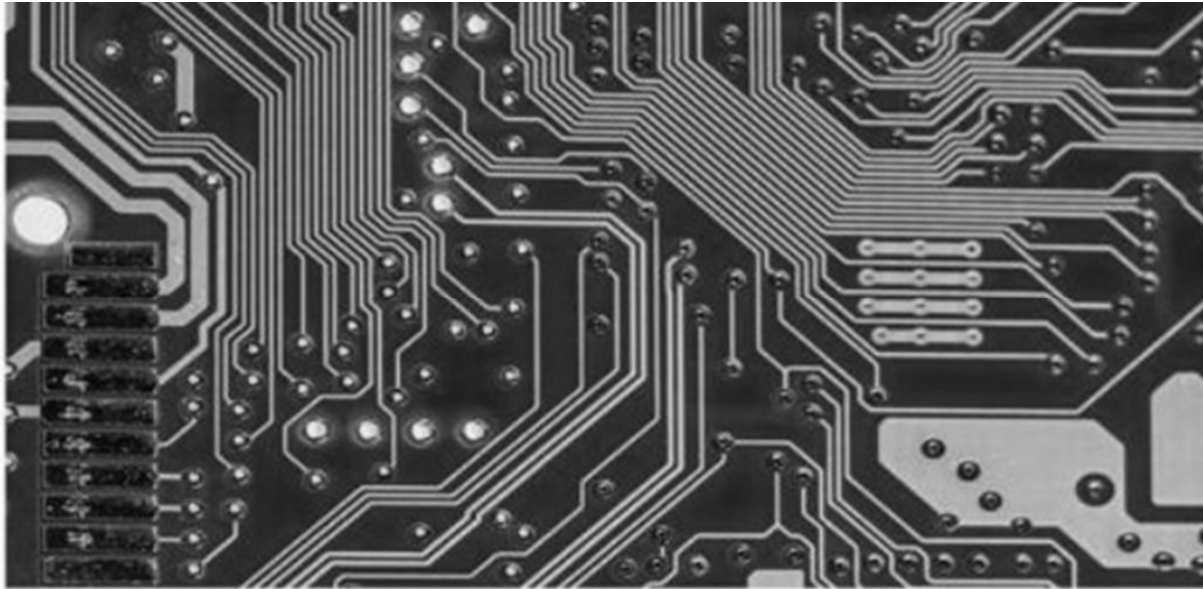
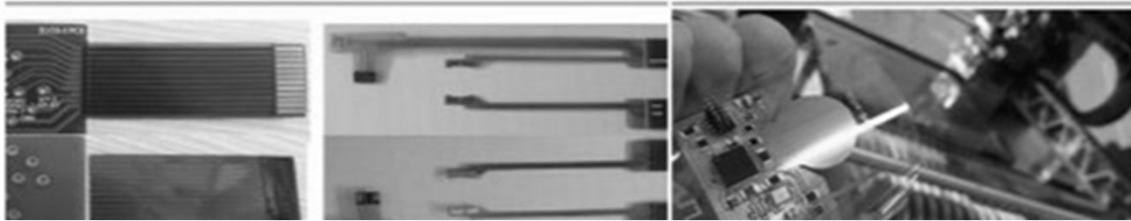
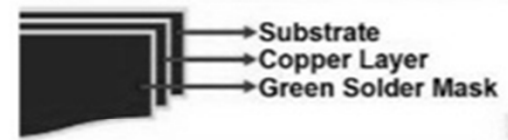
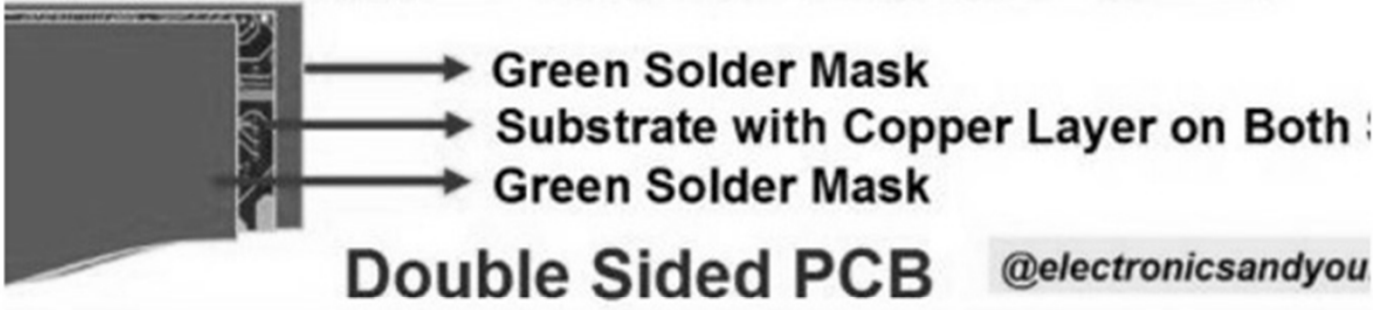


Fig.1: 4-Layer PCB



@electronicsandyou.c



Flexible PCB



PCB Manufacturing Process

Photoengraving

Lamination

Drilling

Solder plating

Testing the circuit board

PCB Design Rules

Layer Process Vs Standard Size

- Minimum trace / space: 7 mils
- Minimum via / hole size: 14 mils
- Minimum pad for plated hole / vias: 26 mils
- Minimum plated slot: 32 mils
- Minimum solder mask Clearance: 4 mils
- Minimum silkscreen Clearance: 4 mils
- Minimum silkscreen line width: 6 mils
- Minimum board copper/edge margin: 10 mils

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- <https://www.youtube.com/watch?v=LqVFXNFGNbc>

TERIMA KASIH

Ada Pertanyaan?