BEES Magazine

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K S R Institute for Engineering and Technology

Department of Electrical and Electronics Engineering

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Together We Make Difference

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Editorial Board

QR Code

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Introduction

Internet fads constantly come and go, but one that has stubbornly stuck around, despite **repeated incorrect predictions** of its imminent demise, is the QR (Quick Response) code.

So what is a QR code and why is it important?

If you've never heard the term before, you may be scratching your head right now. While the more Internet savvy may already know, for those who don't, here's what a common QR code looks like:

Perhaps a bit odd looking at first, this code is something which small business owners and entrepreneurs need to be aware of since it is increasingly becoming an important tool. The QR code is basically a natural extension of the conventional barcode, which has been around **since the mid 1970s** on everything from supermarket groceries to large container shipments. It was designed in 1994 for Japanese auto-makers to track car parts. Now it is being used **by big companies** and **small businesses**.

Advantages of the QR Code

The QR code has many advantages over a conventional barcode, however. The main advantage is that you can store up to a hundred times more information on a QR code than on a conventional horizontal barcode. In addition, QR codes can be scanned from any direction for 360 degrees. This makes them easier for your device to read and lessens the possibility of background interference.

The third main advantage is that from a marketing point of view, the code's appearance is unique and interesting, increasing the likelihood of engaging the customer in any campaign where it might be deployed.

A QR code reader can be downloaded onto a smartphone by anyone, and they are mostly free of charge. This means that any customer can walk into your business with his or her smartphone, and scan a QR code which you have generated. An Android user can use something like **QR Code Reader**, and an iPhone user can download the **Quick Scan** app. Both are free of charge.

There are many websites allowing you to generate QR codes and again, most are free of charge. You can then download them to your computer for printing. A Google search for "QR code generator" brings up countless results, each offering different options. So it is simply a case of selecting the options that works best for you.

QR Code Applications

Now, let's look at some business-related scenarios where you would use QR codes.

- Use a QR Code to direct a customer to the URL for your website, Facebook, Twitter or other social media page.
- Use it to share a text message (anything from "Happy Holidays!" to "Have you seen what we have upstairs?)
- Use it as a discount code to be taken to the checkout counter for 10 percent off, for example.
- Use it on your business card with your contact details embedded inside the code.
- Use it to link to a Google Maps location for your new store location perhaps.
- Use it to link to a YouTube video or channel perhaps demonstrating new products or funny company videos.
- Use it to link to an app store download (perhaps of your company's latest eCommerce app?)
- Use it to embed pricing for your products as an alternative for more conventional price tags.
- Put it on your website's "contact us" page allowing people scan it and get your contact information direct on their phones.
- Put the code on the tables and walls of your restaurant as an easy way for customers to send off a Foursquare or Facebook status update.
- Put a code on your restaurant's takeout menu allowing customers to scan it with their phones and instantly call to place an order.
- Put a QR code at the end of promotional videos taking viewers to a landing page on your website.

Hopefully, you can see by now the advantages of using QR codes in your business. The codes can help you store a tremendous amount of information and provide a creative new way of engaging customers. Encourage them to get their phones out and start scanning. Offer an incentive of a discount available only to customers through the code.

Not everyone is Convinced of QR Code Value

Of course, there are still some marketing experts who believe that QR codes have missed the boat entirely. Marketing strategist **Anise Smith** thinks that the time for QR codes was five years ago, and the lack of popularity in smartphones back then, compared to today, severely hampered the possibility of QR codes seriously taking hold.

"We are currently at a point that the technology needed for QR codes to succeed is in place" said Smith, in an interview with Small Business Trends. "Unfortunately these elements were not in place as QR Codes started to gain in popularity. Had they been in place, QR Codes would have been a game changer. The time for QR codes is now in the past because there's now technology like Augmented Reality which presents much better technological capabilities than QR codes."

Still, if you look around you, you'll see QR codes just about everywhere. Though as GigaOM **points out**, not all application of QR codes uses the technology to its best advantage.

For example, the site mentions QR codes that have been seen on the backs of buses where they are impossible to scan, or QR codes linking to websites not optimized for mobile devices.

Perhaps lack of more thoughtful QR code marketing strategies up until now has hampered the technology's more widespread adoption in the business community. But that may not mean that QR codes are obsolete as a tool for small business. Consider the above applications for QR codes in your business. Creative use of the technology may still give you unexpected advantages when engaging your customers and boosting sales.

Distributed Control System

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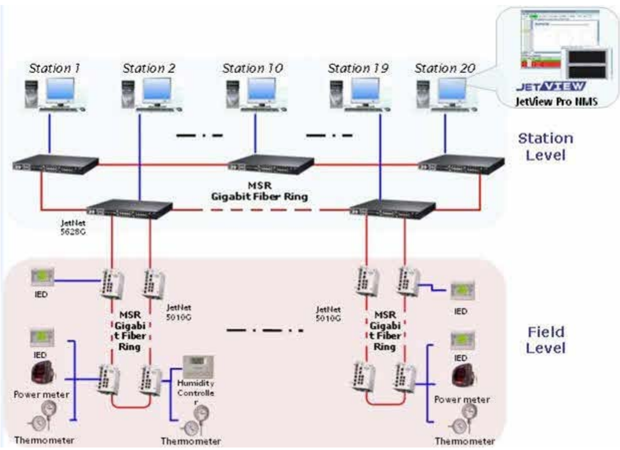
Introduction

Distributed Control System is most popular which is specially designed with redundancy and diagnostic capabilities to improve control reliability and performance. It gives greater flexibility to control distributed discrete field devices and its operating stations

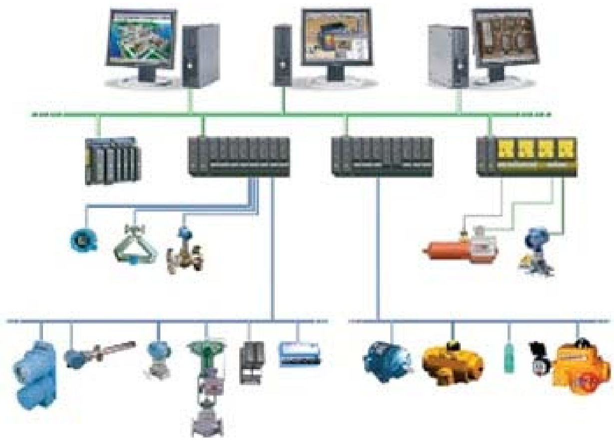
In this era of revolution technology, industrial automation system deals with advanced automation control technologies to have better control performance over complex processes.



Distributed Control System

To increase reliability, productivity and quality while minimizing the production cost, process control industries must be driven by integrated controllers with high distributed control capability.

Distributed Control System is a specially designed control system used to control complex, large and geographically distributed applications in industrial processes. In this, controllers are distributed throughout the entire plant area. These distributed controllers are connected to both field devices and operating PCs through high speed communication networks as shown in figure. Discrete Field devices such as sensors and actuators are directly connected to input and output controller modules through communication bus. These field devices or smart instruments are capable of communicating with PLC's or other controllers while interacting with real world parameters like temperature, pressure, etc.



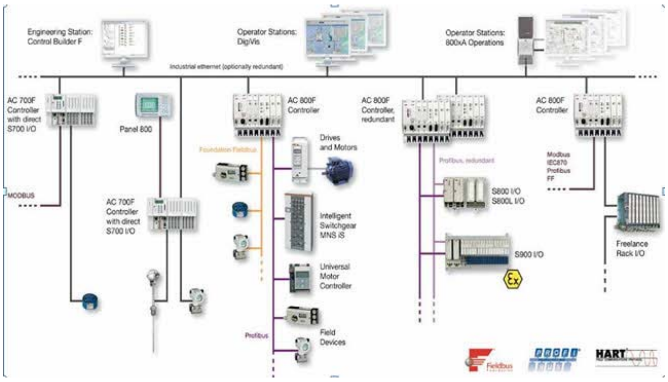
DCS Architecture

Controllers are distributed geographically in various section of control area and are connected to operating and engineering stations which are used for data monitoring, data logging, alarming and controlling purpose via another high speed communication bus.

These communication protocols are of different types such as foundation filed bus, HART, Profibus, Modbus, etc. DCS provides information to multiple displays for user interface.

Basic Elements of Distributed Control System

Distributed Control System continuously interacts with the processes in process control applications ones it gets instruction from the operator. It also facilitates to variable set points and opening and closing of valves for manual control by the operator. Its human machine interface (HMI), face plates and trend display gives the effective monitoring of industrial processes.



Elements of DCS

Engineering PC or controller

This controller is the supervisory controller over all the distributed processing controllers. Control algorithms and configuration of various devices are executed in this controller. Network communication between processing and engineering PC can be implemented by simplex or redundant configurations.

Distributed controller or Local control unit

It can be placed near to field devices (sensors and actuators) or certain location where these field devices are connected via communication link. It receives the instructions from the engineering station like set point and other parameters and directly controls field devices.

It can sense and control both analog and digital inputs / outputs by analog and digital I/O modules. These modules are extendable according to the number of inputs and outputs. It collects the information from discrete field devices and sends this information to operating and engineering stations.

In above figure AC 700F and AC 800Fcontrollers acts as communication interface between field devices and engineering station. Most of the cases these act as local control for field instruments.

Operating station or HMI

It is used to monitor entire plant parameters graphically and to log the data in plant database systems. Trend display of various process parameters provides the effective display and easy monitoring.

These operating stations are of different types such as some operating stations (PC's) used to monitor only parameters, some for only trend display, some for data logging and alarming requirements. These can also be configured to have control capabilities.

Communication media and protocol

Communication media consists of transmission cables to transmit the data such as coaxial cables, copper wires, fiber optic cables and sometimes it might be wireless. Communication protocols selected depends on the number of devices to be connected to this network.

For example, RS232 supports only for 2 devices and Profibus for 126 devices or nodes. Some of these protocols include Ethernet, DeviceNet, foundation filed bus, modbus, CAN, etc.

In DCS, two or more communication protocols are used in between two or more areas such as between field control devices and distributed controllers and other one between distributed controllers and supervisory control stations such as operating and engineering stations.

Important features of DCS

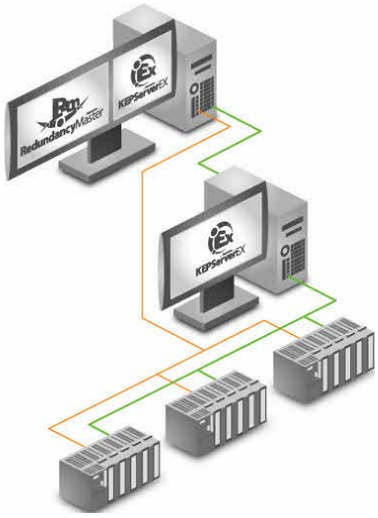
• To handle complex processes:

In factory automation structure, PLC-Programming Logic Controller is used to control and monitor the process parameters at high speed requirements. However due to limitation of number of I/O devices, PLC's cannot handle complex structure.

Handling Complex Processes

Hence DCS is preferred for complex control applications with more number of I/O's with dedicated controllers. These are used in manufacturing processes where designing of multiple products are in multiple procedures such as batch process control.

System redundancy:



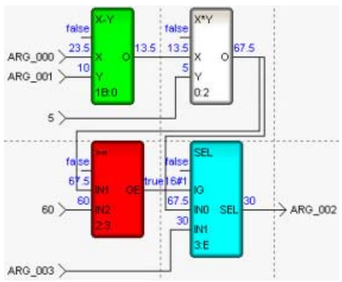
System Redundancy

DCS facilitates system availability when needed by redundant feature at every level.

Resuming of the steady state operation after any outages, whether planned or unplanned is somewhat better compared to other automation control devices.

Redundancy raises the system reliability by maintaining system operation continuously even in some abnormalities while system is in operation.

Lot of Predefined function blocks:



Predefined Function block

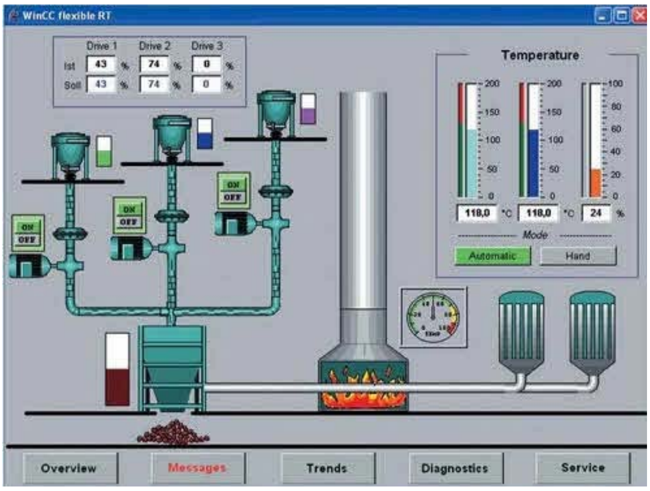
DCS offers many algorithms, more standard application libraries, pre-tested and pre-defined functions to deal with large complex systems. This makes programming to control various applications being easy and consuming less time to program and control.

Powerful programming languages:

It provides more number of programming languages like ladder, function block, sequential, etc for creating the custom programming based on user interest.

More sophisticated HMI:

Similar to the SCADA system, DCS can also monitor and control through HMI's (Human Machine Interface) which provides sufficient data to the operator to charge over various processes and it acts as heart of the system. But this type of industrial control system covers large geographical areas whereas DCS covers confined area.



Sophisticated HMI

DCS completely takes the entire process plant to control room as a PC window. Trending, logging and graphical representation of the HMI's give effective user interface. Powerful alarming system of DCS helps operators to respond more quickly to the plant conditions

Scalable platform:

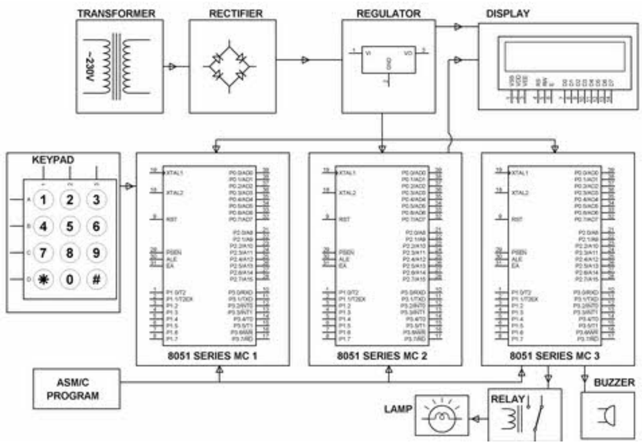
Structure of DCS can be scalable based on the number I/O's from small to large server system by adding more number of clients and servers in communication system and also by adding more I/O modules in distributed controllers.

System security:

Access to control various processes leads to plant safety. DCS design offers perfect secured system to handle system functions for better factory automation control. Security is also provided at different levels such as engineer level, entrepreneur level, operator level, etc.

Application of Distributed Control System

DCS system can be implemented in a simple application like load management using network of microcontrollers.



Application of DCS

Here the input is given from a keypad to a microcontroller, which communicates with the other two microcontrollers. One of the microcontrollers is used to display the status of the process as well as the loads, while the other microcontroller controls the relay driver. The relay driver in turn drives the relay to operate the load.

FACTS

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Introduction

A Flexible AC transmission System refers to the system consisting of power electronic devices along with power system devices to enhance the controllability and stability of the transmission system and increase the power transfer capabilities. With the invention of thyristor switch, opened the door for the development of power electronics devices known as Flexible AC transmission systems (FACTS) controllers. Basically the FACT system is used to provide the controllability of high voltage side of the network by incorporating power electronic devices to introduce inductive or capacitive power in the network.

Types of FACTS Controllers

- **Series Controllers:** Series Controllers consists of capacitors or reactors which introduce voltage in series with the line. They are basically variable impedance devices. Their major task is to reduce the inductivity of the transmission line. They supply or consume variable reactive power. Examples of series controllers are SSSC, TCSC, TSSC etc.
- **Shunt Controllers:** Shunt controllers consist of variable impedance devices like capacitors or reactors which introduce current in series with the line. Their major task is to reduce the capacitivity of the transmission line. The injected current is in phase with the line voltage. Examples of shunt controllers are STATCOM, TSR, TSC, SVC.
- **Shunt-Series Controllers:** These controllers introduce current in series using the series controllers and voltage in shunt using the shunt controllers. Example is UPFC.
- **Series-Series Controllers**: These controllers consist of a combination of series controllers with each controller providing series compensation and also the transfer real power along the line. Example is IPFC.

Types of Series Controllers

- **Thyristor controlled series capacitor (TCSC):** Thyristor controlled series capacitor (TCSC) uses silicon controlled rectifiers to manage a capacitor bank connected in series with a line. This allows utility for transferring more power on a specified line. It generally consists of the thyristors in series with an inductor and connected across a capacitor. It can work in the blocking mode where the thyristor is not triggered and current passes through the capacitor only. It can work in the bypass mode where the current is bypassed to the thyristor and the whole system behaves as a shunt impedance network.

- **Static Series Synchronous Compensators**: SSSC is simply a series version of STATCOM. These are not used in commercial applications as independent controllers. They consist of synchronous voltage source in series with the line such that it introduces a compensating voltage in series with the line. They can increase or decrease the voltage drop across the line.

Parallel Controllers

- **Static Variable Compensators**: Static variable compensator is the most primitive and first generation of FACTS controller. This compensator consists of a fast thyristor switch controlling a reactor and/or shunt capacitive bank to provide dynamic shunt compensation. They generally consist of shunt connected variable impedance devices whose output can be adjusted using power electronic switches, to introduce capacitive or inductive reactance in the line. It can be placed at the middle of the line to increase the maximum power transfer capability and can also be placed at the end of the line to compensate for variations due to load.

Types of SVC are

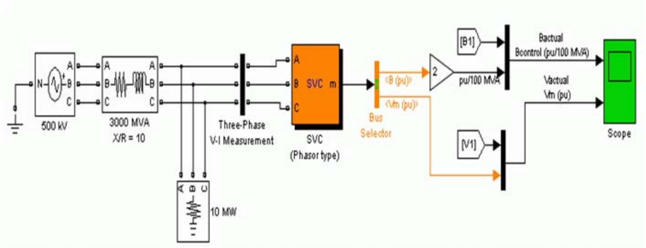
1. **TSR(Thyristor Switched Reactor)**: It consists of a shunt connected inductor whose impedance is controlled in a gradual manner using a Thyristor switch. The Thyristor is fired at angles of 90 and 180 degrees only.
2. **TSC(Thyristor Switched Capacitor)**: It consists of a shunt connected capacitor whose impedance is controlled in a stepwise manner using a Thyristor. The manner of control using the SCR is same as that of TSR.
3. **TCR (Thyristor Controlled Reactor)**: It consists of a shunt connected inductor whose impedance is controlled by the firing angle delay method of SCR wherein the firing of Thyristor is controlled causing a variation in the current through the inductor.

- **STATCOM(Static Synchronous Compensator)** : It consists of a voltage source which can be a DC energy source or a capacitor or a inductor whose output can be controlled using a Thyristor It is used to absorb or generate reactive power.

A Series-Shunt Controller- Unified Power Flow Controller:

They are a combination of STATCOM and SSSC such that both are combined using a common dc source and provide both active and reactive series line compensation. It controls all the parameters of the AC power transmission.

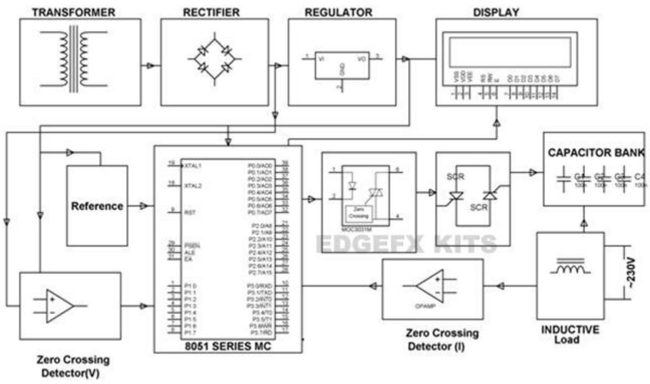
Steady-State Voltage Control using SVC for Flexible AC Transmission Systems



In order to generate Zero crossing voltage pulses we need digitalized voltage and current signals. The voltage signal from the mains is taken and is converted into pulsating DC by bridge rectifier and is given to a comparator which generates the digital voltage signal. Similarly the current signal is converted into the voltage signal by taking the voltage drop of the load current across a resistor. This AC signal will be again converted into digital signal as the voltage signal. Then these digitalized voltage and current signals are sent to the microcontroller.

The microcontroller will calculate the time difference between the zero crossing points of voltage and current, whose ratio directly proportional to the power factor and determines the range in which the power is. In the same manner using Thyristor switched reactor (TSR) also zero cross voltage pulses can be generated for voltage stability improvement.

Flexible AC Transmission System by SVC



The above circuit can be used to improve the power factor of transmission lines using SVC. It uses thyristor switched capacitors (TSC) based on shunt compensation duly controlled from a programmed microcontroller. This is useful to improve the power factor. If the inductive load is connected power factor is lagging because of load current lagging. To compensate for this, a shunt capacitor is connected which draws current leading the source voltage. Then the improvement in power factor will be done. The time lag between zero voltage and zero current pulses is duly generated by operational amplifiers in comparator mode which are fed to the 8051 series of microcontroller.

Using FACTS controllers the reactive power can be controlled. Sub synchronous resonance (SSR) is a phenomenon which can be associated with series compensation under certain adverse conditions. SSR elimination can be done using FACTS controllers. The benefits of the FACTS devices are many like financial benefit, increased quality of supply, increased stability etc.

Mobile Computing

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Introduction

In the 1990's, mobile phones were basically meant to make voice calls and short messaging services. Those of us who were early adopters of this technology having only used the fixed line or fax to communicate found it but hard on the cost side having to pay for both incoming and outgoing calls.

For another decade or more, mobile phones were basically meant to communicate on the move and also provided multi-media messaging (MMS). Thereafter, many cell phones did have added features of consumer devices such as camera, torch light, clock and alarms, calendars making it a multi-purpose device for everyday use. However, iIt was the advent of smart phones that created a revolution in the use of mobile phone for a variety of applications involving data, software, gaming and business applications.

For every computer app, a mobile app

The rapid penetration of the mobile phones among all classes of people have set a new trend for businesses. For every computing application, in parallel a mobile app is also developed. A website for desktops invariably creates the need for a mobile site. Now that many people access the net through mobile, websites have gone into vertical scrolling mode instead of the horizontal mode.

The mobile applications are mostly watered down versions of web applications and computer applications. However, a reversal is in the offing with smart phones likely to deliver more versatile and full featured suite of internet applications, according to Benedict Evans, renowned market analyst speaking at a web summit held in November.

Earlier it was said that software was eating the world (Marc Andreessen two years back) and now Evans believes mobile is going to eat the world.

Mobile OPS

Just as there is an operating system (OS)for computers such as Windows, Unix Linux, smart phones also are run by an operating system. Popular ones are Android, iOS, Blackberry, Windows,RIM among others. Majority stake in the market is held by Android followed by iOS. The operating system enables menu driven applications and programs that are user friendly.

The rapid growth of ecommerce, online bookings globalization of business and financial services necessitated the need for users to login into a network anytime and get access to data, update information or manage systems remotely. This in turn has turned favourable for the growth of mobile computing. On the hardware side, the revolution unleashed by the abundance of Tablets, smart phones, pocket digital assistants (PDA) in the market has helped in creating huge demand for mobile apps and mobile computing solutions.

The demographic shift in population with rising proportion of older age groups has raised a new requirement that they be happy and connected. In fact, the generation gap between the young and the old has been bridged with the advent of user-friendly smart phones and mobile apps, according to an IBM analyst writing for Forbes.

The rapid evolution of mobile communications from 2G, 3G and now 4G has ensured that data, applications and information exchange can be had for a variety of industries and applications. For example, the heart of computing system that enables transactions in a company is the enterprise resource planning (ERP) systems. The development of mobility has ensured that salesmen and marketing team on the move can update data and relevant information in real time to their headquarters and branch offices. This updation of data would enable the managerial hierarchy to better co-ordinate or change strategies for the market based on the goals and targets fixed by the company.

Mobility has ensured that more data is captured from the market place either through social media, internet, online trading activities, bookings through mobile apps which in turn helps the industry to analyse the transactional data to aid marketing efforts.

The mobile Computing Structure

Just as in any connected network, the mobile computing also involves three distinct and inter-connected components-

1) Mobile hardware, 2) communication devices including transmission towers, 3) mobile software and apps.

The mobile hardware includes smart phones, PDAs, tablets, tablet PC's among others. Each passing year is witnessing the launch of several new models with more and more advanced features. The storage, processing capacity and screen resolutions have swiftly gone up making mobile devices at the heart of data capture, storage, processing and communication.

Advantages of Mobile Computing

No doubt, mobile technology has proved to be a boon for mankind just as the personal computer revolution helped us in the 1980's to organize, store and process data in a user-friendly manner with the menu driven Windows systems.

Here are some of the advantages of mobile computing:

- No location constraint: Mobile computing frees the user from being tied to a location and increased bandwidth and speed of transmission makes it possible to work on the move.
- It saves time and enhances productivity with a better return on investment (RoI)
- It provides entertainment, news and information on the move with streaming data, video and audio
- Streamlining of business processes: Mobility has enabled streamlining of business processes, cumbersome emails, paper processing, delays in communication and transmission.
- Newer job opportunities for IT professionals have emerged and IT businesses now have an added service in

their portfolio which only will keep growing as per indicative mobile computing trends.

Career Opportunities in Mobile Computing

The growth of mobile computing has spawned several new career options from hardware servicing to software, operating system, mobile computing applications (apps) development. The main beneficiaries in this regard are engineering graduates, post graduates, diploma holders, computer applications professionals who have done Bachelor of Computer Applications (BCA) or Master of Computer Applications (MCA). Some of the hot job openings are: Game developers, mobile hardware technicians, IPAD developer, mobile apps testing specialist, developer for Android, Blackberry, iPhone, Windows, tower installation and maintenance for network, mobile computing security experts, equipment mechanics, mobile architects, customer care, marketing support, technical support, Key Performance Indicator (KPI) engineer.

Although technical requirements and competence required for each job functions vary, broadly speaking they need to have capabilities in HTML5, Javascript, Jquery, Bluetooth devices, WLAN, GSM, CDMA, WiMAX, Microsoft Share Point 2007/2010, Info Path, among others.

Industry opportunities

Apart from job opportunities for engineers and IT professionals, huge opportunities are awaiting service providers in mobile computing. The huge market for mobile computing is indeed USA. Statista estimates that over 180 million Americans will own a smart phone, and that number will grow by 10% to almost 200 mn in 2016. Every American between the age of 16 and 80 are prospects or customers for industry, according to Jim Blasingame, contributor to Forbes magazine. He is the author of the award winning book, 'The Age of the Customer: Prepare for the moment of relevance'.

According to him, if businesses are not mobile ready they are going to become extinct like the dinosaurs in no time.

The future of Mobile Computing

According to researchandmarkets.com, the global enterprise mobility solutions market is expected to grow at a compound annual growth rate (CAGR) of 35.43% in the next three years. The mobile computing applications of enterprise mobility solutions are in managing mobile computing devices, wireless networks and related services. This is a cloud based technology enabling sustained connectivity. The report said that revenue generated through software licenses ad subscription fees have been used as a yardstick for the future estimates of growth.

According to a Zion Research report, the global enterprise mobility market is expected to rise from US $85 bn in 2014 to US $ 500 bn in 2020, growing at a compounded annual growth rate of 24% between 2015 and 2020. The report covers developments in smart phones, tablets and laptops.

As already outlined, mobility is increasingly been utilized by corporates and retail users for making payments and other transactions.

According to a recent joint survey by Kaspersky Lab and B2B International, 30% of companies use mobile computing devices to access corporate bank accounts and to make financial transactions. Even small and medium enterprises are increasingly using mobile apps for financial transactions.

Increased security

IT majors such as Microsoft has promised to scale up technologies and invest in security on the net, however, amidst these security concerns, mobile computing seems to be relatively free from security threats if industry view from United Kingdom is to be believed.

According to a VMware research, 53% of respondents in the UK and EMEA claimed that increased security was the critical driver for businesses to adapt to mobile model while 38% believed mobile force effectiveness was a trigger and 35% citied improved end user experience.

In mobility announcements that made news last month, Microsoft's new security capabilities in its Enterprise Mobile Suite made news. The new system has introduced telemetry data as part of its Mobility Suite. It enables businesses to see details of the device from which a document was accessed. It is capable of showing where, when, who and on what device a document was accessed.

The telemetry data in the Mobility Suite enabling this facility and Azure Active Directory delivers data to customers and reports users' access to and activities with corporate data.

According to experts, with a little bit of caution and protective measures, mobile security threat can be warded off. Anti-virus software is now widely available and useful tools are provided by Symantec, McAfee and Lookout. It pays to invest in anti-malware and anti-virus. It is also vital that malware library is up to date.

Enterprises can use mobile device management and mobile application management to prevent intrusions, data theft which can be used to manage and enforce security containers. x

Many organisations are now incorporating dual-persona approach to mobile device management software. Here the enterprise data and personal data would be compartmentalized separately with enterprise apps and data not accessible to end users for making changes. The virtual box havng corporate apps will be secured and end users cannot put unmanaged applications in this box.

Personal content in the device will be stored separately in the file system and not in the box. Precautions are taken so that corporate data in the box can't be shared with applications outside the box. However, it is possible to share personal and corporate data between works and personal apps as MAM and MDM tools are there to specify which can be shared and which cannot be.

Solar Charge Controller

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Introduction

A solar charge controller is fundamentally a voltage or current controller to charge the battery and keep electric cells from overcharging. It directs the voltage and current hailing from the solar panels setting off to the electric cell. Generally, 12V boards/panels put out in the ballpark of 16 to 20V, so if there is no regulation the electric cells will damaged from overcharging. Generally, electric storage devices require around 14 to 14.5V to get completely charged. The solar charge controllers are available in all features, costs and sizes. The range of charge controllers are from 4.5A and up to 60 to 80A.

Types of Solar Charger Controller:

There are three different types of solar charge controllers, they are:

1. Simple 1 or 2 stage controls
2. PWM (pulse width modulated)
3. Maximum power point tracking (MPPT)

Simple 1 or 2 Controls: It has shunt transistors to control the voltage in one or two steps. This controller basically just shorts the solar panel when a certain voltage is arrived at. Their main genuine fuel for keeping such a notorious reputation is their unwavering quality – they have so not many segments, there is very little to break.

PWM (Pulse Width Modulated): This is the traditional type charge controller, for instance anthrax, Blue Sky and so on. These are essentially the industry standard now.

Maximum power point tracking (MPPT): The MPPT solar charge controller is the sparkling star of today's solar systems. These controllers truly identify the best working voltage and amperage of the solar panel exhibit and match that with the electric cell bank. The outcome is extra 10-30% more power out of your sun oriented cluster versus a PWM controller. It is usually worth the speculation for any solar electric systems over 200 watts.

Features of Solar Charge Controller:

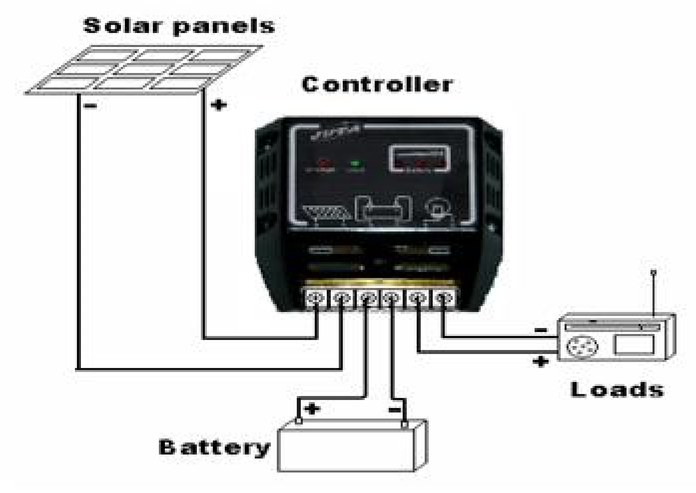
- Protects the battery (12V) from over charging
- Reduces system maintenance and increases battery lifetime
- Auto charged indication
- Reliability is high
- 10amp to 40amp of charging current
- Monitors the reverse current flow

Function of Solar Charge Controller:

The most essential charge controller basically controls the device voltage and opens the circuit, halting the charging, when the battery voltage ascents to a certain level. More charge controllers utilized a mechanical relay to open or shut the circuit, halting or beginning power heading off to the electric storage devices.

Generally solar power systems utilize 12V of batteries. Solar panels can convey much more voltage than is obliged to charge the battery. The charge voltage could be kept at a best level while the time needed to completely charge the electric storage devices is lessened. This permits the solar systems to work optimally constantly. By running higher voltage in the wires from the solar panels to the charge controller, power dissipation in the wires is diminished fundamentally.

The solar charge controllers can also control the reverse power flow. The charge controllers can distinguish when no power is originating from the solar panels and open the circuit separating the solar panels from the battery devices and halting the reverse current flow.



Solar Charge Controller

Applications:

In recent days, the process of generating electricity from sunlight is having more popularity than other alternative sources and the photovoltaic panels are absolutely pollution free and they don't require high maintenance. The following are some examples where solar energy is utilizing.

- Street lights use photovoltaic cells to convert sunlight into DC electric charge. This system uses solar charge controller to store DC in the batteries and uses in many areas.
- Home systems use PV module for house-hold applications.
- Hybrid solar system uses for multiple energy sources for providing full time backup supply to other sources.

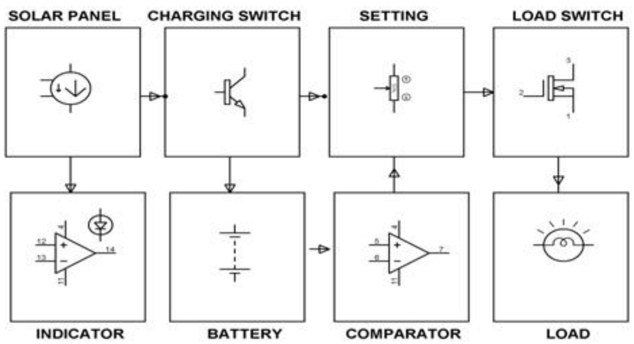
Example of Solar Charge Controller:

From the below example, in this a solar panel is used to charge a battery. A set of operational amplifiers are used to monitor panel voltage and load current continuously. If the battery is fully charged, an indication will be provided by a green LED. To indicate under charging, over loading, and deep discharge condition a set of LEDs are used. A MOSFET is used as a power semiconductor switch by the solar charge controller to ensure the cut off load in low condition or over loading condition. The solar energy is bypassed using a transistor to a dummy load when the battery gets full charging. This will protect the battery from over charging.

This unit performs 4 major functions:

- Charges the battery.
- Gives an indication when battery is fully charged.

- Monitors the battery voltage and when it is minimum, cuts off the supply to the load switch to remove the load connection.
- In case of overload, the load switch is in off condition ensuring the load is cut off from the battery supply.



Block Diagram of Solar Charge Controller

A solar panel is a collection of solar cells. The solar panel converts the solar energy into electrical energy. The solar panel uses Ohmic material for interconnections as well as the external terminals. So the electrons created in the n-type material passes through the electrode to the wire connected to the battery. Through the battery, the electrons reach the p-type material. Here the electrons combine with the holes. When the solar panel is connected to the battery, it behaves like other battery, and both the systems are in series just like two batteries connected serially. The solar panel has totally consisted of four process steps overload, under charge, low battery and deep discharge condition. The out from the solar panel is connected to the switch and from there the output is fed to the battery. And setting from there it goes to the load switch and finally at the output load. This system consists of 4 different parts-over voltage indication and detection, over charge detection, over charge indication, low battery indication and detection. Incase of the over charge, the power from the solar panel is bypassed through a diode to the MOSFET switch. Incase of low charge, the supply to MOSFET switch is cut off to make it in off condition and thus switch off the power supply to the load.

Solar energy is the cleanest and most available renewable energy source. The Modern technology can harness this energy for a variety of uses, including producing electricity, providing light and heating water for domestic, commercial or industrial application.

Chipless RFID Tag

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III year EEE

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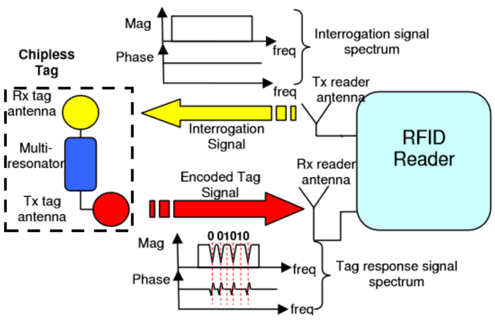
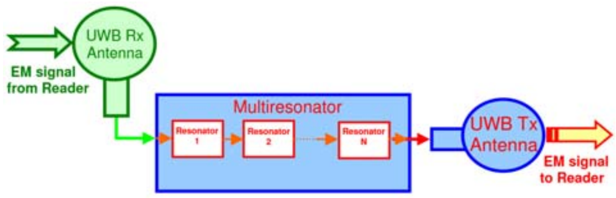
Introduction:

In this article we present a fully printable chipless RFID system based on multiresonators and cross-polarized ultra-wide band (UWB) monopole antennas. The tag's unique ID is encoded as the spectral signatures of the resonators. The chipless RFID system works on retransmission of the interrogation signal with the encoded unique spectral ID. The received and transmitted signals are crosspolarized in order to achieve good isolation between the two. Due to the robust design based on microwave engineering (multiresonators) and antenna technology (cross-polarized Tx/Rx antennas), we believe to have achieved less mutual coupling effects, greater number of possible bits and easier encoding



Principal block diagram of chipless RFID system.

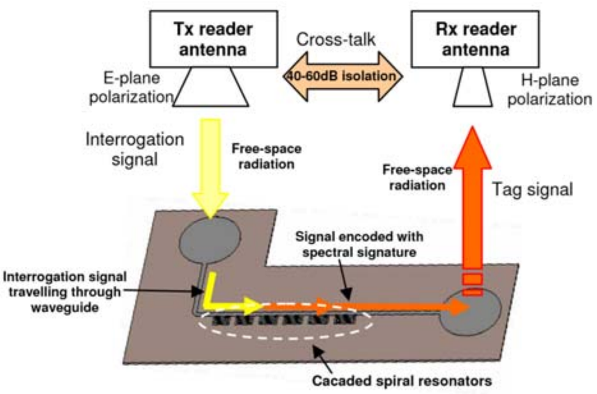
As the chipless RFID system uses spectral signatures for data encoding and is fully passive, the tags do not need any power supply in order to operate. The main application for this chipless RFID system is mainly short range (up to 40 cm) tagging of extremely low cost items. Hence, power limitation restrictions (transmitted EIRP maximum of -45 dBm outdoors and -55 dBm indoors), does not present a major concern for the presented system. The principal block diagram of the chipless RFID system is shown in above figure. The chipless tag encodes data in the frequency spectrum and thus has a unique ID of spectral signatures. The spectral signature is obtained by interrogating the tag by a continuous wave (CW) multi-frequency signal of uniform amplitude and phase. The tag then receives the interrogation signal and encodes the data into the frequency spectrum in both magnitude and phase. The encoded signal is then retransmitted back to the reader. This allows the reader to use two criteria for data decoding – amplitude and phase.



Block diagram of chipless RFID tag.

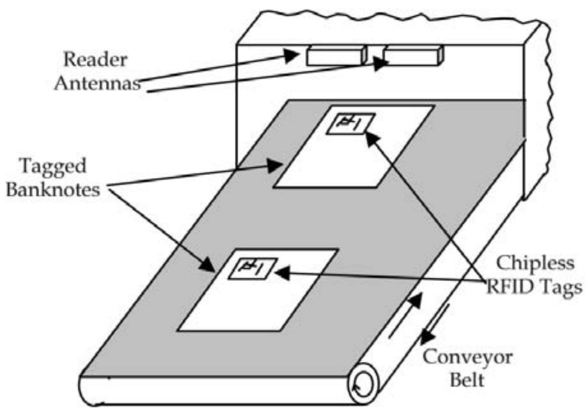
The chipless RFID tag consists of UWB antennas and a multiresonating circuit operating in the UWB frequency spectrum as shown in above figure. The UWB antennas are used to receive the interrogation signal sent from the reader and transmit the signal back to the reader after performing spectral signal modulation by the multiresonator. The multiresonator is a combination of multiple filtering sections which are used to modulate the spectrum of the interrogation signal sent by the reader. Modulation is performed in both magnitude and phase of the spectrum. The chipless RFID reader is an electronic device which can detect the ID of the chipless tag when it is within the reader's interrogation zone.

The RFID reader has transmitting and receiving antennas to send the interrogation signal to the chipless tags and receive the encoded signal from the chipless tags. The RFID reader transmitter comprises a voltage controlled oscillator (VCO), low noise amplifier (LNA) and power amplifier (PA). Tuning of the VCO's output frequency is done by the microcontroller through the digital-to-analog (ADC) converter. The reader transmitter generates the interrogation signal which is sent to the chipless tag. The chipless tranponder encodes its spectral signature into the reader's interrogation signal and sends the signal back to the reader. The signal flow diagram of the chipless RFID system is shown in following figure.



Chipless RFID system signal flow diagram.

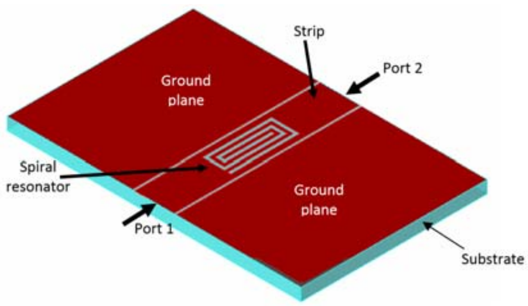
The chipless tag encodes data in the frequency spectrum thus encoding the spectrum with its unique spectral signature. The spectral signature is obtained by the RFID reader by interrogating the tag by a multi-frequency signal. The tag encodes its spectral signature into the interrogation signal spectrum using a multiresonating circuit which is a multi-stop band filter. The multiresonator is a set of cascaded spiral resonators designed to resonate at particular frequencies and create stop bands. The stop band resonances introduce magnitude attenuation and phase jumps to the transmitted interrogation signal at their resonant frequencies which are detected as abrupt amplitude attenuations and phase jumps by the RFID reader. In order to provide isolation between the transmitting and receiving signal, the reader and tag antennas are cross-polarized. As a result, cross-talk between the transmitting and receiving antennas is minimized at the cost of introducing restrictions in tag positioning and orientation. The chipless RFID system is designed for a short range conveyor belt system where the tagged items are tracked moving through the interrogation zone of a fixed reader antenna system as shown in below



Potential conveyor belt application for chipless RFID system.

Chipless tag multiresonator

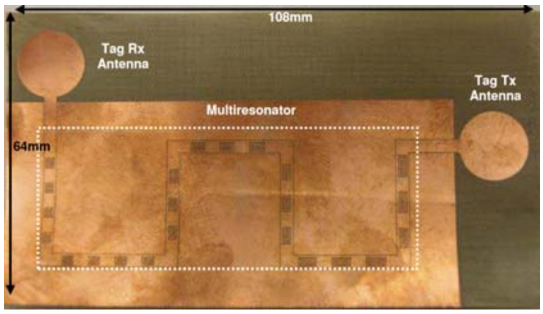
The chipless tag encodes data by using spectral signature encoding. Each tag has a different spectral signature by filtering out a predefined set of frequencies. The multiresonator circuit comprises a set of cascaded spiral resonators which resonate at different frequencies. Coplanar waveguide (CPW) technology was used for designing high Q spiral resonators. The CPW was first proposed by C. P. Wen in 1969 (Wen, 1969). Wen proposed the novel waveguide as a dielectric substrate coated with a single layer of copper. It consists of a conductor centre strip with conductive ground plane sheets on both sides of the strip. The impedance of the strip is determined by the width of the strip, the gap, the permittivity and thickness of the dielectric. In practice this means that we can have multiple widths of the CPW strip on the same dielectric which would have, for example, a 50 ohm impedance at the cost of modification of the gap between the strip and ground planes. This property of CPW makes it a very flexible transmission line technology. CPW technology uses spiral shapes etched out in the stripline to create stop bands. The layout of a spiral resonator designed on 90 μm thin Taconic TF-290 laminate is shown in figure.



Layout of spiral resonator etched out in a CPW strip line.

Chipless RFID tag

The flexible chipless tag was designed on laminate Taconic TF-290 (├r = 2.9, h = 90 μm, tan ├ = 0.0028) using ADS Momentum 2008. For this purpose, the antenna and multiresonators were designed individually. The layout of the chipless RFID tag with design parameters printed on flexible TF-290 laminates is shown in following figure. The tag was designed on CPW, making it single-sided.



The tag encodes 23 bits of data between 5 and 10.7 GHz. The chipless tag is comprised of a vertically- polarized UWB disc-loaded monopole receiving tag antenna, a multiresonating circuit and a horizontally-polarized UWB transmitting tag antenna designed using CPW technology. The chipless tag is designed to fit the Australian banknote and its dimensions are 108mm by 64mm. The spirals were etched out with the spiral trace and separation between spiral traces being 0.2 mm. The 50 ohm CPW strip line was designed to be 2.5 mm with the gap separation from the ground plane being 0.15 mm. The spirals were etched in the strip line with a 3 mm separation between adjacent cascaded spirals.

BiCMOS

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Introduction

At present, in every electrical and electronic device which we use in our daily life consists of integrated circuits which are manufactured by utilizing the semiconductor device fabrication process. The electronic circuits are created on a wafer made up of pure semiconductor materials such as silicon and other semiconductor compounds with multiple steps involving photo lithography and chemical processes.

The process of semiconductor manufacturing was started from Texas in early 1960's and then extended all over the world.

BiCMOS Technology

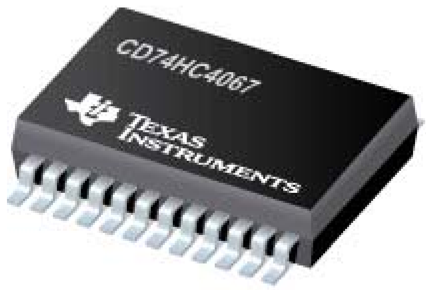
This is one of the major semiconductor technologies and is a highly developed technology, in 1990's incorporating two separate technologies, namely bipolar junction transistor and CMOS transistor in a single modern integrated circuit. So, for the better indulgent of this technology, we can have glance at CMOS technology and Bipolar technology in brief.

BiCMOS CME8000

The figure shown is the first analog/digital receiver IC and is a BiCMOS integrated receiver with very high sensitivity.

CMOS Technology

It is a complementary of MOS technology or CSG (Commodore Semiconductor Group) which was started as source for manufacturing the electronic calculators. After that complementary of MOS technology called CMOS technology is used for developing the integrated circuits such as digital logic circuits along with microcontrollers and microprocessors. CMOS technology affords benefit of less power dissipation and low noise margin with high packing density.

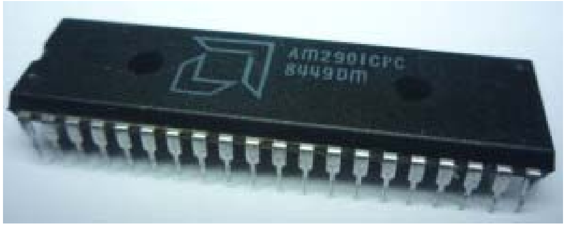


CMOS CD74HC4067

The figure shows the utilization of CMOS technology in manufacturing the digital controlled switch devices.

Bipolar Technology

Bipolar transistors are part of integrated circuits and their operation is based on two types of semiconductor material or depends on both types of charge carriers holes and electrons.These are generally classified into two types as PNP and NPN, classified based on doping of its three terminals and their polarities. It affords high switching as well as input/output speed with good noise performance.



Bipolar AM2901CPC

The figure shows the utilization of bipolar technology in RISC processor AM2901CPC.

BiCMOS Logic

It is a complex processing technology that provides NMOS and PMOS technologies amalgamated each other with the advantages of having very low power consumption bipolar technology and high speed over CMOS technology.MOSFETs grant high input impedance logic gates and bipolar transistors provide high current gain.

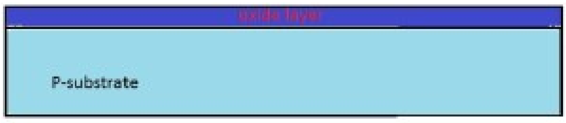
14 Steps for BiCMOS Fabrication

The BiCMOS fabrication combines the process of fabrication of BJT and CMOS, but merely variation is a realization of the base.The following steps show the BiCMOS fabrication process.

Step1: P-Substrate is taken as shown in the below figure

P-substrate

Step2: The p-substrate is covered with the oxide layer

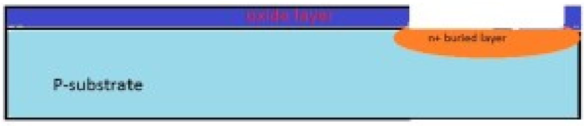


P-substrate with oxide layer

Step3: A small opening is made on the oxide layer

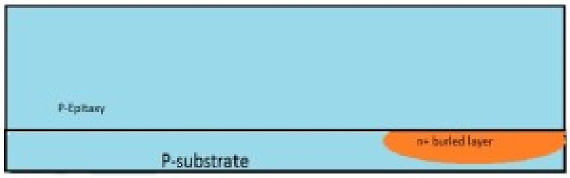
Opening is made on the oxide layer

Step4: N-type impurities are heavily doped through the opening



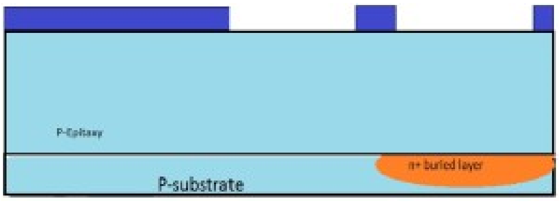
N-type impurities are heavily doped through the opening

Step5: The P – Epitaxy layer is grown on the entire surface



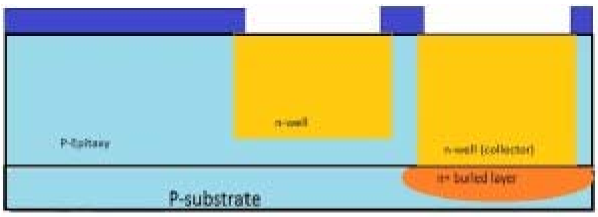
Epitaxy layer is grown on the entire surface

Step6: Again, entire layer is covered with the oxide layer and two openings are made through this oxide layer.



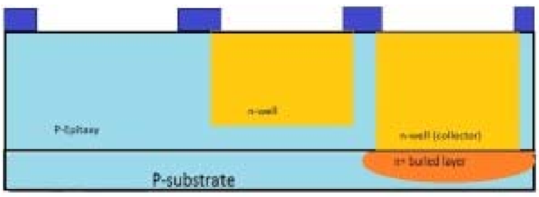
two openings are made through the oxide layer

Step7: From the openings made through oxide layer n-type impurities are diffused to form n-wells



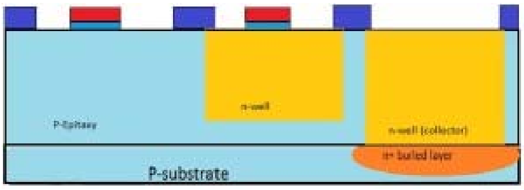
n-type impurities are diffused to form n-wells

Step8: Three openings are made through the oxide layer to form three active devices.



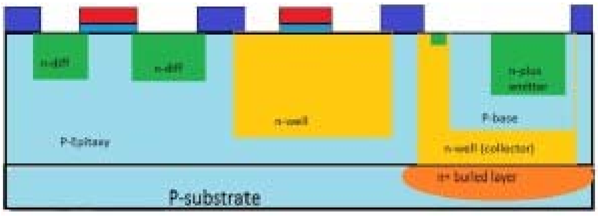
Three openings are made through the oxide layer to form three active devices

Step9: The gate terminals of NMOS and PMOS are formed by covering and patterning the entire surface with Thinox and Polysilicon.



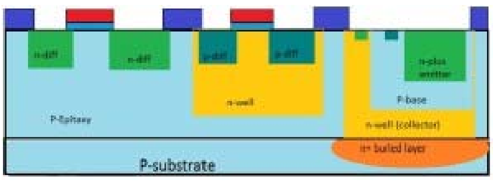
The gate terminals of NMOS and PMOS are formed with Thinox and Polysilicon

Step10: The P-impurities are added to form the base terminal of BJT and similar, N-type impurities are heavily doped to form emitter terminal of BJT, source and drain of NMOS and for contact purpose N-type impurities are doped into the N-well collector.



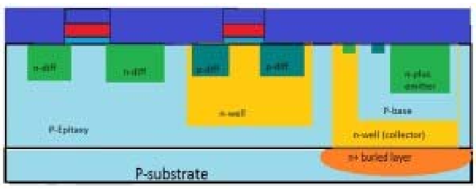
P-impurities are added to form the base terminal of BJT

Step11: To form source and drain regions of PMOS and to make contact in P-base region the P-type impurities are heavily doped.



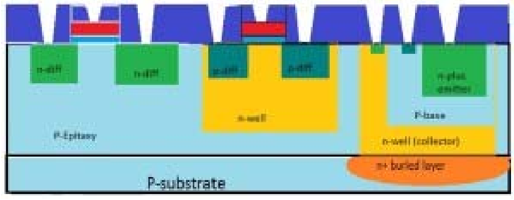
P-type impurities are heavily doped to form source and drain regions of PMOS

Step12: Then the entire surface is covered with the thick oxide layer.



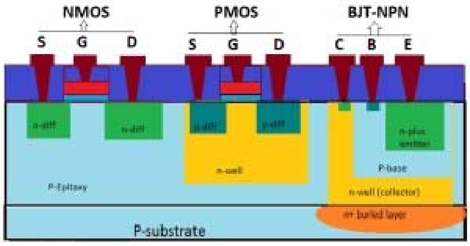
Entire surface is covered with the thick oxide layer

Step13: Through the thick oxide layer the cuts are patterned to form the metal contacts.



The cuts are patterned to form the metal contacts

Step14: The metal contacts are made through the cuts made on oxide layer and the terminals are named as shown in the below figure.



Metal contacts are made through the cuts and terminals are named

The fabrication of BICMOS is shown in the above figure with a combination of NMOS, PMOS and BJT. In the fabrication process some layers are used such as channel stop implant, thick layer oxidation and guard rings.

The fabrication will be theoretically difficult for including both the technologies CMOS and bipolar. Parasitical bipolar transistors are produced inadvertently is a problem of fabrication while processing p-well and n-well CMOS. For the fabrication of BiCMOS many additional steps added for fine tuning of bipolar and CMOS components. Hence, the cost of total fabrication increases.

Channel stopper is implanted in semiconductor devices as shown in the above figureby using implantation or diffusion or other methods in order to limit the spreading of channel area or to avoid the formation of parasitic channels.

The high impedance nodes if any, may cause the surface leakage currents and to avoid the flow of current in places where the current flow is restricted these guard rings are used.

Advantages of BiCMOS technology

- Analog amplifier design is facilitated and improved by using high impedance CMOS circuit as input and remaining are realized by using bipolar transistors.
- BiCMOS is essentially vigorous to temperature and process variations offering good economical considerations (high percentage of prime units) with less variability in electrical parameters.
- High load current sinking and sourcing can be provided by BiCMOS devices as per requirement.
- Since it is a grouping of bipolar and CMOS technologies we can use BJT if speed is a critical parameter and we can use MOS if power is a critical parameter and it can drive high capacitance loads with reduced cycle time.
- It has low power dissipation than bipolar technology alone.
- This technology found frequent applications in analog power managing circuits and amplifier circuits such as BiCMOS amplifier.
- It is well appropriate for input/ouput intensive applications, offers flexible inputs/outputs (TTL, CMOS and ECL).
- It has the advantage of improved speed performance compared to CMOS technology alone.
- Latch up invulnerability.
- It has the bidirectional capability (source and drain can be interchanged as per requirement).

Drawbacks of BiCMOS technology

- The fabrication process of this technology is comprised of both the CMOS and bipolar technologies increasing the complexity.
- Due to increase in the complexity of the fabrication process, the cost of fabrication also increases.
- As there are more devices, hence, less lithography.

BiCMOS technology and Applications

- It can be analyzed as AND function of high density and speed.
- This technology is used as an alternate of the previous bipolar, ECL and CMOS in the market.
- In some applications (in which there is finite budget for power) the BiCMOS speed performance is better than the that of bipolar.
- This technology is well suited for the intensive input/output applications.
- The applications of BiCMOS were initially in RISC microprocessors rather than traditional CISC microprocessors.
- This technology excels its applications, mainly in two areas of microprocessors such as memory and input/output.
- It has a number of applications in analog and digital systems, resulting in the single chip spanning the analog-digital boundary.
- It overpass the gap permitting course of action and circuit margins to be crossed.
- It can be used for sample and hold applications as it provides high impedance inputs.
- This is also used in applications such as adders, mixers, ADC and DAC.

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ARM

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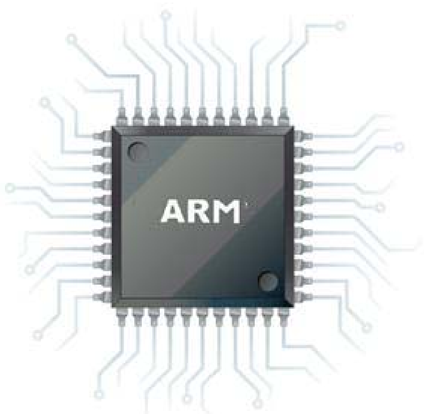
Introduction

ARM stands for Advanced RISC (reduced instruction set computer) machine. ARM started life as part of Acorn makers of the BCC computer, and now designs chip for apple iPad. The first ARM was established in Cambridge University in 1978. The Acorn group computers have developed the first ARM commercial RISC processor in 1985. ARM was founded and very popular in 1990. The ARM using more than 98% of the mobile phones in 2007 and 10 billion processors are shipped in 2008. ARM is the latest technology which replaced by microcontroller and microprocessors. Basically ARM is a 16 bit/ 32 bit Processors or Controllers. ARM is heart of the advanced digital products like mobile phones automotive systems digital cameras and home networking and wireless technologies.



Why ARM is most popular:

- ARM is the most popular processors, particularly used in portable devices due to its low power consumption and reasonable performance.
- ARM has got better performance when compared to other processors. The ARM processor is basically consisting of low power consumption and low cost. It is very easy to use ARM for quick and efficient application developments so that is the main reason why ARM is most popular.

Introduction to ARM Architecture Families:

Version	Family
ARMv1	ARM1
ARMv2	ARM2, ARM3
ARMv3	ARM6, ARM7
ARMv4	Strong ARM, ARM7TDMI, ARM9TDMI
ARMv5	ARM7EJ, ARM9E,ARM10XE
ARMv6	ARM11
ARMv7	Cortex

ARM Architecture Families

Features of Different ARM Versions:

Version 1:

The ARM version one Architecture:

- Software interrupts
- 26-bit address bus
- Data processing is slow
- It support byte, word and multiword load operations

Version 2:

- 26-Bit address bus

- Automatic instructions for thread synchronization
- Co-processor support

Version 3:

- 32-Bit addressing
- Multiple data support (like 32 bit=32*32=64).
- Faster than ARM version1 and version2

Version 4:

- 32-bit address space
- Its support T variant:16 bit THUMB instruction set
- It support M variant: long multiply means give a 64 bit result

Version 5:

- Improved ARM THUMB interworking
- Its supports CCL instructions
- It support E variant : Enhanced DSP Instruction set
- It support S variant : Acceleration of Java byte code execution

Version 6:

- Improved memory system
- Its supports a single instruction multiple data

ARM Nomenclature:

There are different versions of ARM, like ARMTDMI, ARM10XE, the meaning of TDMI and XE is given below:

ARM {X}{Y}{Z}{T}{D}{M}{I}{E}{J}{F}{S}

- X – Family
- Y – Memory management
- Z – Cache
- T – THUMB 16-bit decoder
- D – JTAG Debug
- M – Fast multiplier
- I – Embedded ICE macro cell
- E – Enhanced Instruction
- J – Jazelle (Java)
- F – Vector floating point unit
- S – Synthesizable version

ARM Architecture:

ARM is a load store reducing instruction set computer architecture; it means the core cannot directly operate with the memory. All data operations must be done by registers with the information which is located in the memory. Performing the operation of data and storing the value back to the memory. ARM consist 37 register sets, 31 are general purpose registers and 6 are status registers. The ARM uses seven processing modes that are used to run the user task.

- USER mode
- FIQ mode
- IRQ mode
- SVC mode
- UNDEFINED mode
- ABORT mode
- THUMB mode

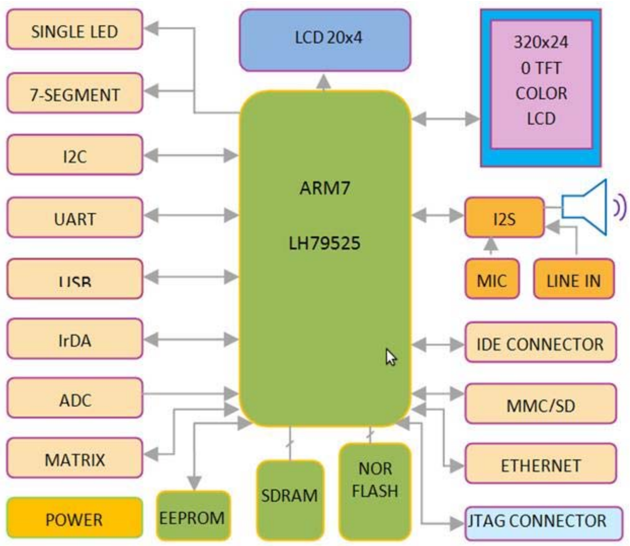
The user mode is a normal mode; which has least number of registers. It doesn't have SPSR and limited access to the CPSR. The FIQ and IRQ are the two interrupt caused modes of the CPU. The FIQ is processing past interrupt and IRQ is slandered interrupt. The FIQ mode has additional five banked registers to provide more flexibility and high performance when critical interrupts are handling. The Supervisor mode is the software interrupt mode of the processor to start up or reset. The Undefined mode traps illegal instructions is executed. The ARM core consist 32-bit data bus and faster data flow. In THUMB mode the 32-bit of data divided into 16-bits and increases the processing speed.

Some of the registers are reserved in each mode for specific use by the core. The reserved registers are

- SP (stack pointer).
- LR (link register).
- PC (program counter).
- CPSR (current program status register).
- SPSR (saved program status register).

The reserved registers are used for specific functions. The SPSR and CPSR contain the status control bits specific properties. These properties are defining operating mode, ALU status flag, Interrupt enable or disable flags. The ARM core is operates in two states 32-bit state or THUMBS state.

ARM7 Block Diagram and Features:



ARM7 Block Diagram

Features of ARM7:

- The ARM7 is a 16/31 – Bit bus
- The static Ram is 40 kb
- On-chip flash programmable memory is 512kb
- It is a high speed controller 60 MHz operation
- Two 10 bit ADC converters provide a total of 14 analog inputs
- One 10- bit D/A converter
- Two 32 bit timers/counters
- 4- CCM (Capture Compare Modulation), 6-PWM, Watchdog timer
- One RTC, 9 interrupts
- One I2C protocol, SPI protocols, SSP protocol
- Two UART serial communication protocols

APPLICATION:

- Industrial control
- Medical systems
- Communication gate way
- Embedded soft modem
- General-purpose Applications
- Access control
- Point of scale

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Program Outcomes (POs)

PO1	**Engineering Knowledge:** Apply the knowledge of mathematics, science, and engineering fundamentals to solve the complex electrical engineering problems.
PO2	**Problem Analysis:** Identify, formulate, review research literature, and analyze complex Electrical and Electronics Engineering problems enabling attainment of conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3	**Design/Development of Solutions:** Design solutions, components or process for complex Electrical Engineering problems to meet the specified needs considering public health, safety and environmental considerations.
PO4	**Conduct Investigations of complex problems:** Exercise research knowledge and technical methodology for design, analysis and interpretation of data to converge to a suitable solution.
PO5	**Modern Tool Usage**: Use modern engineering tools, softwares and equipments to predict, analyze and model engineering problems.
PO6	**The Engineer & Society:** Apply reasoning skills to assess societal, health, safety, legal and cultural issues relevant to the professional engineering practice and take consequent responsibilities in the society
PO7	**Environment and Sustainability:** Realize the impact of the professional engineering solutions and demonstrate the knowledge for sustainable development in environmental context
PO8	**Ethics:** Apply and realize the professional ethics and responsibilities in Electrical engineering practice.
PO9	**Individual and Team Work:** Exhibit Individuality, Leadership and Team spirit in multidisciplinary settings.
PO10	**Communication:** Communicate, comprehend, write reports, design documentation and presentation effectively on complex engineering activities
PO11	**Project Management & Finance:** Demonstrate the Electrical engineering and management principles adhering to financial strategies to manage projects as a member or leader in a team
PO12	**Life Long Learning:** Inculcate independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs)

PSO 1: Electrical drives and control: Graduates will Analyze, design and provide Engineering solutions in the field of Power Electronics and Drives

PSO 2: Embedded system: Graduates will Simulate, experiment and solve complex problems in Embedded System.

KSR INSTITUTE FOR ENGINEERING AND TECHNOLOGY

VISION

To become a globally recognized Institution in Engineering Education, Research and Entrepreneurship.

MISSION

- ❖ Accomplish quality education through improved teaching learning process.
- ❖ Enrich technical skills with state of the art laboratories and facilities.
- ❖ Enhance research and entrepreneurship activities to meet the industrial and societal needs.

Department of EEE

VISION

To produce world class Electrical and Electronics Technocrats and Entrepreneurs with social responsibilities.

MISSION

- ❖ Impart quality education in the field of Electrical and Electronics Engineering through state of the art learning ambience.
- ❖ Enrich interdisciplinary skills and promote research through continuous learning.
- ❖ Enhance professional ethics, entrepreneurship skills and social responsibilities to serve the nation.

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