DOWNLOAD PDF BASIC INTEGRATED CIRCUITS

Chapter 1 : Integrated circuit - Wikipedia

Integrated circuits can be defined as: Integrated circuits (ICs) are, much as their name would suggest, small circuits integrated into a plastic.

Overview[edit] Some TTL logic parts were made with an extended military-specification temperature range. These parts are prefixed with 54 instead of 74 in the part number. A short-lived 64 prefix on Texas Instruments parts indicated an industrial temperature range; this prefix had been dropped from the TI literature by Surface mount parts with a single gate often in a 5-pin or 6-pin package are prefixed with G instead of Some manufacturers released some series equivalent CMOS circuits with a 74 prefix, for example the 74HC was a replacement for the with slightly different electrical characteristics different power supply voltage ratings, higher frequency capabilities, lower "on" resistances in analog switches, etc. See List of series integrated circuits. Conversely, the series has "borrowed" from the series - such as the CD and CD being pin-for-pin functional replacements for 74C and 74C A few alphabetic characters to designate a specific logic subfamily may immediately follow the 74 or 54 in the part number, e. Not all functions are available in all families. In a few instances, such as the and , the same suffix in different families do not have completely equivalent logic functions. Another extension to the series is the xxx variant, representing mostly the bit wide counterpart of otherwise 8-bit-wide "base" chips with the same three ending digits. For more details, refer primarily to the Texas Instruments documentation mentioned in the References section. There are a few numeric suffixes that have multiple conflicting assignments, such as the Larger footprints[edit] Parts in this section have a pin count of 14 pins or more. The lower part numbers were established in the s and s, then higher part numbers were added incrementally over decades. IC manufacturers continue to make a core subset of this group, but many of these part numbers are considered obsolete and no longer manufactured. Older discontinued parts may be available from a limited number of sellers as new old stock NOS , though some are much harder to find. For the following table: Part number column - the "x" is a place holder for the logic subfamily name. For example, 74x00 in "LS" logic family would be "74LS00". Input column - a blank cell means a normal input for the logic family type. Outputs with higher output currents are often called drivers or buffers. Pins column - number of pins for the dual in-line package version; a number in brackets indicates that there is no known dual in-line package version of this IC 74x00 â€” 74x

Chapter 2 : IC Basic Tutorial - Integrated Circuit (IC)

The basics of integrated circuits Integration is a good thing Integrated circuits (IC s) are, much as their name would suggest, small circuit s integrated into a plastic "chip.".

Early digital circuits containing tens of transistors provided a few logic gates, and early linear ICs such as the Plessey SL or the Philips TAA had as few as two transistors. The number of transistors in an integrated circuit has increased dramatically since then. The early integrated circuits were SSI. SSI circuits were crucial to early aerospace projects, and aerospace projects helped inspire development of the technology. Both the Minuteman missile and Apollo program needed lightweight digital computers for their inertial guidance systems. Although the Apollo guidance computer led and motivated integrated-circuit technology, [55] it was the Minuteman missile that forced it into mass-production. The demand by the U. Government supported the nascent integrated circuit market until costs fell enough to allow IC firms to penetrate the industrial market and eventually the consumer market. A typical application was FM inter-carrier sound processing in television receivers. In , Frank Wanlass demonstrated a single-chip bit shift register he designed, with a then-incredible transistors on a single chip. Further development, driven by the same economic factors, led to "large-scale integration" LSI in the mids, with tens of thousands of transistors per chip. Integrated circuits such as 1K-bit RAMs, calculator chips, and the first microprocessors, that began to be manufactured in moderate quantities in the early s, had under 4, transistors. True LSI circuits, approaching 10, transistors, began to be produced around , for computer main memories and second-generation microprocessors. Some SSI and MSI chips, like discrete transistors , are still mass-produced, both to maintain old equipment and build new devices that require only a few gates. The series of TTL chips, for example, has become a de facto standard and remains in production. Very-large-scale integration Upper interconnect layers on an Intel DX2 microprocessor die The final step in the development process, starting in the s and continuing through the present, was "very-large-scale integration" VLSI. The development started with hundreds of thousands of transistors in the early s, As of [update] , transistor counts continue to grow beyond ten billion transistors per chip. Multiple developments were required to achieve this increased density. Manufacturers moved to smaller design rules and cleaner fabrication facilities so that they could make chips with more transistors and maintain adequate yield. Electronic design tools improved enough to make it practical to finish these designs in a reasonable time. Modern VLSI devices contain so many transistors, layers, interconnections, and other features that it is no longer feasible to check the masks or do the original design by hand. Instead, engineers use EDA tools to perform most functional verification work. Microprocessor chips passed the million-transistor mark in and the billion-transistor mark in Through a combination of large size and reduced packaging, WSI could lead to dramatically reduced costs for some systems, notably massively parallel supercomputers. The design of such a device can be complex and costly, and building disparate components on a single piece of silicon may compromise the efficiency of some elements. This has led to an exploration of so-called Network-on-Chip NoC devices, which apply system-on-chip design methodologies to digital communication networks as opposed to traditional bus architectures. A three-dimensional integrated circuit 3D-IC has two or more layers of active electronic components that are integrated both vertically and horizontally into a single circuit. Communication between layers uses on-die signaling, so power consumption is much lower than in equivalent separate circuits. Judicious use of short vertical wires can substantially reduce overall wire length for faster operation. Ever since ICs were created, some chip designers have used the silicon surface area for surreptitious, non-functional images or words. These are sometimes referred to as chip art , silicon art, silicon graffiti or silicon doodling. ICs and IC families[edit].

Chapter 3 : Uses of Integrated Circuits

An integrated circuit or monolithic integrated circuit (also referred to as an IC, a chip, or a microchip) is a set of electronic circuits on one small flat piece (or "chip") of semiconductor material, normally silicon.

However, the presence of those extra switches and LEDs make it very convenient to expand the circuit and help make the circuit layout both clean and compact. It is highly recommended that you have a datasheet for the chip available when you build your circuit. Shown here is my own rendition of what any datasheet shows: Digital logic circuitry does not make use of split power supplies as op-amps do. Like op-amp circuits, though, ground is still the implicit point of reference for all voltage measurements. Note how all inputs of the unused gates inside the chip are connected either to VDD or ground. This is not a mistake, but an act of intentional design. Who cares what signals they receive, if we are not doing anything with their outputs? At worst, this could lead to damage of the chip. At best it means excessive power consumption. In the breadboard illustration, I show all the top inputs connected to VDD, and all the bottom inputs of the unused gates connected to ground. This was done merely because those power supply rail holes were closer and did not require long jumper wires! Please note that none of the unused gate outputs have been connected to VDD or ground, and for good reason! Instead, its upper P-channel output transistor would be turned on in vain, sourcing maximum current to a nonexistent load. This would very likely damage the gate! This way, the input will not be susceptible to stray static voltages. Even if you already know what a NAND gate truth table looks like, this is a good exercise in experimentation: Draw a truth table on a piece of paper like this: As you can imagine, this breadboard circuit is not limited to testing NAND gates. Any gate type may be tested with two switches, two pulldown resistors, and an LED to indicate output status. Additional Improvement An improvement you might want to make to this circuit is to assign a couple of LEDs to indicate input status, in addition to the one LED assigned to indicate the output. This makes operation a little more interesting to observe, and has the further benefit of indicating if a switch fails to close or open by showing the true input signal to the gate, rather than forcing you to infer input status from switch position:

Chapter 4 : List of series integrated circuits - Wikipedia

Integrated circuit (IC), also called microelectronic circuit, microchip, or chip, an assembly of electronic components, fabricated as a single unit, in which miniaturized active devices (e.g., transistors and diodes) and passive devices (e.g., capacitors and resistors) and their interconnections are built up on a thin substrate of semiconductor material (typically silicon).

Find the resistor symbol in the schematic symbols overview. It was just there, consuming power. But with time, I learned that the resistor is actually extremely useful. And as the name suggests, they resist the current. But you are probably wondering: What do I use it for? You use the resistor to control the voltages and the currents in your circuit. Much more that the LED can handle. So the LED will become very hot and burn out after a short amount of time. In this case we call it a current limiting resistor. Capacitor Find the capacitor symbol in the schematic symbols overview. You can think of a capacitor as a battery with very low capacity. You can charge and discharge it just like a battery. The capacitor is often used to introduce a time-delay in a circuit. For example to blink a light. Read more about the capacitor in this article: How Does A Capacitor Work? There are many capacitor types. Most commonly, we divide them into polarized and non-polarized capacitors. We use LEDs to give a visual feedback from our circuit. For example to show that the circuit has power. But, you can also used them to make cool light-show circuits. You see these components everywhere: A very common circuit to build as a beginner is the blinking light circuit. Transistor Find the transistor symbol in the schematic symbols overview. This is probably the hardest of the basic electronic components to understand. A simple way is to look at the transistor as a switch controlled by an electrical signal. If you put about 0. Note that this is true for NPN transistors. There are also other types, but worry about these later. A bit of current on the base produces a current of maybe times more depending on the transistor through the Collector and Emitter. We can use this effect to build amplifiers. Inductor Find the inductor symbol in the schematic symbols overview. Inductors are a bit weird. They are often used in filters. See his response at the end of that article. Integrated Circuit Find the integrated circuit symbol in the schematic symbols overview. An Integrated Circuit IC consists of many basic electronic components. It could be an amplifier, it could be a microprocessor, it could be a USB to serial converterâ€¦ It could be anything! To figure out what a specific IC does, you can read its datasheet. Download Basic Electronic Components [PDF] â€” a mini eBook with examples that will teach you how the basic components of electronics work. What to do next? Now, you know a bit about the basic electronic components. Do you understand the basic electronic components? Leave your comment or questions in the comment field below!

Chapter 5 : Basic Gate Function | Digital Integrated Circuits | Electronics Textbook

Integrated Circuit or IC is an electronic component made up of combination of several transistors, diode, resistor, capacitors in a tiny semiconductor chip. Integrated Circuit Electronic Components or IC are of small size and very light weight.

Analog versus digital circuits Analog , or linear, circuits typically use only a few components and are thus some of the simplest types of ICs. Generally, analog circuits are connected to devices that collect signals from the environment or send signals back to the environment. For example, a microphone converts fluctuating vocal sounds into an electrical signal of varying voltage. An analog circuit then modifies the signal in some useful wayâ€”such as amplifying it or filtering it of undesirable noise. Such a signal might then be fed back to a loudspeaker, which would reproduce the tones originally picked up by the microphone. Another typical use for an analog circuit is to control some device in response to continual changes in the environment. For example, a temperature sensor sends a varying signal to a thermostat , which can be programmed to turn an air conditioner, heater, or oven on and off once the signal has reached a certain value. A digital circuit, on the other hand, is designed to accept only voltages of specific given values. A circuit that uses only two states is known as a binary circuit. Arithmetic is also performed in the binary number system employing Boolean algebra. These basic elements are combined in the design of ICs for digital computers and associated devices to perform the desired functions. Microprocessor circuits Microprocessors are the most-complicated ICs. They are composed of billions of transistors that have been configured as thousands of individual digital circuits, each of which performs some specific logic function. A microprocessor is built entirely of these logic circuits synchronized to each other. Microprocessors typically contain the central processing unit CPU of a computer. Just like a marching band, the circuits perform their logic function only on direction by the bandmaster. The bandmaster in a microprocessor, so to speak, is called the clock. The clock is a signal that quickly alternates between two logic states. Every time the clock changes state, every logic circuit in the microprocessor does something. Calculations can be made very quickly, depending on the speed clock frequency of the microprocessor. Microprocessors contain some circuits, known as registers, that store information. Registers are predetermined memory locations. Each processor has many different types of registers. Permanent registers are used to store the preprogrammed instructions required for various operations such as addition and multiplication. Temporary registers store numbers that are to be operated on and also the result. Other examples of registers include the program counter also called the instruction pointer , which contains the address in memory of the next instruction; the stack pointer also called the stack register , which contains the address of the last instruction put into an area of memory called the stack; and the memory address register, which contains the address of where the data to be worked on is located or where the data that has been processed will be stored. Microprocessors can perform billions of operations per second on data. In addition to computers, microprocessors are common in video game systems , televisions , cameras , and automobiles. Memory circuits Microprocessors typically have to store more data than can be held in a few registers. This additional information is relocated to special memory circuits. Memory is composed of dense arrays of parallel circuits that use their voltage states to store information. Memory also stores the temporary sequence of instructions, or program, for the microprocessor. Manufacturers continually strive to reduce the size of memory circuitsâ€”to increase capability without increasing space. In addition, smaller components typically use less power, operate more efficiently, and cost less to manufacture. Digital signal processors A signal is an analog waveformâ€”anything in the environment that can be captured electronically. A digital signal is an analog waveform that has been converted into a series of binary numbers for quick manipulation. As the name implies, a digital signal processor DSP processes signals digitally, as patterns of 1s and 0s. The digital representation of the voice can then be modified by a DSP using complex mathematical formulas. For example, the DSP algorithm in the circuit may be configured to recognize gaps between spoken words as background noise and digitally remove ambient noise from the waveform. DSPs are also used to produce digital effects on live television. For example, the yellow marker lines displayed during the football game are not really on the field; a DSP adds the lines after the cameras shoot the picture but before it is broadcast. Similarly, some of the advertisements seen on stadium fences and billboards during televised sporting events are not really there. As their name implies, ASICs are not reconfigurable; they perform only one specific function. For example, a speed controller IC for a remote control car is hard-wired to do one job and could never become a microprocessor. An ASIC does not contain any ability to follow alternate instructions. RFICs are analog circuits that usually run in the frequency range of 3 kHz to 2. They are usually thought of as ASICs even though some may be configurable for several similar applications. Most semiconductor circuits that operate above MHz million hertz cause the electronic components and their connecting paths to interfere with each other in unusual ways. Engineers must use special design techniques to deal with the physics of high-frequency microelectronic interactions. These circuits usually run in the 2- to GHz range, or microwave frequencies, and are used in radar systems, in satellite communications , and as power amplifiers for cellular telephones. Just as sound travels faster through water than through air , electron velocity is different through each type of semiconductor material. Silicon offers too much resistance for microwave-frequency circuits, and so the compound gallium arsenide GaAs is often used for MMICs. Unfortunately, GaAs is mechanically much less sound than silicon. It breaks easily, so GaAs wafers are usually much more expensive to build than silicon wafers. Basic semiconductor design Any material can be classified as one of three types: A conductor such as copper or salt water can easily conduct electricity because it has an abundance of free electrons. An insulator such as ceramic or dry air conducts electricity very poorly because it has few or no free electrons. A semiconductor such as silicon or gallium arsenide is somewhere between a conductor and an insulator. It is capable of conducting some electricity, but not much. Doping silicon Most ICs are made of silicon , which is abundant in ordinary beach sand. Pure crystalline silicon, as with other semiconducting materials, has a very high resistance to electrical current at normal room temperature. However, with the addition of certain impurities, known as dopants, the silicon can be made to conduct usable currents. In particular, the doped silicon can be used as a switch, turning current off and on as desired. The process of introducing impurities is known as doping or implantation. An n-type semiconductor results from implanting dopant atoms that have more electrons in their outer bonding shell than silicon. The resulting semiconductor crystal contains excess, or free, electrons that are available for conducting current. A p-type semiconductor results from implanting dopant atoms that have fewer electrons in their outer shell than silicon. In essence, such holes can move through the crystal conducting positive charges. Three bond pictures of a semiconductor. The p-n junction A p-type or an n-type semiconductor is not very useful on its own. However, joining these opposite materials creates what is called a p-n junction. A p-n junction forms a barrier to conduction between the materials. Although the electrons in the n-type material are attracted to the holes in the p-type material, the electrons are not normally energetic enough to overcome the intervening barrier. However, if additional energy is provided to the electrons in the n-type material, they will be capable of crossing the barrier into the p-type materialâ€”and current will flow. This additional energy can be supplied by applying a positive voltage to the p-type material. The negatively charged electrons will then be highly attracted to the positive voltage across the junction. The p-n junctionA barrier forms along the boundary between p-type and n-type semiconductors that is known as a p-n junction. Because electrons under ordinary conditions will flow in only one direction through such barriers, p-n junctions form the basis for creating electronic rectifiers and switches. A forward-biased p-n junctionAdding a small primary voltage such that the electron source negative terminal is attached to the n-type semiconductor surface and the drain positive terminal is attached to the p-type semiconductor surface results in a small continuous current. This arrangement is referred to as being forward-biased. A p-n junction that conducts electricity when energy is added to the n material is called forward-biased because the electrons move forward into the holes. If voltage is applied in the opposite directionâ€”a positive voltage connected to the n side of the junctionâ€—no current will flow. The electrons in the n material will still be attracted to the positive voltage, but the voltage will now be on the same side of the barrier as the electrons. In this state a junction is said to be reverse-biased. Since p-n junctions conduct electricity in only one direction, they are a type of diode. Diodes are essential building blocks of semiconductor switches. Field-effect transistors Bringing a negative voltage close to the centre of a long strip of n-type material will repel nearby electrons in the material and thus form holesâ€”that is, transform some of the strip in the middle to p-type material. This change in polarity using an electric field gives the field-effect transistor its name. While the voltage is being applied, there will exist two p-n junctions along the strip, from n to p and then from p back to n. One of the two junctions will always be reverse-biased. Since reverse-biased junctions cannot conduct, current cannot flow through the strip. The field effect can be used to create a switch transistor to turn current off and on, simply by applying and removing a small voltage nearby in order to create or destroy reverse-biased diodes in the material. A transistor created by using the field effect is called a field-effect transistor FET. The location where the voltage is applied is known as a gate. The gate is separated from the transistor strip by a thin layer of insulation to prevent it from short-circuiting the flow of electrons through the semiconductor from an input source electrode to an output drain electrode. Similarly, a switch can be made by placing a positive gate voltage near a strip of p-type material. A positive voltage attracts electrons and thus forms a region of n within a strip of p. This again creates two p-n junctions, or diodes. As before, one of the diodes will always be reverse-biased and will stop current from flowing.

Chapter 6 : Basics of integrated circuits (ICs)

Describes the basic idea of making integrated circuits "using only one material for all circuit elements and a limited number of compatible process steps for the production thereof." US Patent 2,, Semiconductor device and lead structure by Robert N. Noyce, Fairchild Semiconductor, filed July 30, and issued April 25,

Chapter 7 : Basic Electronic Components Used in Circuits

Integrated Circuit (IC) Created on: 30 July IC stands for "Integrated Circuit". An IC is a tiny circuit made up of resistors, diodes and transistors and placed in a single package.

Chapter 8 : Basic Integrated Circuit Processing (PDF P) | Download book

The following is a list of series digital logic integrated calendrierdelascience.com original series integrated circuits were made by Texas Instruments with the prefix "SN" to create the name SN74xx.

Chapter 9 : Basic Integrated Circuits: Myles H. Marks: calendrierdelascience.com: Books

MOSFET 's (Metal Oxide Semiconductor Field Effect Transistors) are the basic components of an IC. This is because of its high packing density. You can fabricate millions of MOSFET's on a single chip.