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Electronics 1 Part 1 (Quickstudy: Academic)

Quick Study ACADEMIC

ELECTRONICS 1 PART ONE

PART 1 of FUNDAMENTALS OF ELECTRONIC DEVICES AND BASIC ELECTRONIC CIRCUITS

CIRCUITS & SYSTEMS: BASIC DEFINITIONS

ELECTRONIC CIRCUITS

An electronic circuit is an information-bearing signal processing network formed by interconnections of passive components and/or active devices.

Passive Components: Resistor, inductor and capacitor.

Active Devices: (or energy source devices) — transistor, metal-oxide semiconductor, etc.

Electronic System: An arrangement of components (passive elements and/or active devices) with a specified input signal producing a defined output signal.

Signal Processing: Fundamentally, electronic circuits and systems process the input signal. Common processing includes:

- Amplification (magnification)
- Inversion
- Differentiation
- Filtering: Changing the relative magnitude of different frequency components of the signal
- Modulation: Substitution of a particular part of the signal on a carrier wave

Other Electronic Circuits are:

- Harmonic oscillators:** Produce sinusoidal wave forms of desired frequency, or, critical non-sinusoidal waveforms, their other outputs can produce non-sinusoidal wave forms such as square, triangular, etc.
- Digital circuits:** Specific circuits which handle digital wave forms; they can perform computational operations such as addition, subtraction, multiplication, etc. in binary form.

ELECTRICAL SIGNAL

Electrical signal is an information-bearing electrical entity (such as voltage or current) derived from a transducer (e.g. transducer) which is converted to a voltage or current signal by a transducer. Signal processing refers to processing the electrical signal in a predetermined manner so as to modify the nature of the information contained in it. Signal sources can be represented by Fig. 1.

Thomson's equivalent circuit: A signal source represented by a voltage generator $v(t)$ in series with a source (internal) resistance R_s .

Norton's equivalent circuit: A signal source is depicted by a current generator with a short resistance R_s .

Electrical signal is characterized by:

- Amplitude, Frequency and phase parameters. The signal is a time-varying function representing the wave-shape as a function of time. It can be periodic with a definite period T , or, it can be aperiodic. A complex waveform consists of several wave forms of different frequencies. A periodic signal with a complex structure of waveforms has a discrete spectrum of harmonics, i.e. sinusoidal wave forms of magnitudes as dictated by Fourier series expansion. An aperiodic waveform has a continuous spectrum of harmonic components or, per Fourier integral transform.

Examples of signal representation by Fourier series and Fourier transform:

A periodic, continuous, time-varying signal can be represented by a superposition of infinite number of harmonics (line and/or continuous wave forms). Fig. 2 shows the Fourier expansion of a square wave (Fig. 2).

$$v(t) = \frac{A}{\pi} \left[\sin(\omega t) + \frac{1}{3} \sin(3\omega t) + \frac{1}{5} \sin(5\omega t) + \dots \right]$$

Fundamental angular frequency

DIODES: IDEAL & PRACTICAL VERSIONS

An ideal diode is a two-terminal, non-linear, unidirectional conductive element. Ideally, it conducts electricity in one direction and does not allow the current to flow in the opposite direction. Compared to Fig. 3, an ideal diode is a voltage source V_D in series with a resistor R_D in the forward bias and an infinite resistor in the reverse bias.

Actual diodes are characterized by a non-linear relationship between the forward bias with its anode kept at positive potential relative to its other (cathode) terminal. In the reverse bias (anode being at negative potential with respect to cathode), there is a small reverse current (anode to cathode) in the forward bias, i.e., the reverse current is equal to zero. In the reverse bias, i.e., the anode is at negative potential with respect to cathode, there is no current conduction in practical diodes.

DIODES AS CIRCUIT ELEMENTS

Basic applications of diodes:

- Rectification
- Waveform clipping
- Diode as a switch
- Diode as a variable resistor
- Diode as a variable capacitor

Rectification: A diode is a two-terminal element under forward bias and reverse bias. An open circuit when reverse biased. Its use is similar to the transistor as a switch. For $v > 0$, $i > 0$ corresponds to forward bias. For $v < 0$, $i = 0$ corresponds to reverse bias. R_{on} = Equivalent resistance of the switch. R_{off} = Forward resistance of the diode. R_{rev} = Reverse resistance of the diode.

Waveform: A diode can be used to rectify the alternating current waveform (with frequency f) as a one-directional switch. A simple half-wave rectifier is illustrated in Fig. 4. The current flows through the load resistor R_L only during positive half-cycle as the diode conducts (forward bias). During negative half-cycle, the diode is reverse-biased and no current flows through R_L .

NOISE

Noise: An undesired entity introduced into the signal in the circuit, either caused by various circuit elements or electromagnetic interference coupled to the circuit from external sources. Noise is a random phenomenon and affects the quality of the signal. For a periodic signal, the noise in the circuit, the noise level should be measured (high signal-to-noise ratio).



Synopsis

Fundamentals of electronic devices and basic electronic circuits. As an engineer, tradesman or electronics student, this guide will help with over 50 diagrams and equations.

Book Information

Series: Quickstudy: Academic

Misc. Supplies: 6 pages

Publisher: QuickStudy; Chrt edition (March 1, 2001)

Language: English

ISBN-10: 1572225262

ISBN-13: 978-1572225268

Product Dimensions: 8.5 x 11 x 0.1 inches

Shipping Weight: 2.4 ounces (View shipping rates and policies)

Average Customer Review: 4.5 out of 5 stars [See all reviews](#) (17 customer reviews)

Best Sellers Rank: #34,578 in Books (See Top 100 in Books) #1 in [Books > Engineering & Transportation > Engineering > Electrical & Electronics > Circuits > VLSI & ULSI](#) #2 in [Books > Engineering & Transportation > Engineering > Electrical & Electronics > Electronics > Transistors](#) #3 in [Books > Arts & Photography > Music > Theory, Composition & Performance > MIDI, Mixers, etc.](#)

Customer Reviews

I bought probably most of the QuickStudy guides over the years and they were almost always a big help both in and out of class. The several electronics guides were among my favorites. This one covers basic electronics as opposed to electricity and so deals with electronic devices like amplifiers, which it focuses on. Includes amplification, feedback, cascading, and more. You can't include everything of course in a little primer like this but the most important concepts get covered. These guides were durable, colorful, attractive, and fun to use. I have some that are going on decades old and the colors still haven't faded. In school they were almost constant companions in some of my courses. Overall another great little guide from BarCharts/QuickStudy.

Stashed this away for reference on projects if anything is forgotten or disputed. No longer need internet if its not available. The quality is good, but the amount of information is overwhelming. If you are going to actually be studying for a class, I recommend making your own study card in addition to buying this as there are many benefits to doing so.

It's legible, convenient, durable, water proof, etc. It's a handy little cheat sheet. I keep in a binder with the documents for a TI Nspire Calculator. I was kinda hoping that it would cover microwave transmission parameters. Some of that is on the Circuit Theory/Analysis card. Still, there was not much on the cards concerning practical impedance matching circuits. You just can't cram everything on a couple or three cards. All the basics are there. You should be able to derive the rest.

BarCharts are a great little reference. I would not recommend them as a study aid, but as a quick reference, they are great! I have used them for Chem, Physics, Electronics and Math. They are great for what they are.

Lot's of useful information, very handy to have for a quick reference, keeps you from having to crack an old text book or look it up on the internet. I like it, it's very well constructed, now I just have to find a good place to hang it

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