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Electronics 1 Part 2 (Quickstudy: Academic)

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ELECTRONICS 1 PART 2 TWO

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PART 2 of FUNDAMENTALS OF ELECTRONIC DEVICES & BASIC ELECTRONIC CIRCUITS

OPERATIONAL AMPLIFIERS

DEFINITIONS

• A basic differential amplifier (see Electronics 1 Part 1) makes mathematical difference operation and can be modified to operate in addition, subtraction and multiplication. When the operational amplifier is also designated as an Operational Amplifier (Op-Amp).

• An Op-Amp represents, in essence, a high-gain electronic circuit intended to amplify the difference in the signal voltages applied to its non-inverting ($+1$) inputs. In other words, summing $+1$ and non-inverting ($+1$) inputs (Fig. 1).

• An Op-Amp constitutes a differential amplifier made up, for example, of a pair of JFETs driven by a constant current source (Fig. 2). An Op-Amp can also be used as differential pairs.

IDEAL OP-AMP CHARACTERISTICS

• Normal voltage gain, $A \rightarrow \infty$

• Input impedance at both inputs, $Z_{in} \rightarrow \infty$

• Output impedance, $Z_{out} \rightarrow 0$

• Gain-bandwidth product, $A_{FB} \rightarrow \infty$

• Input offset voltage, $V_{IO} = A_{IO} \cdot V_{IO}$ ($A_{IO} = 1$ for ideal)

• With bipolar transistors, it may be difficult to achieve a very high input impedance.

• JFET and MOSFET provide high input impedance capabilities.

OP-AMP OPERATIONAL PARAMETERS

• Reference to typical operating (Fig. 3) above right and non-inverting (Fig. 4) modes of operational characteristics.

INPUT BIAS CURRENT: This is the emitter current in the differential amplifier for active-region operation of the pair of BJT's (Fig. 4). 0.04pA for TAA10400 and TAA10401. $I_B = I_{B1} = I_{B2}$ and $I_B = A_{IO} \cdot V_{IO}$. I_B (mA). This could be large enough to saturate the output. Saturation is overcome by introducing $R_{B1} = R_{B2} = R_B$ and made adjustable to compensate for input offset current due to any differentiation in the differential pair configuration (Fig. 5).

INPUT OFFSET VOLTAGE: V_{IO} (mV). It is required to balance the two inputs in order to obtain the same reference voltage due to input offset voltage. This is balanced by the differential pair devices in the OP-AMP, so that this balancing gives zero output voltage.

CMRR: When the OP-AMP is ideally balanced at the inputs, the output voltage is 0 ($V_{out} = V_{out0}$) and this circuit can reject common-mode signals due to input noise (Fig. 6). $CMRR = 10 \log_{10} (A_{in} / A_{out})$. The ratio A_{in}/A_{out} is called common-mode rejection ratio (CMRR). In practical OP-AMPS, $A_{in} > 0$ and $A_{out} < 0$, so, CMRR is finite and indicates the extent of balance in the OP-AMP (Fig. 7).

OUTPUT VOLTAGE SWING: This is the peak-to-peak voltage range of the output voltage at the output. It is limited by power supply voltages used (no 50 percent of power supply voltage V_{DD}).

INPUT VOLTAGE SWING: Input common-mode voltage swing is limited by the saturation of the differential amplifier at the input (≈ 50 percent of power supply voltage V_{DD}).

LINEAR VOLTAGE-TO-CURRENT CONVERTERS

Fig. 8

LOGARITHMIC AMPLIFIER

Fig. 9

CHARGE AMPLIFIER

Fig. 10

PRECISION RECTIFIER & PEAK DETECTOR

Fig. 11

VOLTAGE FOLLOWER (UNITY GAIN AMPLIFIER)

Fig. 12

INTEGRATOR (LOW-PASS FILTER)

Fig. 13

DIFFERENTIATOR (HIGH-PASS FILTER)

Fig. 14

LEVEL CLAMPING

Fig. 15

REGULATED POWER SUPPLY

Fig. 16

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Synopsis

Part 2 of the fundamentals of electronic devices and basic electronic circuits.

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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.

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.

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.

Nice to have on hand, well constructed gives a lot of useful information.

I was hoping there would be more to it but, its still a good reference

Excellent product. I strongly recommend this item.

High quality and delivered on time.

This is part 1 of 2. It Comes before part 2, and is the first in it's series. It's also laminated, which is great for eating Taco bell near.

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