Transistor amplifier types pdf

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Distinguish the two types of stability for a transistor amplifier. How to use a transistor as an amplifier. Different types of transistor amplifiers. Types of transistor amplifier circuits. Types of transistor amplifier configuration. Types of power amplifier transistor. Explain transistor as an amplifier.

Most of the electronic systems require at least one stage of amplification. Hence amplifiers can be seen in almost all the electronic devices. Amplifiers are the devices that increase the amplitude of the input signal. The output of the power supply is modulated by the Amplifier. Amplifiers increase only the amplitude and the other parameters such as frequency and shape remain constant. There are many types of amplifiers available. But they can be distinguished by the type of signal they amplify. They can also be classified by the type of function they perform. There are three categories of amplifiers depending on the property of their output. Voltage Amplifier Current Amplifier Power Amplifier Let us know discuss about these amplifiers in detailed manner. 1. Voltage Amplifiers: These are most common amplifiers used in the electronic devices. These amplifiers increase the amplitude of the output voltage of the signal. 2. Current Amplifiers: These amplifiers increases the amplitude of the input current compared to the input current waveform. 3. Power Amplifiers: The purpose of the power amplifiers is to increase the power i.e. the product of output voltage and current is greater than the product of input voltage and current. Either the voltage or current at the output may be less than the input, the overall voltage or current product will be greater than the input. When an AC signal is applied to the amplifier, only a part of it is amplified. Depending on the portion of wave amplified, these are classified into four classes. They are Class A Class B Class AB Class C Amplifies can be further classified based on the signal they amplify. They are as follows: 1. Audio Frequency Amplifiers (A.F. Amplifiers): Audio Frequency Amplifiers amplify the audio frequencies. Generally audio frequencies are in the range of 20 Hz to 20 kHz. Some of the HI-FI audio amplifiers may amplify up to 100 kHz. These are used to supply audio frequency power to operate the loud speakers. Most of the modern audio amplifiers are based on solid state dives such as transistors, in early stages they are made of vacuum tubes. 2. Intermediate Frequency Amplifiers (I.F. Amplifiers): Intermediate frequencies are amplified by this amplifier. These amplifiers are used in TV, radio and radar. They provide the maximum voltage amplification of a radio, TV or radar signal, before the video or audio information carried by the signal is demodulated. Their frequency of operation is lower than that of the received radio signal, but higher than the audio or video signals eventually produced by the system. The type of equipment decides the frequency at which I.F. amplifiers operate. 3. Radio Frequency Amplifiers (R.F. Amplifiers): This amplifier increases the power of low-frequency radio signal. These are used to drive antenna of a transmitter. Radio Frequency amplifiers are tuned amplifiers whose the frequency of operation is controlled by the tuned circuit. This circuit can be adjusted depending on the amplifier purpose. Input resistance is generally low, as is gain. A special feature of RF amplifiers is low noise performance. So they are used in the earliest stages of a receiver. The background noise generally produced by any electronic device is kept to a low value as the amplifier handles very low amplitude signals from the antenna. Hence low noise FET transistors used in these stages. 4. Ultrasonic Amplifiers: Ultrasonic amplifiers amplify the ultrasonic waves. These are in the frequency range of around 20 kHz up to about 100 kHz. They are used for specific purposes such as ultrasonic cleaning, ultrasound scanning, remote control systems etc. Each type will operate at narrow band of frequencies within the ultrasonic range. 5. Wideband Amplifiers: Wideband amplifiers will amplify a band of frequencies. They amplify from DC to several tens of MHz They are used in equipment such as oscilloscopes etc. These are used where there is a need to accurately measure signals over a wide range of frequencies. Because of their wide bandwidth, gain is low. 6. Direct Coupled Amplifiers (DC Amplifiers): Direct coupled or DC amplifiers are used to amplify very low frequency signals. The output of one stage is coupled with the input of the next stage in these amplifiers. This amplifier amplifies the DC frequency that is zero frequency. They are mostly used in many electrical control systems and measuring instruments. 7. Video Amplifiers: Video amplifiers are used to improve the video signal and display it with high resolution. The video signal carries all the information about picture in TV and radar systems. They are a special type of wide band amplifier. They are used specifically for signals that are to be applied to video equipment. The bandwidth of video amplifiers depends on use. In TV receivers they extend from 0Hz to 6MHz and is still wider in radar. These amplifiers are used to amplify the signals received from DVDs, computer monitors. They can also be used to amplify the video quality in small TVs that are installed in the vehicles. 8. Buffer Amplifiers: Buffer amplifiers are commonly used to for electrical impedance transformation from one circuit to another. They have amplifier gain of 1.They are used for isolating the circuits from each other. They have high impedance at the input and low impedance at the output . Therefore can be used as impedance matching device. This implies that signals are not attenuated between circuits, which happens when a circuit with high output impedance feeds a signal directly to another circuit having a low input impedance. 9. Operational Amplifiers: Operational amplifiers are high gain electronic voltage amplifiers. The operational amplifiers are used to perform mathematical operations on voltages . They are used in the form of ICs initially they were developed with the vacuum tubes. The operational amplifier has two input terminal mainly. They are inverting and non-inverting. They can be used as inverting amplifiers, non-inverting amplifiers, summing amplifiers, difference amplifier etc. The following figure shows the operational amplifier. Operational Amplifier Symbol Related Post: Function Generator using Operational Amplifier 10. Transistor Amplifiers: Transistor is an electronic device. This is also used as an amplifier. Transistor amplifiers amplify the voltage or current of the input signal. There are two types of transistor devices. 1) BJT (Bipolar junction transistors). 2) FET(Field Effect Transistors). Transistor amplifiers are analyzed in different configurations. They are 1) Common Base, 2) Common Emitter and 3) Common Collector using BJT. By using FET, transistor amplifiers are analyzed in the following configurations. 1) Common Gate, 2) Common Source and 3) Common Drain. In Bipolar Junction Transistors, small current at the terminal of base can control the current at emitter and collector, while in Field Effect Transistors (FET) small voltage at the gate can control the voltage at source and drain. Contributors: jimblom Favorited Favorite 83 Some of the most powerful transistor applications involve amplification: turning a low power signal into one of higher power. Amplifiers can increase the voltage of a signal, taking something from the µV range and converting it to a more useful mV or V level. Or they can amplify current, useful for turning the µA of current produced by a photodiode into a current of much higher magnitude. There are even amplifiers that take a current in, and produce a higher voltage, or vice-versa (called transresistance and transconductance respectively). Transistors are a key component to many amplifying circuits. There are a seemingly infinite variety of transistor amplifiers out there, but fortunately a lot of them are based on some of these more primitive circuits. Remember these circuits, and, hopefully, with a bit of pattern-matching, you can make sense of more complex amplifiers. Common Configurations Three of the most fundamental transistor amplifiers are: common emitter, common collector and common base. In each of the three configurations one of the three nodes is permanently tied to a common voltage (usually ground), and the other two nodes are either an input or output of the amplifier. Common Emitter Common emitter is one of the more popular transistor arrangements. In this circuit the emitter is tied to a voltage common to both the base and collector (usually ground). The base becomes the signal input, and the collector becomes the output. The common emitter circuit is popular because it's well-suited for voltage amplification, especially at low frequencies. They're great for amplifying audio signals, for example. If you have a small 1.5V peak-to-peak input signal, you could amplify that to a much higher voltage using a slightly more complicated circuit, like: One quirk of the common emitter, though, is that it inverts the input signal (compare it to the inverter from the last page!). Common Collector (Emitter Follower) If we tie the collector pin to a common voltage, use the base as an input, and the emitter as an output, we have a common collector. This configuration is also known as an emitter follower. The common collector doesn't do any voltage amplification (in fact, the voltage out will be 0.6V lower than the voltage in). For that reason, this circuit is sometimes called a voltage follower. This circuit does have great potential as a current amplifier. In addition to that, the high current gain combined with near unity voltage gain makes this circuit a great voltage buffer. A voltage buffer prevents a load circuit from undesirably interfering with the circuit driving it. For example, if you wanted to deliver 1V to a load, you could go the easy way and use a voltage divider, or you could use an emitter follower. As the load gets larger (which, conversely, means the resistance is lower) the output of the voltage divider circuit drops. But the voltage output of the emitter follower remains steady, regardless of what the load is. Bigger loads can't "load down" an emitter follower, like they can circuits with larger output impedances. Common Base We'll talk about common base to provide some closure to this section, but this is the least popular of the three fundamental configurations. In a common base amplifier, the emitter is an input and the collector an output. The base is common to both. Common base is like the anti-emitter-follower. It's a decent voltage amplifier, and current in is about equal to current out (actually current in is slightly greater than current out). The common base circuit works best as a current buffer. It can take an input current at a low input impedance, and deliver nearly that same current to a higher impedance output. In Summary These three amplifier configurations are at the heart of many more complicated transistor amplifiers. They each have applications where they shine, whether they're amplifying current, voltage, or buffering. Common EmitterCommon CollectorCommon Base Voltage GainMediumLowHigh Current GainMediumHighLow Input ImpedanceMediumHighLow Output ImpedanceMediumLowHigh Multistage Amplifiers We could go on and on about the great variety of transistor amplifiers out there. Here are a few quick examples to show off what happens when you combine the single-stage amplifiers above: Darlington The Darlington amplifier runs one common collector into another to create a high current gain amplifier. Voltage out is about the same as voltage in (minus about 1.2V-1.4V), but the current gain is the product of two transistor gains. That's β2 -- upwards of 10,000! The Darlington pair is a great tool if you need to drive a large load with a very small input current. Differential Amplifier A differential amplifier subtracts two input signals and amplifies that difference. It's a critical part of feedback circuits, where the input is compared against the output, to produce a future output. Here's the foundation of the differential amp: This circuit is also called a long tailed pair. It's a pair of common-emitter circuits that are compared against each other to produce a differential output. Two inputs are applied to the bases of the transistors; the output is a differential voltage across the two collectors. Push-Pull Amplifier A push-pull amplifier is a useful "final stage" in many multi-stage amplifiers. It's an energy efficient power amplifier, often used to drive loudspeakers. The fundamental push-pull amp uses an NPN and PNP transistor, both configured as common collectors: The push-pull amp doesn't really amplify voltage (voltage out will be slightly less than that in), but it does amplify current. It's especially useful in bi-polar circuits (those with positive and negative supplies), because it can both "push" current into the load from the positive supply, and "pull" current out and sink it into the negative supply. If you have a bi-polar supply (or even if you don't), the push-pull is a great final stage to an amplifier, acting as a buffer for the load. Putting Them Together (An Operational Amplifier) Let's look at a classic example of a multi-stage transistor circuit: an Op Amp. Being able to recognize common transistor circuits, and understanding their purpose can get you a long way! Here is the circuit inside an LM3558, a really simple op amp: The internals of an LM358 operational amplifier. Recognize some amplifiers? There's certainly more complexity here than you may be prepared to digest, however you might see some familiar topologies: Q1, Q2, Q3, and Q4 form the input stage. Looks a lot like an common collector (Q1 and Q4) into a differential amplifier, right? It just looks upside down, because it's using PNP's. These transistors help to form the input differential stage of the amplifier. Q11 and Q12 are part of the second stage. Q11 is a common collector and Q12 is a common emitter. This pair of transistors will buffer the signal from Q3's collector, and provide a high gain as the signal goes to the final stage. Q6 and Q13 are part of the final stage, and they should look familiar as well (especially if you ignore RSC) -- it's a push-pull! This stage buffers the output, allowing it to drive larger loads. There are a variety of other common configurations in there that we haven't talked about. Q8 and Q9 are configured as a current mirror, which simply copies the amount of current through one transistor into the other. After this crash course in transistors, we wouldn't expect you to understand what's going on in this circuit, but if you can begin to identify common transistor circuits you're on the right track!