Lesson 2412-1

Figure 30 explained
Circuit in question

* Denotes resistors are 5W type
1. TR4 and TR5 are connected in (parallel) (push-pull) (push-push).
• To be truly considered to be connected in parallel, the emitters, the bases and the collectors would have to be connected together. Since there is something in-between each of those possibilities, we can eliminate that from our choices. As far as we know, there is not a push-push configuration out there, so the only logical answer to this question is **push-pull** for the configuration.
2. Transistors TR1 and TR2 are connected in the _________ configuration.
• They are connected in the common emitter configuration, or more specifically, the common-emitter voltage-divider bias configuration. We can tell this because the input is on the base of each transistor, with the output being taken from the collector. If the outputs were taken from the emitters instead, then we should have stated common collector configuration.
3. Transistor TR3 is connected in the ______________ configuration.
• This transistor is connected common-emitter. You can tell this by the input being on the base, and the output being taken off the collector (via the transformer T1).
4. Transistors TR4 and TR5 are connected in the __________ configuration.
• Watch this one as your first response would probably be push-pull. While that is true, they still need to be stated as common-base, common-emitter or common-collector. Again, since the input is on the base and the output taken from the collectors, it is a common-emitter. A common base means the input is on the emitter, the output on the collector. The common-collector means the input is on the base, but the output is taken from the emitter.
5. This amplifier (a) (does) (does not) use inverse feedback. If it does, is the feedback local or loop? (b) ___________
• (a) The amplifier does use inverse feedback as the output of a common-emitter circuit is inverted 180° from the input. Since the feedback goes from TR3 to TR1 by passing through TR2, the signal at the base of TR3 is in phase with the signal at the base of TR1. TR3 causes one more inversion (a 180° flip), which makes that statement true. (b) The feedback is a loop, as it has to pass through the components $R_9$ and $C_5$ to make the feedback possible.
6. What is the purpose of $R_9$?
• $R_g$ controls the amount of feedback, as without it basically the loop would be a direct line from the ac considerations. Resistors slow current but they also drop voltage...
7. What is the purpose of $C_5$?
• In this case, knowing the capacitor blocks dc, we would have to say it ensures that only the ac signal is what is being fed back to the input. DC would cause biasing issues, and this would cause the circuit to behave erratically (a possibility we really want to avoid...).
8. What is the purpose of $R_8$?
If you recall our discussion on common-emitter circuits, we used the voltage divider bias as it supplied the best amount of stability without the excess cost of a second supply like the two-supply bias uses. The reason for the emitter resistor ($R_8$) is to provide that stability in the form of temperature control.
9. What is the purpose of $C_6$?
• $C_6$ is used to bypass the emitter resistor of TR2, which increases the gain. There is the tradeoff of losing a slight bit of the temperature stability, but with this particular section the gain is more important.
10. (a) What are the purposes of $R_{12}$ and $R_{13}$? (b) Why do these two resistors not have bypass capacitors across them?
• (a) The resistors are there to keep transistors TR4 and TR5 from overheating (thermal runaway could occur without them), which thereby reduces the amount of distortion present at the output. (b) A capacitor would charge from the output being in essence a pulsating dc, which would cause the signal to drop below the expected values. The reason for this is due to the inability of current to flow with a charged capacitor (to outside appearances, this would be a cutoff transistor).
11. What is the purpose of $R_5$?
• Think of it acting as part of a voltage divider network, with the signal from TR3 being the source for the divider; this makes it part of the feedback network (and the signal is inverted).
12. What is the purpose of $R_{10}$?
• It is basically doing the same thing as $R_5$, but this time without the inversion. It is part of a voltage divider for the beginning of the feedback loop.
13. If you remove resistor $R_2$, you could properly bias TR1 by (a) (increasing) (decreasing) (removing) $R_1$. (b) Why would this not be a good way to bias TR1?
(a) If you remove $R_2$, this removes the voltage divider portion for TR1. To bring it back to the same considerations, we could increase the resistance of $R_1$ (reduce the current since there is no more split from the parallel consideration of $R_2$ and the transistor). (b) It would not be a good idea as now the transistor becomes a base-biased circuit, which is not temperature independent due to $h_{FE}$ ($\beta$) now having its say in the matter. It also means the transistor could not be replaced by the same type of transistor, but that it must be matched exactly with the original transistor’s $h_{FE}$ value.
14. What is the purpose of $C_3$?
• $C_3$ is intended to ensure that if any signal happens to get to the power supply line from TR3 that it will be shorted to ground through this capacitor and not affect the input to TR1. Might not hurt to notice $R_6$ also plays a part in this, but again only to decrease the potential.
15. If the amplifier oscillates, it could be caused by \((C_2) \ (C_5)\) being open.
• If $C_2$ opens, the worst thing we could expect is the signal to decrease. It is only partially bypassing the resistors on TR1, so this would not be an expected cause of oscillation. However, if $C_5$ opens, the feedback loop is gone and now all the circuit would no longer be degenerative. This must mean the opposite occurs so the signal could now oscillate (degenerative feedback inhibits oscillation).
16. Name another capacitor that, if open, might cause the circuit to oscillate. __________
• Since $C_3$ is designed to stop any ac riding on the supply line from getting to the input of TR1, this one opening could cause the same effect as $C_5$ opening.
17. Low gain from the amplifier (could) (could not) be caused by capacitor $C_6$ being open.
• Capacitor $C_6$ is being used in the bypass configuration, and without bypass the gain is lower. Therefore we should be looking for the gain to drop.
18. By what type of coupling is the output of TR1 coupled to the input of TR2?
• The base of TR2 is connected directly to the collector of TR1 so the answer here is and can only be directly coupled.
19. The push-pull stage uses (class A) (class B) operation.
• Since there is no dc biasing on the transistors TR4 and TR5, this indicates class B operation (it takes ac to turn them on).
Any questions?

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