Errata

for

Introduction to Electronic Circuit Design

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(errors marked with an asterisk, *, were fixed in the second printing)

Page	Error
vi	Change the acronym in parentheses following the title of Section 2.8. It should be MESFETs, not MOSFETs. *
vii	Delete "and MOSFETs" from the title of Section 4.3.6. *
11	The equation for i_N in the middle of the page should not have the 10^3 factor in the denominator of the last term.
15	In the 4th line above Aside A1.6, it should say $R_2 >> R_1$, NOT $R_2 >> R_2$.
16	The caption of Figure A1-8 should refer to Figure A1-7, not 1-7.
33	In the first equation in the solution to Exercise 1.3, the subscript 'S' on I_S should be upper case.
63	In the 10th line of text below Figure 2-13, it should say $-x_{dp}$, not x_{dp}.
72	The sentence immediately preceding (2.48) should say "Making use of (2.47) and (2.42) and remembering that $x = 0$ in (2.47) is the same as $x = -x_{dp}$ in (2.42), we obtain." Also, the second line of footnote 12 should read " … small enough to not effect …"
75	In Figure 2-24, the zero on the x-axis should be moved slightly to the left so that $x_{dn} > x_{dp}$.
77	In Figure 2-25, the text in the depletion region should say "drift" not "diffusion". *
87	The typesetting for Equation (2.70) is wrong. The divide-by slash is too long, it should only apply to the exponent. The correct equation is: $n_p(0) = n_{po}e^{V_{BE}/V_T}$.*
94	In Figure 2-39, it should say that $V_{BE3} > V_{BE2} > V_{BE1}$, not the other way around.

112	Equation (2.97) should have $\mathcal{E}(l)$ on the right-hand side as in (2.96).
112	In Equation (2.103), $V_{ch}(l)$ in the integrand should be just V_{ch}. Since we have changed to integrating over voltage, the functional dependence on l is irrelevant.
138	In P2.4, the parenthetical statement is missing the word "on." It should read: (Perhaps you put a soldering iron on it.)
139	2.11 should be replaced by the following: Suppose you want to use two diodes in parallel to pass a large current. You want to be sure that the current is shared approximately equally by the two diodes. **(a)** If they are identical in every way except for their junction areas (measured in the plane perpendicular to the current flow), how much different can their areas be if the currents must be within ±10% of each other? **(b)** Now suppose the diodes are identical except that one of them is at room temperature (300K) and the other is 10ºC hotter. If both of them have 0.6V across them (the voltages *will* be the same if they are in parallel!), what is the ratio of their currents? **(c)** Based on the previous results, do you think that putting discrete diodes in parallel is a practical way to increase their power-handling capacity?
141	In P2.34, it should say "base-width modulation" not "channel-length modulation"
142	In the hint in Problem P2.49, it should say to use (2.101) to help in the change of variables, not (2.111).
138	In P2.10, the "turn-on voltage" is actually defined on page 73 in Section 2.4.2.
141	In P2.39, part (b), it should say that $V_{DS} = -2.5\text{V}$.
198	Delete "and MOSFETs" from the title of Section 4.3.6. *
207	In P4.14 it should say to use V_T = 25.86mV, not 28.6mV.
233	In (5.42), the denominator should have a term $1/\tau_1\tau_2$ instead of the term '1'. In other words, the denominator should be*: $\frac{1}{\tau_1\tau_2} + s\left(\frac{1}{\tau_1} + \frac{1}{R_2C_1} + \frac{1-K}{\tau_2}\right) + s^2$
259	Problem P5.2 is misplaced, it should be listed with the problems for Section 5.4.5 on page 269.
261	The solution for P5.3(b) given on the CD available from Prentice Hall when the book is adopted is incorrect.

264	The final sentence in P5.24 should read "The DC input voltage is 1.5 V." Also, the (jω) terms in this problem should not be subscripts. *
281	Aside A6.2 is confusing – the issue is not really distinguishing between small and large signals, it is between small-signal linearized analysis and DC bias point analysis (which does use large-signal models). The aside should simply be entitled "Notation for small-signal analysis." In addition, the first sentence should read "The notation for small-signal and bias-point analyses is simplified by denoting the "signal" as AC only, even though it may contain a DC component." Also, change the start of the third sentence to read "It is entirely possible – in fact common – for the signal to include …"
285	The equation at the end of the second sentence below (A6.12) is missing parentheses and an exponent. The equation should be: $a_R \ll \left(\alpha_i a_v \alpha_o R_S / r_i\right)^{-1}$
354	At the start of the second new paragraph below (A7.5), the word "If" should be "It." The sentence should begin: "It is often acceptable…"
385	The last sentence in the first paragraph on the page should read "You need to redraw the circuit a bit to see that these circuits are identical."
370	P7.101 should say that I_I varies by ±10%, not V_{CC}.
389	The signs indicating the polarity of v_{bs} in Figure 8-23 are backwards. The plus sign should be on the bottom and the minus sign on top.
398	In the second line above (8.79) the word "ten" was left out. It should read: "to be at least ten times larger…"
399	On the right hand side of Equation (8.83) the leading zero should be deleted; i.e., it should just read 77 mA/V.
401	The first sentence in the paragraph immediately above (8.94) will be clearer if it is changed to read (changes indicated in red); "… the gain ~~cannot be set independently of~~ depends on the DC voltage …"
417	In the first line after (8.131), a_v should be a_{v1}.
422	In the paragraph above (8.150), the text should point out that a unilateral two-port model is an *approximation* for this circuit. The facts that R_i is a function of R_L, see (8.148), and R_o is a function of R_S, see (8.149), clearly show that the circuit is bilateral. Therefore, (8.151) is only approximate and, although thinking about the circuit at that level of abstraction is useful, it is better to derive the gain directly, as in (8.138) or (8.147).

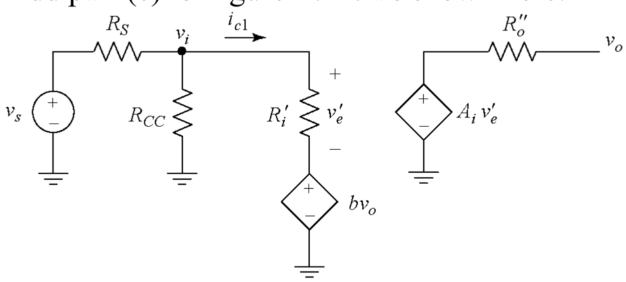
458	In the last sentence of footnote 11, "nonidentity" should be "nonideality"
484	In the solution to Exercise 8.12 part (b), the resistive load would only be 400kΩ if you ignore r_{on}. If r_{on} is included, and we still assume the emitters to be a differential-mode ground, the resistor must be 1.2MΩ, which makes the situation much worse! Also, in the solution for Exercise 8.13, A_{cm} = -0.018 and the CMRR is found using (8.248) and (8.249) to be 10,900 or 81dB.
494	The transistor in Figure 8-152 should be a pnp, not an npn. The emitter is on top (connected to R_E, and the collector is connected to ground.
515	In Figure 9-1, the 'S' subscripts should be lower case.
517	In Exercises 9.1 and 9.2, the 'S' subscripts should be lower case.
517	The sentence immediately following (9.5) should end with the following parenthetical comment: "(i.e., $Q_L = \|Z_L\|/R_s$ and $Q_C = 1/\mathrm{DF} = \|Z_C\|/R_s$)."
521	In the third line of text from the bottom of the page, the inline equation should read (exchange the order of the last two terms so the approximation is correct): $r_e = r_\pi \\| 1/g_m = V_T/I_E \approx 1/g_m$.
523	The peak value in Figure A9-4 should be $1/\tau_F$ (i.e., the 2π should be removed).
529	delete the word "change" from the line immediately above Figure A9-5. *
529	The aside should point out that the circuit in Figure A9-5 *is* unilateral because the voltage amplifier has zero output resistance. That is why the text says the feedback element prevents the overall circuit from "appearing" to be unilateral. The real point here is that even when the voltage amplifier does *not* have zero output resistance (and so the circuit in Figure A9-5 is *not* unilateral), we can frequently approximate the gain of the amplifier as being independent of Z_f and go ahead and find a unilateral circuit as in Figure A9-6 that is *approximately* equivalent to the original.
532	In the 8th line above (9.29), change "make the circuit unilateral by using" to "use". As it stands, this statement is confusing since the Miller *theorem* does not make the circuit unilateral. The circuit is made unilateral by using the Miller *approximation*, which is introduced on page 533.
533	In the 7th line above (9.33) there is a comma that should be deleted to make the

	sentence easier to understand. The 7th line should read: "same element however (C_{oc}), the two …" (the comma after the word element has been deleted)
542	In the fourth line below Figure 9-19, it should read (the change is underlined): "plot uses <u>logarithmic</u> axes and …"
545	In the third line above (9.49), it should read (the change is underlined): "… and <u>logarithmic</u> scales on both …"
549	In Figure 9-30, the element labeled C_{Mout} is a capacitor, not a resistor, so the symbol should be changed.
551	It would be better to not ignore r_b in (9.64). You then get ($R'_S \equiv R_S \Vert R_{BB} + r_b$ on page 549:) $GBW = \underbrace{\left(\frac{R_i}{R_i + R_S}\right)}_{\alpha_i} \frac{g_m R'_L}{(R'_S \Vert r_\pi)C_{in}} \approx \frac{g_m R'_L}{R'_S g_m R'_L C_\mu} \approx \frac{1}{(R_S + r_b)C_\mu}$ The first approximation assumes $\alpha_i \approx 1$, $R'_S \ll r_\pi$ and $C_{in} \approx C_{M_{in}} \approx g_m R'_L C_\mu$. The second approximation assumes $R_S \ll R_{BB}$.
551	In the solution for Example 9.6, just above the first equation, the text refers to Equation (8.109), but it should refer to (8.106).
555	In the caption for Figure 9-34, "see" should be "seen"
557	The comment in the line at the top of the page is wrong – not all three of the transfer functions have DC zeros. In fact, the transfer function given by (9.78) is wrong. If you consider the circuit in Figure 9-36, and denote R_S in parallel with C_S by Z_S, you can write $V_{gs} = V_g - g_m V_{gs} Z_S$. Solving this equation for V_{gs}/V_g and substituting $Z_S = R_S/(1 + j\omega R_S C_S)$ yields the correct form for (9.78) *: $\frac{V_{gs}(j\omega)}{V_g(j\omega)} = \frac{j\omega + \frac{1}{R_S C_S}}{j\omega + \frac{1 + g_m R_S}{R_S C_S}}$
565	In Figure 9-46(a), the capacitor symbol for C_{oc} is missing the left hand vertical line. *
566	There is a typographical error in (9.105). The last term in the equation should be* $\frac{1}{j\omega + \omega_{cH}}$, not $\frac{j\omega}{j\omega + \omega_{cH}}$.

574	In Figure 9-54, the units on the inductor value are incorrect. It should read 10 nH, not 10 nF. *
596	In the numerator of (9.189), r_b should be r_{b2}. Also, the entire resistance shown should be in parallel with $r_{\pi 2}$. Therefore, the equation should be: $\tau_{\pi 2o} = \left[r_{\pi 2} \left\| \left(\frac{R_C + r_{b2} + R_{E2} \| R_L}{1 + g_{m2}\left(R_{E2} \| R_L\right)} \right) \right. \right] C_{\pi 2}$
625	In the solution to Exercise 9.1 the "s" subscript on R_s should be lower case.
626	In the solution for 9.4, the equation for I_C should have V_{CE}/V_A, not V_{CB}/V_A
626	In the solution for 9.5, g_m should be 0.39 mA, not 3.9 mA. This error then propagates to the transistion frequencies, they should be ω_T = 45.3 Grad/s and f_T = 7.2 GHz. Finally, C_{gd} is 2 fF, not 2 pF.
634	Part (a) of Problem P9.3 should say to ignore both parasitic resistors rather than just the series resistance (you can deduce that the parallel resistance should be ignored, but it troubles students and would be better to just say to).
655	In P9.147, remove the comma after the word time.
663	Footnote 2 should say "Do not conclude …" (i.e., add the word "not"
664	In the 5th line down on the page, insert the word forward: "… note that the input voltage of the forward amplifier, …"
665	Add a footnote to the sentence immediately preceding (10.13). The footnote should read: Remember that to find an equivalent resistance we must force either the voltage or current as noted in the discussion relating to (8.67) on page 396.
666	In the line immediately following (A10.3) it should say that for part (d) $i_f = bi_o$ rather than $v_f = bi_o$. Also, delete the final sentence in the caption for Figure A10-1. The sentence you are to delete begins with "The loads may be ideal …"*
667	In the line immediately before (10.21) it should say (change undelined) "parts (c) and (d) of the figure …"
668	In the final line of Exercise 10.3, add the parenthetical comment: "… back (i.e., the one that would control the feedback generator in a two-port model of the feedback network), and then …"

669	The first sentence of the penultimate paragraph should begin "It is not fair, however, to compare the bandwidth …"
675	The first sentence is missing a word. It should read: "…since we want to be able to sum voltages…"
676	The sentence just after (10.38) is confusing because the voltage applied to a port is not determined by the two-port network itself. To be less confusing, the sentence should read: "The input voltage of the two-port network in part (b) of the figure is v'_e, and if the networks in (a) and (b) are equivalent and driven by the same external sources, this will also be the voltage on the input port in part (a) of the figure."
679	In the sentence just before (10.50), when it says "in part (a) of the figure" it should say "in Figure 10.14" instead. Also, to be clear, the line above (10.52) should refer to Figure 10-15 instead of just "the figure" and in the line below (10.52) the phrase "to the real circuit" should be replaced by "to the feedback circuit in Figure 10-14".
680	The final sentence above Figure 10-16 should be two sentences and read as follows (changes indicated in red): We see from our derivation that the voltages are the same in both input loops. Since we equate KVL, and the current is the same at the input to the amplifier, ~~so~~ the results will be useful for finding the gain and input resistance. *
684	Equation (10.73) should read (there is a subscript 'o' missing on one alpha): $v_o = \dfrac{\alpha'_i a' \alpha'_o v_s}{1 + \alpha'_i a' \alpha'_o b}$.
688	In the solution to Example 10.4, it should refer to Figures 10-18(a) and 10-18(b), not 10-12 and 10-13(b).
689	The gain of the controlled source in Figure 10-22 is 100k, not 100kΩ.
691	In Figure 10-24, C_{OUT} should connect to the amplifier in between the two blue regions indicating the forward amplifier and the feedback network to make the discussion clearer. Electrically, it does not matter where C_{OUT} connects along the line going down from the merge terminal of T_3 to R_{M3}, but it should not appear to be connecting inside the feedback network.
693[1]	The caption to Figure 10-25(b) should have the following added to it: As explained in the text, we can't find values for a' and R'_o that will work for all values of R_L since the merge-follower stage is not unilateral. We therefore

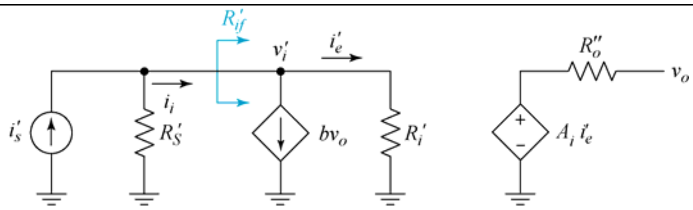
[1] All changes with this footnote on the page number go together.

	absorb R_L into the prime network as well, as shown in part (c) of the figure.
693[1]	Add part (c) to Figure 10-25 as shown here:  (c) The caption for part (c) should read: (c) The circuit after absorbing R_L into the prime network to obtain R_o''. As noted in the text, the gain is now A_i.
693	The following footnote should be added referring to Equation (10.101): Equation (10.101) is only valid when looking into the circuit from v_i (i.e., we have reflected everything to the input side of the network where the current is i_{c1}; since the current in the voltage source bv_o does not affect the voltage, it is unchanged).
693[1]	The text after (10.101) and up to, but not including, (10.103) should be replaced with the following (Equation (10.103) is the same as before and comes immediately after this revised text): We next turn our attention to finding the voltage gain of the prime network. But we again run into a difficulty, this time because the merge-follower stage (T_3) is not unilateral. Therefore, the value of a' will depend on R_L and we can't find values for a' and R_o' that will work for all values of R_L. Nevertheless, we can still find the gains, and even the output resistance, if we now also absorb R_L into the circuit as shown in Figure 10-25(c), where the output resistance has now been denoted by R_o'' and will be found shortly. Also note that since there is no current in R_o'', v_o is equal to the output voltage of the controlled source and, therefore, the gain of the controlled source is now A_i since $$A_i \equiv \left.\frac{v_o}{v_i}\right\|_{b=0} = \frac{v_o}{v_e'}. \qquad (10.102)$$ We now turn our attention to finding the gain for the circuit in part (a) of the figure and write
694[1]	In Figure 10-26, the resistor labeled R_{bi} should be labeled $R_{bi}\|\|R_L$. Also, in the caption, the words "open-circuit" should be deleted.
694[1]	The parenthetical sentence above (10.104) should be deleted and (10.104)

	should be modified to: $\dfrac{v_o}{v_{o2}} = \dfrac{(a_{im3}+1)(R_{bi}\Vert R_L)}{(a_{im3}+1)(R_{bi}\Vert R_L)+r_{cm3}}$
694[1]	Equation (10.105) should be changed to: $R_{i3} \equiv \dfrac{v_{o2}}{i_{c3}} = r_{cm3} + (a_{im3}+1)(R_{bi}\Vert R_L)$.
694	In the sentence immediately after (10.105) it should refer to Figure 10-25(a).
695[1]	In the line immediately preceding (10.110) it should say, "to (10.102), which was obtained for part (c) of the figure …"
695[1]	Equation (10.110) should be changed to: $A_i = \left(\dfrac{r_{cm1}}{r_{cm1}+(a_{im1}+1)R_{bo}}\right)(-g_{m1}R_{i2})(-g_{m2}(R_{O2}\Vert R_{i3}))\left(\dfrac{(a_{im3}+1)(R_{bi}\Vert R_L)}{(a_{im3}+1)(R_{bi}\Vert R_L)+r_{cm3}}\right)$.
695[1]	In the paragraph below (10.110), the two references to R_o' should be changed to R_o'', the reference to Figure 10-25(b) should be changed to 10-25(c), and the reference to the $a'v_e'$ source should be changed to $A_i v_e'$.
695[1]	Equation (10.111) should be changed to: $R_o'' = R_{bi}\Vert R_L \Vert R_x$.
695[1]	In part (a) of Figure 10-27, the resistor R_{bi} should be $R_{bi}\Vert R_L$.
696[1]	In the first line after (10.115) the reference to Figure 10-25(b) should be changed to Figure 10-25(c).
697[1]	Equation (10.118) should be changed to: $A_s' \equiv \left.\dfrac{v_o}{v_s'}\right\vert_{b=0} = \dfrac{v_e'}{v_s'}\dfrac{v_o}{v_e'} = \left(\dfrac{R_i'}{R_i'+R_S'}\right)A_i = \alpha_i' A_i$.
697[1]	The sentence preceding (10.122) and (10.122) itself should be replaced by (there is now new material after Equation 122 as well): The output impedance with feedback can be found in exactly the same way we found (10.84). The only differences are that we have R_o'' instead of R_o', the controlled source gain is $A_i v_e'$ instead of $a'v_e'$, and the impedance we are finding is not the output impedance seen by the load (since we have absorbed R_L into R_o''). Therefore, we denote this output resistance as R_{of}' and find $R_{of}' = \dfrac{R_o''}{1+\alpha_i' A_i b}$. (10.122)

	To find the actual output impedance seen by the load, we look back at Figure 10-25 parts (b) and (c) and recognize that R'_{of} is the resistance seen looking into the output of each part from the right. Therefore, considering part (b) of the figure and remembering that R_{of} is defined as the resistance seen looking to the left from R_L, we realize that $R'_{of} = R_{of} \Vert R_L$ and, therefore, $$R_{of} = \frac{1}{\frac{1}{R'_{of}} - \frac{1}{R_L}}. \qquad (10.122B)$$ It is not at all obvious that this result for R_{of} is independent of R_L as it must be since R_L shows up in several places in the equation for R'_{of}, but in fact, R_L does completely cancel out of the result as it should (it take a couple pages of algebra to prove this to yourself!).
697[1]	Equation (10.123) should be changed to: $\omega_{sf} = \omega_p \left(1+\alpha'_i A_i b\right) = \omega_p \left(1+L_s\right)$.
697[1]	The sentence beginning immediately after (10.124), which includes Equation (10.125), should be changed to read: "where A_i was found in (10.110)." Note that making this change involves deleting (10.125) .
707	The '2' in Equation (A10.5) should be a '1': $R_{o3} \approx \left(1+g_m r_{cm3}\right) r_{o3} = \left(a_{im3}+1\right) r_{o3}$.
714[2]	The following should be added immediately before the last sentence beginning above Figure 10-41, which begins "By direct analysis …": As we saw before in Figure 10-25, we again run into a difficulty because the merge-follower stage (T_3) is not unilateral. Therefore, the value of a' will depend on R_L and we can't find values for a' and R'_o that will work for all values of R_L. Nevertheless, we can still find the gains, and even the output resistance, if we now also absorb R_L into the circuit as shown in Figure 10-41(c), where the output resistance has now been denoted by R''_o as before. Also note that since there is no current in R''_o, v_o is equal to the output voltage of the controlled source and, therefore, the gain of the controlled source is now A_i.
714[2]	Add part (c) to Figure 10-41 as shown here:

[2] All changes with this footnote on the page number go together.

	 (b) The caption for part (c) should read: (c) The circuit after absorbing R_L into the prime network to obtain R_o''. As noted in the text, the gain is now A_i.
715[2]	(10.213) should be changed to: $R_o'' = R_{bi} \left\| \left(\frac{r_{cm2}+R_{O1}}{1+a_{im2}} \right) \right\| R_L$
715[2]	(10.214) should be changed to: $A_i = \left.\frac{v_o}{i_i}\right\|_{b=0} = \frac{v_o}{i_e'} = \frac{v_o}{i_{c2}}\frac{i_{c2}}{i_e}\frac{i_e}{i_e'}$ $= (1+a_{im2})\left(R_{bi}\\|R_L\right)\left(\frac{-a_{im1}R_{O1}}{R_{O1}+r_{cm2}+(1+a_{im2})\left(R_{bi}\\|R_L\right)}\right)\left(\frac{R_{bo}}{R_{bo}+r_{cm1}}\right)$
715[2]	Replace the material beginning with the sentence immediately before (10.215) and ending with (10.216) with: To find the input resistance we first note that $i_e' = i_i - bv_o = i_i - A_i b i_e' \Rightarrow i_e' = \frac{i_i}{1+A_i b}, \quad (10.215)$ and then use this to derive $R_{if}' = \frac{v_i'}{i_i} = \frac{i_e' R_i'}{i_i} = \frac{R_i'}{1+A_i b} = \frac{R_i'}{1+L_i}. \quad (10.216)$
715[2]	Replace the sentence immediately before (10.218) and (10.218) itself with: The resistance seen looking into the output of Figure 10-41(c) is R_{of}' and is found by setting i_s' to zero, driving the output with a source (equal to v_o), and taking the ratio of v_o to the current from it, i_o: $i_o = \frac{v_o - A_i i_e'}{R_o''} = \frac{v_o\left(1-\alpha_i' A_i b\right)}{R_o''} \Rightarrow R_{of}' = \frac{v_o}{i_o} = \frac{R_o''}{1+\alpha_i' A_i b}, \quad (10.218)$
715[2]	Replace the sentence immediately before (10.220) and (10.220) itself with:

	The actual output resistance is then found by considering Figure 10-41(b) and remembering that R_{of} is defined as the resistance seen looking to the left from R_L. Therefore, we realize that $R'_{of} = R_{of} \Vert R_L$ and obtain $$R_{of} = \frac{1}{\frac{1}{R'_{of}} - \frac{1}{R_L}}. \qquad (10.220)$$
715[2]	Replace the sentence immediately before (10.221) and (10.221) itself with: Finally, we obtain $$A_{if} = \frac{v_o}{i_i} = \frac{A_i}{1 + A_i b} = \frac{A_i}{1 + L_i}. \qquad (10.221)$$
718	To be more precise, the third line up from the bottom should read: “the input dictates that the error term is a current ~~current is what is fed back~~; but since…”
727	At the bottom of the page, the penultimate sentence should say the angle of $L(j\omega_{180}) = \pm 180^{\circ}$ rather than just 180º, and the last sentence should say $\lvert L(j\omega_{180})\rvert$ rather than $\lvert L(j\omega)\rvert$.
732	The right-hand sides of equations (10.252), (10.253) and (10.255) should all be multiplied by a_0.
734-735	In Example 10.8, “ζζ” should be “ζ”, “ζ_n” should be “ζ_f” (2 places), “ω_{fn}” should be “ω_{nf}” and “f_{fn}” should be “f_{nf}”. Also, the solution should list $A_{f0} = 0.67$ and the plot in Figure 10-65 should have 0.67 as its final value, not 1.
736	In Figure 10-68, the slope of the magnitude plot should be -60 dB/dec after 100 Mrad/s.
742-743	What is called a “lead-lag” network here should just be called a “lead” network and what is called a “lag-lead” network here should just be called a “lag” network. Also, Figure 10-73 is not drawn correctly, a correct figure is included at the end of this errata. The last sentence of the 1st paragraph on pg. 743 should say “The net result is that ω_u is reduced and the PM increased.” Also, the 2nd sentence of the 2nd paragraph should read “In this technique, a zero-pole pair is used to produce a phase bulge that increases the PM.”
744	In the statement of the Barkhausen criterion at the top of the page, “wo” should be “ω_0”.

750	In the second line from the top of the page, the sentence that begins "Evaluating (10.270) …" should be deleted. No numbers were given in this equation!
751	In the last sentence of the penultimate paragraph, the final two equations should be (an α^2 is missing): $R_{eff} \approx \left(\alpha^2 \left(R_2 \Vert r_{cm}\right)\right) \Vert r_o$ and $\left\vert L(j\omega_0)\right\vert \approx \left(g_m/\alpha\right)\left(\alpha^2\left(R_2 \Vert r_{cm}\right)\right)\Vert r_o$.
753	In Figure 10-89, there should be a resistor, R_2, connected from the control terminal of T_1 to ground.
760	The 3rd line up from the bottom of the solution to 10.3 should read: "… The variable being fed back is v_o and the input summation …"
762	In the solution to Exercise 10.10, A_s = 4.52k, not 4.78k.
766	In the solution to Exercise 10.18, A_i, A_{if} and v_o/v_i should all be negative.
766	In the solution to Exercise 10.21, using $R_5 = R_6 = 6.7\text{k}\Omega$ does not work. The diodes do not limit the amplitude fast enough, so the opamp nonlinearity still gets involved and the distortion is still bad (look at the transient output waveform and notice it still clips at ±5V). If you set $R_5 = R_6 = 4.5\text{k}\Omega$ instead, you will see the total harmonic distortion reduced to 3.1% (you must reset the center frequency in the transient set-up dialog box to 9.9825kHz because the frequency of oscillation is much closer to the designed value of 10kHz when it is that much more linear) and if you look at the transient solution you will see that the waveform is no longer clipped by the op amp. If you reduce R_5 and R_6 further however, the distortion will go up again because there is a more drastic change in the gain when the diodes turn on. For example, if you set $R_5 = R_6 = 3\text{k}\Omega$, the total harmonic distortion increases to over 6.5%.
774	Problem P10.14 should appear just *below* the heading "***Series-Shunt Connection***" not above it. The type of reasoning expected here is illustrated by the second paragraph on page 692.
774	In Problem P10.17 the final sentence reads: "Explain how you find each parameter and provide the raw output as well as the final answer." This statement means you are to explain how you use SPICE to confirm the results obtained in Problem 10.16 (i.e., A_{if}, A_{sf}, R_{if} & R_{of}) and include the raw SPICE output as well as the answer obtained. This statement appears in a number of other problems (marked with an 'S') as well and has a similar meaning in each of them.
776	In Figure 10-115, the output voltage, v_o, is taken from the top of R_{E3}.

782	In Figure 10-124, "V_{DD}" should be labeled "V_{OUT}".
785	In Figure 10-128, the rightmost resistor should be labeled R_L and have a value of 1 kΩ. The voltage at the top of this resistor is v_o.
788	P10.76 part (a) is asking for the minimum *low-frequency* closed-loop gain, A_{f0}
795	In P10.105, it should say in the first sentence to ignore the V_{start} voltage source for this problem. Also, in Figure 10-145 the value of inductor L_1 should be 2 mH, not 2 mA.
832	in the second line below (11.52), it should read (added text italicized) "… setting the square of (11.50) equal to one half *the square* of (11.52)." *
868	In Figure 12-7, the value of $C1$ should be 0.5 μF, not 0.5 μA as printed. Also, the time axis on the plot has the final number on the right cutoff, it should 10 ms. *
876	The text in between (12.8) and (12.9) should read "Now solve (12.8) for i_L, which is $i_{L\max}$. Then find $v_{L\max} = i_{L\max} R_L$;"
876	In the last line of the paragraph after (12.9), there should be a minus sign in front of V_{COUT} so that the equation reads $v_{L\min} = -V_{COUT} = -V_O$.
878	In (12.13) the term $\left(V_{CC} - V_C\right)$ should all be in math font.
880	The following comment should be added at the end of the solution to Example 12.3: The waveforms shown in Figure 12-28 are accurate so long as the output does not *stay* clipped for too long. The waveform shown has a non-zero DC component and, therefore, if the input isn't changed, the DC voltage across C_{OUT} will change over time. We will ignore this point since we are interested in instantaneous clip limits (i.e., the voltages at which the output will just start to clip if the input amplitude is increased), but it should be remembered that because of the coupling capacitor, the DC component of v_O for a circuit like this will always be zero in steady state.
882	In the middle of the paragraph above Exercise 12.3 the maximum average load power should be 162 μW, not 1.62 μW, and the efficiency should be 3%, not 0.03%.
883	The first paragraph of the solution to Example 12.4 should be reworded as follows: The minimum output voltage of this cascade may be limited by either stage. If the base of Q_2 can swing far enough, the emitter follower will limit the

	minimum output voltage to the value given by (12.24). For this example, that limit works out to be $v_{O\min}(\text{EF}) = -2.3\,\text{V}$. The maximum output voltage is determined by the combination of the two stages, which we analyze next.
883	In the caption to Figure 12-34, v_{E2} should be in math font as shown here.
883	The sentence before (12.28) and (12.28) should be changed to read: Finally, the maximum instantaneous output is $$v_{O\max} = v_{E2\max} - V_{E2}, \quad (12.28)$$
884	The first paragraph on this page should be deleted and should be replaced by the continuation of the sentence that included (12.28): which results from the combination of the two stages.
884	In (12.29), R_{Th} should be $R'_{Th} = R_{Th}/(\beta+1)$ as is true for R_C in Figure 12-34(b).
886	At the end of the first line below (12.34), it should refer to Q_2, not Q_1.
897	Equations (12.64) and (12.65) are both missing a factor of ½ in front of the d^2v_o/dt^2 term. *
906	Equation (12.112) is missing a square on the last term in parentheses. The equation should be: $i_{D1}^2 - I_{SS}i_{D1} + \frac{1}{4}\left(I_{SS} - Kv_i^2\right)^2 = 0$
930	In the first line of P12.20 it should say to derive an equation for V_C, not R_C. Also, in P12.21, the equation for $v_{O\min}$ should have "R_{EA}" instead of "R_{E2}".
950	In Exercise 13.4, it should ask how much R_0 can change, not how much R_7 can change. Also see the corrections to the solution on page 959.
952	In Figure 13-13, the digital input b_0 should connect to the control terminal of a generic transistor (T_{0A}) – the transistor is missing from the schematic! T_{0A} and T_{0B} should be a differential pair just like T_{1A} and T_{1B}.
959	The equation shown in the solution to Exercise 13.4 is for a 7-bit DAC, not an 8-bit DAC. To be correct for this exercise, the equation should be: $\frac{1}{781.25(1-x)} - \frac{1}{781.25} = \frac{1}{100{,}000}$, which does produce the numbers given. In addition, the five places in the solution where it refers to R_7, it should say R_0.
970	In (14.12), the first equation should read: $AB = BA$.

993	In Figure 15-1(b), t_{ss} should be slightly further to the right so that it is clear that it occurs *after* the condition $i_D \approx I_F$ is reached.
994	The line immediately following (15.3) should have the phrase "and flows by diffusion across the depletion region." deleted, so the preceding sentence should conclude with (15.3). While technically correct, the added statement is a bit confusing; a more complete explanation is given in Aside 15.1.
994	In the last sentence of the 2nd paragraph on the page, the parenthetical reference to Aside 15.1 should be removed. The aside does not show the charge continuing to build up until steady-state is reached.
994	In the sentence immediately preceding (15.6) and in (15.6) itself, the average minority-carrier lifetime (or transit time) of the diode is denoted by τ_T, while earlier, in (15.2) and Chapter 9, it was denoted by τ_F. This change was not intentional, but both notations are used (SPICE uses TT, as noted in Chapter 4 and Appendix B).
995	In the 3rd line above Figure 15-3, it should say that the reverse recovery time from the simulation is about 16ns. The last line of this paragraph should then end "… $t_{rr} = 16$ ns, which agrees with the simulation (exact agreement is *not* typical).
996	In Figure 15-4, the times t_s and t_{sb} are labeled incorrectly. They should not end when V_D (or V_{Db}) is zero. Rather, they should end when V_D (or V_{Db}) starts to change from its forward bias value towards -3V. Therefore, t_s is about 2ns and t_{sb} is about 5ns.
996	In the sentence immediately preceding Exercise 15.1 and in the exercise itself, the average minority-carrier lifetime (or transit time) of the diode is denoted by τ_T, while earlier, in (15.2) and Chapter 9, it was denoted by τ_F. This change was not intentional, but both notations are used (SPICE uses TT, as noted in Chapter 4 and Appendix B).
996	The following sentence should be inserted just in front of the last sentence on page 996 (in Aside A15.1): The external current reaches its steady-state value before Q_F does (it takes on the order of $2\tau_F$ for Q_F to reach its steady-state value).
997	In Figure A15-1(b), t_{ss} should be slightly further to the right so that it is clear that it occurs *after* the condition $i_D \approx I_F$ is reached.

1016	In Figure 15-18, the transfer characteristic should not go to zero volts for large V_I . It should approach a non-zero value (as in Figure 15-21(b)).
1019	Equation (15.39) is missing a term, there should be a term $\frac{V_{DD}R_{DS1}}{R_{DS1}+R_{DS2}}$ added to the right-hand side so that the equation is: $$V_O = K\left(R_{DS1} \| R_{DS2}\right)\left(V_{DD}-2V_{th}\right)\left(V_{DD}-2V_I\right)+\frac{V_{DD}R_{DS1}}{R_{DS1}+R_{DS2}}$$
1020	Equation (15.42) has a typo (V_{GS2} should be V_{SG2}) and is missing the same term that (15.39) is. Therefore, the equation should be: $$V_O = K\left(V_{SG2}-V_{th}\right)^2\left(R_{DS1} \| R_{DS2}\right)+\frac{V_{DD}R_{DS1}}{R_{DS1}+R_{DS2}}$$ $$= K\left(R_{DS1} \| R_{DS2}\right)\left(V_{DD}-V_I-V_{th}\right)^2+\frac{V_{DD}R_{DS1}}{R_{DS1}+R_{DS2}}$$
1021	In the 3rd sentence of the first paragraph, the statement made ignores the fact that the two resistors will not be equal since $K_p \neq K_n$. Therefore the currents are not equal when $V_O = V_{DD}/2$, but are equal for some V_O slightly removed from that point.
1023	In the very last line on the page it is worth pointing out that the statement assumes C_L is constant, which is not true if the inverters drive other inverters that also change size.
1024	The conclusion stated in (15.54) and the text (on the bottom of page 1023) is correct, but misleading. It is *only* true if C_L is fixed. But, C_L comprises capacitance from the stage driving the load (due to the C_{gd} 's of the transistors), the input capacitance of the next gate(s), and some parasitic capacitances (e.g., the wires connecting the output to the next gates). For gates internal to an IC, all but the parasitic capacitances will also scale with the (*W*/*L*) of the inverter transistors and, in this case, (15.54) does not give the complete story and is misleading since C_L is not constant. See [15.7] for a more detailed discussion.
1067	The answer to Exercise 15.7 is incorrect. With three PMOS transistors each having 7.5 times the minimum and three minimum-size NMOS transistors, the total should be the equivalent of 25.5 minimum-size transistors, not 24.5.
1071	The 3rd sentence in P15.4 should not begin with "If" – in other words, it should begin "The inputs are 0 V when low …." Also, the problem should say to assume that the sources driving v_A and v_B are ideal (i.e., they have zero output

	resistance).
1076	P15.44 should say that V_{DD} = 5V.
1104	In the 14th line down from the top it should say that Vth=±0.5 V and in the 4th line up from the bottom it should say that Vth=±1 V
1105	In the 5th line down from the top it should say that Vth=±1 V
1107	The answer to P1.7 should be: $\frac{v_O}{v_S} = -G_m\left(R_3 \parallel R_4\right)\left(\frac{R_2}{R_1+R_2}\right)$.
1108	The answers given for P6.12(a) are wrong. They should be 4.70mA and 5.31V.
1116	In the solution to P15.25, the best case solution for t_{pLH} should be 2.5/3, not 3/2.5.
1117	There should be index entries for "AM demodulator, 868" and "Amplifier efficiency, 877, 908" *
1118	Under the heading *Amplitude Modulation*, the next line should read "Aside 815-816", not "filters, 815-816". Also, the correct page for the Bandwidth shrinkage factor is 838, not 840. *
1119	Under the heading Charge-control analysis, MOS digital circuits, it should say pages 1022-1024
1121	Under the index entry "Demodulate", there should be an entry "AM, 868" *
1121	The page for De Morgan's theorems is 970, not 972
1122	There should be an index entry for "Efficiency of amplifiers, 877, 908" *
1126	The entry for "Notation" should read: Notation, 31-32 summary, 32 for small-signal analysis, 281
1127	The correct page number for finding Optimum scaling of CMOS inverters is 1025, not 1027. *
1130	Add page 378 to both the "Split-source transformation" and "Source, absorption theorem" entries.
1132	The correct page reference for the Worst-case analysis of DC biasing is 353-356.

* This error has been fixed in the second printing.

The new Figure 10-73 is shown below:

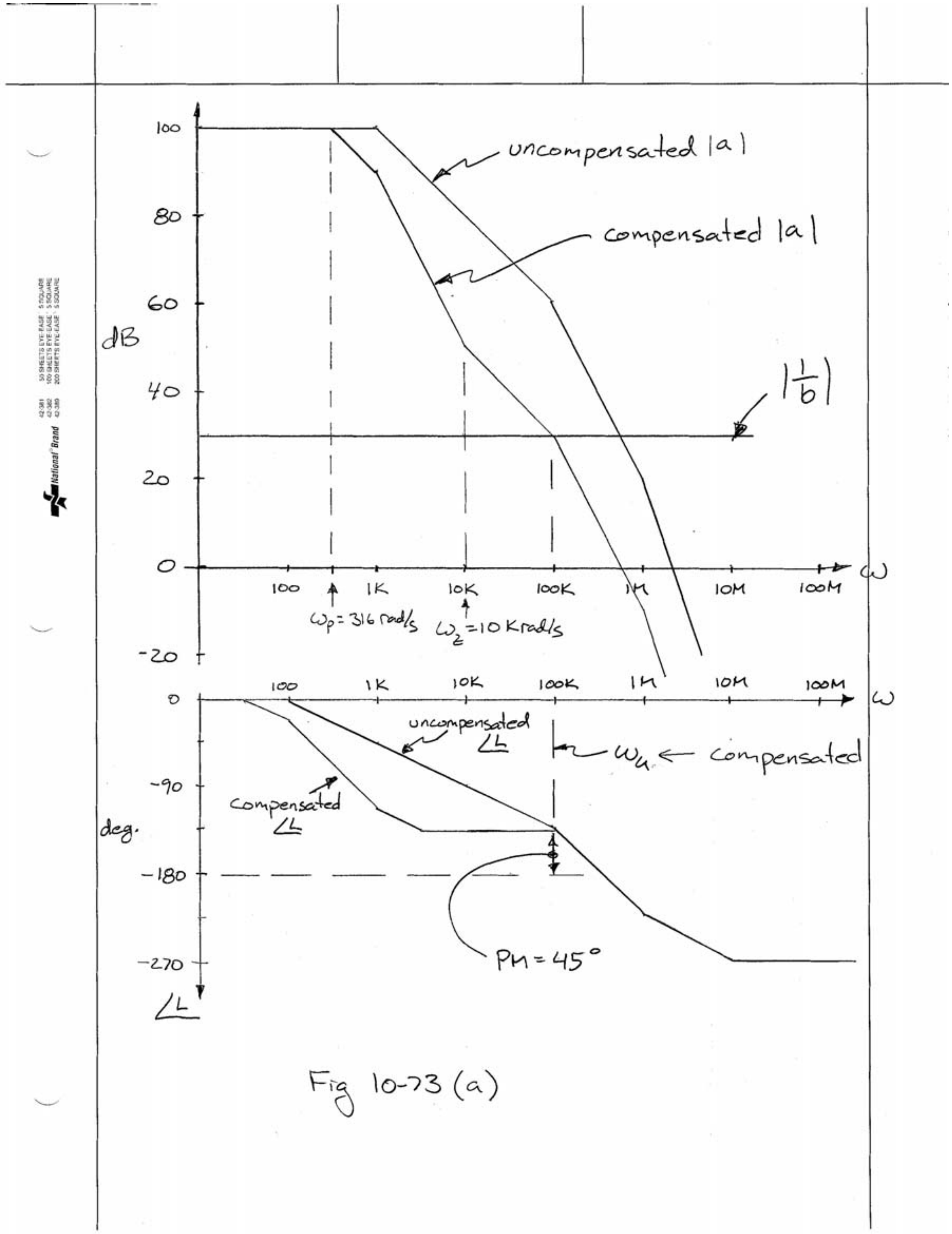


Fig 10-73 (a)

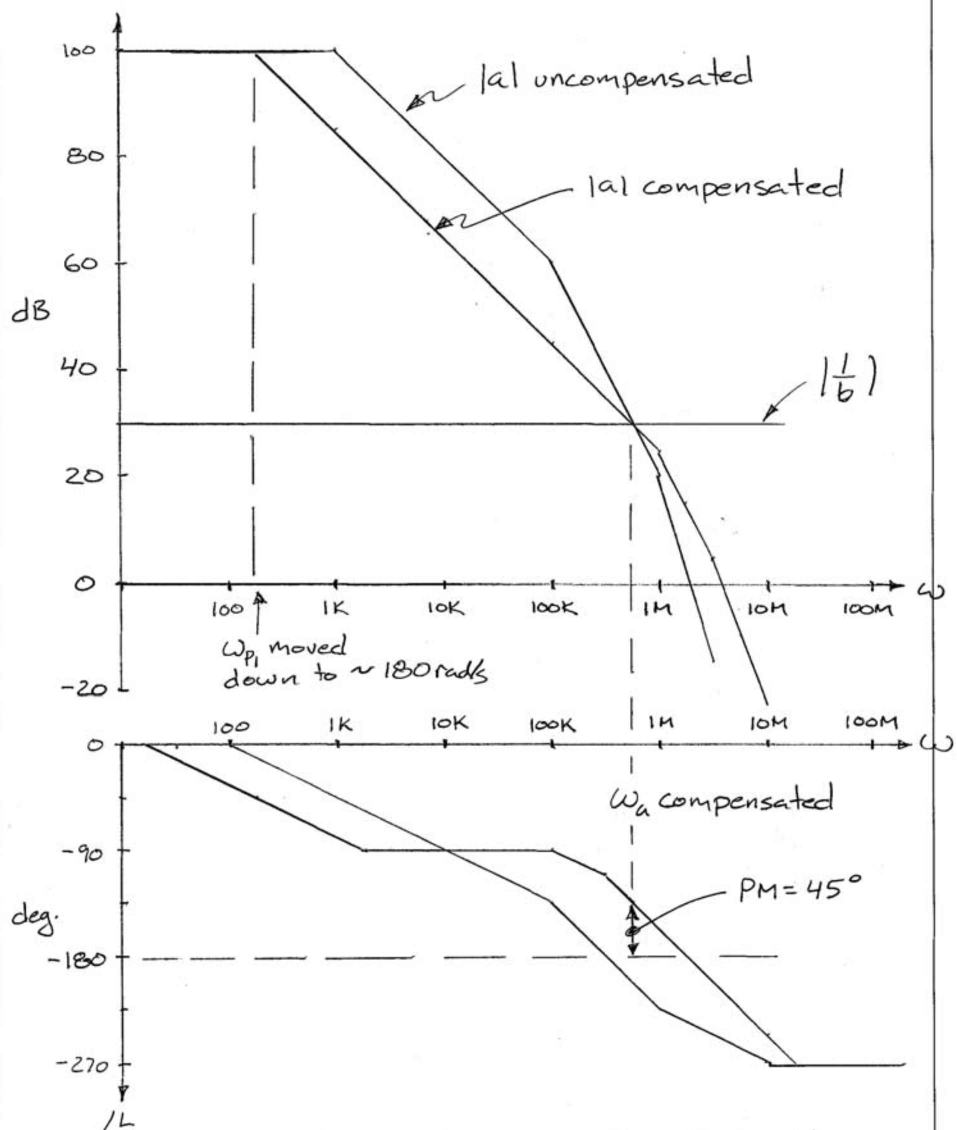


Fig. 10-73 (b)

$\omega_z = 100$ Krad/s

$\omega_p = 32$ Mrad/s

↑ compensation