Ultra Low Power Bioelectronics
Book Errata

March 19, 2012

Chapter 1

Page 8 5^{th} line from the bottom, replace *Chapter 22* with *Chapter 21.*

Chapter 2

Page 34 Figure 2.4, Topmost part, The + and - symbols should be swapped (within the triangular Op-Amp schematic).

Chapter 3

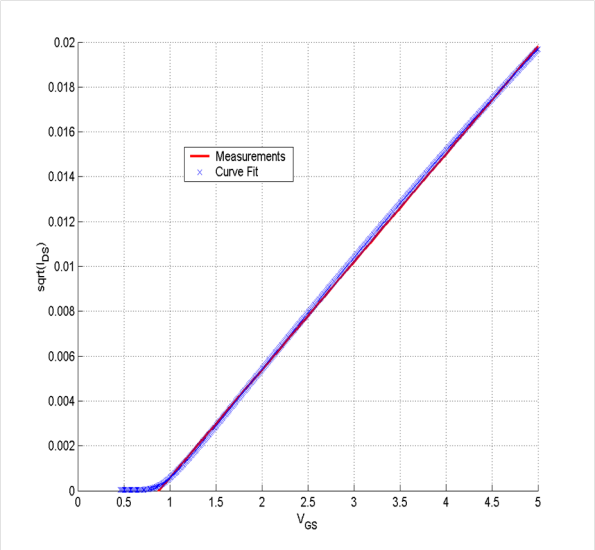
Page 79 Equation (3.15) should be corrected to:

$$n_0(y) = N_A e^{-v_{CB}/\phi_t} e^{-2\phi_F/\phi_t} e^{+\psi(y)/\phi_t}$$

Chapter 4

Page 84 line 6, replace $\frac{\gamma}{\sqrt{2\psi_{se}}}(\psi_S - \psi_{se})$ with $\frac{\gamma}{2\sqrt{\psi_{se}}}(\psi_S - \psi_{se})$

Page 100 Replace figure 4.8 with corrected figure as follows:



Chapter 5

Page 105 Equation (5.8) should be replaced by:

$$g_{mb} = \frac{\partial I_{0S}}{\partial V_{TS}} \cdot \frac{\partial V_{TS}}{\partial v_{BS}} = \left(-\frac{\kappa_S}{\phi_t} I_{DS}\right) \cdot \left(-\frac{1-\kappa_S}{\kappa_S}\right)$$
$$= \frac{(1-\kappa_S)\, I_{DS}}{\phi_t}$$

That is, I_{OS} Should be replaced by I_{0S} at the beginning of the equation

Page 106 Equation (5.12) should be replaced by

$$\frac{\partial i_{DS}}{\partial v_{DS}} = \frac{I_{0S} e^{\kappa V_{GS}/\phi_t} e^{-V_{DS}/\phi_t}}{\phi_t}$$
$$g_{ds} = \frac{I_{DSAT}}{\phi_t} e^{-V_{DS}/\phi_t}$$

hat is, I_{OS}Should be replaced by I_{0S} at the beginning of the equation

Page 117 Equation (5.40) should be replaced by:

$$C_{gs} = \frac{2}{3} WLC_{ox} \left(\frac{1+2\eta}{(1+\eta)^2}\right), \quad C_{gd} = \frac{2}{3} WLC_{ox} \left(\frac{\eta^2+2\eta}{(1+\eta)^2}\right)$$
$$C_{bs} = \left(\frac{1-\kappa_S}{\kappa_S}\right) C_{gs}, \quad C_{bd} = \left(\frac{1-\kappa_S}{\kappa_S}\right) C_{gd}$$
$$C_{gb} = WLC_{ox} \left(\frac{1-\kappa_S}{3}\right) \left(\frac{1-\eta}{1+\eta}\right)^2 = (1-\kappa_S)\,(WLC_{ox} - (C_{gs} + C_{gd}))$$

i.e. the third line has C_{ox} replaced by WLC_{ox}.

Page 119 Line right below equation (5.43), replace *Italicized "1"* with Roman "1". i.e. replace $^{1-\kappa_S}/_{\kappa_S}$ with $^{1-\kappa_S}/_{\kappa_S}$

Page 122

1. Equation (5.47) should be replaced by:

$$C_{gs} = C_{gsi} + C_{gse}$$
$$C_{gd} = C_{gdi} + C_{gde}$$
$$C_{bs} = C_{bsi} + C_{bse}$$
$$C_{bd} = C_{bdi} + C_{bde}$$
$$C_{gb} = C_{gbi} + C_{gbe}$$

That is, in the seconf line, C_{ds}, C_{dsi} and C_{dse} should be replaced by C_{gd}, C_{gdi} and C_{gde}respectively.

2. Equation (5.48) should be replaced by:

$$C_{gbi} = \frac{C_{ox} C_{dep}}{C_{ox} + C_{dep}} WL$$
$$= \frac{C_{ox} C_{ox} \left(\frac{1-\kappa_S}{\kappa_S}\right)}{C_{ox} + C_{ox} \left(\frac{1-\kappa_S}{\kappa_S}\right)} WL$$
$$C_{gbi} = C_{ox}\,(1-\kappa_S)\, WL$$

i.e. all three lines of the equation should be multiplied byWL.

3. Equation (5.49) should be replaced by:

$$C_{gs} = C_{gse}, \quad C_{gd} = C_{gde}$$

$$C_{bs} = C_{bse} \quad C_{bd} = C_{bde}$$

$$C_{gb} = WLC_{ox}\left(1 - \kappa_S\right) + C_{gbe}$$

i.e. $C_{ox}\left(1 - \kappa_S\right)$ in the third line should be replaced by $WLC_{ox}\left(1 - \kappa_S\right)$

Chapter 7

Page 162 line 4, replace *'larger mean free times'* with *'smaller mean free times'*

Page 164 last line, replace a_2 with α_2 (Note: replacement is italicized).

Page 182 first paragraph, second to last line replace *'Chapter 23'* with *'Chapter 24'*

Chapter 8

Page 211 13th line, replace *'1/x_0 dependence'* with *'C_0/x_0 dependence'.*

Chapter 9

Page 216 Figure 9.5, The x-axis mark $\frac{1}{8}$ should be replaced by $-\frac{1}{8}$.

Page 220 Figure 9.9a the label *'1.0'* should be moved down and be situated at the origin where the X-axis and the Y-axis cross.

Page 228 Equation (9.13) should be replaced by:

$$H_{cl}\left(s\right) = \frac{L\left(s\right)}{1 + L\left(s\right)}$$

$$= \frac{\left(\frac{A_{lp}}{A_{lp}+1}\right)}{\frac{\tau_{big}\tau_{sml}}{A_{lp}+1}s^2 + \frac{\left(\tau_{big}+\tau_{sml}\right)}{A_{lp}+1}s + 1}$$

Chapter 11

Page 277

1. Equation (11.3) should be corrected to:

$$\frac{v_{out}\left(s\right)}{i_{in}\left(s\right)} = \frac{1}{g_f}\left(\frac{{}^{A}/_{(1+A)}}{1 + \frac{{}^{sC_{in}/g_f}}{1+A}}\right)$$

$$\text{Where } g_f = \frac{\kappa_S I_{IN}}{{}^{kT}/_{q}}$$

$$\Rightarrow v_{out}\left(s\right) = \frac{kT}{\kappa_S q}\left(\frac{i_{in}}{I_{IN}}\right)\left(\frac{{}^{A}/_{(1+A)}}{1 + \frac{{}^{sC_{in}/g_f}}{1+A}}\right)$$

2. Equation (11.4) should be corrected to:

$$v_{out}(s) = \frac{kT}{\kappa_S q}\left(\frac{\Delta I_{IN}(s)}{I_{IN}}\right)\left(\frac{{}^{A}/_{(1+A)}}{1+\frac{{}^{sC_{in}}/_{g_f}}{1+A}}\right)$$

Page 280 Caption for figure 11.3, replace $I_1 with\ I_1$.

Page 285 Equation (11.9) should be replaced by:

$$r_o = r_o^{M_4} \parallel \left(r_o^{M_2}\left(1+g_s r_o^{M_1}\right)+r_o^{M_1}\right) \approx r_o^{M_4}$$

$$g_A = \kappa g_s = \frac{\kappa I_A}{\phi_t} = g_m \text{ of } \mathrm{M}_1$$

$$A = \frac{v_{out}}{v_{in}} = -g_A r_o$$

$$v_n^2(f) = \frac{4qI_A}{g_A^2}$$

i.e. on the second line, ϕ_T should be replaced by ϕ_t

Page 287 Figure 11.10(a) in the south-west corner, replace $\sqrt{\frac{4qI_A}{g_s^2}}$ with $\sqrt{\frac{4qI_l}{g_s^2}}$. i.e. replace I_A with I_l.

Page 293

1. Line 1, g_A^2 should be replaced by g_A
2. Line 5, replace $A_{lp} = {}^{A}/_{A_{cl}}$ with $A_{lp}^2 = \left({}^{A}/_{A_{cl}}\right)^2$
3. Line 6, replace ${}^{1}/_{A}$ with ${}^{1}/_{A_{cl}}$

Page 294 Equation (11.24) should be replaced by:

$$i = i_M - i_B + I_{par}$$

$$\Delta V = v_{OUT} - v_F$$

$$i_M = I_0 e^{\kappa\Delta V/\phi_t}\left(1-e^{-\Delta V/\phi_t}\right)$$

$$i_B = \frac{I_s}{\beta}\left(e^{-\Delta V/\phi_t}-1\right) \text{ at } \mathrm{v_{OUT}} \text{ side}$$

$$= I_s\left(e^{-\Delta V/\phi_t}-1\right) \text{ at } \mathrm{v_F} \text{ side}$$

i.e. on the third line, $\kappa\Delta v$ should be replaced by $\kappa\Delta V$.

Page 295 Figure 11.15(a), straight vertical line through bipolar transistor from emitter to collector should be deleted

Chapter 12

Page 309 Equation (12.10) should be corrected to:

$$i_{OUT} = i_+ - i_-; i_B = i_+ + i_- + w\frac{i_+ i_-}{i_+ + i_-}; i_+ = e^{\frac{\kappa v_+}{\phi_t}}; i_- = e^{\frac{\kappa v_-}{\phi_t}}$$

$$\boxed{i_{OUT} = i_B \frac{\sinh x}{\beta + \cosh x} \text{ where } \beta = 1 + \frac{\mathrm{w}}{2} \text{ and } \mathrm{x} = \frac{\kappa(\mathrm{v}_+ - \mathrm{v}_-)}{\phi_\mathrm{t}}}$$

Page 324 Equation (12.27) should be corrected to:

$$P = 2V_{DD} I_B$$

$$P = 2V_{DD} \left(2\pi f_c C V_L\right)$$

$$\boxed{\mathrm{P}{=}(V_{DD}\pi N q)\,(f_c)\,(SNR)}$$

Page 327 Figure 12.19(a), v_{out} should be replaced by v_{OUT}.

Chapter 13

Page 353 In table 13.2:

1. First row, fifth column (Underdamped region - ω_n and θ) replace $-\pi/2 < \theta < \pi/2$ with $0 < \theta < \pi$
2. Fourth row, fifth column (Peak frequency - ω_n and θ) replace $\omega_n \cos(\theta)$ with $\omega_n \sqrt{\cos(\theta)}$

Chapter 17

Page 459 First line, replace $R = 0$ with $R = \infty$

Chapter 21

Page 621 Third line, replace $3.2\,{}^{\mathrm{mV}}/_{\mu\mathrm{m}}$ with $3.2\,\mathrm{mV} \cdot \mu\mathrm{m}$

Chapter 22

Page 659 Figure 22.3(b), the text in the figure that says *'Limit set by 1/f noise for a fixed area consumption'* should be replaced by *'Limit set by thermal noise for a fixed power consumption'*.

Chapter 24

Page 757 Third paragraph, penultimate line, move right parenthses at the end of the line to the end of the next line.

Page 772 Second paragraph, first line, replace $I_{R\alpha}$ with $2I_{R\alpha}$.

Page 776 Tenth line of section 24.7, replace 10^6 with 10^7.

Chapter 26

Page 830 In the 3rd line in the second paragraph, replace "*...due to this load was minimal*" with "*...due to this load was maximal*".

Page 847 8th line from the bottom, replace $N\left({}^{R}/_{N}\right)^2 > R^2$ with $N\left({}^{R}/_{N}\right)^2 < R^2$