Update to Typos and Mistakes Found in *Practical Electronics for Inventors*, 2^{nd} ed., by Paul Scherz (McGraw-Hill, 2007)

This is an update to the longer Errata for the text that is being compiled by Martin Ligare during the spring semester of 2008 during the teaching of an Applied Electronics course at Bucknell University. This update covers mistakes and typos discovered between January 17, 2008 and January 22, 2008. The Errata are publicly available at `http://www.eg.bucknell.edu/physics/ph235/`. Additional material for this list should be sent to `mligare@bucknell.edu`.

- p. 113, sentence that begins "Cir-" at the very bottom of the page and continues on to p. 114: Not all fields are "circular"; the field lines around *infinite straight* wires are circular, but it's not strictly true for other configurations. Also, steady currents create fields, but they are not "radiating" fields. Radiation is the result of accelerated charges, i.e., changing currents.

- p. 114, first sentence of 2.24.1: This sentence would be better if it said "*the field of* a charge at rest can be represented . . . "

- p. 115, Figure 2.110, part e.: I think the field symbols $\vec{E}$ and $\vec{B}$ should have subscripts indicating that these are the *radiation* fields, not the total fields. Also, the electric field vector at the 2 o'clock position is pointing the wrong way.

- p. 116, Figure 2.112, left panel: The order of magnitude of the dipole moment of an atom with an unpaired electron is $10^{-23}\,\mathrm{A{\cdot}m^2}$.

- p. 118, first paragraph: The statement that "for a negative charge . . . we must use the left hand" is a bit prescriptive. Most physicists always use the right hand, and reverse the directions for negative charges.

- p. 118, second paragraph: the text says "the net magnetic field of one wire can exert a force on the other wire . . . provided the current is fairly large." The force is not conditional. This would be better stated as "the magnetic field of one wire exerts a force on the other wire." (It is true that if the currents are small, the forces will be small, but the forces always exist for non-zero currents.)

- p. 118, last sentence on the page: The internal dipoles aren't moving. This sentence should be something like "we associate the the macroscopic (observed) force with the forces on the moving charges that comprise the microscopic internal magnetic dipoles . . . ."

- p. 120, first full paragraph: The text states "the effect of the induced force is one akin to an electromotive force . . . ". It's not *akin* to an EMF, it *is* an EMF.

- p. 120, Eq. (2.49): The integrand should be written in terms of vector quantities: $\int \vec{B} \cdot d\vec{A}$. The integral is also missing a leading negative sign.

- p. 119: Fig. 2.116 is incomprehensible.

- p. 120, Fig. 2.117: The problems with this figure are similar to those in the version of this figure on p. 81. In the rightmost figure, the labeling of the angle θ is not really correct. The angle in the flux equation $\Phi = AB\cos\theta$ is the angle between $\vec{B}$ and the *normal* to the surface of $\vec{A}$. In this specific case, with the axis of rotation perpendicular to the field, the illustrated angle happens to have the same value as the angle in the flux equation, but it's not a good to label angles incorrectly. Also, the vertical axis for the sine-wave graph on the right isn't labeled. It should be labeled V to avoid any confusion with Φ or I (which are also sinusoidal, but with a different phase). Also, the equation for I is missing a factor N, and there are missing vector signs in the dot product for flux. (Similar problems occur in the version of this figure on p. 120.)

- p. 125 (Fig. 2.123), and p. 126 (Fig. 2.124): The voltage graphs in both of these figures should indicate that they are graphs of the voltage *across the inductor*, V_L. In both of the figures there is a misleading statement, "Net Voltage = Induced + Applied." The magnitude of the voltage drop across an in ideal inductor is simply given by $V_L = LdI/dt$. The magnitude of the voltage drop across a real inductor is $V_L = IR_{\text{int}} + L\,dI/dt$; this is a sum, but there is nothing in the sum that resembles an "applied" voltage.

- p. 126 (Fig. 2.124), second paragraph: The wording here is misleading. "[W]hen the switch is thrown from position A to B" no voltage is "set up across the inductor attempting to drive the current to zero." The voltage V_S that had been driving the current is simply removed from the circuit.

- p. 128, Example: "following two circuits" should be "following three circuits." (I would also suggest moving the parenthetic comment at the end about the assumed internal resistance of the inductor to the problem statement itself.)

- p. 131, definition of μ_0 near the top of the page: The units are wrong. The units of μ_0 are T·m/A (or equivalently N/A^2). The units are also written in a potentially confusing way. Units should be in roman font, to distinguish them from algebraic symbols that are a part of mathematical expressions. This convention is observed in most of the text, but not for the A (for Amperes) in this expression. This can get get very confusing lower in the page when an italic A is used for area, and the same italic A is used for Amperes.

- p. 131, paragraph following Eq. (2.54): the text incorrectly states that "if you want to double the inductance ... you add ... $\sqrt{2}$ times the original number of turns ...." You don't add this number of turns, you add enough turns turns so that the number of turns is equal to $\sqrt{2}$ times the number of original turns. The statement in words at the end of the sentence, "or 40 percent more turns," is correct.

- p. 131, Answer to Example 2: There are several mistakes here, even though the answer comes out right. First, the equation for L is incorrect. It should be either $L = \mu_0 N^2 A/l$, or equivalently $L = \mu_0 n^2 A l$. The first form is the way it appears in Eq. (2.54), and the second form is the way the solution is worked out (with the switch of N to n). The Answer is also missing an intermediate equals sign. (Note: the units of μ_0 are correct here, but the font for the Amperes is especially misleading in this context.)

- p. 133, Eq. (2.55): Limits of integration should really be used to get this expression right. This is the integrated power from a condition in which $I = 0$ up to a final value of current.

- p. 139, font quibble in first full paragraph: "If the inductance L is ..." should be "If the inductance L is ..." (See first comment for p. 131 above.)

- p. 139, last sentence on page: “inducted” should be “induced.”
- p. 141, Example 12: This question is ill-posed and there isn’t enough information given to answer a well-posed version of the question. In addition, the solution contains an integration error an algebraic error. The problem statement “Calculate the total current that flows …” makes no sense. It’s like stating that a car accelerates at $5\,\mathrm{m/s^2}$ for $3\,\mathrm{m/s}$ and asking for the total velocity. A well-posed question would ask for the velocity as a function of time, or for the instantaneous velocity at a specific time, or perhaps average velocity during the interval, but “total velocity” doesn’t have any meaning. Both velocity and current are rates of change. A well-posed question problem about a car would also have to give an initial velocity; a well-posed Example 12 would similarly require an initial current to be given.

  Here’s my version of Example 12: Suppose you apply a linearly increasing voltage across an ideal 1 H inductor. The initial current through the inductor is 0.5 A, and the voltage ramps from 5 to 10 V over a 10 ms interval. Calculate the current through the inductor as a function of time.

  Answer: Kirchoff’s Voltage Law gives

  $$V_{\text{applied}} - L\frac{dI}{dt} = 0.$$

  Integrating this gives

  $$\int_{t'=0}^{t} \frac{dI}{dt'}\,dt' = \int_{t'=0}^{t} V_{\text{applied}}\,dt',$$

  or

  $$I(t) - I(0) = \int_{t'=0}^{t} (mt' + b)\,dt'.$$

  Carrying out the integration gives

  $$I(t) = I(0) + \frac{1}{2}mt^2 + bt.$$

  At $t = 0.01\,\mathrm{s}$ (the end of the ramp) the current is

  $$I(0.01) = 0.5 + \frac{1}{2} \times 500 \times 0.01^2 + 5 \times 0.01 = 0.575\,\mathrm{A}.$$

  The answer in the text ignores the initial current and has a numerical error in the last equality.

- p. 143, second full paragraph: The text states "[T]he current never reaches the Ohm's Law value." This would be better as the "[T]he current never reaches the *no-inductor* value." Ohm's Law always gives the voltage drop across across the resistor in this circuit, and this can always be used to find the voltage across the inductor, so "the Ohm's Law value" isn't really meaningful.

- p. 144, first and second equations on page: For the de-energizing LR circuit of Fig. 2.128, there is no V_S because the battery is no longer in the circuit. The lefthand side of the first equation and the righthand side of the second should both be zero.

- p. 145, final paragraph in discussion of Fig. 2.138. This paragraph is at best unnecessary, and at worst misleading. There are no negative numbers in the argument of a logarithm here. The quantity $(-V_L/V_S)$ is a positive number, because V_L is negative (see equation for V_L at the bottom of p. 144).

- p. 146, Figure 2.140: The diagrams are great — they show the kind of signals you might actually see in an inductive circuit, but the discussion is completely inadequate (and wrong) without explicit inclusion of the internal resistance of the source. If the source is ideal, the graphs of V_S must be square waves, whether the load is inductive or not.

- p. 147, bottom of page: Inductive reactance of a wire is discussed, but reactance hasn't be introduced previously in the text.

- p. 148, Section 2.24.14: Much of this material is redundant with the discussion of Fig. 2.118 on p. 120; Fig. 2.143 on p. 148 is identical to Fig. 2.118.

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- p. 139, Answer for Example 9: The units are incorrect for the time-derivative of current; they should be A/s, not V/s.
- p. 419, Diode I-V curve in Fig. 4.13: This graph is potentially misleading. The peak inverse voltage rating is typically several orders of magnitude greater than the turn-on voltage, and the leakage current is many, many orders of magnitude less than the peak forward current rating. This isn't the case in this diagram. I have seen diagrams like this in which the scale on the axes is different to the left and below the origin (for example Volts to the right, and 100's of Volts to the left, and mA above the origin and μA below.
- p. 424, Adjustable Waveform Clipper: The negative end of the diode should be about 0.6 V *lower* than the desired output level (not higher as stated in the text).

  The use of a 10 kΩ resistor on the input and a 10 kΩ potentiometer to provide the voltage reference isn't a great choice. If a voltage divider is to be used to provide the voltage reference it's equivalent resistance should be much less than that of the input resistor. (If it isn't, there will be a significant change in the reference voltage as the input voltage increases above $V_{\text{ref}} + 0.6$, and the clipped parts of the waveform won't be flat.) There are, of course, settings of the potentiometer such that the parallel resistance of the two "halves" is very small, but if the potentiometer is set "in the middle" the parallel resistance will be 2.5 kΩ, and this will lead to noticeable deviations from the illustrated behavior.
- p. 448, Discussion of emitter follower: For the illustrated circuit it would be better to say "whenever $V_B \leq 0.6\,\text{V}$ the transistor will turn off."

p. 586, Simple Square-Wave Relaxation Oscillator: The second expression in the equation for V_T is missing a factor of $+15\,\mathrm{V}$.

p. 587, Simple Triangle-wave/Square-wave Generator: The discussion here has a conceptual error, and the formula is wrong (it's not even dimensionally correct). The statement "It will remain in the saturated state until the voltage at the non-inverting input drops below the negative threshold value ($-V_T$)" is simply wrong; it should read "It will remain in the saturated state until the voltage at the non-inverting input drops below *zero*." The voltage V_1 at the input side of R_2 does have a non-zero threshold, and this threshold is given by

$$V_T = -\frac{R_2}{R_3} V_{\mathrm{sat}}.$$

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- p. 537, Notation for negative supply voltage in text and figures: The author calls the positive supply voltage $+V_S$ and the negative supply voltage $-V_S$. This implies that the two supply voltages have the same magnitude. Many op-amps are designed to be run this way, e.g., with supplies at $\pm 15\,\text{V}$, but this is not always true. In fact, many op-amps (and especially comparators) are designed to run from single-sided supplies, in which case the positive and negative supplies clearly don't have the same magnitude. To avoid trouble (see discussion below of Fig. 7.28 on p. 555 for an example) the positive and negative supply voltages should have different labels (V_{CC} and V_{EE} are a common choice).

- p. 538, Second paragraph: The output of the amplifier in Fig. 7.3 given in the text is incorrect; it should be $-V\text{in}R_F/R_{\text{in}}$.

- p. 538, second paragraph: The statement is made that the output of the inverting amplifier is negative is "a result of the inverting input." This is misleading at best. This is an inverting amplifier because of the specific feedback network that is used.

- p. 545, Integrator section: The final result, $V_{\text{out}} = -V_{\text{in}}t/RC$ is only correct in the special case in which V_{in} is constant, and the output of the integrator starts at time $t = 0$ with $V_{\text{out}} = 0$. The graph of the triangle wave output should be inverted.

- p. 550, paragraph on *Voltage Gain*: This paragraph is about the open-loop gain A_0, not A_v.

- p. 555, Fig. 7.28: The negative supply voltages in this figure are grounded. It is true that many comparators are designed to run from single-sided supplies, but this is not universally true, and at this point the text is talking about using general op-amps as comparators, so the figure should be consistent with other figures in the text. (This raises the issue of how to label the supply voltages — see comment above regarding discussion on p. 537. If the labeling of the supply voltages implies that they have the same magnitude, it's impossible to draw a figure like this that covers the possibility of both single-sided and dual supplies.)

- p. 560, Section 7.16: This brief section is really an application that should come in the next section *after* the discussion of op-amps as LED drivers.
- p. 633, Conversion of 247_8 to decimal: 9×8^0 should be 7×8^0.
- p. 633, Fig. 12.3: In example of Octal-to-Binary Conversion the digit 3 should be converted to 011 instead of 010.
- p. 634, Table 12.1: The decimal 08 should be represented in BCD as 0000 1000, not 0001 1000.

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- p. 590, Fig. 9.7: The value of t_{low} given in the work immediately below the circuit diagram is 9.6 ms, while the value given in the graph to the right is 9.4 ms. The second value is consistent with the data.

- p. 590, Fig. 9.7, graph of "Frequency vs. C_1, R_1 and R_2": The values given along the lines in the graph are values of $R_1 + 2R_2$, not $R_1 + R_2$ as indicated in the graph.

- p. 590, Discussion accompanying Fig. 9.7: In the last line of the first paragraph the word "expression" should be "expressions."

- p. 591, Fig. 9.1: The pin 6 input should be connected within the 555 to the non-inverting input of comparator 1. In the figure it's not connected to anything.

- p. 645, Fig. 12.19, lower circuit in the box in the lower right corner of the figure: The labels on the inputs to the upper NAND gate should be switched, so that B is the upper input and A is the lower input.

- p. 646, Discussion accompanying Fig. 12.20: There are several mistakes in this discussion.
  - The sentence starting "Using Identities 17 . . ." should read "Using Identities 17 ($B\overline{B} = 0$) and 11 ($\overline{B} + 0 = \overline{B}$), you get"
  - The equation following the sentence above should be

$$\text{out} = A\overline{B} + 0 + \overline{B} + BC = A\overline{B} + BC + \overline{B}$$

  - The equation after the sentence starting “Using Identities 12 . . . ” should be

$$\text{out} = \overline{B}(1) + BC = \overline{B} + BC$$

- p. 681, last line on page: “cross-AND SR flip-flop” should be “cross-NAND SR flip-flop.”

- p. 682, Fig. 12.70: In the circuit diagram the outputs Q and $\overline{Q}$ are reversed. They are also reversed in the timing diagram. (The truth table is correct, but it is inconsistent with the circuit diagram and the timing diagram.

- p. 682, Fig. 12.70: It’s conventional to label the inputs on the cross-NAND inputs $\overline{S}$ and $\overline{R}$ to indicate that the set and reset conditions are triggered when the inputs go low.

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- p. 586, first paragraph: The statement of the principle of RC relaxation oscillators wrongly implies that the discharge of the capacitor must be rapid - the word *rapidly* should be removed from this sentence. (Note that in the first circuit example, the Simple Square-Wave Relaxation Oscillator, the discharging time constant is exactly the same as the charging time constant.)

- p. 588, Section 9.2: I have an editorial comment regarding this section. This seems like the wrong place to introduce 555 timers because flip-flops, which are an important part of 555s, aren't introduced in the text until Section 12.6.

- p. 714, Fig. 12.117: The label on the top line of the timing diagram should be CLK, not $\overline{\text{CLK}}$.

- p. 714, Fig. 12.117: The initial state for P_0, P_1, P_2, and P_3 in the timing diagram is wrong. When the $\overline{\text{CLR}}$ line goes low, the flip-flops are all reset, which means that the outputs are low. When the $\overline{\text{CLR}}$ line goes high, nothing should change: the flip-flops will remain in the reset state until there is a rising edge on S_{CLK}.

- p. 714, Section 12.8.3: The text reads: "When a clock pulse is applied during this load mode, the 4-bit parallel word is latched simultaneously into the four flip-flops . . ." In the timing diagram no clock pulses are applied during the load mode because the clock is inhibited. The timing diagram makes sense — the load mode loads the parallel word into the inputs, and *after* the loading of the inputs is complete the clock is enabled to step the data through the flip-flops.

- p. 714, Fig. 12.118: There are multiple uses of the symbols D_0-D_3 in this diagram. They are used for the parallel input data lines, and they are used for the D inputs of the flip-flops. This can lead to confusion.