Extra Class License Manual – Errata and Corrections

The following text is intended to support or correct the 9th edition of the *Extra Class License Manual*.

Determine the version of the manual you are using by referring to the first page of the preface inside your copy. Look for the text box with the copyright information where you'll also find the edition and printing information. (If the edition number is not followed by printing information, the book is the first printing.) If the material does not refer to a specific printing, it applies to all versions of the manual.

The question pool for the current Extra Class license took effect on July 1, 2008.

Question Pool Changes

Question E1F13 is withdrawn effective 29 April 2011 due to changes in the FCC Rules regarding spread spectrum operation.

Questions E1C04 and E1C05 were withdrawn effective 1 July 2010 due to the elimination of FCC Rule 97.109(e).

Section III

Page 3-25

Table 3-5 omits the 146-148 MHz allocation for ground-based repeaters.

Page 3-23

The URL www.arrl.org/FandES/field/regulations/io/ has been changed to www.arrl.org/international-regulatory.

Section IV

Page 4-3 (sidebar)

In the paragraph on calculating parallel impedance, the second sentence should begin, "To calculate the *denominator* ($Z_1 + Z_2$) you would write…"

In the first example, the angle should be 30 degrees in all equations, not 60.

Page 4-6 (Section on Magnetic Energy Storage)

The discussion here refers to *electronic current* (the flow of electrons) and not to the more common *conventional current* (the flow of positive charge) that flows in the opposite direction. If electronic current is being discussed, use the *left-hand rule* and if conventional current, use the *right-hand rule*. The exam question refers to the flow of electrons and electronic current.

Page 4-10

In the final example that calculates R_T (parallel), the product of 1 MΩ x 1 MΩ in the numerator should be 1 GΩ, not 1 MΩ. The answer is correct as printed.

Page 4-16

In a series circuit, capacitive reactance cancels inductive reactance and this is reflected in the convention of assigning capacitive reactance a minus sign and inductive reactive a positive sign. Thus, in a series circuit, stating that the reactance values "subtract from each other" can also be stated as "add in opposition".

Page 4-17

In the equation at the very top of the page, the third term should be 10×10^3, not 10×10^4, so it will be in agreement with the conditions of the problem on the previous page. (i.e. f = 10 kHz, not 100 kHz)

Pages 4-18 to 4-26

Regarding the examples illustrating how to calculate the answers for questions E5B07-08 and E5B11-13, the answers for the questions are given in the format of phase angle magnitude followed by direction (leading/lagging). The example calculations give the answer as a signed value (such as -14 degrees for E5B07 in example 4-18). Remember that voltage is the reference for phase angle polarity so that if voltage lags current, phase angle is negative.

Example 4-15

The reactance of the capacitor should be shown as negative: -*j*100 Ω

Example 4-16

Change the subscripts in Step 1 from "C" to "L". The rest of the problem is correct. B_L is negative because it is $1/jX_L = -j(1/X_L)$. That means Y will have a negative angle in an inductive circuit. Taking the reciprocal of Y causes the angle to be inverted and so the angle of Z = 1/Y in an inductive circuit will be positive.

Example 4-18

The equation for r should read = 1031. A more precise value is 1030.77, which rounded up gives 1031. The correct value for Z is then 1031∠-14° Ω. Both the first and second printing are in error. From the third printing, this example is correct.

Example 4-19

The equation for r was mistakenly changed in the second and third printings. The equation should read = 103.

Example 4-20

Again, the answer is right, but the minus sign in the $(-25)^2$ term under the square root sign should be removed.

Example 4-22

The correct value for r is 1031 (1030.77 rounded up) and $Z = 1031\angle 14°\ \Omega$. (see Example 4-18 also)

Page 4-30 (this item was omitted from some previous supplements)

The fourth equation should read: $(2\pi f)(2\pi f) = 1/LC$
-And-
The fifth equation should read: $4\pi^2 f^2 = 1/LC$

Page 4-27 and Example 4-25

The first equation for P_{REAL} should show current-squared (A^2) in the final term before the answer.

Page 4-33

In the final equation for capacitance, the values for C should be 9.7×10^{-11} and 97×10^{-12}. Some printings show the exponents as positive numbers without the minus sign.

Section V

Page 5-6 (this item was omitted from some previous supplements)

In the first paragraph under "Hot-Carrier Diodes" the final sentence should read, "Compare the inner structure of the hot-carrier diode depicted in **Figure 5-8** to the point contact diode shown in Figure 5-7." (The figure references were reversed.)

Section VI

Page 6-9

Equation 6-4 at the top of the page has V_{OUT} and V_{IN} reversed. The correct equation is:

The examples and supporting text are all correct.

In Figure 6-8, the intersection of the load line with the vertical axis should be labeled V_{CC} / R_3+R_4.

Page 6-17

In Figure 6-14, the symbol β (beta) is used to represent the feedback ratio through the feedback network. While this is standard terminology (en.wikipedia.org/wiki/Barkhausen_stability_criterion), beta is also used to represent the ratio of collector to base current in a bipolar transistor. The context of the discussion should be used to alert the reader which meaning of the symbol is used. There are many symbols with multiple uses in electronics – caution is advised, along with a good glossary.

Page 6-24

In the section on Mixers, a better definition of a *passive mixer* is one which does not utilize active components or devices, such as transistors. Diodes are used in passive mixers, but they are *discrete* components and not *passive* components.

Page 6-31

In Figure 6-31, D1 is backwards from what is required to generate the waveforms described.

Section VII

Page 7-6, Table 7-1

The entries for Average values should read:

Sine Wave	Square Wave
0 (full cycle)	0 (full cycle)
0.637 × Peak (half cycle)	0.5 × Peak (half cycle)

Page 7-7

The first paragraph of the page should be changed to read: "When the sine waves for voltage and current are in phase such as in a resistor (see the discussion on power in Chapter 4), power is the *product* of RMS voltage and current. In this case, RMS and average power are the same, so the term P_{AVG} is used."

Page 7-12

In the sidebar on D'Arsonval meter's opening paragraph, the statement "In order to measure ac, you must rectify it and convert the dc voltage back to ac" is misleading. The ac voltage to be measured is rectified (usually by a full-wave bridge rectifier) and applied to the meter's coil, causing a dc current to flow, moving the needle up-scale. The "conversion to ac" is done by calibrating the meter's scale to the RMS value of the applied ac voltage. This calibration is dependent on the waveform of the ac voltage: a square wave and a sine wave of the same peak-to-peak voltage will cause different deflections of the meter. So a better way of stating this in the manual would be, "D'Arsonval meters are dc-operated devices. In order to measure ac, you must rectify it to dc. A bridge rectifier is often used for this purpose. The meter's scale is then calibrated to read effective (RMS) voltage. Such a scale is only useful for sine-wave signals, however."

Page 7-16

All references to error are to maximum absolute error, not an error distribution. Use the counter or display's maximum specified error.

Section VIII

Page 8-5

A change to Equation 8-2 in earlier versions of this document was erroneous – the original equation was correct as printed: baud = WPM / 1.2. Thus, no change to Equations 8-3 and 8-4 is required and the answer to E8C06 (C. Approximately 52 Hz) is correct. We regret the error.

Page 8-23

In the fifth line on the page, the subtractive IMD products should be f_{IMD2} and f_{IMD4}. The interference-generating frequencies are calculated as follows:

> The IMD products most likely to cause the interference are third-order products and of the third-order products described by equations 8-7 to 8-10, the ones that cause interference on nearby ("in-band") frequencies are the subtractive products described by equations 8-8 and 8-10.
>
> Since what is known are f_{IMD}, the frequency of the interfering product (146.70 MHz), and f_1, one of the generating signals (146.52 MHz), the two possible frequencies of the other generating product are found by solving equations 8-8 and 8-10 for f_2. Note that f_1 and f_2 must be consistent in both equations and can't be exchanged.
>
> f_{IMD} = 146.70 MHz (the frequency on which interference is being received)
> f_1 = 146.52 MHz (the known frequency of one interference-generating signal)
> f_2 = the unknown frequency of the other interference-generating signal
>
> Solving equation 8-8 for f_2...
> $f_2 = 2f_1 - f_{IMD} = 2 \times 146.52 - 146.70 = 293.04 - 146.70 = 146.34$ MHz

Solving equation 8-10 for f_2...
$f_2 = (f_{IMD} + f_1) / 2 = (146.70 + 146.52) / 2 = 146.61$ MHz

Page 8-24

In Equation 8-11, P_{IM} should be P_{IM2} and also in the definition following the equation. In the definitions for Equation 8-12, P_{IM} should be P_{IM3}. The denominator in Equation 8-13 should be (IP_3 + MDS). Note that MDS is also abbreviated as P_{MIN} in some publications.

Section IX

Pages 9-3 and 9-4

The figure of 2.14 dB is used as the gain of a dipole over that of an isotropic radiator. Test questions E9A02, E9A14 and E9A15 use the figure of 2.15 dB, however. The actual difference is insignificant and only one answer for those questions is at all close, whether 2.14 or 2.15 dB is used. The amateur literature uses several different figures for the dipole-isotropic gain differences and even the professional literature varies somewhat. In future printings, the ECLM will standardize on 2.15 dB as the value used.

On page 9-3, in the first sentence of the fourth paragraph, change "In contract to" to "In contrast to".

In the discussion relating to Equations 9-1 and 9-2, it is important to note that the Gain being referred to is that of the antenna being measured. Since the antenna being measured will have more gain with respect to an isotropic radiator than a dipole, 2.15 dB must be subtracted from the dBi value and vice versa.

Page 9-7

In the first paragraph under "Azimuthal and Elevation Patterns", remove the word "above" from the final sentence to avoid confusion with Figure 9-6. The referenced Figure 9-5, is on page 9-5.

Page 9-33

Following equation 9-9, add "where Z_0 is the line's characteristic impedance and Z_L is the impedance of the load.

Page 9-35

In the second to last line on the page, "Horizontal constant-resistance lines" should be "Horizontal constant-reactance lines".

Page 9-40

In Figure 9-32, in order for the figure and associated text to use the same nomenclature, change the transmission line characteristic impedance from Z_0 to Z_1, that of the matching section from Z_1 to Z_0, and that of the load from Z_{LOAD} to Z_2.

Section XII – Glossary

Real Power - The correct calculation is the product of the apparent power times the *cosine of the* phase angle between the voltage and current. Words in italics were omitted from the original definition.