Extra Class License Manual – Supplemental Information and Errata

12 May 2016

The following text is intended to support or correct the 10th edition of the *Extra Class License Manual* and the 3rd edition of the *Extra Class Q&A*. New items in this version of the document are in red.

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, 2012.

Question Pool Changes

Question E1D09 was withdrawn from the current pool shortly before it became effective on 1 July 2012. A change in the frequency allocations for the amateur satellite service was overlooked when reviewing the question.

In the 2nd printing, question E6E10 is mistakenly noted in the question pool section as having been withdrawn. This is in error – the question has *NOT* been withdrawn and is still in the question pool.

Supplemental Information

Extra Class License Manual

Significant Digits in Answers: Students may be confused when making calculations because the answer in the question pool or example does not reflect the exact number produced by a calculator. For example, when calculating reactance in Example 4-7 on page 4-21, using the formula for X_L a calculator will display a value of 396.2052. Following the rules of significant digits, the answer should be rounded to 400. A tutorial on significant digits is available online at **www.chem.sc.edu/faculty/morgan/resources/sigfigs**. Although the question pool is not completely consistent regarding significant digits in calculations, the student should expect answers to be rounded or refer to "best representations" to accommodate different methods of calculation. The associated question to this calculation (E5C20) asks only which of the graphed points "best represents" the resulting impedance, for example. High precision is not required in any exam question.

Chapter 4

Page 4-17

Following the equation for X_L at the top of the page, the instructions for drawing the voltage across the inductance would be more clear as, "Draw the voltage across $X_L = E_L = 1\ A \times 1256\ \Omega = 1256\ V$ as a line pointing straight up in the 90° direction. The line should be parallel to the reactance axis…"

Pages 4-18 to 4-28

For rule 2, note that when inverting a number in magnitude – theta form, the angle changes sign. E.g. $1 / |Y|\angle\theta = |1/Y|\angle{-\theta}$. See Examples 4-2 and 4-3.

Example 4-15: the rectangular form of the impedance is
$R = 240 \times \cos(37°) = 193\ \Omega$
$X = 240 \times \sin(37°) = 145\ \Omega$
$Z = 193 + j145\ \Omega$

Example 4-16: the rectangular form of the impedance is
$R = 71 \times \cos(-45°) = 50.2\ \Omega$
$X = 71 \times \sin(-45°) = -50.2\ \Omega$
$Z = 50.2 - j50.2\ \Omega$

Chapter 6

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 6-38

In the discussion of shape factors, the slash between the levels at which bandwidth is measured (-6 dB and -60 dB) was intended to be read as "to" and not "divide by". Nevertheless, the order of the bandwidths is presented in a confusing way. The correct method of calculating shape factor is to divide the -60 dB bandwidth by the -6 dB bandwidth, which for the example given, results in a value of 5.4 divided by 1.8 = 3.0.

Page 6-43

Question E7C11 refers to "back-to-back" L networks forming a Pi network. This is described by Figure 6-42 – imagine L1 in that figure being divided into two series inductors, L1A and L1B. The combination of C1 and L1A forms an L network and the combination of L1B and C2 forms another L network. When connected this way the inductors of the two L networks are in series and the capacitors are connected in shunt at the Pi network's input and output.

Chapter 7

Page 7-14

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

Chapter 8

Page 8-6

Replace the calculation of BW as follows:

The ITU Classification of Emission Standards for determining necessary bandwidths of signals uses a value of 0.8 for the conversion between baud and WPM and suggests a typical value for K of 5 on an HF channel where the signal is subjected to fading. The bandwidth for a 13 WPM signal would then be:

BW = WPM $\times$ 0.8 $\times$ 5 = 10.4 $\times$ 5 = 52 Hz [E8C05]

Page 8-24

Following the calculation of one possible value for f_2 as 146.34 MHz, the following paragraph should refer to solving equation 8-11 for f_2, not f_1.

Chapter 9

Page 9-33, equations 9-10 and 9-11

Rho (ρ) is a complex number so the values for Z in 9-10 must also be complex. If magnitude of Z is used, only the magnitude of ρ is calculated. To calculate SWR by using 9-11, just use the magnitude of ρ, written more correctly as $|\rho|$.

Extra Class Q&A

E1F01 - The 222 MHz amateur band starts at 222 MHz and extends higher in frequency so the "222 MHz band" is part of "amateur frequencies above 222 MHz". "Above 222 MHz" does not mean "above the 222 MHz band" - it just means "above 222 MHz." This is typical of how the regulations are actually worded. There is no discrepancy between answer B and the explanation.

Errata

Extra Class License Manual

Page 2-3

Remove the bracketed reference to E2C06 from the final full paragraph.

Page 2-6

Remove E2C06 from the list of study questions in the blue box.

Page 2-9

Add question E2C06 to the list of study questions in the blue box and to the bracketed question ID at the end of the first full paragraph. In the same paragraph, contest contacts are only discouraged on the 2 meter calling frequency of 146.52 and not on the other bands.

Page 4-2 (first printing)

In the second sentence of the fourth paragraph, positive angles should be described as being measured *counterclockwise* from the X axis and the "second point in Figure 4-2" is the "point at lower left in Figure 4-2".

Page 4-10 (first printing)

In the final example that calculates R_T (parallel), the product of 1 MΩ x 1 MΩ in the numerator should be 1 $T\Omega^2$. The answer is correct as printed.

Page 4-18 (first printing)

In the middle of the page, change the equation B=1/Y to B=1/X.

Page 4-26, Example 4-18 (first printing)

The equation for r should read $\sqrt{(1000)^2 + (-250)^2}$ = 1031. A more precise value is 1030.77, which rounded up gives 1031.

Example 4-20

In the equation for r, the minus sign in the $(-25)^2$ term under the square root sign should be removed. The answer is correct.

Page 4-31 (first printing)

In Example 4-25 the equation should read "$P_{REAL} = (1A)^2 \times 100\ \Omega = 100$ W

Page 4-35

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

Page 5-8

In the first full paragraph, the word “resistivitance” should be “resistance”.

Regarding the characterization of the PIN diode’s switching action:

- With reverse bias, the PIN diode is cut-off and acts like an open circuit to RF.
- With zero bias, the PIN diode acts like a very small capacitor, often small enough that the diode can be considered an open circuit.
- With forward bias, the PIN diode acts like a resistance that decreases with increasing bias current.

Page 6-2

In the page’s final paragraph, the junctions which must be forward-biased are the base-emitter junctions, not the collector-base junctions.

Page 6-4

In the first paragraph, the average dc gain is dependent only on R4, not the sum of R3 and R4. Remove “+R3” from the numerator of equation 6-1.

Page 6-5

In Equation 6-3, replace “R_3” with “r_e”. r_e = 26 mV/ I_e and is the transistor’s internal emitter resistance.

In Figure 6-3, replace R4 and C2 with a direct connection to +9 V.

Page 6-8

In the first paragraph, the reference to a closed-loop circuit should be to an open-loop circuit.

Page 6-10

In Figure 6-8 and in the bullet point labeled “Bias Curve” – the actual bias curve runs along the dc load line. The line labeled “Bias Curve” in the figure is actually a set of points showing different Q-points.

In the bullet point labeled “AC Load Line, the actual behavior is more complex than shown. The AC load line intersects with the X axis at bias point + Ic (quiescent) * (R4 || RL.) The AC load line intersects with the Y axis at bias point + Vce (quiescent) / (R4 || RL)

Page 6-19

Following the bold reference to Figure 6-17 there should be a reference to question [E6E10] that was removed in the Second Printing.

Page 6-38

In the blue box, question E7E06 should be E7C06.

In the paragraph on shape factor, change the sentence beginning, "For example…" to read as follows: For example, a filter that has a -6 dB bandwidth of 1.8 kHz and a -60 dB bandwidth of 5.4 kHz has a shape factor of 5.4 kHz divided by 1.8 kHz = 3.0.

Figure 6-39: the unlabeled 680 pF capacitor is C2 and the unlabeled 27 kΩ resistor is R2.

Page 7-2

In the description of symbols for Equation 7-1, A is the *instantaneous amplitude* of the sine wave in the vertical direction.

Page 7-20

Under N-Channel Enhancement JFET the line beginning ON should read:

ON – V_{GS} between pinch-off voltage (usually -2 to -5 V) and V_{DD} from gate to source; between 0.1 V and V_{DD} from gate to source

LINEAR REGION – Same V_{GS} as ON, 1/3 to 2/3 V_{DD} from drain to source.

Page 8-6

See the entry in the supplemental section above.

Page 8-24

The two equations at the very bottom of the page should read:

$f_2 = 2 \times 14.035 - 14.020 = 14.050$ MHz (order of f_1 and f_{IMD} was reversed, f_2 not 14.005 MHz)
and
$f_2 = (14.035 + 14.020) / 2 = 14.0275$ MHz (consistent order of f_1 and f_{IMD} in both equations)

Page 8-25

In equation 8-12, change "+ MDS)" to "- MDS".

Page 9-22

The middle section of the equation calculating EIRP in Example 9-6 should read 200 x $\log^{-1}$ (0.1). The answer is correct.

Page 9-40, Figure 9-32: Designators of the transmission line impedances in the figure should be changed to agree with the text and equations. Change Z_1 to Z_0, Z_0 to Z_1, and Z_2 to Z_{LOAD}.

Question Pool

E2C06 – the question is actually discussed on page 2-7

Extra Class Q&A – Third Edition

E3B09 – the correct answer, A, was omitted from the text.

E5D18 – the correct answer is B not D.

E7A09 – the explanation is incorrect in that the output of an exclusive NOR (XNOR) gate is a logic “0” if any single input is a logic “1”. Table E7-1 should have a column for the XNOR function that is inverted from the XOR function.

		Output					
Input 1	Input 2	AND	NAND	OR	NOR	XOR	XNOR
0	0	0	1	0	1	0	1
0	1	0	1	1	0	1	0
1	0	0	1	1	0	1	0
1	1	1	0	1	0	0	1

E9F12 – the correct answer is C, not D. The text explaining the answer is correct. Note that the four possible answers are printed in a different order in the Q&A than in the full manual. The correct answer is “a very low impedance”, regardless of the order of the answers.